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15 CLIMATE

15.1 INTRODUCTION

As described in detail elsewhere, the proposed Waste-to-Energy facility will be based on conventional grate incineration technology. The waste is tipped into a bunker prior to being fed into the furnace. In the furnace the waste is incinerated, producing heat, ash and combustion gases.

This study will describe and assess the impact of the proposed scheme, in terms of its impact on climate. Attention will be focused both on Ireland's obligations under the Kyoto Protocol and the effect of the scheme on the total national anthropogenic emissions of carbon dioxide and other greenhouse gases (GHGs) and also in the context of overall climatic impact on the presence and absence of the proposed development.

15.2 CLIMATIC BASELINE

15.2.1 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997[1,2]. For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, Ireland agreed to limit the net anthropogenic growth of the six GHGs (see Table 15.1 and Table 15.2) under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012[3]. In order to meet the ultimate objective of the Convention to prevent dangerous anthropogenic interference in the climate system, cuts of up to 70% in this century are expected to be required[4]. The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties (COP11) to the agreement was convened in Montreal in Dec. 2005. In Article 5 of the Kyoto Protocol, it states that the methodologies for estimating anthropogenic emissions by sources and removal by sinks of all greenhouse gases (except those controlled by the Montreal Protocol) shall be those accepted by the Intergovernmental Panel on Climate Change (IPCC). The Kyoto Protocol entered into force on the 15th of February 2005. GHGs emissions in Ireland in 2003 were approximately 25% above 1990 levels, down from approximately 29% in 2002 and 31% in 2001.

An important part of the approach to reducing greenhouse gas emissions, engrained in the Kyoto Agreement, is that emission reductions should reflect the most economically efficient cost of achieving the set target. As part of this approach, three "flexible mechanisms" are intended to facilitate the cost-effective implementation of the Protocol. These mechanisms are Emission Trading (ET), Joint Implementation (JT) and the Clean Development Mechanism (CDM). Emission trading is a development whereby polluting entities are allocated allowances for their emissions which can subsequently be traded with each other. Emitters for whom it is very expensive to reduce emissions are likely to buy permits

from emitters for whom emissions reduction is more cost-effective thus ensuring that a pre-determined environmental outcome will take place where the cost of reduction is lowest. Due to significant economic growth in Ireland since 1990, it is envisaged that emission trading could be of significant benefit to Ireland in meeting its commitments to limit the growth of greenhouse gas emissions[4] (see Table 15.2). Both Joint Implementation and the Clean Development Mechanisms allow states to share reduction credits by investing in another territory with the aim of reducing emissions. However, the Clean Development Mechanism differs in that the projects are specific to assisting developing countries that are particularly vulnerable to the adverse effects of climate change to meet the cost of adaptation.

15.2.2 Baseline Conditions

Anthropogenic emissions of greenhouse gases in Ireland included in the Kyoto Protocol are given in Table 15.1 and Table 15.2. Combustion of fossil fuels for energy purposes is the greatest source of emissions at 95% of CO_2 and 66% of total emissions (2003 data)[7]. The largest share of energy emissions in 2003 is from fuel combustion for power generation (23% of total emissions) and road transport (17%). Waste represented 3% of total emissions in 2003 and is envisaged to represent 1.5% of total emissions by 2010[4]. Emissions from waste consist mainly of CH_4 with small amounts of other GHGs.

Greenhouse gases have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different greenhouse gases, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The GWP100 for CO_2 is the basic unit (GWP = 1) whereas CH_4 has a global warming potential equivalent to 21 units of CO_2 and N_2O has a GWP100 of 310. Using the aggregated IPCC 100-year Global Warming Potentials, CH_4 emissions from waste accounted for 98% of the Total GWP from waste in 1998.

15.2.3 IPCC Guidelines For National Greenhouse Gas Inventories

The Intergovernmental Panel on Climate Change (IPCC) has outlined detailed guidelines on compiling National Greenhouse Gas Inventories. The guidelines are designed to estimate and report on national inventories of anthropogenic greenhouse gas emissions and removals in order to ensure compliance with the Kyoto Protocol. Anthropogenic refers to greenhouse gas emissions and removals that are a direct result of human activities or are a result of natural processes that have been affected by human activities[5,6]. The quantity of carbon from natural cycles through the earth's atmosphere, waters, soils and biota is much greater than the quantity added by anthropogenic GHG sources. However, the focus of the UNFCCC and the IPCC is on anthropogenic emissions because it is these emissions that have the potential to alter the climate by disrupting the natural balances in carbon's biogeochemical cycle, and altering the atmosphere's heat-trapping ability. The carbon from biogenic sources such as paper and food waste was originally removed from the atmosphere by photosynthesis, and under natural conditions, it would eventually cycle back to the atmosphere as CO_2 due to degradation processes. Thus, these

sources of carbon are not considered anthropogenic sources and do not contribute to emission totals considered in the Kyoto Protocol[5,6].

In relation to solid waste disposal sites (SWDSs) including municipal landfills, detailed guidelines have been outlined for the calculation of GHG emissions[5,6]. The main GHG emission from SWDSs is methane. Even though the source of carbon is primarily biogenic, CH_4 would not be emitted were it not for the human activity of landfilling the waste, which creates anaerobic conditions conducive to CH_4 formation. Although CO_2 is also produced in substantial amounts, the primary source of CO_2 derives from the decomposition of organic material derived from biomass sources (crops, forests) which are re-grown on an annual basis. Hence, these CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology[6].

Similarly, in relation to incineration, a large fraction of the carbon in waste combusted (paper, food waste) is derived from biomass raw materials which are replaced by re-growth on an annual basis. Thus, these emissions should not be considered as net anthropogenic CO_2 emissions in the IPCC Methodology[6]. On the other hand, some carbon in waste is in the form of plastics or other products based on fossil fuel. Combustion of these products, like fossil fuel combustion, releases net CO_2 emissions. Thus, in estimating emissions from waste incineration, the desired approach is to separate carbon in the incinerated waste into biomass and fossil fuel based fractions and thereafter to use only the fossil fuel fraction in calculating net carbon emissions[5,6]. Other relevant gases released from combustion are net GHG emissions including CH_4 and N_2O.

The nature of municipal waste landfilled in Ireland has been catalogued in the National Waste Database Report 2004[7]. The breakdown of household and commercial waste is shown in Table 15.3 whilst the summary of major waste types landfilled in Ireland in 2004 is shown in Table 15.4. In relation to commercial and household waste, a significant fraction of the waste is derived from biogenic origins. An estimate of the fraction of biogenic and inert (inert in the sense that it does not contain carbon) waste from households and commercial waste landfilled in Ireland in general and in the current region surrounding the proposed scheme in 2004 would be of the order of 0.78 (see Table 15.3). In relation to non-hazardous municipal, commercial and industrial waste, the key factor from a climatic viewpoint is the percentage of carbon waste of non-biogenic origins. Although the detailed breakdown of each individual waste stream may vary significantly, non-hazardous waste from each sector would still be expected to consist mainly of biogenic or inert waste. Thus, the categories non-hazardous municipal, commercial and industrial waste have been grouped as MSW in Table 15.A1. Furthermore, it is estimated that, as a worst-case, 0.219 of the MSW waste incinerated is of fossil fuel origin and is thus a net contributor to greenhouse gas emissions (derived from Table 15.3). This estimate has been used as outlined in Appendix 15.1 for estimating the net GHG emissions from the incineration of 200,000 tonnes/annum of municipal, commercial and/or industrial waste. Data from the USEPA indicates that typical USA mixed municipal solid waste (MSW) has about 10% non-biogenic carbon in MSW[5] and thus the estimate of 21.9% in the current analysis is likely to be a worst-case scenario.

15.3 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

15.3.1 Forecasting Methods

Predictions of greenhouse gas emissions from the waste management facility were carried out using the emission factors derived from the IPCC[6] and AP-42 (USEPA)[8] and from information supplied by Indaver Ireland. The prediction of GHG emissions from landfills was developed using the USEPA Landfill Gas Emission Model (LandGEM)[9] and using emission factors derived from the USEPA[10] and the IPCC[6].

15.3.2 Construction

There is the potential for a number of emissions to atmosphere during the construction of the development. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions.

15.3.3 Incineration

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 Indaver Ireland 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 within the range of 150,000 to 200,000 tonnes consisting of all non-recyclable household, commercial and/or industrial waste. For the purpose of this study the maximum annual throughput of 200,000 tonnes is used. The net greenhouse gas contribution from the waste was derived using the procedure recommended by the IPCC and is outlined in Appendix 15.1.

15.3.4 Landfill

In the absence of incineration, the waste will be landfilled at a municipal landfill facility. Therefore, in the current study an assessment has been made of the likely production of greenhouse gases in the absence of incineration. Of the total emission of greenhouse gases from waste in Ireland, landfilling currently accounts for 98% of the total[3]. In the current assessment, 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 200,000 tonnes of waste is landfilled over a 25-year period has been assessed. The landfill is assumed to open in 2010 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. This is probably significantly above actual capture rates with rates likely to be between 50-70% for new landfills and 40%, at most, from existing landfills[3]. In addition, it is assumed that all recovered methane is used for energy recovery. In the Waste Management Act 1996, all Waste Licences issued by the EPA for Landfills now require landfill gas capture and utilisation in energy production or flared where use in energy production is not feasible. 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)[9]. A summary of the methodology employed in the model is given in Appendix 15.1.

15.3.5 Road Traffic

Road traffic would be expected to be an additional source of greenhouse gas emissions as a result of the development. Waste will be transported from the source of the waste to the site for disposal whilst the ash will subsequently be removed from the facility to be landfilled. In the absence of the development, this waste will also be collected and disposed of to landfill. In the absence of a detailed breakdown of the sources of waste and specific landfill locations, a detailed comparison of GHG emissions is not possible between the two options. However, it is likely that the transport associated with landfilling and incineration will lead to similar levels of emissions and moreover these emissions will be minor compared to emissions from the landfilling or incineration of waste. Thus, no detailed assessment has been carried out on the level of greenhouse gases from the transport of waste. However, analysis by the USEPA has estimated that the traffic-derived GHG emissions from both landfilling and waste-to-energy are approximately equivalent at 0.01 MTCE (metric tonnes of carbon equivalent) of anthropogenic CO_2 emission per ton (US) of material either landfilled or incinerated with the resulting ash landfilled[5]. In this context, the impact from the transport of waste accounts for less than 2.5% of the impact from the incineration of waste (excluding energy recovery) and thus is a minor contributor to the overall GHG emission total.

15.3.6 Modelling Methodology – Waste-to-Energy Facility

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 2010. Given in Table 15.5 is the annual greenhouse gas emissions form the site and the total over the period of the development. The emissions have been compared with the estimated Total Greenhouse Gas Emissions in Ireland in 2010[13]. The contribution to the Total Greenhouse gas emissions, in the absence of power generation, is 0.09% of the Total Greenhouse Gas Emissions in Ireland in that year and thus is a very minor source compared to significant industrial sources such as cement manufacture.

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 16MW. As approximately 3MW is required for electrical demand within the plant, the net electrical output from the plant for export to the national grid will be 13MW. Thus, the export of 13MW will give a direct benefit in terms of greenhouse gas emissions which would have been released in the production of 13MW from power stations. In order to calculate the net benefit in terms of greenhouse gas emissions, the likely greenhouse gas emissions from a Combined Cylce Gas Tubine (CCGT) power station (the most GHG efficient power source) producing 13MW of power has been calculated and subtracted from the site's greenhouse gas emissions (see Table 15.6).

Currently, the breakdown of electricity generation in Ireland for the four main fossil fuels is coal at 34%, others (including oil) at 15%, peat at 16% and natural gas at 35% (2003 data)[13]. It is envisaged that renewables will achieve the target of 13.2% of electricity generation by 2010[13]. CO_2 emissions from coal are 77% higher per Joule, peat is 110% higher per joule whilst oil is 49% higher per Joule than natural gas[3]. Thus, the assumption that the displaced power generation is from a CCGT burning natural gas is a worst-case scenario and more pessimistic assumption than using the average fuel profile.

The production of power for export to the national grid is equivalent to a net reduction of 67% in the amount of greenhouse gases emitted from the site. Thus, the actual contribution to the Total Greenhouse Gas Emissions is 0.030% of the Total Greenhouse Gas Emissions in Ireland in 2010.

15.3.7 Modelling Methodology – Landfill

As stated above, it is assumed that 200,000 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)[9]. The model gives the production rate in terms of mass (in tonnes/annum) and volume (in terms of m^3/annum) for both CH_4 and CO_2. Shown in Figure 15.1 is the production rate of CH_4 (in tonnes of CO_2 equivalent) from a landfill which is in operation for 25 years. The model indicates that the peak in production of CH_4 occurs 25 years after opening. Indeed, significant quantities of landfill gas are produced even after 50 years of closing. In the model it is assumed that 50% of the landfill gas is CH_4, which is the default value recommended by the USEPA[9] and the IPCC[6].

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. Gas collection efficiencies are assumed to be 75% whilst the collection efficiency of the control device are assumed to average around 95-99%. These are probably significantly above actual capture rates with rates likely to be between 50-70% for new landfills and 40%, at most, from existing landfills [3]. The controlled CH_4 and CO_2 emission was estimated as shown in Appendix 15.1. Controlled CO_2 emissions include emissions from the CO_2 component of landfill gas (equivalent to uncontrolled emission) and additional CO_2 emissions formed during the combustion of landfill gas (mainly CH_4). The controlled GHG emission total over the period of gas generation is shown in Table 15.7. The controlled emission for CH_4 also includes for oxidation of the CH_4 which may occur in the top layer of soil over the landfill. The USEPA recommended 10% oxidation rate of methane generated has been applied in the current assessment [10]. This factor has also been applied in the current assessment. As stated previously, the primary source of CO_2 derives from the decomposition of organic material derived from biomass sources (crops, forests) which are re-grown on an annual basis and thus CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology[6].

The total GHG emissions given is over a period of more than 100 years with peak generation occurring after 25 years at approximately 177,000 tonnes of CO_2 equivalent in that year. The contribution to the

total greenhouse gas emissions, ignoring the generation of power, for the worst-case year is only 0.25% of the total greenhouse gas emissions in Ireland in 2010 and thus is relatively minor. However, it should be borne in mind that although the landfill is in operation for 25 years, landfill gases will be produced over a considerably longer timescale.

Again, energy recovery is possible using the landfill gas as the fuel source. Based on data from the USEPA[5], there is a net benefit in terms of greenhouse gas emissions, as a result of power generation from landfill gas as a fuel source, which would otherwise have been provided by fossil fuels. 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 the more than 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 0.042% of the total greenhouse gas emissions in Ireland in 2010.

15.4 IMPACT OF DEVELOPMENT ON CLIMATE

15.4.1 Construction

The effect of construction on climate will not be significant.

15.4.2 Incineration

The contribution of the Waste-to-Energy Facility to total greenhouse gas emissions in Ireland is equivalent to only 0.030% of total emissions in 2010, when energy recovery in taken into account. Moreover, in the absence of the development, greenhouse gas emissions will occur from the landfilling of the waste. The contribution to the total greenhouse gas emissions from landfilling 200,000 tonnes of waste, including the generation of power, condensed to a 25-year period, is equivalent to 0.042% of the total greenhouse gas emissions in Ireland in 2010. Thus, the overall annual impact of the proposed Waste-to-Energy Facility on climate is to produce a net benefit of approximately 0.012% of the total greenhouse gas emissions in Ireland in 2010 and will thus will be imperceptible in terms of Ireland's obligations under the Kyoto Protocol.

15.5 DESCRIPTION OF MITIGATION MEASURES

15.5.1 Construction

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

15.5.2 Incineration

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 16MW with a net electrical output from the plant for export to the national grid will be 13MW (see Table 15.4). Thus, the export of 13MW will give a direct benefit in terms of greenhouse gas emissions which would have been released in the production of 13MW from power stations.

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. A recent USEPA report has estimated that approximately 0.01 MTCE per ton (US) of mixed MSW is saved through recycling of metals[(5)].

15.6 REFERENCES

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(3)ERM Limitation and Reduction of CO_2 and Other Greenhouse Gas Emissions in Ireland (1998)

(4)Department on Environment & Local Government Report on the Options For Greenhouse Gas Emission Trading (1999)

(5)USEPA Greenhouse Gas Emissions From Management of Selected Materials in Municipal Solid Waste (2002)

(6)IPCC Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996)

(7)EPA National Waste Database Report 2004 (2006)

(8)USEPA Solid Waste Disposal 2.1- Refuse Combustion, AP-42 (1996)

(9)USEPA Landfill Gas Emission Model (Version 3.02) LandGEM (2005)

(10)USEPA Landfills, Volume III: Chapter 15, Emission Inventory Improvement Program (2001)

(11)Department of Environment & Local Government National Climate Change Strategy (2000)

(12)AEA Technology Economic Evaluation of Emission Reductions of Methane in the Waste Sector in the EU (Bottom-up Analysis) (2001)

(13)ICF Consulting-Byrne Ó Cléirigh Determining the Share of National Greenhouse Gas Emissions for Emissions Trading In Ireland (2004)

(14)USEPA Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition (periodically updated) (1986)

Figure 15.1: Landfill Gas Generation From A 200,000 Tonnes/Annum Landfill Opened For 25 Years

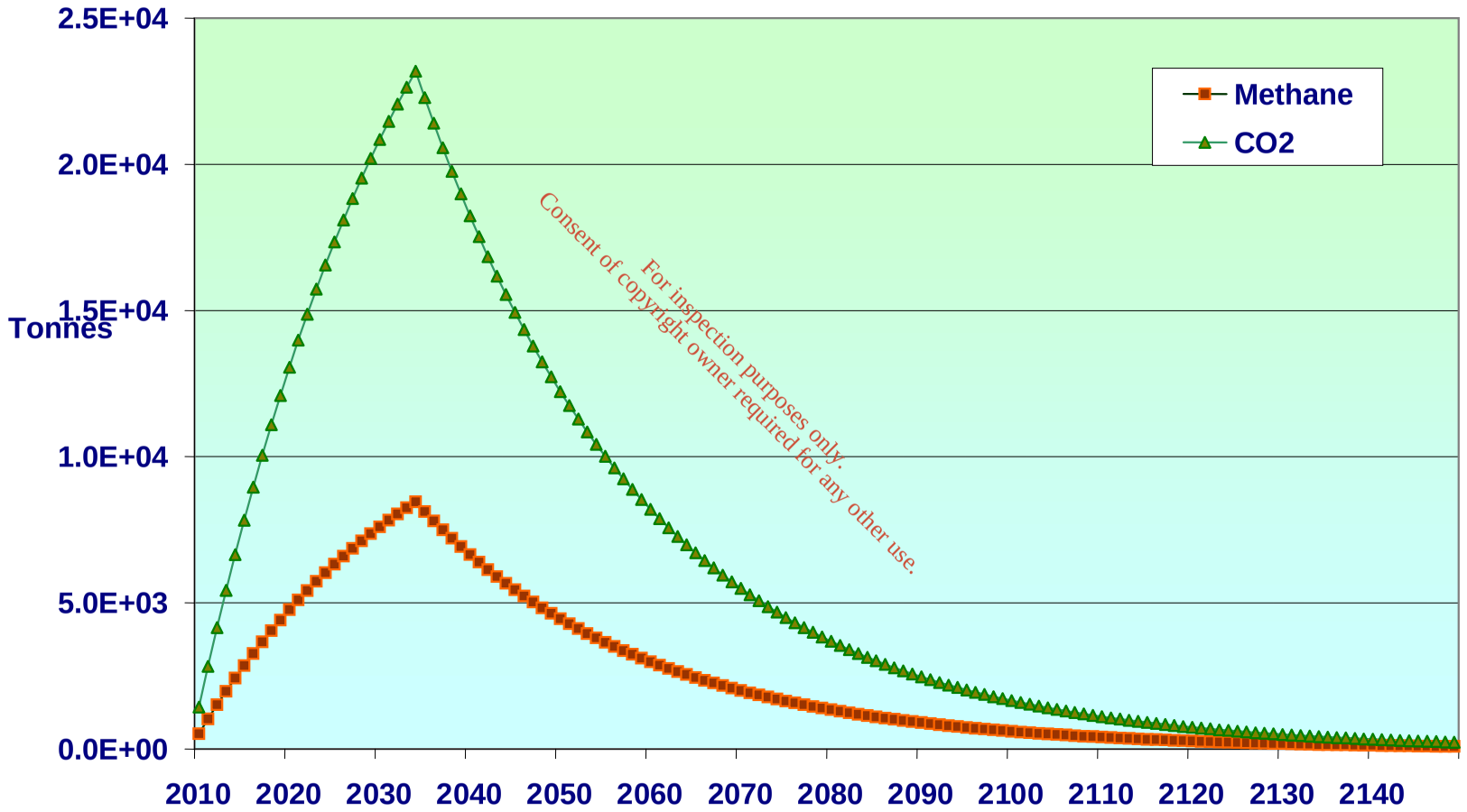


Table 15.1: Greenhouse Gas Emissions (2003) ('000 tonnes)[13]

	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 15.2: Greenhouse Gas Emissions ('000 tonnes CO_2 equivalent)[11]

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	**53,752**	**100**
1998	40,028	13,631	10,069	256	63,984	119	-745	**63,239**	**117.6**
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	137.6	-2,056	**71,894**	**133.8**
2010 High	51,373	12,185	9,720	1,885	75,163	139.8	-1,369	**73,794**	**137.3**

Table 15.3: Composition of Household and Commercial Waste Landfilled In Ireland In 2004[7]

Material	Household		Commercial		Total	
	(%)	(tonnes/annum)	(%)	(tonnes/annum)	(%)	(tonnes/annum)
Paper	19.2%	233,446	35.3%	212,860	24.5%	446,306
Glass	3.7%	45,313	1.5%	9,330	3.0%	54,643
Plastic	13.8%	167,261	12.0%	72,725	13.2%	239,986
Ferrous	1.5%	18,557	1.0%	5,892	1.3%	24,449
Aluminium	1.4%	16,795	0.6%	3,584	1.1%	20,379
Other Metals	0.4%	4,849	1.2%	7,381	0.7%	12,230
Textiles	11.0%	133,310	2.3%	13,676	8.1%	146,986
Organics	36.2%	440,131	37.6%	226,944	36.7%	667,075
WEEE	0.8%	9,179	0.4%	2,677	0.7%	11,856
Wood	0.9%	11,152	0.5%	3,027	0.8%	14,179
Others	11.1%	134,916	7.5%	45,516	9.9%	180,432
Total Fossil Fuel[1]	25.5%	309,750	14.8%	89,078	21.9%	398,828
Total Non-Fossil Fuel	74.5%	905,159	85.2%	514,534	78.1%	1,419,693
Total	100%	1,214,908	100%	603,628	100%	1,818,521

Note: "Others" mainly refers to composites, fine elements such as ash, unclassified incombustibles and unclassified combustibles including wood wastes.

(1) Derived from plastics, WEEE and textiles only and assumes that all WEEE and textiles are synthetic & carbon based (as a worst-case) leading to the fraction of fossil carbon of 0.219.

Table 15.4: Summary of Major Waste Types Accepted into Landfills In Ireland In 2004[7]

Landfill Type	No.	Waste Accepted (tonnes)					
		Household	Commercial	Construction	Industrial	Others	TOTAL
Local Authority	34	1,213,998	355,579	13,275	21,685	60,210	1,664,747
Private / Industrial	33	910	248,049	0	4,523,284	1,095	4,773,338
TOTAL	**67**	**1,214,908**	**603,628**	**13,275**	**4,544,969**	**61,305**	**8,780,201**

Table 15.5: Greenhouse Gas Emissions At Indaver Ireland's Waste Management Facility, Carranstown, Based On 200,000 Tonnes/Annum

	CO_2	N_2O	CH_4	% Of Ireland's Total Emissions[1]
Total / Annum (tonnes)[2]	61028	6.0	26[3]	-
Total / Annum (tonnes CO_2 Equivalent)	61028	1860	546	0.09
Total (tonnes CO_2 Equivalent) Over 25 Years	1.53E+6	4.6E+4	1.4E+4	-

(1) Based on an approximate total emission of 69.5 million tonnes CO_2 equivalent in 2010 (based on estimates given in reference 13 for average over the period 2008-12 (base case))

(2) Based on Revised IPCC Guidelines as outlined in Appendix 1 and reference 6 and using a fraction of fossil carbon as derived from Table 15.3 of 0.219

(3) Assuming, as a worst-case, that all organics are composed of methane.

Table 15.6: Greenhouse Gas Emissions At Indaver Ireland's Waste Management Facility, Carranstown As A Result of Exporting 13MW

	CO_2	N_2O	CH_4	% Of Irelands Total Emissions[1]
CCGT Producing 13MW[2] (tonnes)	42140	1	0.12[3]	-
CCGT Producing 13MW (tonnes CO_2 Equivalent)	42140	310	2.5	
Total / Annum (tonnes CO_2 Equivalent) After Subtraction Of Power	18888	1550	544	**0.030**
Total (tonnes CO_2 Equivalent) Over 25 Years	**4.7E+5**	**3.8E+4**	**1.4E+4**	**-**
Total After Power Generation Over 25 years	**Sum = 5.2E+5 Tonnes CO_2 Equivalent**			

(1) Based on an approximate total emission of 69.5 million tonnes CO_2 equivalent in 2010 (based on estimates given in reference 13 for average over the period 2008-12 (base case))

(2) Based on an energy saving of 0.37t CO_2 / MWh CCGT for electricity generation [12]

(3) Based on assumed methane content of 17% of Total VOCs (AP-42, 1996)[14].

Table 15.7: Total Greenhouse Gas Emissions From The Landfilling Of 200,000 Tonnes/Annum For 25 Years

	CO_2	N_2O	CH_4	Annual % Of Irelands Total Emissions[1]
Total Emissions (tonnes CO_2 Equivalent)[2,3]	-	-	1.57E+6	0.09
Greenhouse Gas Avoid (tonnes CO_2 Equivalent)[4]	8.5E+5			
Total After Power Generation	**Sum = 7.22E+5 Tonnes CO_2 Equivalent**			**0.042**

(1) Based on an approximate total emission of 69.5 million tonnes CO_2 equivalent in 2010 (based on estimates given in reference 13 for average over the period 2008-12 (base case))

(2) Total over a period of over 100 years: peak generation will occur after 25 years

(3) Based on an oxidation rate of 10% and a collection efficiency of 75%

(4) Base on the USEPA default value of 0.18 MTCE avoided utility C per MTCE CH_4[6].

Table 15.8: Comparison of the Climatic Impact of Incinerating 200,000 Tonnes/Waste versus Landfilling of 200,000 Tonnes/Waste For 25 years

Process	Emissions of Carbon Dioxide Equivalent (Tonnes)
Total Incineration After Power Generation Over 25 Years	Sum = 5.2E+5 Tonnes CO_2 Equivalent
Total Landfilling After Power Generation	Sum = 7.2E+5 Tonnes CO_2 Equivalent
Net Impact Of Incineration On Climate	**- 2.0E+5 Tonnes CO_2 Equivalent** **(Net benefit equivalent to 0.012% of emission total in 2010)**

APPENDIX 15.1

Revised 1996 IPCC Guidelines On The Incineration of Waste

Consistent with the IPCC Guidelines[6], only CO_2 emissions resulting from the incineration of waste of fossil origin (e.g. plastics, rubber, waste oil etc) should be included in emission estimates. The carbon fraction that is derived from biomass material (e.g. paper, food waste) is not included.

CO_2 Emissions

The most accurate CO_2 emission estimates results from disaggregating the activity into different waste types (municipal solid waste, sewage sludge, hazardous waste etc.) as the emission factor is based on the carbon content of the waste that is of fossil origin only. The following equation details the calculations involved:

$$CO_2 \text{ emissions (tonnes/yr)} = \Sigma_i (IW_i \times CCW_i \times FCF_i \times EF_i \times 44/12)$$

Where:

i	=	Municipal Solid Waste (MSW)
IW_i	=	Amount of incinerated waste of type i (tonnes/yr)
CCW_i	=	Fraction of carbon content in waste of type i
FCF_i	=	Fraction of fossil carbon in waste of type i
EF_i	=	burn out efficiency of combustion of incinerators for waste of type i
44/12	=	conversion from C to CO_2

Table A15.1: Default Data For Estimation of CO_2 Emissions From Waste Incineration[6]

	MSW	Sewage Sludge	Clinical Waste	Hazardous Waste
C Content of Waste	33-50% default = 40%	10-40% default = 30%	50-70% default = 60%	1-95% default = 50%
Fossil Carbon as % of Total Carbon	30-50% default = 40%	0%	30-50% default = 40%	90-100% default = 90%
Efficiency of Combustion	95-99% default = 95%	95%	50-99.5% default = 95%	95-99.5% default = 99.5%

Note: MSW refers to non-hazardous municipal, commercial and industrial waste

In the current scenario:

CO_2 emissions (tonnes/yr) = 200,000 x 0.40 x 0.219 x 0.95 x 44/12

CO_2 emissions = 61,028 tonnes/yr

Where:

i	=	MSW
IW_i	=	Amount of incinerated waste of type i (200,000 tonnes/annum)
CCW_i	=	Fraction of carbon content in waste of type i (average = 0.219)
FCF_i	=	Fraction of fossil carbon in waste of type i (maximum = 0.30)
EF_i	=	Burn out efficiency of combustion of incinerators for waste of type i (default = 0.95)

In relation to the fraction of waste of non-biogenic origin, this has been estimated based on the detailed breakdown of household and commercial waste currently landfilled in Ireland in 2004 (see Table 15.3). The value of 0.219 should be compared with the USEPA data that typical USA mixed municipal solid waste (MSW) has about 10% non-biogenic carbon in MSW[5].

N_2O Emissions

The calculation of N_2O emissions is based on waste input to the incinerators and an emission factor:

$$N_2O \text{ emissions (Gg/yr)} = \Sigma_i (IW_i \times EF_i) \times 10^{-6}$$

Where:

IW_i	=	Amount of incinerated waste of type i (Gg/yr)
EF_i	=	Aggregate N_2O emission factor for waste of type i (kg N_2O/Gg)

Table A15.2: Default Data For Estimation of N_2O Emissions From Waste Incineration[6]

Incineration Plant Type	**MSW** Kg N_2O / Gg waste (dry)	**Sewage Sludge** Kg N_2O / Gg sludge (dry)	**Clinical Waste** Kg N_2O / Gg waste (dry)	**Hazardous Waste** Kg N_2O / Gg waste (dry)
Hearth of grate	Germany 5.5-66 (average 5.5-11) UK Highest value - 30	400 (Japan: wet)	NA	NA
Rotating	NA	NA	NA	210-240 (Germany)
Fluidised Bed	240–660 Japan (wet)	800 (Germany) 100-1500 (UK) 300–1530 (Japan: wet)	NA	NA

In the current scenario, using the highest report UK emission factor:

N_2O emissions (Gg/yr) = 200 Gg/annum x 30 kg/Gg waste X 10^{-6}

N_2O emissions = 6.0 tonnes /annum

AP-42 - Municial Solid Waste Landfills

The biodegradation of refuse in landfills produces landfill gas, mainly methane (CH_4) and carbon dioxide (CO_2) both of which are also greenhouse gases although only CH_4 is considered of non-biogenic origin. The USEPA[10] recommends that landfill gas emissions are calculated using the Landfill Gas Emission Model (LandGEM)[9]. Although other fates can exist for the gas generated in a landfill, including capture and subsequent microbial degradation, the bulk of the gas generated will be emitted through cracks or other openings in the landfill surface. USEPA recommends in the absence of site-specific data that the LFG consists of 55% CH_4, 40% CO_2 and 5% N_2[8]. For the purposes of estimating emissions both the IPCC[6] and USEPA[10] recommend the use of a 50% CH_4:50%CO_2 LFG ratio.

Emissions from landfills may be controlled by installing a gas collection system and combusting the collected gas through the use of flares or turbines. Gas collection efficiencies are typically around 75%

whilst the collection efficiency of the control device averages around 95 - 99%. The controlled CH_4 emission can be estimated by the equation outlined below:

$$CM_P = [UM_P*(1-\eta_{COL}/100)] + [UM_P*\eta_{COL}/100* (1-\eta_{Cnt}/100)]$$

Where:

CM_P	=	Controlled mass emission of pollutant P, kg/year
UMP	=	Uncontrolled mass emissions of P, kg/year (from LandGEM)
η_{COL}	=	collection efficiency of landfill gas collection system, percent
η_{Cnt}	=	collection efficiency of landfill gas control device, percent

Controlled CO_2 emissions include emissions from the CO_2 component of landfill gas (equivalent to uncontrolled emission) and additional CO_2 emissions formed during the CH_4 component of combustion of landfill gas (mainly CH_4). The following equation, which assumes 100% combustion efficiency for CH_4, can be used to estimate CO_2 emissions from controlled landfills:

$$CMco_2 = UM\ co_2 + [UM_{CH4} *\eta_{COL}/100*2.75]$$

Where:

CM co_2	=	Controlled mass emission of CO_2, kg/year
UM $_{CH4}$	=	Uncontrolled mass emissions of CH_4, kg/year (from LandGEM)
η_{COL}	=	collection efficiency of landfill gas collection system, percent
2.75	=	ratio of molecular weight of CO_2 to the molecular weight of CH_4

Landfill Gas Emission Model (LandGEM)

The landfill gas emission model (LandGEM) estimates air emissions from landfills. The biodegradation of refuse in landfills produces landfill gas, mainly methane (CH_4) and carbon dioxide (CO_2). The model estimates emission rates based on the landfill gas generation rate and the amount of refuse in the landfill. The landfill gas generation rate in the model is based on a first order decomposition model, which estimates the landfill gas generation rate using two parameters: L_O, the potential methane generation capacity of the refuse, and k, the methane generation decay rate, which accounts for how quickly the methane generation rate decreases, once it reaches its peak rate. In the current model the L_O has been calculated as shown below[6]:

$$L_O = (MCF \times DOC \times DOC_F \times F \times 16/12)\ (Mg\ CH_4/Mg\ Waste)$$

Where:

MCF	=	methane correction factor (default = 1)
DOC	=	Degradable organic carbon fraction (Mg C/Mg MSW)
DOC_F	=	Fraction DOC dissimilated (default = 0.77)

F = Fraction by volume of CH_4 in landfill gas (IPCC Default = 0.50)

And where:

DOC = (0.4 x A) + (0.17 x B) + (0.15 x C) + (0.3 x D)

Using Table 15.3:

A = fraction of MSW that is paper and textiles (approx. 33%)

B = fraction of MSW that is garden waste etc

C = fraction of MSW that is food waste (sum of B & C = 37%)

D = fraction of MSW that is wood (approx. 0.8%)

Thus:

DOC = (0.4 x 0.33) + (0.16 x 0.37) + (0.3 x 0.008)

DOC = 0.194

This should be compared with the IPCC default value of DOC = 0.21

Thus:

L_O = (1.0 x 0.194 x 0.77 x 0.50 x 16/12) (Gg CH_4/Gg Waste)

L_O = (0.092) (Mg CH_4/Mg Waste)

L_O = 136 m^3/Mg (site specific)

L_O = 162 m^3/Mg (IPCC Default)

Both of these values should be compared with the two suggested values given in the LandGEM model:

AP-42

Methane Generation Rate k = 0.04 1/yr

Methane Generation Potential L_O = 100 m^3/Mg

Clean Air Act (CAA)

Methane Generation Rate k = 0.05 1/yr

Methane Generation Potential L_O = 170 m^3/Mg

Thus, the AP-42 default parameters have been used in the following calculations as they represent the most appropriate values for the site.

Methane Percentage = 50% (IPCC and USEPA Default)

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10}\right) e^{-kt_{ij}}$$

Where:

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year*)
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate (*$year^{-1}$*)
L_o = potential methane generation capacity (*m^3/Mg*)

In order to enable a comparison between the landfill option and the waste-to-energy option, a length of active operation of the landfill of 25 years has been assumed.

16 CULTURAL HERITAGE

16.1 INTRODUCTION

The proposed development is located in the townland of Carranstown, County Meath. The site is bounded to the south by the R152, the main Drogheda-Duleek road, and to the north by the Drogheda-Navan railway-line (Figure 16.1). There are no archaeological sites in the close vicinity.

An Archaeological Impact Assessment of the site was requested for inclusion in an Environmental Impact Statement for the development. This study is based on field walking and desk-based research. The aim of the study is to address the potential archaeological impact of the industrial development in order to address in advance any archaeological matters that might arise in the course of the development.

16.2 METHODOLOGY

This study was carried out under the following headings:

- Field inspection
- Journal & documentary research
- Cartographic research
- Aerial photographic research
- Sites & Monuments Record, Dept. Environment Heritage and Local Government
- Topographic Files, Irish Antiquities Division, National Museum of Ireland
- Impact Assessment
- Remedial & Mitigation Measures

16.2.1 Field Inspection

The site was visited on July 2005. The weather conditions were good; sunny spells interspersed with heavy showers. The site is divided into four fields (Numbered 1-4, Figure 16.2).

16.2.2 Site Description

The site is located on the northern edge of a low-lying ridge, oriented N-S. It is overlooked by slightly higher ground in Cruicerath townland, immediately to the North; and by the Bellewstown ridge ca. 4km to the South.

The fields are presently under grass. Earthen banks, surmounted by mature blackthorn bushes, enclose each of the fields.

Field 1: This is a flat field which slopes slightly to the West and North (Plate 16.1). No evidence of any archaeological features or remains was found. This field is the highest point of the site, ca. 40m OD (Malin).

Field 2: This field slopes gently to the West. No evidence of any archaeological features or remains was found.

Field 3: This is a long field, oriented SW-NE; it slopes from the south to the north. There is a marked break of slope ca, 20m north of the southern field boundary. No evidence of any archaeological features or remains was found (Plate 16.2).

A small field drain runs along the western boundary of Fields 2 and 3.

Field 4: Only the southern half of this field comes within the boundary of the proposed development. It slopes very slightly from NW-SE. No evidence of any archaeological features or remains was found.

16.2.3 Journal & Documentary Research

Various published sources and artefact corpora were consulted (see Section 16.3). These did not reveal anything of archaeological significance relating to the proposed development site.

16.2.4 Cartographic Research

1st edition Ordnance Survey (1837). County Meath, (sheet 27/1). Scale 6" to 1 mile
Fields 1 and 2 in the site are recorded as having originally been one large field. Field 3 appears to have retained the boundaries it had in 1837. Limestone deposits were noted between the railway line and the road. No other features were recorded in the area (Plate 16.3).

RMR Constraint Map (1996). County Meath, (sheets 27 & 20).
Apart from the division of the field into 1 and 2, the field boundaries appear to have remained the same since the 1837 edition (Plate 16.2).

16.2.5 Aerial Photographic Research

G.S.I. IRL. 1/300-4-73 4720m 11:05am, area 46.0, National sub-zone Oa.
There were no features of archaeological interest identified on the proposed development site or in the immediate area.

16.2.6 Sites and Monuments Record - Department of Environment Heritage and Local Government.

This part of the study was carried out on the basis of the following sources:

i.. Archaeological Survey

The Archaeological Survey is a branch of The Heritage Services, Dept. of Environment, Heritage, and Local Government. It is charged with surveying Ireland's archaeological heritage and publishing the results of its surveys in a series of county columns.

The Survey maintains an archive on individual archaeological sites, which is ordered by county and sub-divided by 6" sheets. The archive contains information on the location, form and preservation of each site and includes maps, plans and photographs when relevant.

For this study any relevant files in this archive were examined and details noted.

ii Sites & Monuments Record (SMR)

The SMR is a list of known archaeological sites compiled by the Archaeological Survey of Ireland from their files. The SMR consists of a numbered list, organised by county and subdivided by 6" map sheets, and sets of constraint maps for each count at scales of 1:12,000 and 1:12,5000, showing the locations of these sites.

The lists and maps were distributed to local authority planning departments as an aid to decision making in the planning process.

For this study the SMR (lists and constraint maps) was consulted for each site. Where any archaeological site occurred all details were noted.

iii Record of Monuments & Places (RMP)

This is a list of known archaeological sites complied by the Archaeological Survey of Ireland, from their files and from site visits carried out by their archaeologists. The RMP consists of a numbered list, organised by county and subdivided by 6" map sheets, and sets of constraint maps for each county at a scale of 1:12,000, showing the locations of these sites.

The lists and maps are distributed to local authority planning departments as an aid to decision making in the planning process.

The RMP was set up under statute in 1994 (Amendment to the National Monuments Act); the provisions of that act protect sites marked on the RMP. The provisions of that act protect owners of sites marked on the RMP. Owners of sites marked on the RMP are required to give a minimum of 2 months written notice to the Minister of the Environment, Heritage and Local Government of any intention to carry out works at such sites.

For this study the RMP (lists and constraint maps) was consulted for each site. Where any archaeological site occurred all details were noted.

There are no known archaeological monuments recorded on the proposed development site in the Sites and Monuments Records.

However there are four recorded monuments in the vicinity (Figure 16.2). The following information was compiled from the Sites and Monuments Record and The Archaeological Survey of Co. Meath.

SMR	ME030-014
Townland	Platin
Class	Inland promontory fort
Nat. Grid co-ords	30787 / 27239
Description	The site is situated on top of a 10m high rock outcrop and covers an area of c. two acres.

Area 1: Consists of a sub circular rock outcrop (21.3m E-W, 25m N-S). There is a panhandle to the south-west and a bank to the north-east corner (5.3m wide, 1.2m high over the exterior, 1m high from the interior). Otherwise the earthwork is defined by scarps c.0.5m. There is a curved depression (6.5m long, c.0.75m deep, 0.9m wide), which maybe a collapsed rock-cut souterrain.

To the east of Area 1 there is a rough platform sloping slightly which dips down to a bank. There is a gap (5.5m wide at the top, 2.3m at the bottom) in the east side of this stony bank, and this offers the easiest access to the south. This bank becomes a scarp on the south side and the bank is interrupted to the north.

A hollow way runs between Area 1 and Area 2 (6.5m wide, 0.5m deep). At its north end it runs on to a platform with ramps running down to the east and west (*c.* 45 angle on the east, *c.* 45-60 angle on the west).

Area 2: Area 2 consists of a triangular bank (16.5m N-S, 29m along its north side).

There is a slight ramp near the north-east corner facing Area 2. To the west there is a modern path. Further west there is a rock outcrop with a bank on its higher east end running north-east (2.5m wide, .03m high).

SMR	ME027-002
Townland	Cruicerath
Class	Earthwork
Nat. Grid co-ords	30450 / 27161
Description	Situated on a rock outcrop (diam. *c.* 29m). The site has been quarried to the west. There is high embankment (2.5m high, 1.5m wide) with a shallow fosse (2m wide, 0.5m deep) to the east of the base. A possible entrance is located to the ESE on an outcropping ridge.

SMR	ME027-006
Townland	Bellewstown
Class	Souterrain
Nat. Grid co-ords	30639 / 26906
Description	There are no visible remains of this souterrain which was discovered in 1964 and almost immediately backfilled without having being inspected. The field surface has been completely worked over by machinery, but apparently there was no surface indication of any structure. Stated by the owner to have been of artificial appearance.

SMR	ME027-03
Townland	Platin
Class	*Castle (site of)* / Church
Nat. Grid co-ords	30626 / 27203
Description	'Platin Hall', now demolished was built on the site of an earlier castle. The house was of brick, three storeys high with a nine bay front, built c. 1700 and possibly designed by Sir William Robinson. The castle was said to have been a D'Arcy castle *Dalton John, History of Drogheda, II 1844. (462 – 463, p.390).*

Church: St. Patrick is said to have founded a church in Blaitine, now Platin, in east Meath[1]. The church has an undivided nave and chancel (int. L 11.3m, int. W 5.2m) with opposing doors toward the west end. A double light window with belfry above is located in the west wall and a triple light window in the east wall.

[1] Brady, Rev. John, 1958. R.M.A.H.S

Three double light windows are located in the south wall and two single light windows, made of sandstone reused from an older foundation, are in the north wall. A fragment of a cross dated c. 1600 featuring foliage and figure sculpture is cemented to the east window[2]. A disc-headed cross is located in the church.

Monastery: One of St. Patrick's original foundations is said to have been at Platin[3].

16.2.7 Topographic Files, Irish Antiquities Division, National Museum of Ireland

The townlands of Carranstown, Caulstown, Cruicerath and Newtown were searched in the Topographic Files of the National Museum of Ireland. Nothing was recorded as having come from the townland of Carranstown; however both Cruicerath and Newtown had recorded stray finds:

Townland	Cruicerath
Barony	Duleek Lower
County	Meath
NMI reg.	1933.580
Habitat	Store C8:21
Nature of site	Found 20ft below surface in quarry.
Find	Bronze pin
Description	Length: 11.75cm; max. width of head: 1.5cm; max. thickness of stem: 0.35cm. The pin was part of a penannular brooch, dating from the Early Christian Period.

Townland	Newtown
Barony	Duleek Lower
County	Meath
NMI reg.	L1934: 7-8 (RIA)
Habitat	Store C12:19
Nature of site	Found in the vicinity of White Rock, a local landmark, in 1920's.
Finds	Stone battle axe Stone hammer
Description	Battle axe: Dimensions: 15cm x 10cm. Made of black basalt, a shaft hole pierces through the axe. Two depressions are marked by a raised circumference Hammer: Dimensions: 6cm x 9cm. Highly polished with central perforation.

[2] PRIA 1984, 101

16.2.8 Characteristics of the Proposed Development

The site is currently in use for pasture. It is proposed to construct a waste management facility consisting of a 70 MW Waste to Energy Plant for the acceptance of Non Hazardous Waste on lands in the townland of Carranstown. Although the boundary of the proposed development encloses an area some 25 acres in extent, the actual footprint of the buildings will only cover some 10 acres of the site, with the remaining land utilised for landscaping to minimise the visual impacts of the facility. However for the purposes of this assessment the entire 25 acres is under consideration.

16.2.9 Predicted Impacts of the Development

Direct Impacts.

On the basis of this study there is no evidence of clearly defined archaeological activity on the proposed development site. However construction of the proposed development will have a negative impact on any archaeological features which may survive below ground. It is also possible that archaeological artefacts may be revealed during construction or ground works for the development. For example, on going research has shown that 14.9% of stone axes have been found on agricultural land (mostly during ploughing) and rough pasture[4]. The physical impact of the development due to its proximity to the World Heritage Site were considered. The proposed facility is a minimum of 3km from the river valley and approximately 5km from the boundary of the World Heritage Site, sufficiently distant so as to render any archaeological impacts not significant. The UNESCO-ICOMOS monitoring mission which reported on the site in 2004, also considered the direct impacts and found that *there were no grounds for believing that the construction of the proposed incinerator itself would have a direct impact on the outstanding universal value of the World heritage site. Any effect on possible archaeological sites of local interest within the application area would be mitigated by archaeological monitoring*[5]

Indirect Impacts:

Possible impacts were considered on the unique winter solstice event, when the rising sun on a number of days around December 22nd shines directly into the passage at Newgrange, illuminating the floor of the burial chamber, deep within the body of the tomb. However, examination of the cartographic evidence shows that the development will be sited some considerable distance, c.3km to the east of the point on the Newgrange horizon, where the sun rises on the 22nd. As far as the events at Newgrange are concerned the entire development will be completely masked by Redmountain ridge. In addition any impacts from vapours from the stack masking the event are addressed elsewhere, however they would have to travel some 3km to the west in order to have any effect. It should be noted that the development includes a heat exchanger which, the developers have assured, would eliminate any visible emission except on damp foggy days when the emissions would not be visible against background cloud.

[3] Cuffe, P. 1964. R.M.A.H.S. 143
[4] Cooney, G & Mandal S, 1998. The Irish Stone Axe Project. Monograph 1, pp.34-8. Bray: Wordwell Ltd.
[5] UNESCO-ICOMOS reactive monitoring mission report on the Archaeological Ensemble on the Bend of the Boyne (Ireland) 17-21 February 2004. p 3

Visual impacts of the development on the World Heritage Site of the bend of the Boyne were also considered. The mass of Redmountain will mask the development from almost all of the core area of the World Heritage Site. The stack however will be visible from Dowth but not from Newgrange or Knowth. Therefore while there will be some visual impact on the World Heritage Site this impact will be minimum particularly compared to the nearby cement factory. The UNESCO-ICOMOS report concurred stating that *while the construction of the incinerator stack will be a visual intrusion, the mission considers that it would have a minimum impact on the world Heritage site compared with the existing cement factory nearby*[6].

A report entitled *Assessment Of Air Quality Impact Of Carranstown Waste Management Facility At Bru Na Boinne* was completed by AWN in March 2004. A summary of the findings of this report is presented in Appendix 16.2.

Possible visual impacts from Bellewstown ridge were examined. The known upstanding archaeology of the Bellewstown ridge is limited to two small low tumuli and a church. The visual impact of the development on these sites will therefore not be significant.

There will be some visual impact on the site of the Battle of the Boyne. Although noted in the Sites and Monument Record as located in the bend of the Boyne close to Oldbridge Obelisk, the battle site could be said to extend southwards as far as Donore Hill, the location of the Jacobite encampment, and as far north as the level ground around Townleyhall, the Williamite camp. The stack will certainly be seen from some of these extended areas of the battlefield. However, the development will be some 3-4km distant from the closest point of the historic site and any impact will not be significant. In addition the UNESCO-ICOMOS mission concluded that *the construction of the incinerator would not appear to preclude any possible interpretation of the course of the Battle*[7].

Finally, impacts on the ecclesiastical centre of Duleek, situated to the west of the proposed development, were addressed. The distance is in fact some 2km from the site at Carranstown to the centre of Duleek village. The village is certainly recognised as an important archaeological and historical site. The early ecclesiastical core of the village has survived down to the present, with the original circular, concentric enclosures, such a distinctive feature of early Christian sites, surviving in the village street pattern. Development within the village has been low level with a number of important archaeological sites listed in the archaeological inventory. These include two high crosses, the remains of a round tower and a cross inscribed slab indicating it to be the site of the pre-Norman St Ciaran's Church. The later medieval church survives in the form of a chancel and aisled nave. There are also the remains nearby of the medieval church of St Patrick. However, the development will have no direct impact on the archaeology of Duleek.

[6] ibid. p 4
[7] ibid p 3

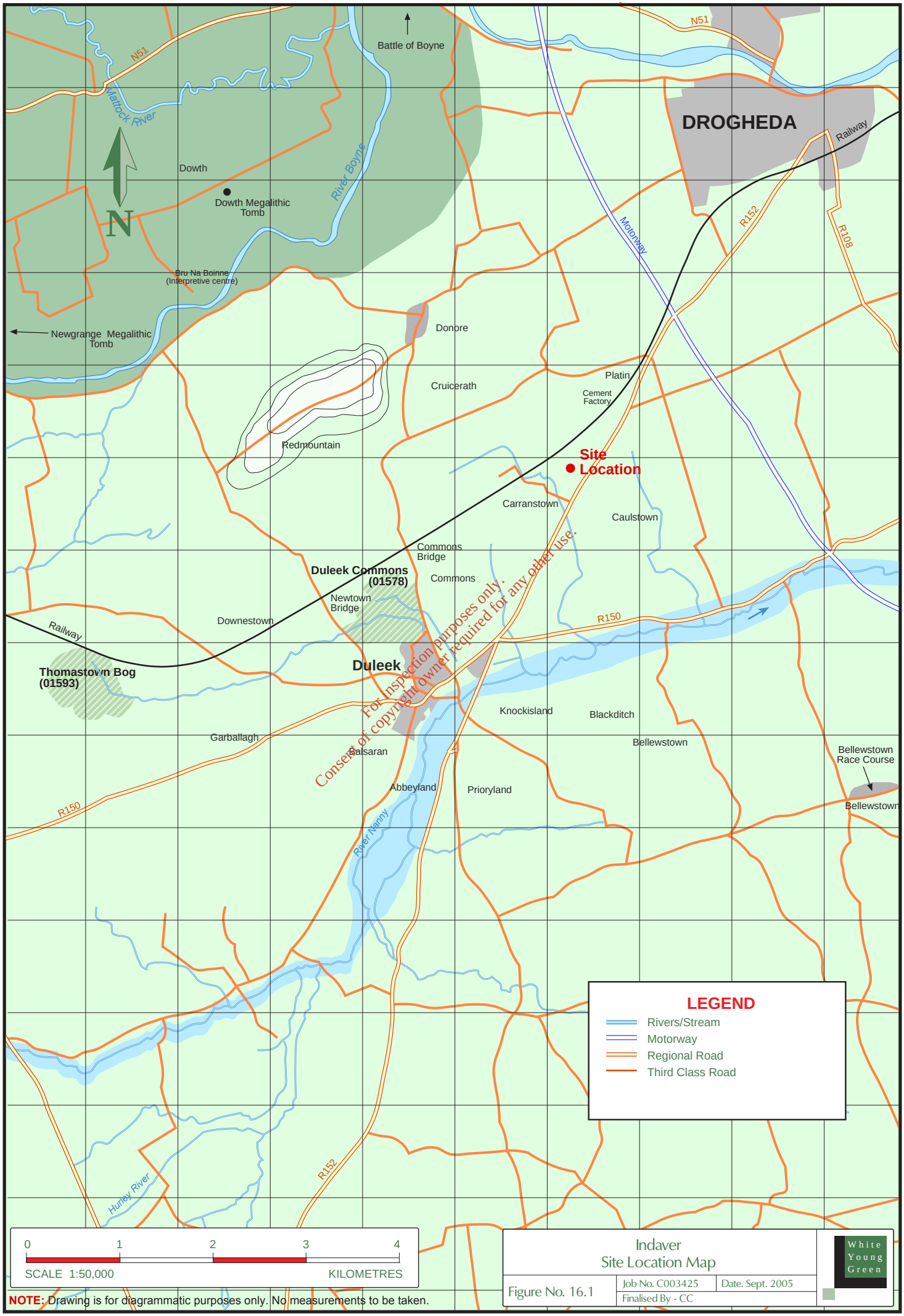
16.2.10 Remedial & mitigation measures[8]

Nothing of archaeological interest was noted during the field visit. Nothing of archaeological interest is recorded in the SMR for the area of the proposal, or in its immediate vicinity. However the development site is situated in a region that was important in Irish pre-historic and historic times. The fertile nature of this part of Meath also means it has been subject to intensive farming practices over a long period of time which may have resulted in the destruction of above ground archaeological features, traces of which may still survive beneath the present ground surface. Therefore given that the development would have a negative impact on any archaeological remains or artefacts surviving below ground it is recommended that:

- Topsoil stripping of the site be monitored by a suitably qualified archaeologist.
- Should any archaeological discoveries be made during construction it is the responsibility of the finder, under the terms of the National monuments Act (1930 & amendments), to immediately report their discovery to the Duty Officer of the National Museum of Ireland. Any archaeological discoveries should also be reported to the heritage authorities in the Department of Environment Heritage and Local Government. These institutions can be contacted at:

National Museum of Ireland Kildare Street Dublin 2	**Department of Environment, Heritage and Local Government,** Dun Sceine Harcourt Lane Dublin 2
Tel: 01-661 9753 Fax: 01-6766116	Tel: 01-4117109 Fax:

[8] All archaeological recommendations are subject to the approval of the relevant statutory authorities.



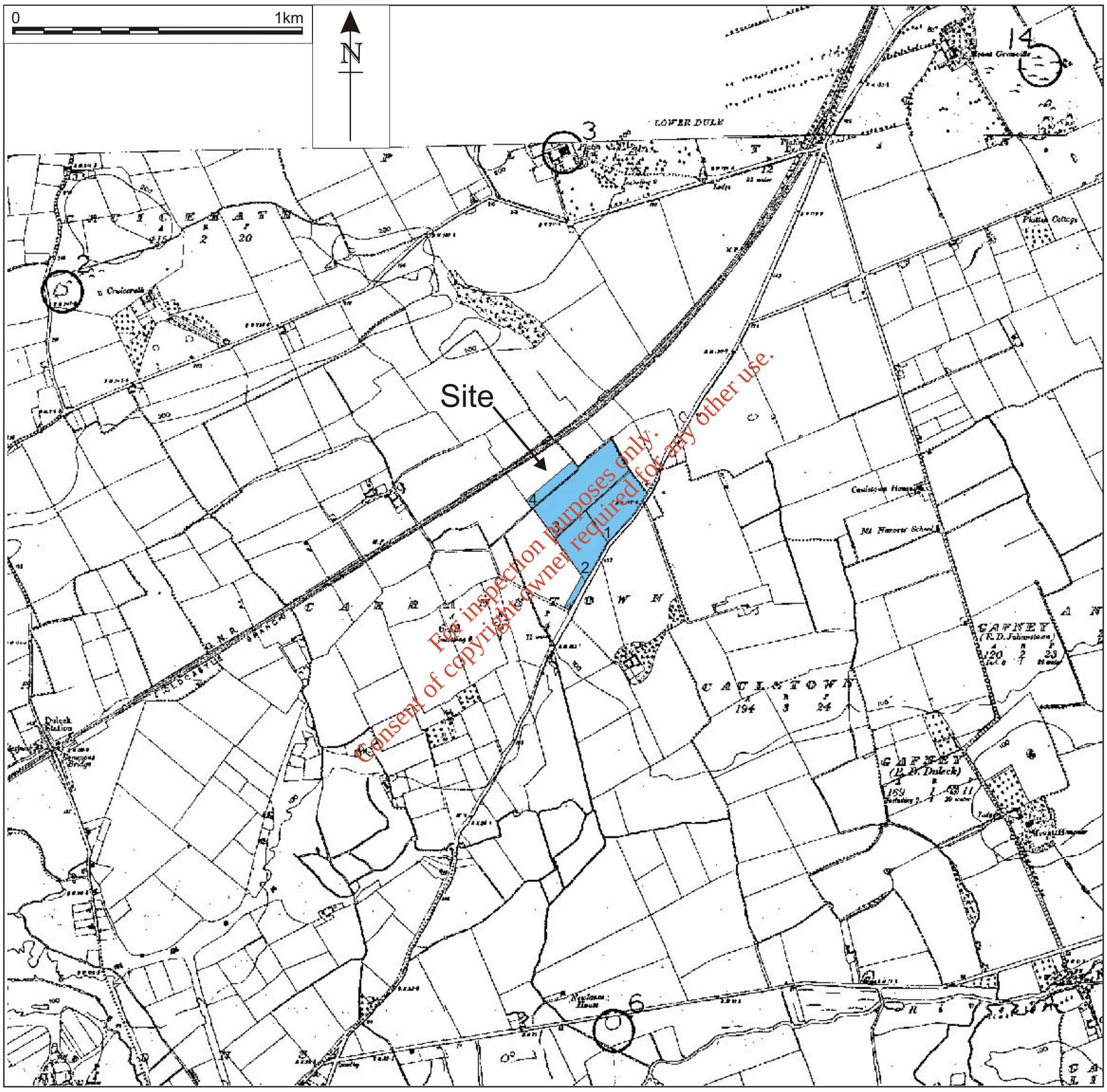


Fig. 16.2 Extract from RMP Constraint Map of Co. Meath, Sheets 27 & 20. Date of issue: 1996.

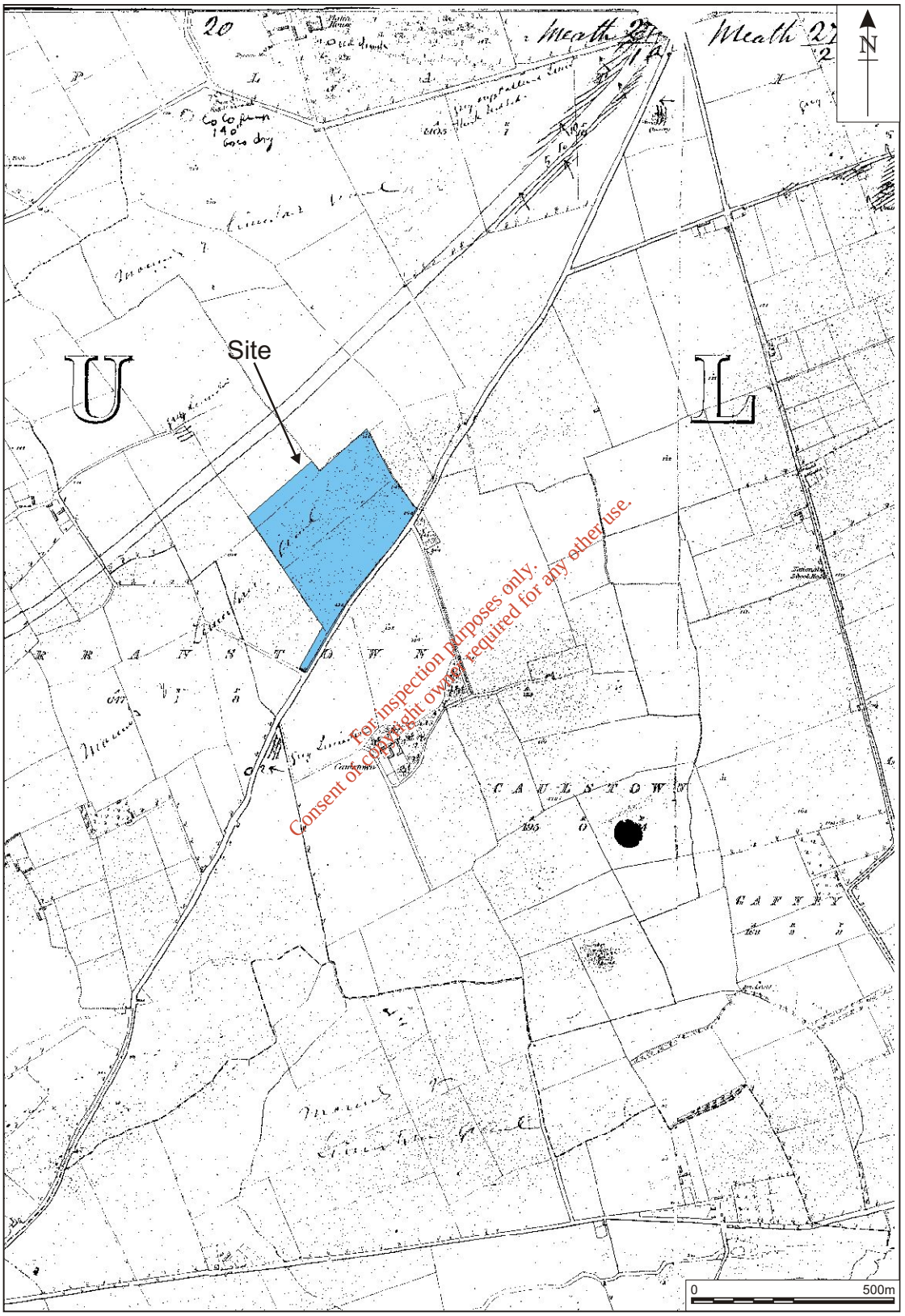


Fig. 16.3 First edition Ordnance Survey map, Co.Meath, sheet 27a/1 & /2. Surveyed 1837. Scale 1:10,560

Plate 16.1 General view of site from southern side of Field 1.

Plate 16.2 Field 3. View from west. Platin cement factory in background.

Appendix 16.1

General archaeological corpora consulted for study

General archaeological corpora consulted for study:

Author	Date	Title
Barry, T.B.	1987	*The Archaeology of Medieval Ireland*, University Press, Cambridge
Bennet, I.	1986-2002	*Excavations* Wordwell, Bray Co Dublin
Bourke, E,	1994	Glass vessels of the first nine centuries AD in Ireland, *J Royal Soc. Antiq. Ir*, 124, 163-209
Burgess, C & S Gerloff	1981	The Dirks and rapiers of Great Britain and Ireland, *Praehistorische Bronzefunde*, IV.7. Meunchen: CH Beck
Clarke, DL,	1970	*Beaker pottery of Great Britain and Ireland*. Cambridge: University Press
Collins, AEP,	1994	The flint javelin heads of Ireland, in D Ó Corráin (ed.) *Irish antiquity*, 111-33. Dublin: Four Courts Press
Earwood, C,	1994	*Domestic wooden artefacts in Britain and Ireland from Neolithic to Viking times*. Exeter: University of Exeter Press
Eogan, G,	1965	*Catalogue of Irish bronze swords*. Dublin: The Stationary Office
Eogan, G,	1974	Pins of the Irish Late Bronze Age, *J Roy Soc Antiq Ir*, 104, 74-119
Eogan, G,	1983	*The hoards of the Irish Later Bronze Age*. Dublin: University College Dublin
Eogan, G,	1994	*The accomplished art. Gold and gold working in Britain and Ireland during the Bronze Age (c. 2,300-650 BC).* Oxford: Oxbow Books Ltd.
Harbison, P,	1976	Bracers and V-perforated buttons in the Beaker and Food Vessel Cultures of Ireland, *Archaeologia Atlantica Research Report*, 1

Harbison, P, 1969a The axes of the Early Bronze Age in Ireland. *Praehistorische Bronzefunde*, IX.1. Muenchen: CH Beck

Harbison, P, 1969b The daggers and the halberds of the Early Bronze Age in Ireland. *Praehistorische Bronzefunde*, VI.1. Muenchen: CH Beck

Kavanagh, RM, 1973 The encrusted urn in Ireland, *Proc Roy Ir Acad*, 73C, 507-617

Kavanagh, RM, 1976 Collared and cordoned cinerary urns in Ireland, *Proc Roy Ir Acad*, 76C, 293-381

Kavanagh, RM, 1991 A reconsideration of razors in the Irish Early Bronze Age, *J Roy Soc Antiq Ir*, 121, 77-104

Killanin, Lord, MA & Duignan MV 1967 *The Shell Guide to Ireland*

Longworth, IH, 1984 *Collared urns of the Bronze Age in Great Britain and Ireland*. Cambridge: Cambridge University Press

Moore, M,J, 1987 Archaeological Inventory of County Meath, Dublin

O'Connor, L, 1991 Irish Iron Age and Early Christian whetstones, *J Roy Soc Antiq Ir*, 121, 45-76

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Appendix 16.2

Summary of Assessment Of Air Quality Impact Of Carranstown Waste Management Facility At Brú Na Boinne

Summary Of Air Impacts At Brú Na Boinne

The United States Environmental Protection Agency (USEPA) approved AERMOD dispersion model has been used to predict the ground level concentrations (GLC) at Brú na Boinne resulting from compounds emitted from Carranstown Waste Management Facility.

Modelling results for the facility indicate that the ambient ground level concentrations at Brú na Boinne resulting from the Waste Management Facility are significantly below the relevant air quality standards for all species. The results for NO_2 indicate that levels at Brú na Boinne reach only 1% of the limit value. With regard to SO_2, the predicted levels at Brú na Boinne will reach at most 0.5% of the limit value, and for all other species modelled, the predicted levels at Brú na Boinne will reach less than 1% of their respective limit values.

Levels of all species are significantly lower than the Human and Ecosystem Standards set by the EU and other European bodies. Thus, the impact air emissions from the Carranstown Waste Management Facility at Brú na Boinne will be insignificant.

Although there are no specific EU standards relating to the maximum levels of ambient air pollutants on stonework or historical monuments, the focus has been on reducing the emissions of the precursors to acid rain such as NO_X, SO_2 and VOCs. The 1999 Gothenburg Protocol to the Convention on Long-range Transboundary Air Pollution, is one such agreement which has set stringent emissions ceilings for NO_X and SO_2 (emissions of SO_2 and NO_X will be reduced by 76% and 43% compared to 1990 levels by 2010). This Protocol has recently been passed into Irish legislation as S.I. No. 10 of 2004. To put the current facility in context, emissions of NO_X, SO_2 and VOCs from Carranstown Waste Management Facility will reach at most 0.4% of their National Emissions Ceilings in 2010.

17. MATERIAL ASSETS

17.1 INTRODUCTION

This chapter evaluates the impacts, if any, which the development will have on material assets. Material assets are defined in the EPA advice notes on current practice in the preparation of Environmental Impact Assessments, 2003 as '*resources that are valued and that are intrinsic to specific places, they may be either human or natural origin and the value may arise for either economic or cultural reasons*'. The assessment of cultural heritage is discussed under Section 16; therefore, this section will evaluate the economic assets only.

Economic assets will be discussed under the following areas including:

- Ownership and access
- Local settlement
- Electricity supply
- Traffic
- Water Supply and Usage
- Waste Management
- Site Utilities
- Agriculture
- Tourism
- Natural Resources

17.2 OWNERSHIP AND ACCESS

Indaver Ireland is a wholly owned subsidiary of Indaver NV and intends to apply for full planning permission for the development of a 70 MW Waste to Energy Plant. The plant will accept non-hazardous waste on lands in the town land of Carranstown, Duleek, County Meath.

The proposed facility will be located on an area of approximately 10 hectares (25 acres) which is currently used for agricultural purposes. The area of the site for development will be approximately 4 hectares (10 acres), with the remaining areas of the site to be utilised for landscaping to minimise the visual impact of the proposed facility. This environmental impact assessment evaluates the 10 hectare (25 acres) site in its entirety.

17.3 LOCAL SETTLEMENT

The nearest local settlements adjacent to the development are the town of Duleek and the village of Donore in County Meath. Duleek is located approximately 2.7 km to the south west of the facility and Donore is approximately 2.6km northwest of the proposed site. These local settlements are evaluated in detail in Section 6 Human Beings. Drogheda town is located about 4km lying to the North East of the site. The local settlements within a 3km radius of the proposed facility are evaluated in detail in Section 6 Human Beings.

17.3.1 Property Prices

waste to energy facility, Vienna City Centre

The National Society for Clean Air in the UK in its report entitled *Public Acceptability of Incineration* state that property values are "frequently an initial concern, but there is no evidence over time of any significant real impact, beyond that likely from any other industrial development." The document quotes research in North America which has unequivocally shown that: "During the proposal, planning and construction stages for an incinerator (as for any large industrial project) there is a short-term impact on property values in the immediate vicinity. Much of this is a result of uncertainty while deliberations continue. Once the facility is operational, property values have been shown to recover.

In developments of all sizes, types and scales there are often short-term impacts on adjoining assets and properties. This is due to the precautionary nature of people to purchase at a time of construction. It is unlikely that the proposed facility will impact on property prices other than during this period. It is likely that the perceived belief that there will be long-term negative impact due to the location of the incinerator is based on mis-information regarding the facility's impact on public health or the environment. It is more likely that once the facility is operational, impact on property values would be eliminated.

There are over 350 municipal waste incinerators operating in Europe. In line with the proximity principle, many are located in cities, suburbs and other areas close to the main source of waste generation. To date, it appears that the findings of research to determine whether a waste-to-energy facility will have a significant long-term effect on property prices within the area of the facility have been insignificant or inconclusive.

17.4 ELECTRICITY SUPPLY

As noted in Section 1, the proposed 70 MW Waste to Energy Plant will generate approximately 16MW of electrical output. It will require 3MW to meet the electrical demands of the facility itself leaving 13MW to be diverted to the National Grid.

One of the principal criteria therefore for assessing the viability of this site included an investigation into the proximity to the electricity grid. This is discussed in detail in Section 3 Alternatives.

The waste to energy plant will export electricity to the local electrical distribution system via 20 kV overhead lines to Rathmullan Substation about 2.5km north of the site. Planning permission is not required for 20 kV lines. The final route for the lines will be determined by the ESB after consultation with landowners.

Due to the layout of the facility and its location to the northerly end of the site, there will be no requirement to divert the existing 110 kV lines traversing the site. See Section 5 for more information on the proposed site and scheme description.

17.5 TRANSPORT

Details regarding the road network are discussed under Section 13, Traffic.

17.6 WATER SUPPLY AND USAGE

17.6.1 Process Water

As the plant uses an effluent free flue gas cleaning process and an air cooled condenser rather than cooling towers it has a significantly lower water requirement than would otherwise be the case. The major water requirement will be for flue gas cleaning. Process water (for the steam cycle), domestic potable water and water for cleaning account for the rest of the demand. The expected water requirements are listed in Table 17.1.

Table 17.1 Water requirement

Use	Quality	Quantity (m^3/hr)
Flue gas cleaning	Well water	7.4
Process (steam cycle)	Potable water	1.0
Domestic supplies	Potable water	2.0
Cleaning	Well water	1.0
Fire fighting	Well water	0.2
Total		**11.6**

The raw water requirement will be supplied by groundwater abstraction and a small supply of potable water from the local water main. Approximately 1m^3/hr will be supplied from Meath County Council's water main on the R152 for potable supplies.

Well trials on site indicate that the aquifer has more that adequate capacity to supply the required quantity without any significant impact on groundwater levels. This is further detailed in Section 10, Groundwater.

The proposed facility re-uses the waste liquids (produced in the scrubbing process) in the cooling process and a solid waste is produced. This eliminates any process water discharge from the facility as no aqueous effluent is generated. This if further explained in Section 5, Proposed Site.

17.6.2 Potable Water

The mains water supply piped along the R152 road supplies many of the residential dwellings in the area. The Limestone aquifer in the area is also used by a number of groundwater abstractors (See Section 11, Surface Water).

The development will use a small quantity of mains water as a potable supply.

17.6.3 Fire Water/ Water Storage Tank

In the event of a fire breaking out in the bunker, the area of waste on fire can be controlled by placing it into the furnace and covering with a layer of waste. However in the unlikely event of the fire not being detected in time, a number of water cannons located in the bunker will be activated to put it out.

All firewater will be contained in the bunker eliminating the need for a firewater retention pond.

17.6.4 Foul Water

During the construction phase domestic effluent generated on site will discharge to temporary sewage containment facilities prior to transport and treatment off site. If planning permission is granted, Meath

County Council has confirmed their agreement to accept domestic effluent generated during construction of the facility for treatment in an appropriate wastewater treatment plant.

During the operational phase domestic sewage from toilets, changing and kitchen areas will discharge via the foul drainage system into an on site effluent treatment system which will then pass through a percolation area to ground. The percolation area will be constructed in accordance with the guidelines in the EPA's Wastewater Treatment Manual.

There will be no trade effluent from site.

Details of the proposed foul water management system are described in Section 11, Surface Water.

17.6.5 Surface Water

Details of the proposed surface water management system are described in Section 11, Surface Water.

17.7 WASTE MANAGEMENT

17.7.1 Construction Phase

Disposal of waste during the construction phase is described in Section 18, Construction Activities.

17.7.2 Operational Phase

Provisions for the installation of recycling collection bins will be provided on site where necessary. Domestic waste generated on site from canteen areas etc will be recycled where appropriate and where disposal is required this will be conducted by Indaver. Any hazardous waste generated on site including cleaning agents, oils, batteries, paints etc will be sent to an Environmental Protection Agency approved waste disposal company for appropriate disposal/ recovery.

The operational waste residues produced in the facility are described in detail in Section 5, Proposed Site. Based on an annual operating capacity of between 150,000 and 200,000 tonnes of waste, the main operational wastes are:

- Bottom Ash (Approximately 50,000 tonnes/yr)
- Boiler Ash (Approximately 3,000 tonnes/yr)
- Flue gas cleaning residues (Approximately 10,000 tonnes/yr)

The treatment and disposal of these waste residues are discussed in detail in Section 5, Proposed Site.

17.7.2.1 Bottom Ash Re-Use Options

This ash residue is non-hazardous and the determination of its classification is described in detail in Section 5. Elsewhere in the EU including Belgium, bottom ash from waste incineration is recovered and used in road construction, as railway ballast or as a substitute covering material on landfill, following treatment in an ash recycling plant. Bottom ash has also been trialled in Taiwan as an aggregate for use in concrete production, asphalt concrete production and bricks. Studies in the UK have found that the fine fraction of MSW bottom ash from the incineration of non-hazardous waste can be processed to form new ceramic materials using conventional ceramic processing technology (Bethanis, et al. 2004).

If the ash is to be used for road construction it must generally be of a different grade (higher quality) than if it were to be disposed of in landfill. At present there is no Irish or European legislation or standard in place to govern the quality of ash for use in roads. This improvement in quality can be achieved by treating the ash in an ash recovery plant. In Germany the quality standard of ash for use in road construction is defined by the Federal Working Group on Waste (LAGA) and is based on leachate tests.

In the absence of an ash recovery facility and a suitable market for recycled bottom ash here in Ireland, this ash will be disposed of to a suitably licensed non-hazardous landfill site. The volume of ash produced by a Waste-to-Energy plant is only 10% of the volume of waste and therefore requires less landfill capacity to dispose of it than sending MSW directly to landfill. In addition, due to the inert nature of the ash it will have less adverse impacts than untreated waste which is currently being landfilled.

Indaver Ireland will dispose of bottom ash to appropriate EPA licensed landfill facilities. EPA licensed landfills located in counties Meath, Louth, Cavan and Monaghan would be suitable for the disposal of this material.

For further information regarding ash outputs and handling see Section 5, Proposed Site.

17.8 SITE UTILITIES

As detailed in Section 17.4 connection to the National Grid will be required however planning permission is not required for the erection of 20 kV lines. The final route for the lines will be determined by the ESB after consultation with landowners. This is being dealt with separately to the EIA process.

Foul water generated at the facility is discussed in Section 17.6.4.

17.9 AGRICULTURE

As noted in Section 1 the proposed facility will be located on an area of 25 acres. The proposed development will be constructed on site lands in question and not on any additional agricultural lands. Therefore a statistical farm survey, which would evaluate land take or severance factors was not undertaken.

Historically, the site has been used as agricultural land and tillage farming (potatoes) has continued on the site for the last 5 years.

Considerable research has been undertaken to study the impact of waste-to-energy facilities on food produce. Some research papers have established a link between the operation of facilities within, or in exceedence of, old emission limits and elevated levels of pollutants in food produce. Many of these studies were on incinerators without gas cleaning systems or energy recovery. The findings of such studies are not directly comparable with the proposed waste-to-energy facility.

To date, there is no evidence to suggest that waste-to-energy facilities operating within the stringent emission limits set down in EC Directive 2000/76 on the Incineration of Waste will impact on food produce. These stringent emission limits and the World Health Organisation Guidelines have been developed to prevent any impact on public health or the environment, including agriculture. Operating well within these standards will ensure that there will be no negative impacts on agricultural practices.

It has also been suggested that the development of waste-to-energy as part of an integrated waste management system will damage Ireland's 'green image' and will leave the country at a competitive disadvantage to other 'green' food producing countries such as New Zealand, which currently does not include incineration as part of its waste management policy.

Incinerator in Maderia

Incinerator in Majorca

The New Zealand Government has produced a national dioxin inventory which states that the main source of dioxins in the environment is uncontrolled fires. The report states that: "It is clear that landfill fires do occur at an unacceptable rate in New Zealand." The emission of dioxins in New Zealand is estimated to be between 14 and 51 g I-TEQ per year as compared to dioxin emissions of between 25 and 39 g I-TEQ per year in Ireland.

In a report entitled "An Action Plan for Reducing Discharges of Dioxin to Air" the New Zealand Ministry for the Environment state that: "State of the art municipal waste incinerators that are operated well could decrease the incidence of landfill fires, and could therefore result in an overall reduction in dioxin discharges."

The Food Safety Authority of Ireland in its report entitled *Report on waste incineration and possible contamination of the food supply with dioxins* states that

"FSAI considers that such incineration facilities, if properly managed, will not contribute to dioxin levels in the food supply to any significant extent and will not affect food quality or safety…. The risks to health and sustainable development presented by the continued dependency on landfill as a method of waste disposal far outweigh any possible effects on food safety and quality."

(Report on Waste Incineration and possible contamination of the food supply with dioxins, Food Safety Authority of Ireland, 2003)

As part of the EPA licence for operation of the proposed facility, the Agency will carry out a programme of monitoring in the areas around the waste-to-energy facility. It is expected that the programme will include monitoring of food produce in the vicinity in conjunction with the Food Safety Authority of Ireland.

Due to the strict emissions controls and regulatory compliance that the plant will be working under, no significant negative impacts to adjacent agricultural lands are expected. The potential impacts of this development to agriculture is addressed in relation to soils and discussed in greater detail in Section 10 (Soils and Geology). Likewise the assimilative capacity of air and water and their respective potential impacts are discussed in Sections 7 and 10 respectively. See Section 6 for potential impact to human health.

17.10 TOURISM

Tourism is discussed under Section 6, Human Beings.

17.11 THE USE OF NATURAL RESOURCES

In so far as possible, construction materials will be from local sources and all imported material that will be used on site will be from approved sources. Further details regarding the construction of the development are outlined in Section 18.

17.12 MITIGATION MEASURES

As all lands within this application are restricted to that outlined within the site boundary, the proposed facility will not result in any significant environmental impacts relating to land severance, land access or disruption to current agricultural land use.

Connection to the National Grid will be by 20kV overhead lines and not by the 110kV lines and therefore will not be the subject of a planning application. However, Indaver Ireland has confirmed that any environmental conditions specified by the above contracts will be adhered to.

Impacts and specified mitigation measures regarding agriculture, site utilities, groundwater/ hydrogeology, surface water, road network, local settlement and tourism are discussed and evaluated in Sections 17, 10, 11, 13 and 6 respectively.

Waste management on site will be conducted in accordance with best practice to encourage as much segregation and recycling on site. Any waste removed from site will be by carriers in receipt of valid waste permits and to disposal facilities approved by the EPA.

17.13 RESIDUAL IMPACTS

With the above mitigation measures in place, neither the construction nor operational phases of the proposed development will result in any significant negative impacts on the existing economic assets.

17.14 REFERENCES

Bethanis S., Cheeseman C.R. and Sollars C.J., 2004 Effect of sintering temperature on the properties and leaching of incinerator bottom ash, *Waste Management and Research* 22, 255-264.

Bethanis S. Cheeseman C.R., 2004. Production of lightweight aggregate from incinerator bottom ash and pulverised fuel ash, *Waste Management*, Rhodes, Greece, 2004.

18 CONSTRUCTION

18.1 INTRODUCTION

This section details the construction works required for the proposed facility and indicates the mitigation measures to be implemented to ensure that potential environmental impacts are minimised. A construction methodology review is also included in Appendix 18.1.

18.2 SITE EVALUATION

Original site evaluation and testing of the site was completed at the site in 2000 and 2001 as detailed in Section 9 (Geology and Soils). General infrastructural construction will require additional geotechnical investigations such as trial pits and california bearing ratio (C.B.R.) tests to verify foundation designs and road construction. All investigations required prior to enabling works shall be carried out in accordance with BS 5930 (Code of Practice for Site Investigations) and site specific site investigation specifications based on the findings of the previous initial site investigation works.

18.3 DURATION AND PHASING

The timing of the commencement of construction is subject to planning, licensing and ecological constraints. It would be expected, that any works associated with site clearance and removal of hedgerows would be seasonally limited to mitigate against any adverse ecological affects.

The works to be conducted will be broadly developed in three phases as follows.

Phase 1

This phase will comprise of the site clearance, fencing, bulk excavation, re-grading and landscape berming and planting. Such site preparation works are expected to be 2/3 months. Haul roads, site roads to sub-base level, main drainage runs, temporary car-parking and staff facilities will also be constructed during this phase.

Phase 2

This phase will comprise the construction of the buildings, roads completion, drainage and infrastructural works completion. It is anticipated that these works will be undertaken over a 16 month period. Large items of plant /equipment will also be installed during this phase.

Phase 3

This phase will comprise the ongoing installation and testing of mechanical and electrical equipment. It is anticipated that the duration for the installation and testing works will take approximately 8 months.

During this phase final completion and finishing works will be carried out in anticipation of handover of the project to the client.

The commissioning of the waste-to-energy facility will begin approximately 12 weeks prior to start up operations. The commissioning activity will involve a number of work groups certifying the various components of the facility. For the final eight weeks of commissioning approximately Indaver Ireland's operating team will join the commissioning crew and from this point continual shift works will begin (i.e. 24hrs/day; 7days/week).

It should be noted that the above is indicative only and may be subject to variations on consent from Meath County Council and also to final schedule agreement with the Contractor.

18.4 SITE PREPARATION

Site Acquisition, Clearance and Management Prior to Construction.

There are no areas of land to be acquired prior to construction. The site clearance process will not commence until the main construction contract is awarded.

Prior to commencement of development at the site written agreement will be sought from the planning authority for details in relation to temporary car parking facilities for construction employees to include;

- construction details to include road base materials, surfacing details and markings,
- surface water drainage details,
- proposals for the reinstatement of the area on completion of the construction phase.

The location of proposed car parking to be provided during the construction period is outlined in Drawing No. 15013\CD\009 of the Planning Package.

Site Preparation Works

Site preparation works will be required in order to facilitate the development. Such works will involve the re-grading of the site. It is anticipated that the materials from such excavation works will be incorporated into the screening berms within the site.

The development at the site will comply with the special requirements in relation to Bord Gáis and the ESB. Such conditions relate to the executing of any works in the vicinity of the Bord Gáis distribution mains and ESB over head cables, which traverses the site. A way leave of 14m and a working strip of 18m will be provided along the extent of the gas main which will be fenced during the construction stage. A cross over will be provided for access of construction traffic to the site (see Drawing 15013|CD|009 of the Planning Package). The overhead power lines will be delineated with a line of goalposts and barrels in accordance with ESB guidelines.

An area of approximately 25m in width will be lowered to allow for movement of construction traffic under the 110kV cables as per ESB guidelines (see Drawing 15013|CD|009 of the Planning Package).

In addition to the landscape proposals detailed under Section 14, the proposed screening mounds and landscaping on the perimeter of the waste management facility site will be carried out during the initial construction phase. Prior to commencement of development, the following will be submitted to the planning authority for written agreement;

- detailed landscaping of proposed screening mounds to include the proposed types/variety of native species, density of planting, maintenance programme and planting to supplement and strengthen hedgerows and tree belts that are to be retained, and
- a programme outlining the timescale for the implementation of the proposed landscape scheme.

All permanent screening bank side slopes will be top-soiled and grass seeded as soon as practicable after their construction. Dust suppression sprays shall be used during periods of dry weather until a stable grass covering has been established.

Site preparation works will also include the site set up by the contractor which will include the following:

- Site Office
- Site Facilities (canteen, toilets, drying rooms etc.)
- Offices for Construction Management Team
- Secure compound for the storage of all on site machinery and materials.
- Carparking
- Permanent and Temporary fencing
- Site security

18.5 PLANT

Equipment to be used during the construction of the facility will be typical of a project of this scale. In general the following machinery will be used:

- Tracked backhoe excavators
- Bulldozers
- Dumper trucks
- Wheeled Excavators
- Fixed Tower and Mobile cranes
- Teleporters
- Rock breakers
- Delivery vehicles for concrete and materials

18.6 EMPLOYMENT

Employment levels across the project will vary depending on the construction programme and the extent of activities occurring on the site. It is expected that during peak activities, there will be between 250 and 300 skilled and unskilled persons working directly on the construction site.

18.7 ACCOMMODATION/FACILITIES

The relevant statutory requirements will be provided for all workers on the construction site including:

- Canteen facilities and drinking water supply
- Toilet, wash up and locker facilities and hot water
- Drying room
- Car parking for workforce
- First Aid Office
- Site Engineers & Resident Engineers offices
- Site offices for Contractors
- Secure site compounds

18.8 CONSTRUCTION OPERATION HOURS

The site construction working hours will be confined to between 0700 and 1900 hours Monday to Saturday, inclusive (excluding public holidays and Sundays).

Working hours may vary slightly depending on weather conditions and daylight hours during winter months. Heavy construction activities will be avoided where possible outside the normal working hours outlined above.

It is envisaged that during the final construction phase works associated with internal fit out (e.g. electrical works) will be conducted outside of the working hours defined above. As these works are internal no environmental nuisances will be generated.

18.9 CONSTRUCTION TECHNIQUES

The construction techniques used will be standard and similar to those that would normally be associated with a large infrastructural project with both a building work element and a large civil engineering element.

18.10 MATERIALS

In so far as possible, construction materials will be from local sources. All imported material that will be used on site will be from approved sources.

18.11 PIPE/DRAINAGE WORKS

The construction of the foul and surface water systems will be a significant element of the project. The infrastructural drainage works will occur in tandem with the overall development the buildings.

Drainage for the roadways will be constructed first as the permanent internal roads will also be used as routes for construction traffic. Temporary settlement ponds and interceptors will be constructed during the initial stages of the contract mitigating against adverse impacts on the existing drainage network.

18.12 EXTENSION OF INFRASTRUCTURE

Services such as ESB and Telecom will be brought to the dedicated construction compound from the nearest available point. Temporary sanitary accommodation will be provided on site. All domestic effluent generated on site will be discharged to temporary sewage containment facilities prior to transport and treatment off site.

18.13 WASTE MANAGEMENT

During the construction phase both solid and liquid waste will be produced at the facility. Minor quantities of liquid waste will be produced during the construction phase of the facility. Waste oils, solvents and paints will be stored in a temporary bunded area prior to transport off site by a licensed contractor. During the construction phase all domestic effluent generated on site will discharge to temporary sewage containment facilities (holding tanks) prior to transport and treatment off site by an Authorised contractor.

It is not envisaged that there will be any spoil materials arising from the construction as all the excavated soil will be re-used as part of the construction process. All solid waste generated during the construction phase will be adequately stored prior to transfer to an authorized facility for recovery/recycling/disposal.

18.14 FENCING AND SECURITY

It is intended to locate a site security hut and controlled access gates at the entrance road, which will be manned during working hours. During construction temporary fencing will be erected around the building compound for the storage of all on site machinery and materials. The permanent perimeter fencing will be erected at an early stage in the works in order to provide a secure site.

18.15 NOISE, VIBRATION AND DUST

Dust emissions during the construction period have been detailed under temporary environmental protection measures. Baseline and proposed noise and vibration emissions have been presented in Section 8.

18.16 TEMPORARY ENVIRONMENTAL PROTECTION MEASURES

During the construction stage a temporary wheel wash will be located along the access road at the entrance to the site. Site construction roads will be sprayed with water during dry periods to mitigate against the formation of dry dust particles.

The movement of excavated materials on site may lead to the formation of airborne dust particles during dry weather periods. Water suppressants will be used during these dry weather conditions.

The screening berms proposed for the facility will be constructed and planted at the earliest opportunity thus limiting the potential for off site migration of air borne dust. Where temporary stockpiles are required the material will be stored in designated areas and will be covered with tarpaulins or regularly dampened during dry weather periods.

During the construction phase of the development, oil and fuel storage tanks, chemicals and all other materials that pose a risk to waters if spilled, will be stored in designated storage areas, which will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s). Filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) will be diverted for collection and safe disposal. Bunded pallets will be used for storage of drums.

During the construction phase all domestic effluent generated on site will discharge to temporary sewage containment facilities prior to transport and treatment off site. Meath County Council has confirmed its agreement to accept domestic effluent generated during construction of the facility for treatment in an appropriate wastewater treatment plant (see Appendix 10.2).

Temporary settlement chambers and interceptors will be constructed as necessary during the early stages of construction mitigating against silt laden run off to the existing drainage network. Prior to commencement of development, written agreement will be sought from the planning authority for details of temporary settlement ponds/silt traps/oil interceptors to control discharges of site surface water run-off during the construction period in advance of the construction of the proposed permanent attenuation tanks. The concentration of suspended solids (SS) of the surface water run-off from the site construction works, for discharge to surface waters, will not exceed 30 mg/litre.

During the construction phase of the proposed development noise levels at the site when measured at noise sensitive locations in the vicinity will not exceed 65dB(A) between 0700 and 1900 hours Monday to Saturday inclusive, excluding public holidays and Sundays, and 45dB(A) at any other time. Noise monitoring locations for the purposes of the construction phase of the proposed development will be agreed in writing with the planning authority prior to commencement of any development on site.

It is proposed to monitor noise, dust deposition and suspended solids of surface water run-off associated with the construction phase and reports detailing such findings will be submitted to the planning authority on a monthly basis.

During the construction phase, all vehicles, other than private cars and vans, exiting the construction site will pass through a wheel-wash facility. It is proposed to install the wheel wash during facility construction as a control mechanism for the reduction of suspended solids within surface water discharges. The discharge from the wheel wash (equipped with a filtering system) will be directed to an oil interceptor prior to discharge to the drainage network.

18.17 POTENTIAL IMPACTS

Good housekeeping and facility management during the construction period will ensure that there will be no negative environmental impacts from the construction of the proposed facility.

18.18 PUBLIC CONSULTATION

Local residents and other members of the local community will have an opportunity to raise any specific issues, concerns or complaints they may have during the construction phase through the Community Liaison Committee which will meet regularly.

Appendix 18.1

Construction Methodology Review

CONSTRUCTION METHODOLOGY REVIEW

FOR

70 MW WASTE MANAGEMENT FACILITY, AT CARRANSTOWN, Co. MEATH

ON BEHALF OF

INDAVER IRELAND

Date	Description	Revision	By	Approved
Jan 06	Construction Methodology Review	A	NK	MMcC

1.0 INTRODUCTION

The following Construction methodology study has been carried out to assess the likely construction methods for the proposed development and their implications on the surrounding environment. The study has been based on construction methods observed in the construction of other such plants abroad and also the construction methods employed on similar sized projects such as Poer stations in this country.

2.0 PROJECT METHODOLOGY

Because of the specialised nature of the Heat treatment/recovery process the Project has been split into two distinct elements;

The first element consists of the main Process Building which will contain the Waste Reception Hall, Incinerator, Flue Gas Treatment Equipment, Steam Generation and the Turbine Building. This element will be tendered and awarded on a turnkey basis, which is normal for this type of development and one which has been carried out successfully by Indaver previously. After award of contract, the Turnkey contractor, who will consist of a Consortium of contractors covering the various disciplines of the works, will carry out a design, construct and commission contract for this element and all its associated equipment. The design and construction will be in accordance with the requirements of detailed specifications for all elements of the work set out in a "Call for Tender" document for the Turnkey Contract.

The second element of work will consist of the design, tender and construction of the "Site Development Contract". The Site Development Contract will consist of all the external infrastructure, support buildings, site development and completions, road realignments, site establishments, temporary surfacings, enabling works etc. These works will be tendered on a competitive tender basis to local/national contractors of sufficient scale and competence to undertake these works. The design and management of these contracts will be carried out on a traditional basis by a design team appointed directly by the client. This element of the works will include all issues requiring liasion with Local/Statuatory Authorities and with local representative groups.

3.0 CONSTRUCTION METHODOLOGY

In both of the above instances the construction methodology follows a similar pattern. The following sections of this report outline the main

phasing of the construction works, how it is envisaged that each phase will be undertaken, what external impacts to the surrounding environment may occur and what mitigation measures will be taken in these cases.

3.1 Scheduling

A Project Schedule will be developed in order to assist with the planning of the project. This schedule will indicate all significant items of work to be carried out both pre-construction and during construction for the project. The schedule is based on experience of similar previous projects, sensible phasing of the works and logical milestone dates.

3.2 Pre-construction Issues

A number of Design issues are to be agreed with Meath County Council prior to commencement of works.

These issues will primarily consist of

- Agreement with respect to the construction of the proposed junction of the Waste Management Facility site and the realignment of the R152 Regional road. These works are to be carried out at the commencement of work to allow safe access for construction traffic to enter and exit the site.

- The agreement of a construction traffic management plan for the control and operation of the new junction during the construction phase.

- Agreement of proposals with respect to temporary facilities for Construction Personnel including details of all sanitary facilities to be provided for the construction period.

- Agreement on details for the provision of temporary carparking facilities for construction employees.

- Agreement of all proposed landscaping.

- Agreement on details to prevent uncontrolled discharges from the site entering local watercourses and to control the concentration of suspended solids in the discharges to the limits noted in the Planning conditions.

- Agreement for the restoration and reinstatement of the entire site following decommissioning of the plant.

The above design issues will be carried out under the auspices of the Site Development Contract design team who will undertake all liasion with the relevant Local/Statutory Authorities.

3.3 Site Establishment

Site establishment will consist of the following:

- Carrying out of basic enabling works to allow access onto the site.
- Securing the site by means of the erection of permanent external fencing.
- Preparation of temporary hardstands to receive contractor accommodation.
- Installation of construction sanitary facilities.
- Establishing relations with the immediate neighbours of the site.

The above works will be carried out after the commencement notice period has expired and notice has been given to the local residents.

The works will be carried out using tracked and rubber wheeled excavation equipment with dumper trucks for hauling spoil. It is envisaged that spoil generated at this stage will be retained on site.

Fencing will consist of temporary fencing to the gas main wayleave area, temporary fencing to the proposed site development area (excluding those areas to be used for tipping / storing excavated material and future landscape berming, and permanent fencing to the perimeter of the site.

Preparation of temporary hardstands for contractor accommodation will consist of stripping topsoil, laying of hardcore beds and casting of temporary concrete bases to receive cabins etc and the laying of temporary hardstands to form access routes between the proposed cabin layouts.

The installation of construction sanitary facilities for the construction personnel will consist of the provision of modular toilet blocks complete with washing facilities for use by the construction personnel and contract administration personnel. These blocks will be provided with effluent containment tanks, which will be certified as leak free and will be pumped out on a regular basis during the course of the works. The toilet blocks will be cleaned on a regular basis. Responsibility for this will rest with the Site Development Contractor and all effluent being removed from site will be taken to a licensed treatment works.

It is proposed at this stage that through the Community Liaison Committee meetings will be held with all site neighbours and local public representative

bodies in order to inform them of the proposed works and to ensure the development of good relations with them.

This may involve some of the following:

- Public meetings to explain the construction phase of the project and its impacts for example, the closure of roads, particularly potential noise impacts, critical stages of works such as installation of major plant etc.

- Regular follow-on meetings with representatives of local groups to enable the voicing of grievances etc.

- Setting up of direct communication routes between the contract administration personnel and the local people / residents.

In this phase the external impacts to the surrounding environment will be minimal with the main one being identified as the locations of the proposed site compounds and their relationship with nearby residences, working hours, noise levels etc.

In the positioning and planning of the site compounds it is envisaged that the following issues of concern will be addressed:

- A noise survey prior to the commencement of work will be undertaken and this will be used as a basis of comparison should there be any complaints about noise levels during construction.

- The proposed lighting levels to be provided in the compounds will be reviewed in order to avoid any undue spillage of light into neighbouring houses or other buildings.

- The location of contractor carparking will be reviewed in order to avoid any off site parking and unnecessary noise interference to neighbouring properties.

- The alteration of existing drainage and the provision of temporary drainage will be reviewed in order to ensure that no interference is caused with the operation of existing drainage systems. Baseline samples of the water quality in existing streams will be taken at this stage.

- Working hours will be limited to those noted in the planning conditions.

3.4 Enabling Works

If the proposed application is successful it is likely that conditions attached will require a number of enabling works to be carried out prior to commencement of the main construction activities on site. These works plus additional works will consist of:

a) The construction of the proposed new junction of the Waste Management Facility access road with the existing regional road R152. At this stage of the contract it is proposed that the access road will be constructed as far as the new roundabout within the confines of the site. The access road will be constructed to completion albeit the wearing course of the road finish will be omitted until closer to completion of all the works on site. The junction will be completed to full specification for handover to the Local Authority. These works be complete within two months of commencement of the development.

The above works will consist of the formation of temporary diversions along the existing R152 with the possible narrowing of the road to single lane traffic controlled by traffic lights, excavation / grubbing up of existing features including paving hedges etc to form the new junction to the waste management facility, laying of hardcore, kerbing, drainage etc, laying of paving and traffic islands, road markings and installation of fencing / security barriers.

These works will be carried out using normal construction equipment and will be typical of road works being carried out across the country at present times.

With respect to their external impacts on the surrounding environment the main issues will be the generation of dust, noise and disruption of normal flow of traffic along the R152.

In the instance of dust it is proposed that surfaces when necessary ie during dry periods will be wetted using water bowsers.

Noise whilst difficult to predict will be no more grievous than normal road works.

Traffic flow will be maintained by the use of automated traffic lights / manned signs and will be carried out in a similar fashion to other road works projects.

These works will be carried out to the specification of Meath County Council and as such will comply with the normal procedures of Meath County Council in carrying out road works.

b) Temporary carparks for construction employees will be constructed at this stage. These will consist of paved hard stand areas and will be constructed complete with drainage, lighting and line markings. The drainage from these areas and the access road will outfall to a silt trap and petrol interceptor in order to prevent contamination of local streams. Based on the anticipated maximum number of site based personnel the carparks will be sized to accommodate approximately 260 cars.

The external impact of this work is considered to be minimal and due to the proposed locations of the carparks issues such as noise, dust etc., will be considerably reduced as they are remote from adjoining properties and will be located behind the proposed site berming.

c) A potable water supply for use within the contractors accommodation will be taken from the existing public water main.

No significant external impacts are expected from this work.

d) Landscaping will commence at the outset of the project and at this stage will consist of the preparation of those areas of proposed of landscaping / berming for receipt of excavated material during the main site development works.

It is proposed to use excavated material from the site development area to form berms for subsequent landscaping on the site. This has the double benefit of reducing the extent of spoil to be removed from site and also allowing the construction of berms along the boundaries with the R152 original road and the eastern boundary of the site which has residences adjacent to it. These berms will serve to reduce the visual impacts of the proposed works, reduce noise levels, reduce any residual impact of lighting from the site and limit the overall intrusivness of the works on adjoining properties. Upon completion of the berming, landscaping will proceed immediately in order to generate growth of vegetation on the berms.

In the carrying out of these works the expected external impacts are noise and dust generation.

With respect to dust it is proposed that the working surfaces will be wetted down with water bowsers / dust suppression sprays during periods of dry weather.

In the instance of noise it is proposed that work along the boundary lines will be restricted to times agreed with the local residences in order to avoid any undue intrusion. The works to the boundaries will be completed in a series of short operations as suitable spoil becomes available from the construction operations. As the berming operations moves away from the boundaries the issue of noise will reduce accordingly.

e) A surface water settlement system will be installed to control the discharge of site surface water runoff during the construction period.

The proposed system will be located on the site in such a fashion as to enable all surface water run off from the site area to be drained and filtered through the settlement system. This system will separate silts from the effluent to levels agreed with the Local Authority.

Similarly while it is noted that the ground water level is typically below the level of proposed excavations/pits on site there will be instances when excavations will require to be pumped free of rain water and all such pumpings will be passed through the silt trap system.

The possible external impact of this is the potential for uncontrolled release of surface water to the existing watercourses. It is proposed that the collection of surface water run off / pumpings will be monitored and controlled by the contract administration staff and that regular inspections of the effluent from the surface water retention system will be carried out along with sampling taken from the adjacent water courses. These will be compared to baseline samples of the water quality in the existing watercourses taken at the commencement of the works.

f) Watertight Bunding for oil and fuel storage tanks and other “risk” materials will be constructed.

The bunding for oil, fuel and other risk materials will typically consist of a reinforced concrete enclosure complete with retaining walls with an adjacent loading / unloading pad which will be drained to a petrol interceptor. This will serve to ensure containment of uncontrolled spillages of leakage of materials into the water system

g) A wheel wash installation will be constructed adjacent to the access road to ensure that all construction vehicles leaving the site have been cleaned.

The wheel wash installation will be monitored by personnel from the construction contract administration staff and these will be responsible to monitor that construction traffic are adequately cleaned prior to leaving the site. Procedures for cleaning the R152 road local to the site using a road sweeper will be agreed with the Local Authority.

3.5 Site Clearance / Development

This phase represents the commencement of the main construction works and will consist of;

a) The grubbing up and removal of all existing hedgerows and removal of the spoil to a licensed facility.

b) Stripping of topsoil from the proposed development areas and storing of same for reuse as covering to the proposed berms and landscaped areas.

c) Dredging of existing water courses on site prior to backfilling them with clean stone and land-drain piping.

d) Bulk excavation to general formation level for all development areas.

e) Laying of hardcore to exposed formation areas to protect the surface of the soil.

f) Formation of earth mounds for future landscaping.

All of the above works will entail the use of heavy construction plant for excavation purposes. These will be augmented by the use of dumper trucks for hauling excavated material both within the site and lorries outside the site to licensed facilities. As noted previously it is anticipated that excavated material will be retained on site to form mounding / berming and landscaping. Where materials such as hedge spoil is generated this will be exported from the site to a liciensed landfill.

At this stage of the works the extent of construction traffic entering and leaving site will increase considerably with the bulk of the movements being to import hardcore from external sources for use as sub-base on exposed formations.

The sequencing of the works within this phase will require that concentration is given to that area to be occupied by the Main Process Building complete with its surrounding hardstand access road etc initially, with subsequent concentration at a later stage in the contract on those support areas to be occupied by the warehouse etc.

The bulk excavation operation for the Main Process Building and its environs requires considerable excavations to reach the proposed formation level of the building for the underground elements such as the waste bunker.

With respect to the external impacts of this phase the main issues are expected to be dust generation, noise from earth moving / haulage traffic, generation of surface water runoff and a considerable increase in the extent of traffic leaving and entering the site.

As with the enabling works it is proposed that dust generation will be limited by the use of water sprays and water bowsers during periods of dry

weather. Similarly the rapid protection of formations as they are exposed will limit drying and dusting of these areas. Monitoring of dust generation at the boundaries of the site will be carried out on a weekly basis and compared to base line studies taking at the commencement of the works. If it is found that dust generation is greater than that allowed under the agreed limits remedial measures in the form of pre-soaking of the ground or further covering of haul areas with stone will be undertaken to minimise dust generation.

With respect to noise generation it is proposed that noise will be monitored at the curtilage of the site and compared to that allowed by the Planning Permission but it should be noted that the provision of berming to the curtilage of the site at an early stage will help to mitigate the effects of noise along the boundaries of the site. Similarly the extent of excavation for the Main Process Building will further limit the intrusion of noise as the excavation works themselves will serve as a baffle to noise travel.

Should noise levels be found to be above those permitted by the conditions of the planning permission, remedial measures such as the erection of baffle screens or provision of quieter equipment will be put in place.

During the excavations works it is proposed that the existing water courses running through the immediate site area will be dredged and back filled with stone. This will render the ditches in a safe manner but will also allow for the collection of water which would naturally permeate into the ditches to be collected by means of land drains which will in turn be directed to the proposed surface water silt trap system.

Traffic entering and leaving the site will do so by means of the new junction constructed at the entrance to the Waste Management Facility on the R152 regional road. As with all accesses onto such a facility, traffic will be required to adhere to normal traffic regulations and relevant signage will be erected for this purpose.

During this period the services of an archeologist will be employed to monitor the excavation works and he will be empowered to halt the works in the event of archaeological features being found.

3.6 Ground Works

The ground works for the proposed development commences at the general formation level reached under the site clearance / development phase. In essence the works will consist of any structures below the level of the ground floor slab upon completion of the development. Typically these works involve the excavation of trenches or pits in which various structures such as foundations, tanks/bunkers, drainage, service ducting and rising elements will be constructed.

With the exception of drainage all of the structures will consist of reinforced concrete elements and these will be designed to be water retaining from both internal and external water pressures where appropriate (ie all under ground tanks, bunkers and pits) and will be designed in accordance with recommended design codes (e.g. BS 8007 Design of Aqueous Liquid retaining Structures) for such structures and constructed using recognized and proven construction methods for such structures. All such constructions will be tested and certified as watertight (in accordance with the relevant code of practice) upon completion of construction of each element.

With respect to drainage the materials for foul, process and surface water drainage will consist of uPVC/HDPE piping linking either precast concrete or solid concrete manholes all of which will be of water tight construction and tested in accordance with the requirements of BS 8301.

From the site investigation reports rock level is generally lower than the proposed excavation level for any of the ground works and as such the requirement for rockbreaking will be minimal. Only in the area of the waste bunker should rock breaking be encountered as the level of the base of the bunker may encounter rock outcrops.

Because of the variability of the structural characteristics of some of the soil layers there may be a requirement for piling to carry specific heavy loads. Should this be the case it is considered that driven precast piles will be the most suitable and economic option. The requirement for piling will only apply within the confines of the Process Building and the effect of both the depth of excavation and the height of the boundary berming will mitigate against any undue noise or disturbance. We would note that the period of piling is would be relatively short ie in the order of 2-3 weeks.

As recorded in the various site investigation reports ground water level will be lower than formation level for the ground works in all but very few situations due to the lowering effect on the ground water level caused by the nearby quarry at Platin Cement Works.

Typically the construction methodology for the groundworks will consist of the following;

Foundations

- Pits will be excavated to the proposed formation level for each foundation base or strip. The formation level will have been predetermined by design based on site investigation data.
- Upon completion of the excavation works the pit will be shored if necessary, to prevent collapse of the sides of the trench, the formation will be blinded with concrete and reinforcement cages lowered into

the pit.

- Concrete will then be poured into the pit to the required level and the formwork removed as necessary.

Undergound Tanks and Bunkers

The above structures will be constructed as follows

- Following excavation for the proposed structure and making good to the sides of the excavation either by battering the banks or the provision of temporary retaining works, the base of the excavation will be blinded with concrete. If ground water / surface water poses a problem a temporary sump will be formed within the excavation at a lower level than the base in order to provide a drain point for pumping operations. Water pumped from the sump will be directed to the settlement system.

- Form work for the base slab will be constructed and the reinforcing cage fixed into position. Concrete will then be poured to form the base slab. The walls will be formed in a similar manner that is with formwork, reinforcing steelwork and concrete. The design and construction of such underground structures will be carried out in accordance with the requirements of BS 8007, which is the Code of Practice for Aqueous Liquid Retaining Structures. The most onerous design condition noted in this Code of Practice will be used in the design of the underground structures for this facility. In addition to these requirements it is further proposed that to provide a secondary defence against leakage through any of the joints in the structure that waterbars will be placed along each of the joints.

- Upon completion of construction of the structure the void around the external wall will be backfilled with suitable material consisting of hardcore or lean-mix concrete in preparation for the casting of the floor slabs.

The possible external impacts to the surrounding environment by the above works are the following;

- The accidental spillage of chemicals used in the concreting process eg formwork oils.

- The generation of dust.

- The generation of noise.

- The generation of waste materials eg timber, concrete, reinforcement,

general building debris.

In dealing with the above, construction operatives will be required to understand hazard labeling on packages and a Health and Safety regime will be put in hand to ensure that the use of all such materials will be carried out only in accordance with the manufacturers recommendations and in controlled areas. Typical of this will be that formwork will be fabricated within a designated area suitable for the use of these materials and the materials themselves will be stored in a bunded area.

With respect to noise and dust the same precautions as noted in previous sections will apply.

With respect to the generation of waste materials a policy of minimising waste and recycling / reusing as much construction material will be instituted. Where waste is generated it will be removed from site on a regular basis in order to prevent the build up of such waste on the site. Such material will be transported under the Waste Collection Permit Regulations to provide licenced facilties. Segregation of waste in accordance with current legislation will be enforced. The site will be patrolled by the contract administration staff to ensure that these measures are complied with.

3.7 Structural Works for Buildings

This phase of the works will consist of the construction of the superstructures of the buildings. Generally the superstructures will consist of structural steel framing, reinforced / precast concrete frames, floors and walls and concrete blockwork.

a) Main Process Building and Turbine Building

The Main Process Building and Turbine Hall will be constructed using a mix of the above structural types.

The main open plan / equipments areas will be framed out in structural steelwork. The use of structural steelwork will allow prefabrication of the structure in these areas thereby reducing the extent of work on site and provides a fast and efficient means of erecting the structure with minimum requirements for temporary works or access platforms.

Erection of the steelwork elements will be carried out using mobile cranes and tower cranes located strategically around each side of the building.

Prior to commencement of fabrication of the steelwork the contractor will

be required to identify and prove an access route to the site from the fabrication yard suitable for transporting the steelwork elements with minimum disruption.

Reinforced and precast concrete will be used to construct the administration area within the Main Process Building, the bunker walls and flooring above ground level, ground floor slabs and miscellaneous stair cores screen walls etc. In these instances the construction is carried out in a similar manner for the ground works by erecting formwork followed by the fixing of reinforcing steel followed by casting the concrete. The use of reinforced / precast concrete is proposed for these areas in that it has an inherent fire rating which will serve to break the building into a number of independent fire rated compartments which in turn will limit the spread of any fire.

The use of concrete blockwork will be by and large limited to the construction of internal and external walling to the administration block area within the Main Process Building and miscellaneous stair core walls or dividing walls in other areas.

During the erection of the structure particularly that area containing the furnace, boilers and flu gas treatment equipment there will be an interface with the mechanical equipment installation. Because of the size of various pieces of equipment which are to be located within the building it will be necessary to install this equipment during the erection of the superstructure of the Main Process Building. This will require coordination between the various contractors to ensure that equipment and structure are on site as required and designed and installed so as to avoid clashes with each other

All of the above constitutes normal construction practice for industrial buildings of this scale and significant precedence for this type of work exists.

With respect to the possible external impacts it is considered that the most significant will be;

- The generation of noise.
- Deliveries to site.
- A significant increase in the number of personnel working on the site.
- The generation of general builders debris.

Noise during this phase will be generated by craneage, general building works, equipment installation and construction traffic. The bulk of the noise will emanate from the Main Process Building site. The distance of this site from adjacent residences (approximately 150 metres) along with the attenuating effects of the berming and depth of excavation shielding the

ground floor level where most of the noise generating construction plant will be located will help to reduce the noise level at the boundaries. Where it is found that these are insufficient further mitigating measures such as the reduction of simultaneous work and quieter plant will be put in place.

The increase in deliveries will reflect a change in the nature of the works on site with the new traffic consisting of increasing amounts of construction materials being brought to site. The impact of this will be felt by the extent of additional traffic throughout the day but this will be adequately catered for by the capacity of the road and new junction.

The increase in personnel on site will be catered for by the provision of on-site carparking and facilities such as canteens etc on site.

The generation of debris will be managed as for the ground works phase.

Support Buildings

The support buildings to the Main Process Building will consist of a fire water pump house, an Education Centre/warehouse/workshop, a gatehouse and a Switch-room building. These buildings will be constructed in a mixture of the three types of construction noted above. Due to their relative scale they are not considered to impose any undue external impacts over those imposed by normal building work throughout the country of a similar scale.

3.8 Building Envelope / Internal Completions

This phasing of the works will consist of the construction of the external envelope of the buildings principally the external facings, cladding and roofing and the internal completion such as doors windows ceiling painting etc.

The Ancillary Buildings consisting of the Warehouse, Pump House and Gatehouse will be enclosed using a variety of external cladding types varying from natural stone to plasterwork to corrugated metal cladding. The scale of these buildings is typical to the vast majority of normal construction works carried on throughout the country and the practices involved in them will constitute normal building practice.

The Main Process Building and Turbine Building because of its height will require specific methods for the installation of cladding and roofing to the external surfaces, specifically the use cradles supported from the building. Internally the completions to the Main Process Building will be minimal and will consist by and large of the installation of doors, suspended ceilings, painting and floor finishes.

In the case of both sets of structures the expected external impact on the local environment will be;

- The generation of debris.
- The risk of wind blown materials emanating from the high building.
- Traffic associated with deliveries of materials through site.
- Uncontrolled releases of paints and other substances used in the completions process.

The generation of debris will be treated as for previous phases.

In order minimise the generation of wind blown debris all materials used above ground level will be required to be tied down where they are exposed to wind. Waste generated will removed immediately on completion of each task.

Deliveries will be catered for by the provision of suitable laydown areas and stacking away from boundaries.

All risk materials such as paint will stored and used only in accordance with the manufacturers recommendations. Where uncontrolled spillages do occur they will be cleaned up immediately and and contaminated soil or material will be removed from site for treatment or licienced disposal.

As with other phases the contract administration team will endeavor to minimise the production of waste materials and where these are generated a rigorous regime of removal to licensed facilities will be adhered to. The issues of health and safety in working at heights will be a specific consideration and all employees working at heights will be required to wear harnesses and be adequately tied back to suitable fall arrestor systems.

3.9 Mechanical, Electrical and Process Interfaces

The Mechanical, Electrical and Process Interfaces will consist of the installation of all mechanical equipment, mechanical services, electrical services and the generator turbine. With respect to the Ancillary Buildings it is considered that the mechanical and electrical installation works involved in these is relatively minor in construction terms due to their low level of service requirement and as such do not pose either significant issue in construction terms or any significant impact in external environment terms.

In the instance of the Main Process Building, due to the relatively large scale of the pieces of equipment to be installed a more controlled approach

will be required in both scheduling and carrying out the construction works. As noted previously it will be necessary to install the large pieces of equipment during the erection of the superstructure for the building. These elements of equipment which will consist of the furnaces, boiler, flue gas treatment equipment, turbine and the scrubbing units will be supplied to site in modules and assembled on location. Typically these items of equipment are provided complete with their own support structure to enable them to be independent of the building enclosure itself. Because of the large nature of these pieces of equipment the manufacturers will be required to appraise the access routes to the site from the relevant port or otherwise in order to ensure that access can be gained to the site. With respect to the remaining mechanical plant items such as pumps, pipework, conveyors etc it is considered that these are typically small enough to be installed after the building envelope has been substantially completed using both manpower and mechanical means for installation.

Electrical works will consist of the installation of electrical services ranging from lighting to heavy duty transformers and power supply / export cables.

With respect to the potential external impact of these works it is considered that the following will be the most likely:

- The generation of noise during the installation of the main pieces of plant.
- Possible road closures when transporting large pieces of equipment to the site.
- The generation of builders debris in the form of cable tails packaging, boxing and general debris.

In each of the above mitigation measures will be taken to ensure that they are not allowed to become a problem to the external environment. The measures taken will reflect those taken for other previous phases of the work and essentially will consist of an ongoing series of measures of monitoring and remedial action as necessary throughout the course of the works.

3.10 Site Completions

This site completions phase of he works will consist of the finishing off of all external works as follows:

- Completion of all hardstandings.

- Completion of all landscaping.
- Completion of external services such as lighting etc.
- Completion of all external drainage systems including the domestic sewage treatment plant.
- General tidying -up.

These works will consist of different trades including paving, excavation, landscaping etc. The works will be considerable in extent due to the large nature of the site involved.

Paving of hardstands will consist of concrete paving, asphalt paving and graveled areas.

Landscaping will consist of final landscaping locally around the buildings, and site boundaries.

Completion of drainage works will consist of tie-ins to all the main drainage systems and installation of the foul drainage treatment plant.

The installation of underground services will consist of the completion of fire main and hydrants, installation of electrical cabling for external lighting, data and communications and power supplies, installation of water mains etc.

The above works constitute normal building type work and are part and parcel of the completions of any major project.

With respect to external impacts the main issues are similar to those generated by the initial site clearance / development works ie the generation of dust, debris, uncontrolled spillages of materials, noise and traffic.
In a similar manner to that noted previously these impacts will be mitigated by following a predetermined course of monitoring and remedial action.

3.11 Demobilisation

This phase will consist of the demobilisation of all the construction establishment such as hutting, temporary carparks, temporary access roads, wheel washes, storm water retention systems etc. These works will take place over an extended period towards the end of the contract as the requirement for various elements of these reduces. The demobilisation process will be carried out hand in hand with the site completion with a view to finishing the site starting from the further most limits and

completing with those areas adjacent to the site entrance.

The potential external environment impacts from this are similar to those for the site completions and the mitigation measures to be taken will go hand in hand with site completions phase.

REFERENCES

1) Carranstown Waste Management Facility – Environmental Impact Statement

2) Geotechnical Report for Greenfield Site at Platin Co Meath (Alpha Engineering Services).

3) Environmental Handbook for Building and Civil Engineering Projects (C.I.R.I.A)

19 INTERACTIONS

In accordance with the requirements of EC Directive 85/337/EC (as amended) and Environmental Protection Agency (EPA) “Guidelines on the Information to be contained in Environmental Impact Statements” and “Advice Notes on Current Practice in the Preparation of Environmental Impact Statements”, published in 2002 and 2003 respectively, the interactions between various environmental factors was completed as part of the environmental impact assessment.

The impacts and likely significant effects on the interaction between any of the following environmental media are discussed below:

- human beings,
- flora and fauna,
- soils and groundwater,
- surface water,
- air,
- noise,
- climate,
- material assets, and
- the landscape

Table 19.1 presents a matrix of interactions likely to occur from the proposed development (highlighted in green). The level of interaction between the various media will vary greatly but the table allows the interactions to be identified and detailed where necessary. If the development does not have the potential to impact or affect the interaction then that interaction is not highlighted in Table 19.1.

The interaction matrix is based on the potential interrelationships of the environmental media both during the construction and operation phases of the proposed development. Details of individual interactions are presented in Table 19.2.

Table 19.1 Interactions between Environmental Media

	Human Beings	Air	Noise	Landscape	Flora & Fauna	Surface Water	Soils & Groundwater	Climate	Material Assets
Human Beings									
Air									
Noise									
Landscape									
Flora & Fauna									
Surface Water									
Soils & Groundwater									
Climate									
Material Assets									

Table 19.2 Discussion of Interactions

Media	Interaction	Discussion
Air	Human Beings	During the construction phase, the main potential impacts on air quality arise due to the generation of dust and the movement of construction traffic at the site. Mitigation measures to prevent such impacts are outlined in Section 19. Based on the emission guidelines outlined in Council Directive 200/76/EC for the protection of the environment and human health, detailed air dispersion modelling has shown that the most stringent ambient air quality standards will not be exceeded. (See Section 7 for additional information relating to air emissions). The odour emission survey predicted ground level concentrations will be within 3.0OuEm-3 at the 98th and 99th percentile limit value for a worst case meteorological year. It was concluded that no predicted odour impacts will be generated from the proposed facility. (See Section 6 for additional information relating to the odour assessment) An independent health assessment was conducted which concluded that all information on the proposed waste-to-energy facility suggest that there will be no deleterious effect on human health either in the immediate vicinity or further away, in the short term or in the longer term. (See Section 6 for further information relating to the health assessment).
	Flora & Fauna	Dust and potential air emissions from the process could have the potential to affect flora and fauna. Detailed air dispersion modelling has shown that the most stringent ambient air quality standards (Council Directive 2000/76/EC) will not be exceeded; therefore no impact on flora and fauna is predicted. (See Section 12 for further information relating to flora and fauna).
	Surface Water	Dust from the proposed development could affect surrounding watercourses. However, as Council Directive 2000/76/EC air quality standards, developed for the protection of the environment and human health, will not be exceeded no impact on surface water is predicted.

Media	Interaction	Discussion
Air	Soils & Groundwater	The generation of dust during excavation works could affect air quality in the vicinity of the proposed works. Mitigation measures to prevent such impacts are outlined in Sections 9 and 19. A dioxin uptake study was completed which modelled PCDD/F (dioxin and furan) soil intake using background concentrations in soil and air. This assessment modelled the impact of deposition rates on soil concentrations of dioxins and furans over 30 year operating life of facility. It was concluded that the proposed facility will have no significant impact on dioxin and furan intake for even the theoretical MARI (Maximum at Risk Individual) and that , with respect to intake, the facility will have no impact on human health (See Section 6 for further information regarding dioxins and human health). Due to the strict emission controls and regulatory compliance that the plant will be working under, no significant negative impacts to adjacent agricultural lands are expected.
	Material Assets	Generation of dust during excavation works could affect agricultural practices in the vicinity of the proposed works. Mitigation measures to prevent such impacts are outlined in Sections 9 and 19. Considerable research has been undertaken to study the impact of air emissions from waste-to-energy facilities on food produce. Some research papers have established a link between the operation of facilities within, or in exceedence of, old emission limits and elevated levels of pollutants in food produce. Many of these studies were on incinerators without gas cleaning systems or energy recovery. The findings of such studies are not directly comparable with the proposed waste-to-energy facility. To date, there is no evidence to suggest that waste-to-energy facilities operating within the stringent emission limits set down in EC Directive 2000/76 on the Incineration of Waste will impact on food produce. These stringent emission limits and the World Health Organisation Guidelines have been developed to prevent any impact on public health or the environment, including agriculture. Operating well within these standards will ensure that there will be no negative impacts on agricultural practices. Due to the strict emissions controls and regulatory compliance that the plant will be working under, no significant negative impacts to adjacent agricultural lands are expected. The potential impacts of this development to agriculture is addressed in relation to soils and discussed in greater detail in Section 6.

Media	Interactions	Discussion
Noise	Human Beings	Sensitive receptors located in close proximity to the proposed development could experience an increase in noise. All noise emissions from the facility will be maintained within EPA regulatory requirements. Mitigation measures have been proposed to prevent exceedances of noise emissions (Section 8). Local residents and other members of the local community will have an opportunity to raise any specific issues, concerns or complaints they may have during the construction phase through the Community Liaison Committee which will meet regularly.
	Flora & Fauna	Noise emissions during construction works could have the potential to impact on birds currently using the site. Following the completion of a bird survey it was concluded that noise associated with the proposed facility during both construction and operation, will not have any adverse impact on any countryside birds found in this area. Noise associated with the construction of the proposed facility will not impact the Peregrine falcons, which breed locally. The birds already contend satisfactorily with a high degree a visual and noise levels associated with routine quarry activities.
	Material Assets	Cattle and other sensitive animals are sensitive to sudden noise impacts which may be associated with the construction phase of the proposed development. Indaver will discuss the schedule of construction works with adjacent landowners to allow movement of such animals prior to any such sudden events.

Media	Interaction	Discussion
Landscape	Human Beings	The proposed development comprises a significant development within a rural landscape. Its construction and early operation will result in localised negative landscape and visual impact. The immediate hinterland is visually dominated by the industrial complex at Irish Cement, which consists of an array of tall silos and associated industrial sheds. The extensive area of extractive industry to the west, while not overly visually intrusive is a major change-agent in the overall agricultural landscape, with local visual impacts on the surrounding roads and boundaries. There is already visual intrusion on the proposed site in the form of an 110kV power line and a 210kV power line traversing in a north to south direction. The proposed Master Landscape Plan will allow for provision of extensive visual buffering of the complex through berming and landscaping, which will assist in visually tying in the development to the surrounding landscape. The development will permanently alter the character of its immediate setting, However it will not impact on sensitive, vulnerable or designated landscape aspects. The visual impact of the proposed development on Newgrange, Dowth, Knowth, site of the Battle of the Boyne and ecclesiastical centre of Duleek were assessed and it was concluded that the resultant impact from the proposed facility would be minimal. (See Sections 14 and 16 for additional information relating to landscape, visual impact and cultural heritage).
	Flora & Fauna	The implementation of the proposed landscaping plan will result in the removal of some potential roosts, foraging and commuting habitats for bats and fauna associated with the site. The implementation of mitigation measures outlined in Section 12 will ensure that impact on fauna in the locality will be negligible. The proposed development will also result in the removal of arable crop land and improved agricultural grassland. The loss of these habitats is of minimal consequence as these are common and widespread in the area. The landscaping plan will provide an opportunity to improve the floral diversity at the site. Restoration of landscape by early planting will be a requirement. Use of species typical to the locality will also be required.

Landscape	**Soils & Groundwater**	Movements and stockpiling of soil during the construction phase has the potential to impact on the landscape. This will be temporary in nature.
	Material Assets	Cultural features have landscape significance and are taken into account in the landscape/visual assessment where appropriate as outlined under Human Beings above.

Media	Interactions	Discussion
Flora & Fauna	**Human Beings**	The impact to flora and fauna related to habitat loss and dislocation. Mitigation measures outlined in Section 12 will ensure that such impacts are minimal.
	Surface Water	Water quality and quantity is an important factor to local flora and fauna. Mitigation measure outlined in Section 11 will ensure that there is no significant impact on either water quality or quantity in the vicinity of the proposed development.
	Soils & Groundwater	The creation of berms could alter the habitats and pathways of fauna. The mitigation measures outlined in Section 12 will ensure that such impacts are minimal.
	Climate	Flora lost during the construction phase of the proposed development will result in greater temperature gain in the immediate vicinity of the exposed soils. This will be temporary in nature. Early planting will be a requirement of the landscape plan.
	Material Assets	Land take for the proposed development will cause some localised loss to terrestrial fauna.

Media	Interaction	Discussion
Surface Water	Human Beings	Mitigation measures outlined in Section 11 will ensure that there will be no significant impact on surface water quality or quantity within the vicinity of the proposed development. The proposed development will not alter the existing drainage network, therefore there will be no potential for flooding of adjacent lands.
	Soils & Groundwater	Run-off during the construction phase has the potential to be silt laden and therefore affect the surrounding watercourses. Mitigation measures outlined in Sections 11 and 19 will ensure that run off during the construction period will be controlled.
	Material Assets	The Nanny is an important amenity to the locality in terms of fishing etc. Mitigation measures outlined in Sections 11 and 19 will ensure that the proposed facility will not impact on its water quality.

Media	Interaction	Discussion
Soils & Groundwater	Human Beings	Dust from construction works has the potential to give rise to nuisance. Mitigation measures proposed in Section 19 will insure such nuisance does not occur. A dioxin uptake study was completed which modelled PCDD/F (dioxin and furan) soil intake using background concentrations in soil and air. This assessment modelled the impact of deposition rates on soil concentrations of dioxins and furans over 30 year operating life of facility. It was concluded that the proposed facility will have no significant impact on dioxin and furan intake for even the theoretical MARI (Maximum at Risk Individual) and that, with respect to intake, the facility will have no impact on human health. Due to the strict emission controls and regulatory compliance that the plant will be working under, no significant negative impacts to adjacent agricultural lands are expected (See Section 6 for additional information relating to Human Health).
	Material Assets	Excavation, movement and placing of soils during the construction period will have an energy requirement. Considerable research has been undertaken to study the impact of dioxins on food produce. To date, there is no evidence to suggest that waste-to-energy facilities operating within the stringent emission limits set down in EC Directive 2000/76 on the Incineration of Waste will impact on food produce. These stringent emission limits and the World Health Organisation Guidelines have been developed to prevent any impact on public health or the environment, including agriculture. Operating well within these standards will ensure that there will be no negative impacts on agricultural practices. (See Sections 6 and 18 for additional information regarding dioxins and agriculture).

Media	Interaction	Discussion
Climate	Material Assets	The contribution of the Waste-to-Energy Facility to total greenhouse gas emissions in Ireland is equivalent to only 0.030% of total emissions in 2010, when energy recovery in taken into account. Moreover, in the absence of the development, greenhouse gas emissions will occur from the landfilling of the waste. The contribution to the total greenhouse gas emissions from landfilling 200,000 tonnes of waste, including the generation of power, condensed to a 25-year period, is equivalent to 0.042% of the total greenhouse gas emissions in Ireland in 2010. Thus, the overall annual impact of the proposed Waste-to-Energy Facility on climate is to produce a net benefit of approximately 0.012% of the total greenhouse gas emissions in Ireland in 2010 and will thus be imperceptible in terms of Ireland's obligations under the Kyoto Protocol. 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 16MW with a net electrical output from the plant for export to the national grid will be 13MW. Thus, the export of 13MW will give a direct benefit in terms of greenhouse gas emissions which would have been released in the production of 13MW from power stations. 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. See Sections 5, 7 and 15 for further information on the process description, air emissions and climate respectively).

Media	Interaction	Discussion
Material Assets	**Human Beings**	The current land use will be permanently altered. The proposed development has the potential to affect property prices within the vicinity of the proposed development. There are over 350 municipal waste incinerators operating in Europe. In line with the proximity principle, many are located in cities, suburbs and other areas close to the main source of waste generation. To date, it appears that the findings of research to determine whether a waste-to-energy facility will have a significant long-term effect on property prices within the area of the facility have been insignificant or inconclusive. Due to the strict emissions controls and regulatory compliance that the plant will be working under, no significant negative impacts to adjacent agricultural lands are expected. The potential impacts of this development to agriculture is addressed in relation to soils and discussed in greater detail in Sections 6 and 18.