Table 8.3 Greenhouse Gas Emissions (2003) ('000 tonnes)[6]

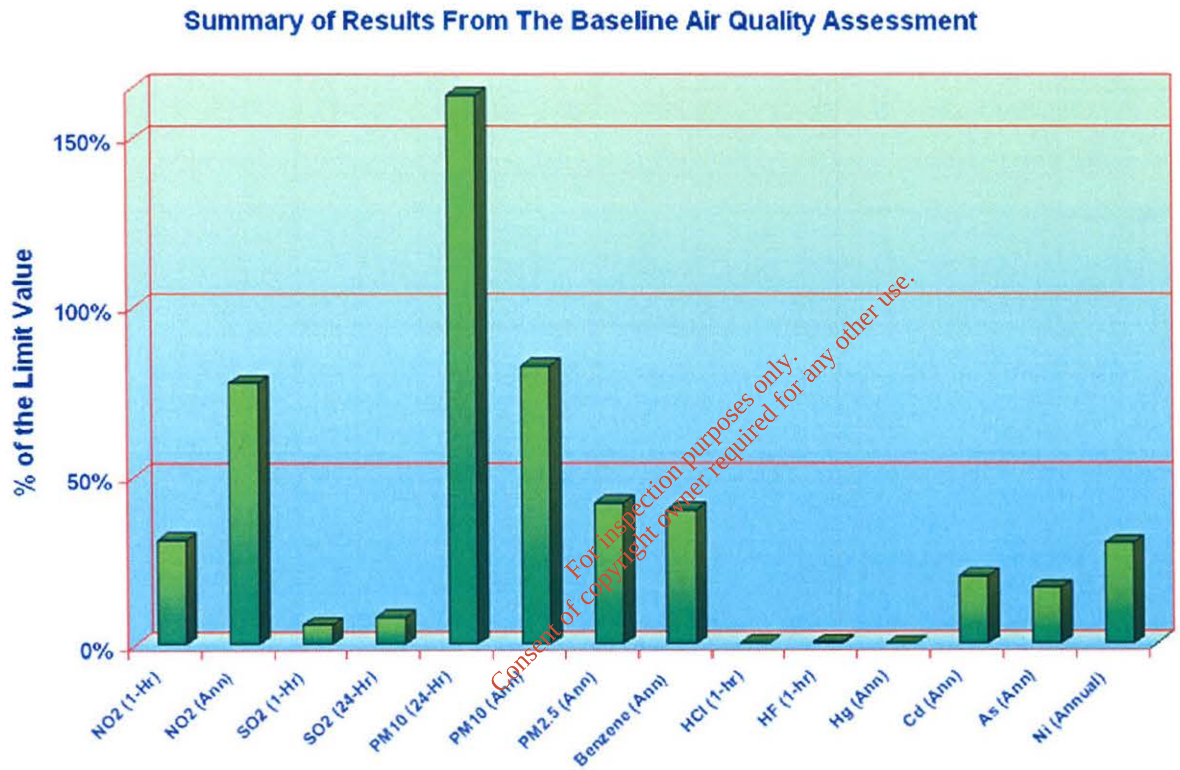
Category	CO_2	CH_4[1]	N_2O[1]	HFC	PFC	SF_6	Totals
Energy	41979	8.5	4.9				43,665
Industrial Processes	2360						2972
Solvents & Other Product Use	111						111
Agriculture		507	26.1				18,747
Land Use Change & Forestry	-981						-981
Waste	0	91.9	0.42				2060
Total	43469	515.5	31.0	288	224	100	66573

(1) The global warming potential of CH_4 is 21 times that of CO_2 whilst N_20 is 310 times that of CO_2.

Table 8.4 Greenhouse Gas Emissions ('000 tonnes CO_2 equivalent)[10]

Year	CO_2	CH_4	N_2O	HFC, PFC, SF_6	Total Emissions	Emission Index	Sinks (Kyoto basis)	Net Total	Net Index
Base Year (1990)	31,575	12,836	9,085	256	53,752	100.0	0	**53,752**	**100.0**
1998	40,028	13,631	10,069	256	63,984	119.0	-745	**63,239**	**119.6**
2000	42,675	13,139	9,630	799	66,243	123.2	-991	**65,252**	**121.4**
2005	47,210	12,940	9,692	1,342	71,184	132.4	-1,523	**69,660**	**129.6**
2010 Low	51,373	12,185	9,720	672	73,950	139.6	-2,056	**71,894**	**133.8**
2010 High	51,373	12,185	9,720	1,885	75,163	139.8	-1,369	**73,794**	**139.3**

Figure 8.2 Results of the Baseline Air Quality Assessment



Project
Dublin Waste To Energy Air Quality Assessment

Reference
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Figure 8.2
Results of the Baseline Air Quality Assessment

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8.3. Emissions and impact on climate

Air Quality

Construction Phase

8.3.1. The construction phase of the project is envisaged to last a period of 36 months. There is the potential for a number of emissions to the atmosphere during the construction of the proposed development. In particular, the construction activities may generate quantities of dust in the immediate region of the construction facility and along the route of the haulage trucks. Construction vehicles, generators etc., will also give rise to some exhaust emissions.

Operation Phase

Assessment Approach

8.3.2. Council Directive 2000/76/EC on the Incineration of Waste has outlined air emission limit values as set out in Table 8.6. The Directive has also outlined stringent operating conditions in order to ensure sufficient combustion of waste thus ensuring that dioxin formation is minimised. Elsam Engineering A/S is committed, as a minimum, to meeting all the requirements of Council Directive 2000/76/EC. Indeed, due to the advanced post-combustion flue gas cleaning technology employed, expected average emission values will be lower than the maximum values used in this study. The maximum and average emission concentrations and mass emission rates have been detailed in Table 8.7.

8.3.3. Emissions from the Site have been assessed firstly under typical operation, secondly based on maximum operating conditions and thirdly under abnormal operating conditions. Maximum operations are based on the Facility operating at 600,000 tonnes per annum and with emission levels at the limits defined in EU Directive 2000/76/EC. Abnormal operating conditions refer to short-term periods in which the limits detailed in EU Directive 2000/76/EC are exceeded. The Dublin WtE Facility has two main process emission points (stacks). The operating details of these major emission points are outlined in Table 8.5. Full details of emission concentrations and mass emissions are given in Annex 8.7 of Appendix 8.

Table 8.5 Process Emission Design Details

Stack Reference	Stack Height (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temp (K)	Volume Flow (Nm^3/hr)(1)	Exit Velocity (m/sec actual)(2)
Stack 1	100	2.40	4.52	328	238,905 – Average	17.6
					275,000 – Maximum	20.3
Stack 2	100	2.40	4.52	328	238,905 – Average	17.6
					275,000 – Maximum	20.3

(1) Normalised to 11% O_2, dry, 273K.
(2) Actual - 11%O_2, dry, 373K

8.3.4. In order to assess the possible impact from the proposed Facility under maximum and abnormal operations, a conservative approach was adopted that is designed to over-predict ground level concentrations. This cautious approach will ensure that an over-estimation of impacts will occur and that the resultant emission standards adopted are protective of ambient air quality. The approach incorporated several conservative assumptions regarding operating conditions at the proposed Facility. This approach incorporated the following features:

- Emissions from all emission points in the assessment (including the cumulative assessment) were assumed to be operating at their maximum emission level, 24 hours/day over the course of a full year. This represents a very conservative approach as typical emission from the proposed Facility will be well within the emission limit values set out in the Waste Incineration Directive.

- For all operating scenarios, it has been assumed that the emission point is operating for 24-hrs/day over the course of the full year.

- Maximum predicted ambient concentrations for all pollutants within a 10 km radius of the Site were reported in this study even though, in many cases, no residential receptors were near the location of this maximum ambient concentration. Concentrations at the nearest residential receptors are generally significantly lower than the maximum ambient concentrations reported.

- Worst-case background concentrations were used to assess the baseline levels of substances released from the Site

- Worst-case meteorological conditions over the period 1993 - 2005 have been used in all assessments. Both meteorological data collected on-site in 2004 and 2005 and Met Eireann data from Dublin Airport over the period 1993 - 2005 has been assessed. On-site data from 2004 and 2005 was modelled and compared to modelled results using Dublin Airport data. The worst-case year with regard to the annual average concentrations was selected for modelling (On-site data 2004). Annual average concentrations using on-site year 2004 meteorological data are 18% higher than the average of the fifteen meteorological year files.

8.3.5. As a result of these conservative assumptions, there will be an over-estimation of the emissions from the Site and the impact of the proposed Facility on human health and the surrounding environment.

Modelling Study Methodology

8.3.6. The air dispersion modelling input data consists of detailed information on the physical environment (including building dimensions and terrain features), design details from all emission points on-site and a full year of worst-case meteorological data. Using this input data, the model predicts ambient ground level concentrations beyond the Site boundary for each hour of the modelled meteorological year. The model post-processes the data to identify the location and maximum value of the worst-case ground level concentration in the applicable format for comparison with the relevant limit values. This worst-case concentration is then added to the existing background concentration to give the worst-case predicted ambient concentration. The worst-case ambient concentration is then compared with the relevant ambient air quality standard for the protection of human health to assess the significance of the releases from the Site.

8.3.7. In the absence of detailed guidance from the Irish EPA, the selection of appropriate modelling methodology has followed the guidance from the USEPA which has issued detailed and comprehensive guidance on the selection and use of air quality models[13,16-17].

8.3.8. Based on guidance from the USEPA, the most appropriate regulatory model for the current application is the AERMOD model (Version 04300). The model is applicable in both simple and complex terrain, urban or rural locations and for all averaging periods[12,13]. The terrain in the region of the Facility was obtained from Ordnance Survey Ireland and imported into the model using the AERMOD terrain pre-processor AERMAP (see Figure 8.3). An overview of the model is outlined in Annex 8.1 of Appendix 8.

8.3.9. The selection of the urban/rural classification is based on the land use procedure of Auer[18] as recommended by the USEPA[13]. An examination of the land-use type around the Site indicated that the urban boundary layer was appropriate.

8.3.10. The AERMOD model is capable of modelling most meteorological conditions likely to be encountered in the region. However, unusual meteorological conditions may occur infrequently, which may not be modelled adequately using AERMOD. One such condition is fumigation which occurs when a plume is emitted into a stable layer of air which subsequently mixes to ground level through either convective transfer of heat from the surface or because of advection to less stable surroundings[14]. A recommended screening model is SCREEN3[13]. An additional consideration in the current location is shoreline fumigation which may occur when tall stacks are located near shorelines. Shoreline fumigation may be caused by the movement from a stable marine environment to an unstable inland environment leading to mixing to ground level at the point of contact. Again, this unusual meteorological condition can be modelled by SCREEN3[14] (full details are outlined in Annex 8.3 of Appendix 8).

Meteorological Considerations

8.3.11. Meteorological data is an important input into the air dispersion model. The local airflow pattern will be greatly influenced by the geographical location. Important features will be the location of hills and valleys or land-water-air interfaces and whether the Site is located in simple or complex terrain.

8.3.12. The selection of the appropriate meteorological data has followed the guidance issued by the USEPA[13]. A primary requirement is that the data used should have a data capture of greater than 90% for all parameters. Two synoptic meteorological stations operated by Met Eireann were identified near the Site – Casement Aerodrome and Dublin Airport. Data collection of greater than 90% for all parameters is required for air dispersion modelling. Both Casement Aerodrome and Dublin Airport fulfil this requirement.

8.3.13. The additional requirements of the selection process depend on the representativeness of the data. The representativeness can be defined as "the extent to which a set of measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application"[15]. The meteorological data should be representative of conditions affecting the transport and dispersion of pollutants in the area of interest as determined by the location of the sources and receptors being modelled.

8.3.14. In the region of the Site, Casement Aerodrome meteorological station is 20km inland with a large terrain feature within 5km south of the Site. In contrast, Dublin Airport is within 5 km of the coast in a region of gentle terrain. Thus, Dublin Airport was judged to be the most appropriate meteorological station for use in the air dispersion model as the proposed Site is in a region of flat terrain and is a coastal location.

8.3.15. The windrose from Dublin Airport for the years 2001-2005 is shown in Figure 8.4. The windrose indicates the prevailing wind speed and direction over the five-year period. The prevailing wind direction is generally from the W-SW direction, with generally moderate wind speeds, averaging around 4-7 m/s.

8.3.16. Meteorological data has also been collected on-site over the full years 2004 and 2005. The relevant parameters monitored were wind speed, wind direction and temperature. The two sets (onsite versus airport data) wind roses were compared to ascertain whether any significant differences were apparent between the two sites (see Figure 8.4). In terms of wind direction, the on-site data veers westerly and north-westerly with a reduced frequency of south-westerly winds compared to the Dublin Airport data. This may be due to the increased proximity to the Dublin hills to the south-west which will tend to channel winds along a more westerly path. In terms of wind speed, the on-site station has lower average wind speeds, which may be reflective of the greater surface roughness of the Site due to the more urban setting. A detailed comparison of the meteorological data is outlined in Annex 8.6 of Appendix 8 in addition to a study of the sensitivity of other key model input parameters.

Background Concentrations

8.3.17. The ambient concentrations detailed in the following sections include both the emissions from the Site and the ambient background concentration for that substance. Background concentrations have been derived from a worst-case analysis of the cumulative sources in the region in the absence of the development. A detailed baseline air quality assessment (Section 8.1) was carried out to assess background levels of those pollutants, which are likely to be significant releases from the Site. Appropriate background values have been outlined in Table 8.8. In arriving at the combined annual background concentration, cognisance has been taken of the accuracy of the approach and the degree of double counting inherent in the assessment. In relation to NO_2, PM_{10}, $PM_{2.5}$ and benzene the baseline monitoring program will have taken into account both the existing traffic levels and existing industrial sources. However, some increases in traffic levels will occur due to the development which has been incorporated into the final combined background levels. Again, in recognition of the various inaccuracies in this approach, the values have been rounded accordingly. A similar approach has been adopted for the other pollutants.

8.3.18. In order to obtain the predicted environmental concentration (PEC), background data was added to the process emissions. In relation to the annual averages, the ambient background concentration was added directly to the process concentration. However, in relation to the short-term peak concentrations, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK Environment Agency(19) 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.

8.4. Cumulative Assessment

8.4.1. As the region around Poolbeg is partly industrialised and thus has several other potentially significant sources of pollutants, a detailed cumulative assessment has been carried out using the methodology outlined by the USEPA. The impact of nearby sources should be examined where interactions between the plume of the point source under consideration and those of nearby sources can occur. These include:

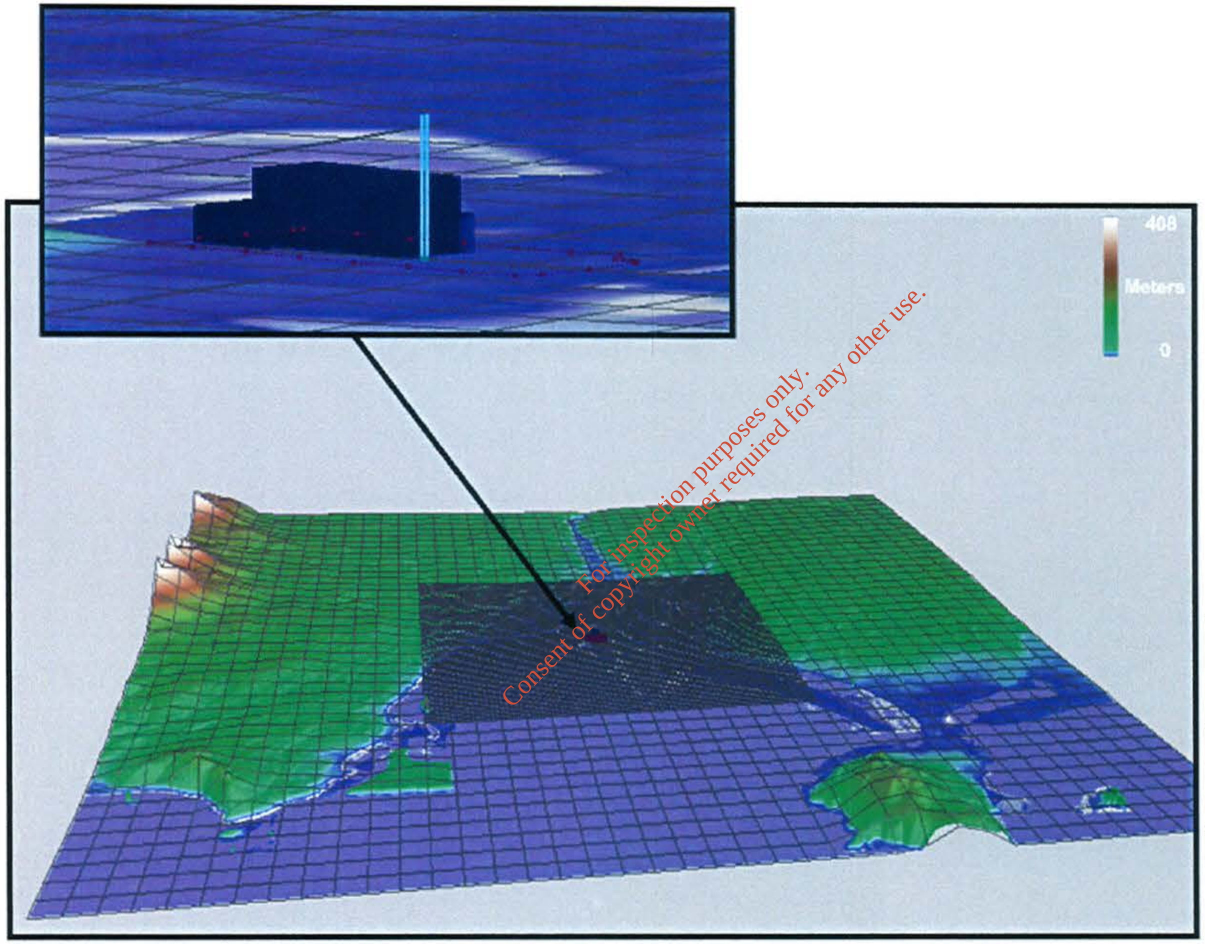
a) the area of maximum impact of the point source,
b) the area of maximum impact of nearby sources,
c) the area where all sources combine to cause maximum impact on air quality(13).

8.4.2. Background concentrations for the area, based on natural, minor and distant major sources need also to be taken into account in the modelling procedure. A major baseline monitoring programme (see Section 8.1) was undertaken over several months which, in conjunction with other available baseline data, was used to determine conservative background concentrations in the region (see Table 8.8).

Ambient Air Quality Standards

8.4.3. The relevant ambient air quality standards are outlined in Table 8.9. Ambient air quality legislation designed to protect human health is generally based on assessing ambient air quality at locations where the exposure of the population is significant relevant to the averaging time of the pollutant. However, in the current assessment, ambient air quality legislation has been applied to all locations over a 20km grid regardless of whether any sensitive receptors (such as residential locations) are present for significant periods of time. This represents a worst-case approach and an examination of the corresponding concentrations at the nearest sensitive receptors relative to the actual quoted maximum concentration indicates that these receptors generally experience ambient concentrations significantly lower than that reported for the maximum value.

Figure 8.3 AERMAP Terrain Processing



Project
Dublin Waste To Energy
Air Quality Assessment

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Figure 8.3
AERMAP Terrain Processing

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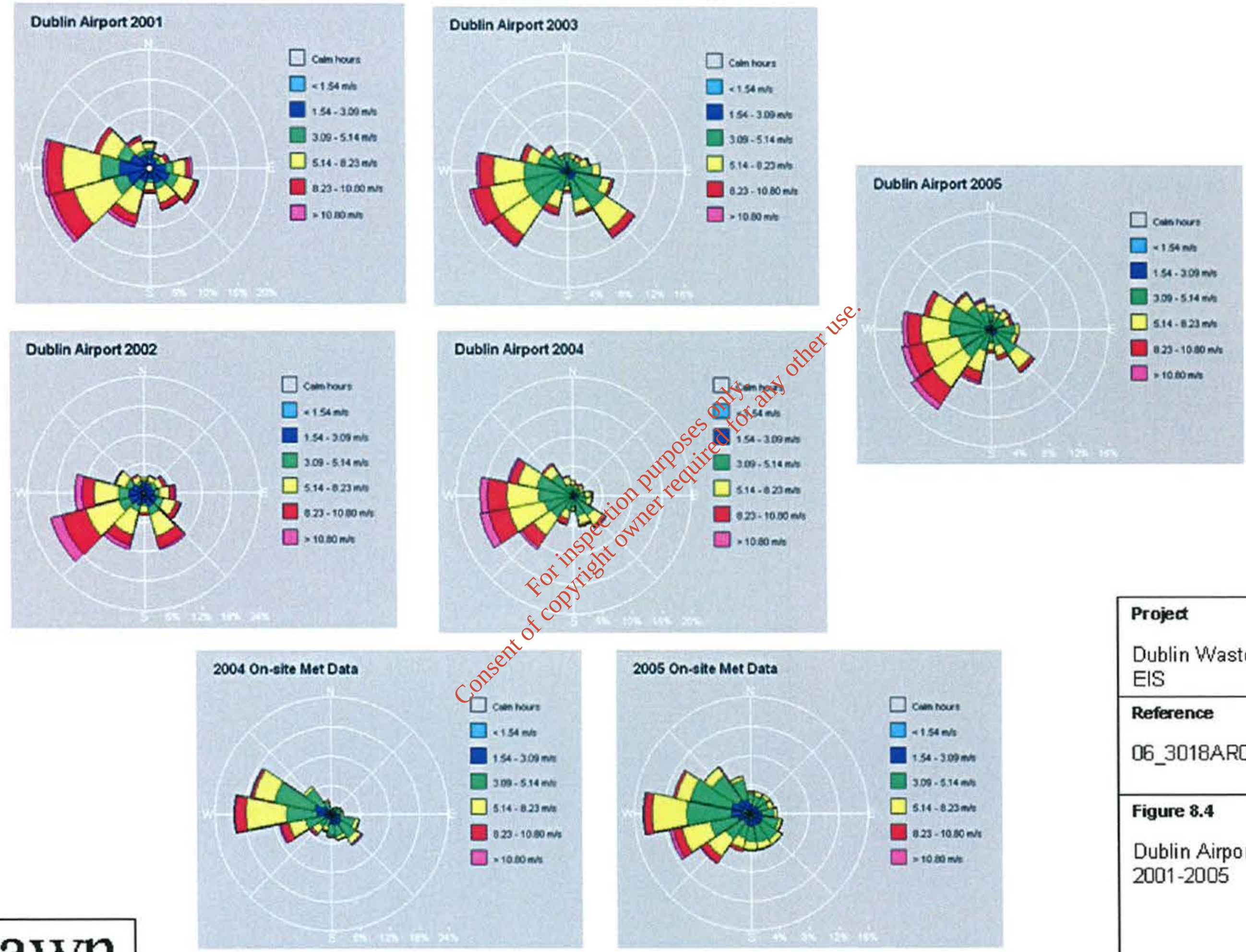
Figure 8.4 Dublin Airport Windrose 2001-2005



Project

Dublin Waste To Energy EIS

Reference

06_3018AR01

Figure 8.4

Dublin Airport Windrose 2001-2005

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Table 8.6 Council Directive 2000/76/EC, Annex V Air Emission Limit Values

Daily Average Values	**Concentration**	
Total Dust	10 mg/m^3	
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	10 mg/m^3	
Hydrogen Chloride (HCl)	10 mg/m^3	
Hydrogen Fluoride (HF)	1 mg/m^3	
Sulphur Dioxide (SO_2)	50 mg/m^3	
Nitrogen Oxides (as NO_2)(1)	200 mg/m^3	
Half-hourly Average Values	**Concentration**	
	(100%)	**(97%)**
Total Dust(2)	30 mg/m^3	10 mg/m^3
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	20 mg/m^3	10 mg/m^3
Hydrogen Chloride (HCl)	60 mg/m^3	10 mg/m^3
Hydrogen Fluoride (HF)	4 mg/m^3	2 mg/m^3
Sulphur Dioxide (SO_2)	200 mg/m^3	50 mg/m^3
Nitrogen Oxides (as NO_2)	400 mg/m^3(1)	200 mg/m^3
Average Value Over 30 mins to 8 Hours	**Concentration(3)**	
Cadmium and its compounds, expressed as Cd	Total 0.05 mg/m^3	
Thallium and its compounds, expressed as Tl		
Mercury and its compounds, expressed as Hg	0.05 mg/m^3	
Antimony and its compounds, expressed as Sb	Total 0.5 mg/m^3	
Arsenic and its compounds, expressed as As		
Lead and its compounds, expressed as Pb		
Chromium and its compounds, expressed as Cr		
Cobalt and its compounds, expressed as Co		
Copper and its compounds, expressed as Cu		
Manganese and its compounds, expressed as Mn		
Nickel and its compounds, expressed as Ni		
Vanadium and its compounds, expressed as V		
Average Values Over 6 – 8 Hours	**Concentration**	
Dioxins and furans	0.1 ng/m^3	
Average Value	**Concentration(4)**	
	Daily Average Value	**30 Min Average Value**
Carbon Monoxide	50 mg/m^3	100 mg/m^3

(1) Until 1/1/2007 the emission limit value for NO_x does not apply to plants only incinerating hazardous waste
(2) Total dust emission may not exceed 150 mg/m^3 as a half-hourly average under any circumstances
(3) These values cover also the gaseous and vapour forms of the relevant heavy metals as well as their compounds
(4) Exemptions may be authorised for incineration plants using fluidised bed technology, provided that emission limit values do not exceed 100 mg/m^3 as an hourly average value.

Table 8.7 Air Emission Values From Proposed Dublin Waste-to-Energy Facility, Poolbeg, Dublin 4

Daily Average Values	**EU Maximum Emission Concentration**	**Annual Average Daily Emission Concentration**	**Maximum Operating Values Combined (both stacks) Emission Rate (g/s)**	**Average Operating Values Combined (both stacks) Emission Rate (g/s)**
Total Dust	10 mg/m^3	5 mg/m^3	1.53	0.66
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	10 mg/m^3	5 mg/m^3	1.53	0.66
Hydrogen Chloride (HCl)	10 mg/m^3	8 mg/m^3	1.53	1.1
Hydrogen Fluoride (HF)	1 mg/m^3	0.8 mg/m^3	0.15	0.11
Sulphur Dioxide (SO_2)	50 mg/m^3	40 mg/m^3	7.6	5.3
Nitrogen Oxides (as NO_2)	200 mg/m^3	180 mg/m^3	30.6	23.9
Hourly Average Value	**Emission Concentration**	**Emission Concentration**	**Combined Emission Rate (g/s)**	**Combined Emission Rate (g/s)**
Cadmium and its compounds, expressed as Cd	Total 0.05 mg/m^3	Total 0.05 mg/m^3	0.0076	0.0066
Thallium and its compounds, expressed as Tl				
Mercury and its compounds, expressed as Hg	0.05 mg/m^3	0.02 mg/m^3	0.0076	0.0027
Antimony and its compounds, expressed as Sb	Total 0.5 mg/m^3	Total 0.40 mg/m^3	0.076	0.043
Arsenic and its compounds, expressed as As				
Lead and its compounds, expressed as Pb				
Chromium and its compounds, expressed as Cr				
Cobalt and its compounds, expressed as Co				
Copper and its compounds, expressed as Cu				
Manganese and its compounds, expressed as Mn				
Nickel and its compounds, expressed as Ni				
Vanadium and its compounds, expressed as V				
Average Values Over 6 – 8 Hours	**Emission Concentration**	**Emission Concentration**	**Combined Emission Rate (g/s)**	**Combined Emission Rate (g/s)**
Dioxins and furans	0.1 ng/m^3	0.05 ng/m^3	15.3 x 10^{-9}	10.6 x 10^{-9}
Average Value	**Emission Concentration**	**Emission Concentration**	**Combined Emission Rate (g/s)**	**Combined Emission Rate (g/s)**
Carbon Monoxide	150 mg/m^3	30 mg/m^3	22.9	4.0

Table 8.8 Estimated annual background concentrations In The Poolbeg Region (μg/m³).

	NO_2	SO_2	PM_{10}	$PM_{2.5}$	CO	TOC(2)	HCl	HF	Dioxins(1)	Cd	Hg	As	Sb	Ni
Baseline Monitoring Program - Year 2005	30.5	5	34	11	-	2.0	0.24	0.01	0.056 pg/m³ 0.055 pg/m³	0.001	0.001	0.001	0.003	0.006
Baseline Monitoring Program - Year 2012(3)	24.7	5	29.1	9.7	-	1.65	0.24	0.01	0.056 pg/m³ 0.055 pg/m³	0.001	0.001	0.001	0.003	0.006
Cumulative Assessment	0.4	9	0.3	0.3	-	-	-	-	-	-	-	-	-	-
Annual Background Concentration - Year 2012	25.1	5	29.4	10	500	1.65	0.24	0.01	0.056 pg/m³ 0.055 pg/m³	0.001	0.001	0.001	0.003	0.006
Dublin WTE Traffic - Year 2012	2.5	-	0.5	0.5	10	0.01	-	-	-	-	-	-	-	-
Annual Background, Cumulative Impact & Site Traffic Concentration (Year 2012)	**27.6**	**14**	**30**	**10.5**	**510**	**1.7**	**0.24**	**0.01**	**0.056 pg/m³ 0.055 pg/m³**	**0.001**	**0.001**	**0.001**	**0.003**	**0.006**

(1) Dioxins reported as firstly non-detects as zero and secondly as non-detects equal to the limit of detection.
(2) Assumed to consist solely of benzene as a worst-case.
(3) Reduction in future years using the Netcen background calculator (January 2006).

Table 8.9 Ambient Air Quality Standards

Emission	Limit/Guideline	SI No. 271 of 2002 (μg/m³)	UK EAL (μg/m³)	WHO 2000 & 1999 (μg/m³)	Council Directive 2004/107/EC (μg/m³)
NO_2	99.8th percentile of 1- Hourly Averages	200			
NO_2	Annual Average	40			
NO_x	Annual Average(1)	30			
SO_2	99.7th percentile of 1- Hourly Averages	350			
SO_2	99.2th percentile of 24- Hourly Averages	125			
SO_2	Annual Average(2)	20			
PM_{10}	90th percentile of 24- Hourly Averages	50			
PM_{10}	Annual Average	40(3)			
$PM_{2.5}$	Annual Average	25(3)			
TOC	Running Annual Average	5.0(4)			
HCl	98th percentile of 1- Hourly Averages		100(5)		
HF	98th percentile of 1- Hourly Averages		3.0(5)		
HF	Annual Average			0.30	
PCDD / PCDF (6)	Annual Average				
Benzo[a]pyrene	Annual Average				0.001
Hg	Annual Average			1.0	
Cd & Tl	Annual Average (Cd)				0.005
Sum of 9 Heavy Metals	Annual Average (Pb)	0.50			
	Hourly Average (Sb)		150		
	Annual Average (As)				0.006
	Hourly Average (As)		15		
	Hourly Average (Cr)		3.0		
	Hourly Average (Co)		6.0		
	Hourly Average (Cu)		60		
	Annual Average (Mn)			1.0	
	Annual Average (Ni)				0.020
	Hourly Average (Ni)		30		
	Daily Average (V)			1.0	

(1) Limit value for the protection of vegetation.
(2) Limit value is for the protection of ecosystems.
(3) Council Directive 1999/30/EC of 22 April 1999 EU 1999/30/EC (relating to limit values for sulphur, dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air). Proposed EU Directive COM (2005) 447 will "replace the indicative limit values for PM_{10} for the year 2010 by a legally binding "cap" for the annual average concentrations of $PM_{2.5}$ of 25 μg/m³ to be attained by 2010".
(4) Limit value is for Benzene as a worst-case.
(5) German VDI (2002), "Technical Instructions on Air Quality Control".
(6) There are no air quality standard limit values for dioxins and furans. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day. A TDI of 4 pgTEQ/kg of body weight per day should be considered a maximal tolerable intake on a provisional basis and that the ultimate goal is to reduce human intake levels of below 1 pgTEQ/kg of body weight per day.

Air Dispersion Modelling Results

8.4.4. The results from the detailed air dispersion modelling of the Facility are summarised below. The modelling, undertaken using the USEPA regulatory model AERMOD, is discussed in detail in Appendix 8.

NO_2 & NO_X

8.4.5. NO_2 modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for the protection of human health for nitrogen dioxide under typical, maximum and abnormal operation of the Site (see Table 8.10 and Figure 8.5 for maximum operations). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the Site boundary. Emissions at maximum operations lead to ambient NO_2 concentrations (including background concentrations) which are 47% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 77% of the annual average limit value at the respective worst-case receptors.

8.4.6. The annual average NO_X concentration (including background concentration) is also below the limit value for the protection of vegetation accounting for 78% of the annual limit value at the worst-case receptor in the region of the SAC, SPA and NHA.

SO2, CO, PM10 & PM2.5

8.4.7. Modelling results indicate that ambient ground level concentrations are below the relevant air quality standards for the protection of human health for sulphur dioxide, carbon monoxide and PM_{10} under typical, maximum and abnormal operation of the Site (see Table 8.10 and Figure 8.5 for maximum operations). Results are also below the proposed air quality standard for $PM_{2.5}$ under typical, maximum and abnormal operation of the Site. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the Site boundary. Emissions at maximum operations equate to ambient concentrations (including background concentrations) ranging from 13% - 76% of the respective limit values at the worst-case receptors.

TOC, HCl & HF

8.4.8. Modelling results indicate that the ambient ground level concentrations are below the relevant air quality guidelines for the protection of human health for TOC (assumed pessimistically to consist solely of benzene), HCl and HF under typical, maximum and abnormal operation of the Site (see Table 8.10 and Figure 8.5 for maximum operations). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the Site boundary. Emissions at maximum operations equate to ambient concentrations (including background concentrations) for HCl and TOC of only 3% and 39% respectively of the ambient limit values.

8.4.9. HF modelling results indicate that emissions at maximum operations equate to ambient HF concentrations (including background concentrations) which are 9% of the maximum ambient 1-hour limit value (measured as a 98th%ile) and 11% of the annual limit value.

PCDD / PCDFs (Dioxins/Furans)

8.4.10. Currently, no internationally recognised ambient air quality concentration or deposition standards exist for PCDD/PCDFs (Dioxins/Furans). Both the USEPA and WHO[20-21] recommended approach to assessing the risk to human health from Dioxins/Furans entails a detailed risk assessment analysis involving the determination of the impact of Dioxins/Furans in terms of the TDI (Tolerable Daily Intake) approach. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day.

8.4.11. Background levels of Dioxins/Furans occur everywhere and existing levels in the surrounding area have been extensively monitored as part of this study. Monitoring results indicate that the existing levels are similar to other urban areas in the UK and Continental Europe. The contribution from the Site in this context is minor, with levels at the worst-case receptor to the north-west of the Site, under typical, maximum and abnormal operation, accounting for only a small fraction of existing levels. Levels at the nearest residential receptor will be minor, with the annual contribution from the proposed Facility accounting for less than 2% of the existing background concentration under maximum operating conditions. Modelled total dioxin particulate deposition flux indicates that deposition levels under typical, maximum and abnormal operations will also be significantly less than that experienced in urban background locations.

PAHs

8.4.12. PAHs modelling results indicate that the ambient ground level concentrations are below the relevant air quality target value for the protection of human health under typical, maximum and abnormal operation of the Site (see Table 8.10 and Figure 8.5 for maximum operations). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the Site boundary. Emissions at maximum operations equate to ambient benzo[*a*]pyrene concentrations (excluding background concentrations) which are only 0.002% of the EU annual average target value at the worst-case receptor.

Hg

8.4.13. Hg modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for the protection of human health under typical, maximum and abnormal operation of the Site (see Table 8.10 and Figure 8.5 for maximum operations). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the Site boundary. Emissions at maximum operations equate to ambient mercury concentrations (including background concentrations), which are only 2% of the annual average limit value at the worst-case receptor.

Cd and Tl

8.4.14. Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standard for the protection of human health for cadmium under typical, maximum and abnormal operation from the Site (see Table 8.10 and Figure 8.5 for maximum operations). Emissions at maximum levels equate to ambient Cd and Tl concentrations (including background concentrations) which are 42% of the EU annual target value for Cd close to the Site boundary (the comparison is made with the Cd limit value as this is more stringent than that for Tl).

Sum of As, Sb, Pb, Cr, Co, Cu, Ni, Mn and V

8.4.15. Modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for the protection of human health for arsenic (As) and vanadium (V) (the metals with the most stringent limit values) under typical, maximum and abnormal operation emissions from the Site (based on the ratio of metals outlined in the Waste Incineration BREF document) (see Table 8.10 and Figure 8.5 for maximum operations). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the Site boundary. Ambient concentrations have been compared to the annual target value for As and the maximum 1-hour limit value for V as these represent the most stringent limit values for the suite of metals. Emissions at maximum operations equate to ambient As concentrations (including background concentrations) which are 23% of the EU annual target value at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are only 2% of the maximum 1-hour limit value at the worst-case receptor. Emissions under abnormal operations equate to ambient As concentrations (including background concentrations) which are 23% of the annual limit value at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are 59% of the maximum 1-hour limit value at the worst-case receptor.

Cumulative Assessment

8.4.16. As the region around Poolbeg is partly industrialised and thus has several other potentially significant sources of pollutants, a detailed cumulative assessment has been carried out using the methodology outlined by the USEPA. A cumulative assessment of all significant releases from nearby sites has been carried out based on an analysis of their IPC Licences The modelling results from the cumulative assessment have been incorporated into the background concentrations for these pollutants (i.e. NO_2, SO_2, PM_{10} and $PM_{2.5}$). Hence the cumulative impact of all significant releases from nearby sites has been included when background concentrations are added to the ambient pollutant concentrations under typical, maximum and abnormal operating conditions.

National Emissions Ceiling

8.4.17. In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution[(22)]. The objective of the Protocol is to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the targets Ireland will, by 2010, have to meet national emission ceilings of 42kt for SO_2 (67% below 2001 levels), 65kt for NO_X (52% reduction), 55kt for VOCs (37% reduction) and 116kt for NH_3 (6% reduction). A comparison of the proposed waste-to-energy Facility's operations with the obligations under the National Emissions Ceiling Directive (EU Directive 2001/81/EC) indicates the impact of the scheme is to increase SO_2 levels by 0.57% of the ceiling levels to be complied with in 2010, NO_X levels by 1.5% of the ceiling levels whereas VOC levels will be increased by 0.09% of the ceiling limits.

Persistent Organic Pollutants

8.4.18. The Stockholm Convention on Persistent Organic Pollutants (the Convention) was signed by 151 nations on May 23 2001 (or within one year from this date)[(23)]. The Convention entered into force on the 17th May 2004. In relation to Annex C compounds, which includes dioxins and furans, a series of measures have been agreed to reduce or eliminate the release of these compounds. The proposed waste-to-energy Facility fulfils the definition of BAT under the Convention, both in terms of Article 5 of the Convention and in terms of Annex C Part IV. A comparison of Dublin WtE Facility's operations with the obligations under the Stockholm Convention on Persistent Organic Pollutants indicates that the Facility will achieve and promote the objectives of the Convention in terms of recovery, recycling, waste separation, release reduction, process modification and BAT.

Table 8.10 Modelling Results Under Maximum Operations (μg/m³).

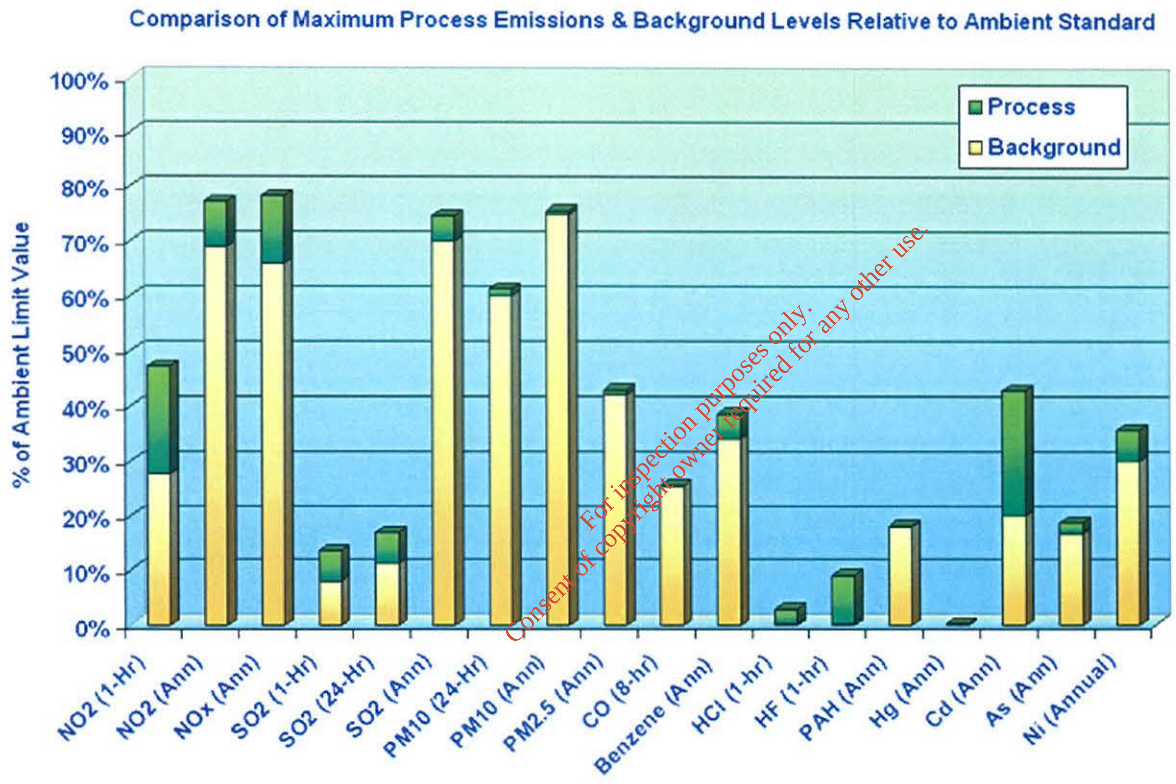
Pollutant	NO_2		NO_x	SO_2			PM_{10}		$PM_{2.5}$	CO	TOC[3]	HCl
Averaging Period[1]	1-hr	Annual	Annual	1-hr	24-hr	Annual	24-hr	Annual	Annual	8-hr	Annual	1-hr
Annual Background, Cumulative Impact & Site Traffic Concentration (Year 2012)	55.2	27.6	19.8[2]	28	14	14	30	30	10.5	1020	1.7	0.48
Process Emissions	39.1	3.3	3.7	19.3	7.1	0.93	0.63	0.23	0.23	51	0.23	2.6
Predicted Environmental Concentration (Year 2012)	94.3	30.9	23.5	47.3	21.1	14.9	30.6	30.2	10.7	1071	1.9	3.1
Ambient Air Quality Standard	**200**	**40**	**30**	**350**	**125**	**20**	**50**	**40**	**25**	**10000**	**5.0**	**100**

(1) For the 1-hr and 24-hr averages, the relevant percentages as detailed in Table 8.9 have been used
(2) Average of annual average NO_2 levels for Bull Island and Irishtown Nature Reserve (corrected to Year 2012).
(3) TOC assumed to consist solely of benzene as a worst-case.

Table 8.10(continued) Modelling Results Under Maximum Operations (μg/m³).

Pollutant	HF		Dioxins	PAHs	Hg	Cd	As	V
Averaging Period	1-hr	Annual	N/A	Annual	Annual	Annual	Annual	Maximum 1-Hr
Annual Background, Cumulative Impact & Site Traffic Concentration (Year 2012)	0.02	0.01	0.056 pg/m³ 0.055 pg/m³	180 pg/m³	0.001	0.001	0.001	0.010
Process Emissions	0.26	0.02	0.0023 pg/m³	0.023 pg/m³	0.0011	0.0011	0.0004	0.008
Predicted Environmental Concentration (Year 2012)	0.28	0.03	0.059 pg/m³ 0.057 pg/m³	180 pg/m³	0.0021	0.0021	0.0014	0.018
Ambient Air Quality Standard	**3.0**	**0.30**	**N/A**	**1,000**	**1.0**	**0.005**	**0.006**	**1.0**

Figure 8.5 Prediction Environmental Concentrations Relative to Ambient Standard



Project	Dublin Waste To Energy Air Quality Assessment
Reference	06_3018AR01
Figure 8.5	Prediction Environmental Concentrations Relative To Ambient Standard

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Summary

8.4.19. Modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards or guidelines for the protection of human health for all compounds under typical, maximum and abnormal operation of the Site. The modelling results indicate that this maximum occurs in the region between the north-western and eastern boundaries. Maximum operations are based on the emission concentrations outlined in EU Directive 2000/76/EC.

8.4.20. An appropriate stack height has been selected to ensure that ambient air quality standards for the protection of human health and the environment will not be approached even under abnormal operating scenarios. The stack height determined by air dispersion modelling which will lead to adequate dispersion was 100 metres above ground level for each of the two main stacks.

8.4.21. The spatial impact of the Facility is limited with concentrations falling off rapidly away from the maximum peak. For example, the short-term limit values at the nearest residential receptor will be less than 13% of the short-term ambient air quality limit values. The annual average concentration has an even more dramatic decrease in maximum concentration away from the Site with concentrations from emissions at the proposed Facility accounting for less than 3% of the limit value (not including background concentrations) at worst case sensitive receptors near the Site.

Climate

Construction Phase

8.4.22. The construction phase of the project is envisaged to last a period of 36 months. There is the potential for a number of GHG emissions to the atmosphere during the construction of the proposed development. In particular, construction vehicles, generators may generate some carbon dioxide and N_2O emissions.

Operation Phase

8.4.23. Incineration would be expected to be the dominant source of CO_2 and N_2O emissions from the development. Detailed waste throughput information was obtained from Elsam Engineering A/S and this information has been used to estimate GHG emissions from the scheme. The annual waste throughput for the proposed Waste Management Facility will be up to 600,000 tonnes consisting of all non-recyclable household, commercial and/or industrial waste. For the purpose of this study the maximum annual throughput of 600,000 tonnes is used. The net greenhouse gas contribution from the waste was derived using the procedure recommended by the European Commission[11] and IPCC[7] and is outlined in Annex 1 of Appendix 8.

Alternative Scenarios In The Absence of Incineration

8.4.24. Ireland has recently formulated a strategy[24] to implement the targets set down in the Landfill Directive (1999/31/EC) to divert biodegradable municipal waste (BMW) from landfills. The Landfill Directive states that the landfilling of BMW shall be capped in 2016 at 35% of the total amount of BMW generated in 1995. In order to achieve this target, it is likely that a diversion rate of 80% of the BMW generated in 2016 will be required[24]. The strategy envisages that recycling of BMW will account for 38.6% of the waste produced with biological treatment accounting for another 19.5% leading to an overall "recycled" total of 58.1%. The aim thereafter is to landfill 19.9% of the BMW with the remaining 22% subject to residual treatment, mainly through incineration[24].

8.4.25. In the absence of incineration, the waste is likely to be landfilled at a municipal landfill Facility thereby possibly exceeding the target for landfilling of biodegradable waste agreed in the Landfill Directive or alternatively the waste will be biologically treated (composted / anaerobic digestion). Therefore, in the current study an assessment has been made of the likely production of greenhouse gases in the absence of incineration assuming either of these two options. Of the total emission of greenhouse gases from waste in Ireland, landfilling currently accounts for 90% of the total[6].

Scenario 1

8.4.26. In scenario one, all non-recyclable waste is assumed to be disposed off at a municipal waste landfill. In order to make a reasonable comparison with the incineration option, the scenario where 600,000 tonnes of waste is landfilled over a 25-year period has been assessed. The landfill is assumed to open in 2012 for a 25-year period. It has also been assumed that the landfill is operated to best practise standards and thus a landfill gas recovery system is installed and has a collection efficiency of 75% for CH_4. The calculation of landfill gas generation rates has followed USEPA methodology which recommends that landfill gas generation rates are derived from the USEPA Landfill Gas Emission Model (LandGEM)[25]. A summary of the methodology employed in the model is given in Annex 1 of Appendix 8.

Scenario 2

8.4.27. In scenario two, all non-recyclable putrescible waste is assumed to be anaerobically digested (it is likely that some of this waste will also be composted but an assumption that all of the putrescible waste will be anaerobically digested is a conservative assumption (i.e. greater net GHG benefit)). In order to make a reasonable comparison with the incineration option, the scenario where 242,220 tonnes (based on a ratio of 90:10 putrescible waste : paper i.e. 36.7% of the 600,000 tonnes of waste is putrescible waste and 10% is paper waste[11]) is anaerobically digested (AD) over a 25-year period has been assessed. It is assumed that the other 357,780 tonnes of non-putrescible waste per annum is landfilled based on the landfilling assumptions outlined in Scenario 1. A summary of the methodology employed in the model is given in Annex 1 of Appendix 8.

Assessment Methodology

8.4.28. In order to calculate the scheme's net contribution to greenhouse gas emissions and the effect of the scheme on Ireland's obligations under the Kyoto Protocol, the total forecasted anthropogenic emissions of the proposed development has been calculated over a period of 25 years which is the lifespan of the development. The baseline year is assumed to be 2012. The contribution to the Total Greenhouse gas emissions, in the absence of power generation, is 0.19% of the Total Greenhouse Gas Emissions in Ireland in that year and thus is a minor source of GHGs.

8.4.29. During the incineration of waste at the Facility the thermal energy generated by the burning of waste will be recovered and will give an electrical output of about 66MW. As approximately 6MW is required for electrical demand within the plant, the net electrical output from the plant for export to the national grid will be 60MW. Thus, the export of 60MW will give a direct benefit in terms of greenhouse gas emissions which would have been released in the production of 60MW from power stations.

8.4.30. In order to calculate the net benefit in terms of greenhouse gas emissions, the likely greenhouse gas emissions from a Combined Cycle Gas Turbine (CCGT) power station (the most GHG efficient fossil-fuel power source) producing 60MW of power has been calculated and subtracted from the Site's greenhouse gas emissions. The production of power for export to the national grid transforms the Site from a net producer of GHGs to having a net positive annual impact on GHG emissions of the order of 0.11% of the Total Greenhouse Gas Emissions in Ireland in 2012.

Modelling Methodology – Landfill

8.4.31. As stated above, for scenario 1, it is assumed that 600,000 tonnes of waste will be landfilled annually in the absence of the development. The impact on climate of the landfilling of this waste over a 25-year period has been calculated using the USEPA approved Landfill Gas Emission Model (LandGEM)[11].

8.4.32. After the calculation of both CH_4 and CO_2 generation rates, it is assumed that emissions from the landfill are controlled by installing a gas collection system followed by combustion of the collected gas through the use of turbines. Total GHG emissions occurs over a period of 100 years with peak generation occurring after 25 years at approximately 130,000 tonnes of CO_2 equivalent emitted in that year. The contribution to the total greenhouse gas emissions, ignoring the generation of power, from the landfilling of 600,000 tonnes of waste is 0.25% of the total greenhouse gas emissions in Ireland in 2012 and thus is minor.

8.4.33. Again, energy recovery is possible using landfill gas as the fuel source. If the emissions are condensed to a 25-year time period (i.e assuming that all emissions occur within a 25 year timeframe instead of 100 years in reality), to allow a comparison with incineration, the annual contribution to the total greenhouse gas emissions, including the beneficial effect of the generation of power, is equivalent to 0.23% of the total greenhouse gas emissions in Ireland in 2012.

8.4.34. An additional consideration is the issue of carbon sequestering in landfills which is not currently considered in the IPCC methodology. During the storage of organic material in landfills, anaerobic conditions inhibit the decomposition of certain wastes such as woody material[11] and thus this biogenic organic material is removed from the carbon cycle. It has been proposed that landfilling should be given a credit for reducing carbon dioxide emissions[11]. The annual contribution to the total greenhouse gas emissions, including the beneficial effect of the generation of power and carbon sequestering, from landfilling 600,000 tonnes/ annum leads to a net positive impact equivalent to 0.08% of the total greenhouse gas emissions in Ireland in 2012.

Modelling Methodology – Anaerobic Digestion (AD)

8.4.35. The anaerobic digestion (AD) facility is assumed to open in 2012 for a 25-year period. It has also been assumed that the Facility is operated to best practise standards and that the AD facility produces a gas rich in methane (60% methane generation is assumed)[11]. The contribution to the Total Greenhouse gas emissions from the anaerobic digestion of 242,220 tonnes of waste per annum is to lead to a net positive impact of 0.01% of the Total Greenhouse Gas Emissions in Ireland in that year.

8.4.36. Again, an additional consideration is the issue of carbon sequestering by soils, whereby a proportion of the carbon becomes converted to very stable humic substance which can persist for hundreds of years. This issue is currently under consideration by the IPCC[11]. The annual contribution to the total greenhouse gas emissions, including the beneficial effect of the generation of power, from Anaerobic Digestion / Landfilling leads to a net negative impact equivalent to 0.04% of the total greenhouse gas emissions in Ireland in 2012. If carbon sequestering is taking into account both for the landfill and the anaerobic digestion, the Anaerobic Digestion / Landfilling scenario leads to a net positive impact equivalent to 0.14% of the total greenhouse gas emissions in Ireland in 2012.

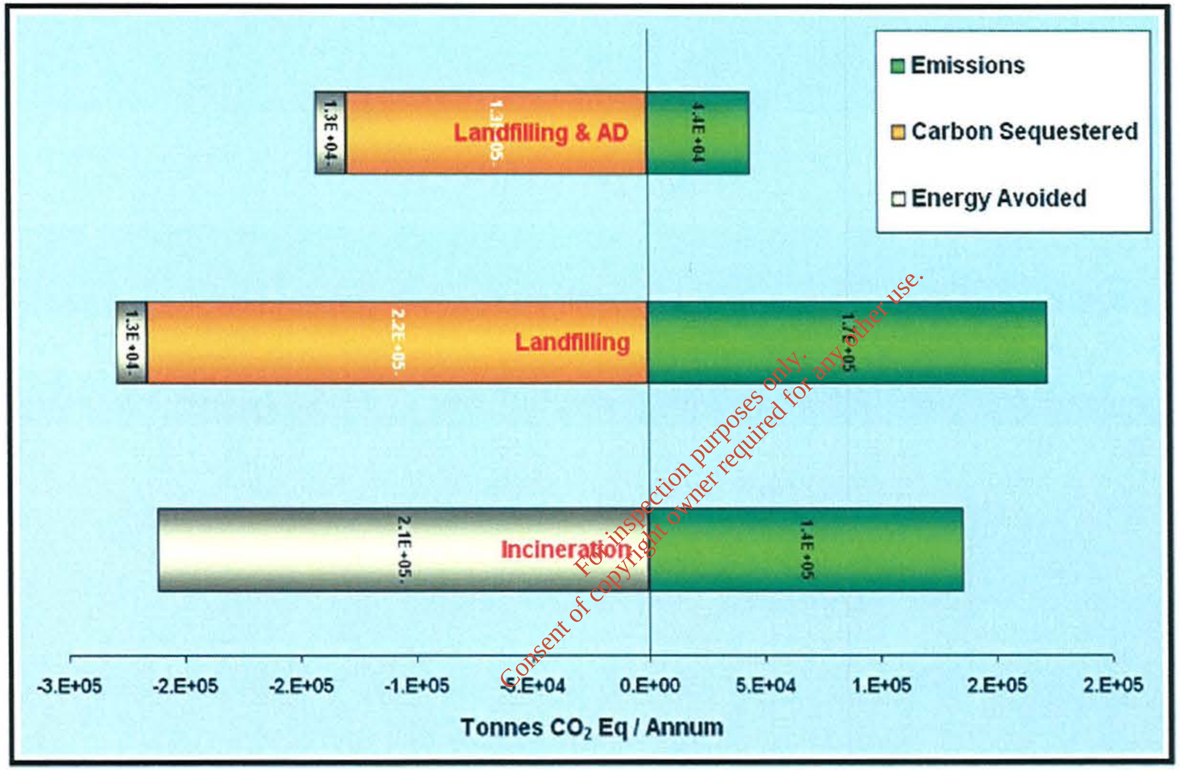
Summary

8.4.37. The contribution of the Waste-to-Energy Facility to total greenhouse gas emissions in Ireland is equivalent to a net positive impact of 0.11% of total emissions in 2012, when energy recovery in taken into account (see Figure 8.6). In the absence of the development, greenhouse gas emissions may occur from the landfilling / AD of the waste. The contribution to the total greenhouse gas emissions from landfilling 600,000 tonnes of waste, including the generation of power but excluding carbon sequestering, condensed to a 25-year period, is equivalent to 0.23% of the total greenhouse gas emissions in Ireland in 2012. Thus, the overall annual impact of the proposed Waste-to-Energy Facility on climate, relative to the landfilling of the waste, is to produce a net benefit of approximately 0.34% of the total greenhouse gas emissions in Ireland in 2012 and thus will be of minor positive impact in terms of Ireland's obligations under the Kyoto Protocol (see Figure 8.6). When allowing for the diversion of biodegradable waste to anaerobic digestion, the overall annual impact of the proposed Waste-to-Energy Facility on climate is still positive by approximately 0.16% of the total greenhouse gas emissions in Ireland in 2012.

8.4.38. Thus, if carbon sequestering is ignored, incineration with energy recovery offers a net saving over both landfilling only and landfilling in conjunction with anaerobic digestion by 0.34% and 0.16% of the total greenhouse gas emissions in Ireland in 2012, respectively.

8.4.39. If carbon sequestering is taken into account, incineration with energy recovery still offers a net saving over landfilling only of the order of 0.03% of the total greenhouse gas emissions in Ireland in 2012. However, landfilling in conjunction with anaerobic digestion offers a small net savings over incineration of the order of 0.03% of the total greenhouse gas emissions in Ireland in 2012 (see Figure 8.6).

Figure 8.6 Comparison of GHG Emission between incineration, Landfilling and Anaerobic Digestion



Project
Dublin Waste To Energy Climate Assessment

Reference
06_3018AR01

Figure 8.6
Comparison of GHG Emission Between Incineration, Landfilling and Anaerobic Digestion

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8.5. Mitigation Measures and Possible Residual Impacts

8.5.1. In order to sufficiently ameliorate any potential negative impacts on the air environment, a schedule of measures has been formulated for both construction and operational phases associated with the proposed Facility.

Air Quality

Construction Phase

8.5.2. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of dust produced will be deposited close to the generated source. A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions.

8.5.3. In order to ensure that no dust nuisance occurs, a series of measures will be implemented. Specifically, staff will monitor to ensure that:

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential Site traffic only apart from the contractor's car park which will be hardcore only.
- Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.
- Vehicles using Site roads will have their speed restricted, and this speed restriction must be enforced rigidly. Indeed, on any un-surfaced Site road, this will be 20 kph, and on hard surfaced roads as Site management dictates.
- Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust.
- Wheel washing facilities will be provided for vehicle exiting Site in order to ensure that mud and other wastes are not tracked onto public roads.
- Public roads outside the Site will be regularly inspected for cleanliness, and cleaned as necessary.
- Material handling systems and Site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

8.5.4. At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the Site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

Operational Phase

8.5.5. A number of measures have been incorporated into the design of the WtE plant to ensure that emissions from the plant do not exceed regulatory emission limit values as outlined in Waste Incineration Directive 2000/76/EC. Furthermore, due consideration has been given to the BREF document on waste incineration.

8.5.6. The process comprises an active carbon and semi-dry lime scrubbing process followed by particle removal in a fabric filter followed by a two-stage wet scrubbing process. The waste scrubbing process will remove the vast majority of HF, HCl, SO_2 and Hg left from the semi-dry stage. In order to obtain a plant free of wastewater from the flue gas cleaning, the small amount of wastewater from the wet process is evaporated in the boiler and subsequently captured by the semi-dry process.

8.5.7. The reduction of dioxin takes place by adding activated carbon to the flue gas prior to the fabric filter, where the dioxin and activated carbon is collected together with the fly ash and FGT residue.

8.5.8. The reduction of NO_X from the combustion process will take place in an SNCR process by injecting ammonia water (NH_4OH) into the first pass of the boiler securing compliance with the Waste Incineration Directive 2000/76/EC.

8.5.9. Air modelling predictions indicate that ambient air quality levels from the proposed Facility will be within the ambient air quality standards at all locations beyond the Site boundary, based on maximum operating conditions. Thus no specific additional mitigation measures are required during the operational phase of the Facility.

Residual Impacts

8.5.10. This section summarises the likely air quality impact associated with the proposed development, taking into account the mitigation measures.

Construction Phase

8.5.11. During the construction phase of the project there may be some impact on nearby properties due to dust emissions from the construction site and other activities. However, due to the formulation of an effective dust minimisation plan, it is considered that the dust nuisance is unlikely to occur.

Operational Phase

8.5.12. Based on the results of air dispersion modelling of process emissions, the air quality impact of the proposed Facility will be insignificant.

Climate

Construction Phase

8.5.13. As there will be no significant impact on climate, no mitigation measures are proposed.

Operational Phase

8.5.14. During the incineration of waste at the Facility the thermal energy generated by the burning of waste will be recovered and will give an electrical output of about 66MW with a net electrical output from the plant for export to the national grid will be 60MW. Thus, the export of 60MW will give a direct benefit in terms of greenhouse gas emissions which would have been released in the production of 60MW from power stations.

8.5.15. The Waste-to-Energy Facility will also recover and recycle ferrous materials during the incineration process. The recycling of metals will require less energy than processes using virgin inputs and thus lead to a direct saving in energy and thus GHG emissions.

Residual Impacts

8.5.16. This section summarises the likely climatic impact associated with the proposed development, taking into account the mitigation measures.

Construction Phase

8.5.17. As there will be no significant impact on climate, no residual impact is envisaged.

Operational Phase

8.5.18. Based on the results of above assessment, the climate impact of the proposed Facility will be positive.

8.6. References

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Table of contents

9. Noise and vibration

9.1. Introduction

This chapter describes the existing noise and vibration levels in the vicinity of the proposed Dublin WtE facility and the predicted impact of noise and vibration from the Facility during construction and operation. Mitigation measures to reduce the potential impact from noise and vibration are provided in section 9.4.

The proposed Waste to Energy facility is located at Ringsend, at the corner of Pigeon House Road and Shellybanks Road. The Site and the noise reference positions are shown on the map below, Figure 9.1.

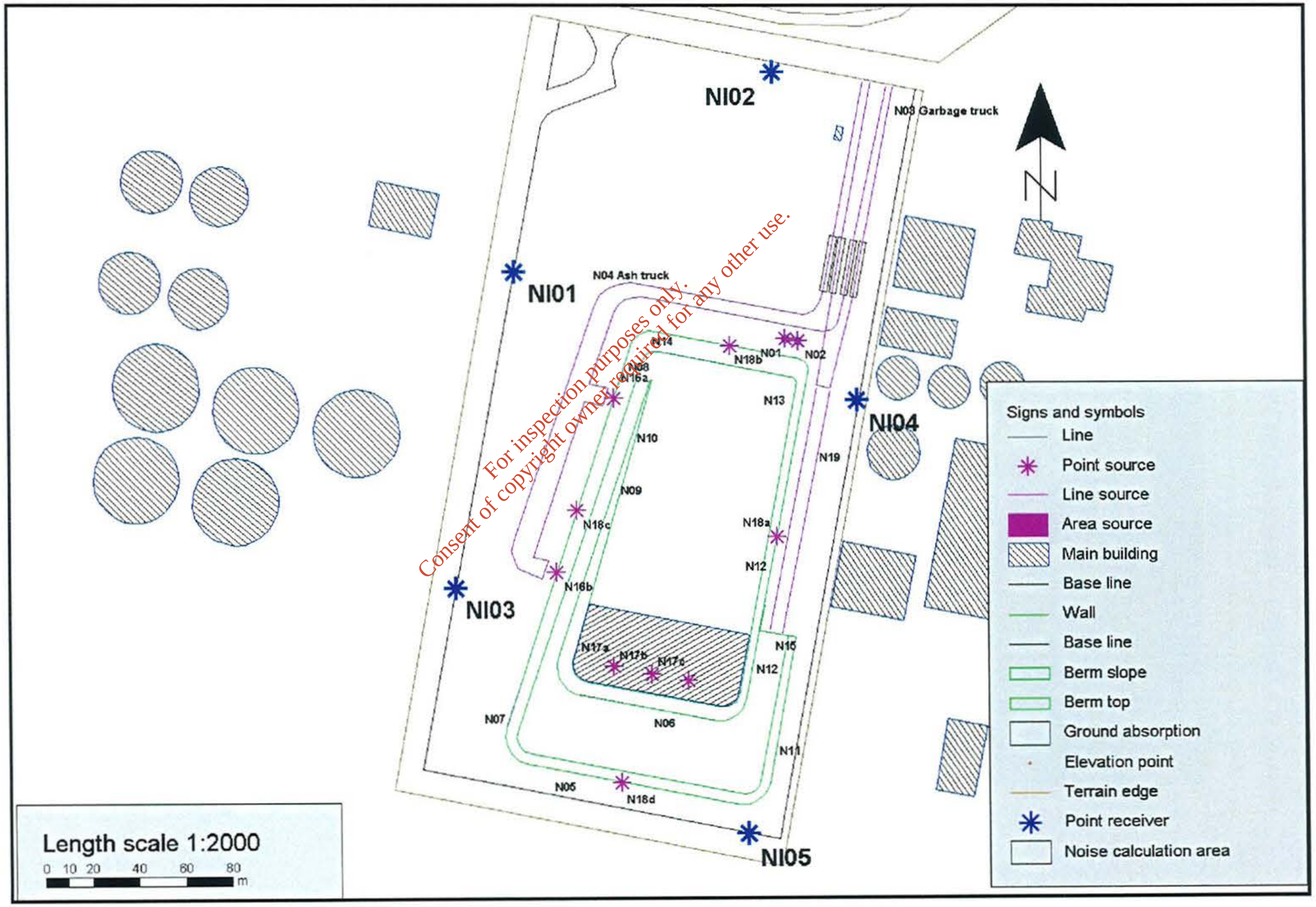
Two situations are described; noise and vibrations during construction and noise and vibrations during operation.

The background noise of the existing environment is measured, the specific noise emitted from the Facility is calculated and the noise impact calculated.

9.2. Noise and vibration in the existing environment

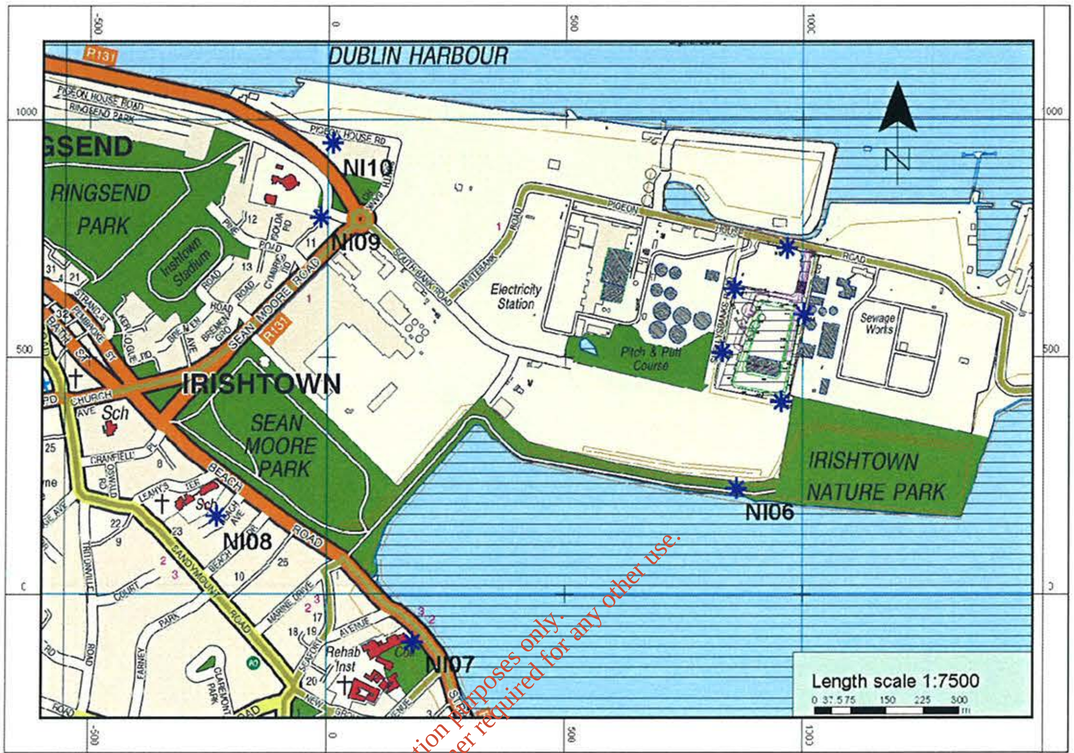
9.2.1. To document the noise in the existing environment, 10 immission positions were selected. Positions NI1 to NI05 are located at the site boundary, covering the Site to the north, west, south and east, as shown in Figure 9.1.

Figure 9.1 The Site – Immission positions NI01-NI05 at site boundary



9.2.2. Positions NI06 to NI10 are located at noise sensitive locations in the vicinity of the Site, as shown in Figure 9.2.

Figure 9.2 The Site – Immission positions NI06 to NI10 at noise sensitive locations



9.2.3. The noise sensitive locations are located at:

NI06	NI07	NI08	NI09	NI10
Walkway and Irishtown Nature Park	Seafort Avenue	Beach Avenue	St. Luke's Road	Coastguards Cottage

Measurements of background noise

9.2.4. All sound pressure levels are given in dB(A).

9.2.5. Measurements of the background noise were made. Measurements at site boundary, positions NI01 to NI05 and at the walkway to Irishtown Nature Park, NI06, were made by Elsam Engineering. Measurements at NI07 and NI09 were made by AWN Consulting. No baseline monitoring has been performed for NI08 and NI10.

9.2.6. The following tables show the measurement results.

Position	Period	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
NI01	Day, average	61.4	98	48	61	53
NI01	Night, average	51.3	76	48	52	50

9.2.7. During the daytime, the dominant noise sources were noise from scrap handling, trucks to the molasses factory and a fan at the Ringsend Wastewater Treatment Works.

9.2.8. During the night time, the dominant noise sources were fan noise from the Ringsend Wastewater Treatment Works and noise from the power plant to the west.

Position	Period	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
NI02	Day, average	65.2	89	54	67	60
NI02	Night, average	56.9	83	54	57	55

9.2.9. During the daytime, the dominant noise sources were noise from scrap handling, primarily from the scrap yard placed on the north side of Pigeon House Road, a fan at a silo to the north of the measuring position, a fan at the Ringsend Wastewater Treatment Works, and to some extent vehicles on Pigeon House Road.

9.2.10. During the night time, the dominant noise sources were fans and to some extent vehicles on Pigeon House Road.

Position	Period	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
NI03	Day, average	57.8	86	48	58	52
NI03	Night, average	51.8	70	45	54	49

9.2.11. During the daytime, the dominant noise sources were noise from scrap handling, trucks to the molasses factory and a fan at the Ringsend Wastewater Treatment Works.

9.2.12. During the night time, the dominant noise sources were fan noise from the Ringsend Wastewater Treatment Works and noise from the power plant to the west.

Position	Period	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
NI04	Day, average	68.5	90	62	70	64
NI04	Night, average	60.7	73	58	61	60

9.2.13. During the daytime, the dominant noise sources were noise from scrap handling and fans and pumps at the Ringsend Wastewater Treatment Works.

9.2.14. During the night time, the dominant noise sources were fan noise from the Ringsend Wastewater Treatment Works.

Position	Period	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
NI05	Day, average	52.5	68	44	54	50
NI05	Night, average	53.0	63	47	54	51

9.2.15. During the daytime, the dominant noise sources were noise from a fan or possibly chimney at the Ringsend Wastewater Treatment Works, engine noise from a dozer/loader tractor and noise from the scrap yard.

9.2.16. During the night time, the dominant noise sources were noise from a fan or possibly chimney at the Ringsend Wastewater Treatment Works. The increased noise levels at night time were caused by the lower wind speed compared to daytime.

Position	Period	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
NI06	Day, average	48.3	79	40	49	45
NI06	Night, average	44.8	64	38	47	41

9.2.17. During the daytime, the dominant noise source was traffic noise from Sandymount. Noise from the industrial area surrounding the Site was not audible. It is estimated that this is caused by the shielding of the two approx 6-8-metre high soil barriers just north of the measuring position.

9.2.18. During the night time, it was not possible to hear industrial noise from the industrial site. The dominant noise sources were traffic noise from Sandymount and seabirds at the sandy beach south of the measuring position.

Position	Period	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}

NI07	Day, average	60.8*	-	-	-	53.0*
NI07	Night, average	56.8*	-	-	-	43.8*

Position	Period	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
NI09	Day, average	63.8*	-	-	-	56.2*
NI09	Night, average	59.5*	-	-	-	47.4*

9.2.19. To summarise the findings of the baseline measurement reports, the noise level at the Site boundary is dominated by noise from the scrap yard north of Pigeon House Road, the scrap yard on the north part of the Site, fans (and possibly chimney) at the Ringsend Wastewater Treatment Works east of the Site, and trucks from the molasses factory at the centre of the Site. In addition to these noise sources, more basic noise comes from dozers/loader tractors and aircrafts from Dublin City Airport. The noise level at the noise sensitive locations (NI06 to NI10) is dominated by noise from the city.

9.3. Impact from noise and vibration

9.3.1. The noise level from the proposed Dublin WtE facility at Ringsend – Dublin has been calculated. This document predicts the sound pressure level from the Facility at the Site boundary and at noise sensitive locations in the vicinity of the Site, during the day and night periods. Calculations have been made for the construction phase and during operation.

9.3.2. As the Facility is not built yet, the calculations are based on sound power levels provided by calculations, experience values from similar waste incineration facilities and standard values taken from acoustic tables.

9.3.3. Calculations of the noise impact have been determined according to "Environmental Noise from Industrial Plants – General Prediction Method" as per Ref 1 of the Noise prediction report. The impact assessment of the predicted noise levels on the surrounding noise environment has been assessed with reference to BS 4112: 1997 "Method for Rating Industrial Noise Affecting Residential and Industrial Areas".

9.3.4. The calculation includes general data on distances, ground level acoustic capabilities, noise screens such as buildings, tanks, screens, etc. The noise-contributing, environmental noise sources are included in the calculation model as point noise sources, line sources or surface sources, including position and size (sound power level). The model calculation of environmental noise is made by means of the program SoundPlan, version 6.1.

The Facility and its noise sources

Noise sources during operation

9.3.5. All noisy equipment will be located inside the building. The lower part of the walls of the buildings is made of concrete, which has a very high noise reduction value. The upper part of the walls is a composite material of metal plate/50mm isolating material/metal plate. The dominant noise sources are trucks transporting waste and ash, the top of the stacks,internal noise transmitted through the facades and ventilation of the buildings.

9.3.6. The table below shows the noise sources and the sound power levels used in the calculations. The levels are maximum allowable limits, and are intended to be specified for the design.

Figure 9.3 Noise sources during operation, sound power level [dB(A) re. 1 pW]

Source	Lw	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
N01. Chimney W	82.4	69	72	76	77	75	74	66	56
N02. Chimney E	82.4	69	72	76	77	75	74	66	56
N03. Waste truck. 10 km/h, slow acc.	84.9	65.3	68.3	74.3	77.3	81.3	78.3	72.3	64.3
N04. Ash truck. 10 km/h, slow acc.	89	69.3	72.3	78.3	81.3	85.3	82.3	76.3	68.3
N05. Facade S, Reception hall	84.5	76	74	80	75	77	74	68	60
N06. Facade S, Waste Bunker	71.5	63	61	67	62	64	61	55	47
N07. Facade W, Reception hall	77.5	69	67	73	68	70	67	61	53
N08. Facade W, Ash building	75.5	67	65	71	66	68	65	59	51
N09. Facade W, Boiler building	82.6	70	72	80	74	72	70	67	60
N10. Facade W, Filter building	77.2	63	65	72	67	72	68	66	55
N11. Facade E, Reception hall	82.5	74	72	78	73	75	72	66	58
N12. Facade E, Boiler building	86.2	73	75	84	77	75	74	70	63
N13. Facade E, Filter building	84	69	71	79	73	79	75	73	61
N14. Facade N, Filter building	82.2	68	70	77	72	77	73	71	60
N15. Opening to reception hall	98.7	79	82	88	91	95	92	86	78
N16a. Opening 1 to Ash building	86.7	67	70	76	79	83	80	74	66
N16b. Opening 2 to Ash building	86.7	67	70	76	79	83	80	74	66
N17a. Ventilation Waste bunker	92	80.1	82.2	83.7	84.2	85.1	85.8	79.6	70.7
N17b. Ventilation Waste bunker	92	80.1	82.2	83.7	84.2	85.1	85.8	79.6	70.7
N17c. Ventilation Waste bunker	92	80.1	82.2	83.7	84.2	85.1	85.8	79.6	70.7
N18a. Ventilation various sort E	85	68.7	71	71.7	76	75.6	71.9	78.9	80.4
N18b. Ventilation various sort N	85	68.7	71	71.7	76	75.6	71.9	78.9	80.4
N18c. Ventilation various sort W	85	68.7	71	71.7	76	75.6	71.9	78.9	80.4
N18d. Ventilation various sort S	85	68.7	71	71.7	76	75.6	71.9	78.9	80.4
N19. Waste vehicle. Ramp up, 10 km/h	87.9	68.3	71.3	77.3	80.3	84.3	81.3	75.3	67.3
N20. Waste truck. Ramp down, 10 km/h	80.9	61.3	64.3	70.3	73.3	77.3	74.3	68.3	60.3

9.3.7. The values of line sources (trucks) are for one truck driving a specific length at the Site. The engine load up the ramp to the reception hall is heavy acceleration, and slow acceleration at all other positions. Due to the pause at the weighbridge, the average speed of the trucks is 10 km/h.

Figure 9.4 Noise reduction of the facade, metal cladding

Frequency [Hz]	63	125	250	500	1000	2000	4000	8000
Rn [dB]	15	20	20	28	30	30	30	30

9.3.8. The sound power level of the facades is calculated from a maximum internal sound pressure level, the noise reduction of the cladding and the area of the facade. The octave distribution is based on measurements from similar facilities and acoustic tables.

Figure 9.5 Calculation of the sound power level of the facades [dB(A) re. 1 pW]

Facade		w [m]	h [m]	Acoustic centre [m]	LpA,max Internal Noise	Sound power level [dB(A) re. 1 pW]								
						63	125	250	500	1000	2000	4000	8000	sum
South:	reception hall	110	15	k19	85	76	74	80	75	77	74	68	60	85
	waste bunker	105	25	k42	70	63	61	67	62	64	61	55	47	72
West:	reception hall	20	15	k19	85	69	67	73	68	70	67	61	53	77
	ash building	110	20	k26	75	67	65	71	66	68	65	59	51	76
	boiler building	55	15	k21	85	70	72	80	74	72	70	67	60	83
	filter building	55	7	k47	85	63	65	72	67	72	68	66	55	77
East:	reception hall	60	16	k19	85	74	72	78	73	75	72	66	58	82

	boiler building	55	31	k21	85	73	75	84	77	75	74	70	63	86
	filter building	55	33	k27	85	69	71	79	73	79	75	73	61	84
North:	filter building	55	23	k22	85	68	70	77	72	77	73	71	60	82

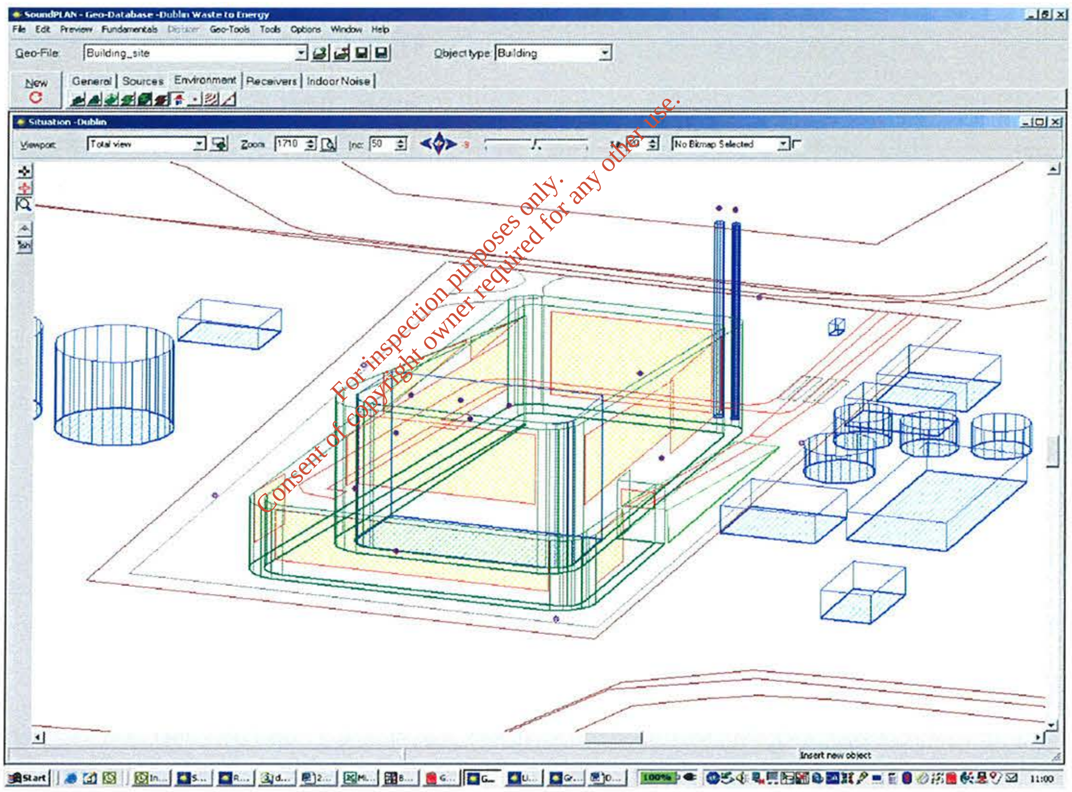
9.3.9. There will be two main openings to the Facility. There will be several gates to the west which will be used by trucks for residues and materials. There will be a gate to the east which will be used by waste trucks.

Figure 9.6 Calculation of the sound power level of the gates [dB(A) re. 1 pW]

Gate		w	h	Acoustic centre	LpA, max	Sound power level [dB(A) re. 1 pW]								
		[m]	[m]	[m]	internal	63	125	250	500	1000	2000	4000	8000	sum
gate east	reception hall	16	6	K9	85	79	82	88	91	95	92	86	78	98
gate west	ash building	11	6	K9	75	67	70	76	79	83	80	74	66	87

9.3.10. A 3D figure of the Site and sources is shown below:

Figure 9.7 The Site



Noise sources during construction

9.3.11. During construction, an elevated noise level from the Site will arise. Dozers, loader tractors, etc. will be in operation, and later building activities will create noise. For a limited period of time during construction, piling will take place, and during commissioning, steam blowing will take place. The noise from these activities will contain impulses and probably tones. It is assumed that the noise from the Site will be lower during all other phases of construction. It is estimated that the worst case period for noise is in the preparation phase of the Site. It is the original intention that construction is carried out 24 hours a day. Noise calculations have therefore been made for this situation.

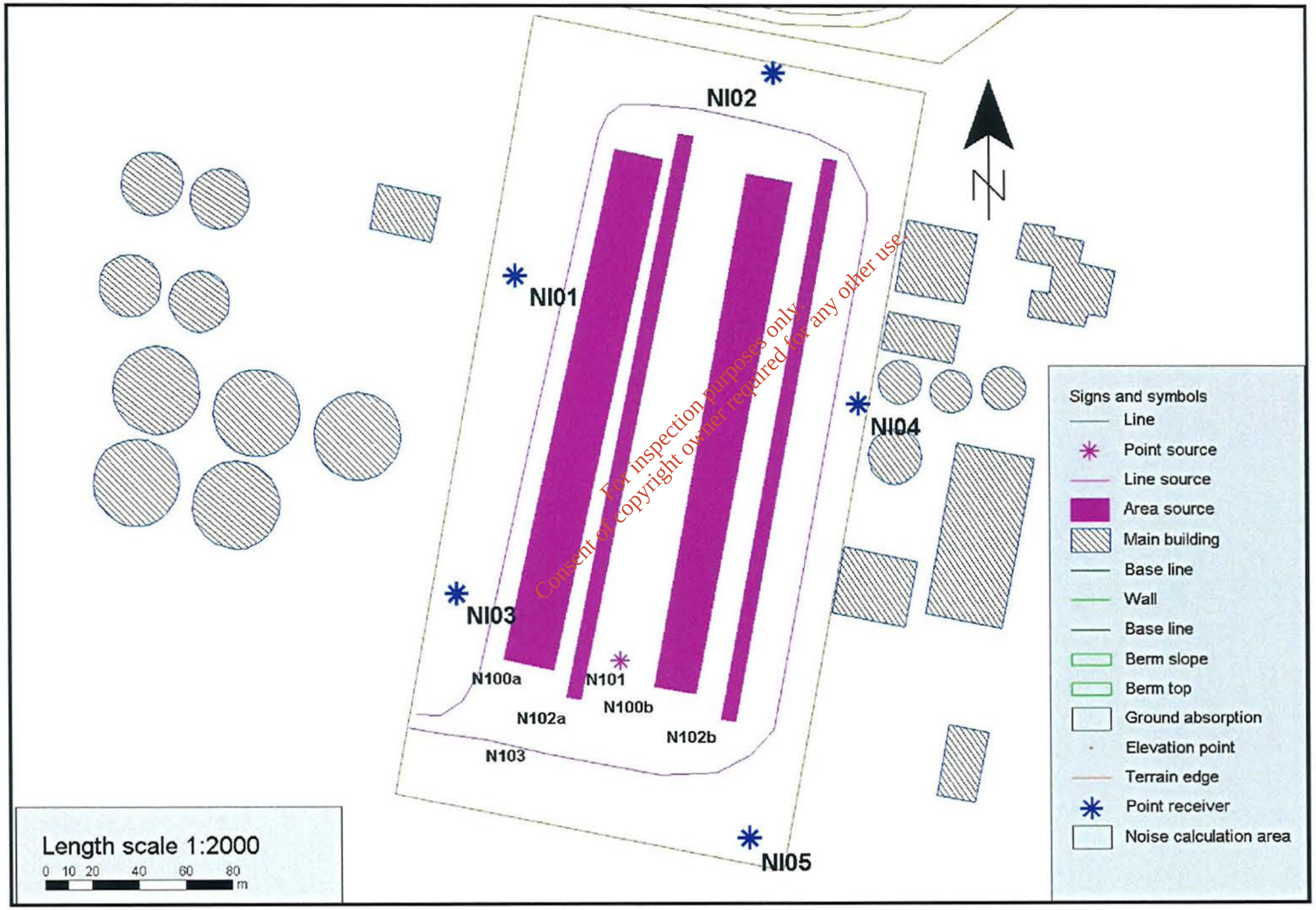
9.3.12. The table below shows the noise sources and the sound power levels used in the calculations:

Figure 9.8 Noise sources during construction, sound power level [dB(A) re. 1 pW]

Source	Lw	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	SrcType
N100a. Dozer a	115.5	79.5	99.4	102	106	110	112	103	89.9	Area
N100b. Dozer b	115.5	79.5	99.4	102	106	110	112	103	89.9	Area
N101 Hammer for piling	120	84.8	100	110	116	113	110	103	91.8	Point
N102a. Loader Tractor	105.1	78.5	87.5	93.5	98.5	100	99.5	92.5	83.5	Area
N102b. Loader Tractor	105.1	78.5	87.5	93.5	98.5	100	99.5	92.5	83.5	Area
N103. Truck. Heavy acc.	96.7	77	80	86	89	93	90	84	76	Line
Sum of all sources	122.0	88.3	104.6	111.4	116.9	116.2	116.4	108.0	96.0	

9.3.13. The noise sources are shown below.

Figure 9.9 The Site – Noise sources during construction



Noise requirements

9.3.14. The operation of the proposed facility will be controlled by the EPA under a licence. In order to assess the operating levels of the Site, the following criteria and guidance documents which may be considered applicable to the operation of the facility in question, have been consulted:

- ***EPA: Guidance Note for Noise in relation to scheduled activities***

  This document states that ideally, if the total noise level from all noise sources is taken into account, the noise level at the sensitive locations should be kept below an L_{Aeq} value of 40-45dB(A) during the night time period and 50-55dB (A) by daytime. Audible tones and impulsive noise at sensitive locations should be avoided. In some particularly quiet areas, such as pastoral, rural settings, where background noise levels are very low, lower noise limits may be more appropriate.

- ***EPA: Guidance Notes for Noise***

  This document suggests that the usual range of values allowed for industrial activities is 55dBL_{Aeq} during the day and 45dB L_{Aeq} during the night. These values relate to noise levels at the nearest noise sensitive locations or at the boundary of the premises.

- ***WHO Guidelines for Community Noise 1999:***

  This document recommends that to protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB L_{Aeq} on balconies, terraces and in outdoor living areas and to protect the majority of people being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB L_{Aeq}. At night time, outside sound levels about 1m from the facades of living spaces should not exceed 45dB L_{Aeq}.

9.3.15. Considering the above guidelines and in order to prevent further increases to noise levels in the surrounding environment, it is proposed that the operational noise levels for the proposed facility should be limited to 50dB L_{Aeq} during day time hours and 40dB L_{Aeq} during night time hours in line with the above guidance documents with no tonal or impulsive noise audible at the noise sensitive locations.

9.3.16. There are no statutory guidelines for construction noise levels in Ireland, these are usually defined by the local authority or limited by operational hours. The following construction noise level limits however are recommended by the National Roads Authority (NRA) for road construction and are widely accepted to represent a reasonable compromise between the practical limitations during a construction project and the need to ensure an acceptable ambient noise level for local residents.

9.3.17. Considering the existing baseline noise levels measured at the noise sensitive locations, these values are considered a reasonable target.

Days and Times L_{Aeq} (1hr)	$L_{Aeq\,(1Hr)}$ dB	$L_{pA\,(max)\,slow}$ dB
Monday to Friday 07:00 to 19:00hrs	70	80_2
Monday to Friday 19:00 to 22:00hrs	60[2]	65[2]
Saturday 08:00 to 16:30hrs	65	75
Sundays and Bank Holidays 08:00 to 16:30hrs	60[2]	65[2]

9.3.18. Where night time construction is required, it is proposed that noise levels are limited to 45dB L_{Aeq} at the nearest noise sensitive locations.

9.3.19. In addition to setting absolute noise level limits, the actual increase in noise levels above existing background noise can be assessed to quantify the impact of the proposed development in terms of noise. The use of BS4142 1997 'Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas' has also been used in the EIS to assess the likelihood of complaints.

Calculation conditions

9.3.20. The calculations are made for the day and the night periods. The day period has a reference time interval of 1 hour, the night period has a reference time interval of 5 minutes.

9.3.21. The operation of the Facility will be continuous day and night, 365 days a year. The basic noise sources are therefore constant round the clock, eg noise from the stacks, facades to boiler and filter building, etc. The noise from trucks vary over 24 hours.

9.3.22. The calculations are based on:

Daytime (08.00 – 22.00)		
Waste trucks:	50 units/h worst case	
Residues trucks:	14 units/h worst case	

Night time (22.00 – 08.00)		
Waste trucks:	5 units/h worst case	= 2 units/5 min. worst case
Residues trucks:	0 units	

9.3.23. In the model, for the construction phase, all sources are in operation continuously day and night.

Calculation results

9.3.24. The sound pressure level "specific noise level" is calculated for the 10 noise immission points surrounding the Site, and the results are shown below:

Figure 9.10 Sound pressure level during operation [dB(A)]

Receiver position	$L_{Aeq, Day}$ [dB(A)]	$L_{Aeq, Night}$ [dB(A)]
NI01. Boundary NW, Shellybanks Road	56.5	50.3
NI02. Boundary N, Pigeon House Road	55.8	51.5
NI03. Boundary SW, Shellybanks Road	55.5	51.1
NI04. Boundary E, towards sewage t. plant	70.8	67.8
NI05. Boundary SE, Corner towards SE	50.0	49.5
NI06. Walkway to Irishtown Nature Park	27.8	25.8
NI07. Seafort Avenue	31.0	27.8
NI08. Beach Avenue	23.9	21.8
NI09. St. Luke's Road	24.5	23.0
NI10. Coastguard Cottages	27.8	23.4

Figure 9.11 Sound pressure level during construction [dB(A)]

Receiver	$L_{Aeq, Day}$ [dB(A)]	$L_{Aeq, Night}$ [dB(A)]
NI01. Boundary NW, Shellybanks Road	69.9	69.9
NI02. Boundary N, Pigeon House Road	66.2	66.2
NI03. Boundary SW, Shellybanks Road	71.7	71.7
NI04. Boundary E, towards sewage t. plant	70.3	70.3
NI05. Boundary SE, Corner towards SE	68.3	68.3
NI06. Walkway to Irishtown Nature Park	46.3	46.3
NI07. Seafort Avenue	50.4	50.4
NI08. Beach Avenue	42.5	42.5
NI09. St. Luke's Road	35.5	35.5
NI10. Coastguard Cottages	38.1	38.1

9.3.25. For information, a grid noise map of the calculated sound pressure level during operation is shown in Figure 9.12 and Figure 9.13. Figure 9.14 shows the day-night sound pressure levels during construction.

Figure 9.12 Grid noise map – during operation, DAY period