

Ford Airfield – Air Quality Cumulative Impacts.

1. Introduction.

The maximum predicted pollutant concentrations from the proposed development at Ford Airfield and the consented Grundon Waste Management Facility at the Ford Circular Technology Park (Planning Ref: WSCC/096/13/F) have been assessed to determine the potential for significant cumulative impacts on proposed receptors at the Ford Airfield development and existing receptors in the vicinity of the Site.

2. Predicted Impacts.

2.1 Ford Airfield.

The maximum concentrations predicted as a result of the traffic associated with the proposed development at Ford Airfield are as set out below (see Tables 18, 21, 25, 26 and 27 of *Hoare Lea, Land at Ford Airfield, Ford, West Sussex, Air Quality Assessment, Revision 7, dated 19 December 2019*; the 'Hoare Lea Report – Appendix 1)). The maximum predicted concentration in Scenario 6 (2030) are marginally higher than those under Scenario 3 (2024). All predicted concentrations have been rounded to one decimal place.

Scenarios 3 and 6 are described in the Hoare Lea Report as:

Scenario 3: Opening year 'with development' (predicted traffic flows in 2024, inclusive of anticipated growth and committed developments, as well as traffic associated with the full build out of the proposed Ford Airfield development and the proposed secondary school plus sixth form adjacent to the Site).

Scenario 6: Future year 'with development' (predicted traffic flows in 2030, inclusive of anticipated growth and committed developments in line with the end of the Local Plan, as well as traffic associated with the full build out of the proposed Ford Airfield development and the proposed secondary school plus sixth form adjacent to the Site).

Predicted annual mean concentrations for Scenario 6 have been used in this cumulative impact assessment and are as follows:

Existing Receptors (maximum at receptor)

- NO₂ – 30.2 µg/m³ (R44 on Lyminster Road, Littlehampton)
- PM₁₀ – 18.9 µg/m³ (R45 Worthing Road, Littlehampton)
- PM_{2.5} – 12.6 µg/m³ (R45 Worthing Road, Littlehampton)

Proposed Receptors (PR1 on Yapton Road)

- NO₂ – 16.7 µg/m³
- PM₁₀ – 16.0 µg/m³
- PM_{2.5} – 10.3 µg/m³

The background concentrations are low, with the maximum background concentrations at the proposed Ford Airfield development in 2017 being 10.1 µg/m³ for NO₂, 14.9 µg/m³ for PM₁₀ and 9.6 µg/m³ for PM_{2.5} (see Table 7 of the Hoare Lea Report). These concentrations are forecast to reduce in the future as a result of UK Government and EU policies and legislation to reduce pollutant emissions¹.

2.2 Grundon Waste Treatment Facility.

The maximum NO₂, PM₁₀ and PM_{2.5} concentrations due to the emissions from the Grundon Waste Treatment Facility have been taken from *Fichtner Consulting Engineers Limited, Grundon Waste Management Limited*,

¹ Defra (2018) Local Air Quality Management Technical Guidance (TG16) – [online] (Last Accessed: 05/11/2020) Available at: <https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf>

Circular Technology Park, Ford, Air Quality Assessment, dated 19 September 2013 (the 'Fichtner Report' – Appendix 2), submitted with the planning application (WSCC/096/13/F). Table 9.1 in the Fichtner Report provides the dispersion modelling results. All predicted concentrations have been rounded to one decimal place.

The maximum ground level annual mean concentrations predicted from the facility (i.e. the process contribution), as detailed in Table 9.1 of the Fichtner Report, are as follows:

- NO₂ – 2.0 µg/m³
- PM₁₀ – 0.2 µg/m³
- PM_{2.5} – 0.2 µg/m³

3. Cumulative Impacts

The sum of the maximum predicted concentrations from both the proposed Ford Airfield development and the consented Grundon Waste Management Facility gives the following pollutant concentrations:

- NO₂ – 32.2 µg/m³
- PM₁₀ – 19.1 µg/m³
- PM_{2.5} – 12.8 µg/m³

These are all well below the annual mean objectives of 40 µg/m³ for NO₂ and PM₁₀, and 25 µg/m³ for PM_{2.5}.

The maximum cumulative impact for NO₂ is 2.0 µg/m³ as detailed in Table 9.4 of the Fichtner Report. Using the EPUK/IAQM matrix as presented in Table 1 of the Hoare Lea Report, a potential maximum predicted concentration of 32.2 µg/m³ would be described as a slight adverse impact.

In reality, however, the maximum annual mean NO₂ concentration from the consented Grundon Waste Management Facility is not predicted to coincide with the worst case receptors at the proposed Ford Airfield development. These are predicted to occur in Littlehampton near the A259/A284 junction.

In the areas where there are existing receptors and where Figure A.4 of the Fichtner Report shows an impact greater than 1% of the air quality objective, the concentrations predicted in 2024 and 2030 with the proposed Ford Airfield development in place are below the air quality objective of 40 µg/m³ (see Table 16 for 2024 and Table 18 for 2030 of the Hoare Lea Report). When the impacts of the proposed Ford Airfield development and the consented Grundon Waste Management Facility are combined in the relevant area, NO₂ concentrations are predicted to be well below 30 µg/m³. This is the 'with development' concentration in the EPUK/IAQM matrix (Table 1 of the Hoare Lea Report) where there may start to be an adverse impact at a receptor.

Therefore it can be concluded that there will not be a significant cumulative impact from the proposed Ford Airfield Development with anticipated traffic growth, committed developments, the proposed secondary school plus sixth form adjacent to the Site and the consented Grundon Waste Management Facility.

At the proposed receptors, taking into account the Grundon Waste Management Facility, the annual mean NO₂, PM₁₀ and PM_{2.5} concentrations will well below the objectives and therefore there will be no adverse cumulative impact on these receptors.

It should be noted that the short term NO₂ objective is unlikely to be exceeded if the annual mean objective is achieved. For PM₁₀ the opposite is true: i.e. the short term objective is more difficult to achieve than the annual mean. However, the short term objective is unlikely to be exceeded where the annual mean concentration is less than 31.5 µg/m³. The PM₁₀ concentrations are predicted to be significantly below this value. There is no short term objective for PM_{2.5}.

4. Other Pollutants.

Table 9.1 of the Fichtner Report provides the maximum predicted environmental concentrations for all the pollutants likely to be emitted from the consented Grundon Waste Management Facility. This shows that the relevant air quality assessment levels will be achieved for all pollutants considered.

5. Conclusion.

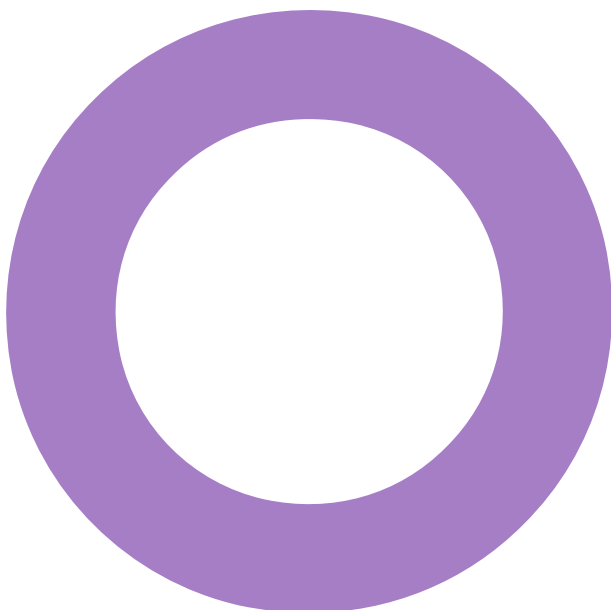
Based on the above analysis, it can be concluded that there will not be a significant cumulative impact on existing receptors or on the proposed receptors at the proposed Ford Airfield development due to the traffic associated with the proposed development, other committed developments, the potential secondary school plus sixth form, anticipated traffic growth in the area and the consented Grundon Waste Management Facility.

Appendix 1.

**Land at Ford Airfield.
Ford, West Sussex.**
**Redrow Homes Southern and
Wates Developments Ltd.**

AIR QUALITY
AIR QUALITY ASSESSMENT

REVISION 07 – 19 DECEMBER 2019



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	27/11/2018	First draft	MS/AD	CH	CR
02	06/12/2018	Second draft	MS/AD	CH	CR
03	11/12/2018	Final draft	MS/AD	CH	CR
04	14/05/2019	Update to ES following change in proposals	CS	CR	CR
05	22/07/2019	Update following finalisation of Masterplan	CS	CR	CR
06	24/10/2019	First Issue	CS	CR	CR
07	19/12/2019	Second issue following update to Site area	CS	CR	CR

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Project number: 1010431

Document reference: REP-1010502-5A-20191219-Ford Airfield AQ-R7

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Executive summary

Redrow Homes Southern and Wates Developments Ltd has appointed Hoare Lea to undertake a detailed air quality impact assessment in support of a of a planning application for a proposed mixed-use development on land at Ford Airfield in order to predict the potential impacts on existing and new receptors as a result of the proposals. The site lies within the administrative authority of Arun District Council and West Sussex County Council.

A qualitative construction dust assessment has been completed in accordance with Institute of Air Quality Management (IAQM) Guidance. Mitigation of construction dust will be required for the scheme and this is typically agreed through provision of a Construction Environmental Management Plan (or equivalent).

Dispersion modelling was also undertaken in order to predict pollutant concentrations across the proposed site as a result of emissions from the local road network. The results indicated that pollutant levels across the site were below the relevant air quality standards and as such, the location is considered suitable for the proposed end use without the inclusion of mitigation measures. Furthermore, the assessment concluded that impacts on existing air quality as a result of the operation of the proposed development were predicted to be negligible at all sensitive receptor locations.

Based on the assessment results, the Proposed Development does not conflict with any national or local planning policy and as such, air quality issues are not considered a constraint to planning consent.

1. Introduction

This air quality assessment has been produced in order to predict the potential impacts associated with the construction and operational phases on existing and future sensitive receptors as a result of a proposed mixed-use development on land at Ford Airfield.

1.1 Development Description

The Site is located within the administrative boundary of Arun District Council (ADC). The village of Ford is located immediately to the north-east of the site, with the villages of Climping and Yapton located to the immediate south-east and west, respectively. The town of Littlehampton is located approximately 1.5km to the east of the site while Bognor Regis is located approximately 2km to the south-west.

The Site extends to 86.63 hectares (ha) and predominantly comprises an area of land formerly used as an airfield. Large areas of the Site now comprise agricultural fields, separated by hedgerows and trees.

The proposals comprise the development of up to 1,500 dwellings (Use Class C3), 60-bed care home (Use Class C2), up to 9,000 sqm of employment floorspace (Use Classes B1), local centre of up to 2,350 sqm including up to 900 sqm retail / commercial (Use Classes A1-A5) and 1,450 sqm community / leisure floorspace (Use Classes D1-D2), land for a two-form entry primary school (Use Class D1), public open space, allotments, new sports pitches and associated facilities, drainage, parking and associated access, infrastructure, landscape, ancillary and site preparation works, including demolition of existing buildings and part removal of existing runway hardstanding

1.2 Report Context

Due to the size of the proposals, an air quality assessment is required to assess the potential for air quality impacts as a result of emissions associated with the construction and operational phases of the Proposed Development on existing and future sensitive receptors. This report has therefore been produced to determine baseline conditions, consider the site suitability for the proposed end-use and provide consideration of potential effects as a result of the proposals.

1.3 Scope

The scope of this assessment has been agreed with the local authority and is limited to the prediction of air quality and dust impacts associated with the construction and operation of the Proposed Development. It draws on existing information to determine whether this is likely to be significant.

1.4 Objectives

The objectives of the assessment are therefore as follows:

- To review current air quality in the area;
- To identify and assess air quality impacts during the construction phase;
- To identify and assess air quality impacts during the operational phase (e.g. additional traffic);
- To assess the significance of these impacts;
- To identify the potential for exposure of future residents to poor air quality; and
- To identify further options for mitigation where required.

1.5 Copyright notice:

Unless otherwise noted, all OS drawings used in this report are subject to Crown copyright and database rights 2019 Ordnance Survey.

2. Assessment Methodology

A staged approach has been adopted; this ensures that the approach taken for the assessment of risk is proportional to the risk of an unacceptable impact being caused. As such, where a simple review of the situation shows that the risk of a health or disamenity impact is negligible, this will be sufficient. In cases where the risk cannot be regarded as insignificant, a more detailed assessment may be required, such as a quantitative screening assessment or an advanced dispersion modelling exercise.

The assessment methodology was agreed with Mr Colin Giddings, Senior Environmental Health Officer at Arun District Council in May 2018. The following sections outline the methodology utilised throughout the assessment.

The assessment of the potential impacts on air quality and the significance of the effects of these impacts requires professional judgement. The experience of those involved in the preparation of the assessment are provided in Appendix A.

2.1 Dust Assessment

Given the requirement for construction activities, there is a potential risk for the generation of dust. For such operations the common concern regarding dust emissions is their potential disamenity effect.

A qualitative risk-screening assessment of the dust generation potential of the construction phase has been carried out using the method detailed in the 2016 Institute of Air Quality Management (IAQM) document '*Assessment of dust from demolition and construction v1.1*'.

2.2 Traffic Exhaust Emissions Impact Assessment

The development has the potential to affect existing air quality as a result of road traffic exhaust emissions associated with vehicles travelling to and from the Site. Potential impacts have been defined by predicting nitrogen dioxide (NO₂), particulate matter (PM) with an aerodynamic diameter of less than 10µm (PM₁₀), and PM with an aerodynamic diameter of less than 2.5 µm (PM_{2.5}) concentrations at relevant locations using dispersion modelling for the following scenarios:

- **Scenario 0:** Model verification;
- **Scenario 1:** Opening year 'without development' (predicted traffic flows in 2024, inclusive of anticipated growth and committed developments, should the proposals not proceed);
- **Scenario 2:** Opening year 'with development' (predicted traffic flows in 2024, inclusive of anticipated growth and committed developments, as well as traffic associated with the full build out of the development);
- **Scenario 3:** Opening year 'with development' (predicted traffic flows in 2024, inclusive of anticipated growth and committed developments, as well as traffic associated with the full build out of the development and the proposed secondary school plus sixth form adjacent to the site);
- **Scenario 4:** Future year 'without development' (predicted traffic flows in 2030, inclusive of anticipated growth and committed developments in line with the end of the Local Plan, should the proposals not proceed);
- **Scenario 5:** Future year 'with development' (predicted traffic flows in 2030, inclusive of anticipated growth and committed developments in line with the end of the Local Plan, as well as traffic associated with the full build out of the development); and
- **Scenario 6:** Future year 'with development' (predicted traffic flows in 2030, inclusive of anticipated growth and committed developments in line with the end of the Local Plan, as well as traffic associated with the full build out of the development and the proposed secondary school plus sixth form adjacent to the site).

Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 4.1.1.0).

The predicted impacts have been assessed against the relevant air quality objectives (AQOs) and are described for individual receptors using the criteria in the Environmental Protection UK/IAQM guidance, as presented in Table 1.

Table 1: Significance Criteria for Annual NO₂ and PM₁₀

Concentration at Receptor in Assessment Year	Predicted Concentration Change as Percentage of Air Quality Objective (AQO) (%)			
	1	2 - 5	6 - 10	> 10
75% or less of AQO	Negligible	Negligible	Slight	Moderate
76 - 94% of AQO	Negligible	Slight	Moderate	Moderate
95 - 102% of AQO	Slight	Moderate	Moderate	Substantial
103 - 109% of AQO	Moderate	Moderate	Substantial	Substantial
110% or more of AQO	Moderate	Substantial	Substantial	Substantial

The overall significance of the predicted impact is determined by using professional judgement taking into account a range of factors including:

- 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

2.3 Future Exposure Risk Assessment

The proposed development has the potential to expose future users to poor air quality. In order to assess NO₂, PM₁₀ and PM_{2.5} concentrations across the site, dispersion modelling was undertaken.

Results were compared with the relevant AQOs to determine the potential for exposure of future residents to poor air quality.

3. Regulatory Standards and Guidance

3.1 European Legislation

European air quality legislation is consolidated under Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidates previous legislation which was designed to deal with specific pollutants in a consistent manner and provides new air quality limit and targets values for fine particulate matter (PM_{2.5}).

3.2 UK Legislation

3.2.1 Air Quality Standards

Current EU Air Quality limit values defined within the Directive have been transposed into UK legislation in the Air Quality Standards Regulations 2010, Statutory Instrument 2010 No. 1001.

3.2.2 Air Quality Strategy

The Air Quality Strategy (UKAQS) 2007 for England, Scotland, Wales and Northern Ireland sets out the Government's policies aimed at delivering cleaner air in the UK. It sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency, local government, business, individuals and transport have in protecting and improving air quality.

The Air Quality Strategy defines 'standards' and 'objectives' in paragraph 17:

"For the purposes of the strategy:

standards are the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive subgroups or on ecosystems;

objectives are policy targets often expressed as a maximum ambient concentration not to be exceeded, either without exception or with a permitted number of exceedances, within a specified timescale."

The air quality objectives considered within this air quality assessment are presented within Table 3.1. It should be noted that the AQOs have the same numerical values as the EU limit values.

Table 2: Air Quality Limit Objective (AQOs)

Pollutant	Concentration	Measured as	Equivalent percentile
NO ₂	40µg/m ³	Annual mean	-
	200µg/m ³	1-hour mean	99.79 th percentile of 1-hour-means (equivalent to 18 1-hour exceedances)
PM ₁₀	40µg/m ³	Annual mean	-
	50µg/m ³	24-hour mean	90.41 th percentile of 24-hour-means (equivalent to 35 24-hour exceedances)
PM _{2.5}	25 µg/m ³	Annual mean	-

In accordance with statutory DEFRA technical guidance for Local Air Quality Management (LAQM(TG16)), the air quality objectives should be assessed at locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective.

A summary of relevant exposure for the objectives presented in Table 2 are shown below in Table 3.

Table 3: Relevant Public Exposure

Objective Averaging Period	Relevant Locations	Objectives should apply at:	Objectives should not apply at:
Annual mean	Where individuals are exposed for a cumulative period of 6 months in a year;	Building facades of residential properties, schools, hospitals etc	Facades of offices Hotels Gardens of residences Kerbside sites
24-hour mean	Where individuals may be exposed for eight hours or more in a day	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure is expected to be short term
1-hour mean	Where individuals might reasonably be expected to spend one hour or longer	As above together with kerbside sites of regular access, car parks, bus stations etc	Kerbside sites where public would not be expected to have regular access

3.3 Local Authority Air Quality Review and Assessment

Local Authorities (LAs), including ADC, have statutory duties to control air quality through a combination of Local Air Quality Management (LAQM) and by use of their wider planning policies.

Under Section 82 of the Environment Act 1995 (Part IV), LAs are required to periodically review and assess air quality within their area of administration under the system of LAQM. This review and assessment involves assessing present and likely future air quality against the AQOs. If it is predicted that levels at the façade of buildings, in the instance of annual mean concentrations, where members of the public are regularly present are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

The results of ADC's Review and Assessment of air quality are summarised in Section 4.3.1

3.4 National Planning Policy

The National Planning Policy Framework (NPPF) 2019 sets out planning policy for England. It includes advice on when air quality should be a material consideration in development control decisions. Relevant sections are set out below:

Paragraph 170:

“Planning policies and decisions should contribute to and enhance the natural and local environment by: preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality”

Paragraph 180:

“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development”.

Paragraph 181:

“Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality

Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

Paragraph 183:

"The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities."

Paragraph 54:

"Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition."

The NPPF is supported by Planning Practice Guidance (PPG)ⁱ.

The PPG states that:

Paragraph 001 (Reference ID: 32-001-20140306):

"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values. It is important that the potential impact of new development on air quality is taken into account in planning where the national assessment indicates that relevant limits have been exceeded or are near the limit."

Paragraph 005 (Reference ID: 32-005-20140306):

"Whether or not air quality is relevant to a planning decision will depend on the Proposed Development and its location. Concerns could arise if the development is likely to generate an air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)."

The PPG also sets out the information that may be required in an air quality assessment, stating that:

Paragraph 007 (Reference ID: 32-007-20140306):

"Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality, and because of this are likely to be locationally specific."

It also provides guidance on options for mitigating air quality impacts, and makes clear that:

Paragraph 008 (Reference ID: 32-008-20140306):

"Mitigation options where necessary will be locationally specific, will depend on the Proposed Development and should be proportionate to the likely impact."

3.5 Local Planning Policy

The Arun Local Plan 2011-2031 sets out the planning framework for the district for the period between 2011 and 2031.

Policy QE DM3 Air Pollution of the Local Plan refers to air quality:

"All major development proposals will be required to assess the likely impacts of the development on air quality and mitigate any negative impacts by:

- a. Ensuring the development is located within easy reach of established public transport services;
- b. Maximising provision for cycling and pedestrian facilities;
- c. Encouraging the use of cleaner transport fuels on site, through the inclusion of electric car charging points; and
- d. Contributing towards the improvement of the highway network where the development is predicted to result in increased congestion on the highway network.

Development proposed nearby any Air Quality Management Area (AQMA) declared within the District within the Plan period, will require an air quality assessment to identify likely impacts of development upon the designated area. Developers will be required to ensure delivery of the actions set out within any Air Quality Action Plan.

Industrial development which is regulated by environmental permits (that creates or results in dust, smell, fumes, smoke, heat, radiation, gases, steam or other forms of pollution) must be located in such a position which ensures that the health, safety and amenity of users of the site or surrounding land is not put at risk and the quality of the environment would not be damaged or put at risk.

Developments shall also be consistent with all other Local Plan policies."

This policy has been considered throughout this air quality assessment.

3.6 Sussex Air Quality Guidance

Air quality and emissions mitigation guidance for Sussex (2013) was developed by members of the Sussex Air Quality Partnership (Sussex-air). The guidance supports the principles of the partnership to improve air quality across Sussex and encourage emissions reductions to improve the environment and health of the population.

The stated purpose of this guidance is to:

- 'Provide a Sussex-wide approach for assessing potential air quality impacts from development and transport related emissions and provide a consistent approach to mitigating those impacts'; and
- 'Provide technical advice to local planning authorities on how to deal with planning applications that could have an impact on air quality'.

This guidance includes an air quality screening checklist however as an air quality assessment has been requested, this is not required. The guidance also outlines mitigation options but is currently under review.

4. Site Setting

The following sections provide detail of the location of the site and the surrounding topography and receptors.

4.1 Site Location

The Site is 86.63 hectares in size and is located to the south-west of Ford. The Proposed Development location predominantly comprises an area of land formerly in use as an airfield. Large areas of the site now comprise agricultural fields, separated by hedgerows and trees. The surrounding typology represents a mix of residential, commercial and light industrial properties, as well as agricultural land uses.

4.2 Receptors

In relation to the Ford Airfield site, the key receptors will be:

- Construction dust: Local residential buildings, persons parking in the vicinity of the Site;
- Existing receptors: residents of near-by properties, occupiers of residences alongside road links used by Site traffic and local schools; and
- New receptors: Occupiers of the new residential properties.

Representative existing receptors were identified from a desk-top study. These are summarised in Table 4, below.

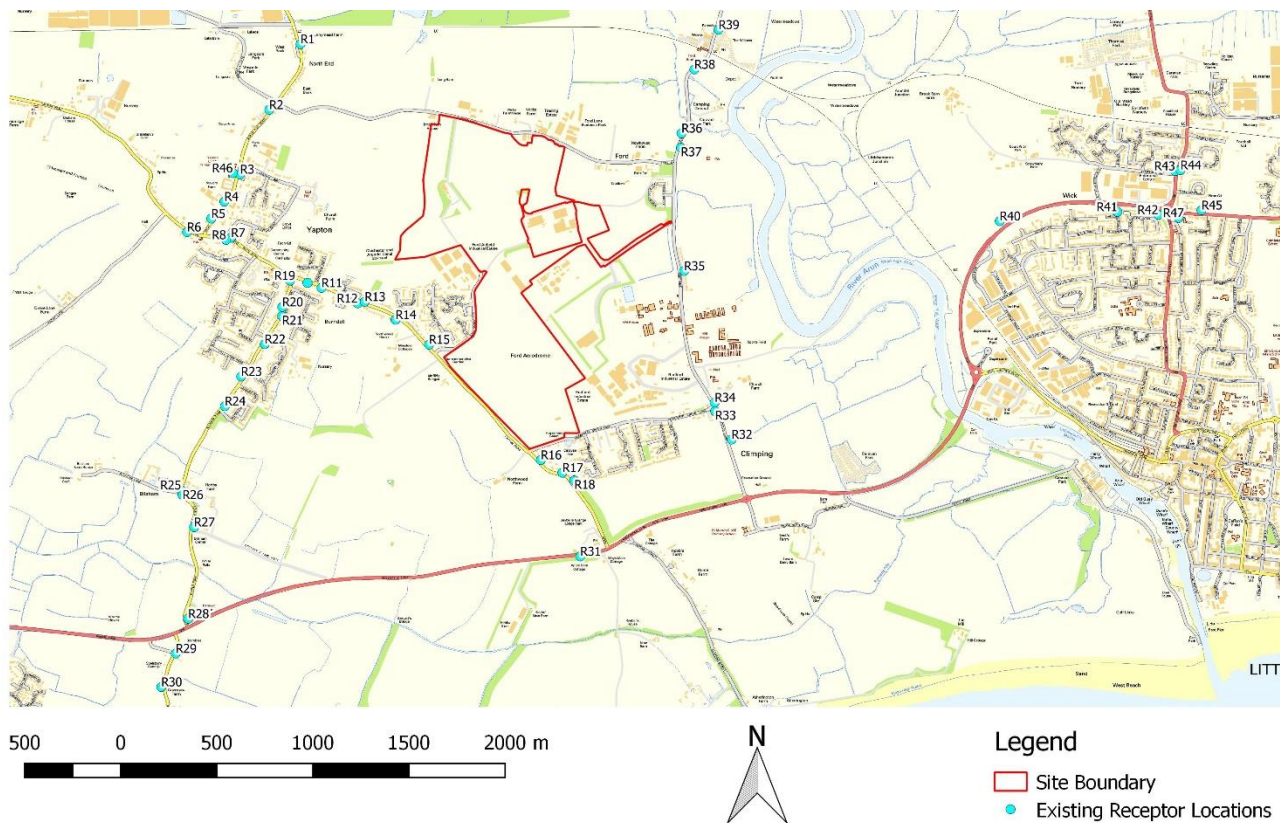
Table 4: Road Traffic Emissions – Existing Sensitive Receptors

Receptor Location		Ordnance Survey Grid Reference (m)	
		X	Y
R1	Residential - North End Road	498132.8	104303.0
R2	Residential - North End Road	497969.6	103961.2
R3	Residential - North End Road	497818.4	103625.3
R4	Residential - North End Road	497736.2	103483.6
R5	Residential - North End Road	497667.8	103394.9
R6	Residential - Main Road	497542.0	103324.8
R7	Residential - Main Road	497771.0	103295.5
R8	Residential - Main Road	497744.9	103284.2
R9	Residential - Main Road	498074.6	103086.8
R10	Residential - Burndell Road	498168.8	103060.1
R11	Residential - Burndell Road	498241.8	103034.6
R12	Residential - Burndell Road	498430.3	102954.0
R13	Residential - Burndell Road	498466.4	102962.3
R14	Residential - Burndell Road	498627.1	102868.6
R15	Residential - Burndell Road	498801.4	102739.3
R16	Residential - Yapton Road	499383.3	102138.8
R17	Residential - Yapton Road	499495.5	102072.3
R18	Residential - Yapton Road	499557.5	102032.4
R19	Residential - Bilsham Road	498077.6	103072.3

Receptor Location		Ordnance Survey Grid Reference (m)	
		X	Y
R20	Residential - Bilsham Road	498037.5	102934.6
R21	Residential - Bilsham Road	498036.7	102886.9
R22	Residential - Bilsham Road	497945.9	102741.6
R23	Residential - Bilsham Road	497823.3	102572.9
R24	Residential - Bilsham Road	497738.6	102418.5
R25	Residential - Bilsham Road	497510.8	101981.9
R26	Residential - Bilsham Road	497518.4	101957.0
R27	Residential - Bilsham Road	497578.2	101789.0
R28	Residential - Bilsham Road	497547.9	101312.3
R29	Residential - Yapton Road	497483.1	101131.4
R30	Residential - Yapton Road	497407.7	100957.2
R31	Residential - Apple Barn Cottage	499588.2	101637.0
R32	Residential - Church Lane	500375.9	102245.4
R33	Residential - Church Lane	500290.8	102392.5
R34	Residential - Church Lane	500288.3	102438.0
R35	Residential - Church Lane	500128.8	103122.4
R36	Residential - Station Road	500115.6	103839.0
R37	Residential - Station Road	500112.2	103763.8
R38	Residential - Ford Lane	500182.5	104171.3
R39	Residential - Ford Lane	500308.1	104377.9
R40	Residential - Henry Lock Way	501771.8	103381.9
R41	Residential - Willow Brook	502384.5	103429.7
R42	Residential - Colebrook Road	502596.9	103414.5
R43	Residential - Lyminster Road	502685.0	103642.5
R44	Residential - Lyminster Road	502712.7	103647.1
R45	Residential - Worthing Road	502822.1	103438.5
R46	Yapton Primary School	497780.3	103631.9
R47	Lyminster Primary School	502703.2	103398.9

Existing sensitive receptor locations are shown on the Figure 1 below.

Figure 1: Road Traffic Emissions – Existing Sensitive Receptors



The Proposed Development also has the potential to introduce new sensitive receptors into an area of poor air quality and therefore a number of proposed sensitive receptor locations have been included within this assessment, utilising the Masterplan (Ref: 23885 - RG-M-78E – Illustrative Master Plan-(1-2500@A1)) to determine locations where there is the potential for elevated pollutant concentrations i.e. adjacent to the road network. These are summarised in Table 5 and shown on Figure 2 below.

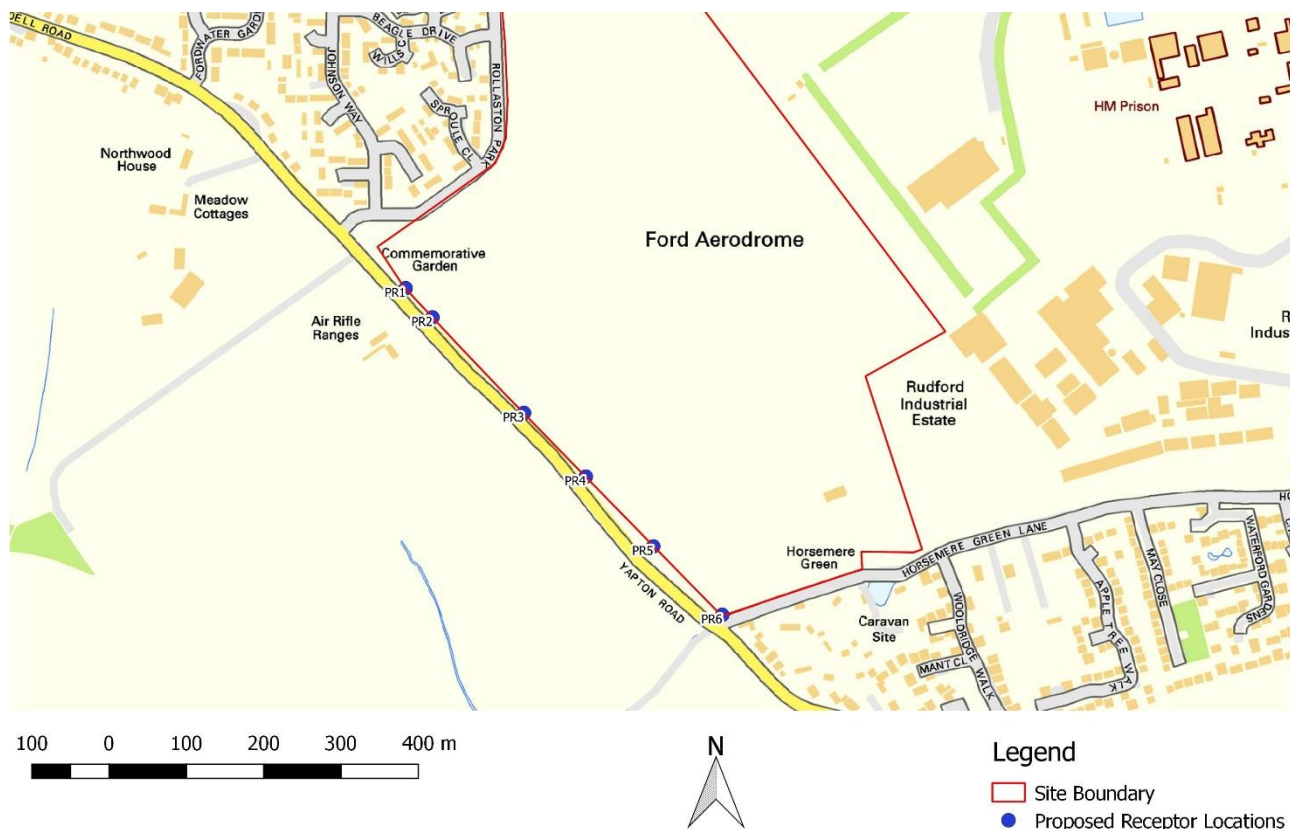
Table 5: Road Traffic Emissions – Proposed Sensitive Receptors

Proposed Receptor Location		Ordnance Survey Grid Reference (m)	
		X	Y
PR1	Proposed Residential Receptor	498929.4	102627.5
PR2	Proposed Residential Receptor	498962.3	102589.1
PR3	Proposed Residential Receptor	499102.8	102493.5
PR4	Proposed Residential Receptor	499163.7	102391.4
PR5	Proposed Residential Receptor	499259.7	102307.7
PR6	Proposed Residential Receptor	499343.1	102267.8

The proposed residential receptors identified above are located along the south eastern boundary of the Site adjacent to Yapton Road. It is noted that the Proposed Development comprises a school as well as other residential units in other parts of the Site however the receptors identified above are the closest to the surrounding road network for which traffic data is available and are therefore considered to be the worst case

locations on the Site. Furthermore, these receptor locations will be an overestimation of the concentrations experienced across the Site as concentrations reduce with distance from the source.

Figure 2: Road Traffic Emissions – Proposed Sensitive Receptors



4.3 Existing Baseline Conditions

4.3.1 Local Authority Review and Assessment

As required under Section 82 of the Environment Act (1995) (Part IV), ADC has conducted an ongoing exercise to review and assess air quality within their area of administration. This process, as reported in the ADC 2018 Annual Status Report, has indicated that concentrations of all Air Quality Strategy pollutants were below the relevant AQOs at locations of relevant public exposure, and as such no AQMAs have been declared within the Council's administrative area.

4.3.2 Monitoring

During 2017 ADC operated a network of 15 NO₂ diffusion tube locations. A summary of recent NO₂ monitoring results from the monitoring locations with most relevance to the Site is presented within Table 6, below.

Table 6: NO₂ Diffusion Tube Monitoring Results

Monitoring Location	Monitored NO ₂ Concentration (µg/m ³)		
	2015	2016	2017
2 - Litt02	25.8	24.4	25.3
3 - Yap03	12.9	12.9	16.9
4 - Litt04	16.1	22.9	27.1

Monitoring Location	Monitored NO ₂ Concentration (µg/m ³)		
	2015	2016	2017
8 - Ford08	17.1	16.6	18.5

Table 6 indicates that the annual mean AQO of 40µg/m³ was achieved at all monitoring locations during recent years. ADC do not undertake PM₁₀ monitoring within the vicinity of the Site.

4.3.3 Background Air Quality

Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK and assist local authorities in their Review and Assessment of air quality.

Mapped background concentrations of NO₂, PM₁₀ and PM_{2.5} were downloaded for grid squares x499500, y102500 and x499500, y103500, which represent the southern and northern parts of the Site, respectively, for the base year (2017), opening year (2024) and a future year (2030). This data is presented in Table 7, below.

Table 7: Estimated Annual Mean Background Concentrations

Grid Square	Pollutant	Predicted Concentrations (µg/m ³)		
		2017	2024	2030
499500, 102500	NO ₂	10.07	8.01	7.17
	PM ₁₀	14.91	13.84	13.84
	PM _{2.5}	9.60	8.70	8.70
499500, 103500	NO ₂	10.46	8.71	8.05
	PM ₁₀	14.95	13.88	13.88
	PM _{2.5}	9.53	8.63	8.63

As detailed above, the background concentrations are well below the objectives for all three pollutants in both grid squares.

5. Dust Assessment

This dust assessment has been undertaken in accordance with the IAQM document 'Assessment of dust from demolition and construction v1.1'.

The construction phases are broken down into four different activities with the potential to generate dust:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

5.1 STEP 1: Screening

There are human receptors located within 50m of the boundary of the site and 50m of the route(s) used by construction vehicles. There are however no notable ecological receptors close to the development site.

According to the IAQM Dust Guidance the risk cannot therefore be regarded as 'negligible' and an assessment is required.

5.2 STEP 2a: Dust Emission Magnitude

5.2.1 Demolition

There are no existing buildings on Site which will require demolition prior to construction of the new buildings. As such, there are no potential dust emissions associated with demolition activities.

5.2.2 Earthworks

The total Site area is greater than 10,000m² and there may be the requirement for material movement from Site during operations. However, the Site itself is over 1.7km long (north to south) and the risk of dust impact will therefore only be greatest when works are closest to existing properties on the western and southern boundaries, for example. The phasing of the development proposals may mean the introduction of new receptors within the overall site boundary whilst other areas are being constructed.

The potential dust emission magnitude as a result of earthworks is therefore considered to be 'large'.

5.2.3 Construction

Based on size of the Proposed Development, the new buildings are anticipated to have a total volume greater than 100,000m³. The potential dust emission magnitude as a result of construction is therefore considered to be 'large'.

5.2.4 Trackout

The final (detailed) construction scheme is not available at the time of writing. Based on the size of the development it is anticipated that there will be more than 50 Heavy Duty Vehicle (HDV) movements per day during certain periods of the construction works and the unpaved road length is likely to be greater than 100m at stages of the build, given the Site orientation. The potential dust emission magnitude as a result of trackout is therefore considered to be 'large'.

5.3 STEP 2b: Sensitivity of the Area

The closest receptors to the Site are located adjacent to the northern, southern and western boundaries. Hence the sensitivity of the area to dust soiling effects on people and property as a result of earthworks and construction activities is regarded as 'high' in these locations. The sensitivity will be, at worst, 'medium' for all other directions due to their commercial / industrial uses.

There are a number of residential receptors within 20m of the anticipated Site access route along Yapton Road. The sensitivity of the area to dust soiling effects on people and property as a result of trackout activities is therefore considered to be 'high'.

Given the low baseline PM₁₀ concentrations, the sensitivity of the area to human health impacts is considered to be 'low'.

5.4 STEP 2c: Risks

The risk of dust soiling during earthworks is likely, during specific stage of Site preparation, to be 'high risk' at the closest receptors before mitigation is considered. The risk of human health impacts during earthworks is considered to be 'low risk' before mitigation is considered.

The risk of dust soiling during construction on the northern, southern and western boundaries of the Site must be regarded as 'high risk' before mitigation is considered. This risk will reduce with distance from the relevant boundaries. The risk of human health impacts during construction must be regarded as 'low risk' before mitigation is considered.

The risk of dust soiling impacts during trackout activities must be regarded as 'high risk' before mitigation is considered. The risk of human health impacts during trackout activities must be regarded as 'low risk' before mitigation is considered.

5.5 STEP 3: Mitigation

The risk of dust impacts at stages of the earthworks, construction and trackout must be regarded as 'high risk', as the most significant risk rating, before mitigation is considered and therefore the high-risk mitigation measures detailed in section 8.2 of the IAQM 'Guidance on the assessment of dust from demolition and construction v1.1' should be considered in this case.

Specific measures will be detailed within a Site Construction Environmental Management Plan which should be approved by the LA before construction commences on site. The level of detail will depend on the risk and should include, as a minimum, the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. Mitigation measures may include (but not be limited to):

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.
- Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.

5.6 STEP4: Effect

The IAQM document 'Assessment of dust from demolition and construction v1.1' describes that, where suitable mitigation is applied, the residual effect will normally be 'not significant'. This is the case with the Ford Airfield scheme where robust mitigation measures are proposed. Full and final details of this mitigation should be provided to the Council before site works commence. This should be produced by the Principal contractor, taking into account the results and mitigation recommendations of this assessment.

6. Dispersion Modelling Assessment

The Proposed Development has the potential to affect existing air quality as a result of road traffic emissions associated with vehicles travelling to and from the Site, as well as expose future occupants to elevated pollution levels. Potential impacts have been defined by predicting pollutant concentrations at the receptors for the following scenarios, as described in section 2.2:

- **Scenario 0:** Model verification;
- **Scenario 1:** Opening year 'without development' (predicted traffic flows in 2024, inclusive of anticipated growth and committed developments, should the proposals not proceed);
- **Scenario 2:** Opening year 'with development' (predicted traffic flows in 2024, inclusive of anticipated growth and committed developments, as well as traffic associated with the full build out of the development);
- **Scenario 3:** Opening year 'with development' (predicted traffic flows in 2024, inclusive of anticipated growth and committed developments, as well as traffic associated with the full build out of the development and the proposed secondary school plus sixth form adjacent to the site);
- **Scenario 4:** Future year 'without development' (predicted traffic flows in 2030, inclusive of anticipated growth and committed developments in line with the end of the Local Plan, should the proposals not proceed);
- **Scenario 5:** Future year 'with development' (predicted traffic flows in 2030, inclusive of anticipated growth and committed developments in line with the end of the Local Plan, as well as traffic associated with the full build out of the development); and
- **Scenario 6:** Future year 'with development' (predicted traffic flows in 2030, inclusive of anticipated growth and committed developments in line with the end of the Local Plan, as well as traffic associated with the full build out of the development and the proposed secondary school plus sixth form adjacent to the site).

The relevant inputs are outlined in the following Sections.

6.1 Dispersion Model

Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 4.1.1.0). ADMS-Roads is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. The use of the ADMS-Roads model has been agreed with the local authority.

6.2 Emission Factors

Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 9.0), released in 2019, which incorporates COPERT 5 vehicle emission factors for NO_x and vehicle fleet information.

There is current uncertainty over NO₂ concentrations within the UK, with roadside levels not reducing as previously expected. Therefore, for this assessment, 2017 (base year) emission factors have been utilised for the prediction of pollution levels for both opening year scenarios and future year scenarios. This provides a robust assessment and assumes that emission rates will not improve in the future.

6.3 Traffic Flow Data

Traffic data including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition (% heavy duty vehicles) was provided by i-Transport, the appointed Transport Consultants for the project. A diurnal profile was also included within the model to represent variations in traffic flow throughout the day. Separate inputs were provided for weekdays, Saturday and Sunday and this information was obtained from DfT data.

Traffic data for a future year of 2031 has been provided by i-Transport, the appointed Transport Consultants for the project, in line with the completion of the Local Plan however in the EFT, emission factors are only available up to 2030. It has been confirmed with i-Transport, that the traffic data provided for the 2031 future year

scenario is also representative of the traffic predicted to be on the network in 2030. It is predicted that between 2030 and 2031 that there will be a 1% growth in traffic flows and therefore utilising 2031 traffic data for a 2030 scenario is an overestimation and provides a robust assessment of air quality impacts.

A summary of the AADT traffic data used in the assessment is provided in Tables 8 and 9, below.

Table 8: 2017 and 2024 Traffic Data

Road Link		AADT Flow				HDV (%)			
		2017 Sc0	2024 Sc1	2024 Sc2	2024 Sc3	2017 Sc0	2024 Sc1	2024 Sc2	2024 Sc3
L1	North End Road	8040	9706	10080	10137	6.7	5.6	5.4	5.4
L2	North End Road, junction	8040	9706	10080	10137	6.7	5.6	5.4	5.4
L3	Yapton Road, west of North End Road, junction	8144	9700	11203	11858	3.1	2.6	2.3	2.2
L4	Yapton Road, west of North End Road	8144	9700	11203	11858	3.1	2.6	2.3	2.2
L5	Main Road, east of North End Road, junction	8144	9700	11203	11858	3.1	2.6	2.3	2.2
L6	Main Road, east of North End Road	8144	9700	11203	11858	3.1	2.6	2.3	2.2
L7	Main Road, west of Bilsham Road	8144	9700	11203	11858	3.1	2.6	2.3	2.2
L8	Burndell Road, west of Bilsham Road, junction	9411	10713	11765	11765	3.9	3.4	3.1	3.1
L9	Burndell Road	9411	10713	11765	11765	3.9	3.4	3.1	3.1
L10	Yapton Road	7654	8635	10211	10211	5.2	4.6	3.9	3.9
L11	Yapton Road North of Oystercatcher Junction	7654	8635	10211	10211	5.2	4.6	3.9	3.9
L12	Bilsham Road, south of Yapton Road, junction	7015	7542	7955	8008	3.5	3.3	3.1	3.1
L13	Bilsham Road, south of Yapton Road	7015	7542	7955	8008	3.5	3.3	3.1	3.1
L14	Bilsham Road, north of A529	7015	7542	7955	8008	3.5	3.3	3.1	3.1
L15	Bilsham Road, north of A530, junction	7015	7542	7955	8008	3.5	3.3	3.1	3.1
L16	A259 east of B2259	22849	29073	30636	30689	3.4	3.2	3.0	3.0
L17	B2132 south of Bilsham Road stagger, junction	5635	5683	5709	5709	3.4	2.9	2.9	2.9
L18	B2132 south of Bilsham Road stagger	5635	5683	5709	5709	3.4	2.9	2.9	2.9
L19	A259 West of Oystercatcher Junction	20386	21615	22733	22733	3.6	3.5	3.3	3.3
L20	Crookthorn Lane	25544	27701	28820	28820	3.7	3.4	3.3	3.3
L21	Crookthorn Lane, junction	25544	27701	28820	28820	3.7	3.4	3.3	3.3
L22	Church Lane, junction	10981	12593	13955	14026	6.2	7.5	6.9	6.9
L23	Church Lane	10981	12593	13955	14026	6.2	7.5	6.9	6.9
L24	Ford Road	6300	6828	7462	7486	4.9	4.6	4.2	4.2
L25	A259 east of Church Lane Roundabout, junction	31476	34008	36005	36075	4.2	4.0	3.8	3.8
L26	A259 east of Church Lane Roundabout	31476	34008	36005	36075	4.2	4.0	3.8	3.8

Road Link		AADT Flow				HDV (%)			
		2017 Sc0	2024 Sc1	2024 Sc2	2024 Sc3	2017 Sc0	2024 Sc1	2024 Sc2	2024 Sc3
L27	A259 south of Broad Piece Roundabout	31476	34008	36005	36075	4.2	4.0	3.8	3.8
L28	A259 north of Broad Piece Roundabout, junction	22432	24569	25940	25987	2.2	2.1	2.0	2.0
L29	A259 north of Broad Piece Roundabout	22432	24569	25940	25987	2.2	2.1	2.0	2.0
L30	A259 west of Wick Roundabout	22432	24569	25940	25987	2.2	2.1	2.0	2.0
L31	Lyminster Road, junction	13150	13491	13491	13491	4.7	4.6	4.6	4.6
L32	Lyminster Road	13150	13491	13491	13491	4.7	4.6	4.6	4.6
L33	Worthing Road, junction	22860	24939	26253	26300	2.5	2.3	2.2	2.2
L34	Worthing Road	22860	24939	26253	26300	2.5	2.3	2.2	2.2
L35	Broad Piece Roundabout	15738	17004	18002	18038	4.2	4.0	3.8	3.8
L36	Wick Roundabout	21606	23058	23847	23874	4.7	4.6	4.6	4.6

Table 9: 2030 Traffic Data

Road Link		AADT Flow			HGV (%)		
		2030 Sc4	2030 Sc5	2030 Sc6	2030 Sc4	2030 Sc5	2030 Sc6
L1	North End Road	9746	10121	10177	5.7	5.5	5.4
L2	North End Road, junction	9746	10121	10177	5.7	5.5	5.4
L3	Yapton Road, west of North End Road, junction	9742	11245	11899	2.7	2.3	2.2
L4	Yapton Road, west of North End Road	9742	11245	11899	2.7	2.3	2.2
L5	Main Road, east of North End Road, junction	9742	11245	11899	2.7	2.3	2.2
L6	Main Road, east of North End Road	9742	11245	11899	2.7	2.3	2.2
L7	Main Road, west of Bilsham Road	9742	11245	11899	2.7	2.3	2.2
L8	Burndell Road, west of Bilsham Road, junction	10758	11810	11810	3.5	3.2	3.2
L9	Burndell Road	10758	11810	11810	3.5	3.2	3.2
L10	Yapton Road	8670	10246	10246	4.7	4.0	4.0
L11	Yapton Road North of Oystercatcher Junction	8670	10246	10246	4.7	4.0	4.0
L12	Bilsham Road, south of Yapton Road, junction	7576	7989	8042	3.4	3.2	3.2
L13	Bilsham Road, south of Yapton Road	7576	7989	8042	3.4	3.2	3.2
L14	Bilsham Road, north of A529	7576	7989	8042	3.4	3.2	3.2
L15	Bilsham Road, north of A530, junction	7576	7989	8042	3.4	3.2	3.2
L16	A259 east of B2259	29199	30762	30815	3.2	3.1	3.1

Road Link		AADT Flow			HGV (%)		
		2030 Sc4	2030 Sc5	2030 Sc6	2030 Sc4	2030 Sc5	2030 Sc6
L17	B2132 south of Bilsham Road stagger, junction	5699	5725	5725	2.9	2.9	2.9
L18	B2132 south of Bilsham Road stagger	5699	5725	5725	2.9	2.9	2.9
L19	A259 West of Oystercatcher Junction	21718	22837	22837	3.5	3.4	3.4
L20	Crookthorn Lane	27831	28949	28949	3.5	3.3	3.3
L21	Crookthorn Lane, junction	27831	28949	28949	3.5	3.3	3.3
L22	Church Lane, junction	12649	14011	14081	7.4	6.9	6.9
L23	Church Lane	12649	14011	14081	7.4	6.9	6.9
L24	Ford Road	6852	7486	7510	4.7	4.3	4.3
L25	A259 east of Church Lane Roundabout, junction	34168	36165	36235	4.0	3.8	3.8
L26	A259 east of Church Lane Roundabout	34168	36165	36235	4.0	3.8	3.8
L27	A259 south of Broad Piece Roundabout	34168	36165	36235	4.0	3.8	3.8
L28	A259 north of Broad Piece Roundabout, junction	24677	26049	26095	2.1	2.0	2.0
L29	A259 north of Broad Piece Roundabout	24677	26049	26095	2.1	2.0	2.0
L30	A259 west of Wick Roundabout	24677	26049	26095	2.1	2.0	2.0
L31	Lyminster Road, junction	13547	13547	13547	4.7	4.7	4.7
L32	Lyminster Road	13547	13547	13547	4.7	4.7	4.7
L33	Worthing Road, junction	25055	26369	26416	2.3	2.3	2.3
L34	Worthing Road	25055	26369	26416	2.3	2.3	2.3
L35	Broad Piece Roundabout	17084	18083	18118	4.0	3.8	3.8
L36	Wick Roundabout	23161	23950	23977	4.7	4.7	4.7

Road widths were estimated from aerial photography and UK highway design standards. A summary of the link parameters is shown in Table 10, below.

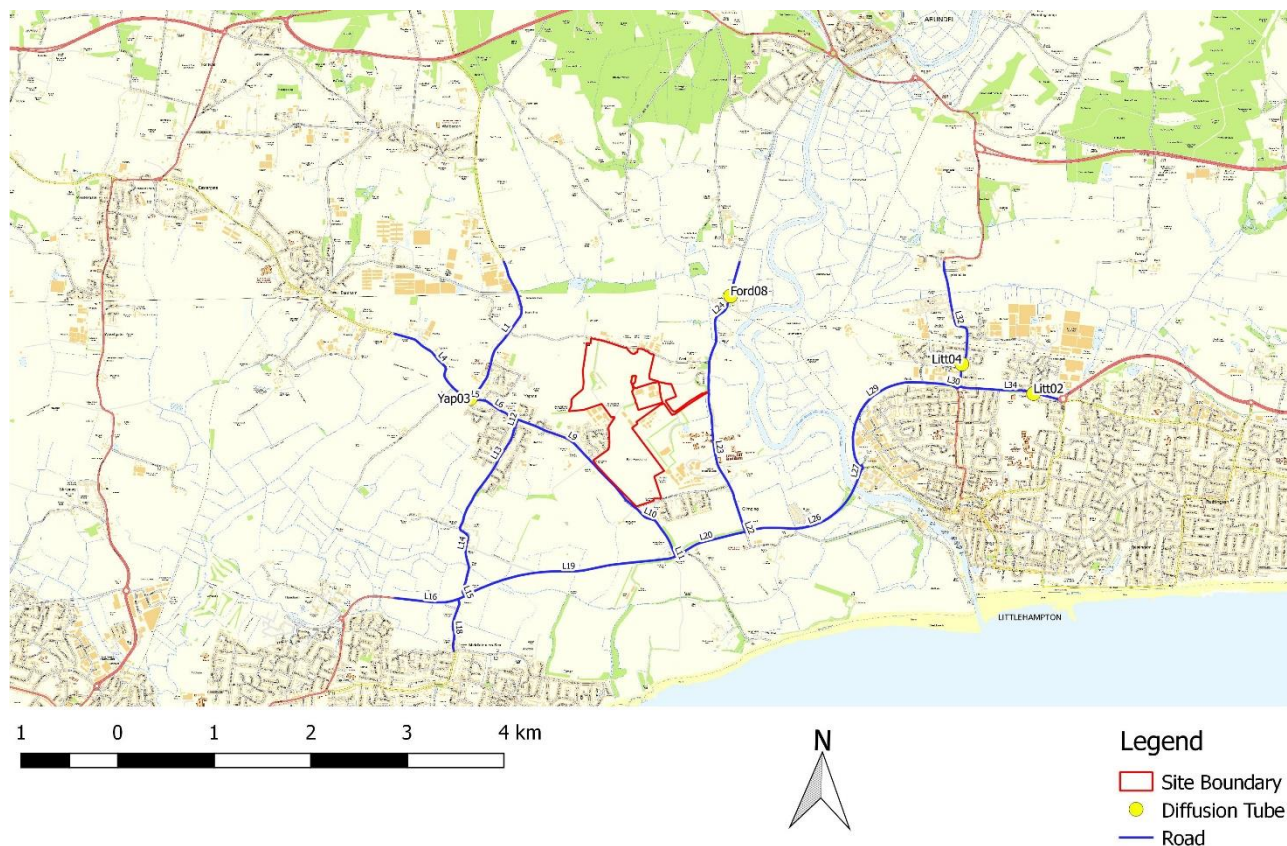
Table 10: Link Parameters

Road Link		Average Vehicle Speed (km/h)	Road Width (m)
L1	North End Road	45	6.5
L2	North End Road, junction	30	6.5
L3	Yapton Road, west of North End Road, junction	30	7.0
L4	Yapton Road, west of North End Road	45	7.0
L5	Main Road, east of North End Road, junction	30	7.0
L6	Main Road, east of North End Road	45	7.0
L7	Main Road, west of Bilsham Road	25	7.0

Road Link		Average Vehicle Speed (km/h)	Road Width (m)
L8	Burndell Road, west of Bilsham Road, junction	25	7.0
L9	Burndell Road	45	7.0
L10	Yapton Road	60	5.8
L11	Yapton Road North of Oystercatcher Junction	25	5.8
L12	Bilsham Road, south of Yapton Road, junction	25	5.8
L13	Bilsham Road, south of Yapton Road	45	5.8
L14	Bilsham Road, north of A529	60	5.8
L15	Bilsham Road, north of A530, junction	25	5.8
L16	A259 east of B2259	80	7.2
L17	B2132 south of Bilsham Road stagger, junction	25	7.2
L18	B2132 south of Bilsham Road stagger	45	7.2
L19	A259 West of Oystercatcher Junction	80	7.3
L20	Crookthorn Lane	60	7.3
L21	Crookthorn Lane, junction	30	7.3
L22	Church Lane, junction	30	7.3
L23	Church Lane	55	6.6
L24	Ford Road	50	6.7
L25	A259 east of Church Lane Roundabout, junction	30	7.2
L26	A259 east of Church Lane Roundabout	60	7.2
L27	A259 south of Broad Piece Roundabout	30	7.2
L28	A259 north of Broad Piece Roundabout, junction	30	15.8
L29	A259 north of Broad Piece Roundabout	80	7.7
L30	A259 west of Wick Roundabout	30	13.6
L31	Lyminster Road, junction	25	16.5
L32	Lyminster Road	30	7.3
L33	Worthing Road, junction	30	12.8
L34	Worthing Road	45	12.8
L35	Broad Piece Roundabout	25	11.2
L36	Wick Roundabout	25	11.2

A map of the model inputs and monitoring points used in the verification process is shown in Figure 3, below.

Figure 3: ADMS-Inputs



6.4 Meteorological Data

Meteorological data used in the assessment was taken from Shoreham meteorological station over the period 1st January 2017 to 31st December 2017 (inclusive). Shoreham meteorological station is located at OS GR: x520095, y105457, which is approximately 21.3km east of the Site.

6.5 Roughness Length

The roughness length is a modelling parameter used to estimate the impact of the surface height on air flows. Roughness lengths of 0.5m and 0.1m were used to describe the modelling domain and meteorological site, respectively.

6.6 Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. Minimum Monin-Obukhov lengths of 10m and 30m were used to describe the modelling domain and meteorological site, respectively.

6.7 Background Concentrations

Annual mean NO₂, NO_x, PM₁₀ and PM_{2.5} background concentrations for use in the assessment were taken from the DEFRA mapping for the grid squares OS GR: x497500, y101500 and x502500, y103500 for receptor locations in the vicinity of the Site and receptor locations in Wick, respectively. For the proposed receptor locations, background concentrations were also taken from the DEFRA mapping but for the grid square x499500, y102500 which covers the southern aspect of the Site. This ensured a robust assessment.

6.8 NO_x to NO₂ Conversion

Predicted annual mean NO_x concentrations were converted to NO₂ concentrations using the spreadsheet (version 7.1) provided by DEFRA, which is the method detailed within DEFRA guidance LAQM(TG16).

6.9 Verification

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons. Model verification is the process by which these uncertainties are investigated and where possible, minimised.

For the purpose of the assessment model, verification was undertaken for 2017 using traffic data, meteorological data and monitoring results from this year as this was the most recent year with all data available.

ADC undertook monitoring of NO₂ concentrations at four locations within the modelling domain during 2017. In order to provide a robust assessment, two model verifications were undertaken; one for receptors located close to the Site using diffusion tubes Yap03 and Ford08 and another for receptors located in Wick using diffusion tubes Litt02 and Litt04. Results were obtained and the road contributions to total NO_x concentrations calculated following the methodology contained within DEFRA guidance LAQM(TG16). The monitored annual mean NO₂ concentrations and calculated road NO_x concentrations are summarised in Tables below.

Table 11: Verification of Monitoring Results in the vicinity of the Site

Monitoring Location	Monitored NO ₂ Concentration (µg/m ³)	Calculated Road NO _x Concentration (µg/m ³)
3 - Yap03	16.9	13.1
8 - Ford08	18.5	17.2

Table 12: Verification of Monitoring Results in Wick

Monitoring Location	Monitored NO ₂ Concentration (µg/m ³)	Calculated Road NO _x Concentration (µg/m ³)
2 - Litt02	25.3	26.2
4 - Litt04	27.1	27.9

The annual mean road NO_x concentrations predicted from the dispersion model and the 2017 monitoring results are summarised in Table 13 for the diffusion tubes in the vicinity of the Site and Table 14 for the diffusion tubes in Wick.

Table 13: Verification of Modelling Results in the vicinity of the Site

Monitoring Location	Calculated Road NO _x Concentration (µg/m ³)	Modelled Road NO _x Concentration (µg/m ³)
3 - Yap03	13.09	10.21
8 - Ford08	17.21	8.91

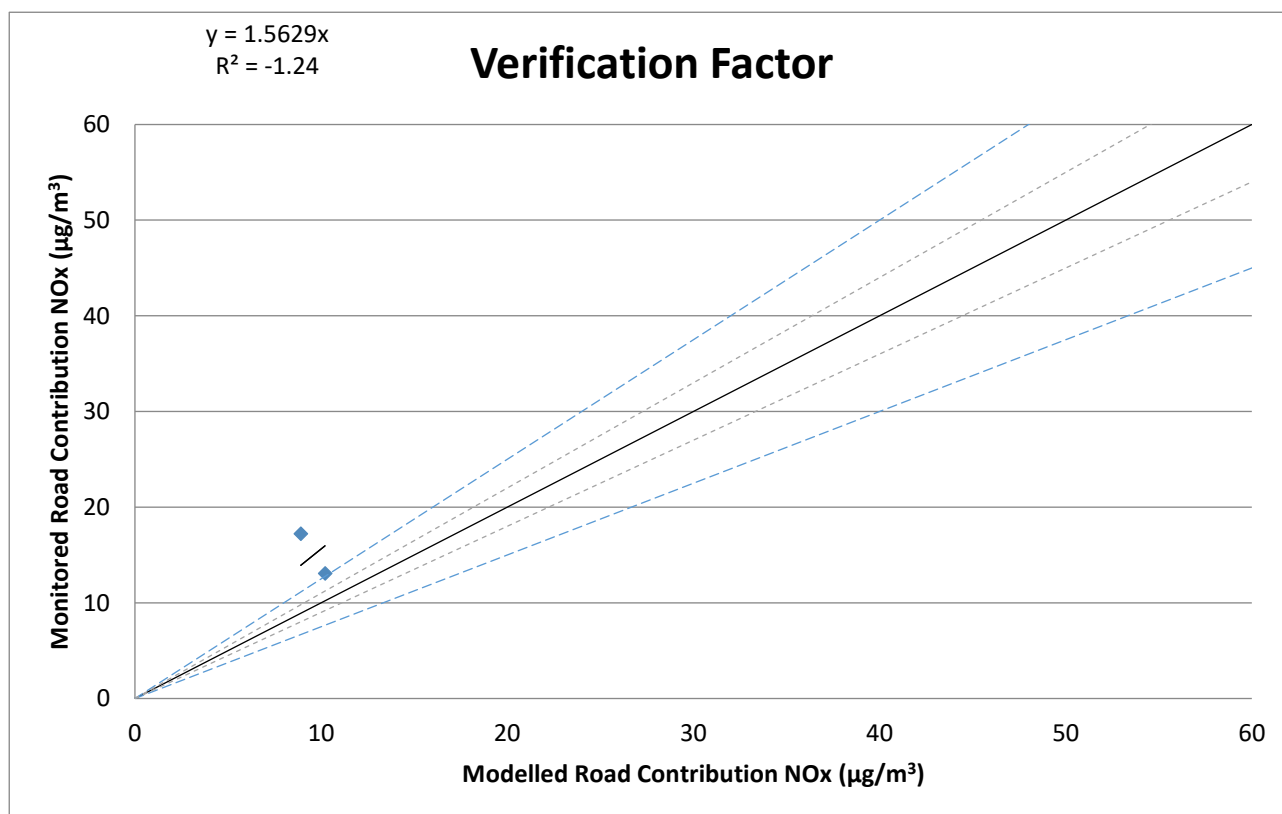
Table 14: Verification of Modelling Results in Wick

Monitoring Location	Calculated Road NO _x Concentration (µg/m ³)	Modelled Road NO _x Concentration (µg/m ³)
2 - Litt02	26.18	11.13

Monitoring Location	Calculated Road NO _x Concentration (µg/m ³)	Modelled Road NO _x Concentration (µg/m ³)
4 - Litt04	27.90	12.25

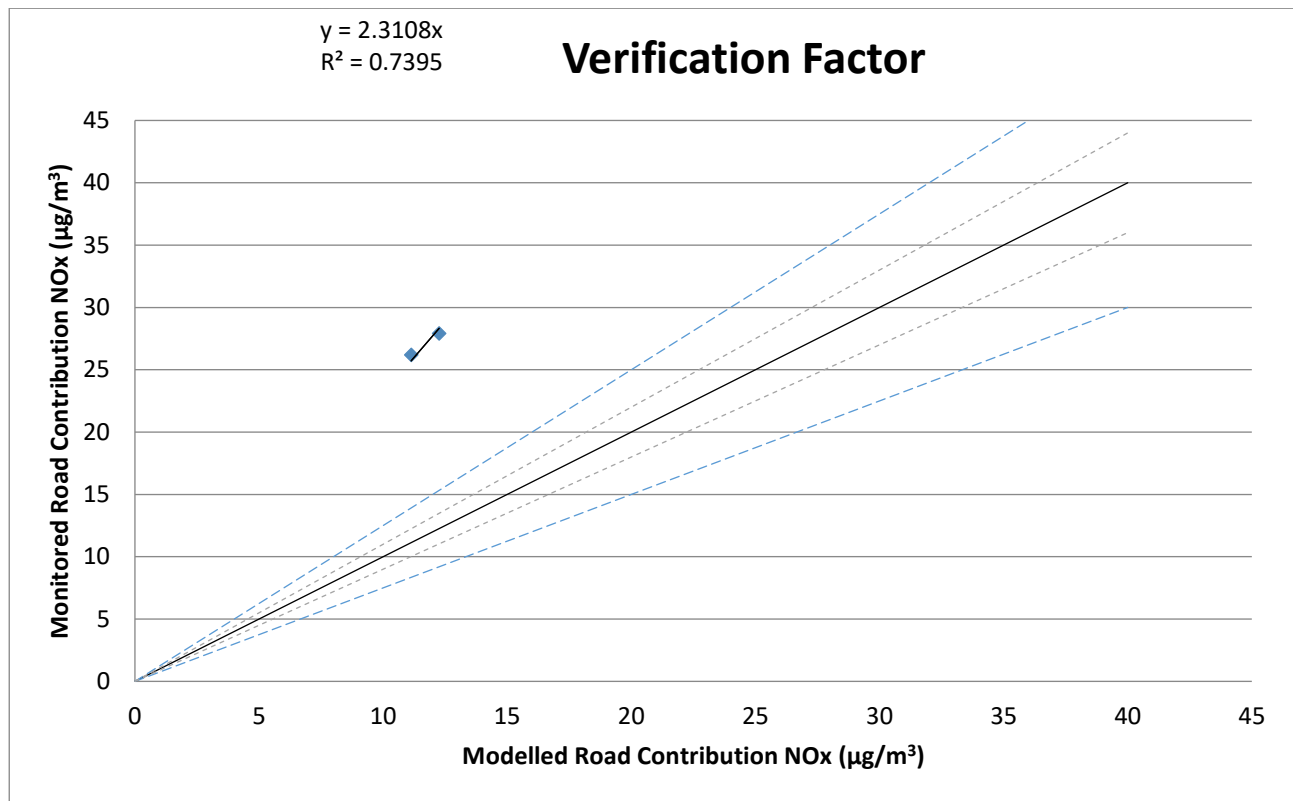
The monitored and modelled road NO_x concentrations were graphed and the equation of the trendline based on linear progression through zero calculated. This indicated that a verification factor of 1.5629 was required to be applied to modelling results at sensitive receptor locations in the vicinity of the Site as shown in Graph 1.

Graph 1: NO_x Verification Factor for Receptors in the vicinity of the Site.



Graph 2 shows that a verification factor of 2.3108 was required to be applied to modelling results at sensitive receptor locations in Wick.

Graph 2: NO_x Verification Factor for Receptors in Wick



Monitoring of PM₁₀ or PM_{2.5} concentrations is not undertaken within the assessment area. The NO_x verification factor was therefore used to adjust PM₁₀ and PM_{2.5} model predictions in lieu of more accurate data in accordance with the guidance provided within DEFRA guidance LAQM (TG16).

7. Assessment of Air Quality Impacts & Constraints

7.1 Impacts on Existing Receptors

Vehicle movements associated with the operation of the Proposed Development will generate exhaust emissions on the local road networks. An assessment was therefore undertaken using dispersion modelling to quantify potential changes in pollutant concentrations at representative receptors.

Annual mean NO₂, PM₁₀ and PM_{2.5} concentrations were predicted for scenarios 1 to 6 to allow for comparison of air quality impacts as a result of the Proposed Development without and with the addition of the proposed secondary school and sixth form located outside of the site boundary for 2024 and 2030 when the proposed development is due to be completed, and in line with the end of the Local Plan, respectively.

NO₂ Concentrations

Table 15 summarises the predicted change in NO₂ concentrations in 2024 with the full build out of the Proposed Development but without the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 15: Predicted Annual Mean NO₂ Concentrations (Scenario 1 and Scenario 2)

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 1	Scenario 2	Change
R1	Residential - North End Road	18.27	18.50	0.23
R2	Residential - North End Road	15.81	15.99	0.18
R3	Residential - North End Road	17.53	17.77	0.24
R4	Residential - North End Road	15.87	16.09	0.22
R5	Residential - North End Road	15.41	15.67	0.26
R6	Residential - Main Road	15.76	16.45	0.69
R7	Residential - Main Road	17.79	18.67	0.88
R8	Residential - Main Road	17.04	17.83	0.79
R9	Residential - Main Road	16.45	17.05	0.60
R10	Residential - Burndell Road	17.56	18.13	0.57
R11	Residential - Burndell Road	17.54	18.11	0.57
R12	Residential - Burndell Road	16.68	17.18	0.50
R13	Residential - Burndell Road	17.43	17.98	0.55
R14	Residential - Burndell Road	14.85	15.21	0.36
R15	Residential - Burndell Road	16.60	17.10	0.50
R16	Residential - Yapton Road	14.91	15.53	0.62
R17	Residential - Yapton Road	15.43	16.12	0.69
R18	Residential - Yapton Road	14.58	15.15	0.57
R19	Residential - Bilsham Road	15.93	16.38	0.45
R20	Residential - Bilsham Road	15.26	15.52	0.26
R21	Residential - Bilsham Road	16.76	17.07	0.31

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 1	Scenario 2	Change
R22	Residential - Bilsham Road	15.91	16.18	0.27
R23	Residential - Bilsham Road	13.57	13.73	0.16
R24	Residential - Bilsham Road	16.60	16.89	0.29
R25	Residential - Bilsham Road	16.53	16.83	0.30
R26	Residential - Bilsham Road	15.62	15.87	0.25
R27	Residential - Bilsham Road	15.26	15.50	0.24
R28	Residential - Bilsham Road	19.13	19.53	0.40
R29	Residential - Yapton Road	17.33	17.48	0.15
R30	Residential - Yapton Road	12.79	12.85	0.06
R31	Residential - Apple Barn Cottage	22.50	23.07	0.57
R32	Residential - Church Lane	16.60	17.13	0.53
R33	Residential - Church Lane	18.82	19.53	0.71
R34	Residential - Church Lane	19.88	20.69	0.81
R35	Residential - Church Lane	16.07	16.58	0.51
R36	Residential - Station Road	13.57	13.84	0.27
R37	Residential - Station Road	15.53	15.94	0.41
R38	Residential - Ford Lane	16.97	17.49	0.52
R39	Residential - Ford Lane	15.27	15.65	0.38
R40	Residential - Henry Lock Way	18.45	18.72	0.27
R41	Residential - Willow Brook	19.93	20.27	0.34
R42	Residential - Colebrook Road	25.40	25.89	0.49
R43	Residential - Lyminster Road	24.37	24.47	0.10
R44	Residential - Lyminster Road	29.96	30.06	0.10
R45	Residential - Worthing Road	28.18	28.78	0.60
R46	Yapton Primary School	17.00	17.17	0.17
R47	Lyminster Primary School	27.11	27.61	0.50

As indicated in Table 15, predicted annual mean NO₂ concentrations were below the relevant AQO at all receptors in both scenario 1 and scenario 2 with a maximum increase of 0.88µg/m³ at R7.

Table 16 summarises the predicted change in NO₂ concentrations in 2024 with the full build out of the Proposed Development plus the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 16: Predicted Annual Mean NO₂ Concentrations (Scenario 1 and Scenario 3)

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 1	Scenario 3	Change
R1	Residential - North End Road	18.27	18.54	0.27
R2	Residential - North End Road	15.81	16.03	0.22
R3	Residential - North End Road	17.53	17.82	0.29
R4	Residential - North End Road	15.87	16.15	0.28
R5	Residential - North End Road	15.41	15.76	0.35
R6	Residential - Main Road	15.76	16.75	0.99
R7	Residential - Main Road	17.79	19.05	1.26
R8	Residential - Main Road	17.04	18.17	1.13
R9	Residential - Main Road	16.45	17.27	0.82
R10	Residential - Burndell Road	17.56	18.16	0.60
R11	Residential - Burndell Road	17.54	18.13	0.59
R12	Residential - Burndell Road	16.68	17.19	0.51
R13	Residential - Burndell Road	17.43	17.99	0.56
R14	Residential - Burndell Road	14.85	15.21	0.36
R15	Residential - Burndell Road	16.60	17.10	0.50
R16	Residential - Yapton Road	14.91	15.53	0.62
R17	Residential - Yapton Road	15.43	16.12	0.69
R18	Residential - Yapton Road	14.58	15.15	0.57
R19	Residential - Bilsham Road	15.93	16.51	0.58
R20	Residential - Bilsham Road	15.26	15.57	0.31
R21	Residential - Bilsham Road	16.76	17.12	0.36
R22	Residential - Bilsham Road	15.91	16.22	0.31
R23	Residential - Bilsham Road	13.57	13.76	0.19
R24	Residential - Bilsham Road	16.60	16.94	0.34
R25	Residential - Bilsham Road	16.53	16.87	0.34
R26	Residential - Bilsham Road	15.62	15.91	0.29
R27	Residential - Bilsham Road	15.26	15.54	0.28
R28	Residential - Bilsham Road	19.13	19.56	0.43
R29	Residential - Yapton Road	17.33	17.49	0.16
R30	Residential - Yapton Road	12.79	12.86	0.07
R31	Residential - Apple Barn Cottage	22.50	23.07	0.57
R32	Residential - Church Lane	16.60	17.16	0.56

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 1	Scenario 3	Change
R33	Residential - Church Lane	18.82	19.57	0.75
R34	Residential - Church Lane	19.88	20.73	0.85
R35	Residential - Church Lane	16.07	16.61	0.54
R36	Residential - Station Road	13.57	13.85	0.28
R37	Residential - Station Road	15.53	15.96	0.43
R38	Residential - Ford Lane	16.97	17.51	0.54
R39	Residential - Ford Lane	15.27	15.67	0.40
R40	Residential - Henry Lock Way	18.45	18.73	0.28
R41	Residential - Willow Brook	19.93	20.27	0.34
R42	Residential - Colebrook Road	25.40	25.90	0.50
R43	Residential - Lyminster Road	24.37	24.47	0.10
R44	Residential - Lyminster Road	29.96	30.06	0.10
R45	Residential - Worthing Road	28.18	28.80	0.62
R46	Yapton Primary School	17.00	17.21	0.21
R47	Lyminster Primary School	27.11	27.62	0.51

As indicated in Table 16, predicted annual mean NO₂ concentrations were below the relevant AQO at all receptors in both scenario 1 and scenario 3 with a maximum increase of 1.26µg/m³ at R7.

Table 17 summarises the predicted change in NO₂ concentrations in 2030 with the full build out of the Proposed Development but without the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 17: Predicted Annual Mean NO₂ Concentrations (Scenario 4 and Scenario 5)

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 4	Scenario 5	Change
R1	Residential - North End Road	18.32	18.56	0.24
R2	Residential - North End Road	15.85	16.03	0.18
R3	Residential - North End Road	17.58	17.82	0.24
R4	Residential - North End Road	15.91	16.13	0.22
R5	Residential - North End Road	15.44	15.71	0.27
R6	Residential - Main Road	15.80	16.48	0.68
R7	Residential - Main Road	17.84	18.71	0.87
R8	Residential - Main Road	17.08	17.86	0.78
R9	Residential - Main Road	16.50	17.09	0.59
R10	Residential - Burndell Road	17.62	18.19	0.57

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 4	Scenario 5	Change
R11	Residential - Burndell Road	17.60	18.17	0.57
R12	Residential - Burndell Road	16.73	17.24	0.51
R13	Residential - Burndell Road	17.48	18.04	0.56
R14	Residential - Burndell Road	14.88	15.25	0.37
R15	Residential - Burndell Road	16.64	17.15	0.51
R16	Residential - Yapton Road	14.93	15.57	0.64
R17	Residential - Yapton Road	15.46	16.16	0.70
R18	Residential - Yapton Road	14.61	15.18	0.57
R19	Residential - Bilsham Road	15.98	16.42	0.44
R20	Residential - Bilsham Road	15.30	15.56	0.26
R21	Residential - Bilsham Road	16.81	17.12	0.31
R22	Residential - Bilsham Road	15.96	16.22	0.26
R23	Residential - Bilsham Road	13.60	13.76	0.16
R24	Residential - Bilsham Road	16.66	16.94	0.28
R25	Residential - Bilsham Road	16.57	16.87	0.30
R26	Residential - Bilsham Road	15.65	15.91	0.26
R27	Residential - Bilsham Road	15.29	15.54	0.25
R28	Residential - Bilsham Road	19.18	19.59	0.41
R29	Residential - Yapton Road	17.36	17.51	0.15
R30	Residential - Yapton Road	12.80	12.86	0.06
R31	Residential - Apple Barn Cottage	22.55	23.14	0.59
R32	Residential - Church Lane	16.62	17.15	0.53
R33	Residential - Church Lane	18.84	19.56	0.72
R34	Residential - Church Lane	19.90	20.73	0.83
R35	Residential - Church Lane	16.09	16.60	0.51
R36	Residential - Station Road	13.59	13.86	0.27
R37	Residential - Station Road	15.56	15.97	0.41
R38	Residential - Ford Lane	17.02	17.53	0.51
R39	Residential - Ford Lane	15.30	15.69	0.39
R40	Residential - Henry Lock Way	18.47	18.75	0.28
R41	Residential - Willow Brook	19.96	20.30	0.34
R42	Residential - Colebrook Road	25.47	25.97	0.50
R43	Residential - Lymminster Road	24.46	24.57	0.11

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 4	Scenario 5	Change
R44	Residential - Lyminster Road	30.10	30.20	0.10
R45	Residential – Worthing Road	28.26	28.91	0.65
R46	Yapton Primary School	17.03	17.20	0.17
R47	Lyminster Primary School	27.20	27.73	0.53

As indicated in Table 17, predicted annual mean NO₂ concentrations were below the relevant AQO at all receptors in both scenario 4 and scenario 5 with a maximum increase of 0.87µg/m³ at R7..

Table 18 summarises the predicted change in NO₂ concentrations in 2030 with the full build out of the Proposed Development plus the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 18: Predicted Annual Mean NO₂ Concentrations (Scenario 4 and Scenario 6)

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 4	Scenario 6	Change
R1	Residential - North End Road	18.32	18.57	0.25
R2	Residential - North End Road	15.85	16.05	0.20
R3	Residential - North End Road	17.58	17.85	0.27
R4	Residential - North End Road	15.91	16.17	0.26
R5	Residential - North End Road	15.44	15.78	0.34
R6	Residential - Main Road	15.80	16.77	0.97
R7	Residential - Main Road	17.84	19.08	1.24
R8	Residential - Main Road	17.08	18.20	1.12
R9	Residential - Main Road	16.50	17.30	0.80
R10	Residential - Burndell Road	17.62	18.22	0.60
R11	Residential - Burndell Road	17.60	18.19	0.59
R12	Residential - Burndell Road	16.73	17.24	0.51
R13	Residential - Burndell Road	17.48	18.05	0.57
R14	Residential - Burndell Road	14.88	15.25	0.37
R15	Residential - Burndell Road	16.64	17.15	0.51
R16	Residential - Yapton Road	14.93	15.57	0.64
R17	Residential - Yapton Road	15.46	16.16	0.70
R18	Residential - Yapton Road	14.61	15.18	0.57
R19	Residential - Bilsham Road	15.98	16.56	0.58
R20	Residential - Bilsham Road	15.30	15.61	0.31
R21	Residential - Bilsham Road	16.81	17.18	0.37

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		
		Scenario 4	Scenario 6	Change
R22	Residential - Bilsham Road	15.96	16.27	0.31
R23	Residential - Bilsham Road	13.60	13.79	0.19
R24	Residential - Bilsham Road	16.66	16.99	0.33
R25	Residential - Bilsham Road	16.57	16.92	0.35
R26	Residential - Bilsham Road	15.65	15.95	0.30
R27	Residential - Bilsham Road	15.29	15.57	0.28
R28	Residential - Bilsham Road	19.18	19.62	0.44
R29	Residential - Yapton Road	17.36	17.52	0.16
R30	Residential - Yapton Road	12.80	12.87	0.07
R31	Residential - Apple Barn Cottage	22.55	23.14	0.59
R32	Residential - Church Lane	16.62	17.18	0.56
R33	Residential - Church Lane	18.84	19.60	0.76
R34	Residential - Church Lane	19.90	20.77	0.87
R35	Residential - Church Lane	16.09	16.63	0.54
R36	Residential - Station Road	13.59	13.87	0.28
R37	Residential - Station Road	15.56	15.99	0.43
R38	Residential - Ford Lane	17.02	17.55	0.53
R39	Residential - Ford Lane	15.30	15.70	0.40
R40	Residential - Henry Lock Way	18.47	18.76	0.29
R41	Residential - Willow Brook	19.96	20.31	0.35
R42	Residential - Colebrook Road	25.47	25.99	0.52
R43	Residential - Lyminster Road	24.46	24.57	0.11
R44	Residential - Lyminster Road	30.10	30.20	0.10
R45	Residential - Worthing Road	28.26	28.93	0.67
R46	Yapton Primary School	17.03	17.23	0.20
R47	Lyminster Primary School	27.20	27.75	0.55

As indicated in Table 14, predicted annual mean NO₂ concentrations were below the relevant AQO at all receptors in both scenario 4 and scenario 6 with a maximum increase of 1.24µg/m³ at R7.

PM₁₀ Concentrations

Table 19 summarises the predicted change in PM₁₀ concentrations in 2024 with the full build out of the Proposed Development but without the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 19: Predicted Annual Mean PM₁₀ Concentrations (Scenario 1 and Scenario 2)

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 1	Scenario 2	Change
R1	Residential - North End Road	16.36	16.41	0.04
R2	Residential - North End Road	15.95	15.99	0.03
R3	Residential - North End Road	16.24	16.28	0.04
R4	Residential - North End Road	15.96	16.00	0.04
R5	Residential - North End Road	15.88	15.92	0.05
R6	Residential - Main Road	15.97	16.10	0.12
R7	Residential - Main Road	16.32	16.48	0.16
R8	Residential - Main Road	16.19	16.33	0.14
R9	Residential - Main Road	16.01	16.11	0.10
R10	Residential - Burndell Road	16.26	16.36	0.10
R11	Residential - Burndell Road	16.27	16.37	0.10
R12	Residential - Burndell Road	16.12	16.22	0.09
R13	Residential - Burndell Road	16.25	16.35	0.10
R14	Residential - Burndell Road	15.81	15.88	0.06
R15	Residential - Burndell Road	16.11	16.20	0.09
R16	Residential - Yapton Road	15.87	15.99	0.12
R17	Residential - Yapton Road	15.96	16.09	0.13
R18	Residential - Yapton Road	15.80	15.91	0.11
R19	Residential - Bilsham Road	15.93	16.01	0.08
R20	Residential - Bilsham Road	15.88	15.93	0.05
R21	Residential - Bilsham Road	16.14	16.19	0.06
R22	Residential - Bilsham Road	15.99	16.04	0.05
R23	Residential - Bilsham Road	15.60	15.63	0.03
R24	Residential - Bilsham Road	16.09	16.14	0.05
R25	Residential - Bilsham Road	15.89	15.93	0.04
R26	Residential - Bilsham Road	15.77	15.80	0.03
R27	Residential - Bilsham Road	15.72	15.75	0.03
R28	Residential - Bilsham Road	16.18	16.23	0.05
R29	Residential - Yapton Road	15.95	15.97	0.02
R30	Residential - Yapton Road	15.37	15.38	0.01
R31	Residential - Apple Barn Cottage	16.75	16.83	0.08
R32	Residential - Church Lane	15.89	15.96	0.07

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 1	Scenario 2	Change
R33	Residential - Church Lane	16.19	16.29	0.10
R34	Residential - Church Lane	16.33	16.45	0.11
R35	Residential - Church Lane	15.82	15.89	0.07
R36	Residential - Station Road	15.48	15.51	0.03
R37	Residential - Station Road	15.73	15.78	0.05
R38	Residential - Ford Lane	15.91	15.98	0.07
R39	Residential - Ford Lane	15.69	15.74	0.05
R40	Residential - Henry Lock Way	17.10	17.15	0.05
R41	Residential - Willow Brook	17.37	17.43	0.06
R42	Residential - Colebrook Road	18.06	18.15	0.09
R43	Residential - Lyminster Road	17.80	17.82	0.02
R44	Residential - Lyminster Road	18.68	18.70	0.02
R45	Residential - Worthing Road	18.75	18.87	0.12
R46	Yapton Primary School	16.75	16.78	0.03
R47	Lyminster Primary School	18.31	18.40	0.09

As indicated in Table 18, predicted annual mean PM₁₀ concentrations were below the relevant AQO at all receptors in both scenario 1 and 2 with a maximum increase of 0.16µg/m³ at R7.

Table 19 summarises the predicted change in PM₁₀ concentrations in 2024 with the full build out of the Proposed Development plus the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 19: Predicted Annual Mean PM₁₀ Concentrations (Scenario 1 and Scenario 3)

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 1	Scenario 3	Change
R1	Residential - North End Road	16.36	16.41	0.05
R2	Residential - North End Road	15.95	15.99	0.04
R3	Residential - North End Road	16.24	16.29	0.05
R4	Residential - North End Road	15.96	16.01	0.05
R5	Residential - North End Road	15.88	15.94	0.06
R6	Residential - Main Road	15.97	16.15	0.18
R7	Residential - Main Road	16.32	16.55	0.23
R8	Residential - Main Road	16.19	16.39	0.21
R9	Residential - Main Road	16.01	16.15	0.14
R10	Residential - Burndell Road	16.26	16.36	0.11

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 1	Scenario 3	Change
R11	Residential - Burndell Road	16.27	16.38	0.11
R12	Residential - Burndell Road	16.12	16.22	0.09
R13	Residential - Burndell Road	16.25	16.36	0.10
R14	Residential - Burndell Road	15.81	15.88	0.07
R15	Residential - Burndell Road	16.11	16.20	0.09
R16	Residential - Yapton Road	15.87	15.99	0.12
R17	Residential - Yapton Road	15.96	16.09	0.13
R18	Residential - Yapton Road	15.80	15.91	0.11
R19	Residential - Bilsham Road	15.93	16.03	0.10
R20	Residential - Bilsham Road	15.88	15.94	0.05
R21	Residential - Bilsham Road	16.14	16.20	0.07
R22	Residential - Bilsham Road	15.99	16.05	0.06
R23	Residential - Bilsham Road	15.60	15.63	0.03
R24	Residential - Bilsham Road	16.09	16.14	0.06
R25	Residential - Bilsham Road	15.89	15.93	0.05
R26	Residential - Bilsham Road	15.77	15.81	0.04
R27	Residential - Bilsham Road	15.72	15.75	0.04
R28	Residential - Bilsham Road	16.18	16.23	0.06
R29	Residential - Yapton Road	15.95	15.97	0.02
R30	Residential - Yapton Road	15.37	15.38	0.01
R31	Residential - Apple Barn Cottage	16.75	16.83	0.08
R32	Residential - Church Lane	15.89	15.96	0.07
R33	Residential - Church Lane	16.19	16.29	0.10
R34	Residential - Church Lane	16.33	16.45	0.12
R35	Residential - Church Lane	15.82	15.89	0.07
R36	Residential - Station Road	15.48	15.51	0.04
R37	Residential - Station Road	15.73	15.78	0.06
R38	Residential - Ford Lane	15.91	15.98	0.07
R39	Residential - Ford Lane	15.69	15.74	0.05
R40	Residential - Henry Lock Way	17.10	17.15	0.05
R41	Residential - Willow Brook	17.37	17.43	0.07
R42	Residential - Colebrook Road	18.06	18.15	0.09
R43	Residential - Lymminster Road	17.80	17.82	0.02

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 1	Scenario 3	Change
R44	Residential - Lyminster Road	18.68	18.70	0.02
R45	Residential - Worthing Road	18.75	18.88	0.12
R46	Yapton Primary School	16.75	16.79	0.04
R47	Lyminster Primary School	18.31	18.40	0.09

As indicated in Table 19, predicted annual mean PM₁₀ concentrations were below the relevant AQO at all receptors in both scenario 1 and 3 with a maximum increase of 0.23µg/m³ at R7.

Table 20 summarises the predicted change in PM₁₀ concentrations in 2030 with the full build out of the Proposed Development but without the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 20: Predicted Annual Mean PM₁₀ Concentrations (Scenario 4 and Scenario 5)

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 4	Scenario 5	Change
R1	Residential - North End Road	16.37	16.41	0.04
R2	Residential - North End Road	15.96	15.99	0.03
R3	Residential - North End Road	16.25	16.29	0.04
R4	Residential - North End Road	15.97	16.01	0.04
R5	Residential - North End Road	15.88	15.93	0.05
R6	Residential - Main Road	15.98	16.10	0.12
R7	Residential - Main Road	16.33	16.49	0.16
R8	Residential - Main Road	16.19	16.34	0.14
R9	Residential - Main Road	16.02	16.12	0.10
R10	Residential - Burndell Road	16.26	16.37	0.10
R11	Residential - Burndell Road	16.28	16.38	0.10
R12	Residential - Burndell Road	16.13	16.22	0.09
R13	Residential - Burndell Road	16.26	16.36	0.10
R14	Residential - Burndell Road	15.82	15.88	0.07
R15	Residential - Burndell Road	16.12	16.21	0.09
R16	Residential - Yapton Road	15.87	15.99	0.12
R17	Residential - Yapton Road	15.97	16.10	0.13
R18	Residential - Yapton Road	15.80	15.91	0.11
R19	Residential - Bilsham Road	15.94	16.01	0.08
R20	Residential - Bilsham Road	15.89	15.93	0.05
R21	Residential - Bilsham Road	16.15	16.20	0.06

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 4	Scenario 5	Change
R22	Residential - Bilsham Road	16.00	16.05	0.05
R23	Residential - Bilsham Road	15.60	15.63	0.03
R24	Residential - Bilsham Road	16.09	16.14	0.05
R25	Residential - Bilsham Road	15.90	15.94	0.04
R26	Residential - Bilsham Road	15.77	15.81	0.03
R27	Residential - Bilsham Road	15.72	15.76	0.03
R28	Residential - Bilsham Road	16.18	16.24	0.05
R29	Residential - Yapton Road	15.95	15.97	0.02
R30	Residential - Yapton Road	15.38	15.38	0.01
R31	Residential - Apple Barn Cottage	16.76	16.84	0.09
R32	Residential - Church Lane	15.89	15.96	0.07
R33	Residential - Church Lane	16.19	16.29	0.10
R34	Residential - Church Lane	16.34	16.45	0.11
R35	Residential - Church Lane	15.82	15.89	0.07
R36	Residential - Station Road	15.48	15.51	0.03
R37	Residential - Station Road	15.73	15.78	0.05
R38	Residential - Ford Lane	15.92	15.98	0.07
R39	Residential - Ford Lane	15.69	15.74	0.05
R40	Residential - Henry Lock Way	17.10	17.15	0.05
R41	Residential - Willow Brook	17.37	17.44	0.06
R42	Residential - Colebrook Road	18.07	18.16	0.09
R43	Residential - Lyminster Road	17.81	17.83	0.02
R44	Residential - Lyminster Road	18.70	18.72	0.02
R45	Residential - Worthing Road	18.77	18.89	0.13
R46	Yapton Primary School	16.75	16.78	0.03
R47	Lyminster Primary School	18.33	18.42	0.09

As indicated in Table 20, predicted annual mean PM₁₀ concentrations were below the relevant AQO at all receptors in both scenario 4 and scenario 5 with a maximum increase of 0.16µg/m³ at R7.

Table 21 summarises the predicted change in PM₁₀ concentrations in 2030 with the full build out of the Proposed Development plus the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 21: Predicted Annual Mean PM₁₀ Concentrations (Scenario 4 and Scenario 6)

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 4	Scenario 6	Change
R1	Residential - North End Road	16.37	16.42	0.05
R2	Residential - North End Road	15.96	16.00	0.04
R3	Residential - North End Road	16.25	16.30	0.05
R4	Residential - North End Road	15.97	16.02	0.05
R5	Residential - North End Road	15.88	15.94	0.06
R6	Residential - Main Road	15.98	16.15	0.18
R7	Residential - Main Road	16.33	16.56	0.23
R8	Residential - Main Road	16.19	16.40	0.20
R9	Residential - Main Road	16.02	16.15	0.14
R10	Residential - Burndell Road	16.26	16.37	0.11
R11	Residential - Burndell Road	16.28	16.38	0.11
R12	Residential - Burndell Road	16.13	16.22	0.09
R13	Residential - Burndell Road	16.26	16.36	0.10
R14	Residential - Burndell Road	15.82	15.88	0.07
R15	Residential - Burndell Road	16.12	16.21	0.09
R16	Residential - Yapton Road	15.87	15.99	0.12
R17	Residential - Yapton Road	15.97	16.10	0.13
R18	Residential - Yapton Road	15.80	15.91	0.11
R19	Residential - Bilsham Road	15.94	16.04	0.10
R20	Residential - Bilsham Road	15.89	15.94	0.05
R21	Residential - Bilsham Road	16.15	16.21	0.07
R22	Residential - Bilsham Road	16.00	16.06	0.06
R23	Residential - Bilsham Road	15.60	15.63	0.03
R24	Residential - Bilsham Road	16.09	16.15	0.06
R25	Residential - Bilsham Road	15.90	15.94	0.05
R26	Residential - Bilsham Road	15.77	15.81	0.04
R27	Residential - Bilsham Road	15.72	15.76	0.04
R28	Residential - Bilsham Road	16.18	16.24	0.06
R29	Residential - Yapton Road	15.95	15.97	0.02
R30	Residential - Yapton Road	15.38	15.38	0.01
R31	Residential - Apple Barn Cottage	16.76	16.84	0.09
R32	Residential - Church Lane	15.89	15.97	0.08

Receptor		Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)		
		Scenario 4	Scenario 6	Change
R33	Residential - Church Lane	16.19	16.30	0.10
R34	Residential - Church Lane	16.34	16.46	0.12
R35	Residential - Church Lane	15.82	15.89	0.07
R36	Residential - Station Road	15.48	15.52	0.04
R37	Residential - Station Road	15.73	15.79	0.06
R38	Residential - Ford Lane	15.92	15.98	0.07
R39	Residential - Ford Lane	15.69	15.75	0.05
R40	Residential - Henry Lock Way	17.10	17.15	0.05
R41	Residential - Willow Brook	17.37	17.44	0.07
R42	Residential - Colebrook Road	18.07	18.16	0.09
R43	Residential - Lyminster Road	17.81	17.83	0.02
R44	Residential - Lyminster Road	18.70	18.72	0.02
R45	Residential - Worthing Road	18.77	18.90	0.13
R46	Yapton Primary School	16.75	16.79	0.04
R47	Lyminster Primary School	18.33	18.42	0.10

As indicated in Table 21, predicted annual mean PM₁₀ concentrations were below the relevant AQO at all receptors in both scenario 4 and scenario 6 with a maximum increase of 0.23µg/m³ at R7.

PM_{2.5} Concentrations

Table 22 summarises the predicted change in PM_{2.5} concentrations in 2024 with the full build out of the Proposed Development but without the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 22: Predicted Annual Mean PM_{2.5} Concentrations (Scenario 1 and Scenario 2)

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 1	Scenario 2	Change
R1	Residential - North End Road	10.46	10.49	0.03
R2	Residential - North End Road	10.22	10.24	0.02
R3	Residential - North End Road	10.39	10.42	0.03
R4	Residential - North End Road	10.23	10.25	0.02
R5	Residential - North End Road	10.18	10.20	0.03
R6	Residential - Main Road	10.23	10.30	0.07
R7	Residential - Main Road	10.44	10.53	0.10
R8	Residential - Main Road	10.36	10.44	0.09

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 1	Scenario 2	Change
R9	Residential - Main Road	10.26	10.32	0.06
R10	Residential - Burndell Road	10.40	10.46	0.06
R11	Residential - Burndell Road	10.41	10.47	0.06
R12	Residential - Burndell Road	10.32	10.38	0.05
R13	Residential - Burndell Road	10.40	10.46	0.06
R14	Residential - Burndell Road	10.14	10.17	0.04
R15	Residential - Burndell Road	10.31	10.37	0.05
R16	Residential - Yapton Road	10.17	10.24	0.07
R17	Residential - Yapton Road	10.22	10.30	0.08
R18	Residential - Yapton Road	10.13	10.19	0.06
R19	Residential - Bilsham Road	10.21	10.26	0.05
R20	Residential - Bilsham Road	10.18	10.20	0.03
R21	Residential - Bilsham Road	10.33	10.36	0.03
R22	Residential - Bilsham Road	10.24	10.27	0.03
R23	Residential - Bilsham Road	10.01	10.02	0.02
R24	Residential - Bilsham Road	10.30	10.33	0.03
R25	Residential - Bilsham Road	10.21	10.24	0.03
R26	Residential - Bilsham Road	10.13	10.15	0.02
R27	Residential - Bilsham Road	10.10	10.12	0.02
R28	Residential - Bilsham Road	10.40	10.44	0.03
R29	Residential - Yapton Road	10.25	10.27	0.01
R30	Residential - Yapton Road	9.89	9.89	0.01
R31	Residential - Apple Barn Cottage	10.76	10.81	0.05
R32	Residential - Church Lane	10.21	10.26	0.04
R33	Residential - Church Lane	10.40	10.46	0.06
R34	Residential - Church Lane	10.49	10.56	0.07
R35	Residential - Church Lane	10.17	10.21	0.04
R36	Residential - Station Road	9.95	9.97	0.02
R37	Residential - Station Road	10.11	10.14	0.03
R38	Residential - Ford Lane	10.23	10.27	0.04
R39	Residential - Ford Lane	10.09	10.12	0.03
R40	Residential - Henry Lock Way	11.48	11.51	0.03
R41	Residential - Willow Brook	11.64	11.68	0.04

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 1	Scenario 2	Change
R42	Residential - Colebrook Road	12.07	12.12	0.05
R43	Residential - Lyminster Road	11.92	11.93	0.01
R44	Residential - Lyminster Road	12.46	12.47	0.01
R45	Residential - Worthing Road	12.47	12.54	0.07
R46	Yapton Primary School	11.27	11.29	0.02
R47	Lyminster Primary School	12.22	12.28	0.05

As indicated in Table 22, predicted annual mean PM_{2.5} concentrations were below the relevant AQO at all receptors in both scenario 1 and 2 with a maximum increase of 0.10µg/m³ at R7.

Table 23 summarises the predicted change in PM_{2.5} concentrations in 2024 with the full build out of the Proposed Development plus the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 23: Predicted Annual Mean PM_{2.5} Concentrations (Scenario 1 and Scenario 3)

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 1	Scenario 3	Change
R1	Residential - North End Road	10.46	10.50	0.03
R2	Residential - North End Road	10.22	10.24	0.02
R3	Residential - North End Road	10.39	10.42	0.03
R4	Residential - North End Road	10.23	10.26	0.03
R5	Residential - North End Road	10.18	10.21	0.04
R6	Residential - Main Road	10.23	10.34	0.11
R7	Residential - Main Road	10.44	10.58	0.14
R8	Residential - Main Road	10.36	10.48	0.12
R9	Residential - Main Road	10.26	10.34	0.08
R10	Residential - Burndell Road	10.40	10.47	0.06
R11	Residential - Burndell Road	10.41	10.47	0.06
R12	Residential - Burndell Road	10.32	10.38	0.05
R13	Residential - Burndell Road	10.40	10.46	0.06
R14	Residential - Burndell Road	10.14	10.17	0.04
R15	Residential - Burndell Road	10.31	10.37	0.05
R16	Residential - Yapton Road	10.17	10.24	0.07
R17	Residential - Yapton Road	10.22	10.30	0.08
R18	Residential - Yapton Road	10.13	10.19	0.06
R19	Residential - Bilsham Road	10.21	10.27	0.06

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 1	Scenario 3	Change
R20	Residential - Bilsham Road	10.18	10.21	0.03
R21	Residential - Bilsham Road	10.33	10.37	0.04
R22	Residential - Bilsham Road	10.24	10.28	0.03
R23	Residential - Bilsham Road	10.01	10.03	0.02
R24	Residential - Bilsham Road	10.30	10.34	0.03
R25	Residential - Bilsham Road	10.21	10.24	0.03
R26	Residential - Bilsham Road	10.13	10.16	0.02
R27	Residential - Bilsham Road	10.10	10.13	0.02
R28	Residential - Bilsham Road	10.40	10.44	0.04
R29	Residential - Yapton Road	10.25	10.27	0.01
R30	Residential - Yapton Road	9.89	9.89	0.01
R31	Residential - Apple Barn Cottage	10.76	10.81	0.05
R32	Residential - Church Lane	10.21	10.26	0.05
R33	Residential - Church Lane	10.40	10.47	0.06
R34	Residential - Church Lane	10.49	10.57	0.07
R35	Residential - Church Lane	10.17	10.21	0.04
R36	Residential - Station Road	9.95	9.97	0.02
R37	Residential - Station Road	10.11	10.14	0.04
R38	Residential - Ford Lane	10.23	10.27	0.05
R39	Residential - Ford Lane	10.09	10.12	0.03
R40	Residential - Henry Lock Way	11.48	11.51	0.03
R41	Residential - Willow Brook	11.64	11.68	0.04
R42	Residential - Colebrook Road	12.07	12.12	0.05
R43	Residential - Lyminster Road	11.92	11.93	0.01
R44	Residential - Lyminster Road	12.46	12.47	0.01
R45	Residential - Worthing Road	12.47	12.54	0.07
R46	Yapton Primary School	11.27	11.30	0.02
R47	Lyminster Primary School	12.22	12.28	0.06

As indicated in Table 23, predicted annual mean PM₁₀ concentrations were below the relevant AQO at all receptors in both scenario 1 and scenario 3 with a maximum increase of 0.14µg/m³ at R7.

Table 24 summarises the predicted change in PM₁₀ concentrations in 2030 with the full build out of the Proposed Development but without the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 24: Predicted Annual Mean PM_{2.5} Concentrations (Scenario 4 and Scenario 5)

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 4	Scenario 5	Change
R1	Residential - North End Road	10.47	10.50	0.03
R2	Residential - North End Road	10.22	10.24	0.02
R3	Residential - North End Road	10.40	10.42	0.03
R4	Residential - North End Road	10.23	10.25	0.02
R5	Residential - North End Road	10.18	10.21	0.03
R6	Residential - Main Road	10.23	10.31	0.07
R7	Residential - Main Road	10.44	10.54	0.09
R8	Residential - Main Road	10.36	10.45	0.08
R9	Residential - Main Road	10.26	10.32	0.06
R10	Residential - Burndell Road	10.41	10.47	0.06
R11	Residential - Burndell Road	10.41	10.47	0.06
R12	Residential - Burndell Road	10.33	10.38	0.05
R13	Residential - Burndell Road	10.40	10.46	0.06
R14	Residential - Burndell Road	10.14	10.18	0.04
R15	Residential - Burndell Road	10.32	10.37	0.05
R16	Residential - Yapton Road	10.17	10.24	0.07
R17	Residential - Yapton Road	10.22	10.30	0.08
R18	Residential - Yapton Road	10.13	10.19	0.06
R19	Residential - Bilsham Road	10.22	10.26	0.05
R20	Residential - Bilsham Road	10.18	10.21	0.03
R21	Residential - Bilsham Road	10.33	10.37	0.03
R22	Residential - Bilsham Road	10.25	10.28	0.03
R23	Residential - Bilsham Road	10.01	10.03	0.02
R24	Residential - Bilsham Road	10.31	10.34	0.03
R25	Residential - Bilsham Road	10.21	10.24	0.03
R26	Residential - Bilsham Road	10.14	10.16	0.02
R27	Residential - Bilsham Road	10.11	10.13	0.02
R28	Residential - Bilsham Road	10.41	10.44	0.03
R29	Residential - Yapton Road	10.26	10.27	0.01
R30	Residential - Yapton Road	9.89	9.89	0.00
R31	Residential - Apple Barn Cottage	10.77	10.82	0.05
R32	Residential - Church Lane	10.21	10.26	0.05

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 4	Scenario 5	Change
R33	Residential - Church Lane	10.40	10.47	0.06
R34	Residential - Church Lane	10.50	10.57	0.07
R35	Residential - Church Lane	10.17	10.21	0.04
R36	Residential - Station Road	9.95	9.97	0.02
R37	Residential - Station Road	10.11	10.15	0.03
R38	Residential - Ford Lane	10.23	10.27	0.04
R39	Residential - Ford Lane	10.09	10.12	0.03
R40	Residential - Henry Lock Way	11.48	11.51	0.03
R41	Residential - Willow Brook	11.64	11.68	0.04
R42	Residential - Colebrook Road	12.08	12.13	0.05
R43	Residential - Lyminster Road	11.93	11.94	0.01
R44	Residential - Lyminster Road	12.47	12.48	0.01
R45	Residential - Worthing Road	12.48	12.55	0.08
R46	Yapton Primary School	11.28	11.29	0.02
R47	Lyminster Primary School	12.23	12.29	0.06

As indicated in Table 24, predicted annual mean PM_{2.5} concentrations were below the relevant AQO at all receptors in both scenario 4 and scenario 5 with a maximum increase of 0.09µg/m³ at R7.

Table 25 summarises the predicted change in PM_{2.5} concentrations in 2030 with the full build out of the Proposed Development plus the inclusion of additional traffic associated with the proposed secondary school and sixth form.

Table 25: Predicted Annual Mean PM_{2.5} Concentrations (Scenario 4 and Scenario 6)

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 4	Scenario 6	Change
R1	Residential - North End Road	10.47	10.50	0.03
R2	Residential - North End Road	10.22	10.25	0.02
R3	Residential - North End Road	10.40	10.43	0.03
R4	Residential - North End Road	10.23	10.26	0.03
R5	Residential - North End Road	10.18	10.21	0.04
R6	Residential - Main Road	10.23	10.34	0.10
R7	Residential - Main Road	10.44	10.58	0.14
R8	Residential - Main Road	10.36	10.48	0.12
R9	Residential - Main Road	10.26	10.35	0.08
R10	Residential - Burndell Road	10.41	10.47	0.06

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 4	Scenario 6	Change
R11	Residential - Burndell Road	10.41	10.48	0.06
R12	Residential - Burndell Road	10.33	10.38	0.06
R13	Residential - Burndell Road	10.40	10.46	0.06
R14	Residential - Burndell Road	10.14	10.18	0.04
R15	Residential - Burndell Road	10.32	10.37	0.05
R16	Residential - Yapton Road	10.17	10.24	0.07
R17	Residential - Yapton Road	10.22	10.30	0.08
R18	Residential - Yapton Road	10.13	10.19	0.06
R19	Residential - Bilsham Road	10.22	10.27	0.06
R20	Residential - Bilsham Road	10.18	10.21	0.03
R21	Residential - Bilsham Road	10.33	10.37	0.04
R22	Residential - Bilsham Road	10.25	10.28	0.03
R23	Residential - Bilsham Road	10.01	10.03	0.02
R24	Residential - Bilsham Road	10.31	10.34	0.04
R25	Residential - Bilsham Road	10.21	10.24	0.03
R26	Residential - Bilsham Road	10.14	10.16	0.03
R27	Residential - Bilsham Road	10.11	10.13	0.02
R28	Residential - Bilsham Road	10.41	10.44	0.04
R29	Residential - Yapton Road	10.26	10.27	0.01
R30	Residential - Yapton Road	9.89	9.89	0.01
R31	Residential - Apple Barn Cottage	10.77	10.82	0.05
R32	Residential - Church Lane	10.21	10.26	0.05
R33	Residential - Church Lane	10.40	10.47	0.07
R34	Residential - Church Lane	10.50	10.57	0.08
R35	Residential - Church Lane	10.17	10.21	0.05
R36	Residential - Station Road	9.95	9.98	0.02
R37	Residential - Station Road	10.11	10.15	0.04
R38	Residential - Ford Lane	10.23	10.27	0.05
R39	Residential - Ford Lane	10.09	10.12	0.03
R40	Residential - Henry Lock Way	11.48	11.51	0.03
R41	Residential - Willow Brook	11.64	11.68	0.04
R42	Residential - Colebrook Road	12.08	12.13	0.06
R43	Residential - Lymminster Road	11.93	11.94	0.01

Receptor		Predicted Annual Mean PM _{2.5} Concentration (µg/m ³)		
		Scenario 4	Scenario 6	Change
R44	Residential - Lyminster Road	12.47	12.48	0.01
R45	Residential - Worthing Road	12.48	12.56	0.08
R46	Yapton Primary School	11.28	11.30	0.02
R47	Lyminster Primary School	12.23	12.29	0.06

As indicated in Table 25, predicted annual mean PM_{2.5} concentrations were below the relevant AQO at all receptors in both scenario 4 and scenario 6 with a maximum increase of 0.14µg/m³ at R7.

7.2 Summary of Results

The results of the air quality assessment on existing sensitive receptors predict a negligible impact as a result of the Proposed Development both in 2024 and 2030, without and with the additional traffic associated with the proposed secondary school for all pollutants. With regards to the EPUK/IAQM guidance, the increases in NO₂, PM₁₀ and PM_{2.5} as a result of the proposals are all predicted to be 75% or less of the long-term average concentration and well below the relevant air quality objectives. Air quality impacts on existing sensitive receptors as a result of the Proposed Development are therefore considered to be not significant.

7.3 Impact on New Receptors

The Proposed Development has the potential to introduce new sensitive receptors into an area of poor quality and therefore an assessment of NO₂, PM₁₀ and PM_{2.5} concentrations at the Site has been undertaken at a number of locations along the south western boundary adjacent to Yapton Road.

Table 26 details the predicted pollutant concentrations for Scenarios 2 and 3 and Table 27 details the predicted pollutant concentrations for Scenarios 5 and 6.

Table 26: Predicted Pollutant Concentrations at Proposed Receptor Locations in 2024

Proposed Receptor	Scenario 2 Concentrations (µg/m ³)			Scenario 3 Concentrations (µg/m ³)		
	NO ₂	PM ₁₀	PM _{2.5}	NO ₂	PM ₁₀	PM _{2.5}
PR1	16.61	16.00	10.25	16.62	16.00	10.25
PR2	16.60	15.99	10.25	16.60	15.99	10.25
PR3	16.00	15.96	10.22	16.00	15.96	10.22
PR4	15.22	15.82	10.14	15.22	15.82	10.14
PR5	13.81	15.56	9.98	13.81	15.56	9.98
PR6	14.82	15.74	10.09	14.82	15.74	10.09

Table 27: Predicted Pollutant Concentrations at Proposed Receptor Locations in 2030

Proposed Receptor	Scenario 5 Concentrations (µg/m ³)			Scenario 6 Concentrations (µg/m ³)		
	NO ₂	PM ₁₀	PM _{2.5}	NO ₂	PM ₁₀	PM _{2.5}
PR1	16.67	16.00	10.25	16.67	16.00	10.25
PR2	16.65	16.00	10.25	16.65	16.00	10.25

Proposed Receptor	Scenario 5 Concentrations (µg/m³)			Scenario 6 Concentrations (µg/m³)		
	NO ₂	PM ₁₀	PM _{2.5}	NO ₂	PM ₁₀	PM _{2.5}
PR3	16.04	15.97	10.23	16.05	15.96	10.23
PR4	15.25	15.82	10.14	15.26	15.82	10.14
PR5	13.83	15.56	9.99	13.83	15.56	9.99
PR6	14.86	15.75	10.10	14.86	15.75	10.10

As no exceedances of any considered air quality objectives are predicted, this follows the 1st hierarchy principle of the IAQM guidance to 'prevent and avoid' exposure'. Therefore, no embedded mitigation into the Proposed Development design (in the form of mechanical ventilation, for example) is required.

8. Mitigation

The IAQM have released a position statement 'Mitigation of Development Air Quality Impacts' which provides guidance on determining appropriate mitigation measures for new development. This states:

'The IAQM position is that the appropriate mitigation solution for the operational air quality impact of any given general development scheme should be principle-led rather than specified by detailed prescription.'

The following hierarchy of principles is provided for use when determining an appropriate level of mitigation:

- Prevent or avoid;
- Reduction and minimisation; and
- Off-setting.

This air quality assessment has shown that impacts associated with additional vehicle emissions produced by the development are predicted to be negligible at all receptors. As such, mitigation to reduce potential impacts is not considered necessary. However, the following measures were identified for inclusion within the proposals in accordance with the IAQM 'Land-Use Planning & Development Control: Planning for Air Quality' guidance':

- Provision of Electric Vehicle (EV) "charge" points;
- Production of a Travel Plan;
- Inclusion of pedestrian pathways within the site layout to encourage walking; and
- All gas-fired boilers to meet a minimum standard of 40mgNO_x/kWh.

These methods are consistent with the requirements of 'Air Quality and Emissions Mitigation Guidance for Sussex' (2013).

The total monetary value of mitigation required can be quantified using a damage cost calculation. The calculation uses the EFT to determine the amount of transport related pollutant emissions a development is likely to produce. The output is then multiplied by the Interdepartmental Group on Costs and Benefits damage costs for the key pollutants, NO_x, PM₁₀ and PM_{2.5} and finally multiplied by 5 to provide a five-year exposure cost value. This is the value of mitigation that is expected to be spent on measures to reduce the impact of the proposed development. The damage cost has been calculated for 2030 without the inclusion of the proposed secondary school and sixth form. This is in line with the completion of the Local Plan.

This has been summarised in the following equation:

5 Year Exposure Cost Value = EFT Output x Damage Costs x 5

The total development trips (AADT) can be calculated by totalling the vehicles (two way) at the following locations.

- Yapton Level Crossing
- B2233 Yapton Road west of North End Road
- Bilsham Road south of Burndell Road mini
- Ford Level Crossing
- A259 West of Oystercatcher Junction
- A259 East of Church Lane Roundabout

Adding the flows gives 5253 AADT at these locations. The input data is summarised in Table 28.

Table 28: Emissions Calculation Inputs

Data	Value
Daily Traffic (generated by development)	5253
Assumed Average Speed (km/h)	50
Average Trip Length (km)	10
NO _x Output (tonnes/year): 2030	2.50582
PM ₁₀ Output (tonnes/year): 2030	0.61444
PM _{2.5} Output (tonnes/year): 2030	0.33882
NO _x Damage Cost (£/tonne)	6,199
PM ₁₀ Damage Cost (£/tonne) *	67,946
PM _{2.5} Damage Cost (£/tonne)	10,5836

*Calculated using PM conversion factor 0.642 as detailed in the DEFRA guidance

Using the inputs detailed above, the damage costs are calculated and are shown in Table 29

Table 29: Damage Costs

Data	Value
Annual Cost of NO _x Emissions (£)	15,533
Annual Cost of PM ₁₀ Emissions (£)	41,748
Annual Cost of PM _{2.5} Emissions (£)	35,859
Total Annual Exposure Cost Value (£)	93,141
Total Five-Year Exposure Cost Value (£)	465,708

As shown in Table 29, the emissions mitigation calculation determined that the development should include direct or indirect mitigation measures to reduce the air quality impacts of road traffic emissions equal to £465,708. This could include measures consistent with sustainable travel, for example.

9. Conclusions

This air quality assessment has been undertaken with the aim of predicting the potential impacts associated with a proposed mixed-use development on land at Ford Airfield.

This report presents the air quality assessment undertaken in relation to air pollution and dust emissions from the development proposals as well as predicting pollutant concentrations across the Proposed Development to assess the potential exposure of future occupiers to poor air quality

The conclusions of the assessment are as follows:

1. Robust mitigation against dust impacts should be adopted throughout the construction phase. These are likely to be detailed in a Construction Environmental Management Plan, or similar;
2. Based on the results of a dispersion modelling assessment, potential impacts on annual mean NO₂, PM₁₀ and PM_{2.5} concentrations associated with additional vehicle emissions from the Proposed Development are predicted to be negligible at all existing receptors in both 2024 and 2030, without and with the additional vehicle emissions associated with the proposed secondary school and sixth form. As such, impacts are not significant according to the EPUK/IAQM criteria; and
3. Based on the location of the Site and the results of a dispersion modelling study, it is considered highly unlikely that future occupiers will be exposed to levels of NO₂, PM₁₀ and PM_{2.5} above the air quality objectives.

As such, the Proposed Development does not conflict with the NPPF or policy QE DM3 of the Arun Local Plan 2011-2031.

Appendix A

The professional experience of the Hoare Lea Team preparing this report are as follows:

Dr Claire Holman, CSci, CEnv, FIEEnvSc, FIAQM

Claire is a Director and owner of Brook Cottage Consultants Ltd., which provides air quality expertise to a range of industrial and public sector clients. She provides an advisory role, reviewing and inputting at key stages of projects for Hoare Lea. She is currently the Chair of the Institute of Air Quality Management (IAQM).

Claire has worked on air quality management for over 35 years. She has experience of developing emission inventories, emission control, ambient monitoring, dispersion, cost benefit and cost-effectiveness analysis and policy development. She has undertaken numerous air quality assessments for new developments. She also advised governments in Europe, Asia and Africa, as well as the European Commission on strategic air quality and climate change issues for the development of policy and new regulations.

Claire is a chartered scientist, a chartered environmentalist, a fellow of the Institution of Environmental Science and a Fellow of IAQM.

Chris Rush, BSc (Hons), MSc, PG Dip Acoustics, CEnv, MIOA, MIEMA, MIEEnvSc, MIAQM

Chris is a Senior Associate Air Quality Consultant with Hoare Lea. He is a Chartered Environmentalist, a Member of the Institute of Acoustics, a Full Member of the Institute of Environmental Management and Assessment, a Member of the Institution of Environmental Sciences and a Member of the Institute of Air Quality Management.

He has a diverse portfolio of experience and has worked on a range of projects from initial site feasibility, through planning and development to construction and operation. Chris's expertise covers planning, noise and air quality, specifically in relation to residential developments, industrial fixed installations such as waste management centres and transportation environmental impacts on developments.

Matthew Stoling, BSc (Hon), FIAQM, MIES

Matt is Director and owner of Isopleth Ltd. He has 20 years' experience of working on air quality with expertise in odour assessment. He has undertaken numerous assessments of the impacts associated with a wide range of sectors including: residential, industrial and retail development, quarrying and mining, transport and infrastructure, renewable energy, intensive agriculture, waste management and wastewater treatment.

Charlotte Smith (Hoare Lea), BSc (Hons) AMIEnvSc, AMIAQM

Charlotte is a Senior Air Quality Consultant at Hoare Lea with over five years' experience in air quality consultancy. She has worked on a range of projects across a number of industries including residential, educational, commercial and industrial for site feasibility studies, planning applications and Environmental Impact Assessments. She also has experience in air quality monitoring at sites ranging from residential and educational facilities to large road network schemes. Charlotte's interests lie in the effects that pollution has on human health and wellbeing.



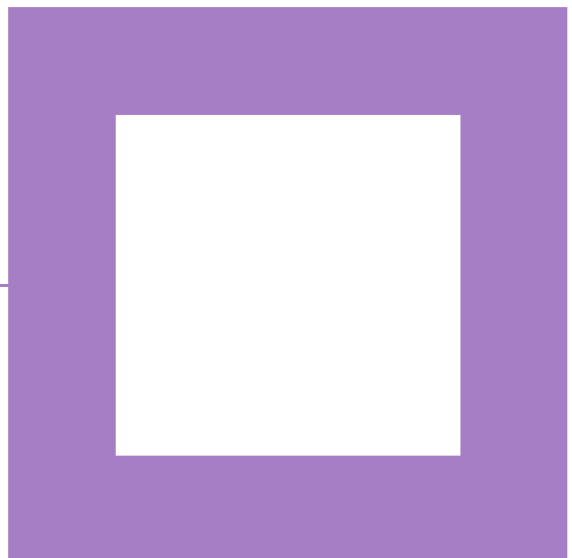
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Appendix 2.

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LIMITED**

**CIRCULAR TECHNOLOGY PARK -
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**GRUNDON WASTE MANAGEMENT LIMITED
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Document Production & Approval Record				
ISSUE NO. 2	NAME	SIGNATURE	POSITION	DATE
<i>Prepared by:</i>	Rosalind Spain		Consultant	19/09/13
<i>Checked by:</i>	Stephen Othen		Technical Director	09/09/13

Document Revision Record		
ISSUE NO.	DATE	DETAILS OF REVISIONS
1	09/09/13	First draft
2	19/09/2013	FINAL following client comments
3		
4		

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MANAGEMENT SUMMARY

Fichtner Consulting Engineers Ltd ("Fichtner") has been engaged to undertake an Air Quality Assessment to support the planning application for the proposed waste treatment facility at the new Circular Technology Park on the former Tarmac Topblock site at Ford Airfield, Arundel. The proposed development will include:

- A Reception/Pre-treatment building, which will house a Materials Recovery Facility (MRF), and enable up to 60,000 tonnes of material to be recycled; and,
- A Residual Waste Treatment Facility employing gasification technology with a capacity of 140,000 tpa, which will convert residual waste that cannot be recycled or recovered into energy in the form of electricity and heat.

Other potential activities (such as the operation of a plastics recovery plant), that may be carried out at the Circular Technology Park in the future, have been considered as part of this assessment, when appropriate. However such activities, which are likely to be of a relatively small scale, are not included as part of the current proposals and would be subject to a separate submission in due course.

The main air quality impacts of the proposals include:

- Process emission from the Residual Waste Treatment Facility process;
- Vehicle emissions associated with the import and export of waste; and
- Odour emissions from the operation of the overall waste treatment facility as well as the transport of waste.

This assessment addresses each of these in addition to the visual impact of the plume.

The assessment has been carried out in a number of stages.

(1) Review of Legislation

In the UK, the levels of pollution in the atmosphere are controlled by a number of European Directives, which have been fully implemented, and by the National Air Quality Strategy. These have led to the setting of a number of Air Quality Objectives (AQOs) for the most significant pollutants, such as oxides of nitrogen and particulate matter. The AQOs are set at a level well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups.

For other pollutants, the Environment Agency sets control levels, called Environmental Assessment Levels, based on work by the World Health Organisation and other national and international bodies.

The Environment Agency sets Critical Levels for the protection of ecosystems. In addition it is noted that deposition of nitrogen and acid gases can cause eutrophication and acidification of habitats. The Air Pollution Information System provides Critical Loads for different habitats which consider the existing pollution loading for the site.

(2) Review of Ambient Air Quality

Monitoring information collected by the UK Government and by local authorities has been used to assess the current levels of pollutants in the atmosphere close to the facility. This has shown that baseline pollutant concentrations are low.

Where local monitoring data is not available, conservative estimates based on national UK monitoring results have been used as a background concentration.

(3) Identification of Sensitive Receptors

When assessing the impact of the development, the assessment considers the point of maximum impact as a worst-case. In addition, the impact has been assessed at a number of identified sensitive receptors including the closest houses, local schools, all European and UK statutory designated ecological sites within 15km of the facility, and all non-statutory designated ecological sites within 2km.

(4) Dispersion Modelling of Emissions

The ADMS 5.0 dispersion model is routinely used for air quality assessments to the satisfaction of local authorities and the Environment Agency. The model uses weather data from the local area was used to predict the spread and movement of the exhaust gases from the stack for each hour over a five year period. The model takes account of wind speed, wind direction, temperature, humidity and the amount of cloud cover, as all of these have an influence on the dispersion of emissions. The model also takes account of the effects of buildings and terrain on the movement of air.

To set up the model, it has been assumed that the plant operates for the whole year and releases emissions at the emission limit all the time. In reality, this is very conservative as the plant will run below the emission limit and will be offline for about 10% of the year for maintenance.

The model was used to predict the ground level concentration of pollutants on a long term and short term basis across a grid of points. In addition concentrations were predicted at the identified sensitive receptors.

(5) Sensitivity of the Model

A detailed analysis of the sensitivity of the model to changes in assumptions has been undertaken to ensure that the most appropriate input parameters have been used.

As part of the sensitivity analysis, a stack height assessment has been undertaken to determine the most suitable stack height of the facility. This included consideration of the impact of emissions at both the point of maximum impact and at local sensitive receptors.

(6) Approach and Assessment of Impact on Air Quality – Protection of Human Health

The impact of air quality on human health has been assessed using a standard approach.

- a) The Environment Agency has stated that the contribution to air quality can be screened out as 'insignificant' if the short term contribution is less than 10% of the air quality objective and the long term contribution is less than 1% of the air quality objective. These screening criteria have been applied initially.
- b) For those pollutants which are not screened out, guidance from Environmental Protection UK has been used for further evaluation. Environmental Protection UK recommend that the magnitude of the impact be described as 'imperceptible', 'small', 'medium' or 'large' and that the significance be described as 'negligible', 'slight adverse', 'moderate adverse' or 'substantial adverse'. In each case, these terms are defined before carrying out the assessment.

The impact of many pollutants on human health can be screened out as 'insignificant'. For those which cannot be screened out, the impact can be described as 'negligible' at all points outside the site boundary.

The Environment Agency approach to assessing the impact of metals has been used which considers the risk of exceeding the EAL based on the existing background levels and contribution from the facility. Using this approach there is no risk of exceeding the EAL, when taking into account that the facility will incorporate a flue gas cleaning system to remove heavy metals.

(7) Approach and Assessment of Impact on Air Quality – Protection of Ecosystems

The impact of air quality on ecosystems has been assessed using a standard approach.

- a) The Environment Agency has stated that, if the contribution within the entire site is less than 1% of the long-term benchmark, the emissions are not likely to have a significant effect either alone or in combination with other sources of pollutants, irrespective of background levels.
- b) If the process contribution is greater than 1% of the relevant long-term benchmark, but the total predicted concentration including background levels is less than 70% of the relevant long-term benchmark, the Environment Agency has stated that the emissions are not likely to have a significant effect.

The modelling shows that, for all statutory designated sites within 10 km, the emissions are not likely to have a significant effect alone or in combination with other sources, irrespective of background levels.

At the local ancient woodland site, concentrations of oxides of nitrogen and sulphur dioxide are predicted to be greater than 1% of the Critical Level. However, when background levels are considered, it can be shown that the emissions are not likely to have a significant effect.

(8) Approach and Assessment of Impact on Air Quality – Deposition of Emissions

The impact of the deposition of nitrogen and acid gases on sensitive habitats has been assessed using a standard approach.

- a) It has been assumed that the facility will operate at the limit values whereas actual operational emission concentrations will be lower.
- b) It has been assumed that all habitats are present at the point of greatest impact.
- c) The impact has been calculated based on the maximum predicted concentration over a 5-year period at each ecological site and applying conservative deposition assumptions from the Environment Agency.
- d) The results have been compared to habitat specific Critical Loads and existing background deposition rates.

The impact of the emissions at all statutory designated sites located is less than 1% of the minimum Critical Load for nitrogen and acid deposition and so emissions are not likely to have a significant effect alone or in combination irrespective of background levels.

(9) Visual Impact of Plume

The visual impact of the plume has been investigated and the results compared to the Environment Agency assessment methodology. The impact of the visible plume from the stack on the facility is 'insignificant'.

(10) Traffic Emissions

The impact of traffic emissions associated with the operational phase can be screened out from further assessment using the DMRB screening criteria and so the impact is considered to be negligible.

(11) Odour

Based on the distance to the nearest sensitive receptor and the mechanisms to be in place to control odorous releases, the impact of operational phase odour emissions from the proposed development is considered to be negligible.

(12) Construction Assessment

The impact of construction phase activities has been addressed using the Institute of Air Quality Management's (IAQM) recommended methodology based on the risk of the site giving rise to dust and sensitivity of the surrounding area. The significance of construction phase dust impacts is predicted to be negligible, providing that any measures to control dust required by legislation are implemented.

(13) Cumulative Process Emissions

Dispersion modelling has been undertaken to determine the cumulative effect of emissions from the Residual Waste Treatment Facility and the local CHP unit. This has shown that the cumulative impact would be well below the AQOs and as such the cumulative effect of emissions should not be seen as a constraint to the development.

(14) Assessment of Impact on Human Health

For most pollutants, the main route for human exposure is through inhalation. However, some pollutants can accumulate in the environment so that the primary route for human exposure is through ingestion in food. For these pollutants, which include dioxins, furans and heavy metals, a detailed human health risk assessment has been carried out to consider all of the following routes for human exposure:

- a) Inhalation of gaseous emissions;
- b) Vapour phase transfer of gaseous emissions to plants and subsequent ingestion of food by animals and humans; and

- c) Deposition of dust to soil, followed by;
 - i) Ingestion of soil attached to unwashed vegetables, during gardening and, for children, during play; or
 - ii) Uptake of pollutants into plants and subsequent ingestion of food.

For ingestion of food, the model takes account of the proportion of home-grown vegetables which are consumed, with a higher level assumed for farmers.

The model predicts the total exposure to the various pollutants and compares this with standard intake criteria, in order to assess the predicted increase in health risks.

The assessment concludes that the facility would not have a significant impact on human health.

In summary, a comprehensive assessment of the impact of the proposed waste treatment facility at the new Circular Technology Park on local air quality and human health has been carried out and this has demonstrated that the facility would not have a significant impact on local air quality, the general population or the local community.

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1 INTRODUCTION

1.1 Background

Grundon Waste Management Ltd is proposing to develop a waste treatment facility at the new Circular Technology Park on the Former Tarmac Topblock site at Ford Airfield, Arundel. The proposed development will include:

- A Reception/Pre-treatment building, which will house a Materials Recovery Facility (MRF) and will enable up to 60,000 tonnes of material to be recycled; and,
- A Residual Waste Treatment Facility employing gasification technology with a capacity of 140,000 tpa, which will convert residual waste that cannot be recycled or recovered into energy in the form of electricity and heat.

Other potential activities (such as the operation of a plastics recovery plant), that may be carried out at the Circular Technology Park in the future, have been considered as part of this assessment, when appropriate. However such activities, which are likely to be of a relatively small scale, are not included as part of the current proposals and would be subject to a separate submission in due course.

The main air quality impacts of the proposals include:

- Process emission from the Residual Waste Treatment Facility process;
- Vehicle emissions associated with the import and export of waste; and
- Odour emissions from the operation of the overall waste treatment facility as well as the transport of waste.

This assessment addresses each of these in addition to the visual impact of the plume.

The Residual Waste Treatment Facility would process circa 140,000 tpa of waste feedstock comprising of waste produced mainly from commercial and industrial premises.

The facility will require an Environmental Permit to operate which will include limits on emissions to air based on those outlined in Annex VI of the IED for waste incineration plants. This will include limits on emissions of oxides of nitrogen, sulphur dioxide, heavy metals and dioxins and furans. This assessment considers the impact of the pollutants potentially released from the facility on human health and ecosystems.

When considering the impact on human health, the predicted atmospheric concentrations have been compared to the Air Quality Objectives (AQOs) and Environmental Assessment Levels (EALs) for the protection of human health. It is noted that for some pollutants such as metals and dioxins they have the potential to accumulate within the environment. A separate human health impact assessment has been undertaken to assess the pathway intake of these pollutants and impacts compared to the Tolerable Daily Intakes (TDIs). This is attached as Appendix H.

When considering the impact on ecosystems the predicted atmospheric concentrations have been compared to the Critical Levels for the protection of ecosystems. It is noted that deposition of emissions over a prolonged period can have nitrification and acidification impacts. An assessment of the long term deposition of pollutants has been undertaken and the results compared to the habitat specific Critical Loads.

1.2 Structure of Report

This report has the following structure.

- National and international air quality legislation and guidance, and local planning policies which relate to air quality, are considered in section 2.
- The assessment methodology is outlined in section 3.
- The current levels of ambient air quality are described in section 4.
- Section 5 highlights residential properties and ecological receptors in the vicinity of the proposed development.

- Section 6 outlines the assessment methodology including screening criteria to be used when assessing the impact of emissions from the facility.
- The inputs used for the dispersion model are contained within section 7.
- Section 8 presents the results of the stack height assessment.
- The impact of emissions assuming the facility complies with the daily emission limit values is presented in section 9.
- Section 10 presents the assessment methodology and results of the assessment of the impact of long term deposition of emissions at ecological sites.
- The impact of emissions assuming the facility complies with the half-hourly emission limit values is presented in section 11.
- The visual impact of the plume is presented in section 12.
- Section 13 details the screening of operational phase traffic emissions.
- The impact of odour emissions from the facility is assessed in section 14.
- Section 15 presents the assessment of construction phase impacts.
- The cumulative impact of emissions from the Residual Waste Treatment Facility and other identified sources within 5km can be found in section 16.
- The conclusions of the assessment can be found in section 17.
- The Appendices include illustrative figures and detailed results tables.

2 LEGISLATION

2.1 European legislation

European air quality legislation is consolidated under Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidates previous legislation which was designed to deal with specific pollutants in a consistent manner and provides new air quality objectives for fine particulates. The consolidated Directives include:

- Directive 99/30/EC – the First Air Quality "Daughter" Directive – which sets ambient air limit values for nitrogen dioxide and oxides of nitrogen, sulphur dioxide, lead and particulate matter;
- Directive 2000/69/EC – the Second Air Quality "Daughter" Directive – which sets ambient air limit values for benzene and carbon monoxide; and
- Directive 2002/3/EC – the Third Air Quality "Daughter" Directive – which seeks to establish long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

The fourth daughter Directive – 2004/107/EC – was not included within the consolidation. It sets health-based limits on polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.

2.2 UK legislation

Directives 2008/50/EC and 2004/107/EC are transposed under UK Law into the Air Quality Standards Regulations (2010).

The UK Air Quality Strategy (2007) is the method of implementation of the air quality limit values in England, Scotland, Wales and Northern Ireland.

The Air Quality Strategy defines "standards" and "objectives" in paragraph 17:

"For the purposes of the strategy

- *standards are the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive subgroups or on ecosystems*
- *objectives are policy targets often expressed as a maximum ambient concentration not to be exceeded, either without exception or with a permitted number of exceedences, within a specified timescale."*

The status of the objectives is clarified in paragraph 22, which also emphasises the importance of European Directives.

"The air quality objectives in the Air Quality Strategy are a statement of policy intentions or policy targets. As such, there is no legal requirement to meet these objectives except in as far as these mirror any equivalent legally binding limit values in EU legislation. Where UK standards or objectives are the sole consideration, there is no legal obligation upon regulators, to set Emission Limit Values (ELVs) any more stringent than the emission levels associated with the use of Best Available Techniques (BAT) in issuing permits under the PPC Regulations. This aspect is dealt with fully in the PPC Practical Guides."

3 AIR QUALITY STANDARDS, OBJECTIVES AND GUIDELINES

In the UK, air quality standards and objectives (AQOs) for major pollutants are described in The Air Quality Strategy (AQS).

The Environment Agency includes Environmental Assessment Levels (EALs) for other pollutants in Environmental Agency Horizontal Guidance Note H1 - Annex F. The long term and short term EALs from this document have been used when the Air Quality Strategy does not contain relevant objectives.

Both AQOs and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups.

Standards and objectives for the protection of sensitive ecosystems and habitats are also contained within Environmental Agency Horizontal Guidance Note H1 - Annex F.

3.1 Nitrogen dioxide

All combustion processes produce nitric oxide (NO) and nitrogen dioxide (NO₂), known by the general term of nitrogen oxides (NO_x). In general, the majority of the NO_x released is in the form of NO, which then reacts with ozone in the atmosphere to form nitrogen dioxide. Of the two compounds, nitrogen dioxide is associated with adverse effects on human health, principally relating to respiratory illness. The World Health Organisation (WHO) has stated that "many chemical species of nitrogen oxides exist, but the air pollutant species of most interest from the point of view of human health is nitrogen dioxide".

The major sources of NO_x in the UK are road transport and power stations. According to the most recent annual report from the National Atmospheric Emissions Inventory (NAEI), road transport accounted for 37% of UK emissions, with power stations accounting for a further 27%. High levels of NO_x in urban areas are almost always associated with high traffic densities.

The AQS includes two objectives to be achieved by 31st December 2005. Both of these objectives are included in the Air Quality Directive, with an achievement date of 1st January 2010.

- A limit for the one-hour mean of 200 µg/m³, not to be exceeded more than 18 times a year (equivalent to the 99.79th percentile).
- A limit for the annual mean of 40 µg/m³.

In addition, the AQS includes objectives for the protection of sensitive vegetation and ecosystems of 30 µg/m³ for the annual mean, and 75 µg/m³ for the daily mean concentration of nitrogen oxides.

3.2 Sulphur dioxide

Sulphur dioxide is predominantly released by the combustion of fuels containing sulphur. Around 68% of UK emissions in 2004 were associated with power stations, with much of the remainder associated with other combustion processes. Emissions of sulphur dioxide have reduced by 87% since 1970, due to a reduction in the number of coal fired combustion plants, the installation of flue gas desulphurisation plants on a number of large coal-fired power stations and the reduction in sulphur content of liquid fuels.

The AQS contains three objectives for the control of sulphur dioxide:

- A limit for the 15 minute mean of 266 µg/m³, not to be exceeded more than 35 times a year (the 99.9th percentile) to be achieved by 31st December 2005.
- A limit for the one hour mean of 350 µg/m³, not to be exceeded more than 24 times a year (the 99.73rd percentile) to be achieved by 31st December 2004.
- A limit for the daily mean of 125 µg/m³, not to be exceeded more than 3 times a year (the 99.2nd percentile) to be achieved by 31st December 2004.

The hourly and daily objectives are included in the Air Quality Directive.

In addition, the AQS includes two objectives for the protection of vegetation and ecosystems. These are a concentration of 20 $\mu\text{g}/\text{m}^3$ (reduced to 10 $\mu\text{g}/\text{m}^3$ where lichens or bryophytes are present) as an annual mean and as a winter average.

3.3 Particulate matter

Concerns over the health impact of solid matter suspended in the atmosphere tend to focus on particles with a diameter of less than 10 μm , known as PM_{10}s . These particles have the ability to enter and remain in the lungs. Various epidemiological studies have shown increases in mortality associated with high levels of PM_{10}s , although the underlying mechanism for this effect is not yet understood. Significant sources of PM_{10}s are road transport (22%), quarrying (16%) and stationary combustion (34%).

The AQS includes two objectives for PM_{10}s to be achieved by the end of 2004, both of which are included in the Air Quality Directive.

- A limit for the annual mean of 40 $\mu\text{g}/\text{m}^3$, to be achieved by 2004.
- A daily limit of 50 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year (the 90.4th percentile) to be achieved by 2004.

The previous AQS included some provisional objectives for 2010. These have been replaced by an exposure reduction objective for $\text{PM}_{2.5}\text{s}$ in urban areas and a target value for $\text{PM}_{2.5}\text{s}$ of 25 $\mu\text{g}/\text{m}^3$ as an annual mean. This target value is included in the Air Quality Directive.

3.4 Carbon monoxide

Carbon monoxide is produced by the incomplete combustion of fuels containing carbon. By far the most significant source is road transport, which produces 67% of the UK's emissions. Carbon monoxide can interfere with the processes that transport oxygen around the body, which can prove fatal at very high levels.

Concentrations in the UK are well below levels at which health effects can occur. The AQS includes the following objective for the control of carbon monoxide, which is also included in the Air Quality Directive:

- A limit for the 8-hour running mean of 10 mg/m^3 , to be achieved by 1st January 2005.

3.5 Hydrogen chloride

There are no AQOs for hydrogen chloride contained within the AQS. However Environment Agency Horizontal Guidance Note H1 Annex F defines the short term EAL as 750 $\mu\text{g}/\text{m}^3$. There is no long-term EAL.

3.6 Hydrogen fluoride

There are no AQOs for hydrogen fluoride contained within the AQS. However Environment Agency Horizontal Guidance Note H1 Annex F defines the short term EAL as 160 $\mu\text{g}/\text{m}^3$ and the long term EAL as 16 $\mu\text{g}/\text{m}^3$.

Appendix B to Annex F of the Environment Agency Horizontal Guidance Note H1 also provides Critical Levels for the protection of vegetation and ecosystems of 5 $\mu\text{g}/\text{m}^3$ as a daily mean and 0.5 $\mu\text{g}/\text{m}^3$ as a weekly mean concentration of hydrogen fluoride.

3.7 Ammonia

There are no AQOs for ammonia contained within the AQS. However Environment Agency Horizontal Guidance Note H1 Annex F defines the short term EAL as 2,500 $\mu\text{g}/\text{m}^3$ and the long term EAL as 180 $\mu\text{g}/\text{m}^3$.

In addition, Appendix B to Annex F of the Environment Agency Horizontal Guidance Note H1 also provides Critical Levels for the protection of vegetation and ecosystems. These are a concentration of 3 $\mu\text{g}/\text{m}^3$ as an annual mean, reduced to 1 $\mu\text{g}/\text{m}^3$ where lichens or bryophytes are present.

3.8 Metals

Lead is the only metal included in the AQS. Lead can have many health effects, including effects on the synthesis of haemoglobin, the nervous system and the kidneys. Emissions of lead in the UK have declined by 98% since 1970, due principally to the virtual elimination of leaded petrol.

The AQS includes objectives to limit the annual mean to 0.5 $\mu\text{g}/\text{m}^3$ by the end of 2004 and to 0.25 $\mu\text{g}/\text{m}^3$ by the end of 2008. Only the first objective is included in the Air Quality Directive.

The fourth Daughter Directive on air quality (Commission Decision 2004/107/EC) includes target values for arsenic, cadmium and nickel. However, the preamble to the Directive makes it clear that the use of these target values is relatively limited. Paragraph (5) states:

"The target values would not require any measures entailing disproportionate costs. Regarding industrial installations, they would not involve measures beyond the application of best available techniques (BAT) as required by Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control (5) and in particular would not lead to the closure of installations. However, they would require Member States to take all cost-effective abatement measures in the relevant sectors."

And paragraph (6) states:

"In particular, the target values of this Directive are not to be considered as environmental quality standards as defined in Article 2(7) of Directive 96/61/EC and which, according to Article 10 of that Directive, require stricter conditions than those achievable by the use of BAT."

Although these target values have been included in the assessment, it is important to note that the application of the target values would not have an effect on the design or operation of facility. The facility will be designed in accordance with BAT and will include cost effective methods for the abatement of arsenic, cadmium and nickel, including the injection of activated carbon and a fabric filter.

Emissions limits have been set in Environmental Permits for similar facilities for a number of heavy metals which do not have air quality standards associated with them. The EALs for these metals, and lead, are summarised in Table 3.1.

Table 3.1: Environmental Assessment Levels (EALs) for Metals

Metal	Daughter Directive Target Level ($\mu\text{g}/\text{m}^3$)	EALs ($\mu\text{g}/\text{m}^3$)	
		Long Term	Short Term
Arsenic	0.006	0.003	-
Antimony	-	5	150
Cadmium	0.005	0.005	-
Chromium (II & III)	-	5	150
Chromium (VI)	-	0.0002	-
Cobalt	-	-	-
Copper	-	10	200
Lead	-	0.25	-
Manganese	-	0.15	1500
Mercury	-	0.25	7.5
Nickel	0.020	0.020	-
Thallium	-	-	-
Vanadium	-	5	1

The EALs in Appendix B to Annex F of the Environment Agency Horizontal Guidance Note H1 take into account the guidelines for metals and metalloids in ambient air for the protection of human health produced by EPAQS in 2009.

3.9 Volatile Organic Compounds (VOCs)

A variety of VOCs could be released from the stack, of which benzene and 1,3-butadiene are included in the AQS and monitored at various stations around the UK. The AQS includes the following objectives for the running annual mean:

- Benzene 5 $\mu\text{g}/\text{m}^3$, to be achieved by 2010.
- 1,3-butadiene 2.25 $\mu\text{g}/\text{m}^3$, to be achieved by 2003.

There are no short-term AQO/EALs for either benzene or 1,3-butadiene.

3.10 Dioxins and furans

Dioxins and furans are a group of organic compounds with similar structures, which are formed as a result of combustion in the presence of chlorine. Principal sources include steel production, power generation, coal combustion and uncontrolled combustion, such as bonfires. The Municipal Waste Incineration Directive and UK legislation imposed strict limits on dioxin emissions in 1995, with the result that current emissions from incineration of municipal solid waste in the UK in 1999 were less than 1% of the emissions from waste incinerators in 1995. The Waste Incineration Directive, now included in the IED, imposes even lower limits, reducing the limit to one tenth of the previously permitted level.

One dioxin, 2,3,7,8-TCDD, is a definite carcinogen and a number of other dioxins and furans are considered to be possible carcinogens. A tolerable daily intake (TDI) for Dioxins, furans and dioxins like PCBs has been recommended by the Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment of 2 pg I-TEQ per kg bodyweight per day.

Dioxins are not normally compared with set EALs, but the probable ingestion rates of dioxins by different groups of people is considered as part of the Human Health Risk Assessment contained as a separate document within the application.

3.11 Polychlorinated biphenyl (PCBs)

PCBs have high thermal, chemical and electrical stability and were manufactured in large quantities in the UK between the 1950s and mid 1970s. Commercial PCB mixtures, which contained a range of dioxin-like and non-dioxin like congeners, were sold under a variety of trade names, the most common in the UK being the Aroclor mixtures. UK legislative restrictions on the use of PCBs were first introduced in the early 1970s.

Although now banned from production current atmospheric levels of PCBs are due to the ongoing primary anthropogenic emissions (e.g. accidental release of products or materials containing PCBs), volatilisation from environmental reservoirs which have previously received PCBs (e.g. sea and soil) or incidental formation of some congeners during the combustion process.

There are no AQOs for PCBs contained within the AQS. However Environment Agency Horizontal Guidance Note H1 Annex F defines the short term EAL as $6 \mu\text{g}/\text{m}^3$ and the long term EAL as $0.2 \mu\text{g}/\text{m}^3$.

A number of PCBs are considered to possess dioxin like toxicity and are known as dioxin-like PCBs. The total intake from dioxins, furans and dioxins like PCBs is compared to the TDI for dioxins, furans and dioxin like PCBs as part of the Human Health Risk Assessment contained as a separate document within the application.

3.12 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are members of a large group of organic compounds widely distributed in the atmosphere. The best known PAH is benzo[a]pyrene (B[a]P). The AQS included an objective to limit the annual mean of B[a]P to $0.25 \text{ ng}/\text{m}^3$ by the end of 2010. This goes beyond the requirements of European Directives, since the fourth Daughter Directive on air quality (Commission Decision 2004/107/EC) includes a target value for benzo(a)pyrene of $1 \text{ ng}/\text{m}^3$ as an annual mean.

3.13 Summary

Table 3.2 summarises the air quality objectives and guidelines used in the air quality assessment. The sources for each of the values can be found in the preceding sections.

Table 3.2: Air Quality Standards (AQS) and Environmental Assessment Levels (EALs)

Pollutant	Limit Value ($\mu\text{g}/\text{m}^3$)	Averaging Period	Frequency of Exceedence
Nitrogen dioxide	200	1 hour	18 times per year (99.79 th percentile)
	40	Annual	-
Sulphur dioxide	266	15 minutes	35 times per year (99.9 th percentile)
	350	1 hour	24 times per year (99.73 rd percentile)
	125	24 hours	3 times per year (99.18 th percentile)

Table 3.2: Air Quality Standards (AQS) and Environmental Assessment Levels (EALs)

Particulate matter (PM ₁₀)	50	24 hours	7 times per year (98.1 th percentile)
	40	Annual	-
Particulate matter (PM _{2.5})	25	Annual	-
Carbon monoxide	10,000	8 hours, running	-
Hydrogen chloride	750	1 hour	-
Hydrogen fluoride	160	1 hour	-
	16	Annual	-
Ammonia	2,500	1 hour	-
	180	Annual	-
Lead	0.25	Annual	-
Benzene	5.00	Annual	-
1,3-butadiene	2.25	Annual, running	-
PCBs	6	1-hour	-
	0.2	Annual	-
PAHs	0.00025	Annual	-

Table 3.3 Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m ³)	Measured as
Nitrogen oxides (as nitrogen dioxide)	75	Daily mean
	30	Annual mean
Sulphur dioxide	10	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystems integrity
	20	Annual mean for all higher plants
Hydrogen fluoride	<5	Daily mean
	<0.5	Weekly mean
Ammonia	1	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystems integrity
	3	Annual mean for all higher plants

4 BASELINE AIR QUALITY

The facility is to be located at the new Circular Technology Park on the former Tarmac Topblock site at Ford Airfield, Arundel. In this section, we have reviewed the baseline air quality and defined appropriate background concentrations to be used within this assessment.

4.1 Air quality review and assessment

As required under Section 82 of the Environment Act (1995) (Part IV), Arun District Council have conducted ongoing exercises to review air quality within their area of jurisdiction. This has shown that there is no risk that the Air Quality Objectives (AQOs) will not be met within the district. As such there are no Air Quality Management Areas (AQMAs) in the district.

The closest AQMA is located approximately 10 km to the west of the site in Chichester. Due to the distance and orientation from the site, it is not considered that this will be a constraint on any development at the site.

4.2 National modelling – mapped background data

In order to assist local authorities with their responsibilities under Local Air Quality Management (LAQM), the Department for the Environment Food and Rural Affairs (DEFRA) provides modelled background concentrations of pollutants throughout the UK on a 1 km by 1 km grid. This model is based on known pollution sources and is used by local authorities in lieu of suitable monitoring data. Mapped background concentrations have been downloaded for the grid square containing the proposed facility. In addition mapped atmospheric concentrations of ammonia are available from DEFRA throughout the UK on a 5 km by 5 km grid. A summary of the mapped background data is presented in Table 4.1.

Table 4.1: Mapped Background Data – at Facility

Pollutant	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)	Dataset
Nitrogen dioxide	13.46	2010 mapped background 2010 dataset
Oxides of nitrogen	18.17	2010 mapped background 2010 dataset
Sulphur dioxide	2.46	2001 mapped background 2001 dataset
Particulate matter (as PM_{10})	14.94	2010 mapped background 2010 dataset
Particulate matter (as $\text{PM}_{2.5}$)	10.08	2010 mapped background 2010 dataset
Carbon monoxide	228	2001 mapped background 2001 dataset
Benzene	0.25	2001 mapped background 2001 dataset
1,3 butadiene	0.11	2001 mapped background 2001 dataset
Ammonia	1.66	2011 mapped background

The data is calibrated using background measurements; for instance, the 2010 mapped background dataset is calibrated against monitoring undertaken in 2010. This dataset has then been projected for future years based on assumed trends.

It is now widely recognised that elevated nitrogen dioxide concentrations during 2010 mean that the projected background concentrations within these maps may be higher than is to be expected in a typical year. As a conservative approach, the mapped background concentration for the year in which the data was validated has been used for the purpose of this assessment. This eliminates any potential uncertainties over anticipated trends in future background concentrations and provides a conservative estimate.

The mapped background dataset for ammonia has been derived from the DEFRA UK deposition maps. These have been generated using the FRAME model which utilises an ammonia emissions inventory including national data of farm animal numbers as well as fertiliser application, crops and non-agricultural emissions. Analysis of the dataset has shown that the mapped background ammonia concentration has been increasing in the area. The latest mapped ammonia data has therefore been used. No projections are made with regards to future background ammonia concentrations.

4.3 AURN and LAQM monitoring data

The UK Automatic Urban and Rural Network (AURN) is a country-wide network of air quality monitoring stations operated on behalf of the DEFRA this includes automatic monitoring of oxides of nitrogen, nitrogen dioxide, sulphur dioxide, ozone, carbon monoxide and particulates.

The closest sites are located approximately 30 km away, one in Portsmouth and one at Brighton Preston Park. These sites are both classified as "urban background" sites which are generally representative of concentrations over a wide urban area. These sites automatically monitor concentrations of nitrogen dioxide, oxides of nitrogen, and particulate matter and are used by DEFRA for compliance reporting against the Ambient Air Quality Directives. No monitoring of carbon monoxide or sulphur dioxide is undertaken within 30 km of the facility.

Monitoring data from these AURN sites is presented in the following tables.

Table 4.2: Portsmouth AURN Monitoring

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)				
		AQO	Mapped Bg 2010	2010	2011	2012
Nitrogen dioxide	Annual mean	40	28.13	21.87	19.00	21.17
	99.79%ile of hourly mean	200	-	96.97	85.08	92.17
Oxides of nitrogen	Annual mean	30	43.95	32.46	27.60	31.55
Particulate matter (as PM10)	Annual mean	40	17.37	28.69	18.04	17.92
	90.40%ile of daily mean	50	-	42.70	28.52	30.77
Particulate matter (as PM2.5)	Annual mean	25	12.50	12.15	15.84	13.59

Table 4.3: Brighton Preston Park AURN Monitoring

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)				
		AQO	Mapped Bg 2010	2010	2011	2012
Nitrogen dioxide	Annual mean	40	21.04	21.72	16.91	16.08
	99.79%ile of hourly mean	200	-	94.00	78.42	82.39
Oxides of nitrogen	Annual mean	30	29.77	33.46	26.91	25.93
Particulate matter (as PM _{2.5})	Annual mean	25	11.01	10.57	12.10	-

Notes:

PM_{2.5} data for 2012 not available.

As shown, monitored pollutant concentrations at these urban background sites are well below the relevant AQOs. For comparison purposes, the annual mean mapped background concentration for the grid square containing each AURN is also shown. This shows that at Brighton Preston Park AURN, the mapped and monitored concentrations are very similar. At Portsmouth AURN, mapped background nitrogen dioxide and oxides of nitrogen concentrations are greater than those monitored whilst PM₁₀ mapped background concentrations are lower.

In addition to the national AURN, local authorities undertake monitoring of a range of pollutants as part of the LAQM review process. Arun District Council do not operate any continuous analysers. However they are a member of the Sussex Air Quality Partnership (Sussex Air) which benefits from the co-ordinated monitoring of air pollutants across the region. However, the closest background continuous analyser contained within the Sussex Air network is the Brighton Preston Park AURN.

Arun District Council undertake non-automatic monitoring of nitrogen dioxide at various locations across the district with the closest approximately 3.6 km to the east of the site at Thatchway Close. A summary of the results of background nitrogen dioxide monitoring is presented in Table 4.4. No other background monitoring sites have been identified within 10 km of the facility.

Table 4.4: Background Nitrogen Dioxide Diffusion Tube Monitoring

Site	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)		
	2010 Mapped Background	2010	2011
Church Lane	17	20	15
Mornington Crescent	14	19	15
Thatchway Close	19	15	13
Westlands	15	17	14
King Street	12	17	16
Priory Road	12	18	13

Notes:

Data from 2012 Air Quality Updating and Screening Assessment for Arun District Council

As shown the monitored background concentrations are very low, being a maximum of 50% of the annual mean AQO, and are generally similar to the mapped background concentrations.

4.4 Hydrogen chloride

Hydrogen chloride is measured on behalf of DEFRA at 30 rural stations as part of the UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP) project. This consolidates the previous Acid Deposition Monitoring Network (ADMN), and National Ammonia Monitoring Network (NAMN). The closest monitoring station is located at Barcombe Mills approximately 47 km to the east of the facility. A summary of data from all UK monitoring sites is presented in Table 4.5, with the monitoring from Barcombe Mills presented separately.

Table 4.5: Hydrogen Chloride Monitoring – UKEAP

Site	Quantity	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)		
		2008	2009	2010
All	Min	0.13	0.09	-
	Max	0.53	0.48	-
	Average	0.27	0.26	-
Barcombe Mills	Average	0.37	0.40	0.30

Notes:

Monitoring from 2011 and 2012 not available at the time of writing this report.

A reporting detailing the annual average concentration during 2010 across the network has not been published. Data for 2010 has been downloaded from the DEFRA UK Pollutant Deposition website.

There is no annual mean assessment level or source of mapped background data for hydrogen chloride. As shown, concentrations at Barcombe Mills are greater than the average of all UK sites but are not the highest concentrations across the UK.

4.5 Hydrogen fluoride

Baseline concentrations of hydrogen fluoride are not measured locally or nationally, since these are not generally of concern in terms of local air quality. However, the EPAQS report 'Guidelines for halogens and hydrogen halides in ambient air for protecting human health against acute irritancy effects' contains some estimates of baseline levels, reporting that measured concentrations have been in the range of $0.036 \mu\text{g}/\text{m}^3$ to $2.35 \mu\text{g}/\text{m}^3$.

In lieu of any local monitoring, the maximum measured baseline hydrogen fluoride concentration has been used for the purpose of this Assessment as a conservative estimate.

4.6 Ammonia

Ammonia is also measured as part of the UKEAP project. The closest currently operational ammonia monitoring station is located at Thursley Common, approximately 38 km to the north. In addition Barcombe Mills (46 km to the east) and Lullington Heath (54 km to the east), are located at similar distances from the south coast and major agglomerations as the proposed site. A summary of data from all UK monitoring sites, in addition to the nearest sites, is presented in Table 4.6. This also includes consideration of the mapped background ammonia concentration for the grid square containing the analysers.

Table 4.6: Ammonia Monitoring – UKEAP

Site	Quantity	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)		
		2008	2009	2010
All	Min	0.06	0.05	-
	Max	8.68	11.85	-
	Average	1.63	1.84	-
Thursley Common	Average	0.59	0.64	0.67
	Mapped Background	0.86	1.08	1.09
Barcombe Mills	Average	1.28	1.22	1.15
	Mapped Background	1.28	1.62	1.64
Lullington Heath	Average	0.68	0.62	1.48
	Mapped Background	0.91	1.16	1.17

Notes:

Monitoring from 2011 and 2012 not available at the time of writing this report.

A reporting detailing the annual average concentration during 2010 across the network has not been published. Data for 2010 has been downloaded from the DEFRA UK Pollutant Deposition website.

As shown, the monitored concentrations follow a similar pattern to the mapped background data - increasing over the last few years. The mapped background is greater than the monitored concentration in all instances except at Lullington Heath during 2010. As such, the mapped background is considered to be a conservative estimate of ammonia concentrations.

4.7 Volatile Organic Compounds

As part of the Automatic and Non-Automatic Hydrocarbon Network, benzene and 1,3-butadiene concentrations are measured at sites co-located with the AURN across the UK. The closest background monitoring site is located at Southampton, approximately 57 km to the west of the facility. Due to this it is considered that the mapped background concentration presented in Table 4.1 should provide the best estimate of concentrations near the site.

4.8 Metals

Metals are measured as part of the Rural Metals and UK Urban/Industrial Networks (previously the Lead, Multi-Element and Industrial Metals Networks). The closest background monitoring station is London Westminster, located approximately 82 km north-east of the facility. A summary of monitoring data from all UK background monitoring locations is presented in Table 4.7.

Table 4.7: Heavy Metal Monitoring – Background Monitoring Sites

Metal	EAL (ng/m ³)	Annual Mean Concentration (ng/m ³)			Max as % of EAL
		2009	2010	2011	
Arsenic	3	0.44	0.51	0.42	16.9%
Cadmium	5	0.23	0.18	0.22	4.6%
Chromium	5,000	2.13	1.48	2.86	0.1%
Copper	10,000	6.39	5.24	6.23	0.1%
Manganese	150	11.47	5.66	4.86	1.1%
Mercury ^(a)	250	2.45	2.02	1.47	1.0%
Nickel	20	1.40	1.56	1.55	7.8%
Lead	250	9.29	7.38	8.18	3.7%
Vanadium	5,000	1.30	0.97	1.01	0.03%
Notes:					
^(a) Consists of both particulate and volatile mercury.					
Monitoring from 2012 not available at the time of writing this report.					

As shown, the monitored background concentrations are very low with arsenic concentrations being the most significant at 17% of the EAL. There is no mapped background data for metals.

4.9 Dioxins, furans and polychlorinated biphenyl (PCBs)

Dioxins and furans are monitored on a quarterly basis at a number of urban and rural stations in the UK as part of the Toxic Organic Micro Pollutants (TOMPs) network. Weybourne is the closest monitoring site with data from the most recent year, located approximately 265 km to the north-east of the facility. A summary of dioxin and furan concentrations from all monitoring sites across the UK is presented in Table 4.8.

Table 4.8: Dioxin, Furan and PCBs Monitoring Results - National

Site	Annual Mean Dioxin and Furans Conc. (fg/TEQ/m ³)			Annual Mean PCBs Conc. (pg/m ³)		
	2008	2009	2010	2008	2009	2010
London	10.94	41.44	38.60	164.18	317.94	254.90
Manchester	18.99	14.21	14.21	133.42	168.38	185.28
Auchencorth*	6.44	0.56	5.01	12.12	44.66	37.40
Middlesbrough	23.98	-	-	138.43	-	-
High Muffles*	1.73	9.38	2.76	20.08	109.94	141.50
Hazelrigg*	3.67	13.49	8.03	14.52	89.18	110.00
Stoke Ferry	-	-	-	-	-	-
Weybourne*	-	22.82	2.49	-	44.66	21.30
UK Average	10.96	16.98	11.85	80.46	129.13	125.06
Average rural sites	3.95	11.56	4.57	145.34	243.16	220.09
Maximum rural sites	6.44	22.82	8.03	15.57	72.11	77.55

Notes:

Data only available to the end of 2010. To show the trends, data has been presented for the last 3 years of available data.

* rural location

As shown, the concentrations vary significantly between sites and years. No site is located in close proximity to the development site and a number of the sites are situated in a very industrialized areas. There is no mapped background data for dioxins and furans.

4.10 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are monitored as part of the PAH network. The closest background monitoring site is located at Hove, approximately 29 km to the east of the facility. For the purpose of this Assessment, benzo(a)pyrene is considered as this is the only PAH for which an AQO has been set. A summary of benzo(a)pyrene concentrations from all monitoring sites within the UK is presented in Table 4.9. Any exceedences of the EAL are highlighted.

Table 4.9: Benzo(a)pyrene Monitoring – National

Site	Quantity	Annual Mean Concentration (ng/m ³)			
		2009	2010	2011	2012
All	Min	0.04	0.03	0.02	-
	Max	2.40	2.00	3.00	-
	Average	0.47	0.51	0.41	-
Background sites	Average	0.41	0.48	0.33	-
Hove	Average	0.18	0.20	0.20	-
Notes: Data only available to the end of 2011.					

As shown in Table 4.9, the EAL for benzo(a)pyrene (0.25 ng/m³) is exceeded at a number of locations within the UK including at background sites. However, the concentrations at Hove, the closest site, are below the EAL. There is no mapped background data for BaP.

4.11 Summary

There is limited monitoring within close proximity of the site. However, data from further afield has indicated that background monitored concentrations are similar to the mapped background data. Hence, in lieu of any local monitoring data, where available the mapped background is considered to provide a good approximation of baseline conditions. Where this data is not available it is considered best practice to use a conservative estimate based on the results from national monitoring networks.

Table 4.10 outlines the values for the annual average background concentrations that are likely to provide a good approximation of the conditions on-site.

Table 4.10: Summary of Background Concentrations

Pollutant	Annual Mean Concentration	Units	Justification
Nitrogen dioxide	13.46	µg/m ³	NETCEN 2010 mapped data from 2010 dataset
Oxides of nitrogen	18.17	µg/m ³	NETCEN 2010 mapped data from 2010 dataset
Sulphur dioxide	2.46	µg/m ³	NETCEN 2001 mapped data from 2001 dataset
Particulate matter (as PM ₁₀)	14.94	µg/m ³	NETCEN 2010 mapped data from 2010 dataset
Particulate matter (as PM _{2.5})	10.08	µg/m ³	NETCEN 2010 mapped data from 2010 dataset
Carbon monoxide	228	µg/m ³	NETCEN 2001 mapped data from 2001 dataset
Hydrogen chloride	2.35	µg/m ³	Maximum monitored concentration from UKEAP over the last 4-years (2008)
Hydrogen fluoride	3.16	µg/m ³	Maximum measured concentration as presented in EPAQS report
Ammonia	1.66	µg/m ³	Mapped background concentration (2011)
Benzene	0.25	µg/m ³	NETCEN 2001 mapped data from 2001 dataset
1,3-butadiene	0.11	µg/m ³	NETCEN 2001 mapped data from 2001 dataset
Mercury	2.45	ng/m ³	Average UK background monitoring (2009)
Cadmium	0.23	ng/m ³	Average UK background monitoring (2009)
Arsenic	0.51	ng/m ³	Average UK background monitoring (2010)
Chromium	2.86	ng/m ³	Average UK background monitoring (2011)
Copper	6.39	ng/m ³	Average UK background monitoring (2009)
Manganese	11.47	ng/m ³	Average UK background monitoring (2009)
Lead	9.29	ng/m ³	Average UK background monitoring (2009)
Nickel	1.56	ng/m ³	Average UK background monitoring (2010)
Vanadium	1.30	ng/m ³	Average UK background monitoring (2009)
Dioxins and furans	22.82	fg/m ³	Maximum monitored at a rural site over the last 4 years (Weybourne 2009)
Dioxin like PBCs	141.50	fg/m ³	Maximum monitored at a rural site over the last 4 years (Weybourne 2009)
Benzo(a)pyrene	0.20	ng/m ³	Maximum monitored concentration at the nearest site – Hove over the last 4 years (2010)

5 SENSITIVE RECEPTORS

5.1 Human sensitive receptors

The general approach to the Assessment is to evaluate the highest predicted process contribution to ground level concentrations. In addition, the predicted process contribution at a number of sensitive receptors has been evaluated. These sensitive receptors are displayed in Figure A.1 of Appendix A and listed in Table 5.1.

Table 5.1: Sensitive Receptors

ID	Receptor Name	Location		Distance from the Stack (m)
		X	Y	
R1	1# Ford Lane	499101	103893	754
R2	2# Ford Lane	499246	103908	692
R3	3# Ford Lane	499674	103662	397
R4	Rodney Crescent	499962	103515	473
R5	Ford Road	500100	103236	554
R6	Ford Open Prison	500137	102865	724
R7	1# Horsemere Green Lane	500109	102385	1,061
R8	2# Horsemere Green Lane	499847	102322	1,009
R9	Beagle Drive	499015	102981	614
R10	Yapton Primary School	497788	103647	1,797

5.2 Sensitive ecological receptors

A study was undertaken to identify the following sites of ecological importance in accordance with Environment Agency Horizontal Guidance H1:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs), or Ramsar sites within 10 km of the facility (or 15 km coal- or oil- fired power station);
- Sites of Special Scientific Interest (SSSIs) within 2 km of the facility; and
- National Nature Reserves (NNR), Local Nature Reserves (LNRs), local wildlife sites and ancient woodlands within 2 km of the facility.

Guidance Note H1 states that some large emitters may be required to screen to 10 km or 15 km for SSSIs.

A screening distance of 10 km has been used for all SACs, SPAs and Ramsar sites. As a conservative assumption a screening distance of 10 km has been used for all SSSIs. These sensitive ecological receptors are listed in Table 5.2.

A review of the citation for each site has been undertaken to determine if lichens are an important part of the ecosystem's integrity for the purposes of determining the relevant Critical Level for the habitat.

Table 5.2: Sensitive Ecological Receptors

Site	Location (m)		Distance from the Main Stack at Closest Point (km)	Lichens identified as present within citation
	X	Y		
European designated sites (within 10 km)				
Duncton & Bignor Escarpment	497390	112940	9.89	No
UK designated sites (SSSIs) (within 10 km)				
Climping Beach	501360	100990	2.92	No
Arundel Park	501520	107300	4.47	No
Fairmile Bottom	497990	108655	5.59	No
Felpham	495055	99290	6.01	No
Arun Banks	502240	109960	7.20	No
Bognor Reef	493388	98690	7.69	No
Eartham Pit	492635	108575	8.70	No
Amberley Mount & Sullington Hill	503820	111470	9.23	No
Halnaker Chalk Pit	492200	108930	9.27	No
Locally designated sites (within 2km)				
Ancient Woodland	499896	104569	1.33	No
NOTES:				
Duncton & Bignor Escarpment has been designated as a SAC and SSSI				

A site may be designated as a SAC for different reasons than when designating the SSSI. A search has been undertaken in APIS for both designations and an assessment made against each critical load provided for completeness.

6 ASSESSMENT METHODOLOGY

6.1 Screening

The Environment Agency Horizontal Guidance Note H1 states that:

"process contributions can be considered insignificant if:

- *the long term process contribution is <1% of the long term environmental standard; and*
- *the short term process contribution is <10% of the short term environmental standard."*

Predicted process contributions have been compared to the AQO/EALs provided in Section 3. Where the emissions of a particular pollutant cannot be considered to be 'insignificant', the predicted concentrations have been evaluated further.

In addition the following screening criteria are outlined in the Environment Agency guidance document "Guidance to Applicants on Impact Assessment for Group 3 Metals Stack Releases – V.3 September 2012":

- Long-term Process Contribution (PC) <1% and Short-term Process Contribution (PC) <10%; or
- Long-term and Short-term Predicted Environmental Concentration (PEC) <100% (taking likely modelling uncertainties into account).

For screening purposes only, the Environment Agency methodology assumes that chromium (VI) comprises 20% of the total background chromium.

Where the impact is within these parameters, the Environment Agency concludes that there is no risk of exceeding the EAL.

6.2 Assessment criteria

Environmental Protection UK provides guidance in their publication "Development Control: Planning for Air Quality" for determining the impact of a development on local air quality. The guidance notes that it is important to be able to provide a consistent approach to describe impacts, and in turn assess the significance. When determining an air quality impact, not only should the magnitude of change be considered, but also the actual concentrations at receptors.

6.2.1 Impact magnitude

The Environmental Protection UK guidance provides the following descriptors for magnitude of change for annual mean emission concentrations.

Table 6.1: Summary of Comparison Descriptors

Magnitude of Change	Description
Large	Increase/decrease >10% of AQO/EAL
Medium	Increase/decrease 5-10% of AQO/EAL
Small	Increase/decrease 1-5% of AQO/EAL
Imperceptible	Increase/decrease <1% of AQO/EAL

The use of the 1% criterion for an 'imperceptible' impact provides consistency with the Environment Agency's 'insignificant' screening methodology.

6.2.2 Significance of impact

The Environmental Protection UK guidance provides the following descriptors for significance.

Table 6.2: Summary of Significance Descriptors (Increase with Scheme)			
Absolute Concentration in relation to standard	Small	Medium	Large
Above Objective/Limit Value with Scheme	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with Scheme (90%-100% of Objective/Limit Value)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with Scheme (75%-90% of Objective/Limit Value)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with Scheme (<75% of Objective/Limit Value)	Negligible	Negligible	Slight Adverse

It should be noted that these are only applicable for describing the effect of annual mean concentrations. Where short-term emissions cannot be screened as 'insignificant', background concentrations have been considered and the risk of exceeding the AQO/EAL has been considered.

6.3 Critical Levels

In addition to the objectives for the protection of human health, the AQS includes Critical Levels for the protection of ecosystems as presented in Table 3.3.

Predicted process contributions have been compared to the Critical Levels for the protection of ecosystems provided in Table 3.3. Where the emissions of a particular pollutant cannot be considered to be 'insignificant', the predicted concentrations have been evaluated further.

6.4 Plume visibility

A previous version of Environment Agency guidance note H1 – July 2003 - provided a methodology to quantify the potential impact from visible plumes. This methodology has not been incorporated into the latest version of H1. However, in lieu of any other appropriate methodology this has been used for the purpose of this assessment.

The following criteria are outlined against which the results of the dispersion modelling can be assessed.

Table 6.3: Summary of Qualitative Plume Visibility Impacts	
Impact	Qualitative description
Zero	No visible impacts resulting from the operation
Insignificant	Plume length extends boundary <5% of the daylight hours per year No local sensitive receptors

Table 6.3: Summary of Qualitative Plume Visibility Impacts

Impact	Qualitative description
Low	Plume length extends boundary <5% of the daylight hours per year Sensitive local receptors
Medium	Plume length extends boundary >5% of the daylight hours per year Sensitive local receptors
High	Plume length extends boundary >25% of the daylight hours per year with obscuration Sensitive local receptors

7 DISPERSION MODELLING METHODOLOGY

7.1 Selection of model

Detailed dispersion modelling was undertaken using the model ADMS 5, developed and supplied by Cambridge Environmental Research Consultants (CERC). This is a new generation dispersion model, which characterises the atmospheric boundary layer in terms of the Monin-Obukhov length and the boundary layer height. In addition, the model uses a skewed Gaussian distribution for dispersion under convective conditions, to take into account the skewed nature of turbulence. The model also includes modules to take account of the effect of buildings and complex terrain.

ADMS is routinely used for modelling of emissions for planning and Environmental Permitting purposes to the satisfaction of the Environment Agency.

7.2 Model inputs

7.2.1 Source and emissions data

The principal inputs to the model with respect to the emissions to air from the Residual Waste Treatment Facility are presented in Table 7.1. Flue gas volumes have been calculated based on a facility processing 140,000tpa of municipal waste, with a Net Calorific Value (NCV) of 10.23 MJ/kg. The facility is a two stream plant, with each stream processing 70,000 tpa. Therefore, two lines have been modelled, each with the same emissions data.

Table 7.1: Source Data		
Item	Unit	Facility
Stack Data		
Height	m	See stack height assessment
Internal diameter	m	1.10
Location (E'ings, N'ings)	m, m	499430.88, 103274.40 499431.72, 103270.37
Flue Gas Conditions		
Temperature	°C	165
Exit moisture content	% v/v	14.75
Exit oxygen content	% v/v dry	7.00
Reference oxygen content	% v/v dry	11.00
Volume at reference conditions (dry, ref O ₂)	Nm ³ /s	14.43
	Nm ³ /h	51,954
Volume at actual conditions	Am ³ /s	19.37
	Am ³ /h	69,744
Flue gas exit velocity	m/s	20.39
Moisture content	kg/kg	0.104

Emissions from the facility have been assumed to comply with the limits prescribed within Chapter VI of the Industrial Emissions Directive as summarised in Table 7.2. In addition, a typical emission limit for ammonia and conservative emission concentrations for benzo(a)pyrene and PCBs have been used.

Table 7.2: Emissions Data – Per Stack

Pollutant	Conc. (mg/Nm ³)	Release Rate (g/s)
Oxides of nitrogen (as NO ₂)	200	2.886
Sulphur dioxide	50	0.722
Carbon monoxide	50	0.722
Particulates	10	0.144
Hydrogen chloride	10	0.144
Volatile organic compounds (as TOC)	10	0.144
Hydrogen fluoride	1	0.014
Ammonia	10	0.144
Cadmium and thallium	0.05	0.001
Mercury	0.05	0.001
Other metals	0.5	0.007
Benzo(a)pyrene	0.2 µg/m ³	2.89 µg/s
Dioxins and furans	0.1 ng/m ³	1.44 ng/s
PCBs	5 µg/m ³	72.15 µg/s

NOTES:

All emissions are expressed at reference conditions dry, 11% oxygen, 273K.

There have been limited measurements of PM_{2.5}s emissions from waste incineration facilities. From information available on the Environment Agency's public registers for waste incineration plants at Bolton, Stoke and Lewisham it is indicated that the PM_{2.5} fraction makes up around 33% of the PM₁₀ fraction. However as a worst-case it has been assumed that the entire PM emissions consist of either PM₁₀ or PM_{2.5} for comparison with the relevant AQOs.

The highest recorded emission concentration of B[a]P from the Environment Agency's public register was 0.105 µg/m³, or 0.000105 mg/m³ (dry, 11% oxygen, 273K).

Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V).

BREF provides a range of values for PCB emissions to air from European municipal waste incineration plants. This states that the annual average total PCBs is less than 0.005 mg/Nm³ (dry, 11% oxygen, 273K). In lieu of other available data, this has been assumed to be the emission concentration for the facility.

In addition to the limits shown in Table 7.2, the IED also details half hourly average limits for a number of pollutants. It should be noted that if the facility continually operated at these limits the daily limits would be exceeded. The plant will be designed to achieve the limits shown in Table 7.2 and as such will only operate at the shorter term limits for short periods on rare occasions.

Table 7.3: Emissions Data – Half Hourly Averages

Pollutant	Conc. (mg/Nm³)	Release Rate (g/s)
Oxides of nitrogen (as NO ₂)	400	5.773
Sulphur dioxide	200	2.886
Carbon monoxide	100	1.443
Particulates	30	0.433
Hydrogen chloride	60	0.866
Volatile organic compounds (as TOC)	20	0.289
Hydrogen fluoride	4	0.058

7.2.2 Meteorological data and surface characteristics

The impact of meteorological data was taken into account by using weather data from Shoreham Airport for the years 2008 – 2012. Shoreham weather station is located approximately 22km to the east of the site. The Environment Agency recommends that 5 years of data are used to take into account inter-annual fluctuations in weather conditions.

Wind roses for each year can be found in Figure A.2 of Appendix A, showing that the winds are predominantly from the south-west.

The surface roughness length has been selected as 0.3m for the site and the weather data site, which is appropriate for the modelling domain.

The Monin-Obukov length for the site can be specified in ADMS. This provides a measure of the stability of the atmosphere and indicates the height above which convective turbulence (i.e. thermal) is more important than mechanical (i.e. friction). This allows for the effect of the urban heat island, to prevent the atmosphere from ever becoming very stable, to be simulated within the model. The Monin-Obukov length of the modelling domain was taken to be 0.2 m which is the value appropriate for rural areas.

7.2.3 Modelling domain

Modelling has been undertaken over a 4.9 km x 4.9 km grid with a spatial resolution of 68m. The maximum grid spacing in each is less than 1.5 times the stack height in accordance with the Environment Agency modelling rule of thumb. Modelling has ensured that the point of maximum impact is contained within the higher resolution grid. Using a grid of 4.9 km has ensured that plot files can be generated to determine the impact over the local area.

Table 7.4: Modelling Domain

Grid	Domain
Grid Spacing (m)	50
Grid Points	99
Grid Start X	497050
Grid Finish X	501950
Grid Start Y	100850
Grid Finish Y	105750

7.2.4 Terrain

It is recommended that, where gradients within 500 m of the modelling domain are greater than 1 in 10, the complex terrain module within ADMS (FLOWSTAR) should be used.

A review of the area surrounding area has deemed that consideration of terrain is not required.

7.2.5 Buildings

The presence of adjacent buildings can significantly affect the dispersion of the atmospheric emissions in various ways:

- Wind blowing around a building distorts the flow and creates zones of turbulence. The increased turbulence can cause greater plume mixing.
- The rise and trajectory of the plume may be depressed slightly by the flow distortion. This downwash leads to higher ground level concentrations closer to the stack than those which would be present without the building.

The Environment Agency recommends that buildings should be included in the modelling if they are both:

- Within 5L of the stack (where L is the smaller of the building height and maximum projected width of the building); and
- Taller than 40% of the stack.

A review of the site layout has been undertaken and the details of the applicable buildings are presented in Table 7.5. The height limitation has been taken as one third of the stack height. A site plan showing which buildings have been contained in the model is presented in Figure A.3 of Appendix A.

Table 7.5: Building Details

Buildings	Centre Point		Height (m)	Length (m)	Width (m)	Angle (°C)
	X (m)	Y (m)				
(new) Advanced Waste Treatment Facility	499470.3	103288.2	22	70	120	346
Hangar no. 1	499359.6	103382.3	20	43	70	346
Hangar no. 2	499484.0	103421.2	20	42	70	346
Reception/Pre-treatment building and MRF #2	499493.7	103387.7	20	15.7	14.5	346
Reception/Pre-treatment building and MRF (previously known as the 'Aerated Block Factory' building) #1	499483.6	103349.2	20	51.5	57.7	346
(new) Steam Turbine Enclosure	499548.1	103285.4	9	15	10	346
(new) Air Cooled Condenser	499542.7	103310.3	12	30	10	346

7.3 Chemistry

The plant will release nitric oxide (NO) and nitrogen dioxide (NO₂) which are collectively referred to as NO_x. In the atmosphere, a proportion of nitric oxide will be converted to nitrogen dioxide in a reaction with ozone which is influenced by solar radiation. Since the air quality objectives are expressed in terms of nitrogen dioxide, it is important to be able to assess the conversion rate of nitric oxide to nitrogen dioxide.

Ground level NO_x concentrations have been predicted through dispersion modelling. Nitrogen dioxide concentrations reported in the results section assume 70% conversion from NO_x to nitrogen dioxide for annual means and a 35% conversion for short term (hourly) concentrations, based upon the worst-case scenario in the Environment Agency methodology. Given the short travel time to the areas of maximum concentrations, this approach is considered conservative.

7.4 Background concentrations

Background concentrations for the Assessment have been derived from monitoring as presented previously in Table 4.10.

For short term averaging periods the background concentration has been assumed to be twice the long term ambient concentration following the Environment Agency Horizontal Guidance Note H1 methodology.

8 STACK HEIGHT ASSESSMENT

In order to minimise the impact of emissions from the Residual Waste Treatment Facility on the local environment, it is important that an appropriate stack height is chosen. This section details the results of the stack height assessment.

The sensitivity of the results to changing the height of the main stack was considered by modelling with stack heights between 30 m and 70 m for all 5 years of weather data.

8.1 Results – long term

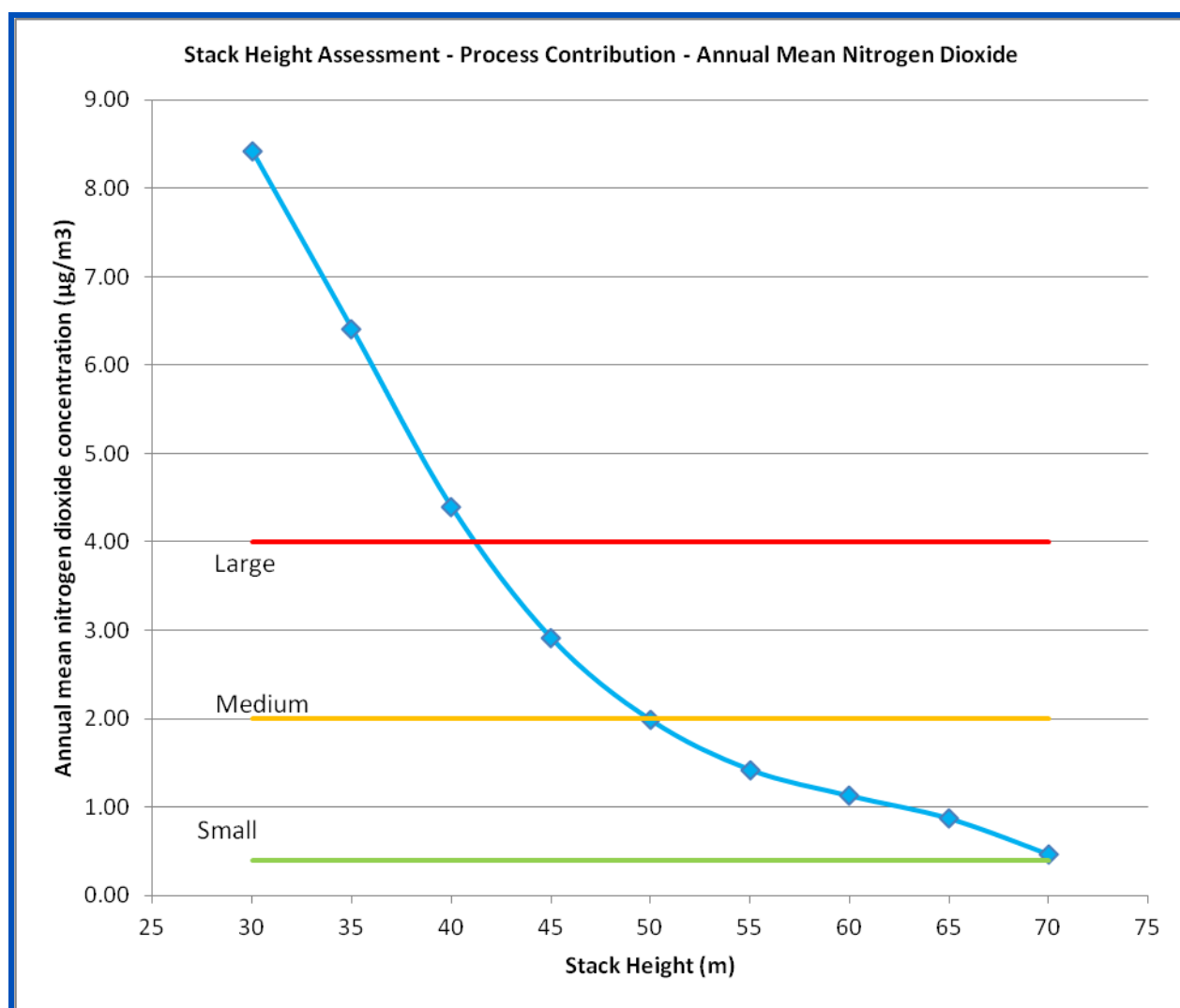
Table 8.1 presents the process contribution of nitrogen dioxide at the point of maximum impact and the significance of effect in accordance with the EPUK assessment methodology.

The following parameters were kept constant:

- Terrain – excluded;
- Buildings – included;
- Surface roughness – 0.3 m; and
- Met data year – 2008 to 2012.

Table 8.1: Stack Height Sensitivity – Nitrogen Dioxide

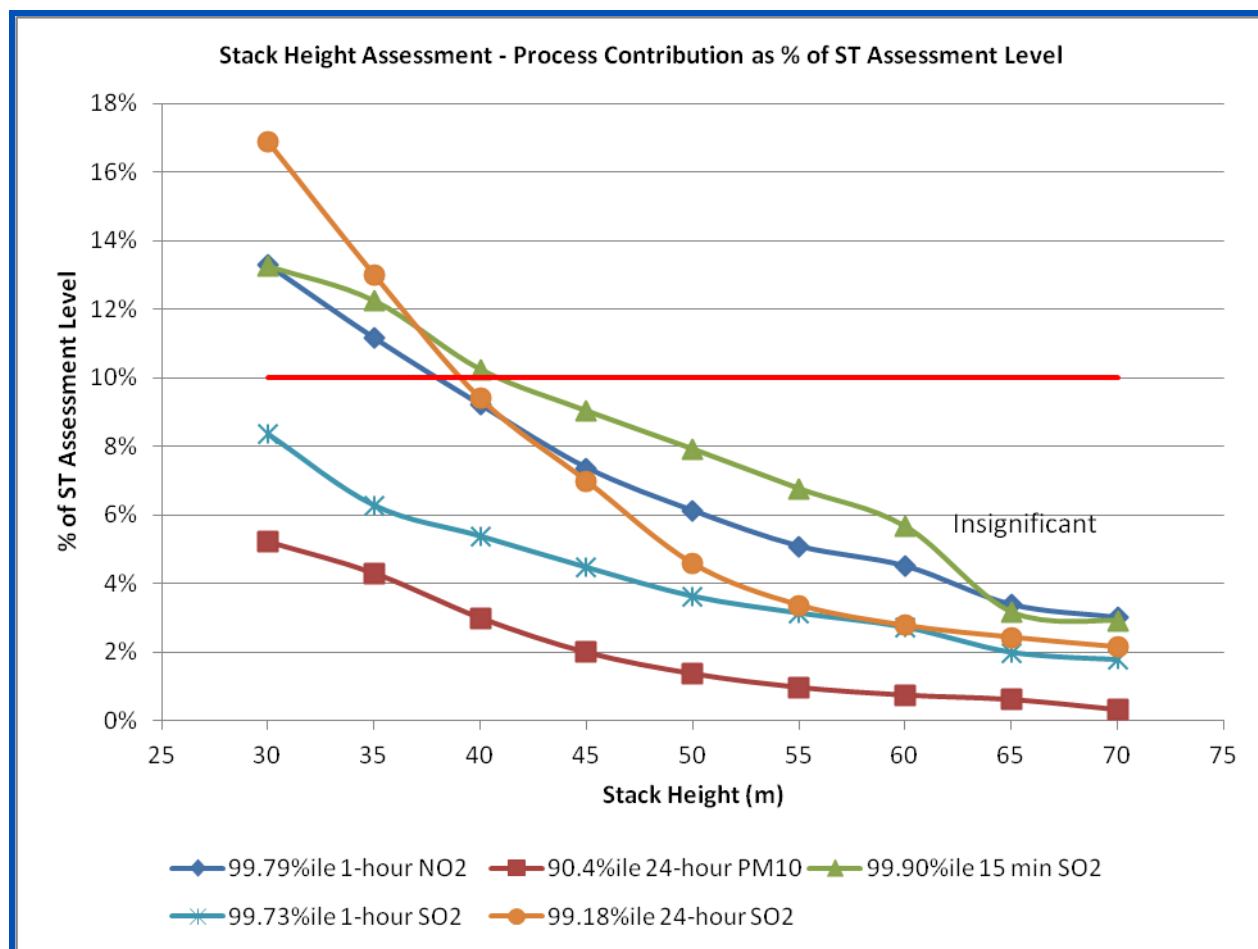
Stack Height (m)	Process Contribution (PC)	Predicted Environmental Concentration (PEC)	Impact Magnitude	PEC in Relation to Objective	Significance
30	8.41	21.87	Large	Well below	Slight
35	6.41	19.87	Large	Well below	Slight
40	4.39	17.85	Large	Well below	Slight
45	2.91	16.37	Medium	Well below	Negligible
50	1.99	15.45	Small	Well below	Negligible
55	1.42	14.88	Small	Well below	Negligible
60	1.13	14.59	Small	Well below	Negligible
65	0.87	14.33	Small	Well below	Negligible
70	0.46	13.92	Small	Well below	Negligible



As shown a stack height of greater than 70 m would be required to ensure the impact can be screened out as 'insignificant' at the point of maximum impact.

8.2 Results – short term

In addition to the impact of long-term emissions, the impact of emissions of pollutants with short-term AQOs has also been considered. The Environment Agency screening methodology states that emissions are considered "insignificant" if the short term process contribution is less than 10% of the AQO.



The short term emissions can be screened out as “insignificant” when the stack height is greater than 40m.

8.3 Summary

A stack height of 50m has been chosen as this is the point at where the benefit of increasing the stack height on ground level pollutant concentrations is reduced and the impact of the Residual Waste Treatment Facility when operating at the daily limit is described as ‘small’.

9 DISPERSION MODELLING RESULTS – LONG TERM EMISSION LIMITS

As discussed in Section 7.2.1, the facility will have daily average limit values for emissions to air. This section details the impact of the facility assuming the Residual Waste Treatment Facility operates at the daily emission limits, which were outlined in Table 7.2.

9.1 Results

Table 9.1 presents the results of the dispersion modelling of emissions from the Residual Waste Treatment Facility at the point of maximum impact and compares these results with the AQO/EALs presented in Table 3.2. Impacts which cannot be screened out as 'insignificant' are highlighted.

Table 9.1: Dispersion Modelling Results – Long Term Emission Limit Values

Pollutant	Quantity	Units	AQO /EAL	Bg Conc.	Process Contribution (PC) at Point of Greatest Impact						Max as % of AQO /EAL	PEC (PC +Bg)	PEC as % of AQO /EAL
					2008	2009	2010	2011	2012	Max			
Nitrogen dioxide	Annual mean	µg/m ³	40	13.46	1.90	1.50	1.99	1.96	1.75	1.99	4.96%	15.45	38.61%
	99.79th%ile of hourly means	µg/m ³	200	26.92	11.77	11.98	12.23	11.13	11.45	12.23	6.12%	39.15	19.58%
Sulphur dioxide	99.18th%ile of daily means	µg/m ³	125	4.92	4.85	5.45	5.72	5.69	4.89	5.72	4.58%	10.64	8.51%
	99.73rd%ile of hourly means	µg/m ³	350	4.92	12.38	12.64	12.65	12.17	12.35	12.65	3.61%	17.57	5.02%
	99.9th%ile of 15 min. means	µg/m ³	266	4.92	17.95	21.05	15.75	15.17	14.68	21.05	7.91%	25.97	9.76%
PM _{10S}	Annual mean	µg/m ³	40	14.94	0.21	0.17	0.22	0.22	0.19	0.22	0.55%	15.16	37.90%
	98.1th%ile of daily means	µg/m ³	50	29.88	0.59	0.57	0.68	0.68	0.60	0.68	1.36%	30.56	61.12%
PM _{2.5S}	Annual mean	µg/m ³	25	10.08	0.21	0.17	0.22	0.22	0.19	0.22	0.87%	10.30	41.19%
Carbon monoxide	8 hour running mean	µg/m ³	10,000	456.00	18.90	15.10	11.60	9.90	9.56	18.90	0.19%	474.90	4.75%
Hydrogen chloride	Hourly mean	µg/m ³	750	4.70	9.81	5.56	6.01	6.44	6.06	9.81	1.31%	14.51	1.93%
Hydrogen fluoride	Annual mean	µg/m ³	16	3.16	0.02	0.02	0.02	0.02	0.02	0.02	0.14%	3.18	19.89%
	Hourly mean	µg/m ³	160	6.32	0.98	0.56	0.60	0.64	0.61	0.98	0.61%	7.30	4.56%
Ammonia	Annual mean	µg/m ³	180	1.66	0.21	0.17	0.22	0.22	0.19	0.22	0.12%	1.88	1.04%
	Hourly mean	µg/m ³	2,500	3.32	9.81	5.56	6.01	6.44	6.06	9.81	0.39%	13.13	0.53%
VOCs (as benzene)	Annual mean	µg/m ³	5	0.25	0.21	0.17	0.22	0.22	0.19	0.22	4.37%	0.47	9.37%

Table 9.1: Dispersion Modelling Results – Long Term Emission Limit Values

Pollutant	Quantity	Units	AQO /EAL	Bg Conc.	Process Contribution (PC) at Point of Greatest Impact						Max as % of AQO /EAL	PEC (PC +Bg)	PEC as % of AQO /EAL
					2008	2009	2010	2011	2012	Max			
VOCs (as 1,3-butadiene)	Annual mean	µg/m ³	2.25	0.11	0.21	0.17	0.22	0.22	0.19	0.22	9.71%	0.33	14.60%
Mercury	Annual mean	ng/m ³	250	2.45	1.04	0.83	1.09	1.08	0.96	1.09	0.44%	3.54	1.42%
	Hourly mean	ng/m ³	7,500	4.90	49.03	27.79	30.05	32.22	30.29	49.03	0.65%	53.93	0.72%
Cadmium	Annual mean	ng/m ³	5	0.23	0.52	0.41	0.55	0.54	0.48	0.55	10.92%	0.78	15.52%
	Hourly mean	ng/m ³	-	0.46	24.52	13.89	15.03	16.11	15.14	24.52	-	24.98	-
Dioxins	Annual mean	fg/m ³	-	22.82	2.09	1.66	2.18	2.15	1.92	2.18	-	25.00	-
PCBs	Annual mean	ng/m ³	200	141.50	0.10	0.08	0.11	0.11	0.10	0.11	0.05%	141.61	70.80%
	Hourly mean	ng/m ³	6,000	283.00	4.90	2.78	3.01	3.22	3.03	4.90	0.08%	287.90	4.80%
PAHs	Annual mean	pg/m ³	25	200.00	4.18	3.31	4.37	4.31	3.85	4.37	1.75%	204.37	81.75%
Other metals	Annual mean	ng/m ³	-	-	8.28	10.92	10.76	9.62	10.92	10.44	See metals assessment		
	Hourly mean	ng/m ³	-	-	277.88	300.52	322.18	302.89	490.31	490.31			

9.2 Significance of effect

As shown in Table 9.1, the process contribution from the Residual Waste Treatment Facility does not cause a breach of the AQO for any pollutant. However, the predicted impact cannot be screened out as 'insignificant' for the following pollutants:

- Annual mean nitrogen dioxide process contributions;
- Annual mean VOCs process contributions;
- Annual mean cadmium process emissions; and
- Annual mean PaH process contributions.

The impacts of the all other pollutants can be screened out as 'insignificant' and further assessment is not required.

Further analysis of the effect of long term emissions where pollutants cannot be screened out as 'insignificant' has been undertaken, taking account of local background air quality conditions. The Environmental Protection UK assessment criteria have been applied. Although the Environmental Protection UK assessment criteria have been developed for determining the significance of impacts of annual mean nitrogen dioxide and particulate matter emissions, the principles have been applied to determine the significance of other annual mean impacts in lieu of any other guidance.

Table 9.2: Significance of Impact – Long Term Emissions

Pollutant	Max PC as % of EAL	Change	Max PEC as % of EAL	Absolute conc. in relation to the objective	Significance
Nitrogen dioxide	4.96%	Small	38.61%	Well below	Negligible
VOCs (as benzene)	4.37%	Small	9.37%	Well below	Negligible
VOCs (as 1,3-butadiene)	9.71%	Medium	14.60%	Well below	Negligible
Cadmium	10.92%	Large	15.52%	Well below	Slight adverse
PaHs	1.75%	Small	81.75%	Below	Negligible

As shown, the total concentration is well below the EAL or AQO in all cases and, when taking into consideration the change in concentration, the significance of the impact is 'negligible' with the exception of cadmium.

Reference should be made to Appendix A for plot files for each pollutant which show where impacts could not be screened out as 'insignificant'. The areas where impacts are considered to be 'small', 'medium' and 'large' are highlighted. As shown, the area where the impact of cadmium is 'large' and the resultant significance of effect is 'slight adverse' is restricted to a small area to the east of the facility where members of the public are not expected to spend prolonged periods of time.

It should be noted that this assessment is considered highly conservative as it assumes that:

- the plant operates at the long term emission limit for the entire year;
- the entire VOC emissions are assumed to consist of either benzene or 1,3-butadiene; and
- the entire cadmium and thallium emissions consist of 50% cadmium, while monitoring from waste facilities has indicated concentrations of cadmium are usually about 8% of the limit.

Figure A.8 of Appendix A shows the cadmium impact as a proportion of the EAL assuming that the emissions of cadmium are usually 8% of the limit. As shown, using this more realistic assumption, the impact is significantly reduced and at all sensitive the impact can be screened out as insignificant.

Analysis of the impact at sensitive receptors is presented in Appendix B. This shows that the impact at all sensitive receptors can either be screened out as 'insignificant' or is considered 'negligible' when taking into account the existing background concentrations. Even when taking into account uncertainties in modelling and background concentrations, it is highly unlikely that the process contribution will lead to a breach of an EAL and there is little potential for significant pollution. A summary of the impact as a proportion of the AQO at each receptor of each pollutant which cannot be screened out as insignificant at the point of maximum impact is presented in the following table.

Table 9.3: Summary of Impact at Receptors

	Annual Mean Concentration as % of the AQO / EAL				
Receptor	Nitrogen dioxide	VOCs (as benzene)	VOCs (as 1,3-butadiene)	Cadmium	PaHs
1 Ford Lane	0.7%	0.6%	1.3%	1.4%	0.2%
2 Ford Lane	0.9%	0.8%	1.7%	1.9%	0.3%
3 Ford Lane	3.9%	3.5%	7.7%	8.7%	1.4%
Rodney Crescent	3.2%	2.8%	6.3%	7.1%	1.1%
Ford Road	1.3%	1.2%	2.6%	2.9%	0.5%
Ford Open Prison	0.4%	0.4%	0.9%	1.0%	0.2%
1 Horsemere Green Lane	0.3%	0.3%	0.6%	0.7%	0.1%
2 Horsemere Green Lane	0.7%	0.6%	1.3%	1.5%	0.2%
Beagle Drive	1.1%	1.0%	2.2%	2.4%	0.4%
Yapton Primary School	0.2%	0.1%	0.3%	0.4%	0.1%

NOTES:

The entire VOC emissions are assumed to consist of either benzene or 1,3-butadiene.

The entire cadmium and thallium emissions are assumed to consist of 50% cadmium, while monitoring from waste facilities has indicated concentrations of cadmium are usually about 8% of the limit.

9.3 Metals – at point of maximum impact

There is a single emission limit for nine group 3 metals (arsenic, antimony, chromium, cobalt, copper, lead, manganese, nickel and vanadium). The impact of these metals has been assessed using the three stage screening methodology outlined in the Environment Agency guidance document "Guidance to Applicants on Impact Assessment for Group 3 Metals Stack Releases – V.3 September 2012".

9.3.1 Stage 1

Using the Environment Agency methodology, the first stage is to predict the impact of each metal, assuming each metal is emitted at 100% of the emission level, and compare against the EALs outlined in Table 3.1.

Table 9.4 displays the results of the first stage screening methodology for long term impacts of metals. Any exceedences of the Environment Agency screening criteria are highlighted.

Table 9.4: Heavy Metal Screening Assessment - Step 1 – Long Term						
Metal	EAL (ng/m³)	Background Conc. (ng/m³)	Process Contribution		PEC	
			Conc. (ng/m³)	As % of EAL	Conc. (ng/m³)	As % of EAL
Arsenic	3	0.51	10.92	364.06%	11.43	381.06%
Antimony	5000	-	10.92	0.22%	-	-
Chromium	5000	2.86	10.92	0.22%	13.78	0.28%
Chromium (VI)	0.2	0.57	10.92	5460.90%	11.49	5746.90%
Cobalt	-	-	10.92	-	-	-
Copper	10000	6.39	10.92	0.11%	17.31	0.17%
Lead	250	9.29	10.92	4.37%	20.21	8.08%
Manganese	150	11.47	10.92	7.28%	22.39	14.93%
Nickel	20	1.56	10.92	54.61%	12.48	62.41%
Vanadium	5000	1.30	10.92	0.22%	12.22	0.24%

Using the first stage screening methodology, the PCs of arsenic, chromium (VI), lead, manganese and nickel are predicted to be greater than 1% of the EAL. However, only the PEC for arsenic and chromium (VI) is predicated to be greater than 100% of the EAL. The assessment methodology states that the PEC should take into account of modelling uncertainty. For lead, manganese and nickel the PEC is less than 65% which means that, even when taking into account of any modelling uncertainty, it is expected that the PEC will remain below the EAL. Arsenic and chromium (VI) have been progressed to the second stage of assessment.

The PEC for all other metals is less than 100% of the EAL and so these can be screened out from further assessment. It is considered that, even when taking likely modelling uncertainties into account, there is little potential for significant pollution and progression to the second stage of assessment is not necessary.

Table 9.5 presents the results of the first stage screening methodology for short term impacts of metals.

Table 9.5: Heavy Metal Screening Assessment - Step 1 – Short Term

Metal	EAL (ng/m ³)	Background Conc. (ng/m ³)	Process Contribution		PEC	
			Conc. (ng/m ³)	As % of EAL	Conc. (ng/m ³)	As % of EAL
Arsenic	-	1.02	490.31	-	491.33	-
Antimony	150,000	-	490.31	0.33%	-	-
Chromium	150,000	5.72	490.31	0.33%	496.03	0.33%
Chromium (VI)	-	1.14	490.31	-	491.46	-
Cobalt	-	-	490.31	-	-	-
Copper	200,000	12.78	490.31	0.25%	503.09	0.25%
Lead	-	18.58	490.31	-	508.89	-
Manganese	1,500,000	22.94	490.31	0.03%	513.25	0.03%
Nickel	-	3.12	490.31	-	493.43	-
Vanadium	1,000	2.60	490.31	49.03%	492.91	49.29%

Using the stage 1 screening methodology, the PEC for all metals is less than 100% of the EAL and so the short term impact of all metals can be screened out from further assessment. While the PC for vanadium is greater than 10% of the EAL, the PEC is less than 50%. Therefore, even when taking into account any modelling uncertainty, it is expected that the PEC will remain below the EAL. It is therefore not necessary to progress short term vanadium emissions to the second stage of assessment.

9.3.2 Stage 2

The second stage of the assessment is to consider a worst case scenario based on currently operating plant, assuming each metal comprises 11% of the total group (i.e. a process contribution of 10.92 ng/m³ apportioned equally across the nine metals).

It is assumed for this worst case screening that the proportion of chromium (VI) to total chromium is 20% as suggested as a worst case by the Expert Panel on Air Quality Standards (EPAQS) paper on Metals and Metalloids.

The results of the second stage assessment are shown below. Any exceedences of the Environment Agency screening criteria are highlighted.

Table 9.6: Heavy Metal Screening Assessment - Step 2 – Long Term

Metal	EAL (ng/m ³)	Background Conc. (ng/m ³)	Process Contribution		PEC	
			Conc. (ng/m ³)	As % of EAL	Conc. (ng/m ³)	As % of EAL
Arsenic	3.00	0.51	1.21	40.45%	1.72	57.45%
Chromium (VI)	0.20	0.57	1.21	606.77%	1.79	892.77%

As shown, although the PC for arsenic is greater than 1% as a worst case scenario, the PEC is well below 100% of the EAL. As such it is considered that, even when taking likely modelling uncertainties into account, there is little potential for significant pollution and progression to the third stage of assessment for emissions of arsenic is not necessary.

As shown, assuming the entire chromium emissions are in the hexavalent form (chromium VI), emissions cannot be screened out using the worst case scenario. Therefore, additional consideration has to be given to the assumptions used in assessing the impact of this pollutant.

9.3.3 Stage 3

The third stage of the assessment is to consider site specific assumptions.

Percentages lower than 11% of the IED ELV

The facility will incorporate a flue gas treatment system to remove heavy metals from the gas stream. This flue gas treatment system is similar to that in use at other UK waste combustion facilities and, as such, we would expect the performance of the proposed flue gas treatment system to be as effective in removing heavy metals as the same system employed at a typical facility.

An analysis of monitoring of metal emissions from 10 Municipal Waste Incinerators in England and Wales is presented in Appendix B of "Guidance to Applicants on Impact Assessment for Group 3 Metals Stack Releases – V.3 September 2012". This is reproduced in the following table.

Table 9.7: Monitoring Data from Municipal Waste Incinerators

Pollutant	Measured Concentration as % of IED Group 3 Limit		
	Mean	Max	Min
Antimony	0.66%	2.30%	0.02%
Arsenic	0.14%	0.60%	0.06%
Chromium	2.18%	10.42%	0.08%
Cobalt	0.08%	0.78%	0.04%
Copper	1.54%	3.26%	0.50%
Lead	3.16%	7.36%	0.06%
Manganese	3.44%	7.30%	0.30%
Nickel	4.40%	27.24%	0.00%
Tin	0.48%	0.48%	0.48%
Vanadium	0.06%	0.20%	0.04%
Total (calculated)	16.14%	59.94%	1.58%
NOTES:			
The maximum nickel concentration is greater than 11% is due to a single measurement outlier. The average is around 4% of the Group ELV.			

As shown, the total chromium emissions are a maximum of 10.42% of the limit; this includes some contribution from chromium (VI).

The Environment Agency guidance also provides an analysis of chromium (VI). Due to the very small amounts of chromium (VI) emitted from municipal waste incinerators, this has been undertaken based on analysis of APC residues. This is reproduced in the following table.

Table 9.8: Chromium VI Analysis from APC Residues

	Effective Cr(VI) Emission Concentration (mg/Nm ³)	% of IED Limit for Total Metals
Mean	3.5×10^{-5}	0.0070%
Minimum	2.3×10^{-6}	0.0005%
Maximum	1.3×10^{-4}	0.0260%

As shown, the maximum chromium (VI) emissions are very low at 0.026% of the total Group ELV.

The predicated process contribution is presented in the following table, taking into account the likely emissions based on the monitored concentrations from existing facilities.

Table 9.9: Heavy Metal Screening Assessment - Long Term – Likely Emissions – Cr(VI)

APC Analysis	Process Contribution	
	Conc. (pg/m ³)	As % of EAL
Mean	0.76	0.38%
Minimum	0.05	0.03%
Maximum	2.84	1.42%

Therefore, based on the monitoring from existing facilities, the process contribution ranges from 0.03% to 1.42% of the EAL.

Background levels

There is no monitoring of the separate species of chromium in the UK. The Expert Panel on Air Quality Standards document Metals and Metalloids (2009) states the ratio of chromium to chromium (VI) is variable and dependent upon the source of chromium. It is noted that in the UK it is likely that less than 20% of the emissions are chromium (VI) and that those emissions with the higher proportions of chromium (VI) are from chromium using industries. The Expert Panel continues to quote data by Rowbotham et al (2000) suggesting that chromium (VI) constitutes between 3% and 8% of the total airborne chromium.

Applying these ratios to the background chromium concentration of 2.86 ng/m³, the background concentration of chromium (VI) would be between 0.09 ng/m³ and 0.23 ng/m³.

Using this assumption the results of the stage 3 screening are presented in the following table. Any exceedences of the Environment Agency screening criteria are highlighted.

Table 9.10: Heavy Metal Screening Assessment - Step 3 – Long Term – Cr(VI)

APC Analysis	Background Conc. (pg/m ³)	Process Contribution			PEC	
		Conc. (pg/m ³)	As % of EAL	As % of Bg	Conc. (pg/m ³)	As % of EAL
Background chromium (VI) is 3% of total chromium						
Mean	85.8	0.76	0.38%	0.89%	86.56	43.28%
Minimum	85.8	0.05	0.03%	0.06%	85.85	42.93%
Maximum	85.8	2.84	1.42%	3.31%	88.64	44.32%
Background chromium (VI) is 8% of total chromium						
Mean	228.8	0.76	0.38%	0.33%	229.56	114.78%
Minimum	228.8	0.05	0.03%	0.02%	228.85	114.43%
Maximum	228.8	2.84	1.42%	1.24%	231.64	115.82%

As shown, assuming the facility performance will be similar to other UK waste incineration facilities and using the updated background concentration, the PEC may range between 43% and 115% of the EAL. The process contribution is anticipated to make a minor contribution to the existing levels.

9.3.4 Chromium (VI) – at receptors

Analysis of the impact at the most impacted sensitive receptor is presented in Appendix B. The maximum annual mean total metal concentration at a receptor was predicted to be 8.66 ng/m³, and the maximum 1-hour concentration at a receptor was predicted to be 115.39 ng/m³. The following table presents the long term chromium (VI) impact based on the monitoring from existing facilities and the background chromium (VI) concentration is based on the range from the work by Rowbotham et al (2000). Full detailed results at receptor locations are presented in Appendix B.

Table 9.11: Summary of Chromium VI Impact Assessment at Maximum Impacted Receptor

APC Analysis	Background Conc. (pg/m³)	Process Contribution			PEC	
		Conc. (pg/m³)	As % of EAL	As % of Bg	Conc. (ng/m³)	As % of EAL
Background chromium (VI) is 3% of total chromium						
Mean	85.8	0.61	0.30%	0.71%	86.41	43.20%
Minimum	85.8	0.04	0.02%	0.05%	85.84	42.92%
Maximum	85.8	2.25	1.13%	2.62%	88.05	44.03%
Background chromium (VI) is 8% of total chromium						
Mean	228.8	0.61	0.30%	0.26%	229.41	114.70%
Minimum	228.8	0.04	0.02%	0.02%	228.84	114.42%
Maximum	228.8	2.25	1.13%	0.98%	231.05	115.53%

Based on the monitoring from existing facilities, the process contribution ranges from 0.02% to 1.13% of the EAL at the most impacted receptor and the PEC may range between 43% and 115% of the EAL. The process contribution is anticipated to make a minor contribution to the existing levels.

Plot files of the annual mean process contribution as a proportion of the EAL for chromium (VI) assuming the plant operates no worse than a currently operating facility (i.e. the max from the APC analysis) is presented in Appendix A. As shown using this assumption the area where impacts are greater than 1% of the EAL is restricted to a very small area.

9.3.5 Summary of metals screening

The long term and short term impact of emissions of metals have been screened using the Environment Agency screening criteria, and it is considered that there is no risk of exceeding any EAL when taking into account that the facility will incorporate a flue gas treatment system to remove heavy metals which will perform to a similar level to existing UK facilities, except for chromium (VI). The assumed chromium (VI) background concentration ranges from 43% to 114% of the EAL, the process will make a small contribution to the existing levels. If it assumed that the facility will perform similarly to other facilities (i.e. the mean APC analysis) the process contribution is less than 1% of the EAL.

9.4 Impact at ecological receptors

The impact at ecological receptors has been quantified and the results compared against the AQOs and Critical Levels presented in Table 3.3. The highest predicted process contributions of to ground level concentrations at the identified ecological receptors are presented in Appendix C. Any exceedences of the 'insignificant' screening criteria are highlighted.

For European designated sites, the Environment Agency Stage 1 and 2 Assessment of New PIR Permissions under the Habitats Regulations states:

"Where the concentration within the emission footprint in any part of the European site(s) is less than 1% of the relevant long-term benchmark, the emissions is not likely to have a significant effect alone or in combination irrespective of background levels.

Where the concentration within the emission footprint in any part of the European site(s) is greater than 1% of the relevant long-term benchmark, do not automatically conclude 'cannot conclude no likely significant effect. Where the PC is greater than 1% for the relevant long-term benchmark, further consideration should be given to the PC in combination with background levels.

Where the PEC within the emission footprint in any part of the European site is less than 70% of the relevant long-term benchmark, the emission is not likely to have a significant effect."

As shown in the tables contained within Appendix C, predicted concentrations are less than 1% of the long-term and 10% of the short-term standard at all ecologically sensitive receptors. Therefore it is concluded that emissions are not likely to have a significant effect alone or in combination irrespective of background levels.

9.5 Impact at Ancient Woodlands

As identified in Section 5.2 there is ancient woodland located within 2km of the facility. The impact of annual mean emissions of oxides of nitrogen, sulphur dioxide and ammonia are presented in the following table. Where the annual mean process contribution exceeds 1% of the long term EAL, or weekly and daily process contribution exceeds 10% of the relevant EAL, these are highlighted. Reference should be made to Appendix A for plot files of the oxides of nitrogen impacts which cannot be screened out.

Table 9.12: Assessment of Impact at Ancient Woodland

Pollutant	CL	Bg Conc.	Process Contribution		Predicted Environmental Concentration	
	µg/m ³	µg/m ³	µg/m ³	As % of CL	µg/m ³	As % of CL
Annual Mean						
Oxides of nitrogen	30	14.94	0.33	1.11%	15.27	50.91%
Sulphur dioxide	20	2.4	0.13	0.64%	-	-
Ammonia	3	-	0.03	0.85%	-	-
Weekly Mean						
Hydrogen fluoride	0.5	-	0.01	1.73%	-	-
Daily Mean						
Oxides of nitrogen	75	-	5.40	7.19%	-	-
Hydrogen fluoride	5	-	0.03	0.54%	-	-
NOTES: <i>Background concentrations are based on the mapped background square containing the ancient woodland. Background concentrations are only presented where the process contribution is greater than 1% of the long term or 10% of the short term AQO.</i>						

As shown in Table 9.12, impacts are greater than 1% of the long term standard for oxides of nitrogen. However, when considering the PEC, emissions of oxides of nitrogen are not likely to have a significant effect.

10 DEPOSITION OF EMISSIONS AT SENSITIVE ECOLOGICAL HABITATS

10.1 Screening

The latest version of the IPPC H1 Technical Guidance Note provides the following screening to assist in the assessment of the impact of deposition of emissions to land.

"Substances released to air do not need to be assessed for deposition to ground unless:

- They are highly toxic, bioaccumulative or persistent.*
- They may have an effect on sensitive receptors which occur within the distance criteria outlined in section 'Screening for nature conservation sites'.*
- They contribute to acidification and eutrophication and are released in substantial quantities. For nature conservation sites they contribute >1% of the relevant Critical Load"*

10.2 Critical Loads

The Air Pollution Information System (APIS) provides Critical Loads for nature conservation sites at risk from acidification and nitrogen deposition (eutrophication).

An assessment has been made for each habitat feature identified in APIS for the specific site. For large designated sites all of the habitat features may not be present at the point of maximum impact. However, as a conservative approach the concentration at the point of maximum impact within each site has been compared to all habitat features identified within APIS.

10.2.1 Nitrogen deposition – eutrophication

A search has been undertaken on for each of the ecological receptors identified in Table 5.2. Appendix D summaries the Critical Loads for nitrogen deposition and background deposition rates as detailed in APIS for each habitat identified.

The impact of the facility has been assessed against these Critical Loads for nitrogen deposition.

10.2.2 Acidification

The APIS Database contains a maximum critical load for sulphur (CLmax), a minimum critical load for nitrogen (CLminN) and a maximum critical load for nitrogen (CLmaxN). These components define the critical load function. Where the acid deposition flux falls within the area under the critical load function, no exceedences are predicted.

A search has been undertaken on for each of the ecological receptors identified in Table 5.2. Each site has a number of habitats, each with different Critical Loads. Appendix D summaries the Critical Loads for acidification and background deposition rates as detailed in APIS for each identified habitat.

The impact of the facility has been assessed against these Critical Load functions. Where a critical load function for acid deposition is not available, the total nitrogen, sulphur and hydrogen fluoride deposition has been presented and compared against the background concentration.

10.3 Methodology

The impact of deposition has been assessed using the methodology detailed within the Habitats Directive AQTAG. The steps to this method are as follows.

- (1) Determine the annual mean ground level concentrations of nitrogen dioxide, sulphur dioxide and ammonia at each site.
- (2) Calculate the total deposition flux ($\mu\text{g}/\text{m}^2/\text{s}$) at each site by multiplying the annual mean ground level concentration by the relevant deposition velocity presented in Table 10.1.
- (3) Convert the dry deposition flux into units of kg of nitrogen or sulphur equivalence, as appropriate, using the conversion factors presented in Table 10.1.

Table 10.1: Deposition Factors

Pollutant	Deposition Velocity (m/s)		Conversion Factor ($\mu\text{g}/\text{m}^2/\text{s}$ to kg/ha/year)
	Grassland	Woodland	
Nitrogen dioxide	0.0015	0.003	96.0
Sulphur dioxide	0.0120	0.024	157.7
Ammonia	0.0200	0.030	259.7

10.3.1 Acidification

Deposition of nitrogen, sulphur and ammonia can cause acidification and should be taken into consideration when assessing the impact of the facility.

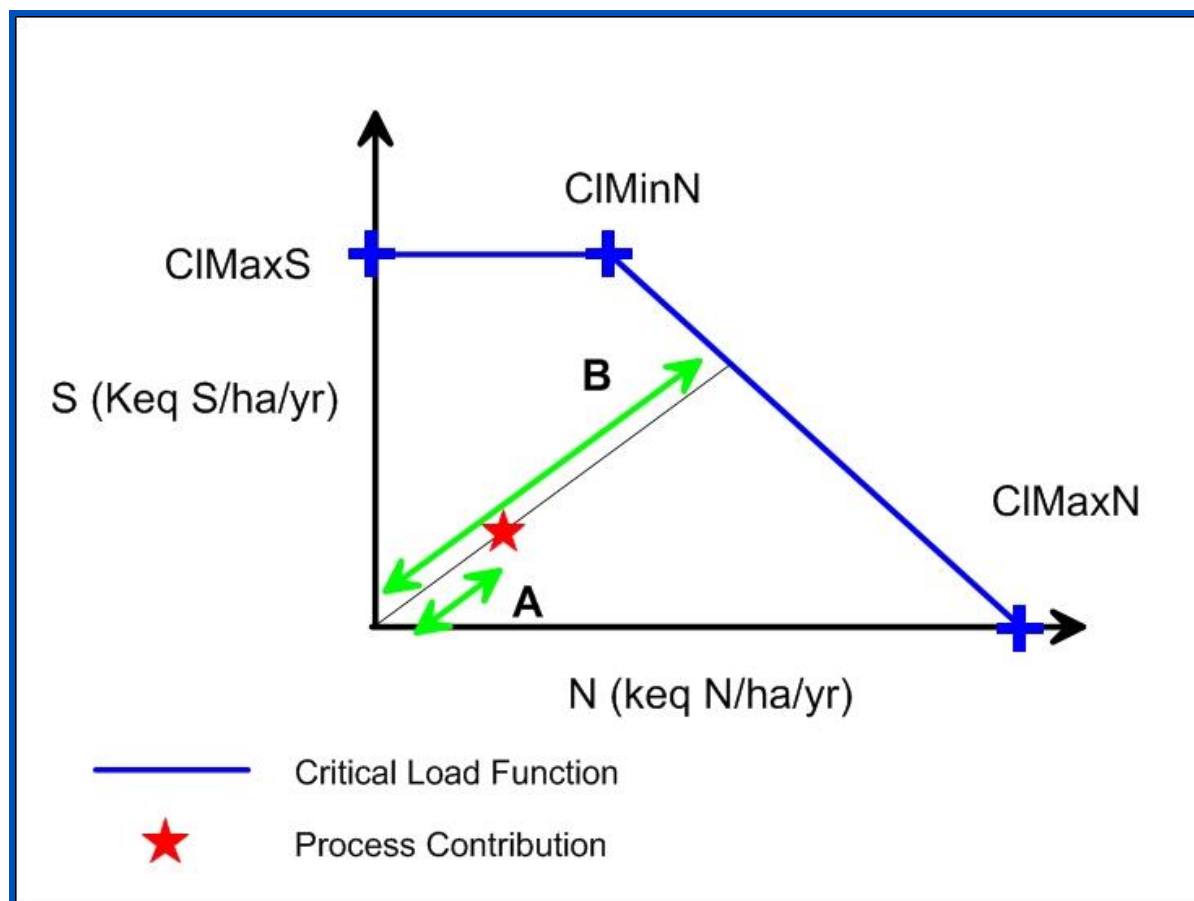
The steps to determine the acid deposition flux are as follows.

- (1) Determine the deposition of nitrogen, sulphur and ammonia.
- (2) Apply the conversion factor for N to the nitrogen and ammonia deposition rate in kg/ha/year to determine the total keq N/ha/year.
- (3) Apply the conversion factor for S to the sulphur deposition rate in kg/ha/year to determine the total keq S/ha/year.
- (4) Plot the results against the critical load functions.

Table 10.2: Conversion Factors

Pollutant	Conversion Factor (kg/ha/year to keq/ha/year)
Nitrogen	Divide by 14
Sulphur	Divide by 16

The process contribution has been calculated as a proportion of the critical load function based on the proportion that length A is of length B as presented in the following figure.



10.4 Results

Appendix E contains detailed results tables including the calculations of the deposition of nitrogen, sulphur and ammonia as a result of emissions from the facility.

10.4.1 Nitrogen deposition

The highest predicted levels of nitrogen deposition at each habitat listed in APIS are presented in Appendix E. The process contribution for nitrogen deposition is presented for completeness even if no critical load is specified within APIS. Where the impact is greater than 1% of the Critical Load this is highlighted.

As shown in Appendix E, the impact of nitrogen deposition from emissions from the facility is less than 1% of the upper and lower Critical Load. Therefore emissions are not likely to have a significant effect alone or in combination on nitrogen deposition irrespective of background levels.

10.4.2 Acid deposition

The impact of the facility has been assessed against the acid Critical Load functions specified in Appendix D.

As shown in Appendix E, the impact of acid deposition from emissions from the facility is less than 1% of the upper and lower Critical Load. Therefore emissions are not likely to have a significant effect alone or in combination on acid deposition irrespective of background levels.

11 DISPERSION MODELLING RESULTS – SHORT TERM EMISSION LIMITS

It is noted that the Residual Waste Treatment Facility has the potential to operate at the half-hourly limits described in Table 7.3. This chapter details the results of the dispersion modelling assuming the Residual Waste Treatment Facility operates at these limits. It should be noted that if the Residual Waste Treatment Facility continually operated at the half-hourly limits, the daily limits would be exceeded. The plant will be designed to achieve the limits described in Table 7.2 and, as such, the results presented in this section are extremely worst case and unlikely.

11.1 Results

This section only includes those pollutants with averaging periods less than 24 hours. This would be considered abnormal operations and is considered within the Abnormal Emissions Assessment which will be submitted as part of an Environmental Permit application.

As shown in Table 11.1, emissions from the Residual Waste Treatment Facility will not cause a breach of any AQO/EAL. However, emissions of nitrogen dioxide and sulphur dioxide cannot be screened out as 'insignificant'. For those pollutants which cannot be screened out as insignificant detailed results tables are presented in Appendix F. When considering the background concentration the PEC is less than 35%. Therefore, even when taking into account uncertainty in background concentrations and modelling, it is not likely that the AQOs will be close to being breached. It should also be noted that this is based on the point of maximum impact and not at receptor locations.

Table 11.1: Dispersion Modelling Results – Short Term Emission Limit Values

Pollutant	Quantity	Units	AQO /EAL	Bg Conc.	Process Contribution (PC) at Point of Greatest Impact						Max as % of AQO /EAL	PEC (PC +Bg)	PEC as % of AQO /EAL
					2008	2009	2010	2011	2012	Max			
Nitrogen dioxide	99.79th%ile of hourly means	µg/m ³	200	26.92	36.22	36.86	37.65	34.25	35.24	37.65	18.82%	64.57	32.28%
Sulphur dioxide	99.18th%ile of daily means	µg/m ³	125	4.92	19.41	21.78	22.88	22.78	19.56	22.88	18.30%	27.80	22.24%
	99.73rd%ile of hourly means	µg/m ³	350	4.92	49.51	50.56	50.58	48.67	49.39	50.58	14.45%	55.50	15.86%
	99.9th%ile of 15 min. means	µg/m ³	266	4.92	71.79	84.21	63.01	60.68	58.71	84.21	31.66%	89.13	33.51%
Hydrogen chloride	Hourly mean	µg/m ³	750	4.70	58.84	33.35	36.06	38.66	36.35	58.84	7.85%	63.54	8.47%
Hydrogen fluoride	Hourly mean	µg/m ³	160	6.32	3.92	2.22	2.40	2.58	2.42	3.92	2.45%	10.24	6.40%

12 VISUAL IMPACT OF PLUME

The visual impact of the stack emissions from the Residual Waste Treatment Facility has been investigated using ADMS 5.

The following table outlines the plume visibility results during daylight hours taking into account the distance to the site boundary in different directions.

Table 12.1: Plume Visibility Results			
Weather Year	Length of longest visible plume (m)	Number of visible plumes outside site boundary during daylight hours	As a % of daylight hours
2008	345	24	0.9%
2009	407	71	2.7%
2010	285	95	3.8%
2011	256	44	1.8%
2012	184	48	1.9%

The plume would be visible outside the main application site boundary for less than 5% of the daylight hours in each year considered. Therefore, it is considered that the impact of the plume is 'insignificant' using the methodology presented in Environment Agency guidance note H1 (July 2003).

13 IMPACT OF TRAFFIC EMISSIONS

13.1 Introduction

Emissions from road vehicles have the potential to adversely impact upon human health by causing an increase in local pollutant concentrations - notably nitrogen dioxide and particulate matter. The effects of emissions from traffic associated with the operational phase of the Circular Technology Park has been assessed using the screening method outlined in Chapter 3 of Volume 11 of the Design Manual for Roads and Bridges (DMRB), produced by the Highways Agency. This methodology is used to determine whether significant air quality effects are likely to occur from traffic related emissions.

13.2 Screening criteria

The DMRB states that further assessment of potential air quality impacts should be undertaken if the following criteria are met on any link affected by a proposed development:

- Increase in 24-hour AADT flow of more than 1,000 vehicles; and/or
- Increase in 24-hour AADT HDV flow of more than 200 vehicles.

If the above criteria are not met the significance of traffic emissions are considered to be negligible.

13.3 Assessment

It is envisaged that the overall Circular Technology Park would generate on average 120 HGV trips per day (i.e. 60 incoming and 60 outgoing movement). This includes the MRF and the Residual Waste Treatment Facility, proposed as part of this planning application, as well as other potential activities that may be carried out at the site in the future (these lie outside the Application Site and would be subject to a separate submission). It is therefore not anticipated that the operation of the Circular Technology Park would give rise to an increase in flows of more than 1,000 vehicles or 200 HGV per day and the significance of operational phase traffic emissions is considered negligible.

13.4 Cumulative impacts

It is noted that exhaust pollutants from vehicles and emissions from the proposed waste treatment facility have the potential to cause cumulative effects. However, the site is designed in such a way that 2 access routes will be used with a one way system in operation with 60 HGV movements per day along each access route.

Due to the low number of vehicles it is not anticipated that cumulative pollutant concentrations would be significantly greater than that predicted for the proposed development alone.

14 ODOUR

There is no specific legislation regarding acceptable or unacceptable odour levels. The primary means of regulation is through the concept of statutory nuisance under Part III of the Environmental Protection Act 1990 and under the Environmental Regulations, where odour is a type of pollution to be regulated. In both cases, the objective of regulation is to ensure that there is no cause for annoyance.

The impact of emissions of odour during the operational phase of the proposed waste treatment facility has been assessed on a qualitative basis. This is based on the distance to sensitive receptors, the design features inherent to the design and the potential for release from the facility.

14.1 Assessment

The closest residential receptors are located approximately 300m to the north east of the site, as highlighted within the Figure A.11. When considering the prevailing wind direction these properties are located down-wind from the facility.

All operations associated with the proposed development will be conducted within enclosed buildings, all equipped with fast acting roller shutter doors. The Residual Waste Treatment facility and associated process will be continuously operated whilst delivery of material will be restricted to the hours of 07:30 to 17:00 Monday to Friday and 07:30 to 13:00 Saturday. As such some storage of waste on site will be required to ensure continuous operation of the plant. Measures will be implemented to ensure storage of fuel is limited minimising the potential for odours to develop.

The proposed waste treatment facility will require an Environmental Permit to operate, which means that fugitive emissions of odour will need to be contained within the permitted site boundary.

Based on the distance to the nearest sensitive receptor and the mechanisms to be in place to control odorous releases, the impact of operational phase odour emissions from the proposed development is considered to be negligible.

15 IMPACT OF CONSTRUCTION PHASE EFFECTS

15.1 Introduction

There is the potential for fugitive dust emissions as a result of construction phase activities. These have been assessed in accordance with the methodology outline within the Institute of Air Quality Management (IAQM) guidance document "Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance" (January 2012).

The risk of dust emissions from a demolition / construction site causing loss of amenity and/or health or ecological effects is related to:

- The activities being undertaken (demolition, number of vehicles and plant etc);
- The duration of these activities;
- The size of the site;
- The meteorological conditions (wind speed, direction and rainfall);
- The proximity of receptors to the activity;
- The adequacy of the mitigation measures applied to reduce or eliminate dust; and
- The sensitivity of the receptors to dust.

The quantity of dust emitted will be related to the area of land being worked and the level of construction activities (nature, magnitude and duration).

The wind direction, wind speed and rainfall, at the time when a construction activity is taking place, will also influence whether there is likely to be a dust impact. Atmospheric conditions which promote adverse impacts can occur in any direction from the site. However, they are more likely to occur downwind of the prevailing wind direction and/or close to the site. Impacts are also more likely to occur during drier periods as rainfall acts as a natural dust suppressant.

The assessment methodology considers three separate dust effects:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to significant increase in exposure to PM₁₀.

15.2 Assessment methodology

The first stage is to determine whether a more detailed assessment is required. The IAQM document recommends that:

"an assessment will normally be required where there are sensitive receptors within 350m of the boundary of the site and/or within 100m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s)."

If no sensitive receptors are present within the stated screening distances then further assessment is not necessary. Impacts at distances greater than the screening distances would be expected to be negligible.

A human receptor refers to any location where a person may experience the annoyance effects of airborne dust or dust soiling or exposure to PM₁₀ over a period of time relevant to the air quality objectives. These include:

- Residential dwellings;
- Schools;
- Hospitals;
- Care homes;
- Hotels;

- Gardens (where relevant public exposure is likely i.e. excluding extremities of gardens or front gardens); and
- Sensitive commercial premises including; vehicle showrooms, food manufactures; and electronics manufactures.

In addition it is noted that the impact of dust soiling should also be considered at ecological receptors this should include statutory and non statutory designated sites, if appropriate.

The second stage is to assess the risk of dust effects rising. A site is allocated to a risk category based on two factors:

- The scale and nature of the works, which determines the risk of dust arising (i.e. the magnitude of potential dust emissions) classed as: small, medium or large; and
- The proximity of receptors, considered separately for ecological and human receptors (i.e. the potential for effects).

The dust emission class is determined by considering the following criteria.

Table 15.1: Dust Emission Class

Dust Emission Class	Activity	Criteria
Large	Earthworks	Total size area > 10,000 m ² , potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), > 10 heavy earth moving vehicles active at any one time, formation of bunds > 8 m in height, total material moved > 100,000 tonnes
	Construction	Total building volume > 100,000 m ³ , piling, on site concrete batching, sandblasting
	Trackout	> 100 HDV (> 3.5t) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100 m
Medium	Earthworks	Total size area 2,500 – 10,000 m ² , moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8 m in height, total material moved 20,000 – 100,000 tonnes
	Construction	Total building volume 25,000 – 100,000 m ³ , potentially dusty construction material (e.g. concrete), piling, on site concrete batching
	Trackout	25 – 100 HDV (> 3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100 m
Small	Earthworks	Total size area < 2,500 m ² , soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 10,000 tonnes, earthworks during wetter months
	Construction	Total building volume < 25,000 m ³ , construction material with low potential for dust release (e.g. metal cladding or timber)
	Trackout	< 25 HDV (> 3.5t) trips in any one day, surface material with low potential for dust release, unpaved road length < 50 m

For trackout, the assessment should be based on the distance over which it might occur. As general guidance, significant trackout may occur up to 500 m from large sites, 200 m from medium sites, and 50 m from small sites, as measured from the site exit. These distances assume no site-specific mitigation.

The risk category for earthwork, construction and trackout, with no mitigation applied, is defined using the tables below.

Table 15.2: Earthworks Risk

Distance to nearest receptor (m)		Dust emission class		
Dust soiling and PM ₁₀	Ecological	Large	Medium	Small
<20	-	High risk site	High risk site	Medium risk site
20-50	-	High risk site	Medium risk site	Low risk site
50-100	<20	Medium risk site	Medium risk site	Low risk site
100-200	20-40	Medium risk site	Low risk site	Negligible
200-350	40-100	Low risk site	Low risk site	Negligible

Table 15.3: Construction Risk

Distance to nearest receptor (m)		Dust emission class		
Dust soiling and PM ₁₀	Ecological	Large	Medium	Small
<20	-	High risk site	High risk site	Medium risk site
20-50	-	High risk site	Medium risk site	Low risk site
50-100	<20	Medium risk site	Medium risk site	Low risk site
100-200	20-40	Medium risk site	Low risk site	Negligible
200-350	40-100	Low risk site	Low risk site	Negligible

Table 15.4: Trackout Risk

Distance to nearest receptor (m)		Dust emission class		
Dust soiling and PM ₁₀	Ecological	Large	Medium	Small
<20	-	High risk site	Medium risk site	Medium risk site
20-50	<20	Medium risk site	Medium risk site	Low risk site
50-100	20 -100	Low risk site	Low risk site	Negligible

The next stage is to determine the significance of dust impacts based on the sensitivity of the surrounding environment. The sensitivity of the area to dust effects is defined using the following factors.

Table 15.5: Sensitivity of Area

Sensitivity of Surrounding Area	Examples	
	Human receptors	Ecological Receptors
Very high	Very densely populated area. More than 100 dwellings within 20 m. Local PM ₁₀ concentrations exceed the objective. Contaminated buildings present. Very sensitive receptors (e.g. oncology units). Works continuing in one area of the site for more than one year.	European designated site
High	Densely populated area. 10 – 100 dwellings within 20 m. Local PM ₁₀ concentrations close to the objective (e.g. annual mean 36-40 µg/m ³) Commercially sensitive horticultural land within 20m.	Nationally designated site
Medium	Suburban or edge of town area. Less than 10 dwellings within 20 m. Local PM ₁₀ concentrations below the objective (e.g. annual mean 30-36 µg/m ³)	Locally designated site
Low	Rural area; industrial area. No dwellings within 20 m. Local PM ₁₀ concentrations well below the objective. (less than 75%) Wooded area between site and receptors	No designations

The significance of effect, without any mitigation measures beyond those required by legislation, is then defined using the following table for each activity.

Table 15.6: Significance of Effect – Pre-mitigation

Sensitivity of Surrounding Area	Risk of Site Giving Rise to Dust Effects		
	High Risk Site	Medium Risk Site	Low Risk Site
Very high	Substantial adverse	Moderate adverse	Moderate adverse
High	Moderate adverse	Moderate adverse	Slight adverse
Medium	Moderate adverse	Slight adverse	Negligible
Low	Slight adverse	Negligible	Negligible

Where the significance of effect is determined to be negligible no mitigation measures, beyond those required by legislation are required. Site specific mitigation should be applied where the effect cannot be considered to be negligible. These should be related to the risk category of the site.

Where background levels are high and additional PM₁₀ may contribute to, or cause, an exceedence of the objective, such as in the situations below, consideration should be given to applying a higher level of mitigation:

- Sites within an AQMA declared for PM₁₀; or

- Sites in areas where the current concentration of PM₁₀ is >90% of either the annual and 24-hour objective.

The significance of effect, after applying suitable mitigation measures, is then defined using the following table for each activity.

Table 15.7: Significance of Effect - Post-mitigation

Sensitivity of surrounding area	Risk of site giving rise to dust effects		
	High risk site	Medium risk site	Low risk site
Very high	Slight adverse	Slight adverse	Negligible
High	Slight adverse	Negligible	Negligible
Medium	Negligible	Negligible	Negligible
Low	Negligible	Negligible	Negligible

15.3 Identification of sensitive receptors

Due to the nature of the site layout, the majority of dust generating activities would not occur at the site boundary. The existing building on site that will house the Reception/Pre-treatment facility and MRF will be maintained with a new building built to house the proposed Residual Waste Treatment Facility. Figure A.11 presents the construction site boundary and proximity zones based on the methodology presented above. The closest property is located approximately 300m to the north-east of the site boundary along Ford Lane. These properties are approximately 350m from the area where the new building will be constructed.

The methodology assesses the significance of the site rather than the significance of the impact on an individual receptor. As such, individual receptors have not been identified.

No statutory or non-statutory designated sites lie within the dust assessment zone and as such an assessment of construction phase dust effects on ecological sites has not been undertaken.

15.4 Assessment

During the construction phase, the following activities have the potential to result in annoyance due to dust soiling, risk to human health due to significant increases in exposure to PM₁₀ and harm to ecological receptors:

-
- Earthworks;
- Construction; and
- Trackout.

15.4.1 Earthworks

During earthworks the dust emission class is predicted to be 'small' as earthworks would be limited to the removal of about 0.5m of ground below the new building.

As shown in Figure A.11 the closest properties are over 200m from the site boundary. Therefore the risk of the site giving rise to dust effects is negligible, assuming no mitigation beyond that required by legislation.

15.4.2 Construction

During construction the dust emission class is predicted to be 'medium' as the building would be a steel portal building with sheeting.

As shown in Figure A.11 the closest properties are over 200m from the site boundary and more likely 350m from the construction area. Therefore, the site is considered to be a 'low risk site' when considering the potential for annoyance due to dust soiling and the risk to health effects due to a significant increase in exposure to PM₁₀. The sensitivity of the area has been determined to be 'low' as the area is in a rural area, with no dwellings within 20m and PM₁₀ concentrations are well below the objectives. The significance of dust annoyance and the risk to human health as a result of construction activities is considered to be negligible, assuming no mitigation beyond that required by legislation.

15.4.3 Trackout

As a result of trackout the dust emission class is predicted to be 'medium' as the worst-case construction phase HGV movements are predicted to be between 25 and 100 movements per day.

As stated it is assumed that significant trackout may occur up to 500 m from a large site. The residential properties along Rodney Crescent have been identified within 20m of this zone. However at this point vehicles will have travelled approximately 900m on the paved access road between where the main construction work are to be carried out and these sensitive receptors. Therefore, the site is considered to be a 'low risk site' when considering the potential for annoyance due to dust soiling and the risk to health effects due to a significant increase in exposure to PM₁₀. The sensitivity of the area has been determined to be 'low' as the area is in a rural area, and PM₁₀ concentrations are well below the objectives. The significance of dust annoyance and the risk to human health as a result of trackout is considered to be negligible, assuming no mitigation beyond that required by legislation.

15.4.4 Summary

These effects would be:

- Temporary – as conditions would return to baseline upon cessation of construction activities;
- Short-term - as they would only occur during specific construction activities and when adverse meteorological conditions occur;
- Direct - as they are directly associated with the activities onsite; and
- Local - as they would impact receptors in close proximity to the site.

The significance of construction phase dust impacts are predicted to be negligible, providing any measures to control dust required by legislation are implemented.

16 CUMULATIVE IMPACT OF OTHER PROCESS EMITTERS

The scoping response provided by West Sussex County Council requested that all processes within 5km should be considered within the cumulative assessment. A review of the “what’s in my backyard” application on the Environment Agency website was undertaken in the absence of any development specification. The only process identified within 5km of the facility which has the potential to have cumulative effects is the CHP plant at the adjacent sewerage treatment works which was approved in December 2012. The CHP plant will have limits on emissions of oxides of nitrogen and carbon monoxide.

A review of the air quality assessment submitted in support of the application has identified the following emission parameters. The base ADMS model has been updated to include this additional source to determine the cumulative impact of emissions.

16.1 Source and emissions data

A review of the air quality assessment submitted in support of the CHP plant planning application has identified the following emission parameters. The base ADMS model has been updated to include this additional source to determine the cumulative impact of emissions.

Table 16.1: Source Data		
Item	Unit	CHP
Stack Data		
Height	m	10
Internal diameter	m	0.250
Location (E'ings,N'ings)	m, m	499458, 103158
Flue Gas Conditions		
Temperature	°C	160
Exit moisture content	% v/v	11.2
Exit oxygen content	% v/v dry	8.8
Reference oxygen content	% v/v dry	5.0
Volume at reference conditions (dry, ref O ₂)	Nm ³ /s	0.606
Volume at actual conditions	Am ³ /s	1.427
Flue gas exit velocity	m/s	29.1
Emissions		
Oxides of nitrogen	g/s	0.303
Carbon monoxide	g/s	0.448

16.2 Results

Table 16.2 presented the results of the cumulative dispersion modelling at the point of maximum impact. As shown cumulative emission are not predicted to cause a breach of the AQO for any pollutant. Therefore, the cumulative effect of emissions should not be seen as a constraint to the development. Detailed results tables for each sensitive receptor are contained in Appendix G.

Table 16.2: Dispersion Modelling Results – Cumulative

Pollutant	Quantity	Units	AQO /EAL	Bg Conc.	Process Contribution (PC) at Point of Greatest Impact						Max as % of AQO /EAL	PEC (PC +Bg)	PEC as % of AQO /EAL
					2008	2009	2010	2011	2012	Max			
Nitrogen dioxide	Annual mean	µg/m ³	40	13.46	2.69	2.69	3.93	2.75	2.61	3.93	9.83%	17.39	43.48%
	99.79th%ile of hourly means	µg/m ³	200	26.92	17.65	18.68	20.32	18.08	18.76	20.32	10.16%	47.24	23.62%
Carbon monoxide	8 hour running mean	µg/m ³	10,000	456.00	52.60	54.72	43.98	39.81	40.10	54.72	0.55%	510.72	5.11%

Analysis has been undertaken of the breakdown of the contribution from the Residual Waste Treatment Facility and the CHP. This is summarised in Table 16.3.

Table 16.3: Annual Mean Nitrogen Dioxide Cumulative Impact Analysis					
	Annual Mean Nitrogen Dioxide Concentration ($\mu\text{g}/\text{m}^3$)				As % of AQO
	Residual Waste Treatment Facility	CHP	Background	Total	
Point of maximum cumulative impact	1.43	2.50	13.46	17.39	43.48%
Point of maximum Residual Waste Treatment Facility impact	1.98	1.34	13.46	16.78	41.95%

As shown, the CHP is the greatest contributor at the point of maximum cumulative impact.

Figure A.12 in Appendix A shows the cumulative impact of annual emissions of nitrogen dioxide from the Residual Waste Treatment Facility and the CHP. This also includes the background contribution.

17 CONCLUSIONS

This Air Quality Assessment has been undertaken to support the planning application for the proposed waste treatment facility at the new Circular Technology Park on the Former Tarmac Topblock site at Ford Airfield, Arundel. This has included a review of existing background pollutant concentrations and the modelling of emissions from the proposed development.

- (1) The review of background concentrations has shown that pollutant concentrations are very low, as would be expected due to the rural nature of the area. In lieu of any local monitoring, modelled mapped background data has been used for a number of pollutants.
- (2) The methodology used in the assessment of the impact on air quality of the proposals uses a number of conservative assumptions. These include the following:
 - a) It is assumed that the facility will continually operate at the proposed limits. In practice, this will not be the case and actual emissions will be less than the limits.
 - b) The maximum ground level concentrations are considered in each case. These concentrations occur in small areas; in general, the concentration will be much lower.
- (3) In relation to the impact on human health, we conclude that:
 - a) Emissions from the facility will not cause a breach of any AQO or EAL;
 - b) The impact at all human sensitive receptors can either be screened out as 'insignificant' or described as negligible when taking into consideration the local background concentration; and
 - c) There is no risk of exceeding an EAL for heavy metals, when taking into account that the facility will incorporate a flue gas cleaning system to remove heavy metals which will perform similar to existing UK facilities.
- (4) In relation to the impact on ecologically sensitive sites, we conclude that:
 - a) Emissions from the facility will not cause a breach of any AQO or EAL; and
 - b) At all statutory designated sites emissions are not likely to have a significant effect alone or in combination irrespective of background levels.
- (5) The impact of traffic emissions associated with the operational phase can be screened out from further assessment using the DMRB screening criteria therefore are considered to be negligible.
- (6) Providing measures to control dust required by legislation are implemented construction phase dust effects are predicted to be negligible.
- (7) Dispersion modelling has been undertaken to determine the cumulative effect of emissions from the Residual Waste Treatment Facility and local CHP unit. This has shown that the cumulative impact would be well below the AQOs and as such the cumulative effect of emissions should not be seen as a constraint to the development.

In summary, the impact of the proposed development is not considered to have a significant impact upon local air quality, the general population or the local community.

Appendix A - Figures

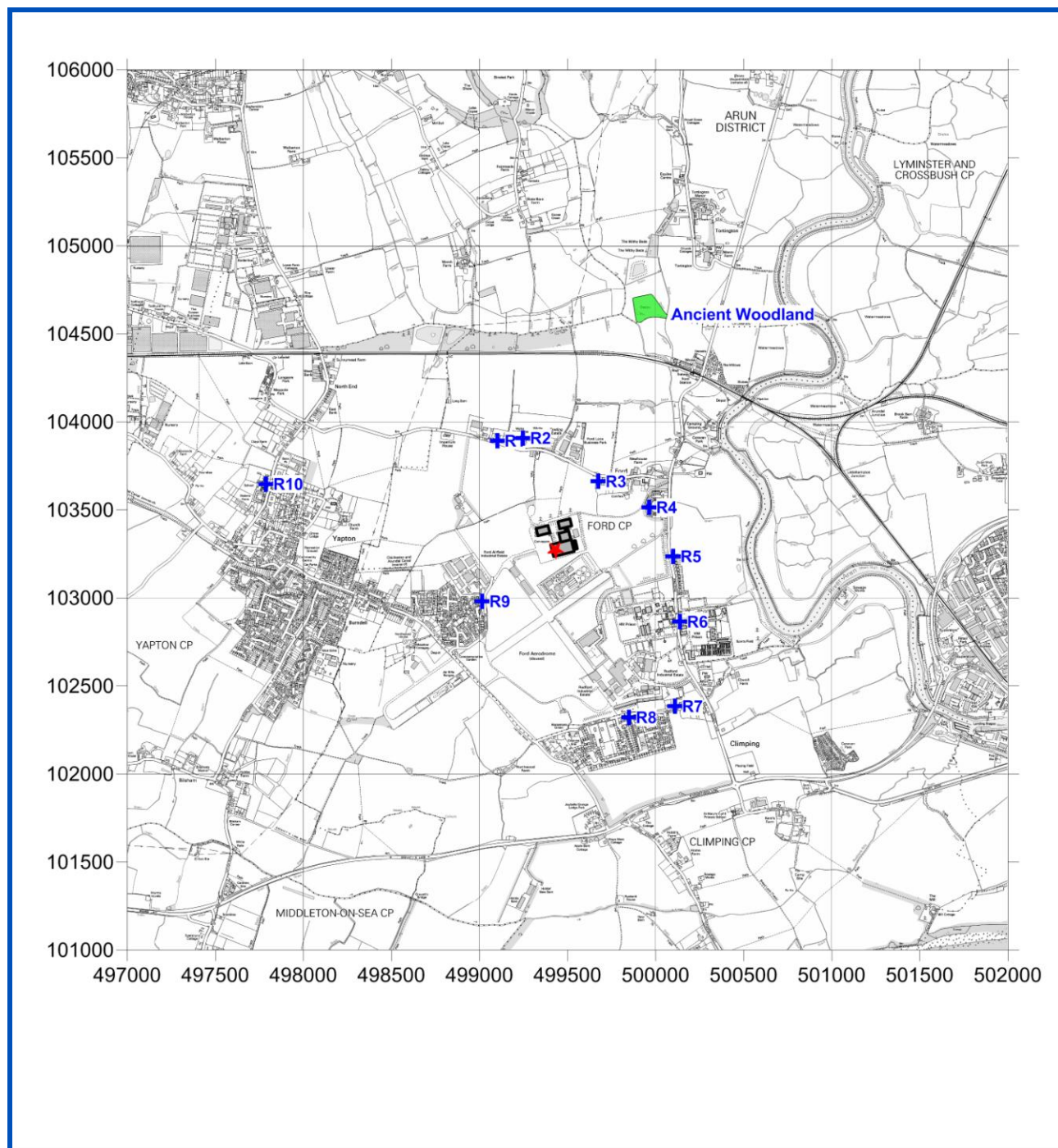
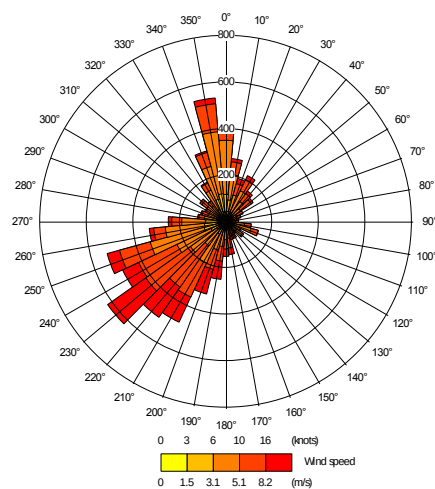
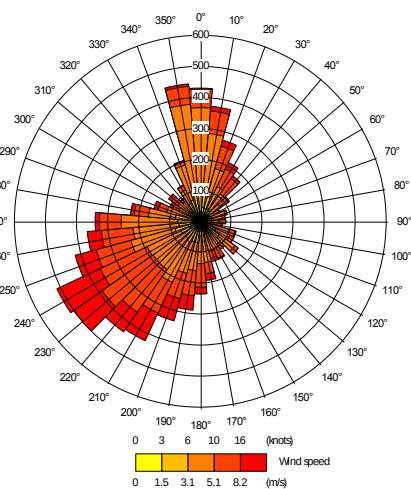
Figure A.1: Site Location and Human Sensitive Receptors and Ancient Woodland

Figure A.2: Wind Roses

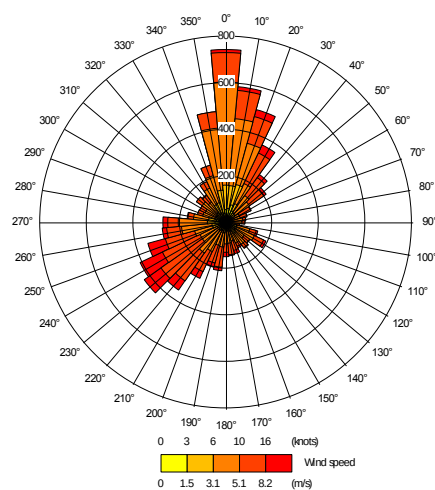
Shoreham 2008



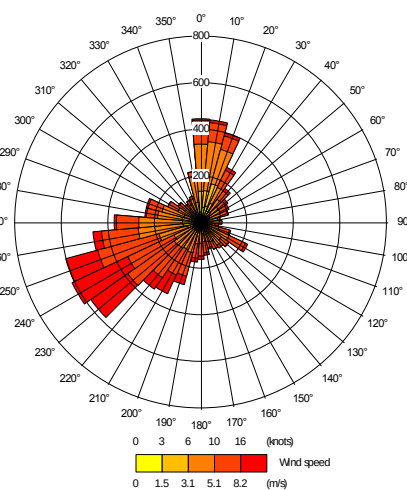
Shoreham 2009



Shoreham 2010



Shoreham 2011



Shoreham 2012

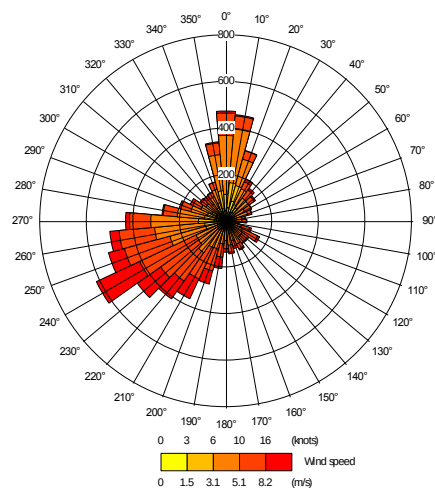


Figure A.3: Building Layout

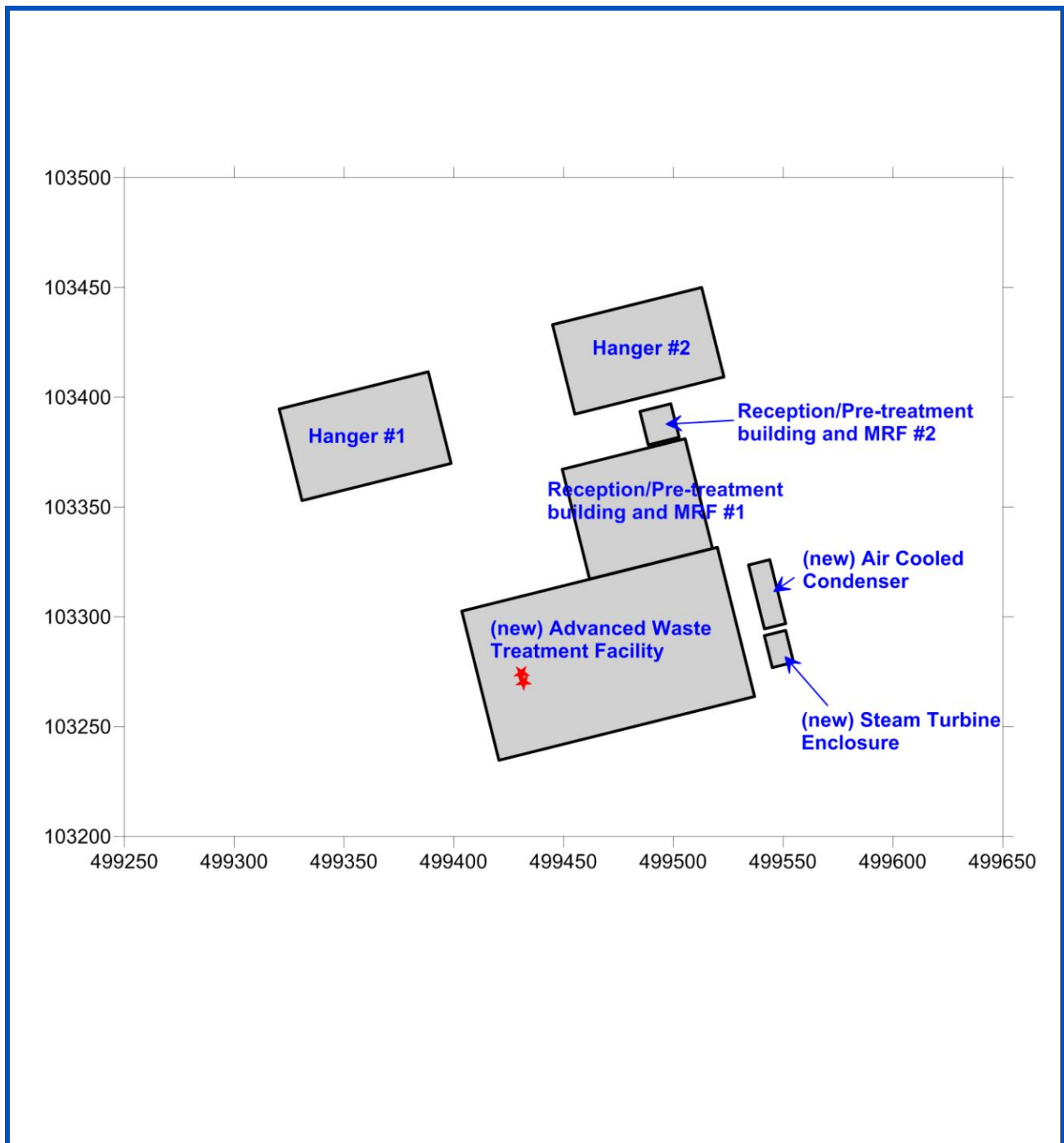


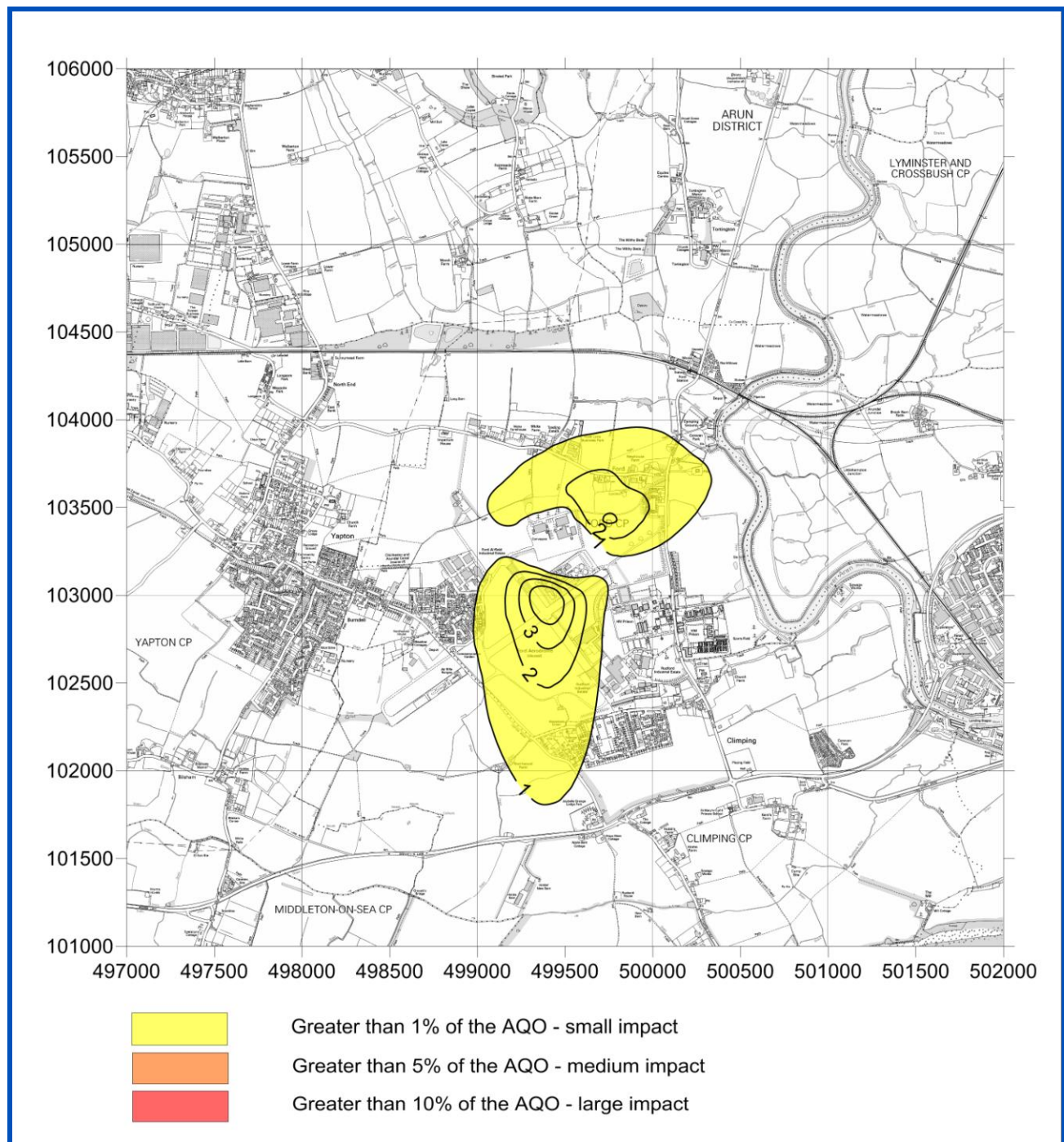
Figure A.4: Annual Mean Nitrogen Dioxide Process Contribution (as % of AQO) - 2010

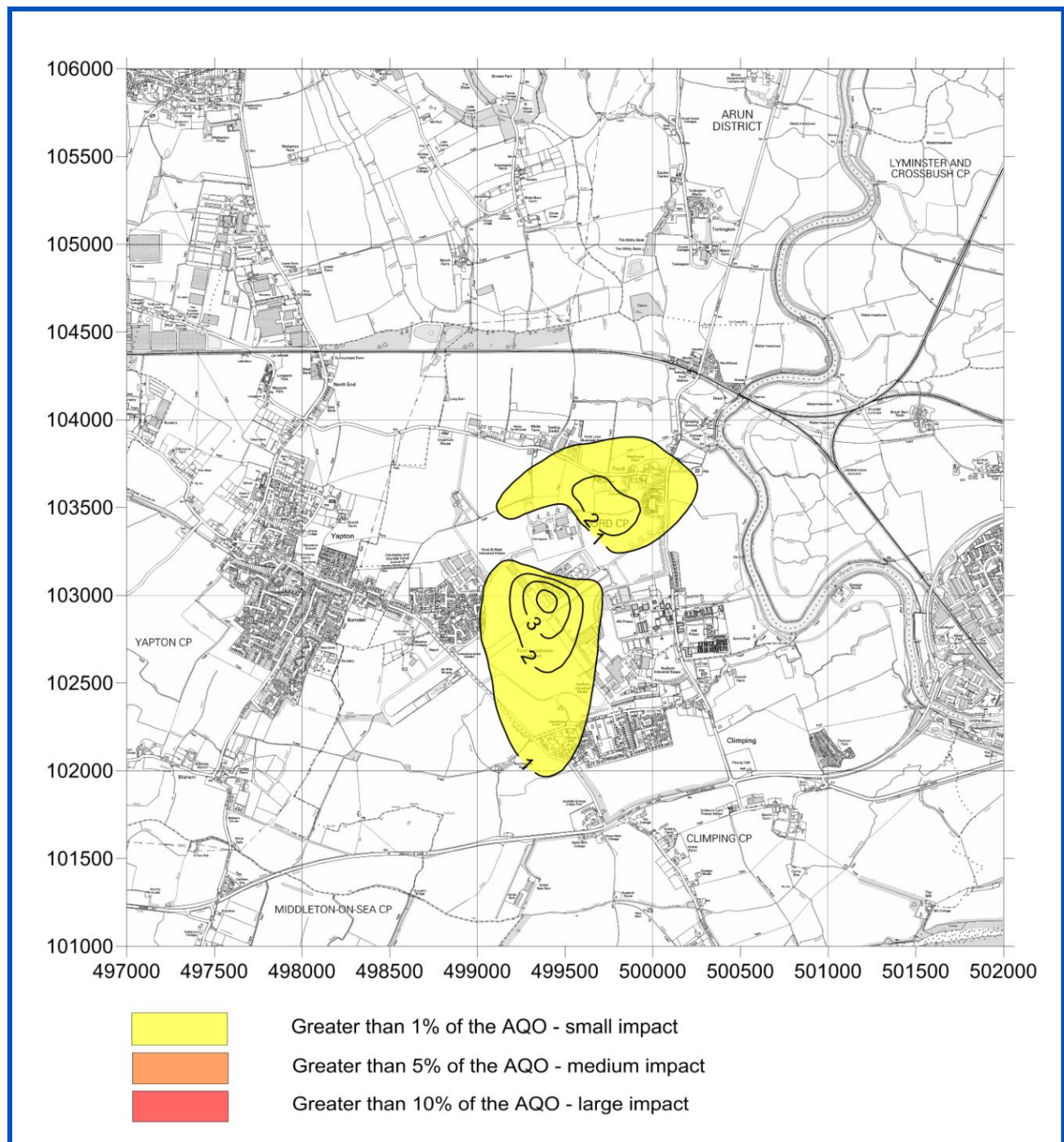
Figure A.5: Annual Mean VOCs (as benzene) Process Contribution (as % of AQO) - 2010

Figure A.6: Annual Mean VOCs (as 1,3-butadiene) Process Contribution (as % of AQO) - 2010

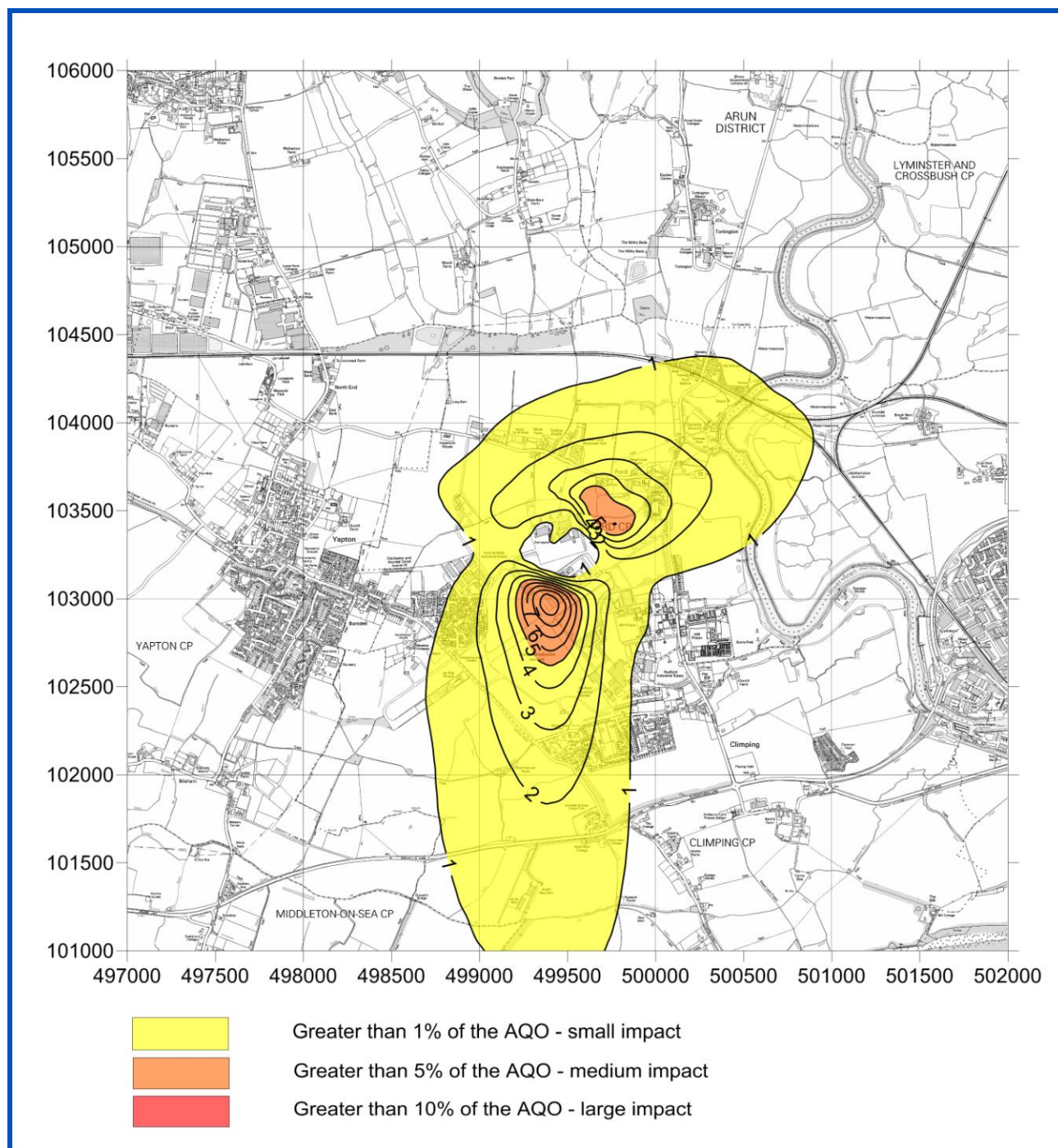


Figure A.7: Annual Mean Cadmium Process Contribution (as % of AQO) – 2010 – 50% of Combined Cadmium and Thallium Emissions Consist of Only Cadmium

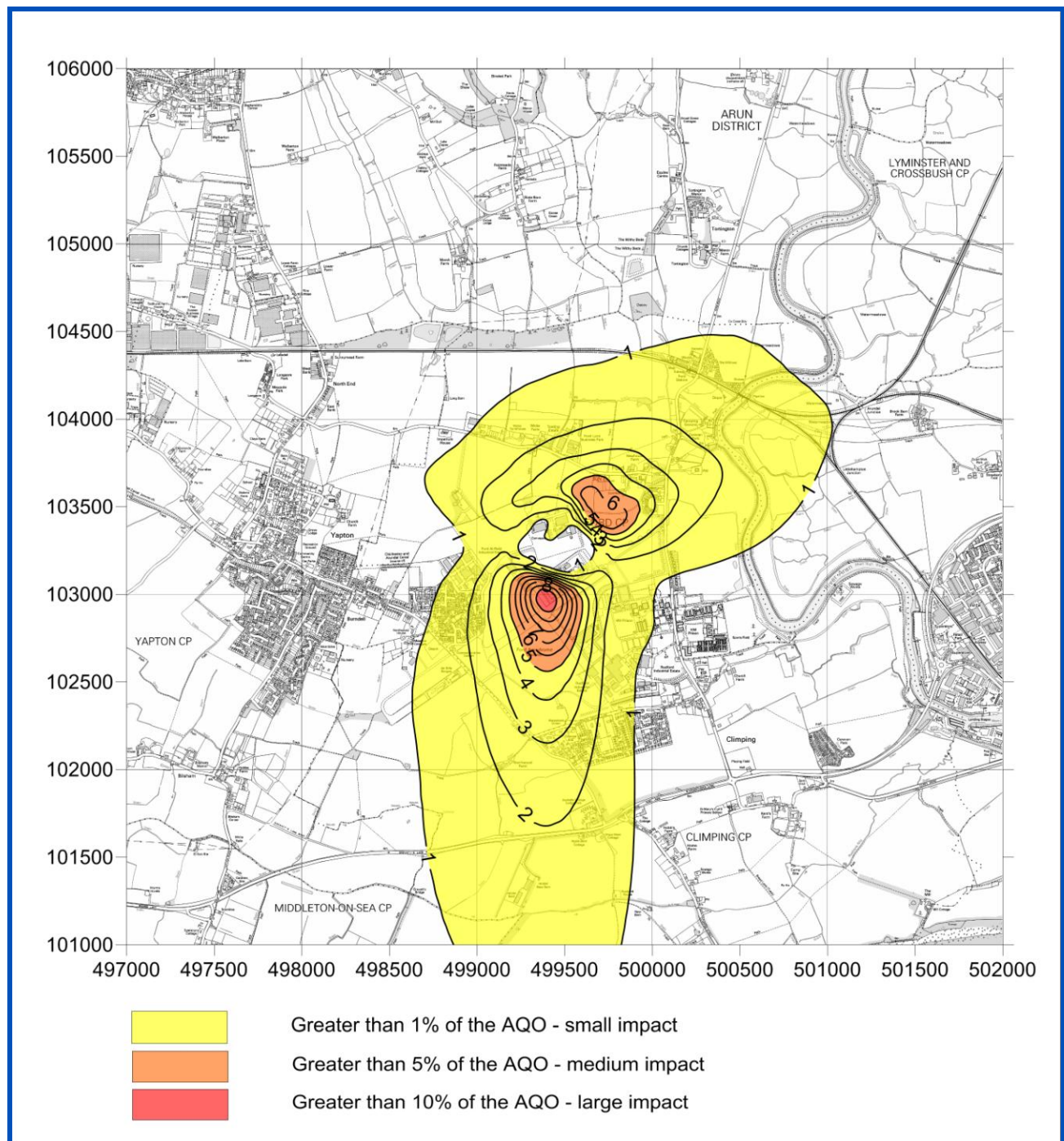


Figure A.8: Annual Mean Cadmium Process Contribution (as % of AQO) – 2010 – 8% of Combined Cadmium and Thallium Emissions Consist of Cadmium

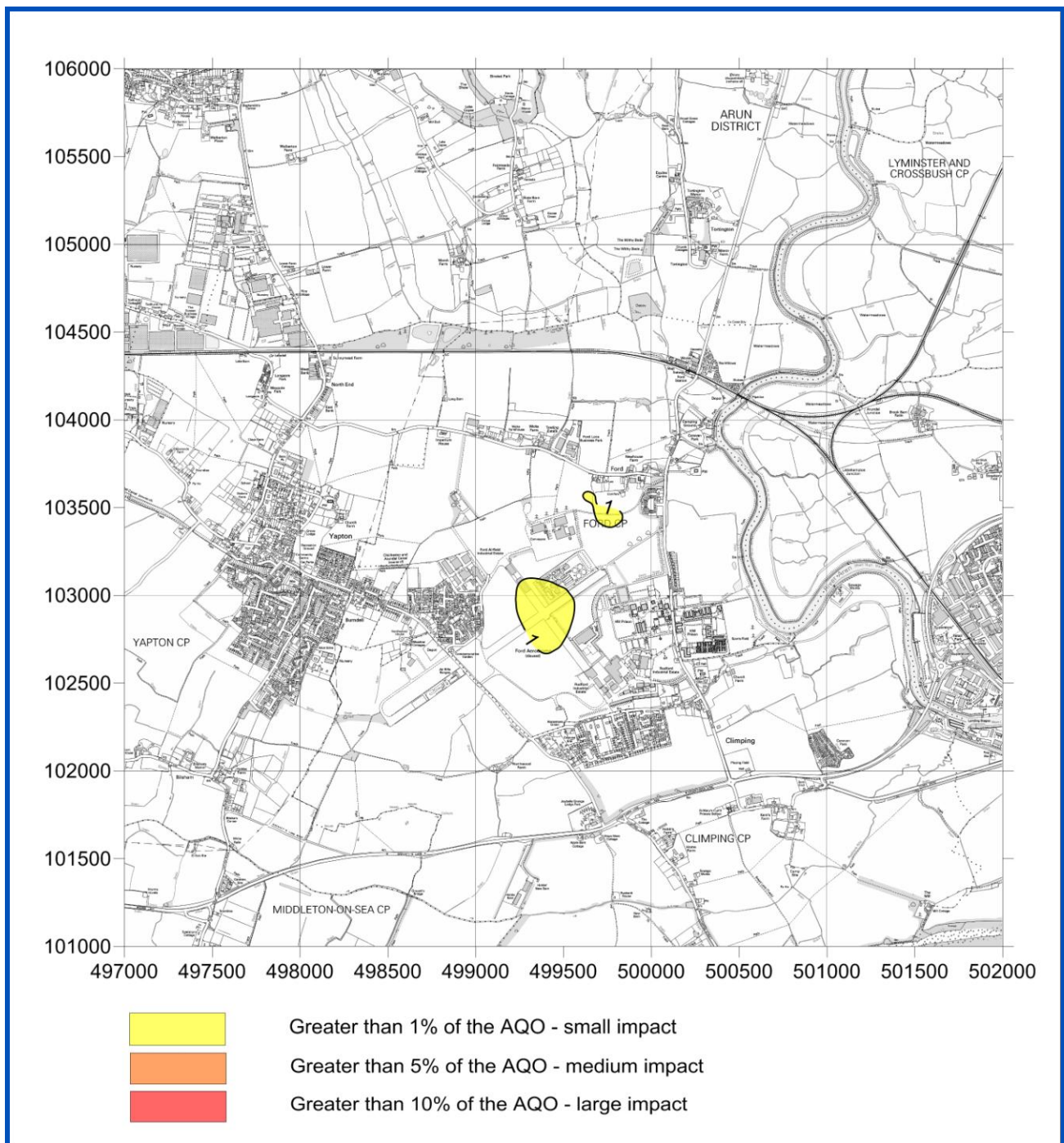


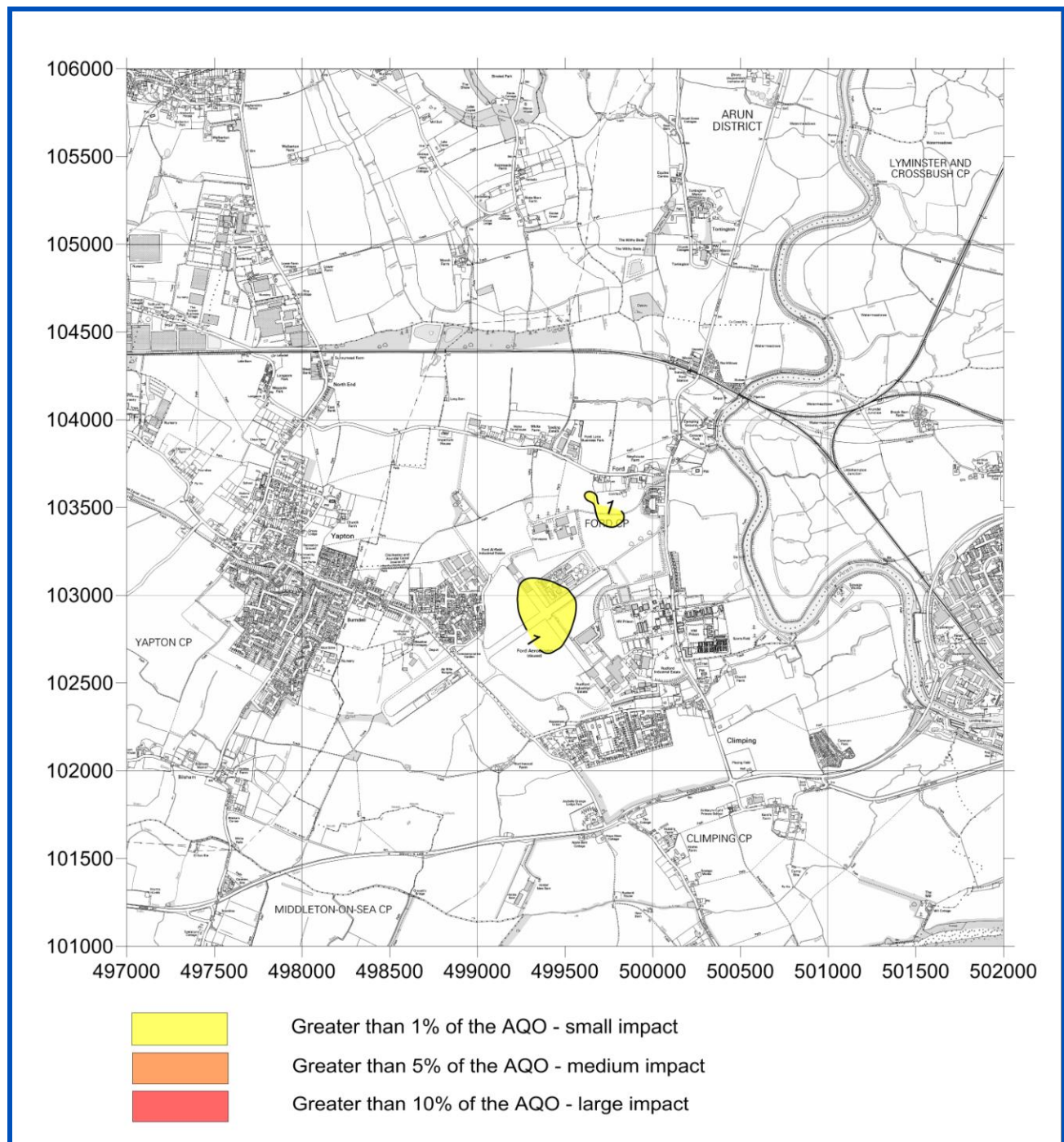
Figure A.9: Annual Mean PaH Process Contribution (as % of AQO) – 2010

Figure A.10: Annual Mean Chromium VI Process Contribution (as % of EAL) – Using maximum APC analysis for all years

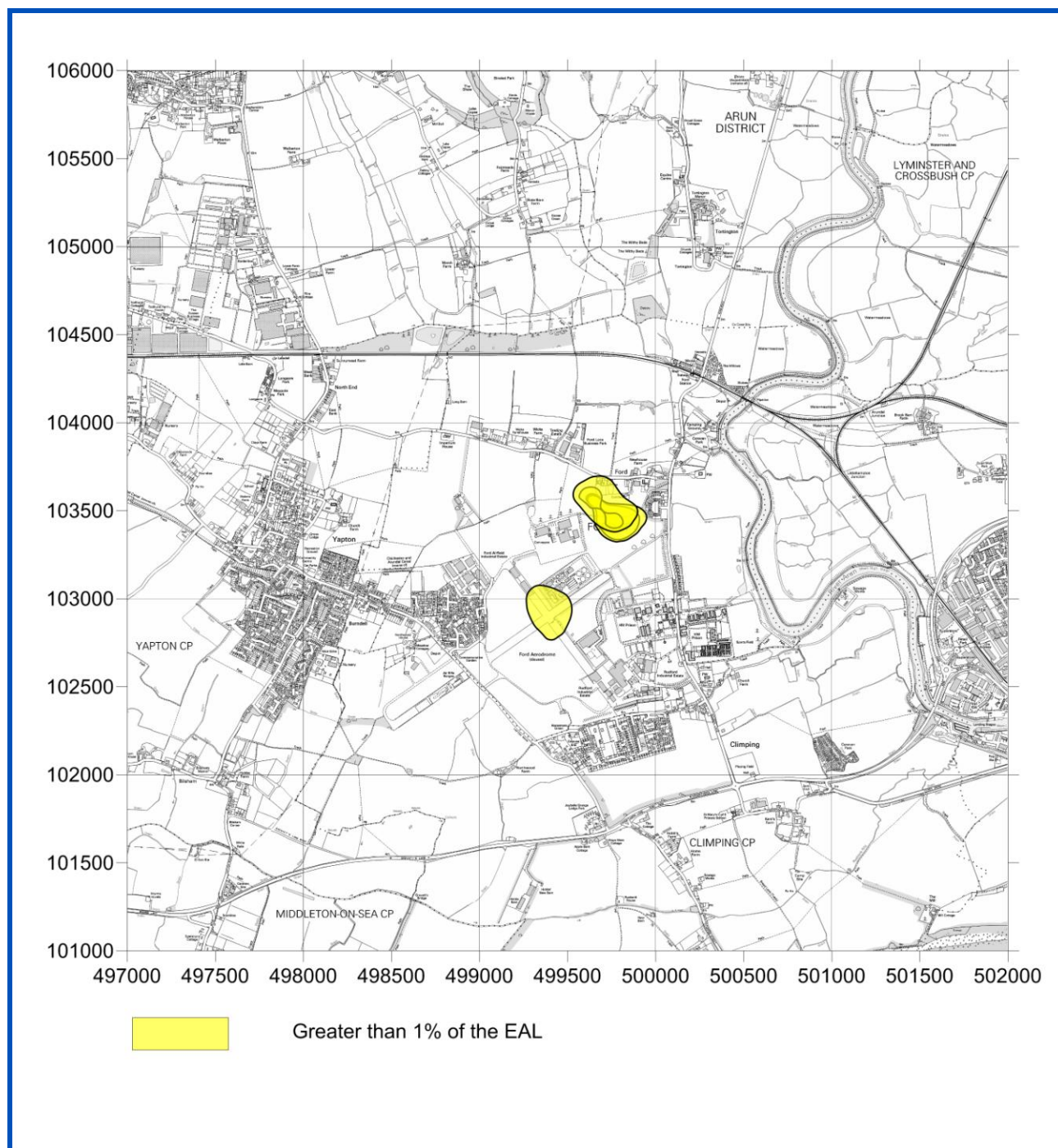


Figure A.11: Dust Receptors Proximity Zones

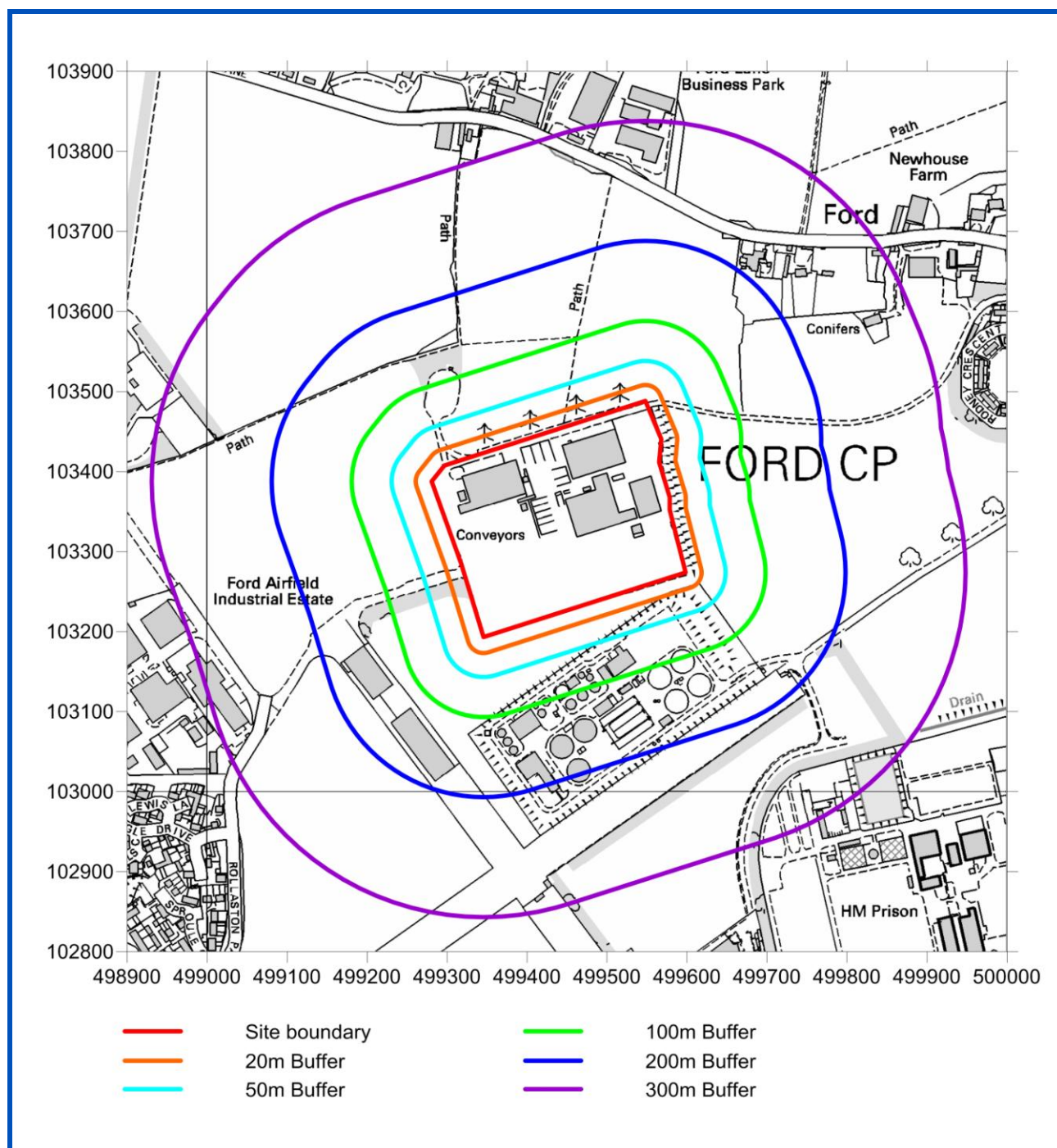
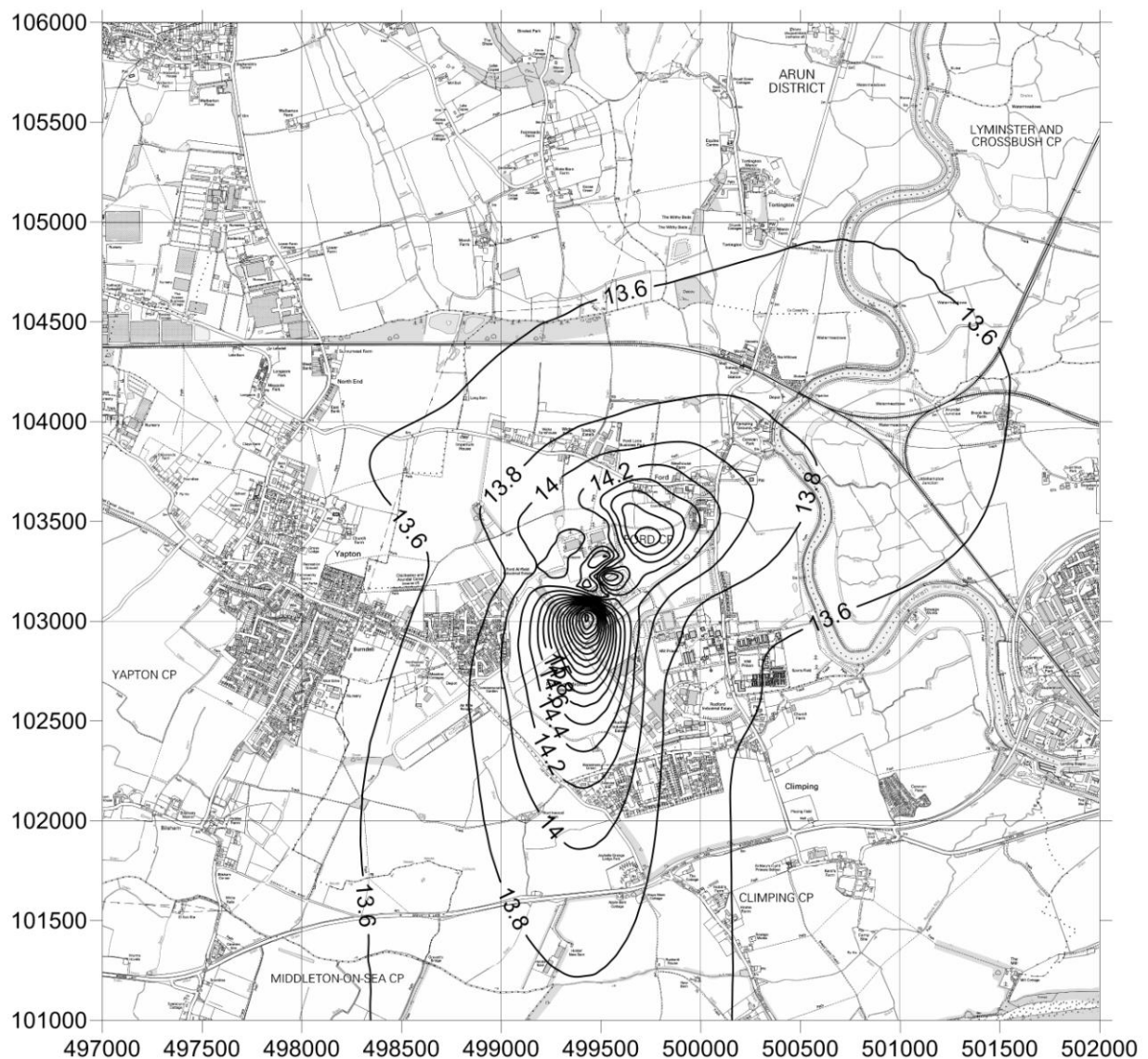


Figure A.12: Annual Mean Nitrogen Dioxide PEC (as $\mu\text{g}/\text{m}^3$) – 2010

Includes contribution from the Residual Waste Treatment Facility, the CHP unit and background

Appendix B – Detailed Results at Sensitive Receptors

Table B.1: Annual Mean Nitrogen Dioxide Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	$\mu\text{g}/\text{m}^3$	As % of AQO	$\mu\text{g}/\text{m}^3$	As % of AQO
1# Ford Lane	0.26	0.7%	13.72	34.3%
2# Ford Lane	0.34	0.9%	13.80	34.5%
3# Ford Lane	1.58	3.9%	15.04	37.6%
Rodney Crescent	1.29	3.2%	14.75	36.9%
Ford Road	0.53	1.3%	13.99	35.0%
Ford Open Prison	0.18	0.4%	13.64	34.1%
1# Horsemere Green Lane	0.13	0.3%	13.59	34.0%
2# Horsemere Green Lane	0.27	0.7%	13.73	34.3%
Beagle Drive	0.44	1.1%	13.90	34.8%
Yapton Primary School	0.06	0.2%	13.52	33.8%
Point of max impact	1.99	4.96%	15.45	38.61%

Table B.2: Annual Mean VOCs (as benzene) Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	$\mu\text{g}/\text{m}^3$	As % of AQO	$\mu\text{g}/\text{m}^3$	As % of AQO
1# Ford Lane	0.03	0.6%	0.28	5.6%
2# Ford Lane	0.04	0.8%	0.29	5.8%
3# Ford Lane	0.17	3.5%	0.42	8.5%
Rodney Crescent	0.14	2.8%	0.39	7.8%
Ford Road	0.06	1.2%	0.31	6.2%
Ford Open Prison	0.02	0.4%	0.27	5.4%
1# Horsemere Green Lane	0.01	0.3%	0.26	5.3%
2# Horsemere Green Lane	0.03	0.6%	0.28	5.6%
Beagle Drive	0.05	1.0%	0.30	6.0%
Yapton Primary School	0.01	0.1%	0.26	5.1%
Point of max impact	0.22	4.37%	0.47	9.37%

NOTES:

Assumes entire TOC emissions consist of only benzene

Table B.3: Annual Mean VOCs (as 1,3-butadiene) Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	$\mu\text{g}/\text{m}^3$	As % of AQO	$\mu\text{g}/\text{m}^3$	As % of AQO
1# Ford Lane	0.03	1.3%	0.14	6.2%
2# Ford Lane	0.04	1.7%	0.15	6.6%
3# Ford Lane	0.17	7.7%	0.28	12.6%
Rodney Crescent	0.14	6.3%	0.25	11.2%
Ford Road	0.06	2.6%	0.17	7.5%
Ford Open Prison	0.02	0.9%	0.13	5.7%
1# Horsemere Green Lane	0.01	0.6%	0.12	5.5%
2# Horsemere Green Lane	0.03	1.3%	0.14	6.2%
Beagle Drive	0.05	2.2%	0.16	7.0%
Yapton Primary School	0.01	0.3%	0.12	5.2%
Point of max impact	0.22	9.71%	0.33	14.60%

NOTES:
Assumes entire TOC emissions consist of only 1,3-butadiene

Table B.4: Annual Mean Cadmium Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	$\mu\text{g}/\text{m}^3$	As % of AQO	$\mu\text{g}/\text{m}^3$	As % of AQO
1# Ford Lane	0.07	1.4%	0.30	6.0%
2# Ford Lane	0.09	1.9%	0.32	6.5%
3# Ford Lane	0.43	8.7%	0.66	13.3%
Rodney Crescent	0.36	7.1%	0.59	11.7%
Ford Road	0.15	2.9%	0.38	7.5%
Ford Open Prison	0.05	1.0%	0.28	5.6%
1# Horsemere Green Lane	0.04	0.7%	0.27	5.3%
2# Horsemere Green Lane	0.07	1.5%	0.30	6.1%
Beagle Drive	0.12	2.4%	0.35	7.0%
Yapton Primary School	0.02	0.4%	0.25	5.0%
Point of max impact	0.55	10.92%	0.78	15.52%

NOTES:
Assumes 50% of total cadmium and thallium emissions consist of cadmium

Table B.5: Annual Mean PaH Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	µg/m ³	As % of AQO	µg/m ³	As % of AQO
1# Ford Lane	0.58	0.2%	200.58	80.2%
2# Ford Lane	0.76	0.3%	200.76	80.3%
3# Ford Lane	3.47	1.4%	203.47	81.4%
Rodney Crescent	2.85	1.1%	202.85	81.1%
Ford Road	1.17	0.5%	201.17	80.5%
Ford Open Prison	0.39	0.2%	200.39	80.2%
1# Horsemere Green Lane	0.28	0.1%	200.28	80.1%
2# Horsemere Green Lane	0.58	0.2%	200.58	80.2%
Beagle Drive	0.97	0.4%	200.97	80.4%
Yapton Primary School	0.14	0.1%	200.14	80.1%
Point of max impact	4.37	1.75%	204.37	81.75%

Table 17.6: Heavy Metal Assessment – Summary of Impact at Most Impacted Receptor – Long Term

Metal	EAL (ng/m ³)	Background Conc. (ng/m ³)	Process Contribution		PEC	
			Conc. (ng/m ³)	As % of EAL	Conc. (ng/m ³)	As % of EAL
Arsenic	3	0.51	0.05	1.73%	0.56	18.73%
Antimony	5000	-	0.20	0.00%	-	-
Chromium	5000	2.86	0.90	0.02%	3.76	0.08%
Chromium (VI)	0.2	0.23	0.0006	0.30%	0.23	115.30%
Cobalt	-	-	0.07	-	-	-
Copper	10000	6.39	0.28	0.0028%	6.67	0.07%
Lead	250	9.29	0.64	0.25%	9.93	3.97%
Manganese	150	11.47	0.63	0.42%	12.10	8.07%
Nickel	20	1.56	2.36	11.79%	3.92	19.59%
Vanadium	5000	1.3	0.02	0.0003%	1.32	0.03%

NOTES:

Assumes emissions are emitted no worse than an existing operating facility using the Environment Agency monitoring data.

Emissions of chromium (VI) are assumed to be similar to the mean monitored from APC analysis.

Appendix C – Detailed Results at Ecological Sites

This section provides the detailed results tables for the impact at each ecological site. This is based on the maximum predicted impact using all 5-years of weather data.

Table C.1: Annual Mean Oxides of Nitrogen Impact at Ecological Sites

Site	AQO/EAL ($\mu\text{g}/\text{m}^3$)	Conc. ($\mu\text{g}/\text{m}^3$)	As % of AQO
European designated sites			
Duncton & Bignor Escarpment	30	0.01	0.04%
UK designated sites			
Climping Beach	30	0.05	0.15%
Arundel Park	30	0.07	0.24%
Fairmile Bottom	30	0.02	0.08%
Felpham	30	0.03	0.09%
Arun Banks	30	0.03	0.11%
Bognor Reef	30	0.02	0.06%
Eartham Pit	30	0.01	0.04%
Amberley Mount & Sullington Hill	30	0.03	0.09%
Halnaker Chalk Pit	30	0.01	0.04%
Locally designated sites (within 2km)			
Ancient Woodland	30	0.33	1.11%

Table C.2: Max Daily Oxides of Nitrogen Impact at Ecological Sites

Site	AQO/EAL ($\mu\text{g}/\text{m}^3$)	Conc. ($\mu\text{g}/\text{m}^3$)	As % of AQO
European designated sites			
Duncton & Bignor Escarpment	75	0.34	0.5%
UK designated sites			
Climping Beach	75	1.50	2.0%
Arundel Park	75	1.21	1.6%
Fairmile Bottom	75	0.89	1.2%
Felpham	75	1.05	1.4%
Arun Banks	75	0.89	1.2%
Bognor Reef	75	0.75	1.0%
Eartham Pit	75	0.54	0.7%
Amberley Mount & Sullington Hill	75	0.53	0.7%
Halnaker Chalk Pit	75	0.50	0.7%
Locally designated sites (within 2km)			
Ancient Woodland	75	5.40	7.2%

Table C.3: Annual Mean Sulphur Impact at Ecological Sites

Site	AQO/EAL ($\mu\text{g}/\text{m}^3$)	Conc. ($\mu\text{g}/\text{m}^3$)	As % of AQO
European designated sites			
Duncton & Bignor Escarpment	20	4.76	0.02%
UK designated sites			
Climping Beach	20	17.84	0.09%
Arundel Park	20	27.83	0.14%
Fairmile Bottom	20	9.52	0.05%
Felpham	20	10.35	0.05%
Arun Banks	20	13.22	0.07%
Bognor Reef	20	6.38	0.03%
Eartham Pit	20	4.97	0.02%
Amberley Mount & Sullington Hill	20	10.16	0.05%
Halnaker Chalk Pit	20	4.58	0.02%
Locally designated sites (within 2km)			
Ancient Woodland	20	128.12	0.64%

Table C.4: Max Weekly Hydrogen Fluoride Impact at Ecological Sites

Site	AQO/EAL ($\mu\text{g}/\text{m}^3$)	Conc. (ng/m^3)	As % of AQO
European designated sites			
Duncton & Bignor Escarpment	0.5	0.56	0.1%
UK designated sites			
Climping Beach	0.5	2.13	0.4%
Arundel Park	0.5	1.93	0.4%
Fairmile Bottom	0.5	1.11	0.2%
Felpham	0.5	1.60	0.3%
Arun Banks	0.5	1.06	0.2%
Bognor Reef	0.5	0.97	0.2%
Eartham Pit	0.5	0.59	0.1%
Amberley Mount & Sullington Hill	0.5	0.81	0.2%
Halnaker Chalk Pit	0.5	0.54	0.1%
Locally designated sites (within 2km)			
Ancient Woodland	0.5	8.64	1.7%

Table C.5: Max Daily Hydrogen Fluoride Impact at Ecological Sites

Site	AQO/EAL ($\mu\text{g}/\text{m}^3$)	Conc. (ng/m^3)	As % of AQO
European designated sites			
Duncton & Bignor Escarpment	5	1.72	0.03%
UK designated sites			
Climping Beach	5	7.50	0.15%
Arundel Park	5	6.04	0.12%
Fairmile Bottom	5	4.45	0.09%
Felpham	5	5.23	0.10%
Arun Banks	5	4.47	0.09%
Bognor Reef	5	3.76	0.08%
Eartham Pit	5	2.70	0.05%
Amberley Mount & Sullington Hill	5	2.63	0.05%
Halnaker Chalk Pit	5	2.49	0.05%
Locally designated sites (within 2km)			
Ancient Woodland	5	26.98	0.54%

Table C.6: Annual Average Ammonia Impact at Ecological Sites

Site	AQO/EAL ($\mu\text{g}/\text{m}^3$)	Conc. ($\mu\text{g}/\text{m}^3$)	As % of AQO
European designated sites			
Duncton & Bignor Escarpment	3	0.95	0.03%
UK designated sites			
Climping Beach	3	3.56	0.12%
Arundel Park	3	5.55	0.18%
Fairmile Bottom	3	1.90	0.06%
Felpham	3	2.06	0.07%
Arun Banks	3	2.64	0.09%
Bognor Reef	3	1.27	0.04%
Eartham Pit	3	0.99	0.03%
Amberley Mount & Sullington Hill	3	2.03	0.07%
Halnaker Chalk Pit	3	0.91	0.03%
Locally designated sites (within 2km)			
Ancient Woodland	3	25.55	0.85%

Appendix D - APIS Critical Loads

Table D.1: Deposition Critical Loads - APIS

Site	Habitat	N Deposition (kgN/ha/yr)			Min CL (keq/ha/yr)			Max CL (keq/ha/yr)			Bg Deposition (keq/ha/yr)	
		Lower Critical Load	Upper Critical Load	Bg	Min N	Max N	Max S	Min N	Max N	Max S	N	S
European Designated Sites – SACs, SPAs												
Duncton & Bignor Escarpment SAC	Asperulo-Fagetum beech forests	10	20	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.24	0.41
UK Designated Sites – SSSIs												
Duncton & Bignor Escarpment SSSI	Lowland beech and yew woodland	5	15	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Upland birchwoods	10	15	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Upland oakwoods	10	15	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Lowland mixed deciduous woodland	10	20	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Wet woodland	10	20	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Wood-pasture and parklands	10	20	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Upland mixed ashwoods	15	20	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Lowland calcareous grassland	15	25	16.94	0.856	4.856	4	0.856	4.856	4	1.1623	0.3376
	Traditional orchards	-	-	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Broadleaved, mixed and yew woodland	5	15	30.66	0.142	2.122	1.97	0.142	11.517	11.375	2.2621	0.4128
	Calcareous grassland	15	25	16.94	0.856	4.856	4	0.856	4.856	4	1.1623	0.3376
Climping Beach	Coastal sand dunes	8	15	13.7	0.223	4.373	4.15	0.438	4.588	4.15	0.8927	0.2362
	Coastal vegetated shingle	8	15	13.7	0.223	4.373	4.15	0.438	4.588	4.15	0.8927	0.2362
	Supralittoral sediment	8	15	13.7	0.223	4.373	4.15	0.438	4.588	4.15	0.8927	0.2362
	Littoral rock	-	-	13.72	-	-	-	-	-	-	0.8927	0.2362
	Littoral sediment	-	-	13.72	-	-	-	-	-	-	0.8927	0.2362
Arundel Park	Lowland beech and yew woodland	5	15	30.24	0.142	2.933	2.791	0.357	11.383	11.218	2.1439	0.3251
	Lowland fens	10	15	16.8	0.233	1.133	0.91	0.438	4.598	4.19	1.0756	0.2725
	Upland birchwoods	10	15	30.24	0.142	2.933	2.791	0.357	11.383	11.218	2.1439	0.3251
	Upland oakwoods	10	15	30.24	0.142	2.933	2.791	0.357	11.383	11.218	2.1439	0.3251
	Lowland mixed deciduous woodland	10	20	30.24	0.142	2.933	2.791	0.357	11.383	11.218	2.1439	0.3251
	Wet woodland	10	20	30.24	0.142	2.933	2.791	0.357	11.383	11.218	2.1439	0.3251
	Wood-pasture and parklands	10	20	30.24	0.142	2.933	2.791	0.357	11.383	11.218	2.1439	0.3251
	Upland mixed ashwoods	15	20	30.24	0.142	2.933	2.791	0.357	11.383	11.218	2.1439	0.3251
	Lowland calcareous grassland	15	25	16.8	0.856	4.856	4	1.071	5.071	4	1.0756	0.2725
	Purple Moor Grass and Rush Pastures	15	25	16.8	0.223	1.133	0.91	0.438	4.598	4.19	1.0756	0.2725
	Aquifer fed naturally fluctuating water bodies	-	-	30.24	-	-	-	-	-	-	0.9336	0.3052
	Eutrophic standing waters	-	-	30.24	-	-	-	-	-	-	0.9336	0.3052
	Mesotrophic lakes	-	-	30.24	-	-	-	-	-	-	0.9336	0.3052

Table D.1: Deposition Critical Loads - APIS

Site	Habitat	N Deposition (kgN/ha/yr)			Min CL (keq/ha/yr)			Max CL (keq/ha/yr)			Bg Deposition (keq/ha/yr)	
		Lower Critical Load	Upper Critical Load	Bg	Min N	Max N	Max S	Min N	Max N	Max S	N	S
Arundel Park	Oligotrophic and dystrophic lakes	-	-	30.24	-	-	-	-	-	-	0.9336	0.3052
	Ponds	-	-	30.24	-	-	-	-	-	-	0.9336	0.3052
	Traditional orchards	-	-	30.24	0.142	2.933	2.791	0.357	11.383	11.218	2.1439	0.3251
	Fen, marsh and swamp	10	15	16.8	0.233	1.133	0.91	0.438	4.598	4.19	1.0756	0.2725
	Calcareous grassland	15	25									
	Standing open water and canals	-	-	30.24	-	-	-	-	-	-	0.9336	0.3052
Fairmile Bottom	Native pine woodlands	5	15	30.66	0.142	1.953	1.811	0.142	11.411	11.269	2.0606	0.3324
	Lowland calcareous grassland	15	25	16.94	0.856	4.856	4	0.856	4.856	4	1.0354	0.2709
	Coniferous woodland	5	15	30.66	0.142	1.953	1.811	0.142	11.411	11.269	2.0606	0.3324
	Calcareous grassland	15	25	16.94	0.856	4.856	4	0.856	4.856	4	1.0354	0.2709
Felpham	None in database	-	-	-	-	-	-	-	-	-	-	-
Arun Banks	Lowland beech and yew woodland	5	15	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
	Upland birchwoods	10	15	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
	Upland oakwoods	10	15	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
	Lowland mixed deciduous woodland	10	20	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
	Wet woodland	10	20	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
	Wood-pasture and parklands	10	20	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
	Upland mixed ashwoods	15	20	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
	Traditional orchards	-	-	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
	Broadleaved, mixed and yew woodland	5	15	30.24	0.142	11.17	11.028	0.142	11.291	11.149	2.1478	0.3393
Bognor Reef	Lowland dry acid grassland	8	15	12.04	0.438	1.318	0.88	0.438	1.328	0.89	0.7474	0.2216
	Coastal sand dunes	8	15	12.04	0.438	1.318	0.88	0.438	1.328	0.89	0.7474	0.2216
	Coastal vegetated shingle	8	15	12.04	0.438	1.318	0.88	0.438	1.328	0.89	0.7474	0.2216
	Acid grassland	8	15	12.04	0.438	1.318	0.88	0.438	1.328	0.89	0.7474	0.2216
	Supralittoral sediment	8	15	12.04	0.438	1.318	0.88	0.438	1.328	0.89	0.7474	0.2216
Eartham Pit	None in database	-	-	-	-	-	-	-	-	-	-	-
Amberley Mount & Sullington Hill	Lowland beech and yew woodland	5	15	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652
	Upland birchwoods	10	15	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652
	Upland oakwoods	10	15	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652
	Lowland mixed deciduous woodland	10	20	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652
	Wet woodland	10	20	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652
	Wood-pasture and parklands	10	20	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652
	Upland mixed ashwoods	15	20	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652

Table D.1: Deposition Critical Loads - APIS

Site	Habitat	N Deposition (kgN/ha/yr)			Min CL (keq/ha/yr)			Max CL (keq/ha/yr)			Bg Deposition (keq/ha/yr)	
		Lower Critical Load	Upper Critical Load	Bg	Min N	Max N	Max S	Min N	Max N	Max S	N	S
Amberley Mount & Sullington Hill	Lowland calcareous grassland	15	25	16.8	0.856	4.856	4	0.856	4.856	4	1.0881	0.3002
	Traditional orchards	-	-	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652
	Broadleaved, mixed and yew woodland	5	15	30.24	0.142	11.335	11.193	0.142	11.394	11.252	2.1675	0.3652
	Calcareous grassland	15	25	16.8	0.856	4.856	4	0.856	4.856	4	1.0881	0.3002
Halnaker Chalk Pit	Limestone pavements	5	10	15.12	-	-	-	-	-	-	-	-
	Inland rock outcrop and scree habitats	5	15	15.12	0.178	1.078	0.9	0.178	4.328	4.15	1.0826	0.2663
	Calaminarian grassland	-	-	15.12	0.856	4.856	4	0.856	4.856	4	1.0826	0.2663
	Open mosaic habitats on previously developed land	-	-	15.12	-	-	-	-	-	-	1.0826	0.2663
	Inland rock	-	-	15.12	0.178	1.078	0.9	0.178	4.328	4.15	1.0826	0.2663

Appendix E – Deposition Results Tables

Table E.1: Annual Mean Process Contribution Used for Deposition Analysis			
Site	Annual Mean Process Contribution (ng/m³)		
	Nitrogen Dioxide	Sulphur Dioxide	Ammonia
European Designated Sites – SACs, SPAs			
Duncton & Bignor Escarpment	8.62	4.76	0.95
UK Designated Sites – SSSIs			
Climping Beach	32.33	17.84	3.56
Arundel Park	50.43	27.83	5.55
Fairmile Bottom	17.26	9.52	1.90
Felpham	18.75	10.35	2.06
Arun Banks	23.96	13.22	2.64
Bognor Reef	11.57	6.38	1.27
Eartham Pit	9.00	4.97	0.99
Amberley Mount & Sullington Hill	18.41	10.16	2.03
Halnaker Chalk Pit	8.30	4.58	0.91

Table E.2: Deposition Calculation – Grassland

Site	Deposition (kg/ha/yr)			Total N Deposition (kgN/ha/yr)	Acid Deposition keq/ha/yr	
	Nitrogen Dioxide	Sulphur Dioxide	Ammonia		N	S
European Designated Sites – SACs, SPAs						
Duncton & Bignor Escarpment	1.24E-03	9.00E-03	4.93E-03	6.17E-03	4.41E-04	5.63E-04
UK Designated Sites – SSSIs						
Climping Beach	4.66E-03	3.38E-02	1.85E-02	2.31E-02	1.65E-03	2.11E-03
Arundel Park	7.26E-03	5.27E-02	2.88E-02	3.61E-02	2.58E-03	3.29E-03
Fairmile Bottom	2.49E-03	1.80E-02	9.87E-03	1.24E-02	8.82E-04	1.13E-03
Felpham	2.70E-03	1.96E-02	1.07E-02	1.34E-02	9.59E-04	1.22E-03
Arun Banks	3.45E-03	2.50E-02	1.37E-02	1.71E-02	1.22E-03	1.56E-03
Bognor Reef	1.67E-03	1.21E-02	6.61E-03	8.28E-03	5.91E-04	7.55E-04
Eartham Pit	1.30E-03	9.40E-03	5.15E-03	6.44E-03	4.60E-04	5.88E-04
Amberley Mount & Sullington Hill	2.65E-03	1.92E-02	1.05E-02	1.32E-02	9.41E-04	1.20E-03
Halnaker Chalk Pit	1.19E-03	8.66E-03	4.74E-03	5.94E-03	4.24E-04	5.42E-04

Table E.3: Deposition Calculation – Woodland

Site	Deposition (kg/ha/yr)			Total N Deposition (kgN/ha/yr)	Acid Deposition keq/ha/yr	
	Nitrogen Dioxide	Sulphur Dioxide	Ammonia		N	S
European Designated Sites – SACs, SPAs						
Duncton & Bignor Escarpment	2.48E-03	1.80E-02	7.39E-03	9.88E-03	7.05E-04	1.13E-03
UK Designated Sites – SSSIs						
Climping Beach	9.31E-03	6.75E-02	2.77E-02	3.70E-02	2.64E-03	4.22E-03
Arundel Park	1.45E-02	1.05E-01	4.32E-02	5.78E-02	4.13E-03	6.58E-03
Fairmile Bottom	4.97E-03	3.60E-02	1.48E-02	1.98E-02	1.41E-03	2.25E-03
Felpham	5.40E-03	3.92E-02	1.61E-02	2.15E-02	1.53E-03	2.45E-03
Arun Banks	6.90E-03	5.00E-02	2.05E-02	2.74E-02	1.96E-03	3.13E-03
Bognor Reef	3.33E-03	2.42E-02	9.92E-03	1.32E-02	9.46E-04	1.51E-03
Eartham Pit	2.59E-03	1.88E-02	7.72E-03	1.03E-02	7.37E-04	1.18E-03
Amberley Mount & Sullington Hill	5.30E-03	3.84E-02	1.58E-02	2.11E-02	1.51E-03	2.40E-03
Halnaker Chalk Pit	2.39E-03	1.73E-02	7.11E-03	9.50E-03	6.79E-04	1.08E-03

Table E.4: Detailed Results – Nitrogen Deposition

Site	Habitat	Deposition Velocity	Process Contribution			Predicted Environmental Concentration		
			PC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL	PEC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL
European Designated Sites – SACs, SPAs								
Duncton & Bignor Escarpment SAC	Asperulo-Fagetum beech forests	Woodland	0.010	0.10%	0.05%	30.670	306.70%	153.35%
UK Designated Sites – SSSIs								
Duncton & Bignor Escarpment SSSI	Lowland beech and yew woodland	Woodland	0.010	0.20%	0.07%	30.670	613.40%	204.47%
	Upland birchwoods	Woodland	0.010	0.10%	0.07%	30.670	306.70%	204.47%
	Upland oakwoods	Woodland	0.010	0.10%	0.07%	30.670	306.70%	204.47%
	Lowland mixed deciduous woodland	Woodland	0.010	0.10%	0.05%	30.670	306.70%	153.35%
	Wet woodland	Woodland	0.010	0.10%	0.05%	30.670	306.70%	153.35%
	Wood-pasture and parklands	Woodland	0.010	0.10%	0.05%	30.670	306.70%	153.35%
	Upland mixed ashwoods	Woodland	0.010	0.07%	0.05%	30.670	204.47%	153.35%
	Lowland calcareous grassland	Grassland	0.006	0.04%	0.02%	16.946	112.97%	67.78%
	Traditional orchards	Woodland	0.010	-	-	30.670	-	-
	Broadleaved, mixed and yew woodland	Woodland	0.010	0.20%	0.07%	30.670	613.40%	204.47%
	Calcareous grassland	Grassland	0.006	0.04%	0.02%	16.946	112.97%	67.78%
Climping Beach	Coastal sand dunes	Grassland	0.023	0.29%	0.15%	13.723	171.54%	91.49%
	Coastal vegetated shingle	Grassland	0.023	0.29%	0.15%	13.723	171.54%	91.49%
	Supralittoral sediment	Grassland	0.023	0.29%	0.15%	13.723	171.54%	91.49%
	Littoral rock	Grassland	0.023	-	-	13.743	-	-
	Littoral sediment	Grassland	0.023	-	-	13.743	-	-
Arundel Park	Lowland beech and yew woodland	Woodland	0.058	1.16%	0.39%	30.298	605.96%	201.99%
	Lowland fens	Grassland	0.036	0.36%	0.24%	16.836	168.36%	112.24%
	Upland birchwoods	Woodland	0.058	0.58%	0.39%	30.298	302.98%	201.99%
	Upland oakwoods	Woodland	0.058	0.58%	0.39%	30.298	302.98%	201.99%
	Lowland mixed deciduous woodland	Woodland	0.058	0.58%	0.29%	30.298	302.98%	151.49%
	Wet woodland	Woodland	0.058	0.58%	0.29%	30.298	302.98%	151.49%
	Wood-pasture and parklands	Woodland	0.058	0.58%	0.29%	30.298	302.98%	151.49%
	Upland mixed ashwoods	Woodland	0.058	0.39%	0.29%	30.298	201.99%	151.49%
	Lowland calcareous grassland	Grassland	0.036	0.24%	0.14%	16.836	112.24%	67.34%
	Purple Moor Grass and Rush Pastures	Grassland	0.036	0.24%	0.14%	16.836	112.24%	67.34%
	Aquifer fed naturally fluctuating water bodies	Grassland	0.036	-	-	30.276	-	-
	Eutrophic standing waters	Grassland	0.036	-	-	30.276	-	-
	Mesotrophic lakes	Grassland	0.036	-	-	30.276	-	-
	Oligotrophic and dystrophic lakes	Grassland	0.036	-	-	30.276	-	-
	Ponds	Grassland	0.036	-	-	30.276	-	-

Table E.4: Detailed Results – Nitrogen Deposition

Site	Habitat	Deposition Velocity	Process Contribution			Predicted Environmental Concentration		
			PC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL	PEC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL
Arundel Park	Traditional orchards	Woodland	0.058	-	-	30.298	-	-
	Fen, marsh and swamp	Grassland	0.036	0.36%	0.24%	16.836	168.36%	112.24%
	Calcareous grassland	Grassland	0.036	0.24%	0.14%	-	-	-
	Standing open water and canals	Grassland	0.036	-	-	30.276	-	-
Fairmile Bottom	Native pine woodlands	Woodland	0.020	0.40%	0.13%	30.680	613.60%	204.53%
	Lowland calcareous grassland	Grassland	0.012	0.08%	0.05%	16.952	113.02%	67.81%
	Coniferous woodland	Woodland	0.020	0.40%	0.13%	30.680	613.60%	204.53%
	Calcareous grassland	Grassland	0.012	0.08%	0.05%	16.952	113.02%	67.81%
Felpham	None in database	-	0.021	-	-	-	-	-
Arun Banks	Lowland beech and yew woodland	Woodland	0.027	0.55%	0.18%	30.267	605.35%	201.78%
	Upland birchwoods	Woodland	0.027	0.27%	0.18%	30.267	302.67%	201.78%
	Upland oakwoods	Woodland	0.027	0.27%	0.18%	30.267	302.67%	201.78%
	Lowland mixed deciduous woodland	Woodland	0.027	0.27%	0.14%	30.267	302.67%	151.34%
	Wet woodland	Woodland	0.027	0.27%	0.14%	30.267	302.67%	151.34%
	Wood-pasture and parklands	Woodland	0.027	0.27%	0.14%	30.267	302.67%	151.34%
	Upland mixed ashwoods	Woodland	0.027	0.18%	0.14%	30.267	201.78%	151.34%
	Traditional orchards	Woodland	0.027	-	-	30.267	-	-
	Broadleaved, mixed and yew woodland	Woodland	0.027	0.55%	0.18%	30.267	605.35%	201.78%
Bognor Reef	Lowland dry acid grassland	Grassland	0.008	0.10%	0.06%	12.048	150.60%	80.32%
	Coastal sand dunes	Grassland	0.008	0.10%	0.06%	12.048	150.60%	80.32%
	Coastal vegetated shingle	Grassland	0.008	0.10%	0.06%	12.048	150.60%	80.32%
	Acid grassland	Grassland	0.008	0.10%	0.06%	12.048	150.60%	80.32%
	Supralittoral sediment	Grassland	0.008	0.10%	0.06%	12.048	150.60%	80.32%
Eartham Pit	None in database	-	0.010	-	-	-	-	-
Amberley Mount & Sullington Hill	Lowland beech and yew woodland	Woodland	0.021	0.42%	0.14%	30.261	605.22%	201.74%
	Upland birchwoods	Woodland	0.021	0.21%	0.14%	30.261	302.61%	201.74%
	Upland oakwoods	Woodland	0.021	0.21%	0.14%	30.261	302.61%	201.74%
	Lowland mixed deciduous woodland	Woodland	0.021	0.21%	0.11%	30.261	302.61%	151.31%
	Wet woodland	Woodland	0.021	0.21%	0.11%	30.261	302.61%	151.31%
	Wood-pasture and parklands	Woodland	0.021	0.21%	0.11%	30.261	302.61%	151.31%
	Upland mixed ashwoods	Woodland	0.021	0.14%	0.11%	30.261	201.74%	151.31%
	Lowland calcareous grassland	Grassland	0.013	0.09%	0.05%	16.813	112.09%	67.25%
	Traditional orchards	Woodland	0.021	-	-	30.261	-	-
	Broadleaved, mixed and yew woodland	Woodland	0.021	0.42%	0.14%	30.261	605.22%	201.74%

Table E.4: Detailed Results – Nitrogen Deposition								
Site	Habitat	Deposition Velocity	Process Contribution			Predicted Environmental Concentration		
			PC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL	PEC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL
Amberley Mount & Sullington Hill	Calcareous grassland	Grassland	0.013	0.09%	0.05%	16.813	112.09%	67.25%
Halnaker Chalk Pit	Limestone pavements	Grassland	0.006	0.12%	0.06%	15.126	302.52%	151.26%
	Inland rock outcrop and scree habitats	Grassland	0.006	0.12%	0.04%	15.126	302.52%	100.84%
	Calaminarian grassland	Grassland	0.006	-	-	15.126	-	-
	Open mosaic habitats on previously developed land	Grassland	0.006	-	-	15.126	-	-
	Inland rock	Grassland	0.006	-	-	15.126	-	-

Table E.5: Detailed Results – Acid Deposition											
Site	Habitat	Deposition Velocity	Process Contribution				Predicted Environmental Concentration				
			N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function	% of Max CL Function	N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function	% of Max CL Function	
European Designated Sites – SACs, SPAs											
Duncton & Bignor Escarpment SAC	Asperulo-Fagetum beech forests	Woodland	7.1E-04	1.1E-03	0.09%	0.02%	2.2407	0.4111	125.0%	23.0%	
UK Designated Sites – SSSIs											
Duncton & Bignor Escarpment SSSI	Lowland beech and yew woodland	Woodland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%	
	Upland birchwoods	Woodland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%	
	Upland oakwoods	Woodland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%	
	Lowland mixed deciduous woodland	Woodland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%	
	Wet woodland	Woodland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%	
	Wood-pasture and parklands	Woodland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%	
	Upland mixed ashwoods	Woodland	4.4E-04	5.6E-04	0.02%	0.02%	1.1627	0.3382	30.9%	30.9%	
	Lowland calcareous grassland	Grassland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%	
	Traditional orchards	Woodland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%	
	Broadleaved, mixed and yew woodland	Woodland	4.4E-04	5.6E-04	0.02%	0.02%	1.1627	0.3382	30.9%	30.9%	
	Calcareous grassland	Grassland	1.7E-03	2.1E-03	0.09%	0.08%	0.8944	0.2383	25.9%	24.7%	
Climping Beach	Coastal sand dunes	Grassland	1.7E-03	2.1E-03	0.09%	0.08%	0.8944	0.2383	25.9%	24.7%	
	Coastal vegetated shingle	Grassland	1.7E-03	2.1E-03	0.09%	0.08%	0.8944	0.2383	25.9%	24.7%	
	Supralittoral sediment	Grassland	1.7E-03	2.1E-03	-	-	0.8944	0.2383	-	-	
	Littoral rock	Grassland	1.7E-03	2.1E-03	-	-	0.8944	0.2383	-	-	
	Littoral sediment	Grassland	4.1E-03	6.6E-03	0.37%	0.09%	2.1480	0.3317	84.5%	21.8%	
Arundel Park	Lowland beech and yew woodland	Woodland	2.6E-03	3.3E-03	0.51%	0.13%	1.0782	0.2758	119.5%	29.4%	
	Lowland fens	Grassland	4.1E-03	6.6E-03	0.37%	0.09%	2.1480	0.3317	84.5%	21.8%	
	Upland birchwoods	Woodland	4.1E-03	6.6E-03	0.37%	0.09%	2.1480	0.3317	84.5%	21.8%	
	Upland oakwoods	Woodland	4.1E-03	6.6E-03	0.37%	0.09%	2.1480	0.3317	84.5%	21.8%	
	Lowland mixed deciduous woodland	Woodland	4.1E-03	6.6E-03	0.37%	0.09%	2.1480	0.3317	84.5%	21.8%	
	Wet woodland	Woodland	4.1E-03	6.6E-03	0.37%	0.09%	2.1480	0.3317	84.5%	21.8%	
	Wood-pasture and parklands	Woodland	4.1E-03	6.6E-03	0.37%	0.09%	2.1480	0.3317	84.5%	21.8%	
	Upland mixed ashwoods	Woodland	2.6E-03	3.3E-03	0.12%	0.12%	1.0782	0.2758	27.9%	26.7%	
	Lowland calcareous grassland	Grassland	2.6E-03	3.3E-03	0.52%	0.13%	1.0782	0.2758	119.5%	29.4%	

Table E.5: Detailed Results – Acid Deposition

Site	Habitat	Deposition Velocity	Process Contribution				Predicted Environmental Concentration			
			N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function	% of Max CL Function	N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function	% of Max CL Function
	Purple Moor Grass and Rush Pastures	Grassland	2.6E-03	3.3E-03	-	-	0.9362	0.3085	-	-
Arundel Park	Aquifer fed naturally fluctuating water bodies	Grassland	2.6E-03	3.3E-03	-	-	0.9362	0.3085	-	-
	Eutrophic standing waters	Grassland	2.6E-03	3.3E-03	-	-	0.9362	0.3085	-	-
	Mesotrophic lakes	Grassland	2.6E-03	3.3E-03	-	-	0.9362	0.3085	-	-
	Oligotrophic and dystrophic lakes	Grassland	2.6E-03	3.3E-03	-	-	0.9362	0.3085	-	-
	Ponds	Grassland	4.1E-03	6.6E-03	0.37%	0.09%	2.1480	0.3317	84.5%	21.8%
	Traditional orchards	Woodland	2.6E-03	3.3E-03	0.51%	0.13%	1.0782	0.2758	119.5%	29.4%
	Fen, marsh and swamp	Grassland	2.6E-03	3.3E-03	-	-	-	-	-	-
	Calcareous grassland	Grassland	2.6E-03	3.3E-03	-	-	0.9362	0.3085	-	-
	Standing open water and canals	Grassland	1.4E-03	2.3E-03	0.19%	0.03%	2.0620	0.3347	122.7%	21.0%
Fairmile Bottom	Native pine woodlands	Woodland	8.8E-04	1.1E-03	0.04%	0.04%	1.0363	0.2720	26.9%	26.9%
	Lowland calcareous grassland	Grassland	1.4E-03	2.3E-03	0.19%	0.03%	2.0620	0.3347	122.7%	21.0%
	Coniferous woodland	Woodland	8.8E-04	1.1E-03	0.04%	0.04%	1.0363	0.2720	26.9%	26.9%
	Calcareous grassland	Grassland	1.5E-03	2.4E-03	-	-	-	-	-	-
Felpham	None in database	-	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
Arun Banks	Lowland beech and yew woodland	Woodland	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
	Upland birchwoods	Woodland	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
	Upland oakwoods	Woodland	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
	Lowland mixed deciduous woodland	Woodland	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
	Wet woodland	Woodland	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
	Wood-pasture and parklands	Woodland	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
	Upland mixed ashwoods	Woodland	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
	Traditional orchards	Woodland	2.0E-03	3.1E-03	0.05%	0.05%	2.1498	0.3424	22.3%	22.1%
	Broadleaved, mixed and yew woodland	Woodland	5.9E-04	7.5E-04	0.10%	0.10%	0.7480	0.2224	73.6%	73.1%
Bognor Reef	Lowland dry acid grassland	Grassland	5.9E-04	7.5E-04	0.10%	0.10%	0.7480	0.2224	73.6%	73.1%
	Coastal sand dunes	Grassland	5.9E-04	7.5E-04	0.10%	0.10%	0.7480	0.2224	73.6%	73.1%
	Coastal vegetated shingle	Grassland	5.9E-04	7.5E-04	0.10%	0.10%	0.7480	0.2224	73.6%	73.1%
	Acid grassland	Grassland	5.9E-04	7.5E-04	0.10%	0.10%	0.7480	0.2224	73.6%	73.1%
	Supralittoral sediment	Grassland	7.4E-04	1.2E-03	-	-	-	-	-	-
Eartham Pit	None in database	-	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%

Table E.5: Detailed Results – Acid Deposition

Site	Habitat	Deposition Velocity	Process Contribution				Predicted Environmental Concentration			
			N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function	% of Max CL Function	N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function	% of Max CL Function
Amberley Mount & Sullington Hill	Lowland beech and yew woodland	Woodland	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%
	Upland birchwoods	Woodland	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%
Amberley Mount & Sullington Hill	Upland oakwoods	Woodland	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%
	Lowland mixed deciduous woodland	Woodland	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%
	Wet woodland	Woodland	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%
	Wood-pasture and parklands	Woodland	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%
	Upland mixed ashwoods	Woodland	9.41E-04	1.20E-03	0.04%	0.04%	1.09E+00	3.01E-01	28.6%	28.6%
	Lowland calcareous grassland	Grassland	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%
	Traditional orchards	Woodland	1.51E-03	2.40E-03	0.03%	0.03%	2.17E+00	3.68E-01	22.4%	22.3%
	Broadleaved, mixed and yew woodland	Woodland	9.41E-04	1.20E-03	0.04%	0.04%	1.09E+00	3.01E-01	28.6%	28.6%
	Calcareous grassland	Grassland	4.24E-04	5.42E-04	-	-	-	-	-	-
Halnaker Chalk Pit	Limestone pavements	Grassland	4.24E-04	5.42E-04	0.09%	0.02%	1.08E+00	2.67E-01	125.2%	31.2%
	Inland rock outcrop and scree habitats	Grassland	4.24E-04	5.42E-04	0.02%	0.02%	1.08E+00	2.67E-01	27.8%	27.8%
	Calaminarian grassland	Grassland	4.24E-04	5.42E-04	-	-	1.08E+00	2.67E-01	-	-
	Open mosaic habitats on previously developed land	Grassland	4.24E-04	5.42E-04	0.09%	0.02%	1.08E+00	2.67E-01	125.2%	31.2%
	Inland rock	Grassland	7.1E-04	1.1E-03	0.09%	0.02%	2.2628	0.4139	126.1%	23.2%

Appendix F – Detailed Results at Sensitive Receptors – Short Term
Emission Limits

Table F.1: 99.79%ile of 1-hour Nitrogen Dioxide Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	$\mu\text{g}/\text{m}^3$	As % of AQO	$\mu\text{g}/\text{m}^3$	As % of AQO
1# Ford Lane	12.37	6.2%	39.29	19.6%
2# Ford Lane	15.74	7.9%	42.66	21.3%
3# Ford Lane	21.00	10.5%	47.92	24.0%
Rodney Crescent	18.34	9.2%	45.26	22.6%
Ford Road	16.37	8.2%	43.29	21.6%
Ford Open Prison	11.62	5.8%	38.54	19.3%
1# Horsemere Green Lane	8.90	4.4%	35.82	17.9%
2# Horsemere Green Lane	12.02	6.0%	38.94	19.5%
Beagle Drive	19.94	10.0%	46.86	23.4%
Yapton Primary School	5.22	2.6%	32.14	16.1%
Point of max impact	37.65	18.82%	64.57	32.28%

Table F.2: 99.18%ile of 24-hour Sulphur Dioxide Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	$\mu\text{g}/\text{m}^3$	As % of AQO	$\mu\text{g}/\text{m}^3$	As % of AQO
1# Ford Lane	6.67	5.3%	11.59	9.3%
2# Ford Lane	7.38	5.9%	12.30	9.8%
3# Ford Lane	15.46	12.4%	20.38	16.3%
Rodney Crescent	16.10	12.9%	21.02	16.8%
Ford Road	10.77	8.6%	15.69	12.5%
Ford Open Prison	6.40	5.1%	11.32	9.1%
1# Horsemere Green Lane	2.87	2.3%	7.79	6.2%
2# Horsemere Green Lane	5.09	4.1%	10.01	8.0%
Beagle Drive	11.27	9.0%	16.19	12.9%
Yapton Primary School	2.30	1.8%	7.22	5.8%
Point of max impact	22.88	18.30%	27.80	22.24%

Table F.3: 99.73%ile of 1-hour Sulphur Dioxide Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	$\mu\text{g}/\text{m}^3$	As % of AQO	$\mu\text{g}/\text{m}^3$	As % of AQO
1# Ford Lane	17.50	5.0%	22.42	6.4%
2# Ford Lane	20.39	5.8%	25.31	7.2%
3# Ford Lane	29.47	8.4%	34.39	9.8%
Rodney Crescent	26.20	7.5%	31.12	8.9%
Ford Road	22.70	6.5%	27.62	7.9%
Ford Open Prison	15.29	4.4%	20.21	5.8%
1# Horsemere Green Lane	12.07	3.4%	16.99	4.9%
2# Horsemere Green Lane	16.80	4.8%	21.72	6.2%
Beagle Drive	25.49	7.3%	30.41	8.7%
Yapton Primary School	6.98	2.0%	11.90	3.4%
Point of max impact	50.58	14.45%	55.50	15.86%

Table F.4: 99.9%ile of 15-minute Sulphur Dioxide Impact at Sensitive Receptors

Receptor	Process Contribution		Predicted Environmental Concentration	
	$\mu\text{g}/\text{m}^3$	As % of AQO	$\mu\text{g}/\text{m}^3$	As % of AQO
1# Ford Lane	22.59	8.5%	27.51	10.3%
2# Ford Lane	33.31	12.5%	38.23	14.4%
3# Ford Lane	34.75	13.1%	39.67	14.9%
Rodney Crescent	31.25	11.7%	36.17	13.6%
Ford Road	28.85	10.8%	33.77	12.7%
Ford Open Prison	25.69	9.7%	30.61	11.5%
1# Horsemere Green Lane	17.55	6.6%	22.47	8.4%
2# Horsemere Green Lane	25.29	9.5%	30.21	11.4%
Beagle Drive	47.67	17.9%	52.59	19.8%
Yapton Primary School	11.91	4.5%	16.83	6.3%
Point of max impact	84.21	31.66%	89.13	33.51%

Appendix G – Detailed Results at Sensitive Receptors – Cumulative
Modelling

Table G.1: Annual Mean Nitrogen Dioxide Impact at Sensitive Receptors				
Receptor	Cumulative Process Contribution (Residual Waste Treatment Facility + CHP)		Predicted Environmental Concentration	
	µg/m³	As % of AQO	µg/m³	As % of AQO
1# Ford Lane	0.31	0.8%	13.77	34.4%
2# Ford Lane	0.41	1.0%	13.87	34.7%
3# Ford Lane	1.82	4.6%	15.28	38.2%
Rodney Crescent	1.55	3.9%	15.01	37.5%
Ford Road	0.79	2.0%	14.25	35.6%
Ford Open Prison	0.26	0.6%	13.72	34.3%
1# Horsemere Green Lane	0.17	0.4%	13.63	34.1%
2# Horsemere Green Lane	0.36	0.9%	13.82	34.5%
Beagle Drive	0.53	1.3%	13.99	35.0%
Yapton Primary School	0.07	0.2%	13.53	33.8%
Point of max impact	3.93	9.83%	17.39	43.48%

Table G.2: 99.79%ile of 1-hour Nitrogen Dioxide Impact at Sensitive Receptors				
Receptor	Cumulative Process Contribution (Residual Waste Treatment Facility + CHP)		Predicted Environmental Concentration	
	µg/m³	As % of AQO	µg/m³	As % of AQO
1# Ford Lane	4.56	2.3%	31.48	15.7%
2# Ford Lane	5.87	2.9%	32.79	16.4%
3# Ford Lane	7.68	3.8%	34.60	17.3%
Rodney Crescent	6.66	3.3%	33.58	16.8%
Ford Road	5.99	3.0%	32.91	16.5%
Ford Open Prison	4.54	2.3%	31.46	15.7%
1# Horsemere Green Lane	3.43	1.7%	30.35	15.2%
2# Horsemere Green Lane	4.70	2.3%	31.62	15.8%
Beagle Drive	7.15	3.6%	34.07	17.0%
Yapton Primary School	1.92	1.0%	28.84	14.4%
Point of max impact	20.32	10.16%	47.24	23.62%

Appendix H – Human Health Assessment

FICHTNER

Consulting Engineers Limited

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LIMITED**

**CIRCULAR TECHNOLOGY PARK
HUMAN HEALTH RISK
ASSESSMENT**

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Document Production & Approval Record				
ISSUE NO. 1	NAME	SIGNATURE	POSITION	DATE
<i>Prepared by:</i>	Rosalind Spain		Consultant	17/09/2013
<i>Checked by:</i>	Stephen Othen		Technical Director	17/09/2013

Document Revision Record		
ISSUE NO.	DATE	DETAILS OF REVISIONS
1	17/09/2013	First draft
2		
3		
4		

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1 INTRODUCTION

The residual waste treatment facility which forms part of the Circular Technology Park will be designed to meet the emission limits contained within the Industrial Emissions Directive (IED).

Despite the advice from health specialists such as the Health Protection Agency that the damage to health from emissions from incineration plants is likely to be very small, and probably not detectable, the specific effects on human health of the proposed plant have been considered. For most substances released from the plant, the most significant effects on human health will arise by inhalation. The air quality objectives (AQOs) outlined within the air quality assessment have been set by the various authorities at a level which is considered to present minimum or zero risk to human health. It is widely accepted that, if the concentrations in the atmosphere are less than the air quality objectives, then the pollutant is unlikely to have an adverse effect on human health.

For some pollutants which accumulate in the environment, inhalation is only one of the potential exposure routes. Therefore, other exposure routes are considered in this assessment.

2 PATHWAYS AND SENSITIVE RECEPTORS

2.1 Identification of pathways

Exposure to gaseous contaminants would occur by direct inhalation or vapour phase transfer to plants. In addition exposure to particulate phase contaminants would primarily occur via indirect pathways following the deposition of particles to soil. The pathways include:

- Ingestion of soil and dust;
- Uptake of contaminants from soil into the food-chain (through home-grown produce and crops); and
- Direct deposition of particles onto above ground crops.

2.2 Sensitive receptors

This assessment considers the possible effects on human health at key receptors, which are likely to be exposed to the greatest impact from the facility, and at the point of maximum impact of annual mean emissions.

The emissions from the facility are expected to be significant only in the locality of the plant. The specific receptors identified in the Air Quality Assessment have been considered in this Assessment. In addition a 'Farmer' receptor has been selected at the point of maximum impact from annual mean process emissions, although it should be noted that this point is actually uninhabited.

These sensitive receptors are listed in Table 2.1, which also contains the receptor designation considered most appropriate for each receptor.

Table 2.1: Sensitive Receptors

ID	Receptor Name	Location		Type of Receptor
		X	Y	
MAX	Point of maximum impact	499400	102950	Farmer
R1	1# Ford Lane	499101	103893	Resident
R2	2# Ford Lane	499246	103908	Resident
R3	3# Ford Lane	499674	103662	Resident
R4	Rodney Crescent	499962	103515	Resident
R5	Ford Road	500100	103236	Resident
R6	Ford Open Prison	500137	102865	Resident
R7	1# Horsemere Green Lane	500109	102385	Resident
R8	2# Horsemere Green Lane	499847	102322	Resident
R9	Beagle Drive	499015	102981	Resident
R10	Yapton Primary School	497788	103647	Resident

3 ASSESSMENT ASSUMPTIONS AND INPUTS

A detailed Health Risk Assessment has been carried out using the Industrial Risk Assessment Program-Human Health (IRAP-h View – Version 4.0). The programme, created by Lakes Environmental is based on the United States Environment Protection Agency (USEPA) Human Health Risk Assessment Protocol. This Protocol is a development of the approach defined by HMIP in 1996, taking account of further research since that date.

The following section details the user defined assumptions used within the IRAP model and justification where appropriate.

3.1 Concentration in soil

The concentration of each chemical in the soil is calculated from the deposition results of the air quality modelling for vapour phase and particle phase deposition. The critical variables in calculating the accumulation of pollutants in the soil are as follows:

- The lifetime of the facility is taken as 30 years.
- The soil mixing depth is taken as 2 cm and 15 cm for produce.

The split between the solid and vapour phase for the substance considered depends on the specific physical properties of each chemical.

In order to assess the amount of substance which is lost from the soil each year through volatilisation, leaching and surface run-off, a soil loss constant is calculated. The rates for leaching and surface runoff are taken as constant, while the rate for volatilisation is calculated from the physical properties of each substance.

3.2 Concentration in plants

The concentrations in plants are determined by considering direct deposition and air-to-plant transfer for above ground produce, and root uptake for above ground and below ground produce. The calculation takes account of the different types of plant; for example, uptake of substances through the roots will differ for below ground and above ground vegetables, and deposition onto plants will be more significant for above ground vegetables.

3.3 Concentration in animals

The concentrations in animals, based on consumption of plants, are calculated from the concentrations in plants, assumed consumption rates and bio-concentration factors. These vary for different animals and different substances, since the transfer of chemicals between the plants consumed and animal tissue varies.

It is also assumed that 100% of the plant materials eaten by animals is grown on soil contaminated by emission sources. This is likely to be a highly pessimistic assumption for UK farming practice.

3.4 Concentration in humans

3.4.1 Intake via inhalation

This is calculated from inhalation rates of typical adults and children and atmospheric concentrations. The inhalation rates used for adults and children are:

- Adults - 20 m³/day; and
- Children – 7.2 m³/day.

These are as specified within the Environment Agency series of reports: "Contaminants in soil: updated collation of toxicology data and intake values for humans". The calculation also takes account of time spent outside, since most people spend most of their time indoors.

3.4.2 Intake via soil ingestion

This calculation allows for the ingestion of soil and takes account of different exposure frequencies. It allows for ingestion of soil attached to unwashed vegetables, unintended ingestion when farming or gardening and, for children, ingestion of soil when playing.

3.4.3 Ingestion of food

The calculation of exposure due to ingestion of food draws on the calculations of concentrations in animals and plants and takes account of different ingestion rates for the various food groups by different age groups.

Most people only eat a fraction of locally-produced food and so exposure factors are applied to allow for this.

3.4.4 Breast milk ingestion

For infants, the primary route of exposure is through breast milk. The calculation draws on the exposure calculation for adults and then allows for the transfer of chemicals in breast milk to an infant who is exclusively breast-fed.

The only pathway considered for dioxins for a breast feeding infant is through breast milk. The modelled scenario consists of the accumulation of pollutants in the food chain up to an adult receptor, the accumulation of pollutants in breast milk and finally the consumption of breast milk by an infant.

The assumptions used were:

- | | |
|---|--------------|
| • Exposure duration of infant to breast milk | 1 year |
| • Proportion of ingested dioxin that is stored in fat | 0.9% |
| • Proportion of mothers weight that is stored in fat | 0.3% |
| • Fraction of fat in breast milk | 0.04% |
| • Fraction of ingested contaminant that is absorbed | 0.9% |
| • Half life of dioxins in adults | 2,555 days |
| • Ingestion rate of breast milk | 0.688 kg/day |

3.5 Assessment pathways

The pathways through which inhalation and ingestion occur and the receptors that have been considered to be impacted via each pathway are:

- | | |
|--|---------------|
| • Direct inhalation | All receptors |
| • Ingestion of soil | All receptors |
| • Ingestion of home-grown produce | All receptors |
| • Ingestion of drinking water | All receptors |
| • Ingestion of eggs from home-grown chickens | Only farms |
| • Ingestion of home-grown chickens | Only farms |
| • Ingestion of home-grown beef | Only farms |
| • Ingestion of home-grown pork | Only farms |
| • Ingestion of home-grown milk | Only farms |

3.6 Estimation of COPC concentration in media

The IRAP-h model uses a database of physical and chemical parameters to calculate the COPC concentrations through each of the different pathways identified. The base physical and chemical parameters have been used in this assessment.

In order to calculate the COPC concentrations a number of site specific pieces of information are required:

- Weather data was obtained for the period 2008-2012 from the Shoreham airport weather station as used within the air quality dispersion modelling. This provides the annual average precipitation which can be used to calculate the general IRAP-h input parameters:

Table 3.1: Ground Type Dependent Properties

Input Variable	Assumption	Value (cm/year)
Annual average evapo-transpiration	70% of annual average precipitation	51.02
Annual average irrigation	0% of annual average precipitation	0
Annual average precipitation	100% of annual average precipitation	72.89
Annual average runoff	10% of annual average precipitation	7.29

- Average wind speed was taken as 4.73 m/s, calculated from the average of the 5 years of weather data for the period 2008-2012 from the Shoreham airport weather station as used within the air quality dispersion modelling.

A number of assumptions have been made with regard to the deposition of the different phases. These are summarised in the following table.

Table 3.2: Deposition Assumptions

Deposition Phase	Dry Deposition Velocities (m/s)	Ratio Dry deposition to Wet deposition	
		Dry Deposition	Wet Deposition
Vapour	0.005	1.0	2.0
Particle	0.010	1.0	2.0
Bound particle	0.010	1.0	2.0
Mercury vapour	0.029	1.0	2.0

3.7 Modelled emissions

For the purpose of assessing potential health impact from the emission from the plant the following emissions have been considered to be relevant to the long-term exposure (chronic).

- (1) Group 1 metals - Mercury and compounds;
- (2) Group 2 metals - Cadmium, Thallium and compounds ;
- (3) Group 3 metals - Antimony, Arsenic, Cadmium Chromium, Lead, Nickel;
- (4) Dioxins, furans and dioxin-like PCBs; and
- (5) Polycyclic aromatic hydrocarbons (Benzo(a)pyrene).

The following table gives the emissions rates of each chemical of potential concern (COPC) modelled. This is based on the combined volumetric flow rate (at reference conditions) of the 2 stacks and the appropriate emission limit values.

Table 3.3: COPC Emissions Modelled			
COPC	Emission rate (g/s)	COPC	Emission rate (g/s)
Antimony	1.59E-03	TetraCDD,2,3,7,8	8.95E-11
Arsenic	1.59E-03	HexaCDD,1,2,3,7,8,9	5.92E-11
Cadmium	7.22E-04	OctaCDD,1,2,3,4,6,7,8,9	1.17E-11
Chromium	1.59E-03	HeptaCDD,1,2,3,4,6,7,8	4.92E-11
Chromium, hexavalent	3.75E-06	OctaCDF,1,2,3,4,6,7,8,9	1.03E-11
Hydrogen chloride	2.89E-01	HexaCDD,1,2,3,4,7,8	8.28E-11
Lead	1.59E-03	PentaCDD,1,2,3,7,8	3.54E-10
Mercuric chloride	6.93E-04	TetraCDF,2,3,7,8	7.99E-11
Mercury	2.89E-06	HeptaCDF,1,2,3,4,7,8,9	1.24E-11
Nickel	1.59E-03	PentaCDF,2,3,4,7,8	7.72E-10
Thallium (I)	7.22E-04	PentaCDF,1,2,3,7,8	4.00E-11
Benzo(a)pyrene	5.77E-06	HexaCDF,1,2,3,6,7,8	2.33E-10
Benzene	2.89E-01	HexaCDD,1,2,3,6,7,8	7.45E-11
		HexaCDF,2,3,4,6,7,8	2.51E-10
		HeptaCDF,1,2,3,4,6,7,8	1.27E-10
		HexaCDF,1,2,3,4,7,8	6.29E-10
		HexaCDF,1,2,3,7,8,9	1.21E-11
		Dioxin like PCBs	2.66E-10

The following assumptions have been made.

- (1) Group 1 metals - mercury and compounds.
 - a) The concentration of elemental mercury has been taken as 0.2% of the total mercury and compounds.
 - b) The concentration of mercury chloride has been taken as 48% of the total mercury and compounds.
 - c) The losses to the global cycle has been taken as 51.8% of the total mercury and compounds.
- (2) Group 2 metals - cadmium, thallium and compounds.
 - a) Based on the Waste Incineration Directive emission rate of 0.05 mg/Nm³ for cadmium, thallium and compounds.
 - b) Assumed that the emissions of cadmium and thallium are each half of the combined limit.
- (3) Group 3 metals - antimony, arsenic, cadmium chromium, lead and nickel.
 - a) Based on the Waste Incineration Directive emission rate of 0.5 mg/Nm³ for "other metals".

- b) The emissions of each of the nine "other metals" in the third group have been taken as one-ninth of the combined limit. The Environment Agency "Guidance to Applicants on Impact Assessment for Group 3 Metals Stack Releases – V.3 September 2012" considers this to be a "worst case" scenario.
- c) The emission rate of Chromium (VI) has been taken as equal to 0.026% (0.00013/0.5 mg/Nm³) of the total chromium emission from the facility. This value is from the Environment Agency "Guidance to Applicants on Impact Assessment for Group 3 Metals Stack Releases – V.3 September 2011" which is based on the speciation of chromium emissions at ten municipal waste incinerators operating under WID in the UK. The flue gas treatment unit used on this facility is BAT (best available technology) and is typical of that employed at the facilities on which this Guidance is based.
- (4) Dioxins and furans.
The split of the different dioxins and furans is based on split of congeners for a release of 0.1 ng I-TEQ/Nm³ as presented in Table 3.4.
- (5) Dioxin like PCBs
The Environment Agency has advised that 44 measurements have been taken at 24 MWIs between 2008 and 2010 of dioxin like PCBs. The following data summarises the measurements:
- Maximum = 9.2×10^{-3} ng[TEQ]/m³
 - Mean = 2.6×10^{-3} ng[TEQ]/m³
 - Minimum = 5.6×10^{-5} ng[TEQ]/m³
- For the purpose of this assessment, as a conservative assumption, the maximum monitored PCB concentration has been used which has been converted to an emission rate using the volumetric flow rate at reference conditions.
- The IRAP software, and the HHRAP database which underpins it, does not include any data on individual PCBs, but it does include data for take-up and accumulation rates within the food chain for two groups of PCBs, known as Aroclor 1254 and Aroclor 1016. Each Aroclor is based on a fixed composition of PCBs. Since we are not aware of any data on the specification of PCBs within incinerator emissions, we have assumed that the PCBs are released in each of the two Aroclor compositions.
- (6) Benzo[a]pyrene.
The highest recorded emission concentration of B[a]P from data collected from the Environment Agency's public register was 0.105 ug/Nm³, or 0.000105 mg/Nm³. As this is not a regulated pollutant and only monitored periodically we have applied a safety factor of 2, assuming an emission of B[a]P of 0.0002 mg/Nm³.
- (7) Benzene.
- a) Based on the Waste Incineration Directive and Industrial Emissions Directive emission rate of 10 mg/Nm³ for VOC emissions from the facility.
- b) The emission of benzene has been taken as 100% of the VOC emission.

Table 3.4: Basis for the Emission Rate of Dioxins and Furans

Dioxin / furan	Split of Congeners for a release of 0.1 ng I-TEQ/Nm ³	I-TEFs for the congeners ¹	Total (I-TEQ) ng/Nm ³	Emission rate (g/s)
2,3,7,8-TCDD	0.0031	1	0.0031	8.95E-11
1,2,3,7,8-PeCDD	0.0245	0.5	0.0123	3.54E-10
1,2,3,4,7,8-HxCDD	0.0287	0.1	0.0029	8.28E-11
1,2,3,6,7,8-HxCDD	0.0258	0.1	0.0026	7.45E-11
1,2,3,7,8,9-HxCDD	0.0205	0.1	0.0021	5.92E-11
1,2,3,4,6,7,8-HpCDD	0.1704	0.01	0.0017	4.92E-11
1,2,3,4,6,7,8,9-OctaCDD	0.4042	0.001	0.0004	1.17E-11
2,3,7,8-TCDF	0.0277	0.1	0.0028	7.99E-11
1,2,3,7,8-PCDF	0.0277	0.05	0.0014	4.00E-11
2,3,4,7,8-PCDF	0.0535	0.5	0.0268	7.72E-10
1,2,3,4,7,8-HxCDF	0.2179	0.1	0.0218	6.29E-10
1,2,3,6,7,8-HxCDF	0.0807	0.1	0.0081	2.33E-10
1,2,3,7,8,9-HxCDF	0.0042	0.1	0.0004	1.21E-11
2,3,4,6,7,8-HxCDF	0.0871	0.1	0.0087	2.51E-10
1,2,3,4,6,7,8-HpCDF	0.4395	0.01	0.0044	1.27E-10
1,2,3,4,7,8,9-HpCDF	0.0429	0.01	0.0004	1.24E-11
1,2,3,4,6,7,8,9-OctaCDF	0.3566	0.001	0.0004	1.03E-11
Total	2.0150	-	0.1000	-

¹ Kutz et al.1990

4 ASSESSMENT CRITERIA

IRAP calculates the total exposure through each of the different pathways so that a dose from inhalation and ingestion can be calculated for each receptor. By default, these doses are then used to calculate a cancer risk, using the USEPA's approach. However, the Environment Agency recommend that the results be assessed using the UK's approach, which is explained in the Environment Agency's document "Human Health Toxicological Assessment of Contaminants in Soil", ref SC050021. This approach involves two types of assessment:

- For those substances with a threshold level for toxicity, a Tolerable Daily Intake (TDI) is defined. This is "an estimate of the amount of a contaminant, expressed on a bodyweight basis, which can be ingested daily over a lifetime without appreciable health risk." A Mean Daily Intake (MDI) is also defined, which is the typical intake from background sources across the UK. In order to assess the impact of the Facility, the predicted intake of a substance is added to the MDI and compared with the TDI.
- For substances without a threshold level for toxicity, an Index Dose (ID) is defined. This is a level of exposure which is associated with a negligible risk to human health. The predicted intake of a substance is compared directly with the ID without taking account of background levels.

Substances can reach the body either through inhalation or through ingestion (oral) exposure and the body handles chemicals differently depending on the route of exposure. For this reason, different TDI and IDs are defined for inhalation and oral exposure.

The following table outlines the MDIs (the typical intake from existing background sources) for the pollutants released from the facility. These figures are defined in the "Contaminants in soil: updated collation of toxicology data and intake values for humans" series of toxicological reports, available from the Environment Agency's website.

Table 4.1: Mean Daily Intake of Each Substance

Substance	Mean Daily Intake, 70 kg adult (µg/kg bw/day)		Mean Daily Intake, 20 kg child (µg/kg bw/day)	
	Intake Ingestion	Intake, Inhalation	Intake Ingestion	Intake, Inhalation
Arsenic	0.07	0.0002	0.19	0.0005
Benzene	0.04	2.9	0.11	7.4
Benzene(a)pyrene	-	-	-	-
Cadmium	0.19	0.0003	0.5	0.0007
Chromium	1.81	0.0009	3.94	0.0011
Chromium (VI)	0.18	-	0.39	-
Methyl mercury	0.007	-	0.019	-
Mercuric chloride	0.014	-	0.037	-
Nickel	1.9	0.0009	4.8	0.002
Dioxins and dioxin like PCBs	0.7		1.8	

Table 4.2: Tolerable Daily Intake of Each Substance ($\mu\text{g}/\text{kg bw}/\text{day}$)

Substance	Index dose, Ingestion	Index dose, Inhalation	TDI, Ingestion	TDI, Inhalation
Arsenic	0.3	0.002	-	-
Benzene	0.29	1.4	-	-
Benzene(a)pyrene	0.02	0.00007	-	-
Cadmium	-	-	0.36	0.0014
Chromium	-	0.001	3	-
Chromium (VI)	-	-	-	-
Methyl mercury	-	-	0.23	0.23
Mercuric chloride	-	-	2	0.06
Nickel	-	-	12	0.006
Dioxins and dioxin like PCBs (pg WHO- TEQ $\text{kg-bw}^{-1} \text{ day}^{-1}$)	-	-	2	

To allow comparison with the TDI for dioxins and dioxin like PCBs, intake values for each dioxin are multiplied by a factor known as the WHO-TEF. The maximum predicted impact, assuming the emissions consist of only 1 aroclor, is then added to determine the impact of all dioxin, furans and dioxin like PCBs. A full list of the WHO-TEF values for each dioxin is provided in Appendix A.

5 RESULTS

5.1 At point of maximum impact - farmer

The following tables outline the impact of emissions from the facility at the point of maximum impact for a farmer receptor. A comparison has been made to the TDI or ID as appropriate.

Table 5.1: Impact Analysis – TDI – Point of Maximum Impact - Farmer

Substance	MDI (% of TDI)		Process Contribution (% of TDI)		Overall (% of TDI)	
	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
Adult						
Cadmium	21.43%	52.78%	11.14%	0.31%	32.57%	53.08%
Chromium	-	60.33%	-	0.77%	-	61.10%
Methyl mercury	-	3.04%	-	0.11%	-	3.15%
Mercuric chloride	-	0.70%	-	0.28%	-	0.98%
Nickel	15.00%	15.83%	5.72%	0.14%	20.72%	15.97%
Dioxins and dioxin like PBCs	35.00%		5.62%		40.62%	
Child						
Cadmium	50.00%	138.89%	14.04%	0.71%	64.04%	139.60%
Chromium	-	131.33%	-	1.25%	-	132.58%
Methyl mercury	-	8.26%	-	0.22%	-	8.49%
Mercuric chloride	-	1.85%	-	0.47%	-	2.32%
Nickel	33.33%	40.00%	7.21%	0.21%	40.54%	40.21%
Dioxins and dioxin like PBCs	90.00%		7.95%		97.95%	

Table 5.2: Impact Analysis – ID – Point of Maximum Impact - Farmer

Substance	Inhalation (% of ID)	Ingestion (% of ID)
Adult		
Arsenic	17.16%	1.39%
Benzene	4.46%	0.52%
Benzo[a]pyrene	1.78%	3.74%
Chromium (VI)	34.33%	-
Child		
Arsenic	21.63%	2.42%
Benzene	5.62%	1.22%
Benzo[a]pyrene	2.25%	5.41%

Table 5.2: Impact Analysis – ID – Point of Maximum Impact - Farmer

Substance	Inhalation (% of ID)	Ingestion (% of ID)
Chromium (VI)	43.25%	-

The total accumulation of dioxins and dioxin-like PCBs in an infant, considering the breast milk pathway and based on the adult farmer receptor at the point of maximum impact feeding an infant, is 1.682 pg WHO-TEQ / kg-bw / day which is 84.08% of the TDI.

5.2 Maximum impact at a receptor

The following tables outline the impact of emissions from the facility at the most affected receptor. Where appropriate a comparison has been made to the TDI or ID.

Table 5.3: Impact Analysis – TDI – Point of Maximum Impacted Receptor

Substance	MDI (% of TDI)		Process Contribution (% of TDI)		Overall (% of TDI)	
	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
Adult						
Cadmium	21.43%	52.78%	9.24%	0.16%	30.67%	52.94%
Chromium	-	60.33%	-	0.05%	-	60.39%
Methyl mercury	-	3.04%	-	0.03%	-	3.08%
Mercuric chloride	-	0.70%	-	0.029%	-	0.73%
Nickel	15.00%	15.83%	4.74%	0.011%	19.74%	15.84%
Dioxins and dioxin like PBCs	35.00%		0.09%		35.09%	
Child						
Cadmium	50.00%	138.89%	11.64%	0.39%	61.64%	139.28%
Chromium	-	131.33%	-	0.15%	-	131.48%
Methyl mercury	-	8.26%	-	0.09%	-	8.35%
Mercuric chloride	-	1.85%	-	0.11%	-	1.96%
Nickel	33.33%	40.00%	5.97%	0.026%	39.31%	40.03%
Dioxins and dioxin like PBCs	90.00%		0.32%		90.32%	

Table 5.4: Impact Analysis – ID – Point of Maximum Impact

Substance	Inhalation (% of ID)	Ingestion (% of ID)
Adult		
Arsenic	14.23%	0.43%
Benzene	3.70%	0.46%
Benzo[a]pyrene	1.48%	0.031%
Chromium (VI)	28.45%	-

Table 5.4: Impact Analysis – ID – Point of Maximum Impact

Substance	Inhalation (% of ID)	Ingestion (% of ID)
Child		
Arsenic	17.92%	1.02%
Benzene	4.66%	0.81%
Benzo[a]pyrene	1.86%	0.08%
Chromium (VI)	35.85%	-

The total accumulation of dioxins in an infant, considering the breast milk pathway and based on the adult residential receptor at R3 – Ford Lane feeding an infant, is 0.027 pg WHO-TEQ / kg-bw / day which is 1.33% of the TDI.

6 CONCLUSIONS

Of all the pollutants considered with a TDI, cadmium is the pollutant that results in the highest level of existing exposure (MDI). The combined impact of cadmium from existing background sources and contributions from the proposed facility at the point of maximum impact is 139.60% of the ingestion TDI for children. However, the Process Contribution from the facility for cadmium is exceptionally small, being only 0.71% of the TDI at the point of maximum impact, and 0.39% or less at receptors. Similarly, the ingestion of chromium from existing background sources and contributions from the proposed facility also exceeds the ingestion TDI for children. However, the Process Contribution from the proposed facility for chromium is again exceptionally small, both at the point of maximum impact and the maximum impacted receptor.

The TDI is set at a level "that can be ingested daily over a lifetime without appreciable health risk". The ingestion of cadmium and chromium by children as a result of background sources is already above the TDI. On the basis that the Process Contribution of these substances is exceptionally small it is not considered that the facility would increase the health risks from this pollutant significantly. For all other pollutants, the combined impact from the facility plus the existing MDI is below the TDI, so there would not be an appreciable health risk based on the emission of these pollutants.

For pollutants which do not have a TDI, a comparison has been made against an Index Dose (ID). The Index Dose is a threshold below which there are considered to be negligible risks to human health. The greatest contribution from the facility is from chromium (VI), which is 43.25% of the Index Dose for children at the point of maximum impact. Therefore, emissions from the facility of chromium (VI) and all other pollutants are considered to have a negligible impact on human health.

Appendix A - Detailed Results Tables

Table A.1: Comparison with ID Limits for Adult Receptors

Receptor	Ingestion (% of ID)			Inhalation (% of ID)			
	Arsenic	Benzene	Benzo(a)pyrene	Arsenic	Benzene	Benzo(a)pyrene	Chromium (VI)
Point of maximum impact – Screening Farmer	1.386%	0.519%	3.743%	17.163%	4.458%	1.783%	34.326%
1# Ford Lane	0.067%	0.072%	0.005%	2.241%	0.582%	0.233%	4.483%
2# Ford Lane	0.091%	0.097%	0.007%	3.036%	0.789%	0.315%	6.072%
3# Ford Lane	0.426%	0.457%	0.031%	14.226%	3.695%	1.478%	28.452%
Rodney Crescent	0.351%	0.377%	0.025%	11.733%	3.048%	1.219%	23.466%
Ford Road	0.147%	0.157%	0.011%	4.901%	1.273%	0.509%	9.801%
Ford Open Prison	0.044%	0.047%	0.003%	1.456%	0.378%	0.151%	2.913%
1# Horsemere Green Lane	0.035%	0.037%	0.002%	1.158%	0.301%	0.120%	2.316%
2# Horsemere Green Lane	0.068%	0.073%	0.005%	2.269%	0.589%	0.236%	4.538%
Beagle Drive	0.105%	0.112%	0.008%	3.495%	0.908%	0.363%	6.991%
Yapton Primary School	0.017%	0.018%	0.001%	0.557%	0.145%	0.058%	1.115%

Table A.2: Comparison with ID Limits for Child Receptors

Receptor	Ingestion (% of ID)			Inhalation (% of ID)			
	Arsenic	Benzene	Benzo(a)pyrene	Arsenic	Benzene	Benzo(a)pyrene	Chromium (VI)
Point of maximum impact – Screening Farmer	2.423%	1.220%	5.411%	21.625%	5.617%	2.247%	43.250%
1# Ford Lane	0.161%	0.128%	0.013%	2.824%	0.734%	0.293%	5.648%
2# Ford Lane	0.219%	0.173%	0.018%	3.825%	0.994%	0.397%	7.651%
3# Ford Lane	1.024%	0.810%	0.083%	17.925%	4.656%	1.862%	35.850%
Rodney Crescent	0.845%	0.668%	0.068%	14.783%	3.840%	1.536%	29.567%
Ford Road	0.353%	0.279%	0.029%	6.175%	1.604%	0.642%	12.350%
Ford Open Prison	0.105%	0.083%	0.008%	1.835%	0.477%	0.191%	3.670%
1# Horsemere Green Lane	0.083%	0.066%	0.007%	1.459%	0.379%	0.152%	2.918%
2# Horsemere Green Lane	0.163%	0.129%	0.013%	2.859%	0.743%	0.297%	5.718%
Beagle Drive	0.252%	0.199%	0.020%	4.404%	1.144%	0.458%	8.808%
Yapton Primary School	0.040%	0.032%	0.003%	0.702%	0.182%	0.073%	1.405%

Table A.3: Comparison with TDI Limits for Adult Receptors

Receptor	Ingestion (% of ID)					Inhalation (% of ID)	
	Cadmium	Chromium	Methyl Mercury	Mercuric Chloride	Nickel	Cadmium	Nickel
MDI of TDI (%)	52.78%	60.33%	3.04%	0.70%	15.83%	21.43%	15.00%
Point of maximum impact – Screening Farmer	53.08%	61.10%	3.15%	0.98%	15.97%	32.57%	20.72%
1# Ford Lane	52.80%	60.34%	3.05%	0.70%	15.84%	22.88%	15.75%
2# Ford Lane	52.81%	60.34%	3.05%	0.71%	15.84%	23.40%	16.01%
3# Ford Lane	52.94%	60.39%	3.08%	0.73%	15.84%	30.67%	19.74%
Rodney Crescent	52.91%	60.38%	3.07%	0.72%	15.84%	29.05%	18.91%
Ford Road	52.83%	60.35%	3.06%	0.71%	15.84%	24.61%	16.63%
Ford Open Prison	52.79%	60.34%	3.05%	0.70%	15.83%	22.37%	15.49%
1# Horsemere Green Lane	52.79%	60.34%	3.05%	0.70%	15.83%	22.18%	15.39%
2# Horsemere Green Lane	52.80%	60.34%	3.05%	0.70%	15.84%	22.90%	15.76%
Beagle Drive	52.82%	60.35%	3.05%	0.71%	15.84%	23.70%	16.17%
Yapton Primary School	52.78%	60.34%	3.04%	0.70%	15.83%	21.79%	15.19%

Table A.4: Comparison with TDI Limits for Child Receptors

Receptor	Ingestion (% of ID)					Inhalation (% of ID)	
	Cadmium	Chromium	Methyl Mercury	Mercuric Chloride	Nickel	Cadmium	Nickel
MDI of TDI (%)	138.89%	131.33%	8.26%	1.85%	40.00%	50.00%	33.33%
Point of maximum impact – Screening Farmer	139.60%	132.58%	8.49%	2.32%	40.21%	64.04%	40.54%
1# Ford Lane	138.95%	131.36%	8.28%	1.87%	40.00%	51.83%	34.27%
2# Ford Lane	138.97%	131.37%	8.28%	1.87%	40.01%	52.48%	34.61%
3# Ford Lane	139.28%	131.48%	8.35%	1.96%	40.03%	61.64%	39.31%
Rodney Crescent	139.21%	131.46%	8.34%	1.94%	40.02%	59.60%	38.26%
Ford Road	139.02%	131.39%	8.29%	1.89%	40.01%	54.01%	35.39%
Ford Open Prison	138.93%	131.35%	8.27%	1.86%	40.00%	51.19%	33.95%
1# Horsemere Green Lane	138.92%	131.35%	8.27%	1.86%	40.00%	50.95%	33.82%
2# Horsemere Green Lane	138.95%	131.36%	8.28%	1.87%	40.00%	51.86%	34.29%
Beagle Drive	138.99%	131.37%	8.28%	1.88%	40.01%	52.86%	34.80%
Yapton Primary School	138.90%	131.34%	8.26%	1.85%	40.00%	50.46%	33.57%

Table A.5: Comparison with Total Dioxin and Dioxin like PCBs TDI Limits for Adult Receptors

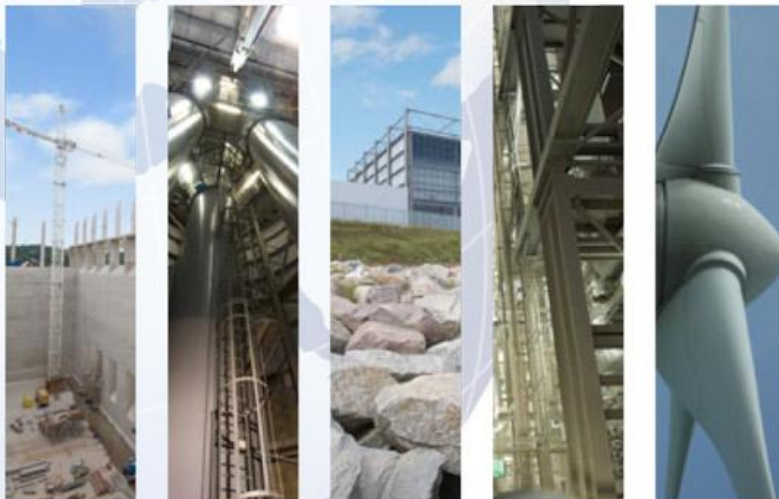
Receptor	Total Inhalation, (pg WHO-TEQ kg ⁻¹ bw day ⁻¹)	Total Ingestion, (pg WHO-TEQ kg ⁻¹ bw day ⁻¹)	Total uptake, (pg WHO-TEQ kg ⁻¹ bw day ⁻¹)	Comparison (% of limit)
MDI (% of TDI)				35.00%
Point of maximum impact – Screening Farmer	2.80E-04	1.12E-01	1.12E-01	40.62%
1# Ford Lane	3.65E-05	2.58E-04	2.95E-04	35.01%
2# Ford Lane	4.95E-05	3.50E-04	3.99E-04	35.02%
3# Ford Lane	2.32E-04	1.64E-03	1.87E-03	35.09%
Rodney Crescent	1.91E-04	1.35E-03	1.54E-03	35.08%
Ford Road	7.99E-05	5.65E-04	6.44E-04	35.03%
Ford Open Prison	2.37E-05	1.68E-04	1.91E-04	35.01%
1# Horsemere Green Lane	1.89E-05	1.33E-04	1.52E-04	35.01%
2# Horsemere Green Lane	3.70E-05	2.61E-04	2.98E-04	35.01%
Beagle Drive	5.70E-05	4.03E-04	4.60E-04	35.02%
Yapton Primary School	9.08E-06	6.42E-05	7.33E-05	35.00%

Table A.6: Comparison with Total Dioxin and Dioxin like PCBs TDI Limits for Child Receptors				
Receptor	Total Inhalation, (pg WHO-TEQ kg ⁻¹ bw day ⁻¹)	Total Ingestion, (pg WHO-TEQ kg ⁻¹ bw day ⁻¹)	Total uptake, (pg WHO-TEQ kg ⁻¹ bw day ⁻¹)	Comparison (% of limit)
MDI (% of TDI)				90.00%
Point of maximum impact – Screening Farmer	3.52E-04	1.59E-01	1.59E-01	97.95%
1# Ford Lane	4.60E-05	9.75E-04	1.02E-03	90.05%
2# Ford Lane	6.24E-05	1.32E-03	1.38E-03	90.07%
3# Ford Lane	2.92E-04	6.19E-03	6.48E-03	90.32%
Rodney Crescent	2.41E-04	5.10E-03	5.35E-03	90.27%
Ford Road	1.01E-04	2.13E-03	2.23E-03	90.11%
Ford Open Prison	2.99E-05	6.34E-04	6.63E-04	90.03%
1# Horsemere Green Lane	2.38E-05	5.04E-04	5.27E-04	90.03%
2# Horsemere Green Lane	4.66E-05	9.87E-04	1.03E-03	90.05%
Beagle Drive	7.18E-05	1.52E-03	1.59E-03	90.08%
Yapton Primary School	1.14E-05	2.43E-04	2.54E-04	90.01%

Table A.7: Basis for the Emission Rate of Dioxins and Furans

Compound	WHO-TEF Multiplier²
HeptaCDD, 1,2,3,4,6,7,8-	0.0031
HeptaCDF, 1,2,3,4,6,7,8-	0.0245
HeptaCDF, 1,2,3,4,7,8,9-	0.0287
HexaCDD, 1,2,3,4,7,8-	0.0258
HexaCDD, 1,2,3,6,7,8-	0.0205
HexaCDD, 1,2,3,7,8,9-	0.1704
HexaCDF, 1,2,3,4,7,8-	0.4042
HexaCDF, 1,2,3,6,7,8-	0.0277
HexaCDF, 1,2,3,7,8,9-	0.0277
HexaCDF, 2,3,4,6,7,8-	0.0535
OctaCDD, 1,2,3,4,6,7,8,9-	0.2179
PentaCDD, 1,2,3,7,8-	0.0807
PentaCDF, 1,2,3,7,8-	0.0042
PentaCDF, 2,3,4,7,8-	0.0871
TetraCDD, 2,3,7,8-	0.4395
TetraCDF, 2,3,7,8-	0.0429

² Van den Berg et al, 2006



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