Appendix 3 – Air Quality and Dust Assessment

Dust Impact Assessment for a Proposed Sand and Gravel Quarry and Restoration Scheme for Land at Lea Castle Farm, Worcestershire

NRS AGGREGATES LTD

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QUALITY MANAGEMENT

Report Title:	Dust Impact Assessment for a Proposed Sand and Gravel Quarry and Restoration Scheme for Land at Lea Castle Farm, Worcestershire
Client:	NRS Aggregates Ltd
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COMPETENCY AND EXPERTISE

The Company

Vibrock Limited is an established independent environmental consultancy who has been providing noise, dust and vibration consultancy services to the quarrying industry for over 25 years. Vibrock Limited is a member of the Association of Noise Consultants and its Consultants are Associate or Corporate Members of the Institute of Acoustics.

The Authors

Aaron Gutteridge BSc (Hons), MSc, AMIOA, AFOH an MSc Applied Acoustics graduate joined Vibrock Ltd May 2015, where he has worked in an Environmental Consultant role specialising in Environmental Acoustics and Air Quality. Aaron regularly undertakes various environmental assessments, such as air quality studies for environmental impact assessments, industrial noise assessments and environmental noise assessments. Mr Gutteridge has recently completed an 'International Environmental Policy and Law Certificate of Credit' as part of the Postgraduate Certificate in Environmental Management, and is currently studying an 'Environmental Impact Assessment Certificate of Credit'. Aaron holds memberships to both the Institute of Acoustics, and BOHS Faculty of Occupational Hygiene.

Daniel Williams BSc MIQ, MIAQM, MIEXPE joined the Vibrock team in 1998, employed as an Environmental Consultant. With 20 years of experience, Daniel has undertaken noise, air quality and vibration monitoring on a wide range of projects across the UK, specialising in the measurement and assessment of air quality and vibration for planning applications, including those requiring EIA, across the civil engineering, construction/demolition, waste disposal and mineral extraction sectors. Mr Williams holds membership to the Institute of Quarrying, the Institute of Air Quality Management and the Institute of Explosive Engineers.

NON-TECHNICAL SUMMARY

1. The plant required to work Lea Castle Farm Sand and Gravel Quarry at Worcestershire, together with associated vehicle movements have the potential to generate dust and other airborne pollutants in the immediate vicinity of their operations. The likelihood of problems caused by such pollutants will be largely influenced by the effectiveness of on site environmental control.

2. Hence potential dust sources have been identified and best practice dust control measures recommended in order to minimise any such disturbance at nearby sensitive locations.

3. The current dust climate has been measured at potential dust sensitive receptors; and these are seen to be typical of a town and outskirts.

4. Climatic conditions local to the site have been accessed and analysed to give an indication of how often the site could be susceptible to fugitive dust events. Such occasions are relatively few.

5. A full PM_{10} assessment in line with the latest recommendations has been undertaken and this clearly shows that the Air Quality Objectives are not expected to be exceeded.

6. Given the intended dust control measures, we are confident that the site can continue to be operated with minimal impact on nearby boundary locations.

7. Furthermore Dispersion Modelling is included in Appendix 4; this has been carried out by EnviroCentre.

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1.0 INTRODUCTION

1.1 It is proposed by NRS Aggregates Ltd to seek planning permission for sand and gravel extraction and restoration operations at Lea Castle Farm located in Worcestershire. Vibrock Limited was commissioned by KEDD Limited to assess the operational phase dust impacts of the proposals. The Dust Impact Assessment was undertaken in accordance with the guidance for dust emission provided in the Planning Practice Guidance to the National Planning Policy Framework.

1.2 The site is located approximately 0.35 km north of Kidderminster (Broadwaters) and some 0.7 km east of Wolverley and 0.375 km south west of Cookley. It lies immediately north of the A4189 Wolverley Road and west of the A449 Wolverhampton Road.

1.3 The proposed application site occupies approximately 45 hectares of land with a maximum elevation of 80 m Above Ordnance Datum (AOD) in the centre of the site, falling to 65 m AOD in the west and 55 m AOD in the east. It is predominantly contained land within an internal agricultural setting. The actual proposed area of mineral extraction covering ~ 30 hectares within the overall site.

1.4 The proposal would involve mineral extraction across an area measuring approximately 30 hectares. An investigation undertaken in 2015 of the site for potential mineral resources identified a reserve area of approximately 3 million tonnes of sand and gravel. A proposed output of 300,000 tonnes per annum is expected, which in turn could provide 10 years of supply. Approximatly 60,000 m^3 per annum of imported inert material will be used for the restoration scheme.

1.5 There are a limited number of residential properties and businesses within the immediate area of the proposed site. The closest properties being those at South Lodge, Broom Cottage, Castle Barns, Lea Castle Equestrian Centre and properties off Brown Westhead Park. Access to the site is to be gained via the A4189 Wolverley Road to the south eastern area of the site.

1.6 There are several internationally designated ecological and local wildlife sites located <1km within the vicinity of Lea Castle Farm as indicated in the table below, these sites will form part of the assessment:

Internationally Designated Ecological Site	
Name	**1km Grid Reference**
The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS)	382500, 278500
Stourvale Marsh	382500, 278500
Puxton Marshes (and LWS)	382500, 277500
Hurcott Pasture	384500, 277500
Hurcott and Podmore Pools (and LWS)	384500, 277500
Local Wildlife Site	
River Stour	383500, 279500
Gloucester Coppice (and Natural Woodland)	383500, 279500
Wolverley Marsh	382500, 278500
Wolverley Court Lock Carr	382500, 278500

1.7 Sand and gravel from the working areas will be excavated across three sequential phases. Won material will be conveyed to the plant processing site via articulated dump trucks. It is anticipated that the plant will consist of one excavator, two articulated dump trucks, one loading shovel and static screen and wash plant.

1.8 The study benefits from a site inspection conducted in August 2018.

2.0 EXISTING ENVIRONMENT

2.1 Introduction

Windspeed and Direction

2.1.1 The generation and dispersal of dust is highly dependent upon meteorological conditions prevalent at the time. The Met Office has advised that wind speed and direction data are recorded at Pershore, Worcestershire approximately 30 km south south east of the proposed development at Lea Castle Farm. Observations of the wind speed and direction are recorded over a ten year period with some 87,588 hourly observations used to compile the relevant wind rose.

2.1.2 The Met Office considers that the data recorded at Pershore over the period January 2008 to December 2017 would be representative of the conditions experienced in the vicinity of the planned Lea Castle Farm development. From our site inspection we consider that this data is not likely to be significantly affected by the site topography. An extract from the Pershore wind speed and direction data is presented in Appendix 1 as an annual wind rose.

Rainfall Data

2.1.3 An indication of the long term average annual number of dry days (i.e. less than 0.2 mm) for the quarry has also been taken from records collected at Pershore (Appendix 2) and indicates that there is an average of 146.4 days per year with rainfall less than 0.2 mm, i.e. about 40 % of the year.

2.2 Existing Air Quality

Deposited Dust

2.2.1 Existing levels of deposited dust will typically be of the order of 56 mg/m²/day (milligrams per square metre per day) annual median, for a general deposit in residential areas and town outskirts, MIRO February 2011. Obviously, values vary daily, particularly during dry weather but also because of local industry. Median (50th percentile) levels of 38 mg/m²/day for open country, and 90 mg/m²/day for commercial town centres are also given by that source. The table overleaf shows these and other dustfall rates.

Location	Median (50th percentile) mg/m²/day	90th percentile mg/m²/day	95th percentile mg/m²/day
Open Country	38	103	140
Residential areas and town outskirts	56	146	203
Commercial Town Centres	90	199	261

2.2.2 Within the area around the site the existing deposited dust levels are influenced mainly by farming activity. The area is considered to be residential and town outskirts.

PM_{10} and $PM_{2.5}$ Particulates

2.2.3 Particulate matter is generally categorised on the basis of the size of the particles. PM_{10} particles are those with a mean aerodynamic diameter less than 10 micrometres (microns), with the smaller $PM_{2.5}$ particles being defined as those with a mean aerodynamic diameter less than 2.5 microns.

2.2.4 Particulate matter is made up of a wide range of materials and arise from a variety of sources. Concentrations of particulate matter comprise primary particles emitted directly into the atmosphere from combustion sources and secondary particles formed by chemical reactions in the air. Particulate matter derives from both human activity and natural sources (such as sea spray and Saharan dust). In the UK the biggest human activity sources are stationary fuel combustion and transport.

2.2.5 As an indication of the likely level of PM_{10} and $PM_{2.5}$ particulates at the site, data has been accessed for the relevant 1km squares of the Automatic Urban and Rural Network (AURN). The PM levels for the grid squares which contain the closest residential receptors to the quarry are detailed. The data presented is for the year 2018 with projected concentrations for the years 2023 and 2028.

Grid Square 383500/278500: No. 5 Brown Westhead Park / No. 1 Brown Westhead Park / South Lodges / Broom Cottage / Four Winds / The Bungalow / Heathfield Knoll School

Year	PM_{10} Annual Mean $\mu g/m^3$	$PM_{2.5}$ Annual Mean $\mu g/m^3$
2018	12.79	8.90
2023	12.46	8.59
2028	12.34	8.45

Grid Square 384500/278500: No. 10 Castle Barns

Year	PM_{10} Annual Mean $\mu g/m^3$	$PM_{2.5}$ Annual Mean $\mu g/m^3$
2018	14.16	9.83
2023	13.81	9.49
2028	13.68	9.35

Grid Square 382500/278500: Brown Westhead Park and Playing Fields / The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS) / Stourvale Marsh / Wolverley Marsh / Wolverley Court Lock Carr

Year	PM_{10} Annual Mean $\mu g/m^3$	$PM_{2.5}$ Annual Mean $\mu g/m^3$
2018	12.39	8.59
2023	12.06	8.28
2028	11.94	8.14

Grid Square 382500/277500: Puxton Marshes (and LWS)

Year	PM_{10} Annual Mean $\mu g/m^3$	$PM_{2.5}$ Annual Mean $\mu g/m^3$
2018	13.11	9.11
2023	12.76	8.77
2028	12.64	8.64

Grid Square 384500/277500: Hurcott Pasture / Hurcott and Podmore Pools (and LWS)

Year	PM_{10} Annual Mean $\mu g/m^3$	$PM_{2.5}$ Annual Mean $\mu g/m^3$
2018	14.69	10.41
2023	14.31	10.04
2028	14.19	9.90

Grid Square 383500/279500: River Stour / Gloucester Coppice (and Natural Woodland)

Year	PM_{10} Annual Mean $\mu g/m^3$	$PM_{2.5}$ Annual Mean $\mu g/m^3$
2018	12.42	8.59
2023	12.10	8.29
2028	11.97	8.16

2.2.6 Within the surrounding area of the planned Lea Castle Farm development, the PM_{10} and $PM_{2.5}$ levels would be influenced by traffic movements on the local road network. Additionally global PM_{10} and $PM_{2.5}$ emissions will also have a considerable influence.

2.3 Air Quality Standards

Deposited Dust

2.3.1 Dust in the community is normally perceived as an accumulated deposit on surfaces such as washing, window ledges, paintwork and other light coloured horizontal surfaces, e.g. car roofs. When the rate of accumulation is sufficiently rapid to cause noticeable fouling, discoloration or staining (and thus decrease the periods between cleaning) then the dust is generally considered to be a nuisance. The point at which an individual makes a complaint regarding dust is highly subjective.

2.3.2 In the UK and Europe there are no definitive standards for deposited particulates, however, criteria and guidelines have been developed in many other countries. Studies undertaken in Australia, for example, have resulted in the adoption of a deposited dust criteria linked to the onset of loss of amenity of about 133 mg/m²/day, averaged over one month. In the UK, long term deposited dust nuisance criteria have been suggested for urban/semi-rural areas at, typically 200 mg/m²/day, averaged over a monthly period.

2.3.3 Custom and practise at quarries, coal, construction and demolition sites have used the figure of 200 mg/m²/day as a nuisance threshold for sites in the UK.

PM_{10} and $PM_{2.5}$ Particulates

2.3.4 The UK National Air Quality Strategy (NAQS) defines air quality standards for eight major pollutants, one of which is for PM_{10} and sets objectives for reductions in the concentrations of those pollutants to be achieved by 2005.

2.3.5 The original PM_{10} standard of 50 µg/m³ as a 24 hour running mean was to be achieved with no more than 4 exceedances per year by the end of 2005. This was considered to be an unrealistic target and as such it was replaced by the limits within the EU Daughter Directive on Air Quality which set a limit of 50 µg/m³ as a daily mean to be achieved by 31st December 2004 and maintained thereafter, with no more than 35 exceedances and an annual average of 40 µg/m³.

2.3.6 Under the 2010 Air Quality Standard Regulations, pollutants of particle size $PM_{2.5}$ should be limited to an annual concentration of 25 µg/m^3 from the year 2015 and 20 µg/m^3 from the year 2020.

Worcestershire Regulatory Services 2016 Air Quality Annual Status Report (ASR) for Wyre Forest District Council

2.3.7 A review of the 2016 Air Quality Annual Status Report has determined:

Monitoring results within the Wyre Forest District Council area demonstrate there has been a slight reduction in NO_2 concentrations between 2014 and 2015 across the district but there is no discernible upward or downward trend in concentrations over the 5 year period 2011 - 2015.

2.3.8 Wyre Forest District Council does not monitor PM10 emissions within the county.

2.4 Health Impact Studies

2.4.1 Medical studies have consistently failed to find any link between dust arising from mineral working and public health. A local doctor who claimed that a nearby site produced demonstrable adverse medical effects upon his patients presented evidence to the Derlwyn Public Inquiry in South Wales. However, that evidence has since been discredited and shown, as an epidemiological study to be fundamentally flawed (British Medical Journal 305, 1992).

2.4.2 In 1992 the Institute of Occupational Medicine (IOM) concluded a three-year epidemiological study of the respiratory health of some one thousand two hundred and forty nine opencast mine employees working over nine sites selected by the IOM (Institute of Occupational Medicine Ltd 1992).

2.4.3 The main conclusions of that study were that dust exposures were low for most occupational occurrences and that neither asthma nor chronic bronchitis is related to exposure to dust in any part of opencast workings. It is only for those workers exposed for 10 years or more in the dustiest of opencast jobs that a small risk of pneumoconiosis was demonstrated.

2.4.4 The Health and Safety Executive have set the occupational exposure limit for dust at 10 mg/m³ as an 8 hour time weighted average. As previously mentioned such a figure may have significance within a site if workers are immediately adjacent to a particular operation prone to high dust emissions. However, due to dilution and dispersion it is extremely unlikely that any residential property around a site would ever experience concentrations of dust as high as this, with environmental dust levels some 100 times less being the norm.

2.4.5 In 1999 the then DETR published the results of a relevant research project by the University of Newcastle upon Tyne under the title “Do particulates from opencast coal mining impair children’s respiratory health?”

2.4.6 The Committee on the Medical Effects of Air Pollutants considered the content of this study, finding that is was “…of a high standard”.

2.4.7 The Committee agreed with the findings of the authors of the report that:

i) Opencast coal mining was associated with a small increase in the mean concentration of airborne particle measured as PM_{10} in areas close to opencast sites. This was due to an increased concentration of shale.

ii) The respiratory health of children living in communities close to opencast coal sites was very similar to that of children living in communities distant from such sites.

2.4.8 Overall, the number of consultations made to general practitioners was similar for children who lived close to opencast sites compared to those who did not.

2.4.9 The Committee noted that the increase in particle concentrations close to opencast sites was not due to the release of coal particles but was more likely due to earth moving and excavation. Such levels of exposure to these materials, as may occur in local communities as a result of any opencast mining, are most unlikely to have any detectable effects on health.

2.4.10 They concluded that from what is known of the long term effects of coal mining on the health of opencast coal miners, that it is most unlikely that opencast sites would have any long term effects on the health of local communities.

2.4.11 The study noted that the differences between opencast areas and the control communities studied during the research was some 2.0 µg/m³ in terms of the gravimetric mean of daily differences in measured PM_{10} values.

2.4.12 Of significance, however, was their finding that the differences between opencast and control communities were not found to be greater under conditions when the contribution of site related PM_{10} dust had been expected to be raised. In such circumstances as when the wind was blowing from the site to the community monitor or during permitted site working hours.

2.4.13 Further guidance with regard to the assessment of PM_{10} is given within the Planning Practice Guidance documentation to the National Planning Policy Framework.

2.4.14 The general basis of this guidance is that dust should as far as possible be controlled, mitigated or removed at source. The document further confirms, with minor refinements, the assessment methodology of the University of Newcastle upon Tyne study.

2.5 Significance of Existing Air Quality

2.5.1 The comparison between existing levels of deposited dust is shown in the table below. The dust levels were monitored using sticky pads with analysis in effective area coverage per day. This has been calculated into $mg/m^2/day$ for comparison with nuisance criteria.

2.5.2 Existing air quality was measured at the perimeter of the development site in close proximity to the receptors.

Measured Air Quality – 24/07/18 – 15/08/18

Location	Deposited Dust (Approximation) $mg/m^2/day$
No. 10 Castle Barns	36
Four Winds	34
The Bungalow	60
South Lodges	52
No. 1 Brown Westhead Park	62
No. 5 Brown Westhead Park	63

2.5.3 During the LAQM review and assessment process the local authority in which the working area falls; Wyre Forest District Council, have not designated any Air Quality Management Areas in relation to PM_{10}. The closest AQMA is Kidderminster ring road, some 1.8 km south of the development, and Welch Gate AQMA which is some 6.4 km south west of the development. Both AQMA relate to NO_2. However this will be considered in the dispersion monitoring for the impact of additional vehicle movements produced by the development.

3.0 POTENTIAL EMISSIONS

3.1 Introduction

3.1.1 The operations involved in the extraction and movement of aggregate have the potential to generate dust emissions. The proposed quarry area is divided into five phases which will be progressively worked and restored throughout the life of the site.

3.2 Soil Stripping

3.2.1 The soil stripping operations required for the proposed quarry at Lea Castle Farm will be limited in duration. Consideration will be given to the weather conditions before soil handling activities are conducted when in close proximity to sensitive receptors. Any soil storage mounds will be seeded as soon as is practicable keeping with site good working practice.

3.2.2 Site vehicle movements will be limited to 15 mph. Material removed as part of the soil stripping operations will be handled in a manner to minimise dust generation through attention to detail such as minimum drop heights.

3.3 Mineral Extraction and Transportation Operations

3.3.1 Throughout all quarry phases the extraction of mineral will be conducted with a tracked excavator and will be transported to the processing plant via two articulated dump trucks.

3.3.2 The sand and gravel to be extracted from the development areas will have a relatively high moisture content which will reduce the potential for dust emission when handling the material. Notwithstanding this, the dust suppression measures detailed within this chapter and within Appendix 3 will be implemented to reduce the potential for dust emission from the site.

3.3.3 The drop height from the excavator bucket to the dump trucks and from the dump trucks to the processing plant will be minimised, the on site speed limit of 15 mph will be adopted. Dust suppression with the use of an on-site water bowser, road sweeper, and sprinkler systems will be implemented as required to mitigate dust generation.

3.3.4 Internal haul roads will consist of compacted material around the processing plant and shall be regularly maintained by grading in order to minimise dust generation.

3.3.5 Mobile plant exhausts and cooling fans will continue to be discharged away from the ground to prevent dust mobilisation.

3.3.6 All mobile plant will be regularly maintained.

3.4 Mineral Processing Plant

3.4.1 Mineral processing for sand and gravel is a wet operation. Mineral from the extraction area will be discharged into a feed hopper to the processing plant. The mineral is then processed via crushing, screening and a sand plant before being stockpiled. Water is used throughout the process helping to minimise dust emissions.

3.4.2 Mineral which has been processed will when possible be shielded from the prevailing wind.

3.4.3 The ground surface will comprise of hard standing with water applied as required. A site speed limit of 15 mph will apply around the processing plant.

3.4.4 Spray rails will be utilised on all screening and crushing plant.

3.4.5 All lorries leaving site with aggregate will be sheeted and will travel via vehicle washing facilities.

3.5 Haulage of Material Off Site

3.5.1 All lorries leaving the site will be sheeted. The site speed controls of 15 mph will be implemented on the site access road. The site access road is hard surfaced which will minimise dust generation.

3.5.2 A road sweeper will be used as required on the site access road with water used as required. The use of water as a dust suppression measure is recognised in the latest MIRO guidance to give a high level of effectiveness. Continued good maintenance and housekeeping of haul road surfaces at all times will reduce the potential for dust emission.

3.5.3 All vehicles will use extensive cleaning facilities provided before accessing public roads.

3.6 Restoration Activities

3.6.1 Any soils handled as part of restoration activities will be managed in accordance with the current site restoration scheme and where relevant seeded as soon as is practicable in order to minimise the potential for dust generation.

3.7 Potential Emission Magnitude

3.7.1 Guidance from the Institute of Air Quality Management " Guidance on the Assessment of Mineral Dust Impacts for Planning, 2016" suggests that the magnitude of potential dust emission should be classified on a scale of impact as small, medium or large based upon the judgement of the assessor. In determining the potential emissions of importance to this application, the following sources are considered:

- Site Preparation and Restoration
- Mineral Extraction
- Materials Handling
- On-Site Transportation
- Mineral Processing
- Stockpiles
- Off-Site Transportation

Site Preparation and Restoration

3.7.2 Short term operations at the site will consist of soil stripping and bund construction/removal. Based on the working proposals layout (ref. KD.LCF.013) the largest areas of simultaneous working with mineral extraction and progressive restoration will be conducted within Phase 4. A working area of approximately 5 ha will be in operation which will be worked utilising an excavator and 2 articulated dump trucks.

3.7.3 The IAQM deems that a site with a working area of >10 ha is of a large potential dust magnitude and a site with a working area of <2.5 ha is of a small potential dust magnitude. A large number of heavy plant is detailed as >10 plant simultaneously active, a small number of heavy plant is detailed as <5 plant simultaneously active. Bunds greater than 8m in height are deemed a large potential dust magnitude, as opposed to bunds smaller than 4m in height are deemed a small potential dust magnitude.

3.7.4 The largest proposed phase at the Lea Castle Farm site is deemed to be a medium working area, with a small number of heavy vehicles used simultaneously; bunds will be small in height, with approximately 60,000m^3 of inert material being moved. The overall scale of potential emission is therefore classed as medium for site preparation and restoration. This is also supported by the material being of a low dust potential with high moisture content.

Mineral Extraction

3.7.5 Mineral will be won using low-energy extraction methods via excavator which will be transported to the processing plant via 2 articulated dump trucks classed as a small potential dust impact. The maximum area of mineral extraction to be worked is approximately 5 ha of Phase 4, classed by the IAQM as a small potential dust impact, with an excavator handling material of high moisture content and loading to an articulated dump truck. The expected mineral extraction rate is estimated to be in the region of 300,000 tonnes per annum across the extraction area.

3.7.6 Given the implementation of dust mitigation measures highlighted in Section 3 and the movement of mineral of high moisture content and low energy extraction methods, the scale of potential dust impact for mineral extraction is judged to be medium.

Materials Handling

3.7.7 The IAQM suggest that >10 loading plant, transferring material of a high dust potential on poorly surfaced ground within 50m of the site boundary should be classified as a large potential dust impact. Conversely, a small potential dust magnitude may include <5 plant, more than 100m of a site boundary, within the quarry void or clean hard standing, transferring material of low dust potential and/or high moisture content.

3.7.8 The mineral to be extracted at the site will utilise one excavator feeding mineral via 2 articulated dumps truck to the feed hopper for processing. The high moisture content and low dust potential of the mineral to be excavated, with the potential use of <10 mobile plant items, the continued use of water as required, minimisation of drop heights, adequate speed controls and the grading of haul routes combine such that the impact from this activity is judged to be of small dust raising potential.

On-Site Transportation

3.7.9 Transportation of mineral from the extraction area to the processing plant located will be via 2 articulated dump trucks. The maximum number of total articulated dump truck movements per day is anticipated to be in the order of 33 loads (66 movements round trip) to the processing plant; this being based on an articulated dump truck working at capacity and transferring 1250 tonnes per day.

3.7.10 The IAQM suggests that transportation movements of >250 on unpaved surfaces of potentially dusty material without the use of conveyors could result in a large dust impact. Conversely a small potential dust magnitude from on-site transportation may include <100 movements of vehicles per day of material with high moisture content and low dust potential with a maximum speed of 15mph. The scale of potential dust impact for on-site transportation is judged to be small.

Mineral Processing

3.7.11 Guidance from the IAQM suggests that a fixed screening plant with a throughput of < 200,000 tpa processing material of a low dust potential and high moisture content presents the potential for a small scale dust impact. Conversely a large potential dust magnitude from mineral processing may include factors such as a mobile crusher and screener processing >1,000,000 tpa of material with high dust potential and low moisture content. In this instance the processing plant at Lea Castle Farm Quarry will have a throughput in of 300,000 tpa and will process mineral with a low dust potential and a high moisture content. The static plant utilises water as part of the mineral processing. The scale of potential dust impact from the plant is therefore classed to be of a small potential for dust emission.

Stockpiles

3.7.12 The IAQM suggest that a site throughput <200,000 tpa, a daily transfer of material and a stockpile area <2.5ha has the potential to result in a small scale of dust impact. A large dust magnitude for stockpiles and exposed surfaces could include a stockpile of a total exposed area of >10 ha in an area exposed to high winds and located <50m from the site boundary. Daily transfer of material with a high dust potential and/or low moisture content, stockpile duration greater than 12 months and quarry production >1,000,000 tpa.

3.7.13 Exposed surfaces and stockpiles at Lea Castle Farm Quarry will be of material of a low dust potential and high moisture content, stored within a location >50m of the site boundary and will be shielded from prevailing wind within the quarry. Together with the mitigation measures as outlined in Section 3 and Appendix 3, the scale of impact is considered to be small for stockpiles and exposed surfaces.

Off-Site Transportation

3.7.14 The IAQM suggest that a large potential dust magnitude from off-site transportation could include total HDV >200 movements in any one day on unsurfaced site access road <20 m in length with no HDV cleaning facilities. No road sweeper available. A small potential magnitude may include <25 HDV movements per day, paved surfaced site access road >50 m in length, with effective HDV cleaning facilities and procedures, the employment of an effective road sweeper.

3.7.15 Off-site transportation at Lea Castle Farm Quarry will be approximately 10 – 20 heavy duty vehicles per day, traversing a haul road >50m and utilisation of extensive vehicle cleaning facilities, therefore the scale of impact from off-site transportation is considered to be small.

Residual Source Emission Classification

Activity	Residual Source Emissions
Site Preparation and Restoration	Medium
Mineral Extraction	Medium
Materials Handling	Small
On-Site Transportation	Small
Mineral Processing	Small
Stockpiles	Small
Off-Site Transportation	Small

4.0 CLIMATIC CONDITIONS

4.1 The frequency of use and the effectiveness of the control measures outlined in Appendix 3 will largely depend upon climatic conditions together with the separation distances involved between any potential dust source and residential locations.

4.2 The highest potential for dust dispersal and deposition occurs on dry windy days and the risk of dust deposition at a particular location is determined by the frequency of these dry winds blowing towards them from a dust generating activity.

4.3 In the guidance 'The Environmental Effects of Dust from Surface Mineral Workings' published in 1995 by the DoE (now part of DEFRA) together with guidance in the former MPS2, it is generally accepted that wind blow of dust does not occur on days when rainfall is above 0.2 mm.

4.4 The meteorological data from Pershore has been analysed in order to quantify the number of dry working days in which the wind direction is in a particular sector.

4.5 Information provided by the Met Office as monitored at Pershore is detailed below:-

Wind Direction	Frequency of Occurrence %
North	4.1
North North East	5.1
East North East	6.5
East	5.1
East South East	3.5
South South East	5.2
South	9.8
South South West	22.1
West South West	11.3
West	8.7
West North West	5.4
North North West	7.5
Calm/variable	5.7

Rainfall less than 0.2 mm

146.4 days per year (Appendix 2).

The information adapted to allow for working days only, i.e. 5½ days per week, 47 weeks per year, is 103.7 working days per year with rainfall less than 0.2 mm.

4.6 Combined with the prevailing wind directions, the number of dry working days each year can be represented as follows:-

Wind Direction	No. of Dry Working Days
North	4.2
North North East	5.3
East North East	6.7
East	5.3
East South East	3.6
South South East	5.4
South	10.2
South South West	22.9
West South West	11.7
West	9.0
West North West	5.6
North North West	7.8
Calm/variable	5.9

4.7 Considering that dust is not likely to be carried by winds of less than 5.6 ms^{-1} (i.e. less than 11 knots), an assessment of the likelihood of a dust occurrence is presented below:-

Wind Direction	No. of Dry Windy Working Days	Dry Windy Working Days as % of the total Number of Dry Working Days per Year (103.7)
North	0.3	0.3
North North East	0.3	0.3
East North East	0.4	0.4
East	0.4	0.4
East South East	0.6	0.6
South South East	1.3	1.3
South	3.0	2.9
South South West	6.6	6.4
West South West	2.4	2.3
West	2.4	2.3
West North West	1.1	1.1
North North West	1.1	1.1

4.8 This value of 5.6 ms^{-1} derives from the Beaufort Wind Scale and is very much in line with the value of 5.4 ms^{-1} as used by the United States Environmental Protection Agency in their dust emission calculations. The value is also below the 5.8 ms^{-1} stated within guidance from MIRO and the Department of the Environment for the initiation of dust emission for disturbed pebbly soils.

5.0 DISCUSSION

5.1 The proposed methods of dust suppression are based on Vibrock Limited's experience of assessing potentially dusty extractive operations over many years in a wide variety of situations. These tried and tested methods of dust suppression have been successfully used at numerous minerals sites across the UK. The proposed dust control measures are recognised as industry best practice and are summarised in Appendix 3. A more intensive list can be found in IAQM Guidance on the Assessment of Mineral Dust Impacts for Planning, May 2016 Table 4 and 5, and MIRO Good Practice Guide: control and measurement of nuisance dust and PM_{10} from the extractive industries, 2011.

5.2 A dust event will only occur if the necessary conditions are present. It is necessary to have a fine material available which is able to be picked up, carried and then deposited by the wind. Such materials are more readily available if dry and physically disturbed. Thus not all site operations are dusty because of the lack of physical disturbance. There must also be a wind of sufficient strength to transport fine particles, and for a particular property to be at risk the wind must blow in that particular direction from the source. The critical wind speed at which a particle becomes airborne depends on many factors including particle size, shape and density. For most mineral dusts the critical wind speed is about 5.6 ms^{-1} (12 mph - 11kts - Force 4 on Beaufort Scale).

5.3 For a dust event to occur there must also be a failure of dust control measures. Particles greater than 30µm make up the greatest proportion of dust emitted from mineral processing and largely deposit within 100 m of sources. Particles between 10 and 30µm are likely to travel from 250 to 400 m, while sub 10µm particles, which make up a small proportion of dust emitted from most mineral processing operations, may travel up to 1 km from sources.

5.4 In considering the climatic conditions, it is clear the winds will predominate from the south west quadrant with an analysis of the number of dry windy working days giving a maximum of some 14 such days likely in a south west direction in any one year. The property locations are identified on Figure 1.

5.5 The IAQM Guidance on the Assessment of Mineral Dust Impacts for Planning presents the following categorisation of frequency of potentially dusty winds and categorises receptor distance from source as distant, intermediate or close as displayed below.

Categorisation of Frequency of Potentially Dusty Winds

Frequency Category	Criteria
Infrequent	Frequency of winds (>5m/s) from the direction of the dust source on dry days are less than 5%
Moderately Frequent	The frequency of winds (>5m/s) from the direction of the dust source on dry days are between 5% and 12%
Frequent	The frequency of winds (>5m/s) from the direction of the dust source on dry days are between 12% and 20%
Very Frequent	The frequency of winds (>5m/s) from the direction of the dust source on dry days are greater than 20%

Category	Criteria
Distant	Receptor is between 200 and 400m from dust source
Intermediate	Receptor is between 100 and 200m from dust source
Close	Receptor is less than 100m from the dust source

5.6 The assessment locations are identified on Figure 1.

Residential Receptors

No. 5 Brown Westhead Park

5.7 The closest approach separation distance at No. 5 Brown Westhead Park is <100m west of Phase 2.

5.8 Winds from the east north east, east, east south east, and south south east and would blow from the site towards the residential property. The property will be shielded from the quarry by existing hedge land and the creation of screening bund.

5.9 A total of 3 dry windy working days are calculated from the above quadrants, representing between <5% of all dry windy working days. No.5 Brown Westhead Park is therefore classed as close from the source of dust and with the potential for dusty winds classed as infrequent.

No. 1 Brown Westhead Park

5.10 The residential property of No. 1 Brown Westhead Park, is located to the west of the proposed development. The closest approach of operations to the receptor will be within Phase 3 with a separation distance of approximately 125 m from the closest of operations during this phase.

5.11 Winds from the north north east, east north east, east, and east south east would blow from the closest of workings towards the property. The property will be shielded from the extraction operations by existing hedge-land. The calculated number of dry windy working days is 2 days from the above quadrants, giving a total of <5% of the total number of dry working days. The number of dry windy working days is therefore classed as infrequent with the distance between potential dust source and receptor classed as intermediate.

South Lodges

5.12 The residential property of South Lodges is located to the south east of Phase 2. The property will be shielded from the works by the creation of a screening bund.

5.13 The property of South Lodges is located <100m from the proposed quarry works of Phase 3. Winds from the north, north north west, and west north west would blow towards South Lodges from Phase 3 for 3 days per annum from the quadrants above, <5% of the total number of dry working days. The number of dry windy working days is classed as infrequent with the separation distance from operations classed as close.

Broom Cottage

5.14 Broom Cottage is a residential property located <100m to the south of the proposed development Phase 3, classed as close.

5.15 The number of dry windy working days when the wind blows from west north west, north north west, north, north north east, and east north east quadrants is 3 days per annum which represents <5% of the total number of dry working days

5.16 The potential for wind of sufficient strength to blow from the site is therefore considered to be infrequent. The property will be shielded from site operations by the creation of a screening bund.

Four Winds

5.17 Four Winds is located approximately 105 m to the south of the proposed quarry works of Phase 4.

5.18 The calculated number of dry windy working days when wind would blow from the proposed Phase 4 from the west north west, north north west, north, and north north east is 3 days per annum, <5% of the total number of dry working days per annum.

5.19 The potential for wind of sufficient strength to blow from the site and to transport dust is therefore considered to be infrequent, with the separation distance from proposed operations classed as intermediate.

No. 10 Castle Barns

5.20 The closest approach separation distance at the residential property of No. 10 Castle Barns is approximately 150 m to the north east of Phase 5.

5.21 Winds from the west, west south west, and south south west would blow from the site towards No. 10 Castle Barns. The property will be shielded from the quarry by bunding around the quarry working area.

5.22 A total of 11 dry windy working days are calculated from the above quadrants, representing between 5% and 12% of all dry windy working days. No. 10 Castle Barns is therefore classed as intermediate from the source of dust and with the potential for dusty winds classed as moderately frequent.

The Bungalow

5.23 The closest approach separation distance at The Bungalow to the proposed development area is <100m east of Phase 1.

5.24 Winds from the north north west, west north west, west, west south west, and south south west would blow from the site towards The Bungalow. The Bungalow will be shielded from the quarry by bunding around the quarry working area.

5.25 A total of 14 dry windy working days are calculated from the above quadrants, representing between 12% and 20% of all dry windy working days. The Bungalow is therefore classed as close from the source of dust and with the potential for dusty winds classed as frequent.

Public Spaces

Brown Westhead Park and Playing Fields

5.26 The closest approach separation distance at Brown Westhead Park and Playing Fields to the proposed development area is approximately 160 m west of Phase 2.

5.27 Winds from the north north east, east north east, east, east south east, and south south east would blow from the site towards the receptor. Brown Westhead Park and Playing Fields will be shielded from the quarry by bunding around the quarry working area and existing hedge land.

5.28 A total of 3 dry windy working days are calculated from the above quadrants, representing <5% of all dry windy working days. The receptor is therefore classed as intermediate from the source of dust and with the potential for dusty winds classed as infrequent.

Heathfield Knoll School

5.29 Heathfield Knoll School is a receptor located <100m to the south west of the proposed development Phase 3, classed as close.

5.30 The number of dry windy working days when the wind blows from north, north north east, and east north east quadrants is 1 day per annum which represents <5% of the total number of dry working days.

5.31 The potential for wind of sufficient strength to blow from the site is therefore considered to be infrequent. The property will be shielded from site operations by the creation of a screening bund and existing hedge land.

Internationally Designated Receptors (SSSI, SAC, RAMSAR) and Local Wildlife Sites (LWS)

The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS)

5.32 The closest approach separation distance is approximately 625 m west of Phase 2.

5.33 Winds from the east and east south east would blow from the site towards the ecological receptor.

5.34 A total of 1 dry windy working day is calculated from the above quadrants, representing between <5% of all dry windy working days; being classed as distant from the source of dust and with the potential for dusty winds classed as infrequent. IAQM states that adverse dust impacts from sand and gravel are uncommon beyond 250m of the operation; it is unlikely the receptor will be impacted by fugitive dust from site operations.

Stourvale Marsh

5.35 Stourvale Marsh is located to the south west of the proposed development. The closest approach of operations to the receptor will be within Phase 3 with a separation distance of approximately 930 m from the closest of operations during this phase.

5.36 Winds from the east north east would blow from the closest of workings towards the receptor. The calculated number of dry windy working days is <1 day from the above quadrants, giving a total of <5% of the total number of dry working days. The number of dry windy working days is therefore classed as infrequent with the distance between potential dust source and receptor classed as distant, however IAQM states that adverse dust impacts from sand and gravel are uncommon beyond 250 m of the operation, it is unlikely the receptor will be impacted by fugitive dust from site operations.

Puxton Marshes (and LWS)

5.37 The Puxton Marshes are located to the south west of Phase 3.

5.38 The receptor is located >1km from the proposed quarry works. Winds from the north north east, and east north east would blow towards the receptor from Phase 2 for 1 day per annum from the quadrants above, <5% of the total number of dry working days. The number of dry windy working days is classed as infrequent with the separation distance from operations classed as distant, however IAQM states that adverse dust impacts from sand and gravel are uncommon beyond 250 m of the operation, it is unlikely the receptor will be impacted by fugitive dust from site operations.

Hurcott Pasture and Hurcott and Podmore Pools (and LWS)

5.39 The receptors are located approximately 660 m to the south east of the proposed development Phase 4, classed as distant.

5.40 The number of dry windy working days when the wind blows from the north north west quadrant is 1 day per annum which represents <5% of the total number of dry working days.

5.41 The potential for wind of sufficient strength to blow from the site is therefore considered to be infrequent, however IAQM states that adverse dust impacts from sand and gravel are uncommon beyond 250 m of the operation, it is unlikely the receptor will be impacted by fugitive dust from site operations.

River Stour

5.42 The River Stour is located approximately 220 m to the north west of the proposed quarry works of Phase 1.

5.43 The calculated number of dry windy working days when wind would blow from the proposed Phase 1 from the east south east, and south south east is 2 days per annum, <5% of the total number of dry working days per annum.

5.44 The potential for wind of sufficient strength to blow from the site and to transport dust is therefore considered to be infrequent, with the separation distance from proposed operations classed as distant.

Gloucester Coppice (and Natural Woodland)

5.45 The closest approach separation distance is approximately 208 m to the north of Phase 1.

5.46 Winds from the south south east, south, and south south west would blow from the site.

5.47 A total of 11 dry windy working days are calculated from the above quadrants, representing between 5% and 12% of all dry windy working days, therefore the receptor is classed as distant from the source of dust and with the potential for dusty winds classed as moderately frequent.

Wolverley Marsh

5.48 The closest approach separation distance at Wolverley Marsh to the proposed development area is approximately 680 m west of Phase 2.

5.49 Winds from the east and east south east would blow from the site towards Wolverley Marsh.

5.50 A total of 1 dry windy working day is calculated from the above quadrants, representing between <5% of all dry windy working days. Wolverley Marsh is therefore classed as distant from the source of dust and with the potential for dusty winds classed as infrequent, however IAQM states that adverse dust impacts from sand and gravel are uncommon beyond 250m of the operation, it is unlikely the receptor will be impacted by fugitive dust from site operations.

Wolverley Court Lock Carr

5.51 The closest approach separation distance to the proposed development area is approximately 610 m south west of Phase 3.

5.52 Winds from the east north east and east would blow from the site towards the receptor.

5.53 A total of <1 dry windy working day is calculated from the above quadrants, representing <5% of all dry windy working days. The receptor is therefore classed as distant from the source of dust and with the potential for dusty winds classed as infrequent, however IAQM states that adverse dust impacts from sand and gravel are uncommon beyond 250 m of the operation, it is unlikely the receptor will be impacted by fugitive dust from site operations.

Pathway Effectiveness

Receptor Distance Category		Frequency of Potentially Dusty Winds			
		Infrequent	**Moderately Frequent**	**Frequent**	**Very Frequent**
	Close	Ineffective	Moderately Effective	Highly Effective	Highly Effective
	Intermediate	Ineffective	Moderately Effective	Moderately Effective	Highly Effective
	Distant	Ineffective	Ineffective	Moderately Effective	Moderately Effective

5.54 In order to determine pathway effectiveness from the IAQM guidance, the receptor distance category and frequency of potentially dusty winds are combined, the results of which are presented for each receptor location below.

Receptor	Pathway Effectiveness
No. 5 Brown Westhead Park	Ineffective
No. 1 Brown Westhead Park	Ineffective
South Lodges	Ineffective
Broom Cottage	Ineffective
Four Winds	Ineffective
No. 10 Castle Barns	Moderately Effective
The Bungalow	Highly Effective
Brown Westhead Park and Playing Fields	Ineffective
Heathfield Knoll School	Ineffective
The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS)	Ineffective*
Stourvale Marsh	Ineffective*
Puxton Marshes (and LWS)	Ineffective*
Hurcott Pasture	Ineffective*
Hurcott and Podmore Pools (and LWS)	Ineffective*
River Stour	Ineffective
Gloucester Coppice (and Natural Woodland)	Ineffective
Wolverley Marsh	Ineffective*
Wolverley Court Lock Carr	Ineffective*

*IAQM states that adverse dust impacts from sand and gravel are uncommon beyond 250m of the operation, even at the dustiest of sites therefore are categorised as Ineffective

5.55 An estimation of dust risk is established for each location based on the pathway effectiveness of dust transmission and the worst case categorisation of residual dust source emission as detailed within Section 3.

Estimation of Dust Impact Risk

		Residual Source Emissions		
		Small	**Medium**	**Large**
Pathway Effectiveness	**Highly Effective Pathway**	Low Risk	Medium Risk	High Risk
	Moderately Effective Pathway	Negligible Risk	Low Risk	Medium Risk
	Ineffective Pathway	Negligible Risk	Negligible Risk	Low Risk

Receptor	Estimation of Dust Impact Risk
No. 5 Brown Westhead Park	Negligible Risk
No. 1 Brown Westhead Park	Negligible Risk
South Lodges	Negligible Risk
Broom Cottage	Negligible Risk
Four Winds	Negligible Risk
No. 10 Castle Barns	Low Risk
The Bungalow	Medium Risk
Brown Westhead Park and Playing Fields	Negligible Risk
Heathfield Knoll School	Negligible Risk
The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS)	Negligible Risk
Stourvale Marsh	Negligible Risk
Puxton Marshes (and LWS)	Negligible Risk
Hurcott Pasture	Negligible Risk
Hurcott and Podmore Pools (and LWS)	Negligible Risk
River Stour	Negligible Risk
Gloucester Coppice (and Natural Woodland)	Negligible Risk
Wolverley Marsh	Negligible Risk
Wolverley Court Lock Carr	Negligible Risk

5.56 For the purpose of identifying receptor sensitivity, the IAQM 2016 Guidance suggests that residential dwellings should be classed as a high sensitivity receptor. Parks and places of work deemed as medium, and farmland and playing fields classed as low sensitivity.

Descriptors for Magnitude of Dust Effects

		Receptor Sensitivity		
		Low	**Medium**	**High**
Dust Impact Risk	**High Risk**	Slight Adverse Effect	Moderate Adverse Effect	Substantial Adverse Effect
	Medium Risk	Negligible Effect	Slight Adverse Effect	Moderate Adverse Effect
	Low Risk	Negligible Effect	Negligible Effect	Slight Adverse Effect
	Negligible Risk	Negligible Effect	Negligible Effect	Negligible Effect

5.57 An assessment of the magnitude of dust effect is presented for each of the receptor locations below:

Receptor	Magnitude of Dust Effect
No. 5 Brown Westhead Park	Negligible Effect
No. 1 Brown Westhead Park	Negligible Effect
South Lodges	Negligible Effect
Broom Cottage	Negligible Effect
Four Winds	Negligible Effect
No. 10 Castle Barns	Slight Adverse Effect
The Bungalow	Moderate Adverse Effect
Brown Westhead Park and Playing Fields	Negligible Effect
Heathfield Knoll School	Negligible Effect
The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS)	Negligible Effect
Stourvale Marsh	Negligible Effect
Puxton Marshes (and LWS)	Negligible Effect
Hurcott Pasture	Negligible Effect
Hurcott and Podmore Pools (and LWS)	Negligible Effect
River Stour	Negligible Effect
Gloucester Coppice (and Natural Woodland)	Negligible Effect
Wolverley Marsh	Negligible Effect
Wolverley Court Lock Carr	Negligible Effect

General

5.58 When conditions for dry windy working days do occur, the implementation of the dust suppression measures discussed in Section 3 and Appendix 3, will ensure that dust emissions are minimised. The use of such best practice measures, which have been implemented at mineral extraction sites throughout the United Kingdom, suggest that such measures will be effective.

Traffic Dispersion Modelling

5.59 The greatest potential for an air quality impact is from changes in traffic flows affecting new or existing residents. The pollutants of concern are nitrogen dioxide and fine particles.

5.60 This will be assessed using ADMS – Roads Dispersion Modelling, a model that is approved for use in detailed assessment dispersion modelling studies in LAQM.TG(16). The model has been subject to extensive validation and inter-model comparison studies.

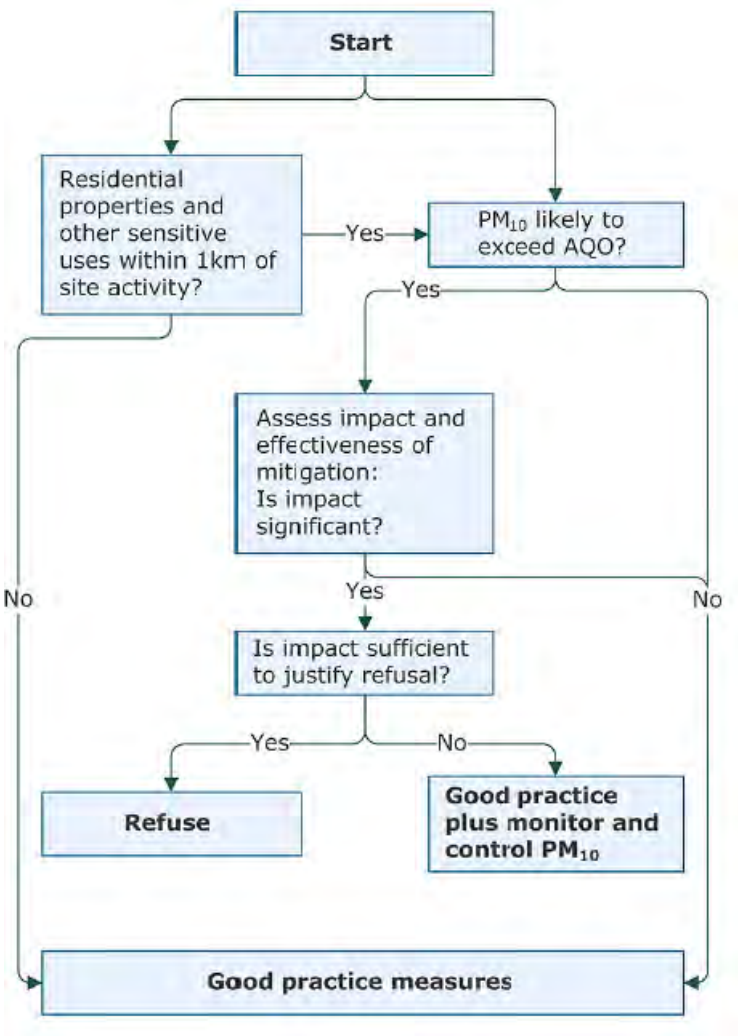
5.61 This work has been undertaken by EnviroCentre, the results of which are presented in Appendix 4.

6.0 PM_{10} ASSESSMENT

6.1 The 1999 DETR publication "Do particulates from opencast coal mining impair children's respiratory health?" recommends an assessment framework with respect to PM_{10} particulates.

6.2 The framework takes a step by step approach to PM_{10} looking at various factors in time via a scheme of straightforward questions set out in a "Proposed Site Assessment Flowchart". If the site is not likely to have a significant impact then best practice measures are recommended. If, however, its impact is significant, either a refusal should follow or additional monitoring and control.

6.3 The Planning Practice Guidance to the National Planning Policy Framework contains an amended version of the assessment framework (shown below).



6.4 To follow the framework the first step is to assess whether the site has a community or particularly sensitive users / premises within 1000 m of the site boundary.

6.5 The second step is then to assess whether the extra burden of PM_{10} particulates from the site is likely to exceed the National Air Quality Objectives (AQO).

Summary of Limit Values and Objectives for Suspended Particulate Matter

PM fraction	Averaging period	Objective/Limit Value	Max allowable exceedances	Target Date
PM_{10}	24 hours	50 µg/m^3	35 times per calendar year	-
	Annual	40 µg/m^3		-
$PM_{2.5}$	Annual	Target of 15% reduction in concentrations at urban background locations		Between 2010 and 2020 (a)
		Variable target of up to 20% reduction in concentrations at urban background locations(c)		Between 2010 and 2020 (b)
	Annual	25 µg/m^3		01.01.2020(a)
		25 µg/m^3		0.101.2015(b)
(a) Target date set in UK Air Quality Strategy 2007 (b) Target date set in Air Quality Standards Regulations 2010 (c) Aim to not exceed 18 µg/m^3 by 2020				

6.6 To undertake this assessment it is recommended that Automatic Urban and Rural Network (AURN) data be accessed.

6.7 If the AURN data indicates that the additional load attributable to site operations, to be taken as 1 µg/m³ for the scope of this assessment, as discussed below, would bring the area above the AQO, then this would indicate that there may be a need for monitoring and control mechanisms. These would be required to be put into place in order to reduce the potential to create PM_{10} dust from the site on those days that exceed the standard.

6.8 If the AURN data indicates that the additional load attributable to site operations alone of 1 µg/m³ would not cause any breach of the AQO, this would indicate that there would be no justification for any additional monitoring and controls over and above best practice measures.

6.9 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, 2003 suggests that quarrying and construction work are thought to account for less than 1 μg/m³ of PM_{10} levels. It could therefore be considered that a loading of 1 μg/m³ is a worst case calculation. The Newcastle Study discussed within Section 2 of this report was based upon an assessment of opencast coal operations and considered a loading of 2 μg/m³ as a process contribution. Opencast coal sites in general move far greater volumes of overburden and have a larger plant complement than many sand and gravel and hard rock quarry operations. This lower dust generating potential for other types of mineral sites is acknowledged in the IAQM Minerals Dust Guidance.

6.10 This study has accessed air quality data from the DEFRA website for the relevant grid squares which contain the closest residential receptors.

Grid Square 383500/278500: No. 5 Brown Westhead Park / No. 1 Brown Westhead Park / South Lodges / Broom Cottage / Four Winds / The Bungalow / Heathfield Knoll School

Year	Projected PM_{10} Burden	
	Number of Exceedances of 50 μg/m³	Annual Mean μg/m³
2018	<1	13.79
2023	<1	13.46
2028	<1	13.34

6.11 For Grid Square 383500, 278500 the highest annual mean when combined with a site attributable load of 1 μg/m³ is for the year 2018 and gives a projected burden of 13.79 μg/m³. Such an annual mean is calculated to produce <1 daily exceedances of 50 μg/m³.

Grid Square 384500/278500: No. 10 Castle Barns

Year	Projected PM_{10} Burden	
	Number of Exceedances of 50 μg/m³	Annual Mean μg/m³
2018	<1	15.16
2023	<1	14.81
2028	<1	14.68

6.12 For Grid Square 384500, 278500 the highest annual mean when combined with the site attributable load of 1 µg/m³ is for the year 2018 and gives a projected burden of 15.16 µg/m³. Such an annual mean is calculated to produce <1 daily exceedance of 50 µg/m³.

Grid Square 382500/278500: Brown Westhead Park and Playing Fields / The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS) / Stourvale Marsh / Wolverley Marsh / Wolverley Court Lock Carr

Year	Projected PM_{10} Burden	
	Number of Exceedances of 50 µg/m³	Annual Mean µg/m³
2018	<1	13.39
2023	<1	13.06
2028	<1	12.94

6.13 For Grid Square 382500, 278500 the highest annual mean when combined with the site attributable load of 1 µg/m³ is for the year 2018 and gives a projected burden of 13.39 µg/m³. Such an annual mean is calculated to produce <1 daily exceedances of 50 µg/m³.

Grid Square 382500/277500: Puxton Marshes (and LWS)

Year	Projected PM_{10} Burden	
	Number of Exceedances of 50 µg/m³	Annual Mean µg/m³
2018	<1	14.11
2023	<1	13.76
2028	<1	13.64

6.14 For Grid Square 382500, 277500 the highest annual mean when combined with the site attributable load of 1 µg/m³ is for the year 2018 and gives a projected burden of 14.11 µg/m³. Such an annual mean is calculated to produce 1 daily exceedances of 50 µg/m³.

Grid Square 384500/277500: Hurcott Pasture / Hurcott and Podmore Pools (and LWS)

Year	Projected PM_{10} Burden	
	Number of Exceedances of 50 µg/m³	Annual Mean µg/m³
2018	<1	15.69
2023	<1	15.31
2028	<1	15.19

6.15 For Grid Square 384500, 277500 the highest annual mean when combined with the site attributable load of 1 µg/m³ is for the year 2018 and gives a projected burden of 15.69 µg/m³. Such an annual mean is calculated to produce <1 daily exceedance of 50 µg/m³.

Grid Square 383500/279500: River Stour / Gloucester Coppice (and Natural Woodland)

Year	Projected PM_{10} Burden	
	Number of Exceedances of 50 µg/m³	Annual Mean µg/m³
2018	<1	13.42
2023	<1	13.10
2028	<1	12.97

6.16 For Grid Square 383500, 279500 the highest annual mean when combined with the site attributable load of 1 µg/m³ is for the year 2018 and gives a projected burden of 13.42 µg/m³. Such an annual mean is calculated to produce <1 daily exceedance of 50 µg/m³.

6.17 Hence the proposed mineral extraction operations at Lea Castle Farm would satisfy the UK Air Quality Objectives for PM_{10} of no more than 35 exceedances per year of a 24 hour mean of 50µg/m³ and an annual mean of 40 µg/m³.

6.18 This procedure clearly indicates that the PM_{10} from this proposal is not likely to exceed the Air Quality Objectives and it is considered that the best practice measures proposed for dust control are appropriate and in proportion to the potential for dust emission.

6.19 As previously noted within this report, sub 10µm particles, which make up a small proportion of dust emitted from most mineral operations, may travel up to 1 km from sources. Of the total PM_{10} dust fraction there will be a percentage of the smaller $PM_{2.5}$ particulate matter.

6.20 In the May 2016 publication by the Institute of Air Quality Management "Guidance on the Assessment of Mineral Dust Impacts for Planning" it is stated that:

"The other potential air quality impact is the increase in ambient suspended particulate matter (PM) concentrations local to the site. As noted earlier, the PM_{10} fraction is relevant to health outcomes. For quarries most of this suspended dust will be in the coarse sub-fraction ($PM_{2.5-10}$), rather than in the fine ($PM_{2.5}$) fraction."

6.21 On the basis of the above comment and the nationally derived ratio of $PM_{2.5}/PM_{10}$; 0.7, it is considered an additional burden of 0.5 μgm^{-3} $PM_{2.5}$ to the annual mean would represent a worst case.

6.22 The application of a 0.5 $\mu g/m^3$ loading to the highest $PM_{2.5}$ concentration considered in this assessment of 10.41 $\mu g/m^3$ for the year 2018 at grid square 384500, 277500 gives a projected $PM_{2.5}$ burden with the addition of quarry operations of 10.91 $\mu g/m^3$ for the grid square containing Hurcott Pasture / Hurcott and Podmore Pools (and LWS). The worst case projected concentration therefore complies with the $PM_{2.5}$ 2015 annual mean criterion of 25 $\mu g/m^3$.

6.23 If the development is permitted, an increase in the annual mean concentration of PM_{10} and $PM_{2.5}$ would not exceed the Air Quality Objectives.

7.0 DUST MANAGEMENT

7.1 The table below presents an assessment of dust effects in accordance with the guidance contained in the IAQM Guidance on the Assessment of Mineral Dust Impacts for Planning.

Magnitude of Dust Effect

Receptor	Location Relative to Dust Source	Worst Case Residual Source Emissions	Pathway Effectiveness	Dust Impact Risk	Receptor Sensitivity	Magnitude of Dust Effect
No. 5 Brown Westhead Park	88m west of Ph2	Medium	Ineffective	Negligible Risk	High	Negligible Effect
No. 1 Brown Westhead Park	125m west of Ph2	Medium	Ineffective	Negligible Risk	High	Negligible Effect
South Lodges	50m south east of Ph2	Medium	Ineffective	Negligible Risk	High	Negligible Effect
Broom Cottage	55m south of Ph3	Medium	Ineffective	Negligible Risk	High	Negligible Effect
Four Winds	105m south of Ph3	Medium	Ineffective	Negligible Risk	High	Negligible Effect
No. 10 Castle Barns	150m north east of Ph3	Medium	Moderately Effective	Low Risk	High	Slight Adverse Effect
The Bungalow	30m east of Ph1	Medium	Highly Effective	Medium Risk	High	Moderate Adverse Effect
Brown Westhead Park and Playing Fields	160m west of Ph2	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect
Heathfield Knoll School	90m south west of Ph2	Medium	Ineffective	Negligible Risk	High	Negligible Effect
The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS)	625m west of Ph2	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect
Stourvale Marsh	930m south west of Ph2	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect
Puxton Marshes (and LWS)	>1km south west of Ph2	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect

Hurcott Pasture	665m south east of Ph3	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect
Hurcott and Podmore Pools (and LWS	660m south east of Ph3	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect
River Stour	220m west of Ph1	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect
Gloucester Coppice (and Natural Woodland)	208m north of Ph1	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect
Wolverley Marsh	680m west of Ph2	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect
Wolverley Court Lock Carr	610m south west of Ph2	Medium	Ineffective	Negligible Risk	Medium	Negligible Effect

7.2 As shown above, the impact on air quality from potential dust emissions is expected at all but two receptors to be negligible effect. No. 10 Castle Barns and The Bungalow could potentially be Slight Adverse Effect / Moderate Adverse Effect if dust mitigation and control measures are not implemented. If the dust control measures identified in Section 3.0 and Appendix 3 are effectively implemented, this will effectively mitigate any potential dust impact.

7.3 The quarry operator will comply with any conditions which may be specified in the planning conditions imposed by the Mineral Planning Authority relating to dust. The operator will refer to the planning conditions and determine an appropriate response, taking into account current and forecast weather conditions.

7.4 All site personnel shall be trained as to the potential sources and effective mitigation of dust.

7.5 Regular visual inspections will be conducted within the site and on the local road network by the site personnel, as deemed necessary and especially during dry windy conditions to ensure that any dust sources are identified and dealt with promptly.

7.6 A complaints log will be held on site. In the event of receiving a dust complaint, the name and location of the complainant, the nature of the dust related complaint, the site activity and prevailing weather conditions at the time of the complaint shall be noted. The site foreman shall investigate the complaint and take any remedial action which is deemed appropriate.

7.7 In the event of a failure of dust mitigation measures, for example in extreme weather conditions, the dust generating activity shall be temporarily suspended, until appropriate dust mitigation is implemented or until a change in weather condition occurs.

7.8 Attention is drawn to IAQM Guidance on the Assessment of Mineral Dust Impacts for Planning, May 2016 – Table 4. Good Practice Mitigation – Design Measures and Table 5. Basic Good Practice Mitigation – Operational Measures

8.0 CONCLUSIONS

8.1 It is unlikely that any significant decrease in local air quality will occur due to the proposed development at Lea Castle Farm Quarry. Any dust occurrence event will be limited and of short duration and will be minimised by implementation of the dust control recommendations.

8.2 With regard to PM_{10} and $PM_{2.5}$ dust levels from the site, analysis has been made of the air quality data. The conclusion of the analysis was that AQO will not be exceeded.

8.3 Overall the effect on air quality of this development with the implementation of suitable dust mitigation measures is considered to be not significant.

9.0 REFERENCES

1. The Environmental Effects of Dust from Surface Mineral Workings, DOE, 1995.

2. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, 2003.

3. National Planning Policy Framework, Department for Communities and Local Government, March 2012.

4. National Planning Policy Framework, Department for Communities and Local Government, February 2019.

5. Planning Practice Guidance, Department for Communities and Local Government, March 2014.

6. Land-Use Planning and Development Control Planning for Air Quality: Planning for Air Quality. Environmental Protection UK and IAQM, May 2015.

7. Good Practice Guide: control and measurement of nuisance dust and PM_{10} from the extractive industries. Mineral Industry Research Organisation, February 2011.

8. Minerals Policy Statement 2. Controlling and mitigating the environmental effects of minerals extraction in England. Annex 1: Dust, Office of the Deputy Prime Minister, 2005.

9. Her Majesty's Inspectorate of Pollution, Technical Guidance Note (Dispersion) D1, HMSO, 1993.

10. Guidance on the Assessment of Mineral Dust Impacts for Planning, IAQM, May 2016.

11. Local Air Quality Management Technical Guidance (TG16), DEFRA April 2016.

12. Worcestershire Regulatory Services 2016 Air Quality Annual Status Report (ASR) for Wyre Forest District Council

FIGURE 1 – PREDICTION LOCATIONS


The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS)
No.5 Brown Westhead Park
Heathfield Knoll School
No.1 Brown Westhead Park
Brown Westhead Park and Playing Fields
River Stour
The Bungalow
Gloucester Coppice (and Natural Woodland)
South Lodges
Broom Cottage
Four Winds
No. 10 Castle Barns

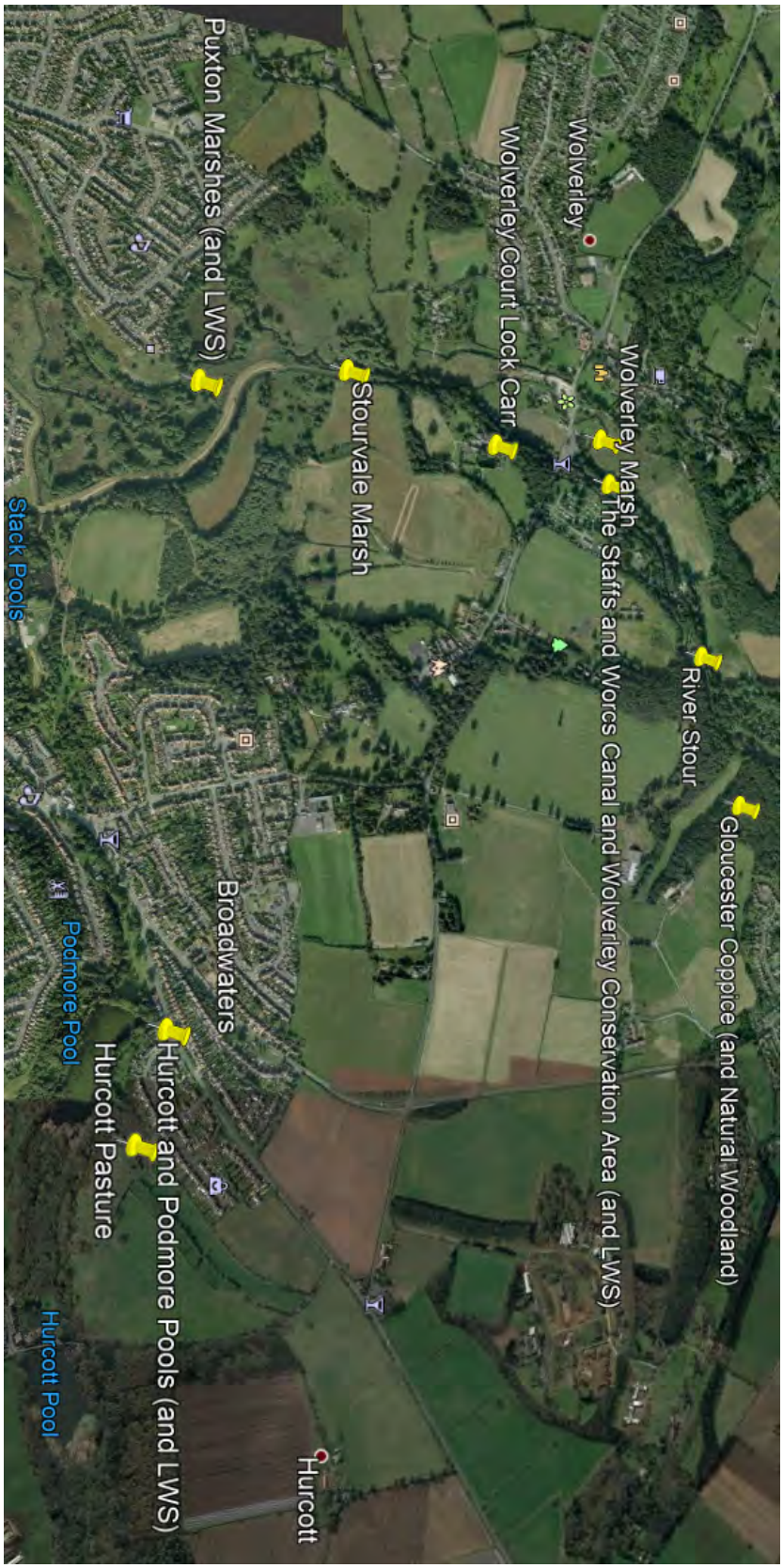
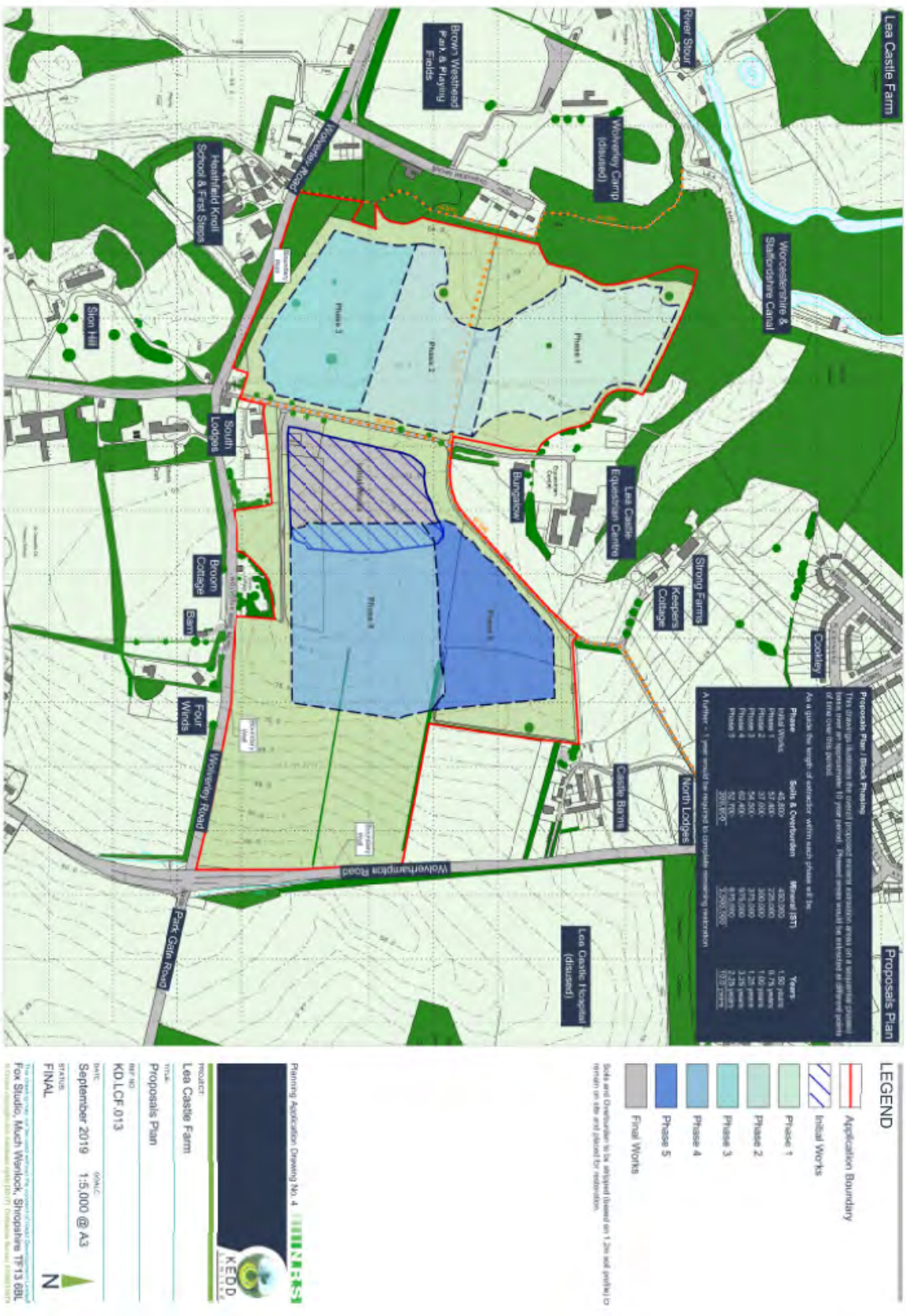
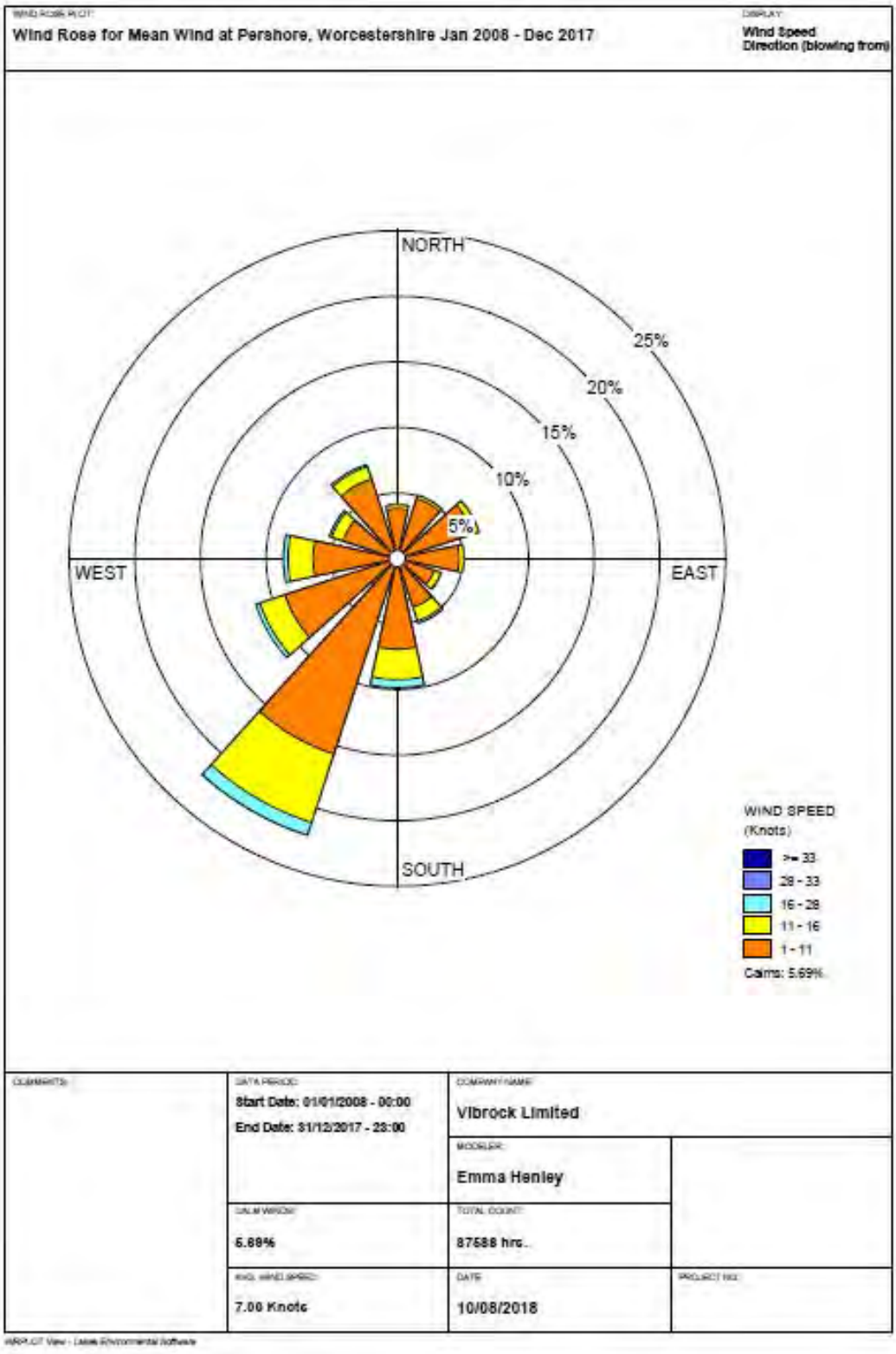

Wolverley
Wolverley Court Lock Carr
Wolverley Marsh
The Staffs and Worcs Canal and Wolverley Conservation Area (and LWS)
River Stour
Gloucester Coppice (and Natural Woodland)
Puxton Marshes (and LWS)
Stourvale Marsh
Stack Pools
Broadwaters
Podmore Pool
Hurcott Pasture
Hurcott and Podmore Pools (and LWS)
Hurcott Pool
Hurcott

FIGURE 2 – WORKING PROPOSALS LAYOUT


Lea Castle Farm
River Stour
Brown Westhead Park & Playing Fields
Wolverley Camp (disused)
Heathfield Knoll School & First Steps
Worcestershire & Staffordshire Canal
Sion Hill
South Lodges
Broom Cottage
Barn
Four Winds
Bungalow
Lea Castle Equestrian Centre
Strong Farms
Keepers Cottage
Cookley
Castle Barns
North Lodges
Lea Castle Hospital (disused)
Wolverley Road
Wolverley Road
Wolverhampton Road
Park Gate Road
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5
Proposals Plan
Proposals Plan / Block Phasing
Phase
Soils & Overburden
Mineral (BT)
Years
Initial Works
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5
LEGEND
Application Boundary
Initial Works
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5
Final Works
Planning Application Drawing No. 4
KEDD
Lea Castle Farm
Proposals Plan
KD.LCF.013
September 2019
1:5,000 @ A3
FINAL
N
Fox Studio, Much Wenlock, Shropshire TF13 6BL

APPENDIX 1


Wind Rose for Mean Wind at Pershore, Worcestershire Jan 2008 - Dec 2017
Wind Speed
Direction (blowing from)
NORTH
EAST
SOUTH
WEST
5%
10%
15%
20%
25%
WIND SPEED
(Knots)
>= 33
28 - 33
16 - 28
11 - 16
1 - 11
Calms: 5.69%
Start Date: 01/01/2008 - 00:00
End Date: 31/12/2017 - 23:00
Vibrock Limited
Emma Henley
5.69%
87588 hrs.
7.00 Knots
10/08/2018

APPENDIX 2

MEAN NUMBER OF DAYS WITH RAINFALL LESS THAN 0.2 MM

10 YEAR PERIOD FROM 2008 TO 2017

Site: Pershore, Worcestershire

Month	No of days
January	8.7
February	9.7
March	15.0
April	15.0
May	14.8
June	15.3
July	14.0
August	13.0
September	14.1
October	12.2
November	6.5
December	8.1
Annual	**146.4**

APPENDIX 3

SUMMARY OF DUST CONTROL MEASURES

Site Operation	Dust Control Measures
Site Preparation and Restoration Mineral Extraction Materials Handling On Site Transportation Mineral Processing Stockpiles Off-Site Transportation	Bunds and overburden stores to be seeded as soon as practicable Controlled use of fixed short haul routes from extraction areas to plant Vehicles to make use of extensive washing facilities Plant transfer points covered and utilise water suppression Haul routes to be regularly maintained by grading to minimise dust generation Water to be used as required Road sweeper to be utilised as and when required Speed controls to be enforced on all haul routes to 15 mph Drop heights to be minimised Mobile plant exhausts and cooling fans to point away from ground All plant to be regularly maintained

APPENDIX 4

DISPERSION MODELLING – TRAFFIC AIR QUALITY ASSESSMENT

Prepared by Envirocentre

Lea Castle Farm, Wolverley
Air Quality Assessment

August 2019

Lea Castle Farm, Wolverley
Air Quality Assessment

Client:	NRS Aggregates Ltd
Document number:	8732
Project number:	471541
Status:	FINAL
Author:	Bryan Cassidy
Reviewer:	Ian Buchan
Date of issue:	14 August 2019
Filename:	471541_LeaCastleFarm_AQA

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EXECUTIVE SUMMARY

EnviroCentre have been commissioned by Vibrock Limited on behalf of NRS Aggregates Limited to undertake an Air Quality Assessment for a proposed sand and gravel quarry and restoration scheme at Lea Castle Farm, Wolverley.

The primary long-term concern in relation to air quality is the emissions generated by traffic and the subsequent impact on the local ambient air quality at residential and public areas located within the vicinity of the main road network. The main pollutant concentrations of concern from this source are nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$). As such an ADMS-Roads model was utilised to assess the potential for air quality to be impacted at residential areas located in the vicinity of the main road network.

Consultation was carried out with Wyre Forest District Council in July 2019 during which the scope and methodology of the assessment was confirmed.

The model predicts no significant change in NO_2, PM_{10} or $PM_{2.5}$ concentrations at all Sensitive Receptors on comparison of the 'with' and 'without' development scenarios.

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd were commissioned by Vibrock on behalf on NRS Aggregates Ltd to undertake an Air Quality Assessment in support of a proposed Sand and Gravel Quarry and Restoration Scheme on land at Lea Castle Farm, Wolverley.

1.2 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

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2 LEGISLATION & GUIDANCE

2.1 Legislative Background

Air quality is protected by national and regional legislation. In the UK, Part IV of the Environment Act 1995 places a statutory duty on local authorities to periodically review and assess the air quality within their area. This involves consideration of present and likely future air quality against air quality standards and objectives. Guidelines of the "Review and Assessment" process of local air quality were published in the 1997 National Air Quality Strategy (NAQS) and associated guidance and technical guidance. In 2000, the Government reviewed the 1997 Strategy and produced a revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland, which resulted in the production of air quality standards and objectives. The most current revision of the Strategy available is dated March 2011 (DEFRA, 2011).

The objectives adopted in England are contained within the Air Quality (England) Regulations 2000 and the Air Quality (England) (Amendment) Regulations 2002 for the purpose of setting national objectives for local authorities in England.

2.2 Air Quality Standards & Objectives

2.2.1 Air Quality Definitions

Standards for air pollution are concentrations over a given time period that are considered to be acceptable in light of what is known about the effects of each pollutant on health and on the environment. They can also be used as a benchmark to see if air pollution is getting better or worse.

An exceedance of a standard is a period of time (which is defined in each standard) where the concentration is higher than that set down by the standard. In order to make useful comparisons between pollutants, for which the standards may be expressed in terms of different averaging times, the number of days on which an exceedance has been recorded is often reported.

2.2.2 National Air Quality Definitions

Table 2-1 provides a summary of the air quality objectives from the Air Quality (England) Regulations 2000 as amended 2002. An objective is the target date on which exceedances of a standard must not exceed a specified number. The results of air quality modelling will be compared against these objectives.

Table 2-1: Summary of Objectives of the UK Air Quality Strategy

Pollutant	Objective	Measured as	To be achieved by
Benzene (All Authorities)	16.25 µg/m^3	Running Annual Mean	31 December 2003
Benzene (Scotland and Northern Ireland Only)	3.25 µg/m^3	Running Annual Mean	31 December 2010
1,3 Butadiene	2.25 µg/m^3	Running Annual Mean	31 December 2003
Carbon Monoxide (Authorities in Scotland Only)	10.0 mg/m^3	Running 8-Hour Mean	31 December 2003
Lead	0.5 µg/m^3	Annual Mean	31 December 2004
	0.25 µg/m^3	Annual Mean	31 December 2008

Nitrogen Dioxide	200 µg/m^3 Not to be exceeded more than 18 times per year	1 Hour Mean	31 December 2005
	40 µg/m^3	Annual Mean	31 December 2005
Particles (PM_{10}) (gravimetric) All authorities	50 µg/m^3 Not to be exceeded more than 35 times per year	24 Hour Mean	31 December 2004
	40 µg/m^3	Annual Mean	31 December 2004
Particles (PM_{10}) (gravimetric) Scotland Only	50 µg/m^3 Not to be exceeded more than 7 times per year	24 Hour Mean	31 December 2010
	18 µg/m^3	Annual Mean	31 December 2010
Particles ($PM_{2.5}$) (gravimetric)* All authorities	25 µg/m^3 (target)	Annual Mean	2020
	15% cut in urban background exposure	Annual Mean	2010 – 2020
Particles ($PM_{2.5}$) (gravimetric) Scotland Only	10 µg/m^3 (Limit)	Annual Mean	2020
Sulphur Dioxide	350 µg/m^3 not to be exceeded more than 24 times a year	1-Hour Mean	31 December 2004
	125 µg/m^{3}not to be exceeded more than 3 times a year	24 Hour Mean	31 December 2004
	266 µg/m^3 not to be exceeded more than 35 times a year	15-Minute Mean	31 December 2005
PAH *	0.25 ng/m^3	Annual Mean	31 December 2010
Ozone *	100 µg/m^3	8 hourly running or hourly mean *	31 December 2005
* not currently assessed by Scottish Local Authorities			

2.2.3 Air Quality Guidance

LAQM.TG16 and LAQM.PG16

Technical Guidance (LAQM.TG(09)) was issued on behalf of the Department of Environment, Food and Rural Affairs (DEFRA) in February 2009 (DEFRA, 2009a). A Policy Guidance (LAQM.PG09) was also issued at the same time (DEFRA, 2009b). This guidance is designed to guide local authorities through the Review and Assessment process and will also be adhered to for the purpose of the air quality assessment.

DEFRA have recently updated LAQM Technical Guidance (LAQM.TG16) (DEFRA, 2016). The main change is in the approach with a greater emphasis on action planning to bring forward improvements in air quality and to include local measures as part of EU reporting requirements. The reporting requirements for Local Authorities also changed with the adoption of an Annual Progress Report. Local Authorities continue to appraise pollutant concentrations of Nitrogen Dioxide (NO_2), Particulate Matter (PM_{10}) and Sulphur Dioxide (SO_2). Local Authorities are also required to work towards reducing levels of $PM_{2.5}$.

Land-use Planning & Development Control: Planning for Air Quality

The document "Land-Use Planning & Development Control: Planning for Air Quality" produced by Environmental Protection UK and Institute of Air Quality Management (EPUK & IAQM, 2017) provides guidance on dealing with air quality issues within the development control process. This guidance provides an assessment approach to defining whether the impact on air quality associated with the proposed development should be of material concern.

The methodology used assesses the change in pollutant concentrations, taking into account the air quality objectives, to assess the impacts of proposed developments on air quality. It also states that the effects on the residents of a proposed development need to be assessed as significant if the air quality objectives at the façade are not met. The assessed effect can be reduced if provision is made to reduce the exposure.

2.2.4 Air Quality Management Areas

The process of review and assessment has raised the profile of air quality assessment as a material planning consideration in development-related projects. For example, where it is known through the review and assessment process that problems in the achievement of air quality standards and objectives exist, the declaration of an Air Quality Management Area (AQMA) can conflict with permissions to develop. That is, the local authority is under a duty to improve air quality within an AQMA due to further breaches of air quality standards and objectives.

Wyre Forest District Council have declared two Air Quality Management Areas within their boundary for NO_2 as outlined below:

- The Kidderminster Ring Road (Horsefair/Coventry Street); and
- Welch Gate.

Of these declared AQMA's, The Kidderminster Ring Road is the closest, being situated circa 1.7km north of the proposed development site.

3 DESCRIPTION & POTENTIAL IMPACTS

3.1 Site Location & Proposed Development

The proposed development site is located at Lea Castle Farm, near Wolverley, Worcestershire on land promoted within the Worcestershire Minerals Local Plan. See Drawing No. 471541-001 (Appendix A) for site location.

The proposal consists of the development of a sand and gravel quarry with progressive restoration with the site scheduled to open in 2020.

3.2 Air Quality Impacts

The primary long term concern in relation to air quality is the emissions generated by traffic and the subsequent impact on the local ambient air quality at residential areas located within the vicinity of the main road network. The main pollutant concentrations of concern from this source are Nitrogen Dioxide and Particulate Matter.

3.3 Consultation

EnviroCentre carried out consultation with Wyre Forest District Council in June 2019 during which the scope and methodology of the assessment was confirmed.

The following considerations were requested by Environmental Health and included within the assessment:

- Verification of the ADMS-model against 2018 measured concentrations at NO_2 diffusion tube SBR121;
- Inclusion of traffic flows from committed development on Stourbridge Road development (18/0163/FULL);
- Utilisation of weather data from Colehill weather station for the year 2018; and
- Sensitivity analysis by assuming no improvement in engine emissions or background concentrations between assessment scenarios.

3.4 Assessment Criteria

The document “Land-Use Planning & Development Control: Planning for Air Quality” produced by Environmental Protection UK and Institute of Air Quality Management (EPUK & IAQM, 2017) provides guidance on dealing with air quality issues within the development control process. This guidance provides an assessment approach to defining whether the impact on air quality associated with the proposed development should be of material concern.

The magnitude of the impact is determined by assessing the amount a pollutant concentration at a sensitive receptor is predicted to change on comparison of the ‘without development’ scenario against the ‘with development’ scenario (see Table 3-1 for impact descriptors). These criteria will be used for assessment purposes.

Table 3-1: Impact Descriptors for Individual Receptors

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	≤ 1	**2 – 5**	**6 – 10**	**> 10**
≤ 75% of AQAL	Negligible	Negligible	Slight	Moderate
76 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
102 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
≥ 110% of AQAL	Moderate	Substantial	Substantial	Substantial

Explanation

1. AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.
2. The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5% will be described as Negligible.
3. The Table is only designed to be used with annual mean concentrations.
4. Descriptors for individual receptors only; the overall significance is determined using professional judgement. For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.
5. When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme;' concentration for an increase.
6. The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approaches and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL.
7. It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

4 ADMS-ROADS DISPERSION MODELLING

The ADMS Dispersion model is approved for use in detailed assessment dispersion modelling studies in technical guidance LAQM.TG16 (DEFRA, 2018). The model has been subject to extensive validation and inter-model comparison studies.

4.1 Assessed Years & Scenarios

The dispersion modelling exercise considered the impact on future and existing residents in areas where traffic movements will alter. The following scenarios were considered:

- 2018 Baseline (for model verification only);
- 2020 Baseline;
- 2020 Baseline + Committed; and
- 2020 Baseline + Committed + Development.

4.2 Sensitive Receptors

The proposed development is likely to alter traffic movements on the road network in its vicinity. Therefore, the sensitive receptors included in the model were selected due to their proximity to the roads most likely to be subject to traffic increases as a result of the development.

The location of each receptor along with the local road network system was input to the air dispersion model using the GIS software ArcMap 10.7 on a digital OS tile of the surrounding area. The sensitive receptors assessed within the model are listed in Table 4-1 below and shown in Drawing No. 471541-002 Appendix A.

Table 4-1: Air Quality Sensitive Receptors

Receptor	Receptor Description	OS Grid Reference
SR1	Castle Barns	384579, 279315
SR2	Residence adjacent to corner of Wolverley Road & Sion Hill	383674, 278835
SR3	Heathfield Lodge	383930, 278782
SR4	The Cottage, Wolverley Road	384193, 278807
SR5	Residence Corner of Chapel Hill & Stourbridge Road	384212, 278130
SR6	42 Wolverhampton Road	384495, 278378
SR7	Park Gate Barn, Park Gate Road	385026, 278657

4.3 Modelled Roads

For local impact assessments the roads included in the calculations should be all those expected to make a significant contribution to pollution at the receptor locations in question. In practise, roads more than 200m away from the receptor can be excluded. Minor roads can also be excluded even when they are closer than 200m to receptors due to their relatively small pollutant contributions. No industrial sources were modelled.

The road links included in the model are listed below:

- Wolverley Road;
- A449 Wolverhampton Road;
- Park Gate Road;
- A451 Stourbridge Road;
- A449 Stourbridge Road; and
- A449 Chester Road North.

A plan detailing the extent of the modelling network is provided in Appendix A.

Traffic data utilised in the assessment was informed by the transport assessment undertaken by The Hurlstones Partnership Limited (Hurlstones) for the project. As part of the assessment automatic traffic counters (ATC's) were deployed at four locations in the vicinity of the development site. However the counts did not provide relevant traffic data for in the vicinity of diffusion tube SBR121 and Hurlstones therefore obtained traffic data from the Department for Transport database. Count point 7156 on Stourbridge Road was utilised to provide data for SBR121.

Following initial discussions with Environmental Health two nearby developments (17/0205/OUTL & 18/0163/FULL) were identified for inclusion as committed developments within the assessment. These applications relate to the Former Lea Castle Hospital Site and a residential development on Stourbridge Road. This request was subsequently relayed to Hurlstones who reviewed the undertaken transport assessments for each site.

For the Stourbridge Road site work is known to have begun on this development and therefore flows have been extracted from the sites Transport Assessment and were included in the 2020 scenarios with the assumption that the site will be completed by then. For the Lea Castle Hospital site Hurlstones outlined their understanding that work had not yet begun on this development and it was therefore unlikely that this development will be in place come 2020 when the quarry will be open for operation. The Transport Assessment only provided the total development flows for the complete development and not incremental flows for different periods during the build. It was therefore agreed with environmental health that this development would be omitted from the cumulative assessment.

The traffic information supplied to EnviroCentre by Hurlstones consisted of Annual Average Daily Traffic (AADT) flows which were then divided by 24 to provide traffic flows per hour, as required by the ADMS-Roads model. The traffic figures from Hurlstones also included values for Light Duty Vehicles (LDV) <3.5t, and Heavy Duty Vehicles (HDV) >3.5t. Growth factors for traffic to future years were obtained from TEMPro.

The widths of the roads (calculated using ArcMap 10.6) and all other road input data can be found in Appendix B. The Traffic Distribution by time of day on all roads: 2018 table in the National Statistics of the Department For Transport (2019) Statistics Bulleting was also used to derive a diurnal variation pattern for all the roads considered in the assessment, see Table 4-2.

Following receipt of the traffic data from Hurlstones it was noted that the proposed scheme is expected to introduce an additional 128 AADT. Of this, 12 will be LGV and 116 will be HGV. Following discussions with the appointed traffic consultant it is noted that of the projected 116 HGV 40% will head south towards Kidderminster. Of the 40% of the traffic heading south it is estimated that 16% would utilise Stourbridge Road to enter the centre of Kidderminster with the remaining 24% staying on Chester Road North and avoiding the centre of Kidderminster.

Therefore, of the flows travelling south, the transport assessment indicates that only 16% of the HGV's will enter into the Kidderminster Air Quality Management Area. This equates to ~19 vehicles AADT. Based upon the criteria for proceeding to an Air Quality Assessment as outlined in Table 6.2 of the EPUK & IAQM 2017 guidance document the impact of the development on the AQMA will not be considered within the assessment as HGV numbers entering into the AQMA are below 25 AADT criteria that would require assessment.

Full details of the traffic data included in the model can be found in Appendix B.

Table 4-2: Diurnal Time Varying Emission Factors

Local Time (Hrs)	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
00:00 – 01:00	0.16	0.15	0.16	0.17	0.19	0.25	0.27
01:00 – 02:00	0.10	0.11	0.12	0.12	0.13	0.17	0.17
02:00 – 03:00	0.09	0.10	0.10	0.11	0.12	0.13	0.12
03:00 – 04:00	0.11	0.12	0.12	0.12	0.13	0.13	0.11
04:00 – 05:00	0.21	0.19	0.19	0.20	0.20	0.15	0.11
05:00 – 06:00	0.55	0.49	0.49	0.48	0.46	0.25	0.16
06:00 – 07:00	1.20	1.18	1.16	1.15	1.06	0.42	0.26
07:00 – 08:00	1.83	1.86	1.84	1.83	1.69	0.67	0.39
08:00 – 09:00	1.82	1.86	1.85	1.84	1.71	0.99	0.57
09:00 – 10:00	1.50	1.53	1.54	1.54	1.48	1.30	0.93
10:00 – 11:00	1.44	1.40	1.41	1.43	1.53	1.56	1.31
11:00 – 12:00	1.47	1.40	1.43	1.46	1.63	1.70	1.53
12:00 – 13:00	1.49	1.43	1.46	1.50	1.72	1.70	1.61
13:00 – 14:00	1.49	1.46	1.49	1.54	1.77	1.62	1.57
14:00 – 15:00	1.56	1.56	1.60	1.64	1.84	1.52	1.52
15:00 – 16:00	1.70	1.74	1.77	1.80	1.94	1.44	1.51
16:00 – 17:00	1.92	1.98	2.00	2.00	2.01	1.42	1.51
17:00 – 18:00	1.91	1.98	1.99	1.99	1.92	1.37	1.39
18:00 – 19:00	1.45	1.55	1.58	1.61	1.59	1.18	1.21
19:00 – 20:00	0.97	1.03	1.08	1.15	1.21	0.91	1.02
20:00 – 21:00	0.68	0.72	0.76	0.82	0.87	0.68	0.80
21:00 – 22:00	0.51	0.55	0.57	0.62	0.64	0.53	0.58
22:00 – 23:00	0.37	0.42	0.44	0.46	0.51	0.46	0.40
23:00 – 00:00	0.23	0.26	0.27	0.30	0.37	0.37	0.25

4.4 Background Air Quality

Background air quality conditions were assessed using data available from DEFRA (2019) using the methods set out in LAQM.TG(16). The background concentrations of nitrogen oxides NO_X), NO_2, PM_{10} and $PM_{2.5}$ are available for a base year of 2015 and for all other years up to 2030. The concentrations are available in OS 1 kilometre grid squares.

For NO_X, PM_{10} and $PM_{2.5}$ these background pollutant concentrations are split into contributions from various sectors and therefore background levels can be obtained and the risk of "double counting" concentrations can be avoided. As only primary roads were modelled as part of the assessment, contributions attributed to trunk roads and minor roads were not removed during the adjustment process.

The proposed development is located within OS Grid square 384500, 278500 and the background pollutant concentrations for the year 2018 are outlined in Table 4-3 below.

Table 4-3: Development Site Background Air Quality Concentrations (384500, 278500)

Year	Pollutant Concentration (µg/m³)							
	NO_2		NO_x		PM_{10}		$PM_{2.5}$	
	Total	Adjusted	Total	Adjusted	Total	Adjusted	Total	Adjusted
2018	10.13	8.03	13.59	10.69	12.26	12.24	8.10	8.08

The model was verified against measured concentrations at NO_2 diffusion tube SBR121 which is located on Stourbridge Road. The diffusion tube is located within OS 1 kilometre grid square 383500, 277500 and the background pollutant concentrations for this grid square are outlined in Table 4-4 below.

Table 4-4: Diffusion Tube Background Air Quality Concentrations (383500, 277500)

Year	Pollutant Concentration (µg/m³)							
	NO_2		NO_x		PM_{10}		$PM_{2.5}$	
	Total	Adjusted	Total	Adjusted	Total	Adjusted	Total	Adjusted
2018	11.25	9.21	15.27	12.43	12.06	12.04	8.24	8.22

In order to provide a conservative scenario and one that best characterised conditions at the existing monitoring location, the assessment utilised the background pollutant concentrations from the grid square that covered the diffusion tube locations (i.e. 383500, 277500).

4.5 Measured Results

In order to verify the accuracy of the ADMS model, measured pollutant concentrations from Worcestershire Regulatory Services air quality monitoring network were obtained. The monitoring location utilised in the assessment is located on Stourbridge Road and is detailed in Table 4-5 below. The verification process is outlined in Section 5.1.

Table 4-5: Monitored 2018 Annual Average NO_2 Concentration

ID	Site Name	Site Type	OS Grid Reference	Orientation to Site	2018 Annual Mean NO2 Concentration (µg/m3)
SBR121	121 Stourbridge Road	Roadside	383905, 277857	South	32.2

On review of the measured results it is noted that NO_2 concentrations are below the relevant Air Quality Objective of 40µg/m³ for 2018.

4.6 Weather Conditions

Meteorology data purchased from ADM Ltd specifically for use in ADMS-Roads was used in this assessment. The data was for the year 2017 and was obtained from the nearest meteorological weather station to the site recording a full suite of meteorological parameters, which is located at Coleshill, North Warwickshire.

This weather station has an altitude of 96m and is located in a rural area approximately 37km east of the proposed development site. The dataset provided by the meteorological station was 97% complete and fully ratified and validated for the year 2018 and included all the meteorological parameters required by the model comprising hourly sequential recordings of:

- Surface temperature;
- Precipitation;
- Wind speed;
- Wind direction;
- Relative humidity; and
- Cloud cover.

The corresponding wind rose for this year is provided in Figure 4-1. It indicates 1 prominent wind direction lying between 160 - 210°, with the greatest percentage of wind speed lying between 6-10 knots.

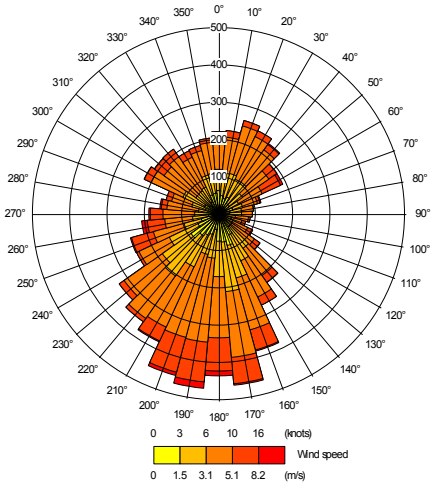

Figure 1: Wind rose for Coleshill weather station for 2017

4.7 Additional Input Data

Additional input data was confirmed through a verification process designed to result in a model which most closely represented conditions at the existing monitoring locations and therefore provide a conservative indication of the pollutant concentrations the assessed sensitive receptors would be exposed to. The following additional input data were therefore utilised in the model:

The chemical reaction scheme option was utilised in the assessment so that the model took into account photochemical reactions between NO, NO_2 and O_3.

The model was run using the 2018 annual average 0_3 concentration for Alston Hill. The respective value is 65.7.

A surface roughness length is used in the dispersion modelling study to characterise the land use of the surrounding area in terms of the frictional effect that will occur due to the interaction of wind with the surface; this is a key component in the generation of atmospheric turbulence, which influences dispersion. A surface roughness length of 0.5 was used to characterise the proposed development site which is representative of

Parkland and Open Suburbia with a surface roughness of 0.3 utilised to characterise the meteorological site which is representative of Agricultural areas (max).

A minimum Monin-Obukhov length is used in the dispersion model to represent the effects of buoyancy on turbulent flows as a result of surface temperature and mechanical mixing in the lower atmosphere. The minimum Monin-Obukhov length used for both the model and the meteorological site was 10m which is considered representative of small towns <50,000 residents.

Both gridded and specified points output were selected in the model so that emissions could be displayed as both contour plots and as values at particular sensitive receptors in the surrounding area. For a full list of the sensitive receptors refer to Section 4.2.

The annual average concentrations of NO_2, PM_{10} and $PM_{2.5}$ were modelled in this assessment.

5 MODELLED RESULTS

5.1 Model Verification

Verification refers to the process of comparing model predicted concentrations to measured pollutant concentrations. It provides a means of determining how the model is performing and can allow for a reduction in model uncertainty.

The model was verified using the measured NO_2 concentrations detailed in Table 4-5 above.

As atmospheric nitrogen dioxide (NO_2) is produced as a result of reactions of nitric oxide (NO) and ozone it is most appropriate to verify the model for atmospheric NO_x which is a combination of NO and NO_2.

The model was therefore run to predict annual mean road NO_x concentrations at the diffusion tube sites, as outlined in Table 4-5, with the resultant NO_2 concentrations then determined by inputting the predicted road NO_x concentration into the DEFRA NO_x to NO_2 calculator.

The obtained modelled NO_2 concentrations were found to be consistently under predicting measured NO2 concentrations at the diffusion tube as is a common occurrence with dispersion models. A series of runs were undertaken to investigate the impact of altering input data on predicted concentrations with the aim of ensuring the resultant model was as representative of conditions as possible. This included varying road traffic speeds and model surface roughness and monin-obukhov length. Table 5-1 below outlines the results from the run which produced the most comparable predicted concentration at the monitoring location.

Table 5-1: Measured & Modelled NO2 Concentrations (Pre Adjustment) for 2018

Site ID	Site Name	Measured Concentration (µg/m³)	Modelled Concentration Pre Adjustment (µg/m³)	% Difference [(modelled-measured)/measured]*
SBR121	121 Stourbridge Road	32.2	22.57	-29.9

Note: *Positive numbers indicate an over prediction and negative numbers an under prediction by the model

Due to the under prediction that was occurring an adjustment factor of 1.23 was determined via the method outlined in LAQM.TG(16) applied to the modelled road contribution NO_2. The post adjustment result is outlined in Table 5-2 below.

Table 5-2: Measured & Modelled NO2 Concentrations (Post Adjustment) for 2018

Site ID	Site Name	Measured Concentration (µg/m³)	Modelled Concentration Pre Adjustment (µg/m³)	% Difference [(modelled-measured)/measured]*
SBR121	121 Stourbridge Road	32.2	32.2	0

Note: *Positive numbers indicate an over prediction and negative numbers an under prediction by the model

In the absence of monitoring results to provide a suitable means of verification for model predicted PM_{10} or $PM_{2.5}$ concentrations, the determined adjustment factor for NO_2 was also applied to the PM_{10} and $PM_{2.5}$ modelled road contributions.

For full details of the verification process refer to Appendix C.

5.2 Model Results

The following sections detail the adjusted modelled results for each of the investigated scenarios for the pollutants NO_2, PM_{10} and $PM_{2.5}$.

As outlined in Section 3.3 it is of note that the future scenarios assume no improvement in background concentrations or engine improvements from the '2018 Baseline' scenario to ensure a conservative assessment.

5.2.1 2018 Baseline Results

Table 5-3 summarises the results from the ADMS-Roads model for the '2018 Baseline' scenario for NO_2, PM_{10} and $PM_{2.5}$.

Table 5-3: 2018 Baseline Results

ID	Receptor Description	Pollutant Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
SR1	Castle Barns	23.88	12.37	8.42
SR2	Residence adjacent to corner of Wolverley Road & Sion Hill	25.2	12.68	8.60
SR3	Heathfield Lodge	27.34	12.90	8.74
SR4	The Cottage, Wolverley Road	25.75	12.78	8.66
SR5	Residence Corner of Chapel Hill & Stourbridge Road	31.58	13.05	8.84
SR6	42 Wolverhampton Road	33.93	13.06	8.85
SR7	Park Gate Barn, Park Gate Road	24.82	12.53	8.52

The predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at all Sensitive Receptors were found to meet the relevant Air Quality Objectives of 40, 18 & 10µg/m³ respectively.

5.2.2 2020 Baseline Results

Table 5-4 summarises the results from the ADMS-Roads model for the '2020 Baseline' scenario for NO_2, PM_{10} and $PM_{2.5}$.

Table 5-4: 2020 Baseline Results

ID	Receptor Description	Pollutant Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
SR1	Castle Barns	24.03	12.38	8.42
SR2	Residence adjacent to corner of Wolverley Road & Sion Hill	25.3	12.69	8.61
SR3	Heathfield Lodge	27.47	12.91	8.74
SR4	The Cottage, Wolverley Road	25.92	12.79	8.67
SR5	Residence Corner of Chapel Hill & Stourbridge Road	31.9	13.07	8.85
SR6	42 Wolverhampton Road	34.13	13.08	8.86

ID	Receptor Description	Pollutant Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
SR7	Park Gate Barn, Park Gate Road	24.95	12.54	8.52

As with the previous scenario, the predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at all Sensitive Receptors were found to meet the relevant Air Quality Objectives of 40, 18 & 10µg/m^3 respectively.

5.2.3 2020 Baseline + Committed Results

Table 5-5 summarises the results from the ADMS-Roads model for the '2020 Baseline + Committed' scenario for NO_2, PM_{10} and $PM_{2.5}$.

Table 5-5: 2020 Baseline + Committed Results

ID	Receptor Description	Pollutant Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
SR1	Castle Barns	24.03	12.38	8.42
SR2	Residence adjacent to corner of Wolverley Road & Sion Hill	25.35	12.69	8.61
SR3	Heathfield Lodge	27.54	12.92	8.75
SR4	The Cottage, Wolverley Road	25.98	12.80	8.68
SR5	Residence Corner of Chapel Hill & Stourbridge Road	32.01	13.08	8.86
SR6	42 Wolverhampton Road	34.15	13.08	8.86
SR7	Park Gate Barn, Park Gate Road	25.04	12.55	8.53

As with the previous two scenarios, the predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at all Sensitive Receptors were found to meet the relevant Air Quality Objectives of 40, 18 & 10µg/m^3 respectively.

5.2.4 2020 Baseline + Committed + Development

Table 5-6 below summarises the results from the ADMs-Roads model for the '2020 Baseline + Committed + Development' scenario for NO_2, PM_{10} and $PM_{2.5}$.

Table 5-6: 2020 Baseline + Committed + Development Results

ID	Receptor Description	Pollutant Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
SR1	Castle Barns	24.11	12.38	8.43
SR2	Residence adjacent to corner of Wolverley Road & Sion Hill	25.36	12.69	8.61
SR3	Heathfield Lodge	27.56	12.92	8.75
SR4	The Cottage, Wolverley Road	26.08	12.81	8.68
SR5	Residence Corner of Chapel Hill & Stourbridge Road	32.27	13.09	8.86
SR6	42 Wolverhampton Road	34.64	13.10	8.87
SR7	Park Gate Barn, Park Gate Road	25.5	12.57	8.54

As with all the previous two scenarios, the predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at all Sensitive Receptors were found to meet the relevant Air Quality Objectives of 40, 18 & 10µg/m^3 respectively.

6 AIR QUALITY ASSESSMENT

The predicted pollutant concentrations for the '2020 Baseline + Committed' and the '2020 Baseline + Committed + Development' scenarios were assessed against the criteria provided in Table 3-1 Section 3.4 of this document.

6.1 NO_2 Assessment

The percentage of the objective level and the impact descriptors for the predicted NO_2 concentrations as a result of the development for each sensitive receptor are provided in Table 6-1 below.

Table 6-1: NO_2 Percentage of Objective Level & Impact Magnitude

ID	Receptor Description	2020 Baseline + Committed (% of objective)	2020 Baseline + Committed + Development (% of objective)	Difference (% of objective)	Impact Magnitude
SR1	Castle Barns	60	60	0	Negligible
SR2	Residence adjacent to corner of Wolverley Road & Sion Hill	63	63	0	Negligible
SR3	Heathfield Lodge	69	69	0	Negligible
SR4	The Cottage, Wolverley Road	65	65	0	Negligible
SR5	Residence Corner of Chapel Hill & Stourbridge Road	80	81	1	Negligible
SR6	42 Wolverhampton Road	85	87	2	Slight
SR7	Park Gate Barn, Park Gate Road	63	64	1	Negligible

The assessment concludes that in relation to NO_2 the impact of the development at each of the considered sensitive receptors is **Negligible** with the exception of SR6 where a **Slight** impact has been predicted.

6.2 PM_{10} Assessment

The percentage of the objective level and the impact descriptors for the predicted PM_{10} concentrations as a result of the development for each sensitive receptor are provided in Table 6-1 below.

Table 6-2: PM_{10} Percentage of Objective Level & Impact Magnitude

ID	Receptor Description	2020 Baseline + Committed (% of objective)	2020 Baseline + Committed + Development (% of objective)	Difference (% of objective)	Impact Magnitude
SR1	Castle Barns	31	31	0	Negligible
SR2	Residence adjacent to corner of Wolverley Road & Sion Hill	32	32	0	Negligible

ID	Receptor Description	2020 Baseline + Committed (% of objective)	2020 Baseline + Committed + Development (% of objective)	Difference (% of objective)	Impact Magnitude
SR3	Heathfield Lodge	32	32	0	Negligible
SR4	The Cottage, Wolverley Road	32	32	0	Negligible
SR5	Residence Corner of Chapel Hill & Stourbridge Road	33	33	0	Negligible
SR6	42 Wolverhampton Road	33	33	0	Negligible
SR7	Park Gate Barn, Park Gate Road	31	31	0	Negligible

The assessment concludes that in relation to PM_{10} the impact of the development is considered to be **Negligible** for all of the assessed Sensitive Receptors.

6.3 $PM_{2.5}$ Assessment

The percentage of the objective level and the impact descriptors for the predicted $PM_{2.5}$ concentrations as a result of the development at each Sensitive Receptor are provided in Table 6-3 below.

Table 6-3: $PM_{2.5}$ Percentage of Objective & Impact Magnitude

ID	Receptor Description	2020 Baseline + Committed (% of objective)	2020 Baseline + Committed + Development (% of objective)	Difference (% of objective)	Impact Magnitude
SR1	Castle Barns	34	34	0	Negligible
SR2	Residence adjacent to corner of Wolverley Road & Sion Hill	34	34	0	Negligible
SR3	Heathfield Lodge	35	35	1	Negligible
SR4	The Cottage, Wolverley Road	35	35	0	Negligible
SR5	Residence Corner of Chapel Hill & Stourbridge Road	35	35	0	Negligible
SR6	42 Wolverhampton Road	35	35	0	Negligible
SR7	Park Gate Barn, Park Gate Road	34	34	0	Negligible

The assessment concludes that in relation to $PM_{2.5}$ the impact of the development is considered to be **Negligible** for all of the assessed Sensitive Receptors.

6.4 Conclusions

An air quality assessment was undertaken utilising an ADMS-Roads air quality model to investigate if there was potential for traffic emissions to have impact upon future and existing residents near road networks in the vicinity of the site.

The 2020 assessment scenarios have identified a **Negligible** impact at all of the sensitive receptors other than at SR6 where a **Slight** impact has been predicted for NO_2.

As per IAQM guidance impact descriptors relate to individual receptors and are not representative of the impact of the whole development (See Table 6.3, point 4). Therefore, due to the fact that the predicted impact of the development at the majority of the assessed receptors is negligible and that the development will not result in increases in target pollutants that will lead to breaches of relevant objective levels the overall impact of the development is considered to be **Negligible.**

Furthermore the assessment has assumed no improvement in background concentrations or engine emissions and the predicted results are therefore considered to be conservative.

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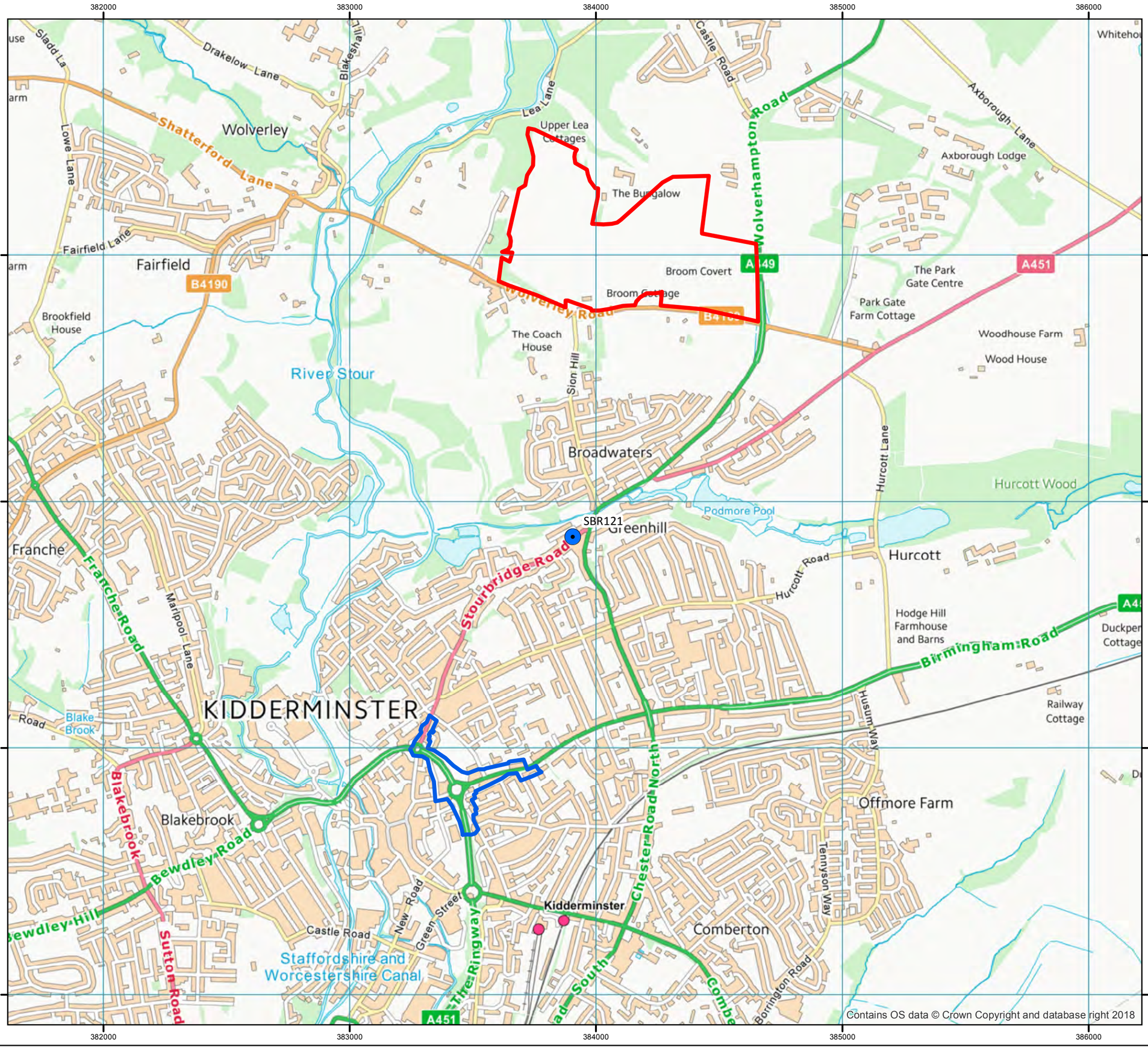
APPENDICES

A DRAWINGS



Legend

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- Kidderminster Ring Road AQMA
- Diffusion Tube

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Client: Vibrock

Project: Lea Castle Farm

Title: Site Location

Status: Draft

Drawing No.: 471541-001

Revision:

Scale: 1:15,000

A3

Date: 15 May 2019

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AH	BC	BC

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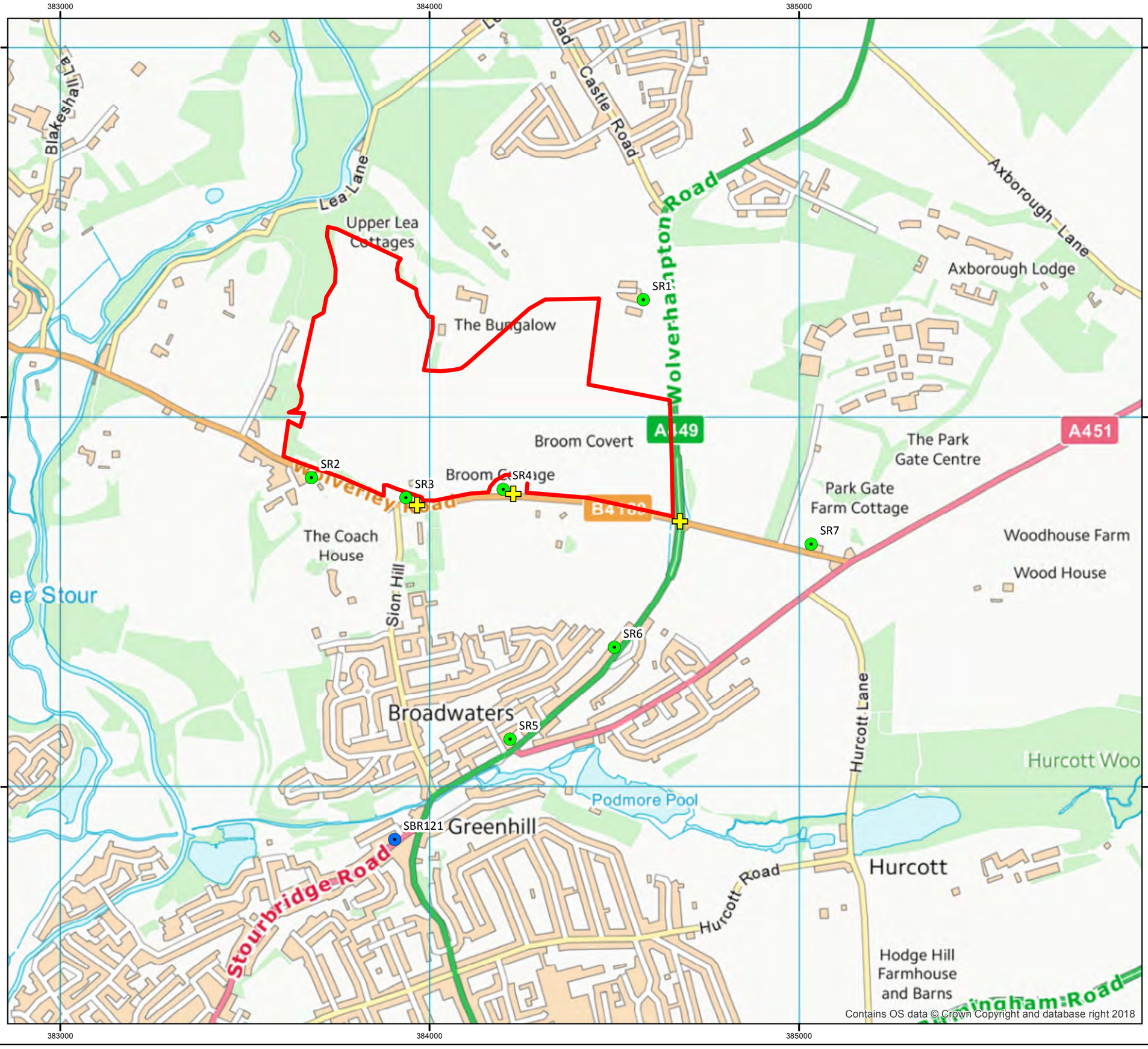
Fax: 0141 341 5045



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- Sensitive Receptors
- Diffusion Tube
- Traffic Counter Locations

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Project: Lea Castle Farm

Title: Sensitive Receptors

Status: Draft

Drawing No.: 471541-002

Revision:

Scale: 1:10,000

A3

Date: 28 June 2019

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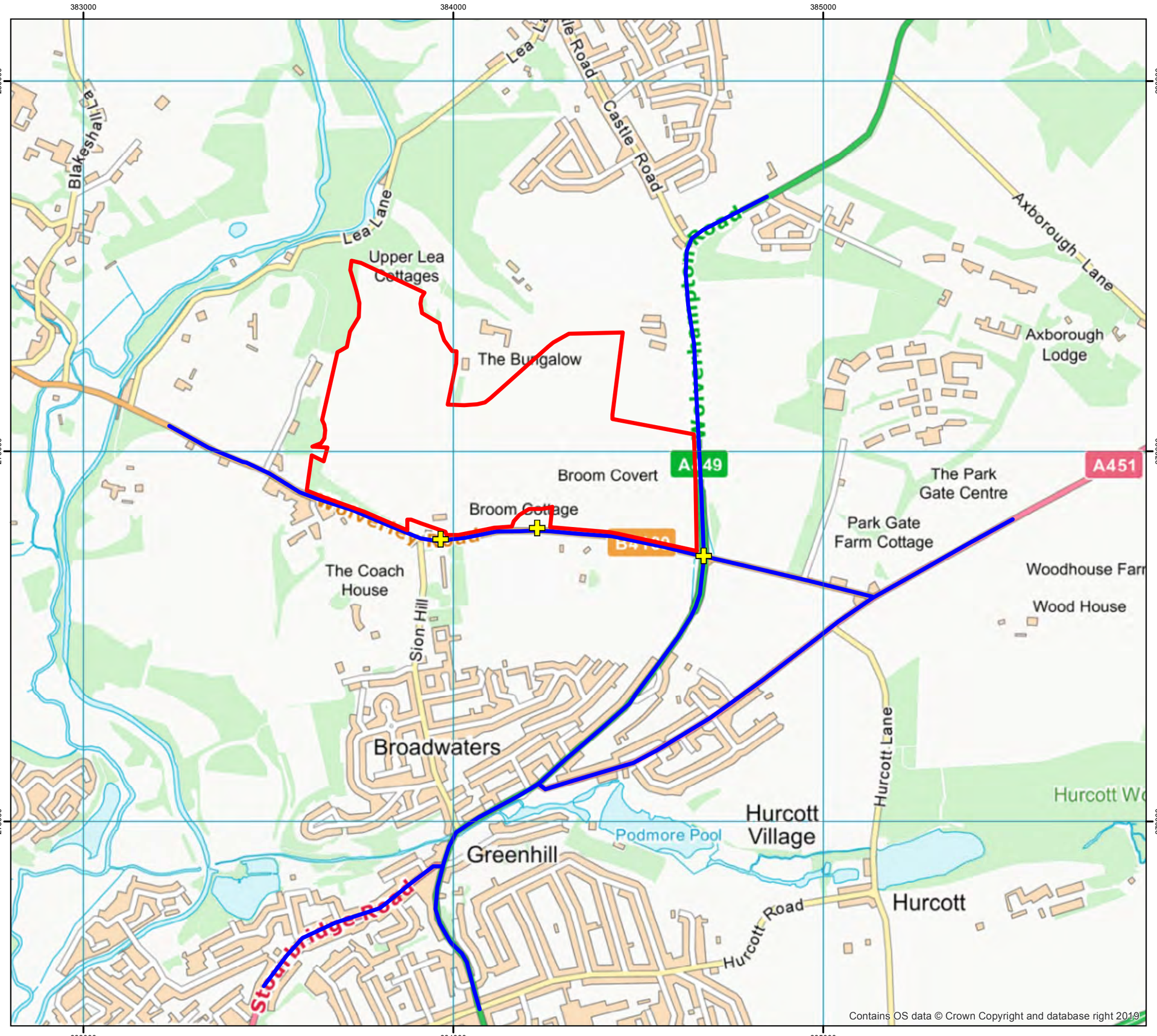

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- Traffic Counter Locations

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Client: Vibrock

Project: Lea Castle Farm

Title: Modelled Roads

Status: Final

Drawing No.: 471541-015

Revision:

Scale: 1:10,000

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Date: 13 August 2019

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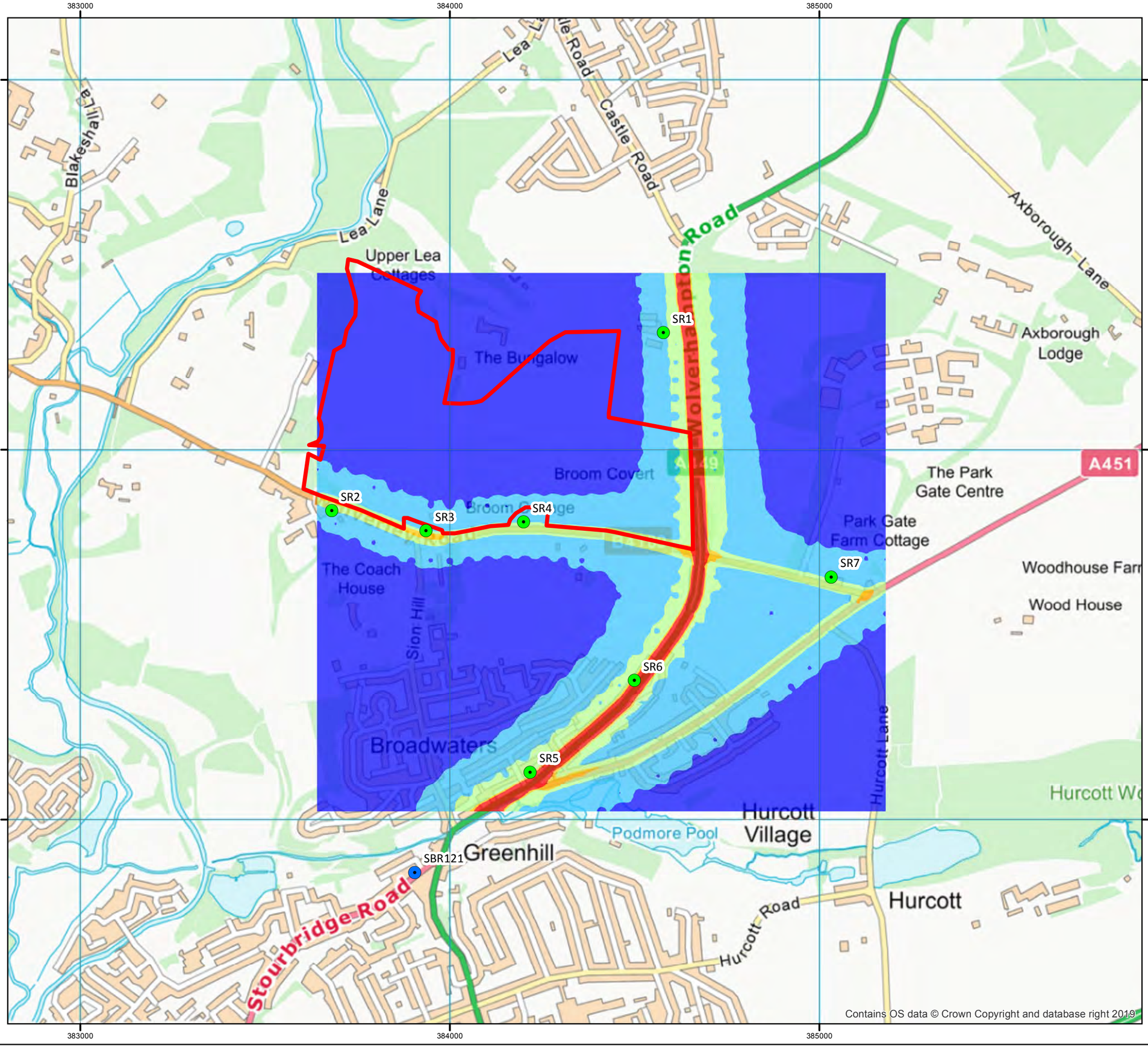

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- Sensitive Receptors
- Diffusion Tube

NO2 Concentration (µg/m3)

- <22
- 22 - 28
- 28 - 34
- 34 - 40
- >40

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Project: Lea Castle Farm

Title: Predicted NO2 Concentrations 2018 Baseline Scenario

Status: Final

Drawing No.: 471541-003

Revision:

Scale: 1:10,000

A3

Date: 07 August 2019

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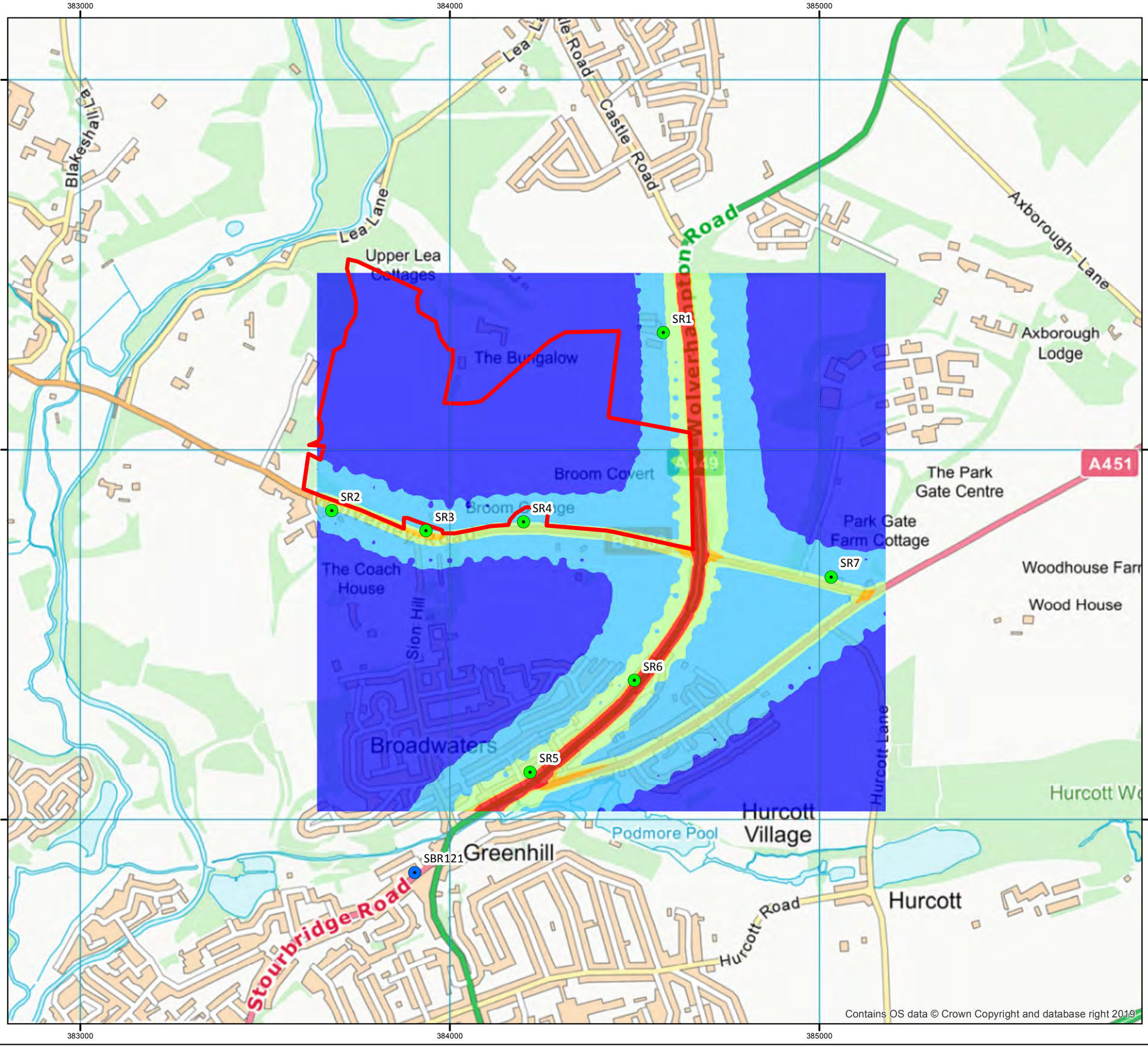

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- Site Boundary
- Sensitive Receptors
- Diffusion Tube

NO2 Concentration (µg/m3)

- <22
- 22 - 28
- 28 - 34
- 34 - 40
- >40

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Client: Vibrock

Project: Lea Castle Farm

Title: Predicted NO2 Concentrations 2020 Baseline Scenario

Status: Final

Drawing No.: 471541-004

Revision:

Scale: 1:10,000

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Date: 07 August 2019

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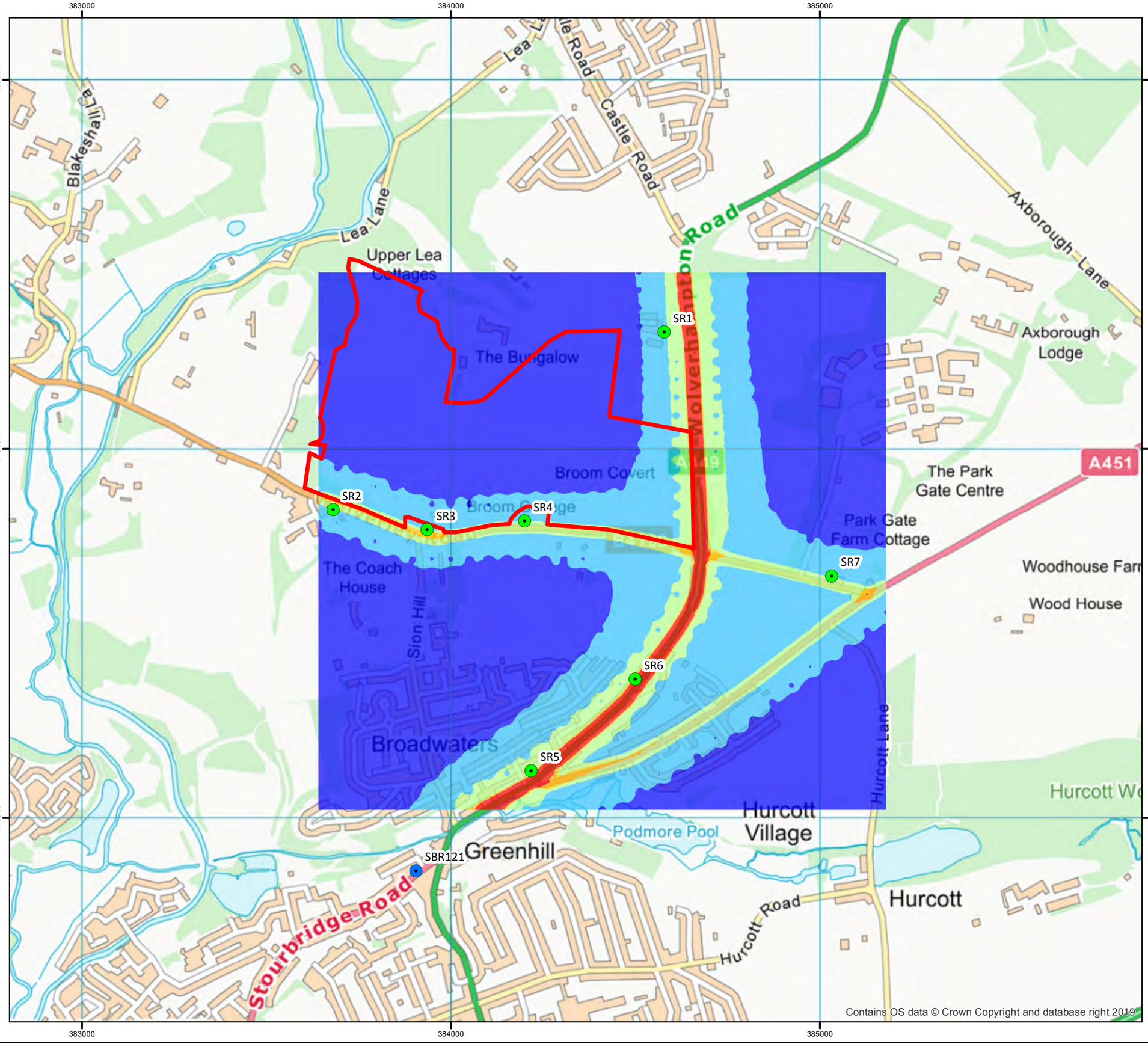

Legend

- Site Boundary
- Sensitive Receptors
- Diffusion Tube

NO2 Concentration (µg/m3)

- <22
- 22 - 28
- 28 - 34
- 34 - 40
- >40

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted NO2 Concentrations
2020 Baseline + Committed Scenario

Status: Final

Drawing No.: 471541-005

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Date: 07 August 2019

Drawn	Checked	Approved
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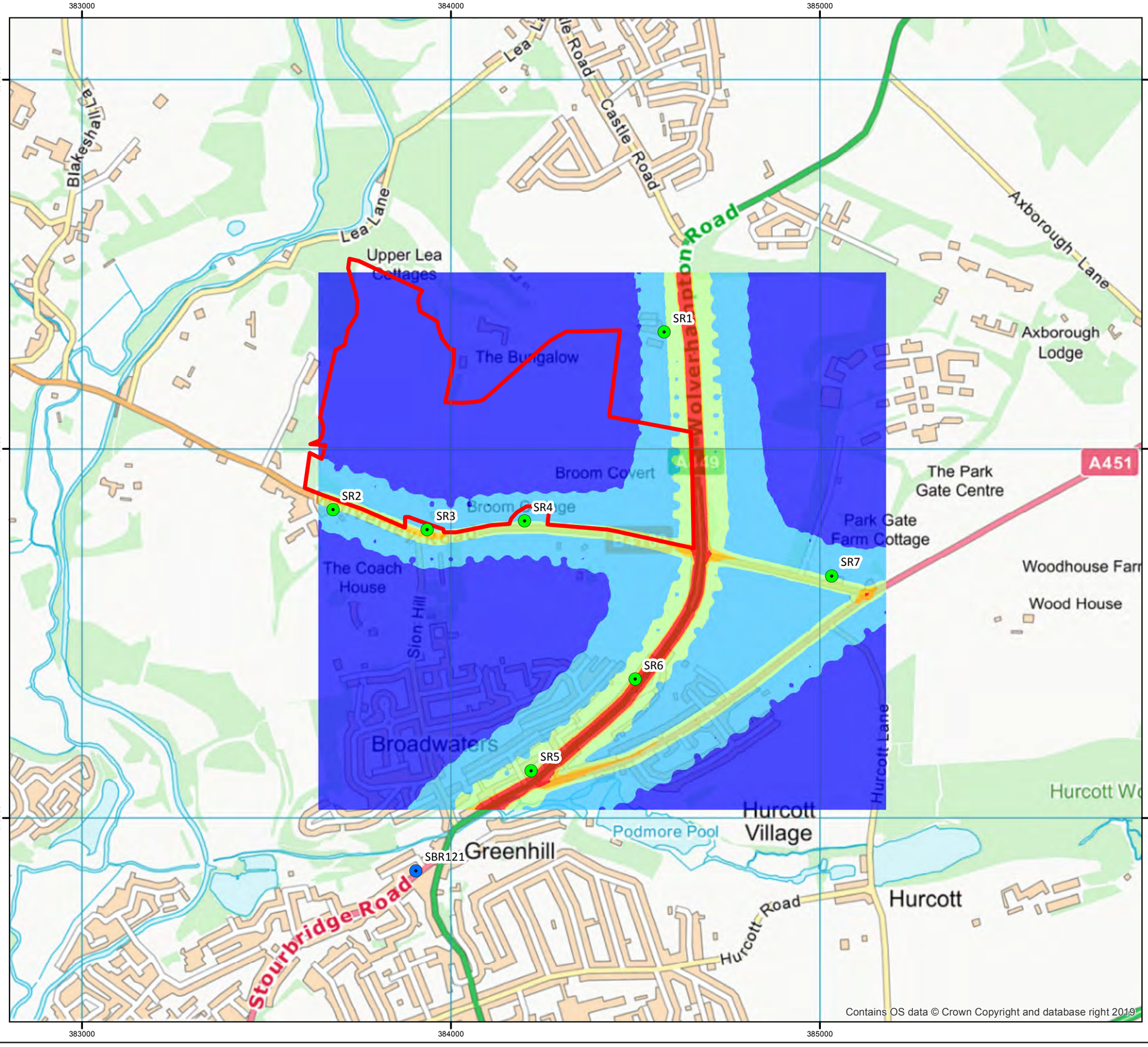

Legend

- Site Boundary
- Sensitive Receptors
- Diffusion Tube

NO2 Concentration (µg/m3)

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- 22 - 28
- 28 - 34
- 34 - 40
- >40

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Client: Vibrock

Project: Lea Castle Farm

Title: Predicted NO2 Concentrations
2020 Baseline + Committed + Development

Status: Final

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Revision:

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A3

Date: 07 August 2019

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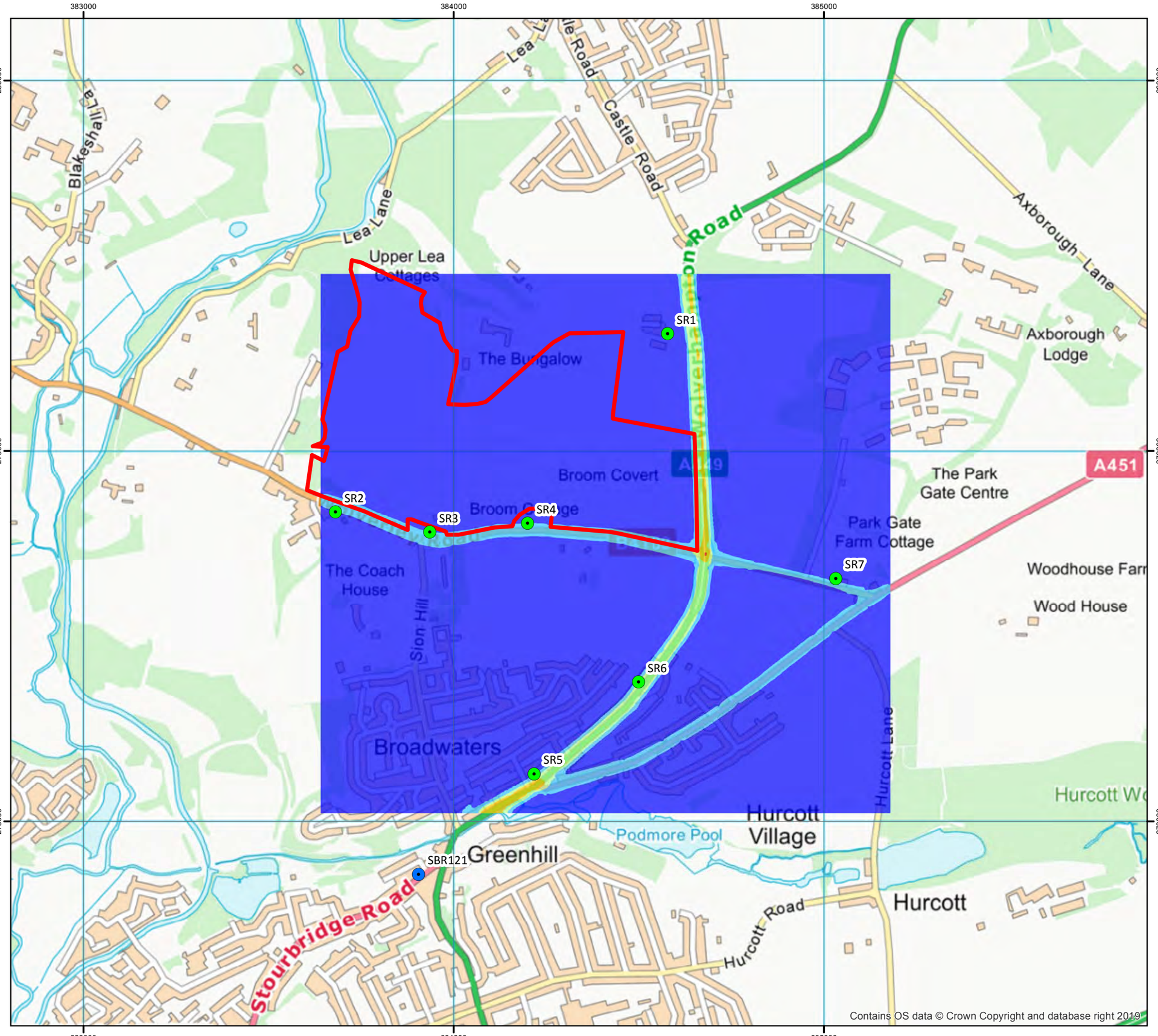

Legend

- Site Boundary
- Sensitive Receptors
- Diffusion Tube

PM10 Concentration (µg/m3)

- <13
- 13 - 14
- 14 - 15
- 15 - 16
- >16

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted PM10 Concentrations 2018 Baseline

Status: Final

Drawing No.: 471541-007

Revision:

Scale: 1:10,000

A3

Date: 07 August 2019

Drawn	Checked	Approved
BC	AH	BC

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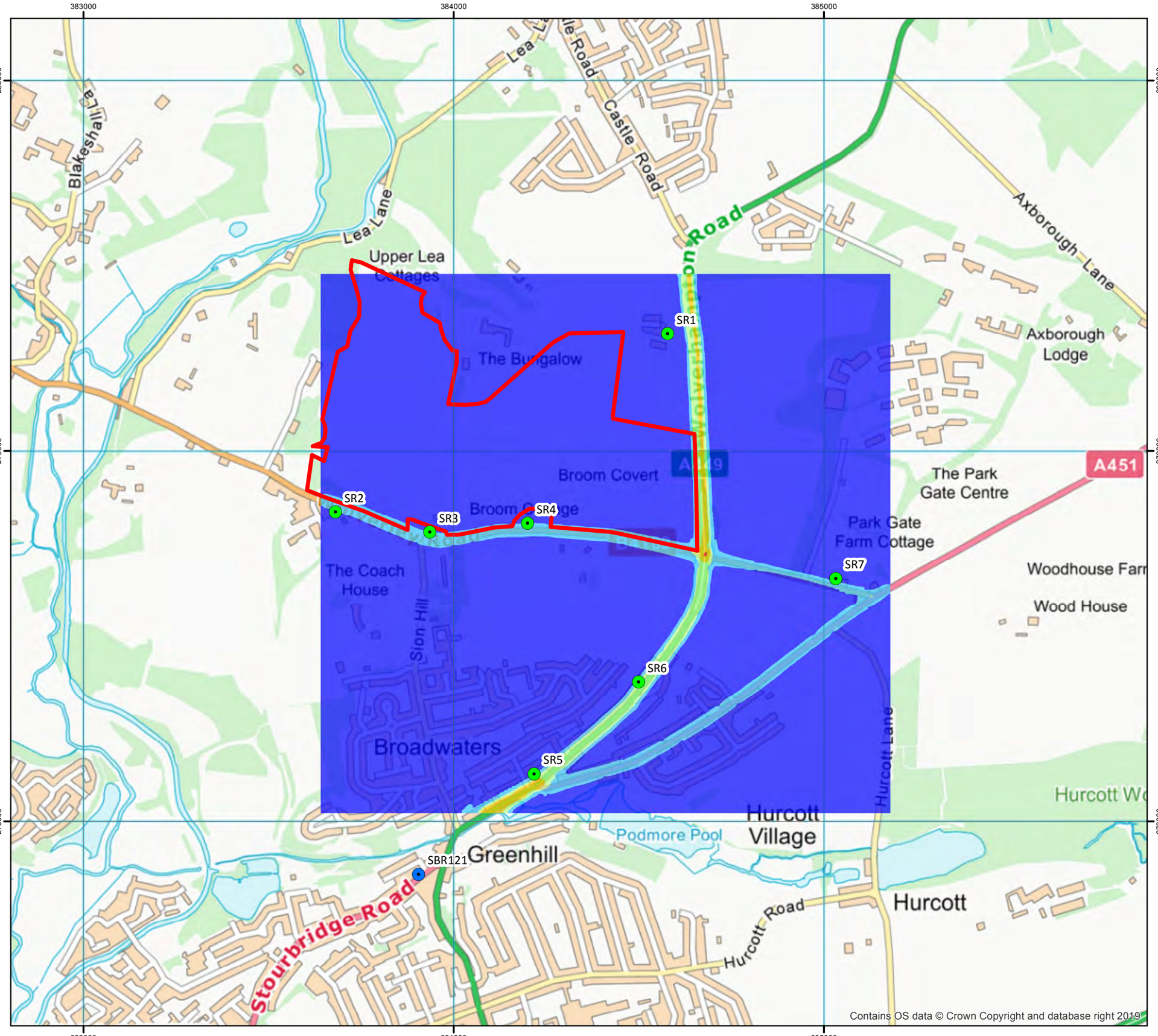

Legend

- Site Boundary
- Sensitive Receptors
- Diffusion Tube

PM10 Concentration (µg/m3)

- <13
- 13 - 14
- 14 - 15
- 15 - 16
- >16

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted PM10 Concentrations 2020 Baseline

Status: Final

Drawing No.: 471541-008

Revision:

Scale: 1:10,000

A3

Date: 07 August 2019

Drawn	Checked	Approved
BC	AH	BC

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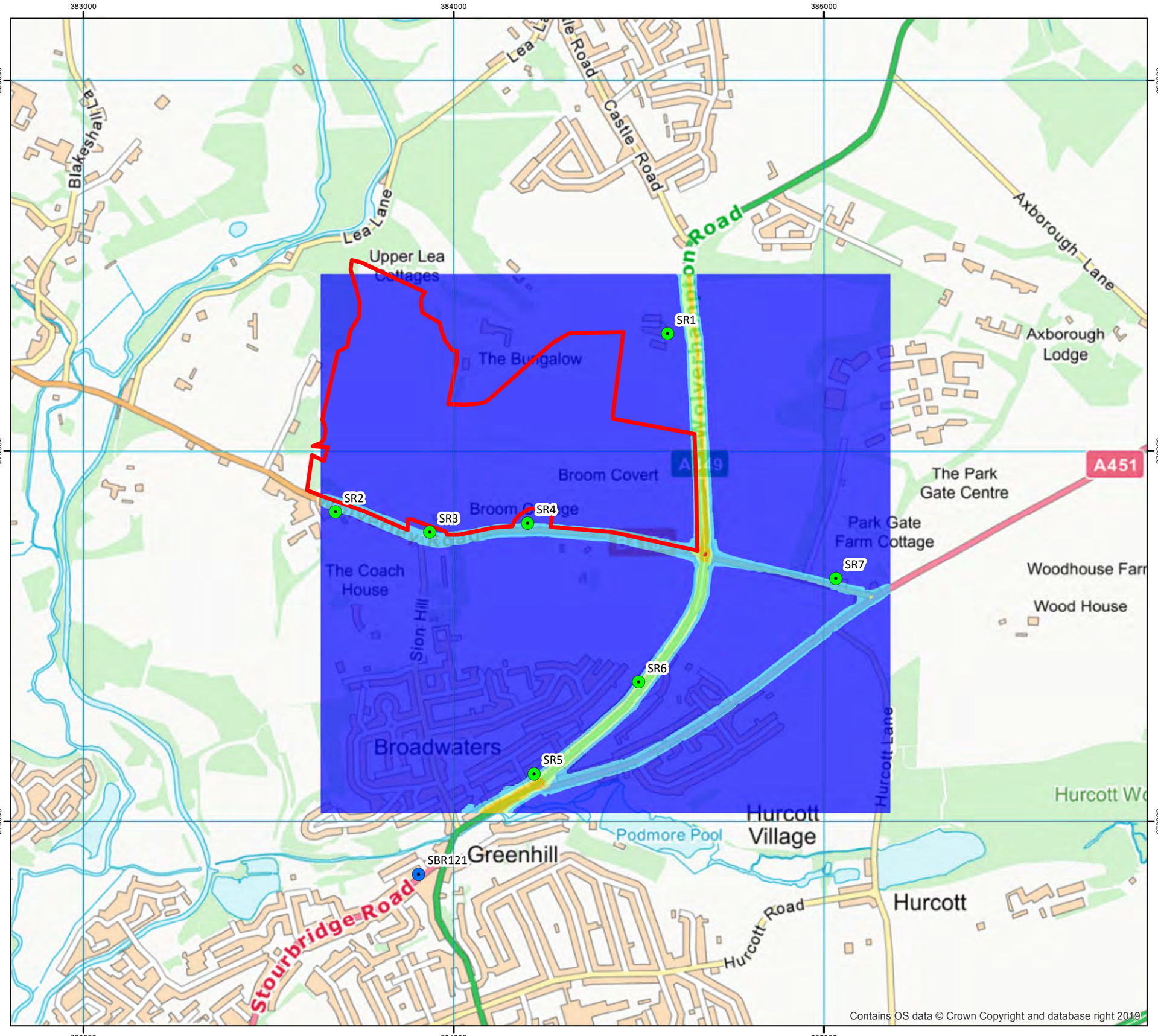

Legend

- Site Boundary
- Sensitive Receptors
- Diffusion Tube

PM10 Concentration (µg/m3)

- <13
- 13 - 14
- 14 - 15
- 15 - 16
- >16

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted PM10 Concentrations
2020 Baseline + Committed

Status: Final

Drawing No.: 471541-009

Revision:

Scale: 1:10,000

A3

Date: 07 August 2019

Drawn	Checked	Approved
BC	AH	BC

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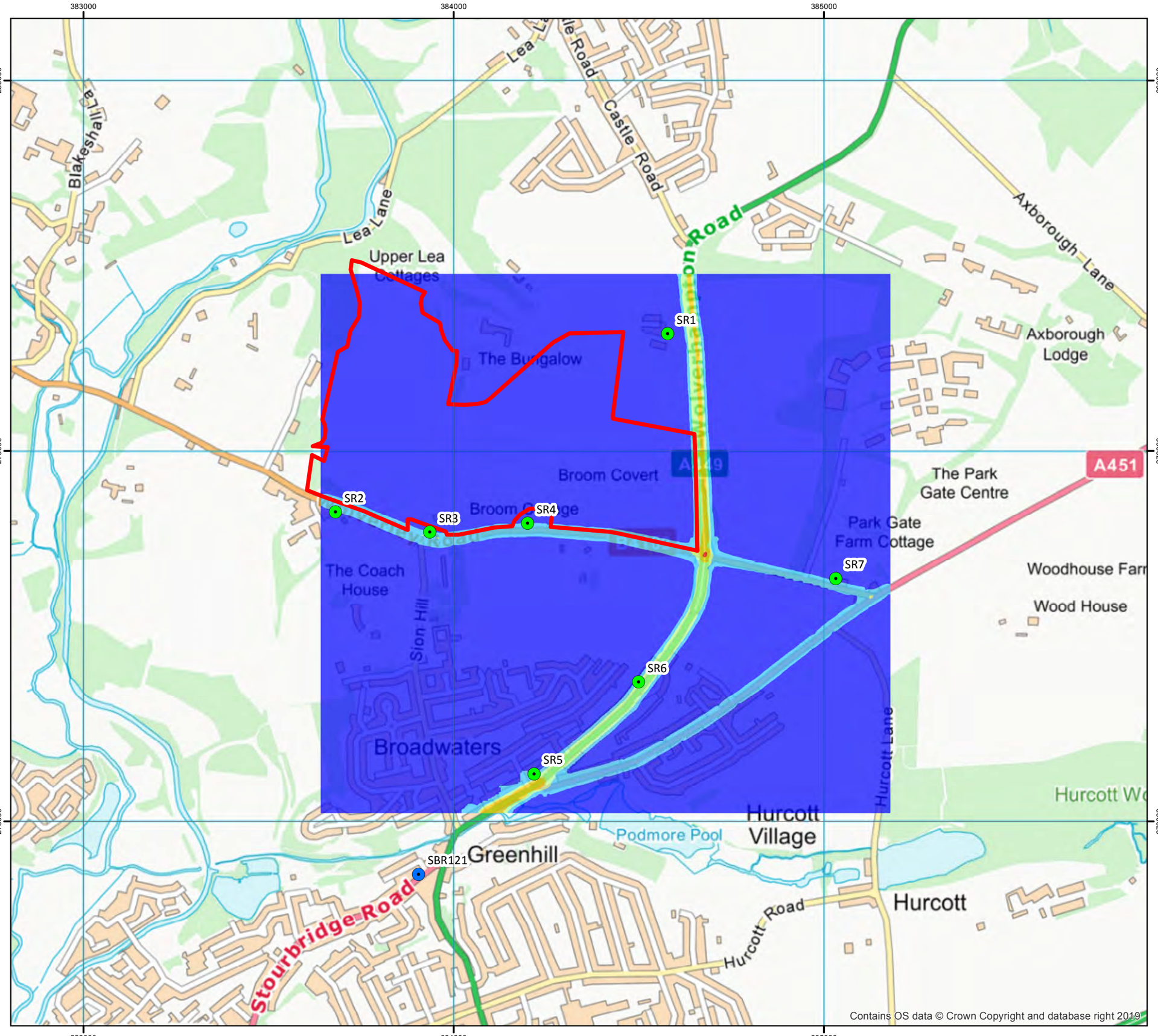

Legend

- Site Boundary
- Sensitive Receptors
- Diffusion Tube

PM10 Concentration (µg/m3)

- <13
- 13 - 14
- 14 - 15
- 15 - 16
- >16

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted PM10 Concentrations
2020 Baseline + Committed + Development

Status: Final

Drawing No.: 471541-010

Revision:

Scale: 1:10,000

A3

Date: 07 August 2019

Drawn	Checked	Approved
BC	AH	BC

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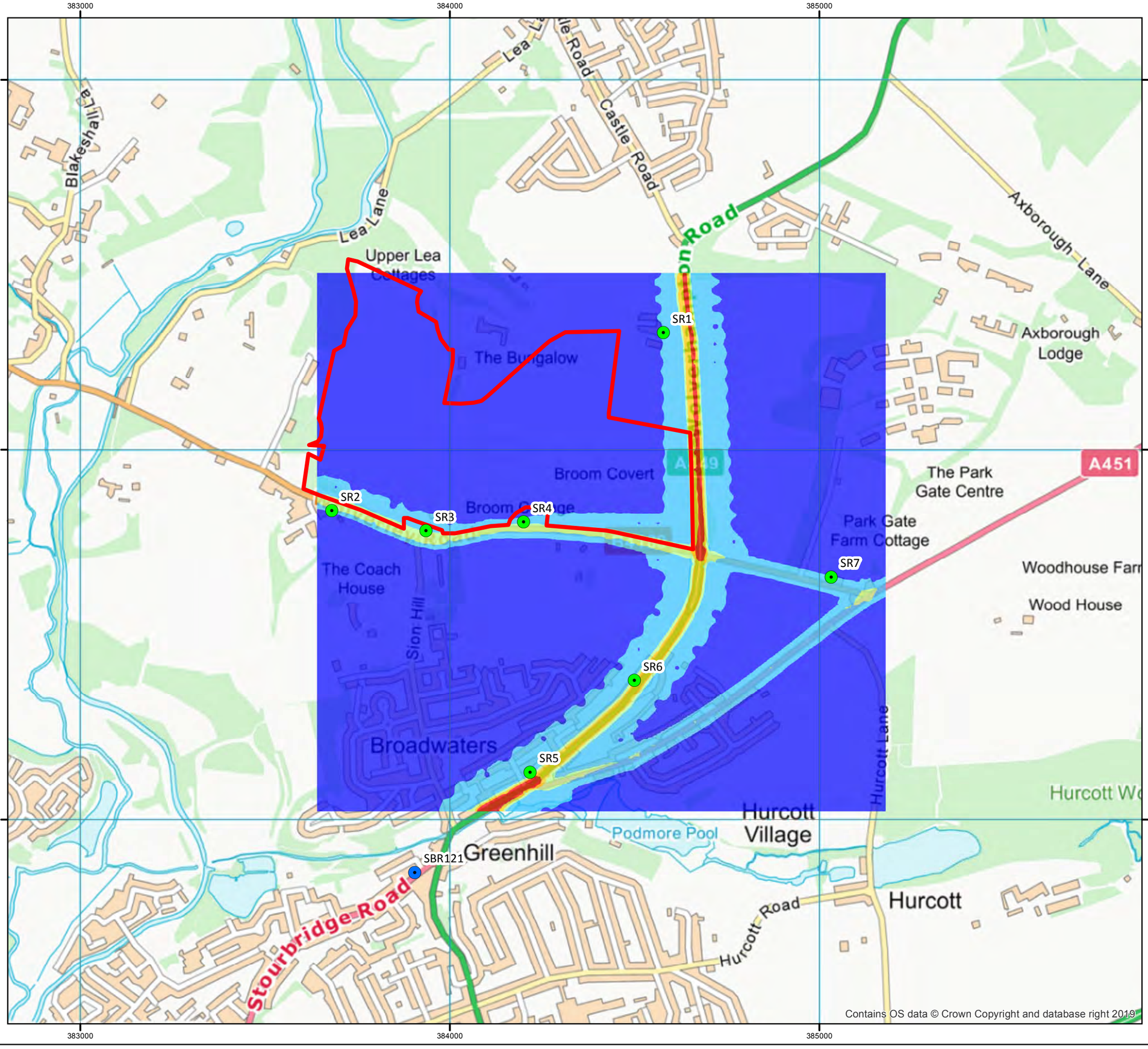

Legend

- Site Boundary
- Sensitive Receptors
- Diffusion Tube

PM2.5 Concentration (µg/m3)

- <8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- >10

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted PM2.5 Concentrations 2018 Baseline

Status: Final

Drawing No.: 471541-011

Revision:

Scale: 1:10,000

A3

Date: 07 August 2019

Drawn	Checked	Approved
BC	AH	BC

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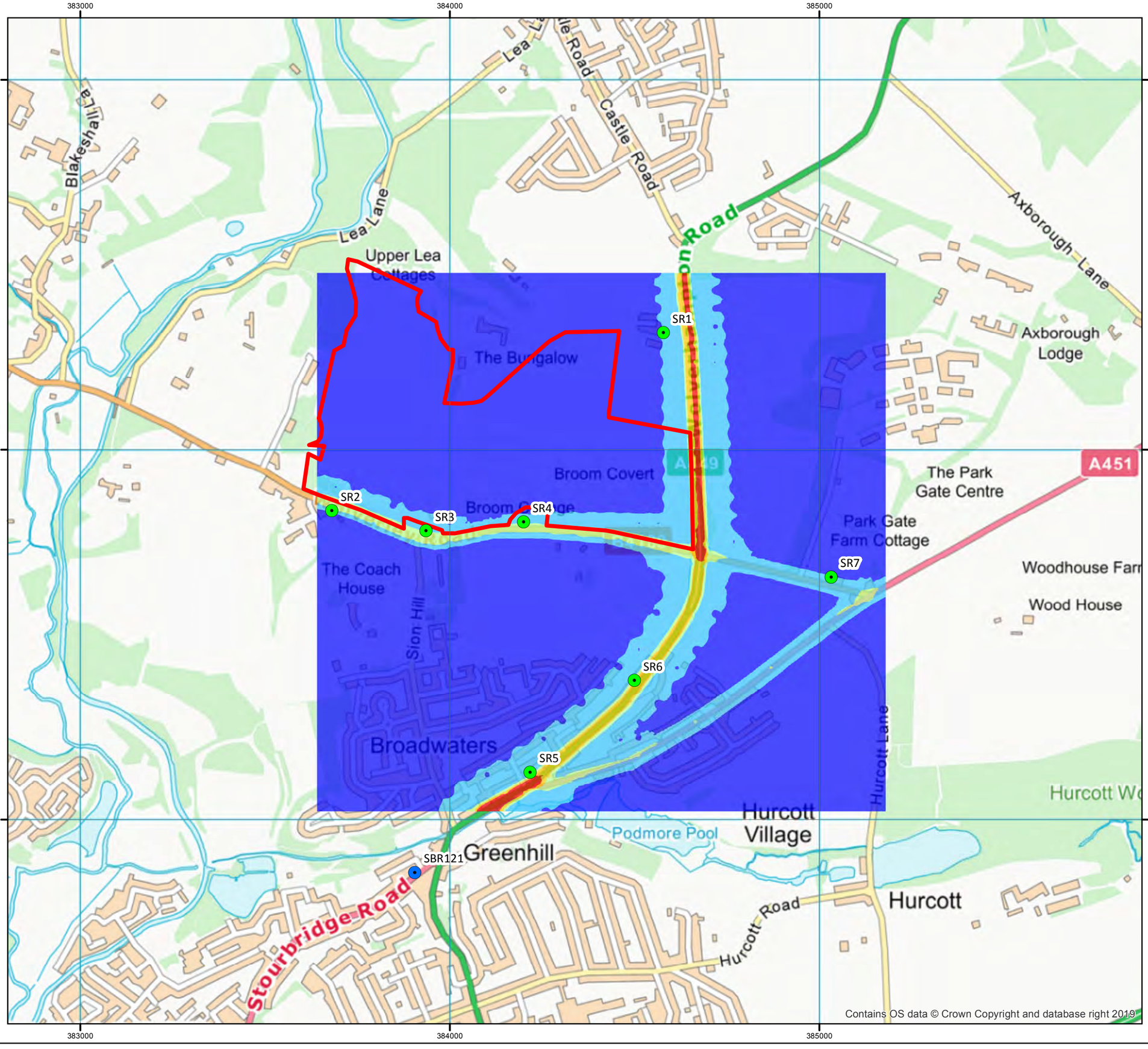

Legend

- Sensitive Receptors
- Site Boundary
- Diffusion Tube

PM2.5 Concentration (µg/m3)

- < 8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- >10

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted PM2.5 Concentrations 2020 Baseline

Status: Final

Drawing No.: 471541-012

Revision:

Scale: 1:10,000

A3

Date: 07 August 2019

Drawn	Checked	Approved
BC	AH	BC

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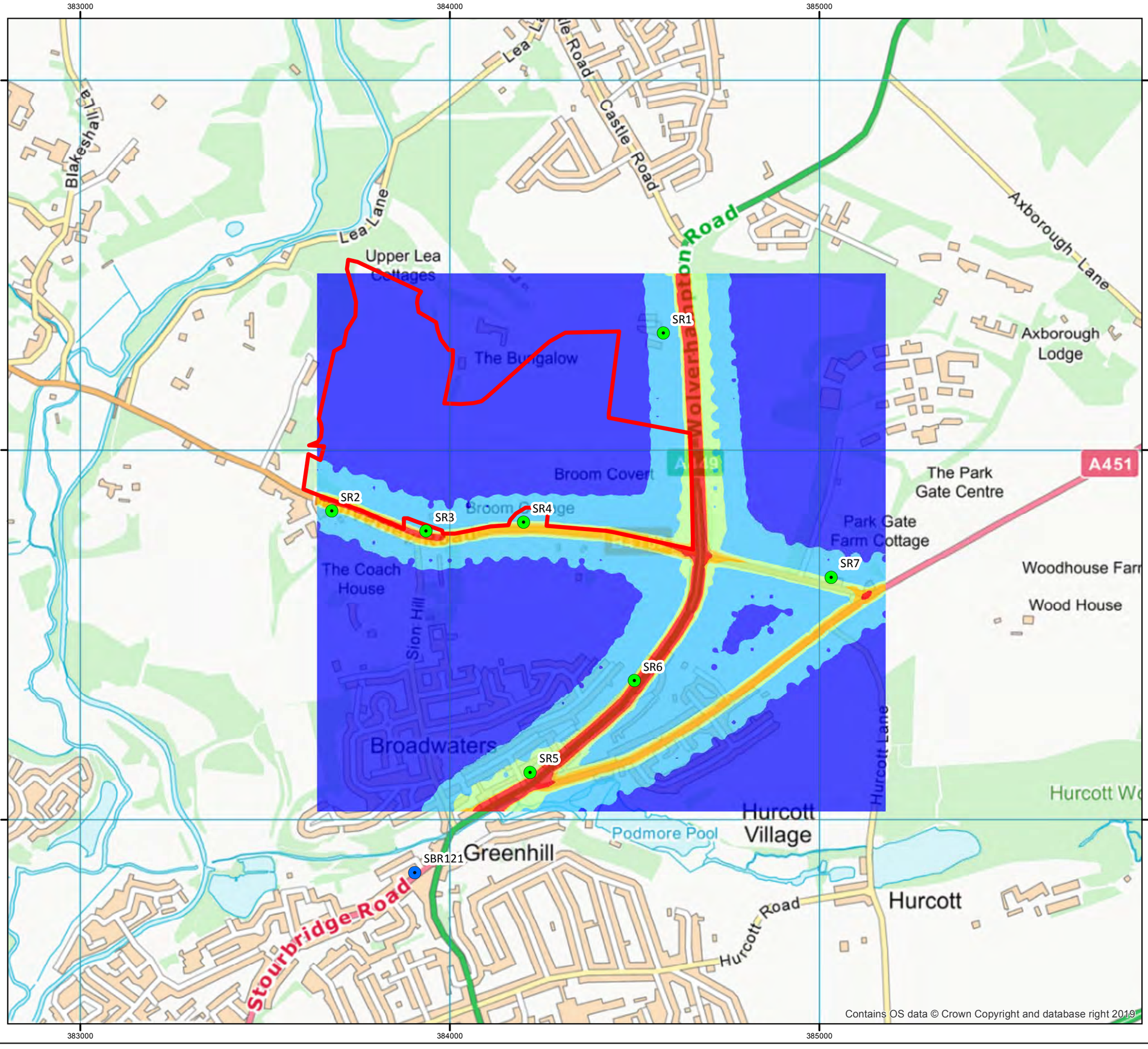

Legend

- Sensitive Receptors
- Site Boundary
- Diffusion Tube

PM2.5 Concentration (µg/m3)

- <8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- >10

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted PM2.5 Concentrations
2020 Baseline + Committed

Status: Final

Drawing No.: 471541-013

Revision:

Scale: 1:10,000

A3

Date: 07 August 2019

Drawn	Checked	Approved
BC	AH	BC

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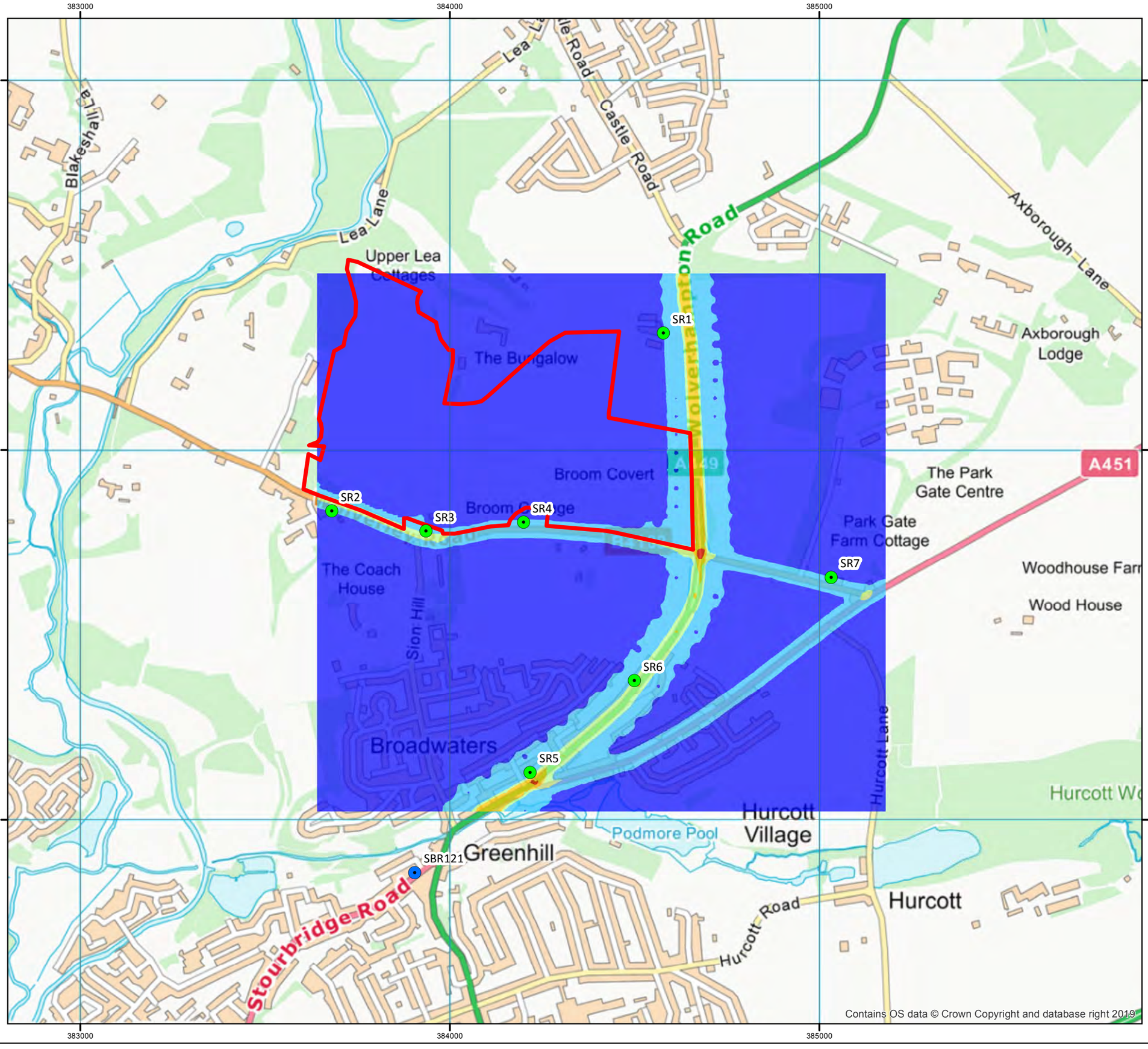

Legend

- Sensitive Receptors
- Site Boundary
- Diffusion Tube

PM2.5 Concentration (µg/m3)

- <8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- >10

Do not scale this map

Client: Vibrock

Project: Lea Castle Farm

Title: Predicted PM2.5 Concentrations
2020 Baseline + Committed + Development

Status: Final

Drawing No.	Revision
471541-014	

Scale		Date
1:10,000	A3	07 August 2019

Drawn	Checked	Approved
BC	AH	BC

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B TRAFFIC DATA

Road Name	Road Type	Canyon Height (m)	Road Width (m)	Vehicle Speed (km/h)		2018 Baseline (Hourly)		2020 Baseline (Hourly)		2020 Baseline + Committed (Hourly)		2020 Baseline + Committed + Development (Hourly)	
				LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV
Wolverley Road	Urban	0	15	5	5	391	11	399	11	403	11	404	16
A449 Wolverhampton Road North of Wolverley Road	Urban	0	15	5	5	580	36	591	37	591	37	591	38
Park Gate Road	Urban	0	15	5	5	238	5	243	5	248	5	248	7
A449 Wolverhampton Road South of Wolverley Road	Urban	0	15	5	5	427	32	435	32	435	32	435	34
A451 Stourbridge Road North East of A449	Urban	0	15	5	5	273	7	278	7	293	7	293	7
A449 Stourbridge Road	Urban	0	15	5	5	779	24	794	25	809	25	809	26
A451 Stourbridge Road SW	Urban	0	15	5	5	480	10	490	10	500	10	500	11
A449 Chester Road North	Urban	0	15	5	5	512	17	522	18	526	18	527	19
Wolverley Road West of Access	Urban	0	15	5	5	481	4	486	4	491	4	491	4

C DEATILED MODEL VERIFICATION

As outlined in Section 5.1 the model was run to predict road NO_x at the included monitoring locations. Measured road NO_x (the total NO_x attributed to road traffic) at the diffusion tube site was calculated by inputting the measured NO_2 annual mean concentrations and obtained background NO_2 concentration into the DEFRA NO_x to NO_2 calculator.

The model was found to consistently under predict measured Road NO_x concentrations at the monitoring location as is a common occurrence when carrying out dispersion modelling. It was therefore deemed appropriate to apply an adjustment factor.

A factor of 1.23 was determined and applied to the modelled road-NO_x concentrations Total nitrogen dioxide could then be determined by combining the adjusted modelled road-NO_x concentrations with the predicted background NO_2 concentrations within the NO_x to NO_2 calculator.

Figure C1 below compares adjusted modelled NO_2 with measured NO_2 at each of the included monitoring locations and shows good agreement.

In the absence of monitoring results to provide a suitable means of verification for model predicted PM_{10} or $PM_{2.5}$ concentrations, the determined adjustment factor for NO_2 was also applied to the modelled road contribution PM_{10} and $PM_{2.5}$.

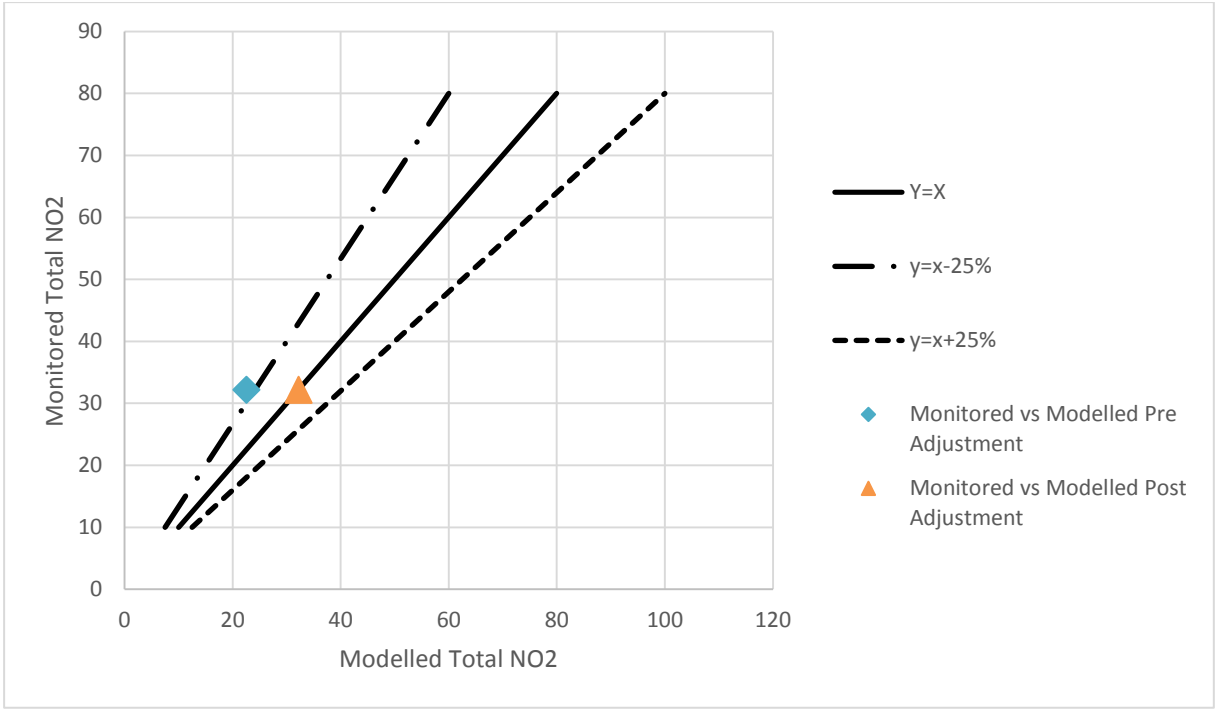

Figure C 1: Monitored vs Adjusted Modelled NO_2