APPENDIX 5.1: AIR QUALITY ASSESSMENT

Appendix 5.1

Cuadrilla Balcombe Limited

Balcombe 2z Hydrocarbon Well Testing

Air Quality Assessment – Technical Report

661310/AQ/02 (02)

OCTOBER 2017

RSK GENERAL NOTES

Report No: 661310/AQ/02 (02)

Title: Air Quality Assessment Technical Report - Balcombe 2z Hydrocarbon Well Testing

Client: Cuadrilla Balcombe Limited

Date: 16th October 2017

Status: Final

Summary

RSK Environment Ltd (RSK) was commissioned by Cuadrilla Balcombe Limited ("Cuadrilla") to undertake an air quality assessment as part of the planning application for the proposed Balcombe 2z hydrocarbon well testing at the Lower Stumble Exploration Site off London Road, near Balcombe, Haywards Heath.

An overview of the planning history and works that have been undertaken on-site to date is included within this report. Cuadrilla is now applying to West Sussex County Council (WSCC) for a new temporary planning permission. The description of development is:

> *"…..Temporary permission for exploration and appraisal comprising the flow testing and monitoring of the existing hydrocarbon lateral borehole along with site security fencing, the provision of enclosed testing flare and site restoration…."*

Whilst an air quality assessment was previously undertaken in 2014 as part of a previous planning application, given the time that has passed since this application, a fully revised air quality assessment has been prepared using latest guidance and data, and is presented within this report.

The borehole is already located at the application site and there will be no significant construction works. Odour and dust associated with this type of development are typically minimal and given the closest residential receptor is approximately 350m from the site, emissions are considered to be insignificant and assessment of odour and dust has been scoped out of the air quality assessment.

The assessment therefore focused on the potential operational phase impacts on local air quality as follows:

- Exhaust emissions from traffic associated with the proposed development;
- Emissions to air from flaring; and
- Emissions to air from generators used to power equipment on site.

Natural gas will be produced during flow testing and will be burnt off from the ground flare. The gas flaring activity will be up to 5000 m^3 of gas per day for 7 days only and generators are anticipated to be operational for up to 12 weeks. As a conservative assessment, it has been assumed that two generators (approximately 220ekW) will be operating on-site, however in reality one generator is anticipated to be operating at any one time with the second on-site as contingency/back-up.

The proposed development will not generate a significant amount of traffic once operational, therefore using 2017 Environmental Protection UK / Institute of Air Quality Management (EPUK-IAQM) guidance, the impact of operational phase traffic on local air quality have been considered to be negligible.

The main potential air quality impact once the proposed development is operational is considered to be emissions from the proposed flare and generator engines. An assessment of operational impacts has been undertaken using AERMOD, an advanced atmospheric dispersion model developed for regulatory purposes, with the use of meteorological data measured between 2012 and 2016 at the Gatwick airport weather station. Concentrations of key air pollutants (oxides of nitrogen (NO_x), nitrogen dioxide (NO_2) particulate matter (PM_{10} and $PM_{2.5}$) and carbon monoxide (CO)) have been predicted at discrete receptor locations.

In order to assess the potential impact of increases in pollutant concentrations attributable to the development on existing sensitive receptors, the results have been interpreted using the 2017 EPUK-IAQM guidance. The proposed development was found to have negligible impact on all pollutant concentrations assessed.

The proposed development was also assessed as having a minimal impact at nearby sites designated for their ecological importance, with regards to nitrogen and acid deposition, and ambient annual mean NO_x concentrations.

An initial radiological impact assessment found no significant impacts in relation to radon gas from the operation of the site and potential exposure of members of the public.

The assessment has concluded that the air quality impact of the proposed development is considered as not significant. As this assessment has determined that the operational phase impacts on local air quality are not significant, additional mitigation measures have not been recommended and the residual impacts are considered to be acceptable.

Abbreviations

APIS	Air Pollution Information System
AQAL	Air Quality Assessment Level
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
CO	Carbon Monoxide
Defra	Department for Environment, Food and Rural Affairs
EC	European Commission
EPUK	Environmental Protection UK
EQS	Environmental Quality Standard
EU	European Union
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
LWS	Local Wildlife Site
MSDC	Mid-Sussex District Council
NAQS	National Air Quality Strategy
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PC	Process Contribution
PEC	Predicted Environmental Concentration
PM_{10}	Particulate matter of size fraction approximating to <10mm diameter
$PM_{2.5}$	Particulate matter of size fraction approximating to <2.5mm diameter
RSK	RSK Environment Limited
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
UK-AIR	UK Atmospheric Information Resource

Contents

1 INTRODUCTION

RSK Environment Ltd (RSK) was commissioned by Cuadrilla Balcombe Limited ("Cuadrilla") to undertake an air quality assessment of the proposed Balcombe 2z hydrocarbon well testing at the Lower Stumble Hydrocarbon Exploration Site, off London Road, near Balcombe, Haywards Heath (RH17 6JH). Figure 1.1 shows the location of the application site, for which the approximate grid reference of the centre of the site is 531022, 129238.

Figure 1.1: Location of Application Site

A brief description of the site's previous planning history and the proposed works are provided below, but further details can be found in the Planning Statement, which forms part of the planning application package.

1.1 Summary of Site History and Proposed Works

The Balcombe 2z hydrocarbon borehole ("the borehole") was drilled by Cuadrilla in 2013 under planning permission WSCC/027/10/BA. The borehole extends approximately 820 metres (m) vertically and 520m laterally. The 2010 planning permission allowed the flow rates in the borehole to be tested and monitored but these works were never completed due to the time limits that were imposed on the works. Therefore, Cuadrilla secured a temporary planning permission in 2014 (ref:

WSCC/005/14/BA) to stimulate the borehole, test and monitor the flows, plug and abandon the borehole and then restore the land back to its original use as forestry storage. Due to the length of time and effort it has taken to commence operational activity in Cuadrilla's Lancashire licence area and the reduction in available UK service support brought about by a decline in oil prices, the borehole flow testing and monitoring has not been completed and the 2014 planning permission has now expired. Cuadrilla would still like to undertake these works so is now applying to West Sussex County Council (WSCC) for a new temporary planning permission. The description of development is:

> *"…..Temporary permission for exploration and appraisal comprising the flow testing and monitoring of the existing hydrocarbon lateral borehole along with site security fencing, the provision of enclosed testing flare and site restoration…."*

With the exception of an increase in the size of the workover rig from 22m to 32m, the proposed development is the same as that which was granted consent in 2014. Planning permission is now being sought for a six-month period and the proposed work involves three stages.

- Stage 1: Exploration borehole testing and operations;
- Stage 2: Plug and abandonment of the well; and
- Stage 3: Demobilisation and restoration of the site.

As part of the proposed works, Cuadrilla is seeking to test the underground limestone rock layer which it has already been determined is (i) hydrocarbon bearing, and (ii) has a significant level of natural fracturing. As such, the proposed flow testing operations **do not include any hydraulic fracturing** and for the avoidance of doubt Cuadrilla has confirmed that it is not proposing to hydraulically fracture this well in the future.

1.2 Air Quality Assessment

As part of the 2014 planning permission a detailed air quality assessment was prepared. Given the time that has passed since this application a fully revised air quality assessment has been prepared using latest guidance and data and is presented within this technical report.

As the borehole pad is already located at the application site, there will be no significant construction works. Odour and dust associated with this type of development are typically minimal and given the closest residential receptor is approximately 350m from the site, it is assumed that these emissions will be insignificant and assessment of odour and dust has been scoped out of the air quality assessment.

The assessment will therefore focus on the assessment of potential operational phase impacts on local air quality as follows:

- Exhaust emissions from traffic associated with the proposed development;
- Emission to air from flaring; and
- Emission to air from generators used to power equipment on site.

2 LEGISLATION, PLANNING POLICY AND GUIDANCE

2.1 Air Quality Strategy

UK air quality policy is published under the umbrella of the Environment Act 1995, Part IV and specifically Section 80, the National Air Quality Strategy (NAQS). The latest *Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air*, published in July 2007 sets air quality standards and objectives for ten key air pollutants to be achieved between 2003 and 2020.

The EU Air Quality Framework Directive (1996) established a framework under which the EU could set limit or target values for specified pollutants. The directive identified several pollutants for which limit or target values have been, or will be set in subsequent 'daughter directives'. The framework and daughter directives were consolidated by Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, which retains the existing air quality standards and introduces new objectives for fine particulates ($PM_{2.5}$).

2.1.1 Air Quality Objectives and Standards

The air quality standards and objectives in the United Kingdom are derived from European Commission (EC) directives and are adopted into English law via the Air Quality (England) Regulations 2000 and Air Quality (England) Amendment Regulations 2002. The Air Quality Limit Values Regulations 2003 and subsequent amendments implement the EU Air Quality Framework Directive into English Law. Directive 2008/50/EC was translated into UK law in 2010 via the Air Quality Standards Regulations 2010.

The relevant[1] Air Quality Strategy (AQS) objectives for England and Wales to protect human health and for the protection of vegetation and ecosystems are summarised in Table 2.1.

Table 2.1: Air Quality Objectives/Standards Relevant to the Proposed Development

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit (μg/m^3)
AQS Objectives for Protection of Human Health			
Nitrogen dioxide (NO_2)	Annual	-	40
	1 hour	18	200
Carbon Monoxide (CO)	8-hour	-	10,000

[1] Relevance, in this case, is defined by the scope of the assessment.

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit (µg/m^3)
Particulate Matter (PM_{10})	Annual		40
	24-hour	35	50
Particulate Matter ($PM_{2.5}$)	Annual	-	25
AQS Objectives for Protection of Vegetation and Ecosystems			
Oxides of nitrogen (NO_x)	Annual	-	30

2.1.2 The Environment Act

The set objectives are to be used in the review and assessment of air quality by local authorities under Section 82 of the Environment Act (1995). If exceedances are measured or predicted through the review and assessment process, the local authority must declare an air quality management area (AQMA) under Section 83 of the Act, and produce an air quality action plan (AQAP) to outline how air quality is to be improved to meet the objectives under Section 84 of the Act.

2.1.3 Ionising Radiations Regulations 1999 and Approved Code of Practice and Guidance

The assessment of radon gas exposure levels requires the consideration of the Ionising Radiations Regulations 1999 and the Approved Code of Practice and guidance.

The following limits are considered relevant to this assessment:

- A maximum dose constraint of 0.3 mSv/yr (300 µSv/yr) for any source from which radioactive discharges are made; and
- Statutory dose limit of 1 mSv/yr (1000 µSv/yr).

2.2 Planning Policy and Guidance

The land use planning process is a key means of improving air quality, particularly in the long term, through the strategic location and design of new developments. Any air quality concern that relates to land use and its development can, depending on the details of the proposed development, be a material consideration in the determination of planning applications.

2.2.1 National Planning Policy

National Planning Policy Framework

In March 2012 The National Planning Policy Framework (NPPF) was published, superseding the bulk of previous Planning Policy Statements with immediate effect. The National Planning Policy Framework was intended to simplify the planning system and includes a presumption in favour of sustainable development.

Section 11 of the NPPF deals with Conserving and Enhancing the Natural Environment, and states that the intention is that the planning system should prevent '*development*

from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability' and goes on to state that '*new development* [should be] *appropriate for its location' and 'the effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account*.'

With specific regard to air quality, the NPPF states that:

> *'Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan'.*

2.2.2 Local Planning Policy

Mid-Sussex District Council (MSDC) are in the process of updating their local plan, but the current local plan is the saved policies from the Mid-Sussex Local Plan 2004. The 2004 Local Plan policies aim to '*…protect existing water resources and to encourage a reduction in the pollution of land, air and water…'*. Policy CS22 states:

> *"…Development will only be permitted which does not cause unacceptable levels of pollution to land, air or water in terms of noise, dust, fumes, vibration, light or heat.*
>
> *Permission will not be granted for development on a site adjacent to an existing use which, as a source of pollution, would have an adverse effect on the proposed development…."*

2.3 Best Practice Guidance Documents

2.3.1 Land-Use Planning & Development Control: Planning for Air Quality

Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) jointly published a revised version of the guidance note 'Land-Use Planning & Development Control: Planning for Air Quality' in 2017 (herein referred to as the '2017 EPUK-IAQM' guidance) to facilitate the consideration of air quality in the land-use planning and developmental control process. It includes screening criteria for determining the likelihood of an air quality assessment being required and criteria for determining the significance of any air quality impacts associated with a development proposal. Details of these criteria within the guidance are replicated in Annex A of this document.

2.3.2 Guidance Document - Air Emissions Risk Assessment for your Environmental Permit

This guidance issued by the Environment Agency and Defra in 2016, has replaced the revoked horizontal guidance 'H1 Annex F – Air Emissions' (Environment Agency, 2011) for assessing industrial emissions in the UK under the Environmental Permitting Regulations. This guidance is primarily related to air quality assessments for

Environmental Permit applications, however it has been referred to within this assessment, where appropriate.

2.3.3 Environment Agency Initial Radiological Assessment Methodology

The Environment Agency published the Initial Radiological Assessment Methodology, Parts 1 and 2, to provide a methodology for an initial radiological assessment methodology which may be used by the Environment Agency and applicant for Radioactive Substances Act 1993 (RSA 93) authorisations to assess whether doses to critical groups of the public exceed specified dose constraints.

3 ASSESSMENT SCOPE & METHODOLOGY

3.1 Overall Approach

The approach taken for assessing the potential air quality impacts of the proposed development may be summarised as follows:

- Correspondence with the local authority on the proposed development in terms of air quality;
- Baseline characterisation of local air quality;
- Qualitative assessment of air quality impacts relating to traffic during the operational phase of the proposed development using 2017 EPUK-IAQM guidance;
- Quantitative assessment of air quality impacts during the operational phase of the proposed development using detailed dispersion modelling assessment of exhaust emissions from the proposed flare and generator engines on human receptors and at ecologically sensitive sites;
- Assessment of the potential exposure of members of the public resulting from the discharge of radon-222 gas to the atmosphere using the Environment Agency's initial radiological assessment methodology;
- Recommendation of mitigation measures, where appropriate, to ensure any adverse effects on air quality are minimised; and,
- Identification of residual impacts resulting from the proposed development.

Prior to commencing with the air quality assessment, RSK sent the proposed methodology to the Environmental Health Officer (EHO) at MSDC, but at the time of writing had not received a response.

3.2 Baseline Characterisation

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. A desk based study has been undertaken including a review of monitoring data available from MSDC and the Applicant (Cuadrilla) and estimated background data from the LAQM Support website maintained by Defra. Background concentrations have been mapped by Defra at a grid resolution of 1x1km for the whole of the UK.

3.3 Operational Impact Assessment

3.3.1 Operational Phase Emissions from Traffic

Once operational, the proposed development will generate additional traffic on the surrounding road network; the emissions to air associated with this traffic have the potential to impact on nearby sensitive receptors. The EPUK-IAQM 2017 guidance provides indicative criteria for when an air quality assessment is required, if none of the criteria are exceeded, it is considered unlikely that there will be any significant impacts

on air quality during the operational phase. A simple screening level assessment against these criteria has been undertaken.

3.3.2 Operational Phase Emissions from Flaring and Generator Engines

As the proposed development includes a single flare point and up to two generator engines, detailed dispersion modelling was considered appropriate to assess the potential impacts on local air quality at sensitive receptors, once operational. The key air pollutants of concern for the operation of the proposed development are NO_x, NO_2, and CO from both the flare point and the generators and also PM_{10} and $PM_{2.5}$ from the generator engines which are diesel fuelled. It is understood that the gas being burnt during flaring is predominantly methane and does not contain sulphur or benzene, therefore sulphur dioxide and benzene have not been considered in this assessment. Natural gas is a clean-burning fuel and emits insignificant quantities of particulate matter, and hence the assessment PM_{10} and $PM_{2.5}$ from the flare is not required.

RSK are not aware of any committed or consented developments in the area with significant emissions to air, and therefore the potential air quality impacts of this proposed development during the operational phase are considered in isolation.

The following subsections provide further information regarding input to the dispersion model including emissions sources, meteorological data and receptors/study area included.

3.3.3 Modelling Software

The American Meteorological Society/United States Environmental Protection Agency (US EPA) Regulatory Model Improvement Committee (AERMIC) was formed to introduce state-of-the-art modelling concepts into the EPA's air quality models. Through AERMIC, a modelling system, AERMOD, was introduced. AERMOD incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. AERMOD is widely used for regulatory purposes.

The impact assessment of the proposed site was undertaken using BREEZE AERMOD with a Geographical Information System (GIS) capability (Version 8.0.0.33).

3.3.4 Emission Sources

The gas flaring activity is proposed to operate continuously for 7 days of the year during flow testing. It has been assumed that the flare will operate continuously (i.e. 24 hours per day) during this 7 day period giving a total of 168 operational hours i.e. 1.9% of the year. Given the short duration of flaring activity, many of the air quality objectives would not apply due to longer averaging periods, however the results have still been compared with the AQS objectives to offer a conservative approach, as detailed further below.

Two generators (each approximately 220ekW) are expected to be on-site during Stage 1 work, one is for redundancy purposes, however for a conservative assessment it has been assumed they could operate at the same time. This is considered an unlikely scenario but will allow for a "worst-case" scenario. It is understood the generators will be used on sites for up to 12 weeks during stages 1 and 2, i.e. 23% of a year. In Stage 2, the generators will only operate between 7.30 and 18.30 hours Monday to Friday and 08.00 to 13.00 hours on Saturdays. During Stage 2 the operating hours on Monday to Friday might extend up to 22.00 hours and Stage 2 will last up to a maximum of 8 weeks. Therefore, as a worst-case conservative assessment the dispersion model has been setup with the use of varying emission factors assuming both generators are operational between 07.30 and 22.00 Monday to Friday and 08.00 to 12.00 on Saturdays.

The Environment Agency guidance (H1 Annex F[2]) indicates that representative operational conditions are assessed. Therefore, it was considered appropriate to model long-term emissions over the whole year, and to multiply the modelled results for the flare and the generators by 1.9% and 23% respectively, to reflect operating hours. This allows for meteorological conditions over the entire year to be appropriately captured.

For assessing short-term impacts, these emission sources were assumed to be operating continuously throughout the year to capture the worst-case meteorological conditions that result in the maximum impact at the assessed receptor locations. Hourly NO_2 concentrations have been predicted for the 99.79^{th} percentile, 24 hour PM_{10} concentrations for the 90.4^{th} percentile and 8 hour mean CO for the 100^{th} percentile, assuming the plant is operational all hours of the year to ensure the worst-case scenario is captured. In reality, the site is expected to operate for much shorter durations as detailed above and therefore the results presented are considered to be overly conservative.

Tables 3.1 and 3.2 present the physical and emission characteristics of the proposed flare and generator engines based on data provided by and agreed with Cuadrilla. Figure 1.1 shows the locations of the stacks in relation to the wider area. The exact location of the generators is not fixed and therefore they have been modelled at the northern boundary of the site which is closest to the existing human receptors for a conservative assessment.

The NO_x and CO emission rates are based on data from the UK Offshore Operators Association guidance document and the upper volume of gas flared per day ($5000m^3$ as allowed by the Environmental Permit).

[2] The guidance 'H1 Annex F – Air Emissions' (Environment Agency, 2011) has now been revoked, but the updated 'Air emissions risk assessment for your environmental permit' (Defra and Environment Agency, 2016) does not offer alternative guidance and so it is still considered appropriate for this purpose.

Table 3.1: Physical and Emission Characteristics of Flare Emission Source Included in the Assessment

Description - Flare	Parameters Included in the Air Dispersion Model per stack
Operation	Operating 24 hours per day, for 7 days
Fuel	Natural gas
Stack height	13.72m above ground
Flare release point diameter	2.438m
Stack exhaust temperature	800^{o}C
Actual stack velocity	20 m/s
Nitrogen oxides (NO_x) emission rate	0.059 g/s
Carbon monoxide (CO) emission rate	0.331 g/s
Number of flare stacks	1
Stack Position	Easting (m) Northing (m) 531010 129196

Table 3.2: Physical and Emission Characteristics of Generator Emission Source Included in the Assessment

Description – per Generator Engine	Parameters Included in the Air Dispersion Model per stack
Operation	Operating between 7.30 and 22.00 hours Monday to Friday and 08.00 to 13.00 hours on Saturdays, for up to 12 weeks – conservative assessment, see section 3.3.4 for further details
Fuel	Diesel
Stack height	2m above ground
Stack diameter	0.2m
Stack exhaust temperature	543.1^{o}C
Actual stack velocity	23.7 m/s
Nitrogen oxides (NO_x) emission rate	0.932 g/s
Carbon monoxide (CO) emission rate	0.158 g/s
Particulate Matter (PM) emission rate	0.008 g/s
Number of generator stacks	2
Stack positions	Easting (m) Northing (m) 531000 129253 531002 129255

3.3.5 Buildings

There are no high-rise buildings within the site or in the vicinity.

3.3.6 Meteorological Data

Hourly sequential meteorological data measured between 2012 and 2016 at the Gatwick Airport meteorological station, located approximately 12km southeast of the site, has been utilised in this model and is considered to be representative of local conditions.

The maximum predicted pollutant concentrations for each of the five years have been reported. The windroses for the meteorological station are presented in Annex B.

3.3.7 Terrain

Ordnance Survey digital terrain data were included in the assessment to account for topographical features of the land covering the model domain.

3.3.8 Background Air Quality Data Used in the Modelling

Whilst some on-site and off-site air quality monitoring has been carried out by Ground-Gas Solution Ltd (GGS) on behalf of CDL in 2013 (detailed further in section 4.2 and referred to as 'pre-drill environmental monitoring'), the monitoring duration was for 25 days and therefore is not representative of annual mean background concentration. A comparison of the pre-drill environmental monitoring data for NO_2 with annual mean NO_2 background concentration data available from the national maps provided by Defra found the data was similar and the use of Defra data, compared to the off-site monitoring, would be more conservative (i.e. concentrations would be higher). The GSS pre-drill environmental monitoring data did not include PM_{10}, $PM_{2.5}$ or CO.

Background NO_2, PM_{10} and $PM_{2.5}$ concentrations for the study area have therefore been taken from the national maps provided by Defra. These maps provide estimated background concentrations for the whole of the UK at a grid resolution of 1km x1km, for all years between 2013 and 2030. The maps assume that background concentrations will improve (i.e. reduce) over time, in line with the predicted reduction in vehicle emissions as well as reductions in emissions from other sources. Due to the current uncertainty in the assumed reductions, background concentrations for 2017 have been considered rather than the anticipated opening year of the proposed development. This is considered a conservative approach.

Annual mean CO concentrations have been taken from the 2001 LAQM Support / UK-AIR background maps, as these are the latest datasets available for CO. For this assessment it has been assumed that there has been no reduction in the background concentration since 2001 to provide a worst-case assessment.

The approach for background NO_x concentrations at ecological receptors is described in Section 3.3.13.

Background concentrations used within the assessment are presented in the baseline section in Table 4.2.

3.3.9 Receptor Locations and Model Domain

Pollutant concentrations were predicted at a number of receptors at existing sensitive locations. Details of all specific receptors included in the modelling study are summarised in Table 3.3 and shown in Figures 3.1 and 3.2 for human receptors and

ecological receptors, respectively. Human receptors were modelled at a height of 1.5m and ecological receptors at a height of 0m.

A review of Defra's MAGIC website was undertaken to identify the designated ecological sites and the Project Ecological Consultants were consulted regarding locations of Local Wildlife Sites (LWS) within 2km of the proposed site. Ecological receptors include sites that are Special Protected Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites (protected wetlands) within 10km of the site, as well as Sites of Special Scientific Interests (SSSIs) and local nature sites (ancient woodlands, local wildlife sites, national and local nature reserves) within 2km of the site, as per the Environment Agency & Defra (2016) guidance. The closest point within each of the designated ecological sites was selected as detailed by the co-ordinates presented in Table 3.3.

Furthermore, for the purpose of considering potential impacts at a greater number of locations by producing isopleths (pollution concentration contours), for the predicted annual and short-term concentrations for NO_2, hypothetical grid receptors spaced at 25m covering approximately a domain of 2km x 2km approximately centred over the proposed site have also been included. Concentrations were modelled at ground level for this grid of receptors.

Table 3.3: Receptors Included in the Dispersion Modelling Assessment

Receptor ID	Receptor Location	Grid reference	
		X	Y
Residential Receptors			
R1	Kemps Farm 1	530740	129554
R2	Kemps Farm 2	530832	129578
R3	Brook Cottage	530586	129882
R4	Holt's Cottages (24 Haywards Heath Road)	531653	129576
R5	Glebe's Farm	531510	129993
R6	Haywards Heath Road	531583	129788
R7	Bowders Farm	531791	129259
R8	Bowder's Cottage	531627	129167
R9	Norfolk Cottages	530257	129479
R10	Upper Pilstye Cottages	530475	128700
R11	Pilstye Farm	530663	128411
Ecological Receptors			
E1	Rowhill Copse LNR	530649	129954
E2	Ardingly Reservoir LNR	531997	129857
E3	Rowhill and Station Pastures LWS	530649	129954
E4	Balcombe Marsh LWS*	531485	128474
E5	Balcombe Estate Rocks LWS	531744	130039
E6	Ardingly Reservoir and Loder Valley Nature Reserve LWS	531997	129857

Receptor	Receptor Location	Grid reference	
E7	Balcombe Lake and Associated Woodlands LWS	531933	130403
E8	Ashdown Forest SAC	539803	131298

Note: *Not found to be sensitive to acid deposition according to APIS.

Figure 3.1: Proposed Site Location with Human (Residential) Receptors

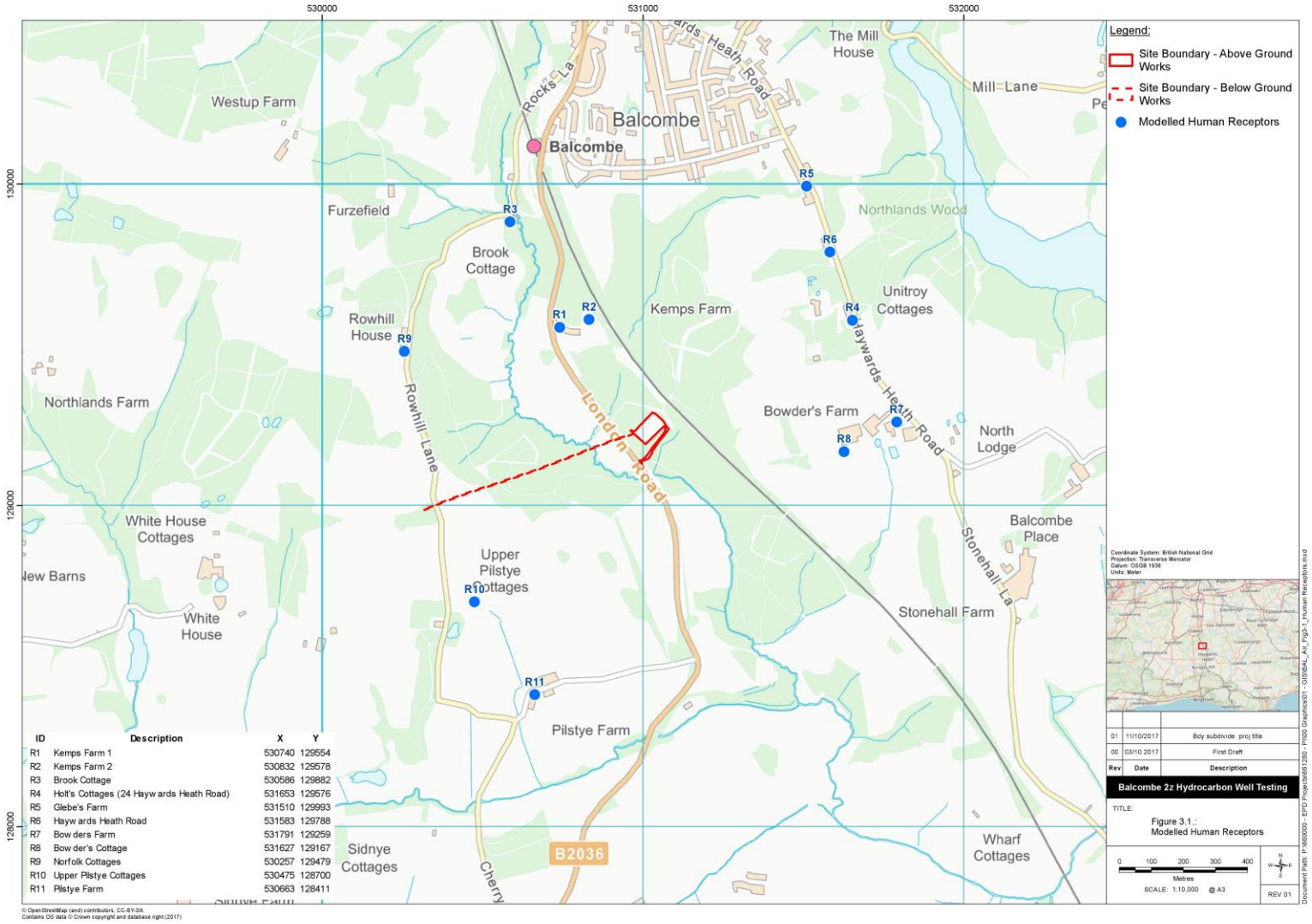
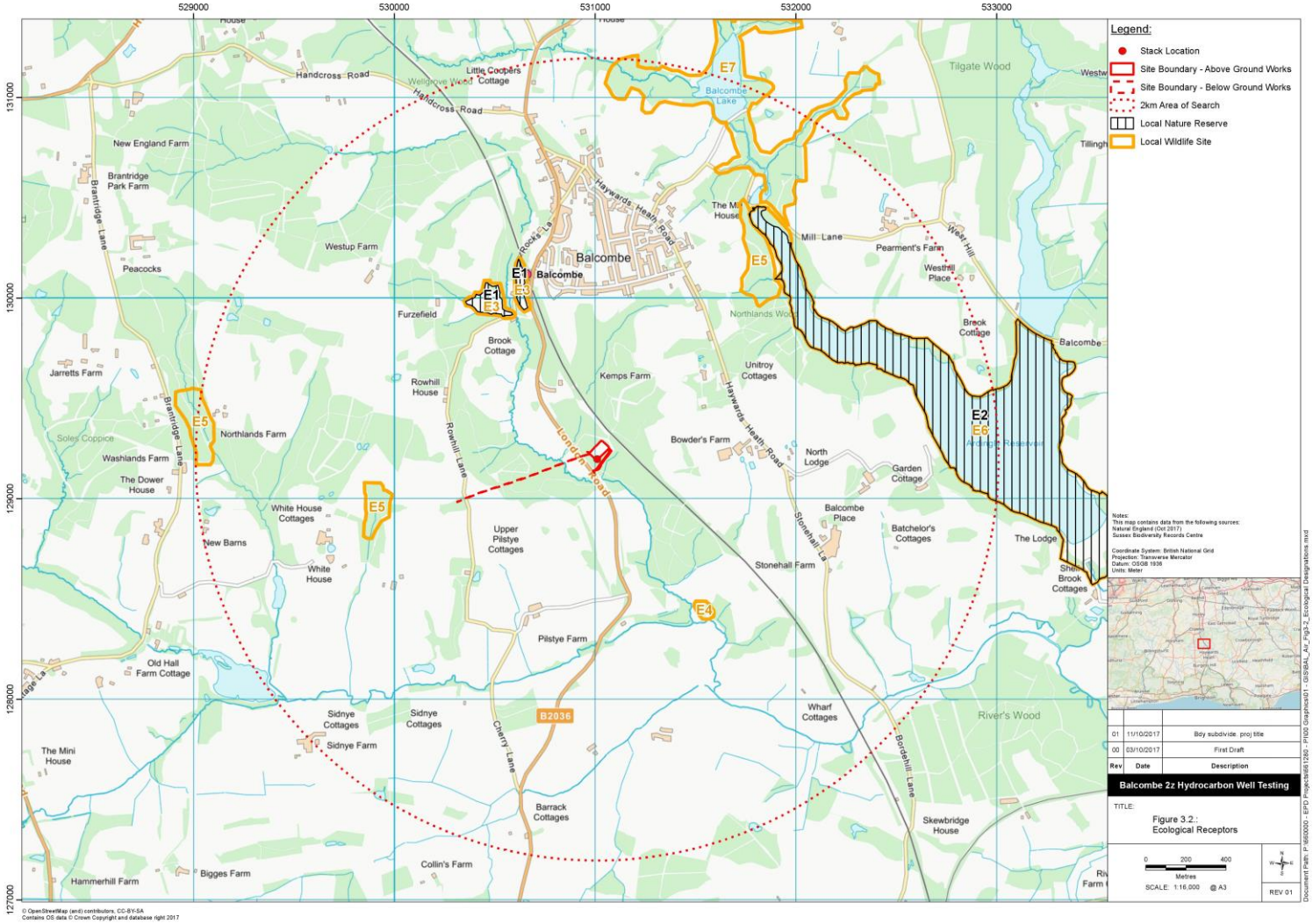


Figure 3.2: Proposed Site Location with Ecological Receptors



3.3.10 NO_x/NO_2 Chemistry

NO_x emitted to the atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO_2, which is of concern with respect to health and other impacts. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as O_3. The dispersion modelling exercise predicts concentrations of NO_x which subsequently require conversion to NO_2.

The conversion rate of NO_x to NO_2 used in this assessment followed Environment Agency guidance, as follows:

- Long-term: Predicted NO_2 annual average concentration = 70% of the predicted annual average NO_x concentration plus annual average background NO_2 concentration; and
- Short-term: Predicted NO_2 99.79th percentile of hourly average concentrations = 35% of the predicted 99.79th percentile of hourly average NO_x concentrations plus twice the annual average background NO_2 concentration.

3.3.11 Predicted Pollution Concentrations

The results of the dispersion modelling assessment are presented and discussed in Section 5.

Isopleths (i.e. pollution concentration contours), for the predicted annual and hourly mean NO_2, are presented in Annex C, for the meteorological year in which the maximum concentrations was modelled at any of the off-site discrete receptor locations.

3.3.12 Significance Criteria

The 2017 EPUK-IAQM guidance includes significance criteria which have been used for the operational phase assessment, as detailed within Annex A.

3.3.13 Nitrogen and Acid Deposition Calculations

Total annual mean NO_x concentrations and acid and nitrogen deposition rates, were calculated at discrete ecological receptor locations within Local Nature Reserves (LNRs) and LWSs within 2km of the proposed development site and SACs/SPAs within 10km. No SSSIs, ancient woods or National Nature Reserves were identified within 2km nor were any Ramsar sites identified within 10km of the proposed development site.

The broad habitat types identifiable at each identified ecological site were provided in consultation with the Project Ecological Consultants (RSK) and information available on the Air Pollution Information System (APIS) for the purpose of the nitrogen and acid deposition calculations. Where more than one habitat type was identified within each

ecological site, it has been assumed that the habitat most sensitive to the proposed development is represented at the modelled discrete receptor location, for a conservative assessment.

Background NO_x concentrations, the critical nitrogen deposition loading capacities, the nitrogen and sulphur acid deposition loading capacities, and background nitrogen and acid deposition rates, were obtained from the APIS website.

The total NO_x concentrations have been compared to the annual mean environmental quality standard (EQS). The nitrogen deposition process contributions (PCs) were compared to the applicable minimum deposition critical loads. The acid deposition process contributions (PCs) were compared to the critical load functions (dependent on the nitrogen and sulphur deposition loading capacities), using the "Critical Load Function tool" on the APIS website.

3.3.14 Operational Phase Discharge of Radon to Air

A precautionary approach has been adopted and the potential radiological exposure of members of the public resulting from the discharge of radon-222 gas (Rn-222) to atmosphere from the exploratory operations on the site.

Rn-222 will be a small component of the natural gas which will potentially travel to the surface during site operations and be discharged via the flare. Rn-222 is also a progeny of radium-226 (Ra-226) which will be present in the returned waters and could potentially de-gas being removed from the produced waters within phase separation equipment and be discharged from site via the flare.

Thoron-220 (Rn-220) gas will also be generated. However Rn-220 has a relatively short half-life and given the relatively low specific activity of the radium-228 (Ra-228) parent within the produced waters (relative to that of Ra-226), the radiological impact of this radionuclide (and its progeny) is anticipated as being negligible, and this has not been considered further within this assessment.

A radiological impact assessment has been undertaken which follows the Environment Agency's Initial Radiological Assessment Methodology, Part 1 User Report and Part 2 Methods and Input Data. The assessment considers the potential exposure of a local resident family, living in a dwelling 100m from the flare and consuming foodstuffs grown at distance of 500m from the flare. This represents a conservative assessment, as the closest residential receptor is nearly 350m from the proposed development site.

3.4 Uncertainties and Assumptions

The following uncertainties and assumptions were made in the air quality assessment:

- Estimated background data from the Defra LAQM website was used in the assessment for human receptors. A comparison with monitoring data for NO_2 results from the pre-drill environmental monitoring data, found the results to not

be dissimilar and use of Defra data at off-site receptor locations offered a more conservative approach;

- For ecological receptors, the APIS website was used to determine the estimated annual mean NO_x concentrations likely to be applicable at each of the ecological receptors locations. It is assumed that these background concentrations are likely to be applicable for the lifetime of the development;
- There will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that wind conditions measured at Gatwick Airport in 2012-2016 were representative of wind conditions at the site. Furthermore, it has been assumed that the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution in order to simplify the real-world dilution and dispersion conditions;
- Long-term emissions were modelled over the whole year, and the results multiplied by 1.9% for flare emissions and 23% for generator engine emissions to represent the duration of operation. This was considered more appropriate than applying a variable emissions profile, as it allows for meteorological conditions over the entire year to be appropriately captured.
- For assessing short-term impacts, these emission sources were assumed to be operating continuously throughout the year to capture the worst-case meteorological conditions that result in the maximum impact at the assessed receptor locations. Hourly NO_2 concentrations, 24-hour PM_{10} concentrations and 8-hour mean CO concentrations have been predicted for the 99.79^{th}, 90.4^{th} and 100^{th} percentile, respectively, assuming the plant is operational all hours of the year. In reality, the flare will operate for 7 days and the generators for up to 12 weeks and therefore the results presented are considered to be very conservative; and
- There is an element of uncertainty in all measured and modelled data. All values presented in this report are best possible estimates.

4 BASELINE AIR QUALITY CHARACTERISATION

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources. Baseline air quality data employed in this study have been obtained from data provided by MSDC, Cuadrilla and the LAQM Support website operated by Defra.

4.1 Local Authority Review and Assessment of Air Quality

As directed by the Environment Act 1995, local authorities are required to review and assess air quality with respect to the standards and objectives for the pollutants specified in the Government's National Air Quality Strategy (2007). Local Authorities are required to undertake annual reporting of the concentrations of defined pollutants in their area.

Where objectives are not predicted to be met, local authorities must declare an AQMA. In addition, local authorities are required to produce an AQAP, which outlines measures aimed at improving air quality within the designated AQMA. MSDC has declared one AQMA, but the site is not located within or near to the AQMA (the AQMA is nearly 14km south of the site).

4.2 Baseline Monitoring Data

A review of the monitoring data available from the MSDC 2017 Air Quality Annual Status Report shows there are no monitoring locations located in the vicinity of the site. The closest monitoring location is diffusion tube MSAQ6 Smugglers End Handcross, approximately 4.9km west of the site. The annual mean concentrations measured at MSAQ6 have consistently been below the UK Air Quality Strategy (AQS) objective between 2012 and 2016, with latest results for 2016 being 28.7µg/m^3.

In 2013, GGS carried out pre-drill environmental monitoring on behalf of Cuadrilla at and near to the site. This included air quality monitoring at two locations on the site itself (BALUW and BALDW) and one location off-site within a field immediately to the south of Newlands, Balcombe. Of relevance to the assessment presented within this report, the monitoring included NO_2 sampling using passive diffusion tube, as presented in Table 4.1. The monitoring was carried out for 25 days on-site and 24 days off-site no bias adjustment of the results was carried out, therefore it is not appropriate to compare this data with the annual mean objective for NO_2.

Table 4.1: Summary of Pre-Drill Monitoring Results for NO_2 in Ambient Air

Site ID	On-site or Off-site	Duration of Monitoring (days)	Measured NO_2 Concentration ($\mu g/m^3$)
BALUW	On-site	25	12.68
BALDW	On-site	25	8.55
BALAQSR01	Off-site	24	7.95

4.3 LAQM Background Data

An explanation of the source of the background data has been provided in section 3.3.8 of this assessment.

The background concentrations used within this assessment, and which are considered to represent the site and the nearby environs, are presented in Table 4.2. The study area falls into several grid squares and therefore an average of these background concentrations have been used to calculate concentrations across the modelled area for the pollution concentration contour plots presented in Annex C.

Background concentrations do not exceed the relevant annual average air quality objectives.

Table 4.2: LAQM Estimated Annual Average NO_2, PM_{10}, $PM_{2.5}$ (2017) and CO (2001) concentrations at the Proposed Development Site

Grid Square	Estimated Annual Average Background Pollutant Concentrations Derived from the LAQM Support website			
	Annual Average NO_2 ($\mu g/m^3$)	Annual Average PM_{10} ($\mu g/m^3$)	Annual Average $PM_{2.5}$ ($\mu g/m^3$)	Annual Average CO ($\mu g/m^3$)
530500, 129500	8.9	14.0	9.9	0.3
531500, 129500	8.8	13.6	9.7	0.3
530500, 128500	8.8	14.3	10.0	0.3
531500, 128500	8.8	13.8	9.8	0.3
531500, 130500	9.2	14.1	10.0	0.3
539500, 131500	8.5	13.5	9.6	0.2
Air Quality Objective	**40**	**40**	**25**	**10,000***
*Maximum daily running 8 hour mean				

5 ASSESSMENT OF IMPACTS

5.1 Operational Phase

5.1.1 Emissions to Air from Operational Phase Traffic

Cuadrilla has advised that the maximum traffic flows associated with the proposed development, in any one day, will be:

- 22 cars; and
- 23 Heavy Goods Vehicles (HGVs).

These flows are only predicted on one day, with traffic flows on the other operational days predicted to be lower.

Table 5.1 presents a comparison of the relevant EPUK-IAQM screening criteria for traffic generation and the traffic flows related to the proposed development. The traffic flows generated by the proposed development are well below the EPUK-IAQM screening criteria; therefore no significant impacts are expected and further assessment of the operational phase traffic is not required.

Table 5.1: Air Quality Screening Criteria from EPUK-IAQM Guidance and Comparison with the Proposed Development

EPUK-IAQM Screening Criteria	Comparison of proposed development to screening criteria
A change of Light Duty Vehicles (LDVs) of: – More than 500 Annual Average Daily Traffic (AADT)	**Criteria not exceeded:** The maximum daily car trip generated by the proposed development is estimated to be 22 car trips, well below 500 AADT.
A change of Heavy Duty Vehicles (HDVs) of: – More than 100 AADT	**Criteria not exceeded:** The maximum daily car trip generated by the proposed development is estimated to be 23 HGV trips, well below 500 AADT.

5.1.2 Operational Phase Emissions from Flaring and Generator Engines

The main potential impact of the proposed development is considered to be emissions from the proposed enclosed ground flare and the two generator engines on the sensitive receptors in the area surrounding the proposed development site. The results of the modelling exercise can be modelled in the following subsections.

5.1.2.1 Dispersion Modelling Results

Human Receptors

The predicted annual and hourly NO_2 concentrations, annual and 24-hour mean PM_{10}, annual mean $PM_{2.5}$ and maximum 8-hourly rolling mean carbon monoxide (CO) concentrations at each of the defined human receptor locations are presented below.

As noted earlier in section 3.3.3, the results have been compared against the AQS objectives for a conservative approach but the operating hours of the flare and generators mean that some AQS objectives not do strictly apply.

The contour plots, for predicted annual and hourly mean NO_2 concentrations are presented in Annex C, for the year in which the impacts were predicted to be largest at the discrete off-site receptor locations modelled.

Annual Mean Nitrogen Dioxide

The maximum predicted annual mean NO_2 concentrations resulting from the operation of the proposed development at each of the assessed discrete human receptor locations for any of the five meteorological data years are presented in Table 5.2.

The highest process contribution (PC) for annual mean NO_2 concentrations at the receptor locations, was predicted to be 0.22µg/m^3, at R2 (Kemps Farm 2). The highest total annual mean concentration was also predicted at R2 and was 9.15µg/m^3 which is well below the objective for annual mean NO_2 concentrations of 40µg/m^3. Therefore, no exceedances of the objective for annual mean NO_2 concentrations were predicted at any modelled receptor locations. A comparison of the results with the 2017 EPUK-IAQM criteria (see Annex A), shows are changes in pollutant concentrations (i.e. the PCs) are <1% and the impact on annual mean NO_2 concentrations is predicted to be negligible at all assessment receptors.

Table 5.2: Maximum Predicted Annual Mean NO_2 Concentrations at Discrete Human Receptors

Receptor ID	Receptor Description	Annual Mean NO_2 Concentration			
		PC	PC as % AQAL	Total Concentration	Total Concentration as % of AQAL
R1	Kemps Farm 1	0.14	0.4%	9.07	22.7%
R2	Kemps Farm 2	0.22	0.6%	9.15	22.9%
R3	Brook Cottage	0.07	0.2%	9.00	22.5%
R4	Holt's Cottages (24 Haywards Heath Road)	0.08	0.2%	8.90	22.2%
R5	Glebe's Farm	0.11	0.3%	8.92	22.3%
R6	Haywards Heath Road	0.12	0.3%	8.93	22.3%
R7	Bowders Farm	0.03	0.1%	8.85	22.1%
R8	Bowder's Cottage	0.05	0.1%	8.87	22.2%
R9	Norfolk Cottages	0.02	0.0%	8.94	22.4%
R10	Upper Pilstye Cottages	0.07	0.2%	8.86	22.1%
R11	Pilstye Farm	0.04	0.1%	8.83	22.1%
Air Quality Objective		40 µg/m^3			

Hourly Mean Nitrogen Dioxide

The maximum predicted 99.79th percentile of the hourly mean NO_2 concentrations resulting from the operation of the proposed development at each of the discrete human receptor locations for any of the five meteorological years (2012 – 2016) are presented in Table 5.3.

The highest PC for the 99.79th percentile of the hourly mean NO_2 concentrations at the receptor locations, was predicted to be 35.92µg/m^3 at R2. The total predicted annual mean concentration at R2 was 53.77µg/m^3 which is well below the objective for 1 hour mean NO_2 concentrations of 200µg/m^3. The PC at R2 is 18.0% of the relevant AQS objective which would be classed as a 'minor adverse' magnitude of change using the EPUK-IAQM criteria. However the 99.79th percentile results assume the plant (flare and two generators) are operational for an entire year as a worst-case scenarios, when in reality the flare will only operate for 7 days and only one generator is expected to be operational at any one time for a period of up to 12 weeks. Taking the conservative nature of the assessment into account and the total predicted concentrations which are well below the relevant objective, the impact on 1 hour mean NO_2 concentrations is considered to be of negligible significance.

Table 5.3: Maximum Predicted 99.79th Percentile of Hourly Mean NO_2 Concentrations at Discrete Human Receptors

Receptor ID	Receptor Description	99.79th Percentile 1 Hour Mean NO_2 Concentration			
		PC	PC as % AQAL	Total Concentration	Total Concentration as % of AQAL
R1	Kemps Farm 1	28.17	14.1%	46.02	23.0%
R2	Kemps Farm 2	35.92	18.0%	53.77	26.9%
R3	Brook Cottage	12.08	6.0%	29.93	15.0%
R4	Holt's Cottages (24 Haywards Heath Road)	9.03	4.5%	26.66	13.3%
R5	Glebe's Farm	9.21	4.6%	26.83	13.4%
R6	Haywards Heath Road	9.00	4.5%	26.62	13.3%
R7	Bowders Farm	5.89	2.9%	23.52	11.8%
R8	Bowder's Cottage	8.28	4.1%	25.90	13.0%
R9	Norfolk Cottages	3.89	1.9%	21.74	10.9%
R10	Upper Pilstye Cottages	8.33	4.2%	25.91	13.0%
R11	Pilstye Farm	6.69	3.3%	24.27	12.1%
Air Quality Objective		200 µg/m^3			

Annual Mean Particulate Matter

The maximum predicted annual mean PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the proposed development at each of the assessed discrete human receptor locations for any of the five meteorological data years are presented in Table 5.4.

The highest PC for annual mean PM_{10} and $PM_{2.5}$ concentrations at the receptor locations, was predicted to be 0.0026µg/m^3, at R2. The highest total annual mean PM_{10} and $PM_{2.5}$ concentrations were predicted at R10 and R11 and were 14.35µg/m^3 and 10.03µg/m^3 respectively, which are well below the relevant objectives. A comparison of the results with the 2017 EPUK-IAQM criteria (see Annex A), shows are changes in pollutant concentrations (i.e. the PCs) are imperceptible (i.e. <0.5%) and the impact on annual mean PM_{10} and $PM_{2.5}$ concentrations are predicted to be negligible at all assessment receptors.

Table 5.4: Maximum Predicted Annual Mean PM_{10} and $PM_{2.5}$ Concentrations at Discrete Human Receptors

Receptor ID	Annual Mean PM_{10} Concentration				Annual Mean $PM_{2.5}$ Concentration			
	PC	PC as % AQAL	Total Concentration	Total Concentration as % of AQAL	PC	PC as % AQAL	Total Concentration	Total Concentration as % of AQAL
R1	0.0017	0.0%	13.99	35.0%	0.0017	0.0%	9.86	39.4%
R2	0.0026	0.0%	13.99	35.0%	0.0026	0.0%	9.86	39.5%
R3	0.0008	0.0%	13.99	35.0%	0.0008	0.0%	9.86	39.4%
R4	0.0010	0.0%	13.63	34.1%	0.0010	0.0%	9.69	38.7%
R5	0.0012	0.0%	13.63	34.1%	0.0012	0.0%	9.69	38.7%
R6	0.0014	0.0%	13.63	34.1%	0.0014	0.0%	9.69	38.7%
R7	0.0004	0.0%	13.63	34.1%	0.0004	0.0%	9.68	38.7%
R8	0.0006	0.0%	13.63	34.1%	0.0006	0.0%	9.68	38.7%
R9	0.0002	0.0%	13.99	35.0%	0.0002	0.0%	9.86	39.4%
R10	0.0008	0.0%	14.35	35.9%	0.0008	0.0%	10.03	40.1%
R11	0.0005	0.0%	14.35	35.9%	0.0005	0.0%	10.03	40.1%
Air Quality Objective	40 µg/m^3				25 µg/m^3			

24 Hour Mean Particulate Matter

The maximum predicted 90.4th percentile of the 24 hour mean PM_{10} concentrations resulting from the operation of the proposed development at each of the discrete human receptor locations for any of the five meteorological years (2012 – 2016) are presented in Table 5.5.

The highest PC for the 90.4th percentile of the 24 hour mean PM_{10} concentrations at the receptor locations, was predicted to be 0.033µg/m^3 at R2. The total predicted annual mean concentration at R2 was 14.02µg/m^3 which is well below the objective for 24 hour mean PM_{10} concentrations of 50µg/m^3. A comparison of the results with the 2017 EPUK-IAQM criteria (see Annex A), shows are changes in pollutant concentrations (i.e. the PCs) are imperceptible (i.e. <0.5%) and the impact on 24 hour mean PM_{10} concentrations is predicted to be negligible at all assessment receptors.

Table 5.5: Maximum Predicted 90.4th Percentile of 24 Hour Mean PM_{10} Concentrations at Discrete Human Receptors

Receptor ID	Receptor Description	90.4th Percentile 24 Hour Mean PM_{10} Concentrations			
		PC	PC as % AQAL	Total Concentration	Total Concentration as % of AQAL
R1	Kemps Farm 1	0.018	0.0%	14.00	28.0%
R2	Kemps Farm 2	0.033	0.1%	14.02	28.0%
R3	Brook Cottage	0.009	0.0%	14.00	28.0%
R4	Holt's Cottages (24 Haywards Heath Road)	0.013	0.0%	13.64	27.3%
R5	Glebe's Farm	0.019	0.0%	13.65	27.3%
R6	Haywards Heath Road	0.020	0.0%	13.65	27.3%
R7	Bowders Farm	0.006	0.0%	13.63	27.3%
R8	Bowder's Cottage	0.010	0.0%	13.64	27.3%
R9	Norfolk Cottages	0.002	0.0%	13.99	28.0%
R10	Upper Pilstye Cottages	0.014	0.0%	14.36	28.7%
R11	Pilstye Farm	0.005	0.0%	14.35	28.7%
Air Quality Objective		50 µg/m3			

8-Hour Mean Carbon Monoxide

The maximum predicted 8-hour rolling mean CO concentrations resulting from the operation of the proposed development at each of the discrete human receptor locations for any of the five meteorological years (2012 – 2016) are presented in Table 5.6.

The highest PC for the 8 hour-rolling mean CO concentrations at the receptor locations, was predicted to be 14.80µg/m^3 at R2. The total predicted annual mean concentration at R2 was 15.31µg/m^3 which is well below the objective for 8 hour-rolling mean CO concentrations of 10,000µg/m^3. A comparison of the results with the 2017 EPUK-IAQM criteria (see Annex A), shows are changes in pollutant concentrations (i.e. the PCs) are imperceptible (i.e. <0.5%) and the impact on 8 hour mean CO concentrations is predicted to be negligible at all assessment receptors.

Table 5.6: Maximum Predicted 8-hour Mean CO Concentrations at Discrete Human Receptors

Receptor ID	Receptor Description	8 Hour Mean CO Concentrations			
		PC	PC as % AQAL	Total Concentration	Total Concentration as % of AQAL
R1	Kemps Farm 1	14.00	0.1%	14.51	0.1%
R2	Kemps Farm 2	14.80	0.1%	15.31	0.2%
R3	Brook Cottage	6.60	0.1%	7.11	0.1%

Receptor ID	Receptor Description	8 Hour Mean CO Concentrations			
		PC	PC as % AQAL	Total Concentration	Total Concentration as % of AQAL
R4	Holt's Cottages (24 Haywards Heath Road)	4.32	0.0%	4.83	0.0%
R5	Glebe's Farm	5.47	0.1%	5.98	0.1%
R6	Haywards Heath Road	4.63	0.0%	5.14	0.1%
R7	Bowders Farm	3.55	0.0%	4.06	0.0%
R8	Bowder's Cottage	4.85	0.0%	5.36	0.1%
R9	Norfolk Cottages	4.23	0.0%	4.74	0.0%
R10	Upper Pilstye Cottages	3.56	0.0%	4.06	0.0%
R11	Pilstye Farm	3.40	0.0%	3.90	0.0%
Air Quality Objective		10,000 µg/m^3			

Ecological Receptors

There is currently no official guidance or significance criteria available for determination of impacts on ecological receptors and the EPUK-IAQM guidance notes it should not be applied for impacts on designated nature conservation sites.

Annual Mean NO_x Concentrations

Table 5.7 presents the maximum annual mean NO_x concentrations predicted at the designated ecological sites considered in the assessment, for any of the meteorological years (2012 -2016).

The annual mean NO_x objective of 30µg/m^3 was met at all ecological receptor assessed. The highest maximum PC is 0.20µg/m^3, predicted at E5 Balcombe Estate Rocks to the northeast of the proposed development. The PCs at all of the ecological receptors are <1% of the AQS objective and impacts are considered to be negligible.

Table 5.7: Maximum Predicted Annual Mean NO_x Concentrations at Designated Ecological Sites

Receptor ID	Receptor Description	Annual Mean NO_x Concentration				
		Background NO_x Concentration (µg/m^3)	PC (µg/m^3)	Total Concentration (µg/m^3)	PC as % Objective	Total Concentration as % of Objective
E1	Rowhill Copse LNR	23.4	0.11	0.4%	12.69	42.3%
E2	Ardingly Reservoir LNR	23.4	0.12	0.4%	12.54	41.8%
E3	Rowhill and Station Pastures LWS	23.4	0.11	0.4%	12.69	42.3%
E4	Balcombe Marsh LWS	14.6	0.06	0.2%	12.39	41.3%

Receptor ID	Receptor Description	Annual Mean NO_x Concentration				
		Background NO_x Concentration ($\mu g/m^3$)	PC ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	PC as % Objective	Total Concentration as % of Objective
E5	Balcombe Estate Rocks LWS	23.4	0.20	0.7%	13.21	44.0%
E6	Ardingly Reservoir and Loder Valley Nature Reserve LWS	23.4	0.12	0.4%	12.54	41.8%
E7	Balcombe Lake and Associated Woodlands LWS	23.4	0.15	0.5%	13.16	43.9%
E8	Ashdown Forest SAC	15.1	0.00	0.0%	11.89	39.6%
Air Quality Objective		30µg/m^3				

Nitrogen Deposition

Results obtained from the dispersion modelling have been used to calculate nitrogen deposition at each ecological receptor location within the assessment for 2012 meteorological data (as the highest NO_x PC results were predicted at E5 for 2012); results are summarised in Table 5.8.

It is noted that, existing background deposition exceeds the lower critical loads for all the assessed ecological sites (except E4), without the operation of the proposed development. However, the PC to nitrogen deposition are predicted to be minimal, with the highest PC of 0.039 kgN/ha/yr predicted at E5; this equates to 0.17% of the lower critical load for this site. Therefore, the operation of the proposed development is considered to have had a minimal contribution to nitrogen deposition at the sensitive ecological sites and no significant impacts are predicted.

Acid Deposition

The results obtained from the dispersion modelling have been used to calculate acid deposition and then input into the Critical Load Function Tool provided on the APIS website along with the critical load data for the habitat; results are presented in Table 5.9. The PC and predicted environmental concentration (PEC) generated by the proposed development have been presented as a percentage of the relevant critical load function.

The PC to acid deposition are predicted to be minimal, with the highest PC of 0.0028 keq/ha/yr predicted at E5 and total PECs are all below the critical loads. Therefore, the operation of the proposed development is considered to have had a minimal contribution to acid deposition at the sensitive ecological sites and no significant impacts are predicted.

Table 5.8: Nitrogen Deposition Contribution at Nearby Ecological Sites

Receptor ID	Receptor Location	Broad Habitat Type	Critical Load Range kg N/ha/yr	PC (kg N/ha/yr)	Total N Deposition keq/ha-yr	Process Contribution as a % of lower critical load	PC as a % of background Deposition Rate
E1	Rowhill Copse	Broadleaved, Mixed and Yew Woodland	10-20	0.015	23.4	0.15	0.06
E2	Ardingly Reservoir	Broadleaved, Mixed and Yew Woodland	10-20	0.025	23.4	0.25	0.11
E3	Rowhill and Station Pastures	Broadleaved, Mixed and Yew Woodland	10-20	0.015	23.4	0.15	0.06
E4	Balcombe Marsh	Fen, Marsh and Swamp: Rich fen	15-30	0.011	14.6	0.07	0.07
E5	Balcombe Estate Rocks	Broadleaved, Mixed and Yew Woodland	10-20	0.039	23.4	0.39	0.17
E6	Ardingly Reservoir and Loder Valley Nature Reserve	Broadleaved, Mixed and Yew Woodland	10-20	0.025	23.4	0.25	0.11
E7	Balcombe Lake and Associated Woodlands	Broadleaved, Mixed and Yew Woodland	10-20	0.030	23.4	0.30	0.13
E8	Ashdown Forest	Northern Atlantic wet heath	10-20	0.001	15.1	0.01	0.00

Table 5.9: Acid Deposition Contribution at Nearby Ecological Sensitive Sites

Receptor ID	Receptor Location	Broad Habitat Type	Background S Deposition (keq/ha-yr)	Background N Deposition (keq/ha-yr)	CLmaxS	CLMinN	CLMaxN	PC as a % of critical load function	Process Environmental Contribution as a % of critical load function
E1	Rowhill Copse	Broadleaved, Mixed and Yew Woodland	0.240	1.670	2.752	0.357	3.109	0.0	61.4
E2	Ardingly Reservoir	Broadleaved, Mixed and Yew Woodland	0.240	1.670	2.961	0.142	3.103	0.0	61.6
E3	Rowhill and Station Pastures	Broadleaved, Mixed and Yew Woodland	0.240	1.670	2.752	0.357	3.109	0.0	61.4
E4	Balcombe Marsh	Fen, Marsh and Swamp: Rich fen	0.21	1.04	This habitat is not sensitive to acidity				
E5	Balcombe Estate Rocks	Broadleaved, Mixed and Yew Woodland	0.26	1.67	2.961	0.142	3.103	0.0	62.2
E6	Ardingly Reservoir and Loder Valley Nature Reserve	Broadleaved, Mixed and Yew Woodland	0.240	1.670	2.961	0.142	3.103	0.0	61.6
E7	Balcombe Lake and Associated Woodlands	Broadleaved, Mixed and Yew Woodland	0.26	1.67	2.961	0.142	3.103	0.0	62.2
E8	Ashdown Forest	Northern Atlantic wet heath: Dwarf Shrub Heath	0.24	1.08	0.96	0.499	1.459	0.0	90.5

5.1.3 Operational Phase Discharge of Radon to Air

During the exploratory phase, the flow testing and associated flaring of the single well site, the assessment assumed the following parameters:

- Natural gas will be flared to a predicted estimation of 35,000 m^3 for 7 days, i.e. approximately 5000 m^3 per day;
- Natural gas contains Rn-222 at a specific activity concentration of 200 Bq/m^3;
- Therefore, a total of 7 MBq Rn-222 is estimated to be carried with the natural gas and discharge from the flare over the 7 day period;
- The well site would generate approximately 82 m^3 of produced water;
- Produced water contains Ra-226 at a specific activity concentration of 113 Bql^{-1};
- Assumed 100% of the Rn-222 produced from decay of the potential Ra-226 of the produced waters is discharged from the site as an aerial release, which equates to 9.27MBq of Rn-222; and
- A release height of 13.72m was used to represent the height of the flare and the appropriate scaling factor of 0.12 was taken from the Environment Agency guidance.

Based on the above parameters and using the Environment Agency initial radiological assessment methodology, the assessment estimates that a member of a local resident family living 100m from the flare could potentially receive an effective dose of 0.0005µSv/yr as a result of hypothetical discharge. The estimated exposure is well below the maximum dose constraint of 300 µSv/yr for a single source and the statutory dose limit of 1000 µSv/yr. Therefore the impact from discharge of radon to air is considered to be insignificant.

5.1.4 Significance of Impacts Identified

As identified above:

- There are no predicted exceedances of the annual and short-term mean AQSs for NO_2, PM_{10}, $PM_{2.5}$ or CO at any of the discrete off-site modelled human receptor locations and the impacts on these pollutant concentrations are considered to be negligible;
- The impacts on background concentrations of annual mean NO_x concentrations, nitrogen and acid deposition at the designated ecologically sensitive sites are considered to be negligible; and
- The potential radiological exposure of the public in relation to radon gas is found to be of negligible significance.

Following the EPUK & IAQM guidance and in light of the above, the air quality impact is not considered to be significant.

6 MITIGATION MEASURES & RESIDUAL IMPACTS

6.1 Operational Phase

As this assessment has determined that the operational phase impacts on air quality are not significant, additional mitigation measures have not been recommended and the residual impacts are considered to be acceptable.

7 CONCLUSIONS

An air quality assessment of a proposed hydrocarbon well testing at Lower Stumble Hydrocarbon Exploration Site off London Road, near Balcombe has been undertaken with reference to existing air quality in the area and relevant air quality legislation, policy and guidance.

The proposed development will not generate a significant amount of traffic once operational, therefore using EPUK-IAQM guidance, the impact of operational phase traffic on local air quality have been considered to be negligible.

The main potential air quality impact once the proposed development is operational is considered to be emissions from the proposed flare and generator engines. An assessment of operational impacts has been undertaken using AERMOD, an advanced atmospheric dispersion model developed for regulatory purposes, with the use of meteorological data measured between 2012 and 2016 at the Gatwick airport weather station. Concentrations of key air pollutants (NO_x, NO_2 PM_{10}, $PM_{2.5}$ and CO) have been predicted at discrete receptor locations.

The highest predicted impacts at the modelled off-site discrete receptor locations in any of the five meteorological years have been reported and compared to the relevant AQS objectives. There were no predicted exceedances of any of the AQS objectives for human or ecological at the modelled discrete receptor locations in any of the modelled meteorological years.

In order to assess the potential impact of increases in pollutant concentrations attributable to the proposed development on existing sensitive receptors, the results have been interpreted using the 2017 EPUK-IAQM guidance. The proposed development was found to have negligible impact on all pollutant concentrations assessed.

The proposed development was also assessed as having a minimal impact at the ecologically sensitive sites, with regards to nitrogen and acid deposition, and ambient annual mean NO_x concentrations.

An initial radiological impact assessment found no significant impacts in relation to radon gas from the operation of the site and potential exposure of members of the public.

The assessment has concluded that the air quality impact of the proposed development is considered as not significant. As this assessment has determined that the operational phase impacts on local air quality are not significant, additional mitigation measures

have not been recommended and the residual impacts are considered to be acceptable.

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ANNEX A
OPERATIONAL IMPACT ASSESSMENT METHODOLOGY

This appendix contains the methodology used in the assessment for the operational impact assessment to include reference to the 2017 EPUK-IAQM guidance.

The significance of impacts can be determined using professional judgement. This judgement should be based on the magnitude of effects identified at each receptor. The magnitude of impacts for long-term annual mean NO_2 concentrations can be derived by the percentage of change in pollutant concentration relative to an Air Quality Assessment Level (AQAL) and long term average pollutant concentration predicted at the receptor, as presented in Table A1.

Table A1: 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 less of AQAL	Negligible	Negligible	Slight	Moderate
79 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
103 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

To assess the magnitude of impacts at each receptor with regards to short-term changes in concentrations, the following method is recommended:

- Process contribution is 10 to 20% of air quality standard or objective – small magnitude;
- Process contribution is 21 to 50% of air quality standard or objective – medium magnitude; and
- Process contribution is greater than 50% of air quality standard or objective – large magnitude.

The EPUK/IAQM guidance notes that the criteria in Table A1 and above should be used to describe impacts at individual receptors and should only be considered as a starting point to make a judgement on significance of effects, as other influences may need to be accounted for. The EPUK/IAQM guidance states that the assessment of overall significance should be based on professional judgement, taking into account several factors, including:

- The existing and future air quality in the absence of the development;
- The extent of current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

ANNEX B - WINDROSES

This appendix contains the windroses for the Gatwick Airport Station from 2012 to 2016.

Figure B1 Windrose for the Gatwick Airport Station – 2012

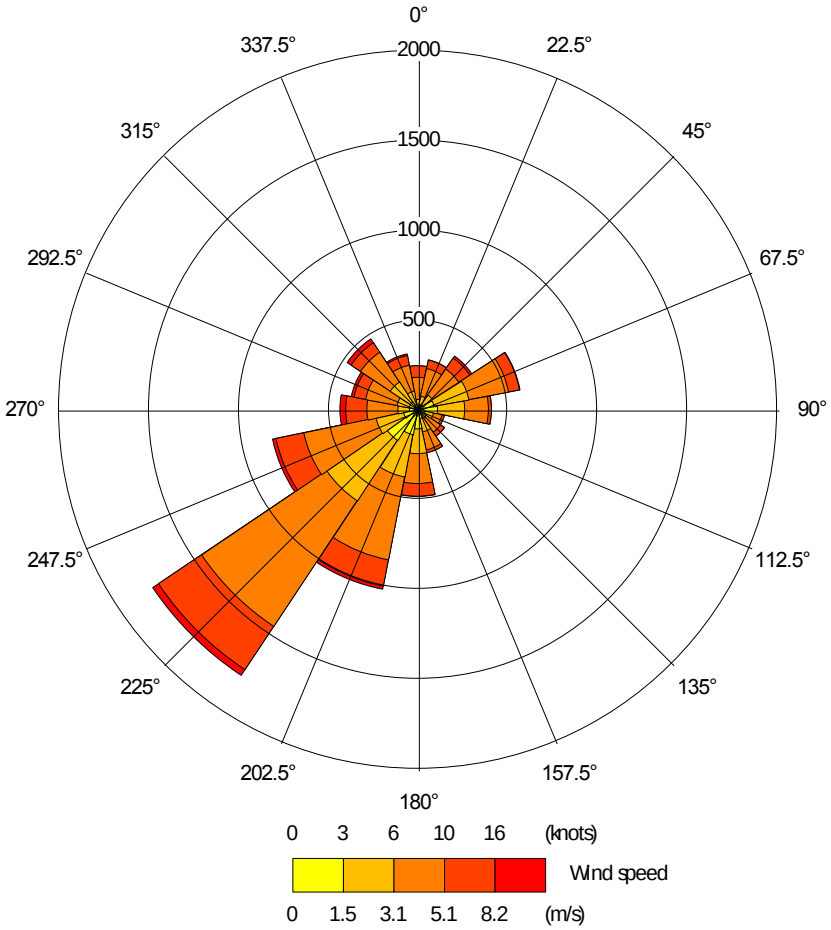


Figure B2 Windrose for the Gatwick Airport Station – 2013

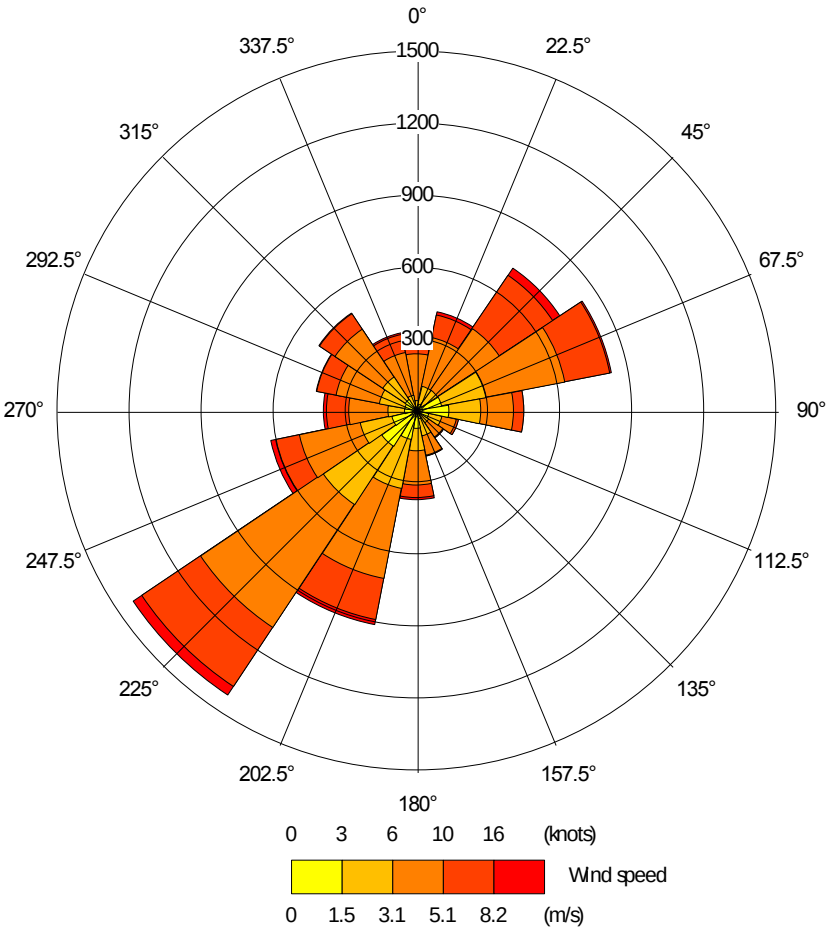


Figure B3 Windrose for the Gatwick Airport Station – 2014

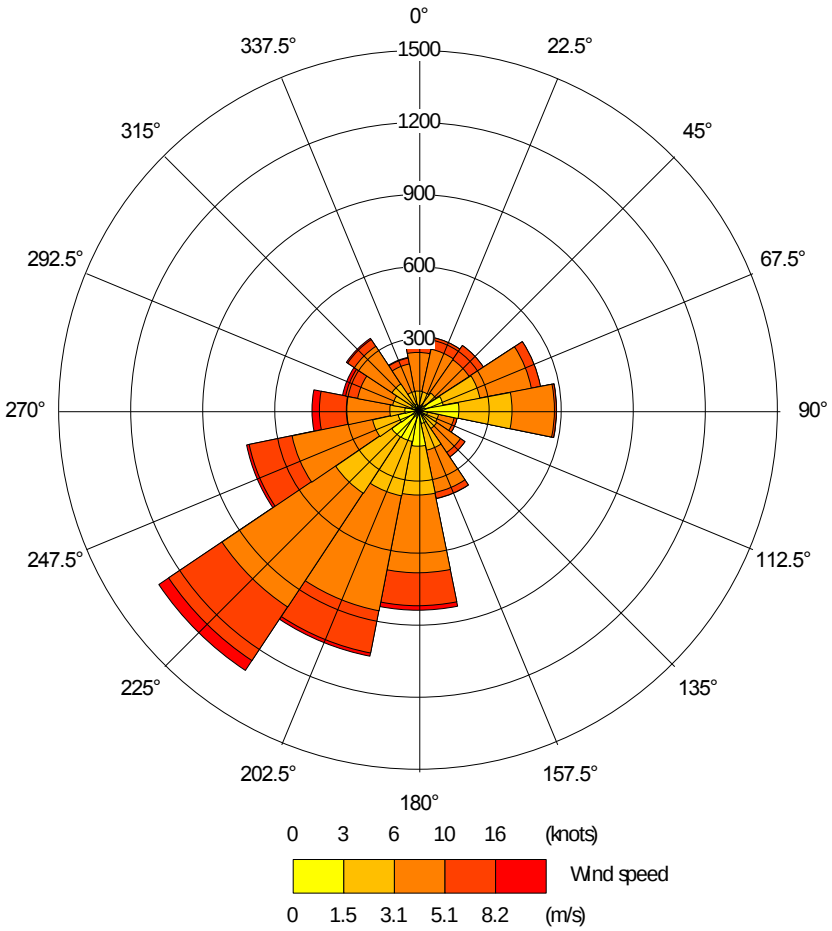


Figure B4 Windrose for the Gatwick Airport Station – 2015

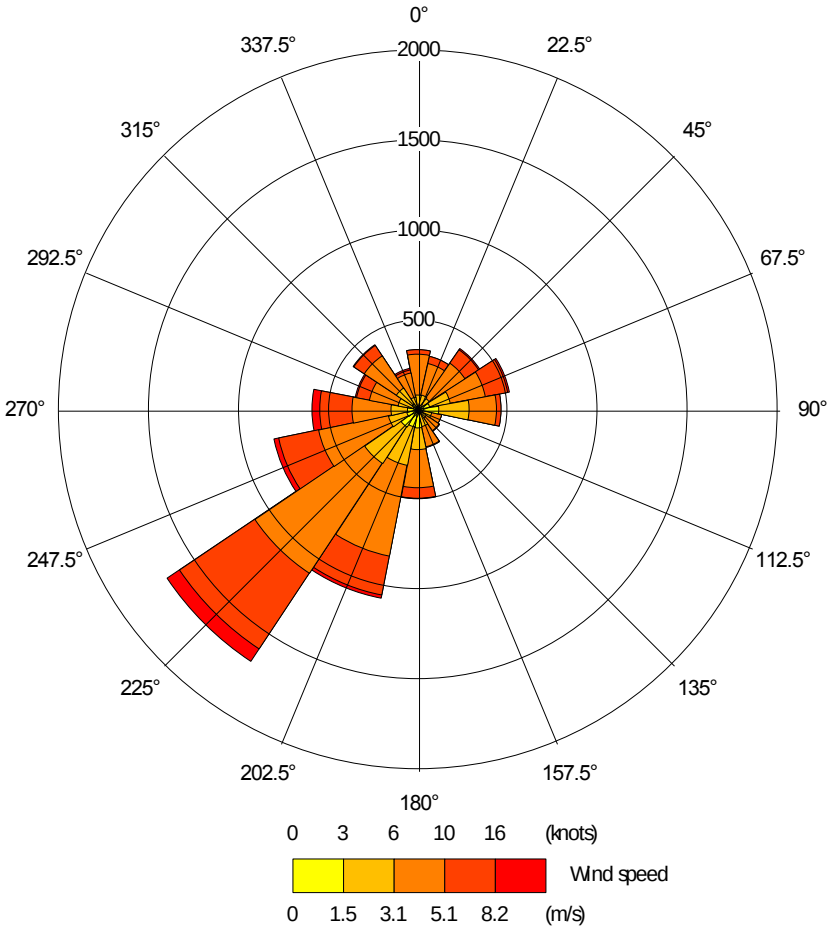
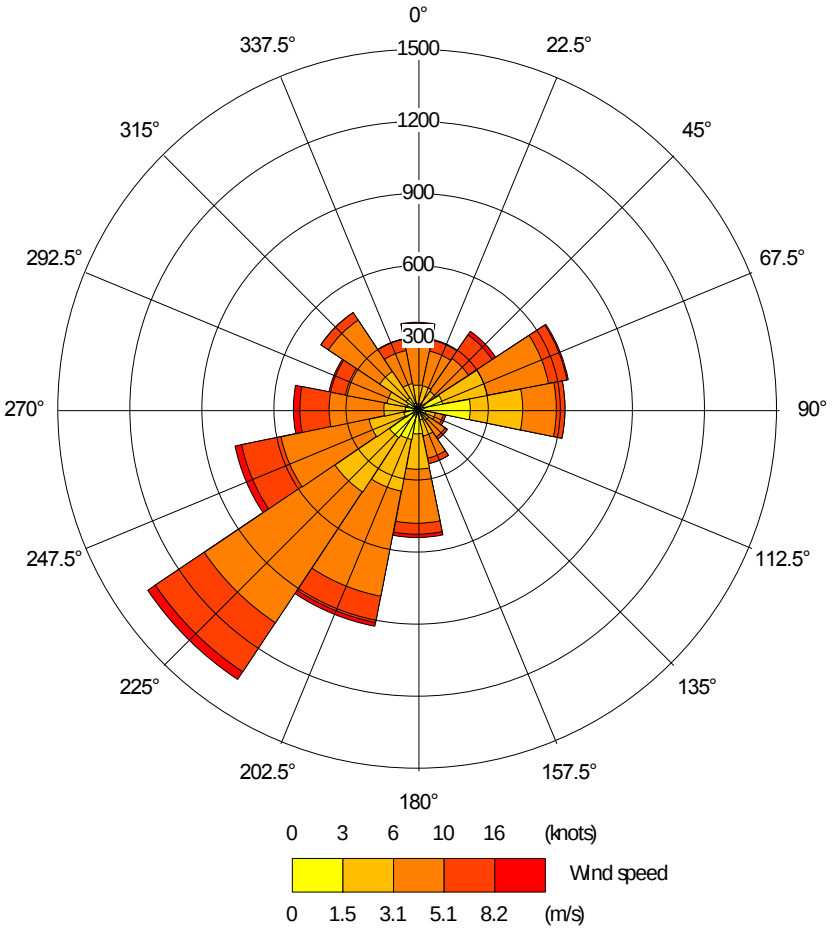


Figure B5 Windrose for the Gatwick Airport Station – 2016



ANNEX C
CONTOUR PLOTS SHOWING PREDICTED NO_2 CONCENTRATIONS

This annex contains contour plots (isopleths) illustrating the total predicted NO_2 concentrations (i.e. process contribution and background concentrations) when the proposed development is operational. The data is based on the meteorological data year which achieved the worst predicted pollutant concentrations for a conservative assessment.

Figure C1 Predicted Annual Average NO_2 Concentrations (µg/m^3) including Background Concentration (2014 meteorological year)

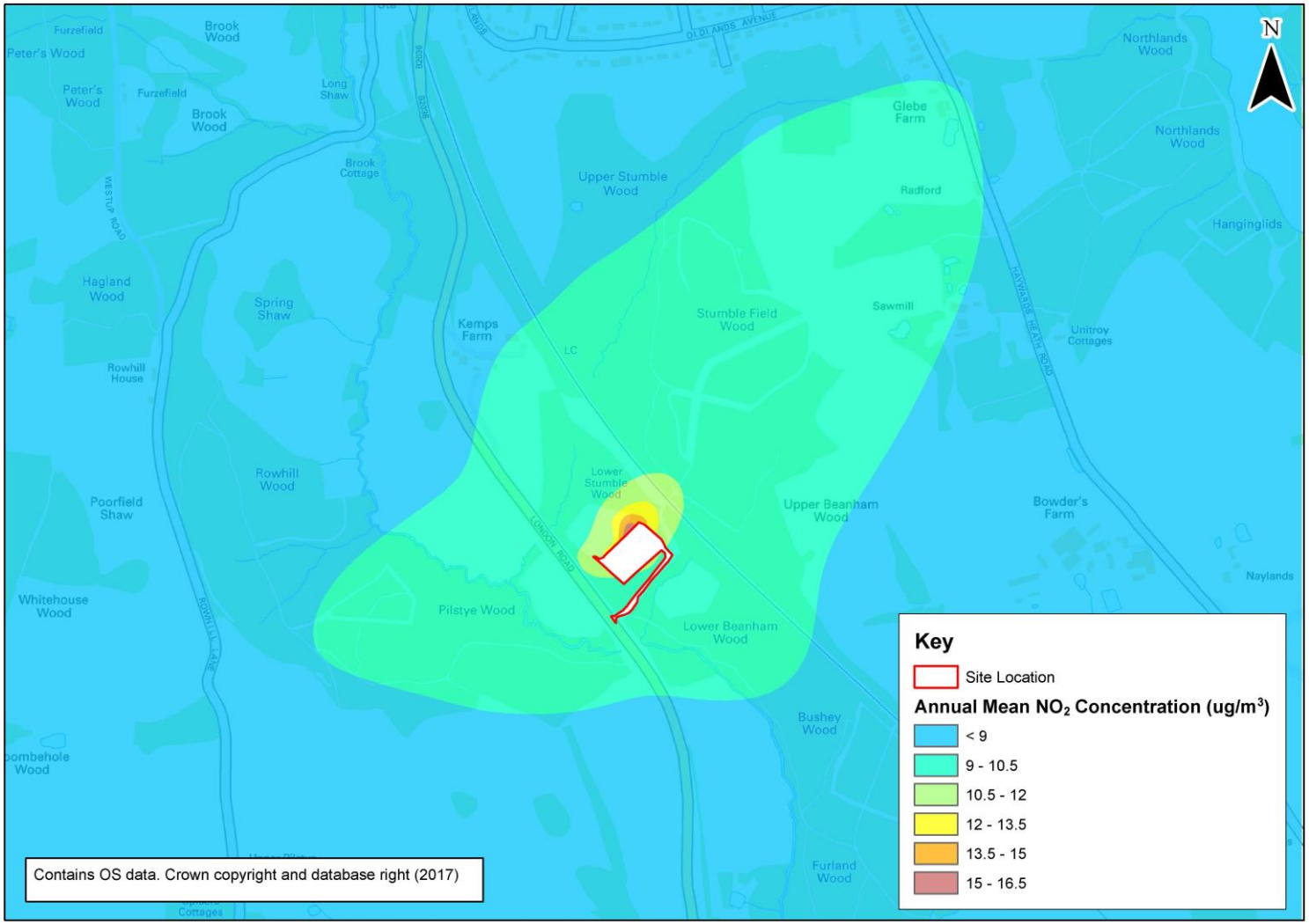


Figure C2 Predicted 99.79th Hourly NO_2 Concentrations (µg/m^3) including Background Concentration (2014 meteorological year)