MVV Environment Baldovie Limited

Dundee EfW CHP

Air Quality Assessment

27 April 2020 |

Job Number 270251-04

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Document verification

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Job title		Dundee EfW CHP		**Job number** 270251-04	
Document title		Air Quality Assessment		**File reference**	
Document ref					
Revision	**Date**	**Filename**	Draft AQ Report		
Draft 1	23 Dec 2016	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Emma Gibbons	Lesley-Anne Stone	Christine McHugh
		Signature			
Final	6 Jan 2017	**Filename**	Final AQ report		
		Description	Final		
			Prepared by	Checked by	Approved by
		Name	Emma Gibbons	Lesley-Anne Stone	Christine McHugh
		Signature			
Final	14 Nov 2019	**Filename**	Issue report 2019		
		Description	Update to assess parallel operations		
			Prepared by	Checked by	Approved by
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		Signature			
Final	26 Mar 2020	**Filename**	Final issue report 2020		
		Description	Incorporating SEPA comments		
			Prepared by	Checked by	Approved by
		Name	Cat Dixon Beccy Wilson	John Hodgson	Michael Bull
		Signature			

Issue Document verification with document ✓

Document Verification

Job title		Dundee EfW CHP			**Job number** 270251-04
Document title		Air Quality Assessment			**File reference**
Document ref		Click here to enter text.			
Revision	**Date**	**Filename**	AQA_reissue 270420_Final_Clean.docx		
Final	27 Apr 2020	**Description**	Updated background concentration analysis and revised to reflect SEPA comments		
			Prepared by	Checked by	Approved by
		Name	Cat Dixon Beccy Wilson	John Hodgson	Michael Bull
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		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
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			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

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Executive Summary

~~This air quality assessment is part of a suite of documents submitted to Dundee City Council (DCC) to accompany an application for planning permission by MVV Environment Services Limited (MVV) (the Applicant) for the parallel operation of both the existing and proposed Energy from Waste Combined Heat and Power Facility (EfW CHP facility) (The Proposed Scheme) on land situated on Forties Road, in the north-east of Dundee (the Application Site).~~

~~The proposed EfW CHP facility would replace the existing Dundee Energy Recycling Ltd (DERL) EfW facility on the neighbouring site on Forties Road.~~

This report presents an update to the air quality assessment undertaken in support of planning application 16/00916/FULM for the Energy from Waste (EfW) Combined Heat and Power (CHP) facility, Forties Road, Dundee, which was submitted by MVV Environment Limited. to Dundee City Council (DCC) on 8 November 2016.

Under Condition 17 of Planning Permission 16/00916/FULM, the proposed EfW CHP facility was to replace the existing EfW facility (formerly known as DERL), with minimal operational overlap between the facilities. MVV Environment Baldovie Limited (MEB) is seeking permission to vary Condition 17 of Planning Permission 16/00916/FULM and ~~paragraphs 2.9.8 and 2.9.9~~ some conditions of Permit No: PPC/A/1003157 (as varied; issued by SEPA on 28 February 2019) to allow for parallel operations of both facilities for a period of up to 10 years, commencing in April 2020.

As agreed with DCC, the ES, and all supporting documentation, including this Air Quality Assessment (AQA), have been updated to assess parallel operations only, with no revisions made to the construction impact assessment.

An assessment of likely air quality and odour effects arising as a result of the construction and operation of the Proposed Scheme has been undertaken. A review of current legislation and planning policy, a baseline assessment describing the current air quality conditions in the vicinity of the Proposed Scheme and an assessment of air quality impacts associated with the construction and operation of the scheme have been undertaken.

~~Air quality effects arising from the following activities have been assessed:~~

- ~~Construction of the Proposed Scheme;~~
- ~~Operation of the Proposed Scheme;~~
- ~~Operation of the Proposed Scheme in combination with other operating developments in the vicinity of the Application Site i.e. cumulative effects.~~

~~Emissions from the adjacent Michelin boiler plant would also be significantly reduced as the proposed EfW CHP facility would supply steam to the Michelin factory for most of the year in place of that produced by the existing boilers.~~

~~The effect on air quality of emissions from the proposed EfW CHP facility were found to be not significant with respect to human and ecological receptors. For~~

~~some limit or EAL values the EFW CHP facility would have a beneficial effect compared with the current DERL facility, despite the worst case assumption carried out using IED maximum emission limit values.~~

The effect on air quality of emissions from the proposed parallel operation of both the existing EfW facility and the EfW CHP facility, which is under construction, were found to be not significant with respect to both human and ecological receptors.

All concentrations resulting from emissions from the existing EfW facility and the EfW CHP facility, which is under construction, operating in parallel are below the relevant standards, with the exception of hexavalent chromium, where the assumed background concentrations (taken from a UK-wide metals data review following discussions with SEPA) already exceed the relevant standards by 313%. For all other pollutants assessed, the impact on air quality is not considered to be significant (see section 4.3.6.1 for more details).

The maximum Predicted Environmental Concentrations (PEC) for annual mean and 24 hour NOx are predicted to exceed the 70% threshold at the Fithie Burn ecological receptor during parallel operations, which is adjacent to the site. The respective Critical Levels for both pollutants are not exceeded (see section 4.3.6.2 for more information). The Burn is not a designated ecological site, however it is directly connected to the Firth of Tay SAC and the Outer Firth of Forth pSPA, approximately 4km away. Liaising with Ecologists it is considered that the potential impact on Firth of Tay SAC and the Outer Firth of Forth pSPA is unlikely to be significant. This is discussed in more detail in the accompanying Habitat Regulations Assessment[1] (HRA).

A human health risk assessment investigated the impact of dioxins, furans, trace metals and dioxin-like PCBs on human health in 2017. It demonstrated that for the proposed EfW CHP facility and the cumulative impacts of the proposed EfW CHP facility and existing EfW plant, it has been demonstrated that the maximally exposed individual is not subject to a significant carcinogenic risk or non-carcinogenic hazard, arising from exposures via both inhalation and the ingestion of foods. The human health risk assessment originally submitted as part of the PPC/A/1003157 variation has therefore been resubmitted as part of this variation application and not been updated.

~~The impact of the EfW CHP facility on odour nuisance was also found to be not significant.~~

The impact of the parallel operations on odour nuisance was also found to be not significant under normal operational conditions and routine maintenance periods. Exceedances of SEPA's most stringent criterion of $1_{OUE}/m^3$ were predicted to ossur at a number of sensitive receptor locations, when considering maximum odour Emission Limit Values contained within the existing Permit. However based on historic odour monitoring data at the facility, this scenario is considered highly unlikely to occur.

[1] Arup, 2019. Habitat Regulations Assessment.

1 Introduction

~~This air quality assessment is part of a suite of documents submitted to Dundee City Council (DCC) in support of an application for planning permission by MVV Environment Services Limited (MVV) (the Applicant) for the construction and operation of an Energy from Waste Combined Heat and Power Facility (EfW CHP facility) (The Proposed Scheme) on land situated on Forties Road, in the north-east of Dundee (the Application Site).~~

~~The proposed EfW CHP facility would replace the existing Dundee Energy Recycling Ltd (DERL) EfW facility on the neighbouring site on Forties Road.~~

This document presents an update to the air quality assessment undertaken as part of the ES prepared in support of planning application 16/00916/FULM for the EfW CHP facility, Forties Road, Dundee, which was submitted by MVV Environmental Baldovie Limited. (MEB) to DCC on 8 November 2016.

Under Condition 17 of Planning Permission 16/00916/FULM, the EfW CHP facility was to replace the existing EfW facility, with minimal operational overlap between the facilities. MVV is seeking permission to vary Condition 17 of Planning Permission 16/00916/FULM and some conditions of Permit No: PPC/A/1003157 (as varied; issued by SEPA on 28 February 2019) to allow for parallel operations of both facilities for a period of up to 10 years, commencing in April 2020.

As agreed with DCC and SEPA, the ES, and all supporting documentation, including this air quality assessment, has been updated to assess parallel operations only, with no revisions made to the construction impact assessment. Therefore, the following should be noted:

1. Construction commenced in January 2018 and first firing on waste is scheduled to commence by the end of March 2020. However, no updates have been made to the construction assessment;
2. All updates to the ES are highlighted in yellow with all removed text shown with a ~~strike through.~~ (Note, Appendices B, C, E and H of this updated air quality assessment are completely new, the title pages have been highlighted to show that these are new reports);
3. In the part of the ES which did not require updating, the existing EfW facilities are referenced as the Dundee Energy Recovery Ltd (DERL) facility. It was renamed to MVV Environment Baldovie (MEB) in 2017;
4. Where the ES has been updated, the existing EfW facility is referred to by its new name of MEB and referred to as the existing EfW facility. The new facility, which is under construction, is referred to as the EfW CHP facility; and
5. The Michelin Type plant is scheduled to close in mid 2020; however, it is still operational. The pipeline between the two facilities has been constructed, however, the connections have not been made. As the site is currently operational, it has been assumed that the facilities will supply

steam to Michelin for the purposes of this assessment. In addition, there is the potential to supply energy to future developments as outlined below.

a. A statement was released on 6 November 2019 stating that "The Dundee's Michelin site has received a £60m funding commitment to turn the former plant into an innovation centre. The new centre will focus on sustainable mobility, clean transport and low carbon energy. Michelin Scotland Innovation Parc (MSIP) will be created over the next decade. The investment is supported by Michelin, Scottish Enterprise and DCC. The new centre will include office space, with an "innovation hub" for collaborations between industry and academia."

b. MVV is in discussion with parties involved in developing MSIP with the objective of delivering energy from the EfW CHP facility to MISP.

6. The Applicant of the original planning application made in November 2016 was MVV Environment Services Ltd. MVV Environment Ltd are operating the existing EfW facility and constructing the EfW CHP facility on the adjoining land through their wholly owned subsidiary MVV Environment Baldovie Ltd (MEB). The Applicant for the application to vary Condition 17 of Planning Permission 16/00916 to allow for parallel operations is, therefore, MEB. As the ES has been updated to assess parallel operations only, reference to the Application has remained as MVV throughout.

Air quality effects arising from the following activities have been assessed:

- Construction of the Proposed Scheme;
- Operation of the Proposed Scheme;
- Parallel Operation of the Proposed EfW CHP facility in combination with the existing EfW facility, and
- Operation of the Proposed Scheme in combination with other operating developments in the vicinity of the Application Site i.e. cumulative effects.

~~Emissions from the adjacent Michelin boiler plant would also be significantly reduced as the proposed EfW CHP facility would supply steam to the Michelin factory for most of the year in place of that produced by the existing boilers.~~

~~Decommissioning of the existing DERL EfW facility will be subject to a separate planning application and has not been considered further in this assessment.~~

For the assessment of operational impacts, the effect of changes in road traffic and emissions to air from the plant have been considered.

1.1 Scope of Assessment

Air quality studies are concerned with the presence of airborne pollutants in the atmosphere. This assessment outlines relevant air quality management policy and legislation, describes the existing air quality conditions in the vicinity of the

Application Site, outlines the nature of the Proposed Scheme and addresses any air quality issues associated with its construction and operation. Mitigation measures are also proposed where necessary which would be implemented to reduce the likely effect of the proposals on air quality, as far as practicable.

For construction impacts, the assessment examines the potential emissions of dust and particulate matter from construction activities and exhaust emissions generated by plant and traffic associated with the Proposed Scheme. ~~For operational impacts, the assessment looks at the potential emissions from the proposed EfW CHP facility. The proposed EfW CHP facility has also been assessed cumulatively with emissions from boilers at the adjacent Michelin factory and during 'hot commissioning' with oil of the proposed EfW CHP facility combined with emissions from the existing DERL plant.~~ For operational impacts, the assessment looks at the potential emissions from the parallel operations of both the existing EfW facility and proposed EfW CHP facility, together with the potential impact from increases in road traffic associated with operating two facilities in parallel. Cumulative effects have also been assessed with emissions from boilers at the adjacent Michelin factory and during 'hot commissioning' with oil of the proposed EfW CHP facility combined with emissions from the existing EfW facility.

~~It should be noted that the proposed EfW CHP facility and the existing DERL plant will not burn waste simultaneously.~~

1.2 Location of the Proposed Scheme

The Proposed Scheme is located approximately 5km north-east of Dundee city centre, on land situated on Forties Road. The centre of the site is approximately at national grid reference (NGR) 344576,732863. A map showing the location of the Proposed Scheme is given in Figure 1.

Land to the north of the Application Site is primarily residential in nature, with some associated green open space. Land to the east is predominantly industrial, with the Michelin Tyre Factory adjacent to the boundary. Land to the south is industrial and residential in nature, with a car-breakers yard located immediately adjacent to the Application Site, beyond which the land-use is primarily residential. Land immediately to the west of the Application Site is a mixture of grassland, scrub and a few industrial units to the north-west.

The Application Site comprises the existing waste management site known as the ~~DERL~~ existing EfW facility (Area E), the existing Authority Transfer Station (ATS) (Area C), the land immediately to the south of the existing EfW ~~DERL~~ facility which is the site of the proposed EfW CHP facility (Area A), a plot of land to the south-west of the existing waste management site on the south side of the Dighty Water (Area B), and land that would be required temporarily for use as a construction compound and for contractor parking (Area D). These areas are shown as the operational boundaries in Figure 2.

Figure 1: Site location

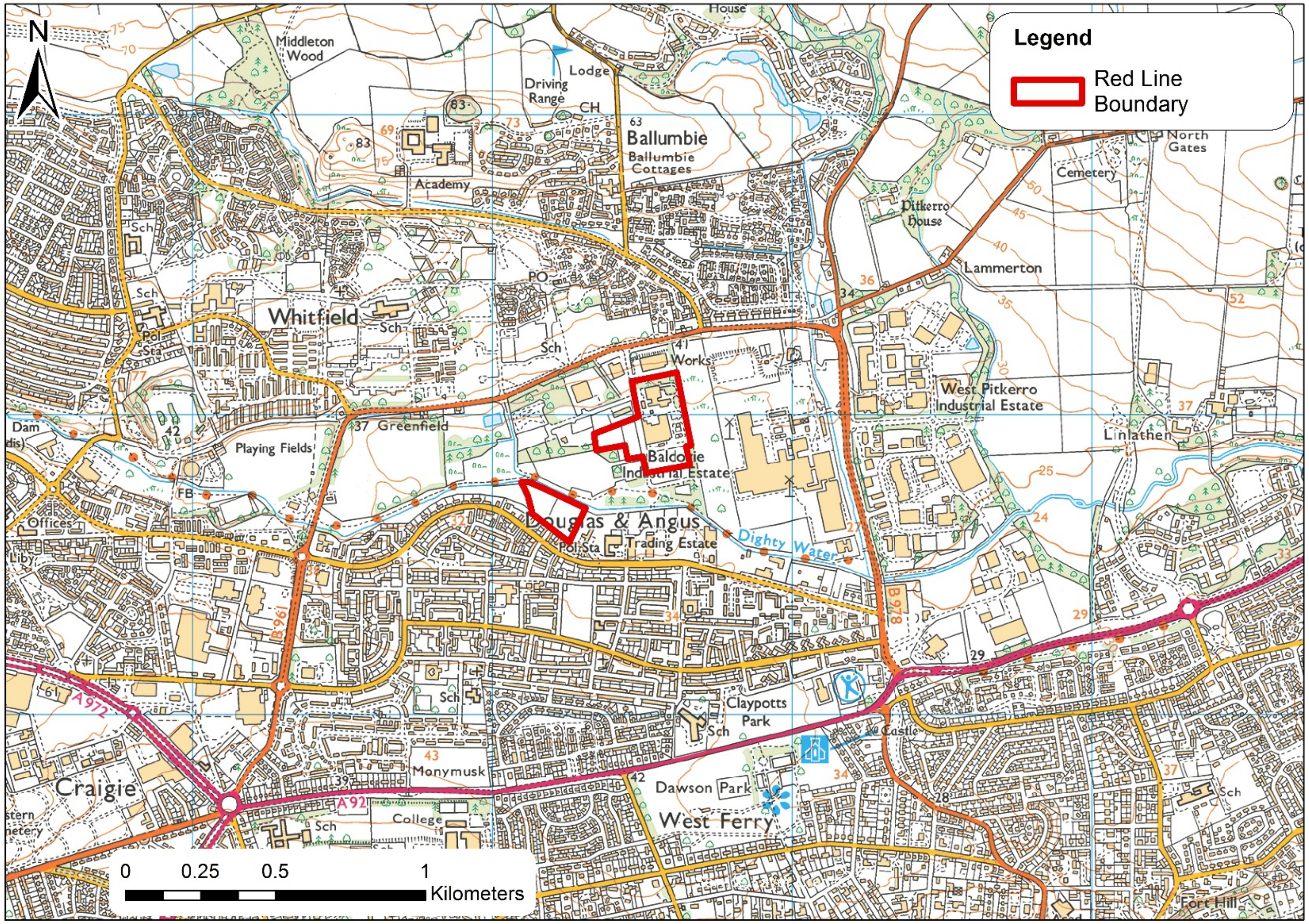
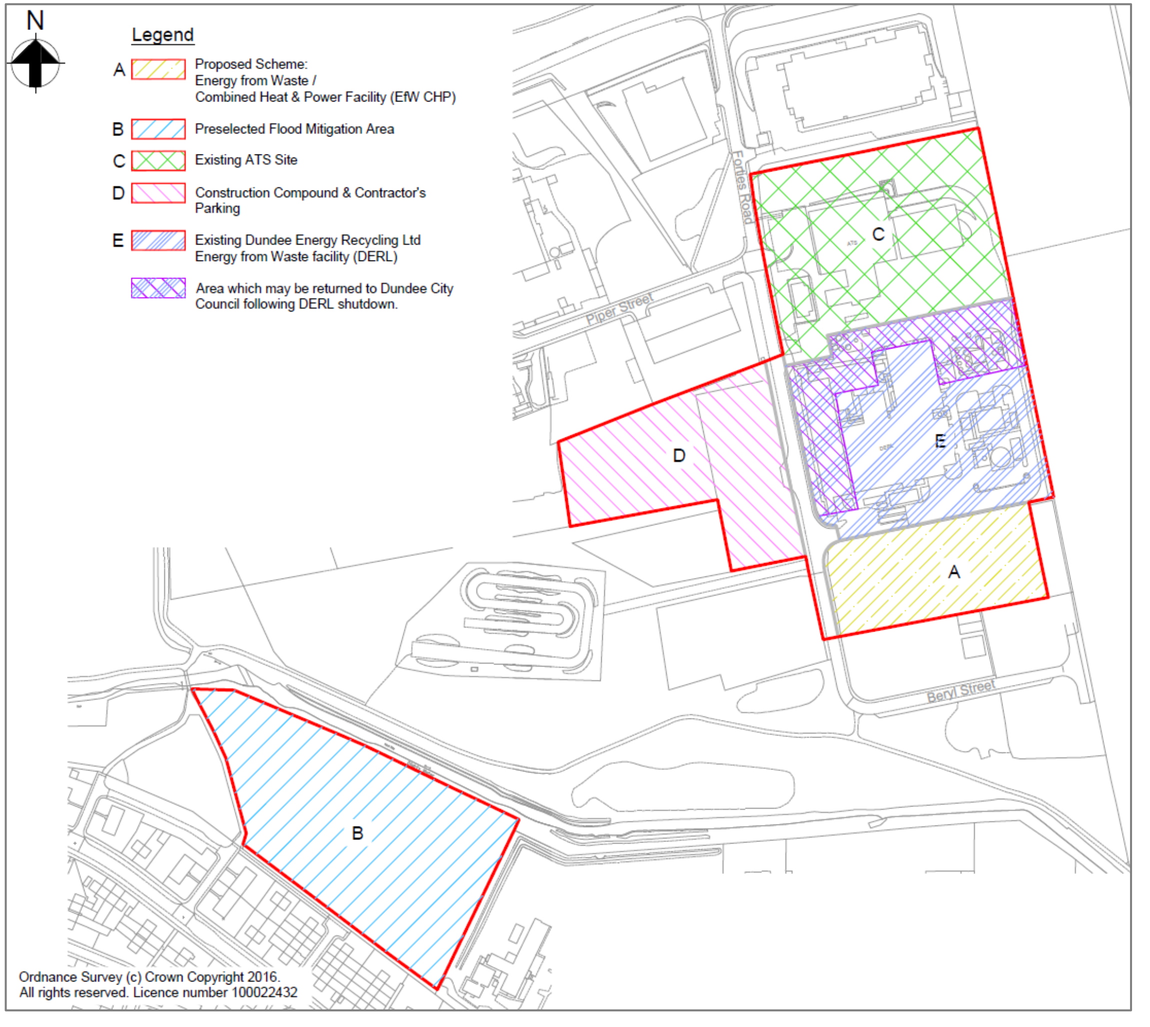


Figure 2: Planning application and operational boundaries plan



2 Air Quality Legislation

2.1 European Air Quality Management

In 1996 the European Commission published the Air Quality Framework Directive on ambient air quality assessment and management (96/62/EC)[2]. This Directive defined the policy framework for 12 air pollutants known to have harmful effects on human health and the environment. Limit values (pollutant concentrations not to be exceeded by a certain date) for each specified pollutant are set through a series of Daughter Directives, including Directive 1999/30/EC (the 1st Daughter Directive)[3] which sets limit values for sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and oxides of nitrogen (NOx), particulate matter (PM_{10}) and lead in ambient air.

In May 2008 the Directive 2008/50/EC[4] on ambient air quality and cleaner air for Europe came into force. This Directive consolidates the above and provides a new regulatory framework for $PM_{2.5}$

The Directive was transposed into legislation in Scotland by the Air Quality Standards (Scotland) Regulations 2010[5]. The Scottish Ministers have the duty of ensuring compliance with the air quality limit values.

2.1.1 Environment (Scotland) Act 1995

Part IV of the Environment (Scotland) Act 1995[6] places a duty on the Scottish Ministers to develop, implement and maintain an Air Quality Strategy with the aim of reducing atmospheric emissions and improving air quality. The Air Quality Strategy[7] for England, Scotland, Wales and Northern Ireland provides the national air quality objectives and a framework for ensuring compliance with these values based on a combination of international, national and local measures to reduce emissions and improve air quality. This includes the statutory duty for local authorities to undergo a process of local air quality management and declare Air Quality Management Areas (AQMAs) where pollutant concentrations exceed the national air quality objectives. Where an AQMA is declared, the local authority needs to produce an Air Quality Action Plan (AQAP) which outlines the strategy for improving air quality in these areas.

[2] Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management
[3] Directive 1999/30/EC of 22 April 1999relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air
[4] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe
[5] Scottish Statutory Instrument 2010 No.204, Environmental Protection, The Air Quality Standards (Scotland) Regulations 2010, 11 June 2010
[6] Environment Act 1995, Chapter 25, Part IV Air Quality
[7] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Volume 1, July 2007

2.2 Air Quality Objectives and Limit Values

Air quality limit values and objectives are quality standards for clean air. Some pollutants have standards expressed as annual average concentrations due to the chronic way in which they affect health or the natural environment (i.e. effects occur (long-term) after a prolonged period of exposure to elevated concentrations) and others have standards expressed as 24-hour, 1-hour or 15-minute average concentrations (short-term) due to the acute way in which they affect health or the natural environment (i.e. after a relatively short period of exposure). Some pollutants have standards expressed in terms of both long-term and short-term concentrations. ~~Table 2 sets out the air quality objectives for Scotland, for the pollutants relevant to this study.~~

The standards apply at either human or ecological receptor locations. The standards which apply at human receptor locations apply where people will be exposed to a pollutant for a period relevant to the standard such as at residential locations, hospitals and schools for annual mean values. Standards which apply to ecological receptors apply at sensitive designated ecological sites.

~~The limit values and objectives have been used to assess the impact of the proposed EfW CHP facility. It is assumed that 100% of the Volatile Organic Compounds (VOCs) emitted by the EfW CHP facility will be benzene (C_6H_6), which represents an extreme worst case assessment.~~

The criteria for assessment of impacts at sensitive human receptors are derived from three sources, and are set out in Table 2:

- EU and UK statutory Air Quality Standards;
- guideline values set out in now withdrawn Environment Agency (EA) H1 document, which are based upon World Health Organization criteria or are derived from occupational health criteria; and
- based upon recommendations by EPAQS[8].

With regard to the criteria set out in the now withdrawn H1 document, there were changes to some criteria between the version 2.1 and version 2.2. In order to provide the most complete assessment possible, reference is made to both H1 v2.1 and H1 v2.2 and where the assessment criteria are different, both have been considered.

The limit values and objectives have been used to assess the impact of the proposed parallel operations of the two facilities.

~~Table 1: Air quality standards and guidelines for Scotland~~

~~Pollutant~~	~~Averaging period~~	~~Limit value/objective~~	~~Date for compliance~~
~~Nitrogen dioxide (NO_2)~~	~~1-hour mean~~	~~200µg/m³ not to be exceeded more than 18 times a year~~	~~31 December 2005~~
	~~Annual mean~~	~~40µg/m³~~	~~31 December 2005~~

[8] EPAQS: Air quality guidelines recommended by the UK Expert Panel on Air Quality Standards

~~Pollutant~~	~~Averaging period~~	~~Limit value/objective~~	~~Date for compliance~~
~~Oxides of nitrogen (NOx)~~	~~Annual mean~~	~~30µg/m³ (for protection of vegetation & ecosystems)~~	~~31 December 2000~~
~~Carbon Monoxide (CO)~~	~~Running 8-hour mean~~	~~10mg/m³~~	~~31 December 2003~~
~~Volatile Organic Compounds (VOCs): Benzene (C_6H_6)~~	~~Annual mean~~	~~3.25µg/m³~~	~~31 December 2010~~
~~Sulphur dioxide (SO_2)~~	~~15-minute mean~~	~~266µg/m³ not to be exceeded more than 35 times a year~~	~~31 December 2005~~
	~~1-hour mean~~	~~350µg/m³ not to be exceeded more than 24 times a year~~	~~31 December 2004~~
	~~24-hour mean~~	~~125µg/m³ not to be exceeded more than 3 times a year~~	~~31 December 2004~~
	~~Annual mean~~	~~20µg/m³ (for protection of vegetation & ecosystems)~~	~~31 December 2000~~
~~Fine particulates (PM_{10})~~	~~24-hour mean~~	~~50µg/m³ not to be exceeded more than 7 times a year~~	~~31 December 2010~~
	~~Annual mean~~	~~18µg/m³~~	~~31 December 2010~~
~~Very fine particulates ($PM_{2.5}$)~~	~~Annual mean~~	~~10µg/m³~~	~~2020~~
~~PAH (benzo[a]pyrene)~~	~~Annual mean~~	~~0.25ng/m³~~	~~31 December 2010~~
~~Lead (Pb)~~	~~Annual mean~~	~~0.25µg/m³~~	~~31 December 2008~~
~~Arsenic (As)~~	~~Annual mean~~	~~6ng/m³~~	~~31 December 2012~~
~~Cadmium (Cd)~~	~~Annual mean~~	~~5ng/m³~~	~~31 December 2012~~
~~Nickel (Ni)~~	~~Annual mean~~	~~20ng/m³~~	~~31 December 2012~~

Table 2: Air Quality Criteria for the Protection of Human Health (Scotland)

Pollutant	**Averaging Period and Statistic**	**Assessment Criterion (µg/m³)**	**Source**
PM_{10}	Annual mean	18	UK/EU AQS
PM_{10}	24 hour mean, not to be exceeded more than 7 times per year	50	UK/EU AQS
$PM_{2.5}$	Annual	10	UK/EU AQS
VOCs (as benzene)	Annual	3.25	UK/EU AQS
CO	8-hour maximum running mean	10,000	UK/EU AQS
CO	1-hour mean	30,000	H1 v2.2
HCl	1 hour	750	H1 v2.2

Pollutant	Averaging Period and Statistic	Assessment Criterion (µg/m³)	Source
HF	1 hour	160	H1 v2.2
SO_2	Annual	50	UK/EU AQS
SO_2	24 hour mean, not to be exceeded more than 3 times per year	125	UK/EU AQS
SO_2	1 hour mean, not to be exceeded more than 24 times per year	350	UK/EU AQS
SO_2	15 minute mean, not to be exceeded more than 35 times per year	266	UK AQS
NO_2	Annual	40	UK/EU AQS
NO_2	1 hour mean, not to be exceeded more than 18 times per year	200	UK/EU AQS
NH_3	Annual	180	H1 v2.1 and v2.2
NH_3	1 hour	2500	H1 v2.1 and v2.2
Cadmium (Cd)	Annual	0.005	H1 v2.1 and v2.2
Thallium (Tl)	Annual	1	H1 v2.1 (not included in v2.2)
Thallium (Tl)	1 hour	30	H1 v2.1 (not included in v2.2)
Mercury (Hg)	Annual	0.25	H1 v2.1 and v2.2
Mercury (Hg)	1 hour	7.5	H1 v2.1 and v2.2
Antimony (Sb)	Annual	5	H1 v2.1 and v2.2
Antimony (Sb)	1 hour	150	H1 v2.1 and v2.2
Arsenic (As)	Annual	0.006	UK/EU AQS
Arsenic (As)	Annual	0.003	EPAQS recommendation and H1 v2.1 and v2.2
Arsenic (As)	1 hour	15	H1 v2.1 (not included in v2.2)
Chromium (Cr)	Annual	5	H1 v2.2 (changed from v2.1)
Chromium (Cr)	1 hour	150	H1 v2.2 (changed from v2.1)
Chromium VI	Annual	0.0002	EPAQS recommendation and H1 v2.1 and v2.2
Cobalt (Co)	Annual	0.2	H1 v2.1 (not included in v2.2)
Cobalt (Co)	1 hour	6	H1 v2.1 (not included in v2.2)
Copper (Cu)	Annual	10	H1 v2.1 and v2.2
Copper (Cu)	1 hour	200	H1 v2.1 and v2.2
Manganese (Mn)	Annual	0.15	H1 v2.2 (new in v2.2)
Manganese (Mn)	24 hour	150	H1 v2.1 (not included in v2.2)
Manganese (Mn)	1 hour	1500	H1 v2.1 and v2.2
Nickel (Ni)	Annual	0.02	H1 v2.1 and v2.2
Lead (Pb)	Annual	0.25	UK AQS
Vanadium (V)	Annual	5	H1 v2.1 and v2.2
Vanadium (V)	24 hour	1	H1 v2.1 and v2.2
Dioxins/ furans	Annual	none	N/A
PAH (as benzo – a –pyrene)	Annual	0.001	UK/EU AQS
	Annual mean	0.2	H1 v2.1 and v2.2

Pollutant	Averaging Period and Statistic	Assessment Criterion (µg/m^3)	Source
Polychlorinated biphenyls (PCBs)	1-hour mean	6	H1 v2.1 and v2.2

(1) UK/AQS AQS: Air Quality Standard – these are currently legally binding in the UK and are derived from CAFE, with the exception of the 15 minutes mean SO_2 AQS which is UK specific
(2) H1: Derived from version 2.1 and/or version 2.2 of the EA Annex F H1 guidance document
(3) EPAQS: Air quality guidelines recommended by the UK Expert Panel on Air Quality Standards
(4) Within the Industrial Emissions Directive emissions of VOCs are considered as the sum of total VOC emissions. However, no air quality standard exists for total VOCs. Therefore, the UK air quality standard for benzene has been adopted; this represents the worst-case as this is a particularly stringent standard compared to those for other VOCs
(5) Within the Industrial Emissions Directive emissions of PAHs are considered as the sum of total PAH emissions. However, no air quality standard exists for total PAHs. Therefore, the UK air quality standard for benzo[a]pyrene has been adopted; this represents the worst-case as B[a]P is the most harmful PAH species.

~~For other pollutants which will be emitted by the Proposed Scheme and regulated under the Industrial Emission Directive, there are no air quality objectives. For these pollutants assessment criteria in the form of Environmental Assessment Levels (EALs) provided by SEPA[28], the EA[29], and the Health and Safety Executive[9], has been used as the latest guidance in the UK. Of the trace metals emitted, there are European limit values for Pb, As, Cd and Ni and for other trace metals EALs are provided. A summary of the appropriate EALs considered for short-term (hourly mean) and long-term (annual mean) averaging periods, for all pollutants not included in Table 2, are presented in Table 3.~~

~~The air quality objectives and limit values as set out in Table 2 and Table 3 are the air quality standards used within this assessment for human health and the protection of vegetation and ecosystems. Where there is more than one standard, the most stringent has been used.~~

~~Table 3: Environmental assessment levels (EALs)~~

~~**Pollutant**~~	~~**Averaging period**~~	~~**Value (µg/m^3)**~~	~~**Source**~~
~~Ammonia (NH_3)~~	~~Annual mean~~	~~180~~	~~EA~~
	~~1-hour mean~~	~~2,500~~	~~EA~~
~~Antimony (Sb)~~	~~Annual mean~~	~~5~~	~~EA~~
	~~1-hour mean~~	~~150~~	~~EA~~
~~Arsenic (As)~~	~~Annual mean~~	~~0.003~~	~~EA~~
	~~Annual mean~~	~~0.006~~	~~UK/EU target~~
~~Benzene (C_6H_6)~~	~~1-hour mean~~	~~195~~	~~EA~~
~~Carbon monoxide (CO)~~	~~1-hour mean~~	~~30,000~~	~~EA~~
~~Chromium, Chromium (II) and Chromium (II) compounds (as Cr)~~	~~Annual mean~~	~~5~~	~~EA~~
	~~1-hour mean~~	~~150~~	~~EA~~

[9] Health and Safety Executive (2011) EH40/2005 Workplace exposure limits (Second edition, published 2011)

~~Pollutant~~	~~Averaging period~~	~~Value ($\mu g/m^3$)~~	~~Source~~
~~Chromium (VI) oxidation state in the PM_{10} fraction~~	~~Annual mean~~	~~0.0002~~	~~EA~~
~~Cobalt (Co)~~	~~Annual mean~~	~~100~~	~~Derived from HSE EH40~~
~~Copper (Cu)~~	~~Annual mean~~	~~10~~	~~EA~~
	~~1-hour mean~~	~~200~~	~~EA~~
~~Hydrogen chloride (HCl)~~	~~1-hour mean~~	~~750~~	~~EA~~
~~Hydrogen fluoride (HF)~~	~~Monthly mean~~	~~16~~	~~EA~~
	~~1-hour mean~~	~~160~~	~~EA~~
~~Manganese (Mn)~~	~~Annual mean~~	~~0.15~~	~~EA~~
	~~1-hour mean~~	~~1,500~~	~~EA~~
~~Mercury (Hg)~~	~~Annual mean~~	~~0.25~~	~~EA~~
	~~1-hour mean~~	~~7.5~~	~~EA~~
~~Polychlorinated biphenyls (PCBs)~~	~~Annual mean~~	~~0.2~~	~~EA~~
	~~1-hour mean~~	~~6~~	~~EA~~
~~Thallium (Tl)~~	~~Annual mean~~	~~100~~	~~Derived from HSE EH40~~
~~Vanadium (V)~~	~~Annual mean~~	~~5~~	~~EA~~
	~~1-hour mean~~	~~1~~	~~EA~~

There are no air quality strategy objectives, European limit values or EALs for dioxins (polychlorinated dibenzo-p-dioxins, PCDDs) or furans (polychlorinated dibenzofurans, PCDFs). Dioxins, furans, dioxin-like PCBs and trace metals have been assessed further in a human health risk assessment (HHRA, Appendix G). This uses the predicted ambient air concentrations of these pollutants to estimate the maximum possible additional dose (resulting from the proposed EfW CHP) of these substances, for a variety of humans (e.g. adult, child, resident, farmer) via inhalation and ingestion, and considers the carcinogenic and non-carcinogenic health impact of these doses.

2.3 Industrial Emissions Directive

The Industrial Emissions Directive (IED) (2010/75 /EU) [10], brought seven separate directives including the Waste Incineration Directive (WID) into a single directive. The IED was transposed into national legislation by The Pollution Prevention & Control (Scotland) Regulations 2012. The legislation contains the ELVs applicable to the ~~proposed EfW CHP Facility~~ EfW Facilities as set out in Table 4. The ELVs are the maximum concentrations the Proposed Scheme can emit. In reality the emissions would be below the ELVs. SEPA is responsible for permitting operations that fall under the IED.

~~Operational air quality from the proposed EfW CHP facility based on emissions at IED ELVs has been assessed as part of the permit submitted to SEPA.~~

[10] Directive 2010/75/EU of 24 November 2010 on industrial emissions (integrated pollution prevention and control)

Table 4: IED ELVs (mg/Nm^3)

Substance	Daily mean(a)	30 minute mean(a)	
		100th percentile	97th percentile
Particulate matter	10	30	10
Nitrogen dioxide (NO_2)	200	400	200
Sulphur dioxide (SO_2)	50	200	50
Carbon monoxide (CO)	50	100 (b)	150 (c)
Hydrogen fluoride (HF)	1	4	2
Hydrogen chloride (HCl)	10	60	10
Total Organic Carbon (TOC)	10	20	10
Group I metals - Cd and Tl (d)	0.05		
Group II metals - Hg (d)	0.05		
Group III metals - Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V (d)	0.5		
Dioxins and Furans (e)	0.1 ng I-TEQ m^3		

(a) Units are in mg/Nm^3 (273K, 0% water, and 11% (dry) O_2) unless otherwise stated
(b) 100th percentile of half hourly average concentrations in any 24 hour period
(c) 95th percentile of 10-minute mean CO concentration
(d) Average over a sample period between 30 minutes and 8 hours
(e) Average over a sampling period of 6 to 8 hours

2.4 Dust Nuisance

Dust is the generic term used in the British Standard document BS 6069 (Part Two) to describe particulate matter in the size range 1–75µm in diameter. Dust nuisance is the result of the perception of the soiling of surfaces by excessive rates of dust deposition. Under the Environmental Protection Act 1990 [11], dust nuisance is defined as a statutory nuisance.

There are currently no standards or guidelines for dust nuisance in the UK, nor are formal dust deposition standards specified. This reflects the uncertainties in dust monitoring technology and the highly subjective relationship between deposition events, surface soiling and the perception of such events as a nuisance. In law, complaints about excessive dust deposition would have to be investigated by the local authority and any complaint upheld (by reference to the relevant tests set out in the Environmental Protection Act 1990) for a statutory nuisance to occur. Dust deposition is generally managed by suitable on-site practices and mitigation rather than by the determination of statutory nuisance and/or prosecution or enforcement notice(s).

[11] Environmental Protection Act 1990, Chapter 43, Part III Statutory Nuisances and Clean Air

2.5 Non-Road Mobile Machinery Regulations and Guidance

The Non-Road Mobile Machinery (NRMM) (Emission of Gaseous and Particulate Pollutants) (Amended) Regulations 2014 (SI 2014/1309) [12], which implement EU Directive 2012/46/EU [13], requires that NRMM engines meet certain emissions standards for different engine types. It also aims to reduce emissions from NRMM through the fitting of devices to engines, to help meet the Stage IV emissions standard, where applicable.

2.6 Ecological Legislation

European Council Directive 92/43/EEC [14] (Habitats Directive) requires member states to introduce a range of measures for the protection of habitats and species. The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) [15] transposes the Directive into law in Scotland.

The Habitats Directive requires the competent authority to firstly evaluate whether the Proposed Scheme is likely to give rise to a significant effect on the European site (Habitats Regulation Assessment screening). Where this is the case, it has to carry out an 'appropriate assessment' in order to determine whether the Project would adversely affect the integrity of the European site.

There are specific objective pollutant concentrations for vegetation called 'critical levels', which are shown in Table 5. These are concentrations below which harmful effects are unlikely to occur. The limit value applies to locations more than 20km from towns with more than 250,000 inhabitants or more than 5km from other built-up areas, industrial installations or motorways. However, the SEPA H1 guidance states that "the critical levels should be applied at all locations as a matter of policy, as they represent a standard against which to judge ecological harm".

There are also critical loads for habitats which are defined as: "a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge". The critical loads used in this assessment are those for nutrient nitrogen deposition and acid deposition and are detailed in ~~Appendix E~~ Appendix C.

The critical loads are set as ranges, reflecting the uncertainty in the present scientific knowledge and evidence-base on the effects of air pollution on sensitive

[12] Non-Road Mobile Machinery (Emission of Gaseous and Particulate Pollutants) (Amendment) Regulations 2014, SI 2014/1309

[13] COMMISSION DIRECTIVE 2012/46/EU of 6 December 2012 amending Directive 97/68/EC of the European Parliament and of the Council on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery

[14] European Council Directive (92/43/EEC) of 21 May 1992, on the conservation of natural habitats and of wild fauna and flora

[15] The Conservation (Natural Habitats, &c.) Regulations (as amended in Scotland) 1994 No. 2716

species. If the upper limit critical load is being exceeded, it is likely that there is harm to the relevant habitat/features arising from the current level of nitrogen deposition. If the deposition level is below the lower limit critical load, it is unlikely that the feature/habitat is being harmed. If the deposition level lies between the lower and upper critical load values, it is not possible to be certain that harmful effects are, or are not, occurring.

The relevant Critical Load Functions (CLFs) for this study have been derived from the most up-to-date information on the APIS website [16].

The objectives within the legislation are used to assess the potential impacts upon any sensitive ecosystems.

Table 5: Critical levels for the protection of ecosystems

Pollutant	Averaging period	Standard
Nitrogen oxides (expressed as NO_2)	Annual mean	30µg/m^3
	Daily mean	75µg/m^3
SO_2 for ecosystems where lichens and bryophytes are present	Annual mean	10µg/m^3
SO_2 for all other ecosystems	Annual mean	20µg/m^3
NH_3 for ecosystems where lichens and bryophytes are present	Annual mean	1µg/m^3
NH_3 for all other ecosystems	Annual mean	3µg/m^3
HF	Weekly mean	0.5µg/m^3
	Daily mean	5µg/m^3

[16] APIS (Air Pollution Information System) www.apis.ac.uk, accessed January 2017

3 Planning Policy and Guidance

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

3.1 National Planning Framework

The third National Planning Framework [17] was published by the Scottish Government in June 2014. This framework sets out a strategy for long term development in Scotland for the next 20-30 years. The main focus of the framework is supporting economic growth and the transition to a low carbon economy and needs to be considered at all strategic and local development plans.

In relation to air quality, the framework states:

> *"Reducing the impact of the car on city and town centres will make a significant contribution to realising their potential as sustainable places to live and invest by addressing congestion, air pollution and noise and improving the public realm."*

3.2 Scottish Planning Policy

The Scottish Planning Policy [18] (SPP) is a statement of the Scottish Government policy on land use planning and provides the Scottish Government's vision on the purpose of land-use planning and desired outcomes. The SPP provides core principles on the operation of the planning system with objectives, statutory guidance on sustainable development, and categorised planning policies for development planning and development management.

3.3 Scotland's Local Air Quality Management Policy and Technical Guidance

Scotland's Local Air Quality Management Policy Guidance [19] provides guidance on the links between air quality and the land-use planning system. The guidance advises that air quality considerations should be integrated into the planning process at the earliest stage, and is intended to aid local authorities in developing action plans to deal with specific air quality problems and create strategies to improve air quality generally. It summarises the main ways in which land-use planning system can help deliver air quality objectives.

[17] The Scottish Government (2014); National Planning Framework for Scotland 3
[18] The Scottish Government (2014); Scottish Planning Policy
[19] The Scottish Government (2016); Local Air Quality Management Policy Guidance PG(S)(16)

Scotland's Local Air Quality Management Technical guidance [20] is designed to support local authorities in carrying out their duties under the Environment Act (1995). This includes various methodologies including model verification, which are appropriate for use in air quality assessments. Where technical guidance is relevant to the assessment, this has been included and used.

3.4 Cleaner Air for Scotland

Cleaner Air for Scotland [21] is a national strategy which links up the various contributing factors and responsible bodies, to encourage them to work together towards the common aim of achieving the best possible air quality for Scotland. Future updates and revisions to Scottish Planning Policy and the National Planning Framework, the Local Development Plans of local authorities and their air quality action plans should take "Cleaner Air for Scotland" into account.

3.5 Local Policy and Guidance

The Dundee Local Development Plan [22] was adopted by Dundee City Council (DCC) in ~~December 2013~~ February 2019 and provides a land use strategy that will guide development across Dundee up to 2029 and beyond.

The following policy was identified in relation to air quality and is relevant to this assessment.

"Policy ~~44~~ 40: Air Quality

There is a general presumption against development proposals that could significantly increase air pollution or introduce people into areas of elevated pollution concentrations unless mitigation measures are adopted to reduce the impact to levels acceptable to the Council."

Additional guidance related to air quality assessments has been prepared by DCC, which is contained in the Supplementary Guidance document: Air Quality and Land Use Planning [23], and the associated Technical Guide [24].

Where relevant, the policy and guidance have been considered throughout this assessment.

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[20] The Scottish Government (2016); Local Air Quality Management Technical Guidance TG(S)(16)

[21] The Scottish Government (2015) Cleaner Air For Scotland The Road To A Healthier Future, November 2015. Accessed at http://www.gov.scot/Resource/0048/00488493.pdf

[22] Dundee City Council (2019) Dundee Local Development Plan.

[23] Dundee City Council. Dundee Local Development Plan Supplementary Guidance: Air Quality and Land Use Planning

[24] Dundee City Council. Air Quality and Land Use Planning SG: Technical Guide

3.6 Consultation

Following appointment, consultation was undertaken with DCC Environmental Health department to confirm approval of the air quality scope. This was agreed via email and telephone communication throughout November/ December 2016.

In 2019, a request for an EIA scoping opinion was submitted to DCC, who responded in September 2019.

DCC confirmed that it is satisfactory to include a review of air quality assessment to date in light of the new BREFs which were expected to be published in Autumn 2019. DCC also noted that it was acceptable to include odour in the air quality assessment.

The scoping opinion noted that an air quality assessment would be required for the likely impacts of running the two facilities in parallel. DCC noted that the applicant should be aware of their area specific guidance: '*DCC LDP Supplementary Guidance: Air Quality and Land Use Planning*' and the accompanying *'Air Quality and Land Use Planning SG: Technical Guide'*.

3.7 Other Relevant Policy and Guidance

3.7.1 Institute of Air Quality Management Guidance (2014)

The Institute of Air Quality Management (IAQM) guidance on construction dust[25] was produced in consultation with industry specialists and gives guidance to development consultants and environmental health officers on how to assess air quality impacts from construction. The IAQM guidance provides a method for classifying the significance of effects from construction activities based on 'dust magnitude' (high, medium or low) and the sensitivity of the area based on the sensitivity of receptors and PM_{10} concentrations[26] in the area. The guidance recommends that once the significance of effect from construction is identified, the appropriate mitigation measures are implemented.

3.7.2 Environmental Protection UK/ Institute of Air Quality Management Guidance (2015)

The ~~2015~~2017 Land-Use Planning & Development Control guidance document[27] produced by Environmental Protection UK (EPUK) and the IAQM provides a framework for consideration of air quality within the planning system to provide a means of reaching sound decisions, having regard to the air quality implications of development proposals. The document provides guidance on when air quality assessments are required by providing screening criteria regarding the size of a

[25] IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction
[26] The guidance does not explicitly consider $PM_{2.5}$ concentrations but $PM_{2.5}$ is a major constituent of PM_{10}.
[27] IAQM and EPUK (2017). Land-use planning and development control: Planning for air quality v1.2

development, changes to traffic flows/composition energy facilities or combustion processes associated with the Proposed Scheme.

3.7.3 Integrated Pollution Prevention and Control (IPPC) Horizontal Guidance Note H1

The IPPC H1 guidance[28] was produced by the EA for England and Wales in collaboration with the SEPA and the Northern Ireland Environment and Heritage Service (EHS). The IPPC is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities. The purpose of H1 guidance note is to provide supplementary information relevant to all sectors, for the appraisal of Best Available Techniques (BAT) and to carry out an appropriate environmental assessment of the overall impact of the emissions resulting from a proposed installation.

More recently the EA has revised the H1 guidance and has developed a web-based version[29], with the latest revision date being August 2016. The SEPA H1 has been followed in the assessment, and where applicable, reference is also made to the EA air emissions risk assessment guidance.

3.8 Odour

Odour is perceived due to a single substance or a mixture of volatile chemical compounds triggering a reaction in the olfactory organ at very low concentrations. Any odour, whether pleasant or unpleasant, can result in a loss of amenity for nearby residents. If the odour is perceived for a sufficiently frequent time above a threshold level, then it can give rise to statutory nuisance. Odour can therefore be an important issue in planning, when proposals are submitted for potentially odorous developments located near sensitive receptors and vice versa.

There is no statutory limit in Scotland for ambient odour concentrations, for either single or a mix of compounds.

3.8.1 SEPA H4 Guidance

The Horizontal Guidance for Odour (H4)[30] was produced by the EA in collaboration with SEPA. The guidance aims to bring consistency to the overall approach to the regulation of odorous emissions, and outlines the main considerations relating to the permitting and regulation of odour-generating activities. The second part of the guidance relates to odour assessment and control and describes a range of odour impact assessment methodologies, gives guidance on the collection of odour samples using analytical and sensory techniques, the control of odour by design, operational and management techniques and outlines

[28] IPPC H1 (2003) Environmental Assessment and Appraisal of BAT
[29] EA (2016) Air emissions risk assessment for your environmental permit
Available at: [https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit]
[30] SEPA (2002) IPPC H4: Horizontal Guidance for Odour

the range of "end-of-pipe" odour abatement technologies available. The H4 guidance is further elaborated in the Odour Guidance from Natural Scotland and SEPA [31].

3.8.2 IAQM Odour Guidance

The IAQM produced guidance in 2014 [32] with the specific intention to provide advice for "assessing odour impacts for planning purposes". It recommends various assessment techniques including the use of a Source-Pathway-Receptor model in which the risk of an adverse odour impact is determined by examining the source characteristics, how effectively the odours can travel from the Source to a receptor (i.e. the Pathway) and examining the sensitivity of the Receptor.

[31] Natural Scotland and SEPA (2010) Odour guidance 2010, Version 1, January 2010
[32] IAQM, Guidance on the assessment of odour for planning, May 2014

4 Methodology

The overall approach to the air quality assessment comprised:

- A review of the existing air quality conditions at, and in the vicinity of, the Proposed Scheme;
- An assessment of the potential changes in air quality arising from the construction of the Proposed Scheme;
- An assessment of the potential changes in air quality and odour arising from the operation of the Proposed Scheme;
- Formulation of mitigation measures, where appropriate, to ensure any adverse effects on air quality or odour are minimised, eliminated or maintained at acceptable levels; and
- An assessment of cumulative effects of the proposed EfW CHP facility (which is under construction) with the existing EfW facility (formerly known as DERL) and the Michelin boilers.

4.1 Method of Baseline Assessment

Existing or baseline ambient air quality refers to the concentration of relevant substances that are already present in the environment. These are present from various sources, such as industrial processes, commercial and domestic activities, traffic and natural sources.

The baseline assessment has considered background air pollutant concentrations from sources including:

- Local authority review and assessment reports and local air quality monitoring data[33];
- Project-specific air quality monitoring carried out by Arup;
- Defra UK Air Information Resource website[34] for details on air quality monitoring and AQMAs;
- Ammonia, Acid Gases and Aerosols, and Heavy Metals Monitoring Networks for the UK[35]; and
- Air Quality Scotland website[36] for local authority background data, and predicted background pollutant concentrations.

4.1.1 Pollutants Assessed

The review of existing air quality conditions considered background data from relevant monitoring studies carried out as part of the local air quality management regime, and data from national monitoring studies, for the following pollutants:

[33] Dundee City Council (2016) https://www.dundeecity.gov.uk/air-quality
[34] Defra (2016) https://uk-air.defra.gov.uk/data/
[35] Defra (2016) https://uk-air.defra.gov.uk/networks/network-info?view=metals
[36] Air quality in Scotland (2016) http://www.scottishairquality.co.uk/

- Nitrogen oxides (NOx) and nitrogen dioxide (NO_2);
- Carbon monoxide (CO);
- Total organic carbons (TOC) as benzene;
- Sulphur dioxide (SO_2);
- Fine particulate matter (PM_{10} and $PM_{2.5}$);
- Hydrogen fluoride (HF) and Hydrogen chloride (HCl);
- Ammonia (NH_3);
- Dioxins and furans;
- Polychlorinated biphenyls (PCB), and Polycyclic aromatic hydrocarbons (PAHs) as benzo(a)pyrene; and
- Trace metals: lead (Pb), arsenic (As), cadmium (Cd), nickel (Ni), thallium (Ti), mercury (Hg), antimony (Sb), chromium (Cr and CrVI), cobalt (Co), copper (Cu), manganese (Mn) and vanadium (V).

4.2 Method of Assessment

4.2.1 Construction Dust Assessment

The construction dust assessment considers the construction of the EfW CHP facility.

The relevant aspects include the potential to generate dust from earthworks, track out (Heavy Duty Vehicles carrying site materials/mud off-site) construction, and emissions from construction equipment and vehicles.

The construction effects have been assessed using a qualitative approach based on latest guidance from the IAQM[25]. The guidance methodology, which is given in detail in ~~Appendix B~~ Appendix F, and provides the basis for the determination of significance for the construction dust assessment. It is considered that where the overall construction dust significance is deemed to be medium or high risk, the overall construction dust impacts of the Proposed Scheme would be significant.

For the construction assessment, works have been assumed to occur across the whole Application Site. This is a precautionary assumption as it assumes dust emissions can occur across the whole site. Taking this precautionary approach ensures any mitigation identified would be sufficient to effectively manage any potential dust emissions. The construction dust assessment methodology and assessment are given in ~~Appendix B~~ Appendix F.

4.2.2 Traffic Assessment

Construction traffic

The development has the potential to impact existing air quality as a result of road traffic exhaust emissions, such as NO_2, PM_{10} and $PM_{2.5}$, associated with construction vehicles travelling to and from the Application Site during the construction phase. A screening assessment was therefore undertaken using the criteria contained within the EPUK/IAQM land-use guidance document[27] to determine the potential local air quality effects associated with construction vehicles.

As the Proposed Scheme lies in an AQMA, the EPUK/IAQM guidance document states the following criteria to help establish when a quantitative assessment of air quality is likely to be considered necessary:

- A change of Light Duty Vehicle (LDV) flows of more than 100 Annual Average Daily Traffic (AADT) movements; and
- A change of Heavy Duty Vehicle (HDV) flows of more than 25 AADT movements;

This screening assessment showed that Forties Road, Drumgeith Road and Baldovie Road are predicted to experience an increase of more than 25 HDV AADT movements and, with exception of Baldovie Road, an increase of more than 100 LDV movements during the construction phase only. An assessment of traffic emissions has therefore been undertaken using the latest ADMS-Roads (version 4.0.1.0) atmospheric dispersion model.

Transport data for the existing situation (assumed to be representative of 2015, the year used for model verification against air quality monitoring data) and the construction phase scenario were provided by the Arup transport planning team. The traffic data used in the assessment of air quality effects is shown ~~Appendix C~~ in the air quality chapter of the ES. Emission rates for all road sources were calculated using Defra's Emissions Factor Toolkit v7.0[37]. Speeds were reduced close to junctions following Defra's Local Air Quality Management Technical Guidance (LAQM.TG16)[38], in which the speed at the junctions is assumed to be 20kph. The roads included in the model are shown in Figure 3.

The assessment has been undertaken for the discrete receptors given in section 4.3.1, which have been selected along the modelled road network. ~~Emissions from traffic affect locations within 200m of roads and therefore no assessment of traffic impacts is required across the gridded output domain discussed in section 4.3.1.~~ The dispersion model set-up and meteorological data used for the assessment of construction traffic impacts is the same as that used in the assessment of operational effects.

Operational traffic

The development has the potential to impact existing air quality as a result of road traffic exhaust emissions, such as NO_2, PM_{10} and $PM_{2.5}$, associated with vehicles travelling to and from the Application Site during the operational phase.

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[37] Defra Emissions Factors Toolkit. Accessed: http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

[38] Defra, 2016. Local Air Quality Management Technical Guidance (TG16). Accessed: http://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf .

A screening assessment was therefore undertaken using the criteria contained within the EPUK/IAQM land-use guidance document[27] to determine the potential local air quality effects associated with vehicles during operation. The screening criteria are the same as those used above for construction traffic. All roads where traffic data was available were included in the assessment, to provide an assessment of local emissions to air.

Traffic data were provided by the Arup transport planning team and the traffic data used in this assessment are shown in the ES.

The traffic assessment scenarios can be summarised as follows:

- Baseline scenario (using 2018 traffic volumes and using 2018 emission factors);
- Do-Minimum (DM) scenario (2020), which is the future year with only the EfW CHP in operation (assuming the existing EfW facility is decommissioned) (using 2020 traffic volumes and using 2018 emission factors); and
- Do-Something (DS) scenario (2020), which is the future year with both the existing EfW and the EfW CHP facility which is under construction in operation together (using 2020 traffic volumes and using 2018 emission factors).

Emission rates have been calculated using the Defra Emissions Factor Toolkit (EFT) v9.0[39]. Impacts on air quality during operation have been modelled using 2018 vehicle emission factors and 2018 background concentrations for all the scenarios to provide a pessimistic assumption of future concentrations. Speeds were reduced close to junctions following Defra's Local Air Quality Management Technical Guidance (LAQM.TG16)[40], in which the speed at the junctions is assumed to be 20kph. The roads included in the model are shown in Figure 3.

The assessment has been undertaken for the discrete receptors given in section 4.3.1.

[39] Defra, 2019. Emissions Factors Toolkit (EFT) v9.0. Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html; [Accessed: July 2019].
[40] Defra, 2016. Local Air Quality Management Technical Guidance (TG16). Accessed: http://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf .

Figure 3: Modelled road network

4.2.3 Model Verification

Model verification refers to the comparison of modelled and measured pollutant concentrations at the same location(s) to determine the performance of the model. This has been possible as scheme specific monitoring has been undertaken by Arup to help establish baseline conditions in the area of the Proposed Scheme. Should the model results for annual mean NO_2 concentrations be largely within ±25% of the measured values and there is no systematic over or under-prediction of concentrations, the LAQM.TG16 guidance advises that no adjustment is necessary. If this is not the case, then the modelled values are adjusted based on the observed relationship between modelled and measured NO_x concentrations due to road traffic to provide a better agreement.

Modelled results may not compare as well at some locations for a number of reasons, including:

- Errors/uncertainties in model input data (e.g. traffic flow and speed data estimates);
- Model setup (including street canyons, road widths, location of monitoring sites);
- Model limitations (treatment of surface roughness and meteorological data);
- Uncertainty in monitoring data, notably diffusion tubes (e.g. bias adjustment factors and annualisation of short-term data); and
- Uncertainty in emissions and emission factors.

These factors were investigated as part of the model verification process to minimise the uncertainties as far as practicable.

4.2.4 NO_x to NO_2 Conversion – Road Traffic Emissions

The model predicts roadside NO_x concentrations, which comprise principally nitric oxide (NO) and primary NO_2 (i.e. NO_2 that is emitted directly from the vehicle exhaust). The emitted NO reacts with oxidants in the air (mainly ozone) to form more NO_2 (known as secondary NO_2). Since only NO_2 has been associated with effects on human health, the air quality standards for the protection of human health are based on NO_2 rather than NO_x or NO. Thus, a suitable NO_x to NO_2 conversion needs to be applied to the modelled NO_x concentrations.

LAQM.TG16 details an approach for calculating the roadside conversion of NO_x to NO_2, which takes into account the difference between ambient NO_x concentrations with and without the development, the concentration of ozone and the different proportions of primary NO_2 emissions in different years. This approach is available as a spreadsheet calculator, with the most up to date version having been released in June 2016 (v5.1)[41].

[41] Defra, 2016. NO_x to NO_2 calculator. http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

4.2.5 Assessment of Impacts and Significance of Effects

The IAQM and EPUK guidance[42] for undertaking air quality assessments within the planning system provides a framework for professionals operating within the planning system to provide a means of reaching sound decisions, having regard to the air quality implications of development proposals.

It should be noted that strictly this guidance only applies to the planning system in England and Wales. Meanwhile, the document states that the general principles of air quality assessment set out within this guidance document are applicable in all parts of the UK and is considered to be applicable for use in Scotland.

The guidance provides an approach to determining the impacts on local air quality at individual receptors and the overall significance of local air quality effects resulting from the Proposed Scheme. The first step is to define the impact descriptors at each sensitive receptor as follows:

- Predict the absolute change in annual mean pollutant concentrations as a proportion of the relevant assessment level (i.e. air quality standard), to determine the magnitude of change;
- Calculate the total predicted pollutant concentrations as a proportion of the relevant assessment level; and
- Examine the magnitude of change in relation to the total predicted pollutant concentrations to determine the impact descriptor.

The impact descriptor therefore depends on the magnitude of the change in predicted concentrations and the total predicted concentrations in relation to the air quality standard, as shown in Table 6.

The guidance also notes that where the change in concentrations is less that 0.5% of the assessment level, only negligible impacts would be anticipated.

The second step is to make a judgement on the overall significance of effect for a proposed development. The impact descriptors at each individual receptor is used along with a set of qualitative factors such as:

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

Professional judgement should be used to determine the overall significance of effects. However, in some circumstances where the proposed development can be judged in isolation, it is likely that a ‘moderate’ or ‘substantial’ impact will give rise to a significance effect, while a ‘negligible’ or ‘slight’ impact will not result in a significant effect.

[42] Moorcroft & Barrowcliffe et al. (2015); Land-use Planning & Development Control: Planning for Air Quality; Institute of Air Quality Management; London

Table 6: Impact descriptors for air quality assessment

Total predicted annual mean concentrations	% Change in concentrations relative to air quality standard			
	1%	2 – 5%	6 – 10%	> 10%
< 75% of standard	Negligible	Negligible	Slight	Moderate
76 – 94% of standard	Negligible	Slight	Moderate	Moderate
95 – 102% of standard	Slight	Moderate	Moderate	Substantial
103 – 109% of standard	Moderate	Moderate	Substantial	Substantial
> 110% of standard	Moderate	Substantial	Substantial	Substantial

4.3 Method of Operational Stack Emission Assessment

~~The assessment has examined the changes in air pollutant concentrations in the surrounding area, that will result from operation of the proposed EfW CHP facility at full capacity (for 2020, the first full year of operation, as a worst case), cumulatively with existing adjacent developments and also the changes to air quality that result from abnormal operation of the proposed EfW CHP facility. The potential effect on human health and on designated wildlife sites has been assessed.~~

The assessment has examined the changes in air pollutant concentrations in the surrounding area, that will result from parallel operation of the existing EfW and EfW CHP facilities and cumulatively with existing adjacent developments. The potential effect on human health and on designated ecological sites has also been assessed.

Once the EfW CHP facility has completed construction it will be hot-commissioned using diesel fuel (for approximately 1.5 months) while the existing EfW facility continues to operate, burning waste. ~~Once the proposed EfW CHP facility is ready to take waste, DERL will cease operation and the proposed EfW CHP facility will burn waste. There will be no simultaneous operation of the two plants burning waste.~~

An assessment of the potential impact from an increase in road traffic emissions has also been undertaken, as a result of the parallel operations.

Next to the proposed EfW CHP is the Michelin tyre plant. The main sources of emissions to air from this plant are the three boilers. Michelin has confirmed that normal operation is to have one boiler operating at 60-80% load, one on standby operating at 10-20% load and one non-operational (for maintenance, servicing, insurance inspections etc). Emissions monitoring data were measured when the boilers were operating at 60% load and so these emissions have been increased by a factor of 80%/60% to estimate emissions at 80% load, which has been used as a worst case (compared with 60% load). Emissions at 20% load have been estimated from the operating load (80%) emissions.

Various scenarios have been modelled to estimate impacts from single plant and combined operations:

~~(A) the DERL facility (80% load) alone~~

~~(B) the proposed EfW CHP alone, burning waste~~

~~(C) the proposed EfW CHP, burning diesel (hot commissioning) + (A)~~

~~(D) Michelin boilers (1 x 80% + 1 x 20% load) + (B)~~

(A) the existing EfW facility alone;

(B) the EfW CHP facility alone;

(C) the existing EfW and EfW CHP facilities operating in parallel;

(D) the EfW CHP facility operating on diesel during hot commissioning and the existing EfW facility burning waste;

(E) the EfW CHP facility burning waste, the existing EfW facility burning waste and Michelin boiler plant, running together for normal operations;

(F) the EfW CHP facility operating on diesel during hot commissioning, the existing EfW facility burning waste, and Michelin boiler plant for normal operations all running together; and

(G) the EfW CHP facility burning waste, the existing EfW facility burning waste and Michelin boiler plant, all running at maximum capacity.

~~To help inform the design, a stack height assessment was carried out, and is presented in Volume 2 Appendix B2 of the Environmental Statement which was submitted to accompany the planning application for the Proposed Scheme.~~

~~Detailed dispersion modelling of annual and hourly mean NO_2 ground level concentrations resulting from emissions from the proposed EfW CHP facility was undertaken. A range of stack heights between 70m and 110m (above ground level) were modelled.~~

~~The assessment showed that annual mean NO_2 concentrations are predicted to decrease steadily with height. Hourly mean concentrations decrease as the stack height increases up to around 87.5m above ground level. At heights above 90m, the rate of decrease in concentration is reduced. It was therefore considered that a 90m stack represents a height at which the additional visual impact of taller stack would begin to outweigh the air pollutant dispersion benefits. The operational assessment has therefore been undertaken based on a 90m stack.~~

The operational assessment considers those pollutants included in the Industrial Emission Directive (IED) and those included within EU, UK and Scottish air quality standards, namely:

- Nitrogen oxides (NOx) and nitrogen dioxide (NO_2);
- Carbon monoxide (CO);
- Total organic carbon (TOC) as benzene;
- Sulphur dioxide (SO_2);
- Fine and very fine particulate matter (PM_{10} and $PM_{2.5}$);

- Hydrogen fluoride (HF) and Hydrogen chloride (HCl);
- Ammonia (NH_3);
- Dioxins (Polychlorinated dibenzo-p-dioxins, PCDDs) and furans (Polychlorinated dibenzofurans, PCDFs);
- Dioxin-like polychlorinated biphenyls (PCB);
- Polycyclic aromatic hydrocarbons (PAHs) as benzo(a)pyrene; and
- Trace metals: lead (Pb), arsenic (As), cadmium (Cd), nickel (Ni), thallium (Ti), mercury (Hg), antimony (Sb), chromium (Cr and CrVI), cobalt (Co), copper (Cu), manganese (Mn) and vanadium (V).

The assessment presented in this chapter relates to the comparison of ambient concentrations to the relevant assessment standards or guidelines. ~~and the change in concentrations with operation of the proposed EfW CHP facility in comparison to the existing DERL facility.~~ The standards and guidelines are intended to protect human health from the inhalation of the pollutants.

In addition to this, two other types of assessment based on potential impacts to air quality have been undertaken.

(1) Impacts on sensitive habitats: the potential impacts of NH_3, NOx, HCl and SO_2 have been assessed, both through the impacts directly to air and through deposition of acid species and nutrient nitrogen.

(2) Impacts on human health resulting from certain organic compounds (dioxins, furans, dioxin-like PCB and PAHs) and trace metals entering the food chain and being ingested by humans over the lifetime of the Proposed Scheme have been assessed (see the Human Health Risk Assessment (HHRA) in Appendix G[43]).

4.3.1 Sensitive Receptors

The receptors relevant to the assessment include residential properties, schools, hospitals and community facilities in the area and other sensitive locations such as designated ecological sites and protected wildlife sites.

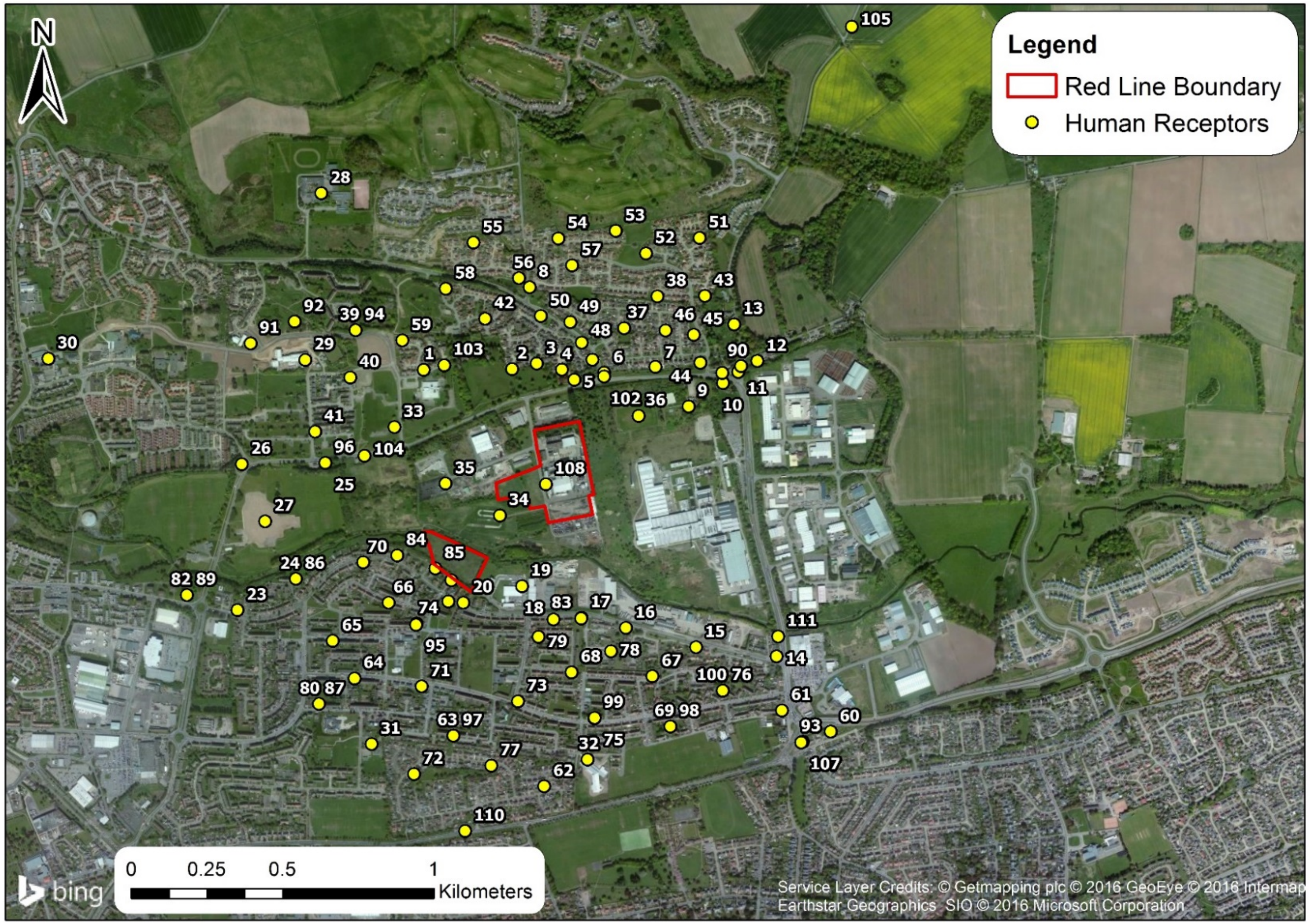
Discrete human receptors have been selected based on relevant sensitive receptors in the vicinity of the EfW CHP facility. Receptors have been selected at locations close to the road network (as discussed above for the assessment of construction traffic) and at a spread of locations around the Application Site. The locations of the human receptors are shown in Figure 4 and details are presented in ~~Table 6~~ Appendix A.

[43] The HHRA originally submitted as part of the PPC/A/1003157 variation considered the potential effects of parallel operations in the cumulative impact assessment and has therefore been resubmitted.

These human receptors have been modelled at heights of 1.5m and 7.5m, representative of inhalation height at ground level and at third floor respectively[44]. Eleven of the receptors are at air quality monitoring locations commissioned as part of the scheme and discussed in section 5.2.2.

[44] The discrete receptors included in the assessment were agreed with Dundee City Council Environmental Health as part of the original Air Quality Assessment and PPC Permit for the new EfW CHP facility.

Figure 4: Location of sensitive receptors



*Receptor 109 is not shown on this map as it is outside the area shown.

~~Table 6: Discrete human receptors [full table removed and replaced with Appendix A]~~

~~The assessment of emissions from the stack of the proposed EfW CHP facility have also been predicted at locations over a Cartesian grid of 15km x 15km with a nested 5km x 5km grid area with a refined spatial resolution. Each grid has the proposed EfW CHP facility stack location as its central point. The gridded output has been used for contour plotting of modelled concentrations.~~

~~For the 15km grid the modelled grid extent was: NGR (337137, 725379) to (352137, 740379), at a height of 1.5m and with a resolution of 150m. For the 5km grid the modelled grid extent was: NGR (342137, 730379) to (347137, 735379), at a height of 1.5m, with a resolution of 50m. The proposed model grid areas are shown in **Error! Reference source not found.**.~~

The modelling of pollutant concentrations from the stacks of the existing EfW and EfW CHP facilities has also included receptors in a Cartesian grid of 15km x 15km with a nested 5km x 5km grid area with a refined spatial resolution. Each grid has the EfW CHP facility stack location as its central point. The gridded output has been used for contour plotting of modelled concentrations.

For the 15km grid the modelled grid extent was: NGR (337137, 725379) to (352137, 740379), at a height of 1.5m and with a resolution of 150m. For the 5km grid the modelled grid extent was: NGR (342137, 730379) to (347137, 735379), at a height of 1.5m, with a resolution of 50m. The proposed model grid areas are shown in Figure 5.

Discrete ecological receptors have been selected based on their designation. Special protection areas (SPAs), special areas of conservation (SACs), Ramsar sites (protected wetlands) and sites of special scientific interest (SSSIs) have been selected within 15km of the EfW CHP facility and local nature sites (ancient woodland, woodland, heathland, local wildlife sites, waterbodies and watercourses, and national and local nature reserves) have been selected within 2km of the EfW CHP facility. The locations of the ecological receptors are shown in Figure 6 and details are presented in ~~Table 7~~ Appendix A.

~~Table 7: Ecological receptors [full table removed and replaced with Appendix A]~~

Figure 5: Model output grid domains

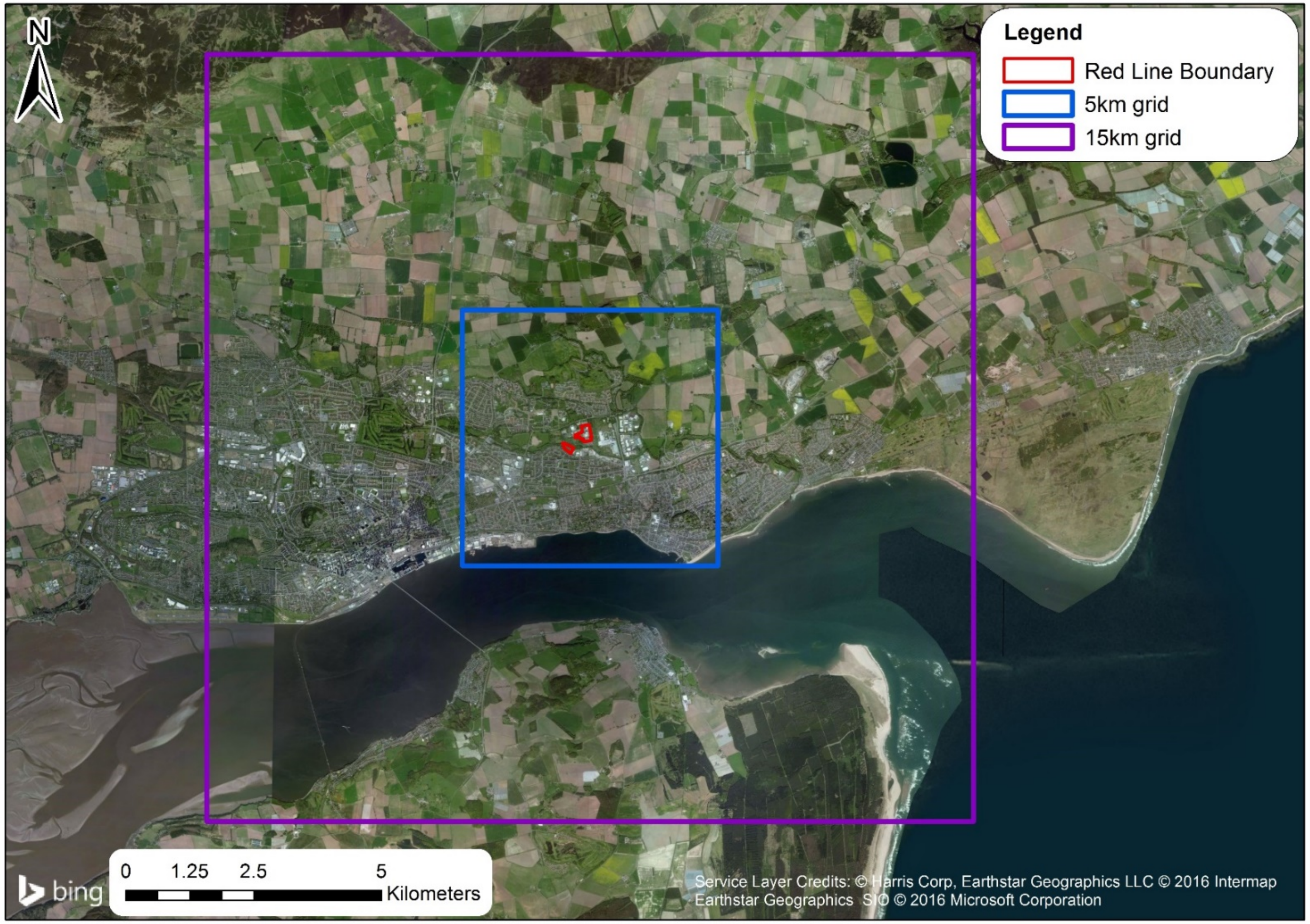
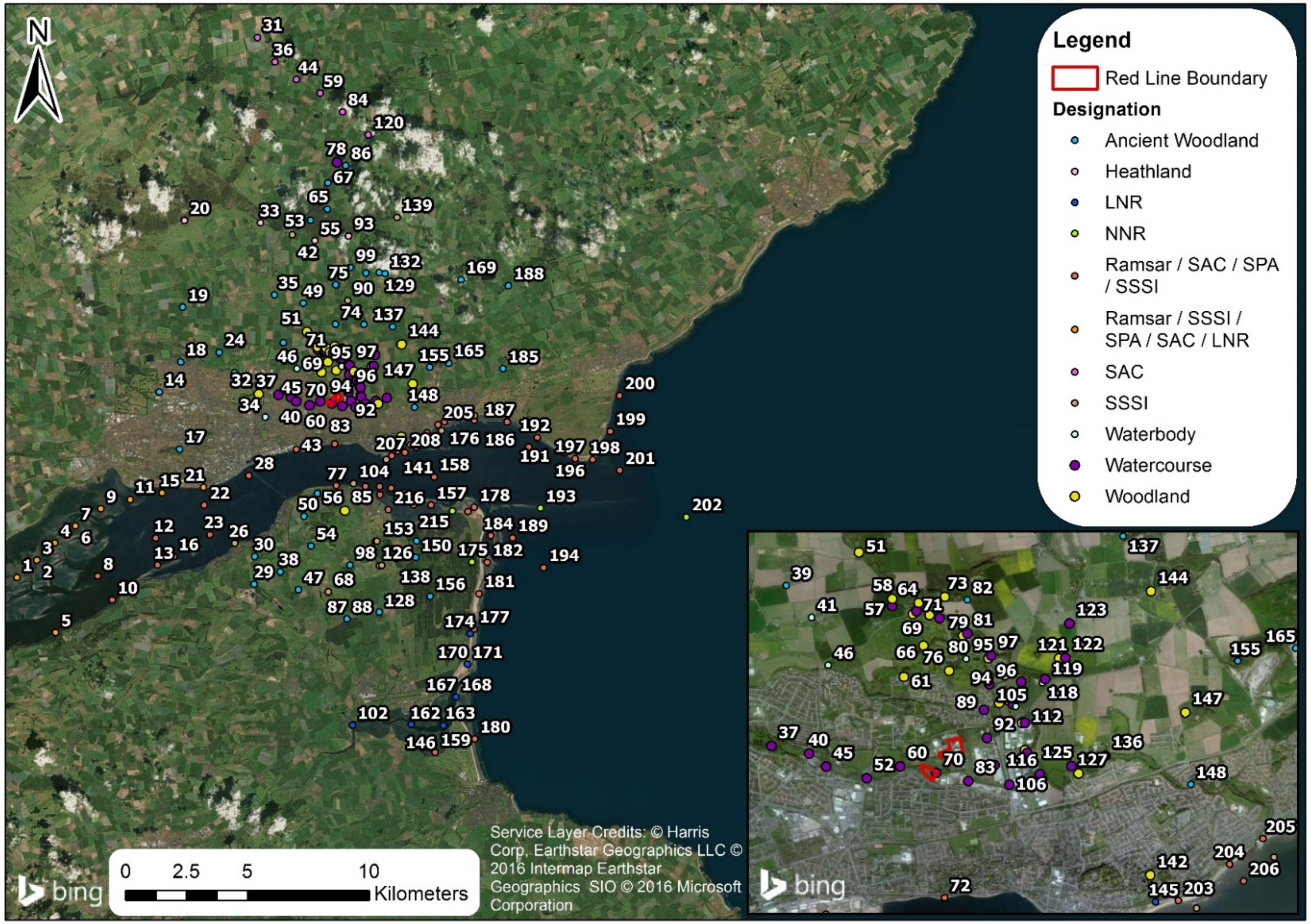


Figure 6: Ecological receptors



4.3.2 Dispersion Model and Set-up

~~For assessment of emissions from the stack of the proposed EfW CHP facility~~ For assessment of the parallel operation stack emissions, the latest ADMS 5 (version 5.2.4.0) atmospheric dispersion model has been used. ADMS has been used to predict long-term and short-term concentrations, at discrete receptors and across a gridded domain, and results have been compared with the relevant objectives.

The following sections detail the inputs and processes used in this assessment.

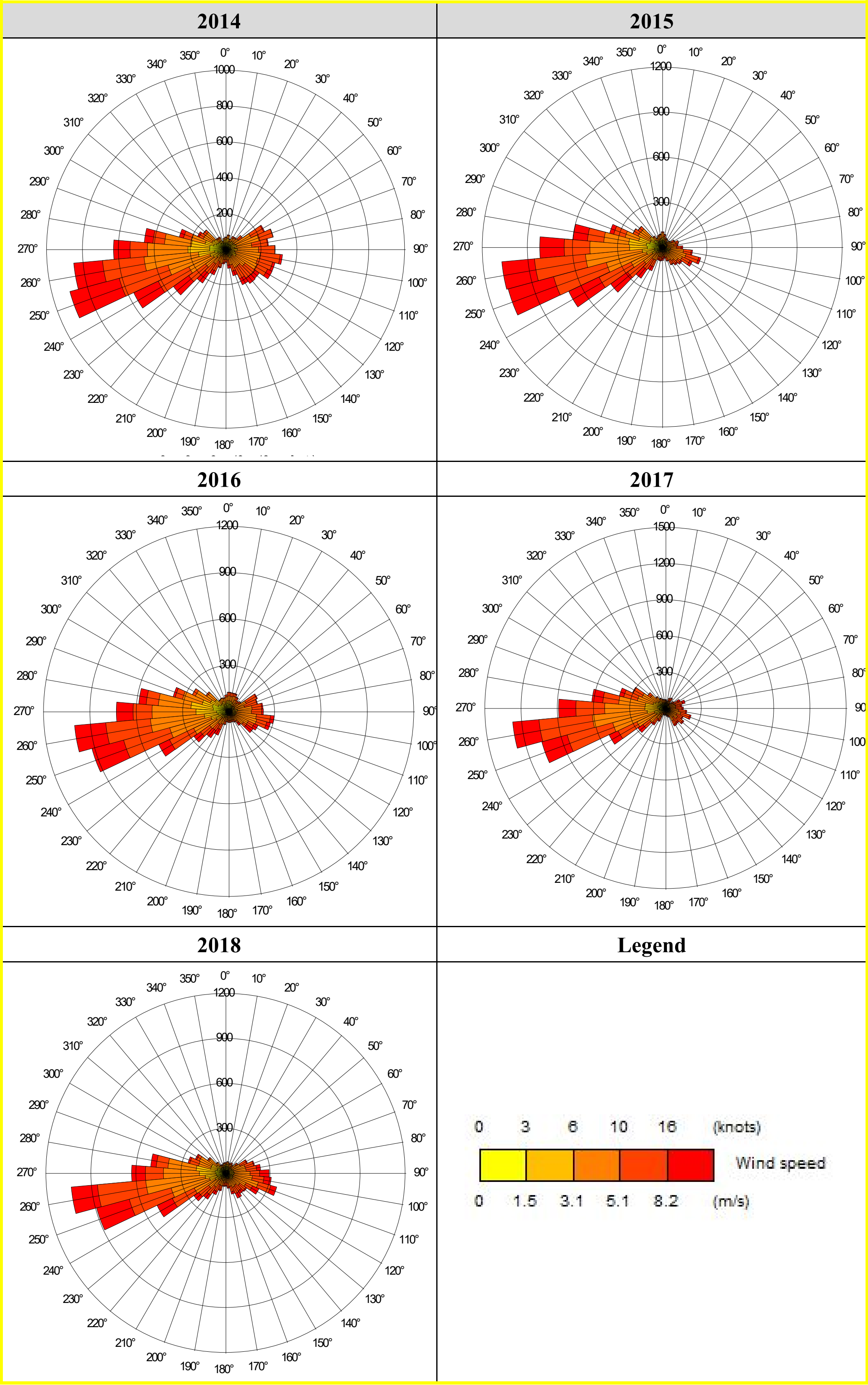
4.3.2.1 Meteorological Data

The local impacts of air pollutant releases vary widely according to the prevailing weather conditions. Meteorological data used in this assessment was measured at RAF Leuchars meteorological station over the period 1st January ~~2011~~2014 to 31st December ~~2015~~2018 (inclusive). The latest five years of data has been obtained to allow sensitivity testing and examine the variation in predicted concentrations for each year. The RAF Leuchars monitoring station lies approximately 10km to the south-east of the site and is considered to be the most appropriate site for this assessment. Hourly sequential observation data from this meteorological station has been used in the assessment. Figure 7 shows the relevant wind roses for this station in ~~2011~~2014 to ~~2015~~2018. It can be seen that the predominant wind direction is from the west/south-west.

In order for the modelling exercise to be representative of local conditions and to predict long-term averages, the dispersion model requires representative meteorological data. Most dispersion models for roads do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS has an advanced option for treating calm conditions, but the default option treats calm wind conditions by setting the minimum wind speed to 0.75m/s. LAQM.TG16 guidance recommends that the meteorological data file is tested within a dispersion model and the relevant output log file checked to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedences. The guidance recommends that meteorological data should only be used if the percentage of usable hours is greater than 75% and preferably 90%.

The datasets for ~~2011-2015~~2014-2018 all had usable hours greater than 90% (~~2011: 96%; 2012: 97%; 2013: 96%; 2014: 96%; and 2015: 97%~~2014: 98%; 2015: 99%; 2016: 99%; 2017: 99%; and 2018: 96%), and therefore the data meets the requirements of the Defra guidance and is adequate for use in dispersion modelling.

Figure 7: Wind roses for Leuchars, 2014 to 2018



4.3.2.2 Surface Roughness and Minimum Monin-Obukhov Length

The extent of mechanical turbulence (and hence, mixing) in the atmosphere is affected by the surface/ground over which the air is passing. Typical surface roughness values range from 1.5m (for cities, forests and industrial areas) to 0.0001m (for water or sandy deserts). In this assessment, the general land-use in the local study area can be described as “parkland, open suburbia” with a corresponding surface roughness of 0.5m, which has been used in the assessment.

Another model parameter is the minimum Monin-Obukhov length, which describes the minimum stability of the atmosphere which is limited due to the urban heat island effect. For this model a length of 30m has been used representing the “mixed urban/industrial” nature of the site and its surroundings.

4.3.2.3 Coastal Effects

The east coast of Scotland experiences a meteorological effect called Haar or sea fog, which can lead to decreased turbulence and mixing at ground level. Depending on the height of the boundary layer inversion in relation to the height of the stack during Haar conditions, this may lead to increased or decreased vertical mixing and dispersion of pollutant emissions from the proposed EfW CHP facility.

Meteorological monitoring data has been used from the RAF Leuchars monitoring site, which is approximately 10km to the south-east of the site and is known to experience Haar conditions. Therefore, the meteorological conditions occurring during the Haar, and coastal meteorology have been taken into account in the modelling assessment through the use of meteorological data measured at this site.

In addition, to investigate further whether coastal meteorological effects have an effect, sensitivity analysis has been undertaken using the coastline module in the ADMS model. The coastline module models the scenario when there is an onshore wind, meteorological conditions are convective, the sea temperature is cooler than the near ground air temperature and the emission is above the internal boundary layer.

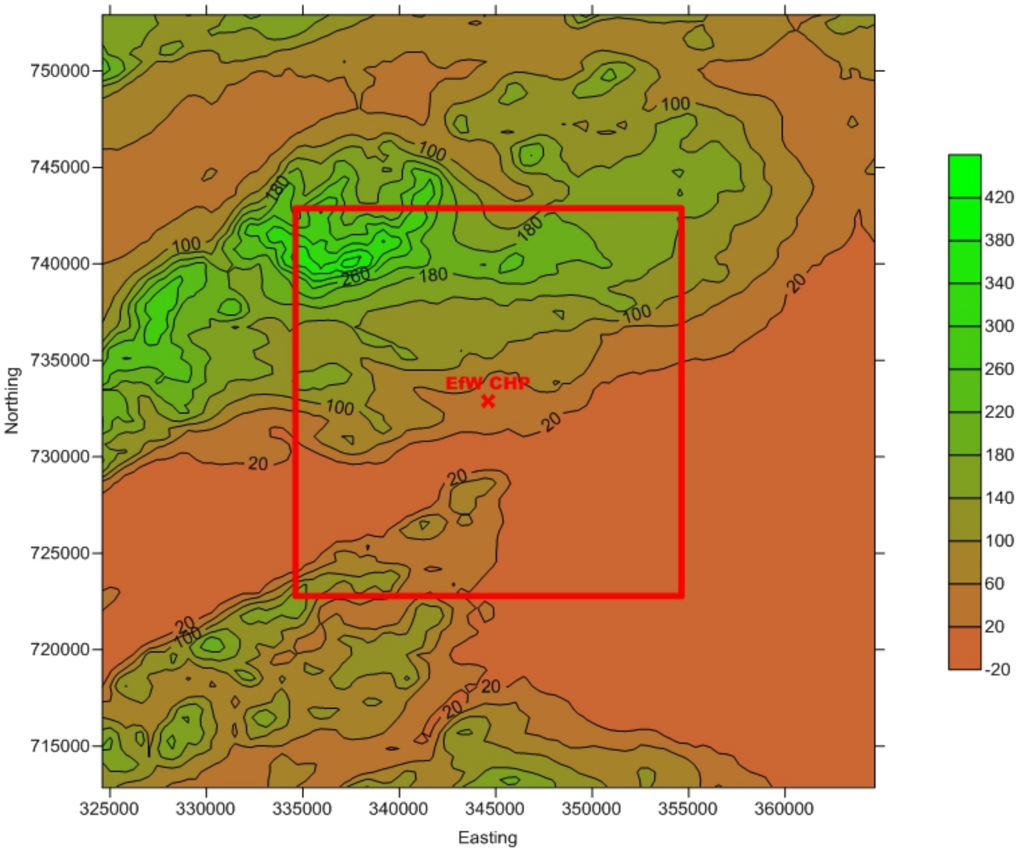
4.3.2.4 Terrain Effects

Large scale terrain effects are also captured by the RAF Leuchars meteorological data. To determine whether more local terrain has an effect, sensitivity analysis has been carried out using terrain data as an input to the ADMS model. Terrain data has been obtained from the Ordnance Survey (OS).

Terrain has been included in the modelling at two scales (small and large grid) as shown in Figure 8.

Following all the modelling sensitivity tests, results were compared, and those inputs generating realistic worst case outcomes have been taken forward. The results from these model runs are presented in section 7 of this report.

Figure 8: Terrain data used (red line indicates the small terrain grid)



4.3.2.5 Buildings

Buildings can have a significant effect on the dispersion of pollutants and have been included in the model. Building geometries on and around the site that have been used as input to the model are shown in Figure 9 and Table 7. The complex building geometry has been simplified for input to the model which only accepts rectangular or circular building shapes.

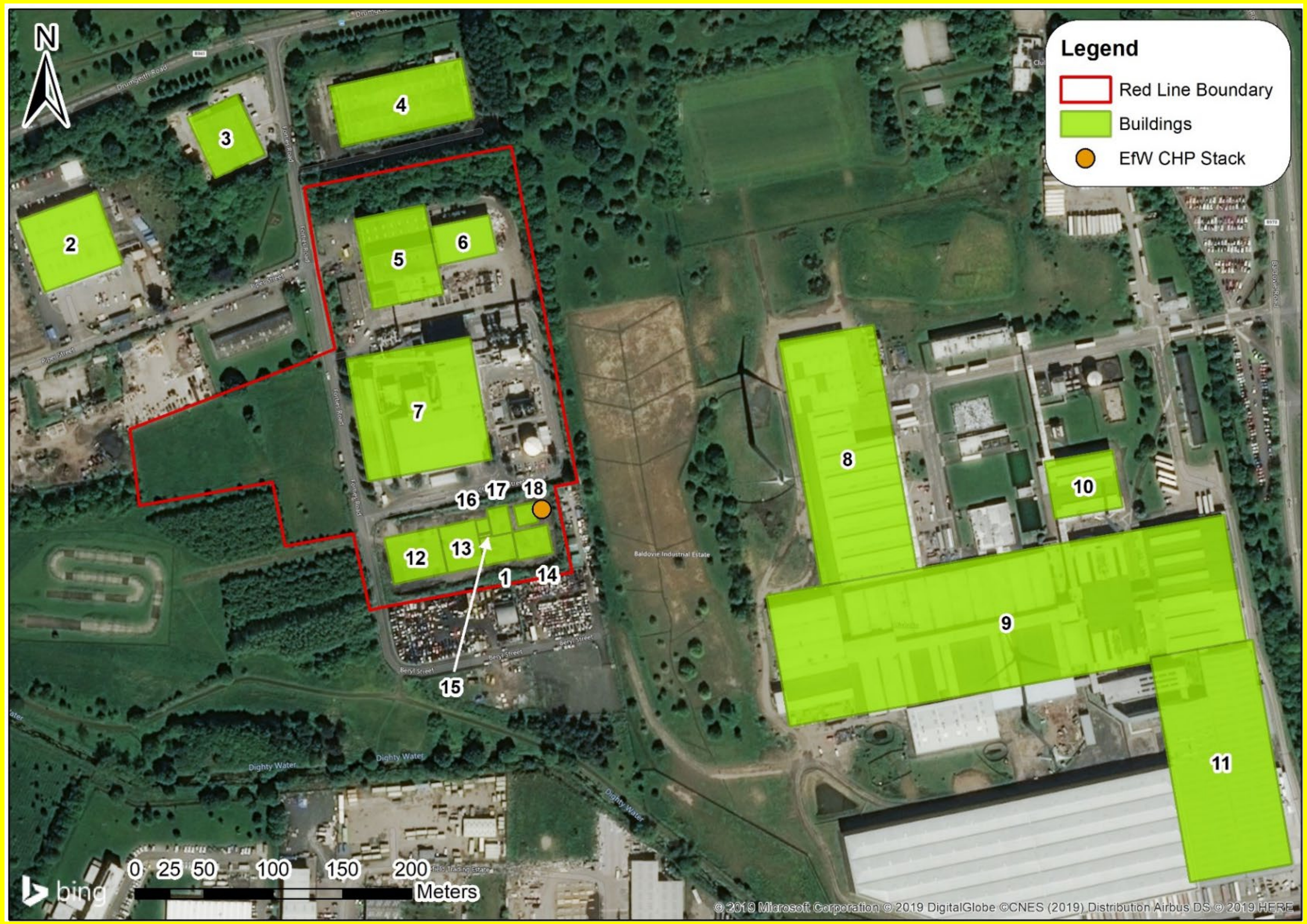
Table 7: Building geometries

ID	Building Name	NGR* (m)		Height (m)	Length (m)	Width (m)	Angle (°)
		X	Y				
1	Line 3 Boiler House	344605	732851	38.52	24.2	20.4	258
2	Aerospace Tooling	344296	733073	11.8	55	60	250
3	Rembrand Timber	344408	733150	13.1	48	40	245
4	Forties Road	344535	733174	9.5	44	98	258
5	ATS 1	344533	733062	25.9	66	52	258
6	ATS 2	344580	733074	25.0	28	44	258
7	~~DERL 3~~Existing EfW	344548	732952	28.9	90	91	260
8	Michelin 1	344858	732917	14.7	182	70	260
9	Michelin 2	344973	732799	14.7	96	336	260
10	Michelin 3	345028	732898	19.3	42	50	260
11	Michelin 4	345128	732698	15	165	75	260
12	New Tipping Hall	344545	732846	13.975	39.4	33.9	258
13	New Fuel Bunker	344579	732853	32.62	27.8	33.9	258
14	New Machine House	344630	732856	31.8	25.7	20.9	258
15	New Admin Stairs	344596	732861	35.9	9.6	2.6	258
16	New Admin Bldg	344594	732868	20.73	9.6	10.4	258
17	New Ash Bunker	344606	732872	12.8	15.1	20	258
18	Line 3 Flue Gas treatment	344625	732876	27	15	15	258

Note: *NGR = National Grid Reference

In the model a "main" building is specified for each stack. For the EfW CHP stack the "EfW CHP" was defined as the main building; for the existing EfW (formerly DERL) stack it was the "Existing EfW~~DERL3~~" building; and for the Michelin boilers it was "Michelin 3".

Figure 9: Buildings input to the model



4.3.2.6 Wind Turbines

Two wind turbines located on the Michelin site to the east of the Proposed Scheme, have been included in the model, to ensure their effects on pollutant dispersion are captured. The turbine parameters used by the model include the hub height, the wind speed at hub height and the thrust coefficient of the turbine. These are given in Table 8.

Table 8: Wind turbine model input parameters

Rated power output		**2,300kW**	
Make/model		Enercon E70	
Number of units		2	
Location		(344987, 732726) and (344790, 732926)	
Turbine rotor diameter		71m	
Hub height		85m	
Wind speed at hub height (m/s)	**Thrust Coefficient (Ct)**	**Wind speed at hub height (m/s)**	**Thrust Coefficient (Ct)**
1	0.00	14	0.34
2	0.10	15	0.28
3	0.27	16	0.23
4	0.36	17	0.19
5	0.42	18	0.16
6	0.46	19	0.14
7	0.48	20	0.12
8	0.50	21	0.10
9	0.50	22	0.09
10	0.50	23	0.08
11	0.49	24	0.07
12	0.45	25	0.06
13	0.39		

4.3.2.7 Stack Parameters and Emissions

The emission parameters for the EfW CHP facility have been based on achieving compliance with the IED (2010/75 /EU). The legislation contains the ELVs applicable to the EfW CHP facility as set out in Table 4.

The modelling of the EfW CHP facility has used ELVs, the maximum emissions permitted, to ensure that a worst-case modelling scenario is considered. There will be times when the plant is non-operational in the year. However, since the times when this occurs cannot always be predicted, it is assumed that the plant operates all hours of the year as a worst case assumption.

Emissions from the existing EfW ~~DERL~~ facility and the Michelin boilers are based on monitored data reports. Table 9, Table 10 and Table 11 give the stack and efflux data used.

Table 9: Existing ~~DERL~~ EfW facility and EfW CHP facility (burning waste) stack parameters

Parameter	**Unit**	**EfW ~~DERL~~ (per flue)**	**EfW CHP**
Stack location	NGR (m)	344625E, 732996N	344637E, 732880N
Stack diameter	m	1.15	1.60
Flue gas efflux velocity	m/s	19.6	14.4
Efflux temperature	˚C	142	130
Stack height (from ground)	m	70	90
Oxygen content	% (dry)	10.9	7.0
Water content	% (volume)	13.7	16.0
NOx (as NO_2)	g/s	2.38	4.39
CO	g/s	0.0542	1.01
VOCs	g/s	0.0328	0.22
PM_{10} (assumed same as TSP)	g/s	0.0186	0.22
$PM_{2.5}$ (assumed same as TSP)	g/s	0.0186	0.22
HCl	g/s	0.212	0.22
HF	g/s	0.000133	0.022
SO_2	g/s	0.291	1.10
Cd + Tl	g/s	0.000178[(a)]	0.0011[(c)]
Hg	g/s	0.000059	0.001
NH_3	g/s	0.00935	0.11
PAH (benzo(a)pyrene, BaP)	g/s	0.000158	0.000304[(b)]
Group III Metals Total	**g/s**	**0.001467**	**0.011[(d)]**
- Antimony	g/s	0.000096	0.00025
- Arsenic	g/s	0.000090	0.00055
- Chromium (total)	g/s	0.000175	0.00202
- Chromium (VI)	g/s	0.0000010	0.0000012
- Cobalt	g/s	0.000028	0.00012
- Copper	g/s	0.000199	0.00064
- Lead	g/s	0.000127	0.00111
- Manganese	g/s	0.000585	0.00132
- Nickel	g/s	0.000124	0.00483
- Vanadium	g/s	0.000043	0.00013
Dioxins and furans	g/s (I-TEQ)	7.04×10^{-10}	2.20×10^{-9}
Dioxin-like PCBs	g/s (non TEQ	9.99×10^{-9}	1.98×10^{-8}[(b)]
Dioxin-like PCBs	g/s (WHO TEQ)	1.61×10^{-10}	3.27×10^{-10} [(b)]

(a) Cd was 67% and Tl 33% of the total measured value of 0.000178g/s - it has been assumed that each metal was emitted at the combined total (worst case assumption)
(b) Estimated from the monitored emissions at DERL as IED does not have emissions of these compounds
(c) It is assumed that Cd and Tl are each emitted at the IED ELV (worst case assumption)
(d) Group III metals were first assumed to be emitted at the IED ELV (0.012g/s), following guidance each metal was then multiplied by the percentages to give the following emission rates (based on mean of 18 Municpal Waste Incinerators emitting Group III metals at a total of 12.6% of the IED. The total of Group III metals for the EfW is identical to the per flue emissions rate from DERL but this is purely coincidental. The emissions of each metal are different.

Table 10: EfW CHP facility (diesel – hot commissioning) stack parameters

Parameter	Unit	EfW CHP diesel firing
Stack location	NGR (m)	344637E, 732880N
Stack diameter	m	1.60
Flue gas efflux velocity	m/s	8.7
Efflux temperature	˚C	120
Stack height (from ground)	m	90
Oxygen content	% (dry)	16.5
Water content	%	6.3
NOx (as NO_2)	g/s	0.345[(a)]
PM (as PM_{10})	g/s	0.493[(a)]
CO	g/s	0.247[(a)]
SO_2	g/s	0.011[(b)]

(a) Assuming exit volume is 60% of the exit volume when the EfW is burning waste, based on emission concentrations of NOx (as NO_2)=70mg/m^3, PM_{10}=10mg/m^3, CO=50mg/m^3 (all volumes at standard reference conditions of 273K, 11(dry)% O_2, 0% $H_2$0, 101.3kPa)
(b) Assuming 2t/hr 0.001% S diesel

Table 11: Michelin stack parameters

Parameter	Unit	80% Load (per flue)	20% Load (per flue)
Stack location	NGR (m)	345044E, 732876N	345044E, 732876N
Stack diameter	m	0.96	0.96
Flue gas efflux velocity	m/s	13.5	3.38
Efflux temperature	˚C	185	185
Stack height (from ground)	m	53.8	53.8
Oxygen content	% (dry)	8.16	8.16
Water content	%	16.1	16.1
NOx (as NO_2)	g/s	0.342[(a)]	0.0684[(a)]

(a) Assuming emission concentration is 100mg/m^3 (at standard reference conditions)

4.3.2.8 Trace metals

Trace metals data from emissions monitoring at the existing EfW facility have been used specifically for the modelling of the EfW facility. Emissions of trace metals from the new EfW CHP facility however, have been assumed to follow the theoretical approach as outlined in the EA guidance on releases from municipal waste incinerators, 2012 [45].

The total emissions of the nine Group III metals (Pb, As, Ni, Sb, Cr, Co, Cu, Mn and V), combined with the percentage of each metal in the emission, have been used to predict the process results for trace metals. It is considered that this EA guidance offers the most robust assessment of trace metal emissions. Step 1 of the

[45] Environment Agency (2012) Releases from waste incinerators: Guidance on assessing group III metal stack emissions from incinerators (Version 4, June 2016)

guidance proposes that each Group III metal is emitted at the IED emission limit value (therefore assumed that the other 8 metals not emitted at all). This represents an unrealistic but theoretical worst case for each of the metals. The guidance then proposes that if any of the predicted environmental concentrations (PECs) exceed the Environmental Assessment Level (EAL) the assessment should proceed to Step 2. Step 2 assumes emissions of Group III metals are at the mean values found from an analysis of 18 municipal waste incinerators. These percentages (of the IED emission rate for Group III metals) are specified in the guidance and are as follows: Pb (2.2%), As (0.2%), Ni (3.0%), Sb (0.3%), Cr (1.7%), Co (0.2%), Cu (1.5%), Mn (3.4%) and V (0.1%). The percentage of CrVI, a form ~~an isotope~~ of Cr, is specified in the guidance as 0.01%. The nine Group III metal percentages total 12.6% indicating that the mean emissions of Group III metals is 12.6% of the IED ELV, and this is what has been assumed in the modelling and assessment of air quality (and is consistent with the method used in the HHRA).

For the Group I metals, the guidance does not specify as percentage composition and so the Group I emissions have been assumed to be 100% Cd and 100% Tl (as per Step 1 of the Guidance). Neither of the PECs exceed the EALs for these two metals so the assessment has not proceeded to Step 2. For the HHRA a Step 2-type approach (more realistic emissions) has been included and this is explained further in Appendix G).

4.3.2.9 Short Term Background Concentrations

For many pollutants there are short-term air quality limits and EALs, such as the 15-minute mean limit for SO_2 and the 24-hour mean limit for PM_{10}. There are no short-term limits for $PM_{2.5}$. The limits are given as a permitted annual number of exceedences of a threshold concentration which can be expressed as an equivalent percentile. For instance the SO_2 15-minute mean limit can be expressed as the 99.9th percentile of the predicted environmental concentration, that is, the sum of the contribution from the process and the background concentration.

99.9th percentile 15-minute mean SO_2 concentrations due to the process (EfW CHP or DERL) were obtained as a direct output from the ADMS model. The modelled concentrations of substances emitted from the plant are combined with background concentrations of the substances present in the environment for comparison with air quality standards. In the case of long-term mean concentrations, the long-term mean concentration contributions from the proposed EfW CHP facility could be added directly to long-term mean background concentrations. It is not possible to add short-term peak background concentrations and process concentrations in the same way. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different from the conditions which give rise to peak concentrations due to emissions from other sources.

This point is addressed in SEPA's H1 guidance[28] which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum short term concentration due to emissions from the source to twice the annual mean background concentration.

The same method has been applied for short-term PM_{10} concentrations and for all other pollutants with short-term limits/EALs.

4.3.2.10 NOx to NO_2 Conversion for Stack Emissions

The air quality model predicts concentrations of nitrogen oxides which is a mixture of NO_2 and nitric oxide (NO). Both gases react in the atmosphere, particularly with ozone. In general, the nitrogen oxides are mainly emitted as nitric oxide and this converts to NO_2 in the atmosphere. The air quality standard has been set for NO_2 and therefore it is important that an appropriate conversion rate is used to calculate NO_2 from the modelled NO_X.

For stack emissions the EA advice on conversion rates has been used, which suggests 35% NO_2 for short-term (i.e. hourly average) and 70% NO_2 for long-term (i.e. annual mean) concentrations. In practice, these ratios represent conditions some distance away from a release source. Close to an industrial source, the proportion of NO_2 in nitrogen oxides is typically much lower than this[46]. Applying these ratios therefore provides a worst case assessment.

4.3.3 Plume Visibility

Water in the emitted gases can condense and form a visible plume. There are no formal or informal standards for visible plume lengths although visible plumes that reach ground level should be avoided. It can be expected that SEPA would seek to reduce the frequency of visible plumes but as this can be at the expense of increased energy usage, a balance has to be made between visible plume length and energy use.

Plume visibility from the stack depends on ambient meteorological conditions, flue gas humidity and the efflux temperature of the stack. A visible plume is formed when the temperature of the ambient air mixed with the flue gas, is lower than the saturation temperature of the water vapour emitted with flue gas. The EfW CHP facility is likely to generate a visible plume for some periods of the year, and this has been modelled and quantified using the ADMS 5 dispersion model.
As noted, there are no standards for visible plume lengths; for this study, the frequency of visible plume lengths up to 3,000m has been examined.

4.3.4 Sensitivity Analysis of Modelling Methods

In order to define the method used to undertake the assessment a number of sensitivity analyses were undertaken to determine which modelling options should or should not be included. Emissions from the proposed EfW CHP were used and the effect of changing elements of the modelling methodology were examined. Each is discussed in detail and the results are presented in the following sections;

[46] Environment Agency (2014). Conversion Ratios for Nox and NO_2

- selection of met station (3 stations examined);
- selection of met year from Leuchars met station (5 years examined);
- consideration of coastal effects;
- comparison of ADMS and AERMOD dispersion models;
- consideration of terrain; and
- consideration of the effect of the buildings and the two neighbouring wind turbines on dispersion (note that the buildings present are relatively short compared to the stack height and therefore this sensitivity predominantly tested the effect of the wind turbines).

The impact on ground level concentrations for a range of pollutants and averaging periods was examined using the maximum predicted on the small grid of receptors (see Figure 5) which gave higher concentrations than at discrete sensitive receptor locations.

A summary of the sensitivity tests is included in Table 12.

Table 12: Summary of sensitivity analyses

	Main Assessment	Sensitivity Study					
		Met station	Met year	Coastal Effects	Model Choice	Terrain	Turbines
Leuchars 2011	û	û	ü	û	û	û	û
Leuchars 2012	û	û	ü	û	û	û	û
Leuchars 2013	û	û	ü	û	û	û	û
Leuchars 2014	û	û	ü	û	û	û	û
Leuchars 2015	ü	ü	ü	ü	ü	ü	ü
Broughty Ferry	û	ü	û	û	û	û	û
Mains Loan	û	ü	û	û	û	û	û
Coastal effects	û	û	û	ü/û	û	û	û
ADMS	ü	ü	ü	ü	ü	ü	ü
AERMOD	û	û	û	û	ü	ü	û
Terrain	ü	ü	ü	ü	û	ü/û	ü
Turbines	ü	ü	ü	û	û	û	ü/û
Buildings	ü	ü	ü	û	û	ü	û

4.3.4.1 Selection of Met Station

ADMS and AERMOD requires certain met data parameters as input; these include wind speed and direction but also cloud cover and temperature data. Wind speed and direction data were available from Broughty Ferry and Mains Loan for 2015; these data were combined with other required parameters from the Leuchars met station. Wind roses from Broughty Ferry and Mains Loan for 2015 are shown in Figure 10 and Figure 11 respectively.

Figure 10: Wind rose from Broughty Ferry meteorological station

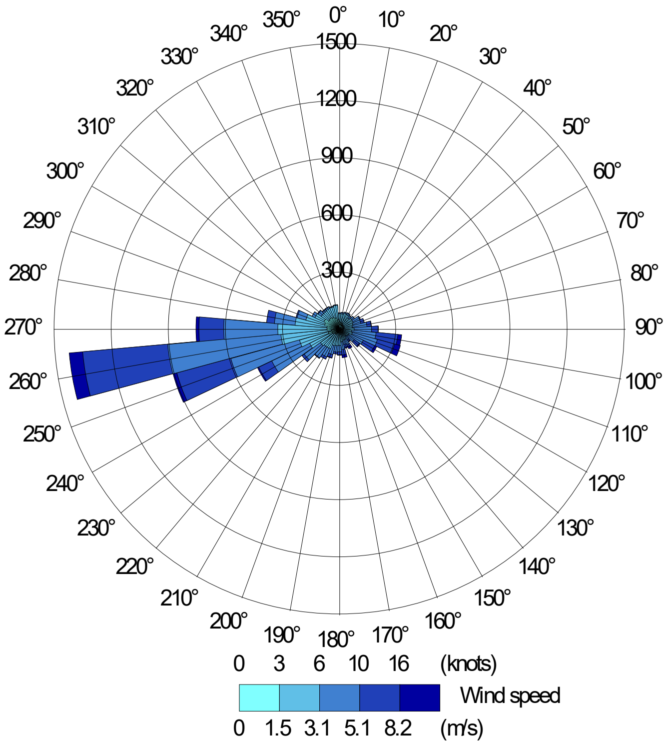
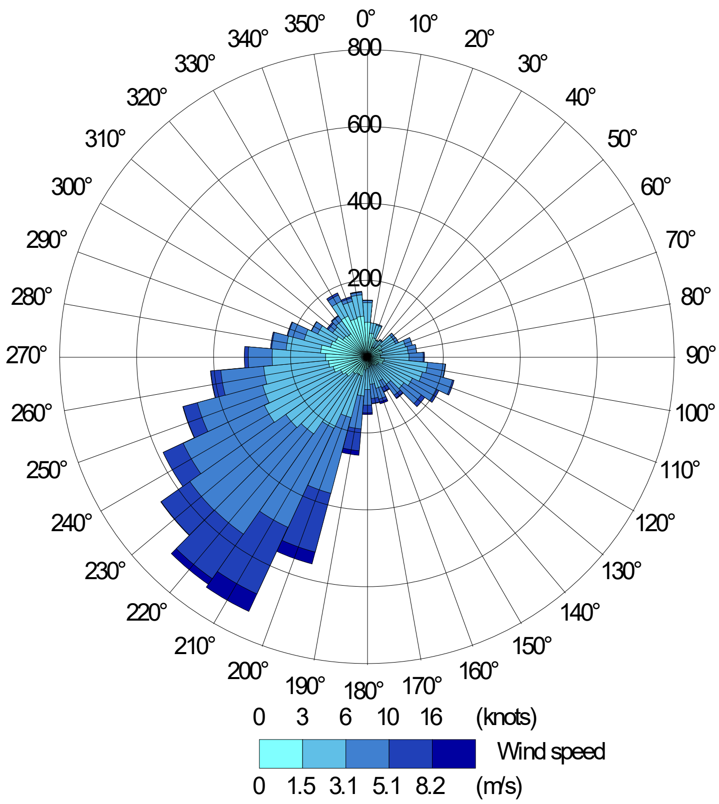


Figure 11: Wind rose from Mains Loan meteorological station



Annual mean ground level concentrations of NO_2 and PM_{10} were predicted for each of the three met stations (2015) including terrain and building effects. The maximum concentrations (from the small output grid) are presented in the table below. Bold underline indicates the maximum value in the series.

Table 13: Sensitivity of ambient concentrations to choice of met station

Met station	Maximum annual mean concentration (µg/m³)	
	NO_2	PM_{10}
Leuchars 2015	**<u>0.94</u>**	**<u>0.067</u>**
Broughty Ferry 2015	0.82	0.058
Mains Loan 2015	0.65	0.046

Table 13 shows that the selection of Leuchars 2015 met data gives rise to the maximum concentrations; the alternative met stations result in concentrations around 70-85% of those using Leuchars 2015 met data.

4.3.4.2 Selection of Met Year

The effect of using each of the five years (2014-2018) of met data from Leuchars met station on the ground level concentrations was examined for the primary averaging periods / statistic combinations included in the study, to cover the pollutants of interest. These averaging periods were namely:

- Annual mean (covering most pollutants including: NO_2, PM_{10}, $PM_{2.5}$, VOCs, NH_3, HF, HCL and all heavy metals);
- 24 hour 98.08th percentile (for PM_{10});
- 1 hour 99.79th percentile (for NO_2); and
- 15 minute 99.90th percentile (for SO_2).

It is not necessary to carry out the sensitivity for each pollutant as the sensitivity to met year will be the same for each averaging time/statistic combination. The maximum concentration (from the small output grid) are presented in Table 14 (bold underline indicates the maximum value in the series).

It should be noted that the sensitivity testing was undertaken using an arbitray pollutant emission rate of 1 g/s rather than actual measured / designed emission limits from the facility. The concentrations presented in Table 14 are therefore for comparative purposes only and do not reflect what the predicted ground level concentrations from the facility during parallel operations may be. They are provided to illustrate the potential variation in eventual results using different meteorological datasets.

Based on the 2015 meteorological year resulting in the greatest predicted concentrations for the annual mean averaging period, together with annual mean criteria affecting the greatest number of pollutants, the 2015 dataset was chosen for use in the modelling. Some of the results do show higher concentrations in years other than 2015, however the differences are considered to be small and so 2015 was selected for the assessment of parallel operations.

Table 14: Sensitivity of ambient concentrations to choice of met year

Maximum concentration (µg/m³)	**2014**	**2015**	**2016**	**2017**	**2018**	**Variation of 2015 from Max Value**
Annual Mean	0.68	**0.86**	0.68	0.84	0.70	-
24 hour 98.08th percentile (PM_{10})	**3.31**	3.20	2.89	2.92	2.98	3.5%
1 hour 99.79th Percentile (NO_2)	5.81	5.94	5.83	**6.14**	5.87	3.2%
15 min 99.90th percentile (SO_2)	6.47	6.50	6.44	**6.83**	6.58	4.9%

4.3.4.3 Coastal Effects

The ADMS coastal effects module has been used to examine the effect on maximum annual mean NO_2 and PM_{10} concentrations (see section 4.3.2.3 for more description of this aspect of modelling). The ADMS model requires that the coastline is a straight line and uses this to determine when the winds (using the hourly met data) are onshore. The configuration of the coastline input to ADMS is shown in Figure 12.

Figure 12: Representation of the coastline input to ADMS

The maximum concentrations (from the small output grid) are presented in Table 15 (bold underline indicates the maximum value in the series) using 2015 Leuchars met data.

Table 15: Sensitivity of ambient concentrations to using the ADMS coastal module

Max (µg/m^3)	Without coastal module in ADMS	With coastal module in ADMS
Annual Mean NO_2	0.46	0.46
Annual Mean PM_{10}	0.033	0.033

The results show that inclusion of the coastal module in ADMS makes negligible difference to the results. This was the expected result as use of the coastline module only makes a difference to results for a small number of hours, and the impact is short-range i.e. within about 1km of the coastline. Hence, the coastal module has not been included in the main assessment.

4.3.4.4 Model Choice (ADMS/AERMOD)

The ADMS 5 model has been used for the assessment, as the model was developed for the UK and is considered appropriate for this application. ADMS 5 includes the capability to run the main model options of AERMOD[47, 48], which is a similar model developed in the US.

[47] CERC (2016) ADMS 5 Atmospheric Dispersion Modelling System User Guide
[48] US EPA Preferred/Recommended Models https://www3.epa.gov/scram001/dispersion_prefrec.htm

A sensitivity analysis has been undertaken using the AERMOD model. ADMS meteorological data has been used for both model runs, and the met processor in ADMS has been used to convert the met data for use in the AERMOD model run. Modelling results from each model were compared and the realistic worst case assumptions taken forward to full assessment.

The maximum concentration (from the small output grid) are presented in Table 16 (bold underline indicates the maximum value in the series) using 2015 Leuchars met data, with terrain and buildings. Results are also presented for AERMOD with and without terrain to determine whether the AERMOD model is sensitive to terrain.

Table 16: Sensitivity of ambient concentrations to choice of dispersion model

Maximum concentration (µg/m^3)	ADMS with terrain	AERMOD with terrain	AERMOD without terrain
Annual mean NO_2	**0.94**	0.36	0.36
Annual mean PM_{10}	**0.067**	0.026	0.026

The results show that ADMS gives a higher annual mean maximum concentration by a factor of approximately 3 and that terrain makes no difference to the results using AERMOD. Hence, ADMS has been used in the main assessment.

4.3.4.5 Terrain

The effect on annual mean NO_2 and PM_{10} concentrations of including terrain in the ADMS model using 2011-2015 Leuchars met data was investigated. Terrain was found to increase concentrations and so terrain has been included in the main assessment. See section 4.3.2.3 for further details of the terrain modelled.

The maximum concentration (from the grid, concentrations at sensitive receptors were lower than those on the grid) are presented in Table 17 (bold underline indicates the maximum value in the series) using 2015 Leuchars met data, with buildings.

Table 17: Sensitivity of ambient concentrations to inclusion of terrain

Maximum concentration ($\mu g/m^3$)	ADMS with terrain	ADMS without terrain
Annual mean NO_2	**0.94**	0.85
Annual mean PM_{10}	**0.067**	0.061

The results show terrain increases annual mean concentrations by around 10% and so terrain has been included in the main assessment.

4.3.4.6 Effect of turbines and buildings

ADMS has the ability to include the effect of wind turbines and buildings on dispersion. The effect on annual mean NO_2 and PM_{10} concentrations of including buildings and the two turbines on the Michelin site using ADMS model, Leuchars 2015 met data was investigated including the effect of terrain. See section 4.3.2.6 for further description of the buildings and wind turbine data used as input to the model.

Table 18: Sensitivity of ambient concentrations to the inclusion of the wind turbine effects on dispersion

Maximum concentration ($\mu g/m^3$)	ADMS with turbines/buildings	ADMS without turbines/ buildings
Annual mean NO_2	**0.94**	0.46
Annual mean PM_{10}	**0.067**	0.033

The results show that inclusion of the buildings and wind turbines increases annual mean concentrations by around 50% and so buildings and wind turbines have been included in the main assessment.

4.3.5 Nutrient Nitrogen Deposition and Acid Deposition

With regard to nitrogen and acid deposition, site and habitat specific critical loads and existing deposition rates have been taken from the Air Pollution Information System (APIS) website[16]. Predicted deposition at ecological receptors has been compared against the lowest critical loads to provide a worst case assessment.

The assessment has looked at the Critical Load Functions (CLFs) for acidity using the graphs on the APIS website. The CLF graphs for the most sensitive species in each designated area have been used to estimate the worst case impact.

The information on the critical loads and the most sensitive habitat for each designated for vegetation of nutrient nitrogen and acidity (nitrogen and sulphur) are given in ~~Appendix E~~ Appendix C.

Acid deposition is assessed in terms of the Critical Load Functions (CLFs) for acidity, which are a function of nitrogen (N) and sulphur (S) deposition. The critical load functions are site- and feature/habitat-specific. Total nitrogen (N) deposition has been derived from the addition of ammonia and nitrogen dioxide deposition results. While HCl and HF give rise to acid deposition they are not assessed as part of the CLFs.

The CLFs comprise two lines on a graph, which represent two envelopes of safety (reflecting the present uncertainty in the scientific knowledge and evidence-base on the effects of acidic air pollution on sensitive species). If the total acid deposition rate falls above the higher ‘maximum CL’ graph, it is likely that there are harmful effects on the relevant habitat/features arising from the current level of acid (due to both nitrogen and sulphur) deposition. If the total acid deposition level is below the lower ‘minimum CL’ graph, it is unlikely that the feature/habitat is being harmed. If the current total acid (due to both nitrogen and sulphur) deposition level lies between the lower and upper CLFs, it is not possible to be certain that harm is occurring.

The dry deposition flux for each receptor location has been calculated based on recommended deposition velocities as shown in Table 19.

Table 19: Recommended dry deposition velocities

Chemical species	Recommended deposition velocity, m/s	
NO_2	Grassland	0.0015
	Forest	0.003
SO_2	Grassland	0.012
	Forest	0.024
NH_3	Grassland	0.020
	Forest	0.030
HCl	Grassland	0.025
	Forest	0.060

Conversion factors are used to convert dry deposition flux from units of µg/m^3 /m^2/s to kg/ha/yr are shown in Table 20.

Table 20: Conversion factors ~~to change units~~ from µg/m^2/s of chemical species X to kg of X/ha/yr

Chemical species	Conversion factor µg m^2/s of species X to kg/ha/year	
NO_2	of N:	96
SO_2	of S:	157.7
NH_3	of N:	259.7
HCl	of HCl:	306.7

The unit of ‘equivalents’ is also used for acidification purposes, rather than a unit of mass. Essentially it means ‘moles of charge’ i.e. it is a measure of how acidifying the chemical species can be. It is denoted by ‘keq’.

To convert kg/ha/yr to keq/ha/yr multiply the deposition flux by the conversion factors shown in Table 21.

Table 21: Conversion factors ~~to alter units~~ from kg of N or S ha/yr to keq of N or S ha/ya

Species	Conversion factor kg/ha/year to keq/ha/year
N	0.071428
S	0.0625

For hydrogen chloride (HCl) both wet and dry deposition has been considered, and results are a sum of both deposition methods. A constant value of 0.00007 has been used for the wet deposition coefficient[49].

4.3.6 Assessment of Impacts and Significance of Effect

4.3.6.1 Human Health

The assessment of air quality impacts and the overall significance of effect for human health receptors has been determined following the methodology set out in the EPUK/IAQM land-use planning guidance. The full methodology and criteria is presented in section 4.2.5.

For permitting purposes however, SEPA's H1 guidance recommends that if the predicted contribution of the installation under investigation termed Predicted Contribution (PC) exceeds 1 per cent of the Environmental Assessment Level (EAL), then the contribution of the installation in conjunction with the prevailing background airborne concentration, termed Predicted Environmental Concentration (PEC) must be assessed against the EAL. If the total PEC is less than 70 per cent of the EAL, the installation is not likely to have a significant effect on human health.

4.3.6.2 Ecology

SEPA's H1 guidance has been followed for the assessment of ecological receptors. Similarly to above, if the PC exceeds 1 per cent of the Critical Level, then the contribution of the installation in conjunction with the prevailing background airborne concentration (PEC) must be assessed against the Critical Level. If the total PEC is less than 70 per cent of the Critical Level, the installation is not likely to have a significant effect on the sensitive ecosystem.

The critical levels are concentrations below which harmful effects are unlikely to occur. The critical level for NOx applies to locations more than 20km from towns with more than 250,000 inhabitants or more than 5km from other built-up areas, industrial installations or motorways. However, SEPA's H1 guidance states that "*the critical levels should be applied at all locations as a matter of policy, as they represent a standard against which to judge ecological harm*".

For ecological sites the H1 test set out above has been used. The overall significance of effect at ecological receptors has been concluded with input from the ecologists for the Proposed Scheme.

[49] AWN Consulting (2012). Technical note: request for additional information. Available at: http://www.epa.ie/licences/lic_eDMS/090151b28046a5c7.pdf

4.4 Methodology for Odour Assessment

The SEPA and Natural Scotland 2010 Odour Guidance[31] provides indicative criteria for significant odour pollution. The guidance proposes a range of criteria that depend on the relative offensiveness of the odour and are based on the annual 98th percentile of hourly mean odour concentrations. The 98th percentile of hourly means is determined by calculating the odour concentration for every hour of the year at a point, sorting these concentrations into ascending order and then taking the value where 98% of the hourly means have lower predicted concentrations (and therefore 2% of the hourly mean have higher concentrations than the 98th percentile).

For the more unpleasant odours such as processes involving decaying animal remains a criterion of 1.5 ou_E/m^3 as a 98th percentile of annual hourly mean concentrations is used. Moderately offensive odours (e.g. fat frying) have a criterion of 3 ou_E/m^3. Less unpleasant odours, for example from baking, have a less stringent standard of 6 ou_E/m^3.

The guidance also sets locally adjusted criteria to be used for 'hypersensitive populations' or where such odour is likely to generate a high level of complaints, for example, a more stringent criterion of 1.0 OU_E/m^3 is specified for the most offensive odours, where applicable, rather than 1.5 OU_E/m^3.

These criteria are only used where numerical odour modelling is carried out but they do highlight some general principles that are important in assessing the potential for nuisance:

- A certain level of odour is considered to be tolerable if it is below a certain intensity and frequency;
- Nuisance or annoyance is more likely when the odours are unpleasant (i.e. offensive); and
- Nuisance or annoyance can occur even with odours considered to be pleasant.

4.4.1 IAQM Guidance

The Institute of Air Quality Management (IAQM) produced guidance[32] which recommends various assessment techniques including the use of a Source-Pathway-Receptor model. The risk of an adverse odour impact is determined by examining the source characteristics, how effectively the odours can travel from the Source to a receptor (i.e. the Pathway) and examining the sensitivity of the Receptor. Example risk factors presented in the guidance are shown in Table 22.

Table 22: IAQM Source-Pathway-Receptor approach

Source Odour Potential	Pathway Effectiveness	Receptor
Factors affecting the source odour potential include: • The magnitude of the odour release	Factors affecting the odour flux to the receptor are: • Distance from source to receptor	Use professional judgement based on the expectation of the users at the receptor location (Table 23 below).

• How inherently odorous the compounds are • The unpleasantness of the odour	• The frequency of winds from source to receptor • The effectiveness of any mitigation in reducing flux to the receptor • The effectiveness of dispersion/dilution in reducing the odour flux to the receptor • Topography and terrain	

The following table has been reproduced from the IAQM Odour Guidance and relates to the sensitivity of people to odour. Professional judgement is required to identify between the spectrums of high and low receptor sensitivity, taking into account the general principles listed in Table 23.

Table 23: IAQM receptor sensitivity to odours

Receptor Sensitivity	Details
High sensitivity receptor	Surrounding land where: • users can reasonably expect enjoyment of a high level of amenity; and • people would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Examples may include residential dwellings, hospitals, schools/education, tourist/cultural and food retail/processing.
Medium sensitivity receptor	Surrounding land where: • users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or • people wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Examples may include places of work, commercial/retail premises and playing/recreation fields.
Low sensitivity receptor	Surrounding land where: • the enjoyment of amenity would not reasonably be expected; or • there is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Examples may include industrial use, farms, footpaths and roads.

4.4.2 Odour Impacts

The guidance recommends that the impact on the environment (and sensitive receptors) of any odour emission is estimated, and that an assessment ascertains whether emissions produce an unacceptable impact. To do this, the following are considered:

- Identity of the odour;

- The rate of emission of the odour;
- A characterisation of the odour source;
- The proximity and location of the source to sensitive receptors; and
- Local topography and meteorological conditions.

The magnitude of odour impact depends on a number of factors and the potential for complaints varies due to the subjective nature of odour perception. The IAQM Odour Guidance includes information on the **FIDOL** acronym which is a useful reminder of the factors that will determine the degree of odour pollution (note this is the same FIDOL acronym used in the SEPA Odour Guidance, 2010):

- **F**requency of detection - frequent odour incidents are more likely to result in complaints;
- **I**ntensity as perceived - intense odour incidents are more likely to result in complaints;
- **D**uration of exposure - prolonged exposure is more likely to result in complaints;
- **O**ffensiveness - more offensive odours have a higher risk of resulting in complaints; and,
- **L**ocation sensitivity - sensitive areas are more likely to have a lower odour tolerance.

The FIDOL acronym has been used to determine the likelihood of odour being generated by the Proposed Scheme. It is important to note that even infrequent emissions may cause loss of amenity if odours are perceived to be particularly intense or offensive.

Quantitative odour modelling has also been undertaken to assess the potential impact from the parallel operations at discrete human receptor locations.

~~It is important to note that even infrequent emissions may cause loss of amenity if odours are perceived to be particularly intense or offensive. The FIDOL factors can be further considered to provide the following issues in regards to the potential for an odour emission to cause a nuisance:~~

- ~~The rate of emission of the compound(s);~~
- ~~The duration and frequency of emissions;~~
- ~~The time of the day that this emission occurs;~~
- ~~The prevailing meteorology;~~
- ~~The sensitivity of receptors to the emission i.e. whether the odorous compound is more likely to cause nuisance, such as the sick or elderly, who may be more sensitive;~~
- ~~The odour detection capacity of individuals to the various compound(s); and,~~
- ~~The individual perception of the odour (i.e. whether the odour is regarded as unpleasant). This is greatly subjective, and may vary significantly from individual to individual. For example, some individuals may consider some odours as pleasant, such as petrol, paint and creosote.~~

~~A Source-Pathway-Receptor assessment has been undertaken having regard to the aspects of the FIDOL acronym has been undertaken to determine the likelihood of odour being generated by the Proposed Scheme.~~

4.4.3 Assessment of Significance

The IAQM guidance provides a matrix to determine the overall significance of a proposed scheme based on the odour impact and the sensitivity of the receptor. The matrix is shown in Table 24. The criteria set out in Table 24 have been used to determine the significance of the Proposed Scheme with regard to odour. Where the overall effect is moderate adverse or above, this is considered to be significant, otherwise the effect is considered to be not significant.

The regulation of the proposed development under an environmental permit will minimise and control odour where possible through the application of BAT. These have been considered to be embedded in the design when determining the significance of effect.

Table 24: IAQM suggested descriptors for significance of odour effects

Odour Exposure (Impact)	**Receptor Sensitivity**		
	Low	**Medium**	**High**
Very Large	Moderate Adverse	Substantial Adverse	Substantial Adverse
Large	Slight Adverse	Moderate Adverse	Substantial Adverse
Medium	Negligible	Slight Adverse	Moderate Adverse
Small	Negligible	Negligible	Slight Adverse
Negligible	Negligible	Negligible	Negligible

5 Baseline Assessment

The overall approach to the baseline air quality assessment comprises a review of the existing air quality conditions in the vicinity of the Proposed Scheme.

5.1 Sources of Air Pollution

The main sources of air pollution in the vicinity of the Proposed Scheme are road traffic and industrial sources.

5.1.1 Industrial Processes

Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met and ensuring that any releases to the environment are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified as Part A or Part B processes, and are regulated through the Pollution Prevention and Control (PPC) system. The larger more polluting processes are regulated by the SEPA, and the smaller less polluting ones by the local authorities. Local authorities tend also to regulate only for emissions to air, whereas the SEPA regulates emissions to air, water and land.

A review of the Scottish Pollutant Release Inventory (SPRI) shows that there are currently ~~28~~34 processes regulated by SEPA within 16km (10miles) of the Proposed Scheme site, as shown in Figure 13 and Table 25.

The impacts of all industrial processes in the area on local air quality are taken into account in the background concentrations shown in this report, and therefore have not been explicitly modelled in this assessment with two exceptions: the existing EfW facility and the Michelin facility. These sources have been included in the baseline assessment and cumulative assessment respectively.

Figure 13: SPRI sites within 16km of the Proposed Development

Table 25: SPRI sites within 16km of the Proposed Scheme

ID	Site name	Approximate site location (OS grid ref)		Distance from site (km) and (direction)
		x	y	
~~1~~	~~ASKA Energy~~	~~337449~~	~~732996~~	~~7.1 (E)~~
2	Day International *	340102	732264	4.5 (E)
3	Halley Stevenson (Dyers & Finishers)	338933	730157	6.3 (SW)
4	D C Thomson & Company	342386	732087	2.3 (SW)
5	Michelin Tyres	345118	732736	0.6 (E)
6	Rockwell Solutions	335280	732011	9.3 (E)
7	Existing EfW facility ~~Dundee Energy Recycling~~	344545	732960	0.1 (N)
8	GRC Skip Hire & Waste Management	341551	730652	3.8 (SW)
9	Ninewells Medical School, NHS Tayside	336570	730654	8.3 (SW)
10	Peacehill Farm, T D Forster & Son	338648	725206	9.7 (SW)
11	Ardownie Quarry, D Geddes (Contractors)	349323	734071	4.9 (E)
12	Healthcare Environmental Services *	335144	732081	9.4 (E)
13	Nynas UK	341650	730701	3.7 (SW)
14	Wellbank Landfill Site, UK Waste Management	347520	737702	5.6 (NE)
15	Ninewells Hospital, NHS Tayside	339005	730390	6.1 (SW)
16	University of Dundee Incubator Building	339072	729992	6.2 (SW)
~~17~~	~~Millipore~~	~~335260~~	~~730373~~	~~9.6 (SW)~~
18	Poultry Farm, Ian Jamieson & Partners	353117	734167	8.7 (E)
19	Tealing Poultry Farm	340326	737875	6.5 (SW)
20	Cransley First Broiler Farm	332191	733988	12.4 (E)
21	East Adamston Poultry Farm	332936	735482	11.9 (NE)
22	Discovery Flexibles	341216	731199	3.8 (SW)
~~23~~	~~University Of Dundee~~	~~339727~~	~~730031~~	~~5.6 (SW)~~
24	Ramsay McBain	337605	731437	7.1 (SW)
25	The James Hutton Institute	334196	729871	10.8 (SW)
26	D J Laing (Contracts)	335099	732101	9.5 (E)
~~27~~	~~Petterden Waste Recycling~~	~~342988~~	~~739105~~	~~6.4 (N)~~
28	The British Millerain Co	342872	730928	2.6 (SW)
29	Rembrand Timber	343111	736651	3.7 (N)

30	Sodra Wood	342108	730853	3.1 (SW)
31	Eurofins Phrama Discovery Services	335338	730367	9.0 (SW)
32	Dundee City Council Baldovie Recycle Centre	344177	732939	0.2 (W)
33	D. Geddes Contractor	346631	736364	3.7 (NE)
34	Concept Life Sciences Dundee	339076	730014	5.6 (SW)
35	NWH Waste Services Nobel Road	335097	732304	8.9 (W)
36	NWH Waste Services Petterden Wood Processing Facility	342575	739785	6.8 (N)
37	Augean North Sea Services	342155	730852	2.7 (SW)
38	Garpit Poultry Farm	346025	727105	6.0 (S)

Notes:

* ‘Day International’ and ‘Healthcare Environmental Services’ appear in the 2018 SPRI, however they are listed as ‘not yet submitted’, indicating that they may not have renewed their agreement with SEPA in 2018 by filing a return.

Where text is displayed as strikethrough, these processes were listed in 2016 but are no longer listed in 2018. These processes remain in the table to easily facilitate comparison with previous planning submissions of this report.

N = north, E = east, S = south, W = west

5.2 Local Air Quality

All of Dundee City council area was declared an AQMA in 2013. The AQMA was declared due to exceedences of the 1-hour and annual mean NO_2 air quality objectives, and the annual mean PM_{10} air quality objective. Figure 14 shows the site location and the boundaries of the AQMA.

5.2.1 Local Air Quality Monitoring

The city of Dundee carries out automatic monitoring of NO_2 and PM_{10} concentrations at ~~seven~~ 13 monitoring sites in the city. Details of the monitoring sites are outlined in Table 26. Automatic monitoring involves the use of instruments which continuously draw air through the instrument, and provide data on short averaging periods such as 15 minutes.

Local monitoring data on the Air Quality Scotland[50] website has been reviewed and annual mean concentrations of NO_2 and PM_{10} data from all automatic air quality sites in Dundee is shown in Table 27 and Table 28 for 2013 to 2018, with site locations shown in Figure 15. ~~There are no sites monitoring $PM_{2.5}$ in Dundee. Annual mean concentrations of NO_2 exceeded the air quality objective of 40 µg/m^3 at the two kerbside sites (DUN5 Seagate and DUN6 Lochee Road) in 2015. Annual mean concentrations of PM_{10} exceeded the air quality objective of 18 µg/m^3 at one of the kerbside sites, DUN6 Lochee Road, in 2015.~~

Annual mean concentrations of NO_2 exceeded the air quality objective of 40µg/m^3 at two roadside sites (CM5 Seagate and CM4 Lochee Road) in 2018. Annual

[50] Defra (2019) https://uk-air.defra.gov.uk/aqma/maps

mean concentrations of PM_{10} exceeded the air quality objective of 18µg/m^3 at two kerbside sites in 2018: CM9 Logie Street and CM15 Albert Street.

The number of exceedences of the short-term air quality objectives for NO_2 and PM_{10} are shown in Table 30 and Table 31. For PM_{10} daily mean concentrations of 50 µg/m^3 are not to be exceeded more than 7 times a year, and for NO_2 hourly mean concentrations of 200 µg/m^3 are not to be exceeded more than 18 times a year. There were no sites which exceeded the PM_{10} objective ~~2013, 2014 or 2015~~ from 2013 to 2018. One site (~~DUN6~~CM4 Lochee Road), which is a kerbside site, exceeded the NO_2 objective in 2013; no other sites exceeded the NO_2 objective ~~in 2013, 2014 or 2015~~ from 2013 to 2018.

In 2018, DCC began monitoring $PM_{2.5}$ at two continuous monitoring sites: CM4 Lochee Road and CM12 Mains Loan. Annual mean concentrations of $PM_{2.5}$ for 2018 are provided below in Table 29. Neither site recorded an exceedance in 2018.

Concentrations at the background monitoring sites (~~DUN1 Mains Loan, DUN4 Broughty Ferry~~ CM12 Mains Loan, CM3 Broughty Ferry Road) met the relevant air quality objectives for NO_2 and PM_{10} ~~in 2013, 2014 and 2015~~ from 2013 to 2018.

Table 26: Automatic air quality monitoring sites in Dundee City

Site ID	Site name	Site type	OS grid reference		Pollutants monitored
			X	Y	
CM12	Mains Loan	Urban background	340972	731893	NO_2, PM_{10}, $PM_{2.5}$
CM2	Union Street Rollalong	Roadside	340235	730091	NO_2, PM_{10}
CM5	Seagate Romon	Roadside	340487	730446	NO_2, PM_{10}
CM3	Broughty Ferry Road Rollalong	Urban industrial	341970	730977	NO_2, PM_{10}
CM14	Meadowside Romon	Roadside	340243	730653	NO_2, PM_{10}
CM4	Lochee Road Romon	Roadside	338861	730773	NO_2, PM_{10}, $PM_{2.5}$
CM6	Whitehall Street Romon	Roadside	340278	730156	NO_2, PM_{10}
CM13	Broughty Ferry Road Partisol	Urban industrial	341971	730978	PM_{10}
CM9	Logie Street Osiris	Kerbside	338176	731298	PM_{10}
CM15	Albert St Osiris	Kerbside	341090	731105	PM_{10}
CM16	Broughty Ferry Road Osiris	Urban Industrial	341970	730977	PM_{10}
CM17	Myrekirk Osiris	Roadside	335438	731740	PM_{10}
CM18	Stannergate Osiris	Roadside	343322	731073	PM_{10}
Note: The CM2 Union Street site was discontinued in 2016.					

Table 27: Annual mean NO_2 concentrations from automatic monitoring sites

Site ID	Site name	Annual mean NO_2 concentration (µg/m^3)					
		2013	2014	2015	2016	2017	2018
CM12	Mains Loan	*	13	10	11	12	12
CM2	Union Street	31	29	28	N/A	N/A	N/A
CM5	Seagate	**55**	**55**	**50**	**47**	**44**	**46**
CM3	Broughty Ferry Road	-	-	-	12.7	19.7	23.3
CM14	Meadowside	**49**	**40**	38	36	35	34
CM4	Lochee Road	**52**	**46**	**48**	**45**	**44**	**43**
CM6	Whitehall Street	**41**	**43**	36	37	35	38

Notes:
'-' indicates no monitoring of this pollutant is undertaken at this site.
'*' indicates data capture less than 75% at the monitoring site in this year.
Concentrations in **bold** exceed the relevant air quality objectives.
Monitoring ceased at Union St in 2016.

Table 28: Annual mean PM_{10} concentrations from automatic monitoring sites

Site ID	Site name	Annual mean PM_{10} concentration (µg/m^3)					
		2013	2014	2015	2016	2017	2018
CM12	Mains Loan	12	13	12	10	10	9
CM2	Union Street	15	16	17	N/A	N/A	N/A
CM5	Seagate	16	**18**	15	14	16	16
CM3	Broughty Ferry Road	16	15	13	12	11	11
CM14	Meadowside	**19**	17	16	16	15	15
CM4	Lochee Road	**18**	**19**	**20**	**19**	**18**	13
CM6	Whitehall Street	-	-	-	15	15	16
CM13	Broughty Ferry Road	-	15	13	12	11	11
CM9	Logie Street	-	16	16	14	15	**19**
CM15	Albert St	-	**21**	**19**	15	14	**18**
CM16	Broughty Ferry Road	-	15	12	12	11	11
CM17	Myrekirk	-	**18**	**18**	16	12	14
CM18	Stannergate	-	**27**	**27**	**21**	14	12

Notes:
'-' indicates no monitoring of this pollutant is undertaken at this site.
'*' indicates data capture less than 75% at the monitoring site in this year.
Concentrations in **bold** exceed the relevant air quality objectives.
Monitoring ceased at Union St in 2016.

Table 29: Annual mean $PM_{2.5}$ concentrations from automatic monitoring sites

Site ID	Site name	Annual mean $PM_{2.5}$ concentration (µg/m^3) for 2018
CM4	Lochee Road	5.7
CM12	Mains Loan	5.5

Table 30: 1-hour mean for NO_2 at automatic air quality monitoring sites

Site ID	Site name	No. exceedences of the hourly mean NO_2 air quality objective of 200 µg/m^3					
		2013	2014	2015	2016	2017	2018
CM12	Mains Loan	*	0	0	0	1	0
CM2	Union Street	0	0	0	N/A	N/A	N/A
CM5	Seagate	10	0	0	0	0	0
CM3	Broughty Ferry Road	-	-	-	0	0	0
CM14	Meadowside	0	0	0	0	0	0
CM4	Lochee Road	-	0	0	4	6	6
CM6	Whitehall Street	0	0	0	0	0	0

Notes:
'-' indicates no monitoring of this pollutant is undertaken at this site.
'*' indicates data capture less than 75% at the monitoring site in this year.
Concentrations in **bold** exceed the relevant air quality objectives.
Monitoring ceased at Union St in 2016.

Table 31: 24-hour mean for PM_{10} at automatic air quality monitoring sites

Site ID	Site name	No. exceedences of the daily mean PM_{10} air quality objective of 50µg/m^3					
		2013	**2014**	**2015**	**2016**	**2017**	**2018**
CM12	Mains Loan	1	1	1	0	0	0
CM2	Union Street	1	2	7	N/A	N/A	N/A
CM5	Seagate	4	3	3	0	3	1
CM3	Broughty Ferry Road	4	1	2	0	0	0
CM14	Meadowside	4	2	4	3	1	4
CM4	Lochee Road	3	1	5	2	4	1
CM6	Whitehall Street	-	-	-	1	1	4
CM13	Broughty Ferry Road	-	1	0	0	0	0
CM9	Logie Street	-	2	4	0	2	11
CM15	Albert St	-	14	8	2	3	5
CM16	Broughty Ferry Road	-	3	2	1	0	1
CM17	Myrekirk	-	3	7	1	0	2
CM18	Stannergate	0	16	15	4	2	0

Notes: '-' indicates no monitoring of this pollutant is undertaken at this site. '*' indicates data capture less than 75% at the monitoring site in this year.
Concentrations in **bold** exceed the relevant air quality objectives.
Monitoring ceased at Union St in 2016.

Figure 14: Dundee AQMA

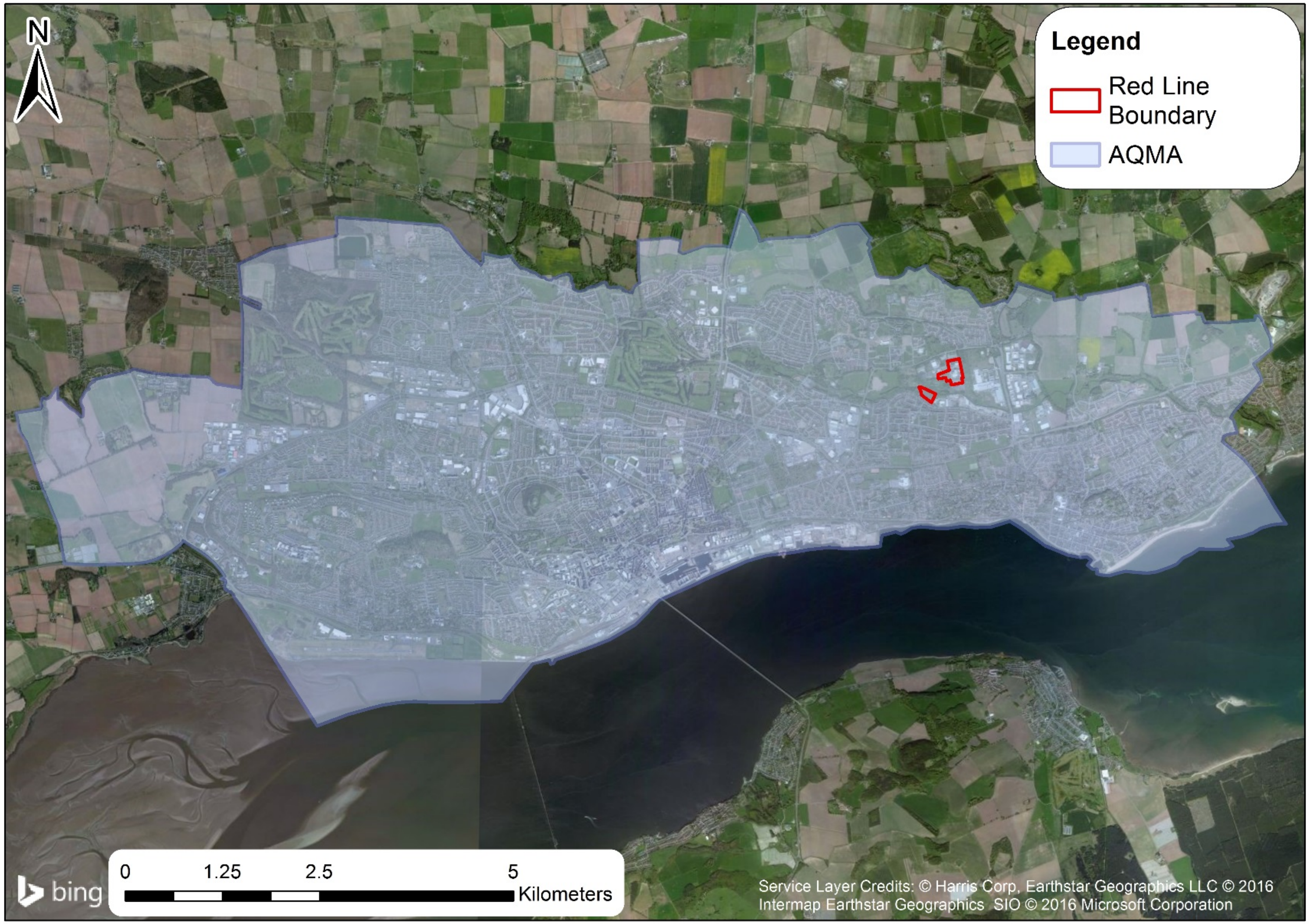


Figure 15: Dundee City Council automatic air quality monitoring sites

5.2.2 Project-specific Monitoring

A baseline monitoring survey of NO_2 in the area has been carried out, between November 2015 and 2016 to complement the baseline assessment of existing air quality conditions in the area.

Monitoring has been undertaken using diffusion tubes, which are a passive monitoring method widely used in the UK for measuring ambient concentrations of NO_2. Diffusion tubes consist of a small plastic tube containing a chemical reagent which absorbs the pollutant to be measured (in this case NO_2) directly from the air. Eleven monitoring points were selected, including one adjacent to the existing EfW ~~DERL~~ facility, eight locations close to residential properties, one background location and one co-located with an automatic monitor operated by DCC. The monitoring locations are shown in Figure 15 and details are provided in the Table 32.

Table 32: Project-specific monitoring locations

Site ID	Site Name	Site Type	OS Grid Ref	
			x	y
1	Baldovie/Drumgieth Road	Roadside	345088	733302
2	Drumgeith Road	Roadside	344696	733290
3	Britannia Drive	Roadside	344167	733328
4	Britannia Drive	Roadside	343903	733028
5	Kellas Road	Background	345517	734449
6	Balmerino Road	Roadside	344190	732616
7	Balunie Drive	Roadside	345349	732079
8	Forties Road (Proposed Site)	Roadside	344504	732934
9	Meadowside Automatic Monitor	Roadside	340245	730655
10	Arbroath Road/ Gotterstone Avenue	Roadside	344236	731786
11	4 Brot'y Ferry Court	Roadside	345272	732430

Diffusion tubes were attached to street furniture, fixed at a height representative of human exposure. Duplicate or triplicate tubes are used at each location and, following a four-week monitoring period, they are sent to a UKAS accredited laboratory for analysis.

A full year of monitoring has been carried out, with the exception of two locations, which were added at a later date to provide additional data at the council's request. Where necessary, results have been annualised and all results have been bias-adjusted based on the comparison of data from diffusion tubes co-located at the Meadowside automatic monitor. Bias-adjustment accounts for uncertainty associated with using a passive monitoring method. The results are shown in Table 33 and the sites are shown in Figure 16. Average concentrations at all monitoring sites close to the Application Site are below the annual mean NO_2 objective.

Figure 16: MVV air quality monitoring sites

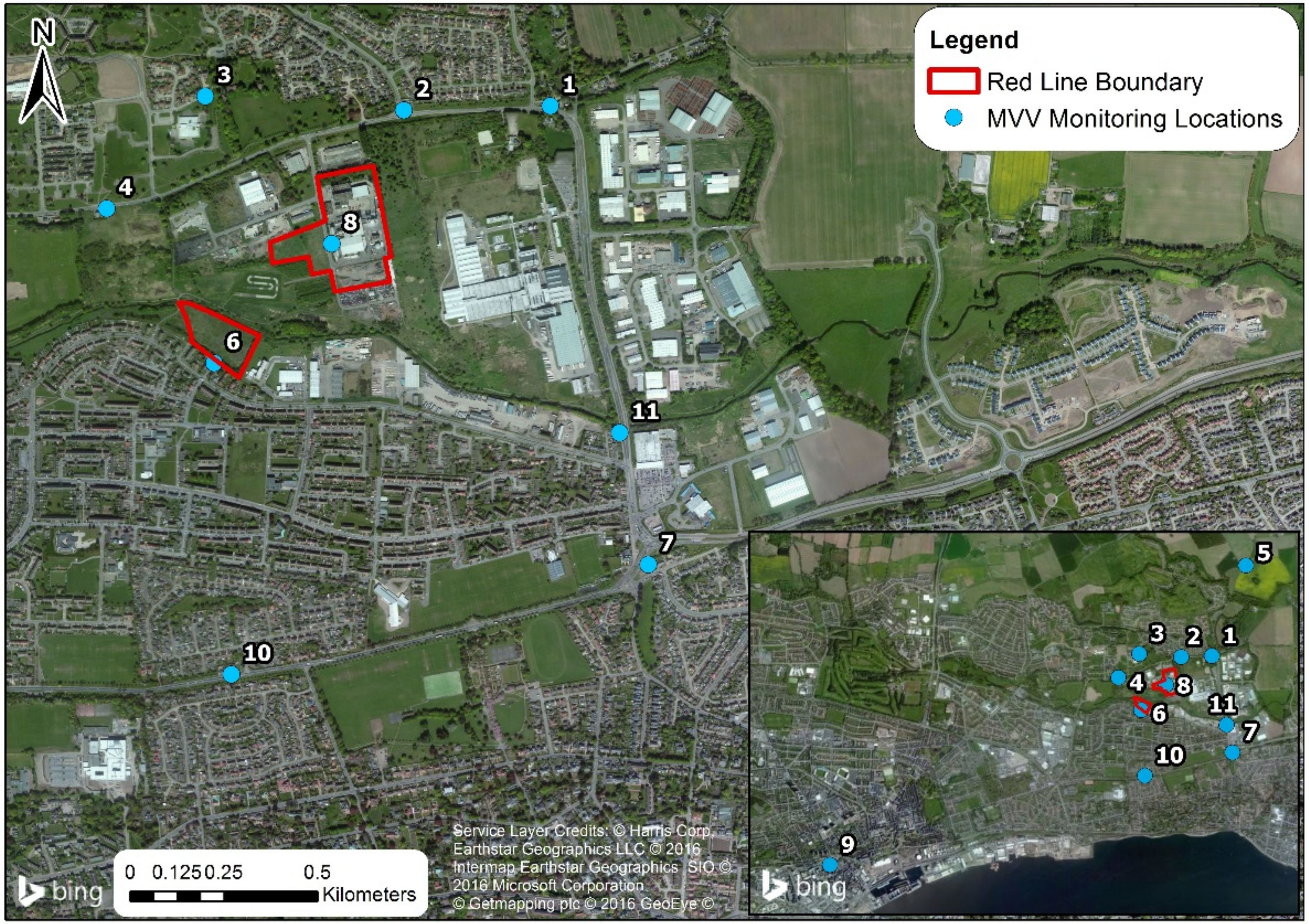


Table 33: MVV air quality monitoring data

Site ID	Site name	Mean NO_2 concentration (µg/m^3)												
		Period 1	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**	**Period 7**	**Period 8**	**Period 9**	**Period 10**	**Period 11**	**Period 12**	**Bias-adjusted annual average**
1	Baldovie/Drumgieth Road	39.0	25.2	34.5	32.0	24.5	22.2	24.5	21.5	21.3	26.0	28.4	38.5	24.4
2	Drumgeith Road	41.0	24.6	34.3	32.2	23.0	18.1	19.3	18.8	17.7	22.4	26.2	38.7	22.9
3	Britannia Drive	20.7	15.5	18.7	15.6	8.6	6.4	-	8.7	-	12.7	11.6	21.1	12.1
4	Britannia Drive	33.2	21.1	30.3	28.5	16.5	13.2	13.9	15.1	13.5	15.2	20.1	33.7	18.4
5	Kellas Road	21.4	16.9	17.9	16.9	9.7	8.9	8.0	9.9	9.4	14.3	11.6	21.1	12.0
6	Balmerino Road	22.2	16.3	21.4	20.0	9.3	6.9	6.1	-	8.6	13.5	12.0	23.3	12.6
7	Balunie Drive	24.6	29.8	37.9	37.5	24.7	19.2	18.9	23.2	22.4	26.7	26.7	45.7	24.4
8	Forties Road (Proposed Site)	22.8	17.8	21.6	21.4	12.0	9.7	9.8	7.9	11.0	13.0	15.7	25.0	13.6
9	Meadowside Automatic Monitor	51.2	40.1	46.5	45.1	39.1	36.3	34.7	33.9	33.0	-	36.0	48.7	35.1
10	Arbroath Road/ Gotterstone Avenue	-	-	-	42.4	29.1	24.1	27.3	25.7	30.7	34.6	35.1	53.6	29.2
11	4 Brot'y Ferry Court	-	-	-	31.9	21.0	17.1	21.0	20.3	-	28.9	26.2	40.7	23.2

Notes: '-' denotes no monitoring undertaken at that site during that period.
A bias-adjustment factor of 0.87 was derived and applied to the monitored annual average concentrations at each location

~~5.2.3 Defra's Background Pollutant Concentrations~~

~~Background concentrations refer to the existing levels of pollution in the atmosphere, due to a variety of sources, such as roads and industrial processes.~~

~~The Scottish Air website[51] includes estimated background air pollution data for NOx, NO_2 and PM_{10} for each 1km by 1km OS grid square in Scotland. Background maps, created using a base year of 2013, are available for the years 2013 to 2030. Scotland-specific maps are not currently available for $PM_{2.5}$. The Scottish Government advise that for $PM_{2.5}$, the Defra UK-wide background maps[52] are used instead. Scottish map data has been used to predict NOx, NO_2 and PM_{10} concentrations, and Defra map data has been used to predict $PM_{2.5}$ concentrations.~~

~~The main Proposed Scheme (areas A, C, D and E) crosses two 1km grid squares (centred on 344500, 733500 and 344500, 732500). The estimated pollutant concentrations for 2015 (baseline) and 2020 (opening year for the Proposed Scheme) for these grid squares are shown in Table 34. All estimated background pollutant concentrations are below the relevant air quality objectives.~~

~~Table 34: Estimated annual mean background pollutant concentrations~~

~~Grid Ref~~		~~Annual mean concentration (µg/m³)~~							
		~~2015~~				~~2020~~			
~~X~~	~~Y~~	~~NO_x~~	~~NO_2~~	~~PM_{10}~~	~~$PM_{2.5}$~~	~~NO_x~~	~~NO_2~~	~~PM_{10}~~	~~$PM_{2.5}$~~
~~344500~~	~~733500~~	~~13.8~~	~~9.2~~	~~11.1~~	~~7.2~~	~~10.9~~	~~7.3~~	~~10.7~~	~~6.9~~
~~344500~~	~~732500~~	~~16.5~~	~~11.0~~	~~10.8~~	~~7.2~~	~~13.5~~	~~9.0~~	~~10.8~~	~~7.2~~
~~Air quality objective~~		~~30~~	~~40~~	~~18~~	~~10~~	~~30~~	~~40~~	~~18~~	~~10~~

5.2.4 Summary of Monitoring Data of Background Concentrations

Background concentrations for each pollutant are shown inTable 36. Following discussions with SEPA, an approach was taken to review background concentrations for heavy metals, dioxins and furans across a UK-wide basis, covering 40 sites. In order not to focus on any particular monitoring sites in the UK, an average UK-wide annual mean concentration was calculated for each year for each pollutant, over the past five years (or where data were available). This review comprised data from all representative and available urban background heavy metals monitoring sites, with any sites considered to contain outliers for a particular pollutant removed from that analysis. Only urban-background monitoring sites were included in the analysis to replicate potential baseline

~~51 Air Quality in Scotland (2016) Data for Local Authority Review and Assessment purposes. Available at: http://www.scottishairquality.co.uk/data/mapping?view=data~~
~~52 Defra (2016) Background Mapping data for local authorities – 2013 Available at: https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013~~

conditions in and around Dundee. The one exception to this is for the trace metal Antimony, which is only monitored at rural-background sites.

The focus on urban-background UK-wide monitoring sites (that were specifically operational for at least one year during the period 2013-2018), reduces the number of sites considered down to 13 sites, for the trace heavy metal pollutants. Monitoring sites that were considered to have outlying data compared to other sites for the same pollutant, were removed from the analysis. The removal of these sites brought down the variation in the data and reduced the standard deviation value of the yearly average. Four sites in particular had instances of removal from the yearly averages for some of the pollutants monitored, namely; Sheffield Tinsley, Sheffield Centre, London Westminster, and Swansea Coedgwilym.

Error! Reference source not found. Table 35 shows the summary of the average UK-wide review of background concentrations for heavy metals. Table 36 then contains the individual background concentrations for each pollutant used in the assessment and the reasoning behind the choice.

The Defra background concentrations, section 5.2.3, were not used as they were lower than monitored concentrations. Full details of all data considered is outlined in Appendix A. Appropriate locations have been selected based on data availability and proximity to the Application Site. As described in section 4.3.2.9, background concentrations for short-term limits and EALs will be calculated as twice the annual mean background concentration.

Table 35: Summary of UK urban-background monitoring sites annual average background concentrations

Pollutant	As	Cd	Co	Cr	Cu	Hg	Mn	Ni	Pb	Sb	Va	D&F
UK average 2013	0.65	0.17	0.14	2.10	7.05	1.92	4.64	1.30	8.17	0.54	1.29	6.83
UK average 2014	0.82	0.20	0.13	1.92	7.35	-	6.08	1.88	8.78	-	1.61	9.71
UK average 2015	0.75	0.13	0.11	2.33	6.72	-	4.85	1.34	8.68	-	0.88	5.14
UK average 2016	0.72	0.17	0.13	2.32	7.22	-	5.12	1.32	7.30	-	0.90	16.75
UK average 2017	0.77	0.16	0.11	1.92	6.94	-	4.95	1.00	7.50	-	0.91	-
UK average 2018	0.74	0.19	0.13	3.13	7.32	-	5.88	7.05	9.90	-	1.14	-

"-" indicates that there was no data recorded for the pollutant in that year
Units for trace metals - ng/m^3
Units for (D&F) dioxins and furans - fg TEQ/m^3

Table 36: Summary of background air quality monitoring data

Pollutant	Averaging period	Concentration	Units	Year	Reasoning
Nitrogen oxides (NOx)	Annual mean	16	µg/m^3	2018	Data from Dundee Mains Loan automatic urban background monitoring site, for average of 2018
Nitrogen dioxide (NO_2)	Annual mean	12.3	µg/m^3	2018	Data from Dundee Mains Loan automatic urban background monitoring site, for 2018
Carbon monoxide (CO)	Max 8-hour running mean	0.09	mg/m^3	2018	Data from Edinburgh St Leonards urban background monitoring site, for average of 2018. This is the nearest background monitoring site to the Proposed Scheme site, which monitors for CO.
	Max 1-hour mean	1.2	mg/m^3	2018	
Total organic carbon (TOC) as benzene (C_6H_6)	Annual mean	0.24	µg/m^3	2018	Data from Auchencorth Moss rural background monitoring site. This is the nearest automatic benzene monitoring site to the Proposed Scheme site.
Sulphur dioxide (SO_2)	Max 15-minute mean	12.8	µg/m^3	2018	Data from Edinburgh St Leonards urban background monitoring site, for 2018. This is the nearest background monitoring site to the Proposed Scheme site, which monitors for SO_2.
	Max 1-hour mean	10.9	µg/m^3	2018	
	Max 24-hour mean	5.65	µg/m^3	2018	
	Annual mean	2.3	µg/m^3	2018	
Fine particulate matter (PM_{10})	Max 24-hour mean	28	µg/m^3	2018	Data from Dundee Mains Loan automatic urban background monitoring site, for 2018.
	Annual mean	9.1	µg/m^3	2018	

Pollutant	Averaging period	Concentration	Units	Year	Reasoning
Ultra-fine particulate matter ($PM_{2.5}$)	Annual mean	5.5	µg/m^3	2018	Data from Dundee Mains Loan automatic urban background monitoring site, for average of 2018.
	Max 1-hour mean	None	-	-	
Hydrogen fluoride (HF)	Monthly average	None	-	-	No background monitoring carried out in the UK.
Hydrogen chloride (HCl)	Max 1-hour mean	3.4	µg/m^3	2013-2014	Data from Auchencorth Moss rural background monitoring site. This is the nearest automatic monitoring site to the Proposed Scheme site. Data for average of 2013 and 2014 has been selected, as 2015 has data capture <75%.
Ammonia (NH_3)	Annual mean	0.89	µg/m^3	2018	Data from Auchencorth Moss rural background monitoring site. This is one of the nearest automatic monitoring sites to the Proposed Scheme site, and has recorded concentrations higher than at Edinburgh St Leonards.
Dioxins and furans	Annual mean	16.75	fg TEQ/m^3	2016	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Polychlorinated biphenyls (PCB)	Annual mean	0.000038	µg/m^3	2010	Data from Auchencorth Moss rural background monitoring site. This is the nearest Toxic Organic Micro Pollutants (TOMPs) monitoring site to the Proposed Scheme site. 2010 is the most recent data available.
Polycyclic aromatic hydrocarbons (PAHs) as benzo(a)pyrene	Annual mean	0.06	ng/m^3	2018	Data from Edinburgh St Leonards urban background monitoring site, for 2018.

Pollutant	Averaging period	Concentration	Units	Year	Reasoning
Lead (Pb)	Annual mean	9.90	ng/m^3	2018	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Arsenic (As)	Annual mean	0.82	ng/m^3	2014	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Cadmium (Cd)	Annual mean	0.20	ng/m^3	2014	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Nickel (Ni)	Annual mean	1.88	ng/m^3	2014	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Thallium (Ti)	Annual mean	None	-	-	No background monitoring carried out in the UK.
Mercury (Hg)	Annual mean	1.92	ng/m^3	2013	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the

Pollutant	Averaging period	Concentration	Units	Year	Reasoning
					greatest UK-wide average year. This method was agreed following discussions with SEPA.
Antimony (Sb)	Annual mean	0.54	ng/m^3	2013	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all rural-background monitoring sites as Antimony is only monitored in rural locations. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Chromium (Cr)	Annual mean	3.13	ng/m^3	2018	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Hexavalent chromium (CrVI),	Annual mean	0.63	ng/m^3	2018	The CrVI background concentrations are assumed data, based on 20% of the chromium data in-line with EA guidance[40].
Cobalt (Co)	Annual mean	0.11	ng/m^3	2017	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Copper (Cu)	Annual mean	7.35	ng/m^3	2014	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.

Pollutant	Averaging period	Concentration	Units	Year	Reasoning
Manganese (Mn)	Annual mean	6.08	ng/m^3	2014	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.
Vanadium (V)	Annual mean	1.61	ng/m^3	2014	An average UK-wide annual mean concentration was calculated for each year over the past five years (or where data were available), comprising data from all representative and available urban background heavy metals monitoring sites. The value selected represents the greatest UK-wide average year. This method was agreed following discussions with SEPA.

6 Construction Assessment

6.1 Construction Dust

The outcome of construction dust assessment is presented in ~~Appendix B~~ Appendix F, which is reproduced from the Environmental Statement submitted as part of the planning application for the ~~Proposed Scheme~~EfW CHP facility.

6.2 Construction Traffic

6.2.1 Predicted Pollutant Concentrations

Annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations have been predicted at each of the sensitive receptors shown in Figure 4, following the methodology outlined in section 4.2.2 of this report.

Model verification refers to the comparison of modelled pollutant concentrations with measured concentrations at the same points to determine the performance of the model. Should the model results for NO_2 be largely within ±25% of the measured values and there is no systematic over or under-prediction of concentrations, then no adjustment is necessary according to LAQM.TG16.

The model verification exercise has been undertaken using those locations available from the project-specific monitoring survey. At the request of DCC, monitored concentrations have been used as the background concentrations used in the model verification. As shown in Table 37, modelled concentrations are predicted to be greater than monitoring locations, probably due to the use of the monitored background concentrations rather than Defra gridded background concentrations (section 5.2.3). As modelled concentrations are greater than monitored concentrations and at the majority of location modelled concentrations are in 25% of monitored concentrations, no adjustment of modelled concentrations has been undertaken. This should provide a conservative (pessimistic) estimate of concentration impacts due to construction traffic.

Table 37: Comparison of modelled and monitored annual mean NO_2 concentrations

Monitoring location	Monitored NO_2 concentration (µg/m^3)	Modelled NO_2 concentration (µg/m^3)	Difference (modelled–monitored)/monitored (%)
Baldovie/Drumgieth Road	24.4	31.0	27%
Drumgeith Road	22.9	30.2	32%
Britannia Drive	12.1	12.5	3%
Britannia Drive	18.4	24.4	32%
Kellas Road	12.0	12.1	0%
Balmerino Road	12.6	13.6	8%
Balunie Drive	24.4	32.0	31%

Monitoring location	Monitored NO_2 concentration ($\mu g/m^3$)	Modelled NO_2 concentration ($\mu g/m^3$)	Difference (modelled–monitored)/monitored (%)
Forties Road (Proposed Site)	13.6	14.5	7%
Meadowside Automatic Monitor	35.1	35.1	0%
Arbroath Road/ Gotterstone Avenue	29.2	36.4	25%
4 Brot'y Ferry Court	23.2	26.0	12%

6.2.1.1 Nitrogen Dioxide (NO_2)

Annual mean NO_2 concentrations at each of the assessed receptors are shown in ~~Table 35~~ Appendix D. An impact descriptor has also been derived using the criteria in Table 6. At each of the assessed receptors, additional vehicles during the construction phase are predicted to have a negligible impact on annual mean NO_2 concentrations and the annual mean NO_2 objective would be met at all locations.

~~Table 35: Predicted annual mean NO_2 concentrations ($\mu g/m^3$) and impact descriptor [full table removed and replaced with Appendix D]~~

6.2.1.2 Particulate Matter (PM_{10})

Annual mean PM_{10} concentrations at each of the assessed receptors are shown in ~~Table 36~~ Appendix D. An impact descriptor has also been derived using the criteria in Table 6.

The annual mean PM_{10} objective would be met at all locations with the exception of two receptors which are located at the junction of the A92 and Baldovie Road. It should be noted however, that at these receptors the objective is predicted to be exceeded without construction traffic. Additional construction vehicles do not lead to a significant increase in pollutant concentrations at these locations and therefore the impact of additional construction vehicles on annual mean PM_{10} concentrations is negligible.

~~Table 36: Predicted Annual Mean PM_{10} Concentrations ($\mu g/m^3$) and Impact Descriptor [full table removed and replaced with Appendix D]~~

6.2.1.3 Fine Particulate Matter ($PM_{2.5}$)

Annual mean $PM_{2.5}$ concentrations at each of the assessed receptors are shown in ~~Table 37~~ Appendix D. An impact descriptor has also been derived using the criteria in Table 6.

At each of the assessed receptors, additional vehicles during the construction phase are predicted to have a negligible impact on annual mean $PM_{2.5}$ concentrations and the annual mean $PM_{2.5}$ objective would be met at all locations.

~~Table 37: Predicted annual mean $PM_{2.5}$ concentrations (µg/m^3) and impact descriptor [full table removed and replaced with Appendix D]~~

Assessment of significance

As shown above, the impact descriptor for all pollutants assessed as a result of the increase in vehicles associated with the construction phase of the EfW CHP facility was predicted to be negligible at all sensitive receptors. The annual mean NO_2 and $PM_{2.5}$ objectives are predicted to be met at all locations. The annual mean PM_{10} objective is predicted to be met at the majority of locations with the exception of receptors located at the junction of the A92 and Baldovie Road at which the objective is predicted to be exceeded without construction traffic.

Based on this, the significance of the predicted change in air quality as a result of additional traffic during the construction phase of the EfW CHP facility is considered to be **not significant**.

7 Operational Assessment

7.1 Assessment of Traffic Impacts

Annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations have been predicted at each of the sensitive receptors shown in Figure 4, following the methodology outlined in section 4.2.2 of this report.

Model verification refers to the comparison of modelled pollutant concentrations with measured concentrations at the same points to determine the performance of the model. Should the model results for NO_2 be largely within ±25% of the measured values and there is no systematic over or under-prediction of concentrations, then no adjustment is necessary according to LAQM.TG16.

The model verification exercise has been undertaken using monitoring sites on the modelled road network with 2018 monitored data[53]. At the request of DCC, monitored concentrations have been used as the background concentrations used in the model verification and throughout the assessment. As shown in Table 38, modelled concentrations are predicted to be lower than monitored concentrations. Defra guidance indicates that if modelled concentrations are within +/- 25% of monitored concentrations then model adjustment is not required. In this case, the difference is 22.8%. Although this is within +/-25%, the modelled concentrations are lower than monitored concentrations, so to provide a conservative assessment, adjustment of modelled concentrations has been undertaken. This should provide a conservative (pessimistic) estimate of concentration impacts due to operational traffic. The model adjustment factor was calculated to be 1.81 and has been applied to annual mean NOx traffic results.

It should be noted that model verification was undertaken for both the construction traffic assessment and the operational traffic assessment and an adjustment factor was applied to the operational results, but not to the construction results. This is due to the two model verifications being undertaken at different stages, using different sets of monitoring data. During the construction traffic assessment, the project specific monitoring was ongoing, and this data was used to carry out the model verification for that assessment. However, during the operational traffic assessment for proposed parallel operations, the original project specific monitoring had ceased, so a single local authority diffusion tube site was the only site available for which to verify the operational traffic model.

Table 38: Comparison of modelled and monitored annual mean NO_2 concentrations

Monitoring location	Monitored NO_2 concentration ($\mu g/m^3$)	Modelled NO_2 concentration ($\mu g/m^3$)	Difference (modelled–monitored)/monitored (%)
DT 171 Claypotts	25.9	20.0	-22.8

[53] Although the construction traffic model verification previously used the 2015/16 project-specific monitoring sites, these sites are no longer operated and a DCC diffusion tube is used for model verification of the operational traffic assessment as it provides 2018 data.

7.1.1 Modelled results

This section provides the results of the assessment of effects on air quality from the operation of both the existing EfW facility and proposed EfW CHP facility, which is under construction.

The traffic data for the DM and DS scenarios for 2020 (year of opening) was modelled using emissions data and background concentrations for 2018. This represents a conservative assessment of the likely impacts, assuming no improvements in vehicle emissions locally and nationally would be made between 2018 and 2020.

7.1.1.1 Nitrogen Dioxide (NO_2)

Annual mean NO_2 concentrations at each of the assessed receptors are shown in Appendix B. The magnitude of impact with the scheme in operation has been assessed using the EPUK significance criteria in Table 6. Predicted concentrations are below the annual mean air quality objective (40µg/m^3) at all of the sensitive receptor locations for each modelled scenario. The highest concentration was predicted at receptor 110 and was 19.8µg/m^3 in the baseline scenario, 29.5µg/m^3 in the DM and DS scenario (to one decimal place).

The magnitude of change to annual mean NO_2 concentrations at all receptor locations is predicted to be negligible.

7.1.1.2 Particulate Matter (PM_{10})

Annual mean PM_{10} concentrations at each of the assessed receptors are shown in Appendix B. The magnitude of impact with the scheme in operation has been assessed using the EPUK significance criteria in Table 6. Predicted concentrations are below the annual mean air quality objective (18µg/m^3) at all of the sensitive receptor locations for each modelled scenario. The highest concentration was predicted at receptor 110 and was 10.6µg/m^3 in the baseline scenario, 11.0µg/m^3 in the DM and DS scenario (to one decimal place).

The magnitude of change to annual mean PM_{10} concentrations at all receptors for all scenarios are predicted to be negligible.

7.1.1.3 Fine Particulate Matter ($PM_{2.5}$)

Annual mean $PM_{2.5}$ concentrations at each of the assessed receptors are shown in Appendix B. The magnitude of impact with the scheme in operation has been assessed using the EPUK significance criteria in Table 6. Predicted concentrations are below the annual mean air quality objective (10µg/m^3) at all of the sensitive receptor locations for each modelled scenario. The highest concentration was predicted at receptor 110 and was 6.4µg/m^3 in the baseline scenario, 6.6µg/m^3 in the DM and DS scenario (to one decimal place).

The magnitude of change to annual mean $PM_{2.5}$ concentrations at all receptors for all scenarios are predicted to be negligible.

7.1.1.4 Assessment of significance

The magnitude of change for NO_2, PM_{10} and $PM_{2.5}$ concentrations is negligible at all receptors. Therefore, the overall effect of operating both facilities together (in terms of road traffic) on local air quality is considered as not significant.

7.2 ~~Impact of EfW CHP Emissions~~ Assessment of EfW Stack Emissions

Impact of Parallel Operations – Normal Operating Conditions

~~This section presents the predicted environmental concentrations (PEC) resulting from the operation of the proposed EfW CHP facility under normal operating conditions.~~

~~A summary of results at human receptors is presented in Table 38 and detailed results are presented in Appendix D. A summary of model predictions at ecological receptors is presented in Table 39 with detailed results given in Appendix E. Appendix F shows colour shade contour plots of the PEC for key long-term and short-term pollutant limits.~~

~~All concentrations resulting from emissions from the DERL facility (current situation) and the proposed EfW CHP facility are below the relevant standards. The impact on air quality of the proposed EfW CHP facility, compared to the current operations of the DERL facility, results in a beneficial impact to air quality in terms of~~ $\cancel{NO_2}$~~, HCl, PAHs/B(a)P, PCBs and all Group III trace metals, and negligible negative impact for the other pollutants. The impact on human receptors is therefore not significant.~~

~~At ecological receptors the maximum PECs are all well below 70% of the standard and therefore the impact at ecological receptors is negligible and the effect is not significant. The maximum 24-hour mean concentration is predicted to decrease with EfW CHP facility operation compared with the DERL facility operation.~~

~~At ecological receptors the process contribution to nutrient nitrogen deposition is no more than 0.26% (which is predicted at Barry Links) and acid deposition is no more than 8% of the critical load (which is also predicted at Barry Links). The Predicted Environmental Deposition rate (PEDR), the sum of the process contribution to deposition and the background deposition rate, exceeds 70% of the critical load only where the background on its own exceeds. The effect is therefore considered not significant.~~

~~Dioxins and furans do not have an EAL so cannot be assessed in the same way but impacts are reduced as a result of the proposed EfW CHP facility compared to the current impact from the existing DERL facility and the impact of this on human health is presented in the human health risk assessment (Appendix G).~~

~~It should be noted that while actual emissions from the DERL facility have been used for the assessment, the emissions used for the EfW CHP facility are those given by the IED limit values and they therefore represent the worst case~~

~~emissions. Actual emissions would be no greater than then IED emission limit values and could be less. The assessment of the EfW CHP facility therefore represents a worst case.~~

This section presents the predicted process contribution (PC) and predicted environmental concentrations (PEC) resulting from the parallel operation of the existing EfW and proposed EfW CHP facilities under normal operating conditions.

A summary of results at the point of maximum impact on the grid is presented in Table 40 and detailed results for all discrete receptors are presented in Appendix B. A summary of model predictions at ecological receptors is presented in Table 41 with detailed results given in Appendix C. Appendix H shows colour shade contour plots of the PEC for key long-term and short-term pollutant limits.

The results in Table 40 are based on the worst case met data year, and the maximum predicted PCs and PECs are compared to their respective standards. Concentrations are considered potentially significant if the long-term PC is greater than 1% of the long-term standard, or the short-term PC is greater than 10% of the short-term standard.

Human Receptors

For the majority of pollutants assessed, the impact of the parallel operations is not significant. Potentially significant impacts were identified for long-term NO_2, VOCs (as benzene), PAHs (as benzo(a)pyrene), hydrogen chloride, arsenic, cadmium, nickel and hexavalent chromium (CrVI); these go forward to the second screening stage. All other pollutants can be screened out of assessment because their PCs are less than 1% of their respective EALs [54]. The PEC results are presented for all pollutants for completeness.

The second screening stage compares the long-term PECs which have not been screened out as insignificant. Concentrations are considered potentially significant if the long-term PEC is greater than 70% of the long-term standard. For all pollutants assessed, none of the PECs are above the EALs with the exception of CrVI. This is shown in Table 39.

With regard to the predicted long-term CrVI concentrations, these however are not considered to be significant for several reasons. The PC/EAL for CrVI is predicted to be 1.27%, however when considering the total predicted concentrations, the PEC/EAL is predicted to be 315%. Furthermore, the CrVI background concentrations based on an assumed 20% ratio of the chromium background, in-line with the EA guidance for assessing group III metal stack emissions[45], which is considered to be conservative.

The Health and Safety Executive (HSE) outlines [55] that CrVI and its compounds are typically used and found in many industrial processes, including stainless steel

[54] Defra and EA (2016). Air emissions risk assessment for your environmental permit. Available at https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
[55] HSE, 2013. Working with Chromium – are you at risk? Available at https://www.hse.gov.uk/pubns/indg346.pdf

production and other chromium alloys, pigments in paints, chemical manufacturing, production of dyes, leather tanning and electroplating. Based on a review of the existing industrial installations through the Scottish Pollutant Release Inventory within 10 miles of the facility (see section 5.1.1), potential industrial sources of Cr and Cr VI are considered to be minimal and thus likely to be lower than those assumed in the assessment (taken from a UK-wide review).

Cr is understood to be emitted when burning coloured newsprint and mixed paper, plasticfilm, lawn waste, wood, textiles, footware and fines. A research paper published in 2015 [56] focused on the analysis of metal particle emissions around a six municipal waste incineration (MWI) facilities in England and Wales. Whilst the study found that when comparing rural and traffic-based monitoring locations near to MWI facilities, ambient concentrations of Cr were recorded to increase by 1.6 - 3.0 times when MWI emissions were detected, the actual contribution of MWI emissions to the ambient levels of Cr however was considered to be very small. The research also showed that traffic emissions were clearly identified as the main source of metals at one site in London and overall, the analysis found no evidence of incinerator emissions in ambient metal concentrations around four of the six MWIs considered.

Furthermore, it was noted that the EU Directive (2011/65/EU) (Restriction of the use of certain Hazardous Substances), limits the use of hazardous substances (including Cr (VI)) in electrical and electronic equipment. Emissions of heavy metals from incinerators are therefore expected to continually decrease which will have a beneficial impact on future emissions.

In reality, therefore ambient CrVI concentrations are considered unlikely to be exceeding the relevant EAL in the area around the facility. This is consistent with the Air Quality Assessment submitted as part of the original Permit Application for the consented EfW CHP facility currently under construction.

Dioxins and furans do not have an EAL so cannot be assessed in the same way and therefore the impact of this on human health is presented in the human health risk assessment (Appendix G). For the cumulative impacts of the EfW CHP facility and existing EfW facility operating in parallel, it has been demonstrated that the maximally exposed individual is not subject to a significant carcinogenic risk or non-carcinogenic hazard, arising from exposures via both inhalation and the ingestion of foods.

Ecological Receptors

At ecological receptors the maximum PECs during normal operation are all below 70% of the standard, except for annual mean NOx, 24 hour NOx and annual mean NH_3 (when compared to the standard for lichens and bryophytes). This data is shown in Table 41.

With regards to annual mean NOx, the maximum PEC for parallel operations at the Fithie Burn ecological receptor is 71.0% of the EAL.

[56] Font et. al 2015. Using metal ratios to detect emissions from municipal waste incinerators in ambient air pollution data. Atmospheric Environment, Volume 113, July 2015, Elsevier.

With regards to 24 mean NOx, the maximum PEC for parallel operations at the Fithie Burn ecological receptor is 77% of the EAL. The Fithie Burn is located directly adjacent to the existing EfW facility and the EfW CHP facility.

Whilst the predicted ground level concentrations are above the 70% PEC of the EAL threshold for annual mean and 24 hour NOx, the respective Critical Levels for both pollutants are not exceeded. It is not considered that the slight increase in nitrogen loading resulting from the small increase in NOx concentrations will have a material impact on any of the conservation objectives of the European designated sites. This has been agreed with the project Ecologists and is discussed in more detail in the accompanying Habitat Regulations Assessment[57] (HRA).

Predicted impacts of NH_3 also exceed the 70% PEC threshold when using the most stringent 1µg/m^3 criterion for sites featuring lichens and bryophytes. This is due to background concentrations already being at the EAL. Following consultation with the project Ecologists, the less stringent 3µg/m^3 criterion however for all sites without lichens and bryophtyes is considered most applicable. The impact at all ecological receptors for annual mean NH_3 is therefore considered to be negligible and the effect is not significant.

As shown in Appendix C, at ecological receptors the greatest predicted process contribution to nutrient nitrogen deposition, as a result of parallel operations and those sites where data is available, is <1% (0.74% of EAL), which is predicted at Barry Links.

Acid deposition at Barry Links is predicted to exceed the 1% PC threshold. The Predicted Environmental Deposition rate (PEDR), the sum of the process contribution to deposition and the background deposition rate, exceeds 70% of the Critical Load only where the background already exceeds. This is a result of existing deposition rates exceeding the minimum Critical Load values at the River Tay SAC and Barry Links SAC. It is therefore not envisaged that existing deposition rates will be adversely affected at European designated sites as a result of the parallel operation. Consequently, no significant impacts on qualifying SPA, SAC and Ramsar features are envisaged – the PC's are less than 1% of the critical load and are therefore insignificant. This is shown in Appendix C.

Although the impacts of this assessment have been agreed with the project Ecologists to be not significant, it is useful to note that this assessment is based on using the maximum emission limits, as is considered best practice guidance. This provides a conservative and worst-case assessment. It is known that the actual emissions can be lower than the maximum limits used, which could bring the PEC below 70% of the EAL for Fithie Burn.

[57] Arup, 2019. Habitat Regulations Assessment.

~~Table 39: Predicted maximum impact to air quality concentrations (μg/m³) resulting from emissions from existing EfW and the EfW CHP facility~~

~~**Pollutant**~~	~~**Averaging period**~~	~~**Environmental Assessment Level (EAL)**~~	~~**Baseline**~~	~~**Existing EfW Process Contribution (PC)**~~	~~**Proposed EfW PC**~~	~~**Combined Total PC**~~	~~**PC/ EAL**~~	~~**Predicted Environmental Contribution (PEC)**~~	~~**PEC/ EAL**~~
		~~ug/m³~~	~~ug/m³~~	~~ug/m³~~	~~ug/m³~~	~~ug/m³~~	~~%~~	~~ug/m³~~	~~%~~
~~PM_{10}~~	~~Annual mean~~	~~18~~	~~9.1~~	~~0.03~~	~~0.05~~	~~0.08~~	~~0.46%~~	~~9.2~~	~~51%~~
	~~24 hour mean, not to be exceeded more than 7 times per year~~	~~50~~	~~28.0~~	~~0.12~~	~~0.19~~	~~0.31~~	~~0.62%~~	~~28.3~~	~~57%~~
~~$PM_{2.5}$~~	~~Annual mean~~	~~10~~	~~5.50~~	~~0.03~~	~~0.05~~	~~0.08~~	~~0.83%~~	~~5.6~~	~~56%~~
~~NO_2~~	~~Annual mean~~	~~40~~	~~12.3~~	~~2.85~~	~~0.72~~	~~3.57~~	~~**8.93%**~~	~~15.9~~	~~40%~~
	~~1 hour mean, not to be exceeded more than 18 times per year~~	~~200~~	~~24.6~~	~~9.90~~	~~3.52~~	~~13.42~~	~~6.71%~~	~~38.1~~	~~19%~~
~~SO_2~~	~~24 hour mean, not to be exceeded more than 3 times per year~~	~~125~~	~~5.65~~	~~2.09~~	~~1.05~~	~~3.14~~	~~2.51%~~	~~8.8~~	~~7.0%~~
	~~1 hour mean, not to be exceeded more than 24 times per year~~	~~350~~	~~10.85~~	~~3.38~~	~~2.38~~	~~5.76~~	~~1.65%~~	~~16.6~~	~~4.7%~~
	~~15 minute mean, not to be exceeded more than 35 times per year~~	~~266~~	~~12.75~~	~~3.78~~	~~3.85~~	~~7.63~~	~~2.87%~~	~~20.4~~	~~7.7%~~
~~CO~~	~~Maximum 8 hour daily mean~~	~~10,000~~	~~90.0~~	~~0.57~~	~~2.05~~	~~2.62~~	~~0.03%~~	~~92.6~~	~~0.9%~~
~~VOC~~	~~Annual Mean~~	~~3.25~~	~~0.2~~	~~0.056~~	~~0.05~~	~~0.11~~	~~**3.31%**~~	~~0.3~~	~~10.7%~~

~~HCl~~	~~Annual mean~~	~~20~~	~~1.70~~	~~0.363~~	~~0.05~~	~~0.41~~	**~~2.07%~~**	~~2.1~~	~~10.6%~~
	~~1 hour maximum~~	~~750~~	~~3.40~~	~~7.74~~	~~1.67~~	~~9.41~~	~~1.25%~~	~~12.8~~	~~1.71%~~
~~HF~~	~~Annual mean~~	~~16~~		~~0.0002~~	~~0.01~~	~~0.01~~	~~0.03%~~	~~0.0~~	~~0.03%~~
	~~1 hour maximum~~	~~160~~		~~0.0049~~	~~0.17~~	~~0.17~~	~~0.11%~~	~~0.2~~	~~0.11%~~
~~Dioxins~~	~~No AQS~~	~~-~~	~~1.91x10^{-08}~~	~~1.20x10-09~~	~~5.14x10-10~~	~~1.72x10-09~~		~~0.0~~	
~~PAHs~~	~~Annual mean~~	~~0.0010~~	~~0.0001~~	~~2.71x10-04~~	~~7.10x10-05~~	~~3.42x10-04~~	**~~34.2%~~**	~~0.0~~	~~40%~~
~~Ammonia~~	~~24 hour maximum~~	~~180~~	~~1.92~~	~~0.08~~	~~0.13~~	~~0.21~~	~~0.12%~~	~~2.1~~	~~1.2%~~
	~~1 hour maximum~~	~~2500~~	~~1.92~~	~~0.34~~	~~0.83~~	~~1.18~~	~~0.05%~~	~~3.1~~	~~0.12%~~
~~Sb~~	~~Annual mean~~	~~5.0~~	~~2.00x10^{-04}~~	~~1.65x10-04~~	~~5.91x10-05~~	~~2.24x10-04~~	~~0.00%~~	~~4.24x10-04~~	~~0.01%~~
	~~1 hour maximum~~	~~150~~	~~4.00x10^{-04}~~	~~3.51x10-03~~	~~1.92x10-03~~	~~5.43x10-03~~	~~0.00%~~	~~5.83x10-03~~	~~0.00%~~
~~As~~	~~Annual mean~~	~~0.0060~~	~~2.00x10-04~~	~~1.55x10-04~~	~~1.28x10-04~~	~~2.83x10-04~~	**~~4.72%~~**	~~4.83x10-04~~	~~8.05%~~
	~~Annual mean~~	~~0.0030~~	~~2.00x10-04~~	~~1.55x10-04~~	~~1.28x10-04~~	~~2.83x10-04~~	**~~9.44%~~**	~~4.83x10-04~~	~~16.1%~~
	~~1 hour maximum~~	~~15~~	~~4.00x10-04~~	~~3.30x10-03~~	~~4.17x10-03~~	~~7.48x10-03~~	~~0.05%~~	~~7.88x10-03~~	~~0.05%~~
~~Cd~~	~~Annual mean~~	~~0.0050~~	~~2.60x10-05~~	~~2.05x10-04~~	~~2.57x10-04~~	~~4.62x10-04~~	**~~9.24%~~**	~~4.88x10-04~~	~~9.76%~~
	~~1 hour maximum~~	~~1.5~~	~~5.20x10^{-05}~~	~~4.38x10-03~~	~~8.35x10-03~~	~~1.27x10-02~~	~~0.85%~~	~~1.28x10-02~~	~~0.85%~~
~~Co~~	~~Annual mean~~	~~0.20~~	~~7.29x10-05~~	~~4.74x10-05~~	~~2.82x10-05~~	~~7.56x10-05~~	~~0.04%~~	~~1.48x10-04~~	~~0.07%~~
	~~1 hour maximum~~	~~6.0~~	~~1.46x10-04~~	~~1.01x10-03~~	~~9.18x10-04~~	~~1.93x10-03~~	~~0.03%~~	~~2.07x10-03~~	~~0.03%~~
~~Cu~~	~~Annual mean~~	~~2.0~~	~~1.77x10-03~~	~~3.40x10-04~~	~~1.49x10-04~~	~~4.89x10-04~~	~~0.02%~~	~~2.26x10-03~~	~~0.11%~~
	~~1 hour maximum~~	~~60~~	~~3.54x10-03~~	~~7.26x10-03~~	~~4.84x10-03~~	~~1.21x10-02~~	~~0.02%~~	~~1.56x10-02~~	~~0.03%~~
~~Cr~~	~~Annual mean~~	~~5~~	~~9.53x10-04~~	~~2.99x10-04~~	~~2.70x10-03~~	~~3.00x10-03~~	~~0.06%~~	~~3.95x10-03~~	~~0.08%~~
	~~1 hour maximum~~	~~150~~	~~1.91x10-03~~	~~6.39x10-03~~	~~1.54x10-02~~	~~2.17x10-02~~	~~0.01%~~	~~2.37x10-02~~	~~0.02%~~
~~Cr VI~~	~~Annual mean~~	~~2x10-04~~	~~1.91x10-04~~	~~1.76x10-06~~	~~7.70x10-07~~	~~2.53x10-06~~	**~~1.27%~~**	~~1.93x10-04~~	**~~96.6%~~**
~~Pb~~	~~Annual mean~~	~~0.50~~	~~1.03x10-03~~	~~2.17x10-04~~	~~2.59x10-04~~	~~4.76x10-04~~	~~0.10%~~	~~1.51x10-03~~	~~0.30%~~
~~Mn~~	~~24 hour maximum~~	~~150~~	~~2.27x10-03~~	~~4.99x10-03~~	~~1.61x10-03~~	~~6.60x10-03~~	~~0.00%~~	~~8.87x10-03~~	~~0.01%~~
	~~1 hour maximum~~	~~1500~~	~~2.27x10-03~~	~~2.14x10-02~~	~~1.00x10-02~~	~~3.14x10-02~~	~~0.00%~~	~~3.37x10-02~~	~~0.00%~~
~~Hg~~	~~Annual mean~~	~~0.25~~	~~9.00x10-04~~	~~1.00x10-04~~	~~2.57x10-04~~	~~3.57x10-04~~	~~0.14%~~	~~1.26x10-03~~	~~0.50%~~
	~~1 hour maximum~~	~~7.5~~	~~1.80x10-03~~	~~2.14x10-03~~	~~8.35x10-03~~	~~1.05x10-02~~	~~0.14%~~	~~1.23x10-02~~	~~0.16%~~
~~Ni~~	~~Annual mean~~	~~0.020~~	~~2.47x10-04~~	~~2.12x10-04~~	~~1.13x10-03~~	~~1.34x10-03~~	**~~6.71%~~**	~~1.59x10-03~~	~~7.95%~~

	~~1 hour maximum~~	~~30~~	~~4.94x10-04~~	~~4.53x10-03~~	~~3.67x10-02~~	~~4.13x10-02~~	~~0.14%~~	~~4.18x10-02~~	~~0.14%~~
~~Tl~~	~~Annual mean~~	~~1.0~~		~~9.91x10-05~~	~~2.57x10-04~~	~~3.56x10-04~~	~~0.04%~~	~~3.56x10-04~~	~~0.04%~~
	~~1 hour maximum~~	~~30~~		~~2.11x10-03~~	~~8.35x10-03~~	~~1.05x10-02~~	~~0.03%~~	~~1.05x10-02~~	~~0.03%~~
~~V~~	~~Annual mean~~	~~5.0~~	~~5.10x10-04~~	~~7.32x10-05~~	~~3.08x10-05~~	~~1.04x10-04~~	~~0.00%~~	~~6.14x10-04~~	~~0.01%~~
	~~24 hour maximum~~	~~1.0~~	~~1.02x10-03~~	~~3.65x10-04~~	~~1.61x10-04~~	~~5.26x10-04~~	~~0.05%~~	~~1.55x10-03~~	~~0.15%~~

Table 40: Predicted maximum impact to air quality concentrations (µg/m^3) resulting from emissions from the existing EfW and the EfW CHP facilities operating in parallel.

Pollutant	**Averaging period**	**Environmental Assessment Level (EAL)**	**Baseline**	**Existing EfW Process Contribution (PC)**	**Proposed EfW PC**	**Combined Total PC**	**PC/ EAL**	**Predicted Environmental Contribution (PEC)**	**PEC/ EAL**
		µg/m^3	**µg/m^3**	**µg/m^3**	**µg/m^3**	**µg/m^3**	**%**	**µg/m^3**	**%**
PM_{10}	Annual mean	18	9.1	0.03	0.05	0.08	0.46%	9.2	51.0%
	24 hour mean, not to be exceeded more than 7 times per year	50	28.0	0.12	0.19	0.31	0.62%	28.3	56.6%
$PM_{2.5}$	Annual mean	10	5.50	0.03	0.05	0.08	0.83%	5.6	55.8%
NO_2	Annual mean	40	12.3	2.85	0.72	3.57	**8.93%**	15.9	39.7%
	1 hour mean, not to be exceeded more than 18 times per year	200	24.6	9.90	3.52	13.42	6.71%	38.1	19.0%
SO_2	24 hour mean, not to be exceeded more than 3 times per year	125	5.65	2.09	1.05	3.14	2.51%	8.8	7.03%
	1 hour mean, not to be exceeded more than 24 times per year	350	10.85	3.38	2.38	5.76	1.65%	16.6	4.75%

	15 minute mean, not to be exceeded more than 35 times per year	266	12.75	3.78	3.85	7.63	2.87%	20.4	7.66%
CO	Maximum 8 hour daily mean	10,000	90.0	0.57	2.05	2.62	0.03%	92.6	0.93%
	Maximum1 hour daily	30,000	180	0.09	8.35	8.44	0.03%	188	0.63%
VOC	Annual Mean	3.25	0.24	0.06	0.05	0.11	**3.31%**	0.35	10.7%
HCl	Annual mean	20	1.70	0.36	0.05	0.41	**2.07%**	2.11	10.6%
	1 hour maximum	750	3.40	7.74	1.67	9.41	1.25%	12.8	1.71%
HF	Annual mean	16	-	2.28x10^{-04}	0.01	0.01	0.03%	0.01	0.03%
	1 hour maximum	160	-	4.87x10^{-03}	0.17	0.17	0.11%	0.17	0.11%
Dioxins	No AQS	-	1.68x10^{-07}	1.20x10^{-09}	5.14x10^{-10}	1.72x10^{-09}	-	1.69x10^{-07}	-
PAHs	Annual mean	0.001	6.00x10^{-05}	2.71x10^{-04}	7.10x10^{-05}	3.42x10^{-04}	**34.2%**	4.02x10^{-04}	40.2%
Ammonia	Annual mean	180	0.89	0.08	0.13	0.21	0.12%	1.10	0.61%
	1 hour maximum	2500	1.78	0.34	0.83	1.18	0.05%	2.96	0.12%
Sb	Annual mean	5.0	5.43x10^{-04}	1.65x10^{-04}	5.91x10^{-05}	2.24x10^{-04}	<0.01%	7.67x10^{-04}	0.02%
	1 hour maximum	150	1.09x10^{-03}	3.51x10^{-03}	1.92x10^{-03}	5.43x10^{-03}	<0.01%	6.52x10^{-03}	<0.01%
As	Annual mean	0.006	8.15x10^{-04}	1.55x10^{-04}	1.28x10^{-04}	2.83x10^{-04}	**4.72%**	1.10x10^{-03}	18.3%
	Annual mean	0.003	8.15x10^{-04}	1.55x10^{-04}	1.28x10^{-04}	2.83x10^{-04}	**9.44%**	1.10x10^{-03}	36.6%
	1 hour maximum	15	1.63x10^{-03}	3.30x10^{-03}	4.17x10^{-03}	7.48x10^{-03}	0.05%	9.11x10^{-03}	0.06%
Cd	Annual mean	0.0050	1.96x10^{-04}	2.05x10^{-04}	2.57x10^{-04}	4.62x10^{-04}	**9.24%**	6.58x10^{-04}	13.2%
	1 hour maximum	1.5	3.92x10^{-04}	4.38x10^{-03}	8.35x10^{-03}	1.27x10^{-02}	0.85%	1.31x10^{-02}	0.87%
Co	Annual mean	0.20	1.14x10^{-04}	4.74x10^{-05}	2.82x10^{-05}	7.56x10^{-05}	0.04%	1.89x10^{-04}	0.09%
	1 hour maximum	6.0	2.28x10^{-04}	1.01x10^{-03}	9.18x10^{-04}	1.93x10^{-03}	0.03%	2.16x10^{-03}	0.04%
Cu	Annual mean	2.0	7.35x10^{-03}	3.40x10^{-04}	1.49x10^{-04}	4.89x10^{-04}	0.02%	7.83x10^{-03}	0.39%
	1 hour maximum	60	1.47x10^{-02}	7.26x10^{-03}	4.84x10^{-03}	1.21x10^{-02}	0.02%	2.68x10^{-02}	0.04%
Cr	Annual mean	5.0	3.13x10^{-03}	2.99x10^{-04}	2.70x10^{-03}	3.00x10^{-03}	0.06%	6.13x10^{-03}	0.12%
	1 hour maximum	150	6.27x10^{-03}	6.39x10^{-03}	1.54x10^{-02}	2.17x10^{-02}	0.01%	2.80x10^{-02}	0.02%

Cr VI	Annual mean	2.0x10^{-04}	6.27x10^{-04}	1.76x10^{-06}	7.70x10^{-07}	2.53x10^{-06}	**1.27%**	6.29x10^{-04}	**315%***
Pb	Annual mean	0.50	9.90x10^{-03}	2.17x10^{-04}	2.59x10^{-04}	4.76x10^{-04}	0.10%	1.04x10^{-02}	2.08%
Mn	Annual mean	0.15	6.08x10^{-03}	1.00x10^{-03}	3.08x10^{-04}	1.31x10^{-03}	0.87%	7.39x10^{-03}	4.93%
	24 hour maximum	150	0.012	4.99x10^{-03}	1.61x10^{-03}	6.60x10^{-03}	<0.01%	0.02	0.01%
	1 hour maximum	1500	0.012	2.14x10^{-02}	1.00x10^{-02}	3.14x10^{-02}	<0.01%	0.04	<0.01%
Hg	Annual mean	0.25	1.92x10^{-03}	1.00x10^{-04}	2.57x10^{-04}	3.57x10^{-04}	0.14%	2.28x10^{-03}	0.91%
	1 hour maximum	7.5	3.84x10^{-03}	2.14x10^{-03}	8.35x10^{-03}	1.05x10^{-02}	0.14%	1.43x10^{-02}	0.19%
Ni	Annual mean	0.020	1.88x10^{-03}	2.12x10^{-04}	1.13x10^{-03}	1.34x10^{-03}	**6.71%**	3.22x10^{-03}	16.1%
	1 hour maximum	30	3.75x10^{-03}	4.53x10^{-03}	3.67x10^{-02}	4.13x10^{-02}	0.14%	4.50x10^{-02}	0.15%
Tl	Annual mean	1.0	-	9.91x10^{-05}	2.57x10^{-04}	3.56x10^{-04}	0.04%	3.56x10^{-04}	0.04%
	1 hour maximum	30	-	2.11x10^{-03}	8.35x10^{-03}	1.05x10^{-02}	0.03%	1.05x10^{-02}	0.03%
V	Annual mean	5.0	1.61x10^{-03}	7.32x10^{-05}	3.08x10^{-05}	1.04x10^{-04}	<0.01%	1.72x10^{-03}	0.03%
	24 hour maximum	1.0	3.23x10^{-03}	3.65x10^{-04}	1.61x10^{-04}	5.26x10^{-04}	0.05%	3.75x10^{-03}	0.38%
*Background data used in the assessment for chromium VI were already 313% of the relevant EAL. The backgrounds concentrations were assumed to be 20% of the value used for chromium (in-line with EA guidance), which was estimated following a UK-wide review of the metals monitoring network.									

Table 41: Predicted maximum impact to air quality concentrations (µg/m^3) at ecological receptors resulting from emissions from the existing EfW and the EfW CHP facilities operating in parallel.

Pollutant	**Averaging period**	**EAL (µg/m^3)**	**Background concentration (µg/m^3)**	**Existing EfW PC (µg/m^3)**	**Proposed EfW PC (µg/m^3)**	**Total PC (µg/m^3)**	**PC / EAL (%)**	**PEC / EAL (%)**	**Meets EAL?**
NO_x	Max 24-hour mean	75	32.0	22.1	3.7	25.8	34%	77.1%	Y
	Annual mean	30	16.0	4.72	0.79	5.51	18%	71.7%	Y
SO_2	Annual mean [a]	10	2.3	0.58	0.20	0.77	8%	30.7%	Y
	Annual mean	20	2.3	0.58	0.20	0.77	4%	15.4%	Y
NH_3	Annual mean [a]	1	0.89	0.02	0.02	0.04	4%	92.8%	N*

	Annual mean	3	0.89	0.02	0.02	0.04	1%	30.9%	Y
HF	Max 24-hour mean	5	-	<0.01	0.02	0.02	0%	0.40%	Y
HF	Max weekly mean	0.5	-	<0.01	0.02	0.02	3%	3.40%	Y
*Ammonia (NH_3) background already 89% of EAL for lichen and bryophytes. [a] More stringent ecological limit for habitats with lichen and bryophytes present.									

7.3 Impact of Parallel Operations – Implications of upcoming BREF Limit Values

In December 2019, the European IPPC Bureau issued the Final Issue of the Waste Incineration BREF document[58]. As such, consideration has been made as to the potential implications of more stringent flue gas 'associated emission limits' (BAT-AELs) on the ground level concentrations, as it is likely that both the existing EfW and the EfW CHP facility will need to comply with these emissions limits in the future.

For the purposes of this study, as agreed with SEPA, the BREF BAT-AELs have only been applied to the EfW CHP facility. MVV has confirmed however that the existing EfW facility will be able to meet reduced BAT-AELs that are likely to be applied by SEPA.

Only those pollutants whereby proposed BREF BAT-AELs are more stringent than those emission limits in the IED have been considered as discussed earlier.

It is also assumed for this study that the efflux characteristics of the exhaust gases remain the same. It is possible that through the introduction of additional abatement required to meet these BAT-AELs, the efflux parameters may be affected (temperature, velocity etc) and dispersion will be affected. These results should therefore be viewed as indicative only.

The purpose of the more stringent AELs is to reduce pollutant emissions. As a result, it is expected that this will naturally have a beneficial effect on air quality with lower predicted ground level concentrations compared to IED.

Table 42 and Table 43 details the potential effect of the the more stringent BAT-AELs set out in the BREF from the EfW CHP facility.

The corresponding emissions limits which have been reduced from the IED to the BREF have also been included for transparenct. To be conservative, the upper limit within each of the BAT-AEL ranges has been used in this study, as marked in **bold**.

58 https://eippcb.jrc.ec.europa.eu/sites/default/files/2020-01/JRC118637_WI_Bref_2019_published_0.pdf <<Accessed February 2020>>

Table 42: Predicted maximum impact to air quality concentrations (µg/m³) resulting from BREF emission limits at the EfW CHP facility

Pollutant	**Averaging period**	**EAL**	**Baseline**	**Total PC BREF**	**Total PC with BREF / EAL**	**IED Emission Limit**	**New BREF Emission Limit Range (BAT-AELs)**
		ug/m³	**ug/m³**	**ug/m³**	**%**		
PM_{10}	Annual mean	18	9.1	0.057	0.32%	10 mg/m³ (as Total Dust / PM)	<2-**5** mg/m³
	24 hour mean, not to be exceeded more than 7 times per year	50	28.0	0.21	0.43%		
$PM_{2.5}$	Annual mean	10	5.5	0.057	0.23%		
NO_2	Annual mean	40	12.3	2.90	**7.25%**	200 mg/m³	New plant: 50-**120** mg/m³ Existing plant: 50-**150** mg/m³
	1 hour mean, not to be exceeded more than 18 times per year	200	24.6	10.7	5.34%		
Dioxins (PCDD/F)	No AQS	-	$1.68x10^{-07}$	$1.62x10^{-09}$	-	0.1 ng I-TEQ/Nm³	New plant:<0.01-**0.06** ng I-TEQ/Nm³ Existing plant:<0.01-**0.08** ng I-TEQ/Nm³ (Long term sampling period)
Cd	Annual mean	0.0050	$1.96x10^{-04}$	$3.08x10^{-04}$	6.16%	0.05 mg/m³	<0.005-**0.02** mg/m³
	1 hour maximum	1.5	$3.92x10^{-04}$	$7.72x10^{-03}$	0.51%		
Hg	Annual mean	0.25	$1.92x10^{-03}$	$1.51x10^{-04}$	0.06%	50 µg/m³	New plant: 1-**10** µg/m³ Existing plant: 1-**10** µg/m³ (Long term sampling period)
	1 hour maximum	7.5	$3.84x10^{-03}$	$3.81x10^{-03}$	0.05%		
Tl	Annual mean	1.0	-	$2.02x10^{-04}$	0.02%	0.05 mg/m³	<0.005-**0.02** mg/m³
	1 hour maximum	30	-	$5.45x10^{-03}$	0.02%		

Table 43: Predicted maximum impact to air quality concentrations (µg/m^3) at ecological receptors resulting from BREF emission limits at the EfW CHP facility

Pollutant	Averaging period	EAL	Baseline	Total PC BREF	Total PC with BREF / EAL	Total PEC BREF	Total PEC with BREF / EAL
		ug/m^3	ug/m^3	ug/m^3	%	ug/m^3	%
NOx	Max 24-hour mean	75	32.0	21.4	28%	53.4	71.2%
	Annual mean	30	16.0	4.44	15%	20.5	68.2%

7.4 Plume Visibility

~~Water in the emitted gases from the proposed EfW CHP can condense and form a visible plume. The ADMS model calculates the occurrence of visible plumes and their length using the efflux parameters and mixing ratio: the kg of water in the plume per kg of dry air. The mixing ratios used in the modelling were:~~

- ~~DERL: 0.0931 kg/kg~~
- ~~EfW CHP facility: 0.0993 kg/kg~~

~~The predicted plume lengths are shown in Figure 17 for the existing DERL plant and the proposed EfW CHP. The chart shows the frequency of predicted plume lengths at various increments of plume length. It is predicted that from the EfW CHP facility there would be visible plumes greater than 20m in length during 45 hours of the year compared with 5 hours of the year for the existing DERL facility. Although there is a predicted increase in the number of visible plumes over 20m, they are predicted to occur for just 0.5% of the time.~~

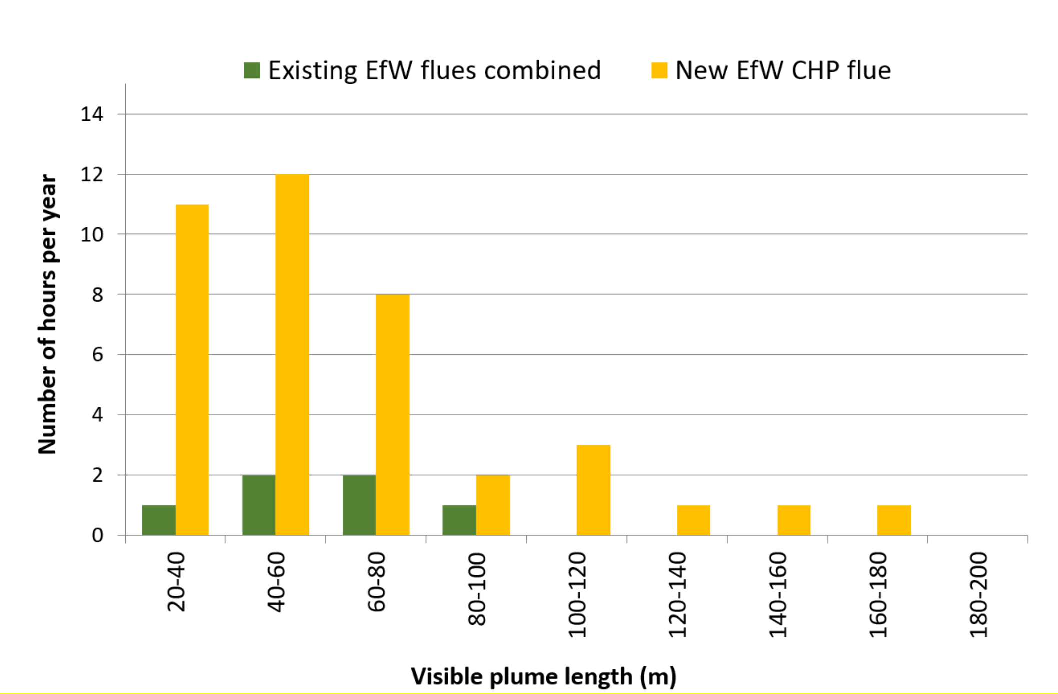
Water in the emitted gases from the EfW CHP facility which is under construction can condense and form a visible plume. The ADMS model calculates the occurrence of visible plumes and their length using the efflux parameters and mixing ratio: the kg of water in the plume per kg of dry air. The mixing ratios used in the modelling were:

- existing EfW facility: 0.0931 kg/kg
- EfW CHP facility: 0.0993 kg/kg

The predicted plume length is shown in Figure 17 for the existing facility and the proposed EfW facility. The chart shows the frequency of predicted plume lengths at various increments of plume length. It is predicted that from the parallel operation of the facilities there would be visible plumes greater than 20m in length during 45 hours of the year.

There is no guidance available from an air quality perspective for the assessment of significance of a visible plume. Significance of the plume has been discussed in the Landscape and Visual Impact chapter of the Environmental Statement.

Figure 17: Visible plume length by number of hours per year



7.5 Assessment of Significance

Taking into consideration the existing air quality conditions in the area, the predicted changes in pollutant concentrations due to the Proposed Scheme and the associated impacts, it is likely that effects on local air quality will arise from the operation of the new EfW CHP and the existing EfW will be **not significant**.

8 Odour Assessment

A qualitative assessment has been undertaken, following the SEPA guidance, to determine the impact of the Proposed Scheme on odour. The area immediately surrounding the proposed development is predominantly industrial with some odour likely generated due to existing activities. There are community facilities such as the cycle racing track and sports ground within 120m of the proposed site boundary where amenity could be impacted as a result of the proposed development. The closest residential properties to the Application Site boundary are approximately 150m to the north of the site, but the residential receptors 320m to the south, are closer to the potential odour source, the waste reception buildings.

Typical wind conditions in the area have been established using meteorological data from the RAF Leuchars as discussed in section 4.3.2.1. This shows that the predominant wind direction is westerly/south-westerly. Locations downwind of odorous sources at the proposed development are therefore more likely to be affected. Meteorological conditions will affect frequency, duration and intensity of odours for receptors depending on their direction from the proposed development.

8.1 Odour Sources

Potential odour emission sources from the proposed development comprise:

- The waste reception buildings comprising;
  - The existing EfW ~~DERL~~ facility tipping hall ~~for bulky waste~~; and
  - The EfW CHP facility tipping hall and adjacent waste storage bunker.

Waste tipping will be carried out within a contained environment. Vehicles delivering waste to the EfW CHP facility will enter the tipping hall and tip waste into the waste bunker.

Odour emissions from the waste reception building may occur from the air released when the main door is opened to admit the waste vehicles, however, the building is designed to be kept under negative pressure, created by the internal air extraction for use in the combustion process. The air for combustion will be drawn from the waste bunker, which will in turn draw the air from the tipping hall. During periods when no waste delivery is programmed, including during the night-time, the tipping hall roller shutter door will be kept closed.

The air flow will pass from the openings in the tipping hall, including the vehicle access door and wall vents, through the waste tipping chutes into the waste storage bunker and then into the combustion process, via the primary combustion air system. The combustion process would destroy any odorous compounds.

Bunker management procedures will be employed to avoid the development of anaerobic conditions. This will include mixing and frequent turnover of waste in the bunker so that waste does not accumulate. Waste will be well mixed to ensure minimum time in the bunker which reduces the potential for generation of odour.

The waste bunker is equipped with an off-line ventilation facility which provides an air change rate of up to twice the storage area volume per hour. The air is drawn into the waste bunker via the tipping hall, and therefore provides containment of odour from the tipping area. The air is cleaned by a separate activated carbon and dust filter and vented from a discharge at the top of the facility building, to ensure no odour or dust release to the environment.

~~8.2 Pathway~~

~~The potentially odorous sources associated with the proposed development are located to the south of the site. The predominant wind direction in this area is westerly/south-westerly so the most affected areas are to the east/north-east of the Application Site.~~

~~8.3 Receptor~~

~~The closest residential receptors to the waste reception buildings lie approximately 320m to the south, to the south of Ballunie Drive and 270m to the north, north of Drumgeith Road. A high level of amenity would be afforded to residents therefore the receptor sensitivity is high.~~

~~There are commercial/industrial properties and community facilities within 150m of potentially odorous sources. These locations are considered to be of medium sensitivity and are expected to enjoy a reasonable level of amenity.~~

~~A greater distance of sensitive properties from the proposed development is beneficial as this provides areas where dispersion of odours can occur prior to amenity of properties being affected.~~

8.4 FIDOL assessment

The aspects of an odour impact described by the FIDOL acronym have been assessed:

8.4.1 Frequency

The process of receiving~~, sorting~~ and storing waste will be undertaken in the enclosed existing EfW ~~DERL~~ facility tipping hall ~~for bulky waste~~ and the EfW CHP facility tipping hall/waste bunker for bulky and non-bulky waste[59]. There is the potential for the release of odours when vehicles are delivering waste to the site which can occur throughout the day (07:00 to 20:00) 7 days a week. There are no night time waste deliveries.

[59] Only bulky waste screened by Councils will go to EfW CHP for direct tipping and feeding to boiler ~~There will be only minimal sorting of e.g. bulky and trade waste – which is a small proportion of the overall waste handled.~~

8.4.2 Intensity

The majority of processes on site will not emit odours. Where odorous activities are undertaken on site, these will be controlled where possible, and undertaken in an enclosed area. The air extraction system will exhaust the extracted air via the combustion process or via an activated carbon filter. In both cases the intensity of the odours released from the site is likely to be low. However, the potential for odour release at these times is minimised by the mitigation measures described above.

~~8.4.3 Duration~~

~~Waste vehicles would arrive at the proposed development to deliver waste up to 7 days a week (not at night). However, the potential for odour during these times is reduced by the mitigation (such as negative pressure and the door being closed when deliveries are not expected).~~

8.4.4 Offensiveness

The main potential source of odour is the tipping hall and waste bunker. Odours from waste could be considered unpleasant and to be moderately offensive.

8.4.5 Location Sensitivity

~~Residential receptors are high sensitivity receptors. The closest lie 320m to the south and 270m to the north of odorous sources within the Proposed Scheme. Commercial/industrial properties and community facilities are medium sensitivity receptors. The closest lie 150m to the north.~~

The potentially odorous sources associated with the EfW CHP facility are located to the south of the site. The predominant wind direction in this area is westerly/south-westerly so the most affected areas are likely to be to the east/north-east of the Application Site.

Residential receptors are considered to be high sensitivity receptors. The closest residential receptors lie 320m to the south (to the south of Ballunie Drive) and 270m to the north (north of Drumgeith Road) of odorous sources within the EfW CHP facility site. There are commercial/industrial properties and community facilities within 150m of potentially odorous sources.

8.5 Odour Quantitative Assessment

In-line with best practice guidance, quantitative assessment of odour has also been conducted using ADMS 5 dispersion modelling to determine the likely odour concentrations emitted from parallel operations during normal operating conditions and when the incineration process is not operating during maintenance periods.

The model requires odour emission rates as input, obtained for each of the significant odour sources on site. These are used by the dispersion model in combination with local meteorological conditions to derive the odour concentrations at the site.

8.5.1 Overview

During normal operating conditions, odorous air will be extracted from each of both existing EfW facility and EfW CHP facility waste bunkers and used in the combustion process. The high combustion temperatures destroy the odorous compounds in the incoming air before the flue gases are exhausted through the respective 70m and 90m main facility stacks. In addition, at the existing EfW facility only, an Odour Abatement System is in operation continuously to extract air principally from the Refuse Derived Fuel (RDF) store (but also from the hammermill and conveyor areas) and discharge to atmosphere via a dedicated vent.

When the incineration process is not operational, for instance during maintenance periods, at the EfW facility the odorous air will be continue to be extracted through the Odour Abatement System. At the EfW CHP facility, odorous air will be extracted from the waste bunkers and released to atmosphere after passing through an activated carbon and dust filtration system.

Potential odour impacts arising from the following activities have been assessed:

a) Parallel operation of the existing EfW facility and the EfW CHP facility during normal operating conditions;

b) Parallel operation of the existing EfW and the EfW CHP facility when there are no main combustion stack emissions, for instance during maintenance periods, based on odour sampling data at the facility; and

c) Parallel operation of the existing EfW facility and the EfW CHP facility when there are no main combustion stack emissions, based on the permitted odour emission limit values (ELV) at the facility.

Methodology

The SEPA and Natural Scotland 2010 Odour Guidance[31] provides indicative criteria for significant odour pollution. The guidance proposes a range of criteria that depend on the relative offensiveness of the odour and are based on the annual 98th percentile of hourly mean odour concentrations. The guidance also sets locally adjusted criteria to be used for hypersensitive populations or where such odour is likely to generate a high level of complaints:

- 1.5ou_E/m^3 for most offensive odours (eg. processes involving decaying animal remains) (*1.0 ou_E/m^3 for hypersensitive populations*);
- 3ou_E/m^3 for moderately offensive odours (eg. fat frying) (2.5 *ou_E/m^3 for hypersensitive populations*); and
- 6ou_E/m^3 for less offensive odours (eg. baking) (*5.5 ou_E/m^3 for hypersensitive populations*).

Odour from the waster bunker is best described as moderately offensive. In the results sections the predicted odour concentrations have been compared with all three odour criteria.

8.6 Odour Dispersion Modelling

The model requires odour emission rates as input, obtained for each of the significant odour sources on site. These are used by the dispersion model in combination with local meteorological conditions to derive the odour concentrations from the facilities.

The overall approach to the quantitative odour assessment comprises:

- Identification of odour emission sources;
- Assessment of likely odour emissions from each source;
- Identification of the output domain and specified sensitive receptors;
- Set up of a suitable dispersion model to represent each odour source and to include suitable meteorological data;
- Running the dispersion model to predict the 98th percentile of hourly means; and
- Preparing tables of results and/or contour plots of the results and comparing with an appropriate standard.

Dispersion modelling has been carried out using the ADMS 5 software to determine the likely odour concentrations emitted from the EfW CHP facility during normal operating conditions and when the incineration process is not operating during maintenance periods.

8.6.1 Model Set-up

The model runs were set out in Section 4.2 of the permitting report[60] and the same meteorological parameters, terrain data, residential receptors and contour domain were used in the model runs for odour dispersion modelling. The sources were modelled as point sources.

Input data

The vent parameters and emission rates used for modelling during operational and maintenance periods are listed in Table 44.

The odour emission rates in ou_E/s have been calculated from the volumetric flow rate and odour concentrations obtained at the existing EfW facility[61]. In the

[60] Arup (2017), Dundee EfW CHP Facility, Air Quality Assessment for Permitting.
[61] ADAS, 2019. Odour Concentration Assessment (Olfactometry) to Evaluate Odour Emissions at the Plant Air Extraction Stack at the MVV Environment Baldovie Ltd (MEB) Waste to Energy Plant. Stack Odour Emissions Report, May 2019

absence of data for the EfW CHP facility, odour emission rates have been assumed to be the same as those sampled in the existing facility.

The receptors relevant to the assessment include residential properties, schools, hospitals and community facilities. Discrete human receptors have been selected based on relevant sensitive receptors in the vicinity of the facility, at a spread of locations around the EfW CHP facility site. They are the same human receptors as in the main air quality assessment. The locations of the human receptors are shown in Figure 4 and details are presented in Appendix A. These human receptors have been modelled at heights of 1.5m and 7.5m, representative of inhalation height at ground level and at third floor respectively[62].

[62] The discrete receptors included in the assessment were agreed with Dundee City Council Environmental Health as part of the original Air Quality Assessment and PPC Permit Variation for the new EfW CHP facility

Table 44: Emission parameters during operational and maintenance conditions

Parameter	Units	Normal Operations	Maintenance Period using Sampled Odour Emission Concentrations		Maintenance Period using Permitted Odour Emission Limit Values	
		Existing EfW Facility	Existing EfW Facility	EfW CHP Facility	Existing EfW Facility	EfW CHP Facility
Stack/release height	m	40	40	38.8	40	38.8
Internal diameter at exhaust	m	1.2	1.2	1.2	1.2	1.2
Volume flow rate	Am^3/s	16.7	16.7	16.7	16.7	16.7
Efflux temperature	°C	10	10	10	10	10
Efflux velocity	m/s	14.7	14.7	14.7	14.7	14.7
Exit odour concentration	ou_E/m^3	2,342	2,342	2,342	6,000*	3,000*
Odour emission rate	ou_E/s	39,065	39,065	39,065	100,800	50,040
*Odour Emission Limit Values as specified in current Permit						

8.7 Odour Modelling Results

The 1 hour 98th percentile odour concentrations at the specified receptors for the three assessed scenarios, are shown in Appendix E.

The results show that the most stringent criterion of 1.0ou_E/m^3, applicable for 'hypersensitive populations', is not exceeded at any of the receptors considered for the normal operating scenario.

Exceedances of the 1.0 ou_E/m^3 criterion are predicted at one receptor location in the upset scenario (maintainance period) up to a maximum of 1.1 ou_E/m^3, which is Receptor 34 - the BMW track. The BMX track is not considered as a hypersensitive population as this is an outdoor location.

Exceedances of the 1.0 ou_E/m^3 criterion are predicted at 19 receptor locations when considering a maintenance scenario using the SEPA permitted emission limit values, up to a maximum of 2.1 ou_E/m^3. The 19 receptor locations are:

- Receptor 2 - 41 Ashkirk Gardens
- Receptor 3 - 24 Ashkirk Gardens
- Receptor 4 - 2 Montpellier Gardens
- Receptor 5 - 1 Montpellier Gardens
- Receptor 6 - Baldovie Cottage West
- Receptor 9 - Michelin Athletic Club
- Receptor 10 - Baldovie Cottage
- Receptor 11 - Jubilee Cottage
- Receptor 19 - Tayside Police
- Receptor 22 - 168 Balunie Drive
- Receptor 34 - BMX Track
- Receptor 35 - Civic Amenity Site
- Receptor 36 - Football Pitch
- Receptor 85 - 130 Balunie Drive at height
- Receptor 90 - The Toll House
- Receptor 101 - Baldovie/Drumgieth Road diffusion tube location
- Receptor 102 - DT - Drumgeith Road diffusion tube location
- Receptor 106 - DT - Balmerino Road diffusion tube location
- Receptor 108 - DT - Baldovie Road diffusion tube location

This conservative maintenance scenario modelled at SEPA limits is considered highly unlikely to occur, based on historic odour monitoring data at the facility.

8.8 Summary

~~The assessment of odour effects has identified that the impact of odour is likely to be small, assuming that odour is minimised at source by use of good bunker management procedures and controlled through the application of Best Available Techniques (BAT), as required by the environmental permit, for instance use of the proposed odour control unit. An Odour Management Plan will be produced as part of the environmental permit application. The derivation of odour impact used the Sourcx10-Pathway-Receptor model which take into account the FIDOL qualitative method.~~

~~Using the criteria set out in Table 25, the Proposed Development is considered to be small in impact when the planned mitigation is required. The receptors have a high sensitivity and are relatively far from the source. The operation would therefore have a negligible effect on odour concentrations at sensitivity receptors. The changes in odour as a result of the Proposed Development are considered to be **not significant**.~~

The assessment of odour effects has identified that the impact of parallel operations is likely to be small, assuming that odour is minimised at source by use of good bunker management procedures and controlled through the application of Best Available Techniques (BAT), as required by the environmental permit, for instance, use of the proposed bunker ventilation system in the EfW CHP facility. An Odour Management Plan will be produced as part of the environmental permit application.

The derivation of odour impact used the FIDOL qualitative method; and the Proposed Scheme is considered to result in a small impact, that will be not significant, with the application of planned mitigation. Sensitive receptors are also relatively far from the source and not downwind under prevailing wind conditions.

Dispersion modelling has also been undertaken with regards to assessing the potential impact of the parallel operations on odour nuisance.

Under normal operational conditions and routine maintenance conditions, the potential impact was found to be not significant. A number of sensitive receptor locations were predicted to experience odour concentrations above SEPA's most stringent criterion of $1_{OUE}/m^3$, when considering maintenance conditions at both facilities, based on the maximum odour Emission Limit Values in the existing Permit. This conservative maintenance scenario however is considered highly unlikely to occur, based on historic odour monitoring data at the facility.

9 Cumulative effects

~~9.1 Introduction~~

~~The cumulative assessment considers two future scenarios as described in section 4.3:~~

~~(C) the proposed EfW CHP facility operating on diesel during hot commissioning and the DERL facility burning waste; and~~

~~(D) the proposed EfW CHP facility and Michelin boiler plant, running together.~~

~~9.2 Proposed EfW CHP during hot commissioning and DERL burning waste~~

~~This assessment considers the cumulative impact on pollutants that would arise from the combustion of diesel (i.e. NO_2, CO, PM_{10} and SO_2) at the proposed EfW CHP facility. Other pollutants that are emitted by the DERL facility would not be emitted from the proposed EfW CHP facility operating on diesel and so there would be no cumulative impact. Only short term statistics (not annual means) are presented as the hot commissioning will only last around 1.5 months. The results are shown in Table 40. It shows:~~

~~a) estimated background concentrations;~~

~~b) background + DERL; and~~

~~c) background + DERL + proposed EfW CHP.~~

~~The results are presented for the maximum resulting concentration (background + DERL + proposed EfW CHP) for the gridded and sensitive receptors - not the maximum change as a result of the emissions from the proposed EfW CHP.~~

~~The impact of adding the hot commissioning emissions to those of DERL operating on waste is **negligible** and all concentrations are below the relevant air quality standards. The impact is therefore not significant.~~

~~9.3 Proposed EfW CHP Facility plus Michelin Boilers~~

~~This assessment considers the cumulative impact of operation of the proposed EfW CHP facility in combination with boilers operating at Michelin (i.e. one boiler operating at 80% load and one on standby at 20% load with the 3rd not operating).~~

~~This is a worst-case assessment as most of the time when the proposed EfW CHP is operating it will deliver steam to the Michelin works and therefore the boilers at Michelin will not be operating or may be on standby. The only potential for cumulative impact is from emissions of NOx as the Michelin boilers are gas-fired.~~

~~Emissions of other pollutants (e.g. PM_{10}) will be negligible from Michelin. The results are shown in Table 41.~~

~~The impact of operating the Michelin boilers running concurrently with the proposed EfW CHP results in a **beneficial** predicted impact to air quality, compared to the current situation of DERL + Michelin.~~

9.4 Introduction

The cumulative assessment considers four future scenarios as described in section 4.3:

(D) the EfW CHP operating on diesel during hot commissioning and the existing EfW facility burning waste;

(E) the EfW CHP burning waste, the existing EfW facility burning waste and Michelin boiler plant, running together for normal operations;

(F) the EfW CHP operating on diesel during hot commissioning, the existing EfW facility burning waste, and Michelin boiler plant for normal operations all running together; and

G) the EfW CHP burning waste, the existing EfW facility burning waste and Michelin boiler plant, all running at maximum capacity;

9.5 EfW CHP Facility During Hot Commissioning (option D)

This assessment considers the cumulative impact on pollutants that would arise from the combustion of diesel (i.e. NO_2, CO, PM_{10} and SO_2) at the EfW CHP during hot commissioning, and the existing EfW facility burning waste. Other pollutants that are emitted by the existing EfW facility would not be emitted from the EfW CHP facility operating on diesel and so there would be no cumulative impact. The results are shown in Table 45.

The impact of adding the hot commissioning emissions to those of the existing EfW facility operating on waste is negligible and all concentrations are below the relevant air quality standards. The impact is therefore not significant.

9.6 Parallel Operations Plus Michelin Boilers – Normal (option E)

This assessment considers the cumulative impact of operation of the existing EfW facility and the EfW CHP facility both burning waste in combination with boilers operating at Michelin (i.e. one boiler operating at 80% load and one on standby at 20% load with the 3rd not operating).

The only potential for cumulative impact is from emissions of NOx as the Michelin boilers are gas-fired. Emissions of other pollutants (e.g. PM_{10}) will be negligible from Michelin. The results are shown in Table 46.

The potential impact on human health is not considered to be significant, since the 70% of the EAL criteria is met.

At one ecological receptor (Fithie Burn), the maximum PECs for annual mean NOx and 24-hour NOx are above the 70% PEC of the EAL threshold. The results are shown in Table 47. It is not envisaged that existing deposition rates will be adversely affected at European designations as a result of the parallel operation. The predicted concentrations have been examined by the project Ecologists, who consider that there are no significant impacts on SPA, SAC and Ramsar features. This is discussed in more detail within the accompanying HRA[57].

With regards to annual mean NOx, the maximum PEC at the Fithie Burn ecological receptor for all sites operating in parallel is 71.2% of the EAL. This is compared to 71.0% PEC of the EAL without including Michelin.

With regards to 24-hour mean NOx, the maximum PEC at the Fithie Burn ecological receptor for all sites operating in parallel is 77.9% of the EAL. This is compared to 77.1% PEC of the EAL without including Michelin. It is not considered that the slight increase due to the combined operation of the existing EfW facility, EfW CHP and Michelin Plant in both annual mean and 24-hour mean NOx on this single tributary will have a material impact on any of the conservation objectives of the European designated sites. This has been agreed with the project Ecologists and is discussed in more detail in the accompanying HRA[57].

9.7 Existing EfW Facility and EfW CHP Facility During Hot Commissioning Plus Michelin Boilers (normal) (option F)

This assessment considers the cumulative impact of the EfW CHP facility during hot commissioning with diesel fuel in combination with boilers operating at Michelin, and emissions from the existing EfW facility burning waste.

The only potential for cumulative impact is from emissions of NOx, as the Michelin boilers are gas-fired, with the hot commissioning only lasting around 1.5 months.

The impact on human health is not considered to be significant. The results are shown in Table 48.

9.8 Parallel Operations Plus Michelin Boilers – Maximum (option G)

This assessment considers the unrealistic worst-case cumulative impact of the existing EfW facility and EfW CHP facility, in combination operating at the emission limits, with boilers operating at Michelin all at full load.

The only potential for cumulative impact is from emissions of NOx as the Michelin boilers are gas-fired. Emissions of other pollutants (e.g. PM_{10}) will be negligible from Michelin. The results are shown in Table 49.

The potential impact on human health is not considered to be significant.

Similarly to Option D above, at one ecological receptor (Fithie Burn), the maximum PECs for annual mean NOx and 24 hour NOx are above the 70% PEC of the EAL threshold.

With regards to annual mean NOx, the maximum PEC at the Fithie Burn ecological receptor for all sites operating in parallel is 71.2% of the EAL. This is compared to 71.0% PEC of the EAL without including Michelin, suggesting that Michelin is not the dominant source of emissions.

With regards to 24-hour mean NOx, the maximum PEC at Fithie Burn ecological receptor for all sites operating in parallel is 77.9% of the EAL. This is compared to 77.1% PEC of the EAL without including Michelin, again suggesting that Michelin is not the dominant source of emissions. Although the PEC as a percentage of the EAL is greater than the 70% threshold, the actual PEC for 24 hour mean NOx is below the EAL standard. It is not considered that the slight increase due to the combined operation of the existing EfW facility, the EfW CHP and Michelin Plant on 24-hour mean NOx at this single tributary will have a material impact on any of the conservation objectives of the European designated sites. This is not considered as significant and has been agreed with the project Ecologists and is discussed in more detail within the accompanying HRA[57].

At all other ecological locations, the combined PEC is less than the 70% of the EAL criterion.

It is expected that Michelin will cease operations at the facility in mid 2020.

Table 45: Cumulative impact: Hot commissioning of the EfW CHP and the existing EfW facility (Option D)

Pollutant	Averaging period	EAL ($\mu g/m^3$)	Background concentration ($\mu g/m^3$)	Existing EfW Facility + Hot commissioning of the EfW CHP Facility Max. concentration ($\mu g/m^3$)		PC / EAL (%)	PEC / EAL (%)	Meets EAL?
				PC	PEC			
PM_{10}	Annual mean	18	9.1	0.05	9.15	0.25%	50.8%	Y
	24 hour mean, not to be exceeded more than 7 times per year	50	28	0.17	28.2	0.34%	56.3%	Y
$PM_{2.5}$	Annual mean	10	5.5	0.09	5.59	0.85%	55.9%	Y
NO_2	Annual mean	40	12.3	2.92	15.2	7.30%	38.1%	Y
	1 hour mean, not to be exceeded more than 18 times per year	200	24.6	10.27	34.9	5.13%	17.4%	Y
SO_2	24 hour mean, not to be exceeded more than 3 times per year	125	5.65	2.10	7.76	1.68%	6.21%	Y
	1 hour mean, not to be exceeded more than 24 times per year	350	10.9	3.41	14.3	0.98%	4.08%	Y
	15 minute mean, not to be exceeded more than 35 times per year	266	12.8	3.83	16.6	1.44%	6.23%	Y
CO	Maximum 8 hour daily mean	10000	90	0.57	90.6	0.01%	0.91%	Y

Table 46: Cumulative impact: Existing EfW facility, EfW CHP facility and Michelin (normal operations) – human receptors (Option E)

Pollutant	Averaging period	EAL ($\mu g/m^3$)	Background concentration ($\mu g/m^3$)	Existing EfW + New EfW CHP + Michelin Max. concentration ($\mu g/m^3$)		PC / EAL (%)	PEC / EAL (%)	Meet EAL?
				PC	PEC			
NO_2	1-hour	200	24.6	14.5	39.1	7.27%	19.6%	Y
	Annual	40	12.3	3.80	16.1	9.51%	40.3%	Y

Table 47: Cumulative impact: Existing EfW facility, EfW CHP facility and Michelin (normal operations) – ecological receptors (Option E)

Pollutant	Averaging Period	EAL ($\mu g/m^3$)	Background concentration ($\mu g/m^3$)	Existing EfW + New EfW CHP + Michelin Max. concentration ($\mu g/m^3$)		PC/EAL (%) %	PEC / EAL (%)
				PC	PEC		
NOx	24-hour	75	32.0	26.4	58.4	35.2%	77.9%
	Annual	30	16.0	5.35	21.64	17.8%	71.2%

Table 48: Cumulative impact: EfW CHP hot commissioning and existing EfW facility and Michelin (normal operations) – human receptors (Option F)

Pollutant	Averaging period	EAL ($\mu g/m^3$)	Background concentration ($\mu g/m^3$)	Existing EfW Facility + Hot commissioning New EfW CHP Facility + Michelin Max. concentration ($\mu g/m^3$)		PC / EAL (%)	PEC / EAL (%)	Meet EAL?
				PC	PEC			
NO_2	1-hour	200	24.6	11.4	36.0	5.69%	18.0%	Y
	Annual	40	12.3	3.16	15.5	7.89%	38.7%	Y

Table 49: Cumulative impact: Existing EfW and EfW CHP and Michelin (Maximum operating limits)) – human receptors (Option G)

Pollutant	Averaging period	EAL (µg/m³)	Background concentration (µg/m³)	Existing EfW + New EfW CHP + Michelin (Max) Max. concentration (µg/m³)		PC / EAL (%)	PEC / EAL (%)	Meet EAL?
				PC	PEC			
NO_2	1-hour	200	24.6	14.7	39.3	7.35%	19.6%	Y
	Annual	40	12.3	3.85	16.2	9.63%	40.4%	Y

Table 50: Cumulative impact Existing EfW and New EfW CHP and Michelin (Maximum operations) – ecological receptors (Option G)

Pollutant	Averaging Period	EAL (µg/m³)	Background concentration (µg/m³)	Existing EfW + New EfW CHP + Michelin (MAX) PEC Max. concentration (µg/m³)		PC/EAL (%) %	PEC / EAL (%)
				PC	PEC		
NOx	24 hour	75	32.0	26.4	58.4	35.2%	77.9%
	Ann	30	16.0	5.35	21.64	17.8%	71.2%

10 Mitigation

No additional mitigation measures have been proposed with respect to effects from operation of the proposed EfW CHP facility, as the predicted impacts are negligible or beneficial.

The abatement which is proposed for the EfW CHP facility is outlined in the BAT assessment, and includes:

- The use of modern combustion technology and effective combustion control to limit carbon monoxide and oxides of nitrogen emissions;
- The use of Selective Non Catalytic Reduction (SNCR) to control the generation of emissions of NOx;
- The regulation of primary air by the advanced combustion control system to minimise NOx;
- The use of activated carbon to control heavy metals and dioxins and furans.
- The use of lime injection to control acid gases; and
- A high efficiency dust collection system (fabric-filters) which will control emissions of particulates on a constant basis.

~~10.1 Construction~~

~~All appropriate mitigation measures have been included in the Construction Environmental Management Plan (CEMP) for the Proposed Scheme.~~

~~10.2 Operation~~

~~No additional mitigation measures have been proposed with respect to effects from operation of the proposed EfW CHP facility, as the predicted impacts are negligible or beneficial.~~

~~The abatement which is proposed for the EfW CHP facility is set out below:~~

- ~~The use of modern combustion technology and effective combustion control to limit carbon monoxide and oxides of nitrogen emissions;~~
- ~~The use of Selective Non Catalytic Reduction (SNCR) to control the generation of emissions oxides of nitrogen, when necessary as indicated by the continuous monitoring;~~
- ~~The use of activated carbon to control heavy metals and dioxins and furans, when necessary as a consequence of the fuel being burned;~~
- ~~The use of lime injection to control acid gases, when necessary; and~~
- ~~A high efficiency dust collection system (fabric-filters) which will control emissions of particulates on a constant basis.~~

11 Conclusion

An assessment of likely air quality and odour effects arising as a result of parallel operation of the existing EfW facility and EfW CHP facility has been undertaken. A review of current legislation and guidance, a baseline assessment describing the current air quality conditions in the vicinity of the Proposed Scheme and an assessment of air quality impacts associated with operation of the scheme have been undertaken.

~~All concentrations resulting from emissions from the DERL facility (current situation) and the proposed EfW CHP facility are below the relevant standards. The impact on air quality of the proposed EfW CHP facility, compared to the current operations of the DERL facility, results in a beneficial impact to air quality in terms of NO_2, HCl, PAHs/B(a)P, PCBs and all Group III trace metals, and negligible negative impact for the other pollutants. The impact on human receptors is therefore **not significant**.~~

~~At ecological receptors the maximum PECs are all well below 70% of the standard and therefore the impact at ecological receptors is negligible and the effect is not significant. The maximum 24-hour mean concentration is predicted to decrease with EfW CHP facility operation compared with the DERL facility operation.~~

~~At ecological receptors the process contribution to nutrient nitrogen deposition is no more than 0.26% (which is predicted at Barry Links) and acid deposition is no more than 8% of the critical load (which is also predicted at Barry Links). The Predicted Environmental Deposition rate (PEDR), the sum of the process contribution to deposition and the background deposition rate, exceeds 70% of the critical load only where the background on its own exceeds. The effect is therefore considered **not significant**.~~

All concentrations resulting from emissions from the existing EfW facility and the EfW CHP facility operating in parallel, are below the relevant standards, with the exception of hexavalent chromium, whereby the assumed background concentration (taken from a UK-wide metals data review) already exceeds the relevant EALs by 313%. For all other pollutants assessed, the impact on air quality is not considered to be significant.

At ecological receptors the maximum PECs during normal operation are all below 70% of the EAL, except for annual mean NOx and 24 hour NOx. With regards to annual mean NOx, the maximum PEC for parallel operations at the Fithie Burn ecological receptor is 71.0% of the EAL. With regards to 24 mean NOx, the maximum PEC for parallel operations at the Fithie Burn ecological receptor is 77% of the EAL. The respective Critical Levels however for both pollutants are not exceeded.

Whilst the Fithie Burn is not a designated ecological site, the Burn is directly connected to the Firth of Tay SAC and the Outer Firth of Forth pSPA, approximately 4km away. The results of the air quality assessment have been provided to the project Ecologists who conclude that the potential impact on the SAC and pSPA is unlikely to be significant.

At ecological receptors the process contribution to nutrient nitrogen deposition is less than 1% (which is predicted at Barry Links) however the acid deposition is no greater 1% of the critical load (which is also predicted at Barry Links). The Predicted Environmental Deposition rate (PEDR), the sum of the process contribution to deposition and the background deposition rate, does exceeds 70% of the critical load only where the background on its own exceeds. The effect is therefore considered not significant.

Dioxins and furans, trace metals and PCBs have been considered in the human health risk assessment. For the EfW CHP facility, which is under construction, and the cumulative impacts of the EfW CHP facility, which is under construction and existing EfW facility, it has been demonstrated that the maximally exposed individual is not subject to a significant carcinogenic risk or non-carcinogenic hazard, arising from exposures via both inhalation and the ingestion of foods.

~~The cumulative assessment considered two scenarios, the proposed EfW CHP operating on diesel during hot commissioning and the DERL burning waste, and the proposed EfW CHP and Michelin installation, running together. A negligible impact has been predicted under both scenarios, with some beneficial impacts predicted with operation of the proposed EfW CHP.It should be noted that while actual emissions from the DERL facility have been used for the assessment, the emissions used for the EfW CHP facility are those given by the IED limit values and they therefore represent the worst case emissions. Actual emissions would be no greater than then IED emission limit values and could be less. The assessment of the EfW CHP facility therefore represents a worst case.~~

~~The impact of the EfW CHP facility on odour nuisance was also found to be **not significant**.~~

The cumulative assessment considered four scenarios;

- the EfW CHP facility operating on diesel during hot commissioning and the ~~DERL~~ existing EfW facility burning waste;
- the existing EfW facility and the EfW CHP facility burning waste and Michelin installation in operation;
- the EfW CHP facility during hot commissioning on oil, the existing EfW facility burning waste and the Michelin installation, running together; and,
- the existing EfW facility and the EfW CHP facility burning waste and Michelin installation at full boiler capacity in operation.

A negligible impact has been predicted under all scenarios, with the exception of ecological impacts at the Fithie Burn for annual mean and 24 hour NO_X, where the PECs are predicted to be >70% of the Critical Level.

While actual emissions from the existing EfW facility have been used for the assessment, the emissions used for the EfW CHP facility are those given by the Industrial Emissions Directive (IED) limit values. Actual emissions would be lower than then IED emission limit values and therefore the assessment of the EfW CHP facility represents a worst case.

Furthermore, the existing EfW facility and EfW CHP facilities will be obliged to work towards meeting tighter emissions limits contained within the recently published Waste Incineration Best Available Technique Reference (BREF) document (December 2019). A number of pollutants are set to have emission limit reductions compared to those within the IED, including NOx. As such, this assessment of parallel operations represents a worst case.

With regards to odour, the impact of the parallel operations on odour nuisance under normal operational conditions and routine maintenance conditions was found to be not significant.

A number of sensitive receptor locations were predicted to experience odour concentrations above SEPA's most stringent criterion of $1_{OUE}/m^3$, when considering maintenance conditions at both facilities, based on the maximum odour Emission Limit Values in the existing Permit. This conservative maintenance scenario however is considered highly unlikely to occur, based on historic odour monitoring data at the facility.