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Attachment I

I. Existing Environment & Impact of the Activity

I.1 Assessment of Atmospheric Emissions

Describe the existing environment in terms of air quality with particular reference to ambient air quality standards.

Provide a statement whether or not emissions of main polluting substances (as defined in the Schedule of S.I. 394 of 2004) to the atmosphere are likely to impair the environment.

Give summary details and an assessment of the impacts of any existing or proposed emissions on the environment, including environmental media other than those into which the emissions are to be made.

Attachment Nº I.1 should also contain full details of any dispersion modelling of atmospheric emissions from the activity, where required. When carrying out dispersion modelling, regard should be had to the "Guidelines for the Preparation of Dispersion Modelling Assessments for Compliance with Regulatory Requirements – an Update to Royal Meteorological Society Guidance" or similar guidelines from a recognised authority.

I.1.1 Existing Environment

(i) Macro Climate

Macro climate is the climate of a large geographical area or country. Ireland's climate is influenced by the warm waters of the Gulf Stream and is in the path of the prevailing south-westerly winds coming from the Atlantic Ocean. Accordingly, Ireland does not suffer from the extreme temperatures experienced by many other countries at similar latitude. The average annual temperature is approximately 9°C.

Annual mean wind speeds vary between approximately four metres per second in the east midlands and seven metres per second in the northwest. Average rainfall varies between 800 and 2,800 millimetres with highest rainfall in the northwest, west and southwest of the country due to the dominating south-westerly winds from the Atlantic. The number of days with more than one millimetre of rainfall varies between 150 and 200 days per annum.

Ireland normally receives between 1,400 and 1,700 hours of sunshine each year, with sunshine duration being highest in the southeast of the country. Ireland's geographical position off the northwest of Europe close to the path of Atlantic low pressure systems tends to maintain the country in humid, cloudy airflows for much of the time.

(ii) Micro Climate

Wexford is surrounded in the south by the Atlantic Ocean and in the east by the Irish Sea, to the west by County Waterford and the Barrow Estuary, and to the North West by County

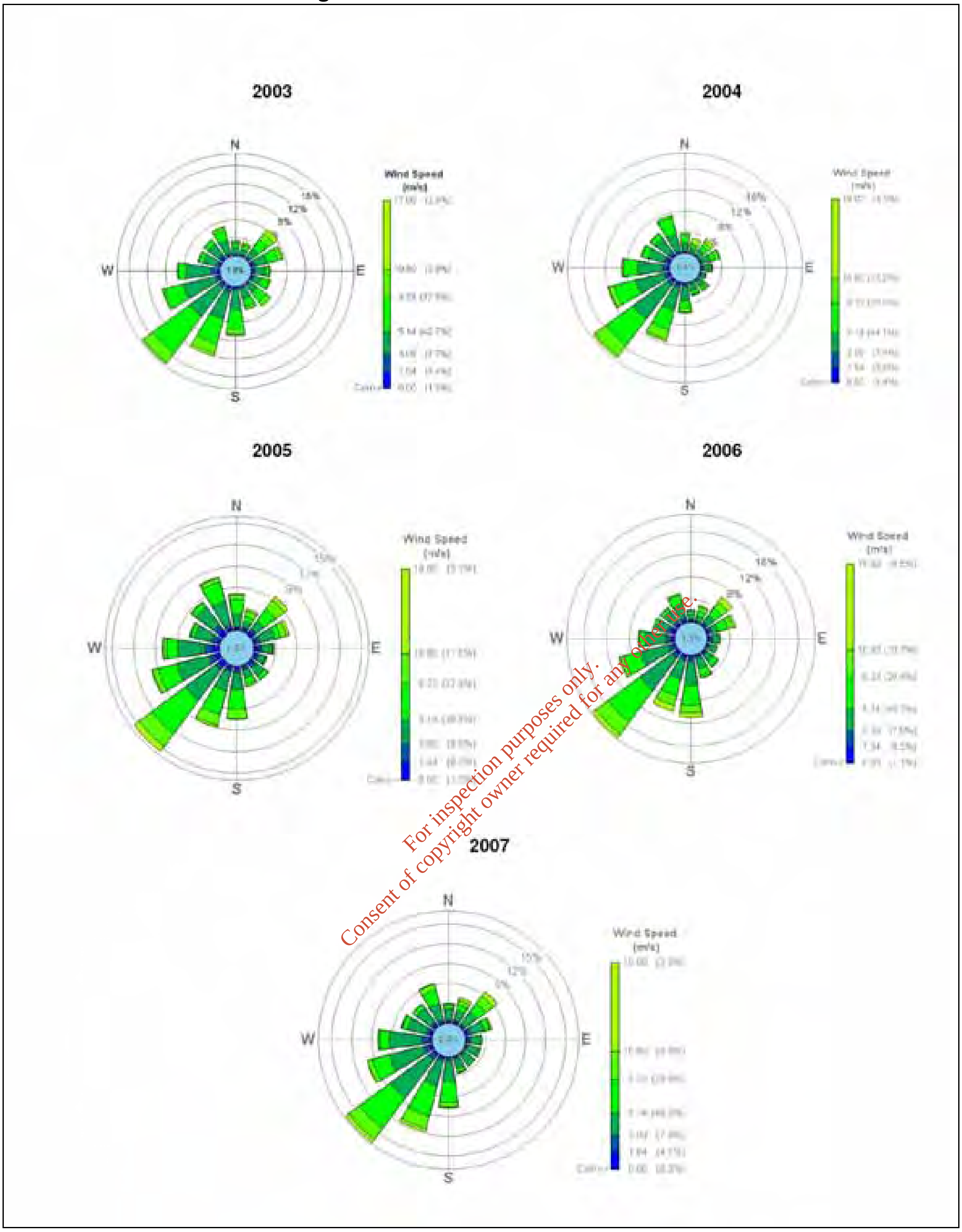
Kilkenny. The Blackstairs Mountains form part of the boundary to the north, as do the southern edges of the Wicklow Mountains.

The landscape of the county is diverse with largely low-lying fertile land as the characteristic landscape with complex agricultural patterns. Evergreen tree species are also extensively cultivated. The highest point in the county is Mount Leinster in the Blackstairs Mountains in the north-west on the boundary with County Carlow. The main geographical features of the county include the hilly valley of the River Barrow on the West, and the River Slaney through the centre.

Neutral and stable atmospheric stabilities are the most common type of stability category found in the region around the proposed site. This meteorological phenomena, typical Irish climate, occurs mainly when the weather is cloudy raining or windy. A combination of the aforementioned atmospheric stability categories restricts dispersion of pollutants from stacks close to the ground and air pollution levels are likely to increase under these meteorological conditions. Dispersion of pollutants is addressed in this assessment.

Wind roses summarise the occurrence of winds at a specific location, showing their strength, direction and frequency. Wind at a particular location can be influenced by numerous factors including obstruction by buildings or trees, the nature of the terrain and deflection by nearby mountains or hills. Wind roses at Rosslare Meteorological Station indicate that the prevailing wind direction is south westerly. The monthly average of wind strengths recorded range from 4.9 to 6.6 metres per second with winds between 6.2 and 6.6 metres per second being the most prevalent.

Figure I.1.1 Rosslare Harbour Wind Roses



(iii) Specific site conditions

The proposed development site is located within the existing Great Island power station lands. The station grounds are situated at the confluence of the rivers Barrow and Suir on the eastern shore of the Barrow Estuary, within the townland of Great Island, Co. Wexford (OS Grid Reference: E 268907, N 114574). Great Island Power Plant, formerly operated by the

Electricity Supply Board (ESB) currently operates on Heavy Fuel Oil (HFO) and has a maximum electrical export capacity of 240 MW.

Great Island Power Plant occupies an area of approximately 143 acres. The proposed development site will occupy approximately 19 acres and is brown field, located within the confines of the existing operational power plant facility. This area, for the most part (approximately 85%), is unused and clear of structures and services.

The existing Heavy Fuel Oil (HFO) fired power plant will continue to operate keeping the Emission Limit Values (ELV's) set by the EPA in its current Licence (Licence Reg. NºP0606-02) until the new CCGT becomes operational and the existing plant decommissioned. Tables I.1.1 and I.1.2 show the current ELV's applicable to the existing plant. Emission points referenced as A1-1 and A1-2 refer to the common stack for boilers 1 and 2. Point A1-3 refers to the stack for boiler 3.

Emission Point Reference No.: A1-1 & a1-2			
Rating: 175 MW thermal input (per boiler)			
Volume to be emitted: • Maximum in any one day (per boiler): 4,396,947 m^3 • Maximum rate per hour (per boiler): 179,456 m^3			
Minimum discharge height: 137.5 m above ground			
Parameter	ELV (mg/ m^3)	Annual emissions ceilings (tonnes)	
		Unit 1	Unit 2
Oxides of sulphur (as SO_2)	1700	770	723
Nitrogen oxides (as NO_2)	850	204	191
Dust	250	23	21

Table I.1.1 Current ELV's for units 1 & 2 of the existing HFO fired plant

Emission Point Reference No.: A1-3		
Rating: 305 MW thermal input		
Volume to be emitted: • Maximum in any one day (per boiler): 7,541,044 m^3 • Maximum rate per hour (per boiler): 314,210 m^3		
Minimum discharge height: 137.5 m above ground		
Parameter	ELV (mg/ m^3)	Annual emissions ceilings (tonnes)
Oxides of sulphur (as SO_2)	1700	1957
Nitrogen oxides (as NO_2)	900	528
Dust	200	59

Table I.1.2 Current ELV's for unit 3 of the existing HFO fired plant

The nearest area of settlement is at Cheekpoint, Co. Waterford, located approximately 700 metres to the south of the site. In County Wexford, the nearest significant area of settlement is Campile, located approximately 3.75 kilometres to the east. A number of one-off houses are located in proximity to the site boundary, the nearest occupied dwelling is located approximately 450 metres to the northwest of the actual development site. There are no schools, hospitals or churches located within a 1 kilometre radius of the development. The nearest school is located approximately 5 kilometres to the north east.

I.1.2 Ambient Air Quality

Ireland's small population and good air quality in general mean that a relatively small number of monitoring stations are considered sufficient across the country for the purposes of implementing the EU Air Directives. In 2008, there were 48 air quality monitoring stations operating in Ireland. For regulatory purposes under the Framework Directive, each EU member state is divided into "Zones" and "Agglomerations". For Ireland, four zones are defined in the Air Quality Regulations (2002). The main areas defined in each zone are:

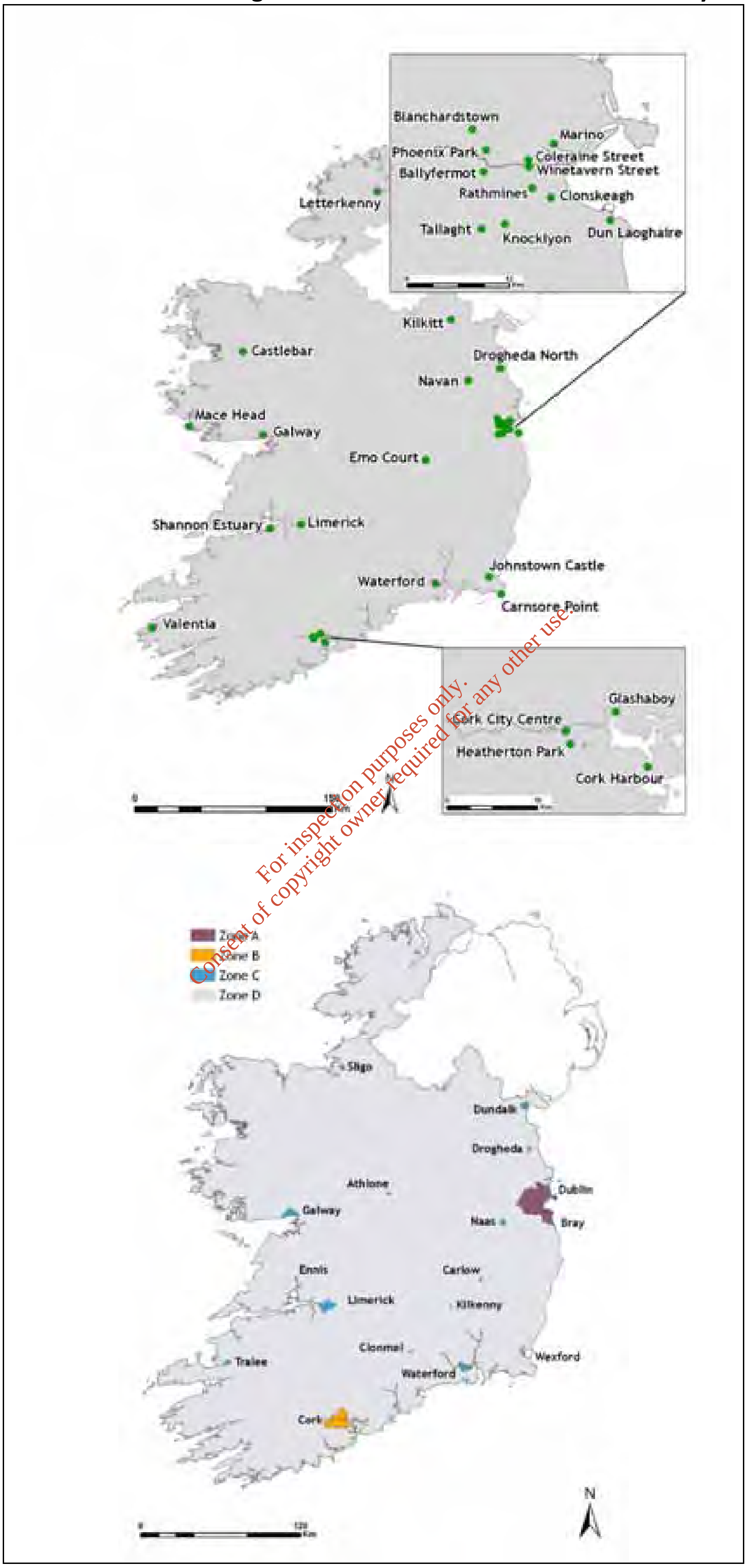
- Zone A: Dublin Conurbation
- Zone B: Cork Conurbation
- Zone C: Other cities and large towns comprising Galway, Limerick, Waterford, Clonmel, Kilkenny, Sligo, Drogheda, Wexford, Athlone, Ennis, Bray, Naas, Carlow, Tralee, Dundalk, Navan, Letterkenny, Celbridge, Newbridge, Mullingar and Balbriggan.
- Zone D: Rural Ireland, i.e. the remainder of the State excluding Zones A, B and C.

The proposed development at Great Island is located in Zone D. Therefore, monitoring data has been sought from the EPA which is representative of rural areas in Ireland.

At the moment, there is no available air quality monitoring station representing air quality in Zone D in close proximity of the proposed site. Therefore, an average of all the air quality monitoring stations within Zone D has been used to provide background pollutant concentrations for the purposes of dispersion modelling. Monitoring data from other stations located in Zone C were not considered in this assessment as they are representative of urban areas and therefore concentrations are typically elevated due to higher contributions from road traffic emissions. Figure I.1.2 shows the Air Monitoring Station Network in 2008 and the Air Quality Zones.

Table I.1.3 presents the background concentrations of pollutants relevant to site activities measured at the Zone D monitoring stations for the most recent reports available (2004 to 2008). In addition, Table I.1.3 presents the PM2.5 concentrations at Old Station Road (Zone B) as PM2.5 data is not currently measured in Zone D.

Figure I.1.2: Air Monitoring Station Network in 2008 and Air Quality Zones



Monitoring Station	Pollutant	Unit	Averaging Period	2004	2005	2006	2007	2008	Average
Zone D	NO_2	µg/m3	Annual Mean	8	7.7	5	8.8	11.4	8.18
	NO_X			12	13.3	8.3	14.4	20.2	13.64
	SO_2			3.67	3.3	2	3.4	4.8	3.43
	CO	mg/m3		0.5	0.3	0.2	0.3	0.4	0.34
	PM_{10}	µg/m3		21.5	18	17.6	18.6	18.6	18.86
Old Station Road (Cork)	$PM_{2.5}$			ND*	11	9	8	9	9.25

Table I.1.3: Background Pollutant Concentrations

*ND: Not determined

For the purposes of describing the existing ambient air quality, a conservative assumption of 90th percentile of the short-term observations (assumed to be 8 hour averaging periods and less) has been used as the background level. This is approximately equivalent to twice the annual mean.

Twice the 2004 to 2008 average annual mean concentrations measured has been added to the short-term (hour and 24 hours) modelled value. For long-term averaging periods (annual), the 2004 to 2008 average annual mean concentrations measured for each pollutant has been added to the long-term modelled value.

Table I.1.4 summarises the assumed ambient concentrations in the area of Great Island while Table I.1.5 shows the Air Quality Standards according to the Irish Air Quality Standard Regulations, 2002 (S.I. Nº. 271 of 2002)

Table I.1.4: Summary of assumed Background Concentrations

Monitoring station	Pollutant	Unit	Short-term	Long-term
Zone D	NO_2	µg/m³	16.36	8.18
	NO_X		-	13.64
	SO_2		6.87	3.43
	CO	mg/m³	0.68	0.34
	PM_{10}	µg/m³	37.72	18.86
Old Station Road (Cork)	$PM_{2.5}$		-	9.25

Table I.1.5: Air Quality Standards and Target Values

Pollutant	Averaging period	Standard/Target values	Not to be exceeeded more than	Target Date
NO_X	Annual	30	-	-
NO_2	1 hour	200	>18 times pcy	01.01.10
	Annual	40	-	01.01.10
SO_2	1 hour	350	>24 times pcy	-
	24 hour	125	>3 times pcy	-
	Annual and winter	20	-	-
PM_{10}	24 hour	50	>35 times pcy	31.12.04
	Annual	40	-	-
$PM_{2.5}$	Annual	25	-	31.12.15

The Great Island area is mainly rural-agricultural. There are no significant atmospheric emissions sources near the proposed development, apart from those from the existing HFO fired plant, which will not coexist with the new CCGT plant while operating. The nearest industrial facility is located three kilometres to the west. The main licensed industrial facilities with potential atmospheric emission sources in these areas are approximately seven kilometres to the west of the proposed site.

Due to the distance of these facilities, and the fact that emissions from them are already accounted for within the assumed background concentrations of the study area, they do not require further explicit consideration within the dispersion model.

I.1.3 Main Polluting Substances

The proposed development will be designed to operate on natural gas as the primary fuel with distillate fuel oil used as back-up. The distillate fuel oil will be limited to 0.1% sulphur content as per the requirements of EU Directive 1999/32/EC.

The new power plant will use the latest technology gas turbine units to achieve an efficient and high availability plant concept. It is envisaged that firing on back-up fuel will occur for less than 2% (seven days per year) of the total firing time, predominantly to test that systems are functioning correctly.

Exhaust gases will be emitted to atmosphere through a single flue stack with a height of 60 metres.

The main emissions to atmosphere from the new CCGT plant correspond to the following polluting substances listed in the schedule of S.I. 394 of 2004:

- (1) Sulphur dioxide and other sulphur compounds
- (2) Oxides of nitrogen and other nitrogen compounds
- (3) Carbon monoxide
- (6) Dust (PM_{10} and $PM_{2.5}$)

(i) Oxides of Nitrogen

Combustion of fossil fuels generally produces many forms of nitrogen oxides, the principal ones being nitrogen monoxide (NO) and nitrogen dioxide (NO_2), commonly referred to as NO_X. The proportion varies depending on the combustion technology and the fuel being burnt. In the case of a gas turbine unit, approximately 90 - 95% of the NO_X is present as NO, with most of the remainder being NO_2. When NO enters the atmosphere, it is gradually oxidised to NO_2 by reaction with ozone and other chemicals in the air.

NO is a colourless and tasteless gas. It is readily converted to NO_2 (a more harmful form of NO_X) by chemical reaction with the ozone present in the atmosphere. NO_2 is a yellowish-orange to reddish-brown gas with a pungent, irritating odour and a strong oxidant.
The production of NO_X during combustion depends on several factors, with the principal ones being:

- Nitrogen in the fuel;
- Temperature of combustion;
- Geometry of the combustion chamber; and
- Ratio of fuel to combustion air.

All NO_X produced from the combustion of fossil fuels originates from nitrogen in the fuel or from nitrogen in the air that is used for combustion. NO_X from the fuel is referred to as 'fuel NO_X' and NO_X from the air is generally referred to as 'thermal NO_X'. The proportion of fuel NO_X to thermal NO_X and other emissions depends on the temperature of combustion. With an increase in combustion temperature, there is an increase in thermal NO_X emissions, and hence in the overall NO_X emissions. The formation of thermal NO_X is strongly dependent on the maximum flame temperature and the period that the gases remain at this temperature.

(ii) Sulphur Dioxide

Sulphur Dioxide (SO_2) is a colourless, non-flammable gas with a penetrating odour that irritates the eyes and air passages. It reacts on the surface of a variety of airborne solid particles, is soluble in water and can be oxidised within airborne water droplets. The most common sources of SO_2 include fossil fuel combustion, smelting, manufacture of sulphuric acid, conversion of wood pulp to paper, incineration of waste and production of elemental sulphur. Coal burning is the single largest man-made source of sulphur dioxide accounting for about 50% of annual global emissions, with oil burning accounting for a further 25-30%. The most common natural source of sulphur dioxide is volcanoes.

(iii) Carbon Monoxide

CO is a colourless and odourless gas, formed when carbon in fuel is not burned completely. It is a component of motor-vehicle exhaust which accounts for most of the CO emissions nationwide. Consequently, CO concentrations are generally higher in areas with heavy traffic congestion.

CO enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissue. The health threat from levels of CO sometimes found in the ambient air is most serious for those who suffer from cardiovascular disease such as angina. At much higher levels of exposure, not commonly found in ambient air, CO can be poisonous, and even healthy individuals may be affected.

Visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability and difficulty in performing complex tasks are all associated with exposure to elevated CO levels.

(iv) Particulate Matter

For the purposes of air quality assessments, particulate matter is normally split into two definitions on the basis of the particle diameter; 'dust' and 'respirable' particulates. 'Dust' is a generic term which usually refers to particulate matter in the size range 1-75 microns. Respirable particulates are defined as those which are capable of penetrating to the gas-exchange region of the lungs. For the purpose of the environmental assessment, many air quality standards assign this type of particulate to two further classifications; PM_{10} (particles with an aerodynamic diameter of up to 10 microns) and $PM_{2.5}$ (particles with an aerodynamic diameter of up to 2.5 microns).

The primary air quality issue associated with construction and decommissioning phase dust emissions is loss of amenity and/or nuisance caused by, for example, soiling of buildings, vegetation and washing and reduced visibility. Both airborne dust and deposited dust are therefore considered.

(v) Greenhouse Gases

Under the Kyoto agreement, Ireland has committed to limiting the increase of greenhouse gases to 13% above its 1990 levels, a level that has to be reached during the period 2008-2012. The EU Council has committed to achieving a 20% reduction in emissions of 1990 levels by 2020. Under the Greenhouse Gas Emissions Trading Directive 2003/87/EC, operators included in the list are allocated greenhouse gas emissions allowances at the beginning of each year. If the operator does not meet their target they can buy or sell allowances within the EU. Combustion Installations such as the proposed development, with a rated thermal input exceeding 20 MW are included in this scheme. New entrants to the market must apply to the designated authority for an allowance of CO_2 emissions under the Directive.

Increased atmospheric levels of greenhouse gases such as Carbon Dioxide (CO_2) enhance the natural greenhouse effect and are widely recognised as the leading cause of climate change. CO_2 arises from a wide range of sources including the combustion of fossil fuels. The emissions from a combustion source are dependent both on the rate at which the fuel is consumed (dependent on the size and efficiency of the plant) and the inherent carbon content of the fuel.

Combustion of either natural gas or distillate oil within a CCGT plant will generate emissions of CO_2, which is acknowledged as a greenhouse gas. The emissions intensity of the proposed power plant (assuming natural gas as the primary fuel) has been estimated and compared to other types of combustion plants. Based upon normal operating conditions, the emissions intensity of the plant are:

- CCGT at Great Island: 0.3429 tCO_2 / MW;
- Coal fired power station: 0.8505 tCO_2 / MW;
- Modern coal fired power station: 0.7560 tCO_2 / MW; and
- Oil fired power station: 0.6957 tCO_2 / MW.

The above comparison clearly demonstrates that the CCGT plant represents a low carbon solution compared with alternative fossil fuel generation. Additional advantages associated to CCGT development is that it is acknowledged to be a flexible, reliable, commercially proven technology that provides firm capacity (i.e. available whenever required) and also balancing services to the grid.

I.1.4 Assessment Methodology of Operational Phase

The approach to the assessment of emissions from the proposed stack (A2-1) involved the following key elements:

- Establishing the Ambient Concentration (AC) from consideration of local air quality monitoring data;
- Quantitative assessment of the operational effects on local air quality from stack emissions utilising an advanced dispersion model; and
- Assessment of Process Contributions (PC) from the proposed plant in isolation and resultant Predicted Environmental Concentrations (PEC) taking into account cumulative effects through incorporation of the AC.

The AC has already been established in the previous sub-sections that discuss ambient air quality. The quantitative assessment includes consideration of following operational scenarios:

- Scenario 1: Proposed 430 MW CCGT operating at full load firing natural gas. Includes consideration of long term and short term averaging air quality standards for NO_X, PM_{10} and $PM_{2.5}$.
- Scenario 2: Proposed 430 MW CCGT operating at full load firing distillate fuel oil. Includes consideration of short term air quality standards for NO_X, SO_2, and PM_{10}.

A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources such as a power plant. The ADMS (Atmospheric Dispersion Modelling System) version 4.1, is an internationally recognised model, and it was selected for this assessment. ADMS is a practical dispersion model, developed by Cambridge Environmental Research Consultants (CERC), which models a wide range of buoyant and passive releases to atmosphere either individually or in combination. It uses an in-built meteorological pre-processor developed by the UK Met Office and also includes a terrain converter utility for preparation of terrain data. ADMS calculates the mean concentration over flat terrain and also allows for the effect of plume rise, complex terrain, buildings, radioactive decay and deposition. The model has been subject to extensive validation by the Environment Agency for England and Wales and HSE (the UK Health and Safety Executive). Additionally, the EPA favours using ADMS for complex modelling scenarios, as it is included in *the Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)* by the EPA as one of the advanced models suitable for assessments regarding major installations.

ADMS comprises a number of individual modules each representing one of the processes contributing to dispersion or an aspect of data input and output.

(i) (i) Meteorological Data

The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability, as described below:

- Wind direction determines the sector of the compass into which the plume is dispersed;
- Wind speed affects the distance that the plume travels over time and can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise; and
- Atmospheric stability is a measure of the turbulence of the air, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. New generation dispersion models, such as ADMS, use a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

For meteorological data to be suitable for dispersion modelling purposes, a number of parameters need to be measured on an hourly basis. These include wind speed, wind direction, cloud cover and temperature. There are only a limited number of sites where the required meteorological measurements are made.

The most representative observing station for the region of the proposed development site that records all the required parameters is at Rosslare Harbour. The year of meteorological data that is used for a modelling assessment can have a significant effect on source contribution concentrations. Therefore, five years of hourly sequential data from Rosslare Harbour (2003 to 2007) have been used as input data for the dispersion modelling to ensure that the full range of meteorological conditions that are likely to affect plume dispersion are considered within the assessment. The results presented are the maximum (worst case) concentrations of the 5 years modelled.

Data from 2008 was not included in the assessment as the Rosslare meteorological station was closed in the first quarter of 2008. Windroses produced from the station's data were presented in Figure I.1.1: Rosslare Harbour Wind Roses.

(ii) Terrain

The presence of elevated terrain can significantly affect (usually increase) ground level concentrations of pollutants emitted from elevated sources such as stacks, by reducing the distance between the plume centre line and ground level and increasing turbulence and, hence, plume mixing.

Complex terrain data exists within the study area of the air quality assessment (20 kilometre radius around the site). Therefore, terrain data has been included within the ADMS dispersion model with a terrain resolution of 200 metres for a fine grid (15x15 km) and 350m for a coarse grid (40x40 km).

(iii) Surface Roughness

Roughness of terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. This is accounted for by a parameter called the surface roughness length. The predominant land use within 15-20 kilometres of the proposed site can be characterised as mixed agricultural type and the River Barrow. To account for the largely cultivated land and water around the study area, a surface roughness length of 0.3 was assigned for the ADMS modelling.

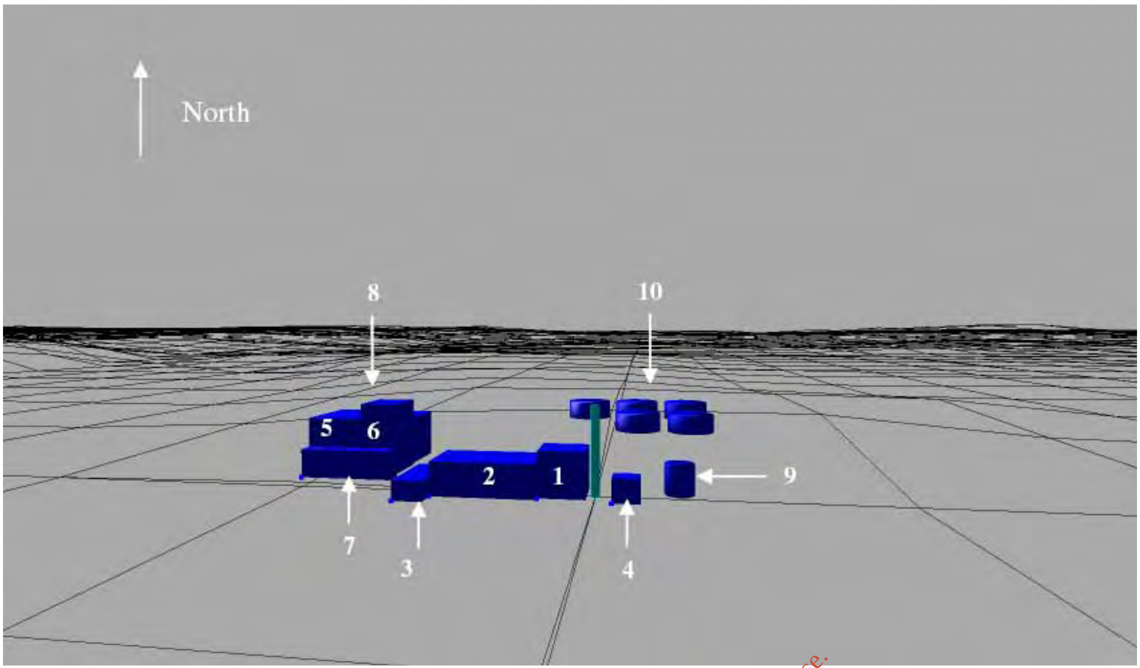
(ii) Building Downwash

The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. Where building heights are greater than about 30% of the stack height, downwash effects can be significant. The dominant buildings in the study area (i.e. with the greatest dimensions likely to promote turbulence) are the exiting boiler house buildings. The structures listed in Table I.1.9 and illustrated in Figure I.1.3 have been included in the dispersion model.

Table I.1.9: Structure Dimensions

Structure	Number (Refer to Figure I.1.3)	Height (m)	Length (m)	Width (m)
HRSG	1	31	31	26
Gas and Steam Turbine	2	23	69	37
Electrical Annex	3	13	47	20
Auxiliary Boiler	4	16	19	15
Boiler House 1	5	40	40	31
Boiler House 2	6	50	27	31
Boiler House 3	7	20	67	10
Station Engine Room (1-2)	8	35	79	37
Demineralised Water Tank	9	21	-	10 (radius)
5 Oil Tanks (each Tank)	10	15	-	20 (radius)

Figure I.1.3: Great Island - Proposed CCGT Plant Buildings and Existing Buildings



Stack Height Determination

In order to complete dispersion modelling it is necessary to establish an appropriate exhaust stack height. The underlying principle of air pollution control is to minimise the release of pollutants to the atmosphere and promote sufficient dispersion and dilution of released pollutants within the atmosphere to ensure ground level impacts are not significant.

The first part of this principle is controlling emissions at sources through abatement techniques. These are well established for gas turbines and include the use of dry low-NO_X burners when firing on natural gas and water injection when firing on distillate oil. The second part is the determination of the optimum release conditions, including stack height determination to ensure that subsequent ground level concentrations of the released pollutants remain within acceptable limits.

The objective of the stack height determination is to establish at what stack height local building wake effects are no longer a major constraint thereby ensuring the adequate dispersion of pollutants. The primary determinant of the stack height is therefore the local building heights.

On the basis of the above, the stack height determination considers:

- A unit emission rate of 1 g/s enabling the influence of meteorological conditions to be determined;
- All averaging periods relevant to the air quality assessment;
- A range of all likely meteorological conditions through the use of five years (2003-2007) of hourly sequential meteorological data from a representative measuring station (Rosslare Harbour).

Plant emissions characteristics assumed are identical to those reported in the following subsection 'Emission Data'.

The model has been run using ADMS to determine what stack height is required to overcome local building wake effects. Terrain in the vicinity of the plant is considered likely to affect plume dispersion. Particularly since there are changes in gradient within the site, and hence terrain data have been included in the model. The model was run assuming stack heights between 40m and 100m at 10m incremental spacing. Results were obtained for short term and long term NO_2 averaging periods to this assessment.

The dispersion modelling for the purposes of stack height determination assumed a grid domain of 15km by 15km from the CCGT stack with 200m receptor spacing. Results are reported for the maximum affected location. This is considered a robust and conservative approach.

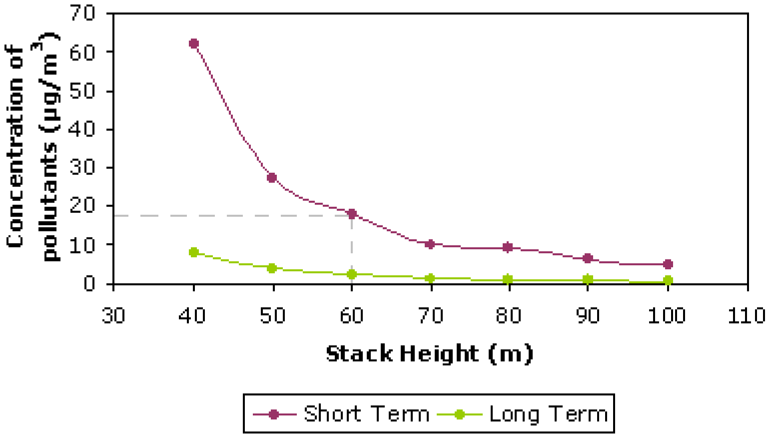
Modelled results are ground level concentrations predicted by the model for the CCGT stack. These results illustrate that for stack heights below 50m, local building wake effects are predicted to have a significant influence over dispersion. At stack heights above 60m, local building wake effects are no longer a major constraint for the short and long term averaging period in respect to the air quality standards.

On that basis, a height of 60m is recommended for the stack of the proposed plant.

Stack Height (m)	Concentration of Pollutants (µg/m^3)	
	Short Term	Long Term
40	62	7.8
50	27	3.9
60	18	2.2
70	10	1.3
80	9	0.9
90	6	0.8
100	5	0.6

Table I.1.10: Stack Height Determination Results

Figure I.1.4: Stack Height Determination Results



(iii) Emissions Data

The relevant emissions data for natural gas and distillate fuel oil firing corresponding to Scenarios 1 to 2 respectively are summarised in Table I.1.10. Pollutant emission rates are based on the relevant emission limits for NO_X, SO_2, PM_{10} and $PM_{2.5}$ established in the Large Combustion Plant Directive. Emissions data represent current likely 'worst case' scenarios.

Scenario / Parameter	1	2
Fuel Type	Natural Gas	Distillate Fuel Oil
NO_X Concentration (mg/Nm^3) (b)	50	120
NO_X Mass Emission Rates (g/s)	39.9	115.3
SO_2 Concentration (mg/Nm^3) (b)	-	0.1% Sulphur Content
SO_2 Mass Emission Rates (g/s)	-	43.3
PM Concentration (mg/Nm^3) (b)	5	50
PM_{10} Mass Emission Rates (g/s)	1.3	15.6
Actual Volumetric Flow (m^3/s)	765.7	829.8
Efflux Temperature (ºC)	89.9	102.7
Efflux Velocity (m/s)	27.1	29.3
Stack Diameter (m)	6	
Stack Height (m)	60	

Table I.1.11: Air Emission Data from Great Island CCGT Power Plant

Note: (a) Assumes Normal Operating Mode – CCGT at full load
(b) Concentrations at 15% O_2 Dry, 0 ºC, 1 atm

The primary fuel used by the power plant will be natural gas. Therefore, Scenario 1 assumes a 100% annual plant load factor (8,760 hours) as a worst case assumption (in reality the actual annual plant load factor will be lower to account for periods of shut down and maintenance).

As noted previously, back-up fuel (considered in Scenario 2) will be used rarely (expected to be less than 2% of the operating hours) with normal operation being on natural gas. It is therefore not appropriate to consider long-term averaging periods (annual mean) for Scenario

2 when firing on distillate fuel oil. In order to infer the maximum potential short-term effects, the proposed development is assumed to operate firing on distillate fuel oil with a 100% plant load factor to ensure that consideration of plant operation coinciding with the worst-case meteorological conditions for dispersion is conservatively addressed.

(iv) Percentage oxidation of NO_X to NO_2

The NO_X emissions associated with the power plant will typically comprise approximately 90% nitrogen monoxide (NO) and 10% nitrogen dioxide (NO_2) at source. The NO oxidises in the atmosphere in the presence of sunlight, ozone and volatile organic compounds to form NO_2, which is the principal concern in terms of environmental health effects.

There are various techniques available for estimating the portion of the NO_X that is converted to NO_2. Methods used for the calculation of long-term (annual mean) NO_2 concentrations and short-term (hourly mean) NO_2 concentrations used within the assessment are detailed below.

Long-Term Averaging Periods

The UK Environment Agency recommends that for a 'worst case scenario', a 70% conversion of NO_X to NO_2 should be considered for calculation of annual mean concentrations. If a breach of the annual average NO_2 air quality standard occurs, the UK Environment Agency requires further assessment where operators are asked to justify the use of percentages lower than 70%.

For the purposes of this assessment, a 70% conversion of NO_X to NO_2 is assumed for annual average NO_2 concentrations in line with the UK Environment Agency's recommendations, which are considered relevant for applications in Ireland.

Short-Term Averaging Periods

Using a similar approach to the treatment of long-term averaging periods, the UK Environment Agency recommends that for a 'worst case scenario', a 35% conversion of NO_X to NO_2 should be considered for calculation of hourly mean concentrations. If a breach of the hourly mean NO_2 air quality standard occurs, the UK Environment Agency requires further assessment where operators are asked to justify the use of percentages lower than 35%.

Therefore, for the calculation of short-term contributions from the proposed plant to ground level concentrations of NO_2, 35% of the modelled NO_X contribution has been used as advocated by the UK Environment Agency which is considered relevant for applications in Ireland.

(v) Human Health Receptors

The area immediately surrounding the proposed site is a rural area with the River Barrow located to the south section of the plant. In order to assess potential impacts on sensitive receptors, modelling was carried out to predict pollutant concentrations across a study area of 20 kilometres from the plant's stack. This involved modelling a fine grid of receptors up to

7.5 kilometres from the CCGT stack with a receptor spacing of 200 metres, and a coarse grid of receptors up to 15 kilometres away with a receptor spacing of 1 kilometre.

Outputs from the modelled grid have been used to present the maximum ground level process contributions (PC) from the modelled Scenarios. The maximum concentrations have been interpreted against the significance criteria described below to assess the overall significance of operation phase impacts.

In addition, outputs from the modelled grids have been used to produce contour plots to illustrate the geographical spread of process contributions across the study area.

(vi) Significance Criteria - Human Health Receptors

A number of approaches can be used to determine whether the potential air quality effects of a development are significant. However, there remains no universally recognised definition of what constitutes 'significance'.

Guidance is available from a range of regulatory authorities and advisory bodies on how best to determine and present the significance of effects within an air quality assessment. It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively.
In order to ensure that the descriptions of effects used within this report are clear, consistent and in accordance with recent guidance, definitions have been adapted from Environmental Protection UK Development Control: Planning for Air Quality in the absence of any equivalent in Ireland.

Table I.1.12 provides descriptors used for changes in concentrations as a result of the proposed development.

Descriptor	Averaging Periods	
	Short Term	Long Term
Very Large	>50%	>25%
Large	25 – 50%	15 – 25%
Medium	15 – 25%	10 – 15%
Small	10 – 15%	5 – 10%
Very Small	5 – 10%	1 – 5%
Extremely Small	≤5%	≤1%

Table I.1.12: Magnitude Descriptor for Process Contributions (PC)
Note: Change as a percentage of the relevant Air Quality Standard

The magnitude of the change identified must be considered in the context of existing air quality conditions within the study area in order for the significance of that magnitude to be determined. The most important aspects to consider are whether existing concentrations are above or below the relevant air quality standard.

Table I.1.13 provides descriptors for the significance of air quality effects based on the magnitude descriptors in the context of existing conditions. It should be recognised that professional judgement is required in the interpretation of air quality assessment significance.

Table I.1.13: Descriptors for Impact Significance

Notes:

- The EPUK example has been used as a framework for this assessment; however, professional judgement is still required to determine the significance of any change.

Absolute Concentrations in Relation to AQS	Extremely Small	Very Small	Small	Medium	Large	Very Large
Above AQS without scheme	Slight adverse	Slight adverse	Substantial adverse	Substantial adverse	Very substantial adverse	Very substantial adverse
Below AQS without scheme, above with scheme	Slight adverse	Moderate adverse	Substantial adverse	Substantial adverse	Very substantial adverse	Very substantial adverse
Below AQS with scheme, but not well below	Negligible	Slight adverse	Slight adverse	Moderate adverse	Moderate adverse	Substantial adverse
Well below AQS with scheme	Negligible	Negligible	Slight adverse	Slight adverse	Slight adverse	Moderate adverse

- AQS = Air Quality Standard
- 'Well below standard' = <75% if the AQS

Table I.1.13 is intended as a tool to help interpret the results of the air quality assessment.

The significance framework described above has been applied to maximum ground level concentrations as determined by the dispersion modelling.

(vii) Ecological Assessment – Methodology

The assessment of the effects of emissions to air from the proposed plant on ecologically designated sites has been carried out. European and nationally designated sites within a 20 kilometre radius have been considered within the assessment. Special Areas of Conservation (SAC), Special Protection Areas (SPA), Natural Heritage Areas (NHA) and Proposed Natural Heritage Areas (pNHA) designations were identified in this area, as shown in Figure I.1.5 - Designated Sites within 20 km of the Proposed Plant.

Predicted process contributions to atmospheric concentrations and deposition have been presented for comparison with relevant critical levels and critical loads. As critical levels and critical loads are based on long term (annual) averaging periods, concentrations at designated sites have been presented based on the results for Scenario 1 only. Therefore, contributions from SO_2 emissions have not been considered further as these emissions will be present for very short term periods.

Critical Levels

Critical levels for the protection of vegetation and ecosystems are specified within relevant European air quality directives and corresponding Irish air quality regulations. NO_X has been identified as the key pollutant to assess air quality impacts on designated sites. For all receptors, process contributions and predicted environmental concentrations of NO_X have been calculated for comparison against the critical level. Background NO_X concentrations at each designated site are identified in Table I.1.4.

Critical Loads

Critical loads are quantitative estimates of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

Process contributions to acid deposition have been derived from dispersion modelling using ADMS. Deposition rates were calculated using the following empirical methods in the Habitats Directive (AQTAG 06) guidance:

- Calculate dry deposition flux (0.0015 m/s for NO_X assumed as deposition velocities):

Dry deposition flux = ground level concentration x deposition velocity

(μg/m^2/s) (μg/m^3) (m/s)

- Convert units from μg/m^2/s to units of kg/ha/year by multiplying the dry deposition flux by standard conversion factors (96 for NO_X).
- Convert to units of equivalents (keq/ha/year), which is a measure of how acidifying the chemical species can be, by multiplying the dry deposition flux (kg/ha/year) by standard conversion factors (0.071428 for N).

Wet deposition in the near field is not significant compared with dry deposition for nitrogen and therefore for the purposes of this assessment, wet deposition has not been considered further.

Figure I.1.5: Designated Sites within 20 km of the Proposed Plant

Contributions to acid deposition have been compared with critical loads for acidity applicable to the study area. These have been obtained from a report published by the Netherlands Environmental Assessment Agency in 2005 which provides maps of critical loads of acidity across Europe. For Ireland critical loads are provided for '(semi)natural vegetation', 'forest', and 'all ecosystems'.

Due to the range of habitats present in the study area, critical loads applicable to 'all ecosystems' have been used. Excerpts of the maps focussing on critical loads for Ireland, are presented in Figures I.1.6 to I.19. Where a range of critical loads is provided by the maps, the lowest critical load has been selected to ensure a conservative assessment. Furthermore, where the study area encompasses more than one critical load range, the most conservative (lowest) has been used.

Figure I.1.6: Nutrient Nitrogen Critical Load (CLnutN) (eq/ha/yr)
5th Percentile All Ecosystems. Netherlands Environmental Assessment Agency (2005)
European Critical Loads and Dynamic Modelling: CCE Status Report 2005

Figure I.1.7: Maximum Sulphur Critical Load (CLmaxS) (eq/ha/yr)
5th Percentile All Ecosystems. Netherlands Environmental Assessment Agency (2005)
European Critical Loads and Dynamic Modelling: CCE Status Report 2005

Figure I.1.8: Maximum Nitrogen Critical Load (CLmaxN) (eq/ha/yr)
5th Percentile All Ecosystems. Netherlands Environmental Assessment Agency (2005)
European Critical Loads and Dynamic Modelling: CCE Status Report 2005

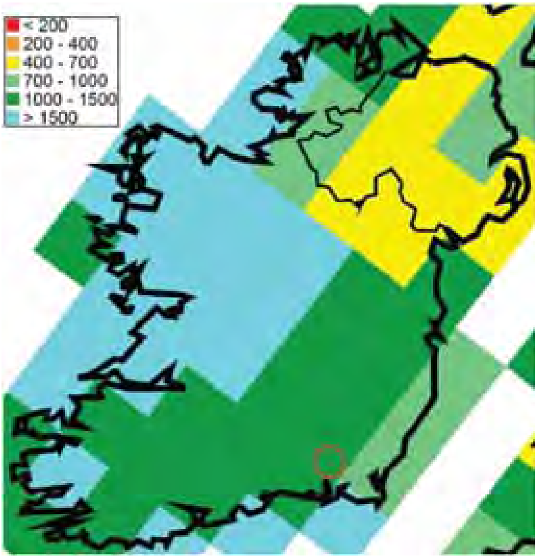
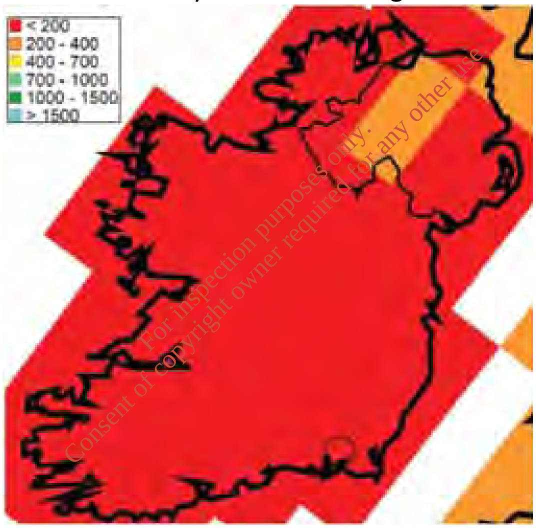


Figure I.1.9: Minimum Nitrogen Critical Load (CLminN) (eq/ha/yr)
5th Percentile All Ecosystems. Netherlands Environmental Assessment Agency (2005)
European Critical Loads and Dynamic Modelling: CCE Status Report 2005



Sulphur and nitrogen compounds can contribute to acidification. Therefore, a Critical Load Function (CLF) has been developed which defines combinations of sulphur and nitrogen deposition that will not cause harmful effects. The use of a CLF also allows assessment of the effects of processes which contribute to acid deposition - in this case combustion of natural gas resulting in emissions of nitrogen.

In order to allow comparison of total acid deposition with critical loads for acidity, values for background deposition of acid have been added to modelled process contributions. Background deposition values have been obtained from a report published by the Norwegian Meteorological Institute in 2006 (under the EMEP Programme), which provides maps of background deposition of nitrogen across Europe. Excerpts of the maps, focussing on background concentrations for Ireland, are presented in Figures I.1.10 and I.1.11. Use of the EMEP data within the assessment is considered appropriate as it is also used by Netherlands Environmental Assessment Agency in their critical load status reports.

Figure I.1.10: Sulphur Deposition ($mg \cdot m^2yr^1$) 2004
Netherlands Environmental Assessment Agency (2005)
European Critical Loads and Dynamic Modelling: CCE Status Report 2005

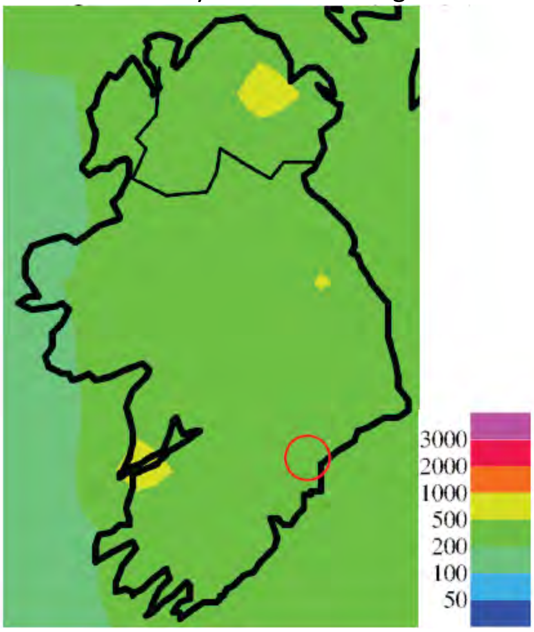
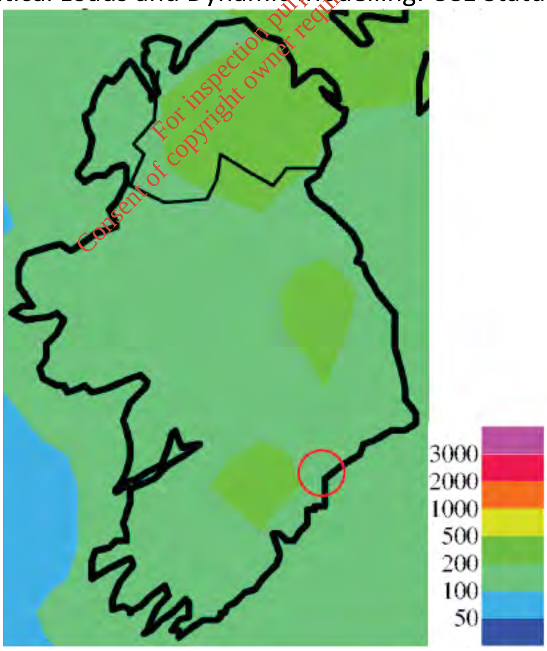


Figure I.1.11: Nitrogen Deposition ($mg \cdot m^2yr^1$) 2004
Netherlands Environmental Assessment Agency (2005)
European Critical Loads and Dynamic Modelling: CCE Status Report 2005



Where a range of background deposition is provided by the maps, the highest value has been selected to ensure a conservative assessment.

Process contributions to nitrogen deposition have been derived from dispersion modelling using ADMS. Deposition rates were calculated using empirical methods in the Habitats Directive (AQTAG 06) guidance as follows:

- Calculate NO_X dry deposition flux (0.0015 m/s for NO_X assumed as deposition velocity):

Dry deposition flux = ground level concentration x deposition velocity

($\mu g/m^2/s$) ($\mu g/m^3$) (m/s)

- Convert units from µg/m2/s to units of kg/ha/year by multiplying the dry deposition flux by standard conversion factors (96 for NO_X).

Wet deposition of nitrogen in the near field has not been considered for the reasons given previously.

Contributions to nitrogen deposition have been compared with critical loads for nutrient nitrogen in the study area, presented in figures I.1.6, I.1.8 and I.1.9.
Where a range of critical loads is provided by the maps, the lowest critical load has been selected to ensure a conservative assessment.

Receptors

In order to assess potential effects process contributions on designated ecological sites within 20 kilometres of the proposed plant, within each designated site a series of receptors were chosen representing changes in process contributions across an area.

Figure I.1.5 (Designated Sites within 20 km of Proposed Plant) shows the location of the designated sites in relation to the proposed plant and discrete receptors assessed.

Significance Criteria – Ecological Receptors

For the assessment of designated sites, Process Contribution effects are concluded to be negligible if the process contribution is less than 1% of the relevant critical level or critical load.

I.1.5 Assessment of Operational Phase – Modelling Results

(i) Air Quality Assessment

The results of the dispersion modelling are summarised and interpreted below for each of the assessment scenarios. The model results are presented in tabular form and as contour plots.

Scenario 1

Table I.1.14 summarises the results of modelling maximum Process Contributions (PCs) to ground level NO_2, PM_{10} and $PM_{2.5}$ concentrations from the proposed plant firing natural gas and resultant Predicted Environmental Concentrations (PECs), including the Ambient Concentration (AC). All results presented in Table I.1.14 are compared with the relevant air quality standards. Maximum predicted annual mean Process Contributions from the five modelled years have been presented.

Pollutant	Averaging period	AQS	PC Max	Max PC as % of AQS	Magnitude of PC	AC	PEC Max	Max PEC as % of AQS	Significance descriptor
NO2	1 hour (99.79th percentile)	200	17.6	8.8	Very Small	14	31.6	15.8	Negligible
	Annual	40	2.2	5.5	Small	7	9.2	22.9	Slight Adverse
PM10	24 hour (90.41st percentile)	50	0.7	1.4	Extremely Small	36	36.7	73.4	Negligible
	Annual	40	0.1	0.3	Extremely Small	18	18.1	45.3	Negligible
PM2.5	Annual	25	0.1	0.4	Extremely Small	9	9.1	36.4	Negligible

Table I.1.14: Significance of Impacts - Scenario 1 (µg/m3)

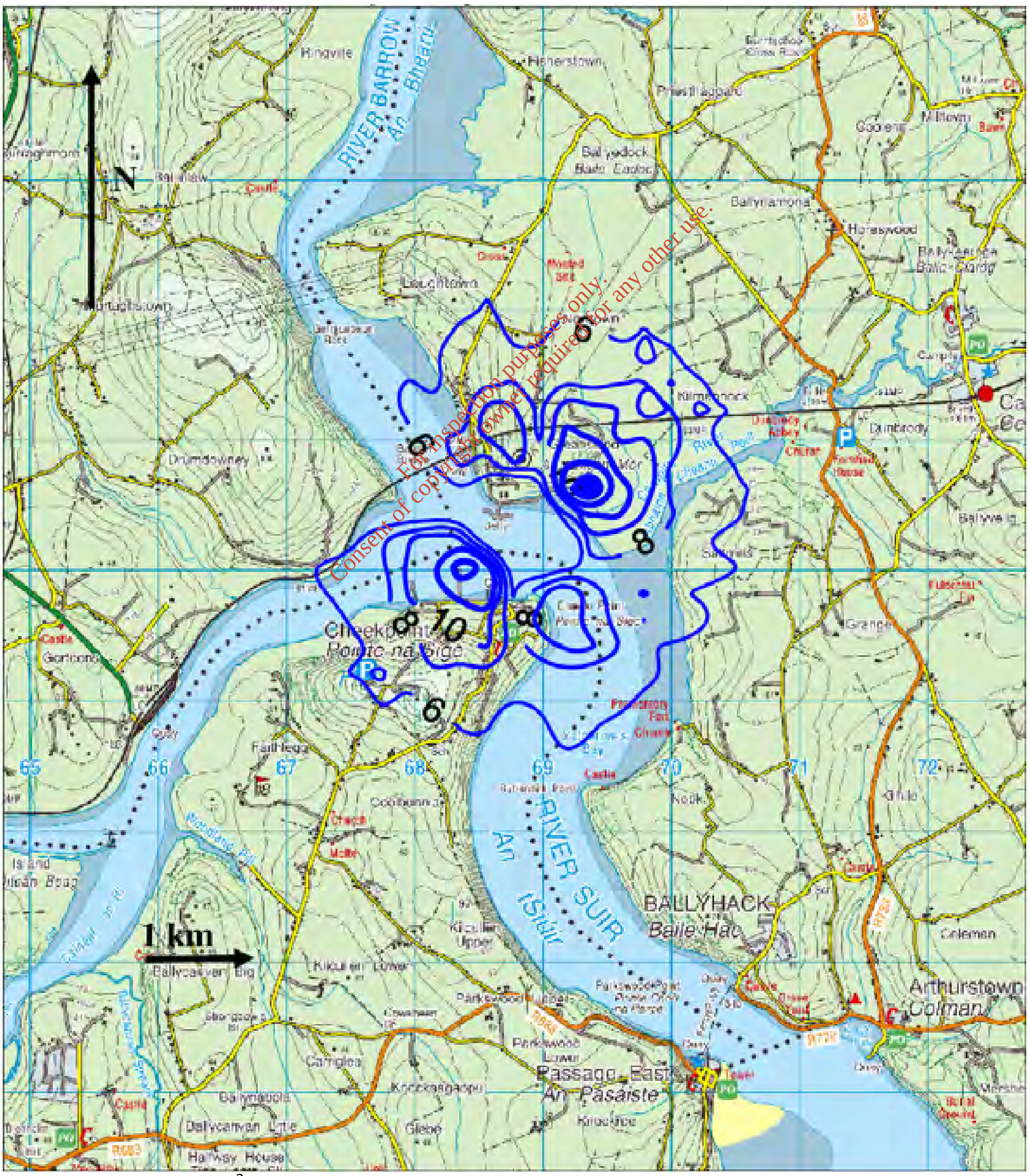
Notes:

- AQS = Air Quality Standard
- PC = Process Contributions
- AC = Ambient Concentrations
- PEC = Predicted Environmental Concentration (PC + AC)

Contour plots of short-term and long-term NO_2 contributions are presented in Figure I.1.11 and Figure I.1.12. The contour plots indicate that the highest short-term and long-term contributions of NO_2 from the proposed development are predicted to occur approximately within 250 metres to the north-east of the site.

Table I.1.14 indicates that the Predicted Environmental Concentrations for all pollutants are 'well below' the relevant air quality standards. Effects from Process Contributions are concluded to be 'negligible' for all pollutants and averaging periods with the exception of annual mean NO_2 concentrations which are concluded to be 'slight adverse'.

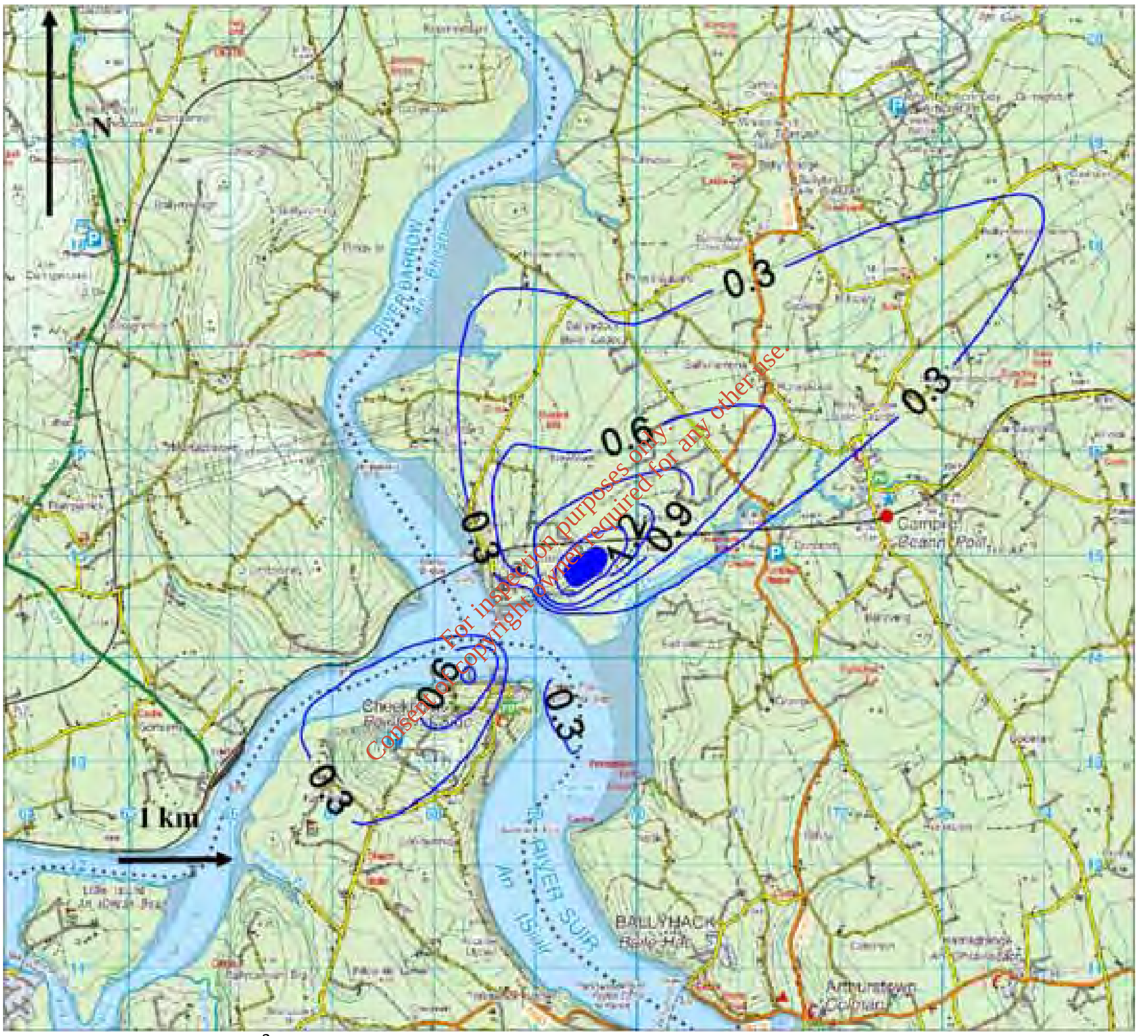
Figure I.1.12: Predicted 99.79th Percentile Hourly Average NO_2 Concentrations - Process Contribution
Scenario1



- Concentrations in µg/m^3

- Proposed Plant firing on natural gas
- 35% of NO_X to NO_2 conversion
- 2003 meteorological year (worst case)
- Contour at 2 µg intervals

Figure I.1.13: Predicted Annual NO_2 Concentrations - Process Contribution Scenario1



- Concentrations in µg/m^3
- Proposed Plant firing on natural gas
- 70% of NO_X to NO_2 conversion
- 2003 meteorological year (worst case)
- Contour at 0.3 µg intervals

Scenario 2

The results of modelling maximum Process Contributions (PC) to ground level concentrations from the proposed plant when firing distillate fuel oil and resultant Predicted Environmental Concentrations (PEC), including the Ambient Concentration (AC) are summarised in Table I.1.15 and compared with the relevant air quality standard (AQS). Results presented are for short term averaging periods only (i.e. 1 hour and 24 hour) as the plant will only fire on distillate fuel oil for short periods. Maximum predicted annual mean Process Contributions from the five modelled years have been presented.

Pollutant	Averaging period	AQS	PC Max	Max PC as % of AQS	Magnitude of PC	AC	PEC Max	Max PEC as % of AQS	Significance descriptor
NO2	1 hour (99.79th percentile)	200	45	22.4	Medium	14	59	29.4	Slight Adverse
SO2	1 hour (99.73rd percentile)	350	48	13.8	Small	6	54	15.6	Slight Adverse
	24 hour (99.2nd percentile)	125	29	23.6	Medium	6	35	28.4	Slight Adverse
PM10	24 hour (90.41st percentile)	50	3.7	7	Very Small	36	39.7	79.3	Slight Adverse

Table I.1.15: Significance of Impacts - Scenario 2 (µg/m3)

Notes:

- AQS = Air Quality Standard
- PC = Process Contributions
- AC = Ambient Concentrations
- PEC = Predicted Environmental Concentration (PC + AC)

The results presented in Table I.1.15 show that the Process Contributions and Predicted Environmental Concentrations of all pollutants considered are well within the relevant air quality standards.

Contributions of NO_2 and SO_2 are less than 25% of the relevant air quality standards and Predicted Environmental Concentrations are less than 30% of the relevant air quality standards. Maximum short-term NO_2 and SO_2 impacts are therefore considered to be of 'slight adverse' significance.

Short-term contributions of PM_{10} are less than 10% of the relevant air quality standards and as Predicted Environmental Concentrations are 79% of the relevant air quality standards, maximum short-term PM_{10} impacts are considered to be 'slight adverse'.

To release the effects presented in Table I.1.15, the proposed plant would need to operate on distillate fuel oil, coinciding with the worst-case meteorological conditions for dispersion. Even on this basis, effects are not considered to be significant and in practice, such events are unlikely and represent the absolute upper limits for short-term effects from the facility.

Auxiliary Boiler

In addition to the gas turbine unit, there may also a requirement for an auxiliary boiler on site. The auxiliary boiler will also fire natural gas but is a negligible emission source compared with emissions from the gas turbine (its emissions being only approximately 0.5% of those from the CCGT).

Air emissions during start-up and shut-down periods

During start up and shut down periods, combustion temperatures and pressures change rapidly resulting in inefficient combustion periods and therefore higher pollutant concentrations occur. Peak emission concentrations will occur approximately 15 to 20 minutes after start-up corresponding to 30% plant load. Once the gas turbine reaches 40% load and above, NO_X concentrations will achieve relevant emission limits.

Given the limited period of the start-up and shut-down periods (typically extending no more than 30 minutes), air quality impacts resulting from elevated emission concentrations are not considered to be significant taking into account the relevant averaging periods associated with the air quality limit values.

Nonetheless, the Applicant will maintain a record of start-up and shut-down periods for inspection by the EPA if required.

(ii) Ecological Assessment

Critical levels

Results of predicted NO_X contributions from the proposed plant are presented in Table i.1.4. Maximum predicted annual mean Process Contributions from the five modelled years have been presented.

The maximum modelled increase in annual mean NO_X concentrations at ecological sites within 20 kilometres of the proposed plant is at the Lower River Suir (2.9% of the air quality standard). Lower River Suir is designated as a Special Area of Conservation (SAC) located approximately 1.1 kilometres South West of the proposed site. As all process contributions are well below 1% of the AQS with the exception of the Lower River Suir, and the predicted environmental concentrations are well below the relevant AQS, effects on designated sites are concluded to be negligible.

Critical Loads – Acidification

Contributions to nitrogen acid deposition at each designated site have been derived from the ADMS dispersion modelling. Figure i.1.12: Minimum Critical Load Function – Lower River Suir presents a Critical Load Function (CLF) based on the minimum critical load for the Lower River Suir which is predicted to experience the greatest increases in acid deposition, along with the maximum predicted total acid deposition (i.e. including background). It can be seen that, with or without contributions from the proposed plant, predicted acid deposition is below the critical load 'envelope of protection'. Furthermore, maximum predicted process contributions to acid deposition are very small in comparison to the minimum CLF.

Site	Designation	Distance from Plant (km)	AQS	AC	PC	Max PC as % AQS	PEC
Balleyhack	pNHA	4.1	30	12	0.24	0.8	12.24
Balleykelly Marsh	pNHA	6.7	30	12	0.25	0.8	12.25
Mid Waterford Coast	SPA	19	30	12	0.04	0.1	12.04
Hook Head	pNHA, SAC	14	30	12	0.08	0.3	12.08
Boley Fen	pNHA	9.5	30	12	0.16	0.5	12.16
Dunmore East Cliffs	pNHA	14	30	12	0.07	0.2	12.07
Duncannon Sandhills	pNHA	7.6	30	12	0.12	0.4	12.12
Belle Lake	pNHA	9.4	30	12	0.05	0.2	12.05
Carrickavranty Reservoir	pNHA	18.3	30	12	0.04	0.1	12.04
Islandtarnsery Fen	pNHA	18.4	30	12	0.04	0.1	12.04
Kilbarry Bog	pNHA	9.5	30	12	0.09	0.3	12.09
Kings Channel	pNHA	6.1	30	12	0.18	0.6	12.18
Grannyferry	pNHA	9.9	30	12	0.05	0.2	12.05
Lough Cullin	pNHA	7.6	30	12	0.07	0.2	12.07
Lower River Suir (Coolfinn, Portlaw)	pNHA	18.4	30	12	0.03	0.1	12.03
Lower River Suir	SAC	1.1	30	12	0.88	2.9	12.88
Rathsnagadan Wood	pNHA	18	30	12	0.07	0.2	12.07
Kylecorragh Wood	pNHA	15.1	30	12	0.08	0.3	12.08
Brownstown Wood	pNHA	15	30	12	0.06	0.2	12.06
Waterford Harbour	pNHA	4.6	30	12	0.23	0.8	12.23
Tramore Back Strand	SPA	13	30	12	0.04	0.1	12.04
Tramore Dunes and Backstrand	pNHA, SAC	13	30	12	0.04	0.1	12.04

Keeragh Islands	NHA, SPA	19.1	30	12	0.04	0.1	12.04
Oaklands Wood	pNHA	10.8	30	12	0.13	0.4	12.13
Tintern Abbey	pNHA	11.4	30	12	0.07	0.2	12.07
Bannow Bay	SPA	12.2	30	12	0.05	0.2	12.05
	SAC	13.7			0.1	0.3	12.1
	pNHA	13.2			0.11	0.4	12.11
Barrow River Estuary	pNHA	0	30	12	0.01	0	12.01
River Barrow and River Nore	pNHA	0	30	12	0.01	0	12.01

Table I.1.16: NOx critical levels at Designated Sites (µg/m3)

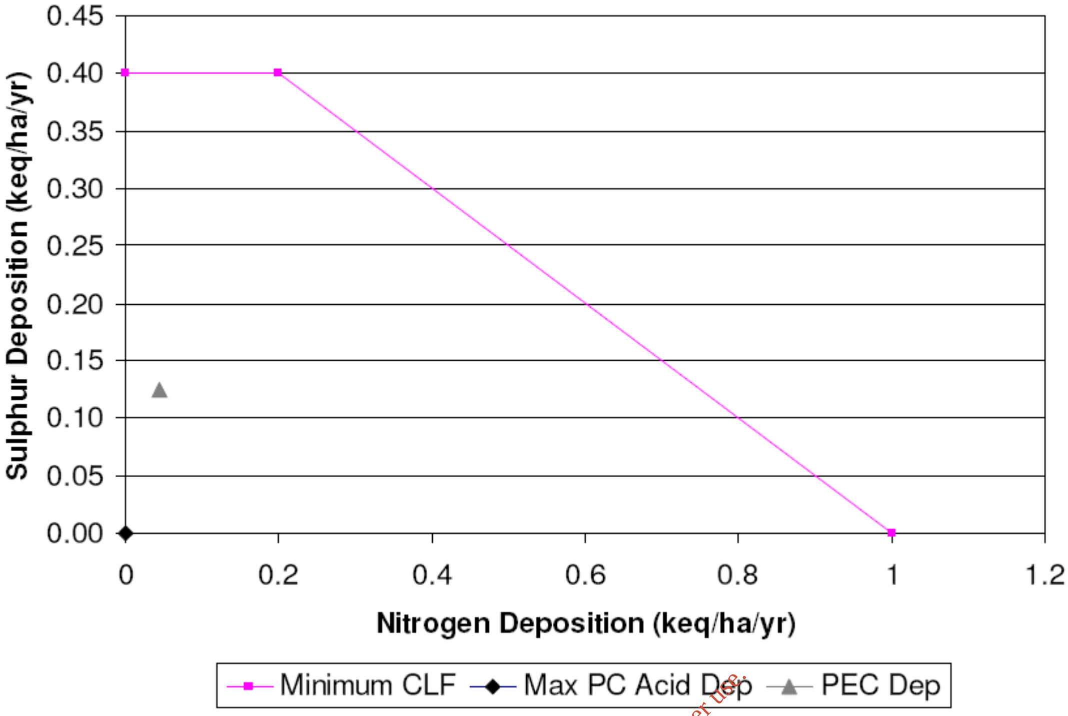
Notes:

- PC = Process Contributions
- PEC = Predicted Environmental Concentration
- AQS = Relevant Air Quality Standard

Site	Designation	Max Predicted Acid Deposition Contribution
Balleyhack	pNHA	0.0024
Balleykelly Marsh	pNHA	0.0026
Mid Waterford Coast	SPA	0.0005
Hook Head	pNHA, SAC	0.0008
Boley Fen	pNHA	0.0016
Dunmore East Cliffs	pNHA	0.0007
Duncannon Sandhills	pNHA	0.0013
Belle Lake	pNHA	0.0005
Carrickavranty Reservoir	pNHA	0.0004
Islandtarnsery Fen	pNHA	0.0004
Kilbarry Bog	pNHA	0.0009
Kings Channel	pNHA	0.0019
Grannyferry	pNHA	0.0005
Lough Cullin	pNHA	0.0007
Lower River Suir (Coolfinn, Portlaw)	pNHA	0.0003
Lower River Suir	SAC	0.0091
Rathsnagadan Wood	pNHA	0.0007
Kylecorragh Wood	pNHA	0.0009
Brownstown Wood	pNHA	0.0006
Waterford Harbour	pNHA	0.0023
Tramore Back Strand	SPA	0.0004
Tramore Dunes and Backstrand	pNHA, SAC	0.0004
Keeragh Islands	NHA, SPA	0.0005
Oaklands Wood	pNHA	0.0013
Tintern Abbey	pNHA	0.0008
Bannow Bay	SPA	0.0005
	SAC	0.001
	pNHA	0.0011
Barrow River Estuary	pNHA	0.0001
River Barrow and River Nore	pNHA	0.0001

Table I.1.17: Maximum Predicted Acid Deposition Contribution at Designated Sites (keq/ha/year)

Figure I.1.14: Minimum Critical Load Function – Lower River Suir



Note:

- CLF = Critical Load Function
- PC = Process Contribution to Acid Deposition
- PEC = Predicted Environmental Concentration Deposition (Process Contribution + Background)

Critical Loads – Eutrophication

Contributions to the Critical Loads for Eutrophication at each site have been derived from the ADMS dispersion modelling.

Maximum process contributions from the dispersion modelling are reported in Table I.1.18. The results are compared with the assumed critical load. Predicted total nitrogen deposition contribution at each designated site is presented and compared with the relevant critical load.

The results presented in Table I.1.18 indicate that nitrogen deposition contributions to all designated sites are less than 1% of the critical load except Lower River Suir which is approximately 2.3%. Table I.1.18 presents results for the total nitrogen deposition (i.e. including background deposition). It can be seen that no exceedances of the critical load are predicted.

Site	Designation	Critical Load	Max predicted N deposition contribution	Max predicted N deposition contribution as % Critical Load	Background N deposition	Max predicted Total N deposition	Max predicted Total N deposition as % Critical Load
Balleyhack	pNHA	5.6	0.034	0.6	0.609	0.643	11.5
Balleykelly Marsh	pNHA	5.6	0.036	0.6	0.609	0.645	11.5
Mid Waterford Coast	SPA	5.6	0.006	0.1	0.609	0.615	11.0
Hook Head	pNHA, SAC	5.6	0.011	0.2	0.609	0.62	11.1
Boley Fen	pNHA	5.6	0.023	0.4	0.609	0.632	11.3
Dunmore East Cliffs	pNHA	5.6	0.01	0.2	0.609	0.619	11.1
Duncannon Sandhills	pNHA	5.6	0.018	0.3	0.609	0.627	11.2
Belle Lake	pNHA	5.6	0.007	0.1	0.609	0.616	11.0
Carrickavranty Reservoir	pNHA	5.6	0.006	0.1	0.609	0.615	11.0
Islandtarnsery Fen	pNHA	5.6	0.006	0.1	0.609	0.615	11.0
Kilbarry Bog	pNHA	5.6	0.013	0.2	0.609	0.622	11.1
Kings Channel	pNHA	5.6	0.026	0.5	0.609	0.635	11.3
Grannyferry	pNHA	5.6	0.007	0.1	0.609	0.616	11.0
Lough Cullin	pNHA	5.6	0.01	0.2	0.609	0.619	11.1
Lower River Suir (Coolfinn, Portlaw)	pNHA	5.6	0.004	0.1	0.609	0.613	10.9
Lower River Suir	SAC	5.6	0.127	2.3	0.609	0.736	13.1
Rathsnagadan Wood	pNHA	5.6	0.009	0.2	0.609	0.618	11.0
Kylecorragh Wood	pNHA	5.6	0.012	0.2	0.609	0.621	11.1
Brownstown Wood	pNHA	5.6	0.009	0.2	0.609	0.618	11.0
Waterford Harbour	pNHA	5.6	0.033	0.6	0.609	0.642	11.5
Tramore Back Strand	SPA	5.6	0.006	0.1	0.609	0.615	11.0
Tramore Dunes and Backstrand	pNHA, SAC	5.6	0.006	0.1	0.609	0.615	11.0
Keeragh Islands	NHA, SPA	5.6	0.006	0.1	0.609	0.615	11.0
Oaklands Wood	pNHA	5.6	0.018	0.3	0.609	0.627	11.2

Tintern Abbey	pNHA	5.6	0.011	0.2	0.609	0.62	11.1

Table I.1.18: Predicted total Nitrogen deposition at Ecological Receptors (kg N/ha/year)

Site	Designation	Critical Load	Max predicted N deposition contribution	Max predicted N deposition contribution as % Critical Load	Background N deposition	Max predicted Total N deposition	Max predicted Total N deposition as % Critical Load
Bannow Bay	SPA	5.6	0.008	0.1	0.609	0.617	11.0
	SAC	5.6	0.014	0.3	0.609	0.623	11.1
	pNHA	5.6	0.016	0.3	0.609	0.625	11.2
Barrow River Estuary	pNHA	5.6	0.001	0.0	0.609	0.61	10.9
River Barrow and River Nore	pNHA	5.6	0.001	0.0	0.609	0.61	10.9

Table I.1.18 (cont.): Predicted total Nitrogen deposition at Ecological Receptors (kg N/ha/year)

I.1.6 Statement of Impacts of Atmospheric Emissions

The definition of air pollution in the Air Pollution Act is "*a condition of the atmosphere in which a pollutant is present in such a quantity as to be liable to-*

(i) be injurious to public health, or
(ii) have a deleterious effect on flora or fauna or damage property, or
(iii) interfere with amenities or with the environment".

The results of this assessment indicate that concentrations of all relevant pollutants are predicted to remain well below the relevant air quality standards when the plant is firing on either natural gas or distillate fuel oil. The predicted impacts of the maximum Process Contributions for all pollutants are concluded to be of negligible to slight adverse significance.

Results of the assessment of impacts on Designated Sites as a result of atmospheric NO_X concentrations, acid deposition, and nitrogen deposition show that all Process Contributions are less than one percent of the relevant Environmental Quality Standards except at the Lower River Suir where Process Contributions of NO_X and nitrogen deposition are above one percent of the critical level and relevant critical load. However, total NO_X concentrations and nitrogen deposition rates (including background concentrations) at the Lower River Suir remain well below the relevant criteria and hence are not significant in air quality terms. The ecological assessment has concluded that the air quality effects at the Lower River Suir site are negligible.

Detailed dispersion modelling of the operational phase predicts that the significance of effects of the proposed plant on human health and sensitive ecological receptors would be categorised as 'negligible' overall. Please refer to EIS for additional information on modelling if required.

I.2 Assessment of Impact on Receiving Surface Water

Describe the existing environment in terms of water quality with particular reference to environmental quality standards or other legislative standards. Table I.2(i) should be completed

Provide a statement whether or not emissions of main polluting substances (as defined in the Schedule of S.I. 394 of 2004) to water are likely to impair the environment.

Give summary details and an assessment of the impacts of any existing or proposed emissions on the environment, including environmental media other than those into which the emissions are to be made.

Full details of the assessment and any other relevant information on the receiving environment should be submitted as **Attachment Nº I.2.**

I.2.1 Introduction:

The operation of the CCGT power plant is anticipated to produce and discharge into the Barrow Estuary the following waste water streams, previously treated when required:

- Process waste water
- Cooling water
- Foul water
- Surface water run-off

This attachment describes the baseline surface water quality and hydrology of the receiving environment in the vicinity of the proposed development and the mitigation measures needed, if any, to address any significant impacts with respect to water consumption, waste water discharge and flood risk.

I.2.2 Existing water quality

(i) Water Body Status

In 2008 the Barrow Suir Nore Estuary (Water Body Code IE_SE_100_0100) was categorised as a Transitional Water Body of overall **Moderate** Status (interim classification) with an overall risk result of "**1a-At Risk"**. The water body passed the Specific Pollutants (Annex VIII of the Water Framework Directive) criteria but failed in relation to Chemical Status (Annex X). Integrated Pollution Prevention and Control (IPPC) Point Risk Sources and Waste Water Treatment Plant Point Risk Sources were classified as "**1a-At Risk"**. The Barrow River Estuary is classified as a proposed Natural Heritage Area (pNHA). The River Barrow and River Nore are classified as Special Areas of Conservation (SACs).

In line with the EU Water Framework Directive and its transposition into Irish law, the overall objective for the Barrow-Suir-Nore Estuary is to restore it to "**Good**" status by 2015.

According to the Water Quality in Ireland Report for 2007-2008 the Barrow-Suir-Nore Estuary is considered to present an **Intermediate** *Quality level*.

The estuary was considered to be of **Good** *conservation status* by the National Parks and Wildlife Service (NPWS) and at least Good overall protected areas status.

The estuary **failed** in the *chemical status* category (Priority Hazardous Substances) only. The failure parameters were:

- Brominated Diphenyl Ethers (BDE),
- Mercury,
- Benzo/Indeno-pyrenes,
- Endosulfan and
- Pentachlorobenzene

It should be noted that there are no known discharges from the proposed development which would introduce these elements into the receiving environment. Furthermore the current discharge from the existing HFO plant does not affect any of the substances listed above. The discharge from the proposed CCGT will be similar in make-up to the HFO plant, therefore no affect is anticipated on the *chemical status* category of the receiving water body

Details of the criteria used by the EPA in determining the interim Water Framework Directive classification for the Barrow-Suir-Nore Estuary are re-produced in Table I.2.1. A copy of the report for the estuary is presented in Appendix I.2.1 Barrow Suir Nore Estuary Report.

General conditions	Biology quality elements	Specific Pollutants (Annex VIII)	Chemical Status (Annex X)	Ecological Status	Surface Water Status	Conservation Status (NPWS)	Overall Protected Area Status	Rivers Likely Status
High/Good/Moderate[1]	Good	Pass	Fail[2]	Good	Moderate	Good	At Least Good	Not Specified

Table I.2.1: EPA Interim Classification Criteria for the Barrow Suir Nore Estuary

Notes:

1. High or Good status was achieved for Molybdate Reactive Phosphorous (MRP), Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD). Moderate status was achieved for Dissolved Inorganic Nitrogen (DIN). The European Communities Environmental Objectives (Surface Waters) Regulations does not include a DIN threshold for transitional water bodies. DIN is therefore not applicable for the purposes of WFD classification for the Barrow Suir Nore Estuary.
2. The water body failed both Maximum Allowable and Annual Average Concentrations – Analysis based on National Screening Exercise.

Table I.2(i) SURFACE WATER QUALITY

(Sheet 1 of 2) Monitoring Point/ Grid Reference: 14B013800 / E271720 N127650

Parameter	Results (mg/l)				Sampling method[2] (grab, drift etc.)	*Normal Analytical Range[2]	Analysis method / technique
pH							
Temperature							
Electrical conductivity EC							
Ammoniacal nitrogen NH_4-N							
Chemical oxygen demand							
Biochemical oxygen demand							
Dissolved oxygen DO							
Calcium Ca							
Cadmium Cd							
Chromium Cr							
Chloride Cl							
Copper Cu							
Iron Fe							
Lead Pb							
Magnesium Mg							
Manganese Mn							
Mercury Hg							

Surface Water Quality (Sheet 2 of 2)

Parameter	Results (mg/l)				Sampling method (grab, drift etc.)	*Normal Analytical Range	Analysis method / technique
Nickel Ni							
Potassium K							
Sodium Na							
Sulphate SO_4							
Zinc Zn							
Total alkalinity (as $CaCO_3$)							
Total organic carbon TOC							
Total oxidised nitrogen TON							
Nitrite NO_2							
Nitrate NO_3							
Faecal coliforms (/100mls)							
Total coliforms (/100mls)							
Phosphate PO_4							

(ii) Existing Operations

The existing power generation plant comprises three conventional steam generating units (Units 1, 2 and 3) operating on Heavy Fuel Oil (HFO). Units 1 and 2 each have operating capacities of 60 MW. Unit 3 has an operating capacity of 120 MW.

Each Unit operates independently and comprises a boiler, steam turbine/condenser and auxiliary plant. Seawater, used for cooling of the steam turbine condensing plant, is dosed with Sodium Hypochlorite, as required. Boiler treatment chemicals currently in use on-site include aqueous Ammonia, aqueous Hydrazine and Tri-sodium Phosphate.

Units 1 and 2 have been operational since 1967/1968 whilst Units 3 has been in operation since 1972, with an established record of environmental compliance. The existing plant is regulated under IPPC licence Registration Number P0606-02.

Potable Water Consumption

Potable water is used in the canteen, main building, welfare facilities, water treatment plant (i.e. feedwater for the existing Units) and for general site cleaning.
This water is sourced from the Wexford County Council mains supply.
Potable water consumption is currently approximately 177,161m^3/annum or 20m^3/hr, when all the three Units of the existing HFO plant are operating.
Approximate potable water consumption rates for the existing plant are presented in Table I.2.2.

Use	Average Demand (m^3/hr)
Operation of existing units 1, 2 and 3	19.36
Domestic Water (welfare facilities, canteen, general site cleaning)	0.86
Total	**20.22**

Table I.2.2: Existing Potable Water Demands

It is anticipated that existing potable water demand will be reduced to 37% of the current maximum demand as a direct result of the replacement of the existing plant with the proposed CCGT.

Effluent discharges

Typical effluent discharge volumes from the existing three Units amount to 17.36 m^3/hr, approximate values for each Unit are provided hereunder:

- Unit 1: 4.48 m^3/hr
- Unit 2: 4.48 m^3/hr
- Unit 3: 8.40 m^3/hr

Table I.2.3 presents the permitted discharges to water as specified in the existing IPPC licence (Registration Number P0606-02).

Wastewater	Emission Point Ref No.	Max/d (m^3/hr)	Max/hr (m^3/hr)	ELV's (mg/l unless otherwise specified)
Condenser Cooling Water	SW2	1,204,080	50,170	Temperature 15ºC above estuarine water 12ºC (98%ile of hourly values over a year) Thermal Load 352 MWth (maximum) 335 MWth (98%ile of hourly values over a year)
Boiler Blowdown (Prior to dilution with surface water)	SW5	40	-	pH 6-10
Boiler Blowdown/Engine Room Drains (prior to dilution with surface water)	SW6	-	-	pH 6-10 Mineral Oil 20
Engine Room Drains (prior to dilution with surface water)	SW7	-	-	Mineral Oil 20
Cooling Water Screen Wash Water	SW8	1,970	-	Chlorine 0.5
Water treatment neutralisation Tank	SW13	150		pH 6-9 Ammonia 34 kg/d Suspended solid 100

Table I.2.3: Permitted Emissions to Water. Source: IPPC Licence (Registration No. P0606-02)

I.2.3 Assessment of Impacts on Surface Water

(i) Baseline Evaluation Criteria

Directive 2000/60/EC (the Water Framework Directive) was adopted by the European Parliament and Council in 2000. The Water Framework Directive (WFD) establishes a legal framework for the protection, improvement and sustainable management of inland surface waters, transitional waters, coastal waters and groundwater.

The aim of the WFD is to prevent the deterioration in the existing status of waters (including the maintenance of "High Status" where it exists) and to ensure that all waters, with some limited exceptions, achieve at least "Good Status" by 2015.

The *European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003)*, as amended by the *European Communities (Water Policy) (Amendment) Regulations, 2005*, transposed the WFD into Irish law establishing eight River Basin Districts (RBDs) on the island of Ireland for the co-ordinated management of water resources. Water bodies were delineated into groundwater, river, lake, transitional and coastal water bodies and, in accordance with the requirements of the WFD, an analysis of the characteristics and impact of human activity on each RBD was undertaken. This analysis provided an assessment of the likely condition of all water bodies and established a baseline for identifying future priority actions for subsequent stages in the river basin planning approach.

The *European Communities Environmental Objectives (Surface Waters) Regulations, 2009* (S.I. 272 of 2009) give effect to the criteria and standards to be used for classifying surface waters in accordance with the ecological objectives approach of the WFD. In accordance with the regulations waters classified as 'High' or 'Good' must not be allowed to deteriorate. Waters classified as less than good must be restored to at least good status within a prescribed timeframe. In addition, the regulations address certain shortcomings identified by the European Court of Justice in relation to Ireland's implementation of the Dangerous Substances Directive (76/464/EEC, as amended).

The regulations set standards for biological quality elements and physico-chemical conditions, supporting biological elements (e.g. temperature, oxygen balance, pH, salinity, nutrient concentrations and specific pollutants), which must be complied with. These parameters establish the *ecological status* of a water body.

The *chemical status* of a water body is assessed based on thresholds set for certain chemical pollutants, known as priority and priority hazardous substances.

A water body must achieve both "good ecological status" and "good chemical status" before it can be considered to be at "'good status".

The regulations also state that, for the purpose of classification, a status of less than good is assigned in the case of a body of surface water where the environmental objectives for an associated protected area requiring special protection by virtue of obligations arising from specific national legislation for the protection of water, or for the conservation of habitats and species directly dependent on water, are not met.

None of the substances emitted to surface waters by the activity is considered as a "Relevant Pollutant" or "Priority Action Substance" according to the *EU Water Framework Directive (2000/60/EC)*, the *National Regulations implementing the WFD (SI No. 722 of 2003)* and the *National Regulations implementing the Nitrates Directive (SI No. 788 of 2005).*

(ii) Impact Assessment Criteria

Magnitude

The magnitude of an impact is assessed in consideration of its intensity, and its extent in space and time. The criteria used to assess the magnitude of the developments impacts on surface water and the objectives of the WFD are presented in Table I.2.4.

Criteria	Impact Magnitude
Impact is long-term or permanent duration (>5 years); Impact on surface water has a clearly noticeable and significant impact on the objectives of the WFD and the SERBD River Basin Management Plan; and The affected area has limited or no potential to recover.	High
Impact is of medium-term duration (1-5 years); Impact on surface water has a clearly noticeable and significant impact on the objectives of the WFD and the SERBD River Basin Management Plan; and The affected area has the potential to recover.	Medium
Impact is of temporary (weeks) or short-term duration; Impact on surface water has a clearly noticeable and significant impact on the objectives of the WFD and the SERBD River Basin Management Plan; and The affected area has the potential to recover.	Low

Table I.2.4: Criteria for Assessment of Impact Magnitude

Notes:
- SERBD = South Eastern River Basin District
- WFD = Water Framework Directive

Significance

The significance of all impacts is assessed in consideration of the magnitude of the impact and the importance/sensitivity of the affected area.
Impact significance is described as being *Not significant,* of *Low* significance, of *Medium* significance, or of *High* significance.

(iii) Identification of Potential Impacts

The overall operational phase impact of the proposed development on the Barrow-Suir-Nore Estuary, compared with the existing situation, is considered to be of low significance for the reasons outlined below.

According to the interim 2008 WFD classification the Barrow Suir-Nore-Estuary is classified as being of **Moderate** status. The WFD categorisation (and the associated Draft River Basin Management Plan for the SERBD) incorporates the discharges from the existing power plant which has been operational for over 40 years, with an established record of compliance. As detailed in Table I.2.1, EPA Interim Classification Criteria for the Barrow Nore-Suir-Estuary, the NPWS considers the estuary to be of good conservation status. The ecological status was considered to be Good, with all relevant general conditions classified as being of either High or Good status.

The interim WFD categorisation was defaulted to Moderate status due to failures in the chemical status category only, specifically BDE, Mercury, Benzo/Indeno-pyrenes, Endosulfan and Pentachlorobenzene. There are no known discharges from the proposed development which would introduce these elements into the receiving environment and it is not considered that the proposed discharges will in anyway cause deterioration in categorisation status for the estuary.

The volumes of discharges proposed during the operational phase, which are of a similar physico-chemical composition to discharges from the existing HFO plant, will be significantly reduced as presented in Table I.2.5 below.

Waste Water	Existing 3 Units (m^3/hr)	Proposed CCGT (m^3/hr)	Reduction as %
Boiler Blowdown	17.36	6.55	62.27
Condenser Cooling Water	50,170	25,000	50.17

Table I.2.5: Reduction in Effluent Discharges

Reported analytical data for many Transitional water bodies in Ireland, including the Barrow Suir-Nore-Estuary, is limited due to the non-implementation of a dedicated monitoring programme for Specific Relevant Pollutants. Data, for the purposes of WFD classification, has therefore been taken from the National Screening Exercise and the Marine Institute's shellfish waters monitoring programme and other related programmes, as appropriate. The level of confidence which can be assigned to these datasets is low to moderate. The reasons for which are outlined in EPA's explanatory note *Interim Classification of Irish Coastal and Transitional Waters for the Purposes of the EU Water Framework Directive* (June 2009) which are reproduced hereunder:

- *The data analysed were collected for the shellfish waters directive and therefore do not adhere to the sampling requirements of the WFD (Sampling points representative of 'status' within a water body, surveillance monitoring, and frequency (i.e., considerably less than 12 times per year).*
- *Issues with respect to exceedence of lead (mostly EC MAC-EQS), copper and zinc (mostly SI 12 2001 AA-EQS) standards, which may in part reflect the natural variability of metals in seawater and to some extent uncertainties*

associated with their sampling measurement as seawater is a difficult matrix for metal analysis.

- *Further investigation is required to determine whether such exceedence reflects natural variability, artefacts, or anthropogenic inputs within the catchment.*
- *Data on contaminants in shellfish flesh were also available for many of these areas and these provide a good picture of water quality with respect to some metals and organochlorine contaminants, as shellfish act as time integrated samplers for these substances.*
- *For some substances there were issues with Limit of Quantification being higher than the EQS.*

It should also be noted that many of the pollutant and chemical limit values specified in the *European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. 272 of 2009)* are based on mean annual values. Due to the limited datasets available it is possible that the classification of receiving waters will improve, without any mitigation measures being undertaken, once a body of analytical data becomes available.

All practicable steps will be taken to mitigate the adverse impact of the proposed discharges on the receiving water body (i.e. the waste water will be treated to a high standard prior to discharge in accordance with BAT).

The replacement of a Heavy Fuel Oil firing power plant with a natural gas firing CCGT power plant is in accordance with Government policy to replace old and inefficient plant and is of significant overall environmental benefit. Irrespective of whether the proposed discharges take place, the SERBD River Basin Management Plan will implement measures which will restore the water body from Moderate to Good status and it is not considered that the proposed development in any way contradicts the measures provided therein.

Details of the water discharge modelling results showing the effect of the new CCGT discharge on the estuary are included in the Hydrodynamic Modelling report (Appendix I.2.2 of this Application). The report concludes (based on the analysis of a number of tidal scenarios) that not only the current plant is not causing a relevant impact on the estuary, but also that reductions in both extent and temperature of the thermal plume once the CCGT is commissioned and the HFO plant is decommissioned will be achieved.

(iv) Residual Impacts

The existing HFO plant has been in operation since 1967/1968 and is a licensed activity under the IPPC regime, as regulated by the EPA. The proposed development is consistent with the existing activities on the site. The proposed discharges are of a similar physico-chemical nature to existing waste water. However, the volumes will be significantly reduced. Due to the magnitude of impacts and the positive changes from the current situation, the proposed activities will not have an adverse effect on the integrity of the sites or the qualifying features of the conservation objectives of the Natura 2000 sites. As a consequence, the overall residual impact of the proposed development on surface waters during the operational phase is considered to be not significant, when compared with the existing situation.

I.2.4 Statement of Impacts on Surface Waters

The effluent discharges from the site will be of a similar composition to discharges from the existing plant. However, the volumes will be significantly reduced. As a consequence it is considered that the proposed development will not have a significant adverse impact on the receiving environment, when compared to the existing situation.

Appendix I.2.1 Barrow Suir Nore Estuary Report

Nore Estuary Report

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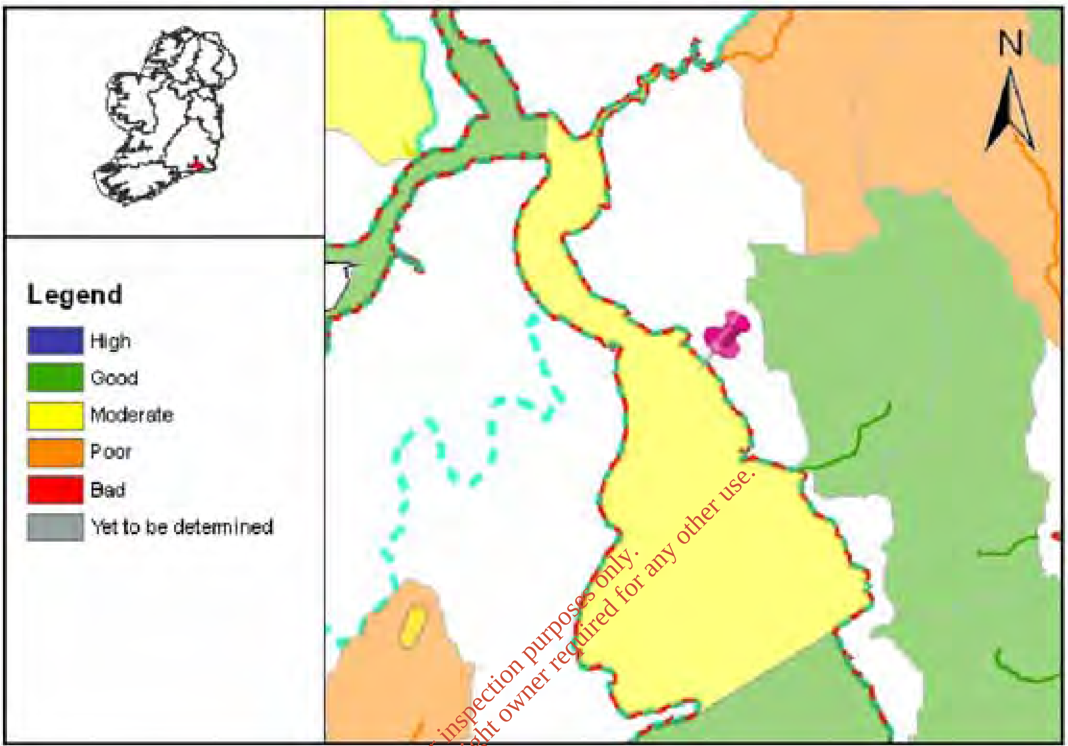
Full Report for Waterbody Barrow Suir Nore Estuary



Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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Summary Information:

WaterBody Category:	Transitional Waterbody
WaterBody Name:	Barrow Suir Nore Estuary
WaterBody Code:	IE_SE_100_0100
Overall Status:	Moderate
Overall Objective:	Restore
Overall Risk:	1a At Risk
Applicable Supplementary Measures:	Urban & Industrial;
	Report data based upon Draft RBMP, 22/12/2008.

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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Status Report

WaterBody Category: Transitional Waterbody

WaterBody Name: Barrow Suir Nore Estuary

WaterBody Code: IE_SE_100_0100

Overall Status Result: Moderate

	Status Element Description	Result
EX	Status from Monitored or Extrapolated Waterbody	True
	General Conditions	
DIN	Dissolved Inorganic Nitrogen	Moderate
MRP	Molybdate Reactive Phosphorus	High
DO	Dissolved Oxygen as percent saturation	High
BOD	Biochemical Oxygen Demand	Good
T	Temperature	Pass
	Biological Elements	
PB	Phytoplankton - Phytoblooms	
PBC	Phytoplankton - PhytoBiomass (Chlorophyll)	Good
MA	Macroalgae	
RSL	Reduced Species List	
SG	Angiosperms - Seagrass and Saltmarsh	
BE	Benthic Invertebrates	
FI	Fish	Good
	HydroMorphology	
HY	Hydrology	
MO	Morphology	Good
	Specific Pollutants	
SP	Specific Relevant Pollutants (Annex VII)	Pass
	Conservation Status	
CN	Conservation Status (Expert Judgement)	Good
	Protected Area Status	
PA	Overall Protected Area Status	At least good

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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	Overall Status	
ES	Ecological Status	Good
CS	Chemical Status	Fail
O	Overall Ecological Status	Moderate

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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Risk Report

WaterBody Category: Transitional Waterbody

WaterBody Name: Barrow Suir Nore Estuary

WaterBody Code: IE_SE_100_0100

Overall Risk Result: 1a At Risk

south eastern

	Risk Test Description	Risk
	Point Risk Sources	
TP1	WWTPs (2008)	1a At Risk
TP2	CSOs	2b Not At Risk
TP3	IPPCs (2008)	1a At Risk
TP4	Section 4s (2008)	2b Not At Risk
TPO	Overall Risk from Point Sources - Worst Case (2008)	1a At Risk
	Hydrology	
THY1	Water balance - Abstraction	2b Not At Risk
	Marine Direct Impacts	
TMDI 1	Dangerous Substances	1b Probably At Risk
TMDI 2	OSPAR	
TMDI 3	UWWT Regs Designations	
TMDI O	Marine Direct Impacts Overall - Worst Case	
	Point / MDI Worst Case	
TPOL	Worst case of Point Overall and MDI OverallOverall (MIMAS) Morphological Risk - Worst Case (2008)	1a At Risk
	Overall Risk	
RA	Transitional Overall - Worst CaseOverall (MIMAS) Morphological Risk - Worst Case (2008)	1a At Risk

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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Risk Report

WaterBody Category: Transitional Waterbody

WaterBody Name: Barrow Suir Nore Estuary

WaterBody Code: IE_SE_100_0100

Overall Risk Result: 1a At Risk

south eastern

	Risk Test Description		Risk
	Point Risk Sources		
TP1	WWTPs (2008)	1a	At Risk
TP2	CSOs	2b	Not At Risk
TP3	IPPCs (2008)	1a	At Risk
TP4	Section 4s (2008)	2b	Not At Risk
TPO	Overall Risk from Point Sources - Worst Case (2008)	1a	At Risk
	Hydrology		
THY1	Water balance - Abstraction	2b	Not At Risk
	Marine Direct Impacts		
TMDI 1	Dangerous Substances	1b	Probably At Risk
TMDI 2	OSPAR		
TMDI 3	UWWT Regs Designations		
TMDI O	Marine Direct Impacts Overall - Worst Case		
	Point / MDI Worst Case		
TPOL	Worst case of Point Overall and MDI OverallOverall (MIMAS) Morphological Risk - Worst Case (2008)	1a	At Risk
	Overall Risk		
RA	Transitional Overall - Worst CaseOverall (MIMAS) Morphological Risk - Worst Case (2008)	1a	At Risk

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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Objectives Report

WaterBody Category: Transitional Waterbody

WaterBody Name: Barrow Suir Nore Estuary

WaterBody Code: IE_SE_100_0100

Overall Objective: Restore

	Objectives Description	Result
	Objectives	
OB1	Objective 1 - Protected Areas	Restore
OB2	Objective 2 - Protect High and Good Status	Not Applicable
OB3	Objective 3 - Restore Less Than Good Status	Not Applicable
OB4	Objective 4 - Reduce Chemical Pollution	Restore
OBO	Overall Objective	Restore
	Deadline	
YR	Default Year by which the objective must be met	2015
OBO	Overall Objective and Deadline	Restore - 2015

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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Basic Measures Report

WaterBody Category: Transitional Waterbody

WaterBody Name: Barrow Suir Nore Estuary

WaterBody Code: IE_SE_100_0100

	Basic Measures Description	Applicable
	Key Directives	
BA	Bathing Waters Directive	Yes
BI	Birds Directive	No
HA	Habitats Directive	Yes
DW	Drinking Waters Directive	No
SEV	Major Accidents and Emergencies (Seveso) Directive	Yes
EIA	Environmental Impact Assessment Directive	Yes
SE	Sewage Sludge Directive	Yes
UW	Urban Waste Water Treatment Directive	No
UW	Urban Waste Water Treatment Directive	No
PL	Plant Protection Products Directive	Yes
NI	Nitrates Directive	Yes
IP	Integrated Pollution Prevention Control Directive	Yes
	Other Stipulated Measures	
CR	Cost recovery for water use	Yes
SU	Promotion of efficient and sustainable water use	No
DWS	Protection of drinking water sources	No
AB	Control of abstraction and impoundments	No
PT	Control of point source discharges	Yes
DI	Control of diffuse source discharges	Yes
GWD	Authorisation of discharges to groundwater	No
PS	Control of priority substances	Yes
MOR	Control of physical modifications to surface waters	Yes
OA	Controls on other activities impacting on water status	Yes
AP	Prevention or reduction of the impact of accidental pollution incidents	Yes

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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Urban and Industrial Discharges Supplementary Measures Report

WaterBody Category: Transitional Waterbody

WaterBody Name: Barrow Suir Nore Estuary

WaterBody Code: IE_SE_100_0100

	Point discharges to waters from municipal and industrial sources	Result
PINDDIS	Is there one or more industrial discharge (Section 4 licence issued by the local authority or IPPC licence issued by the EPA) contained within the water body?	Yes
PINDDISR	Are there industrial discharges (Section 4 licence issued by the local authority or IPPC licence issued by the EPA) that cause the receiving water to be 'At Risk' within the water body?	Yes
PB1	Basic Measure 1 - Measures for improved management.	Yes
PB2	Basic Measure 2 - Optimise the performance of the waste water treatment plant by the implementation of a performance management system.	No
PB3	Basic Measure 3 - Revise existing Section 4 license conditions and reduce allowable pollution load.	Yes
PB4	Basic Measure 4 - Review existing IPPC license conditions and reduce allowable pollution load.	Yes
PB5	Basic Measure 5 - Investigate contributions to the collection system from unlicensed discharges.	Yes
PB6	Basic Measure 6 - Investigate contributions to the collection system of specific substances known to impact ecological status.	Yes
PB7	Basic Measure 7 - Upgrade WWTP to increase capacity.	Yes
PB8	Basic Measure 8 - Upgrade WWTP to provide nutrient removal treatment.	Yes
PS1	Supplementary Measure 1 - Measures intended to reduce loading to the treatment plant.	Yes
PS2	Supplementary Measure 2 - Impose development controls where there is, or is likely to be in the future, insufficient capacity at treatment plants.	Yes
PS3	Supplementary Measure 3 - Initiate investigations into characteristics of treated wastewater for parameters not presently required to be monitored under the urban wastewater treatment directive.	No
PS4	Supplementary Measure 4 - Initiate research to verify risk assessment results and determine the impact of the discharge.	Yes
PS5	Supplementary Measure 5 - Use decision making tools in point source discharge management.	Yes
PS6	Supplementary Measure 6 - Install secondary treatment at plants where this level of treatment is not required under the urban wastewater treatment directive.	No
PS7	Supplementary Measure 7 - Apply a higher standard of treatment (stricter emission controls) where necessary.	Yes

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

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PS8	Supplementary Measure 8 - Upgrade the plant to remove specific substances known to impact on water quality status.	No
PS9	Supplementary Measure 9 - Install ultra-violet or similar type treatment.	No
PS10	Supplementary Measure 10 - Relocate the point of discharge.	Yes

Date Reported to Europe: 22/12/2008

Date Report Created 02/03/2010

Appendix I.2.2

Great Island Hydrodynamic Modelling



Great Island Power Station

Hydrodynamic Modelling

May 2010

Endesa Ireland Limited

Mott MacDonald

Great Island Power Station

Hydrodynamic Modelling

May 2010

Endesa Ireland Limited

3 Grand Canal Plaza, 5th Floor, Grand Canal Street Upper, Dublin 4.

Mott MacDonald, Demeter House, Station Road, Cambridge CB1 2RS, United Kingdom
T +44(0) 1223 463500 F +44(0) 1223 461007 W www.mottmac.com

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Mott MacDonald, Demeter House, Station Road, Cambridge CB1 2RS, United Kingdom
T +44(0) 1223 463500   F +44(0) 1223 461007   W www.mottmac.com

Content

Mott MacDonald

1. Introduction

1.1 Overview

Mott MacDonald was commissioned by Endesa Ireland Limited (Endesa) to undertake a detailed thermal plume hydrodynamic modelling study for the proposed developments to the Great Island Power Plant. It is intended that the existing 240 MW power station, which is fuelled by Heavy Fuel Oil (HFO), is replaced with a 430 MW Combined Cycle Gas Turbine (CCGT) power station which will be primarily fuelled by natural gas. Technology advances mean that that there will be a lower demand for cooling water for the new power station as compared to the existing requirements although the temperature rise of the discharged cooling water will remain the same.

The purpose of this hydrodynamic modelling study is to assess the thermal plume which can be expected once the new CCGT plant is in operation under various climatic and tidal conditions. The report also describes the dispersion characteristics of the existing activity which facilitates the calibration process.

1.2 Integrated Pollution Prevention Control Licensing

The existing Great Island power plant operates under an IPPC licence as issued by the Environmental Protection Agency. The cooling water discharge element of this license is detailed in Table 1.1 below. The IPPC license will be reviewed and amended for the proposed CCGT plant.

Table 1.1: Existing Condenser Cooling Water Permitted Emissions

Emission Reference Nr.	Max/Day (m^3)	Max/Hour (m^3)	Emission Limit
SW2	1,204,080	50,170	Temperature 15°C above estuarine water. 12.0°C (98%ile of hourly values over a year). Thermal Load 352MWth (Maximum). 335MWth (98%ile of hourly values over a year). Chlorine 0.5mg/l.

Source: IPPC license (Registration Number P0606-02)

There is also one further condition on the license as follows:

No effluent shall be discharged which results in a temperature increase at the edge of the mixing zone of greater than 1.5°C in the receiving system. The mixing zone shall not exceed 25% of the estuarine cross sectional area at any point.

1.3 Hydrodynamic Model

The model has been built using Mott MacDonald's in house modelling software HYDRO-3D. This software was developed over many years by staff at Mott MacDonald, and is supplemented by a strong association with the University of Surrey, from where numerous MSc and PhD students have studied and developed the model facilities. The model has been applied to studies across the world and, in addition, has been audited externally. Further details on the theory behind HYDRO-3D and an overview of the processes and equations used by the model to simulate water movement and plume dispersion have been included in Appendix D.

2. Background Information

2.1 Geographical Location

It is proposed that the CCGT will be constructed on the existing Great Island site, at OS Grid Reference E 268907, N 114574. This site is at the confluence of the Rivers Barrow and Suir at Great Island in County Wexford. Although the proposal involves the construction of a new CCGT, the design includes utilising the existing cooling water intake and outfall structures. Figure 2.1 shows the location of the power station and also the locations of the cooling water intake and outfall.

Figure 2.1: Location of Great Island Power Station

2.2 Meteorological Conditions

Ireland has a generally temperate climate and does not experience particularly extreme conditions. The most representative weather station to the study area is Rosslare, in the south east of the country, for which the Irish Meteorological Service has 30 year average data. The average annual temperature is around 10^{o}C with an average wind speed of approximately 6 m/s and yearly rainfall averages around 880 mm. Full details of the 30 year temperature averages for Rosslare may be found in Appendix A.

2.3 Barrow, Suir, Nore Estuary

The power station is at the confluence of the River Barrow and the River Suir. The River Barrow Estuary is a proposed Natural Heritage Area and the River Barrow, River Nore and Lower River Suir are designated Special Areas of Conservation (see EIS for further details) which are legal definitions for site and/or species which are protected under the Wildlife Acts, 1976 and 2000 and the European Union Habitats Directive 92/43/EEC.

2.4 Power Station Conditions

The existing power station at Great Island currently operates three units on HFO, all of which are in need of replacing. As for the existing power station, cooling water is required to absorb heat from the proposed CCGT plant when in operation. It is proposed that this cooling water will be abstracted from and returned to the Barrow Estuary using the intake and outfall structures that are in place for the existing power plant and indicated on Figure 2.1. The temperature rise of the discharged cooling water from the proposed CCGT is designed to be the same as the existing generated from existing activities, i.e., a 12^{o}C rise above ambient. However it should be noted that the volume of cooling water required is expected to drop significantly, from a maximum of around 50,170m^3/hr (IPPC license maximum) to a maximum of approximately 25,000m^3/hr (as stated in the EIS) when the CCGT is fully operational. This equates to a reduction in the volumes of cooling water discharged of approximately 50%.

Table 2.1: Comparison between Existing and Proposed Thermal Discharges

Variable	Existing Scenario	Proposed CCGT Scenario
Temperature Rise	12^{o}C	12^{o}C
Maximum Volume Discharged	50,170 m^3/hr	25,000 m^3/hr

3. Model Construction

3.1 Data Availability

Much of the data needed to build and calibrate the hydrodynamic model was readily available at the start of the project. However, it is important that high quality data are used for all aspects of the modelling to ensure that the model predictions are as accurate as possible. Therefore a bathymetric survey was commissioned to cover the critical area for the thermal plume around the outfall as there was not sufficiently detailed bathymetric information in this area.

Furthermore, there was only limited data available on river flow for the Suir and Barrow and therefore a hydrological analysis was undertaken to estimate the river flow for the Barrow and Suir at their confluence as this data was unavailable, based on gauging stations further upstream on the River Barrow, River Suir and River Nore, see Section 3.2.4.

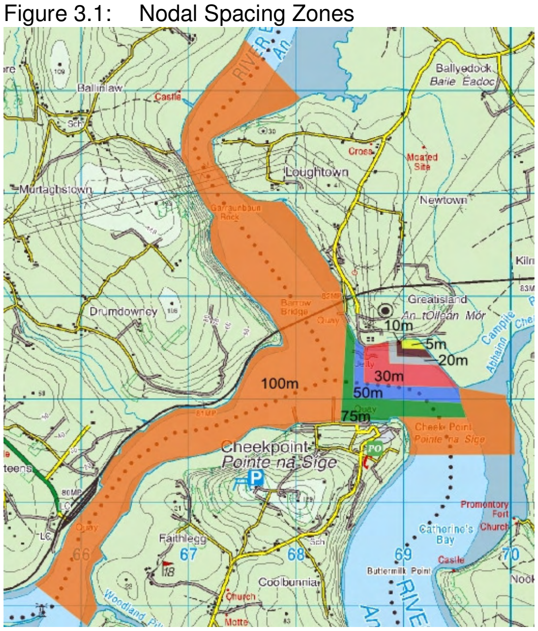
3.2 Model Development

3.2.1 Model Network

The network is the skeleton of the hydrodynamic model. It comprises the nodes and elements that are used for the mathematical calculations that form the basis of the model. The nodes are specified to be a set distance apart from each other and these distances can vary in zones so that in the area of interest the nodes can be very close together to show a high level of detail in the results whereas further from the area of interest the nodal spacing can be much larger which means that the model run time is not excessive. The total modelled area in this case is just under 5 km^2.

For this model the nodal spacing ranged from 100 m to 5 m, as shown by the coloured zones in Figure 3.1. This means that the model is very detailed in the area of interest as a 5 m grid is high resolution for modelling.

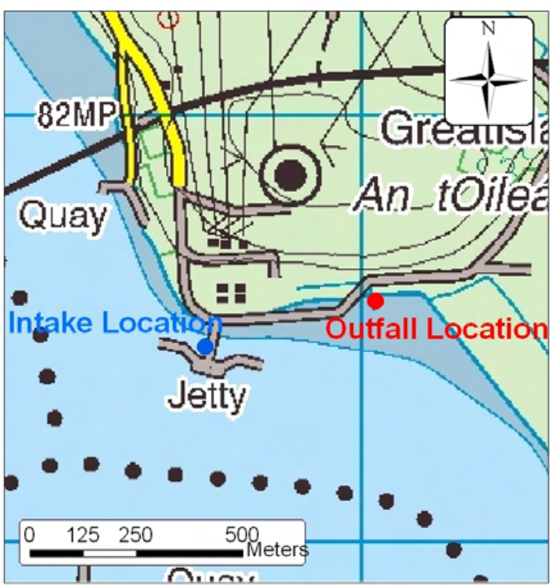
Figure 3.1: Nodal Spacing Zones



3.2.2 Intake and Outfall

The proposed power station developments will use the existing cooling water intake and outfall structures. Figure 3.2 shows the approximate locations of the cooling water intake and outfall. The outfall structure is a channel opening into the estuary at the location indicated by the red dot on Figure 3.2.

Figure 3.2: Cooling Water Intake and Outfall Locations

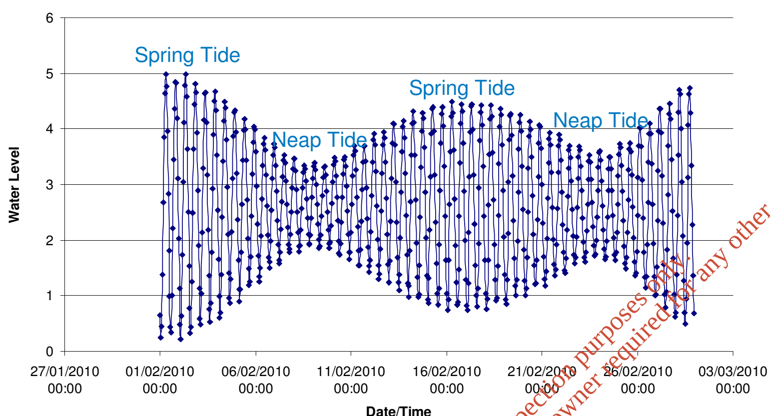


3.2.3 Tidal Boundary

Tidal data was analysed from the Admiralty Tables Volume 1 (2010) to obtain typical summer and typical winter 28 day tidal cycles. The two tidal cycles are very similar and the winter prediction is shown in Figure 3.3. As labelled in the figure, the largest tides are the spring tides and the smallest are the neap.

To provide a comprehensive assessment of the thermal plume, the model was run for both the spring and neap tidal scenario for both summer and winter conditions.

Figure 3.3: 28 Day Tidal Prediction – February 2010



3.2.4 River Flow

3.2.4.1 Available Data

River flow data was obtained from the public network of hydrometric gauging stations as set out in the Register of Hydrometric Stations in Ireland. The scope of this network includes 48 stations on the Barrow, Nore and Suir rivers. Catchment area and average rainfall were given for all stations, with values of Dry Weather Flow (DWF) and Q95 (the flow exceeded for 95% of the time on average) for 22 of the stations. Flow values were not available for stations within the regions of tidal influence due to the variable flow dynamic in such areas which is typical of such environments.

The combined catchment area is 9160 km^2, over one eighth of the area of the Republic of Ireland and similar to major UK river basins such as the Thames and Severn.

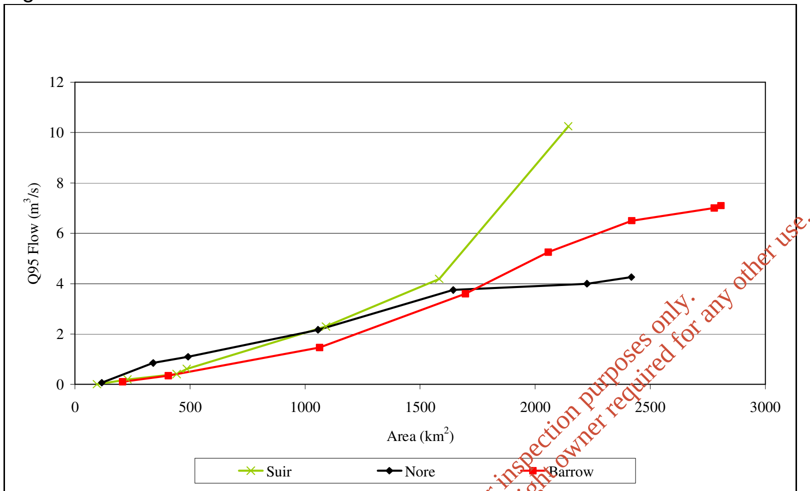
The station information is summarised in Appendix B.

3.2.4.2 Flow Estimates for the Barrow Bridge Confluence

Average and low flows in the vicinity of the power station for the Rivers Barrow and Suir are of most interest for modelling. Average flows can be estimated with reasonable reliability from average rainfall and assumed average losses (primarily through evapotranspiration from plants). Low flow estimates can be based on the published station information about Q95 for “typical” low flows and the DWF for a more severe condition.

The build-up of Q95 within the three subcatchments is illustrated in Figure 3.4. This shows reasonably steady growth with increasing area except for the last point on the Suir. The data shows 4.2 m^3/s at Caher Park where the catchment area is 1583 km^2 and 10.3 m^3/s at Clonmel where the area is 2144 km^2, an increase of almost 150% in Q95 for an increase in area of only 35%. Whilst it is possible that the additional catchment has much more sustained low flows it is more likely that the values are not consistent (perhaps due to the use of different periods of data), and for the purposes of this study it is considered appropriate to exclude the Clonmel value thereby presenting a conservative lower flow estimate.

Figure 3.4: Growth of Q95 with Catchment Area



Values of Q95 for the furthest downstream stations in each sub-catchment (excluding Clonmel) are shown in Table 3.1. These have been used to estimate the Q95 values for the Barrow and Suir rivers at the confluence near Cheek Point, as shown in Table 3.2. By a similar procedure the DWF would be approximately 7 m^3/s for each river.

Table 3.1: Estimates of Q95 for Subcatchments

			Q95	
River	Station	Area (km^2)	(m^3/s)	($l/s/km^2$)
Suir	Caher Park	1583	4.19	2.6
Nore	Brownsbarn	2418	4.26	1.8
Barrow	Graiguenamanagh	2808	7.10	2.5
Nore/Barrow		5226	11.36	2.2

Table 3.2: Estimation of Q95 at the Cheek Point Confluence

River	Area (km^2)	Q95 ($l/s/km^2$)	Q95 (m^3/s)
Suir	3572	2.6	9.5
Barrow	5587	2.2	12.1
Combined	9160	4.8	21.6

Average flows have been estimated from average rainfall and assumed average losses of 400mm, as shown in Table 3.3.

Table 3.3: Estimation of Average Flow at the Cheek Point Confluence

River	Area (km^2)	Rain (mm/y)	Losses (mm)	Runoff (mm)	Mean Flow (m^3/s)
Suir	3572	1161	400	761	86
Barrow	5587	996	400	596	106
Combined	9160	1061	400	661	192

All the derived flows are summarised in Table 3.4. It should be noted that these refer to fluvial flow and take no account of tidal flows. The data utilised was obtained from publicly maintained datasets and the values for the various stations are generally consistent with one another. The magnitude of Q95 values is in keeping with what we would expect for catchments of this size and average rainfall and where anomalies at individual gauging stations have been integrated on the assumption of a worst case scenario 'lower flow' basis.

Table 3.4: Summary of Flow Estimates for Cheek Point Confluence (m^3/s)

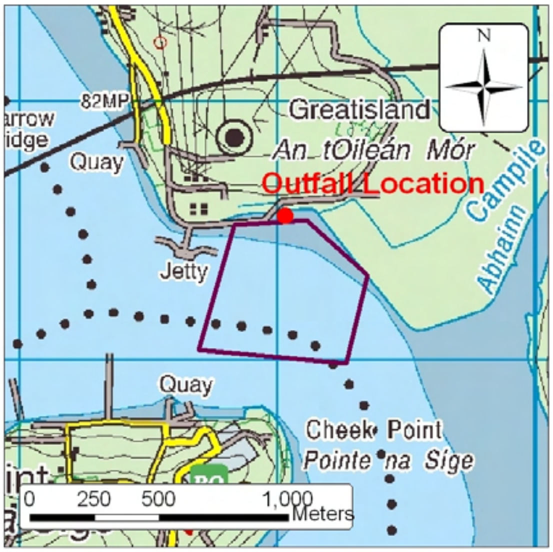
River	Mean	Q95	DWF
Suir	86	9.5	7.2
Barrow	106	12.1	6.7
Combined	192	21.6	14.0

The river flow data for the River Barrow and River Suir was used as an inflow to the hydrodynamic model approximately 4 km upstream of the power station so that the model could reach its own equilibrium and so that the tides and currents were accurately represented at the estuary.

3.2.5 Bathymetry

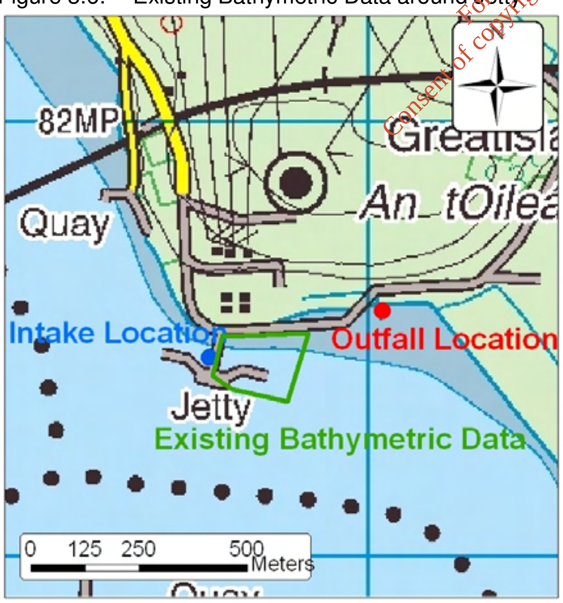
There was no detailed bathymetry available in the area of interest around the outfall and therefore a bathymetric survey was commissioned as part of this modelling study. This survey covered the vicinity of the outfall structure in detail covering the area shown in Figure 3.5.

Figure 3.5: Area covered by Bathymetric Survey



Previously surveyed bathymetric data was available for the area inside the jetty, this was used to improve the bathymetric surface for this part of the model. The area covered by this data is shown in Figure 3.6.

Figure 3.6: Existing Bathymetric Data around Jetty



In addition to the new bathymetric survey data around the outfall and previously surveyed area inside the jetty, digital bathymetry data was purchased from SeaZone to cover the entire extent of the model. The data is from charted bathymetry and previous surveys. This gave us complete bathymetric coverage of the model extent.

As there were a number of sources of bathymetric data, the most accurate data for each area of the model was selected and these were merged to create complete bathymetric surface for the entire model extent.

3.2.6 Climatic Conditions

There was an abundance of climatic data available. 30 year averages for Rosslare, the closest station for which the Irish Meteorological Service has records for were analysed to determine which month's typical conditions would be used for the summer conditions in the model and which for the winter conditions. This data is included in Appendix A.

The worst case scenario for thermal plume size is likely to be when the temperatures are at their warmest, this is in July and August. July was selected for the summer scenario as the solar radiation is stronger than in August. Similarly, the winter condition selected is January.

The climatic data required for the hydrodynamic model are air temperature, wind speed, wind direction, incoming solar radiation, relative humidity and cloud cover. All this data except incoming solar radiation was supplied as hourly data for 2003 to 2007. There were occasional individual readings within this data where no data was available and as these were so few they were removed from the assessment. The data was analysed to obtain an average for each climatic variable for each hour in January and July (1am, 2am, 3am etc). These data were then interpolated to provide an estimate for every 10 minutes within a 24 hour period and this data was used in the model. The hourly data averages for January and July may be found in Appendix C.

Incoming solar radiation was calculated from the average solar radiation for the latitude of the study area.

The ambient water temperature of the estuary was calculated from EPA data. The site selected was Barrow Bridge as it is close to the power station but also upstream so any discharge from the power station should not have an impact on the temperatures recorded at this site. The ambient temperature used for winter conditions was an average of all recorded temperature readings for February at Barrow Bridge (there was no data for January) and similarly for summer conditions an average was calculated from all recordings for July at Barrow Bridge. The average ambient temperature for winter was estimated to be 8.0^{o}C and the average ambient temperature for summer was estimated at 17.8^{o}C.

3.2.7 Mud Flats

Due to the tidal range of the area, up to around 5 m for a spring tide, there are inter-tidal areas which are exposed when the tide is very low. This includes the mud flats area around the mouth of the outfall channel. Inter-tidal areas further away from the outfall could be ignored as they have no impact on the plume but consideration of drying areas around the outfall channel and plume coverage is essential. These areas were carefully represented in the hydrodynamic model by allowing the porosity to gradually reduce over the mud flats, resulting in the model gradually reducing the volume of water in these areas, thus representing the wetting and drying.

4. Model Calibration and Verification

4.1 Introduction to Calibration and Verification

Calibration and verification are used in numerical modelling exercises to minimise the inherent uncertainties in these methods. The calibration process involves running the model for a scenario (or scenarios) with a known outcome, for this study the model has been run for a neap tidal cycle for a day that the thermal plume was surveyed and where much of the climatic and tidal data was recorded, in addition, the power station operating conditions were recorded. This enables the comparison of the model results to the known conditions and if necessary modification of the model so that it accurately represents the conditions.

Once the model has been calibrated and is representing the conditions accurately it is verified by running another (different) known scenario (or scenarios) and checking that these conditions are also being represented accurately. For this study the verification data was from a similar survey of the plume under spring tidal conditions where climatic, tidal and power station conditions were recorded.

Generally, the more data available to calibrate and verify the data, the more confidence one can place in the numerical model results.

4.2 Calibration and Verification Data Used

To calibrate and verify the model we used reports on two previous surveys monitoring the thermal plume of the existing power station undertaken by ESB International. One of the reports covers a neap tidal cycle and one a spring tidal cycle and therefore one of these was used for calibration and one for verification. The objective of the surveys was to 'measure the extent and thermal characteristics of the cooling water discharge plume from the power station' which is ideal as this data could then be used as a direct comparison with the model results.

The reports provide useful data, regarding the tidal heights, power station operations at the time of the survey, some climatic conditions and thermal plume temperature and extent. See Table 4.1 and Table 4.3 for the data used in the calibration and verification models.

Climatic data used in the calibration and verification process was for Rosslare as the data for the production runs is from the same station so the model required calibrating to climatic data for this location. See Table 4.2 and Table 4.4 for climatic data used in the calibration and verification models.

Table 4.1: Data used for Calibration (21st October 1996)

Variable	Value
Power station discharge volume	9 820 m^3/h
Ambient water temperature	13.03°C
Temperature rise of discharge water	10.8°C
Low water	07:33, 1.4 m
High water	13:34, 3.7 m
Low water	20:09, 1.3 m

Source: Thermal Plume Survey: Neap Tide 21 October 1996. ESB International.

Table 4.2: Climatic Data used for Calibration (21st October 1996)

Time	Wind Speed (knots)	Wind Direction (degrees)	Air Temperature (°C)
07:00	5	250	7.8
08:00	6	230	8.6
09:00	6	230	10.3
10:00	4	250	12.0
11:00	5	240	13.2
12:00	6	220	13.5
13:00	7	210	13.0
14:00	7	210	13.0
15:00	7	200	13.2
16:00	7	190	12.5
17:00	9	190	12.2
18:00	9	190	11.5
19:00	6	160	12.0
20:00	10	160	12.0

Source: Thermal Plume Survey: Neap Tide 21 October 1996. ESB International.

NOTE: 1 knot = 0.514 m/s

Table 4.3: Data used for Verification (14th October 1996)

Variable	Value
Power station discharge volume	24 550 m^3/h
Ambient water temperature	14.14°C
Temperature rise of discharge water	7.0°C
Low water	01:32, 0.7 m
High water	07:29, 4.3 m
Low water	13:47, 0.6 m
High water	19:43, 4.3 m

Source: Thermal Plume Survey: Spring Tide 14 October 1996. ESB International.

Table 4.4: Climatic Data used for Verification (14th October 1996)

Time	Wind Speed (knots)	Wind Direction (degrees)	Air Temperature (°C)
07:00	13	170	14.1
08:00	14	180	14.2
09:00	14	180	14.5
10:00	14	180	14.2
11:00	11	220	14.5
12:00	13	210	14.0
13:00	13	210	14.7
14:00	12	210	14.7
15:00	13	220	15.0
16:00	13	220	14.3
17:00	7	270	13.0
18:00	5	250	11.0
19:00	6	230	11.1
20:00	7	230	11.0

Source: Thermal Plume Survey: Spring Tide 14 October 1996. ESB International.

NOTE: 1 knot = 0.514 m/s

4.3 Results of Calibration and Verification

The calibration and verification survey reports have some key features of the thermal plume recorded and a selection of isotherm plots for various tidal stages. The key features have been summarised in the following tables which compare the model results to the surveyed data. Values are not exact and have been rounded in places as no modelling exercise is totally accurate. It is important to note that there is a discrepancy between the location of the outfall provided for the modelling (which is accurate to reality) and the location drawn on the surveyed plots from 1996. Measurements indicated in the following tables for modelled results are from the location of the outfall as modelled. The isotherm plots were used as a visual aid in model calibration however have not been included in this report. The calibration and verification results indicate that a good match between modelled results and observed results was obtained.

4.3.1 Calibration: Neap Tidal Cycle

		Temp Rise at Outfall (°C)	Distance of Plume Upstream (m)	Distance of Plume Downstream (m)
Flood Flow (HW-3hr)	Report	Just over 5.0	200	300
	Model	>5.0	200	260
High Water	Report	Just over 3.0	250	150 (south)
	Model	>5.0	200	180 (south)
Ebb Flow (HW+3hr)	Report	4.0	Less than 1°C at 130m	Less than 1°C at 130m
	Model	>5.0	As observed in report (plume up to 150m)	As observed in report (plume up to 200m)
Low Water	Report	Over 5.5	-	150
	Model	>5.0	150	180

4.3.2 Verification: Spring Tidal Cycle

		Temp Rise at Outfall (^oC)	Distance of Plume Upstream (m)	Distance of Plume Downstream (m)
Ebb Flow (HW+3hr)	Report	Max 4.0 ^oC at 50m	-	Over 500
	Model	>5.0	<150	320
Low Water	Report	6.0	-	400
	Model	>5.0	220	290
Flood Flow (HW-3hr)	Report	<4.5	Towards jetty	Small
	Model	>5.0	To jetty (320m)	<200
High Water	Report	<4.5	-	200 (south)
	Model	5.0	220	220 (south)

4.4 Limitations of Calibration and Verification Data

The ESB International reports do not specify some of the climatic data required in the modelling such as cloud cover, incoming solar radiation, relative humidity. The data used for these climatic variables was therefore selected to be the average conditions for the time of the study, October. Furthermore, some specific conditions on the day of the calibration and verification model runs may not be fully represented in the modelling because it is impossible to include all physical conditions, for example, mud flats such as are around the outfall are usually prone to change.

As there was no data recorded regarding the flow rates of the River Barrow and River Suir at their confluence due to the tidal influence in this area the data used was the estimated average flow (see Section 3.2.4). Due to this uncertainty, in the model production runs a typical low flow (Q95) was used to be conservative. This means that the plumes are a ‘worst case scenario’ and were overestimated rather than underestimated.

This study has only been calibrated against one event and verified against one other event. Had more data been available this could have also been used in the calibration and verification process to ensure the model is performing accurately.

The model has been successfully calibrated and verified against two physical surveys, there are sources of error within the survey methods used and reporting of the surveys that may affect the calibration of the model. Such as measurement error, especially as the measurements are taken in 0.5^oC increments. There will also be human error in the surveying and reporting of the plumes. As we did not undertake these surveys it is impossible to estimate the significance of these errors although it is unlikely that they would have been published if the errors were thought to be large.

Regarding the overall calibration and verification process, the accuracy is thought to be within acceptable limits and to remain conservative, when the production runs were carried out they were run under worst case scenarios to ensure that the plumes were not underestimated.

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5. Model Production Runs

5.1 Model Runs

Once calibrated, the model was run for four scenarios, this was to obtain an assessment of the thermal plume under various typical conditions of weather and tidal cycle. The four scenarios are summarised in Table 5.1 below.

Table 5.1: Model Scenarios Run

Model Scenario	Climatic Conditions	Tidal Conditions	River Flow
Scenario 1	Summer	Neap Tide	Q95
Scenario 2	Summer	Spring Tide	Q95
Scenario 3	Winter	Neap Tide	Q95
Scenario 4	Winter	Spring Tide	Q95

The Q95 flow (see Section 3.2.4) was used for all runs as this is an average low flow condition which is a worst case for the plume, the more river flow there is, the more mixing of the plume. Therefore the thermal plume predictions are a worst case scenario.

Table 5.2 shows the existing and proposed scenario discharges modelled. The maximum discharges were used in the modelling as a 'worst case scenario'.

Table 5.2: Comparison between Existing and Proposed Thermal Discharges

Variable	Existing Scenario	Proposed CCGT Scenario
Temperature Rise	12°C	12°C
Maximum Volume Discharged	50,170 m^3/hr	25,000 m^3/hr

5.2 Extreme Conditions

The extreme case was selected to be lowest astronomical tide (LAT) as this is the lowest tide level which can be expected at Cheek Point under any astronomical conditions. Low tide is critical for the thermal plume due to the low water level which reduces mixing, especially for this location as the cooling water is discharged over the mud flats at low tide.

As Cheek Point is a secondary port there was no data on LAT at Cheek Point available, however the Admiralty Tide Tables Volume 1 (2010) had data for the LAT at Cobh (-0.1 m chart datum), the standard port corresponding to Cheek Point. They also indicate the translation between low water level at Cobh and Cheek Point (0.1 m). This means that the low water level at LAT can be estimated to be 0.0 m chart datum, or 0.13 m Poolbeg datum.

5.3 Sensitivity Tests

Sensitivity tests were necessary as there was no river flow or current data for the Suir and Barrow near the confluence. Therefore data from gauging stations further upstream on the Barrow, Nore and Suir were used in a hydrological assessment to predict the mean flow, Q95 and dry weather flow of the Barrow and Suir at their confluence (see Section 3.2.4). As a conservative approach was needed in the modelling, Q95 was used for the production runs, however due to the lack of actual data at the confluence, two sensitivity tests on the impact of the river flow used on the modelled results were undertaken, the calculated value of dry weather flow was used for one model run and the estimated mean flow was used for another.

6. Model Results

6.1 Production Runs

The following plumes are the maximum extent of the plume at any time for the given scenario. This means they are composite plots of the plume extent as it moves over the modelled 28 day tidal cycle. They indicate the maximum temperature rise that can be expected at a given point at any time under the particular modelled conditions, rather than being the plume extent at a given instant in time. Note that they are a worst case scenario for a number of reasons including:

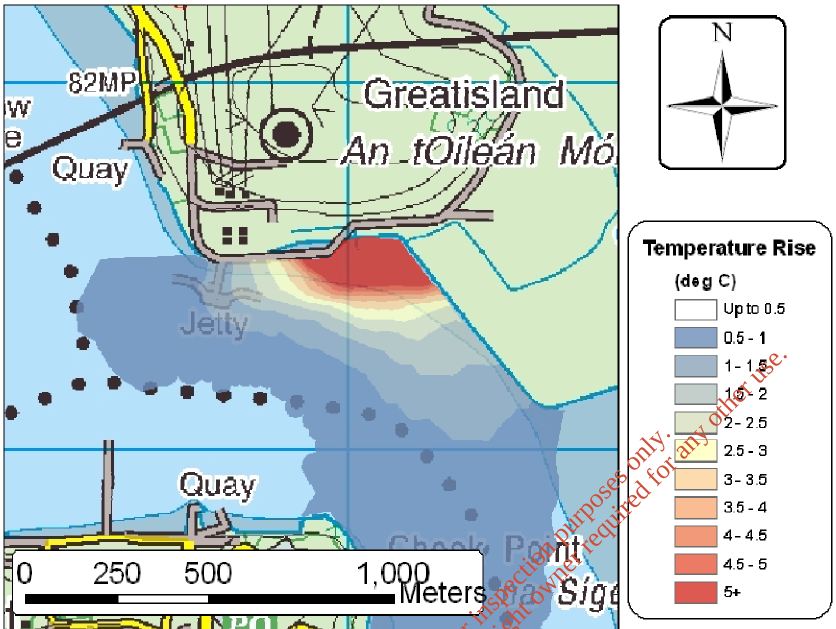
- Estimated river low flow was used as there is no recorded data for river flow at or near the confluence of the Rivers Barrow and Suir due to the tidal influence in this area.

- The outfall from the power station was taken to be the maximum operating discharge at a 12°C rise above ambient for a continuous period of 10 days.

Each of the plumes is followed by the modelled maximum plume for the existing power station under the same conditions to give an indication of the maximum possible reduction in plume extent. There is no modelled maximum plume for the existing power station for the winter climatic conditions with a spring tide as this was established to be a non-critical run early in the modelling as the cooler temperatures and high flushing rates from the spring tide mean that the plume is small. There is however the modelled proposed CCGT for these conditions for completeness.

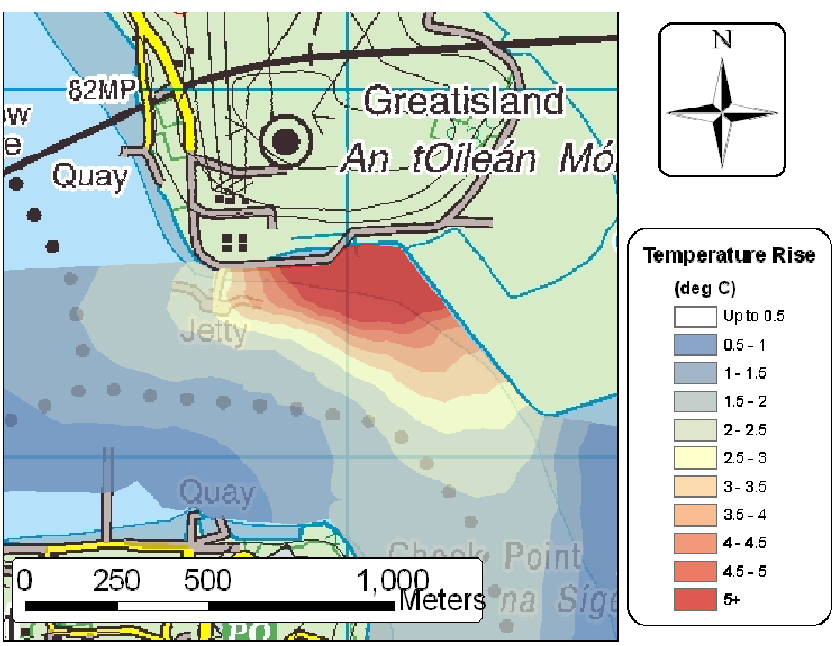
6.1.1 Summer Conditions, Neap Tide

Figure 6.1: Modelled maximum plume for proposed CCGT (summer, neap tide conditions)



PROPOSED SCENARIO

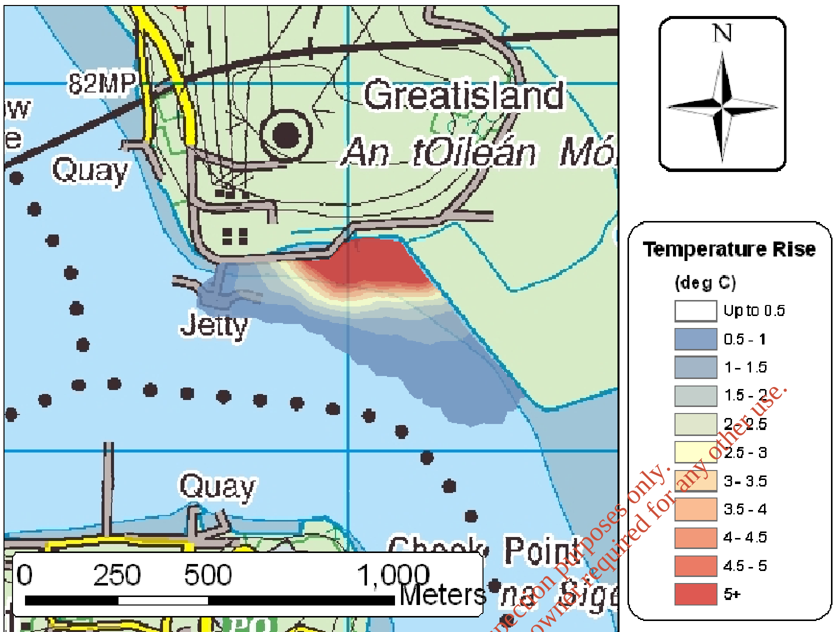
Figure 6.2: Modelled maximum plume for existing power station (summer, neap tide conditions)



EXISTING SCENARIO

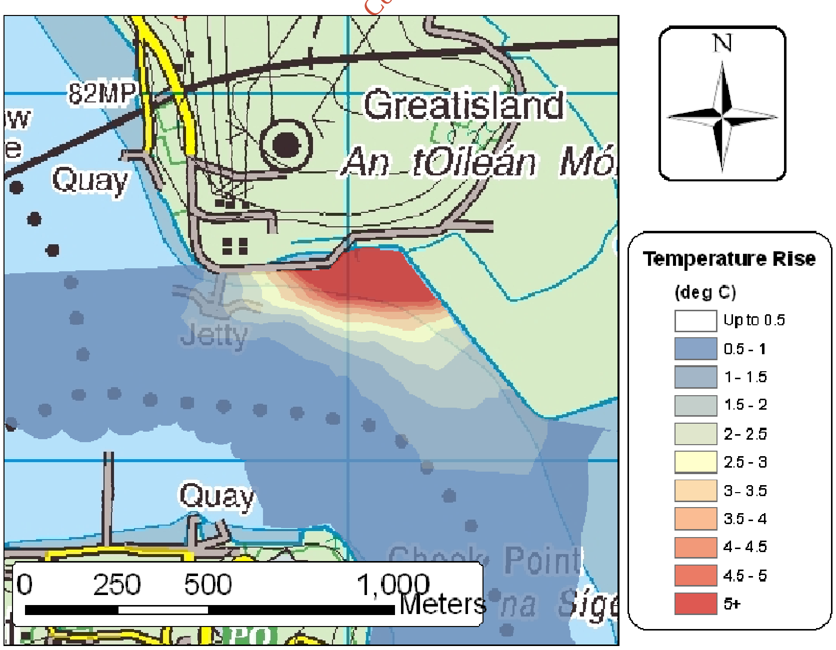
6.1.2 Summer Conditions, Spring Tide

Figure 6.3: Modelled maximum plume for proposed CCGT (summer, spring tide conditions)



PROPOSED SCENARIO

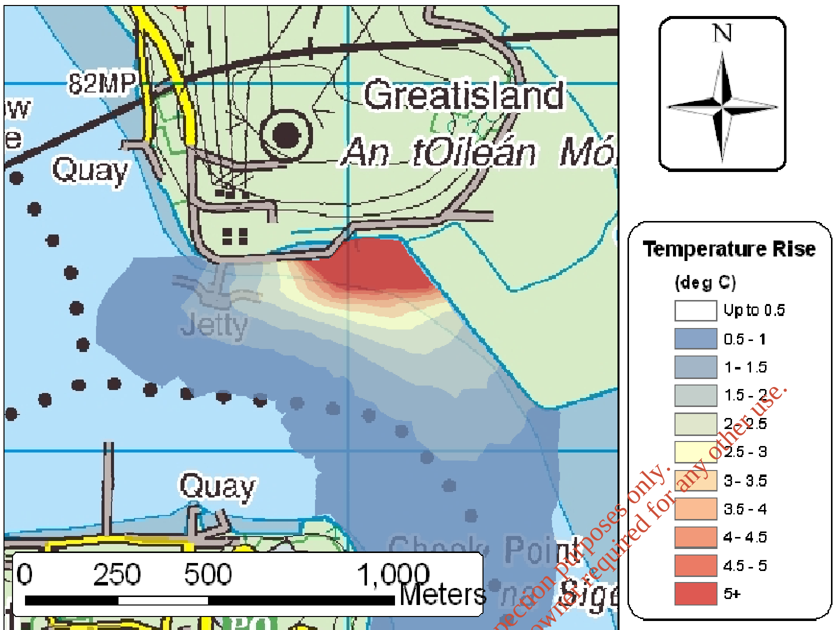
Figure 6.4: Modelled maximum plume for existing power station (summer, spring tide conditions)



EXISTING SCENARIO

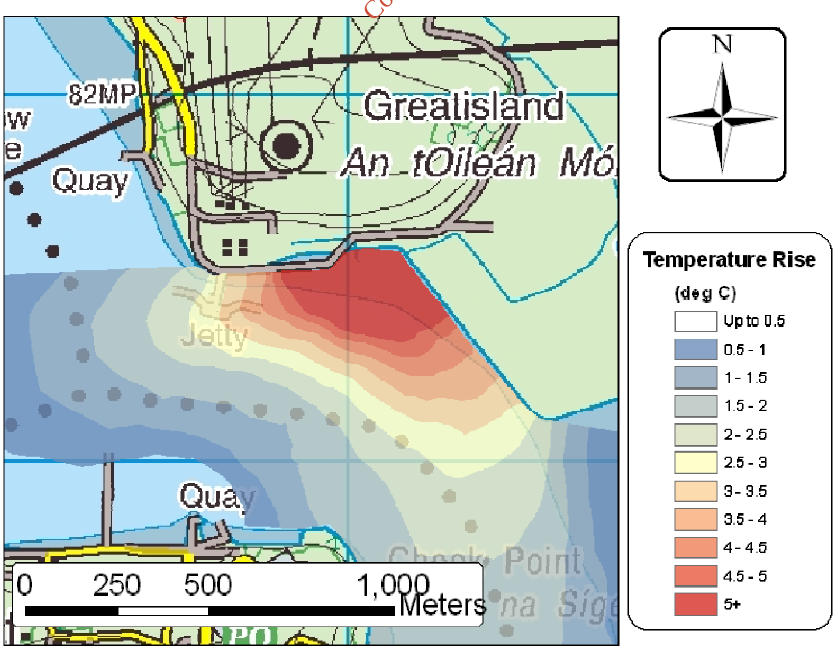
6.1.3 Winter Conditions, Neap Tide

Figure 6.5: Modelled maximum plume for proposed CCGT (winter, neap tide conditions)



PROPOSED SCENARIO

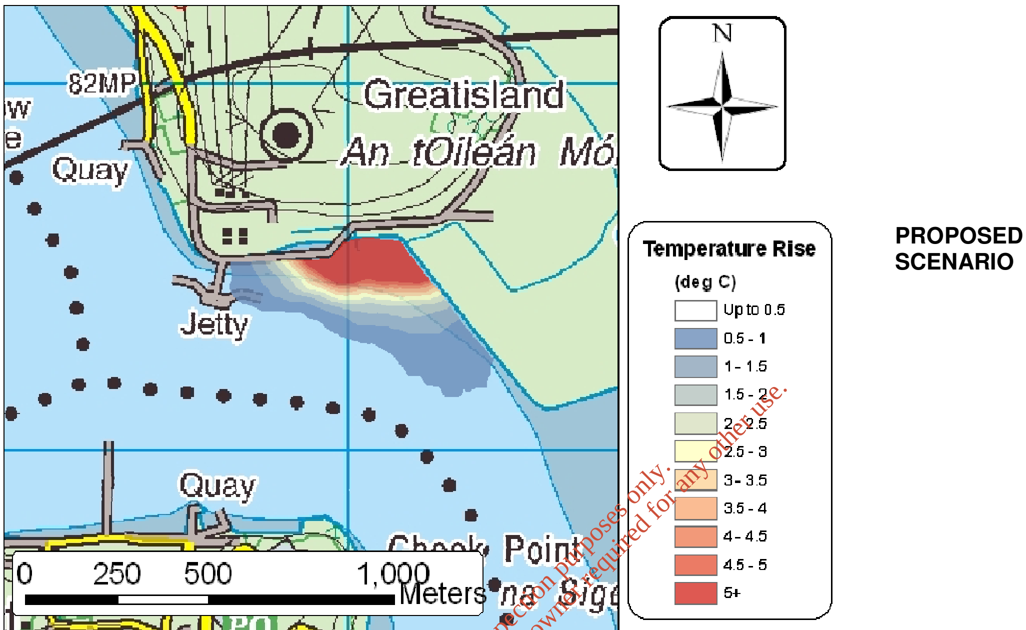
Figure 6.6: Modelled maximum plume for existing power station (winter, neap tide conditions)



EXISTING SCENARIO

6.1.4 Winter Conditions, Spring Tide

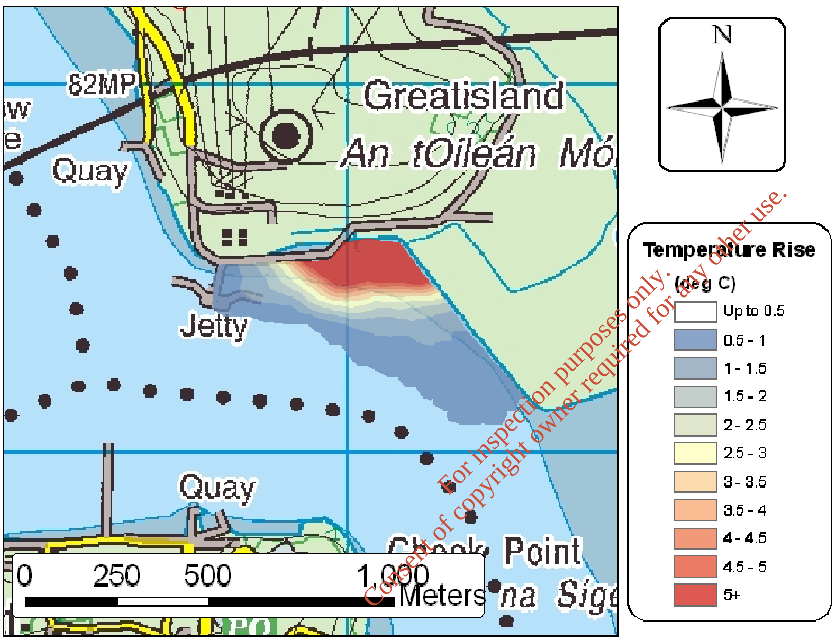
Figure 6.7: Modelled maximum plume for proposed CCGT (winter, spring tide conditions)



6.2 Extreme Case: Lowest Astronomical Tide

An extreme conditions test with lowest (LAT) astronomical tide was modelled to assess the impact of extreme low water on the thermal plume, the results are shown below. The LAT model was run with summer conditions as the ambient temperature is warmer, giving a worst case and it was modelled with a spring tide as this is when LAT occurs.

Figure 6.8: Modelled maximum plume for proposed CCGT (summer, spring tide conditions with LAT)

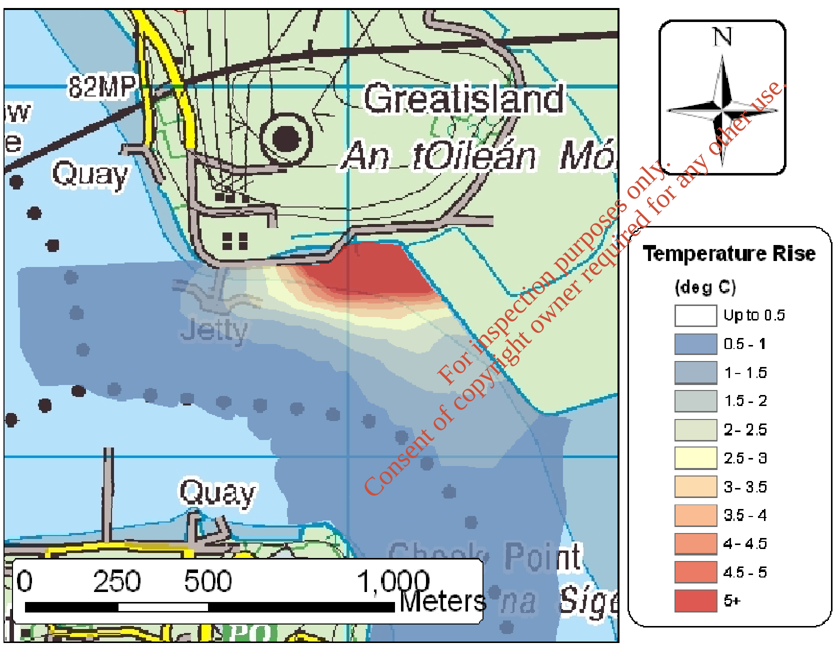


PROPOSED SCENARIO, LAT

6.3 Sensitivity Tests: Variations in Flow

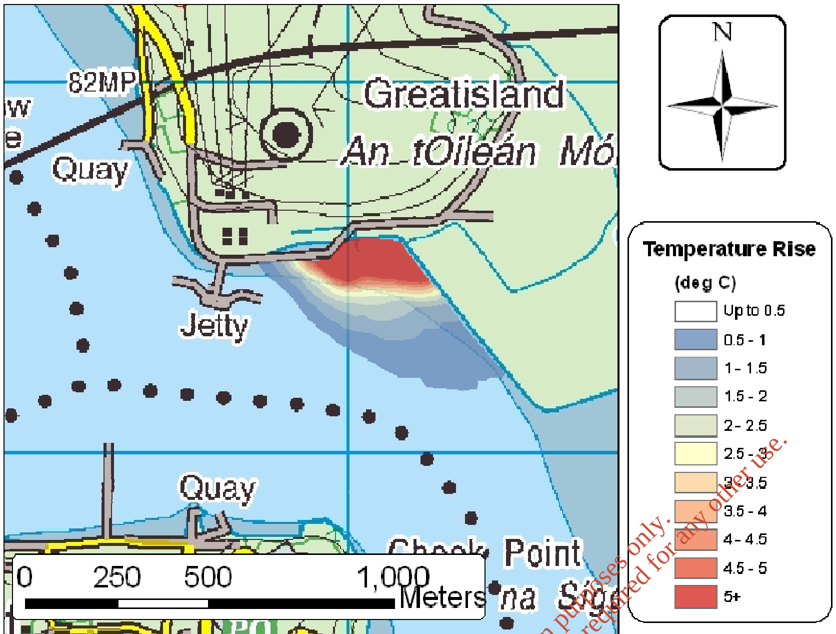
Sensitivity tests were undertaken to assess the impact of river flow on the extent of the plumes. One additional model run was undertaken for dry weather flow (DWF) and one for estimated mean flow. The summer neap conditions were selected for the model run as these are a worst case scenario (the results can be compared to Figure 6.1, the summer, neap tide conditions with Q95 for the proposed CCGT). As the river flow has a large impact on the plume extent, the existing power station conditions were also run for average flow for the summer, neap tide conditions for comparison, these results are included in Figure 6.11 (these results can be compared with Figure 6.2, the summer, neap tide conditions with Q95 for the existing power station).

Figure 6.9: Modelled maximum plume for proposed CCGT (summer, neap tide conditions with DWF)



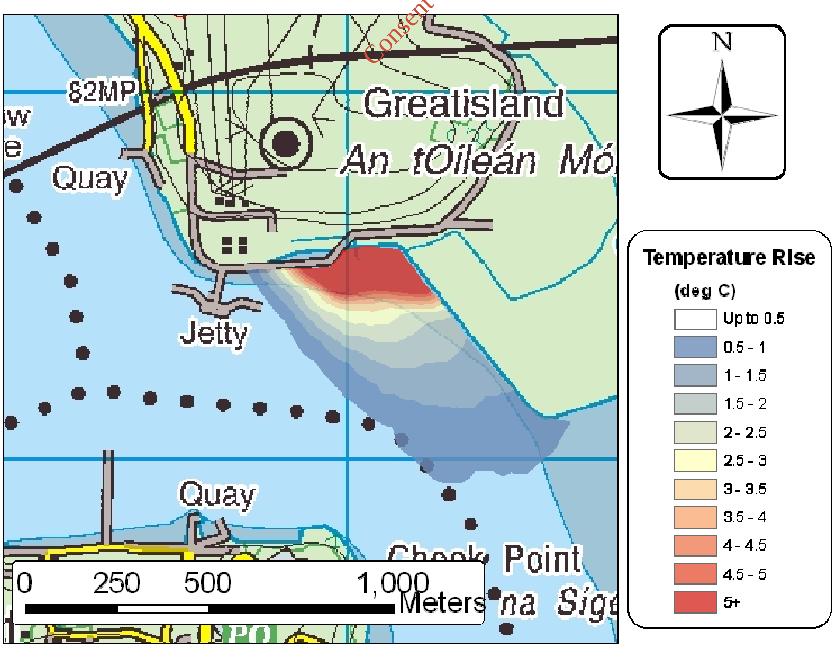
PROPOSED SCENARIO, DWF

Figure 6.10: Modelled maximum plume for proposed CCGT (summer, neap tide conditions with average flow)



PROPOSED SCENARIO, AVERAGE FLOW

Figure 6.11: Modelled maximum plume for existing power station (summer, neap tide conditions with average flow)



EXISTING SCENARIO, AVERAGE FLOW

7. Conclusions

The results indicate that the existing power station is compliant with the IPPC licence, particularly when considering that the sensitivity test for average flow in the Rivers Barrow and Suir indicates that the model production runs are likely to be larger than the plume which would be observed under most conditions. Furthermore the proposed CCGT development is significantly reducing the anticipated plume when compared to equivalent conditions for the existing power station.

It can be seen from the modelled results that there is expected to be a significant reduction in both the extent and temperature of the thermal plume from the power station once it has been developed to a CCGT as opposed to the current scenario.

The thermal plume is most severe under neap tidal conditions for both summer and winter conditions, this is due to the reduced mixing and flushing of the water as there is a smaller tidal range. The reduction of the plume extent is also most significant under neap tidal conditions although the model shows that the spring tidal conditions will also see a considerable reduction in plume extent and temperature. This is to be expected as the thermal load has been approximately halved.

The extreme case of LAT has shown that the plume that is to be expected under these rare conditions is actually not significantly worse than for the comparable summer model run with spring tidal conditions. The overall extent of the plume is very similar although the temperature rise of the plume at any given point tends to be marginally higher.

The sensitivity tests undertaken to assess the impact of dry weather flow (DWF) and estimated average flow in the estuary on the plume showed that the plume is larger for DWF than the comparable Q95 summer model run with neap tidal conditions, although not significantly. This is due to the fact that the estimated Q95 and DWF are not significantly different from one another. When compared to the modelled average conditions it can clearly be seen that the river flow has a substantial impact on the size of the plume.

As river flow has been shown to have an impact on the plume extent and the modelling was developed to be a worst case scenario, the plume extents for normal conditions during the year will be less than the modelled plume shown in the production runs (Figures 6.1, 6.3, 6.5 and 6.7). To set this in context, the models were run with a low flow (estimated Q95, the flow which is exceeded 95% of the time i.e. represents conservative conditions) rather than average flows. Therefore for much of the year typical plumes can be expected to be much smaller than those modelled in the production runs and closer to those in the sensitivity test of the average flow condition (Figure 6.10).

This modelling exercise has illustrated that the proposed CCGT development will have a significant benefit in terms of thermal plume in the estuary under all climatic and tidal conditions when compared to the existing power station conditions. It also shows that under the conservative conditions modelled the current IPPC license is not likely to be breached for the proposed CCGT development.

Appendices

Appendix A. 30 Climatic Averages for Rosslare

	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	year
TEMPERATURE (degrees Celsius)													
mean daily max.	8.2	7.9	9.3	10.9	13.2	15.9	17.9	17.9	16.3	13.8	10.6	9.1	**12.6**
mean daily min.	3.9	3.8	4.3	5.6	7.9	10.4	12.1	12.2	10.8	9.0	5.9	4.8	**7.6**
mean	6.1	5.9	6.8	8.3	10.5	13.2	15.0	15.0	13.6	11.4	8.2	7.0	**10.1**
absolute max.	12.7	13.0	14.2	20.1	20.3	25.4	26.2	25.9	21.5	19.2	15.7	14.0	**26.2**
absolute min.	-4.4	-4.1	-2.5	-1.0	-0.3	4.7	5.2	6.2	2.6	0.7	-2.5	-3.1	**-4.4**
mean no. of days with air frost	2.4	2.0	1.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.6	**8.0**
mean no. of days with ground frost	11.0	8.6	7.2	4.4	1.3	0.0	0.0	0.0	0.1	0.8	5.6	8.5	**47.4**
RELATIVE HUMIDITY (%)													
mean at 0900UTC	86	85	84	82	81	82	82	84	84	86	85	86	**84**
mean at 1500UTC	81	79	76	76	77	78	77	78	77	80	79	82	**78**
SUNSHINE (hours)													
mean daily duration	1.94	2.47	3.87	5.74	6.88	6.59	6.29	5.86	4.79	3.27	2.50	1.75	**4.33**
greatest daily duration	8.2	9.8	11.8	13.4	15.4	15.8	15.9	14.0	12.8	10.2	8.6	7.3	**15.9**
mean no. of days with no sun	11	8	5	3	1	2	1	2	3	6	9	11	**61**
RAINFALL (mm)													
mean monthly total	94.9	69.6	67.2	55.9	55.4	50.7	50.6	70.9	71.9	94.9	97.6	97.6	**877.2**
greatest daily total	44.9	33.4	48.9	27.9	31.0	32.6	79.1	61.0	63.6	54.8	56.7	44.8	**79.1**
mean no. of days with >= 0.2mm	18	15	16	14	14	13	11	13	14	16	16	17	**176**
mean no. of days with >= 1.0mm	14	11	12	10	10	8	8	9	10	12	13	13	**129**
mean no. of days with >= 5.0mm	7	5	5	4	4	3	3	4	5	6	6	7	**59**
WIND (knots)													
mean monthly speed	12.9	12.8	12.4	11.8	11.4	10.1	9.5	10.0	10.7	11.6	12.1	12.8	**11.5**
max. gust	76	76	66	75	57	51	50	56	72	87	71	80	**87**
max. mean 10-minute speed	46	44	42	52	35	38	35	37	47	50	45	50	**52**
mean no. of days with gales	2.5	1.5	1.1	1.3	0.3	0.2	0.1	0.2	0.5	0.9	1.3	1.9	**11.7**
WEATHER (mean no. of days with...)													
snow or sleet	2.7	3.7	1.9	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.2	1.3	**10.7**
snow lying at 0900UTC	0.8	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	**1.8**
hail	1.8	1.1	2.5	2.1	1.0	0.3	0.0	0.0	0.1	0.4	1.2	1.2	**11.8**
thunder	0.4	0.2	0.1	0.4	0.8	1.0	1.0	0.7	0.6	0.5	0.7	0.3	**6.7**
fog	2.0	2.2	3.2	4.2	3.2	4.4	5.0	4.6	3.9	2.5	1.7	1.6	**38.5**

Appendix B. Gauging Station Information

Station Nr	Waterbody	Location	Area (km^2)	Av rain (mm) 1971-2000	DWF (m^3/s)	Q95 (m^3/s)	Irish Grid Reference
14106	BARROW	KILLABBAN BR.	9	892	---	---	S698857
14042	BARROW	REARY VALLEY	33	1265	---	---	N361130
14039	BARROW	REARYMORE	35	1246	---	---	N362130
14010	BARROW	FORREST LR.	125	1069	---	---	N454090
14003	BARROW	BORNESS	207	1080	0.07	0.11	N463093
14005	BARROW	PORTARLINGTON	405	1009	0.15	0.35	N540126
14107	BARROW	BAYLOUGH BR.	432	998	---	---	N606124
14006	BARROW	PASS BR	1064	927	0.80	1.47	N622110
14002	BARROW	DUNRALLY	1212	918	---	---	N636017
14020	BARROW	BERT	1566	914	---	---	S659969
14105	BARROW	ATHY	1573	914	---	---	S671959
14041	BARROW	CROMABOO ATHY	1620	912	---	---	S681939
14019	BARROW	LEVITSTOWN	1697	909	1.70	3.60	S706876
14034	BARROW	BESTFIELD LOCK	2057	912	2.18	5.25	S717797
14022	BARROW	BARROW NEW BRIDGE	2070	912	---	---	S720780
14001	BARROW	CARLOW	2252	914	---	---	S716762
14018	BARROW	ROYAL OAK	2419	918	2.40	6.50	S689614
14051	BARROW	BALLYKEENAN	2769	935	---	---	S726450
14029	BARROW	GRAIGUENAMANAGH U/S	2778	935	3.10	7.00	S712439
14023	BARROW	GRAIGUENAMANAGH	2808	937	3.30	7.10	S723420
14067	BARROW EST	ST MULLINS	2850	941	---	---	S731376
14061	BARROW	NEW ROSS	5484	994	---	---	S718273
14062	BARROW	ROSBERCON	5484	994	---	---	S715272
14063	BARROW	RAHEEN	5488	994	---	---	S708262
14064	BARROW	MARSH MEADOW	5500	994	---	---	S706259
14065	BARROW	PINK POINT	5525	995	---	---	S685229
14066	BARROW	BARROW BRIDGE U/S	5587	996	---	---	S684149
15008	NORE	BORRIS IN OSSORY	116	1086	0.04	0.07	S239880
15053	NORE	DERRYDUFF	258	1201	---	---	S309922
15035	NORE	DANGANROE	268	1193	---	---	S325929
15007	NORE	KILBRICKEN	340	1178	0.40	0.85	S362899
15004	NORE	MCMAHONS BR.	491	1115	0.60	1.10	S418797
15012	NORE	BALLYRAGGET	1057	1052	1.17	2.17	S441716
15040	NORE	OSSORY BRIDGE	1572	1051	---	---	S512558
15002	NORE	JOHN'S BR.	1644	1048	2.00	3.75	S506561
15011	NORE	MOUNT JULIET	2226	1042	2.80	4.00	S550424
15006	NORE	BROWNSBARN	2418	1044	3.00	4.26	S617391
16037	SUIR	KNOCKNAGERAGH	96	1078	0.00	0.01	S131725
16004	SUIR	THURLES	229	1042	0.09	0.20	S129586
16028	SUIR	BALLYCARRANE	442	1016	0.17	0.41	S117559
16002	SUIR	BEAKSTOWN	486	1014	0.30	0.62	S092552
16008	SUIR	NEW BRIDGE	1090	1117	1.10	2.30	S001341
16009	SUIR	CAHER PARK	1583	1133	3.20	4.19	S052228
16011	SUIR	CLONMEL	2144	1163	6.50	10.25	S208222
16062	SUIR EST.	CARRICK ON SUIR	2777	1154	---	---	S402214
16061	SUIR EST.	FIDDOWN	2972	1154	---	---	S466197
16063	SUIR EST.	BARROW BRIDGE D/S	5587	996	---	---	S678147
16064	SUIR EST.	CHEEK POINT	9160	1060	---	---	S690138

Mott MacDonald

Appendix C. Hourly Climatic Data Averages

	January					July				
Hour	Temp (°C)	Wind Speed (m/s)	Wind Direction (deg)	Cloud Cover (oktas)	Rel. Humidity (%)	Temp (°C)	Wind Speed (m/s)	Wind Direction (deg)	Cloud Cover (oktas)	Rel. Humidity (%)
00:00	7.23	6.81	225.81	5.46	85.75	14.39	4.06	216.91	4.86	**89.75**
01:00	7.28	6.81	227.16	5.54	85.30	14.39	4.22	213.32	5.20	91.25
02:00	7.21	6.74	229.87	5.59	85.55	14.26	4.37	212.48	5.38	91.65
03:00	7.15	6.75	234.32	5.51	85.95	14.17	4.33	202.48	5.69	92.27
04:00	7.03	6.62	234.84	5.46	86.56	14.06	4.26	201.28	5.39	91.89
05:00	6.99	6.46	236.65	5.15	86.05	14.05	4.12	203.27	5.71	91.82
06:00	6.93	6.38	228.13	5.03	86.32	14.40	4.30	208.86	5.81	91.76
07:00	6.84	6.37	230.00	5.12	86.12	15.06	4.72	211.95	5.70	88.77
08:00	6.87	6.41	229.03	5.61	86.30	15.49	5.01	209.34	5.96	86.61
09:00	6.86	6.22	225.68	5.66	85.63	15.97	5.04	194.34	5.71	83.80
10:00	7.27	6.46	222.75	5.70	84.70	16.46	5.27	188.94	5.71	81.33
11:00	7.85	6.65	222.52	5.66	82.73	16.82	5.46	186.82	5.78	80.08
12:00	8.18	6.83	220.77	5.67	81.19	17.06	5.60	181.89	5.74	79.39
13:00	8.40	6.97	224.06	5.65	79.66	17.25	5.70	179.15	5.64	78.88
14:00	8.50	6.90	216.90	5.63	78.79	17.31	5.80	185.18	5.55	78.79
15:00	8.41	6.95	211.23	5.70	79.46	17.36	5.83	190.09	5.36	78.95
16:00	8.11	6.71	214.58	5.82	80.83	17.22	5.79	191.69	5.38	78.96
17:00	7.73	6.53	219.42	5.68	82.07	17.00	5.63	190.35	5.40	80.04
18:00	7.61	6.56	217.42	5.32	82.65	16.71	5.23	194.75	5.39	81.02
19:00	7.51	6.66	219.87	5.30	82.83	16.26	4.86	191.89	5.20	83.09
20:00	7.47	6.73	223.35	5.50	83.19	15.64	4.51	193.08	5.26	85.80
21:00	7.47	6.83	218.19	5.57	83.79	15.12	4.23	188.59	5.12	87.84
22:00	7.34	6.71	221.10	5.59	84.82	14.80	4.08	200.51	5.01	88.75
23:00	7.31	6.68	225.16	5.22	85.05	14.57	3.98	207.44	5.00	88.96

Appendix D. Theoretical Background to HYDRO-3D

D.1. Governing Equations

The model uses the principles of conservation of mass and momentum over a control volume. The fundamental equations describing fluid flow are attributed to Navier and Stokes. The model includes Reynolds shear stresses, which arise from the presence of turbulence. The governing equations of fluid flow are presented below.

D.1.1. Hydrodynamics

D.1.1.1. Momentum Equation

The generalised turbulent flow equation, based on Reynolds average stress and using the Boussinesq approximation for turbulent flows, is given in the x-direction of the Cartesian co-ordinate system:

$$\frac{\partial \bar{u}}{\partial t} + \bar{U}\nabla\bar{u} = 2\omega\bar{v}\sin\phi - \frac{1}{\rho}\frac{\partial P}{\partial x} + \left[\frac{\partial}{\partial x}\varepsilon_{xx}\left(\frac{\partial \bar{u}}{\partial x} + \frac{\partial \bar{u}}{\partial x}\right) + \frac{\partial}{\partial y}\varepsilon_{xy}\left(\frac{\partial \bar{u}}{\partial y} + \frac{\partial \bar{v}}{\partial x}\right) + \frac{\partial}{\partial z}\varepsilon_{xz}\left(\frac{\partial \bar{u}}{\partial z} + \frac{\partial \bar{w}}{\partial x}\right)\right]$$

Similarly the momentum equation in the y- and z-directions can be represented by the following equations:

$$\frac{\partial \bar{v}}{\partial t} + \bar{U}\nabla\bar{v} = 2\omega\bar{u}\sin\phi - \frac{1}{\rho}\frac{\partial P}{\partial y} + \left[\frac{\partial}{\partial x}\varepsilon_{yx}\left(\frac{\partial \bar{v}}{\partial x} + \frac{\partial \bar{u}}{\partial y}\right) + \frac{\partial}{\partial y}\varepsilon_{yy}\left(\frac{\partial \bar{v}}{\partial y} + \frac{\partial \bar{v}}{\partial y}\right) + \frac{\partial}{\partial z}\varepsilon_{yz}\left(\frac{\partial \bar{v}}{\partial z} + \frac{\partial \bar{w}}{\partial y}\right)\right]$$

$$\frac{\partial \bar{w}}{\partial t} + \bar{U}\nabla\bar{w} = -g - \frac{1}{\rho}\frac{\partial P}{\partial z} + \left[\frac{\partial}{\partial x}\varepsilon_{zx}\left(\frac{\partial \bar{w}}{\partial x} + \frac{\partial \bar{u}}{\partial z}\right) + \frac{\partial}{\partial y}\varepsilon_{zy}\left(\frac{\partial \bar{w}}{\partial y} + \frac{\partial \bar{v}}{\partial z}\right) + \frac{\partial}{\partial z}\varepsilon_{zz}\left(\frac{\partial \bar{w}}{\partial z} + \frac{\partial \bar{w}}{\partial z}\right)\right]$$

Where:

$\bar{u}$ time-averaged velocity component in the x-direction

$\bar{v}$ time-averaged velocity component in the y-direction

$\bar{w}$ time-averaged velocity component in the z-direction

u' fluctuating velocity component in the x-direction (m/s)

v' fluctuating velocity component in the y-direction (m/s)

w' fluctuating velocity component in the z-direction (m/s)

x,y,z co-ordinates of a point in the Cartesian system (m)

t time(s)

ω angular velocity of the earth (radians/s)

ϕ latitude of the location (deg)

μ kinematic viscosity (m^2/s)

ε kinematic eddy viscosity (m^2/s)

P pressure (N/m^2)

ρ density of water

g acceleration due to gravity (m/s^2)

τ_{ij} stress acting perpendicular to i-axis and along j-direction

ε_{ij} eddy viscosity acting perpendicular to i-axis and along j-direction

D.1.1.2. Continuity Equation

The continuity equation is given by the following expression:

$$\nabla \overline{U} = 0$$

Where:

$$\overline{U} = \bar{i}\,\overline{u} + \bar{j}\,\overline{v} + \bar{k}\,\overline{w}$$

$$\nabla = \bar{i}\frac{\partial}{\partial x} + \bar{j}\frac{\partial}{\partial y} + \bar{k}\frac{\partial}{\partial z}$$

where $\bar{i}$, $\bar{j}$ and $\bar{k}$ are unit vectors along the Cartesian axes x, y and z.

D.1.2. Advection and Dispersion

The water quality parameters are simulated in the HYDRO-3D model using the advection-dispersion equation. The advection-dispersion equation (ADE) with components for source and sink terms is defined by the following expression:

$$\frac{\partial C}{\partial t} + u\frac{\partial C}{\partial x} + v\frac{\partial C}{\partial x} + w\frac{\partial C}{\partial x} - \frac{\partial}{\partial x}\left(D_x \frac{\partial C}{\partial x}\right) - \frac{\partial}{\partial y}\left(D_y \frac{\partial C}{\partial y}\right) - \frac{\partial}{\partial z}\left(D_z \frac{\partial C}{\partial z}\right) + KC - S = 0$$

Where:

C concentration of a determinand.

u velocity of flow in the x-direction

v velocity of flow in the y-direction

w velocity of flow in the z-direction

D_x dispersion coefficient along the principal direction x

D_y dispersion coefficient along the principal direction y

D_z dispersion coefficient along the principal direction z

K decay rate

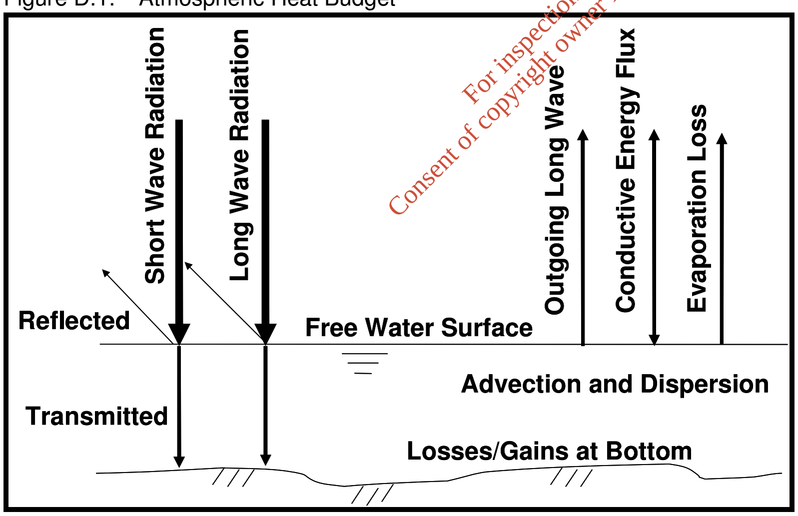
S source and sink term.

The above equation assumes that the co-ordinate axes are oriented towards the principal direction of the dispersion coefficients.

D.1.3. Heat Budget

In order to correctly simulate the impact of the discharge of cooling waters at an elevated temperature, both mixing and changes due to radiation, evaporation and convection must be modelled accurately. Changes in water temperature due to atmospheric heat exchange can be visualised as:

Figure D.1: Atmospheric Heat Budget



Atmospheric heat exchange is simulated in the model using the following formulation[i]:

$$H = Q_{sn} + Q_{an} - Q_{br} - Q_e \pm Q_c$$

Where:

H net surface heat flux (kcal/m^2/h);

Q_{sn} net short wave radiation (kcal/m^2/h);

Q_{an} net long wave radiation (kcal/m^2/h);

Q_{br} long wave back radiation (kcal/m²/h);

Q_e evaporative heat loss (kcal/m²/h);

Q_c energy convected to or from the water body (kcal/m²/h);

and: $$Q_{sn} = Q_s - Q_{sr}$$

Where:

Q_s short wave radiation incident to water surface (kcal/m²/h);

Q_{sr} reflected short wave radiation (kcal/m²/h);

and; $$Q_{an} = Q_a - Q_{ar}$$

Where:

Q_a incoming long wave radiation (kcal/m²/h);

Q_{ar} reflected long wave radiation (kcal/m²/h);

D.1.3.1. Short Wave Radiation

Net short wave radiation is the difference between the incident and reflected radiation. Short wave radiation is affected by reflection, scattering and absorption by gases, water vapour, clouds and dust particles. A simplified formulation for net short wave radiation has been developed[ii]:

$$Q_{sn} \approx 0.94 Q_{sc} (1 - 0.65 C^2)$$

Where:

Q_{sc} clear sky radiation (kcal/m²/h);

C fraction of sky covered by clouds.

D.1.3.2. Long Wave Radiation

Long wave radiation results from the re-emission of solar radiation at much longer wavelengths by water vapour, carbon dioxide and ozone. The net long wave radiation can be calculated using[iii]:

$$Q_{an} = 1.16.10^{-13} (1 + 0.17 C^2)((T_a.1.8 + 32) + 460)^6 .0.113$$

Where:

T_a dry bulb air temperature (°C).

D.1.3.3. Long Wave Back Radiation

Long wave back radiation can be accurately determined because the emissivity of a water surface is known precisely. As this is normally the largest component of the heat fluxes, it means that the overall flux can be calculated relatively accurately.

$$Q_{br} = 0.97.\sigma.(T_s + 273.15)^4$$

Where:

T_s surface water temperature (^oC);

σ Stefan-Boltzmann constant ($1.357.\ 10^{-8}.\ 3.6$ kcal/m^2/h/K^4)

D.1.3.4. Evaporative Heat Flux

Evaporative heat flux is a result of the loss of the latent heat of evaporation as water vapour is lost to the atmosphere. This is defined as:

$$Q_e = \rho L_w E$$

Where:

ρ fluid density (kg/m^3);

L_w latent heat of evaporation (kcal/kg);

and the latent heat of evaporation can be defined as:

$$L_w = 597 - 0.57T_s$$

Where:

E evaporation rate (m/h);

and the evaporation rate can be defined as:

$$E = (a + bW)(e_s - e_a)$$

Where:

a,b empirical coefficients;

W wind speed above the water surface (m/s);

e_s saturation vapour pressure at the water surface (mb);

e_a vapour pressure of the overlying atmosphere (mb).

D.1.3.5. Conductive Heat Flux

Convective heat loss results from the direct loss (i.e. not evaporative loss) of heat from a water surface by convection resulting from the movement of air. This heat flux is closely related to evaporative heat loss and can be defined as:

$$Q_c = Q_e (6.19.10^{-4}) p \frac{T_s - T_a}{e_s - e_a}$$

Where:

p atmospheric pressure (mb)

[i] United States Environmental Protection Agency. "*Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling (Second Edition)*". Environmental Research Laboratory. Office of Research and Development. USEPA.
[ii] Ryan, P.J. and D.R.F. Harleman. "*An Analytical and Experimental study of Transient Cooling Pond Behavior*". MIT, Cambridge, Mass. 1973.
[iii] Swinbank, W.C. *"Longwave Radiation from Clear Skies"*. Quarterly Journal of the Royal Meteorological Society, Vol 89, pp. 339-348.

I.3 Assessment of Impact of Sewage Discharge

Give summary details and an assessment of the impacts of any existing or proposed emissions on the environment, including environmental media other than those into which the emissions are to be made.

*Full details of the assessment and any other supporting information should form **Attachment N° I.3.***

I.3.1 Details of Emissions to Sewers

There will be no emissions to a municipal (local authority) sewage network from the operations of the proposed development.

I.4 Assessment of Impact of Ground/Groundwater Emissions

Describe the existing groundwater quality. Table I.4(i) should be completed.
Give summary details and an assessment of the impacts of any existing or proposed emissions on the ground (aquifers, soils, sub-soils and rock environment), including any impact on environmental media other than those into which the emissions are to be made. This includes landspreading, land injection etc.

Land on which material may be landspread shall be identified on a suitable scaled map (1:10,560 and 1:50,000) and submitted as no greater than A3 size. All vulnerable (as a result of ground emissions) surface water bodies must be identified on these maps. Additional information should be included in ***Attachment Nº I.4****.*

Landspreading of Agricultural/Non Agricultural Wastes

Table I.4(ii) should be completed where applicable. Further information is available in the Application Guidance Document.

I.4.1 Details on Emissions to Ground or Groundwater

There will be no emissions to ground or groundwater from the facility.

I.4.2 Details of Land spreading of Agricultural / Non-Agricultural Waste

There will be no landspreading of agricultural / non agricultural waste associated with any waste generated at the facility.

Table I.4(i) GROUNDWATER QUALITY
(Sheet 1 of 2) Monitoring Point/ Grid Reference: **NOT APPLICABLE***

Parameter	Results (mg/l)				Sampling method (composite etc.)	Normal Analytical Range	Analysis method / technique
	Date	Date	Date	Date			
pH							
Temperature							
Electrical conductivity EC							
Ammoniacal nitrogen NH_4-N							
Dissolved oxygen DO							
Residue on evaporation (180°C)							
Calcium Ca							
Cadmium Cd							
Chromium Cr							
Chloride Cl							
Copper Cu							
Cyanide Cn, total							
Iron Fe							
Lead Pb							
Magnesium Mg							
Manganese Mn							
Mercury Hg							
Nickel Ni							
Potassium K							
Sodium Na							

GROUNDWATER QUALITY (SHEET 2 OF 2)

Parameter	Results (mg/l)				Sampling method (composite, dipper etc.)	Normal Analytical Range	Analysis method / technique
	Date	Date	Date	Date			
Phosphate PO_4							
Sulphate SO_4							
Zinc Zn							
Total alkalinity (as $CaCO_3$)							
Total organic carbon TOC							
Total oxidised nitrogen TON							
Arsenic As							
Barium Ba							
Boron B							
Fluoride F							
Phenol							
Phosphorus P							
Selenium Se							
Silver Ag							
Nitrite NO_2							
Nitrate NO_3							
Faecal coliforms (/100mls)							
Total coliforms (/100mls)							
Water level (m OD)							

TABLE I.4(ii): LIST OF OWNERS/FARMERS OF LAND

Land Owner	Townlands where landspreading	Map Reference	Fertiliser P requirement for each farm

Total P requirement of the client List **<u>* NOT APPLICABLE</u>**

TABLE I.4(iii): LANDSPREADING

Land Owner/Farmer **<u>* NOT APPLICABLE</u>**

Map Reference **<u>* NOT APPLICABLE</u>**

Field ID	Total Area (ha)	(a) Usable Area (ha)	Soil P Test Mg/l	Date of P test	Crop	P Required (kg P/ha)	Volume of On-Farm Slurry Returned (m^3/ha)	Estimated P in On-Farm Slurry (kg P/ha)	(b) Volume to be Applied (m^3/ha)	P Applied (kg P/ha)	Total Volume of imported slurry per plot (m^3)

Total volume that can be imported on to the farm:

Concentration of P in landspread material	- kg P/m^3
Concentration of N in landspread material	- kg N/m^3

*There will be no landspreading of agricultural / non agricultural waste associated with any waste generated at the facility.

I.5 Ground and/or Groundwater Contamination

Summary details of known ground and/or groundwater contamination, historical or current, on or under the site must be given.

Full details including all relevant investigative studies, assessments, or reports, monitoring results, location and design of monitoring installations, plans, drawings, documentation, including containment engineering, remedial works, and any other supporting information should be included in ***Attachment N^o I.5****.*

I.5.1 Baseline Conditions

(i) Geology

Regional Geology

According to the Geological Survey of Ireland (GSI, 2009), refer to Environmental Impact Statement, the geology underlying the site comprises Ordovician Volcanics consisting of the Campile Formation with undifferentiated felsic volcanics. The Campile Formation is described as pale coloured rhyolites in grey and brown slaty mudstones with occasional andesites.

Encountered Geology

A Phase 1 and Phase 2 assessment undertaken by URS in 2008 (Phase 1 and Phase 2 Environmental Site Assessment, ESB Great Island Power Generating Station, URS, 2009) identified the following geology at the site:

The overburden of the upper tier of the Station Grounds comprised a thin (less than 0.5 m thickness) layer of fine-grained sandy and silty topsoil overlying weathered bedrock. The geology of the parking bay areas is likely to be similar to that encountered in the upper tier.

Near the 220 kV switching yard 1.75 m thickness of loose brown clay was encountered overlying bedrock.

On the lower tier, up to 6.5 metres of fill material was encountered along the southern margin, comprising a lower layer of clays with occasional boulders, underlying an upper layer of boulders. Near the northern margins of this lower tier, up to 3 metres of natural clays overlying bedrock were encountered.

(ii) Site Evaluation

Site History

The existing power station was constructed in two stages, over agricultural lands. The first stage involved the commissioning of two 60 MW Units, in 1967 and 1968. Stage 2 involved the commissioning of a 120 MW Unit, in 1972.

Two areas of the site were subject to waste disposal operations. These were developed during the two main phases of construction of the Great Island Generating Station in the mid-1960s and early 1970s and were developed for the deposition of excess rock fill, building materials and spoil.

The northern segment of cell 1 ("station dump") was additionally used for general waste disposal during operation of the generating station between mid-1960s and mid-1990s. The wastes deposited in this area included fuel oil, boiler washings, laboratory waste, building rubble, canteen waste and asbestos removed during turbine overhauls and other maintenance activities. In 2005, with the agreement of the EPA, the landfill was capped.

It is important to note that the capped areas onsite are monitored under the current licence and the proposed development will not in any way interfere or disrupt these areas.

Site Assessment

This section refers to Phase 1 and Phase 2 Environmental Site Assessment undertaken by URS and finalised in November 2009. This assessment addressed the entire site. Samples were analysed for a range of inorganic and organic parameters, however, not all samples were analysed for the complete suite of analytical parameters.

The URS report drew the following conclusions based on the site works undertaken:

- Overall the site is considered suitable for the continued industrial use from the perspective of human health implications to site users.
- Risks to surface water and groundwater from a number of metals, fluoride, polycyclic aromatic hydrocarbons (PAH) and hydrocarbon indicator compounds were identified. However, URS concluded that the potential risks were not significant across the majority of the site.
- Samples collected from within the 220 kV compound located in the northern section of the site identified exceedances for hydrocarbons (mineral oil), arsenic, copper and zinc which may represent a risk to human health receptors. This area is upgradient of the proposed development area.
- Arsenic exceedances which may represent a risk to human health receptors were identified in two soil samples. One of these locations is upgradient of the proposed development area.
- PAH exceedances were identified adjacent to the proposed development area along the southern boundary of the site.
- Coliforms were detected in the groundwater and surface water at the site. URS conclude that this is likely to be as a result of local upgradient agricultural practices but may also be related to on-site activities.
- Elevated concentrations of ammonia were detected in groundwater. The origin was attributed to the former waste disposal area.

URS conclude that based on existing data, no remedial action was considered necessary at the site assuming a continued industrial land use scenario. However, it was identified that further assessment was required in some areas to confirm this conclusion, including areas where intrusive investigation was not possible due to the operational nature of the site.

It should be noted that the exceedances identified in the URS report are in comparison with generic assessment criteria which are conservative by nature. A site specific assessment, using site specific assessment criteria, may indicate that there are no risks to receptors associated with the exceedances identified.

Since receiving the final approved version of the URS report in November 2009, Endesa commissioned a contractor called INERCO to complete a further study. This study (see Appendix I.5.1.) concluded the following:

- The substances located in the monitoring wells at the banks of the estuary are likely to be representative of the quality of the aquifer which is drained and alimented by the estuary. It is considered that the regional aquifer is likely not affected by the substances encountered.

- In general comparisons between the campaign carried out by URS ad the current one by Inerco, no significant variations were observed. The values are remaining in the same order of magnitude. Bearing in mind that the activity (of the current plant) is ongoing, it is understood that the situation of the site in terms of soils and underground waters has not experienced any deterioration in quality.

- It is our view that, with the exceptions noted, the site does not pose a risk to human health which prevents the performance of the activity, nor the implementation of the new CCGT project.

I.5.2 Statement of Impacts of Ground and/or Groundwater Contamination

All areas of contaminated land have been disclosed to the EPA and are managed and monitored in compliance with the existing IPPCL P0606-02.

I.6 Assessment of the Environmental Impact of On-site Waste Recovery and/or Disposal.

Describe the arrangements for the prevention and recovery of waste generated by the activity.

Give details, and an assessment of the impact of any existing or proposed on-site waste recovery/disposal on the environment, including environmental media other than those into which the emissions are to be made.

This information should form ***Attachment N^{o} I.6.***

I.6.1 Waste Recovery and Disposal

There will be no on-site waste recovery and/or disposal.

I.7 Noise Impacts

Give details and an assessment of the impacts of any existing or proposed emissions on the environment, including environmental media other than those into which the emissions are to be made.

Ambient noise measurements

Complete Table I.7 (i) in relation to the information required below:

(i) State the maximum Sound Pressure Levels which will be experienced at typical points on the boundary of the operation. (State sampling interval and duration)

(ii) State the maximum Sound Pressure Levels which will be experienced at typical noise sensitive locations, outside the boundary of the operation.

(iii) Give details of the background noise levels experienced at the site in the absence of noise from this operation.

Prediction models, maps (no larger than A3), diagrams and supporting documents, including details of noise attenuation and noise proposed control measures to be employed, should form ***Attachment N^o I.7.***

I.7.1 Assessment Methodology

(i) Study Area

The Great Island power plant occupies an area of approximately 143 acres. The proposed development site will occupy approximately 19 acres.

The surrounding area is predominantly characterised by agricultural lands. The Waterford to Wexford railway line runs under the site access road immediately north of Great Island power plant. Agricultural lands are located further north of the site and to the east. As the area is generally rural in character, the predominant businesses in the area relate to agriculture. The area immediately surrounding the proposed site is pasture land.

The site is located at the confluence of the River Suir and River Barrow, on the shores of Waterford Harbour. The Barrow, Suir, Nore Estuary is approximately 530m wide from the site to the opposite shore.

The nearest area of settlement is at Cheekpoint, Co. Waterford, located approximately 700 metres to the south of the site, on the other side of the river.

In County Wexford, the nearest significant area of settlement is Campile, located approximately 3.75 kilometres to the east. A number of one-off houses are located in proximity to the site boundary, the nearest occupied dwelling is located approximately 450 metres to the northwest of the actual development site. There are no schools, hospitals or churches located within a 1 kilometre radius of the development. A school and GAA club are located approximately 5 kilometres to the north east of the site. A health centre is located in Campile.

(ii) Baseline Evaluation Criteria

Given that the future development site located in a brownfield (i.e. it has been developed previously – existing HFO plant - and it is located in an area which can no longer be considered an undisturbed natural environment), the baseline in terms of noise can be set in relation to the current situation with the HFO plant running.
This means that the background noise levels experienced at the site are those typical of a HFO power plant operation, as the development site is located within the confines of an existing operational plant.

Condition 8 of the current IPPC Licence in place for the HFO plant stipulates that:

8.1 The licensee shall carry out a noise survey of the site operations annually. The survey programme shall be undertaken in accordance with the methodology specified in the 'Environmental Noise Survey Guidance Document' as published by the Agency. The licensee shall consult with the Agency on the timing of the survey. A record of the survey results shall be available for inspection by any authorised persons of the Agency, at all reasonable times and a summary report of this record shall be included as part of the AER.

8.2 Activities on-site shall not give rise to noise levels off-site, at noise sensitive locations, which exceed the following sound pressure limits (LAeq,30 minutes):

8.2.1 Daytime: 55 dB(A),
8.2.2 Night-time: 45 dB(A).

8.3 There shall be no clearly audible tonal component or impulsive component in the noise emission from the activity at any noise sensitive location.

Annual monitoring is carried out by the applicant operator to ensure compliance with these criteria. Surveys that are being carried out now for the existing HFO power plant cover four (4) monitoring locations on the boundary of the operation. These monitoring locations are shown in Table I.7.1 and Figure I.7.3.

Existing Noise Monitoring Locations	Ref.	Irish Grid Reference	
		Northing	Easting
Main Gate	NML1	268573	114825
Jetty Gate	NML2	268655	114508
Cooling Water Outfall	NML3	269001	114599
Matter and Platt (beside 110Kv switchyard)	NML4	268574	114713

Table I.7.1: Annual Noise Monitoring Locations

The existing HFO power plant is, at present, compliant with the sound pressure limits set in the IPPC Licence.

(iii) Impact Assessment Criteria

Magnitude

The magnitude of an impact is assessed in consideration of its intensity, and its extent in space and time. The criteria used to assess the magnitude of impacts from noise are shown in Table I.7.2.

Criteria	Impact Magnitude
The permanent change is greater than or equal to 10dB	High
The permanent change is greater than or equal to 5dB	Medium
The permanent change is greater than 3dB	Low

Table I.7.2: Noise Impact Evaluation Criteria

Significance

The significance of all impacts is considered in consideration of the magnitude of the impact and the importance/sensitivity of the affected area. As the noise assessment is focused on human receptors and in particular those sensitive at night time, which are the most sensitive receptors, the significance of the impact is determined by the magnitude as any change in operational noise will be permanent.

Noise Propagation Model

Propagation of noise from operation of the proposed CCGT plant was predicted using the proprietary modelling software SoundPlan. Noise predictions were made using this software according toguidelines specified in *ISO 9613-2: Attenuation of Sound Propagation Outdoors: General Method of Calculation, International Organisation for Standardisation, 1996*. This methodology considers the strength and size of the noise sources, screening effects due to local topography and intervening buildings, dispersion of sound energy over distance, and attenuation due to ground and air absorption.

Topographical data for the area of the proposed development has been supplied digitally, in the form of elevation contours and spot-heights. Buildings in the area are included in the model and have been identified through site visits, consultation with plant personnel and review of mapping information.

Noise source strengths for the proposed power plant items for the steady-state operation of the facility are summarised in Table E.5(i) Noise Emission. Sound power levels for individual equipment were provided by a number of potential suppliers. These levels provide an accurate representation of the noise levels likely to be associated with each plant item. As the area to the north of the development site consists primarily of agricultural land and to the south is water, appropriate soft and hard ground attenuation has been included for all predictions of noise at noise sensitive receptors.

The power plant currently in operation on site is licensed by the Environmental Protection Agency (EPA) – IPPC Licence P0606-02. Noise emission limit values as outlined in Section I.7.A(ii) have been stipulated in Condition 8 of the licence and are in line with the guidance issued by the EPA, *Guidance Note for Noise In Relation To Scheduled Activities*, 2nd Edition, 2006.

The proposed Combined Cycle Gas Turbine (CCGT) power plant will have a capacity of approximately 430 MW for export to the national grid. The plant will operate principally as a base load plant, with a high annual factor, at or near 100% load during the weekday daytime hours and reduced load or shut down during the night and at weekends, when necessary.

As the plant is likely to operate during the night-time hours, the plant will have to be able to achieve the night-time criteria at full load. Therefore the primary assessment criteria will be:

$L_{Aeq,30min}$ 45dB(A) free-field

I.7.2 Description of the Existing Noise Environment and Noise Sensitive Receptors

The Great Island power plant is located on the Co. Wexford coastline at the confluence of the River Suir and Barrow. The townland of Great Island is made up predominately of agricultural land with a number of scattered residential properties. Cheekpoint, to the south of the site on the opposite side of the river, is the closest town (C. 700 m). Cheekpoint is a quiet tourist location with little traffic passing through it and surrounded by agricultural land.

In such rural settings the predominant noise sources are typically traffic, agricultural vehicles and associated activities. In this case the Great Island power plant is currently in operation and there are a number of industrial activities located at Waterford Harbour, 2 kilometres to the west of the site, so industrial noise currently forms a part of the environmental noise character of the wider area.

As required under Condition 8 of the current IPPC licence, the site carries out an annual noise survey. Annual surveys cover four (4) monitoring locations at the site boundary. These are outlined in Table I.7.1.

No noise sensitive locations outside the boundary of the operation have been considered since, according to the results of the Noise Propagation Model, the operation of the new power plant will not give rise to noise levels at noise sensitive receptors (refer to Figure I.7.2). This is due to the presence of the river acting as a noise screen and the long distance to the nearest areas of settlement (see section I.7.A(i)).

In order to carry out the propagation model, some monitoring locations outside the site boundary were considered. Refer to Appendix nº I.7.1 for more information on this issue.

I.7.3 Identification of Potential Impacts

(i) Main Noise Emission Points

It is expected that the main noise emission points at the new CCGT Plant will be:

N1 — Inlet Filter Face
N2 — Stack Exit
N7 — Turbine Compartment Vent Fans
N9 — Transformers (x5)

The main noise emission points locations are outlined in Figure I.7.1. A location for the turbine comparment vent fans is not yet determined, however the Turbine building where they will be installed is marked in the Figure.

Noise emissions during the normal operational regime will be continuous, with a maximum noise level (LAeq) of 65 dB(A) within the site boundaries and in the immediate shore, and less than 45 dB(A) at sensitive receptors, as outlined below. For more information about noise emission points, refer to Attachment nº E.5 — *Noise Emissions*.

(ii) Rise to noise levels off-site

Predicted operational noise contours have been produced to give an indication of the contribution of the proposed power plant to environmental levels. Table I.7.3 summarises the predicted noise levels at the closest NSRs. Figure I.7.2 presents the predicted noise contours at 1.8 metres above ground level.

NSR	Impact Assessment Criterion	Existing Background night-time levels	Predicted Level (Lar, T dB) arising from plant	Combined noise levels	Exceedance of noise Criterion (dB)	Magnitude of change
1	45	43	39	45	0	+2
2	45	43	39	45	0	+2
3	45	43	40	45	0	+2
4	45	43	37	44	0	+1
5	45	43	38	44	0	+1

Table I.7.3: Night-time Operational Noise Levels at Receptors

As can be seen from Table I.7.4 the predicted noise levels from the operation of the plant are lower than the 45 dB(A) criterion. The predicted noise from the plant was added to the average existing background noise levels. The results indicate that the noise criterion will not be exceeded at any of the noise sensitive receptors and the predicted magnitude of change is low.

I.7.4 Mitigation Measures

According to the *EPA Guidance Note for Noise in relation to Scheduled Activities (2nd Edition, 2006)*, emphasis is put in controlling noise at source rather than controlling noise propagation. Propagation is controlled by mitigation measures only where control at the source is not possible or insufficient in order to meet the noise assessment criteria.

The operation of the power plant will be licensed by the EPA. Noise limits as described in Section I.7.A(ii) will be applicable to the site. As demonstrated in Section I.7.C, predicted noise levels are not expected to exceed the noise assessment criteria at any of the noise sensitive receptors. Modelling of noise from the proposed power plant is based upon a conceptual layout and plant type. It is noted that screening has been incorporated around the HRSG to minimise potential noise impacts from the plant. During detailed design the noise model can be refined and detailed mitigation, if necessary, will be identified and incorporated into the design to ensure compliance with the required IPPC licence conditions.

I.7.5 Residual Impacts

Predicted noise levels at the noise sensitive receptors during operation do not exceed the assessment criteria. As part of the detailed design process detailed modelling of the plant layout and operation will be carried out and will incorporate mitigation measures as necessary to ensure the criteria are met.

No significant residual impacts are predicted to occur at the noise sensitive receptors.

I.7.6 Statement of Noise Emissions Impacts

Predicted noise levels at the noise sensitive receptors during operation do not exceed the assessment criteria. As part of the detailed design process detailed modelling of the plant layout and operation will be carried out and will incorporate mitigation measures as necessary to ensure the criteria are met. No significant residual impacts are predicted to occur at the noise sensitive receptors.

Table I.7(i): AMBIENT NOISE ASSESSMENT

Third Octave analysis for noise emissions should be used to determine tonal noises

	National Grid Reference	Time	Sound Pressure Levels		
	(6N, 6E)		$L(A)_{eq}$	$L(A)_{10}$	$L(A)_{90}$
1. SITE BOUNDARY					
NML1	E268573, N114825	15:10-15:40 26/11/09	74.6	58.7	54.9
NML2	E268655, N114508	16:34-17:04 26/11/09	70.2	77.9	63.1
NML3	E269001, N114599	17:48-18:18	70.0	51.2	49.7

		26/11/09			
NML4	E268574, N114713	17:10-17:40 26/11/09	67.7	55.3	53.4
2. NOISE SENSITIVE LOCATIONS					
NML5	E268550, N115080	Daytime	42	N/D	40.33
		Night-time	40.75	N/D	37
NML6	E268438, N115139	Daytime	42.25	N/D	37.75
		Night-time	41	N/D	36.75
NML7	E268761, N113685	Daytime	43.5	N/D	40
		Night-time	43.75	N/D	39.25

Note: All locations should be identified on accompanying drawings

Figure I.7.1: Main Noise Emission Points

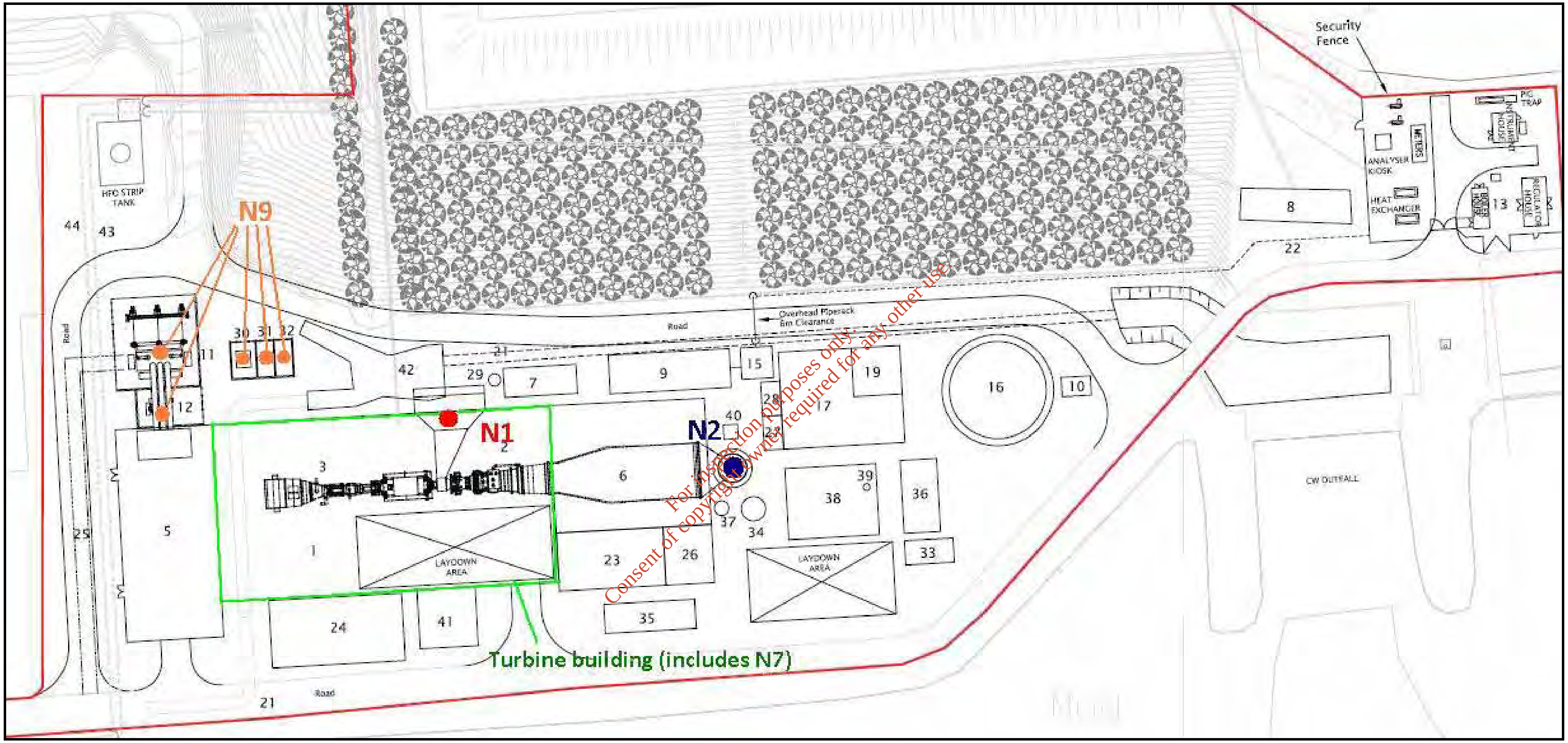


Figure I.7.2 Noise Contours Normal Operation at 1.8m height

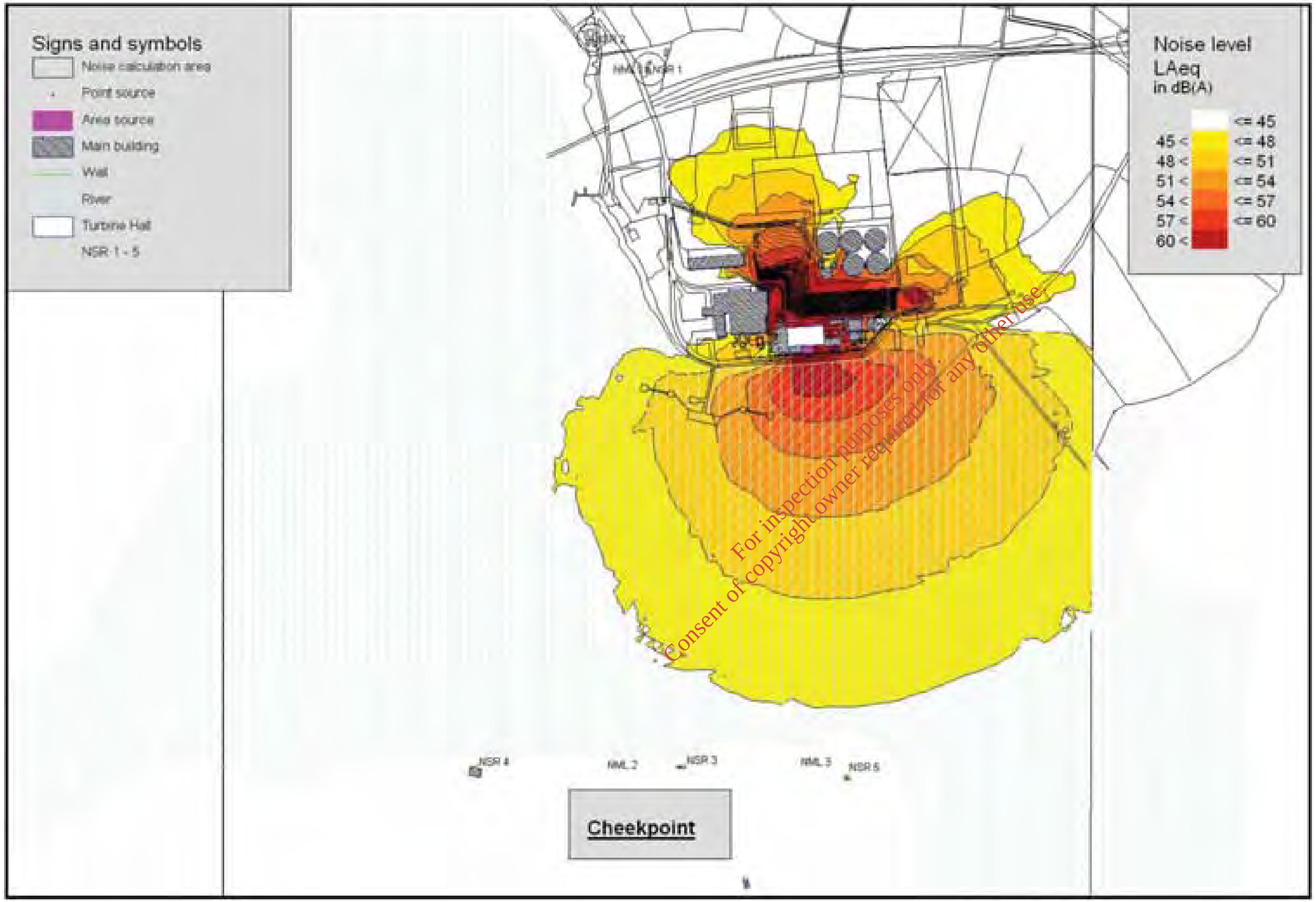


Figure I.7.3: Current Monitoring Locations

Appendix I.7.1: Noise Monitoring Locations considered for the Noise Propagation Model

Three monitoring points outside the facility limits were taken into account for the Noise Propagation Model. These noise monitoring points (namely NML5, NML6 and NML7) are considered to be representative for the existing Noise Sensitive Receptors (NSR1 to 5). Description of NMLs outside the power plant boundaries and their relation to NSRs are depicted in Table I.7.4.

Ref.	Ref.	Location	Description
NML 5	NSR 1	Last Bungalow on Approach Road to Station and in line of sight of the Station	Station clearly audible. Occasional passing traffic and wildlife.
	NSR 2	Nex bungalow north of NSR1 on Approach Road to Station and in line of sight of the Station Approx 400 m from Main gate	No baseline monitoring carried out at this point. The noise environment would be similar or the same as NML 1.
NML 6		"Cheeckpoint" on Coast Road 1/3 distance from Main Pier to old pier	Station clearly audible. Occasional passing traffic and wildlife.
	NSR 3 & 4	Residential properties near this location were selected to be representative of NSR in this area	No baseline monitoring carried out at this point. The noise environment would be similar or the same as NML 2.
NML 7		"Cheekpoint" on "Board of Works" ground in line with Unit 3 Chimney	Station clearly audible. Occasional passing traffic and wildlife.
	NSR5	Residential property to the east of NML 3 was selected to be representative of NSR in the area.	No baseline monitoring carried out at this point. The noise environment would be similar or the same as NML 3.

Table I.7.4: Description of Monitoring Locations and Noise Sensitive Receptors

It is important to emphasize that NML5 to 7 are not the planned Noise Monitoring Locations for the annual noise survey to be carried out for the new CCGT Plant, but only for this assessment. Ambient Noise Monitoring and Sampling Points are further discussed in Section F.2: *Emission Monitoring and Sampling Points*.

Figure I.7.4: Monitoring Locations and Sensitive Receptors considered for the Noise Propagation Model

I.8 Environmental Considerations and BAT

Describe in outline the main alternatives, if any, to the proposals contained in the application.

Describe any environmental considerations which have been made with respect to the use of cleaner technologies, waste minimisation and raw material substitution.

Describe the measures proposed or in place to ensure that:

(a) The best available techniques are or will be used to prevent or eliminate or, where that is not practicable, generally reduce an emission from the activity;

(b) no significant pollution is caused;

(c) waste production is avoided in accordance with Council Directive 75/442/EEC of 15 July 1975 on waste; where waste is produced, it is recovered or, where that is technically and economically impossible, it is disposed of while avoiding or reducing any impact on the environment;

(d) energy and other resources are used efficiently;

(e) the necessary measures are taken to prevent accidents and limit their consequences;

(f) the necessary measures are taken upon definitive cessation of activities to avoid any pollution risk and return the site of operation to a satisfactory state.

Supporting information should form Attachment N^o I.8.

The proposed development in Great Island is a CCGT generating station with an electrical output of 430 MW. This power plant, when developed, will be one of the most efficient CCGT generating stations on the all-Ireland grid. The development will use best available technology in defining and achieving such high levels of efficiency which will result in reducing environmental impacts and also optimising electricity generation for each unit of fuel used.

I.8.1 Techniques for the Prevention and Minimisation of Resource Consumption in power generation

Endesa Ireland Ltd. is developing a project addressing the technical design and future construction and operation of a new Combined Cycle Gas Turbine (CCGT) power plant with an envisaged commercial operation date by Quarter 1, 2013. Once the new CCGT power plant becomes operational the existing HFO plant will be decommissioned. The proposed location of the new CCGT power plant is within the boundaries of the current licence (P0606-02) as referenced previously in this application.

The plant will be designed in accordance with *Reference Document on Best Available Techniques for Large Combustion Plants, (adopted July 2006).*

The new plant will operate on a continuously manned basis 24 hours a day, 365 days a year, with personnel working on a shift arrangement. The CCGT will have a nominal capacity of 430 MW and will export electricity, via an underground cable, to the onsite existing switchyard. The plant will normally operate on full load resulting in a plant efficiency of approximately 58 %.

The CCGT plant incorporates the following processes:

A gas turbine, burning natural gas, drives a generator for electricity production. Exhaust gases from the gas turbine pass through a Heat Recovery Steam Generator (HRSG) to generate high-pressure steam. The steam generated in the HRSG drives a steam turbine, which also turns the generator providing additional electrical power. The steam is condensed back to water via a Condenser for re-use in the HRSG. This condenser is cooled by a once through direct cooling system. The combined cycle process consists of two thermodynamic cycles working together to produce electricity as efficiently as possible.

The first cycle comprises a gas turbine and an electrical generator coupled together on one main shaft, which rotates at high speed. The gas turbine consists of a compressor section, a combustion chamber and a turbine section. Air is drawn in through an intake filter, compressed and fed into the combustion chamber where fuel is injected and ignited. The resulting hot combustion gases passing through the turbine section rotate the shaft driving the compressor and the electrical generator to produce the rated electrical power output. Operation of a gas turbine, as described above, is referred to as open or simple cycle mode.

It is possible, however, to generate approximately 50% more electricity from the hot exhaust gases by passing them through a HRSG or boiler, which uses the heat from the exhaust gases to generate steam, which is fed to a steam turbine. Exhaust gases from the CCGT are discharged to the atmosphere via a stack located at the outlet of the HRSG.

The high pressure steam produced in the HRSG is supplied through inter-connecting pipework to the steam turbine which is coupled to the same generator as the gas turbine (i.e. 'single shaft' design), further driving the generator to generate more electricity. The steam is expanded to vacuum conditions in the steam turbine to extract as much energy as possible. The steam is then fed to the Condenser where it is condensed back to water and fed back to the HRSG to generate more steam thereby conserving water within a closed cycle. The cooling required for the condensing the steam back to water is provided by once through cooling water from the local estuary as per the current HFO plant, albeit with the new CCGT requiring less cooling water from the estuary. Table 14.7 in Section 14.5.3 in the EIS identifies the efficiencies in using BAT in the cooling water system as per the *Integrated Pollution Prevention and Control (IPPC) Reference Document on the application of Best Available Techniques to Industrial Cooling Systems, December 2001* for the proposed development.

Natural gas and feed water will be steam heated prior to use to further optimise plant efficiency.

The main elements of the plant will be subject to a long term service agreement, all key elements of the plant will be incorporated into the Planned Preventative Maintenance Programme (PPMP) thereby maintaining efficiency levels.

The inherent efficiency of energy transformation, thereby reducing resource consumption and emissions of greenhouse gases, together with the utilisation of a once through cooling system, are considered to meet the requirements of BAT.

Opportunities for the prevention and minimisation of resource use (including waste generation), energy and water consumption will be implemented through the EMS. Waste, energy and water consumption audits will be undertaken within the timeframes specified in the IPPC licence.

I.8.2 Techniques for the control of Atmospheric Emissions

The plant will operate on natural gas, a clean fuel resulting in negligible emissions of Particulate Matter and Sulphur Dioxide. In line with the requirements of the commission for Energy Regulation distillate, with a sulphur content of less than 0.1%, will be stored on site to be used in the event of interruption to the natural gas supply.

The maintenance of all atmospheric abatement, control and monitoring equipment will be incorporated into the PPMP. All equipment will be maintained and calibrated in accordance with manufacturer's specifications.

Techniques for the control of atmospheric emissions are discussed for each pollutant in turn hereunder:

Nitrogen Oxides

The primary mechanism for the formation of thermal NOx in gaseous fuels is through the formation of NOx from nitrogen in the air during the combustion process. The gas turbine generator will be fitted with a dry low NOx burner. Thermal NOx is formed at high temperatures. The dry low NOx burner optimises the air / fuel ratio producing a uniform low temperature flame in the combustion chamber to minimise the production of NOx when operating with natural gas. Water injection will be employed when the plant is operating on distillate fuel. Water will be injected directly into the combustion chamber. The evaporation of water requires heat which is then not available to heat the flame decreasing the flame temperature and reducing the amount of NOx produced.

An auxiliary boiler, of less than 5 MW, will be employed, if required, to provide heat to the plant during start up periods (this will be very infrequent as the plant is designed as a "baseload plant", i.e. continuous running). Emissions from the auxiliary stack equate to approximately 0.5% of those from the main stack. The CCGT and auxiliary boiler will not operate simultaneously, emissions from the auxiliary boiler are therefore considered to be insignificant.

Sulphur Dioxide

Emissions of Sulphur Dioxide arise from the presence of Sulphur in fuel. Natural gas is generally considered free from Sulphur while the distillate used on site will contain <0.1% Sulphur. The use of low Sulphur fuel is considered to meet the requirements of BAT.

Carbon Monoxide

Natural gas and distillate are very clean fuels which allow practically complete combustion in gas turbine combustors. BAT for the control of CO emissions is optimisation of the combustion process. CO is a product of incomplete combustion due to inefficient mixing of the fuel and combustion air, short residence times and low combustion temperatures. As the formation mechanisms of NOx and CO are similarly influenced by combustion temperatures it is critical that optimum conditions are employed.

In accordance with BAT the plant will operate on an advanced computerised control system which will ensure optimum combustion conditions and high boiler performance that support the reduction of emissions. The use of advanced materials, good plant and combustion chamber design, as well as the use of high performance monitoring and process control techniques and maintenance of the combustion system will further minimise the potential for CO emissions.

Particulate Matter

Solid fuel will not be used on site thereby reducing the potential for particulate matter arising from plant operations. As stated in BAT guidance, the control of particulate emissions from gaseous fuels is not necessary. Control techniques from the emissions of particulates from the combustion of liquid fuels include controlled combustion to prevent soot formation as discussed previously.

I.8.3 Techniques for the Control of Emissions to Water

Three main waste water streams will be generated on site:

- Treated foul water;
- Treated process wastewater; and
- Surface Water Run-off
- Cooling water

Foul Water

In accordance with BAT foul water, comprising sewage and domestic type waste water, emanating from the site will be treated in an on-site biological unit. The treated wastewater will be monitored prior to discharge to the estuary.

Process Waste Water

The water used in the HRSG will be demineralised water conditioned with supplementary chemicals i.e. Carbohydrazide, Tri-sodium Phosphate and Ammonia. Dosing of boiler feedwater will be carefully controlled and minimised to reduce the impact of the waste water on receiving waters.

It is necessary to maintain the salt content in the HRSG water / steam cycle below a certain threshold to prevent depositions through evaporation and accelerated corrosion. In order to maintain the quality of the HRSG water it is therefore necessary to regularly blow down water from the HRSG. The boiler blowdown will consequently contain low concentrations of salts. The blow down water from the boiler circulation system will be quenched in a boiler flash vessel. The blowdown will then discharge to the process waste water discharge tank.

Condensate drain waste will also discharge to the process wastewater discharge tank. Compressor cleaning waste water will be disposed of hazardous waste. In accordance with BAT process waste water drains will run above ground and will be completely segregated from uncontaminated storm water.

Process wastewater will be mixed and pH corrected, as required. Settled solids from the discharge tank will be removed from site by appropriately licensed / permitted contractors. The wastewater will be continuously monitored for Ammonia, Conductivity, Dissolved Oxygen, pH, Total Organic Carbon and temperature. An on-site laboratory will also be provided to offer additional monitoring as required.

A maximum of 157.2m^3 of process waste water will be discharged each day. The discharge tank has a capacity of 200m^3 thereby providing adequate retention capacity for failure events.

Neutralisation and sedimentation are considered to meet the requirements of BAT for process waste water.

Surface Water Run-off

Surface water run-off will discharged via a silt trap and an oil / water interceptor. Separate drainage will be provided for areas with a contamination risk. In general, hardstanding areas of the site will drain by gravity thereby minimising energy consumption. However, water collected in bunded areas (i.e. bulk storage tanks) will require pumping to minimise the potential for contaminated water entering the drainage system.

The distillate tanks are appropriately bunded in order to fully contain the volume of distillate stored in the event of a catastrophic failure (Refer to Quantitative Risk Assessment – Land Use Planning Report, Appendix 3.3 of EIS). Water collected in the tank bund, and apron, will be discharged via safety shutdown valves and the silt trap and oil / water interceptor. The bulk storage tank will be fitted with automatic control systems to prevent overfilling.

All chemical conditioning materials required for boiler feedwater will be stored under cover in UN approved containers. The chemical storage room will incorporate dedicated integral bunds. Spills and leaks will be cleaned by appropriately experienced personnel using absorbent materials. The waste arising will be disposed of off-site by appropriately authorised contractors.

Pipes, bunds and storage facilities will be regularly checked for deterioration, damage and leaks. Integrity testing and the maintenance of all wastewater abatement control and monitoring equipment will be incorporated into the PPMP. All equipment will be maintained and calibrated in accordance with manufacturer's specifications.

Cooling Water Discharge

As explained above the plant will use once-through cooling as per the current HFO plant albeit requiring less cooling water due to the reduced steam requirement. The condenser will be monitored for temperature rise during operation. The hydrodynamic modelling report entitled Great Island Power Plan Hydrodynamic Modelling Report (Mott MacDonald 2010) demonstrates that this system will not breach the existing IPPC licence and will provide significant benefits over the existing power station. It is anticipated that the new CCGT will require approximately 20,000m^3 of water per hour, versus 50,000m^3 per hour of water as required by the existing HFO plant.

I.8.4 Techniques for the Control of Noise Emissions

The impact of noise from the plant will be restricted to a relatively close area around the site.
The following noise abatement measures will be employed on site in accordance with BAT:

- The gas turbine, steam turbine and generator will be located in an enclosure.
- Enclosures will be ventilated with low noise fans.
- The steam turbine support structure will incorporate cladding.
- Boiler feed pumps will be enclosed within a pump house.
- Maintenance of parts of plant and equipment will be undertaken as part of the PPMP.
- Noisy maintenance works, alarm testing and drills will not take place during night time hours or in the early part of the morning, where practicable.
- Noise will be prevented at source where possible through the employment of suitable work practices and the selection of quiet plant and machinery.
- Noise control and acoustical performance targets will be key issues in the selection of site vehicles and ancillary machinery.
- Noise control measures will be effectively managed e.g. doors and windows to noisy areas will be closed when the plant is operating.
- Unavoidably noisy activities will be positioned as far from sensitive receptors as possible.
- Site personnel will receive noise awareness training in noise control such as avoiding revving of engines and switching off noisy equipment when not in use.
- Ambient noise monitoring will be undertaken on an annual basis at both boundary and nearest sensitive receptor locations.
- The HRSG will be partially cladded to abate noise

Noise arising from plant operation is not normally expected to exhibit tonal or impulsive characteristics. Under normal conditions the plant will operate on natural gas which will be piped directly into the site thereby negating the impact of noise resulting from road transportation.

I.8.5 Raw Material Selection and Use

Distillate with a sulphur content of <0.1% will be used on site. Natural Gas will be piped directly from the Bord Gáis Network. Natural Gas and distillate oil specifications will be stipulated in the supply contracts, their use will be optimised to meet the required combustion efficiencies and testing regimes. The use of natural gas is considered to meet BAT for fuel types in the combustion of fossil fuels.

Raw water, for use in the HRSG, will be sourced from the local public Water Scheme. There will be a 37% improvement over the existing water intake on the current plant. The plant will maintain a buffer capacity in the onsite reservoir ($9,000m^3$), in addition where necessary, supply of water from the water sheme will take place during low demand periods in order to minimise any potential impact on water supply in the area.

Feed water will be treated with conditioning chemicals prior to use in the HRSG. HRSG water will be subject to on site testing and monitoring to ensure optimisation.

Carbohydrazide, an oxygen scavenger, has been selected for use on site. Initially anhydrous Hydrazine was considered but an assessment of the comparative hazardous characteristics determined that Carbohydrazide was a more sustainable option.

The conditioning chemicals selected provide proven optimisation of the HRSG, their use will be optimised through controlled dosing. The use and selection of laboratory chemicals will be determined by the on-site monitoring requirements however their use will be minimised wherever possible. Cleaning products will be of a water based biodegradable nature wherever possible. A hazardous detergent will however be required for compressor cleaning.

In accordance with BAT guidance it is anticipated that turbine control oil and lubricating oil will be changed every ten years and possibly soon after commissioning. On each occasion the quantity of oil will equate to approximately 45,000 litres.

Approximately $7m^3$ of compressor cleaning waste will be produced on each cleaning occurrence to periodically remove dirt and grease from the blades. It is anticipated that compressor cleaning will take place once / twice per annum.

It is anticipated that spent ion exchange resin will be changed once every three to five years.
Backwash from the water treatment plant will be discharged to the process waste water discharge tank.

All raw materials used on site will be subject to a COSHH assessment and compliance with REACH. A review of new developments in raw material selection will be incorporated into the EMS. Prior agreement will be sought from the EPA prior to a revision of raw material use.

I.8.6 Waste Management Hierarchy

The volume of waste generated by the facility will be relatively small. Waste will be managed on site in accordance with the Waste Management Hierarchy. Where possible the generation of waste will be avoided. Where this is not possible the production of waste will be minimised and sent for recovery. Where this is not technically or economically feasible the waste will be disposed of. All waste will be managed by appropriately authorised contractors in accordance with relevant legislation.

A baseline waste audit will take place within the timeframe specified in the IPPC licence (as per current licence arrangements). The waste audit process will identify all waste streams generated on site and determine opportunities for waste prevention, minimisation and re-use. The audit will also include an assessment of current waste management practices and determine if additional opportunities for waste recovery exist. The findings of the waste audit will be incorporated into, and managed through, the EMS.

An annual waste minimisation report will be developed demonstrating the efforts made to reduce consumption. A material balance will be included illustrating the fate of all waste materials.
Records of the quantity, nature, source and quantity of any waste sent for recovery or disposal will be maintained.

I.8.7 Energy Efficiency

Energy efficiency is integral to the overall design of a CCGT plant. CCGT technology is the most efficient form of conventional thermal power generation. The plant will operate on an advanced computerised control system which will support optimisation of generation efficiency.

In order to establish efficiency criteria on power generation, it is necessary to take into account that the performance of any combustion facility is limited by the ideal efficiency of its thermal process (Carnot efficiency).

$$\eta_{T.Carnot} = 1 - \frac{T_0}{T}$$

The plant performance is set by two parameters: the ambient temperature (T0) and the temperature at which the heat is risen (T), both expressed in Kelvin (K). It seems clear that the higher T reached and the lower T0 is, the higher the 'Carnot' efficiency will be. This is applicable to real facilities performance.

Conventional gas or steam turbines can only optimize their real performance by modifying one of these two parameters. In steam turbines, performance is optimized by lowering T0 at the condenser. However, T is limited by the boiler materials.

In gas turbines, combustion chambers yield high temperature heat, which increases T, but they do not have a way to reduce T0 since there is no condenser.

A Combined Cycle enables an increase in thermal performance by modifying both parameters. High temperature heat is yielded in the gas turbine combustion chamber, and there is a condenser in the steam cycle.

Figure I.8.1 shows a comparison between theoretical Carnot efficiency and actual efficiency rates reached through current power generation technologies (fossil fuels). It can be clearly stated that CCGT efficiency exceeds those of the rest of technologies.

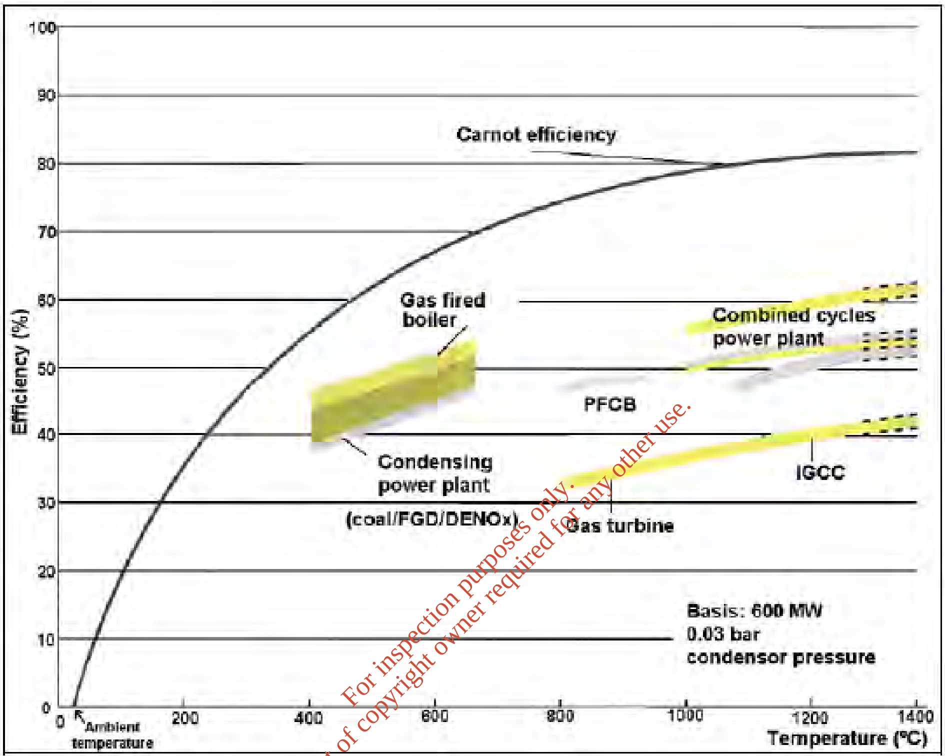


Figure I.8.1: Carnot efficiency and actual efficiency of existing generation technologies (Source: Reference Document on Best Available Techniques (BREF) for Large Combustion Plants)

Recent technical innovations on gas turbines have lead to an increase in the performance of combined cycles without implying a significant increase in the initial costs. Consequently, many CCGT plants are being designed and built, and some existing gas turbines or steam turbines are being converted to combined cycles.

According to the last LCP BREF (Reference Document on BAT for Large Combustion Plants, released by the IPPC European Bureau on July 2006) cogeneration (Combined Heat and Power, or CHP) offers the highest efficiency and is the most effective option to reduce emissions to air. Cogeneration is considered BAT for any new build power plant whenever the local heat demand is high enough to warrant its construction. These are not the circumstances of our case, in which, steam is directed to the steam turbine in its entirety for power generation. This is considered the second best choice concerning thermal efficiency. CHP is only viable when there are industrial requirements for heat or steam or if there are large residential heat requirements in the vicinity of the power station, these circumstances do not arise in Great Island.

The utilisation of CCGT technology for the case of study can be considered as BAT as far as energy efficiency is concerned. The planned CCGT plant at Great Island will be able to reach on average an efficiency rate exceeding 58%, i.e. for every 100 megawatts of heat input, more than 58 megawatts output (approx.), as electricity, is achieved. Approximately 38% is derived from the gas turbine and a further 20-21% is derived from the steam turbine. The remaining loss of energy is due to condensing the steam back to water.

As a state-of-the-art power plant, this development will utilise the best available power generation technologies, combustion control technologies and control systems. In addition the facility will be operated in accordance with stringent regulatory controls and limits. New CCGT power plants are efficient, clean, reliable and safe. Also the proposed facility will operate on natural gas rather then the current situation where the site is operating on Heavy Fuel Oil, this will result in significant improvement in emissions with negligible emissions of Sulphur Dioxides and Particulate Matter. There will also be a reduction in cooling water requirements.

An energy efficiency manager will be recruited to optimise the efficiency of the overall plant. I addition audits will be completed within the timeframe specified in the IPPC Licence (audits have been completed in the currently licensed site). The audit will be undertaken in accordance with the Guidance Note on Energy Efficiency Audits, EPA (2003). The audit will include an assessment of the quantity and cost of energy to the site over a given period. The findings of the energy audit will be used to identify opportunities for energy efficiency improvements on site. Energy efficiency targets, determined through the auditing process, will be incorporated into, and managed through, the EMS.

I.8.8 Accident and Incident Prevention

As is currently the case, the new facility will be manned 24 hours a day, 365 days a year. The site will be enclosed within a boundary fence; security will be managed on site by a specialist contractor. Car parking will be provided at the administration building as per current practice. Only approved contractor(s), delivery, collection and site vehicles will be permitted access to the operational area of the site.

All transfers of oil from and to the tanks will be supervised by suitably trained members of staff. In addition adequate containment through bunding has been incorporated around the distillate storage area thereby preventing any release of distillate to the surrounding area in the event of a catastrophic failure of the tanks.

All potentially polluting substances, including waste, will be stored in designated areas in appropriate UN approved containers within bunds, drip trays or spill pallets, as deemed necessary. Hazardous chemicals and waste will be stored in accordance with HSG 71 Chemical Warehousing - The Storage of Packaged Dangerous Substances. All chemicals stored on site will be subject to a COSHH assessment. A chemical inventory, including MSDS's will be maintained on site. All containers and bunds will be inspected regularly to ensure they have not become damaged or degraded. All tanks will be contained within bunds and fitted with level gauges and alarms which will be incorporated into the PPMP. All areas on site with potentially polluting substances will be hardstanding with channels directing run-off to contained areas. All waste water will be subject to monitoring prior to discharge from the site.

Any faults detected will be prioritised. Faults associated with health and safety and environmental equipment will be given highest priority and action will be taken immediately. Leaks of potentially polluting substances will be repaired as soon as practicable. Drip trays will be provided immediately, if repair is not possible the leaking equipment will be appropriately contained prior to safe removal from the facility.

As is currently the case accidental spillages will be contained and cleaned immediately by suitably trained personnel. Spill equipment stocks will be stored at strategic locations around the site. Stocks will be subject to regular inventory checks. Incidents, accidents and near-misses will be recorded on site and notified to the appropriate authorities in accordance with licence requirements.

Leaks and excessive pressure increases in the Bord Gáis supply will trigger alarms and shutoff valves within the site and along the Bord Gáis Network. Valves and flanges will be fitted with leak detection alarms connected to the manned control room. Valves on site will be fitted with manual override mechanisms. Safe shutdown programmes will be incorporated into the computerised control system. An emergency generator will be provided to supply power to essential plant in the event of an interruption to power supply.

As per the existing procedures, good housekeeping practices and regular monitoring of tanks and equipment will minimise the likelihood of leaks and spills occurring on site and ensure that if any leaks / spills do occur, they will be contained and controlled immediately.

As is currently the case, site inductions will include safety requirements and emergency evacuation procedures. Site personnel will be provided with training on accident prevention and emergency response. Fire wardens and first aiders will be assigned in accordance with best practice guidelines in line with the current plant Emergency Response Plan (ERP).

Refresher training will be undertaken as necessary and all records will be maintained on site.
Emergency drills will be undertaken in accordance with the recommendations of the Emergency Services and as per the ERP. All personnel will be issued with appropriate safety and personal protective equipment.

An Emergency Incident Response Plan will be developed and implemented in consultation with the local emergency services. The plan will include emergency response contact details for both site personnel and emergency services, maps and plans of the facility, emergency procedures, MSDS's, chemical inventories and equipment lists. Emergency contact details for the emergency services and other relevant authorities will be displayed at prominent locations around the facility.

The current Fire Emergency Response Plan will also be revised and implemented in the proposed CCGT in consultation with the local fire department. A Fire Water Retention Study will be undertaken in accordance with the conditions of the IPPC licence. Fire doors will comply with BS 476- 22:1987 - Fire tests on building materials and structures. Fire protection and suppression systems will be installed in accordance with National Fire Protection Association (NFPA) guidelines. The facility will also be subject to fire safety certification.

Fire alarms and fire extinguishers will be placed in all buildings on site in accordance with the recommendations of the local fire department. Training in their use will be provided by a suitably qualified specialist. The facility is considered to be a lower tier Seveso site due to the quantity of distillate stored. A Quantitative Risk Assessment has been prepared in consultation with the Health & Safety Authority (HSA). A copy of the report is appended to the EIS in Appendix 3.3, in addition to Section B of this application.

I.8.9 Cessation of Activities

As the new CCGT and existing HFO plant will not operate in parallel, decommissioning of each of the plants will be separately addressed.

Thus, the RMP (Residuals Management Plan) and ELRA (Environmental Liabilities Risk Assessment) documents which are currently in place and approved for the existing power plant will be exercised upon decommissioning of the HFO plant, in compliance with the current IPPCL.

In terms of the proposed CCGT, the plant is expected to be operational for at least 25 years. On cessation of activities the plant will either be redeveloped as a power generating facility or the site will be redeveloped in an alternative form. Considering the proximity of the site to the grid connection it is envisaged that the site will remain a power generating facility.

In the event that the facility is decommissioned the following indicative programme will be implemented:

All plant equipment and machinery will be emptied, dismantled and stored under appropriate conditions until it can be sold. If a buyer cannot be found the material will be recovered or disposed of through licensed waste contractors and hauliers.

- Plant services, including pipelines and cabling, will be decommissioned and disconnected to the boundary of the installation.
- If plant, machinery and services are required to be cleaned on site prior to removal all necessary measures will be implemented to prevent the release of polluting substances.
- All chemicals, fuel and waste will be removed from the facility. Unused chemicals will be returned to the supplier where possible.
- Waste will be recycled wherever possible. All waste movement, recycling and disposal operations will be controlled by appropriately authorised waste contractors.
- The site and all associated buildings will be secured. All structures and plant will be removed and the site returned to a condition as close as possible to a greenfield site.

- If buildings are to be retained, a maintenance programme will be implemented to ensure they do not decay or present an unacceptable health and safety risk.
- All associated licences and permits will be surrendered.
- An Aftercare Management Plan will be developed and implemented in agreement with the EPA, Wexford County Council, NPWS and other relevant stakeholders if required.

A detailed "Closure, Restoration and Aftercare Management Plan" (CRAMP) will be developed and submitted to the EPA within six (6) months of commencement of operations - or as otherwise agreed with the EPA - in accordance with *Guidance on Environmental Liability, Risk Assessment, Residuals Management Plans and Financial Provision, EPA (2006).*

Following these Guidelines, the CCGT plant is given a "3" in the Risk Category analysis and classification. In addition, it is classified a "G4 " type of activity because it falls under the umbrella of the operation of combustion installations with a rated thermal input equal to or greater than 50 megawatts (MW). The CRAMP report results mandatory in this case.

The plan will be reviewed annually as part of the Annual Environmental Report (AER) and will include:

- A scope statement
- Criteria for successful decommissioning
- A programme to achieve stated criteria
- If relevant, a test programme
- Details of how costs will be underwritten

Appendix I.2.3 Great Island Ground Investigation Report INERCO

SOIL AND GROUNDWATER INVESTIGATION AT GREAT ISLAND GENERATING STATION, CAMPILE, NEW ROSS, COUNTY WEXFORD

IN/MA-09/0905-002/02

MARCH 2010

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APPENDIX

1. INTRODUCTION

1.1 BACKGROUND

This report presents the findings, conclusions and recommendations of a soil and groundwater investigation at ENDESA IRLAND´s Great Island Power Generatind Station.

The works were undertaken at the request of ENDESA IRLAND LTD (hereafter ENDESA).

This assessment was perfonred in accordance with INERCO Proposal number IN/MA-09/0905 dated November 27th, 2009.

INERCO completed the fieldworks between:

- February 2nd and 13th 2010 and
- February 22th and 23th 2010,

This report contents:

1. Introduction.
2. Site settings.
3. Scope of work.
4. Fieldworks Results.
5. Soil analytical results.
6. Groundwater analytical results.
7. Conclusions and recomendations.

1.2 OBJECTIVES

Several soil and groundwater investigations were carried out at this site since 1996.

These investigations are based on the review of the Phase 1 and 2 Environmental Site Assessment prepared by URS Ireland Limited on behalf of ESB Great Island Power Generating Station, dated December 30th, 2008.

These investigations give a special relevance to the following specific areas:

- Areas overlapping the layout of the new project (new combined cicle), where basically there are no monitoring points in place and historic data.

- Areas already identified as potentially contaminated, outside the new project limits but inside the site boundaries.

The main objectives of the investigation were as follows:

- To complete the investigations previously carried out by URS.
- To get evidence of current situation in terms of contamination in soil and groundwater.
- To assess the need for remediation and the scope of work of this activity.
- To conclude on the convenience of implementing additional monitoring points (not included at the moment in the current IPPCL).

1.3 LIMITATIONS

INERCO has prepared this report for the use of ENDESA IRELAND LTD in accordance with generally accepted consulting practices and for the intented purposes as stated in the agreement under which this report was completed. This report may not used by any other party without the explicit written agreemen of INERCO. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Field investigations have been restrictited to a level of detail required to achieve the stated objectives of the work. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay.

2. SITE SETTING

2.1 SITE LOCATION AND DESCRIPTION

Great Island Generating Station is located at the confluence of the Rivers Suir and Barrow.

The site has a surface area of 68 Ha.

Figure I.1 Site location is presented in Appendix I.

The station comprises three generation units with a total electricity generation capacity of 240 MWe, two 60 MWe units and one 120 MWe unit. Each unit consists of a boiler, steam turbine and auxiliary plant that are independent of each other.

Heavy Fuel Oil (HFO) is the main fuel and distillate oil is used for start-up. The HFO is shipped to the site and stored in an oil tanks farm. Distillate oil is also stored on site and tankered to site by road.

To the east of the station is located a former waste disposal area, with two rectangular cells.

2.2 SURROUNDING LAND USE

The surrounding area is predominantly agricultural:

- To the north: a railway track and some agricultural lands beyond it.
- To the south: the River Suir estuary.
- To the east: agricultural lands.
- To the west: The River Barrow.

2.3 SITE HISTORY

The power station was constructed in two main phases over agricultural lands:

- 1967 and 1968: First phase - Commissioning of two 60 MW Units.
- 1972: Second phase - Commissioning of a 120 MW Unit.

The waste disposal areas were developed during the two main phases of construction of the Generating Station through the placement of excess rock fill, building materials and spoil.

2.4 REGIONAL HIDROLOGY

The following water bodies are located near the site (as indicated in Figure I.1):

- The site is located on the eastern bank of River Suir and River Barrow.
- The Barrow-Nore-Suir Estuary is located to the south.
- The Campile River is located to the south southeast of the site.
- An adicional stream flows through the southern part of the site, between the former waste disposal area and a eastern Wetlands and discharges into the Suir.

According to the information reviewed, EPA considers that:

- The water in Barrow-Nore-Suir Estuary as being of moderate quality.
- The River Suir as being at risk of achieving good status.
- The Campile River and the Barrow-Nore-Suir Estuary as being possibly at risk of not achieving good status.
- The River Barrow estuary is a proposed Natural Heritage Area (NHA).
- The River Barrow and the River Suir are designated as Special Areas of Conservation (SAC).

2.5 REGIONAL GEOLOGY

Most of the South Wexford area forms the southern end of the Leinster Massif, a complex region of Precambrian and Lower Palaeozoic rocks. Structurally, the Lower Palaeozoic and Precambrian rocks fall into three northeasterly trending belts (see Figure I.2), separated by major faults. These faults are repeatedly cut and displaced by younger, north or north north westerly trending minor faults giving irregular, stepped margins to the units on the map (see Figure I.2). The Precambrian and Lower Palaeozoic rocks are unconformably overlain by an Upper Palaeozoic succession in the northwest and the south of the area.

2.5.1 The Northwestern Belt

The Ordovician Ribband Group in the broad Northwestern Belt (see Figures I.2 and I.3) is divided into four formations. From the base in the northwest, these are the Maulin, Ballylane, Oaklands and Kilmacthomas Formations. They are overline by the Campile Formation of the Duncannon Group. All these formations are dominated by slaty mudstones.

West of the River Barrow, the Campile Formation (part of the Duncannon Group) is overline by the basaltic and andesitic volcanics and the mudstones of the Ballynaclogh Formation which are followed, in turn, by further rhyolites in the Clashabeema Formation. In contrast with the more westerly area, grey mudstones and sandstones dominate here, with only subordinate rhyolites.

2.5.2 The Duncannon Group

The Carrighalia Formation siltstones contain some volcanic detritus (they are tuffaceous). The formation was quickly followed by the extrusion (and intrusion into unconsolidated sediments at the surface) of great thicknesses of volcanic lavas and tuffs of the Campile Formation.

The volcanic are mostly pale coloured rhyolites which originated as viscous, gassy magmas that erupted explosively and were deposited as fragmentary tuffs and, more specially, as very coarsely fragmental agglomerates. The volcanic rocks include thinly flow-banded, rhyolitic lavas, with occasional basaltic and andesitic lavas and tuffs.

The Figure I.4 show the Bedrock Geology (1:100,000 Map series. South Wexford. Sheet 23. Geological Survey of Ireland) of the zone where Endesa Great Island is located.

2.6 REGIONAL HIDROGEOLOGY [1]

The hydrogeological characteristics of the strata in the South Wexford area are very variable. Some brief details from the area where Endesa Great Island is located are:

- Aquifer present: Duncannon Group.
- Distribution: Strikes NE-SW.
- Lithology: rhyolites, lavas and tuffs interbedded with sediments.
- Thickness: 600 m (NE) - 4,000 m (SW).
- Specific capacity: 10 - 200 m^3/d/m.
- Well yield: 400 - 2,000 m^3/d.

South Wexford covers one of the driest parts of Ireland and potential recharge to the aquifers ranges from 400 – 600 mm/yr. The bulk of this recharge normally occurs between late October and early March.

The Precambrian and Lower Palaeozoic rocks, together with the Leinster Granite, underlie most of the region. These rocks have similar characteristics and can be described together. Apart from the volcanic, these strata are impermeable and considered to be aquitards. Groundwater flows in these areas is normally restricted to the top 30 m of rock, fault zones, and the overlying Quaternary deposits. Well yields are generally only sufficient for domestic or farm

[1] D. Tietzsch-Tyler & A.G. Sleeman; Geology of South Wexford. A Geological Description to Accompany the Bedrock Geology 1:100,000 Map Series, Sheet 23, South Wexford. 1994. Geological Survey of Ireland, Dublin.

(25 - 50 m^3/day) supplies. Well yields are greatest in the low lying or weathered areas of granite and least in the higher grade metamorphic rocks.

The volcanic rocks of the Duncannon Group are considered to be a major aquifer. The rhyolites are the most permeable of these rocks, however, the individual units thin out rapidly away from the volcanic vents. This aquifer has been developed to provide part of the regional water supply in the County Wexford and around Waterford City.

According to the information reviewed:

- The Campile Formation is considered a Regionally Important Fissured bedrock aquifer.

- Groundwater in the west of the site is described by the GSI as extremely vulnerable (see Figure I.5), due to the importance of the groundwater resource.

- There are eleven wells within a three-kilometre radius of the site. Ten of them are the site investigation wells located at the site, varying from 3.2 to 19 m bgl depth, and one used for domestic supply located 2.7 km to the southwest of the site, across the estuary.

- Groundwater beneath the site property is reportedly protected as Drinking Water under the European Union Water Framework Directive.

2.7 SITE ENVIRONMENTAL SENSITIVITY

Due to the proximity of the rivers and estuary, and to the depth of groundwater, the site is considered to have an environmental setting of:

- Moderate to high regarding surface water sensitivity.
- Moderate to high regarding groundwater sensitivity.

3. SCOPE OF WORK

This section describes the investigations and analytical program performed by INERCO.

The scope of work includes the investigation of the following areas:

- The new project area, considered as not sufficiently characterized within previous investigations.
- Tanks farm.
- 220 kV switching yard.
- 110 kV switching yard.
- Main building.

The following Table presents a summary of particular objectives of the investigations carried out by INERCO in each area.

TABLE 3.1
INERCO INVESTIGATIONS OBJECTIVES FOR EACH AREA

Area	Results of previous investigations	INERCO investigations objective
New project area	This area was not enough characterized	To assess potential soil and groundwater contamination which could interfere with the new project in particular around the underground storage tanks and groundwater contamination which might come from the tanks farm and the switching areas.
Tanks farm	Potential groundwater contamination coming from these areas and potentially affecting down-gradient areas was not well assessed	To assess potential groundwater contamination which can affect down-gradient areas.
220 kV switching yard		To perform an additional soil investigation between the two switching areas.
110 kV switching yard		To assess potential groundwater contamination down-gradient of the 110 kV switching area.
Main building	Potential source of PAH and Phenols contamination in soils.	To assess if dismantlement are foreseen but can also be carried out to get a baseline of the area and to analyse concentrations evolution.

3.1 SOIL INVESTIGATION AND SAMPLING

The Drilling works at the site were performed by Priority (PGL) and Hilliard Ltd and supervised by INERCO.

17 points of control (4 trial pits, 6 boreholes and 7 monitoring wells) were carried out in the 5 areas.

The boreholes were executed by cable percussive rig until the rock and by percussion hammer utilising compressed air until 4 meters depth in the boreholes and minimum 2 meter below groundwater level in monitoring wells.

The trial pits were performed by an excavator until the rock. The excavations were backfilled with the excavated materials.

Beteween each borehole, the sampling material were cleaned to reduce the potential risk of cross-contmiantion between boreholes.

A field engineer observed the nature of the soils encountered and the presence of contamination.

Head-space readings were measured using a photo-ioniser (PID) to assess the presence of ionisable volatile organic compounds.

Observations made by the field engineer and the head-space readings were noted on borehole logs, presented in Appendix II. For each trial pit of borehole, one to two soil samples were collected for the laboratory analisis. The samples were manually taken using new pair of nitrile gloves for each sample collected.

The soil samples were then placed in glass bottes, inmediateley sealed with Teflon caps to reduce volatilizazion losses and maintained at a constant temperature of approximately 4 ºC in a cool box with freeze packs. The refrigerated samples were couried to the laboratory under chain-of-custody procedures.

The borings were backfilled with the excavated soil.

The following Table summarizes the soil investigation scope of work.

TABLE 3.2
SOIL INVESTIGATION AND SAMPLING

POINTS OF CONTROL					
Location	**Executed Points of Control**	**BH / MW / TP**	**BH / MW / TP depth**	**Sample**	**Sample depth**
New Project Area	9 (6 BH & 3 MW)	BH301	2.5 m	BH301-1	0.5 m
		BH302	4.0 m	BH302-1	0.6 m
		BH303	4.0 m	BH303-1	0.8 m
				BH303-2	4.0 m
		BH304	4.0 m	BH304-1	0.7 m
				BH304-2	4.0 m
		BH305	4.0 m	BH305-1	0.5 m
				BH305-2	4.0 m
		BH306	4.0 m	BH306-1	0.5 m
				BH306-2	2.0 m
		MW301	12.5 m	MW301-1	1.0 m
		MW302	17.5 m	MW302-1	1.8 m
		MW303	7.0 m	MW303-1	0.5 m
Tanks farm	2 TP	TP301	2.7 m	TP301-1	1.0 m
				TP301-2	2.7 m
		TP302	1.4 m	TP302-1	0.5 m
				TP302-2	1.4 m
220 kV switching yard	2 TP	TP303	2.2 m	TP303-1	0.5 m
				TP303-2	2.0 m
		TP304	3.5 m	TP304-1	1.0 m
				TP304-2	3.5 m
110 kV switching yard	3 MW	MW304	4.5 m	MW304-1	0.4 m
		MW305	20.0 m	MW305-1	1.0 m
		MW306	27.5 m	MW306-1	1.5 m
				MW306-2	7.5 m
				MW306-3 (1)	7.5 m
Upstream from the Power Plant	1 MW	MW307	30.5 m	MW307-1	0.5 m

MW: Monitoring Well; **BH**: Borehole; **TP**: Trial Pit. (1) Duplicated sample.

Figures I.6 and I.7 in Appendix I present the location of these new trial pits, boreholes and monitoring wells.

3.2 GROUNDWATER INVESTIGATION AND SAMPLING

Monitoring wells were drilled using cable percussive rig until the rock and by percussion hammer using compressed. Wells instalation was carried as follows:

- Wells were equipped with HPDE tubing of 50 mm.

- A 0.2 mm screen section was installed across tha observed water table.

- The screen section was surrounded by silica washed and calibrated gravel.

- The gravel section was sealed by bentonite and concrete up to the surface.

- The monitoring wells were closed by a hermetic stopper in the bottom and in the top, and by a metallic superficial small chest for its protection.

For each well, the sampling procedure was as follows:

- An interface probe was used to measure the static water level and to assess the presence of free phase oil products in the wells.

- The monitoring wells were cleaned by purging at least between 3 and 5 annular volumes of water.

- Measurement of the electrical conductivity, Ph, Temperature, O_2 and Redox.

- After stabilization, the groundwater was sampled. Groundwater samples were placed in bottles suitable for their preservation according to the analisis and were kept at a temperature of approximately 4ºC in a cool box with freese packs. The samples were sent on a daily base to the laboratory.

- A photo-ioniser (PID) was used to assess the presence of ionisable volatile organic compounds at the head of the monitoring wells.

The new and existing monitoring wells were levelled to assess the likely groundwater flow direction.

Description of the well instalation is presented in Appendix II.

The following Table summarizes the groundwater investigation scope of work.

TABLE 3.3
GROUNDWATER INVESTIGATION AND SAMPLING

POINTS OF CONTROL					
Location	**Points of control**	**Monitoring Well**	**Monitoring Well depth**	**Sample**	**Groundwater level**
New Project Area	3 (Installed by INERCO)	MW301	12.50 m	MW301	3.78 m
		MW302	17.50 m	MW302	3.83 m
		MW303	7.00 m	MW303	3.57 m
	3 (Installed in the past)	BH201	9.34 m	BH201	3.78 m
		BH202	6.83 m	BH202	3.34 m
		BH3	6.14 m	BH3	2.85 m
110 kV switching yard	3 (Installed by INERCO)	MW304	4.50 m	MW304	0.61 m
		MW305	20.00 m	MW305	7.74 m
				MW305 (1)	7.74 m
		MW306	27.50 m	MW306	12.05 m
	1 (Installed in the past)	BH206	6.50 m	BH206	2.60 m
Upstream from the Power Plant	1 (Installed by INERCO)	MW307	30.50 m	MW307	18.74 m
Main Building	4 (Installed in the past)	BH203	8.85 m	BH203	3.07 m
		BH204	3.49 m	(2)	2.73 m
		BH205	18.87 m	BH205	6.15 m
		BH2	5.10 m	BH2	3.0 m

(1) Duplicated sample. (2) BH204 was dry.

Figures I.6 and I.7, in Appendix I, present the location of the existing and new monitoring wells.

3.3 LABORATORY ANALYSIS PROGRAM

The analytical scope of work was defined on the basis of historical information and considering the industrial activities that are carried out in Great Island.

The analyses were performed by Alcontrol Laboratory credited by United Kingdom Accreditation Service (UKAS), with No. 1291 Testing Laboratory Accreditation Certificate for chemical analysis of soil, water and air. The following tables present laboratory analysis carried out in soil and groundwater samples.

TABLE 3.4
SOIL ANALYSIS

Family	Components
Metals	Antimony (Sb), Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Selenium (Se), Vanadium (V) and Zinc (Zn).
TPH Criteria Working Group	Aliphatics: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C16-C35, C21-C35 and C35-C44. Total Aliphatics: C5-C12, C12-C44 and C5-C44. Aromatics: C6-C7, C7-C8, EC8-EC10, EC10-EC12, EC12-EC16, EC16-EC21, EC21-EC35, EC35-EC44 and EC40-EC44. Total Aromatics: C6-C12, EC12-EC44 and C6-C44. TPH (Aliphatics + Aromatics) C5-C44. Surrogate Recovery
Volatiles Organic Compounds	1.1.1.2-Tetrachloroethane, 1.1.1-Trichloroethane, 1.1.2.2-Tetrachloroethane, 1.1.2-Trichloroethane, 1.1-Dichloroethane, 1.1-Dichloroethene, 1.1-Dichloropropene, 1.2.3-Trichlorobenzene, 1.2.3-Trichloropropane, 1.2.4-Trichlorobenzene, 1.2.4-Trimethylbenzene, 1.2-Dibromo-3-chloropropane, 1.2-Dibromoethane, 1.2-Dichlorobenzene, 1.2-Dichloroethane, 1.2-Dichloropropane, 1.3.5-Trimethylbenzene, 1.3-Dichlorobenzene, 1.3-Dichloropropane, 1.4-Dichlorobenzene, 2.2-Dichloropropane, 2-Chlorotoluene, 4-Bromofluorobenzene, 4-Chlorotoluene, 4-Isopropyltoluene, Bromobenzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Carbon Disulphide, Carbontetrachloride, Chloroethane, Chloroform, Chloromethane, Chorobenzene, cis-1-2-Dichloroethene, cis-1-3-Dichloropropene, Dibromochloromethane, Dibromofluoromethane, Dibromomethane, Dichlorodifluoromethane, Dichloromethane, Hexachlorobutadiene, Isopropylbenzene, Methyl Tertiary Butyl Ether, Naphthalene, n-Butylbenzene, Propylbenzene, sec-Butylbenzene, Styrene, Tert-amyl methyl ether, tert-Butylbenzene, Tetrachloroethene, Toluene-d8, trans-1-2-Dichloroethene, trans-1-3-Dichloropropene, Trichloroethene, Trichlorofluorormethane and Vinyl Chloride
PAH's	Acenaphthene, Acenaphthene-d10, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Chrysene, Chrysene-d12, Dibenzo(ah)anthracene, Fluoranthene, Fluorene, Indeno(123cd)pyrene, Naphthalene, Naphthalene-d8, Perylene-d12, Phenanthrene, Phenanthrene-d10, Pyrene and PAH 16 EPA Total .
BTEX	MTBE, GRO C5-C12, Benzene, Toluene, Ethilbencene, o-Xylene, p/m-Xylene, Sum m&p and o Xylene, Sum of BTEX.
PCB's	PCB congener 28, PCB congener 52, PCB congener 101, PCB congener 118, PCB congener 138, PCB congener 153, PCB congener 180 and total of 7 Congeners PCBs.
Phenols	2,3,5-Trimethylphenol, 2-Isopropylphenol, Cresols, Phenol, Xylenols and Total Phenols.
Others	Total Organic Carbon, Total Cyanide, Chloride (soluble), Fluoride (soluble), Total Sulphate and Asbestos Presence Screen

TABLE 3.5
GROUNDWATER ANALYSIS

Family	Components
Dissolved Metals	Aluminium (Al), Antimony (Sb), Arsenic (As), Barium (Ba), Boron (Bo), Cadmium (Cd), Calcium (Ca), Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Lead (Pb), Manganese (Mn), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Potassium (K), Selenium (Se), Sodium (Na), Vanadium (V) and Zinc (Zn).
Anions	Sulphate (soluble), Nitrate as N, Nitrite as N and Phosphate (Ortho as P)
TPH Criteria Working Group	Aliphatics: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16 (Aqueous), C16-C21 (Aqueous), C21-C35 (Aqueous). Total Aliphatics: C5-C12, C5-C35 (Aqueous), C12-C35 (Aqueous). Aromatics: C6-C7, C7-C8, EC8-EC10, EC10-EC12, EC12-EC16 (Aqueous), EC16-EC21 (Aqueous), EC21-EC35 (Aqueous). Total Aromatics: C6-C12, C6-C35 (Aqueous), EC12-EC35 (Aqueous). Total Aliphatics & Aromatics C12-C44 (Aqueous). TPH C5-C35 (Aqueous). Surrogate Recovery %
BTEX	MTBE, GRO C5-C12, GRO (C8-C10A), Benzene, Toluene, Ethyl Benzene, m & p-Xylene, o-Xylene, Sum m&p and o-Xylene and Sum of BTEX
Volatiles Organic Compounds	1,1,1,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, 1,1-Dichloroethane, 1,1-Dichloroethene, 1,1-Dichloropropene, 1,2,3-Trichlorobenzene, 1,2,3-Trichloropropane, 1,2,4-Trichlorobenzene, 1,2,4-Trimethylbenzene, 1,2-Dibromo-3-chloropropane, 1,2-Dibromoethane, 1,2-Dichlorobenzene, 1,2-Dichloroethane, 1,2-Dichloropropane, 1,3,5-Trichlorobenzene, 1,3,5-Trimethylbenzene, 1,3-Dichlorobenzene, 1,3-Dichloropropane, 1,4-Dichlorobenzene, 2,2-Dichloropropane, 2-Chlorotoluene, 4-Chlorotoluene, 4-Isopropyltoluene, Bromobenzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Carbon disulphide, Carbontetrachloride, Chlorobenzene, Chloroethane, Chloroform, Chloromethane, cis-1,2-Dichloroethene, cis-1,3-Dichloropropene, Dibromochloromethane, Dibromomethane, Dichlorodifluoromethane, Dichloromethane, Hexachlorobutadiene, Isopropylbenzene, Methyl Tertiary Butyl Ether, Naphthalene, n-Butylbenzene, Propylbenzene, sec-Butylbenzene, Styrene, Tert-amyl methyl ether, tert-Butylbenzene, Tetrachloroethene, trans-1,2-Dichloroethene, trans-1,3-Dichloropropene, Trichloroethene, Trichlorofluoromethane and Vinyl Chloride
Semi Volatiles Organic Compounds	1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3-Nitroaniline, 4-Bromophenylphenylether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenylphenylether, 4-Methylphenol, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Azobenzene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-ethylhexyl) phthalate, Butylbenzyl phthalate, Carbazole, Chrysene, Dibenzo(a,h)anthracene, Dibenzofuran, Diethyl phthalate, Dimethyl phthalate, Di-n-butyl phthalate, Di-n-Octyl phthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno (1,2,3-cd) Pyrene, Isophorone, Naphthalene, Nitrobenzene, N-nitrosodi-n-propylamine, Pentachlorophenol, Phenanthrene, Phenol and Pyrene
PCBs	PCB congener 28, PCB congener 52, PCB congener 101, PCB congener 118, PCB congener 138, PCB congener 153, PCB congener 180 and Total of 7 Congener PCBs (Aqueous)
Phenols	Phenol, Cresols, Xylenols, 2,3,5-Trimethylphenol, 2-Isopropylphenol and Phenols Total of 5 Speciated
Aqueous PAHs	Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Indeno(123cd)pyrene, Naphthalene, , Phenanthrene, Pyrene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(ah)anthracene, Fluoranthene, Fluorene and PAH 16 Total
Others	Ammoniacal Nitrogen as N, Total Alkalinity Filtered as $CaCO_3$, BOD True Total, COD, Total Coliforms, Total Cyanide, E. Coli, Sulphate (soluble), Nitrate as N, Nitrite as N, Phosphate (Ortho as P), Total Hardness as $CaCO_3$ and Total Dissolved Solids

4. FIELDWORKS RESULTS

This section presents the fieldworks results.

4.1 FIELDWORKS EXECUTION

The fieldworks were carried out between:

- February 2nd and 13th 2010.
- February 22th and 23th 2010.

The supervision of the execution of the above mentioned boreholes, trial pits and monitoring wells, as well as the sampling of soil and groundwater, were performed by a field engineer experimented in investigation of soils and groundwater.

4.2 LOCAL GEOLOGY

On the basis of drilling works, the shallow geology beneath the site appears to be as follows for each area:

TABLE 4.1
LOCAL GEOLOGY

Area	Average Depth (m)	Soil Description	Comments
New Project Area	0 - 3.5	Brown Silty Gravely Sand	The rock's depth increases from Northwest to Southeast (0.5 m to 4 m). To the South of this area (from 0 m to 4 m) we encountered mainly silty gravelly sand.
	3.5 - 18	Rock	
110 kV – 220 kw switching yard	0 - 0.75	Sandy Gravel	The rock's depth increases from East to West (0.5 m to 8.5 m). To the West of this area (from 0 m to 8.5 m) we encountered gravelly sandy silt.
	1 - 27.5	Rock	
Upstream from the Power Plant	0 - 0.5	Clayey Gravel	This description is based on only one borehole executed upstream of the power plant.
	0.5 - 30.5	Rock	

The lithological columns of the trial pits and boreholes are presented in Appendix II.

4.3 LOCAL HIDROGEOLOGY

The following Table presents the average phreatic level in each investigated area.

TABLE 4.2
AVERAGE PHREATIC LEVEL DEPTH

Area	Average pheatic level (m)	Comments
Upstream from the Power Plant	19 m	This information is based on the only borehole executed, placed to approximately 1300 m to the north of new project area.
110 kV Switching yard	0.6 – 12	The groundwater level increases in south-east to northwest direction.
Main Building	3.75	These areas are in the north and next to the estuary of the river Suir.
New Project Area	3.5	

The depth of the phreatic level measured in each of the existing and installed monitoring wells, as well as the results of the topographically levelled executed in each point of control, appear in the next Table.

TABLE 4.3
MEASURED PHREATIC LEVELS IN EXISTING AND INSTALLED MONITORING WELLS (29 TIME ZONE)

Location	Monitoring Well	UTM X (m)	UTM Y (m)	Topographic Ground Level (mls)	Dept to water from ground surface (m)	Water Level (mls)
New Project Area	MW301	637115	5793992	4,26	3,78	0.48
	MW302	636994	5793979	4,40	3,83	0.57
	MW303	636931	5794065	7,28	3,57	3.71
	BH201	636962	5793960	4,07	3.78	0.29
	BH202	636983	5793928	3,64	3.34	0.30
	BH3	637042	5793952	4,14	2.85	1.29
110 kV switching yard	MW304	636784	5794057	8,15	0,61	7.54
	MW305	636725	5794081	11,43	7,74	3.69
	MW306	636718	5794146	15,15	12,05	3.10
	BH206	636744	5794057	9,91	2.60	7.31
Upstream from Power Plant	MW307	636997	5794436	28,92	18,74	10.18
Main Building	BH203	636871	5793924	3,71	3.07	0.64
	BH204	636871	5793926	3,67	2.73	0.94
	BH205	636701	5794013	10,25	6.15	4.10
	BH2	636803	5793937	3,62	3.00	0.62

mls: Meters / level of the sea.

According to the water levels map, the general groundwater flow direction is towards the estuary, with local fluctuations towards south-east and south-west in the east and west of the asseses area respectively.

In the area of study, the phreatic surface gets down from the level of the 10.18 mls in the N of the areas of the power plant up to the average level 0.73 mls in its SW limit (main building) and to the avarage level 0.58 mls in its South limit (New Project).

An interpretation of the groundwater flow direction, presented in Appendix I, Figure I.8, was carried out on the basis of the data gathered.

Based on this interpretation, we consider that:

- Beneath the power plant, at the banks of the Estuary, there is a groundwater mass in hydraulic contact with Esturary's surface waters.

- Upstream of the power plant, there is likely the regional hydrogeological system, which is behaving as an unconfined aquifer in which groundwater flows through fractures preferentially and is likely draining towards the shallow aquifer and the Estuary.

Monitoring wells MW301 and MW302 were installed to the north of the new project emplacement to assess an upstream potencial contamination generated in 220 kV switching yard and the tanks farm.

Monitoring wells MW303, MW304, MW305 and MW306 were installed downstream of the 110 kV switching yard to assess a potencial contamination generated in this area.

The monitoring well MW307 was installed upstream of power plant property to assess the groundwater quality background of the area.

4.4 FIELDWORKS OBSERVATIONS

4.4.1 Soil

In the Appendix II are presented the field sheets of the trial pits, boreholes and installed monitoring wells. No visual nor olfactory observations of contamination were observed during the soil investigation.

4.4.2 Groundwater

The values of the parameters measured in the wells during groundwater sampling are presented in Appendix II.

In the majority of the monitoring wells, these paramenters were in the range typically encountered in groundwater and are not considered to suggest evidence of contamination. It should be noted that the conductivity in BH202 overcomes the equipment detection limit (20 mS/cm).

No free-phase product or particular odour was encountered in the monitoring wells.

A photo-ioniser (PID) was used to assess the presence of ionisable volatile organic compounds at the head of the monitoring wells. The monitoring wells were purged before the measurement during approximately 5 minutes. PID´s measures are presented in Appendix II. No significant PID readings were recorded.

5. SOIL ANALYTICAL RESULTS

5.1 SOIL ASSESSMENT CRITERIA

The soil analytical samples were compared with UK Stage 2 Generic Assessment Criteria (GAC). The GAC are conservative screening criteria protective of human health (assuming on-going industrial use of the site) and controlled waters (groundwater). If the concentrations are below the GAC, then the risks to human health and controlled waters are considered negligible. If the concentrations are above the GAC, there is a potential risk to human health and / or controlled waters.

Metal concentrations in soil were compared against background data for Irish soil published by the EPA[*]. The published data was based on test samples collected from across the Republic of Ireland and to remove the effect of statistical outliers, the 95 percentile values were used as screening criteria. It should be noted that these 95-percentile values represent Irish background levels and are not indicators of environmental risk.

The Dutch Screening Values (DSV) and the Dutch Intervention Values (DIV) are also used to asses the soil analytical results. These criteria have been used to provide continuity with previous environmental assessment reports of the site. The DIVs represent levels above which there may be a risk to human receptors and above which more detailed site-specific risk assessment may be required.

[*] Environmental Protection Agency, *Towards a National Soil Database (2001-CD/S2-M2)*, 2007.

5.2 SOIL ANALYTICAL RESULTS

The following Tables present the soil analytical results that overcome GAC, EPA Background and DIV's data.

TABLE 5.1
SOIL ANALYTICAL RESULTS IN BOREHOLES

Component	BH 301-1	BH 302-1	BH 303-1	BH 303-2	BH 304-1	*HH GAC*	*CW GAC*	*EPA*	*Dutch MAC-SV*	*Dutch MAC-IV*
METALS (mg/kg)										
Arsenic	18.1	12.7	21.3	10.5	16.4	*500*	*0.29*	*21.9*	*29*	*76*
Barium	36.5	33.9	117	23.6	30.6	*22,000*	*4.11*	*454.5*	*160*	*920*
Cadmium	1.14					*348*	*0.55*	*1.652*	*0.8*	*13*
Chromium	26.5	12.6	15.4	14.7	9.68	*5,000*	*6.5*	*86.8*	*100*	*380*
Copper	36.9	15.5	16.0	10.5	14.3	*71,700*	*0.04*	*45.9*	*36*	*190*
Lead	26.3	24.1	19.7	10.2	9.53	*750*	*0.4*	*61.9*	*85*	*530*
Molybdenum			1.67			*17,000*	*1.41*	*3.29*	*3*	*190*
Nickel	35.1	11.6	25.1	13	10.5	*5,000*	*0.76*	*50*	*35*	*100*
Vanadium	73.4		110			*3,160*	*20*	*104.8*	*42*	*250*
Zinc	108	88.6	105	44	28.8	*665,000*	*0.29*	*144.7*	*140*	*720*
PCB's (mg/kg)										
Total of PCBs	0.276					*16.8*	*0.003*	*NV*	*0.02*	*1*
PAH's (mg/kg)										
Benz(a)anthracene	0.0515	0.0337				*97*	*0.03*	*NV*	*NV*	*NV*
Benzo(a)pyrene	0.0902					*14*	*0.09*	*NV*	*NV*	*NV*
TPH's (mg/kg)										
Aromatics EC12-EC16					2.82	*593*	*0.44*	*NV*	*NV*	*NV*
Aromatics EC16-EC21	2.94	3.33		1.87		*770*	*1.4*	*NV*	*NV*	*NV*
Aromatics EC21-EC35	174	69.5		16		*1,230*	*11.1*	*NV*	*NV*	*NV*
TPH (Aliph. + Arom.) C5-C44	1,030	402		162		*NV*	*NV*	*NV*	*50*	*5,000*
OTHERS										
Fluoride (soluble) (mg/kg)	1.54			1.45		*36,900*	*0.08*	*NV*	*500*	*NV*

HH GAC: Human Health Generic Assessment Criteria; **CW GAC**: Controlled Waters Generic Assessment Criteria; **SV**: Screening Value; **IV**: Intervention Value; **NV**: Non Value

TABLE 5.1 (Cont. I)
SOIL ANALYTICAL RESULTS IN BOREHOLES

Component	BH 304-2	BH 305-1	BH 305-2	BH 306-1	BH 306-2	*HH GAC*	*CW GAC*	*EPA*	*Dutch MAC-SV*	*Dutch MAC-IV*
METALS (mg/kg)										
Arsenic	10.2	17.1	16	24.3	29.8	*500*	*0.29*	*21.9*	*29*	*76*
Barium	34.1	41.1	35.6	154	163	*22,000*	*4.11*	*454.5*	*160*	*920*
Chromium	18.5	18	9.02	12.5	11.1	*5,000*	*6.5*	*86.8*	*100*	*380*
Copper	10.8	14.6	11.6	18.5	17.6	*71,700*	*0.04*	*45.9*	*36*	*190*
Lead	13.1	19.6	7.73	13.0	12.8	*750*	*0.4*	*61.9*	*85*	*530*
Nickel	13.7	21.4	11	25.1	15.6	*5,000*	*0.76*	*50*	*35*	*100*
Vanadium	24.5	32.1		96.4	40.3	*3,160*	*20*	*104.8*	*42*	*250*
Zinc	43.4	56.0	32.5	108	102	*665,000*	*0.29*	*144.7*	*140*	*720*
TPH's (mg/kg)										
Aromatics EC12-EC16		1.38				*593*	*0.44*	*NV*	*NV*	*NV*
Aromatics EC16-EC21		10.6				*770*	*1.4*	*NV*	*NV*	*NV*
Aromatics EC21-EC35		35				*1,230*	*11.1*	*NV*	*NV*	*NV*
TPH (Aliph. + Arom.) C5-C44		228	82.3			*NV*	*NV*	*NV*	*50*	*5,000*
OTHERS										
Fluoride (soluble) (mg/kg)			1.47	1.25		*36,900*	*0.08*	*NV*	*500*	*NV*

HH GAC: Human Health Generic Assessment Criteria; **CW GAC**: Controlled Waters Generic Assessment Criteria; **SV**: Screening Value; **IV**: Intervention Value; **NV**: Non Value

TABLE 5.2
SOIL ANALYTICAL RESULTS IN MONITORING WELLS

Component	MW 301-1	MW 302-1	MW 303-1	MW 304-1	MW 305-1	MW 306-1	*HH GAC*	*CW GAC*	*EPA*	*Dutch MAC-SV*	*Dutch MAC-IV*
METALS (mg/kg)											
Antimony	0.629					1.41	*7,500*	*0.23*	*1.54*	*3*	*22*
Arsenic	19.3	19.8	15.6	10.1	10.9	18.8	*500*	*0.29*	*21.9*	*29*	*76*
Barium	54.1	62.5	27.2	30.2	35.7	62.7	*22,000*	*4.11*	*454.5*	*160*	*920*
Chromium	21.2	25.2	8.09	8.00	19.4	80.7	*5,000*	*6.5*	*86.8*	*100*	*380*
Copper	13.8	19.9	9.00	5.77	31.1	40.9	*71,700*	*0.04*	*45.9*	*36*	*190*
Lead	11.7	32.3	3.50	6.33	5.85	17.1	*750*	*0.4*	*61.9*	*85*	*530*
Nickel	18.8	22.8	7.39	6.69	10.6	56.2	*5,000*	*0.76*	*50*	*35*	*100*
Selenium						1.18	*8,000*	*0.05*	*2.67*	*0.7*	*100*
Vanadium		35.6			22.9	58.1	*3,160*	*20*	*104.8*	*42*	*250*
Zinc	52.7	65.3	24.1	43.1	46.6	84.7	*665,000*	*0.29*	*144.7*	*140*	*720*
PAH's (mg/kg)											
Acenaphtene						30.3	*100,000*	*23*	*NV*	*NV*	*NV*
Benz(a)anthracene	0.0356	0.042					*97*	*0.03*	*NV*	*NV*	*NV*
TPHs (mg/kg)											
Aromatics EC12-EC16		8.02	8.19				*593*	*0.44*	*NV*	*NV*	*NV*
Aromatics EC16-EC21		2.16	3.91				*770*	*1.4*	*NV*	*NV*	*NV*
Aromatics EC21-EC35		28.8	25.4	18.4	19		*1,230*	*11.1*	*NV*	*NV*	*NV*
TPH (Aliph. + Arom.) C5-C44				69.1	83.4	67.1	*NV*	*NV*	*NV*	*50*	*5,000*

HH GAC: Human Health Generic Assessment Criteria; **CW GAC**: Controlled Waters Generic Assessment Criteria; **SV**: Screening Value; **IV**: Intervention Value; **NV**: Non Value

TABLE 5.2 (Cont. I)
SOIL ANALYTICAL RESULTS IN MONITORING WELLS

Component	MW 306-2	MW 306-3	MW 307-1	*HH GAC*	*CW GAC*	*EPA*	*Dutch MAC-SV*	*Dutch MAC-IV*
METALS (mg/kg)								
Antimony	1.71	1.88		*7,500*	*0.23*	*1.54*	*3*	*22*
Arsenic	11.3	11.3	11.2	*500*	*0.29*	*21.9*	*29*	*76*
Barium	53.1	51.1	35	*22,000*	*4.11*	*454.5*	*160*	*920*
Chromium	147	155		*5,000*	*6.5*	*86.8*	*100*	*380*
Copper	27.3	29.3	4.60	*71,700*	*0.04*	*45.9*	*36*	*190*
Lead			4.88	*750*	*0.4*	*61.9*	*85*	*530*
Nickel	110	107	2.80	*5,000*	*0.76*	*50*	*35*	*100*
Vanadium	73.8	72.9		*3,160*	*20*	*104.8*	*42*	*250*
Zinc	69.0	64.3	23.2	*665,000*	*0.29*	*144.7*	*140*	*720*
TPHs (mg/kg)								
Aromatics EC21-EC35	17.5	18.6	11.6	*1,230*	*11.1*	*NV*	*NV*	*NV*
TPH (Aliph. + Arom.) C5-C44	116	152		*NV*	*NV*	*NV*	*50*	*5,000*

HH GAC: Human Health Generic Assessment Criteria; **CW GAC**: Controlled Waters Generic Assessment Criteria; **SV**: Screening Value; **IV**: Intervention Value; **NV**: Non Value

TABLE 5.3
SOIL ANALYTICAL RESULTS IN TRIAL PITS

Component	TP 301-1	TP 301-2	PT 302-1	TP 302-2	TP 303-1	TP 303-2	TP 304-1	TP 304-2	*HH GAC*	*CW GAC*	*EPA*	*Dutch MAC-SV*	*Dutch MAC-IV*
METALS (mg/kg)													
Antimony	1.39	1.19	0.989		0.784	0.830	1.13		*7,500*	*0.23*	*1.54*	*3*	*22*
Arsenic	37.7	36.7	34.2	38.3	34.3	29.8	27.1	20.0	*500*	*0.29*	*21.9*	*29*	*76*
Barium	55.8	50.2	61.8	65.0	64.9	65.6	55.8	40.1	*22,000*	*4.11*	*454.5*	*160*	*920*
Chromium	29.9	23.6	33.5	32.8	34.1	34.6	33.9		*5,000*	*6.5*	*86.8*	*100*	*380*
Copper	35.8	28.9	34.5	35.5	35.8	32.1	34.6	9.09	*71,700*	*0.04*	*45.9*	*36*	*190*
Lead	26.6	28.4	26.0	40.7	23.1	24.3	18.8	4.18	*750*	*0.4*	*61.9*	*85*	*530*
Nickel	41.5	28.6	37.8	38.4	36.2	34.1	36.4	3.85	*5,000*	*0.76*	*50*	*35*	*100*
Vanadium	25.8	23.7	33.1	32.9	34.0	33.9	38.8		*3,160*	*20*	*104.8*	*42*	*250*
Zinc	82.3	67.5	80.9	80.1	80.7	76.8	77.1	8.02	*665,000*	*0.29*	*144.7*	*140*	*720*
PAH's (mg/kg)													
Benz(a)anthracene							0.0347		*97*	*0.030*	*NV*	*NV*	*NV*

HH GAC: Human Health Generic Assessment Criteria; **CW GAC**: Controlled Waters Generic Assessment Criteria; **SV**: Screening Value; **IV**: Intervention Value; **NV**: Non Value

5.3 EVALUATION OF SOIL ANALYTICAL RESULTS

5.3.1 New Project Area

This corresponds to the samples taken at points: BH301, BH302, BH303, BH304, BH305, BH306, MW301, MW302, MW303 (this monitoring well is located upstream the area).

Heavy metals

None of the HH GAC or Dutch MAC-IV were exceeding in any of the samples taken.

The concentrations analysed are all, except one, below EPA background levels. Only one sample is exceeding the EPA levels:

- BH303-1, vanadium (110 mg/kg), a value close to the EPA background level (104 mg/kg). This is an isolated value, as in sample BH303-2, the concentration obtained is lower than the detection limit. It is considered that this presents no risk for carrying out of the activity.

In metals, the CW GAC were exceeding at various points; however, is understood that these values are very conservative since they are much lower than the background levels published by the EPA.

Organic Compounds

None of the HH GAC or Dutch MAC-IV were exceeding in any of the samples taken.

In the sample taken at BH301-1, concentrations of PCBs (0.276 mg/kg) and TPH (1,030 mg/kg) were detected above the Dutch MAC-SV values. However these are not exceeding the intervention values and therefore do not require remediation actions.

According to the results obtained in this assessment and in previous URS's investigation in this area, no concentrations of contaminant were detected which might pose a risk for the use for which the site is intended.

5.3.2 Tanks Farm

In this area, trial pits TP301 and TP302 were carried out.

Heavy metals

In all the soil samples, values were detected slightly higher than the EPA levels of arsenic. The values also exceed the Dutch MAC-SV. In the fieldwork, there was no evidence of contamination observed. These concentrations are likely due to the geochemical background in this area.

The excessive level of arsenic in this area was also found in one of the trial pits carried out in the URS study, and even in greater concentrations.

Neither the field observations nor the detected concentrations of metals associated with the presence of HFO (vanadium and nickel) lead to believe that there have been major fuel leaks. For this reason, no risk is considered to be found for industrial use in this area.

Organic Compounds

There was no exceeding of the references used for HH GAC or Dutch MAC-SV. Neither the EPA nor the Dutch MAC-SV levels were exceeded.

In the study carried out by URS, no references were exceeded in the trial pits, and so in this area there is no problem caused by organic compounds.

Other compounds

No concentrations of other compounds analysed were detected which exceeded the references.

5.3.3 220 kV Switching Yard

In this area the trial pits TP303 and TP304 were carried out.

Heavy metals

None of the soil samples analysed showed concentrations of substances with values greater than the HH GAC or Dutch MAC-IV.

In the conclusions of the assessment carried out by URS, it was determined that there was no risk caused by the presence of metals in this area.

The results obtained in this study corroborate that in this area there is no risk posed by heavy metals.

Organic Compounds

None of the samples showed concentrations higher than the HH GAC or Dutch MAC-IV levels.

Only was detected concentration of Benzo(a) anthracene slighty in excess of the CW GAC. It is considered this concentration does not present any risk for human health.

In the assessment carried out by URS, none of the samples taken outside the 220 kV switching yard showed the presence of organic contaminants in concentrations higher than the references.

Given the above, no risk is considered to be found in this area.

Other compounds

Of the compounds analysed, no concentrations were detected which might pose a risk.

5.3.4 110 kV Switching Yard

Downstream this area, 3 boreholes (with installation of monitoring wells) were carried out, MW304, MW305, MW306.

Heavy metals

None of the samples analysed showed concentrations of metals higher than the HH GAC or Dutch MAC-IV.

In the samples analysed at point MW306-1, 2 and 3, values of heavy metals (Sb, Cr, Ni and V) were detected, higher than the Dutch MAC-SV and higher than the EPA background levels for (Sb, Cr and Ni). This monitoring well is located in a garden area, and it is possible that the results may be associated with some filling used materials.

In the investigation carried out by URS, the most enclosed sampling points carried out at MW 306 did not detect concentrations of these metals, higher than the levels indicated (they only exceed the CW GAC).

Given the above, no risk is considered to be found in this area.

Organic compounds

None of the concentration values obtained in the samples analysed exceed the HH GAC or Dutch MAC-IV.

The TPH levels exceed the Dutch MAC-SV, although the concentrations are considered low.

In the three samples analysed in the MW306-1, 2 and 3, the value of 50 mg/kg of TPH was exceeded. This may be indicative, as with the indications before about metals, of an isolated point caused by some filling used.

Other compounds

There are no values of other compounds which indicate the possible existence of risk for the performance of the activity.

6 GROUNDWATER ANALYTICAL RESULTS

6.1 GROUNDWATER ASSESSMENT CRITERIA

Groundwater analytical results were assessed by comparing them to the EPA Interim Guideline Values (IGVs) and Dutch Values. EPA guidelines were developed using a number of existing water quality guidelines in use in Ireland including existing national Environmental Quality.

6.2 GROUNDWATER ANALYTICAL RESULTS

The following Tables present the groundwater analytical results that are above IGV's. The empty cells indicate that results are not exceeding these data.

TABLE 6.1
GROUNDWATER ANALYTICAL RESULTS IN INSTALLED MONITORING WELLS

Component	MW 301	MW 302	MW 303	MW 304	MW 305	MW 305 (2)	MW 306	MW 307	IGV	DSV (1)	DSV (2)	DIV
ANIONS AND CATIONS (µg/l)												
Antimony Dissolved								0.442	*NV*	*NV*	*0.15*	*20*
Chromium Dissolved	9.28	2.71	1.99	1.23	2.53	2.58	5.51		*30*	*1*	*2.5*	*30*
Manganese Dissolved		264			363	338			*50*	*NV*	*NV*	*NV*
Molybdenum Dissolved	15.6								*NV*	*5*	*3.6*	*300*
Nickel Dissolved							2.3		*20*	*15*	*2.1*	*75*
Potassium Dissolved (mg/l)	12.1	10.7							*5*	*NV*	*NV*	*NV*
Selenium Dissolved							1.61	1.18	*NV*	*NV*	*0.07*	*160 (*)*
Vanadium Dissolved							1.67		*NV*	*NV*	*1.2*	*70 (*)*
BIOLOGICAL AND OTHERS (mg/l)												
E.coli (on liquids) (CFU/100ml)				1			3	21	*0*	*NV*	*NV*	*NV*
Total Coliforms (W) (CFU/100ml)	1,300		37	121	60		10		*0*	*NV*	*NV*	*NV*
SVOC (µg/l)												
Phenol		1.9						1.25	*0.5*	*NV*	*NV*	*NV*
PAH (µg/l)												
Fluoranthene (Aq.)	0.0998	0.0178							*1*	*0.003*	*NV*	*1*
Anthracene (Aq.)	0.0255								*10,000*	*0.0007*	*NV*	*5*
Chrysene (Aq.)	0.0641								*NV*	*0.003*	*NV*	*0.2*
Benzo(a)anthracene (Aq.)	0.092								*NV*	*0.0001*	*NV*	*0.5*
Benzo(k)fluoranthene (Aq.)	0.0386								*0.05*	*0.0004*	*NV*	*0.05*
Benzo(a)pyrene (Aq.)	0.0953	0.0146							*0.01*	*0.0005*	*NV*	*0.05*
Benzo(ghi)perylene (Aq.)	0.0388								*0.05*	*0.0003*	*NV*	*0.05*
Indeno(123cd)pyrene	0.0335								*0.05*	*0.0004*	*NV*	*0.05*
Total petroleum hydrocarbon TPH (µg/l)												
Total Aliph. & Arom. C12-C44 (Aq.)	775		32	23					*10*	*50*	*NV*	*600*

IGV: EPA Interim Guideline Values; **DSV**: Dutch Screening Value; **DIV**: Dutch Intervention Value.
(1) Shallow (<10 m –gl), (2) Deep (>10 m –gl): only for MW306 and MW307. (*) Indicative level for serious contamination.

TABLE 6.2
GROUNDWATER ANALYTICAL RESULTS IN EXISTING MONITORING WELLS

Component	BH 201	BH 202	BH 203	BH 205	BH 206	BH2	BH3	*IGV*	*DSV*	*DIV*
ANIONS AND CATIONS (µg/l)										
Arsenic Dissolved							14.8	*10*	*10*	*60*
Barium Dissolved							59.8	*100*	*50*	*625*
Boron Dissolved		1,030					1,210	*1,000*	*NV*	*NV*
Calcium Dissolved (mg/l)		225						*200*	*NV*	*NV*
Chromium Dissolved	3.04	1.85	3	2.17	2.65	1.56	4.80	*30*	*1*	*30*
Molybdenum Dissolved	5.17							*NV*	*5*	*300*
Potassium Dissolved (mg/l)	12.1	197	15.1				143	*5*	*NV*	*NV*
Sodium Dissolved (mg/l)	234	5,530	350				5,460	*150*	*NV*	*NV*
Sulphate (soluble) (mg/l)		1,260					1,040	*200*	*NV*	*NV*
Total Hardnessas $CaCO_3$ (mg/l)		3,880					2,340	*200*	*NV*	*NV*
Total Dissolved Solids (by meter) (mg/l)	1,050	23,000	1,400				17,300	*1,000*	*NV*	*NV*
NUTRIENTS (mg/l)										
Phospate (Ortho as P)		0.0506						*0.03*	*NV*	*NV*
BIOLOGICAL AND OTHERS (mg/l)										
E.coli (on liquids) (CFU/100ml)		120	12		1		15	*0*	*NV*	*NV*
Total Coliforms (W) (CFU/100ml)		820	18		6	2	90	*0*	*NV*	*NV*
Total petroleum hydrocarbon TPH (µg/l)										
Total Aliph. & Arom.C12-C44 (Aq.)					190			*10*	*50*	*600*
VOC (µg/l)										
1,1,1-Trichloroethane			5.33					*500*	*0.01*	*300*

IGV: EPA Interim Guideline Values; **DSV:** Dutch Screening Value; **DIV:** Dutch Intervention Value.

6.3 EVALUATION OF GROUNDWATER ANALYTICAL RESULTS

6.3.1 Background underground quality

MW307 was installed upgradiant of the power plant to asss the background groundwater quality.

The analytical results of antimony and selenium are above of the Dutch SV. E. Coli and phenol was also detected above IGV.

6.3.2 New Project Area, Tanks Farm and 220 kV Swtiching Yard

Samples of groundwater were analysed in the new monitoring wells installed MW301, MW302, MW303 and in the existing monitoring well BH201, BH202 and BH3. These monitoring wells are located in the new project area and downstream tanks farm and 220 KV Swithching areas.

Heavy metals

None of the samples analysed showed values which were higher than the Dutch IV. In all the samples analysed, values of Chromium higher than the Dutch SV were detected, although none of them exceed the IGV. This may be indicative of a background level in the area, and is not considered a risk for the activity being carried out.

On the monitoring well MW301 the IGV for potassium were exceeded, and the Dutch SV for Molybdenum.

It should be pointed out that the analyses of the samples taken on the monitoring wells installed in previous studies, for metals, have not shown any relevant increases compared to the research carried out by URS. In some cases the concentrations go down and in others they go up, but only slightly; it is thus considered that even with the currently functioning installation, the situation of the site remains stable.

Organic compounds

All the results obtained are lower than the Dutch IV, except in TPH on the monitoring well MW301 (775 µg/l). In this monitoring well, concentrations were also detected higher than IGV and the Dutch SV in PAH. These values may indicate an isolated situation, since in the rest of the monitoring wells installed in the area these concentrations was not detected. Is is recommended to include this monitoring well in the groundwater monitoring of the site.

It should be pointed out that in the existing monitoring wells, no increase in any organic compound was observed, respect to the URS research.

Other compounds

Values higher than IGV were detected in MW301, MW303, BH202 and BH3 for potassium, sodium, sulphate, total hardness and TSD in the existing monitoring wells. These high values were also detected in the previous URS study, with increases in the concentration values and decreases in others, although the orders of magnitude remain constant.

These figures are indicative of brackish waters likely caused by the proximity of the estuary.

Because they are not waters used for human consumption, there is no risk to human health.

High values for coliforms have been analysed in MW301, MW303, BH202 and BH3. These high values may have been due to the agricultural activity carried out in the vicinity of the plant or from from leaks of the septic tank or pipes. Nevertheless, since they are not destined for human consumption there is no health risk.

The same can be said about the high values of E. Coli in BH202 and BH3. Is is recommended to include these monitoring wells in the groundwater monitoring of the site.

6.3.3 110 kV Switching Yard

Downsteam form this area the MW304, MW305 and MW306 were installed. In addition, samples were taken at the existing BH206.

<u>Heavy metals</u>

None of the water samples showed higher values than the Dutch IV.

All the samples showed chromium values above the Dutch SV but they do not exceed IGV in any case. This presents no cause of risk to human health.

At MW305, manganese was detected above the IGV. It should be pointed out that in the URS study, at the BH206, values for manganese above IGV were detected, and in this campaign the values were lower. This is not considered to be a problem and present no risk to human health.

At the MW306 concentrations of nickel, selenium and vanadium above Dutch SV were detected. Even though this in not an important consideration there is a certain relation to the concentrations detected in the soil. Is is recommended to include these monitoring wells in the groundwater monitoring of the site.

<u>Organic compounds</u>

No organic compounds concentrations above the reference values used were detected in any sample, except for the sample taken at BH206 which was above the IGV for TPH. This value was not detected in the URS study. This should be controlled in next monitoring campains. But there is no risk to human health since these waters are not for human consumption. Is is recommended to include these monitoring wells in the groundwater monitoring of the site.

<u>Other compounds</u>

Values above the IGV for coliforms were detected at MW305, MW306 and BH206, even though in values below the ones for the new project area. Since these waters are not for human consumption, there is no risk to human health.

6.3.4 Main building

In this area samples were taken at 4 existing monitoring wells, BH203, BH205, BH206 and BH2.

Heavy metals

The same as in the rest of the monitoring wells the Dutch SV for chromium were exceeded but in no case did they exceed the IGV and they indicate health risk.

Organic compounds

1,1,1-Trichloroethane was detected above the Dutch SV at BH203 but not over the IGV.

In the campaign carried out by URS, VOCs at this point were not detected. No risk is considered, however, this should be control future monitoring campaigns to determine whether this is just a one-time occurrence. Is is recommended to include these monitoring wells in the groundwater monitoring of the site.

It should be pointed out that in the investigation carried out by URS, concentrations of PAH higher than the IGV were detected in BH2. In this case no concentrations of these compounds were detected higher than the detection limits.

Other compounds

In BH203, Potassium, Sodium and TDS were detected with values higher than the IGV. These values may be indicative of brackish water. These concentrations are not considered to be a risk.

In BH203 coliforms and E. Coli were detected higher than the IGV. Because they are not waters for human consumption, there is no risk considered to health.

7. CONCLUSIONS AND RECOMENDATIONS

Taking into account the results of the investigation carried out by INERCO and comparing them to the assessment given by URS back in 2008, INERCO can state the following conclusions:

Soil:

New Project area:

- Concentrations of all compound analyzed are below Dutch Intervention Values.
- In the area where the **new project** is going to be developed, in the BH 301-1, concentration of PCB was exceeding the Dutch MAC-SV, and some samples exceeding TPH Dutch MAC-SV (BH 301-1, BH 302-1, BH 303-2, BH 305-1/2), but always are below Dutch IV.
- Thus, INERCO considers that:
  - Soil in the new project area should not be an issue for the future development and construction.
  - These concentrations do not mean any risk for human health.
  - Remediation actions are not required.

Other areas (new project area surroundings):

- Concentrations of all compound analyzed are below Dutch Intervention Values.
- In relation to the **rest of the areas** investigated, only the samples from MW-306 (the area downstream of the 110 kV switching area) need to be highlighted, since values of heavy metals (Sb, Cr, Ni, V) have resulted slightly higher that Dutch MAC-SV. Sb, Cr and Ni levels are also higher than the background levels of the EPA. MW-306 is located in a garden and these concentrations might be associated to the use of filling materials.
- Thus, INERCO considers that:
  - These concentrations do not mean any risk for human health
  - Remediation actions are not required

Groundwater:

New Project area:

- Concentration of TPH found in MW301 slightly exceeds the Dutch IV. In this monitoring well, concentrations higher than the IGV or Dutch SV were also detected for PAH. These values are likely to indicate an isolated affection, since in the remaining monitoring wells installed in the area, this TPH and PAH concentration levels were not detected. From a technical point of view, this TPH concentration is not likely to be impacting the Estuary water quality, but seem to be isolated and specifically located around MW301 due to the fact that it has not been detected in near monitoring wells.

- Thus, INERCO considers that Remediation actions are not required and INERCO recommends including this monitoring well in the groundwater monitoring procedures of the site.

- Potassium, sodium, sulphates, total hardness and TSD were detected in concentrations higher than the reference values in several groundwater samples. This is likely to be indicating brackish waters because of the proximity of the Estuary. In any case, this is not considered to mean a risk for human health.

- High values of coliforms have been detected in MW301, MW303, BH202 and BH3. These high values might be caused by the agricultural activity carried out in the vicinity of the plant or from leaks of the septic tank or pipes. Nevertheless, since they are not destined for human consumption there is no health risk. The same conclusion applies to the values encounterd for E. Coli in BH 202 and BH 3.

INERCO recommends including these monitoring wells in the groundwater monitoring procedures of the site.

Other areas:

- Concentracions of all compounds analyzed are below Dutch Intervention Values. Thus, INERCO considers that remediation actions are not required.

- In the rest of the areas, only MW 306 (nickel, selenium and vanadium) showed concentrations which might be indicative of a light groundwater affection. Due to the fact that concentrations higher than the references were also detected in the soil sample in this specific location, INERCO recommends to include this monitoring well in the groundwater monitoring procedures of the site.

- 1, 1, 1-Trichloroethane was detected above the Dutch SV at BH 203 but not over the IGV. INERCO recommends including these monitoring wells in the groundwater monitoring procedures of the site.

General conclusions:

- The substances detected in the monitoring wells located at the banks of the Estuary are likely representative of the quality of the shallow aquifer which is drained and feeded from the Estuary water. It is considered that the regional aquifer is not being negatively affected by the substances encountered.

- In general terms, when comparing the results of the investigation campaigns carried out by URS in 2008 and the current one carried out by INERCO in 2010, no significant changes were observed. The results remain in the same range so there is no evidence of any contamination level increase trend. Bearing in mind that the existing power plant activity is ongoing, it is understood that the situation of the site in terms of soils and underground waters has not experienced any deterioration in terms of quality.

In summary, INERCO considers that the site does not pose any risk to human health which could affect the performance of the activity and the area is valid for commercial or industrial use, not requiring remediation actions prior to the future development.

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Attachment J

J. Accident Prevention & Emergency Response

Describe the existing or proposed measures, including emergency procedures, to minimise the impact on the environment of an accidental emission or spillage.

Also outline what provisions have been made for response to emergency situations outside of normal working hours, i.e. during night-time, weekends and holiday periods

Describe the arrangements for abnormal operating conditions including start-up, leaks, malfunctions or momentary stoppages.

Supporting information should form ***Attachment Nº J.***

J.1 Identification of Hazards

The current Environmental Management System (EMS) will be review to address the proposed development. The review of the EMS will include the identification of hazards associated with site activities.

The process will identify risks associated with:

- Materials storage, materials handling, generation of waste and noise; and
- Potential for incidents and emergency situations (e.g. spillage of oil, release of chemicals, failure of containment bunds), which could result in environmental impacts.
- An Environmental Aspects Register for all site activities, products and services will be developed. The resulting aspects and impacts register will be maintained and updated providing an on-going system for identifying, managing and reducing risks from the facility.
- The EMS and site operations will be subject to both internal and external auditing.

J.2 Accident Prevention

The following measures will be implemented on site in the proposed facility to minimise the potential for accidents and incidents.

- The plant will be designed in accordance with Best Available Techniques (BAT) technology.
- The site, and control room, will be manned 24 hrs a day, 365 days a year.
- Security systems will be put in place to prevent unauthorised access to the site.
- Access to restricted areas will be prevented (i.e. boundary fences, locked doors and cabinets).
- Visitors will be required to register with security personnel and comply with Health and Safety controls, including Personal Protective Equipment (PPE) requirements.
- A Planned Preventative Maintenance Programme (PPMP) will be developed and implemented. The PPMP will incorporate calibration and integrity testing of monitoring, abatement and control equipment. Records will be maintained on site.

- Key elements of plant will be included in a Long-Term Service Agreement with the supplier.
- Duplicate or stand-by equipment will be provided, where necessary.
- Potentially polluting leaks will be repaired as soon as practicable. Leaking equipment will be appropriately contained. If it is not possible to repair the equipment it will be removed from the site. Accidental spillages will be contained and cleaned up immediately by suitably trained personnel.
- An emergency generator will be provided to supply power to critical plant in the event of an interruption to power supply.
- The current formal procedures and systems will be reviewed and where necessary developed for the logging and recording of all complaints, incidents and near misses of the proposed facility. The system will be managed through the revised EMS.
- The current formal procedures and systems will be reviewed and where necessary developed for emergency response including fire, spillage and leak response of the new facility. The roles and responsibilities of personnel involved in incident management will be specified in the Emergency Response Plan (refer to Section J.3).
- As per the current systems, Induction training will include general safety procedures and requirements on site as well as emergency evacuation procedures. All personnel will receive Emergency Response, EMS and general Environmental Awareness Training. Refresher training will be provided as required.
- Site personnel will be provided with role specific training on accident prevention and emergency response. Refresher training will be provided, as necessary. All training records will be maintained on site.
- All personnel will be adequately equipped with safety and PPE. PPE will be checked and replaced as required and in accordance with manufacturer's recommendations.
- All personnel and contractors will be technically competent and suitably trained to undertake the tasks assigned.
- A Permit to Work system will be introduced on site.
- Evacuation and emergency scenario response drills will be undertaken in consultation with the local emergency services.
- The Operator will be required to obtain a Fire Safety Certificate from Louth County Council.
- All potentially polluting substances, including waste, will be stored in designated areas in appropriate UN approved containers within bunds, drip trays or spill pallets, as required.
- Chemicals, oils and waste stores will be inspected regularly to ensure that containers have not become damaged or degraded.
- Hazardous chemicals and waste will be stored in accordance with *HSG 71 Chemical Warehousing – The Storage of Packaged Dangerous Substances.*
- All chemicals stored on site will be subject to a COSHH assessment and compliance with REACH.
- An up to date inventory of potentially polluting substances will be maintained, through the reviewed EMS, identifying storage locations.

- Raw material purchasing procedures will be managed through the Quality Management System (QMS).
- Bulk storage tanks, containing potentially polluting substances, will be bunded and fitted with level gauges and alarms to prevent overfilling.
- The proposed distillate tank and the current diesel tank farm will be refurbished as per QRA requirements (as contained in Attachment B) preventing escape of diesel in the unlikely event of a catastrophic tank failure.
- The distillate storage tank will be fitted with a vapour recovery system.
- Bulk storage of materials will be managed in accordance with *Reference Document on Best Available Techniques on Emissions from Storage, July 2006* and *IPC Guidance Note on Storage and Transfer of Materials for Scheduled Activities, EPA (2004).*
- The gas pipe will be welded to minimise the occurrence of leaks. Valves and flanges will be fitted with leak detection alarms connected to the manned control room. Gas leaks will trigger alarms and shut off valves within the site and along the Bord Gáis Network. Emergency shut-down valves on the internal gas pipeline will ensure complete shut-down of gas supply within 60 seconds of leak detection.
- Safe shutdown programmes will be incorporated into the computerised control system.
- All automatic valves on site will have the capability to be manually overridden in the event of in interruption to power supply.
- All storage and containment areas will be subject to regular inspection.
- All areas on site with potentially polluting substances will be hardstanding with channels directing run-off to a contained area via a hydrocarbon interceptor and silt trap. Surface water collected within bunds will require pumping. All channels will be fitted with non-return valves.
- Loading of tanks will take place within bunds. Trained staff will supervise loading and unloading.
- Spill kits will be located at strategic points around the site.
- Forklifts and / or trolleys will be used to transport drums and IBC's around the site. Routes will remain free of obstacles. The containers will be securely fixed to the forklift / trolley using pallets or drum clamps. Drivers will be appropriately trained and qualified.
- Discharges and emissions from the site will be regulated through plant design, flow restrictions and monitoring to minimise the risk of flooding and exceedences of IPPC licence limits.
- Good housekeeping practices will be maintained on site.

J.3 Emergency Response

J.3.1 Emergency Response Plan

The current Emergency Response Plan will be reviewed and amended accordingly at the facility in consultation with the local emergency services. The plan does and will include the following elements:

- Facility maps and plans.
- Inventory of chemicals, oils and waste types detailing storage location(s).
- Roles and responsibilities.
- Emergency response organisation and procedures.
- Contact details for site personnel and emergency services.
- Site alarm systems.
- Communications.
- Material Safety Data Sheets (MSDS's) for chemicals and oils stored on site.
- Equipment lists and locations(s).

Emergency contact details for the Emergency Services and other relevant authorities (e.g. Bord Gáis, Gaslink, ESB and EirGrid) will be displayed at prominent locations around the facility)

J.3.2 Fire Response

The current Fire Emergency Response Plan will be reviewed and amended accordingly as part of the main Emergency Response Plan. The plan will detail duties and responsibilities of personnel in the event of a fire.
Evacuation procedures and assembly points will be detailed. Specific preventative and fire fighting measures include:

- Fire doors in compliance with *BS 476-22:1987 – Fire tests on building materials and structures.*
- Water, Carbon Dioxide (CO2) and foam based fire protection and suppression systems in accordance with National Fire Protection Association (NFPA) guidelines.
- Stock of 1,640m^3 of water for fire fighting purposes (this is a dedicated 500m^3 tank in addition to 1,140m^3 segregated in reservoir).
- Foam based fire fighting system for diesel storage area.
- CO^2 fire suppression system for the gas turbine.
- Fire alarms and fire extinguishers in all buildings on site.
- Appropriate fire fighting training provided by a suitably qualified specialist.
- A Firewater Retention Study will also be undertaken in accordance with the requirements of the IPPC licence.

J.3.3 Emergency Procedures

The current set of emergency procedures will be comprehensively assessed and amended where necessary to accommodate the new facility on the site. Site personnel will receive health and safety and environmental training on procedures, appropriate to their roles and responsibilities.

(i) Accidents, Incidents and Near Miss Reporting

The current procedures will be reviewed describing the reporting mechanism and requirements regarding incidents and accidents on site. Systems will be developed to ensure that any process, condition or action that has caused, or has the potential to cause, an accident or incident is investigated and reviewed to reduce or eliminate further risk. The system will be managed by the EHS Manager, who will communicate any and all reports to the Plant Manager. Incidents, accidents and near-misses will be notified to the appropriate authorities in accordance with licence conditions and legislative requirements.

(ii) Major Accidents

The current procedures will be reviewed detailing the appropriate arrangements for handling a major incident or accident on site such as a fire, explosion, or catastrophic tank failure. The procedure will include evacuation procedures and communications and will be developed in accordance with the recommendations of the local emergency services.

(iii) Environmental Aspects and Impacts Assessment

The current procedures will be reviewed detailing the criteria for identifying environmental risks and undertaking environmental aspect and impact assessments. A significance rating system will be implemented in order to enable the assessor to quantify the risk involved and prioritise the implementation of the necessary precautions to eliminate or minimise the risk.

(iv) Complaints

The current procedures will be reviewed providing guidelines for the handling of complaints and enquiries received from members of the public, the press, Local Liaison Group and other stakeholders. Complaints and enquiries will be reported to the EHS Manager. All complaints will be recorded, investigated and responded to.

As per current procedure a complaints form will be completed detailing the date and time of receipt of the complaint, the nature of the complaint and time and date of the offending occurrence, contact details, measures taken to address the complaint and all communications with the person lodging the complaint. Every practicable measure will be taken to address the issue to the satisfaction of the complainant. Records of all complaints received will be available for inspection. The EHS Manager will direct general enquiries and enquiries from the press to the appropriate contacts.

(v) Spill and Leak Control

The current Spill and leak Control procedures will be reviewed describing the actions to be taken in the event of spills and leaks of individual chemicals or substances. The procedure will describe the containment measures, clean up and subsequent disposal requirements in accordance with the relevant MSDS, as appropriate. Spill kits will be provided at various locations around the site. Requirements for regular inventories of the spill kits will be specified.

J.4 Seveso II

In accordance with the *European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2000* (Seveso II Directive), the facility is considered a lower tier Seveso site due to the quantity of diesel (10,000 m3) stored.

A copy of the Major Accidents Hazard report, submitted to the Health and Safety (HSA) Authority as part of the planning application, is appended to Attachment B of this application.

J.5 Public Liability Insurance

An Environmental Liability Assessment will be developed in accordance with the EPA document, "*Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision, 2006*" within the timeframe specified in the IPPC licence. Details of Financial Provision and appropriate Liability Insurance will be agreed with the EPA.

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Attachment K

K. Remediation, Decommissioning, Restoration and Aftercare

Describe the existing or proposed measures to minimise the impact on the environment after the activity or part of the activity ceases operation, including provision for post-closure care of any potentially polluting residuals.

Supporting information should be included as **Attachment No. K.**

K.1 Approach for the existing HFO power plant

As the new CCGT and existing HFO plant will not operate in parallel, decommissioning of each of the plants will be separately addressed.

Thus, the RMP (Residuals Management Plan) and ELRA (Environmental Liabilities Risk Assessment) Reports which are currently in place and approved for the existing power plant will be exercised upon decommissioning of the HFO plant, in compliance with the current IPPCL.

K.2 Approach for the proposed CCGT plant

A detailed "Closure, Restoration and Aftercare Management Plan" (CRAMP) will be developed and submitted to the EPA within six (6) months of commencement of operations - or as otherwise agreed with the EPA - in accordance with *Guidance on Environmental Liability, Risk Assessment, Residuals Management Plans and Financial Provision, EPA (2006).*

Following these Guidelines, the CCGT plant is given a "3" in the Risk Category analysis and classification. In addition, it is classified a "G4 " type of activity because it falls under the umbrella of the operation of combustion installations with a rated thermal input equal to or greater than 50 megawatts (MW). The CRAMP report results mandatory in this case.

The plan will be reviewed annually as part of the Annual Environmental Report (AER) and will include:

- A scope statement
- Criteria for successful decommissioning
- A programme to achieve stated criteria
- If relevant, a test programme
- Details of how costs will be underwritten

K.3 Decommissioning of the CCGT plant

It is envisaged that operations at the facility will commence in 2013 and the CCGT plant is expected to be operational for at least 25 years. Upon cessation of activities, the plant will either be redeveloped as a power generating facility or be redeveloped in an alternative form. Given the fact that the site is in proximity to the grid connection it is envisaged that the site will remain a power generating facility.

The following detail provides an indicative programme of works that will be implemented in the event of CCGT plant decommissioning to prevent environmental pollution:

- All plant equipment and machinery will be emptied, dismantled and stored under appropriate conditions until it can be sold. If a buyer cannot be found, the material will be recovered or disposed of through appropriately authorised waste contractors and hauliers.

- Plant services, including pipelines and cabling, will be decommissioned and disconnected to the boundary of the installation.

- If plant, machinery and services are required to be cleaned on site prior to removal all necessary measures will be implemented to prevent the release of polluting substances.

- All chemicals, fuel and waste will be removed from the facility. Unused chemicals will be returned to the supplier where possible.

- Waste will be recycled wherever possible. All waste movements, recycling and disposal operations will be controlled by appropriately authorised waste contractors.

- The site and all associated buildings will be secured. All structures and plant will be removed and the site returned to an acceptable condition. If buildings are to be retained, a maintenance programme will be implemented to ensure they do not decay or present an unacceptable health and safety risk.

- If considered necessary, remediation works will be carried out and the safe disposal of potential contaminated soils will be completed as per approved procedures

- All associated licences and permits will be surrendered.

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Attachment L

L. Statutory Requirements

Indicate how the requirements of Section 83(5)(a)(i) to (v) and (vii) to (x) of the EPA Acts, 1992 and 2003 shall be met, having regard, where appropriate, to any relevant specification issued by the Agency under section 5 (3) of the Act and the reasons for the selection of the arrangements proposed.

Indicate whether or not the activity is carried out, or may be carried out, or is located such that it is liable to have an adverse effect on –

(ii) site placed on a list in accordance with Chapter 1 of SI 94 of 1997, or

(iii) a site where consultation has been initiated in accordance with Article 5 of the EU Habitats Directive (92/43/EEC), or

Indicate whether or not the activity is liable to have an adverse effect on water quality in light of S.I. No. 258 of 1998 (Local Government (Water Pollution) Act, 1977 (Water Quality Standards for Phosphorus) Regulations, 1998).

Indicate whether any of the substances specified in the Schedule of the EPA (Licensing) (Amendment) 2004, S.I. 394 of 2004, are discharged by the activity to the relevant medium.

The PoE Act in Section 83(5)(xi) specifies that the Agency shall not grant a licence unless it is satisfied that the applicant or licensee or transferee as the case may be is a fit and proper person. Section 84(4) of the PoE Act specifies the information required to enable a determination to be made by the Agency.

- *Indicate whether the applicant or other relevant person has been convicted under the PoE Act, the Waste Management Act 1996, the Local Government (Water pollution) Acts 1977 and 1990 or the Air Pollution Act 1987.*

- *Provide details of the applicant's technical knowledge and/or qualifications, along with that of other relevant employees.*

- *Provide information to show that the person is likely to be in a position to meet any financial commitments or liabilities that may have been or will be entered into or incurred in carrying on the activity to which the application relates or in consequence of ceasing to carry out that activity.*

*Supporting information should be included as **Attachment Nº L** with reference to where the information can be found in the application.*

L.1 Protection of the Environment Act, 2003 – Section 83 (3)

Section 83 (3) of the Protection of the Environment Act 2003 states that in considering an application for a licence or a revised licence, or the review of a licence or a revised licence under this Part, the Agency shall have regard for:

(i) any relevant air quality management plan under section 46 of the Air Pollution Act 1987, or water quality management plan under section 15 of the Local Government (Water Pollution) Act 1977, or waste management plan

(ii) any relevant noise regulations under section 106,

(iii) any special control area order under section 39 of the Air Pollution Act 1987, in operation in relation to the area concerned,

(iv) the policies and objectives of the Minister or the Government in relation to the prevention, elimination, limitation, abatement or reduction of emissions for the time being extant,

(v) (i) the environmental impact assessment (if any submitted with the application)

(ii) any submissions or observations made to the Agency in relation to the Environmental Impact Statement

(iii) any further information or particulars submitted in relation to the Environmental Impact Statement in compliance with a notice given under regulations under section 8, and

(iv) where appropriate, the comments of other Member States of the European Communities in relation to the effects on the environment of the proposed activity, insofar as the statement, submissions, comments, observations, information or particulars relate to the effects on the environment of emissions from the activity, and

(vi) such other matters, related to the prevention, elimination, limitation, abatement or reduction of emissions as it considers necessary

L.1.1 Air Quality Management Plan

Co. Wexford

Wexford County Council does not operate a formal Air Quality Management Plan under section 46 of the Air Pollution Act 1987.

L.1.2 Water Quality Management Plan

Great Island site is situated in the **South Eastern River Basin District (SERBD)**. The main catchments are the three sister rivers (Barrow, Nore and Suir) and the Slaney, but there are also many smaller catchments along the coastline. Marine waters include Waterford Estuary, where the Barrow, Nore and Suir systems flow into the sea. Groundwater and aquifers in the area are also relevant as source for drinking water.

The SERBD is one of the largest River Basin Districts in Ireland, covering approximately one fifth of the country. It has a land area of nearly 13,000 km2 and covers a total overall area of 14,000 km2 when the coastal and transitional waters are included. The district includes the Barrow, Nore, Suir and Slaney River Basins along with smaller basins in the coastal areas of Wexford and Waterford. The boundary also extends one nautical mile off territorial waters.

There are 13 Local Authorities in the district namely Carlow, Cork, Kildare, Kilkenny, Laois, Limerick, Offaly, North Tipperary, South Tipperary, Waterford, Waterford City, Wexford and Wicklow.

The **SERBD Project** was the first project established in Ireland to facilitate implementation of the Water Framework Directive (WFD) (see Section L.2.3), funded under Ireland's National Development Plan. The project commenced in April 2002 and is financed by the Department of Environment, Heritage and Local Government through the National Development Plan.
The SERBD Project has been successful in achieving all of the milestones in the WFD implementation process.

In December 2004 an analysis of pressures and impacts on water in the SERBD, including an economic analysis of water use, was completed (Characterisation Report).

In December 2006 a WFD Monitoring Programme was made operational, basically being carried out by the EPA (EU Water Framework Directive Monitoring Programme - EPA Prepared to meet the requirements of the EU Water Framework Directive (2000/60/EC) and National Regulations implementing the Water Framework Directive (S.I. No. 722 of 2003) and National Regulations implementing the Nitrates Directive (S.I. No. 788 of 2005)).

Also in 2006, a timetable and work programme for the completion of the River Basin Management Plan was published allowing six months for public consultation.
In June 2007 a report on the significant water and management issues in the SERBD was published allowing six months for public consultation (Water Matters Report).

In December 2008 a Draft River Basin Management Plan was published allowing six months for public consultation.

This draft of the management plan covers the six-year period from 2009 until 2015 (any remaining issues or new problems will be tackled in two further six-year plans, 2015–2021 and 2021–2027).

The WFD categorisation (and the associated Draft River Basin Management Plan for the SERBD) incorporates the discharges from the existing power plant which has been operational for over 40 years, with an established record of compliance. As detailed in Table 14.3, EPA Interim Classification Criteria for the Barrow Nore Suir Estuary, the NPWS considers the estuary to be of good conservation status. The ecological status was considered to be Good, with all relevant general conditions classified as being of either High or Good status.

The interim WFD categorisation was defaulted to Moderate status due to failures in the chemical status category only, specifically BDE, Mercury, Benzo/Indeno-pyrenes, Endosulfan and Pentachlorobenzene. There are no known discharges from the proposed development which would introduce these elements into the receiving environment and it is not considered that the proposed discharges will in anyway cause deterioration in categorisation status for the estuary.

L.1.3 Waste Management Plan

The *South East Region Waste Management Plan 2006-2011* was developed by South Tipperary County Council on behalf of the six authorities of the South East Region, namely South Tipperary County Council, Waterford County Council, Waterford City Council, Kilkenny County Council, Wexford County Council and Carlow County Council. The plan sets out proposals for the management of waste in the region over the plan duration.

Waste Management is discussed in detail in Attachment H.2 of this application.

L.1.4 Noise Regulations

Section 106 of the Environmental Protection Agency Act, 1992 gives power to the Minister of the Environment, Heritage and Local Government to make regulations for the purpose of the prevention or limitation of any noise which may give rise to nuisance or disamenity, constitute a danger to health or damage property.

The Environmental Protection Agency Act, 1992 (Noise) Regulations, 1991 (SI 179/1994) provide redress in the case of general neighbourhood noise problems. Redress for noise emission exceedences from the facility will be provided through the IPPC licensing regime.

The plant will operate in accordance with all relevant legislation and guidance relating to noise including the EPA's Guidance Note for Noise in relation to Scheduled Activities, 2nd edition, 2006.
An assessment of noise impacts is provided in Attachment I.7 of this application.

L.1.5 Special Control Areas

The facility is not located within a special control area as defined under section 39 of the Air Pollution Act, 1987.

L.1.6 Prevention, Elimination, Limitation, Abatement or Reduction of Emissions

The Environmental Impact Statement (EIS) completed for the facility has been guided by relevant ministerial guidelines and statutory regulations in relation to the prevention, elimination, limitation, abatement and reduction of emissions.

The facility will operate in accordance with the conditions of the IPPC licence, planning permission, the Final Draft BAT Guidance Note on Best Available Techniques for the Energy Sector (Large Combustion Plant Sector), EPA, 2008 and the Large Combustion Plant Regulations 2003 (SI 644/2003).

L.1.7 Environmental Impact Statement

Copies of the EIS, submitted as part of the planning application, are enclosed with this application.

Submissions and comments received from statutory bodies and interested parties were considered throughout the design phase of the plant and preparation of the EIS.

Written responses from statutory bodies received prior to the submission of the planning application are included as Appendix 6 Scoping and Consultation of the EIS.

No comments were received from other Member States of the European Community in relation to the planning application.

L.2 Protection of the Environment Act 2003 – Section 83 (5)

Section 83 (5) (a) of the *Protection of the Environment Act 2003* states that the Agency shall not grant a license or revised license for an activity unless it is satisfied that:

(i) any emissions from the activity will not result in the contravention of any relevant air quality standard specified under section 50 of the Air Pollution Act 1987, and will comply with any relevant emission limit value specified under section 51 of the Air Pollution Act 1987,

(ii) any emissions from the activity will comply with, or will not result in the contravention of, any relevant quality standard for waters, trade effluents and sewage effluents and standards in relation to treatment of such effluents prescribed under section 26 of the Local Government (Water Pollution) Act 1977,

(iii) any emissions from the activity or any premises, plant, methods, processes, operating procedures or other factors which affect such emissions will comply with, or will not result in the contravention of, any relevant standard including any standard for an environmental medium prescribed under regulations made under the European Communities Act 1972, or under any other enactment

(iv) any noise from the activity will comply with, or will not result in the contravention of, any regulations under section 106

(v) any emissions from the activity will not cause significant environmental pollution

(vi) the best available techniques will be used to prevent or eliminate or, where that is not practicable, generally to reduce an emission from the activity,

(vii) having regard to Part III of the Act of 1996, production of waste in the carrying on of the activity will be prevented or minimized or, where waste is produced, it will be recovered or, where that is not technically or economically possible, disposed of in a manner which will prevent or minimise any impact on the environment

(viii) energy will be used efficiently in the carrying on of the activity

(ix) necessary measures will be taken to prevent accidents in the carrying on of the activity and, where an accident occurs, to limit its consequences for the environment and, in so far as it does have such consequences, to remedy those consequences

(x) necessary measures will be taken to prevent accidents in the carrying on of the activity and, where an accident occurs, to limit its consequences for the environment and, in so far as it does have such consequences, to remedy those consequences

L.2.1 Air Quality Standard Regulations

The Air Pollution Act, 1987 has largely been superseded by the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002) (AQS Regulations). The AQS Regulations transposed the requirements of the Air Quality Directive 96/62/EEC and Directive 1999/30/EEC (relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air). Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe sets binding standards for fine particulates PM2.5, the Directive must be transposed into Irish law by May 2010. Limits for PM2.5 must be met by 2015.

Atmospheric emissions from the facility will include Carbon Dioxide (CO2), Nitrogen Oxides (NOx) and Carbon Monoxide (CO) from the burning of natural gas. The concentration of Sulphur Dioxide (SO2) in natural gas is negligible. On rare occasions, during interrupted gas supply or periods of plant testing , the facility will operate on diesel, containing less than 0.1% Sulphur.

The air quality impact assessment, described in Attachment I.1 of this application, was assessed against the AQS Regulations in accordance with the limits specified in the Large Combustion Plant Regulations 2003 (SI No. 64 of 2003). An assessment of Particulate Matter emissions is provided and based on a "worst-case" scenario approach in relation to weather conditions, continuous operation, natural gas and diesel firing, concluded that emissions are within relevant air quality limit values and overall, short-term and long-term impacts are considered to be neutral regardless of firing on natural gas or diesel.

The CCGT plant would be subject to the EU Emissions Trading Scheme (EU ETS) as discussed in Attachment I.1. and will be included in its implementation concept beyond 2012.

L.2.2 Water Quality Standards

Directive 2000/60/EC (the Water Framework Directive) was adopted by the European Parliament and Council in 2000. The Water Framework Directive (WFD) establishes a legal framework for the protection, improvement and sustainable management of inland surface waters, transitional waters, coastal waters and groundwater.

The aim of the WFD is to prevent the deterioration in the existing status of waters (including the maintenance of "High Status" where it exists) and to ensure that all waters, with some limited exceptions, achieve at least "Good Status" by 2015.

The *European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003)*, as amended by the *European Communities (Water Policy) (Amendment) Regulations, 2005*, transposed the WFD into Irish law establishing eight River Basin Districts (RBDs) on the island of Ireland for the co-ordinated management of water resources. Water bodies were delineated into groundwater, river, lake, transitional and coastal water bodies and, in accordance with the requirements of the WFD, an analysis of the characteristics and impact of human activity on each RBD was undertaken. This analysis provided an assessment of the likely condition of all water bodies and established a baseline for identifying future priority actions for subsequent stages in the river basin planning approach.

The *European Communities Environmental Objectives (Surface Waters) Regulations, 2009* (S.I. 272 of 2009) give effect to the criteria and standards to be used for classifying surface waters in accordance with the ecological objectives approach of the WFD. In accordance with the regulations waters classified as 'High' or 'Good' must not be allowed to deteriorate. Waters classified as less than good must be restored to at least good status within a prescribed timeframe. In addition, the regulations address certain shortcomings identified by the European Court of Justice in relation to Ireland's implementation of the Dangerous Substances Directive (76/464/EEC, as amended).

The regulations set standards for biological quality elements and physico-chemical conditions, supporting biological elements (e.g. temperature, oxygen balance, pH, salinity, nutrient

concentrations and specific pollutants), which must be complied with. These parameters establish the "**ecological status**" of a water body.
The "**chemical status**" of a water body is assessed based on thresholds set for certain chemical pollutants, known as priority and priority hazardous substances.

A water body must achieve both "good ecological status" and "good chemical status" before it can be considered to be at "'good status". The regulations also state that, for the purpose of classification, a status of less than good is assigned in the case of a body of surface water where the environmental objectives for an associated protected area requiring special protection by virtue of obligations arising from specific national legislation for the protection of water, or for the conservation of habitats and species directly dependent on water, are not met.

In 2008 the Barrow Suir Nore Estuary (Water Body Code IE_SE_100_0100) was categorised as a Transitional Water Body of overall **Moderate** Status (interim classification) with an overall risk result of **1a At Risk**. The water body passed the Specific Pollutants (Annex VIII of the WFD) criteria but failed in relation to Chemical Status (Annex X). Integrated Pollution Prevention and Control (IPPC) Point Risk Sources and Waste Water Treatment Plant Point Risk Sources were classified as **1a At Risk**. The Barrow River Estuary is classified as a proposed Natural Heritage Area (pNHA). The River Barrow and River Nore are classified as Special Areas of Conservation (SACs).

The overall objective for the Barrow Suir Nore Estuary is to restore it to Good status by 2015. The estuary was considered to be of Good conservation status by the National Parks and Wildlife Service (NPWS) and at least Good overall protected areas status. The estuary failed in the chemical status category (Priority Hazardous Substances) only, the failure parameters were Brominated Diphenyl Ethers (BDE), Mercury, Benzo/Indeno-pyrenes, Endosulfan and Pentachlorobenzene, (it should be noted that there are no known discharges from the proposed development which would introduce these elements into the receiving environment).

A copy of the report for the estuary is presented in Appendix 14.2 of the EIS (Full Report for Water Body Barrow Suir Nore Estuary).

L.2.3 European Directives and Community Regulations

The relevant environmental European Directives and Community Regulations associated with site activities relate to atmospheric, water and noise emissions, materials handling, waste management and environmental liability. Impact assessments relating to air, water and noise emissions from the facility are discussed in Attachment I of this application. Materials handling and waste management are discussed in Attachments G and H. Environmental Liabilities are discussed in Attachment J.

Endesa Ireland Ltd is committed to complying with all relevant transposed Directives and European Community Regulations as well as the conditions of the IPPC licence and planning permission. A register of all environmental legislation will be included in the EMS. The register will be regularly updated and reviewed in line with changes of legislative requirements.

L.2.4 Noise Regulations

Noise emissions from the site will be regulated through the IPPC regime. As discussed in Section L.1.4, the plant will operate in accordance with all relevant legislation and guidance relating to noise including the EPA's Guidance Note for Noise in relation to Scheduled Activities, 2nd edition, 2006.

The noise impact assessment is described in detail in Attachment I.7 of this application.

L.2.5 Environmental Pollution

The impact assessments, discussed in Attachment I of this application, demonstrate that the operation of the facility will not result in significant negative environmental impacts.

L.2.6 Waste Regulations

Waste will be managed on site in accordance with the Waste Management Hierarchy. As discussed in Attachment H, it is anticipated that approximately 60% of waste arisings on site will be recovered or recycled.

Waste arisings will be characterized prior to leaving the site and all waste movements and handling will be undertaken in accordance with Waste Management Act 1996, as amended, and all other relevant legislation.

Only competent and authorised waste contractors will be engaged to manage waste arising from the facility.

All documentation pertaining to waste management, including C1 forms, TFS forms (where relevant), waste permits and licences will be retained on site.

L.2.7 Energy Efficiency

Energy efficiency is discussed in detail in Attachment G.2. An energy efficiency audit will be completed within the timeframe specified in the IPPC licence (energy efficiency audits have been completed under the existing licence). The audit will be undertaken in accordance with the Guidance Note on Energy Efficiency Audits, EPA (2003).

An energy efficiency plan will be developed and implemented through the EMS annual programmes.

The EMS will focus on resource and energy use minimisation.

Objectives and targets (included in the EMS annual programmes as well) will be developed to ensure continuous improvements, as considered practicable.

L.2.8 Accident, Prevention and Control

As discussed in Attachment J of this application, all practicable measures and systems will be implemented to prevent accidents and incidents as a result of site activities.

The current Emergency Response Plan will be reviewed including the Fire Response Plan and associated Firewater Retention Study.

A copy of the Major Accidents Hazard report, submitted to the HSA as part of the planning application, is appended to Attachment B of this application. Endesa Ireland Limited are currently in the process of achieving ISO 18001 Certification for the existing HFO plant.

L.2.9 Cessation of Activities

Cessation of activities of the new CCGT is discussed in Attachment K. A detailed "Closure, Restoration and Aftercare Management Plan" (CRAMP) will be developed and submitted to the EPA within six months of commencement of operations of the proposed CCGT, or as otherwise agreed with the EPA.
For the existing plant as explained in the Section 1 Summary and Background and Section K of this application, the current RMP and ELRA will continue to be in force until final decommission and demolition is completely finished.

L.3 Designated Areas

As part of the Ecological Impact Assessment undertaken during the EIA for the proposed development, an Appropriate Assessment Screening report was prepared.

The screening process has indicated that the proposed development does have the potential to affect the qualifying features of interest of the two Natura 2000 sites, the River Barrow and River Nore SAC and the Lower River Suir SAC. However, on examination it is clear, that due to combinations of the proposed mitigation measures, the magnitude of impacts and the positive changes from the current situation, the proposed activities will not have an adverse effect on the integrity of the sites or the qualifying features of the conservation objectives of the Natura 2000 sites. Therefore significant impacts are not likely to occur.

A full copy of the Appropriate Assessment Screening report is contained in Appendix 12.2 of the EIS.

L.4 Fit and Proper Person

The Applicant, nor any proposed member of senior management, has been convicted of an offence under the *Protection of the Environment Act 2003*, the *Waste Management Act 1996 (as amended)*, the *Local Government (Water Pollution) Acts 1977 and 1990* or the *Air Pollution Act, 1987*.
The recruitment process for prospective employees will include a screening process for convictions against the regulations as listed.

A suitably qualified and technically competent Maintenance Contractor, with previous experience maintaining power plants, will be contracted by the Operator. The Maintenance Contractor will have responsibility for the day to day maintenance of the plant. The contract between the Operator and the Maintenance Contractor will detail key health and safety and environmental obligations and responsibilities.

All personnel will be technically competent and suitably qualified to undertake their assigned tasks. Training records will be maintained on site and available for inspection.

L.5 Financial Liability

An Environmental Liability Assessment will be developed in accordance with the EPA document, *Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision, 2006* within the timeframe specified in the IPPC licence.

The total cost of financial provisions will be agreed with the EPA and met by Endesa Ireland Limited.

ANNEX 2: CHECKLIST FOR ARTICLE 10 COMPLIANCE

Article 10 of the Environmental Protection Agency (Licensing) Regulations, 1994 to 2004 sets out the statutory requirements for information to accompany a licence application. The Application Form is designed in such a way as to set out these questions in a structured manner and not necessarily in the order presented in Article 10. In order to ensure a legally valid application in respect of Article 10 requirements, all Applicants should complete the following checklist and submit it with the completed Application Form.

Article 10(2)		**Section in Application**	**Checked by Applicant ✓**
(a)	give the name, address and telephone number of the applicant and, if different, any address to which correspondence relating to the application should be sent and, if the applicant is a body corporate, the address of its registered or principal office,	Section B.1	✓
(b)	give - (i) in the case of an established activity, the number of employees and other persons working or engaged in connection with the activity on the date after which a licence is required and during normal levels of operation, or (ii) in any other case, the gross capital cost of the activity to which the application relates,	Section B.4	✓
(c)	give the name of the planning authority in whose functional area the activity is or will be carried on,	Section B.5	✓
(d)	in the case of a discharge of any trade effluent or other matter (other than domestic sewage or storm water) to a sewer of a sanitary authority, give the name of the sanitary authority in which the sewer is vested or by which it is controlled,	Not applicable – no discharges to sewer	✓
(e)	give the location or postal address (including where appropriate, the name of the relevant townland or townlands) and the National Grid reference of the premises to which the activity relates,	Section B.2	✓
(f)	specify the relevant class or classes in the First Schedule to the Act to which the activity relates,	Section B.3	✓
(g)	specify the raw and ancillary materials, substances, preparations, fuels and energy which will be produced by or utilised in the activity,	Attachment G	✓
(h)	describe the plant, methods, processes, ancillary processes, abatement, recovery and treatment systems, and operating procedures for the activity,	Attachments C, D & F	✓

Article 10(2) *continued.../*		**Section in Application**	**Checked by Applicant ✓**
(i)	indicate how the requirements of section 83(5)(a)(i) to (v) and (vii) to (x) of the Act shall be met, having regard, where appropriate, to any relevant specification issued by the Agency under section 5(3) of the Act and the reasons for the selection of the arrangements proposed,	Attachment L	✓
(j)	give particulars of the source, nature, composition, temperature, volume, level, rate, method of treatment and location of emissions, and the period or periods during which the emissions are made or are to be made,	Attachments E, F & I	✓
(k)	describe the arrangements for the prevention or minimisation of waste and, where waste is produced, the on and of site arrangements for the recovery or disposal of solid and liquid wastes,	Attachment H.2	✓
(l)	specify, by reference to the relevant European Waste Catalogue codes as prescribed by Commission Decision 2000/532/EC of 03 May 2000, the quantity and nature of the waste or wastes produced or to be produced by the activity,	Attachment H.2	✓
(m)	provide: (i) details, and an assessment, of the impacts of any existing or proposed emissions on the environment, including on an environmental medium other than that or those into which the emissions are or are to be made, and (ii) details of the proposed measures to prevent or eliminate, or where that is not practicable, to limit, reduce or abate emissions,	Attachments F & I	✓
(n)	identify monitoring and sampling points and outline proposals for monitoring emissions and the environmental consequences of any such emissions,	Attachments F & I	✓
(o)	describe the condition of the site of the installation,	Attachment D.2	✓
(p)	describe in outline the main alternatives, if any, to the proposals contained in the application which were studied by the applicant,	Attachment I.8	✓
(q)	specify the measures to be taken to comply with an environmental quality standard where such a standard requires stricter conditions to be attached to a licence than would otherwise be determined by reference to best available techniques,	Attachment I.8	✓
(r)	describe the measures to be taken for minimising pollution over long distances or in the territory of other states,	Attachments F & I	✓

Article 10(2) *continued.../*		**Section in Application**	**Checked by Applicant ✓**
(s)	describe the measures to be taken under abnormal operating conditions, including start-up, shutdown, leaks, malfunctions, breakdowns and momentary stoppages,	Attachments D, E, F & I	✓
(t)	describe the measures to be taken on and following the permanent cessation of the activity or part of the activity to avoid any risk of environmental pollution and to return the site of the activity to a satisfactory state,	Attachment K	✓
(u)	describe, in the case of an activity which gives, or could give rise, to an emission containing a hazardous substance which is discharged to an aquifer and is specified in the Annex to Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances, the arrangements necessary to comply with said Council Directive,	Attachment I	✓
(v)	include any other information required under Article 6(1) of Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control,	Attachments D-L	✓
(w)	include a non-technical summary of information provided in relation to the matters specified in paragraphs (f) to (v) above,	Attachment A	✓
(x)	state whether the activity consists of, comprises, or is for the purposes an establishment to which the European Communities (Control of Major Accident Hazards involving Dangerous Substances) Regulations, 2000 apply,	Attachment B.9	✓

Article 10(3)		Section in Application	Checked by Applicant ✓
(a)	a copy of the relevant page of the newspaper in which the notice in accordance with article 6 has been published,	Attachment B.8	✓
(b)	a copy of the text of the site notice erected or fixed on the land or structure in accordance with article 7,	Attachment B.8	✓
(c)	a copy of the notice given to the planning authority under section 85(1)(a) of the Act,	Attachment B.8	✓
(d)	a copy of such plans, including a site plan and location map (no larger than A3), and such other particulars, reports and supporting documentation as are necessary to identify and describe -		
	(i) the activity	Attachment B.2	✓
	(ii) the position of the site notice in accordance with article 7	Attachment B.8	✓
	(iii) the point or points from which emissions are made or are to be made, and	Attachments B & E	✓
	(iv) monitoring and sampling points, and	Attachment F	✓
(e)	a fee specified in accordance with section 94 of the Act.	Receipt of payment Enclosed	✓

Article 10(4)		Checked by Applicant ✓
(b)	A signed original and 2 hardcopies of the application and accompanying documents/particulars in hardcopy format plus 2 copies of all files in electronic searchable PDF format on CD-Rom shall be submitted to the headquarters of the Agency. In cases where an E.I.S. is required to be submitted to the Agency in support of the application, a signed original and 2 hardcopies of the EIS plus 16* copies of all files in electronic searchable PDF format on CD-Rom shall be submitted to the headquarters of the Agency. * Energy sector applicants = 18 copies	✓
	Hardcopies submitted	✓
	CD version submitted.	✓