HUMAN HEALTH RISK ASSESSMENT OF RELEASES FROM THE PROPOSED HIGH TEMPERATURE INCINERATION PLANT, NEWTON AYCLIFFE

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ACRONYMS/TERMS USED IN THE TEXT

ADM	Air Dispersion Modelling
AQSs	Air Quality Standards
BAT	Best Available Techniques
COPCs	Contaminants of Potential Concern
COT	Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment
Dioxin like PCBs	Dioxin like polychlorinated biphenyls
Dioxins and furans	Polychlorinated dibenzo para-dioxins and polychlorinated Dibenzofurans
EA	Environment Agency
ECL	Environmental Compliance Limited
ELV	Emission Limit Value
EP	Environmental Permit
GLCs	Ground Level Concentrations
HHRA	Human Health Risk Assessment
HHRAP	Human Health Risk Assessment Protocol
HMIP	Her Majesty's Inspectorate of Pollution
HTI	High Temperature Incineration
MDI	Mean Daily Intake
MWIs	Municipal Waste Incinerators
OCL	Olive Compliance Limited
PCDFs	Polychlorinated dibenzofurans
SSCM	Site Specific Conceptual Model
TDI	Tolerable Daily Intake
The Installation	Proposed High Temperature Incineration Plant
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

1. INTRODUCTION

1.1. Overview

1.1.1. Environmental Compliance Ltd ("ECL") were commissioned by Olive Compliance Limited ("OCL") to undertake a human health risk assessment ("HHRA") of releases from the proposed High Temperature Incineration ("HTI") plant ("the Installation"), at Land north of Hitachi Rail Europe Limited, Millenium Way, Aycliffe Business Park, Newton Aycliffe, in support of an Environmental Permit ("EP") application to the Environment Agency ("EA").

1.1.2. A comparison of the results of the associated air dispersion modelling ("ADM") study - see ECL document reference OLCO.01.01/ADM – was undertaken to assess the impact of releases to air from the proposed facility against European and national air quality standards ("AQSs"). This effectively represents a health risk assessment for those pollutants for which an AQS has been assigned. The AQSs have been developed primarily in order to protect human health via known uptake mechanisms, such as inhalation and ingestion.

1.1.3. However, some pollutants, including polychlorinated dibenzo-para-dioxins and polychlorinated dibenzofurans ("dioxins and furans") and dioxin-like polychlorinated biphenyls ("dioxin-like PCBs"), have human health impacts at significantly lower ingestion levels, and it is considered that setting an AQS to control human exposure against these is not appropriate. Consequently, a different human health risk model is required which better reflects the potential effects of dioxin and furan uptake in humans. Accordingly, there is a requirement for a HHRA assessing the impact of dioxins and furans and dioxin-like PCBs that takes into account the principal exposure routes in humans and the fact that the main risk to health is through accumulation in the body over time.

1.1.4. Exposure to dioxins and furans can be by a variety of possible exposure pathways including direct exposure by inhalation of gases and fine particulates and indirect exposure following the deposition of trace contaminants to land and subsequent transfer by biogeochemical processes through soils and vegetation into the food chain.

1.1.5. Although the EA does not prescribe any particular assessment method, environmental permit applications for these types of processes typically follow either the approach developed by the EA's predecessor body – Her Majesty's Inspectorate of Pollution ("HMIP") – *Risk Assessment of Dioxin releases from Municipal Waste Incinerators* (1996) approach or the United States Environmental Protection Agency ("USEPA") *Human Health Risk Assessment Protocol ("HHRAP") for Hazardous Waste Combustion Facilities* (EAP530-R-05-006, September 2005) approach. This assessment has been undertaken using the US EPA HHRAP methodology.

2. RISK ASSESSMENT – METHODOLOGY

2.1. Scope of Works

2.1.1. This assessment evaluates the possible effects on the health of the local human population likely to be exposed to emissions from the Installation. The geographic scope of the study is based on the same 4km by 4km grid used in the air dispersion modelling study.

2.1.2. Given that the assessment is related to exposure through the direct inhalation of affected air, and indirect exposure through ingestion of affected food and locally grown produce on soil which may be affected by the deposition and accumulation of emissions from the proposed Installation, the only emissions relevant to the assessment are those arising from the HTI stack at the proposed Installation. Fugitive emissions are not considered relevant to this assessment.

2.1.3. The substances emitted from the stack - termed hereafter the contaminants of potential concern ("COPCs") - can be considered under the following categories:

- substances for which any effects are more likely to be acute, and which tend to occur shortly after exposure; these substances can be subdivided into two groups:
  - acid gases, such as sulphur dioxide, nitrogen dioxide, hydrogen chloride and hydrogen fluoride; and
  - other substances, such as carbon monoxide and fine particulate matter.
- substances for which any effects are likely to be chronic, and which tend to arise from prolonged exposure; these substances can also be subdivided into two groups:
  - heavy metals; and
  - semi-volatile and non-volatile organic chemicals, specifically dioxins and furans and dioxin-like PCBs.

2.1.4. COPCs for which AQSs have been assigned have not been assessed further. These COPCS are:

- particulate matter;
- sulphur dioxide;
- carbon monoxide;
- oxides of nitrogen (expressed as nitrogen dioxide);
- ammonia;
- hydrogen chloride;
- hydrogen fluoride;
- volatile organic compounds ("VOCs", expressed as total organic carbon);
- mercury;
- cadmium;
- thallium;
- antimony;
- arsenic;
- chromium;
- cobalt;
- copper;

- lead;
- manganese;
- nickel;
- vanadium; and
- benzo-a-pyrene.

2.1.5. An ADM study (ECL Report Reference OLCO.01.01/ADM) was undertaken to assess the impact of releases from the Installation's main discharge stack.

2.1.6. The study was undertaken using the ADMS modelling package, which is one of the models recognised by the EA as being suitable for such studies. The full modelling study report is provided separately. The assessment concludes that releases from the Installation are considered unlikely to result in a breach of current air quality standards or have a detrimental effect on local human health.

2.1.7. Accordingly, the risks to human health from these pollutants have been assessed as part of the atmospheric dispersion modelling study, therefore, no further assessment is considered necessary. Consequently, only dioxins and furans and dioxin-like PCBs, have been subject to the full USEPA HHRAP methodology.

2.2. Approach to Risk Assessment

2.2.1. The approach taken by the IRAP-h View software seeks to quantify the hazard faced by the receptor- the exposure of the receptor - to the substance identified as being a potential hazard and then to assess the risk of exposure, as follows:

(i) *Quantification of the exposure* - an exposure evaluation that determines the dose and intake of key indicator chemicals for an exposed person. The dose is defined as the amount of a substance contacting the body (e.g., in the case of inhalation - the lungs) and intake is the amount of the substance absorbed into the body. The evaluation is based on, worst case, conservative scenarios, with respect to the following:

- location of the exposed individual and duration of exposure;
- exposure rate; and
- emission rate from the source.

(ii) *Risk characterisation* - following quantification of the exposure, the risk is characterised by examining the toxicity of the substances to which the individual has been exposed and evaluating the significance of the calculated dose in the context of probabilistic risk.

2.3. Methodology for Estimating Exposure to COPCs

2.3.1. In order to estimate exposure from the emissions from the Installation considered in the assessment, the following steps have been undertaken:

(i) measurement or estimation of emissions from the source - emissions have been based on the relevant emission limit values ("ELVs"), and, therefore, are likely to be an overestimate of the actual emissions;

(ii) modelling the fate and transport of the emitted substances through the atmosphere and through soil, water and biota following deposition onto land; atmospheric dispersion modelling has been undertaken using ADMS 6.0 (see ECL Report OLCO.01.01/ADM). Concentrations of the COPCs in the environmental media are estimated at the point of exposure, which may be through inhalation or ingestion.

(iii) calculation of the uptake of the emitted substances into humans coming into contact with the affected media and the subsequent distribution in the body; this element of the assessment us undertaken using IRAP-h View.

2.3.2. With regard to Step (iii), the exposure assessment considers the uptake of dioxins and furans, and dioxin-like PCBs, by various categories of human receptors (resident/farmer/fisher). It should be noted that IRAP-h View does not have a category for a "workplace" receptor therefore the "resident" receptor parameters can be adjusted appropriately, for example for a school, the exposure time would be restricted to 8 hours per day, 5 days a week and 38 weeks a year or for a workplace the exposure time would be restricted to 8 hours per day, 6 days a week and 47 weeks a year. In the interests of a conservative assessment, all "workplace" receptors have been assessed without adjusting of parameters.

2.3.3. The assessment will evaluate potential impacts on human health from potential dioxin emissions and dioxin-like PCB emissions, both in terms of the long-term inhalation, and the overall long-term exposure through additional viable routes such as the food chain.

2.3.4. In accordance with the recommended UK tiered approach to risk assessment, the HHRA has considered worst-case scenarios for all receptors in assuming multiple exposure conditions where all pathways of exposure in each land use scenario were considered to be viable. Some of these assumptions are both extremely conservative and also very unlikely, and, therefore, the assessment is likely to overestimate any potential impacts.

2.3.5. A discussion of cumulative impacts is provided in the Committee Report, as provided with the planning application documents for the proposed development[1]. Paragraph 339 of the Committee Report states:

Cumulative impacts from proposed or committed developments in the vicinity of the proposed development have been considered within the technical chapters of the ES. The ES states that there are no identified already constructed and established waste management or other technically similar facilities within close proximity to the site for which cumulative effects have been considered. In addition, the applicant has investigated the details of any other projects which could in combination with the proposed development, give rise to cumulative significant effects and no such other schemes have been identified. The assessment of cumulative impact concludes that no unacceptable successive or simultaneous effects are likely to occur as a result of the proposed development. In terms of the assessment of the combined and the cumulative effects from the proposed development on the site on the surrounding areas, the ES considers it has

[1] Durham County Council Planning Services, Committee Report for Planning Application DM/21/01500/WAS. Available online via: https://publicaccess.durham.gov.uk/online-applications/files/B99C2613A342B15E3E58C342BCFB8A5F/pdf/DM_21_01500_WAS-COMMITTEE_REPORT-3060188.pdf

been determined that there are no likely significant such effects on these areas. Given that none of the individual environmental areas reach the threshold of unacceptable, the totality of these effects would not result in them being cumulatively unacceptable nor in combination.

2.3.6. Consequently, it is considered that the potential for cumulative air quality impacts have been adequately addressed as part of the works undertaken for the planning application. Cumulative impact discussions will therefore not feature any further as part of this study and were not considered as part of the air dispersion modelling assessment.

3. HAZARD IDENTIFICATION

3.1. Introduction

3.1.1. Hazard identification aims to identify contaminants of concern, their distribution in the different media and consequently to which relevant receptors are exposed. As there are no recognised UK protocols for estimating the level of human exposure to COPCs through all relevant pathways of exposure, the USEPA HHRAP was used to estimate all exposures using the predicted air concentration and depositions rates provided by the air dispersion modelling study undertaken using ADMS 6.0.

3.1.2. Hazard identification[2] comprised an identification of the substances of potential concern; consideration of how they could be released and transferred into the environment; and identification of those who could potentially be affected by these hazards.

3.1.3. A site-specific conceptual model ("SSCM") of the hazards, based on the source-pathway-receptor, concept has been produced. The SSCM provides an indication of the:

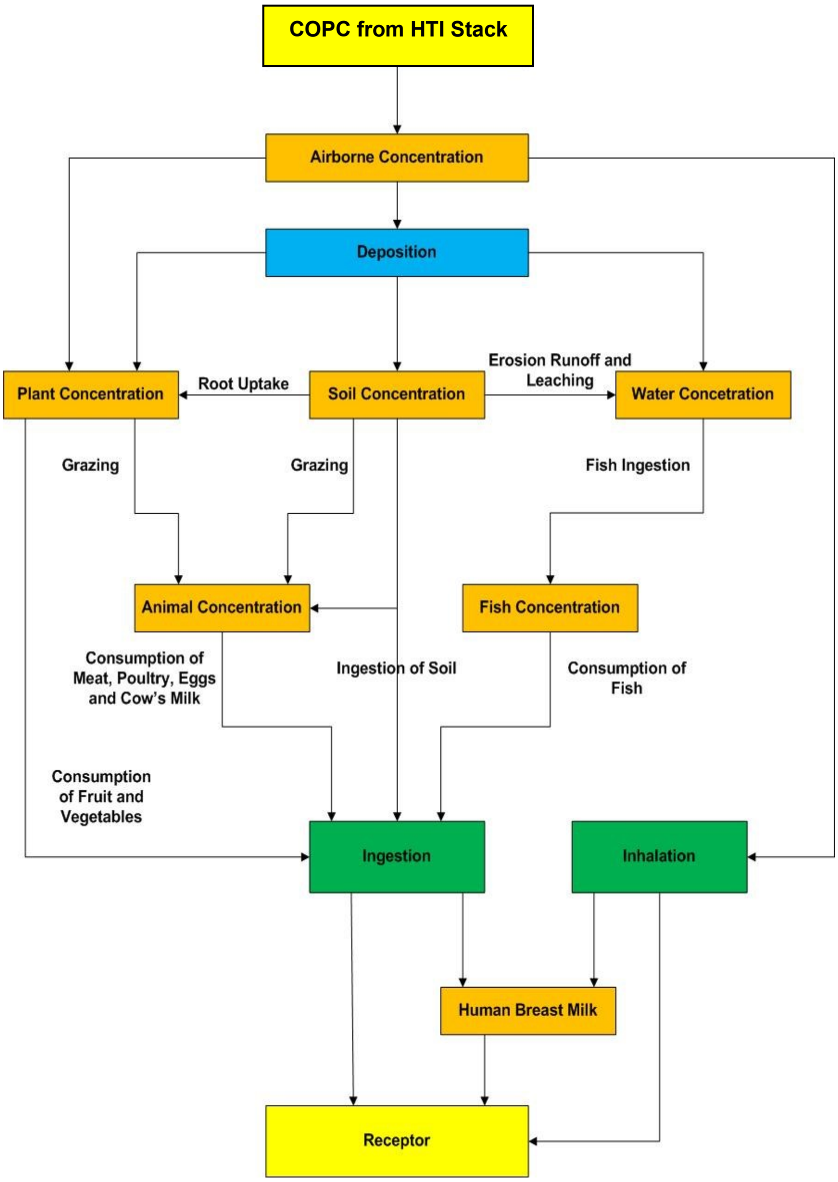
- principal hazards sources on the site: i.e., the point source emissions from the HTI stack;
- COPCs;
- behaviour of COPCs in the identified media, considering potential exposure via airborne pathways, deposition on soils, uptake by home grown vegetables and other agricultural products, uptake by animals and uptake by humans;
- potential sensitive receptors; and
- pathways connecting the COPCs and sensitive receptors.

3.2. Conceptual Site Model

3.2.1. The development of a conceptual site model is used to identify the potential sources, critical pathways and receptors that require assessment and is provided in Figure 1.

[2] Note: Hazard Identification for this HHRA relates to hazards identified from emissions to air only.

Figure 1: Conceptual Site Model



3.3. Potential Exposure Pathways

3.3.1. Based on the conceptual site model, the following pathways were considered as part of the HHRA:

- inhalation (including acute inhalation);
- ingestion of soil;
- consumption of fruit and vegetables;
- consumption of poultry and eggs;
- consumption of meat (beef, pork and fish);
- consumption of cow's milk and human breast milk; and
- consumption of drinking water.

3.3.2. Members of the local population are only likely to be exposed to significant effects associated with emission of dioxins and furans and dioxin-like PCBs from the Installation if:

- they spend significant periods of time at locations where and when emissions from the proposed Installation increase the concentration of dioxins/furans and dioxin-like PCBs above the existing background concentration;
- they consume food grown at locations where emissions increase the concentration of dioxins/furans and dioxin-like PCBs above the concentration normally present in food from those locations;
- they undertake activities likely to lead to ingestion of soils at locations where emissions have increased the concentration of dioxins/furans and dioxin-like PCBs in the soil above background levels; and
- they drink water from sources exposed to increased concentrations of dioxins/furans and dioxin-like PCBs above the levels normally present.

3.3.3. The extent of exposure that any person may experience will depend directly on the degree to which they engage in any or all of the above activities, and by how much the existing background concentration of dioxins/furans and dioxin-like PCBs increases as a result of the operation of the proposed Installation. The drinking water pathway is considered to be highly unlikely as very few people are likely to collect and drink water in the vicinity of the proposed Installation.

3.4. Pathways Relevant to the Proposed Installation

Inhalation

3.4.1. People living and working in close proximity to the proposed Installation may be exposed to marginally higher levels of dioxins/furans and dioxin-like PCBs as result of the operation of the proposed Installation for the proportion of time they spend there. Consequently, this pathway is considered relevant to this assessment.

Ingestion of Soil

3.4.2. People working on the land in close proximity to the proposed Installation may be exposed to marginally higher levels of dioxins/furans and dioxin-like PCBs are as result of the operation of the proposed Installation for the proportion of time they work there. As the surrounding land use to the proposed Installation is a mixture of industrial, agricultural and residential, this pathway is considered relevant to this assessment.

Consumption of Fruit and Vegetables

3.4.3. It is likely that the majority of people purchase their fruit and vegetables from commercial outlets which are likely to source their produce from outside the locality. Unless a substantial proportion of fruit and vegetables sold are produced locally, the majority of the local population's exposure to dioxins/furans and dioxin-like PCBs will not be affected by the operation of the proposed Installation.

3.4.4. People who consume fruit and vegetables grown in the vicinity of the proposed Installation may be exposed to marginally higher levels of dioxins/furans and dioxin-like PCBs, although any increase is likely to be small compared with existing exposures. The likelihood of individuals obtaining almost all of their fruit and vegetable consumption from gardens and allotments is likely to be low. Nevertheless, this pathway is considered relevant to this assessment as there are allotments in the area.

Consumption of Poultry and Eggs

3.4.5. Free-range poultry may be exposed to dioxins/furans and dioxin-like PCBs through soil ingested with food picked up from the ground. It is not known if rearing of free-range poultry occurs to a significant level in the vicinity of the proposed Installation. Therefore, the consumption of chicken and eggs could be a potential exposure scenario and consequently, this pathway is considered relevant to this assessment.

Consumption of Meat

3.4.6. As with free-range poultry, pigs and cattle may be exposed to dioxins/furans and dioxin-like PCBs through soil ingested with food picked up from the ground. It is not known if rearing of these animals occurs to a significant level in the vicinity of the proposed Installation. However, the consumption of meat could be a potential exposure scenario and consequently, this pathway is considered relevant to this assessment.

3.4.7. It should be noted that not all exposure scenarios will result in the ingestion of home-grown meat and animal products and these food products are only considered by the IRAP-h View for farmers and for families of farmers.

Consumption of Fish

3.4.8. It should be noted that as with the ingestion of meat, not all exposure scenarios will result in the ingestion of fish. The ingestion of fish is only considered where there is a local water body that is used for fishing and where the diet of the fisher (and family) may be regularly supplemented by food caught from these local water sources.

3.4.9. Due to the lack of observable fishable areas in the vicinity of the Installation, the consumption of fish is not considered relevant to this assessment.

Consumption of Cow's Milk

3.4.10. It is possible that dairy herds may be exposed to dioxins/furans and dioxin-like PCBs through soil ingested with their food. It is unlikely that people living in residential locations would rear cows and consequently consume cow's milk. Therefore, consumption of cow's milk is only considered for the farm receptors.

3.4.11. It is unknown whether any of the farms in the vicinity of the proposed Installation are dairy farms, therefore the consumption of cow's milk is considered relevant for all farms assessed.

Consumption of Human Breast Milk

3.4.12. Babies may be exposed to dioxins/furans and dioxin-like PCBs via ingestion of contaminated breast milk. The potential for contamination of breast milk is especially high for dioxin-like compounds which are highly lipophilic and are likely to accumulate in breast milk. The mother may be exposed to dioxins/furans and dioxin-like PCBs via the inhalation or ingestion pathways. Consequently, consumption of breast milk is considered relevant to this assessment.

Drinking Water

3.4.13. Potential exposure through the ingestion of drinking water requires contamination of the local drinking water sources. There are no major aquifers or drinking water reservoirs within the vicinity of the proposed Installation. There are also no potable surface water abstraction points within 2km of the proposed Installation. Consequently, this pathway has been discounted for the purposes of this assessment.

3.4.14. The USEPA HHRA incudes the ingestion of locally abstracted groundwater as a potential pathway of exposure where this pathway may be of potential concern. There is one active groundwater abstraction point located approximately 1km from the proposed Installation. However, this as this is for industrial use, the ingestion of abstracted groundwater was not considered in this assessment.

3.4.15. It should be noted that the USEPA have concluded that the buildup of dioxins in an aquifer over realistic travel times relevant to human exposure was predicted to be so small as to essentially be zero.

3.4.16. A further pathway exists via deposition of emissions directly into surface water, e.g., rainwater storage tanks or local drinking water supplies. Surface water generally undergoes a number of treatment steps, consequently any contaminants would be removed prior to consumption. Rainwater harvesting tanks do not undergo the same treatment processes, however, they generally have a very small surface area and as such the potential for the buildup of COPCs is limited.

3.4.17. Consequently, the drinking water pathway is considered to be an insignificant risk and has been excluded from the assessment.

Dermal Absorption

3.4.18. There is potential for exposure to dioxins/furans from dermal absorption. However, both HMIP and the USEPA note that the contribution from dermal exposure is a very minor pathway and is typically small relative to contributions resulting from the total uptake. Consequently, this pathway has been excluded from the assessment.

3.5. Receptors

3.5.1. USEPA guidance on HHRA recommends that resources for characterising the exposure setting should initially be focused on the areas surrounding the emission sources and extending out to about 1.5 km, where the most significant deposition has been generally observed.

3.5.2. For this assessment, the same 4km by 4km grid and 18 potentially sensitive human receptor locations specified in the air dispersion modelling study were used (ECL report reference OLCO.01.01/ADM).

3.5.3. The purpose of characterising the exposure setting is to identify current human activities or land uses that provide the basis for evaluation of recommended exposure scenarios that may result due to exposure to emissions from one or more emission sources.

3.5.4. In addition to those receptors obtained via a review of mapped data, IRAP-h View allows the digitisation of areas of concern where risk receptors and exposure scenarios can be selected for evaluation. Once an area has been defined, the model identifies, within each of the specified areas, all the grid nodes with the highest yearly averages for each modelled air parameter (e.g., air concentration, dry deposition, wet deposition) for each phase (e.g., vapour, particle, particle-bound) to each emission source. This will result in the selection of one or more receptor grid nodes as the location of one or more exposure scenario locations that meet the following criteria:

- highest vapour phase air concentration;
- highest vapour phase dry deposition rate;
- highest vapour phase wet deposition rate;
- highest particle phase air concentration;
- highest particle phase dry deposition rate;
- highest particle phase wet deposition rate;
- highest particle-bound phase air concentration;
- highest particle-bound phase dry deposition rate; and
- highest particle-bound phase wet deposition rate.

3.5.5. These sensitive receptors are then labelled “RI_1”, “RI_2”, “RI_3” etc. In the case of this scenario, three grid nodes have been identified. On inspection of these grid nodes, they are either on land due to be developed for industrial purposes or on agricultural land. Consequently, in the interest of a conservative assessment the resident and farmer scenarios will be assessed for both (as mentioned previously, there is no “worker” scenario therefore the resident scenario is used to assess workplace exposure).

3.5.6. The locations of all potentially sensitive receptors are indicated on the Risk Receptors Map in Figure 2 and further detail provided in Table 1. The distance and heading are calculated as a straight-line measurement from the HTI stack of the proposed Installation to the defined receptor.

Table 1: Potentially Sensitive Human Receptors Used in the HHRA

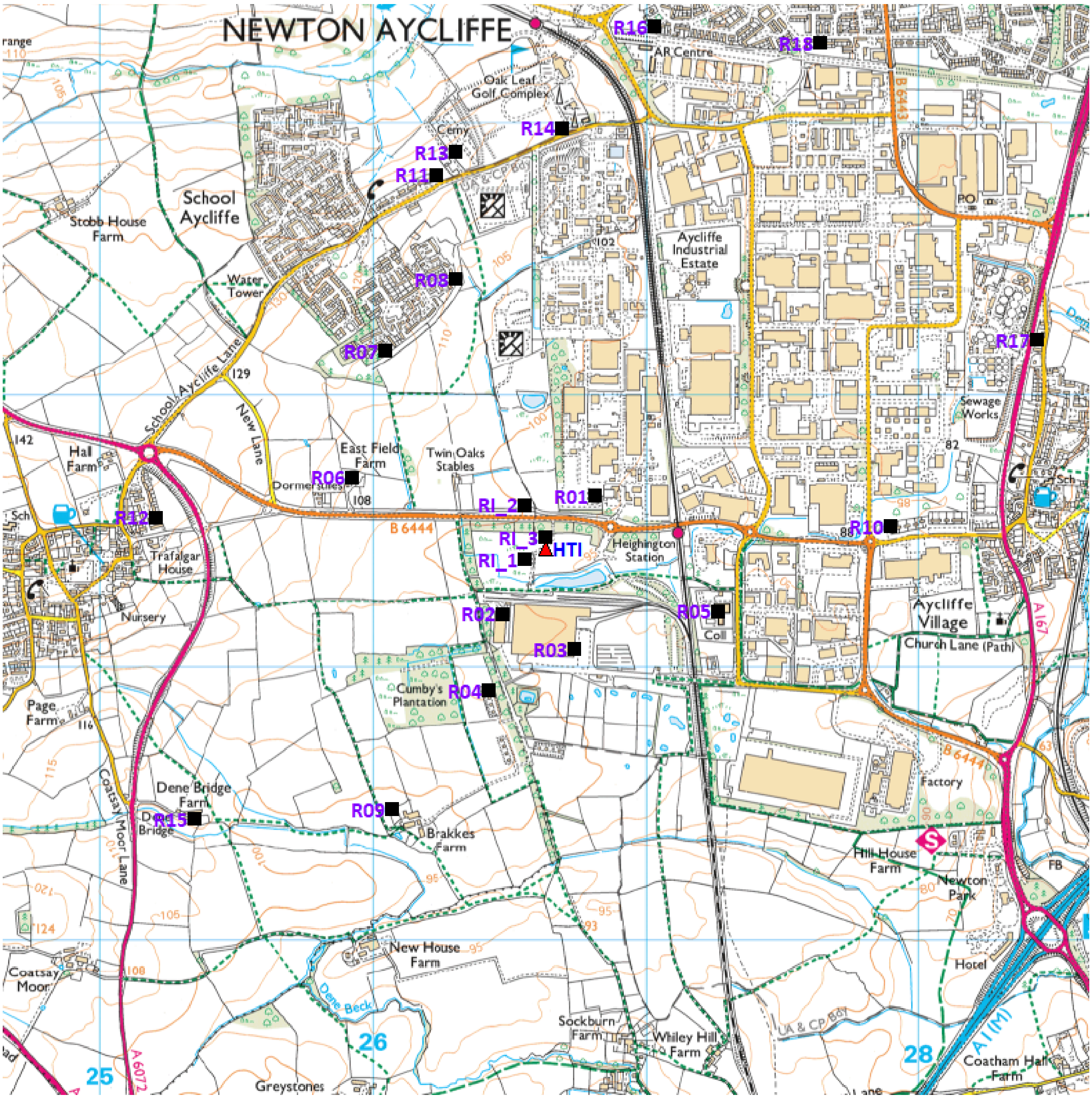
Ref.	Name	Resident	Farmer	Fisher [(a)]	Easting, Northing (X, Y)	Distance from Source (m)	Heading (°)
R01	Industrial	✓			426818,522628	262	43
R02	Hitachi Rail Intake Vents (14m from ground level)	✓			426479,522196	289	214
R03	Hitachi Rail (Ground level)	✓			426746,522065	386	164
R04	Clay Pigeon Shooting	✓			426431,521913	563	202
R05	College	✓			427269,522205	670	110
R06	East Field Lane (smallholding)	✓	✓		425930,522696	756	290
R07	Cherry Tree Drive	✓			426052,523161	933	321
R08	Magnolia Close	✓			426306,523424	1,043	341
R09	Bracks Farm	✓	✓		426076,521477	1,113	210
R10	Heighington Road	✓			427904,522516	1,267	86
R11	North Cottages	✓			426239,523806	1,427	344
R12	Kieran Maxwell Lane	✓			425211,522549	1,433	275
R13	West Cemetery	✓			426307,523891	1,493	347
R14	Sports Ground	✓			426697,523979	1,544	2
R15	Dene Bridge Farm	✓	✓		425352,521443	1,626	232
R16	Cumby Road	✓			427037,524352	1,957	12
R17	Durham Road	✓			428443,523200	1,958	67
R18 (b)	Finchale Road	✓	✓		427645,524291	2,110	28
RI_1	Land within the ownership area of the proposed Installation	✓	✓		426560,522396	89	243
RI_2	Agricultural area north of the Installation	✓	✓		426560,522596	179	333
RI_3	Land within the ownership area of the proposed Installation	✓	✓		426640,522476	40	360

Notes to Table 1

(a) The 'Fisher' scenario was not considered relevant to any of the identified receptors due to the lack of observable fishable areas within the output grid assessed.

(b) Given the very close proximity of this receptor to Finchale Road Allotment (situated immediately south), it has been assumed some residents in the vicinity of this receptor may eat the locally grown produce. Consequently, to exercise caution, it has been included under both the resident and farmer exposure scenarios.

Figure 2: Risk Receptors Map



4. ASSESSMENT

4.1. Introduction

4.1.1. The basis for the HHRA is predictive modelling using the ADMS atmospheric dispersion model to estimate the likely ground level concentrations of all pollutants and deposition rates for dioxins and furans as a result of emissions from the Installation.

4.2. Dispersion Modelling

4.2.1. The model set up is identical to that used in the atmospheric dispersion modelling study (ECL document reference: OLCO.01.01/ADM).

4.2.2. All emissions characteristics, building heights, etc were retained from the ADM assessment. As the human health risk assessment requires information on the deposition of substances to surfaces, as well as the airborne concentrations, ADMS has been used to predict the following:

- the airborne concentration of vapour, particle and particle bound substances emitted from the HTI discharge stack;
- the wet deposition rate of particle and particle bound substances; and
- the dry deposition rate of vapour, particle and particle bound substances.

4.2.3. Details of particle sizes, density and assumed fractions are provided in Table 2.

Table 2: Particle Size, Density and Fractions

Particle Diameter (µm)	Particle Density (g/cm^3)	Mass Fraction [a]	Area Fraction [b] [c]
1	1	0.25	0.625
2.5	1	0.25	0.25
10	1	0.5	0.125

Notes to Table 2
(a) Assumed for particle phase.
(b) Assumed for particle bound phase.
(c) Calculated from the mass fraction using US EPA HHRAP method.

4.3. Sources of Dioxins and Furans

4.3.1. For the purpose of assessing potential health impact associated with the effect of dioxin and furan and PCB emissions from the Installation; the HTI stack is the only relevant emission source. Annex VI of the IED prescribes ELVs for emissions to air which are considered to be of relevance to long term exposure (chronic health effects), together with the associated Best Available Techniques ("BAT") conclusions document for the Waste Incineration Sector.

4.3.2. The maximum Ground Level Concentrations ("GLCs ") of dioxins and furans at the location of the human sensitive receptors, was predicted using ADMS 6. IRAP-h View automatically extracts various air parameters from the air modelling plot-files and converts them into the required format. Air parameters generated by IRAP-h View include hourly air concentration from the particle phase, particle bound and vapour phase, annual average dry deposition from the particle phase, particle bound and vapour phase and annual average wet deposition from the particle phase, particle bound and vapour phase.

4.3.3. The air dispersion model considers dioxins as a single compound. However, the general term dioxins denotes a whole family of compounds based on two benzene rings fused to a central dioxin ring; in total, there are 75 individual dioxins, with each distinguished by the position of the chlorine atoms in the benzene rings. Furans - more correctly termed polychlorinated dibenzofurans ("PCDFs") - are similar in structure to PCDDs, but in the case of PCDFs, the two benzene rings are fused to a central furan ring. The term furans also denotes a whole family of compounds, again, with each distinguished by the position of the chlorine atoms in the benzene rings.

4.3.4. Each individual dioxin and furan are referred to as a 'congener' and each has different physical properties and toxicity levels which affect their atmospheric behaviour. The methodology used in IRAP-h View, therefore must consider the fate and transport of the dioxins and furans on a congener specific basis. It does this by accounting for the varying volatility of the congeners and their different toxicities.

4.3.5. In order to undertake the assessment, it is necessary to calculate the individual dioxin/furan congener emission rates. For the purposes of this assessment, the congener profile used for the Installation is based on the standard profile for municipal waste incinerators ("MWIs") derived by HMIP. The individual dioxin/congener emission rates are then calculated as indicated in the footnotes to Table 3. Note that the individual congener I-TEFs are detailed in Table 3 for reference.

4.3.6. The individual dioxin/congener emission rates detailed in Table 3 are then inputted into the IRAP-h View model.

Table 3: Dioxin and Furan Congener Profile and Emission Rates

Dioxin/Furan Congener	Individual Dioxin/Furan Congener Concentrations in HMIP Representative MWI ng/Nm^3 [(a)]	WHO-TEF (2005) ng/Nm^3	Emission Concentration WHO-TEQ ng Nm^3 @ 1ng/Nm^3	Emission Concentration WHO-TEQ ng Nm^3 @ 0.06 ng/Nm^3	Emission Rate ng/s [(b)]	Emission Rate g/s [(b)]
2,3,7,8 - TCDD	0.031	1	0.031	0.00186	0.00682	6.82E-12
1,2,3,7,8 - PeCDD	0.245	1	0.245	0.0147	0.0539	5.39E-11
1,2,3,4,7,8 - HxCDD	0.287	0.1	0.0287	0.00172	0.00632	6.32E-12
1,2,3,6,7,8 - HxCDD	0.258	0.1	0.0258	0.00155	0.00568	5.68E-12
1,2,3,7,8,9 - HxCDD	0.205	0.1	0.0205	0.00123	0.00451	4.51E-12
1,2,3,4,6,7,8 - HpCDD	1.704	0.01	0.0170	0.00102	0.00375	3.75E-12
OCDD	4.042	0.0030	0.0121	0.000728	0.00267	2.67E-12
2,3,7,8 - TCDF	0.277	0.1	0.0277	0.00166	0.00610	6.10E-12
1,2,3,7,8 - PeCDF	0.277	0.03	0.00831	0.000499	0.00183	1.83E-12
2,3,4,7,8 - PeCDF	0.535	0.3	0.161	0.00963	0.0353	3.53E-11
1,2,3,4,7,8 - HxCDF	2.179	0.1	0.218	0.0131	0.0480	4.80E-11
1,2,3,6,7,8 - HxCDF	0.807	0.1	0.0807	0.00484	0.0178	1.78E-11
1,2,3,7,8,9 - HxCDF	0.042	0.1	0.00420	0.000252	0.000925	9.25E-13
2,3,4,6,7,8 - HxCDF	0.871	0.1	0.0871	0.00523	0.0192	1.92E-11
1,2,3,4,6,7,8 - HpCDF	4.395	0.01	0.0440	0.00264	0.00968	9.68E-12
1,2,3,4,7,8,9 - HpCDF	0.429	0.01	0.00429	0.000257	0.000944	9.44E-13
OCDF	3.566	0.0030	0.0107	0.000642	0.00236	2.36E-12

Notes to Table 3

(a) Taken from Table 7.2a, *Risk Assessment of Dioxin Releases from Municipal Waste Incineration Processes,* HMIP, 1996. The concentrations indicated are based on an ELV of 1 ng/Nm^3 before correction for the individual congener WHO-TEFs.

(b) The emission rates have been calculated from the individual concentrations at the ELV of 0.06 Nng/m^3 and the discharge stack volumetric flow rate of 3.67 Nm^3/s at reference conditions (i.e., 273K, 101.3kPa, 11% dry oxygen).

4.4. Sources of Dioxin-like PCBs

4.4.1. For the purpose of assessing potential health impact associated with the effect of dioxin-like PCB emissions from the proposed facility, the process discharge stacks are the only relevant emission source. Dioxin-like PCB emissions are considered to be of relevance to long term exposure (chronic health effects).

4.4.2. The maximum GLCs of dioxin-like PCBs, at the location of the human sensitive receptors, was predicted using ADMS 6. IRAP-h View automatically extracts various air parameters from the air modelling plot-files and converts them into the required format. Air parameters generated by IRAP-h View include hourly air concentration from the particle phase, particle bound and vapour phase, annual average dry deposition from the particle phase, particle bound and vapour phase and annual average wet deposition from the particle phase, particle bound and vapour phase.

4.4.3. The air dispersion model considers PCBs as a single compound. However, the general term PCBs denotes a whole family of compounds, PCBs and dioxin like PCBs. This assessment considers the dioxin-like PCBs only. There are twelve dioxin like PCBs listed in Table2-5 of Chapter 2 of the US EPA's Human Health Risk Assessment Protocol, namely, PCB 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 189. Toxicity Equivalency Factors for the twelve were taken from the 2005 World Health Organisation *Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxin and Dioxin-like Compounds*.

4.4.4. The emissions profile for the twelve dioxin-like PCBs were obtained from emissions test data supplied by the technology provider, which were provided solely as a percentage breakdown. In the interest of a conservative assessment, the concentrations were therefore calculated as a proportion of the PCB ELV used in the air dispersion modelling assessment (i.e., 0.0036 ng/m^3).

4.4.5. Emission rates for the proposed Installation are provided in Table 4.

Table 4: PCB Profile and Emission Rates

Congener	Average Result (ng/m³) (a) (b)	WHO 2005 TEF	Emission Concentration WHO-TEQ ng Nm³ (dry)	Emission Rate (ng/s) (b)	Emission Rate (g/s) (b)
77	0.000648	0.0001	6.48E-08	2.38E-07	2.38E-16
81	0.000288	0.0003	8.64E-08	3.17E-07	3.17E-16
126	0.000720	0.1	7.20E-05	2.64E-04	2.64E-13
169	0.000360	0.03	1.08E-05	3.96E-05	3.96E-14
105	0.000252	0.00003	7.56E-09	2.77E-08	2.77E-17
114	0.0000720	0.00003	2.16E-09	7.93E-09	7.93E-18
118	0.000252	0.00003	7.56E-09	2.77E-08	2.77E-17
123	0.0000360	0.00003	1.08E-09	3.96E-09	3.96E-18
156	0.000288	0.00003	8.64E-09	3.17E-08	3.17E-17
157	0.000252	0.00003	7.56E-09	2.77E-08	2.77E-17
167	0.000108	0.00003	3.24E-09	1.19E-08	1.19E-17
189	0.000324	0.00003	9.72E-09	3.57E-08	3.57E-17

Notes to Table 4

(a) Information supplied by the technology provider as a percentage breakdown. In the interest of a conservative assessment, these were then calculated as a proportion of the PCB ELV used in the air dispersion modelling assessment (i.e., 0.0036 ng/m³).

(b) The emission rates have been calculated from the individual concentrations at the ELV of 0.0036 ng/m³ and the discharge stacks volumetric flow rate of 3.67 Nm³/s at reference conditions (i.e., 273K, 101.3kPa, 11% dry oxygen).

4.5. Estimation of COPC Concentration in Media

4.5.1. The IRAP-h View model used for the revised HHRA is equipped with a database of physical and chemical parameters used to calculate the media concentrations for all relevant COPCs. These are chemical specific values based on current international knowledge.

4.5.2. In addition to the default values, which were used for this revised HHRA, site-specific data are required for some of the parameters. These include the following:

- annual average evapotranspiration;
- annual average irrigation;
- annual average precipitation;
- annual average runoff; and
- annual average wind velocity

4.5.3. The site-specific data used for the area is as follows:

- annual average precipitation = 63.9 cm/year (average value taken from meteorological data);
- annual average runoff = 31.3 cm/year (from Defra – for England and Wales 49% of rainfall);
- annual average irrigation = 10.9cm/year (irrigation = (precipitation – runoff) x 1/3);
- annual average evapotranspiration = 21.7 cm/year (evapotranspiration = (precipitation – runoff) x 2/3);
- annual average wind velocity = 3.74 m/s (average value taken from meteorological data); and
- annual average air temperature = 9.50^{o}C (average value taken from meteorological data).

Calculation of COPC Air Concentration for Direct Inhalation

4.5.4. Air concentrations used to calculate direct inhalation of COPCs risks are characterised as the total of vapour and particle air concentrations inhaled. Two calculations are performed, one to evaluate the long term or chronic exposure and the other to evaluate the short term or acute exposure.

Calculation of COPC Concentrations in Soil

4.5.5. COPC concentrations in the soil are calculated by summing the particle and vapour phase deposition of COPCs to the soil. Following deposition, COPCs may be incorporated into the upper layers of the soil where produce is grown.

4.5.6. The calculation of soil concentration incorporates a term that accounts for the loss of COPCs by several mechanisms, including leaching, erosion, runoff, degradation (biotic and abiotic) and volatilisation. All these mechanisms will result in a lowering of the soil concentration associated with the deposition rate.

4.5.7. Soil conditions, such as pH, structure, organic matter content and moisture content, affect the distribution and mobility of COPCs. Loss of COPCs from the soil is modelled by using rates that depend on site-specific data about the physical and chemical characteristics of the soil.

Calculation of COPC Concentrations in Produce

4.5.8. Indirect exposure, resulting from the ingestion of produce, depends on the total concentration of COPCs in the leafy and fruit portions of the produce. Produce can be contaminated by three mechanisms, namely:

- particle deposition - wet and dry deposition of particle-bound COPCs on the leaves and fruit of plants;
- vapour transfer - the vapour phase uptake of plants through their foliage; and
- root uptake - the root uptake of COPCs available from the soil and their transfer to the portions of the plant.

4.5.9. The sum of contamination occurring through all three of these mechanisms will result in the total COPC concentration in produce.

Calculation of COPC Concentrations in Beef and Dairy

4.5.10. COPC concentrations in beef tissue and milk produced are estimated on the basis of the amount of COPCs that the cattle are assumed to eat in their diet. Cattle's diet is assumed to consist of forage (pasture and hay), silage and grain.

4.5.11. Further consumption of COPCs may occur through the cattle's ingestion of soil. The COPC concentration in the feed (forage and silage) is calculated as a sum of contamination occurring through the following mechanisms:

- particle deposition - wet and dry deposition of particle-bound COPCs on plants;
- vapour transfer - the vapour phase uptake of plants through their foliage; and
- root uptake - the root uptake of COPCs available from the soil and their transfer to the portions of the plant.

4.5.12. The potential for grain contamination is assumed to occur through root uptake only.

Calculation of COPC Concentrations in Pork

4.5.13. COPC concentrations in pork are estimated on the basis of the amount of COPCs that the pigs are assumed to eat in their diet. A pigs' diet is assumed to consist of silage and grain.

4.5.14. Further consumption of COPCs may occur through the pigs' ingestion of soil. The COPC concentration in the silage is calculated as a sum of contamination occurring through the following mechanisms:

- particle deposition - wet and dry deposition of particle-bound COPCs on plants;
- vapour transfer - the vapour phase uptake of plants through their foliage; and
- root uptake - the root uptake of COPCs available from the soil and their transfer to the portions of the plant.

4.5.15. The potential for grain contamination is assumed to occur through root uptake only.

Calculation of COPC Concentrations in Poultry Meat and Eggs

4.5.16. Estimates of COPC concentrations in poultry and eggs are based on the amount of COPCs that chickens are assumed to consume through their diet. The COPC route of exposure for chickens is assumed to be through soil and grain. Grain contamination is assumed to occur only through root uptake.

Quantifying Exposure

4.5.17. Calculating COPC-specific exposure rates for each exposure pathway involves estimation of certain factors such as the media concentration and consumption rates. Consumption rates were estimated based on the recommendations and default values provided by the USEPA. The fraction of contaminated food stuffs consumed as a fraction of the diet as whole was based on those provided in the HMIP methodology. This methodology does not provide data for a 'fisher scenario' therefore the values quoted for a farmer were used.

5. ASSESSMENT OF IMPACT

5.1. Assessment Criteria

5.1.1. IRAP-view allows calculation of the total exposure (i.e., from both inhalation and indirect pathways) for all dioxins and furans from the Installation. To assess the impact, a comparison of the total daily intake of dioxins and furans with the UK's Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment ("COT") tolerable daily intake ("TDI") values is also made. (Note: The COT is an independent scientific committee that provides advice to the Food Standards Agency, the Department of Health and other Government Departments and Agencies on matters concerning the toxicity of chemicals).

5.1.2. The current TDI is 2pg/kg(bw)/day. Consequently, any value less than 100% of the TDI is considered acceptable.

5.1.3. A mean daily intake ("MDI") is also defined, which is the typical intake from background sources (including dietary intake) across the UK. The typical MDI, set by the Environment Agency, for an adult is 0.7pg WHO-TEQ/kg bw/day and a child is 1.8pg WHO-TEQ/kg bw/day[3][4].

5.2. Proposed Installation Contribution to Total Daily Intake - Dioxins and Furans

5.2.1. The predicted total daily intake of dioxins and furans (averaged over a lifetime (70 years)) has been compared against the COT total daily intake value of 2pg TEQ/kg body weight/day at each of the sensitive receptors and is provided as Table 5 for the resident scenario and Table 6 for the farmer scenario.

Table 5: Dioxins and Furans Total Daily Intake – Process Contributions Only (Resident Scenario)

Receptor	Resident Child		Resident Adult	
	Intake	% of TDI	Intake	% of TDI
R01	0.00272	0.136%	0.000907	0.045%
R02	0.000144	0.007%	0.0000479	0.002%
R03	0.00101	0.051%	0.000337	0.017%
R04	0.000584	0.029%	0.000195	0.010%
R05	0.000469	0.023%	0.000156	0.008%
R06	0.000140	0.007%	0.0000468	0.002%
R07	0.000683	0.034%	0.000228	0.011%
R08	0.000640	0.032%	0.000213	0.011%
R09	0.000164	0.008%	0.0000548	0.003%

[3] Environment Agency, Soil Guideline Values for dioxins, furans and dioxin-like PCBs in soil, Science report SC050021/Dioxins SGV, 2009a.

[4] Environment Agency, Contaminants in soil: updated collation of toxicological data and intake values for humans Dioxins, furans and dioxin-like PCBs, Science report SC050021/TOX 12, 2009b

Table 5: Dioxins and Furans Total Daily Intake – Process Contributions Only (Resident Scenario) (Cont.)

Receptor	Resident Child		Resident Adult	
	Intake	% of TDI	Intake	% of TDI
R10	0.000312	0.016%	0.000104	0.005%
R11	0.000399	0.020%	0.000133	0.007%
R12	0.0000490	0.002%	0.0000163	0.001%
R13	0.000336	0.017%	0.000112	0.006%
R14	0.000228	0.011%	0.0000762	0.004%
R15	0.0000516	0.003%	0.0000173	0.001%
R16	0.000153	0.008%	0.0000512	0.003%
R17	0.000162	0.008%	0.0000541	0.003%
R18	0.000130	0.006%	0.0000434	0.002%
RI_1	0.000293	0.015%	0.0000964	0.005%
RI_2	0.00659	0.329%	0.00219	0.110%
RI_3	0.000766	0.038%	0.000238	0.012%

Notes to Table 5
Intake expressed as WHO-TEF pg/kg bw/day.

Table 6: Dioxins and Furans Total Daily Intake – Process Contributions Only (Farmer Scenario)

Receptor	Farmer Child		Farmer Adult	
	Intake	% of TDI	Intake	% of TDI
R06	0.00247	0.12%	0.00172	0.09%
R09	0.00292	0.15%	0.00203	0.10%
R15	0.000943	0.05%	0.000656	0.03%
R18	0.00232	0.12%	0.00161	0.08%
RI_1	0.00469	0.23%	0.00326	0.16%
RI_2	0.111	5.54%	0.0769	3.85%
RI_3	0.00815	0.41%	0.00570	0.29%

Notes to Table 6
Intake Expressed as WHO-TEF pg/kg bw/day.

5.2.2. It can be seen from the data in Tables 5 and 6 that the total predicted total daily intake of dioxins and furans varies depending on receptor type and location, and ranges from 0.0000163 pg WHO-TEF/kg body weight/day for the resident adult at R12 (residential properties at Kieran Maxwell Lane) to 0.111 pg WHO-TEF/kg body weight/day for the Farmer Child scenario at RI_2 (Agricultural area north of the Installation).

5.2.3. The maximum process contribution of the proposed Installation to the COT TDI is 5.54%. Consequently, the contribution of the proposed Installation to the intake of dioxins and furans is negligible.

5.3. Proposed Installation Contribution to Total Daily Intake - PCBs

5.3.1. The predicted total daily intake of PCBs (averaged over a lifetime (70 years)) has been compared against the COT total daily intake value of 2pg TEQ/kg body weight/day at each of the sensitive receptors and is provided as Table 7 for the resident scenario and Table 8 for the farmer scenario.

Table 7: PCBs Total Daily Intake – Process Contributions Only (Resident Scenario)

Receptor	Resident Child		Resident Adult	
	Intake	% of TDI	Intake	% of TDI
R01	4.22E-07	0.000021%	1.38E-07	0.0000069%
R02	0.00E+00	0%	0.00E+00	0%
R03	2.65E-07	0.000013%	8.44E-08	0.0000042%
R04	1.23E-07	0.0000061%	3.98E-08	0.0000020%
R05	9.60E-08	0.0000048%	3.09E-08	0.0000015%
R06	3.97E-08	0.0000020%	1.27E-08	0.00000063%
R07	1.75E-07	0.0000087%	5.59E-08	0.0000028%
R08	1.67E-07	0.0000084%	5.34E-08	0.0000027%
R09	3.77E-08	0.0000019%	1.23E-08	0.00000061%
R10	6.03E-08	0.0000030%	1.96E-08	0.0000010%
R11	1.11E-07	0.0000056%	3.56E-08	0.0000018%
R12	1.65E-08	0.00000083%	5.25E-09	0.00000026%
R13	9.46E-08	0.0000047%	3.03E-08	0.0000015%
R14	6.40E-08	0.0000032%	2.06E-08	0.0000010%
R15	1.55E-08	0.00000077%	4.97E-09	0.00000025%
R16	4.18E-08	0.0000021%	1.34E-08	0.00000067%
R17	3.03E-08	0.0000015%	9.91E-09	0.00000050%
R18	3.05E-08	0.0000015%	9.89E-09	0.00000049%
RI_1	1.14E-07	0.0000057%	3.50E-08	0.0000017%
RI_2	1.37E-06	0.000069%	4.40E-07	0.000022%
RI_3	9.17E-07	0.000046%	2.69E-07	0.000013%

Notes to Table 7
Intake expressed as WHO-TEF pg/kg bw/day.

Table 8: PCBs Total Daily Intake – Process Contributions Only (Farmer Scenario)

Receptor	Farmer Child		Farmer Adult	
	Intake	% of TDI	Intake	% of TDI
R06	2.64E-07	0.000013%	1.91E-07	0.000010%
R09	2.72E-07	0.000014%	1.95E-07	0.000010%
R15	1.05E-07	0.0000053%	7.58E-08	0.0000038%
R18	2.19E-07	0.000011%	1.57E-07	0.0000079%
RI_1	6.40E-07	0.000032%	4.70E-07	0.000023%

Table 8: PCBs Total Daily Intake – Process Contributions Only (Farmer Scenario) (Cont.)

Receptor	Farmer Child		Farmer Adult	
	Intake	% of TDI	Intake	% of TDI
RI_2	9.47E-06	0.00047%	6.83E-06	0.00034%
RI_3	4.06E-06	0.00020%	3.06E-06	0.00015%

Notes to Table 8
Intake expressed as WHO-TEF pg/kg bw/day.

5.3.2. It can be seen from the data in Tables 7 and 8 that the total predicted total daily intake of dioxins and furans varies depending on receptor type and location, and ranges from 0 pg WHO-TEF/kg body weight/day for resident child/adult at R02 (Hitachi Rail Intake Vents (14m from ground level) to 0.00000947 pg WHO-TEF/kg body weight/day for the Farmer Child scenario at RI_2 (Agricultural area north of the Installation).

5.3.3. The maximum process contribution of the proposed Installation to the COT TDI is 0.0005%. Consequently, the contribution of the proposed Installation to the intake of PCBs is negligible.

5.4. Total Intake – Cumulative Impact, Dioxins, Furans and PCBs

5.4.1. This section relates to emissions of dioxins, furans and PCBs from the proposed Installation and incudes existing background intake.

5.4.2. The total daily intake is the sum on the potential intake due to process emissions and the average daily background intake (i.e., that arising from other sources), referred to as the mean daily intake ("MDI") (see Section 5.1.3). It should be noted that MDI is 35% of the adult intake and 90% of a child's intake.

5.4.3. A comparison of predicted intakes - arising from dioxins, furans and PCBs from both Installation and the MDI with the TDI is provided in Table 9 for the resident scenario, and Table 10 for the farmer scenario.

Table 9: Total Daily Intake of Dioxins, Furans and PCBs (Resident Scenario)

Receptor	Resident Child		Resident Adult	
	MDI + Intake	% of TDI	MDI + Intake	% of TDI
R01	1.80	90.14%	0.701	35.05%
R02	1.80	90.01%	0.700	35.00%
R03	1.80	90.05%	0.700	35.02%
R04	1.80	90.03%	0.700	35.01%
R05	1.80	90.02%	0.700	35.01%
R06	1.80	90.01%	0.700	35.00%
R07	1.80	90.03%	0.700	35.01%
R08	1.80	90.03%	0.700	35.01%

Table 9: Total Daily Intake of Dioxins, Furans and PCBs (Resident Scenario) (Cont.)

Receptor	Resident Child		Resident Adult	
	MDI + Intake	% of TDI	MDI + Intake	% of TDI
R09	1.80	90.01%	0.700	35.00%
R10	1.80	90.02%	0.700	35.01%
R11	1.80	90.02%	0.700	35.01%
R12	1.80	90.00%	0.700	35.00%
R13	1.80	90.02%	0.700	35.01%
R14	1.80	90.01%	0.700	35.00%
R15	1.80	90.00%	0.700	35.00%
R16	1.80	90.01%	0.700	35.00%
R17	1.80	90.01%	0.700	35.00%
R18	1.80	90.01%	0.700	35.00%
RI_1	1.80	90.01%	0.700	35.00%
RI_2	1.81	90.33%	0.702	35.11%
RI_3	1.80	90.04%	0.700	35.01%

Notes to Table 9
Intake expressed as WHO-TEF pg/kg bw/day.

Table 10: Total Daily Intake of Dioxins, Furans and PCBs – Process Contributions (Farmer Scenario)

Receptor	Farmer Child		Farmer Adult	
	MDI + Intake	% of TDI	MDI + Intake	% of TDI
R06	1.80	90.12%	0.702	35.09%
R09	1.80	90.15%	0.702	35.10%
R15	1.80	90.05%	0.701	35.03%
R18	1.80	90.12%	0.702	35.08%
RI_1	1.80	90.23%	0.703	35.16%
RI_2	1.91	95.54%	0.777	38.85%
RI_3	1.81	90.41%	0.706	35.29%

Notes to Table 10
Intake expressed as WHO-TEF pg/kg bw/day.

5.4.4. It can be seen from the data in Table 9 and 10 that the total predicted total daily intake of dioxins, furans, and PCBs, together with the MDI, varies depending on receptor type and location, however the COT TDI 2pg/kg(bw)/day is not exceeded at any location.

6. CONCLUSIONS

6.1.1. An assessment of the possible effects on the health of humans due to emissions of dioxins and furans, and dioxin like PCBs from the proposed Installation has been undertaken. The assessment was based on an individual's exposure to the worst-case emission level of dioxins and furans over a lifetime and consuming a proportion of locally grown food. This is demonstrated by the Farmer scenario at the maximum point of ground level concentration of emissions.

6.1.2. To identify the level of potential risk from exposure to each COPC in all relevant pathways of exposure, a site conceptual model was produced, and potentially sensitive human receptors identified.

6.1.3. Using a combination of ADMS and IRAP-h View, modelling has demonstrated that the total dioxin intake is substantially less than the health protective level of 2pg/day – the highest concentration being only 5.54% of the COT TDI for dioxins and furans, and 0.0005% for dioxin like PCBs.

6.1.4. This conclusion is considered robust as it is based on the worse-case approach both in terms of the emissions from the Installation considered and the maximum ground level concentration used regardless of scenario.

6.1.5. Consequently, it can be concluded that potential exposure to emissions from the proposed Installation will not pose unacceptable risk to receptors identified in the assessment.