Eleven

Air Emissions

11 Air Emissions

11.1 Introduction

Emissions to atmosphere will arise as a result of both construction and operation of the terminal.

Dust may be generated during construction. If uncontrolled, elevated dust deposition can occur beyond the site boundary and lead to complaints arising from soiling of property. Construction plant and road traffic will also generate exhaust fumes.

Emissions from the operation of the terminal will include combustion products from plant supplying motive, electrical and heat energy to the gas terminal. Certain combustion products have the potential to affect health and European Union air quality standards are specified to ensure air emissions do not exceed levels that are designed to protect human health and ecosystems. Fugitive emissions may occur from leaks in equipment and losses from tank storage. Like certain combustion gases such as carbon dioxide, these do not present a risk to health at ambient concentrations but can contribute to other regional and global environmental issues.

Significant hydrocarbon emissions are not anticipated as a result of routine operation. In the event of emergencies or abnormal operating conditions hydrocarbon releases will be efficiently burnt at height in flares. Natural gas may also be flared using a ground flare to allow maintenance activities to proceed safely.

Releases to atmosphere during the construction and operational phases will be minimised by the selection of the most appropriate technologies and control measures. The gas terminal will be designed and constructed to international standards. The site will also require an Integrated Pollution Prevention and Control (IPPC) Licence. As part of the licensing process the site will demonstrate compliance with European benchmarks of environmental performance. Such benchmarks are derived from the best performing technology available on the market to ensure any impact on the environment is minimised.

This Section has been prepared by RSK ENSR Environment Ltd.

11.2 Study Methodology

This Section of the EIS aims to identify and assess the sources and potential impact of atmospheric releases from the terminal. The emission components with the greatest potential to impact on health are oxides of nitrogen (NOx) and specifically nitrogen dioxide (NO_2). Dispersion modelling using the latest generation of computer model has been carried out to predict how releases from the gas terminal disperse in the atmosphere and to determine the potential levels of exposure at sensitive locations including nearby houses.

The remainder of this Section is set out as outlined below:

- emission characteristics of the proposed terminal;
- the legislative context that defines air quality standards and limits;
- description of the background air quality;
- identification of potential interactions with other sources;
- characteristics of the proposed terminal during operation;
- a summary of mitigation measures that will minimise releases to air;
- odour prevention;
- potential impacts associated with the proposed terminal;
- impact assessment including modelling approach and methodology;
- model results;
- air quality monitoring that will be carried out; reinstatement and residual impacts;
- microclimate; and
- the conclusions and summary.

11.3 Emissions Characteristics of the Proposed Development

11.3.1 During Construction

There is the potential for emissions to atmosphere to arise during the construction of the terminal development. In particular, construction activities may generate quantities of dust. Road traffic, construction vehicles, generators, etc., will give rise to exhaust emissions. Road traffic emissions will consist mainly of carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), particulates (PM), sulphur dioxide (SO_2) and hydrocarbons (HC) including benzene. Vehicle fuels have low concentrations of sulphur, and sulphur dioxide emissions from vehicles are typically only significant in highly trafficked, urban areas.

Most machinery on site will be powered by diesel engines. In order to control the emission of excess exhaust fumes and smoke, the contractor will ensure that all items of plant and equipment are correctly adjusted and maintained.

Table 11.1: Potential Emission Components and their Associated Effects on Health and Ecosystems

Component	Potential Terminal Related Source	Effect on Health and Ecosystems
Dust or Particulate Matter (PM)	Construction activity particularly from vehicles passing over dry, unpaved roads	Deposition may cause soiling of surfaces and can reduce vegetation growth
Fine Particulate Matter (PM_{10}) Particulate with a diameter of less than 10 microns	Construction activity	Elevated exposure can cause respiratory problems in sensitive individuals
Oxides of Nitrogen (NOx) including Nitrogen Dioxide (NO_2)	Combustion sources including vehicles	NOx comprises nitric oxide (NO) and nitrogen dioxide (NO_2). Only NO_2 is presently considered to have potential influence on human health at ambient concentration. Elevated exposure to NO_2 can cause respiratory problems in sensitive individuals. Elevated levels of NOx including NO_2 can affect plant growth.
Carbon monoxide (CO)	Combustion sources including vehicles	Elevated exposure can lead to dizziness and loss of concentration. Impairs the carriage of oxygen around the human body.
Sulphur dioxide (SO_2)	Produced in limited quantity from refined fuels including petrol and diesel. Negligible levels emitted from combusting natural gas.	Elevated exposure can cause respiratory problems in sensitive individuals
Benzene (C_6H_6)	Main source is from the combustion and vapour loss of petrol used in vehicles	Considered a carcinogen. Ambient air quality standards are set at level that represents exceedingly small risk to health.

Table 11.2: Relevant Air Quality Standards and Guidelines

Pollutant	Averaging Period	Standard ($\mu g/m^3$)	Percentile	Maximum Exceedences per year	Target Date
PM_{10} Stage 1	24 hours Annual	50 40	90.4th	35	Jan 2005 Jan 2005
PM_{10} Stage 2	24 hours Annual	50 20	98.1th	7	Jan 2010 Jan 2010
NO_2	1 hour 1 hour Annual Annual (vegetation)	200 200 40 30	99.8th 98th	18 175	Jan 2010 Now Jan 2010 Now
CO	8 hours	10,000	-	-	Jan 2005
SO_2	1 hour 24 hours Annual (ecosystems)	350 125 20	99.7th 98.9th	24 3	Jan 2005 Jan 2005 Now
Benzene	Annual average	5	-	-	Jan 2010

11.3.2 During Operation

The primary combustion processes at the proposed terminal are a fired heater, gas turbines, power generating engines, and in the event of emergency or certain maintenance activities, the flare systems. The main pollutants of concern in terms of local air quality are oxides of nitrogen and carbon monoxide. NOx is a generic term normally considered to be a mixture of nitrogen monoxide (NO) and nitrogen dioxide (NO_2). The majority of nitrogen oxides are emitted as nitrogen monoxide, a proportion of which subsequently oxidises to nitrogen dioxide, mainly by reaction with atmospheric ozone.

The proposed terminal may also emit particulate matter (PM / PM_{10}) but in such small quantities that the impact on ambient concentrations will be negligible. The main source of particulate matter during the operation of industrial installations often derives from material handling or the combustion of fuels. The raw materials handled at the proposed terminal will be principally gaseous or liquid in nature and will hence not generate particulate emissions. The limited quantity of material that can generate dust will be covered and handled to prevent any significant releases. The principal fuel used at the terminal will be gas and will not generate particulate when combusted. Only small quantities of particulate matter may be generated by the combustion of condensate, which being a very light hydrocarbon fraction will burn cleanly and efficiently.

Exploratory well tests have indicated that there are no sulphur compounds present in either the gas or the condensate; thus emissions of sulphur dioxide are not anticipated as a result of burning gas or condensate at the terminal.

Initial tests also indicate that the gas contains trace levels of mercury. The potential for mercury emissions will be minimised through the installation of a mercury removal unit on the gas and condensate streams.

Fugitive emissions of volatile organic compounds (VOC) and methane may arise from process areas, product loading and from tank loading and unloading activities.

In common with other vehicles on the local road network, vehicles accessing the site will emit carbon monoxide, nitrogen oxides, particulates and hydrocarbons including benzene.

11.4 Legislative Context - Air Quality Standards and Limits

Air quality standards have been developed and incorporated into Irish statute to protect human health and the environment. International agreements have also been drawn up to identify performance standards and limit the generation of air quality pollutants at a regional, national and global level. Relevant legislation and agreements are discussed below.

11.4.1 Air Quality Standards and Guidelines

The European Commission (EC) has formally adopted the Air Quality Framework Directive (96/62/EC). The first daughter Directive, 99/30/EC (adopted April 1999), set specific limits for four air pollutants: nitrogen dioxide, sulphur dioxide, PM_{10} and lead. These limit values are presented in Table 11.2. In December 2001, the EC adopted the second daughter Directive, 2000/69/EC, relating to limit values for benzene and carbon monoxide (CO) in ambient air. These Directives have been transposed into Irish legislation by the Air Quality Standards Regulations, 2002 (SI No. 271 of 2002).

Such standards have been set by environmental and health professionals across Europe following extensive worldwide research and are designed to protect the most sensitive of receptors, including for example elderly humans with existing respiratory ailments and areas valued for their flora and fauna. The effects on human health and ecosystems of the various compounds discussed in this Chapter are summarised in Table 11.1.

A number of the standards are expressed as percentile concentrations. The percentile represents the percentage of time for which the concentration is below that stated value. A concentration expressed as a 98^{th} percentile for example, is the concentration that is below the value for 99.8 percent of the time (or is exceeded for just 0.2% of the time). Standards expressed as percentiles hence allow concentrations higher than the stated limit value for a certain percentage of time without adverse impact on health or ecosystems.

In addition to the standards identified in Table 11.2, the World Health Organisation has set guideline values for the protection of health and ecosystems. These are generally similar to the levels specified in Table 11.2. Slight variations to the limits specified in the Air Quality Standards Regulations include a one hour guideline for NO_2 (200 $\mu g/m^3$) and a guideline NO_2 value for the protection of sphagnum dominated vegetation (expressed as an annual average) of 12$\mu g/m^3$. WHO guidelines are not described in statute but many of their recommendations are

incorporated into the standards identified in the Air Quality Standards Regulations, 2002.

Various international initiatives, protocols and Directives also exist to limit and reduce emissions at a national level.

The gas terminal is not subject to the Irish Solvents Regulations (SI 543 of 2000) as solvents are not used for applications covered within the Regulations and corresponding EU Directive. Solvent use at the terminal is very low. Methanol is used as an anti-freeze agent but releases are tightly controlled.

11.5 Background Air Quality Data

No publicly available air quality data for the region has been identified. To assess the current levels of certain key air pollutants around the terminal site, a sampling programme has been carried out. Three sampling surveys have been undertaken:

- September-October 2001;
- January-February 2002; and
- September-October 2003.

The results are summarised in Table 11.3.

Table 11.3: Background Air Quality

Substance	Concentrations (µg/m3)	
	Overall Measured Average	Limit
Nitrogen dioxide	2	40/30 (1)
Sulphur dioxide	2	20
Benzene	<1	5
Total VOC	228	N/A
PM10	12.4	50

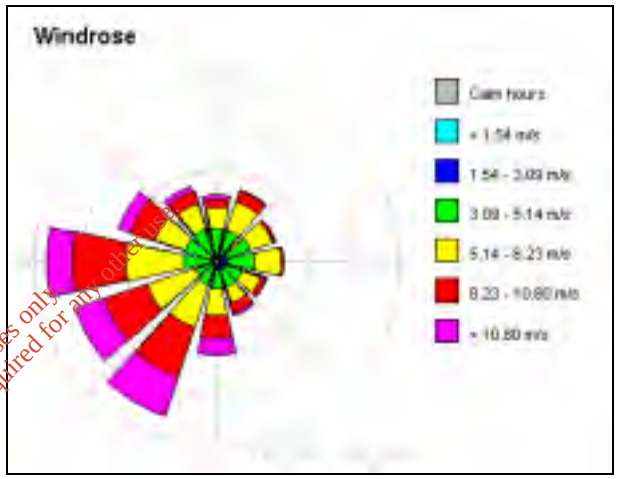
Note: (1): The 40µg/m^3 limit is for nitrogen dioxide for the protection of human health. A 30µg/m^3 limit for oxides of nitrogen (including nitrogen dioxide) also exists for the protection of ecosystems (see Table 11.1)

The results show that the air quality in the region is very good, with pollutant levels well below the relevant air quality standards. This is as expected for a rural area with little road traffic and few industrial sources of air pollutants.

11.5.1 Local Meteorology

The predominant wind direction is from the south-west and will disperse emissions away from the nearest residential dwellings for the majority of time. The frequency of wind direction and windspeed is illustrated in Figure 11.1. The windrose included in this figure identifies the frequency of the wind direction from where the wind is coming from as opposed to going to. Winds are typically moderate to strong and periods of very low winds or calm when dispersion characteristics can be restricted are shown to be very infrequent. The meteorological data was collated at Belmullet, which is the nearest and most representative meteorological station where data is collated in sufficient detail for use in this assessment. The year 1999 has been included for illustration. Local geographic features are not considered to significantly impair dispersion from emission sources or change local wind conditions. The potential influence of the local microclimate on dispersion is described further in Section 11.17.

Figure 11.1 : Windrose (Belmullet, 1999)



11.6 Interactions with Other Sources in the Region

Other emissions sources in the vicinity of the gas terminal include road traffic and potentially, releases from the Bellacorick Power Station, located approximately 10 miles south-east of the terminal. The peat-fired power station is due to stop the generation of electricity in 2004/5. A Planning Application has however been submitted to construct a modern, gas-fired plant on adjacent land. Releases from the Bellacorick peat-fired power station or subsequent proposed gas-fired power station on adjacent land may influence local air quality. Any interactions from these sources however are expected to be limited due to the spatial separation between Bellacorick and Bellanaboy

Contributions from existing road traffic to ambient air quality conditions are identified in the air quality monitoring described in Section 11.5. Background air quality has been included in screening assessments of construction and operational vehicle activity.

11.7 Characteristics of the Proposed Development

11.7.1 During Construction

As identified in Section 11.4, the main source of emissions during construction relate to construction vehicles and machinery. Particulate emissions may also be generated from the handling of raw materials.

Vehicles and machinery will release exhaust fumes into the air. Emissions will include releases of oxides of nitrogen, carbon monoxide, sulphur dioxide, benzene and PM_{10}. Vehicles will also potentially generate dust, including PM_{10}, in the event of passing over dry, unpaved surfaces.

Vehicles movements and onsite construction machinery will include:

- approximately 400 round trips per day using heavy good vehicles (HGV) to remove peat to the planned peat deposition site at Srahmore;
- up to 41 HGV movements per day to the construction site;
- an estimated 262 peak morning trips for construction workers; and
- onsite vehicles and machinery which, like HGV vehicles, will use diesel as a fuel.

The most significant activity with the potential to affect health and ecosystems is predicted to be the movement of peat from the terminal to the peat deposition site at Srahmore, as this will involve the largest number of vehicle trips that are also in close proximity to sensitive locations.

Certain raw materials will be dusty in nature. These raw materials will be kept covered to prevent dust generation.

11.7.2 During Operation

Process Units / Activities

The following equipment / activities at the terminal will result in emissions to atmosphere:

- heating medium heater;
- sales gas compressor turbines;
- electricity generation gas engines;
- emergency power generation engines;
- firewater pump engines;
- HP (High Pressure) and LP (Low Pressure) emergency flares;
- maintenance flare;
- fugitive emissions (leakages); and
- tank and product loading.

There are other minor sources of emissions on the site, such as the Open Drains Sump and the Treated Water Sump, but emissions from these sources are predicted to be negligible.

Emissions arising from combustion processes are summarised in Table 11.4.

A detailed process description is provided in Section 2. A brief description of the purpose of each unit or activity and the resulting emissions is given below. Releases to air will be regulated by the Environmental Protection Agency (EPA) and defined in the site's Integrated Pollution Prevention and Control Licence. An IPPC Licence application is currently under development and will be submitted during 2004. The licence issued by the EPA will be designed to ensure ambient air quality standards are not breached and effects on human health and vegetation are minimised or eliminated entirely.

Heating Medium Heater

The heating medium heater supplies heat to the gas inlet heater, the condensate heater and the methanol reboiler. The main fuel for the heater will be condensate. However, if there is insufficient condensate then the gas will be used particularly later in the field life when condensate production decreases.

Low NOx burners are to be employed in the heating medium heater in order to minimise emissions of NOx. Burners of this nature conform with the application of Best Available Techniques (BAT) principle. As a result, NOx emissions will be an average 203 mg/Nm^3 when fired on condensate fuel and 124 mg/Nm^3 when fired on gas.

The use of produced condensate in the heater as the main fuel for the heater makes use of an otherwise unwanted product.

Sales Gas Compressor Turbine

Two gas turbines (one operating, one standby) drive the sales gas compressors that are used to compress the gas to export pressures. Each turbine will have its own exhaust stack.

The turbines will be designed to comply with the EU's large combustion plant Directive. They will incorporate low NOx burners, significantly reducing emissions of NOx. NOx emission concentrations will be an average 51 mg/Nm^3 of exhaust gas. The relevant limit in the large combustion plant Directive is 75 mg/Nm^3.

Key emissions and operating parameters will be continuously monitored. Should any abnormalities

be found the turbine affected will be shut down and repaired and the spare turbine will operate.

Electricity Generation Gas Engines

Currently there is no external (grid) power supply to the terminal site and the generator packages have been designed to supply the power requirement for the entire site. Initially, three generators will be installed, two of which will be in use during normal operating conditions, running at equal load and discharging through individual exhausts.

Later in the life of the field (after year 9), the power requirement may increase and, if proven to be necessary, it is planned to add a fourth generator. For the purposes of this report, when considering emissions from the electricity generators, it has been assumed that the maximum emissions will be equivalent to the emissions from two of the original specification generators, running concurrently.

Gas is a cleaner fuel than diesel in almost all respects and thus, by using gas as the fuel for power generation on the site, the majority of emissions are minimised. Low NOx burners are to be used, in order to minimise NOx emissions. The specification of the engines will be in accordance with the suggested stack emission limits in the UNECE Long Range Transboundary Air Pollution Protocol.

NOx emission levels from these engines will be 500 mg/Nm^3.

Emergency Electricity Generator and Firewater Pumps

A diesel fired emergency generator will be installed to provide electricity in the event of a failure to the electricity supply from the gas engines. The provision of back-up supplies will ensure that critical systems can continue to operate and ensure site safety. The generator will be run for 1 hour per week to confirm availability.

Four firewater pumps will be driven by diesel fired compression ignition engines. Each pump will be run for 1 hour per week to confirm availability.

HP / LP Emergency Flares and Maintenance Ground Flare

The terminal will be equipped with a high pressure (HP) and a low pressure (LP) flare system, to be used in the case of over-pressure in the relevant parts of the plant. The benefits of the system are protection of personnel, plant and equipment and minimisation of atmospheric emissions.

The two flares will be situated in close proximity to each other and will be 40 m high. Typical vendor information indicates that the flare stacks have a hydrocarbon destruction efficiency of 98%.

The terminal will also house a ground flare for maintenance flaring. The ground flare is normally isolated and is put into service prior to maintenance activities.

Flaring was chosen over venting as the method for emergency pressure release and maintenance as it is considered to be significantly less harmful to the environment.

The extent of emissions arising from flaring activities will depend on the requirement for emergency and maintenance flaring. In accordance with Shell's Environmental Policy, the flare systems will not be used under normal operating conditions. During commissioning, the flare systems will be tested. Table 11.4 presents the predicted annual release of combustion gases arising from pilot gas use for the ground flare. The figures in Table 11.4 are based on operation of the ground flare for seven to fourteen days per year. Annual emissions data for emergency flaring is not included as this event will be very infrequent. Emissions arising from emergency flaring have, however, been assessed by atmospheric dispersion modelling.

Fugitive Emissions

Fugitive emission sources are limited to minor leakages from connections, isolation and control valves, relief valves, rotating equipment and analysers. This type of emission is small but unavoidable in this type of installation. By minimising the number of potential sources, fugitive emissions can be reduced significantly. Low-leakage plant items including relief valves, flanges and pumps will be installed to minimise releases further. United Kingdom Offshore Operators Association (UKOOA) guidelines have been used to estimate the amount of gas released through such leakages. Table 11.5 below gives a breakdown of the expected fugitive emissions. The composition of fugitive emissions has been assumed to be that of process gas.

Tank and Product Loading

Emissions from storage tanks and product loading have been estimated based on the predicted amount of condensate and methanol to be processed during the life of the Corrib gas field. Where volatile and potentially flammable materials are stored, the tanks have been designed to minimise releases to air through a combination of internal floating roofs and use of nitrogen blanketing where appropriate.

Table 11.4 Typical Annual Emissions from Combustion Sources

Source	Annual emission (kg)			
	NOx as NO_2	CO	SO_2	Particulates
Heating medium heater – on condensate	12,264	3,504	TBC	TBC
Heating medium heater – on gas	11,388	4,380	Negligible	Negligible
Sales gas compressor turbines	36,792	45,552	Negligible	Negligible
Power generation engines	50,808	29,784	Negligible	Negligible
Firewater pumps	6,448	603	374	104
Emergency generator	868	244	TBC	21
Maintenance ground flare	504	TBC	Negligible	Negligible

Table 11.5 Fugitive Emissions – Process

Component	Number in Terminal	Emission Factor (kg/component/year)	Total Annual Release (kg/yr)
Connections	4,800	2.4	11,520
Valves	2,384	33.9	80,818
Rotating Shafts	43	101	4,343
Analysers	12	-	20,102
Other	50	42.7	2,135
		TOTAL	**118,918**

Note: UKOOA emission factors used.

Table 11.6 Emissions from Tanks and Product Loading

Source	Methane emission (kg/year)	VOC emission (kg/year)
Fixed roof condensate tanks	0.35	194.95
Floating roof condensate tanks	0.63	3.13
Floating roof methanol tanks	3.43	17.14
Tanker loading emissions	63.46 – minimum (year 10) 127.2 – maximum (years 1-3)	3525.8 – minimum (year 10) 7071.45 – maximum (years 1-3)
TOTAL	**67.87 – minimum** **131.6 - maximum**	**3744 – minimum** **7334 - maximum**

Note: the floating roof methanol tanks are assumed to have zero emissions of other hydrocarbon components

UKOOA guidelines have been used to estimate tank emissions and the results are presented in Table 11.6.

Road tanker loading emissions have been estimated based on the predicted maximum amount of condensate to be exported during gas field life. A comparison of the variability of emissions has been given based on minimum and maximum condensate fuel usage in the heating medium heater. UKOOA guidelines were used to derive these data.

Emissions of fugitive releases will not occur at concentrations that will impact on human health. Fugitive releases with the potential to generate odour are described in Section 11.9.

11.8 Summary of Mitigation Measures

Potential air quality impacts during construction include releases to air from construction and haulage vehicles and the generation of dust. Traffic emissions will be minimised through appropriate vehicle maintenance and route selection to and from the terminal. Dust will be mitigated by the application of best practice dust suppression and containment techniques including the prevention of dust accumulation and

ensuring dusty materials are either moist or sheeted.

The terminal will be constructed to international design standards and will minimise combustion products and fugitive releases. Such design considerations will minimise releases to air.

Combustion processes have been designed to be energy efficient and minimise the quantity of fuel used, thereby minimising releases of emissions. Gas is the main fuel used onsite and is the lowest emission fuel available. Any out of specification gas will also be used as fuel for heating applications rather than be discharged to atmosphere. Low-NOx burners will be installed on the gas turbines and heating medium heater to reduce NOx releases further. The use of clean-burn gas engines will also minimise emissions from the power generators.

A leak of natural gas from the process presents a fire risk. Inherent site safety features will minimise the potential for uncontained (fugitive) releases of natural gas to air. Such features include continuous welded pipelines to ensure a sealed system from the arrival of offshore gas to the distribution of sales gas. Tanks storing volatile liquid materials will have internal floating roof designs with a nitrogen blanket where appropriate to minimise emissions from these sources.

Monitoring during the construction and operation of the terminal will assess the effectiveness of the mitigation measures introduced.

11.9 Odour Prevention

Sales gas prior to export will be odorised as required by BGE to aid leak detection at its points of use. Odorant will be stored in a double skinned stainless steel vessel. The odorant injection facilities will be mounted in a sealed enclosure with a nitrogen purge to prevent leakage. The purge vent will be fitted with an activated carbon filter. The filter will remove any fugitive releases of odorant and will be replaced as part of planned maintenance to ensure over-saturation does not occur. During maintenance, any releases to air will be neutralised by the use of a water spray mist. Over-filling of the odorant tank during odorant deliveries will be prevented through careful inventory control. Tank filling will be carried out via a closed system with a vapour return to the delivery tank to prevent any release to the atmosphere.

The design of the plant and the mitigation measures employed will prevent odour problems from occurring at offsite sensitive locations.

11.10 Potential Impacts of the Proposed Terminal Development

The potential atmospheric impact of the terminal development is a marginal reduction of air quality as a result of emissions arising from terminal construction and operational activities. The impact on air quality has been compared to ambient air quality standards to assess the potential impact on human health and ecosystems.

11.11 Do Nothing Scenario

In the absence of the development, there would be no anticipated change in air quality. Monitoring surveys carried out in 2001 to 2003 have identified the current air quality is very good. Baseline monitoring is described in more detail in Section 11.5.

11.12 Predicted Impacts of the Proposed Development

11.12.1 During Construction

Elevated levels of dust including PM_{10}, can potentially impact on health. Dust generation during construction is however unlikely to be a significant impact given the wet nature of the terminal site. Should very dry conditions occur, standard techniques of dust suppression will be used. This will involve spraying road and ground surfaces with water. Dusty materials will be sheeted during transport to site and storage. Vehicle wheel washers and road sweepers will also be used to reduce mud and dust build up on haulage roads and minimise any transference onto public highways. Measures to prevent dust generation will also prevent the generation of PM_{10}. Particulate matter is fine enough to enter the respiratory tract and potentially affect health at elevated exposure levels. Additional dust monitoring will be provided during construction activities to demonstrate implemented control measures are effective.

The greatest quantity of traffic-derived emissions will be generated during peat removal, with up to 400 round trips of heavy goods vehicles between the terminal site and the peat deposition site anticipated per day. To assess the impact on emissions from these movements in combination with existing traffic flows, other site traffic and the prevailing background air quality, a screening assessment methodology developed by the UK Highways Agency has been used. The procedure identified in the Design Manual for Roads and Bridges (DMRB, Volume 11, Section 3, Part 1 – Highways Agency, 2003) has been used to compare predicted air quality at sensitive locations along the R314 and proposed haul route with ambient air quality standards. Other phases of the

terminal construction will generate lower traffic emissions compared to the initial removal of peat.

The DMRB procedure calculates concentrations for pollutants up to 200m from the roadside using emission factors for the vehicle mix and traffic speeds on the roadway. Where sensitive locations are within 200 metres of different roads, the contributions from each road are aggregated together even though this is normally prevented by the direction of prevailing winds. The assessment incorporated this and other conservative estimates of traffic flows and vehicle speeds to ensure a robust assessment of likely air quality impacts during construction activities.

Concentrations of benzene, carbon monoxide and oxides of nitrogen were predicted for (i) housing located at Bellanaboy Bridge (ii) near to the junction of the R314 and local road LP1204 and (iii) along the R314 to the east of the proposed terminal where some houses are located approximately 20 metres from the road. The highest concentrations at any sensitive location were calculated to be less than 30% of any air quality standard identified in the Air Quality Standards Regulations, 2002.

Controlling the flow of vehicles can help minimise emissions from traffic. To assist in the prevention of congestion, a traffic management plan will be in place to manage the vehicular traffic to the terminal site and HGV movements during peat removal. Traffic management and route selection is described further in Section 15.

No significant air quality impacts including negative impacts on human health are predicted to arise from construction activity.

11.12.2 During Operation

Local Air Quality

In the context of this study, the principal substance that has the potential to impact on local air quality and subsequent effects on health and ecosystems is nitrogen dioxide. NOx emissions are generated as a result of combustion activities at the terminal.

The potential environmental impact of NOx emissions from the terminal is discussed in the atmospheric dispersion modelling study (Section 11.13).

Other pollutants such as carbon monoxide, PM_{10}, sulphur dioxide, benzene and other VOCs and mercury can have an effect on local air quality and potentially human health but releases are not anticipated to be significant from the terminal site.

During operation, carbon monoxide will be produced from combustion processes. Emission concentrations will typically be an order of magnitude higher than the ambient air quality standard. Dispersion modelling described in the following Sections predicts that emissions will be dispersed to concentrations three to four orders of magnitude lower than its original emission concentration at nearby sensitive locations. Concentrations will hence be well within ambient air quality standards following dispersion.

There are very few emission sources of PM_{10} and sulphur dioxide as the principal fuel will be gas and any emissions from the use of condensate will be very low due to its clean-burning nature and negligible sulphur content. The principal source of benzene relate to vehicles as opposed to process related sources. Lower vehicle movements will occur during the operational phase of the terminal compared with the construction phase. Predicted concentrations of benzene during operational of the terminal will hence be even lower than those described in Section 11.12.1 (i.e. less than 30% of the air quality standard)

Carbon dioxide and methane (substances with Global Warming Potential) are considered a hazard to the global environment rather than the local air quality and are discussed in Section 14. Substances with Photochemical Ozone Creation Potential can have effects on a local, regional and global scale. These effects are discussed below.

Photochemical Ozone Creation Potential (POCP)

Although ozone in the stratosphere has a beneficial role, ozone in the lower layers of the atmosphere is considered to act as a 'greenhouse' gas. At sufficient concentrations low-level ozone can also cause respiratory problems and affect vegetation. Low-level ozone formation arises primarily as a result of a series of complicated chemical reactions, initiated by sunlight. The main source of ozone formation occurs through the reaction of oxides of nitrogen and VOCs.

Emissions of compounds that can contribute to photochemical ozone creation may arise from fugitive releases of natural gas and methanol. Methane, the principal component of natural gas, has a very low POCP value. Releases of natural gas will be minimised by the mitigation measures identified in Section 11.8. Methanol, whilst having a higher value of POCP will also only be emitted to atmosphere in relatively minor concentrations due to the mitigation measures employed. Such measures include the recovery of methanol in the methanol still and use of internal floating roofs and nitrogen

blankets to prevent evaporation of methanol from storage tanks.

11.13 Modelling Approach and Methodology

Atmospheric dispersion modelling has been used to predict the potential air quality impacts of the proposed terminal and hence any potential influence on human health, flora and fauna. The approach and the input data used are described in this section.

11.13.1 Approach

Detailed dispersion modelling has been undertaken using BREEZE AERMOD (v4.0.7), a third-generation model approved by the EPA and other regulatory bodies worldwide. The modelling predicts how emissions released from the terminal will disperse in the atmosphere under the prevailing weather conditions and the likely concentrations of pollutants to which members of the public and sensitive locations will be exposed to. Both long term (annual) and short term (hourly or eight-hourly) NO_2 and CO concentrations have been calculated for comparison with the Irish statutory air quality limits discussed in Section 11.4.1. Other pollutants potentially emitted have not been modelled as they will not be emitted if significant quantities relative to air quality standards.

The following scenarios have been modelled:

(i) Typical Operation

Typical operation includes emissions from the heating medium fired heater, sales gas compressor turbine and two electricity generating engines.

The scenario does not include emissions from the ground flare, firewater pumps or the emergency generator as these are only expected to operate infrequently (typically around one hour per week).

(ii) Emergency Flaring

The emergency flaring scenario was included in dispersion modelling undertaken as part of the first Bellanaboy Bridge Terminal EIA. It showed that air quality impacts from emergency flaring were not significant. Emergency flaring will be a very infrequent event.

11.13.2 Model Input Data

All critical factors that can influence dispersion were included in the modelling. This included the development of a three-dimensional representation of the site and surrounding terrain to predict how buildings and terrain would influence airflows across the site and plume dispersion. Five years of meteorological data, collected from a representative meteorological station, were incorporated into the model (1997-2001, Belmullet Meteorological Station). The model subsequently predicted air quality concentrations beyond the site boundary for every hour of the five years of met data collated.

11.13.3 NOx Chemistry

NOx emissions arising from combustion processes consist largely of nitrogen monoxide (NO). On release to the atmosphere, NO is oxidised to NO_2, which is of greater concern in terms of air quality. The chemistry of NO_2 formation is complex and depends on a number of factors including the presence of oxidants such as ozone.

The modelling exercise was undertaken assuming that 100% oxidation of NO to NO_2 took place. Actual maximum ground level NO_2 concentrations arising from the terminal are likely to be significantly less than the values predicted by the modelling, as much of the NOx emitted will be in the form of NO when it reaches the ground. The modelling is therefore conservative in nature in order to ensure a robust assessment of potential air quality impacts associated with the proposed development.

11.14 Modelling Results: Predicted Ground Level Concentrations

The tables below present the maximum ground level concentrations (glc) for each modelling scenario. Long term (annual) and short term (hourly for NO_2, eight-hourly for CO) ground level concentrations have been calculated for comparison with existing and proposed EU standards / limits:

- Annual average glc: average concentration experienced throughout a calendar year; and
- 1 hourly average (99.8th percentile) glc: 1 hour average concentration that is not exceeded for 99.8% of the year (i.e. may be exceeded for 18 hours of the year).

The stated concentrations identify process contributions only. The interaction with background air quality is identified in Section 11.13.2.

The predicted maximum annual average NO_2 concentration (4.9 $\mu g/m^3$) arising from process contributions is significantly lower than the annual average limits for the protection of both human health and vegetation. The maximum short-term hourly average (99.8th percentile) predicted ground level NO_2 concentrations (71 $\mu g/m^3$) is also well below the applicable ambient air quality limit.

Concentrations of carbon monoxide are clearly insignificant and are not discussed further.

Table 11.7: Predicted Maximum Ground Level Concentrations

Year of meteorological data	Ground level concentrations (µg/m^3) – maximum of all model output points		
	NO_2 annual average	NO_2 1 hour average, 99.8th percentile	CO 8 hour average
1997	3.2	54	49
1998	3.6	67	58
1999	4.9	71	57
2000	4.2	67	54
2001	3.4	64	52

Modelling of the flares undertaken as part of the first Bellanaboy Bridge Terminal EIA showed that the impact of emissions from emergency flaring will not cause a significant impact on local air quality. Emergency flaring will be a very infrequent event and any impact will be short in duration.

11.14.1 Receptors

Twenty houses (human receptors) have been identified within a 2km radius of the proposed terminal site. The mapped location of houses is presented in Figure 11.2.

Sensitive ecological sites in the vicinity of the terminal include:

- Sruwaddacon Bay SPA (part of the Glenamoy Bog Complex);
- Carrowmore Lake Complex (inc. Aghoos river and the river from Muingingaun);
- Pollatomish Bog; and
- Slieve Fyagh Complex.

The maximum long term and short term ground level concentrations of NOx at these receptors, arising from typical operating conditions for the terminal, has been determined and the results are presented in Table 11.8.

The geographical variation in concentration of predicted NO_2 beyond the site boundary is illustrated in the form of concentration contours at the end of this Chapter. If a location is within two contours, the predicted concentration at that location will be between the values stated for each contour line. The contours demonstrate that predicted concentrations fall rapidly with distance from the site boundary and are well within applicable ambient air quality standards at all times.

11.14.2 Discussion of Modelling Results

Tables 11.7 and 11.8 illustrate NOx concentrations at all locations beyond the site boundary including houses and ecological features will be well within relevant air quality standards. NOx modelling assumes all NOx is in the form of NO_2.

The maximum predicted annual average glc of NO_2 arising from typical process contributions is 4.9 µg/m^3 occurring at a point adjacent to the terminal's southern security fence.

The maximum predicted 1 hour average (as a 99.8th percentile) glc of NO_2 is 71 µg/m^3, occurring as a result of typical operation, at the same point on the southern security fence. This compares against the EU and Irish standard of 200 µg/m3. The highest 1-hour concentration (as a 100th percentile) during the same period was 77 µg/m^3. This is the one-hour concentration which is not exceeded and compares against the WHO standard of 200µg/m^3.

During typical operation, the maximum ground level NO_2 concentrations (as process contributions) in the vicinity of human and / or sensitive ecological receptors are low, being never more than 2.5% and generally less than 1% of the annual average limits for the protection of human health and vegetation and not more than 7% (generally less than 5%) of the short term limit (as a 99.8th percentile).

The above predicted glc values relate to process contributions only. Given the very good air quality in the area surrounding the gas terminal, concentrations in combination with background air quality will still be well within air quality standards.

Existing background air quality was discussed in Section 11.5. The highest predicted annual average NO_2 concentration resulting from the operation of the terminal in combination with measured background levels is 7µg/m^3. Such a concentration is less than 20% of the ambient air quality standard for NO_2 designed for the protection of human health. The highest predicted concentration in combination with existing air quality at any domestic dwelling is 7% of the standard.

Figure 11.2: Location of Nearby Houses

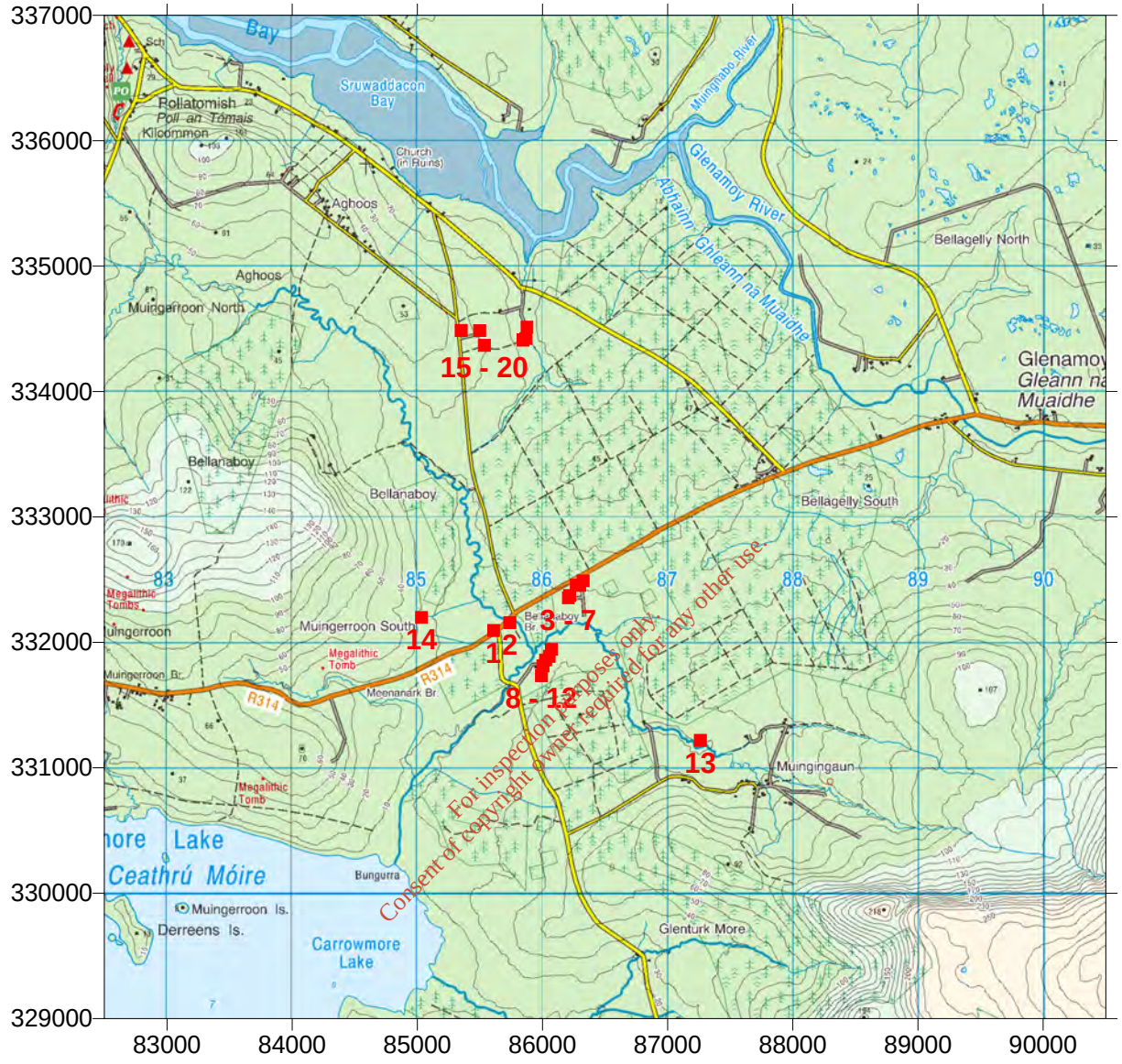


Table 11.8: Maximum NO_2 Ground Level Concentrations at Key Receptors

Receptor	Location		Annual Average	1 hour average (99.8th percentile)(2)
			Max GLC (µg/m^3)	
House 1	85609	332096	0.2	7.1
House 2	85740	332158	0.3	7.4
House 3	86206	332355	0.5	9.9
House 4	86217	332374	0.5	10.3
House 5	86297	332454	0.6	11.3
House 6	86324	332491	0.7	12.2
House 7	86269	332457	0.6	11.4
House 8	86072	331945	0.2	7.3
House 9	86054	331890	0.2	7.1
House 10	86025	331861	0.2	6.8
House 11	85991	331736	0.2	6.2
House 12	86003	331813	0.2	6.5
House 13	87261	331219	0.2	7.7
House 14	85033	332199	0.2	6.5
House 15	85350	334488	0.2	7.1
House 16	85535	334368	0.2	7.7
House 17	85867	334423	0.2	8.4
House 18	85875	334514	0.2	8.5
House 19	85498	334487	0.2	7.5
House 20	85845	334412	0.2	8.3
Sruwaddacon Bay(3)	~ 1.5km N of Terminal		0.2	5 to 10
Carrowmore Lake Complex(3)	~ 2km SW of Terminal		<0.1	<5
Pollatomish Bog(3)	~ 2.5km W of Terminal		<0.1	<5
Slieve Fyagh Complex(3)	~ 2.5km SE of the Terminal		<0.1	5 to 10

The EU and Irish ambient air quality limit for oxides of nitrogen (NOx) is designed to ensure the protection of ecosystems. NOx includes both nitric oxide (NO) and nitrogen dioxide (NO_2). Whilst no background monitoring data is available for NOx, the majority of background NOx in rural areas is typically in the form of NO_2. The dispersion modelling has effectively modelled NOx (assuming all NOx emissions are in the form of NO_2, not just the actual NO_2 component).

The modelling results for NO_2 are hence likely to be a very good indicator of combined levels of NOx arising from both process contributions and background air quality (from other sources), The highest predicted annual average concentration in this case is less than 25% of the ambient air quality standard designed to protect ecosystems. Predicted concentrations at sensitive ecosystem receptors are much lower still than this highest predicted value. The concentrations are also within the WHO guideline value for the protection of sphagnum dominated vegetation.

The modelling assessment incorporated a number of worst-case assessments that are likely to over predict ground level concentrations. Additionally, the predicted maximum concentration originating from industrial sources such as those present at the gas terminal typically occur under different weather conditions to background sources such as traffic. The peak concentrations (e.g. over a one hour period) arising from process and background sources may therefore not coincide either spatially or temporally. Given the very low background concentrations of NO_2 measured over extended periods, short period concentrations arising from existing sources are also likely to be low. It is generally regarded that provided process contributions are controlled, as demonstrated in this Chapter, compliance with annual average standards will also ensure compliance with short period standards (i.e. the one hour NO_2 standard) including the WHO guideline value. Even if the highest predicted short period concentrations from the process coincided with the highest short period concentration from existing sources, compliance with all applicable standards for the protection of health is predicted.

11.15 Air Quality Monitoring

Dust monitoring will be implemented during the construction phase of the development to confirm that dust control strategies are effective and will not

cause dust deposition problems or an adverse impact on health.

No monitoring of air quality associated with releases from vehicle exhausts is proposed. The screening assessment described in Section 11.12 predicted that air quality would be well within air quality limits at sensitive locations in close proximity to the R314 and haul route during the construction phase. Traffic flows during the operational phase of the gas terminal will be significantly lower than during the construction phase.

Stack emissions will be monitored at source in accordance with the requirements of the IPPC Licence.

11.16 Reinstatement and Residual Impacts

No combustion will occur after gas reception has stopped and there will be no vehicle activity associated with the terminal once decommissioning and abandonment is complete, therefore there will be no residual air quality impacts as a result of the terminal development abandonment.

11.17 Microclimate Considerations

The site and surrounding area within 1km is relatively flat and open and good dispersion conditions are expected. The prevailing wind direction is from the south west. However, localised land-sea effects, land to lake effects and the influence of hills on wind direction can be expected. Such effects are likely to lead to higher localised winds than would otherwise be the case, again aiding dispersion.

The Bellanaboy hill ridge lies approximately 3km to the west of the terminal road. The peaks of Glenturk Beg, Slieve Fyagh and Carrafull lie to the south and hill ridges are extensively present to the south east. The hills however do not form a continuous boundary where land rises steeply on all sides of the terminal site. The site is therefore not located within a basin, where poor dispersion effects can be extenuated. The hill ridge may cause localised influence in wind direction and wind speeds but such effects are not expected to decrease the level of dispersion.

Poor dispersion can occur under certain weather characteristics known as inversions which form in very light or calm wind and stable atmospheric conditions. The wind rose illustrated in Figure 1 identifies that such wind conditions are very infrequent.

11.18 Conclusions and Summary

The study concludes that atmospheric emissions resulting from the development will not have a significant impact on the local environment or human health, either during its construction or operation.

The greatest potential impact to health and the environment during construction was identified to be from construction vehicle emissions. An assessment has identified exposure levels at nearby sensitive receptors including domestic dwellings will be well within ambient air quality standards. A dust management strategy combined with ambient monitoring will be implemented to control releases of dust and PM_{10}.

The pollutant most likely to impact on local air quality as a result of terminal operation is NO_2. Predictive dispersion modelling has been carried out to determine the maximum ground level concentrations of NO_2 for typical operation and for emergency flaring.

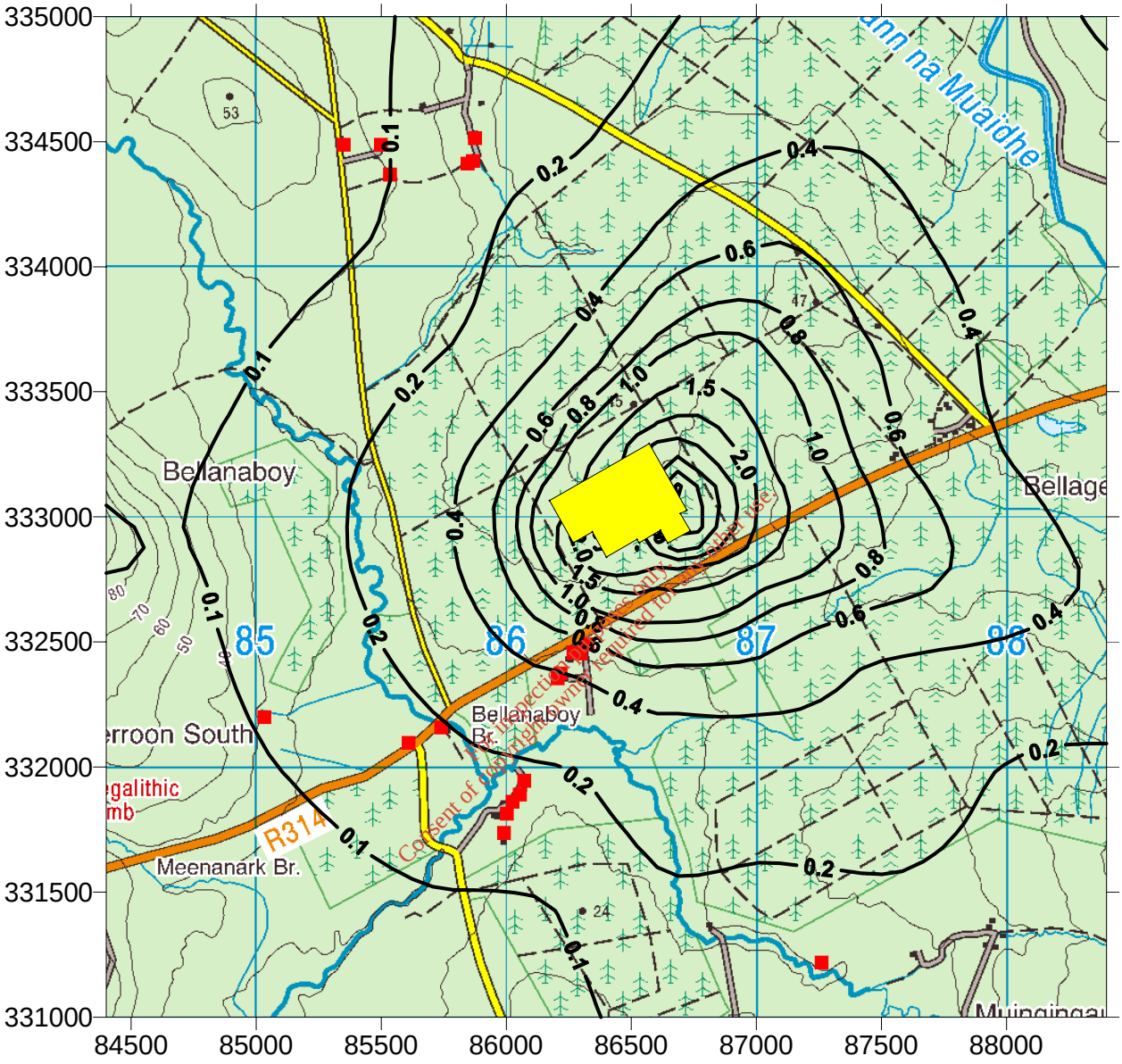
The modelled scenarios were highly conservative and the results indicate that:

- typical operation does not result in ground level concentrations of NO_2 that would exceed or approach any of the air quality limits;
- emergency flaring does not result in ground level concentrations of NO_2 that would exceed or approach any of the air quality limits for NO_2; and
- even in the hypothetical event that worst case emergency flaring and typical operations were taking place concurrently, the limits would not be exceeded.

Based on the modelling results, operations at the terminal site will not result in a significant impact on local air quality. This conclusion is based on a comparison of the ground level NO_2 concentrations predicted by highly conservative dispersion modelling with relevant air quality standards and guidelines. Such standards and guidelines have been set by environmental and health professionals across Europe following extensive worldwide research. They are designed to protect the most sensitive of receptors, including for example elderly humans with existing respiratory ailments and sensitive areas valued for their flora and fauna.

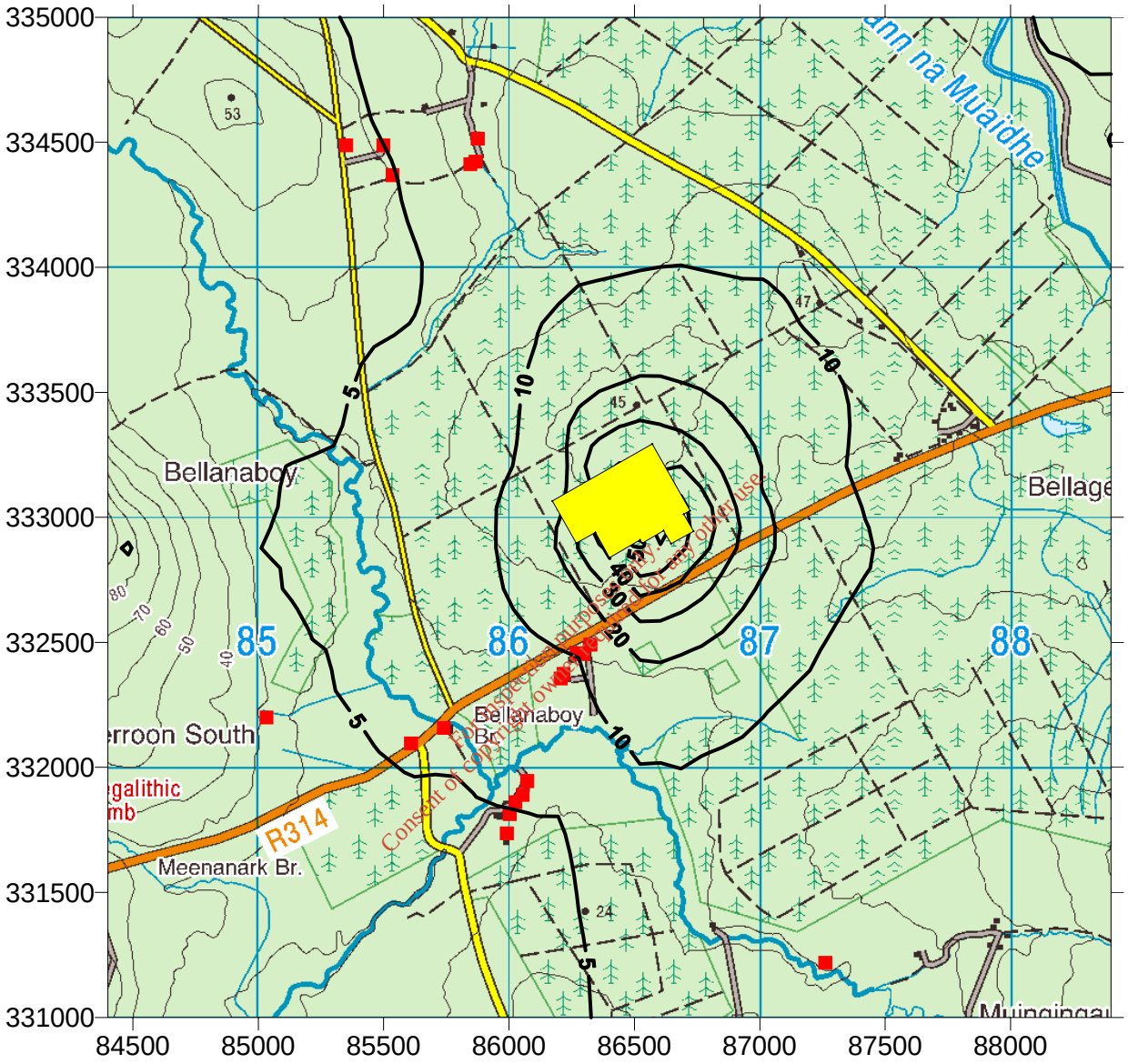
Existing air quality is very good and will remain so with the terminal in operation. No residual air quality impacts are anticipated as a result of the terminal development.

Figure 11.3 Concentration Contour of Annual Average NOx as NO_2 Concentrations Arising from Process Contributions from the Terminal



(1999 Meteorological data. Air Quality Standard is 40µg/m^3 for the protection of health and 30µg/m^3 for the protection of ecosystems)

Figure 11.4 Concentration Contour of One-Hour NOx as NO_2 (expressed as a 99.8th percentile) Arising from Process Contributions from the Terminal



(1999 Meteorological data. Air Quality Standard is 200µg/m^3 for the protection of health)

Twelve

Noise

12 Noise

12.1 Introduction

This section considers the potential impact of noise and vibration generated during the various stages of the proposed terminal development. The assessment has been undertaken by Alan Saunders Associates on behalf of Shell.

Implications of construction, commissioning and operation of the terminal facilities are considered in the context of appropriate standards and guidelines, along with requirements for monitoring and controlling levels of resultant noise and vibration.

General procedures for construction are well known. Typical techniques have been assumed in order to predict the impacts in this section, enabling previously measured and published standard noise and vibration source data to be considered.

The precise details of methods to be used in the construction and commissioning will be the responsibility of the construction contractor (yet to be selected). The contractor will be required to produce detailed environmental and safety management procedures. These will be discussed with Mayo County Council and agreements will be made on noise limits for points in the vicinity before construction begins, together with any requirements to monitor compliance with such limits.

Detailed noise data has been supplied regarding the actual equipment proposed for the terminal from the vendors. This information has formed the basis of the terminal assessment.

The Environmental Protection Agency will regulate the noise emissions from the terminal under the Integrated Pollution Prevention and Control (IPPC) Licensing regime. An IPPC Licence will be applied for in due course.

12.2 Study Methodology

12.2.1 Guidelines for Noise Impact Assessment

Guidelines published for consultation jointly by the Institute of Acoustics and Institute of Environmental Management and Assessment in 2002 have been used for reference, the overriding requirement however, being compliance with the EIA Directive (85/337/EEC).

12.2.2 Environmental Noise Climate

The area surrounding the proposed terminal site is rural and sparsely populated. Consequently, only a relatively small population will be impacted. These characteristics also result in low background noise levels against which increased levels of noise will be more noticeable.

12.2.3 Environmental Noise Surveys

An integral part of an environmental noise impact assessment of a proposed development is an understanding of the noise environment that exists in the area potentially affected by the development. It is, therefore, accepted practice to undertake background noise measurements at surrounding locations that may be sensitive to noise. These are usually the dwellings that are in the immediate vicinity of the site.

Background noise measurements were carried out in July 2000, November 2001 and October 2003. These noise surveys established baseline conditions in the vicinity of the proposed terminal site in accordance with ISO 1996 Acoustics - Description and measurement of environmental noise.

Various weather conditions were encountered during the noise surveys, ranging from strong wind and heavy rain to relatively calm, benign conditions. Noise levels measured during periods of precipitation are generally excluded from baseline noise data, as are excess levels generated by traffic movements on wet roads after periods of rain.

12.3 Receiving Environment

12.3.1 Noise Survey Results

Prevailing conditions in the vicinity of the site are dominated by westerly weather fronts coming in from the Atlantic Ocean, with high average and maximum wind speeds. Entirely calm conditions occur infrequently; a review of weather data from June 2002 to March 2003 indicates calm conditions occur less than 2% of the time.

When calm conditions do occur, and in the absence of other local noise sources, such as local traffic and agricultural vehicles, very low background noise conditions can be experienced.

Detailed survey measurements were carried out employing both manned and automated monitoring equipment to establish fluctuations in prevailing noise levels over time, and provide qualitative assessments of dominant ambient noise sources. These noise survey measurements are summarised in this section.

For the purposes of this assessment a 24-hour period has been divided into daytime (07:00-19:00), evening (19:00-23:00) and night time (23:00-07:00).

Daytime

During the daytime period individual traffic movements along the nearby roads, which generate considerable noise levels at times, dominate the noise environment around the site. Traffic along the R314 is generally audible at considerable distance, with a lesser contribution from traffic on the local road to Bangor.

Daytime minimum background noise levels have been measured below 30dB L_{A90}, but average L_{Aeq} levels are generally above 50dB, depending on proximity to road noise sources.

Evening

The minimum background noise levels during the evening tend to be similar to those during the quiet periods of the day, although the average level decreases along with a reduction in traffic activity. L_{A90} levels below 30dB are normal, with L_{Aeq} averages dropping to around 45dB.

Night-time

During the night the area can be described as an isotropic environment (no continuous dominant noise sources). Background noise levels are consistent with those occurring during lulls in activity during the day and evening, but with more frequent opportunities to approach minimum values.

Although relatively infrequent, calm conditions at night can result in the lowest background L_{A90} values of around 20dB. Average L_{Aeq} levels at night tend to drop to between 35 and 40dB.

12.4 Characteristics of the Proposed Development

The proposed terminal development refers to the construction and operation of all plant and facilities within the boundary of the site.

The terminal has been assessed in terms of the construction phase, normal operational conditions and emergency conditions.

12.4.1 Construction Phase

The construction of the terminal will take place over a period of two years. The ambient noise will fluctuate depending on the machinery used, time of construction and distance of receptors to the terminal site. In addition increased traffic will also result in an increase in ambient noise level. The key potential sources of noise and/or vibration are as follows:

- site traffic;
- piling;
- earth moving; and
- steel erection.

12.4.2 Normal Operation of Terminal

There are a large number of plant items associated with the normal operation of the terminal, the majority of which are continuously active throughout the working period.

The engineering design of the terminal processes and systems enables the use of accurate vendor noise data for the plant proposed.

12.4.3 Emergency Operation – Terminal Flare

The use of the flare will be addressed in isolation, as this constitutes high level emergency operation where safety concerns are paramount. A ground flare will be used during maintenance.

12.4.4 Maintenance Ground Flares

A small isolated ground flare has been installed to avoid non-emergency use of the high level flares. This flare will be used for the combustion of the non-recoverable gas prior to a maintenance activity. This is configured to minimise noise impact, as part of the normal operational noise control strategy for the terminal.

12.4.5 Other Emergency Plant

There will be a number of additional emergency plant items on the terminal site including emergency electricity generators, fire water pumps and pressure safety valves. These will be markedly quieter than the flare. To provide for a robust assessment, these items have been included in the normal daily operation of the terminal.

12.5 Potential Impact of the Proposed Development

12.5.1 Construction Phase

The impacts of all construction work will be within the scope of the accepted standards and guidelines. These will maintain a regime of noise and vibration control and monitoring to ensure that impact on the sensitive receivers is kept to a reasonable level on an ongoing basis.

Exceptional operations, such as restricted night-time or weekend working, will require consultation and liaison with the local residents and local authority to limit their impact.

The assessment presented here has been prepared using the most recent, typical noise data available for construction operations likely to be employed and the timings of such operations.

The terminal contractors' responsibilities will include reference to this document prior to commencement of site operations. In consideration of these factors, the contractors will also be responsible for any mitigation requirements to ensure that any agreed target noise levels can be achieved in practice throughout the scheme.

Standard Construction

Normal construction activities have been cross-referenced with standard noise source data to give an estimate of site noise levels. These values have been calculated using the procedures described in British Standard (BS) 5228:1997 'Noise Control on Construction and Open Sites'.

These calculations indicate that typical daytime construction noise levels will not exceed approximately 65dB $L_{Aeq,1hour}$ at any of the closest dwellings. However, in the early stages of the construction project with piling and soil stabilisation operations underway, these levels may be exceeded.

Due to the nature of the processes involved, noise levels will not be constant, fluctuating with operating periods for each item of plant and the combination of machinery being used at any one time. Noise levels will also vary depending on time and distance from the terminal site. Neighbouring residents will not, therefore, be continually exposed to these noise levels for extended periods.

During the period of earthworks where peat is transported from the terminal site to the peat deposition site at Srahmore, there will be additional road noise traffic (see below).

Road Traffic Noise

Traffic associated with construction of the terminal will be routed via main roads as far as is possible. Due to the rural nature of the area, however, some minor roads will have to be used for access. These routes proposed in Section 16 are subject to the Traffic Management Plan to be agreed with Mayo County Council.

The increase in traffic movements on minor roads is likely to cause a noticeable increase in daytime noise levels. This effect will be localised and temporary, and will be restricted to the construction phase of the scheme.

HGV traffic on local roads will need to be controlled by careful planning of material movements to and from site as part of the construction programme.

Significant numbers of such vehicle movements will be required at specific times in the construction programme. Although these activities will increase road traffic noise levels, they do not represent an introduction of a new noise impact as the local roads already support a wide variety of agricultural and construction-related heavy vehicle movements.

Communication with affected residents is essential in minimising the adverse affect of this potentially noisy process in the early stages of the construction program.

Rock Excavation

The construction of the terminal will require large movements of material within the site and from it. A large proportion of this material (peat and weathered rock) will be excavated by back hoe. This is unlikely to result in high levels of noise and vibration. It is possible that very small areas may require the use of ripping/rock breakers, which will produce more significant levels of both noise and vibration. The extent, nature and depth of these activities will be determined by a detailed borehole survey prior to construction.

Piling

The piling operation will take place during the first part of the construction process, when retaining walls and foundations are being built as part of the civil construction phase (see Section 3.3.4).

It is possible to control the levels of noise and vibration generated through piling, by adjusting the force applied on each impact cycle. Reduced impact force, however, reduces the process efficiency such that the operation takes considerably longer. It is usually found that the benefits of slightly reduced noise levels are out-weighed by the resultant increase in exposure duration. Only in extreme cases, usually due to very close proximity to residential properties, is this justified.

Ground conditions in which piling is required are expected to be relatively compliant, with significant resistance only encountered at the end of the piling cycle as competent load-bearing sub-strata are encountered. Generated levels of both noise and vibration are expected to be relatively low for such activities.

Good communications and public relations in the early stages of the construction program are the most important factors in minimising the adverse

affect of this potentially noisy process. Any resultant impact will be short-lived.

Other Site Operations

In addition to the operations above, the excavation of peat will necessitate the need for pumps on site. Generators will also be required for security lighting at night.

The combined noise levels for one diesel pump and one generator have been predicted using BS 5228, and can be expected to drop below 55dB(A) at distances in excess of about 300m.

During the construction period, there will also be air compressors on site for pneumatic tools.

Appropriate noise control measures will be implemented to minimise noise emissions, especially at night.

The limited period of construction and compliance with the requirements for mitigation of noise and vibration will ensure that impact on the local environment is kept to an acceptable level.

12.5.2 Normal Operation of the Terminal

Under normal operational conditions, noise levels emitted from the terminal site will be relatively constant with the majority of plant items running continuously. Some items that run intermittently contribute less to the overall noise levels, but are more likely to attract attention during start up and shut down. All such plant items are assumed to run continuously to offset this effect.

The normal operation of the terminal plant will be controlled such that it has an acceptable impact on the local environment and sensitive receivers.

This will require compliance with the nighttime criterion of 35dB $L_{Aeq,15mins}$ at the nearest sensitive receptor.

Daytime operation has been designed to comply with the daytime criterion of 45dB $L_{Aeq,1\ hour.}$ This includes maintenance and routine test operations, which are normally expected to be operated on a daytime only basis.

The engineering design of the terminal plant and processes has been developed and amended to ensure that compliance with these requirements can be achieved.

A plant noise emissions model was developed during this process by the engineering team to prioritise noise control activities, which comprised over 150 separate noise sources, including external plant, process buildings and noise re-radiated from pipework.
Typical noise data have been used comprising a combination of vendor data for the actual equipment proposed and comparable data from similar installations.

This model was independently verified using alternative proprietary software, to within an overall accuracy of 1dB(A).

The degree to which this data will reflect actual noise levels emitted from the terminal site has been reviewed. It is considered that the predicted noise levels are sufficiently accurate to ensure compliance at the most sensitive receptor positions for specific meteorological conditions.

This engineering model was then developed further, using topographical and meteorological data, to provide a more detailed study of noise propagation over greater distances. This enables the overall impact on the area at large to be better assessed.

The results of the noise propagation model show contour maps of predicted noise levels for daytime and night time scenarios at 1.7m above local ground height. These are shown in Figures 12.1, 12.2, 12.3 and 12.4.

A daytime model is also presented which allows for typical prevailing wind conditions of 16.7 knots from 190 degrees.

12.5.3 Emergency Operation – Terminal Flares

In an emergency situation, such as a gas leak or a fire, safety considerations would require the removal of gas inventory from certain sections of plant or from the inlet of the export pipeline by the combustion of vented gas from the emergency flare.

Emergency flaring could occur at any time of day or night, whereas maintenance operations are normally carried out during the day. Rather than releasing the gas directly to atmosphere, it is burned in the form of a controlled flare. Flare facilities will be provided at the terminal for low and high-pressure emergency gas systems. These flares are referred to as the LP and HP flares.

Noise levels generated by the emergency flares are likely to be higher than any item of general plant within the facility, and are not readily attenuated by any form of industrial noise control.

Figure 12.1 Daytime Operational Noise: Calm Conditions (Includes Ground Flare)

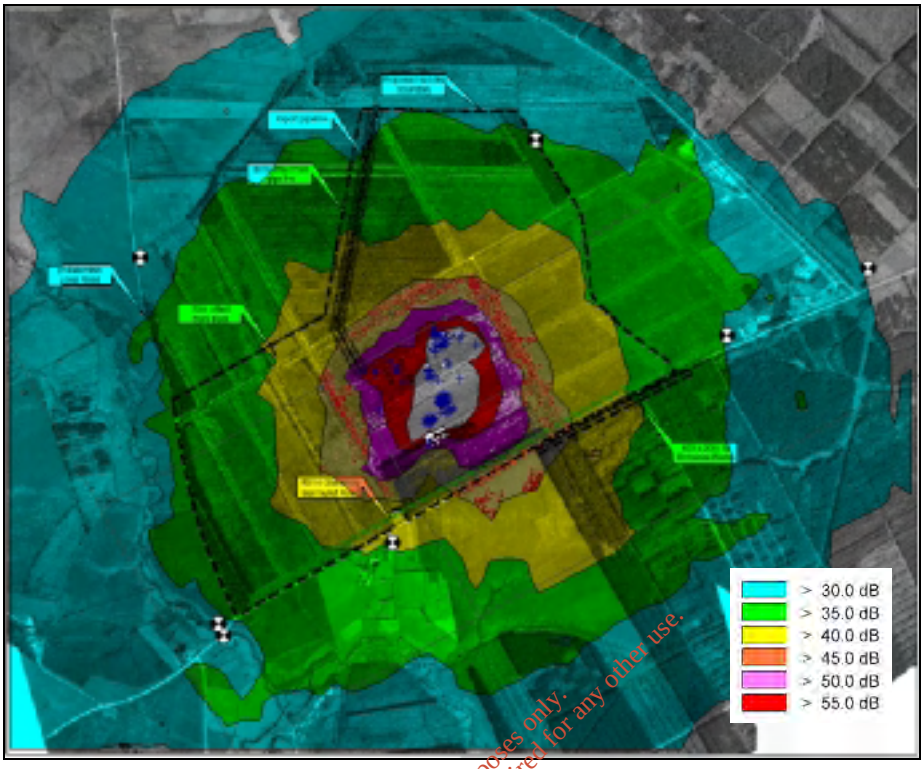


Figure 12.2 Daytime Operational Noise with 190° Wind at 8.6m/s, Met Condition D (Includes Ground Flare)

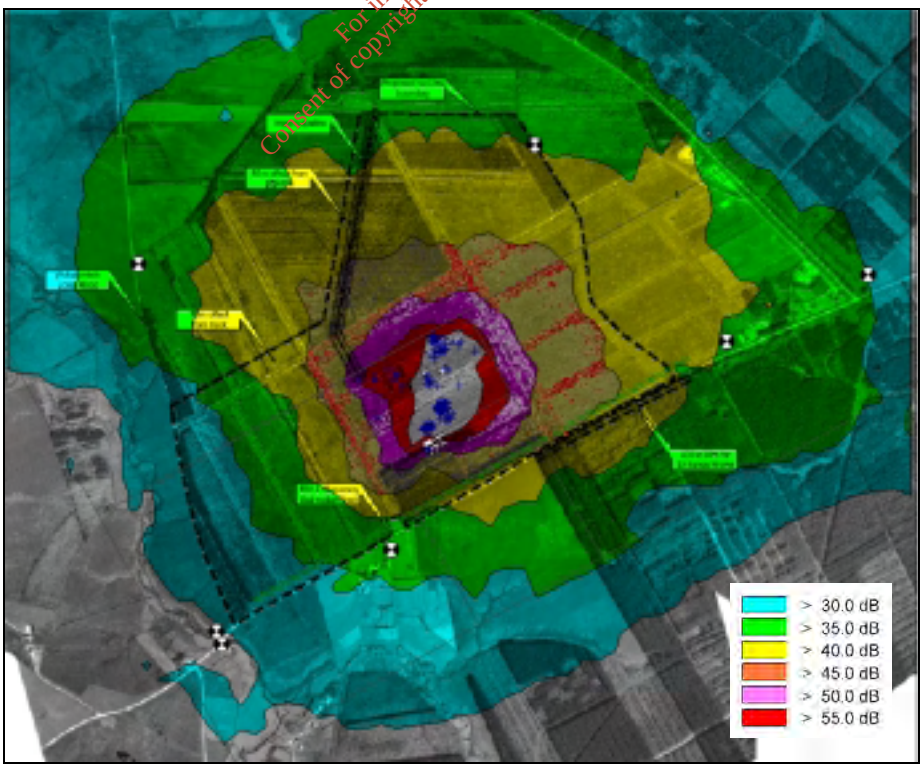


Figure 12.3 Night-time Operational Noise Calm Conditions

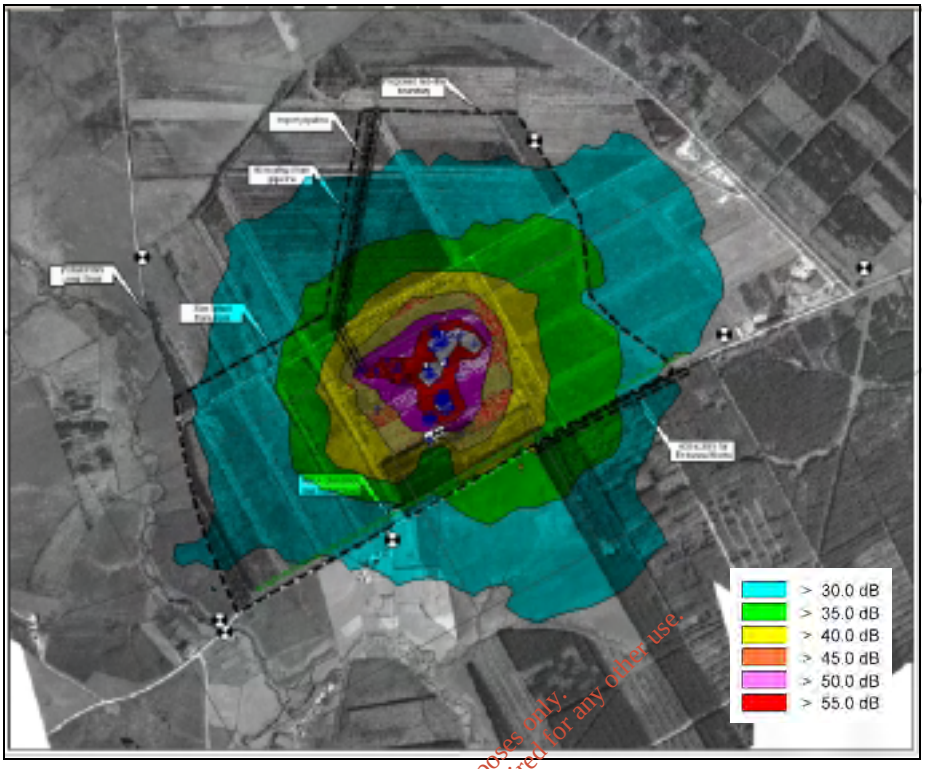


Figure 12.4 Night-time Operational Noise with 190° Wind at 8.6m/s, Met Condition D

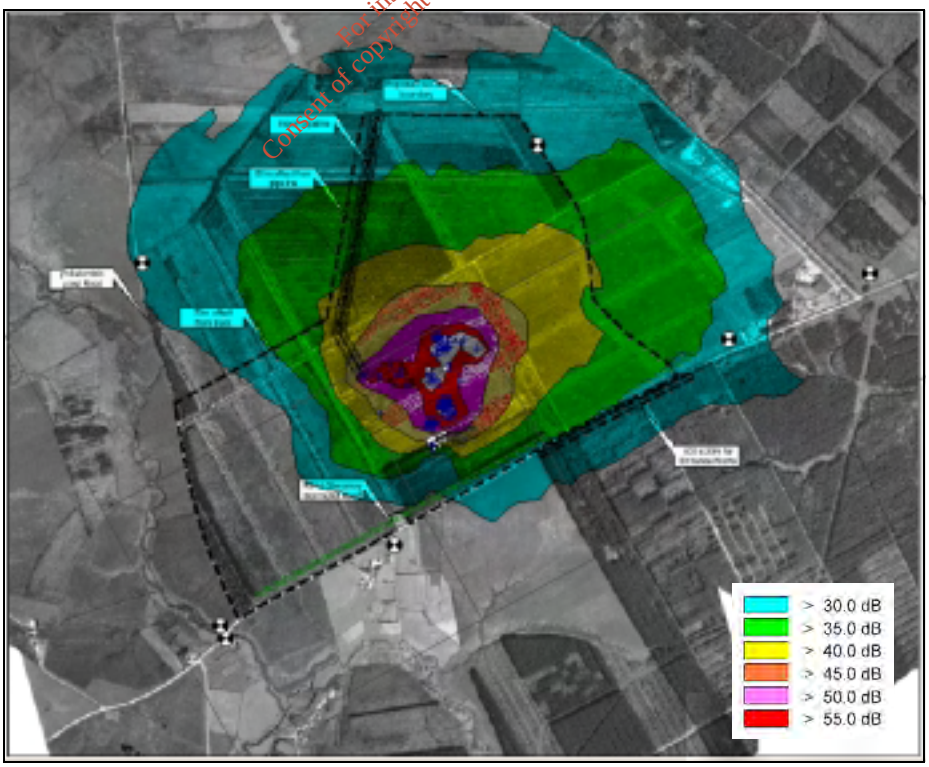
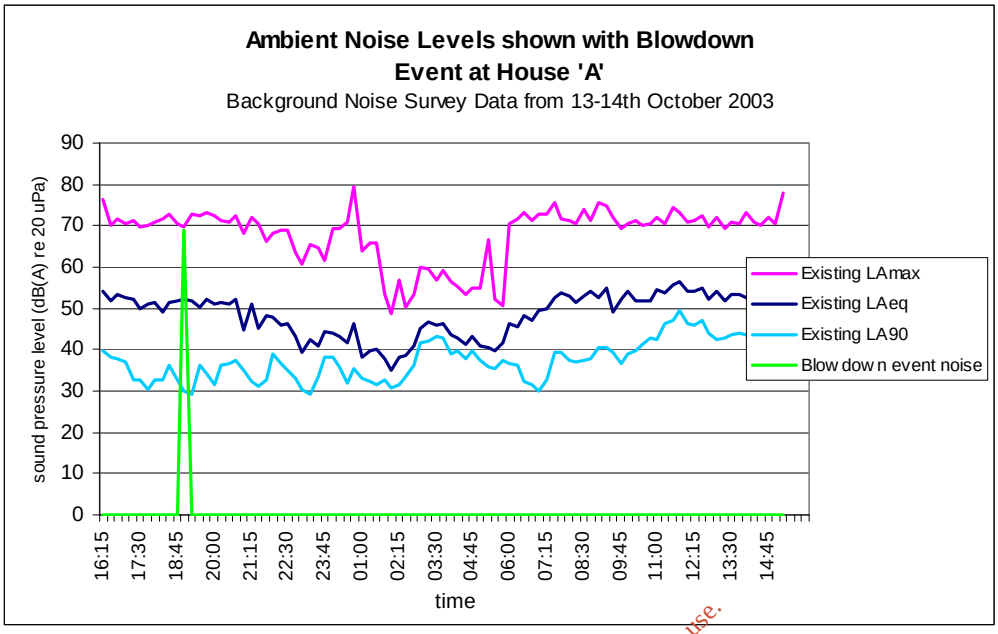


Figure 12.5 Ambient Noise Levels Shown With Blowdown Event at House 'A'



In the event of the emergency flare having to be used, the noise limits set by EU (Noise Directive 86188 EEC) for workers in the plant will not be exceeded.

Since the flares are not lit under normal operating conditions, it is not relevant to apply noise control restrictions as for everyday plant and machinery.

The flares will need to be tested on commissioning of the terminal to ensure correct operation, and this would be a planned event, with public notification. Operation thereafter would be a highly unusual occurrence, which could be described as a once in a lifetime event.

The resultant noise levels should be considered, nonetheless, to gain a full appreciation of the environmental impact of the entire operation.

To achieve the statutory depressurisation requirements, the engineering design has established flare rates and durations, which would be involved in a depressurisation event. Noise emissions have been assessed for this profile to the nearest residential property, at a distance of approximately 615m.

An $L_{Aeq,15min}$ level of just below 70dB has been established for such an event. By way of comparison, this is a similar noise level to that generated by a small modern petrol lawnmower at a distance of about 10 metres.

The significance of such a depressurisation flaring event can be assessed against otherwise prevailing background noise levels in Figure 12.5, which plots the resultant noise level against ambient noise monitoring data from the terminal site.

12.5.4 Other Emergency Plant

The terminal will include other plant items, such as emergency generators, and fire pumps, which are only required for operation under emergency conditions and for programmed daytime testing. These pieces of equipment are less noisy than the flares and are located much closer to ground level.

It can be concluded that these quieter emergency plant items can also be deemed acceptable in the context of their operational necessity. Such plant is largely included within the control of normal daytime plant in any event.

12.6 Mitigation Measures

12.6.1 Construction Impact Mitigation

In the absence of other specific legislation or guidance documentation relating to noise emissions from construction sites, reference will be made to British Standards and other relevant planning and reference documents as appropriate. The EPA document Guidance Note for Noise in Relation to Scheduled Activities does, however, give guidance on noise and vibration thresholds for quarrying and mining activities. It is understood that these limits

will be considered applicable to any rock blasting which may be required in certain areas.

The BS 5228 Standard states that complaints due to industrial noise increase as the difference between generated noise level and the background increases. It considers that a similar effect could occur for construction activities but suggests the tolerance may differ when it is known that the timing of the activity is of a short duration.

In consideration of the likely noise and vibration levels to be generated during the various phases of the scheme, the following mitigation measures will be adopted to minimise the impacts on neighbouring residents:

- detailed impacts for these activities will be assessed by the contractors to ensure compliance with the stated standards and guidelines, and local authority requirements;
- consideration to be given to use of vehicle reversing lights during hours of darkness instead of the usual reversing bleepers;
- the majority of construction work will take place during the 'daytime' period of 0700 to 1900 hours;
- fundamental to the contractors' duties will be the requirement to provide mitigation of noise and vibration where required and to the best standard practicable;
- the contractors will be required to minimise the need for heavy lorry traffic. This will be essential in minimising noise and vibration impacts on local residents and those living along the routes proposed for the delivery to site of construction materials (see Section 16);
- best practicable measures to reduce noise levels to a minimum will be employed at all times;
- normal working hours will be discussed and agreed with Mayo County Council before construction begins;
- any construction activities that may have to continue on a 24-hour basis will only proceed following consultation with Mayo County Council;
- where appropriate, residents living near the terminal site will be kept informed of the contractors' proposed working schedule and will be advised of the times and duration of any abnormally noisy activity likely to cause concern; and
- the contractors will be made aware of the necessity to avoid unnecessary noise from the site, particularly at night.

Recommendations have also been made with specific reference to the local L1204 road between R313 and R314, which will carry significant volumes of peat transportation vehicles during the early stages of construction. These comprise:

- road condition survey prior to commencement;
- repair works to all sections of road where the surface generates excess noise and / or impact, in the immediate proximity of roadside residences;
- additional signage specific to site traffic, including speed restrictions in key areas; and
- road condition survey on completion and repair works as necessary.

12.6.2 Noise Control Targets

Control of noise from the normal activities associated with construction of the terminal will be achieved by restricting working hours and by the best practicable means mitigation measures described above.

A working target of 65dB $L_{Aeq,1hour}$ is suggested as a daytime limit for resident's properties for most of the construction phase, against which noise monitoring throughout the construction programme can be compared. By way of comparison, this is a similar noise level to that generated by a small modern petrol lawnmower at a distance of about 14 metres. However in the initial months, the levels may be higher.

Noise monitoring positions would then be agreed with Mayo County Council, prior to commencement of significant works on site, to determine compliance with the noise emissions targets. Positions should be determined which can be readily access by site personnel, but accurately reflect the degree of off-site noise impact.

If specific activities are required which can be expected to exceed this level, this would be agreed in advance with Mayo County Council, with sufficient notice given to nearby residents and other interested parties.

A complementary target for night-time noise emissions from the construction site would be 45dB $L_{Aeq,1hour}$. To achieve this level, overnight plant such as pumps and lighting generators will need to be suitably attenuated. By way of comparison, this is a similar noise level to that generated by a small modern petrol lawnmower at a distance of about 140 metres.

12.6.3 Vibration Control Targets

The only site operation likely to give rise to any noticeable vibration levels is piling.

The Guidance given in 'Guidance Note for Noise in Relation to Scheduled Activities', 1995 on vibration levels relates to blasting operations, and states a limit of 8mm/s peak particle velocity at any residence for frequent operations. Piling vibration levels must be kept well within this limit.

Experience of piling vibration impact suggests that at levels in excess of a lower threshold of 1mm/s, some adverse comments can be expected from occupants of exposed dwellings. For operations expected to be at or in excess of this threshold, therefore, prior notice should be given to Mayo County Council and the residents concerned.

12.6.4 Operation Impact Mitigation

Minimising noise has been an integral part of the design of the terminal. For example:

- gas turbines and inlet and outlet pipework will be acoustically insulated, along with other major plant items and housed within buildings with specified sound insulation performance;
- the plot layout has been configured considering the location of dominant noise sources and the noise emission footprint; and
- stringent noise limits have been specified for all significant items of plant.

The Environmental Protection Agency will regulate noise under the Integrated Pollution Prevention Control (IPPC) Licence. This will apply to ongoing noise emissions from terminal operation.

The terminal will house numerous items of noise generating equipment, most of which will operate continuously.

Mitigation of noise related to the day-to-day operation of the terminal site will be achieved as an integral factor in its design and installation. After baseline noise surveys and discussions with Mayo County Council, the specified noise criteria (as assessed at the nearest noise sensitive property under free field conditions) were set as follows:

- Daytime (07:00 - 23:00) 45dB $L_{Aeq,1hour}$
- Night-time (23:00 - 07:00) 35dB $L_{Aeq,15mins}$

By way of comparison, these are similar noise levels to those generated by a small modern petrol lawnmower at a distance of about 140 and 450 metres respectively.

These noise criteria represent the best standard of noise control available, and are considerably more stringent than those often applied to such developments. For example they are 10dB lower than the EPA guidance document for noise 'Guidance Note for Noise in Relation to Scheduled Activities'.

A significant degree of industrial noise control will be required to achieve these levels, and will be the sole function of a considerable amount of terminal equipment. Commissioning tests will be required on completion of the facility to demonstrate that compliance with the criteria levels has been achieved, with additional mitigation implemented if required.

Ongoing compliance with the noise criteria levels will require a detailed test and maintenance program to ensure that noise levels are appropriately controlled and noise control equipment continues to function effectively. Noise limits and associated performance monitoring will be carried out in accordance with conditions to be set as part of the IPPC Licence for the terminal.

Any new plant or processes subsequently installed at the site will be subjected to a thorough noise audit to ensure that compliance with the environmental criteria is not compromised.

The noise impact of flaring will be mitigated by the relatively large propagation distances involved and by the use of the low-noise ground flare, for planned maintenance activities.

12.7 Predicted Impact of the Proposed Development

12.7.1 Construction

Construction of the terminal will last approximately two years. During this period, the construction processes and ancillary noise sources will generate increased noise levels.

The site is remote, and it is expected that compliance with normal construction noise controls can be achieved without undue impact on the construction program.

Noise controls have been specified, which the construction contractors will be required to observe. These controls are not set at an onerously low level, since it is appreciated that a certain degree of increased noise is inevitable during the construction phase and can be tolerated due to its finite duration.

Any particularly noisy operations or activities will be planned in advance, in order to ensure that appropriate community liaison can be put in place. The maintenance of good communications and

public relations are essential in minimising the impact on the local community.

The most significant noise impacts will arise from piling, earth moving and site traffic.

Vibration levels generated by piling works are unlikely to reach the stated limit as measured on the site boundary. Levels at the nearest dwellings will be significantly lower, and unlikely to exceed the threshold recommended for triggering additional liaison with Mayo County Council. Vibration measurements will be carried out at the commencement of the piling programme to confirm this.

The impact is shown in Table 12.1 and can be summarised as moderate in the immediate vicinity of the site and access roads, and temporary.

Table 12.1 Construction Noise Impact

Indicator	Predicted Change at Receptor		
	< 1km from Terminal	Traffic Along Haul Route	> 1km from Terminal
L_{Amax}	None / Slight Increase	None / Slight Increase	None
L_{Aeq} / L_{A10}	Increase	Large Increase	Slight Increase
L_{A90}	Slight Increase	None	None
N	Increase	Increase	None
Summary	Moderate Impact	Moderate Impact	Negligible Impact

12.7.2 Terminal Operation

Detailed modelling of noise emissions from the terminal has been undertaken. This has established that compliance with the specified noise limits is achievable with the type of installation proposed.

The residential receptor positions to the south and south west of the terminal site, near Bellanaboy Bridge, are likely to be the most affected by noise levels, since these are the closest to the terminal. Noise emissions modelling activity has concentrated on these areas to ensure compliance with the planning noise criteria.

Normal wind conditions will serve to reduce noise exposure at all of the key receptor points, as the prevailing wind blows to the north east - the direction in which residential properties are most distant.

Table 12.2 Operational Noise Impact

Indicator	Predicted Change at Receptor		
	< 1km from Terminal	Traffic Along Haul Route	> 1km from Terminal
L_{Amax}	None	None	None
L_{Aeq} / L_{A10}	None / Slight Increase	None	None
L_{A90}	Increase	None	None / Slight Increase
N	None	None	None
Summary	Moderate Impact	No Impact	Negligible Impact

The prevalence of relatively high wind speeds in the area also reduces the extent of noise impact from the terminal, by elevating background noise levels, which would otherwise be very low.

The impact is shown in Table 12.2 and can be summarised as moderate, affecting a relatively small number of individuals.

12.8 Monitoring

A programme of noise and vibration monitoring will be implemented in accordance with the conditions stated as part of the planning permission of the IPPC Licence and may include the following:

- operation – initial commissioning measurements of noise emissions and annual monitoring of noise impacts at sensitive receivers or at positions stated by IPPC Licence; and
- additional plant – the introduction of additional plant or variations to the proposed installation may require an acoustic audit as determined by conditions of the IPPC Licence.

12.9 Reinstatement and Residual Impacts

Ongoing noise impacts are only likely to be experienced in the immediate vicinity of the terminal site during construction and, to a much lesser extent, operational phases of the project.

Construction noise has been considered and assessed. It has been determined that some residents may be adversely affected, albeit temporarily, within close proximity of the terminal and mitigation measures have been established to minimise this impact.

Operational noise limits have been specified to control this impact, which will be controlled through IPPC Licensing. Calculations based on the currently proposed equipment at the terminal site confirm that compliance with the limits anticipated can be achieved.

Decommissioning activities will be carried out under the same controls and mitigation activities as construction of the terminal, although the impact can be expected to be significantly lower.

No residual noise impact is predicted following decommissioning and reinstatement.

Thirteen

Landscape and Visual Impact

13 Landscape and Visual Impact

13.1 Introduction

This section assesses the likely impacts of the proposed development on the landscape character and visual amenity of both the immediate and wider environs of the site.

This landscape and visual impact assessment has been undertaken by RSK ENSR Environment Ltd in conjunction with Brady Shipman Martin between August and October 2003, and builds upon an existing detailed knowledge of the proposed terminal site and its wider environs.

This assessment is based upon extensive and detailed existing baseline data dating from 2000 to early 2003, and includes information gathered in previous extensive consultations with Shell, representatives of Mayo County Council, Coillte Teó and others.

In order to assess the likely impacts, detailed site surveys to assess the landscape character and visual environment were undertaken.

13.2 Study Methodology

The landscape and visual impact assessment assesses the following:

Landscape Impacts, including:

- direct impacts upon specific landscape elements within and adjacent to the site;
- effects on the overall pattern of the landscape elements which give rise to the landscape character of the site and it's surroundings; and
- impacts upon any special interests in and around the site.

Visual Impacts, including:

- direct impacts of the development upon views in the landscape; and
- overall impact on visual amenity.

Visual impacts may be defined under 'visual intrusion' and 'visual obstruction', where:

- 'visual intrusion' is impact on a view without blocking, and
- 'visual obstruction' is impact on a view involving blocking thereof.

13.3 Significance Criteria

Various significance criteria are commonly used in assessing landscape and visual impacts. Many of these are particular to practices and based on years of professional experience in the area of landscape and visual impact assessment[1]. Yet others are proposed by particular bodies in relevant fields[2] or as standardisations of significance criteria across a wide range of environmental issues[3]. The criteria as set out in the EPA Guidelines on Information to be contained in Environmental Impact Statements are general in their description present difficulties in the direct relevant application and description of landscape and visual impacts.

Table 13.1 sets out the significance criteria ratings used for this assessment, which has been based on criteria included in the guidance from The Landscape Institute, listed in conjunction with the relative EPA criteria guidance.

The ratings may have negative, neutral or positive applications where:

- Positive impact – A change that improves the quality of the environment.
- Neutral impact – A change that does not affect the quality of the environment.
- Negative impact – A change that reduces the quality of the environment.

Terms relating to the duration of impacts are as described in the EPA Guidelines as:

- Temporary Impact - lasting one year or less;
- Short-term Impact - lasting one to seven years;
- Medium-term Impact - lasting seven to fifteen years;
- Long-term Impact - lasting fifteen to sixty years; or
- Permanent Impact - lasting over sixty years.

[1] 2002, The Landscape Institute & Institute of Environmental Managements & Assessment: Guidelines for Landscape and Visual Impact Assessment (2nd Ed.)

[2] 2002, Department of Environment (UK) Design Manual for Roads and Bridges, Vol. 11, Section 3, Part 5.

[3] 2002, EPA Guidelines on information to be contained in Environmental Impact Statements, Glossary of Impacts.

Table 13 .1 Significance Criteria

Project Criteria	EPA Rating
None / Negligible - No or only a very small part of the development, or work or activity associated with it, is discernible.	Imperceptible - An impact capable of measurement but without noticeable consequences
Slight - The proposals constitute only a minor component of the wider view, which might be missed by the casual observer or receptor. Awareness of the proposals would not have a marked effect on the overall quality of the scene.	Slight - An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate - The proposals form a visible and recognisable new element within the overall scene and may be readily noticed by the observer or receptor.	Moderate - An impact that alters the character of the environment in a manner that is consistent with the existing and emerging trends
Substantial - The proposals form a significant and immediately apparent part of the scene that affects and changes its overall character.	Significant - An impact which, by its character, magnitude, duration or intensity alters a sensitive aspects if the environment
Severe - The proposals become the dominant feature of the scene to which other elements become subordinate and they significantly affect and change its character.	Profound - An impact which obliterates sensitive characteristics

13.4 References

The assessment included a review of relevant statutory documents, including the Mayo County Development Plan 2003-2009 and the associated Landscape Appraisal.

The assessment has been undertaken with due regard to the advisory guidelines set out in the following documents:

- EPA: Advice Notes On Current Practice (in the preparation of Environmental Impact Statements) 1995;
- EPA: Guidelines On Information To Be Contained In Environmental Impact Statements 2002;
- The Landscape Institute / Institute of Environmental Management & Assessment: Guidelines for Landscape and Visual Impact Assessment, Second Edition 2002;
- Mayo County Development Plan, 2003-2009; and
- Appendix X Landscape Appraisal of County Mayo County Development Plan 2003-2009.

Various amenity and landscape publications and information relating to the local environment have also been reviewed.

13.5 Characteristics of the Proposed Development

The full site comprises approximately 160 hectares of which approximately 25 hectares will be used in the provision of the terminal and associated development as detailed in the following paragraphs.

Approximately 13 hectares will be graded to provide a level base set at 33.4m AOD Malin for the proposed terminal. One hectare will be used for parking and temporary construction facility.

The remaining approximately 135 hectares will primarily be used in the retention and long term protection of existing conifer screening and open grassland areas, the provision of additional screening, together with areas set aside for ecological mitigation proposals. As such, the proposed terminal area itself will occupy less than 10% of the site where over 80% comprises areas of existing plantation / screening, proposed planting / screening and buffer.

The development will comprise the following principal elements, which are to be considered as part of the landscape and visual impact assessment:

- single finished platform level of 33.4m AOD Malin;
- combined high pressure & low pressure flare stack - height approx. 40 m above existing ground level at the flare stack location (36.5m AOD Malin);
- ground flare stack – approx 12m above finished platform level;
- methanol still - height approx. 33 m above finished platform level;
- heating medium heater - height approx. 20 m above finished platform level;
- sales gas compressor/turbine stacks- height approx. 22 m above finished platform level;

- power generator exhausts – approx 16m above finished platform level;
- sales gas compressor after coolers - top of equipment approx 20m above finished platform level, top of inlet pipes approx 22m above finished platform level;
- telecommunications mast - height approx. 22 m above finished platform level; and
- bulk product methanol storage tanks, raw methanol storage tanks & condensate storage tanks - approx 10m above finished platform level.

Other features of the development include:

- establishment of a temporary construction and lay down areas to the north-east of the terminal footprint;
- sequential operations to undertake the on-site windrowing and exportation of excavated peat (as described in Section 3.5.6);
- car parking to accommodate 40 car spaces;
- areas of hard-standing for tankers for loading and off loading and internal circulation roads
- main access road from the R 314;
- warehouse and maintenance buildings ridgelines at approx 45.3m AOD;
- control building, ridgeline at approx 43m AOD;
- administration building ridgeline at approx 40m AOD;
- security fencing around the terminal footprint and low level stockproof fencing close to the boundary of the site; and
- low-intensity lighting and high level emergency lighting.

The proposed development has an anticipated life-span of about 20 years at which stage it is proposed to substantially remove all of the development back to base level, cover the site with soil and finish by grassing and general landscaping.

13.6 Receiving Environment - Character of the Surrounding Wider Landscape

The site is located toward the northern reaches of a large inland area of predominantly flat to gently undulating low-lying and partly modified blanket bog. This landscape is notably enclosed to the south and west by prominent uplands and the open and exposed nature of the lowland landscape is interrupted by prominent and extensive coniferous plantations and occasional lines of trees. The site itself is located on gentle south face slopes within the north western extent of this large coniferous area.

In general the area is sparsely populated, with individual dwellings and farmsteads well spaced and scattered throughout the area. Small numbers of residential properties tend to be varyingly clustered on and around small areas of improved grassland and along the more distant coastal edge where the land is of a more improved nature. In the vicinity of the site properties are located immediately south & south west of the site (less than 1km distant) near Bellanaboy Bridge. They are also found at greater distance (over 1km) north of the site both approaching, and at, Aghoos and east of the site (over 1.5km) again both approaching, and at, Glenamoy.

Within plantation areas the roads are strongly enclosed, otherwise the roads are generally open, not being defined by walls or hedges, so enabling long range views, occasionally restricted by landform or by vegetation.

Within the expansive landscape, even in close proximity, the site is not significant, viewed as it is, as part of a much larger complex of coniferous plantation. When travelling the roads or traversing the landscape the eye is drawn over the low-lying moorland/grassland to the dark encircling ranges of hills and mountains, including the Muingerroon-Bellanaboy Hill (170m AOD) to the north west, Slieve Fyagh (331m AOD) to the south east and the Knocknascollop-Derreens range of hills (238-244m AOD) to the south-west.

To the south west Carrowmore Lake offers diversity, and in appropriate light, reflection to the dark upland landscape. As such, the site is neither prominent or of particular focus of attention in travelling through this landscape either by road or otherwise.

The principal amenity activities in the area are walking on surrounding roads and hills, and fishing the local streams and Lake Carrowmore. The fifteen-piece North Mayo Sculpture Trail, 'Tír Sáile', which extends from Ballina to Blacksod via Belmullet, has one piece, '*Stratified Sheep*' located along the Bangor Local Road just off the R314 Belmullet-Ballycastle Regional Road, near Bellanaboy Bridge (see Section 5, Plate 5.1).

13.7 Character of the Proposed Gas Terminal Development Area

The site is situated in the townland of Bellagelly South, north of and contiguous with, the R314 Belmullet-Ballycastle regional road at a point almost immediately east of Bellanaboy Bridge, near Bangor Erris in northwest County Mayo. Glenamoy, some 3km to the east and Pollatomish, some 4km to the north are the nearest villages. The site lies approximately 8km inland from the proposed pipeline landfall site at Dooncarton.

The site is on part of the former Peatland Experimental Station at Glenamoy, which was established by the Department of Agriculture in 1959. The Station ceased to function in the early 1980s. The topography of the site within the planning application boundary rises from approximately 15 m AOD in the extreme south west of the site by Bellanaboy Bridge to a high point of almost 46m AOD in the north eastern corner of the actual terminal footprint.

The site itself comprises approximately 160 hectares partly of wet soft rush dominated grassland varyingly surrounded and divided by wide belts and plantations of primarily Lodgepole Pine (*Pinus contorta*) and Sitka Spruce (*Picea sitchensis*). The conifer plantings, which are laid out in generally regular east-west and north-south blocks, are of greatly varying age with average heights ranging from 3m to over 16m in height. The highest stands within the site are located to the south along the R314 Belmullet-Ballycastle Regional Road, to the west along the Bellanaboy Bridge-Pollatomish Local Road and to the north.

The plantations are prominent features within the local and wider landscape and act as important high level screens interrupting the otherwise smooth terrain of moorland/grassland. All the existing plantations show good growth patterns and younger plantations exhibit strong annual growth.

Figure 13.1 illustrates an aerial photograph of the landscape surrounding the site, taken in August 2003, with the proposed terminal superimposed. A sequential letter has individually identified all the existing plantations within the planning application boundary.

From detailed information obtained from the 1992 Coillte Teo Inventory Reports both the species composition and year of planting has been determined.

A feature of many of the roads around the site is the prominent and dense groves of Rhododendron, (*Rhododendron ponticum*) which frame the roadside corridors. These plantings are most notable along the R314 Belmullet-Ballycastle Regional Road where it runs along the site and especially along both sides of the Bellagelly-Pollatomish Local Road to the east of the site. New Zealand Flax, (*Phormium tenax*) is also frequently seen in sheltered plantations on the site.

While the above description outlines a complex arrangement of matrix of conifer plantations and open wet grassland, within the local landscape, the site in effect appears as a relatively 'standard commercial coniferous plantation' in its varying stages of planting, growth and harvesting.

13.8 Impact on Landscape Planning

The statutory or non-statutory landscape planning aspects relating to the area can be considered in terms of national, county and local status.

13.8.1 National Landscape Designations or Listings

The 'Inventory of Outstanding Landscapes in Ireland', prepared by An Foras Forbartha in 1977 has no listing pertaining to any part of the site or the immediate surrounds. Such listings in the wider vicinity of the site tend to be focused on the coastal areas (Nr 105 Benwee Head (13km distant) & Nr 106 Erris Head (18km distant) to the northeast and northwest and upland areas (Nr 17 Nephin Beg Range (minimum 20km distant) to the south.

As such, the proposed development will have no negative impact on any national landscape amenity or scenic designations or listings.

County Landscape Designations or Listings

The County Mayo Development Plan 2003-2009 is the statutory planning control document pertaining to the study area. Appendix X of the Development Plan includes a Landscape Appraisal of County Mayo.

13.8.2 County Mayo Development Plan 2003-2009

At Section 3.1.5 'Environment, Heritage & Conservation' the Plan includes the following principal landscape / visual related references:

Policies EH-LC1 and EH-LC2 specifically relate to Landscape Character. Policy EH-LC1 confirms that it is an objective of the Council through the Draft Landscape Character Appraisal "to recognise and facilitate appropriate development in a manner that has regard to the character and sensitivity of the landscape, to ensure that development will not have a disproportionate effect on the existing or future character of a landscape, in terms of location, design, visual prominence, that development will have regard to the effects of the developments on views from the public realm towards sensitive or vulnerable features and areas".

Policy EH-LC2 confirms that it is an objective of the Council "that all development in the County shall be considered in the context of the policies set out for the four Principal Policy Areas defined in the Landscape Character Appraisal of County Mayo,

provided such policies do not conflict with the County Development Plan".

Policy EH-VP1 states that it is the policy of the Council "to ensure that development does not adversely interfere with views and prospects and the amenities of places and features of natural beauty or interest when viewed from the public realm. Views and prospects worthy of preservation and protection are indicated on Map 12".

Map 12 entitled 'Scenic Views' indicates there are no Views and Prospects pertaining to the site itself or its immediate surrounds. The plan does indicate that scenic views are available to either side of the Barnatra - Dooncarton - Pollatomish – Aghoos Local Road. The plan indicates that the 'Highly Scenic Views' are out to sea and that the 'Scenic Views' are severely restricted by topography. This road is some distance northwest and north of the site and primary views are away from the site towards the coast. The site is almost always screened or otherwise insignificant and largely imperceptible within its context. Any impact is considered to be negligible given that the proposal will be effectively screened and visually insignificant in any wide and expansive landscape view from this area. See Photomontage Viewpoint Nrs. 12 & 13.

Plan 12 indicates that both 'Highly Scenic Views' and 'Scenic Views' are available along the western shoreline of Carrowmore Lake to the south west of the site. The Plan also indicates that the Belmullet to Ballycastle Road (R314) is listed as one of the Scenic Routes in the County.

From west of Carrowmore Lake, views of the site are very limited and where possible are from distance (5km +) where there are significantly wider and expansive views to the surrounding landscape. The site is relatively indistinguishable in its wider coniferous setting. As such, any impact is considered to be slight given that the proposal will be insignificant in this wide and expansive landscape view. See Photomontage Viewpoint Nr. 14.

It is considered that the proposed development will be most readily viewed when travelling east along the R314 Belmullet to Ballycastle Regional Road. The impact is limited to approximately a 2.5km stretch of the R314 Road approaching Bellanaboy Bridge. As the site comes in to view travelling east along the R314 at some 2.5km distance, the view from the road is both expansive and panoramic south over Carrowmore Lake, southeast towards the Slieve Fyagh Uplands, which lies straight ahead, and to a lesser degree, north to the Muingerroon Upland. The site is largely unremarkable and not a point of visual attention other than as part of a large area of conifer plantation.

Most of the low level plant is completely screened by the existing trees along the Pollatomish Road, however it will be possible to view the upper sections of the tallest features of the terminal, which will be seen protruding above the trees and above the skyline. Some of the pipe racks, the power generation building, and the maintenance flare will also be visible above or contiguous with the existing tree line to the west of the site. The impact is considered to be moderate/substantial in nature along this short section of road, see Photomontage Viewpoint 10.

As the road approaches Bellanaboy Bridge and the site, lower elevation and existing plantations effectively screen out the proposed development. See Photomontage Viewpoint 9. With the exception of the immediate entrance area there is no view of the terminal or its associated features from the R314 immediately adjoining the site boundary. See Photomontage Viewpoint 5.

From the vast majority of the R314 in the vicinity of the site, the terminal will be either entirely or effectively screened by existing coniferous plantation with negligible impact. While aspects of the terminal will be visible from a short section of the road, it is considered significant that even here the proposal is substantially screened and the site is not primary or significant in views from the road. The overall impact of the proposed development on the experience of travelling the R314 in the vicinity of the site is considered to be of a slight negative nature and principally of short to medium term during as proposed coniferous planting on lands to the west of the terminal footprint will establish as effective screening.

The issue of 'Scenic Routes' and Areas Designated as 'Highly Scenic Vistas' are also included in the Landscape Appraisal.

Landscape Appraisal of County Mayo 2003-2009

In Section 2.4, of the Landscape Appraisal the proposed terminal site is located within landscape character unit, Area C – North West Coastal Bog. Figure 13.2 is an extract from the Appraisal and illustrates the location of the site within Area C.

The key characteristics of this large landscape unit are described as:-

"…low lying bog strip, located between the western coastline and the Beg Range to the east. It has a homogeneous, exposed, moorland appearance throughout. The topography is smoothly contoured with bog/moor type grasses being the predominant vegetation."

Figure 13.2 Landscape Character Units

The land use is described as essentially peat bog, with areas of agriculture (i.e. complex cultivation patterns) and coniferous forestry also being present. Areas of natural grassland and transitional woodland scrub occur throughout the major land uses.

Section 2.4 characterises the Critical Landscape Factors of Area C as essentially smooth terrain covered by low vegetation comprising moorland and bog grasses. The Appraisal determines that in landscape terms the low vegetation has similar characteristics to the smooth terrain and that the two factors are interrelated due to soil attributes.

The Appraisal assesses that the smooth terrain covered by grassland vegetation, is generally uniform in appearance, allowing vistas over long distances, and that the uniform appearance of the grassland vegetation cover fails to break up the long distance visibility.

The Appraisal concludes that in such terrain, distances can appear shorter and development closer or larger. As a result development can have a disproportionate visual impact in such terrain, due to an inherent inability to be absorbed, physically or visually.

However, as illustrated on Figure 13.1 and described in Section 13.7 above, in contrast to the landscape characteristics which are more typical of the vast majority of the landscape within Area C, both the immediate and wider surroundings of the proposed terminal site are somewhat atypical of the character unit in that the proposed site benefits from the presence of extensive areas given over to dense coniferous plantations of varying age and structure.

The existing plantations provide an immediate, significant and effective screen enclosing the majority of the boundaries of the terminal. The inherent screening provided by the plantations ensures that they have the ability to physically and visually absorb the development.

The plantations have the effect of breaking up long distance visibility and significantly limit views across the landscape, particularly at close range. Furthermore, the effective coniferous matrix derived from the stages of forestry, including, planting, various growth patterns, mature forest and felling

presents a visual discontinuity within the landscape, which is in stark contract to the otherwise smooth terrain of open moorland or grassland typical of the landscape unit. Given the nature and variety of coniferous dominated plantations which pertain, it is considered that the site has a high visual absorption capacity. i.e. a high ability to visually absorb development without adverse impact on the surrounding landscape typical of the landscape character unit.

In addition to descriptions of landscape character, Section 3 of the Appraisal designates areas as 'Vulnerable, Sensitive, Normal and Robust'. The policy with regard to areas designated as Vulnerable, states that "development in the environs of these areas must not be shown to impinge in any significant way upon its character, integrity or uniformity when viewed from the surroundings. Particular attention should be given to the preservation of the character and distinctiveness as viewed from scenic routes".

With specific regard to the proposed site, the following designations are of relevance.

In Section 3.1(a), 'Areas Designated as Vulnerable', a sub-division under this designation includes 'The Shorelines of Lakes, Rivers and Estuaries'. Carrowmore Lough, Bellananaminnan River and the Glenamoy River are all listed under this designation. The proposed site does not directly abut upon the banks or shorelines of any of these lakes or rivers. Distant views from the western shoreline of Carrowmore Lake have been considered previously.

Within the sub-division 'Skylines and Ridges', the principal skylines and ridges relevant to the proposed site include Slieve Fyagh, Knocknalower, Carrafull, Knocknascollop, Carrowteige and Pollatomish. At varying distance these ridges almost encircle the site. In views from elevated locations to the west, north west, south west and south east, the site is visible to varying extents set low and contained within its surrounds of extensive conifer plantations. Views from such elevated vantage points are long ranging with dramatic and focusing landscapes in the background. As such, any impact from such areas is slight at most.

In Section 3.2(a) 'Main Areas Designated as Sensitive', a sub-division under this designation includes 'Natural Grassland' and two small areas west of Glenamoy (north of the R314) are listed. The western most area is contained within the site. The policy with regard to sites that are listed as sensitive states that "these are areas with a distinctive, homogeneous character, dominated by natural processes. Development in these areas has the potential to create impacts on the appearance and character of an extensive part of the landscape".

As described earlier, the proposed site was formerly the location of a Peatland Experimental Station. The objectives of the Station were to find suitable methods of reclaiming and fertilizing blanket bog for agriculture and forestry. The land management included drainage, improvements, liming and fertilizing the vegetation and introduction of shelterbelts planting, horticultural and industrial crops. Consequently, in scientific terms, the grasslands within the proposed site cannot be designated as 'natural'. Furthermore open areas of the site are all visually contained within a surround of dense coniferous plantation, limiting the visual sensitivities of such areas from external vantage points. The proposal entails the retention of large grassland areas though the central grassland area will be excavated for the terminal footprint giving a locally moderate negative impact.

'Coniferous Plantations' is included as a sub-division of Section 3.3(a) 'Areas Designated as Normal'. As described, the proposed site is located within a larger area of extensive coniferous plantations and the policy with regard to areas designated as normal states " large areas of Mayo are designated as normal landscape. These areas have a potential to absorb a wide range of new developments, subject to normal planning and development control procedures".

The site of the proposed development benefits from its location, being essentially contained within extensive coniferous trees, consequently, the site has a significant level of inherent screening potential increasing its visual absorption capacity. The proposed development is considered to have a slight negative impact within this designation.

In Section 3.6 of the Appraisal the document lists 'Areas Designated as Scenic Routes'. Figure 13.3 indicates both the designated scenic routes and locations of scenic vistas. All of these areas are similarly designated in the County Development Plan and have been discussed in detail previously.

Principal Policy Areas

In Section 4 of the Landscape Appraisal divides the county into four Principal Policy Areas, based on the grouping of the differing character units displaying similar visual landscape elements. The proposed site is included with Principal Policy Area 1 – Montaine Coastal Zone and its location within the Zone is illustrated on Figure 13.4.

Figure 13.3 Scenic Routes and Vistas

A set of indicative policies have been established for each Principal Area, based on the specific landscape attributes of the character unit (critical landscape factors), to determine the robustness and sensitivities of the landscape. The indicative policies provide a framework in the County Mayo Development Plan.

The Appraisal describes the Montaine Coastal Zone as: "…visually distinct in County Mayo landscape terms, as it incorporates in a relatively small area, two dramatic landscape attributes, being a steep and rugged shoreline and mountains rising immediately above. These elements make it a desirable setting for visitors and also particularly sensitive to inappropriate development".

Seven indicative policies have been established for the Zone, of which 3 are of particular relevance with regard to the assessment of landscape character and visual amenity of the proposed development:

"Policy 3 – Encourage development that will not have a disproportionate effect on the existing character of the coastal environment in terms of location, design and visual prominence".
The development will not have a disproportionate effect on the existing coastal environment due to the careful selection of a site with significant, effective and immediate screening. The positioning of the terminal in a reduced level location within the plantations, combined with proposed mitigation measures in the form of colour treatments and proposed planting will minimise the potential for visual prominence from both the local and wider landscape. The significance of impact of the proposed development is considered to be slight negative.

"Policy 4 – Consider development that does not significantly interfere or detract from scenic coastal vistas, as identified in the Development Plan, when viewed from the public realm".

Figure 13.4 Principal Policy Areas

The site has no visual connection to the coast, located as it is on south facing slopes over 5km from the coast. As such, the proposed development will not detract from designated scenic coastal vistas along either the Pollatomish to Banatra route or the local road north of Pollatomish looking to Broadhaven Bay. From these routes the terminal is either totally screened by intervening topography or the direction of the scenic coastal vista is in the opposite direction to the terminal site itself. Consequently there will have no negative impact on scenic coastal vistas.

"Policy 5 – Encourage development that will not interrupt or penetrate distinct linear sections of primary ridgelines and coastlines when viewed from areas of the public realm".

The development is set within coniferous plantations in an inland lowland landscape. As such, the proposal will have no negative impact on distinct linear sections of primary ridgelines and coastlines.

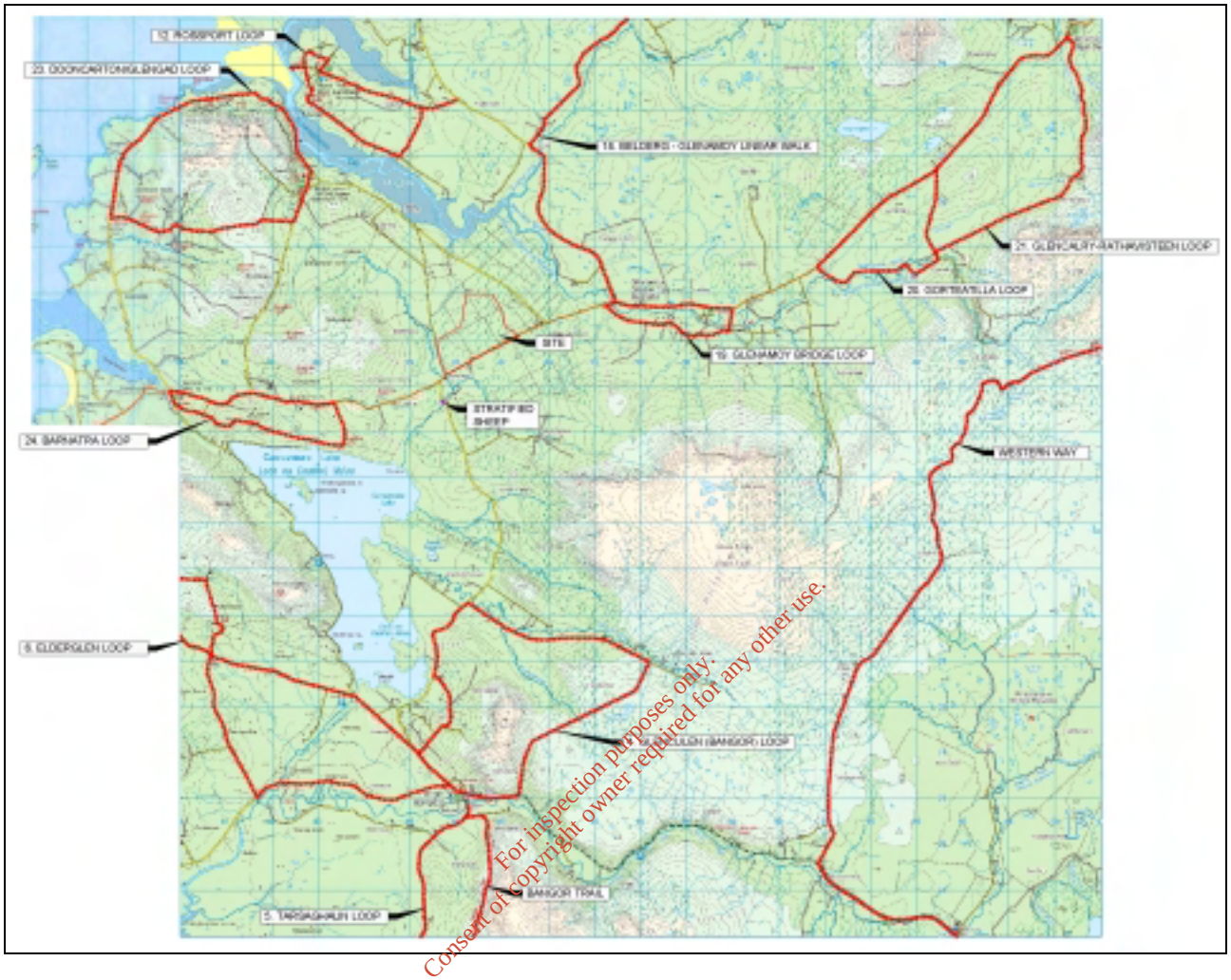
Landscape Sensitivity Matrix

Following the classification of the differing landscape character units into Principal Policy Areas with the differing Indicative Policies determined for each Area, the Council has been able to establish a Landscape Sensitivity Matrix set against a range of potential development types.

Chapter 5 of the Appraisal states under Section 5.1, that the purpose of the 'Development Impact Landscape Sensitivity Matrix' "is to provide a quick reference guide for both planners and developers to determine the likely success of a planning application for a particular land use in a particular area".

The section confirms that the Matrix should be used as a "guidance and decision supporting tool not a decision making tool". The Matrix states that within Policy Area 1, Industrial/Commercial development type would constitute a Medium-Low potential to create an adverse impacts on the existing landscape character.

Figure 13.5 Erris Walks



Medium potential is defined as; "Such developments are likely to be clearly discernible and distinctive, however, by careful siting and good design, the significance and extent of impacts can be minimised to an acceptable level". Low potential is defined as "Such development is likely to be widely conceived as normal and appropriate unless siting and design are poor".

The site for the proposed terminal has been carefully selected to take maximum advantage of extensive coniferous plantations, which will provide immediate, significant and effective screening. The inherent screening provided, combined with careful attention to the design, layout and colour treatments applied to component parts of the facility, will ensure that the vast majority of the development will not be readily discernible in the landscape.

Furthermore the site has the capacity to facilitate appropriate and significant mitigation of landscape and visual impact through retention of existing screening and the establishment of new screening to the west of the terminal footprint. This choice of site combined with the design and layout of the terminal and the mitigation measures proposed ensures that significance and extent of any landscape and visual impact is minimised.

As such, overall, the impact of the proposed development is considered to be slight negative in nature.

13.9 Siuloidi Iorrais (Erris Walks)

A series of 24 circular and linear walks including the Bangor Trail and the Western Way are promoted throughout the Barony of Erris. Among the nearest are the Belderg-Glenamoy linear walk; the Glencullen (Bangor) circular walk, and the Glengad (Pollatomish) circular walk. These routes, together with other local and longer distance routes, are illustrated on Figure 13.5.

None of the walks cross or border the proposed site and any available views that may be discernible from the walks will be expansive, from long distance, with the site enclosed by extensive plantations. Photomontage 16B is taken from a location close to Annie Brady Bridge on part of the Belderg-Glenamoy linear walk. In visual terms, the proposed development will have a negligible impact from designated walks within both the local and wider landscape.

A short section of the Glencullen walk uses part of the Bangor to Bellanaboy local road which will be subject to temporary impacts by increased traffic movements during the peat removal operations, see Section 16).

13.10 Impact on Visual Amenity

The potential visibility of the terminal site is dependent upon a range of factors, including location of viewpoint, angle of the sun, time of year and weather conditions. Of equal importance is whether the development is seen completely, or in part, above or below the skyline, where land provides a backdrop and where there is a complex foreground or an expansive landscape surrounding the view.

13.10.1 Visual Assessment Surveys

In conjunction with the landscape survey, a visual survey has been undertaken in order to assess the potential visual impact of the proposed development.

If the landscape is to absorb the development successfully, it must be integrated in a way that protects, and where possible enhances the visual appearance of the landscape.

Following the site appraisal, a number of key viewpoints from sensitive receptors which may be affected by the development have been identified. Table 13.2 lists the key viewpoints identified, provides a precise grid reference and indicates the distance of the viewpoint from the centre of the site. Figure 13.6 indicates the location of the viewpoints.

Computer generated photomontage images have been prepared from all the identified viewpoints and are included in Appendix A. A statement of photomontage methodology is provided in Appendix A.

It should be noted that the photomontage study was undertaken during October 2003. However, due to the dominance of the coniferous vegetation in the surrounding landscape, any seasonal variation in the assessment of visual impact would be negligible.

13.10.2 Site Visibility

In visual terms, even in close proximity, the site is insignificant. The site appears as a relatively 'standard commercial coniferous plantation' in its varying stages of planting, growth and harvesting. The site does not display any notable characteristics and is both unremarkable and indistinguishable from its wider surroundings, viewed as it is, as part of a much larger complex of coniferous plantation. As such the site is not a focus of attention in travelling through the landscape, either by road or otherwise.

The proposed site of the terminal is surrounded on all sides by coniferous plantations and/or lines of trees, with the plantations along the north western and south eastern boundaries being particularly effective screens.

13.10.3 Assessment of Visual Impact of the Proposed Development

The greatest potential for visual impact as a result of the proposed development is the introduction of an industrial type facility into an essentially rural landscape. The proposed terminal facilities include a small number of tall features in excess of 30 m high, some of which will be visible as they protrude above the surrounding coniferous plantations. The majority of the facilities will be screened by the surrounding trees.

A Visual Impact Schedule has been prepared which summarises the results of both the landscape and visual studies and assesses the overall degree of significance of visual impact for each viewpoint. The Schedule is presented with the photomontages in Appendix A, and a brief description of the degree of significance of the visual impacts is included below.

13.10.4 Visual Impact From Properties

The screening is such that there will be no or negligible visual impact on the nearest properties, which are located to the south and south west of the site (Photomontage Viewpoints 7, 7a, & 9).

Properties to the south west at greater distance will have a moderate/substantial negative impact, see (Photomontage Viewpoint 11). The site is not of prime focus in views from this property, which are generally of an expansive nature encompassing the surrounding uplands to the south and west and the existing coniferous planting along the south of the site means that all of the eastern part of the development will be screened. However, views of the tops of the flare stack, methanol still, some of the methanol tanks and pipe racks in the north west of the site and the tops of the water treatment building will be visible, some of which will break the skyline.

Figure 13.6 Viewpoint Locations

Table 13.2 Viewpoint Locations

Viewpoint No.	Title	Easting	Northing	Distance From Target (m)
1	View looking North East from residential property, Bellanaboy Bridge (Mr S Murphy).	85076	332147	1,700
2	View looking SE adjacent to residential property.Lenamore (Mr B Sheeran)	85823	334407	1,510
2A	View looking SSE from Bellagelly to Pollatomish Local Road	85604	335057	2,000
3	View looking SE from residential property. Lenamore (Mr J Flannery)	85444	334455	1,750
4	View looking W from access road adjacent to residential property Glenamoy	89766	333424	2,980
5	View looking W from R314 road	87934	333354	1,510
5A	View looking W from R314 road just west of Glenamoy	88665	333589	2,300
6	View looking SW from residential driveway on Rossport Road, Glenamoy.	89353	334129	3,080
7	View looking NNE from residential property Bellanaboy Bridge (Mr P Healy)	86333	332490	570
7A	View looking NE from residential property Bellanaboy Bridge (Mr P Healy)	86211	332408	650
8	View looking NNE from Bangor – Bellanaboy Local Road.	85716	331690	1,540
9	View looking NE from R314 adjacent to residential property Bellanaboy Bridge (Mrs J Healy)	85657	332119	1,260
10	View looking NE from R314 road near Meenanmark Bridge	84945	331757	2,090
11	View looking NNE from residential property Bellanaboy Bridge (Mr M Healy)	86067	331958	1,230
12	View looking SE from Bellanaboy Bridge to Pollatomish Local Road.	85405	333754	1,300
13	View looking SE from road adjacent to residential properties, Aghoos	84118	335519	3,360
14	View looking NE from 'Scenic View' parking area, Carrowmore Lake	83046	328320	5,830
15	Not used			
16	View looking SSW from road above Glenamoy and Muingnabo Rivers.	87005	336318	3,430
16A	View looking SSW from road at confluence of Glenamoy and Muingnabo Rivers	87005	336318	3,900
16B	View looking SW from Local Road just south of Annie Brady Bridge	87886	336346	3,700
17	View looking NNW from highest dwelling, Muingingaun	87672	330528	2,960
18	View looking N from Bangor to Bellanaboy Bridge Local Road	85979	331001	1,940
19	View looking SE from track at Carnhill.	81306	335964	5,820

There will be a generally negligible neutral impact on properties to the north and east of the site where the tops of the higher stacks/flares will only appear contiguous with or slightly above the existing tree-line, a tree-line which will continue to grow and provide increasing screening (Photomontage Viewpoint 2, 2a, 16, 16 a & 16b from the north and 4, 5 & 6 from the east).

There will be a slight neutral impact on properties to the north west of the site where the tops of the higher stacks/flares/methanol still and some pipe racks and methanol tanks will appear contiguous with the existing tree lines. None of these elements will break the skyline and the tree lines will continue to grow and provide increasing screening (Photomontage Viewpoint 3 & 13).

Only one property lies directly west of the site located at a similar elevation to the terminal (Photomontage Viewpoint 1). Available views from this property will include the most open views of the development, which will be seen within a large conifer plantation where expansive panoramic views are both south of and beyond the site to distant hills and mountains. Following construction, taller features including the flare stack, methanol still and the sales gas compressor stacks will be seen protruding above the trees and above the skyline. The methanol storage tanks, heating medium heater stack, pipe rack to the north west of the site, and parts of the slug catcher will be visible above the coniferous trees. Much of the intervening lands between the site and property have been planted with conifers, which will in time, together with proposed on-site planting, provide almost entire screening.

The impact is assessed to be of a moderate/substantial negative nature in the immediate and short term but developing coniferous screening proposed for immediately west of the terminal footprint will provide effective medium and longer term screening.

In overall terms, the terminal will be screened from most properties from the outset, though significant short term visual impact is expected to arise at a small number of properties. All of these properties will be effectively screened in the medium and longer term and as such the overall visual impact from properties is considered to be slight adverse in nature.

13.10.5 Visual Impact from Roads and Surrounds

Even with existing planting, the screening is such that effectively there will be no view of the proposed development from roads and other areas to the immediate south, east, north east and north. As such, areas anti-clockwise from south through east to north will have no or only a negligible impact (Photomontage Viewpoints in anti-clockwise order: 7, 7a, 5, 4, 6, 16, 16a, 16b, 2, 2a & 12).

There will be a slight neutral impact on roads and surrounds to the north west and east of the site, where only the upper sections of the taller features will appear either contiguous with the tree lines or at greater distance above the treelike, (Photomontage Viewpoints 5A, 3 & 13).

The proposed development will be most readily viewed when travelling north along the Bangor to Bellanaboy Bridge Road. The impact is limited to approximately a 2.5km stretch of the Bangor Road approaching the junction with the R314. From this road, expansive views are directed north and north west towards the rounded upland area of the Bellanaboy / Muingerroon Hills. The site lies to the east of true north and is not directly in a forward line of vision. From this location, it will be possible to see the flare stack, the methanol still and the air coolers above the tree and skyline. The methanol tanks and the pipe racks to the north west of the site will also be visible, but these will be set into the surrounding forestry and will not break the skyline. The existing and proposed view from this part of the road, which is considered to have a moderate/substantial negative impact, is shown in Photomontage Viewpoint 18.

Nearer the site, as shown in Photomontage Viewpoint 8 the view is also a moderate/substantial negative impact. For road users, views of the site will be at right angles to the direction of travel and when travelling the Bangor Road, views are generally directed north and north west towards the rounded upland area of the Bellanaboy / Muingerroon Hills. The existing coniferous planting along the south of the site, the low level of this viewpoint relative to the site, and the fact that the site is cut into the existing topography, means that most of the eastern part of the development will be screened, with the exception of the tops of the flare stack, the methanol still and the air coolers. In addition, the tops of the water treatment building, the methanol tanks, and the pipe racks to the north west of the site will be visible, some of which will break the skyline.

As the site comes in to view travelling east along the R314 at some 2km distance, the view from the road is both expansive and panoramic south over Carrowmore Lake, south east towards the Slieve Fyagh Uplands, which lies straight ahead, and to a lesser degree, north to the Muingerroon Upland. The site is largely unremarkable and not a point of visual attention other than as part of a large area of conifer plantation. It will be possible to view the

terminal as a small element in the wider landscape and not directly located in the primary views. However, the flare stack, methanol still, sales gas compressor stacks, air coolers, heating medium heater stack and the water treatment building will be seen protruding above the trees and above the skyline. Some pipe racks, the power generation building, and the maintenance flare will also be visible above or contiguous with the existing tree line to the west of the site. Most of the low level plant is completely screened by the existing trees along the Pollatomish Road. The impact along this short section of road is considered to be moderate/substantial negative in nature, see Photomontage Viewpoint 10.

As the road approaches Bellanaboy Bridge and the site, lower elevation and existing plantations effectively screen out the proposed development. See Photomontage Viewpoint 9.

In views from the south east from higher elevations than the site, the terminal will be visible contained within extensive plantations. The tops of the flare stack, the methanol still, the air coolers, the sales gas compressor stacks, the water treatment building, the heating medium heater, the methanol tanks, the pipe racks along the north of the site, and the warehouse and maintenance building are visible above the tree line to the south of the site. Of these, only the flare stack, the methanol still, the air coolers and the sales gas compressor stacks break the northern tree line beyond. None of the features break the skyline. The impact is considered to be moderate negative in nature. See Photomontage Viewpoint 17.

In long distance views (5km +) from the western edge of Lake Carrowmore. Expansive, open views looking north east across the lake in the direction of the terminal. From here, the terminal will be insignificant in the wider landscape. The north western half of the terminal will be visible against a backdrop of forestry and mountains and the flare stack will be the only element that will break the skyline. The impact is considered to be slight negative. See Photomontage Viewpoint 14.

In views from elevated locations to the west and north west, the development is visible but set low within the conifer plantation. Views from such elevated vantage points are long ranging and towards the more dramatic and focusing landscapes in the background. As such, any impact from such areas is slight negative at most (see Photomontage Viewpoint 19).

In overall terms, the terminal will be effectively screened from local roads, though significant short term visual impact is expected to arise from short sections of the R314 and Bangor to Bellanaboy Bridge Roads. Even in these instances, it is considered that given the proposed planting west of the terminal, the development will eventually be substantially screened from local roads in the medium and longer term. As such the overall visual impact from roads is considered to be slight adverse in nature.

13.10.6 Night Time Visual Impact

At night, the local landscape in the vicinity of the terminal is almost completely dark, with only very limited sources of light visible, primarily from the scattered residential properties and from the elevated vantage of Erris Water Works overlooking Carrowmore Lake. The local roads are unlit, with car headlights providing passing light source.

During the operation of the terminal, the site will require to be lit at night, essentially for safety and site security purposes. The following types of lighting will be required:

- emergency/escape lighting;
- security and perimeter fence lighting;
- general building lighting;
- road lighting within the terminal only;
- illumination of walkways, platforms and pipe racks; and
- illumination of car park and security gate.

The main access road from the R314 to the terminal boundary will not be lit.

All lighting has been designed to keep the potential for light emissions to a minimum. The terminal is operated from the control room and at night operators will rarely need to visit the plant process areas. In consequence the walkways, platforms, and pipe racks will normally not be illuminated by outdoor lighting. Outdoor lighting within the terminal itself will be controlled by photoelectric cells so enabling lights to be activated only in the vicinity of where it is directly required. Road-lighting within the terminal will be a maximum of 5m high and will utilize high pressure sodium vapour lamps to include precise optical control to eliminate the potential for excessive upward or spill light.

The security fence lighting shall be arranged such that the fence and the area outside of the fence itself will be illuminated to approximately 10Lux (whilst leaving the patrol / perimeter road in comparative darkness). Fence lighting will utilise tungsten-halogen lamps within luminaries of a narrow beam type and will only operate in limited instances of emergency or when triggered by intrusion.

Aimed luminaries shall provide illumination at ground level, on each walkway or platform, and below pipe racks.

The taller features such as the flare stack and methanol still will have permanent light fittings attached to them, however, the number of lights that may be visible above the tree lines will be minimal.

In addition to the choice of light fittings that will minimize the potential for light pollution, the effective screening provided by the surrounding coniferous plantations would further assist in minimising any spread of light away from the site itself.

To illustrate a typical arrangement of light fittings and potential light levels emitted from a similar gas facility, Plates 13.1 and 13.2 of the existing gas terminal at Point of Ayr, North Wales are indicated below.

It should be noted that this terminal includes a constantly burning flare stack, which is not proposed at Bellanaboy, and that the Point of Ayr terminal does not benefit from being contained within extensive coniferous plantations which provide a high level screen to prevent views of the lower level equipment.

Plate 13.1 Point of Ayr Terminal - Day

Both the day and night time photographs are taken from the same location, from an elevated position with direct, clear views onto the terminal site. Plate 13.2 illustrates the night time view and indicates that the most obvious light source is emitted from the flare stack. The other light sources are not as bright as the flare source and do not emit or spread light either upwards or away from the terminal. (It should be noted that the lowest level of lighting on the photograph would, in the case of Bellanaboy, not be visible due to the screening provided by the coniferous trees).

For both the local road user and for local residents, the lighting arrangement proposed for the terminal will appear little different from the existing isolated property lighting within the local and wider landscape.

It can be assessed that the significance of night time visual impact will be slight neutral.

Plate 13.2 Point of Ayr Terminal - Night

13.11 Do Nothing Scenario

If the development did not proceed the landscape character would remain essentially unchanged, with the only changes being the plantation management programme involving the felling and re-planting of the different plantation blocks.

13.12 Mitigation of Landscape and Visual Impact

The mitigation strategies proposed for the development, particularly in respect to the mitigation of impacts relating to landscape and visual effects will take numerous forms.

The implementation of these strategies will have the effect of ensuring that the development will be successfully integrated into the local and wider landscape.

13.12.1 Terminal Design

Minimising the apparent height and massing of the terminal, as a result of architectural detailing and colour treatments, can lessen the potential visual impact of the terminal facilities. It is proposed that the following colour finishes will be applied to the terminal facilities:

- structural steel – dark grey;
- piping, equipment (including tall structures) – mid grey;

- methanol, condensate, diesel and other miscellaneous storage tanks – olive green;
- equipment building walls – olive green
- architectural building walls – light grey; and
- equipment and architectural roofs – dark grey.

In particular, for nearer receptors, the choice of colour finish will assist in softening the visual impact and help to blend the new structures into the existing backdrop of surrounding trees, and distant hills. In longer distance views the colour choice is not as critical, the actual layout of the terminal facilities on the site and final juxtaposition of the taller structures in association with the existing features is more important.

In addition to colour treatment, other mitigation measures such as locating the terminal within an area of mixed age coniferous plantation; retention of existing screening; setting a reduced level for the terminal platform, etc have already been incorporated into the design of the terminal.

13.13 Landscape & Ecological Mitigation Strategy

In conjunction with the mitigation measures proposed for the terminal facilities themselves, other specific strategies have been developed to mitigate the significance of impact on the landscape character, visual amenity and nature conservation interest of the site.

13.13.1 Retention and Protection of Existing Trees

The principal strategy is the long term retention and protection during construction, of the maximum possible area of existing coniferous plantations, not only around the immediate boundaries of the terminal, but on all land within the planning application boundary. Significantly all the existing plantations show good growth patterns and younger plantations exhibit strong annual growth.

13.13.2 Coillte Teo Felling Programme

During the detailed discussions held with Coillte Teo information was provided on the anticipated felling programme of the plantations around the terminal site. The felling programme has influenced the securing of land to be held under the long term control and future land management responsibility of Shell.

The securing of land within the planning application boundary will ensure that a continuous effective screen around the whole of the terminal site can be maintained throughout the lifespan of the development. The plan included as Figure 13.7 illustrates the existing plantations within the planning application boundary, and is included in Appendix B.

13.13.3 Proposed Planting

The site surveys and subsequent visual impact assessment has identified that the south western boundaries of the terminal are the most open to views from the surrounding landscape. Consequently, in order to supplement and reinforce the existing remnant coniferous tree belt to the west of the terminal site, an additional belt of predominately coniferous trees up to 100 metres wide is proposed in the open wet grassland to the west of the terminal boundary.

This new plantation will be implemented by the importation of new forestry tree stock supplied from Coillte Teo nurseries. It will comprise of predominately coniferous species consistent with those species currently growing on the site including Lodgepole Pine (Pinus contorta), Sitka Spruce (Picea sitchensis) and Scots Pine (Pinus sylvestris). Imported coniferous stock would range between 25-30cms, 40-60cms and 60-80cms in height.

In conjunction with the proposed plantation, and throughout the rest of the site, frequent groupings of low deciduous tree and shrub species will be planted on the margins of the plantations. On the drier ground Mountain Ash (Sorbus aucuparia) and Birch (Betula pubescens) will be used and in the wetter more waterlogged ground, Alder (Alnus glutinosa), and Willow species (Salix aurita, S cinerea subsp oleifolia and S. caprea) will predominate.

The height of imported deciduous stock would range between 40-60cms, 60-80cms and 100-125cms and will comprise native species.

It is proposed that the imported plant stock will be supplemented, where possible, by the translocation of some of the existing willow scrub directly impacted by the construction works, together with the taking of hard wood cuttings from existing deciduous trees such in as the Salix species.

13.13.4 Ecological Mitigation Proposals

The ecological mitigation proposals have been incorporated as an integral part of the landscaping strategy for the development. These will aim to enhance the diversity of the known flora and fauna of the area.

These proposals should be read in conjunction with information included in Section 6 Terrestrial Flora and Fauna.

The principal ecological mitigation will include:

- Supplementing the low deciduous scrub habitat (comprising essentially of Willow species) lost to construction works. The scrub will be planted along the margins of the existing plantations and will include other native tree species such as Alder, Birch and Mountain Ash. This proposal will assist in extending planting belts that act as foraging and breeding areas into the areas of wet grassland.

- It is envisaged that this mitigation measure will have the benefit of increasing the semi-natural woodland habitat and will assist in offsetting the dominance of the transient, intensively managed coniferous plantations by increasing the habitat diversity on the site.

- Provision of wetland compensation habitat, including small areas of open water and areas of redbud. Reed species such as Phragmites australis (Common Reed). Phalaris arundinacae (Canary Reed Grass) and Typha latifolia (Reedmace), in conjunction with marginal plants including Soft Rush (Juncus effusus) will be translocated from other parts of the site and planted into the wetland areas.

- The increased provision of wetland habitat will be principally located in association with the proposed settlement ponds in the southwest corner of the site. The open water habitat will be developed primarily as breeding sites for frogs and to increase the diversity of habitats on the site.

The strategy for both the landscape and ecological mitigation are illustrated on Figure 13.8 and Figure 13.9, and included in Appendix B.

Site Reinstatement Proposals

Following the decommissioning of the terminal, it is proposed to remove offsite all terminal facilities, however the perimeter drains and settlement ponds will remain. The concrete platform will be broken up and the material removed offsite. Any remaining foundation stone will be ripped to relieve compaction. The ground level will be roughly graded to fall towards the perimeter drains. It is proposed to import mineral soils across the area formerly occupied by the platform, to an average depth of 300mm. The imported soil will again be roughly graded so as to form small hollows and gentle undulations with levels generally falling towards perimeter site drains. It is envisaged that water will collect in the hollows to supplement the wetland habitats elsewhere on the site.

The ground will be sown with a 'basic' grass seed mix of locally sourced seed which will be supplemented by seed collected from site. Juncus and Calluna vegetation from elsewhere on the site will be translocated into the grass area. Tree and shrub species tolerant of waterlogged ground will be planted to form an open mosaic of deciduous trees and low deciduous scrub. Species will include Alder (Alnus qlutinosa), Willow spp. (Salix aurita, S. cinerea subsp. oleifolia and S. caprea). The reinstatement proposals will provide additional habitats to complement habitats created during the initial planting scheme.

The reinstatement proposals are indicated in Figure 13.10, included in Appendix B.

13.13.5 Mitigation Programme

Phase 1 Programme

Phase 1 mitigation works will be undertaken during the construction phase of the terminal. Works within this phase will comprise the planting of the new coniferous plantation to the west of the terminal site. Extensive planting of deciduous trees and low deciduous scrub along the margins of the new plantation together with the additional marginal planting in association with the existing plantation to the north of the terminal will be implemented.

In association with the construction of the settlement ponds during the early stages of the construction works, the wetland compensation habitat will be developed.

Tree and shrub planting will be undertaken along the boundary with the R314, in conjunction with the creation of small areas of open water and redbud compensation habitat in the southwestern section of the site.

Phase 2 Programme

Mitigation works within this phase will be implemented following completion of construction activities.

Further planting of deciduous trees and low deciduous scrub along the margins of the existing plantations to the east and south of the terminal will be implemented. New planting will be undertaken in association with the proposed main entrance features, including the proposed stone walling and ESB facility.

13.14 Predicted Impact of the Proposed Terminal

13.14.1 During Construction

Landscape and visual impacts will result both from the temporary construction and the permanent structures associated with the operational phases of the terminal development. Impacts may result from the following aspects:

Temporary

- site establishment requiring the removal of existing landscape features, including remnant lines of coniferous trees and shrubbery; and
- construction activities, including presence of large plant and cranes.

Permanent

- permanent features introduced as part of the terminal, including buildings and stacks;
- operational features, such as visible emissions, lighting; and
- height above ordnance datum (AOD) of tall features.

The potential impacts on the landscape resource are identified by addressing the following issues:

- aesthetic value of the landscape setting and its sensitivity to change;
- nature and value of any landscape resources likely to be lost due to development; and
- visual relationship between its site and its setting.

13.14.2 Impact of Proposed Development on Landscape Character

The development proposes the construction of a major facility in a generally remote but accessible landscape. The impact on landscape character as a result of the terminal development is primarily a result of a change in land use in a relatively small section of the overall site from peat bogland and commercial forestry, to that of an industrial facility, in an area which has few major industrial areas of any scale, and no significantly sized structures or built up areas.

However, while not entirely so, the proposed site is inherently and strongly screened by evergreen conifer plantations, particularly along the sensitive southern boundary with the R314, a tourist route with residential properties at proximity.

The site of the proposed terminal has been carefully chosen to take maximum advantage of extensive coniferous plantations, which will provide immediate, significant and effective screening. The inherent screening provided, combined with careful attention to the design, layout and colour treatments applied to component parts of the facility, will ensure that the vast majority of the development will not be readily discernible in the landscape. This choice of site ensures that overall, the impact of the proposed development is considered to be slight negative in nature.

This assessment of the significance of impact is further confirmed with reference to the Sensitivity Matrix included in the Landscape Appraisal document. As outlined in Section 13.8.2 of this assessment, the Matrix states that within Policy Area 1, Industrial/Commercial development type would constitute a Medium-Low potential to create an adverse impact on the existing landscape character.

13.15 During Operation

Although the landscape and visual impact can be considerably reduced from nearby receptors, through the implementation of the proposed mitigation measures, the visual impacts produced as a consequence of the protrusion of the taller elements into the skyline from certain viewpoints cannot be fully mitigated. This is of more relevance when viewed across the open landscape from middle and longer distance viewpoints. However, in these views, the development is a relatively small element within the landscape and is not of prime focus in the views, which are generally of an expansive nature.

The choice of site ensures that during the life time of the terminal, overall the impact of the proposed development is considered to be slight negative in nature.

13.16 Monitoring

Following the completion of the planting operations proposed as part of the mitigation of the development, it is best practice to undertake a period of post planting monitoring (‘aftercare’). This will last for a five-year period.

After the five-year period, once planting has become established, monitoring will be governed by a Shell Landscape Management Plan, which will monitor planting throughout the life of the project.

13.16.1 Aftercare Inspections

Typical monitoring operations during the five-year aftercare period will include:

- regular inspections at least once every four months;
- plant replacement - near to the end of the growing season (September), the identification and replacement of trees and shrubs which have died within the previous growing season to be undertaken; and
- ensuring the site is neat and tidy and maintaining all planting and grassed areas in a healthy condition.

13.16.2 Maintenance Operations

The aim of the monitoring period is to provide for the proper establishment and growth of all plant material by the operations listed below:

- replacement planting as necessary;
- weed control;
- irrigation;
- pruning of trees and shrubs;
- prevention of insect attack and disease;
- checking of tree stakes, ties;
- refirming plant material; and
- removal of waste materials.

13.17 Reinstatement and Residual Impacts

Shell is keen to adopt a sensitive and sustainable design approach, and integrate the scheme into the landscape whilst retaining and respecting both the landscape character and the visual environment.

The long term proposal will see the substantial removal of the terminal, including all above-ground features. Thereafter it is proposed to reinstate a peat/grassland environment sensitively planned on the basis of actual monitored site conditions to reflect and enhance local ecology and bio-diversity. In such, a manner it is considered that the proposed development will have no adverse residual impacts, see Figure 13.10 in Appendix B.

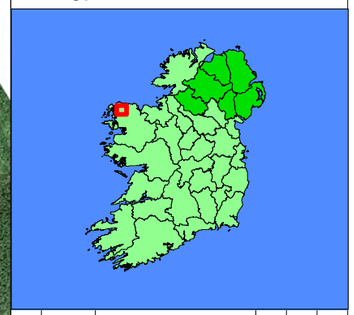
Existing Plantation Areas

Planning Application Boundary

Existing plantations within proposed SEPIL ownership

Area	Existing average height (m)	Year of planting	Species composition
A	13.0	1959	SS/LP
B	14.0	1959	SS/LP
C	13.5	1960	SS/LP
D	7.6	1985	LP
E	8.0	1985	SS
F	12.5	1958	SS/LP
G	3.5	1985	SS
H	7.3	1985	SS/LP
I	8.0	1985	SS
J	5.0	1985	SS/LP
K	8.2	1985	LP
L	6.2	1985	SS
M	4.0	1985	SS
N	8.3	1985	LP
O	14.8	1959	LP
P	14.6	1959	SS/LP
Q	1.7	1996	SS
R	3.5	1985	LP
S	4.0	1985	LP
T	4.0	1985	LP
U	2.2	1996	SS
V	4.0	1985	SS/LP

Average existing heights based on BKS survey of September 2003
SS Sitka Spruce
LP Lodgepole Pine



Rev	Date	Description	Drn	Chk	App
01	16/12/03	Revised Title Bar	IM	NH	JW
00	4/11/03	Initial Draft	IM	NH	JW

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BELLANABOY BRIDGE TERMINAL

Corrib natural gas

TITLE: **13.1**
AERIAL PHOTOGRAPH INDICATING EXISTING PLANTATIONS

SCALE: 1:10,000 REV 01

FILE NAME: P40036\CT-AERIAL PLAN.WOR

Fourteen

Climate

14 Climatic Impact

14.1 Introduction

This section describes the emissions associated with the gas terminal that have the potential to affect or contribute to:

- global warming (releases of 'greenhouse' gases); and
- ozone depletion.

Releases with the potential to impact on local air quality are described in Chapter 11. This includes discussion of microclimate considerations.

14.1.1 Global Warming

The main compounds that contribute to global warming are carbon dioxide (CO_2) and methane (CH_4). Other compounds have the potential to contribute to global warming but are generally released in much smaller quantities.

Global warming and the management of emissions with the potential to contribute to global warming are an increasingly important issue for Ireland. An international agreement was drawn up (the Kyoto Protocol) in response to rising emissions of the principal contributing compounds which has subsequently been ratified by the European Union.

Under the burden sharing agreement within the European Union to implement the Protocol, Ireland agreed to a limit of 13% above 1990 emission levels to be achieved between 2008 and 2012. By 2001, the level of global warming releases however had risen by 31% above the 1990 levels following a period of rapid economic growth. Numerous initiatives are in place to reduce emission levels under the Government's National Climate Change Strategy and EU initiatives including the draft Directive on Emission Trading.

Global warming has numerous potential implications for Ireland's environment including:

- greater risk of seasonal flooding with an increased rainfall in winter and decrease in summer;
- changes to habitats and ecosystems including the drying of peatlands; and
- effects on sea and river levels and influence on water resources.

14.1.2 Influence of the Gas Terminal on Releases with Global Warming Potential

The proposed development should be viewed in the context of:

- the benefits of providing a secure and indigenous supply of natural gas;
- the combustion of natural gas produces lower global warming emissions in comparison with alternative fossil fuels; and
- the requirement to minimise releases during the construction and operation of the terminal itself.

Most primary energy in Ireland is provided by fossil fuels, the majority of which derive from imported coal and oil. Domestically, peat is also used and natural gas use has increased with the provision of supplies from gas fields off the Cork coastline and via an interconnector from the UK.

Natural gas releases lower emissions of carbon dioxide than alternative fossil fuels per unit of useful energy contained within the fuel. As can be seen in Table 14.1, natural gas releases 23% less carbon dioxide than crude oil and 47% less than peat per unit of energy. Natural gas use is additionally more efficient at its point of use, thereby requiring less fuel to be consumed and hence producing lower emissions. This applies to the use of gas for most applications including space heating and electricity generation.

Table 14.1: Emissions of Carbon Dioxide (CO_2) from Different Fuels

Fuel	CO_2 Generated per Unit of Energy Content (tonne CO_2 / TJ)
Natural gas	56.1
Natural gas liquids	63
Crude oil	73.3
Peat	105.9

Source: IPCC, 1996.

The use of natural gas to displace other fossil fuels will assist in minimising and potentially reducing global warming emissions at a national level in combination with other initiatives.

Releases to atmosphere with global warming potential will arise as a result of both the construction and operation of the terminal. This includes:

- releases of carbon dioxide from the combustion of natural gas and other fuels to provide energy for the site; and
- potential fugitive emissions of natural gas during its operation.

The terminal process plant has been designed to minimise such releases and these measures are described in Section 14.6.

14.1.3 Other Releases with the Potential to Affect Climate

Other considerations with the potential to influence climate include the generation of ozone at lower levels of the atmosphere (tropospheric or low-level ozone formation) and the depletion of ozone at higher levels in the atmosphere (stratospheric ozone depletion).

The use of ozone depleting substances during the operation of the terminal is not anticipated. Refrigerants used may have global warming potential, however such systems are sealed and loss of material would not normally occur. Leaks are not considered to be significant in the context of site operations. Impacts on ozone depletion associated with the proposed development are not considered to be significant and further discussion within this section has been limited to releases with global warming potential and specifically to carbon dioxide (CO_2) and natural gas, the principal component of which is methane (CH_4).

14.1.4 Global Warming Potentials of Specific Releases

Many compounds released to air have the potential to contribute to global warming. The measure of Global Warming Potential (GWP) was developed in order to express emissions on a common basis. GWP is a measure of the global warming potential over a 100-year period relative to the GWP of carbon dioxide. In this scale, carbon dioxide is assigned a GWP value of 1. Natural gas (assuming all gas is methane) has a GWP factor of 21.

A release of 1 kg of natural gas therefore has the equivalent GWP of 21kg of carbon dioxide. There are hence significant benefits in minimising releases of natural gas and, where such releases do occur, converting the release into carbon dioxide through combustion. Such considerations have been incorporated into the design of the gas terminal.

14.2 Study Methodology

This section of the EIS aims to identify and assess the sources and describe the measures in place to minimise releases of compounds with global warming potential. The residual generation of these compounds has then been quantified. Many natural and human activities generate releases that can contribute to global warming. Due to the diverse nature of sources, the effect that releases from the gas terminal have on global warming cannot be specifically quantified within this EIS. Quantities however have been related in comparison to total emissions of global warming gases in Ireland (as $C0_2$ equivalent) and relative to the benefits of greater gas use by the end-user.

14.3 Characteristics of Proposed Development

14.3.1 Construction

The combustion of fuels in contractor, construction and haulage vehicles along with small-scale electricity generators will emit carbon dioxide. Additional emissions may be generated during the commissioning of the gas terminal including relatively minor releases of natural gas during the purging of equipment.

Releases of carbon dioxide will also be generated in the production and transportation of raw materials used in the construction of the terminal. In particular this includes the use of cement and steel. Whilst not included in the quantification of releases within this assessment, releases associated with raw materials will be minimised through careful purchasing controls and construction scheduling.

Peat will be removed from the site prior to construction. Peat during its formation captures carbon in the form of biomass accumulation. As the peat bed grows methane can be emitted where low levels of oxygen are present within the peat deposit (anaerobic conditions). Microbes within the peat may also emit smaller concentrations of nitrous oxide (N_2O). Methane is a more potent global warming gas than carbon dioxide and nitrous oxide is more potent still.

Whether peatland is a net sink or net emitter of global warming concentrations depends primarily on the balance between carbon dioxide fixation and the release of methane. This balance can vary depending on many factors including the level of the water table. Bord Na Mona considers the peatland at the terminal site to be approximately carbon neutral given the prevailing conditions at the site.

The peat removed from the site will be repositioned at a local peat extraction site owned by Bord Na Mona to conserve peatland and prevent the release of locked carbon into the atmosphere. Whilst the removal of the peat will lead to a release of trapped methane emissions as the peat is moved, this

methane would have been released to air over time regardless if the peat remained *in situ*. Any release with global warming potential during peat removal will hence be insignificant.

14.3.2 Operation

During operation, terminal emissions will comprise:

- releases of carbon dioxide from combustion processes to provide energy to the terminal; and
- fugitive emissions of natural gas.

The principal combustion processes include the gas compressors to pressurise sales gas into the national distribution network and power generators to provide electricity to the site. A heater unit will also be present to refine and recycle methanol used as an anti-freeze within the onshore and offshore facilities.

Fugitive emissions may occur from non-permanent connections such as valves and flanges. Potential fugitive release sources and appropriate mitigation measures have been described further in Section 14.6

Significant hydrocarbon emissions are not anticipated as a result of routine operation. In the event of emergencies or abnormal operating conditions natural gas and hydrocarbon releases will be efficiently burnt at height. The design incorporates numerous safety features to prevent the loss of natural gas. They include relief valves, flare systems and emergency shutdown (ESD) valves to prevent the generation of potentially flammable leaks and hence loss to air in the unlikely event of an overpressure in the system or equipment failure.

14.4 Potential Impact of the Proposed Development

The terminal development will result in emissions associated with climate change. This includes releases of carbon dioxide and natural gas and to a much lesser extent, other hydrocarbon compounds.

14.5 Do Nothing Scenario

In the absence of the development, there will be no anticipated change in releases to air at the terminal Location. However, the potential benefits of the Corrib development for control of greenhouse gases in Ireland generally will also not be realised.

14.6 Mitigation Measures

14.6.1 Initial Design Considerations

The gas terminal has been designed to minimise combustion products and fugitive releases. These measures will minimise releases to air with global warming potential.

Combustion processes have been designed to be energy efficient and minimise the quantity of fuel used, thereby minimising releases of carbon dioxide. Hydrocarbon condensate that would otherwise require offsite disposal is also used as a fuel for the heating medium fired heater.

A leak of natural gas from the process presents a flammable risk. Inherent site safety features will minimise the potential for uncontained releases of natural gas to air. Such features include continuous welded pipelines to ensure a sealed system from the arrival of offshore gas to the distribution of sales gas. The terminal will be constructed to international design standards.

Pressure relief valves designed to prevent over-pressure in the system will be additional sources of fugitive releases. Low leakage relief valves have been considered in the design of the terminal. Should a significant leak or venting of natural gas occur from the valves, the gas will be collected and flared, thereby converting natural gas into carbon dioxide, which has a much lower GWP.

Onsite heating requirements will be met by the combustion of off-spec gas or hydrocarbon condensate.

14.6.2 During Operation

Combustion efficiency checks will be carried out on combustion plant to ensure all plant operates at optimum efficiency.

Fugitive emissions of natural gas will be minimised through regular maintenance and the implementation of the Environmental Management Plan that will be prepared as part of the site's Integrated Pollution Control (IPC) licence issued by the Environmental Protection Agency (EPA). A maintenance flare will also combust gas where depressurisation of the plant is required for maintenance activities. In the highly unlikely event of a significant leak of natural gas into the air in the vicinity of plant, gas detection systems will identify any leak, which will then be remedied by onsite technicians.

Table 14.2: Greenhouse Gas Emissions from the Terminal

Source	Emissions (tonne/yr)		GWP (tonne of CO_2 equivalent per yr)
	CO_2	CH_4	
Energy Use/Power Generation			
Heating Medium Heater	10,560	0.03	10,560
Sales Gas Compressor Turbines	26,795	3.9	26,878
Electricity Generator Engines	6,341	6.2	6,471
Fugitive Releases			
General Process Gas Leaks plus Tank and Product Loading	1	105	2,206
Total	43,697	115	46,115

Note: Emissions are calculated using predicted fuel usage, as detailed in the draft IPC licence application, and UKOOA emission factors (UKOOA, 1999). Emissions from the firewater pumps, emergency generator engine and the flare systems have not been accounted for, as these are intermittent, minor sources only. The GWP emissions from these sources during normal operation will be approximately 100 tonnes CO_2 equivalent.

The application of Best Available Techniques (BAT) to both the design and operation of the gas terminal will be further identified in the IPC licence application. In this regard BAT relates not only to the design of the gas terminal but also the way it is managed during the full life cycle of the site.

14.7 Predicted Impact of the Proposed Development

14.7.1 During Construction

The only predicted impacts will be associated with:

- movements of construction vehicles and on site generators; and
- energy used to produce and transport raw materials.

14.7.2 During Operation

The projected quantity of emissions with global warming potential from each potential source is identified in Table 14.2. Total GWP emissions from the site are projected to be of the order of 0.05 million tonnes per year (as CO_2-equivalent).

In the year 2000, total emissions of CO_2 equivalent released in Ireland were an estimated 66.3 million tonnes. The quantity generated from the gas terminal represents less than 0.08% of this figure.

If the natural gas distributed into the national network by the gas terminal displaced an equivalent amount of crude oil in energy terms, this would lead to a potential reduction of 2.4 million tonnes of CO_2 equivalent ignoring minor leaks of gas from the transmission system. This figure is nearly fifty times greater than the projected releases from the terminal and does not take into account the higher efficiency of use associated with gas at the end-user. In reality the displacement (or emission reduction) will be less than 2.4 million tonnes of CO_2-equivalent as the gas supplied will supplement applications where natural gas is already used or is required to meet rising energy demand to a certain extent. The calculation however demonstrates that when considered on a national level, the benefits of a secure, indigenous source of natural gas outweigh the effect of emissions with global warming potential generated from the site itself.

14.8 Monitoring and Reporting

No direct monitoring of carbon dioxide is proposed as emissions can be accurately predicted from the consumption of fuel or combusted material. Monitoring of natural gas may be required as part of any IPC licence condition to minimise fugitive emissions but this is unlikely to be necessary on a continuous basis. Fire and gas detection systems will also be present.

Annual emission calculations of releases with global warming potential will be prepared as part of the site's Annual Environmental Report the preparation of which is likely to be a requirement of the IPC licence. The calculations will also be required to identify baseline and operating emissions in subsequent years as part of any trading agreement.

The EPA has identified standard methods of calculation to ensure '*completeness, consistency, transparency and accuracy'*. Such calculations are likely to be independently audited. The EU Emissions Trading Scheme will establish allowance trading to promote reductions of greenhouse gases.

14.9 Reinstatement and Residual Impacts

The worst-case combination of fugitive and combustion emissions of carbon dioxide and natural gas result in an estimated maximum annual GWP of approximately 0.05 million tonnes of CO_2 equivalent. It is not possible to quantify the actual impact of specific greenhouse gas sources or sinks on the climate or environment as a whole.

Fifteen

Cultural Heritage
(Archaeological and Architectural Heritage)

15 Cultural Heritage (Archaeological and Architectural Heritage)

15.1 Introduction

This section assesses the archaeological, architectural and historical importance of the land under consideration for the proposed terminal.

The main purpose of this section is to assess the impact of the planned development on cultural heritage and to propose measures to safeguard any monuments, buildings, features or finds of antiquity therein.

The cultural heritage in Ireland is safeguarded through national and international policy designed to secure the protection of the cultural heritage resource to the fullest possible extent (Department of the Arts, Heritage, Gaeltacht & the Islands 1999, 35). This is undertaken in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention), ratified by Ireland in 1997. The National Monuments Act 1930 to 1994 and relevant provisions of the National Cultural Institutions Act 1997 are the primary means of ensuring the protection of recorded archaeological remains. A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments.

The County Mayo Development Plan (2003-9) also contains specific policies with regard to the protection of cultural heritage resources.

The term 'monument' (under the 1930 to 1994 Act) includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. It should also be noted that the scope of the Acts is not restricted to monuments of archaeological interest. Monuments of architectural and historical interest also come within the scope of the Acts.

This section has been prepared by RSK ENSR Environment Limited using reports prepared by Margaret Gowen and Co. Ltd.

15.2 Study Methodology

15.2.1 Desk-based Assessment

Initially a detailed desk-based assessment was undertaken using the following sources:

Sites and Monuments Record (SMR)

The primary source of information for the desk study is the Sites and Monuments Record (SMR) maintained by the archaeological survey of the Department of the Environment, Heritage and Local Government. The SMR documents all known upstanding archaeological monuments, their original location (in cases of destroyed monuments) and the position of possible sites identified as cropmarks on vertical aerial photographs. It is based on a comprehensive range of published and publicly available documentary and cartographic sources. The SMR has no statutory basis.

Record of Monuments and Places (RMP)

The RMP was established under Section 12 of the National Monuments Act, 1994. It holds the name, location and brief descriptions of historical monuments or archaeological complexes throughout the country, at the discretion of the Minister for Environment, Heritage and Local Government.

In practice the RMP is based on the non-statutory SMR, appended with updated information from the Archaeological Survey of Ireland. It is not required that prior notification be given to the owner or occupier of the land before a feature is included in the RMP. Nor does official notification have to be given to the owners of the land for the inclusion of monuments or places in a county inventory.

Topographical Files of the National Museum of Ireland (NMI)

The topographical files of the National Museum of Ireland (NMI) identify recorded stray finds held in the museum's archive. The finds, which have been donated to the state in accordance with National Monuments legislation, are provenanced to townland. They sometimes include reports on excavations undertaken by NMI archaeologists in the twentieth century.

Documentary and Cartographic Sources

Various documentary, literary and cartographic references were consulted (see References).

Geofilm

An aerial film (Geofilm™) of the terminal site, prepared by RSK Orbital Ltd on behalf of RSK ENSR Environment Ltd, was examined to identify areas of archaeological potential, topography and current land use.

15.2.2 Field Inspection

A field inspection at the reception terminal site was undertaken to assess current and previous land use, local topography and any additional information relevant to the report. It also sought to identify any low-visibility archaeological features with little surface expression.

Field inspection and monitoring of a series of engineering test pits was also undertaken.

15.2.3 Consultations

Consultation on the appropriate methodology to be used took place with National Monuments Section of the Department of the Environment, Heritage and Local Government at the early stages of the archaeological assessment. Reviews of as yet unpublished works and discussion sessions were held with a number of individual archaeologists familiar with the study area.

15.2.4 Architectural Heritage

The County Mayo Development Plan (2003) was examined for presence of protected structures on or near the terminal plant site.

15.2.5 Assessment of Impact

The land for the proposed terminal was initially reviewed at a 1:50,000 scale on Discovery series mapping and again at 1:10,000 scale.

All archaeological information was transferred onto a set of 1:10,000 OS (I) maps provided by Shell.

The impact of the proposed terminal site has been assessed through comparison of the footprint of the proposed scheme with the information gathered on known and potential cultural heritage resources.

15.3 Receiving Environment

15.3.1 Physical Environment

The terminal site covers an area that is situated on flat to gently undulating blanket bog and forest. The western part of the site slopes in a gentle gradient towards a small stream valley several hundred meters to the west of the proposed site. The peat, judging from the exposed sediments in open drainage channels, varies from about 1 m to 4 m depth over the underlying bedrock and gravels.

15.3.2 Cultural Landscape

The vegetation on the site consists of broad alternating strips marsh grass and coniferous forestry (in various stages of maturity) running east-west. This former open blanket bogland environment served as a Coillte experimental forestry plantation and, as a result, repeated planting and harvesting of trees over the decades has extensively disturbed the surface of the bog. A regular grid of silted drainage channels occurs in this area. Some surface traces of deep plough furrows, at approximately 5m intervals, can be observed in places.

The area has been sub-divided into large rectangular land blocks by post-and-wire fencing. A number of metalled tracks also traverse the area allowing machinery access to the forestry.

15.3.3 Known Cultural Heritage Resources

The terminal site is located in the Barony of Erris, translated from the Irish *Iar Ros,* meaning the western promontory. Part of the townlands of Bellanaboy, *Bel atha na buidhe* meaning the yellow mouth of the ford and obviously referring to the colour of the bog and Bellagelly, *Bel atha na gile* or *gaill* meaning the mouth of the ford of the bright place or foreigners, form the proposal area.

The Dooncarton mountain range forms the north and western backdrop of the terminal site, (Figure 15.1). A number of archaeological monuments, ranging from megalithic tombs to promontory forts, stone circles and enclosures, are located on this peninsula; all indicate an archaeological presence from Neolithic times onwards.

Adjacent to the site at Bellanaboy Bridge, pine stumps have been found in the shallow peat; the basal sample of one pine stump gave a radiocarbon date of 7,110 +75BP (Hakansson, 1974), 20cm above this a date of 4340 +65BP was recorded which fits with the late pine phase. The gap of 2800 years between the dates of the two layers suggests that the rate of growth was exceptionally slow. These dates are important in determining the initiation of blanket bog in the north Mayo region. Neolithic stonewall field systems predate the bog, and it follows that their construction must have taken place prior to the initiation of the bog, which in turn must have preceded the growth of the pines rooted in the bog (Caulfield et al. 1998). In the area proposed for the terminal site location, the dating results imply that the bog and pine stumps predate Neolithic archaeological activity.

There are no recorded archaeological monuments located within the boundary for the proposed terminal site.

There are no archaeological stray finds or artefacts identified in the townland of Bellagelly South within the confines of the proposed terminal site.

The field inspection revealed no new sites.

No archaeological material, finds or features were revealed during the archaeological monitoring of investigation test pits.

There are no sites of architectural heritage interest within the boundary of the proposed terminal site recorded in the County Mayo Development Plan.

15.3.4 Archaeological Potential

The terminal site is located in an area of Coillte forestry plantation. The ground surface of the site has been heavily disturbed through its previous use as an experimental grassland station and forestry plantation.

There is a scarcity of recorded archaeological monuments in the immediate area. No known archaeological sites are recorded in the Bellagelly South townland or the surrounding bog land. The methods employed for intensive forestry plantation such as deep ploughing and ridge and furrow techniques have disturbed the ground, and it is unlikely that archaeological sites survive intact in the bog. If they do, they may certainly have been truncated by forestry practices.

The high proportion of blanket bog in County Mayo masks evidence of pre-bog settlement, such as the field systems with no visible ground expression that have been identified beneath the bog by the probing method at Ceide, Rathlackan and Belderg Beg. Other evidence such as hut sites and megalithic tombs suggest that a co-operative effort in large-scale forest clearance was very probable in the Neolithic, and the division of the landscape would appear to indicate the work of a settled organised community. The construction of tombs and development of field complexes may have also spanned several centuries.

A survey was conducted during the 1950's (Frank Mitchell 1990) to determine the characteristics of the Glenamoy area prior to the growth of the bog.

The objective of Professor Frank Mitchell was to ascertain a picture of the pre-bog landscape in the Glenamoy area. An environmental sample of blanket bog was excavated to a depth of 6m beneath which there was half a metre of fen peat. The fen peat showed open vegetation similar to that which covered the majority of Ireland about 10,000 years ago. At 3m, evidence was found of agriculture accompanied by very high values for pine pollen. Tree pollen was still present in relatively high values up to 2m, but above that the countryside seems to have been largely devoid of trees (Mitchell 1990).

At Bellanaboy Bridge, immediately south-west of the terminal site, an exposed section of blanket bog along a river bank was examined. Two superimposed layers of pine stumps, one at the base of the peat, the other 0.2 m higher, were radiocarbon dated to 7,100±75BP years and 4,350±65BP years, respectively. These dates suggest that the rate of growth of the bog was extremely slow and that the bog had already formed by the Neolithic period. Around 4,000 years ago, a great expansion of pine on bog surfaces took place in western and central Ireland. Pine also flourished on raised bogs in the midlands between 4,000 and 3,500 years ago.

On the western seaboard, pine stumps are widely present deep in the peat, and, as sea level was lower in prehistory, peat can be found below the current high-water mark.

South of Carrowmore Lake, at Muinhin Bridge, a horizon of charred pine stumps was recorded. The findings were similar to Glenamoy and the upper level at Bellanaboy Bridge dating approximately to 4,000 years ago. With archaeological activity indicated in the wider area due to the presence of megalithic tombs and finds such as a spearhead, looped spearhead, knife and two stone moulds, these charred stumps may be the result of deliberate clearance fires or natural causes. There are no recorded finds from the townland of Bellagelly South at the site of the proposed terminal in the National Museum of Ireland topographical files.

Though no surface features of archaeological significance were noted during the course of field inspection there may be some potential for the survival of sub-surface wetland. It is highly unlikely that pre-bog archaeological remains exist in the undisturbed basal layers of the bog in this area as the bog developed prior to the Neolithic period.

15.4 Characteristics of the Proposed Development

The proposed Planning Application area covers 160 ha of land. Within this, the terminal (and its associated buildings and car parking) will occupy 13 ha.

15.4.1 During Construction

It is understood that the construction will commence with the installation of an access road, site fencing and the construction of a site perimeter drainage system. It is planned to excavate 450,000 m^3 of peat

and 200,000m^3 of mineral soils within the terminal footprint. Details are given in Section 3.

15.4.2 During Operation

During operation the proposed terminal noise, waste water, air, landscape and light emissions would marginally increase. Measures have been taken to minimise these effects. Details are given in, Sections 9,10,11,12, and 13 respectively. Clean runoff from the terminal site will also be directed into local watercourses.

15.5 Potential Impacts of the Proposed Development

15.5.1 During Construction

Comprehensive developments that involve considerable excavation and topographical remodelling, and excavation for deep foundations in peatlands can disturb or even remove items of historical, cultural and archaeological interest.

To date, no archaeological deposits, finds or features have previously been revealed as a result of an archaeological field inspection of the site or engineering investigations.

Prehistoric and historic features of an organic nature such as trackways, as well as megalithic tombs, cist burials and pre-bog field systems have been found in bog conditions. Examples of this occurring in North County Mayo are:

- the extensive pre-bog field systems located at the Ceide Fields;
- a cist burial in the Bord na Mona peatlands in Bellacorick; and
- megalithic activity and sites of a prehistoric nature in the townlands north and west of the terminal site, such as Dooncarton and Rosdoagh.

The likelihood of revealing items of an archaeological nature is significantly reduced due to the ground disturbance that has occurred as a result of the Coillte forestry activity on site and the early initiation date for the development of blanket bog in the region. However, there remains the possibility that archaeological material could be revealed during the ground-preparation works.

15.5.2 During Operation

There will be no impact on archaeology during the operational phase of the project.

15.6 Do Nothing Scenario

If the development did not proceed, there would be no affect on the potential subsurface archaeology of the area.

15.7 Mitigation Measures

There are no known archaeological sites, features or finds within the proposed terminal area.

The method and amount of peat extraction will be established and agreed in advance with The National Monuments Section in order for the appropriate archaeological mitigation to be put in place.

It is proposed to have an archaeologist on site at the site preparation stage of the proposed development to monitor the removal of peat.

15.8 Predicted Impact of the Proposed Development

15.8.1 During Construction

There will be no impact on archaeology during the construction stage, as the site will be archaeologically monitored during the removal of peat at site preparation stage of development. If archaeological features are present they will be identified and all issues resolved prior to construction.

Results from the site investigation test pits and field inspection revealed no presence of archaeological features, finds, material, soil and/or deposits. Nothing of archaeological significance was revealed. It can therefore be assumed that the overall impact on archaeology will be negligible.

15.8.2 During Operation

There are no operational effects anticipated in relation to archaeology.

15.8.3 Worst Case Scenario

Under the worst-case scenario, the terminal site would disturb previously unknown below surface archaeological features, or a large scale complex. Archaeological monitoring of the site preparation works will ensure the recognition and recording of any such remains.

15.9 Monitoring

Monitoring will ensure the recognition and proper recording of any archaeological feature revealed by the peat extraction. The degree of archaeological

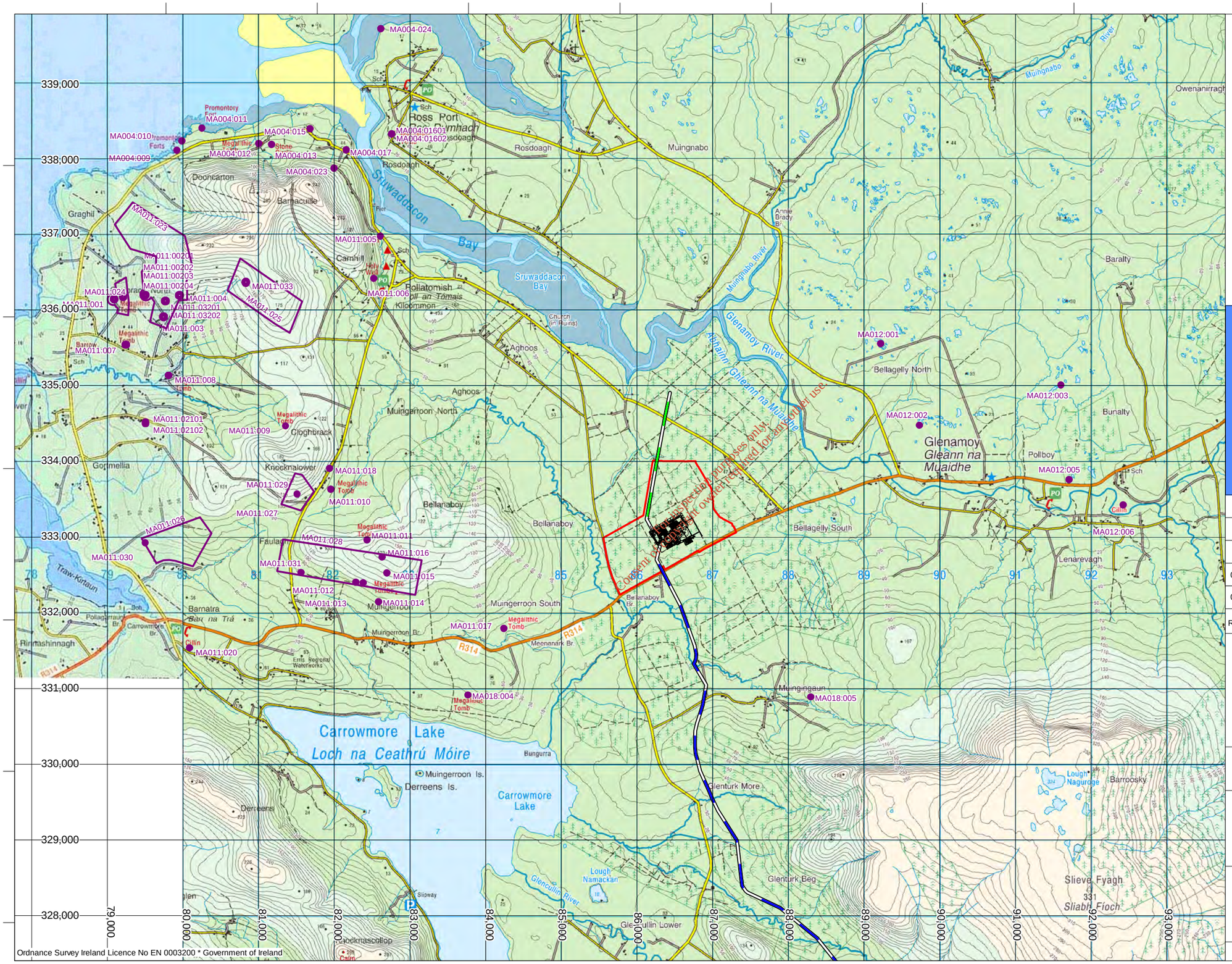
monitoring required will be decided in consultation with Mayo County Council, The National Monuments Section of the Department of the Environment, Heritage and Local Government and the National Museum of Ireland (NMI).

15.10 Residual Impacts – Terminal

There will be no residual effects in relation to archaeology.

Table 15.1 Archaeological Monuments in the Region (see Figure 15.1)

Mon. No	Nat. Grid	Townland	Classification
MA004-009	7987/33813	Glengad or Dooncarton	Promontory Fort
MA004- 01001	7989/33820	Glengad or Dooncarton	Promontory Fort
MA004-01002	7989/33820	Glengad or Dooncarton	Castle
MA004-01003	7989/33820	Glengad or Dooncarton	Building(s)
MA004-01004	7989/33820	Glengad or Dooncarton	Hut Site
MA 004-011	8025/33840	Glengad or Dooncarton	Promontory Fort
MA004-012	8104/33821	Glengad or Dooncarton	Court-Tomb
MA004-013	8117/33819	Glengad or Dooncarton	Stone Circle
MA004-024	8264/33973	Rosdoagh	Ringfort possible
MA011-006	8253/33642	Carnhill	Holy Well
MA011-009	8137/33446	Knocknalower	Portal Tomb
MA011-010	8190/33361	Knocknalower	Megalithic Tomb unclassified
MA011-011	8246/33296	Faulagh	Megalithic Tomb unclassified
MA011-012	8224/33240	Faulagh	Megalithic Tomb
MA011-013	8236/33237	Faulagh	Megalithic Tomb unclassified
MA011-014	8254/33213	Muingerroon South	Megalithic Tomb unclassified
MA011-015	8282/33227	Muingerroon South	Court Tomb
MA011-016	8268/33255	Muingerroon South	Megalithic Tomb unclassified
MA011-017	8419/33179	Muingerroon South	Court Tomb
MA011-018	8195/33390	Knocknalower	Cist
MA011-020001	8001/33157	Carrowmore	Children's Burial Ground
MA011-020002	8001/33157	Carrowmore	Enclosure
MA011-027	8148/33344	Knocknalower	Field system Pre-Bog
MA011-026	7997/33337	Gortmellia	Field System Pre-Bog
MA011-028	8215/33257	Faulagh/Muingerroon South	Field System Pre-Bog
MA011-029	8137/33344	Knocknalower	Stone Circle
MA011-030	7935/33310	Gortmellia	House Site
MA011-031	8155/33259	Faulagh	House Site
MA012-001	8923/33555	Bellagelly	North Crannog Possible
MA012-002	8974/33453	Bellagelly	North Crannog (s) Possible
MA012-003	9156/33503	Bunalty	Crannog Possible
MA012-005	9178/33380	Bunalty	Crannog (s) Possible
MA012-006	9242/33344	Lenarevagh	Children's Burial Ground
MA018-004	8386/33086	Muingerroon South	Court-Tomb
MA018-005	8831/33090	Muingingaun	Enclosure



Corrib Pipeline (Preferred Option)

BGE Mayo to Galway Gas Pipeline

SMR Site

Proposed Terminal Site

Planning Application Boundary

Rev	Date	Description	Drn	Chk	App
01	16.12.03	Revised Title Bar	IM		
00	28.10.03	First Draft	IM		

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BELLANABOY BRIDGE TERMINAL

Corrib natural gas

TITLE: **FIG 15.1**
BELLANABOY BRIDGE TERMINAL
ARCHAEOLOGICAL ASSESSMENT

SCALE: 1:50,000

REV 01

FILE NAME: P40036ICT - ARCHAEOLOGY.WOR

Sixteen

Material Assets

16 Material Assets

16.1 Introduction

Material assets are those resources available to the local community. In this section, the impact of the proposed terminal focuses on:

- waste production, treatment and disposal;
- the use of the local road network; and
- the consumption of chemicals, potable water and rock.

In terms of power supply the terminal will be self sufficient relying on gas to power its main generators and gas or condensate to power the heating medium heater. Fuel oil will be imported for the standby generator sets.

16.2 Waste Production, Treatment and Disposal

16.2.1 Introduction

This section considers the solid waste that will be generated during the construction of the terminal and during its operation. The treatment and disposal of liquid effluents is discussed in Section 10. This section has been prepared by RSK ENSR Environment Ltd.

16.2.2 Study Methodology

This assessment of the waste generation from the proposed Bellanaboy Bridge Terminal has been conducted as a desk top study.

The study categorised the types of waste that will be generated as Hazardous Waste or Non-Hazardous Waste. Reference was made to the Environmental Protection Agency's European Waste Catalogue, which integrates the EU Hazardous Waste List compiled under Commission Decision 2000/532/EC (as amended). Hazardous Waste is defined in the Annexes to Council Directive 91/689/EEC.

The following organisations were contacted for information:

- Environmental Protection Agency (EPA Headquarters, Wexford); and
- Mayo County Council (Castlebar).

16.2.3 Receiving Environment

Waste stored on-site pending its removal could affect the soil, geology and hydrology at the terminal site. Section 8 (Soils and Geology) and Section 9 (Hydrology and Drainage) include descriptions of the relevant aspects of the receiving environment that could be affected by the on-site storage of waste.

16.2.4 Characteristics of the Proposed Development

This section summarises the characteristics of the proposed terminal at Bellanaboy Bridge that are relevant to the consideration of waste management.

The annual generation of Non-Hazardous Waste during the construction phase of the development (compactable general waste, chemical toilet waste and cooking oil) is estimated in Table 16.1. Annual generation estimates for Hazardous Waste during the construction phase of the development (oily waste and clinical waste) are presented in Table 16.2. The annual generation of Hazardous Waste during the terminal's operation is further broken down in Table 16.3, which lists the types and quantities of different types of oily wastes, empty drums, and chemical wastes.

Some of the Hazardous Waste will be generated during the terminal's operation on an intermittent or semi-continuous basis. Generally, wastes produced on this basis will relate to the treatment of water produced from the hydrocarbon reservoir. Other Hazardous Waste will be generated during the terminal's operation on an occasional basis. This material will be predominately salts and scale deposits which will be removed from equipment during maintenance and refurbishment activities.

It is possible that maintenance of equipment could generate naturally occurring radioactive material (NORM). In the unlikely event that this occurs, NORM would only be encountered after the first three years of terminal life. It would be generated once every three years during programmed maintenance. It is not expected that more than a few kilogrammes of NORM might be generated every three years.

16.2.5 Potential Impact of the Proposed Development

There is the potential for impacts to arise from Non-Hazardous Waste if there is no management in place. Examples of this would be poor housekeeping or loss of containment. The impacts in any event are unlikely to be significant.

By contrast, loss of containment of Hazardous Waste presents a more significant impact, because the materials are intrinsically hazardous, there is a possibility of soil and or ground water contamination. Should Hazardous Waste or NORM enter the environment, the impacts could be significant.

Table 16.1: Non-Hazardous Construction Waste

Waste	Description	Year	Volume (m^3)	Mass (tonnes)
General compactable waste	Municipal waste, packaging	2004 2005 2006		26 178 85
Chemical toilet waste		2004 2005 2006	234 1 603 761	
Cooking oil	Vegetable based oil	2005	43	
General construction waste	Concrete products, timber formwork, steel pile and rebar cutoffs	2004 2005		100 200
Peat	Excavated peat	2004/5	450,000	495,000

Note: The excavated peat will be transported to a deposition site at Srahmore where it will be used in the rehabilitation of a cut over peat land. Wherever possible construction waste will be re-used/recycled.

Table 16.2: Hazardous Construction Waste

Waste	Description	Volume (m^3)	Mass (tonnes)
Oily waste	Oil contaminated Personnel Protective Equipment, oily rags, lubrication oil		4.9/year
Clinical waste	First aid waste	0.31/year	

Table 16.3: Hazardous Operational Waste

Waste	Description	Volume (m^3)	Mass (tonnes)	Frequency
Aqueous filter cartridge type	Oil contaminated sand and inorganic salts	0.40	0.05	1 per annum
Condensate filter cartridge type	Oil contaminated sand and inorganic salts	0.27	0.05	Annual
Odorisation package activated carbon	Oil contaminated anthracite	1.00	2.50	1 every 4 years
Mercury removal bed	Oil contaminated absorbent	3.00	7.50	Every 3 years
Export methanol filter cartridge type 2 no.	Oil contaminated sand and inorganic salts	0.01 each	0.05 each	Annual
Product methanol filter cartridge type	Oil contaminated sand and inorganic salts		0.05	Annual
TPS sludge*	Oil contaminated sand and inorganic salts	5.00	10.00	Every 3 years
Produced water treatment sludge	Metals and inorganic salts	73	150.00	Annual
Produced water treatment cartridge type	Oil contaminated salts	2	4	1 per annum
Scale inhibitor drums/IBC		2		Annual
Corrosion inhibitor drums		2		Annual
Contaminated heating medium	Contaminated tri-ethylene glycol	30.00	28.56	Every 10 years
Methanol still reboiler scale	Inorganic salts and sand with slight oil contamination	4.80	12.00	Every 3 years
Tankage and/or vessel sludge	Oil contaminated sand and inorganic salts	50.00	100.00	Every 3 years
Methanol reboiler tubes	Carbon steel with oil contaminated sand and inorganic salts		7.00	Every 6 years
Methanol still valve trays	Carbon steel with oil contaminated sand and		1.00	Every 3 years

Waste	Description	Volume (m^3)	Mass (tonnes)	Frequency
	inorganic salts			
Chemical waste	Spent chemicals used in laboratory	5	4.5	Annual
Clinical waste		0.03		Annual
*The inlet filter separator will be periodically washed out and the waste water sent to the TPS.				

16.2.6 Do Nothing Scenario

If the development did not proceed, there would be neither waste generation nor disposal.

16.2.7 Mitigation Measures

Mitigation measures include waste management planning, which addresses the impacts associated with waste production, treatment and disposal and ensures compliance with the relevant legislation.

The relevant waste management legislation comprises certain European Union Directives and Regulations, and the Irish legislation that implements them.

European Union Legislation

Council Directive (75/442/EEC) on Waste

This Framework Directive on Waste establishes general rules for waste management and introduces the 'polluter pays' principle. The Directive recognised that the recovery and reuse of waste should be encouraged. It provides that EU Member States must take all the necessary measures to ensure that waste is recovered or disposed of without endangering human health and in a manner that does not harm the environment.

Council Regulation (EEC) No.259/93

This Regulation concerns the supervision and shipment of waste within, into, and out of the European Union. It requires consignment notes to control the shipment of Hazardous Waste, and defines waste categories.

Council Directive (1991/689/EEC)

This Hazardous Waste Directive sets out requirements for records of the type, quantity and disposal destination of hazardous waste to be maintained by a consigner.

Irish Legislation

The Waste Management Act, 1996 to 2003 provide for:

- a comprehensive and modern regulatory framework for the effective organisation of the management of waste in Ireland;
- the assignment of licensing functions to public authorities in relation to waste management, e.g. the EPA and local authorities; and
- measures - mainly regulatory powers - designed to improve national performance in relation to the prevention, minimisation and recovery or recycling of wastes.

The Waste Management (Licensing) Regulations, 2000 are followed by the EPA for licencing landfill and other waste disposal sites.

The Waste Management (Permit) Regulations, 1998 are used by local authorities who operate a permit system for certain waste recovery activities.

The Waste Management (Hazardous Waste) Regulations, 1998 regulates batteries, asbestos, PCBs and waste oil.

The Waste Management (Transfrontier Shipments of Waste) Regulations 1998, and the Waste Management (Movement of Hazardous Waste) Regulations 1998 require consignment notes for waste movements and give effect to the provisions of Council Regulation (EEC) 259/93 on the supervision and control of shipments of waste within, into and out of the European Community.

Waste Management Plan

Implementation of a Waste Management Plan will minimise the potential impact of the proposed terminal with respect to solid waste.

Shell will produce a Waste Management Plan as part of the detailed design. This will ensure rigorous management and control of the wastes generated by the terminal.

In particular, the plan will set out how Shell will:

- collect and minimise the waste generated;
- reuse or recycle wherever possible;

- separate, store and contain securely and label all wastes;
- nominate someone to be responsible for waste management at the terminal;
- employ suitably licensed waste contractor(s) for disposal purposes;
- audit the licence(s) of the waste contractor(s) and check their disposal site(s); and
- monitor and periodically audit the waste management system and activities.

The proposed terminal waste facility will have dedicated laydown areas for waste materials. This is designed to minimise the consequences associated with losses of containment.

Consignments of waste leaving the site will be recorded on consignment notes through to the final destination in accordance with the relevant legislation. The recycling or ultimate disposal of waste will be certified by the parties receiving or processing each consignment.

Non-Hazardous Waste Disposal

The generation of non-hazardous operational waste will be minimised where practicable, by maximising recycling and re-use and minimising packaging. For example, surplus excavated material will be re-used on site where possible. All peat excavated will be sent off site to the peat deposition site (see Section 3). Excavated sub soil, which is expected to be predominantly sands and gravels with some weathered rock, will be re-used as part of the construction where possible.

A licensed waste contractor will dispose of residual waste at an appropriate facility within County Mayo.

There are currently two landfill sites accepting municipal and non-hazardous waste in County Mayo. The licence conditions for these are shown in Table 16.4.

The construction site will be supplied with portable toilets. A licensed contractor will empty these on a regular basis, and the waste will be disposed of at a licensed facility.

Hazardous Waste Disposal

This material will be treated at the proposed terminal to minimise the volume of material transported. They will be segregated and classified as Hazardous Waste and disposed of via a licensed waste contractor.

Due to the limited facilities available for treatment/disposal of hazardous waste within the Republic of Ireland, it is likely that the Hazardous Waste, including possible NORM, will have to be exported to continental Europe for disposal at an appropriately licensed facility.

In any event, a licensed waste contractor will transport any Hazardous Waste generated during the construction and operational phases of the project by road to a licensed Hazardous Waste Transfer Facility. The Hazardous Waste transfer stations in Ireland are listed in Table 16.5.

If it is necessary to export the waste, it will be shipped to appropriate facilities operating dedicated handling and treatment processes. These facilities will be selected to ensure they have full abatement and monitoring capabilities and conform to stringent standards for emissions to air, water and land.

In respect of possible NORM consignments, the developer will apply for a solid waste licence from the Radiological Protection Institute of Ireland (RPII), as required by the Radiological Protection Act, 1991 (ionising radiation) Order, 2000, S.I.No. 125 of 2000. Staff responsible for maintenance work would be trained in the handling of NORM, and be equipped with appropriate personal protective equipment. Work with radiological sources would be covered by the terminal's work permit system. A compound for handling NORM would be established on-site, with NORM sealed in drums. This is in accordance with industry practice and with the requirements of the RPII implementing the Radiological Protection Act.

During removal of Hazardous Waste, trained personnel will monitor and assess the condition of material and containers. The waste will be disposed of using a licensed waste contractor.

The proposed mitigation measures will minimise the potential impact of Hazardous Waste and NORM as far as reasonably practicable.

16.2.8 Predicted Impact of the Proposed Development

Where waste is generated it will be stored securely, transported and ultimately disposed of in strict accordance with EU and Irish legislation.

Particular care will be exercised with the Hazardous Waste and NORM if present. The on-site waste management system will ensure that these materials cannot be released into the environment at the terminal.

Development of a Waste Management Plan, and the setting and auditing of challenging targets for waste minimisation will effectively eliminate any environmental impacts in the vicinity of the terminal. By selecting appropriate disposal facilities, it will

reduce impacts at off-site locations to the lowest levels that are reasonably practicable.

16.2.9 Monitoring

All waste removed from the proposed Bellanaboy Gas Terminal will be checked to ensure it is properly classified as either Non-Hazardous or Hazardous Waste. Where there is any doubt, the material will be treated as Hazardous Waste.

Before leaving the site, Hazardous Waste will be analysed to determine the concentrations of: oil, water, mercury, copper, zinc, arsenic, cadmium, nickel, chromium, lead, benzene, toluene, xylene and methanol.

Consignment notes will be retained to provide a documentary record of wastes taken off site. All waste contractors will be audited prior to selection, and periodically checked as part of an ongoing waste management assurance programme.

Table 16.4: Active Landfill Sites in County Mayo

Waste License Register No.	Applicant/ Holder Name	Facility Location	Status of Application	Type of waste permitted	Annual Capacity (tonnes)	Life span*
21-1	Mayo County Council	Derrinumera, Newport (Grid. Ref. G 103 296)	Licensed	Non-Hazardous	40,000	>10 years
67-1	Mayo County Council	Rathroeen, Ballina (Grid. Ref. G 123 323)	Application in progress - no decision yet	Non-Hazardous	45,000	>10 years
* Both Derrinumera and Rathroeen landfill sites have more than 10 years capacity for current demand and fill rates. It is not expected that Bellanboy Terminal will significantly affect the remaining capacity due to the low quantities of non hazardous waste requiring to be land filled.						

Table 16.5: Hazardous Waste Transfer Stations in Republic of Ireland

Waste License Register No.	Applicant/ Holder Name	Facility Location	Status of Application	Type of waste permitted	Annual Capacity (tonnes)
36-1	Minchem Chemicals Ltd.	Tolka Quay Road, Dublin 1	Licensed	Hazardous	22,000
40-1	Sorundon Ltd. T/A Irish Environmental Services	520 Beech Rd, Western Industrial Estate, Naas Rd, Dublin 112	Licensed	Various Hazardous wastes	3,200
41-1	Shannon Environmental Services	Smithstown Industrial Estate, Shannon, Co. Clare	Licensed	Hazardous	20,000
112-1	National Recycling and Environmental Protection Ltd.	National Recycling and Environmental Protection Ltd., John F. Kennedy Drive, JFK Industrial Estate, Naas Rd, Dublin 12	Application in progress - no decision yet	Hazardous	not yet determined

16.2.10 Reinstatement and Residual Effects

The cessation of the facility will be planned up to 5 years prior to the last gas date. This will allow sufficient time to investigate recycle and reuse options and analysis of the ground around and underneath the terminal. The requirements of the IPPC license and legal requirements in place at the time will be met for reinstatement. It is envisaged that the site will be covered with soil and restored by grassing and general landscaping. If there is soil contamination all foundations will be removed and other non-soil type material to a depth of 1 metre below grade.

Subject to Mayo County Council's requirements it is possible that the proposed terminal perimeter fence may be left around the resulting reinstated area. Monitoring will continue to occur for a period of time agreed with the relevant regulatory body. The residual impact of the removal of the gas terminal will be minimised through landscaping.

16.3 Traffic Impact Assessment

16.3.1 Introduction

This section examines the traffic impact of the proposed gas terminal site and the associated peat deposition area on the local road network. Additional traffic will occur on the roads in the area as a result of the project, the key phases of which are, peat removal, terminal construction and operation.

The total Bellanaboy site measures approximately 160 hectares of which the terminal occupies approximately 13 hectares. A gas pipeline will connect the Corrib gas field to the terminal via a landfall at Dooncarton. The location of the gas terminal site and proposed peat deposition site (located at Srahmore near Bangor) are shown in Figure 16.1.

16.3.2 Methodology

This section considers the following issues:

- examination of the geometry and pavement condition of the existing road network;
- suitability of the surrounding road network to cater for the additional traffic generated by the proposed development during the construction and operational phases of the project;
- issues concerning the local residents regarding traffic generated by the proposed development as expressed during the public consultation phase of this project;
- mitigation measures required to allow the development to be constructed in a safe manner; and
- proposed traffic management plan to minimise the impact of the development on the environment within the study area.

16.3.3 Structure of Section

Following this introduction this section is divided into three further sections as follows:

- existing road and traffic conditions;
- assessment of proposed development traffic; and
- mitigation measures.

16.4 Existing Road and Traffic Conditions

16.4.1 Introduction

A series of surveys were carried out to determine the existing road and traffic conditions across the study area road network. These surveys consisted of junction turning traffic counts and a detailed road inventory.

Based on these surveys the options for transporting plant and materials were examined before a preferred route was chosen. This was subsequently subjected to more detailed surveys and analyses.

16.4.2 Traffic Study Methodology

In order to establish the baseline traffic flows on the existing road network, junction turning count surveys have been undertaken at eight locations across the study area between March 2001 and October 2003. The traffic survey locations are presented in Figure 16.6. The results of surveys in the form of traffic flow diagrams are presented in Figures 16.2 to 16.5.

The traffic survey information gathered was cross-referenced against the yearly profile to ensure the most onerous base flows were used in the traffic analysis.

From examining National Roads Authority (NRA) traffic data for typical roads in the general area of the proposed development the consultants noted that traffic volumes on the routes increase significantly during the peak tourist season between the months of June and September. It was found that the peak month with regard to traffic flows is August.

The Maam Cross N59–13 and Mulranny N59-06 NRA automatic traffic counter (ATC) stations (the closest to the proposed terminal site) give a monthly profile of traffic experienced on the road network in the vicinity of the proposed development.

Traffic data from the above ATC stations were examined for the year 2002. The most pertinent results are tabulated in Table 16.6 below.

Table 16.6 Traffic Count Data

NRA Station	October	August
Maam Cross	2756	4518
Mulranny	2336	4019

From the above results a factor of 1.72 was used in order to "factor up" the October count data to reflect the summer period tourist peak.

The following traffic flows were used as the basis for the traffic analysis carried out at Junction 4 and 7.

Figure 16.2 Traffic Flow Junction 4 2003 Base Year Factored 0830-0930

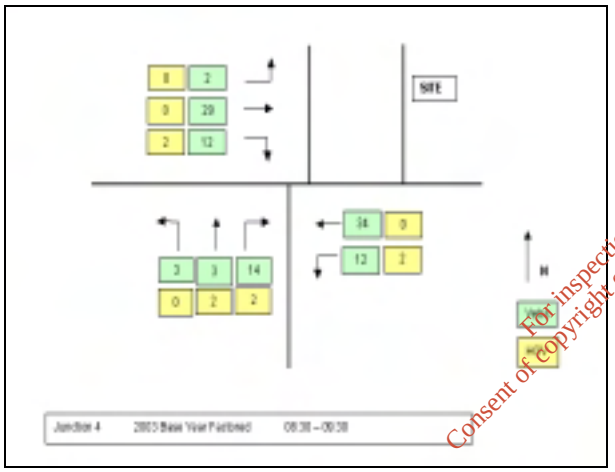


Figure 16.3 Traffic Flow Junction 7 2003 Base Year Factored 0830-0930

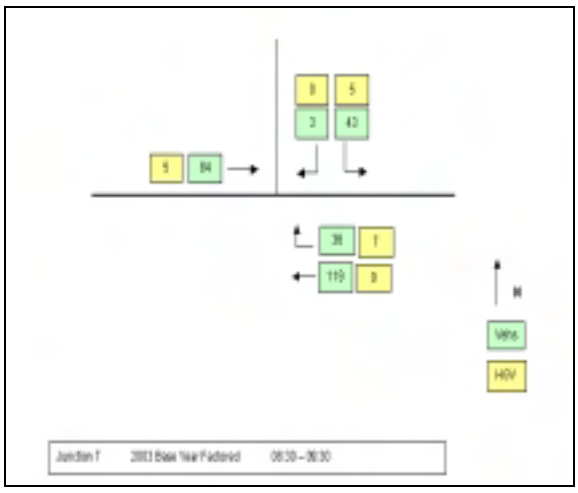


Figure 16.4 Traffic Flow Junction 4 2003 Base Year Factored 1630-1730

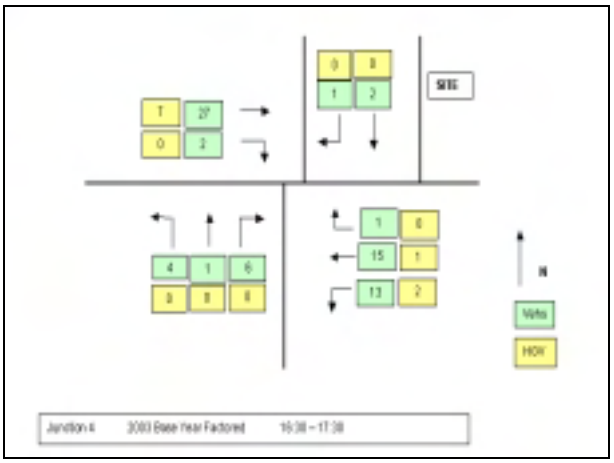
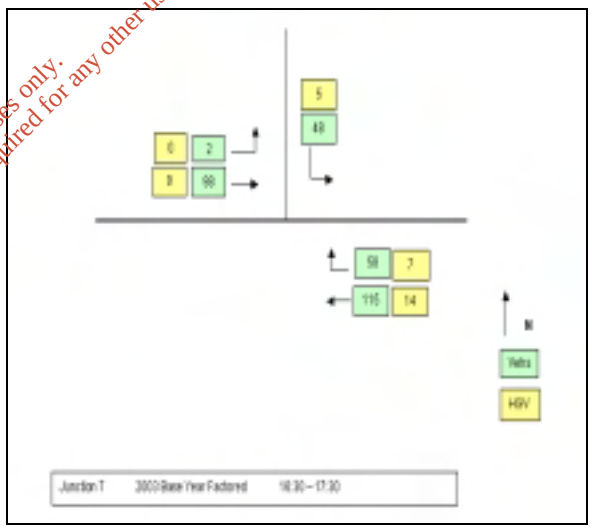


Figure 16.5 Traffic Flow Junction 7 2003 Base Year Factored 1630-1730



16.4.3 Receiving Environment

Road Network Inventory

A detailed network inventory was undertaken for all roads in the vicinity of the proposed development that could potentially be used as access routes to the site. As well as examining the pavement condition, and carriageway design of all links, the geometry of each individual junction was also recorded to determine any remedial measures that may be required. In this section the characteristics of each link will be described.

Figure 16.1 Key Locations and Proposed Peat Haul Route

Figure 16.6 Location of Traffic Surveys

N59 Ballina/Bangor – This route is a National Secondary Route that passes through Crossmolina. The width of the road varies from 5.5m to 6.5m and is single carriageway over its full length. The pavement is generally of reasonable condition. Some sections of the road show evidence of recent upgrading, however remedial measures in the form of surfacing and widening are desirable at some locations. Average speeds on the route are approximately 50 mph. The horizontal and vertical alignment of the route varies significantly along the entire route, which restricts sight distances and safe passing at some locations.

The main restriction in capacity on the route occurs at the westerly section of the road on the approach to Crossmolina, where narrow road width, coupled with extensive on-street parking, could potentially reduce the capacity of the link or cause some congestion. However, traffic volumes are low and this problem should not result in significant congestion or queuing in the town.

Examination of the Mayo County Development Plan 2003-2009, it identifies this route as one of the main secondary routes for improvement.

The main traffic generators along this route have included the Bellacorrick Power Station and a wind farm, so it is clear that this route has been used previously to facilitate significant construction projects.

R313 Bangor/Belmullet – This route is a regional road of varying width from 6.5m to 4.5m at its narrowest location. The pavement is generally of reasonable condition and it was observed that both buses and heavy vehicles traverse the route frequently. A new river crossing approximately 3.5km west of Bangor, at the junction of the Carrowmore Drive and the R313 has been constructed. At this location the road widens to approximately 6.5 m. A new wider crossing has recently been completed.

A quarry is located between Bangor and Bunnahowen, which generates a number of heavy vehicle movements, however, generally there are no other significant generators of traffic along the route. It is understood that the annual production capacity at the quarry is significant.

Immediately north of the quarry there is a narrow, skew bridge, which may cause some restriction to traffic flows, however, it was observed that the

construction of a new wider crossing had commenced.

R314 Ballina / Bunnahowen– This route, known as the Coast Road, is a very scenic route connecting Ballina to Belmullet via the coast through such towns as Killala, an important fishing port, and Ballycastle. The carriageway design on this route varies significantly, with road widths averaging between 5m and 6m. A number of bottlenecks are located along the route, the most significant of these being at Killala, where heavy goods movements are restricted. It is noted from the Mayo County Development Plan 2003-2009, that a possible by-pass of the town is listed as an objective of Mayo County Council. This would improve the traffic movements in the town considerably, however, the provision of such a link is probably outside the time scale for the construction project. It was noted that heavy vehicles avoid the R314 through Killala, by diverting to the R315 at Ballycastle.

Another constriction occurs at the skew bridge located between Killala and Ballycastle, approximately 5km west of Killala. This route is extensively used as a tourist route and there is an important viewing point located at Minnaun. The horizontal and vertical alignments of the road vary considerably, however, the route does appear to cater for heavy vehicle movements, particularly for vehicles used for tree felling and peat extraction operations.

R315 Ballycastle/Crossmolina – This route has an average width of approximately 5m and is generally in a poor condition. Both the horizontal and vertical alignments of the route vary considerably and passing vehicles is very difficult in many locations. The route however has the one advantage of avoiding the narrow street to the west of Crossmolina. No villages or traffic generators of note are found along this link and thus it has very small traffic volumes.

County Roads – A number of county roads were assessed in the same context as the main routes. Generally these routes run between the R314 and the R313. The most direct of these in respect to access to and egress from the site was the route immediately to the east of Carrowmore Lake, L1204. This route has an average width of 5.5m and its surface is in a good condition. Several sections of the route have been recently upgraded and a new (improved) river crossing has been recently constructed. Journey time surveys undertaken along this route show that with an average speed of 40 mph this link can be traversed in less than 9 minutes.

Observations made on this route show that there are a number of existing heavy vehicle movement at present for a tree felling operation at the Bellanaboy Bridge end of the link. There are only two notable "pockets" of housing on this route indicating that a minimum number of residents would be affected by any increase in traffic volumes on this route.

Another county road located to the west of Carrowmore Lake, L5284, known as Carrowmore Drive, was also examined. It was found that while the route was used at present for heavy vehicle movements, it would not be suitable as the route is protected in the County Development Plan because of the Scenic Views of high importance. In addition, the average road width is less than 5m, and is unprotected from the lake in a number of locations. The carriageway is generally in a poor condition and its horizontal geometry would make it unsuitable for use by significant numbers of HGVs.

Two other county roads linking the R313 to the R314 were examined to the northwest of Carrowmore Drive, however, neither of these routes demands further examination as each has been found to be less favourable for any additional traffic as the route would be some 20 km longer on roads of lower quality than those of the proposed route.

Recommended Route to Construction Site

The above routes were examined on the basis of their geometry, gradients, traffic volumes and the number of residential units affected. On the basis of the above examination of the study area road network, FaberMaunsell recommend the following route be used to access the site:

- N59 to Bangor; R313 to County Road L1204; County Road L1204 to R314; and, thence to the site access road. This route would be used by construction workers and Heavy Goods Vehicles accessing the site.

16.4.4 Characteristics of the Proposed Development

In this section the number of trips generated during the operational, peat removal and terminal construction phases of the proposed development have been examined. It is clear from the outset that in this case the peat removal stage is the critical condition in the context of the number of trips generated.

The number of trips generated in the operational phase of development is based on the proposed number of employees at the facility and examination of similarly sized facilities.

The estimated number of trips generated (both HGV and employee) by the development in the peat removal phase of the project is based on information provided by Arup Consulting Engineers from their estimates of the volume of peat to be removed from the site.

The number of trips generated during the construction phase of the project is based on the construction schedule supplied by Shell.

Before carrying out the above assessments the following assumptions have been made in relation to traffic generation:

- background traffic will not grow significantly as a result of other adjacent development during the period of construction; and
- all site operative trips to/from the site will occur before 08:00 each morning and after 18:00 each evening.

Operational Phase of the Development

It is estimated that approximately 50 people will be employed at the terminal when its operation commences. The development will operate in four shifts, which means there will be approximately 15 to 20 people on site at any time. In addition there will be a low number of commercial vehicles required for the operation of the terminal such as catering supplies and maintenance vehicles. The operational phase of the development has been examined in the first instance as this will be the phase which represents the longest term impact on the surrounding road network. We would estimate that no more than 3 heavy goods vehicles or light goods vehicles per day (on average) would service the site.

The number of these vehicles would not exceed two in the peak hour. In order to model the worst case scenario it has been assumed that 20 vehicles enter and 20 vehicles leave the site during the peak hour to account for overlap in traffic due to shift changes. It is also worth noting that it was assumed that 100% of traffic will arrive from Bangor via the L1204 and from Glenamoy simultaneously in order to model the onerous case of right turning vehicles.

The junctions have been analysed for this scenario and the results of the analysis show a negligible increase in the traffic flows and no significant impact on the road network.

The results of the analysis have been shown in Table 16.7 below.

Table 16.7 Traffic Analysis Results for Operational Phase

Table 16.7	Junction4	Junction 7
Max. RFC	0.047	0.21
Queue (Vehs)	0.0	0.3

Construction of Peat Deposition Site

It is estimated that up to 18,000 m^3 of stone will be required to construct the proposed peat deposition site at Srahmore. The importation of the majority of this material will take place before any peat will arrive from the terminal site. It is anticipated that this material will be imported from a local quarry. This quantity of material has been included in the analysis of the peat removal to ensure the worst-case scenario is modelled.

The peat removal phase will involve the removal of circa 450,000 m^3 of peat from the development site and relocation of same to the peat deposition site. It is envisaged that the peat removal process will take place within a period of up to 6 months. No other significant construction activities are expected to take place on the site in parallel with peat removal. However, the process is weather dependant, and may need to take place over two seasons. In order to perform a robust analysis the consultants have assumed the following conservative assumptions:

- the volume of peat to be moved is c 450,000 m^3. It is planned to use a fleet of trucks 40 to 45 in number to carry out 400 return journeys per day, assuming a 45 - 55 minute turn around;
- the type of vehicle proposed is a conventional rigid 4 axle tipper truck with a payload of up to 18 tonnes but generally they will carry 10 m^3 of peat which weighs approx 12 tonnes, the use of roll over covers may be deployed if required;
- the expected time frame is up to 6 months subject to weather windows;
- peat will generally be moved from 07.00hrs to 19.00hrs Monday to Friday and 07.00hrs to 16.00hrs on Saturdays (in periods of good weather increased operations may be considered to reduce the haulage operation duration, only with the prior approval of Mayo County Council);
- road maintenance may be carried out on weekends as and when required;
- staff involved in moving the peat off site will be approx. 60 in transport, 40 on site at Bellanaboy and 50 at the deposition site; and
- assuming a 12-hour total working period per day and distributing the total number return truck journeys throughout the day, it is expected that a

maximum of c 42 truck movements per hour will take place.

The haul route for peat removal is shown in Figure 16.1.

Key junctions that were analysed by the consultants are also identified. The two most important junctions on the access route to the site:

- Junction 4 – Junction of R314/L1204 and the proposed site access road; and
- Junction 7- Junction of L1204 and R313.

It should be noted that the analysis to determine if the junctions have sufficient capacity to accommodate the traffic volumes has been carried out assuming the two-way movement of trucks at Junction 7. In the examination of the road geometry of the junction of the L1204 and R313 it has been concluded that a one-way system will operate at the junction (as shown in Figure 16.1) in order to improve safety. From a traffic capacity point of view this will be less onerous than the two-way system analysed.

The assessments have been carried out using the Transport Research Laboratory computer junction simulation package, VPICADY, to determine junction volume/capacity ratios. This package is particular to priority-controlled junctions and also provides information regarding the queue lengths and delays experienced at the junctions. It should be noted that an RFC (Ratio of Flow to Capacity) greater than 0.85 is considered over-capacity. Thus a junction with an RFC less than 0.85 is deemed to be operating within capacity and any queues or delays which may be experienced are minimal.

The results for the analysis are outlined in Table 16.8 below.

Table 16.8 Traffic Analysis Results for Peat Removal Phase

Table 16.8	Junction 4	Junction 7
Max. RFC	0.162	0.313
Queue (Vehs)	0.2	0.4

Terminal Construction Phase (after peat removal)

Examination of the proposed work programme shows that the maximum number of car trips made to the proposed terminal by site operatives will be 328 vehicles in the morning peak hour in any month during the construction phase of the project based on maximum 500 (Q3) site operatives employed on the site This figure represents the maximum number of vehicles generated by the construction site in the morning peak hour in any month. During some periods there will be up to 100 trucks per day e.g. during dressing of the site and pouring concrete. During other phases (up to 75% of the construction period) the frequency of HGV movements would be much lower.

The consultants have examined the scenario that all staff trips to the site are via the L1204 route. This assumes a worst case scenario that all site operatives will reside in the vicinity of Ballina. It is estimated that the duration of the terminal construction will take approximately 2 years.

Table 16.9 Traffic Analysis Results for Terminal Construction Phase

Table 16.9	Junction4	Junction 7
Max. RFC	0.536	0.775
Queue (Vehs)	1.1	3.5

16.4.5 Predicted Impact of the Proposed Development

It has been demonstrated that the study area road network can adequately cater for the traffic volumes generated by the development during construction and when fully operational.

The largest impact on the study area road network will arise as a result of the number of trips made during the peat removal and construction phases of the development which occurs over a relatively short period of time (in comparison to the operational phase).

However, it has been shown that the proposed study area road network can adequately cater for the volumes of traffic generated in the worst-case scenario. The main traffic impact will be in relation to the pavement maintenance. As a result, Shell are committed to carrying out mitigation measures to minimise the impact of the development. These have been discussed in further detail in the following section.

16.4.6 Do Nothing Scenario

If the development did not proceed, additional construction traffic would not be generated.

16.4.7 Mitigation Measures

Whilst it is clear from the above assessment that the road network and proposed materials haul route can cater for the overall traffic volumes generated by the scheme, Shell are anxious to minimise the overall affect on the residents and general environment

within the study area. With this in mind, a Traffic Management Plan has been developed to actively control the number and types of vehicles arriving/departing from the development and the time at which they occur, particularly during the peat removal phase of the project.

This strategy has been discussed with Mayo County Council as part of the pre planning discussions and has been broadly agreed.

16.4.8 Predicted Impacts

The main impact of the heavy construction vehicles will be in the context of possible damage to the pavement due to the amount of traffic using the route during the construction phase.

A joint survey has been carried out by Tobin Consulting Engineers and Mayo County Council of the proposed haul route. This survey identifies areas where road realignment is required to ensure a minimum road width is provided to allow vehicles to pass in a safe manner. This geometrical survey is supported by a road pavement design analysis and pavement strengthening proposals. The extent of bridge and culvert strengthening work has also been agreed with Mayo County Council as part of pre-planned discussions and will be carried out at the developers expense.

In summary the development will not have any significant traffic effects when it is operational. During the construction phase the volumes of traffic can be catered for on the road network as demonstrated in the junction analysis results and a specific haul route (L1204) has been identified. This haul route will be strengthened to mitigate against the damaging effects of the HGV's on the road pavement and structures along the route. The extent of strengthening works has been agreed as part of the pre planning discussions with Mayo County Council. Where necessary the haul route will be widened to ensure that vehicles can pass safely and again the extent of the road widening has been agreed with Mayo County Council.

A traffic/transportation plan has been prepared to assess and control the movement of vehicles during the construction phase. This plan has been discussed and broadly agreed with both Mayo County Council and the Gardai.

Monitoring

Shell will ensure that their main contractor and all sub-contracting firms involved in the project adhere to the Traffic Management Plan. Shell also propose to monitor the route used by heavy vehicles as well as the load they are carrying. To minimise the effects of heavy vehicles on the wearing course of the roadway, the developers are committed to ensuring that the maximum load of each vehicle will not be exceeded and this will be strictly monitored on-site by the provision of a weight bridge. Loads exceeding the permissible load will result in actions being taken against the contractor concerned.

16.4.9 Reinstatement and Residual Effects

Shell is committed to reinstating the pavement as required after construction is completed.

16.5 Consumption of Chemicals

16.5.1 Introduction

This section considers the use of chemicals during operation. It has been prepared by RSK ENSR Environment Ltd.

16.5.2 Study Methodology

This assessment of chemical use has been conducted as a desk top study and has drawn on information provided by Shell.

16.5.3 Characteristics of the Proposed Development

Chemicals will be used for a variety of purposes, including gas conditioning, water treatment, etc. Table 16.10 lists all the chemicals and their uses on site and specifies the maximum inventory that will be held and the annual amounts that are expected to be used. Additionally during construction some paints, solvents and adhesives will be used. Their storage, use and disposal will be covered by the Contractors Environmental Management Plan which will comply Shell Standards and be subject to audits by Shell.

16.5.4 Potential Impact of the Proposed Development

The potential impact of chemical use is limited to the reduction of the availability of the materials themselves and the environmental impacts associated with their manufacture.

16.5.5 Mitigation Measures

Mitigating the effects of use may consist of:

- selecting suppliers whose manufacturing processes minimise the impacts associated with the production of the chemicals, and
- designing processes that minimise the consumption of the chemicals through recovery and re-use.

Section 20 outlines the Environmental Management System that will be implemented at the terminal. The arrangements for operational control will include provision for materials purchasing that take account of the environmental performance of the suppliers of key chemicals that will be used on site.

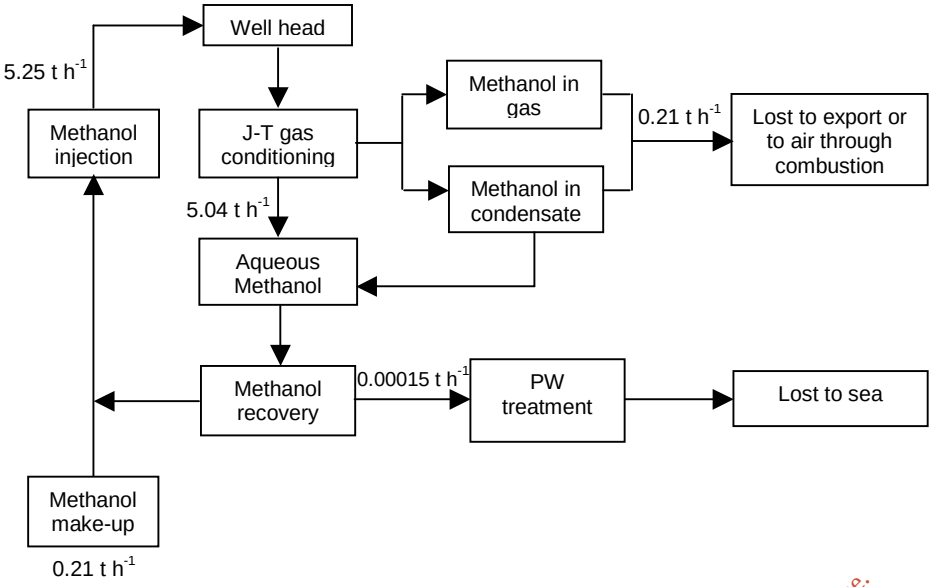
Process design will minimise the use of chemicals by:

- controlling dosing equipment to inject the minimum amounts required for the process;
- adopting closed systems that minimise losses (e.g. the use of tri-ethylene glycol as a heating medium); and
- maximising the recovery of those chemicals that are re-circulated in the process and can be recovered for re-use, e.g. methanol.

Table 16.10: Chemical Inventories and Use

Material/ Substance	Maximum Amount stored (tonnes)	Estimated Maximum Annual Usage (tonnes)	Nature of Use
Diesel (aliphatic petroleum distillates)	66	To be determined	Fuel
Methanol	3629	1825	Hydrate Inhibitor (i.e. antifreeze agent)
Dyno Kl-3040 (polyamine derivative)	4	70	Pipeline Corrosion Inhibitor
Scaletreat 868 (maleic acid copolymer)	0.5	0.6	Methanol Still Scale Inhibitor
Tri-Ethylene Glycol	81	0 (single fill, replenished as required, minimal losses expected)	Heating Medium
Nitrogen	2 (backup only)	To be determined. Capacity of generation package = 250Nm^3/hr	Blanketing of Storage Tanks, Purging of Process Equipment
Hydrochloric Acid (5%)	10	20	Acid Wash of Methanol Still (descalant)
Natural Gas Odorant (80% Tertiary Butyl Mercaptan, 20% Di-Methyl Sulphide)	9	22	Natural Gas Odorant
Hydrated Lime	15	110	Produced/Surface Water Treatment
2-4-6 Trimercapto-s-triazine Trisodium Salt (TMT 15)	1	20.4	Produced/Surface Water Treatment
Sulphuric Acid (30%)	25	62.4	Produced Water Treatment
Milifloc EA900 Polyelectrolyte (anionic water soluble polymer in emulsion) or equivalent	1	5.8	Produced/Surface Water Treatment
Sodium Hydroxide (30%)	3	7.7	Produced Water Treatment
Ferric Chloride Solution	1	2.7	Produced/Surface Water Treatment
Hydrochloric Acid (30%)	3	6.2	Produced Water Treatment
Sodium Sulphate	1(future use)	To be determined. Possible future use.	Produced Water Treatment
Avista Vitec 5000 (Hydroxyethane 1,1 diphosphonic acid; Sodium diethylene penta (methylenephosphonate)	0.09	1	Nanofiltration membrane scale inhibitor (Produced Water Treatment) -
Sodium Hypochlorite	0.5	To be determined. Generated on site from Sodium Chloride	Potable Water Storage Tank – Bacterial Growth Inhibitor.
Sodium Chloride	0.4	1	Potable Water Chlorination Package
Propane	1	0 (backup only)	Backup fuel for Flare Ignition Systems
Avista Roclean P111 (Sodium Percarbonate; Sodium Tripolyphosphate; Ethylene Diamine Tetraacetic Acid)	1	To be determined	CIP Cleaning Chemical (Produced Water Treatment)

Figure 16.7 Schematic of Methanol Recovery



Methanol will be used to prevent the formation of gas hydrates in the pipeline. It will be injected into the gas stream at a rate of about 5.25 tonnes per hour via the umbilical running from the terminal to the well heads.

Simulations indicate that methanol losses through the gas conditioning process will be of the order of 4.0% of the total methanol injected offshore.

The losses of methanol in the gas stream are a function of the temperature and pressure drop resulting from gas conditioning, which is optimised to maximise the separation of hydrocarbons and methanol from the gas stream prior to compression for export.

16.5.6 Predicted Impact of the Proposed Development

The mitigation measures described above address the two key ways in which the impacts associated with the use of chemicals as material assets can be reduced. On this basis, the environmental impacts associated with the *use* of chemicals are judged to be insignificant.

16.6 Consumption of Potable Water

Service water is provided via a ring main. Service water is also distributed to site from the firewater ring main via hydrants. Potable water will be supplied by tanker during construction then by mains supply. No significant environmental impact is anticipated from this activity.

16.7 Consumption of Rock Fill

16.7.1 Introduction

This section considers the use of rock during construction. It has been prepared by RSK ENSR Environment Ltd.

16.7.2 Study Methodology

This assessment of rock use has been conducted as a desk top study and has drawn on information produced from a digital ground model that has been used to estimate the material balance for the cut and fill required for the construction of the terminal platform and the areas for ancillary works.

16.7.3 Characteristics of the Proposed Development

Section 3 describes the construction of the site and outlines the material balance for the cut and fill required to construct the terminal platform and areas associated with ancillary works such as roads, loading areas, etc.

Table 16.11 Requirements for Imported Rock Fill

Use	Imported Rock Fill (m^3)
Roads	20,000
Compounds and Bays	8,000
Over site dressing	20,000
Ponds, Drainage and Gabions	30,000
Total	**78,000**

Creation of the terminal platform will generate an excess of cohesive material (clays and silts) amounting to about 50,000 m3, which will have to be disposed of off site. The surplus material will be removed from the site over the duration of the construction project to suitable waste permit holding sites via the improved road network. The fill requirements here, however, will exceed that generated from the cut and fill operation in the terminal area. An additional 78,000m^3 of crushed rock will be required, mainly for the dressing of roads and the terminal platform. Table 16.12 summarises the anticipated uses of imported rock fill.

16.7.4 Potential Impact of the Proposed Development

The potential impact of the use of crushed rock fill is limited to:

- the reduction of the availability of the rock for other uses;
- possible effects on ground water quality as a result of a different chemistry compared to that of the local geology; and
- the effects on local habitats as a result of related changes to soil chemistry.

In practice, however, the use of rock fill will be limited to areas that have already been cleared of their natural vegetation.

16.7.5 Mitigation Measures

Mitigating the effects of use may include minimising the amounts required to be imported. The level of the terminal has been determined to optimise the cut and fill balance, thereby minimising the need for imported fill.

The use of a Digital Ground Model and the careful location of the site to minimise the need for imported rock fill will limit material requirements.

16.7.6 Predicted Impact of the Proposed Development

The mitigation measures described above address the two key ways in which the impacts associated with the use of rock fill as material assets can be reduced. On this basis, the environmental impacts associated with the use of rock are judged to be insignificant.

16.8 Consumption of other materials during construction

Table 16.12 presents the quantities of other materials that are expected to be consumed during the construction period:

Table 16.12: Other materials consumed during construction.

Material	Quantity
Concrete	17,500m^3
Sheet piles	26,000m^2
Concrete piles	2,000
Lime/cement binder	36,500 tonnes

16.8.1 Potential impact

It is unlikely that any of these materials will be recovered or re-used. As with any construction project there will always be some material that will be permanently consumed as part of the fabric of the facility. It is therefore not considered to be a significant impact.

Seventeen

Mitigation and Impacts Summary and Impact Interactions

17 Mitigation and Impacts Summary and Impact Interactions

17.1 Introduction

This section summarises the potential environmental effects associated with the proposed Bellanaboy Bridge Terminal. The mitigation and impacts arising from the peat deposition site at Srahmore are discussed in a separate volume of this EIS. It lists the general sources of impact associated with the project, such as:

- physical presence of the facilities;
- atmospheric emissions;
- discharges to sea and water courses; and
- solid waste and accidental events.

Aspects of the development may have one or more of the following interactions with the environment:

- disturbance of habitats and species (e.g. disturbance to breeding birds, otters, frogs, badgers and blanket bogs) as well as interaction with the local community as a result of its physical presence;
- impact on air quality from atmospheric emissions and contributions to climate change;
- impact on water quality from discharges;
- visual intrusion;
- land use for waste disposal;
- impact on the environment from accidental releases;
- the requirement for use of natural resources.

The planned activities have the potential to affect the receiving environment in the vicinity of the terminal development. Any upset conditions and accidental events could affect a wider geographic area.

This section presents the evaluation of the relative significance of the environmental effects with particular reference to the sensitivities of the key environmental components.

For each activity the predicted impacts, including their source and the pathway of effect, have been identified. As far as practical the impacts, and where relevant the sources, have been quantified. The mitigation or prevention measures incorporated into the project design or operating strategy have then been identified and the relative significance of the residual effects has been evaluated.

In practice the assessment of residual environmental effects is an iterative process involving the review and modification, as required, of the project through the full design process.

This section also addresses the potential for impact interactions based on the EPA Advice Notes on Current Practice and the EC DG XI Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions.

17.2 Evaluation of Relative Ecological Significance

In order to evaluate the potential effects from the project, a set of standard criteria for assessing the significance of effects or hazards have been applied. Table 17.1 provides a summary of these criteria.

Table 17.1 Criteria for Assessing Significance of Effect or Hazard

Significance Category	Severity of Impact (after implementation of appropriate mitigation measures/actions)
Significant	Substantial adverse changes in an ecosystem. Changes are well outside the range of natural variation and unassisted recovery could be protracted.
Moderate	Moderate adverse changes in an ecosystem. Changes may exceed the range of natural variation. Potential for recovery within several years without intervention is good, however, it is recognised that a low level of impact may remain.
Minor	Minor adverse changes in an ecosystem. Changes might be noticeable, but fall within the range of normal variation. Effects are short-lived, with unassisted recovery occurring in the near term. However, it is recognised that a low level of impact may remain.
Negligible	Changes in an ecosystem that are unlikely to be noticeable (i.e. well within the scope of natural variation).
Beneficial	Changes resulting in positive, desirable, or beneficial effects on an ecosystem.

Notes: The definitions are intended to categorise residual effects. Residual effects are impacts expected following the implementation of mitigation measures or controls. An effect that would have been 'Significant' without action by the Project may be assessed to be 'Moderate', 'Minor', or 'Negligible' after effective mitigation or control measures are put in place. (RSKENSR 2003).

This evaluation considers the vulnerability, temporal sensitivity and recoverability of the receiving environment and the geographical extent of the effect.

Table 17.2: Assessment of Site Specific Potential Effects and Proposed Mitigation Measures

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
OPERATIONAL PHASE		
Noise and Vibration		
Principal sources of noise and vibration are: • Plant operation.	• Operational noise controlled through IPPC licensing. • Terminal site positioned as far as possible from local sensitive receptors. • Selection of modern low noise equipment shielded by acoustic screens where appropriate. • Monitoring.	**MINOR** • Temporary significant noise levels during specified operations. • Ongoing noise impact in the close vicinity of the terminal.
Visual Impact		
Principal visual features of the terminal are: • Tall features e.g. stack for HP and LP flares, methanol still, heater and turbine exhausts. • Associated equipment including bulk storage tanks and ancillary buildings. • Lights at night. • Visible emissions.	**Design** • Apparent mass minimised as a result of architectural detailing, construction materials and colour treatment. • Retaining existing mature vegetation as far as possible for screening. • Planting. • Development of a light emissions management plan which will keep the use of unnecessary lighting to a minimum with override for emergency situations. • Use of 'downlighter' type light standards where appropriate. **Planting** • Planting scheme using transported trees from site, plus imported stock of native species to integrate the scheme into the local wider landscape. • Planting protected from wind and rabbit damage. • Regular post-planting monitoring, with stock replacement as necessary.	**MODERATE/MINOR** • Minor or negligible impact from adjoining roads and housing at short distance from the site. • Moderate impacts from sections of roads in middle distance. • Moderate impacts on one house in the middle distance.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Air Emissions		
• Combustion processes, resulting in releases to the atmosphere of typical combustion-related products, which may have an impact on local air quality and/or the global environment.	• Plant will comply with EU Directive on large combustion plant, where applicable. • Low NOx burners are employed wherever possible.	**NEGLIGIBLE** • Modelling has indicated that maximum ground level concentrations of NOx will be well within EU limits.
• Fugitive releases, from storage, product loading and general leakages which may have long-term impact on the Global Environment.	• The number of potential sources is minimised through design (welded joints, internal floating roofs and nitrogen blanket on storage tanks, high integrity valves etc). • Flaring, in the event of an emergency depressurisation, prevents methane release into the atmosphere.	**NEGLIGIBLE** • Global Warming Potential.
Bulk Liquids Storage		
• Condensate tankage (3 tanks in total). • Heating medium tank. • Methanol (5 tanks in total) • Odorant storage tank.	• Stored in tanks with bunding to accommodate 110% of a single tank content or 25% of the combined total of all tanks in a bund. No valves or pipework will penetrate the bund.	**NO DIRECT EFFECT** • Bulk liquids effectively contained, therefore effects associated with use only.
Chemicals Management		
• Storage. • Selection. • Transfer.	• Chemicals stored in accordance with manufacturer's instructions. • Chemical containers stored in suitably bunded areas to contain spills and leaks during storage and transfer operations. Spills and leaks directed to the drain system. • Volume of stored chemicals minimised.	**NO DIRECT EFFECT** • Chemicals effectively contained, therefore effects associated with chemicals use only.
Employment and Use of Local Goods and Services		
• 50 full time jobs	• Local people and services will be employed where possible.	**BENEFICIAL**

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Outfall and Discharges		
• The outfall will discharge treated water from the terminal. This effluent is primarily treated produced water from the reservoir mixed with treated rainwater run-off from the terminal. • Produced water from gas fields normally contains some traces of aromatic hydrocarbons. In addition suspended solids and some heavy metals will occur depending upon the specific Reservoir characteristics. • Sewage treatment during operations (subject to IPPC)	• Monitoring of the effluent concentrations prior to discharge to sea will be carried out routinely in accordance with the IPPC Licence. • The water handling strategy includes three stages of water treatment to EQS levels prior to discharge. • In the unlikely event that substances are present in the water for which treatment is not available at the terminal then specific treatment systems will be installed. In the meantime the water will be transported away from the terminal by road tanker for disposal by a licensed contractor. • Surface water discharge from unpaved areas and building roofs will be via settlement ponds	**NEGLIGIBLE** • Release of aqueous emissions to coastal waters. • Non-discernable effects would be confined to the immediate vicinity of the discharge point.
Generation of Wastes		
• Generation of small quantities of waste including office waste, paper, foul and grey water, canteen wastes, silty water and NORM. • Transportation of wastes will generate emissions comprising greenhouse gases and VOCs. • Use of finite landfill space and generation of CH_4 as waste breaks down in landfill.	• Waste will be stored securely, transported and ultimately disposed of in strict accordance with EU Regulations. • A Waste Management Plan will be developed and will record waste sources, methods for recording quantities, on-site storage and disposal method for all wastes. Consideration to be given to the segregation of waste, re use and recycling. Audits to be carried to ensure compliance with plan. • Waste disposal contractors to be audited to ensure they have the correct licences to carry and dispose of waste. • Hazardous waste will be analysed before leaving site. • All site personnel to receive training on the waste management plan.	**NEGLIGIBLE** • Small quantities of waste will use finite landfill space. • Short term, temporary increase of greenhouse gas emissions from landfill. • Small quantities of exhaust gases from vehicles taking waste for disposal.
Flora and Fauna		
• Habitat replacement and creation. • Recolonisation of the deposited peat. • Alien and ruderal species may colonise disturbed areas in the short term.	• Replacement and created habitats will be monitored to ensure successful implementation. • Adjacent habitats will also be monitored. • Vegetation management to control alien and ruderal species.	**BENEFICIAL** • Increase the representation of flora and fauna species. • Development of new communities leading to enhanced biodiversity.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
CONSTRUCTION PHASE		
Site Clearances and Preparation		
• Peat removal and transfer to deposition site. • Peat and soil stabilisation. • Cut and fill. • Piling. • Importation of gravel, rock fill, steel and ready-mix concrete • On site concrete batching plant if required (not currently being considered). • Import of equipment for terminal. • Noise from construction activities. • Vehicle emissions.	• Minor excavated material to be re-used on site; peat will go to a dedicated peat deposition site. • Installation of ponds in order to prevent sediment transport into local water courses. • Traffic Management Plan. • Dust control measures to be applied. • Minimise traffic noise through Traffic Management Plan. • Regulate hours for high noise operations. Liase with Mayo County Council and local residents in advance. • Minimise offsite removal, & import material for site preparation. • Traffic plan to reduce congestion.	**MODERATE** • Temporary significant increase in vehicle movements in the vicinity of the terminal and particularly between the terminal site and the peat deposition site. • Temporary noise associated with clearance, preparation and traffic movements.
Generation of Wastes		
Primary waste sources are: • Sewage. • Construction waste. • Domestic waste. • Water from ground dewatering. • Transportation of wastes will generate emissions comprising greenhouse gases and VOCs. • Disposal of wastes will use finite landfill space and generate CH_4 as waste decomposes.	• Sewage to be collected in portable facilities and removed and disposed of by licensed contractor. • Minimise construction and domestic waste through implementation of Waste Management Plan. The plan will determine the source, methods for recording quantities, on-site storage and disposal method for all wastes. Consideration to be given to the segregation of waste, re use and recycling. Audits to be carried to ensure compliance with plan. • All site personnel to receive training and tool box talks on the waste management plan. • Plan to be audited prior to construction and twice during construction period. • No construction camp - personnel will use local existing accommodation facilities • So far as is practicable, excavated material to be re-used within landscape works at the terminal. Peat to be taken to a dedicated deposition site. • Waste disposal contractors to be audited to ensure they have the correct licences to carry and dispose of waste. Procedures to be rationalised between the contractors working on adjacent sites to minimise transport effects.	**MINOR** • Re-use of construction compound material at the terminal will minimise the requirement for landfill and associated transport effects and use of finite landfill space. • Short term, temporary increase of greenhouse gas emissions from landfill.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Noise and Vibration		
Principal sources of noise and vibration are: • Ground preparation. • Construction activities. • Traffic. • Testing and commissioning.	• Noise controls specified to the construction contractors. • Careful planning of HGV movements. • Repair of local roads before and after use. • High noise operations planned in advance in consultation with Mayo County Council and notified in advance to affected local residents.	**MODERATE** • Temporarily increased noise levels to local residents during construction.
Air Emissions		
• Traffic movements – 400 return trips daily during peat removal. • Dust from traffic and ground preparation.	• Traffic Management Plan will help regulate traffic flow. • Vehicles will be serviced regularly to minimize emissions. • Dust suppression techniques such as spraying road and ground surfaces with water will be applied.	**NEGLIGIBLE** • Very localized and temporary decrease in air quality in vicinity of vehicle movements but well within air quality standards.
Impact on Local Residents and Visitors		
• Presence of construction operation.	• Contractors to notify and erect signage to inform recreational users and visitors of construction works and access or other restrictions.	**NEGLIGIBLE** • Short term temporary effects during the construction period.
Use of Local Services		
Increase in use of: • Bed and Breakfast accommodation. • Self catering accommodation. • Local services. To date €1,000,000 has been spent on local goods and services as a result of the Corrib project. Each construction worker is expected to spend €8,000/year locally.	• Contractor to use local suppliers wherever possible.	**BENEFICIAL** • Beneficial increase in trade for local suppliers and services over the construction period.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Flora and Fauna		
• Clearance of site will result in the loss of existing vegetation. • Construction/operational disturbance to fauna. • Release of phosphates when peat disturbed. • Sediment release affecting aquatic fauna.	• Timing of works to minimise disturbance. • Careful planting with native species. • Additional field surveys. • Monitor phosphate levels at silt ponds and peat repository. • Adherence to proposed pollution and sediment control measures.	**MINOR** • Long term low level of disturbance to fauna. • Long term loss of low ecological value habitat. • Terminal site is essentially reclaimed bog with wet grassland, and remnant conifer plantation. Site of low ecological value.
Employment		
• Approximately 500 people will be employed over the 2 year construction period.	• Contractors to employ local people wherever possible with the appropriate skills.	**BENEFICIAL** • Positive effect on local employment
Use of Natural Resources		
Terminal construction will require the use of: • Potable water. • 70,000m^3 imported crushed rock. • Fuel. Construction will generate: • 200,000m^3 mineral soils, terrace deposits and weathered rock. • 450,000m^3 of peat	• Excess cohesive and granular material to be re-used as fill for ancillary site works. • Peat to be transferred to designated deposition site. • Imported rock will be similar to the local geology. • Maintain engines to ensure optimal operation and use 'greener' fuels where practicable.	**MODERATE** • Not considered to be unduly unusual for a project of this size and type
Archaeology		
• Site clearance and peat extraction.	• Archaeological watching brief during peat removal from the site.	**MINOR** • Unlikely to be any impacts on archaeology. • No known archaeological monuments listed on SMR for the site. • No visual archaeological features. • Previous forestry practices likely to have destroyed any sites below peat.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Visual Impact		
• Site establishment requires removal of existing landscape features. • Construction activities will include the presence of large plant and cranes.	• Retention of existing vegetation to be maximized. • Large plant and cranes to be removed from site when no longer required.	**MINOR** • Temporary visual disturbance due to construction activities.
Aqueous Discharges		
Principal sources of aqueous discharge are: • Surface water run-off which may be silt enriched. • Small volumes of water from de-watering operations.	• Discharge will be via silt ponds, which are provided with equipment to contain any spillages of oil and fuel.	**NEGLIGIBLE** • Release of uncontaminated water to local watercourses.
DECOMMISSIONING AND AFTER-USE		
Noise and Vibration		
Principal sources of noise will be: • Decommissioning activities.	• Adherence to set noise limits. • Monitoring.	**MINOR** • Temporary elevated noise levels but less extensive than during construction phase.
Waste		
• Waste materials from disassembly of the terminal.	• Options for reuse and recycling will be considered before the facility is dismantled. • The site will be checked for contamination; if contamination is found, the foundations and other non-soil type material will be removed to a depth of 1 metre below grade.	**NEGLIGIBLE** • Some waste will be sent to landfill and use finite landfill space. • Small quantities of exhaust gases from vehicle use for waste disposal.
Land Use		
• Final land use to be determined after cessation of operational activities.	• EIA will be undertaken. • Environmental Management Plan will be prepared and implemented.	**NEGLIGIBLE** • Reversion of land to semi- natural habitat is likely unless an alternative beneficial use is identified.
Hydrology		
• Slight increase in groundwater vulnerability due to peat removal.	• Issue to be considered in decommissioning plan. • Any contaminated ground to be removed.	**NEGLIGIBLE**

The term 'ecosystem' in the above table can be taken to mean the physical environment and the biological communities that live within that environment. Typically impacts to populations and communities are considered rather than impacts to individuals. However, in certain cases involving threatened or endangered species, impacts to individuals may be of greater concern.

17.3 Screening Assessment of the Sources of Impacts and the Residual Effects

A screening assessment of the sources of impacts associated with normal operations is presented in Table 17.2. This provides a summary of the control and mitigation measures incorporated into the development, the nature of the residual effect and the relative significance categories.

Operation

- noise;
- visual impact;
- air emissions;
- bulk liquids storage;
- chemicals management;
- employment and use of local goods and services;
- the outfall and associated discharges;
- generation of wastes;
- flora and fauna.

Construction

- site clearance and preparation;
- generation of wastes;
- noise and vibration;
- air emissions;
- local residents and visitors;
- use of local services;
- flora and fauna;
- employment;
- use of natural resources;
- archaeology
- visual impact;
- aqueous discharges;

Decommissioning and After Use

- noise and vibration;
- waste;
- land use;
- hydrology.

17.4 Assessment of Impact Interactions

All environmental factors inter-relate to some extent. Interactions between impacts have been addressed in Sections 5 – 16 of this volume of the Environmental Impact Statement.

They are too numerous to summarise in this Section but Figure 17.2 gives an indication of the type of interactions presented by a project such as the Bellanaboy Bridge Terminal. The figures demonstrate the consequential nature of impacts and the inherent inter-relationship between the physical, natural and human environment.

Figure 17.1 Permanent land-take – Interactions with the Human and Natural Environment

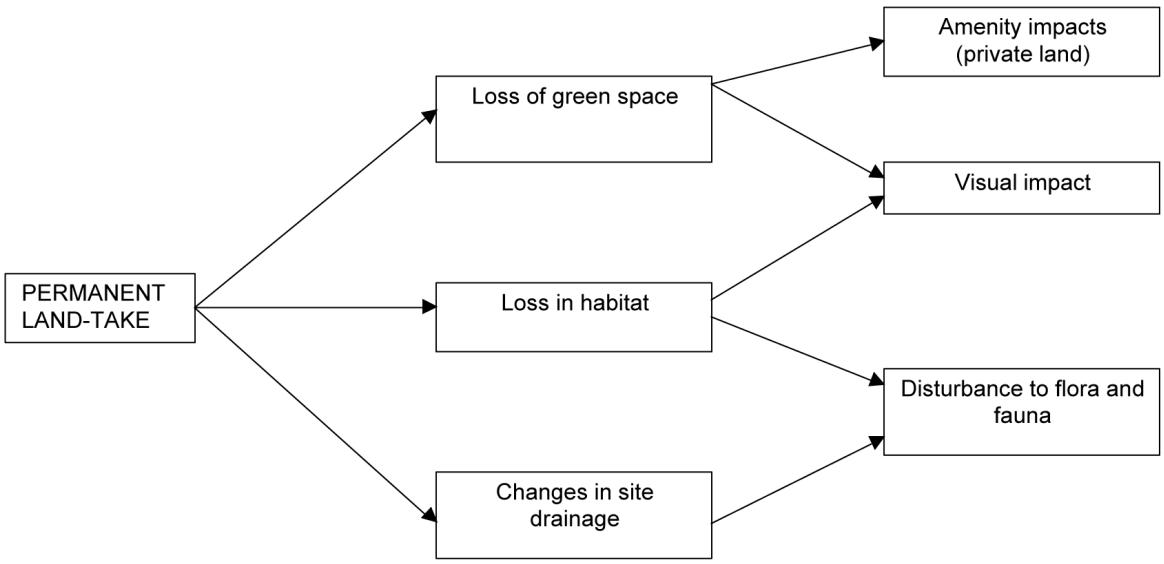


Figure 17.2 Construction Phase – Interactions with Human and Natural Environment

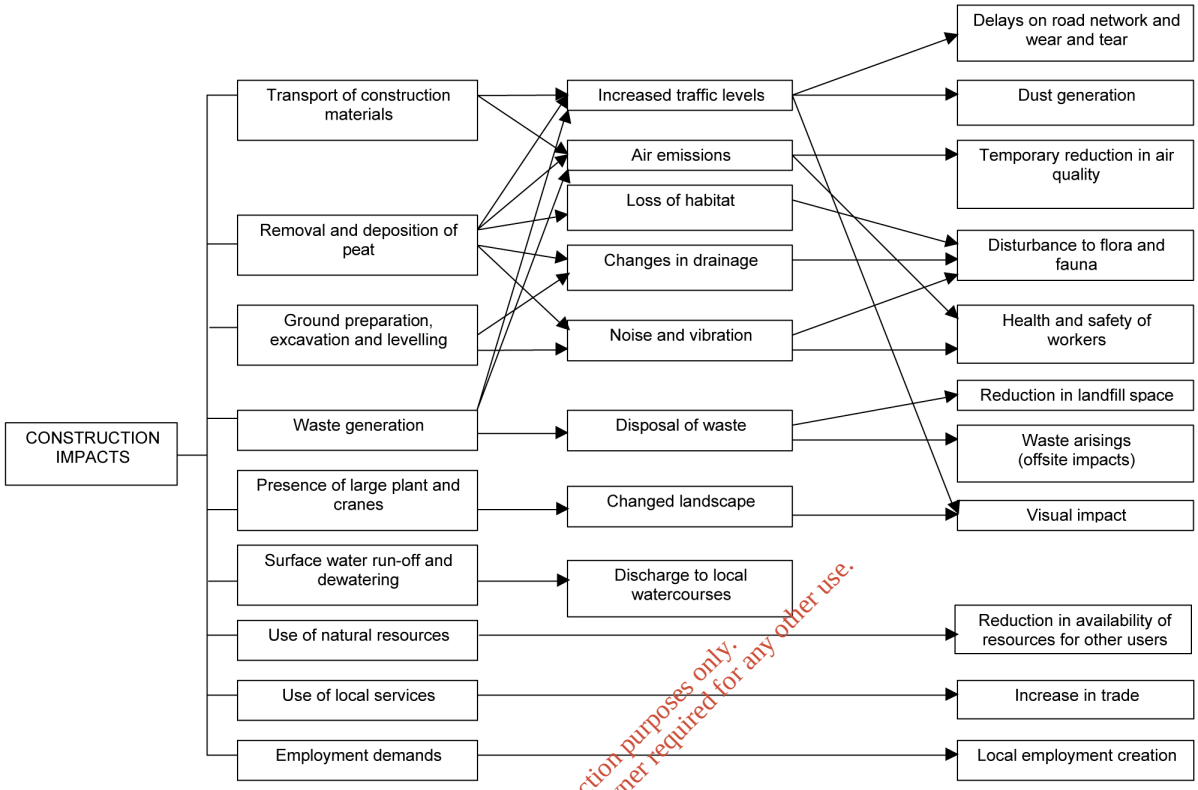


Figure 17.3 Operational Phase – Interactions with the Human and Natural Environment

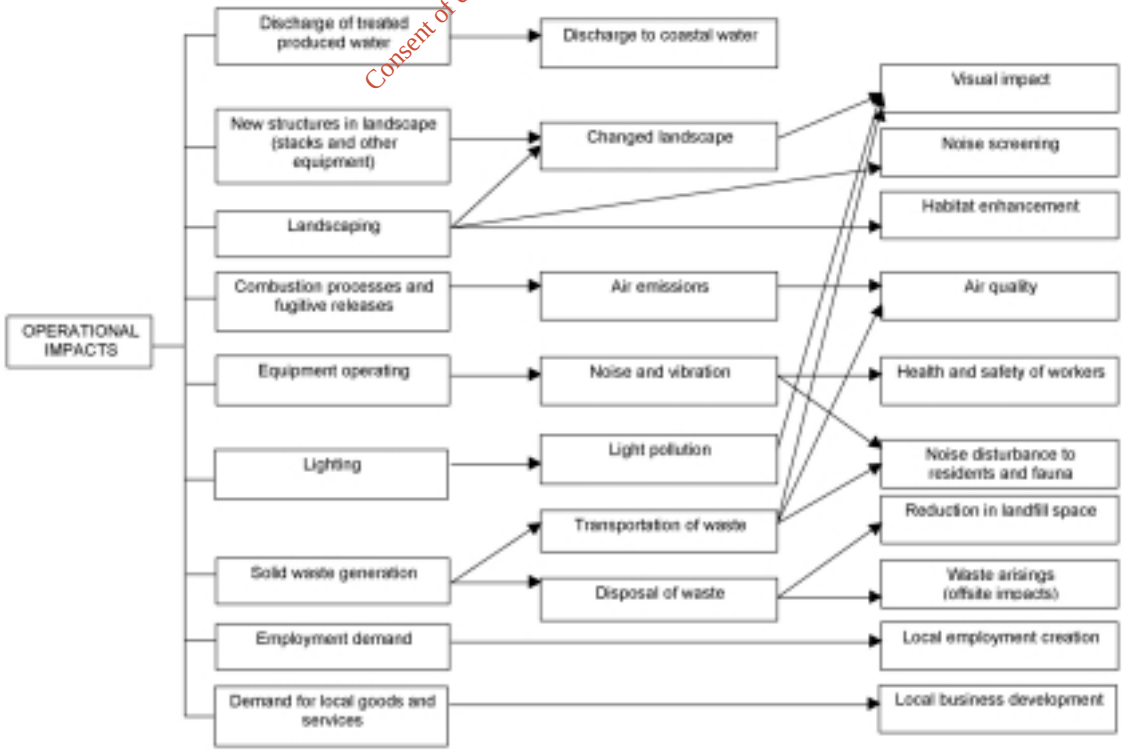


Table 17.3: Probability, Consequence and Risk Categories Used for Assessment of the Non-Routine Events

Probability Category Response Requirement /Ecological Consequence	A Possibility of repeated incidents	B Possibility of isolated incidents	C Possibility of occurring sometime	D Not likely to occur
I (extended duration / full scale response) Severe	Higher Risk	Higher Risk	Higher Risk	Medium Risk
II (Serious / significant resource commitment) Major	Higher Risk	Higher Risk	Medium Risk	Medium Risk
III (Moderate / limited response of short duration) Moderate	Higher Risk	Medium Risk	Medium Risk	Low Risk
IV (Minor / little or no response needed) Minor / Negligible	Medium Risk	Low Risk	Low Risk	Low Risk

17.5 Non routine Events

17.5.1 The Environmental Risk Assessment Process

Table 17.3 presents a matrix for risk assessment used in determining the likely risk of the upset condition and accidental events that could occur. A screening assessment for upset conditions and accidental events is presented in Section 17.5.2.

The assessment of risks for abnormal operations and accidental events, collectively called non-routine events, utilises the probability, consequence and risk categories presented in Table 17.3.

In Table 17.4 Potential hazard scenarios are identified and the risk of their occurrence and the subsequent consequences are assessed in terms of impacts on the environment.

17.5.2 Assessment of Non-Routine Events

Non-routine events include those associated with upset conditions and those associated with emergency / accidental events.

The key hazard scenarios identified as likely to lead to emergency / accidental events are summarised in Table 17.4.

Table 17.4 The key hazard scenarios for potential emergency / accidental events

Release of flammable gas from process system
Release of flammable liquid Release of condensate Release of product and wet methanol
Chemical, waste or fuel spill / Discharge of unacceptable levels of waste, and effluents Spillage resulting from failure of equipment or personnel error or inadequate storage and containment
Operation of flare during emergency such as pipeline blowdown or during testing and commissioning.

For the purpose of this environmental risk assessment these hazard scenarios have been categorised in accordance with the consequential effects that would result from these hazard scenarios.

The plant will be a lower tier site under the Seveso II Directive as the quantities of hazardous materials on site are above the lower tier threshold but below the top tier threshold.

The summary of the findings of the environmental risk assessment of the sources of effect associated with the key hazard scenarios is presented in Table 17.5.

Table 17.5: Environmental Risk Assessment of the Effects Associated with the Key Hazard Scenarios

Source / Scale of Effect	Control and Mitigation	Environmental Consequence and Overall Risk Category
Terminal Operations		
• Release of flammable gas from process system	• Each process area can be isolated using Emergency Shutdown valves.	• Ecological Consequence Category: III (MODERATE) • Probability Category D • Overall Risk Category: LOW
• Release of flammable liquids. Release of condensate. Release of product and wet methanol	• All storage tanks are bunded, the bund capacity being 110% of the tank volume or 25% of the total volume of all tanks in the bund (whichever is the greater).	• Ecological Consequence Category: I/II (MEDIUM/SEVERE) • Probability Category D Overall Risk Category: MEDIUM, high if associated with a fire.
Waste and Wastewater Handling		
• Chemical, waste or fuel spill / Discharge of unacceptable levels of waste, and effluents Spillage resulting from failure of equipment or personnel error or inadequate storage and containment	• Routine inspection and monitoring of equipment and discharge effluents in accordance with IPPC. • Procedures in place. • Training of personnel. • All processes are BAT	• Ecological Consequence Category: IV (Minor) • Probability Category: B • Overall Risk Category: Low • Consequence dependent on the nature of the material. Effluents could lead to toxic effects on terrestrial and aquatic habitats.
Operation of Flare		
• Operation of flare during emergency such as pipeline blowdown or during testing and commissioning.	• Flare designed and located in order to have minimal impact on the environment.	• Ecological Consequence Category: IV (MINOR) • Probability Category C • Overall Risk Category: LOW

Eighteen

Cumulative Impacts

18 Cumulative Impacts

18.1 Introduction

This section considers the cumulative impacts that the proposed terminal development could cause through interaction with the construction and operation of the other elements of the Corrib project and with other developments in the area. It has been prepared by RSK ENSR Environment Ltd using the 'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions', prepared for the European Commission (DG X1) and the EPA Advice Notes on Current Practice.

18.2 Identification of Other Developments in the Vicinity

Information relating to the other elements of the Corrib project has been provided by Shell and their consultants. Other developments in the vicinity of the Bellanaboy Bridge Terminal have been identified through discussion with statutory and non-statutory consultees.

18.2.1 Corrib Project

The Corrib natural gas field development has four distinct elements:

- offshore: which comprises the seabed installations, offshore pipeline and an 9km pipeline from the landfall to the terminal site;
- terminal: the subject of this EIS;
- onshore: the 150km Mayo to Galway Pipeline that will export gas from the terminal to the national gas grid near Craughwell in Co Galway; and
- peat removal and deposition, covered in a separate volume of this EIS.

The construction and operation of the Bellanaboy Bridge Terminal therefore forms one part of the overall development of the Corrib natural gas field. Potential impacts resulting from construction of the offshore facilities/pipeline, the Mayo-Galway onshore pipeline and the peat deposition site are addressed in separate Environmental Impact Statements but have the potential to interact with impacts resulting from construction of the Bellanaboy Bridge Terminal. Impacts arising from the upgrading the haul road and moving the peat from the terminal site to the deposition site are addressed in this EIS but are also included in this section as peat removal will be a substantive off-site operation.

18.2.2 Other Developments

Other known developments in the vicinity that may interact with the Bellanaboy Bridge Terminal have been identified as:

- the construction of a small (approximately 68 MW) gas-fired power station at Bellacorick, which has planning permission. The power plant will burn natural gas from the Mayo to Galway pipeline. The construction schedule is therefore tied to the availability of this pipeline, which links to the Corrib development;
- the proposed demolition of the ESB peat-fired power station at Bellacorick which is due to close by 2005; and
- the possible development of a wind farm on the site of the ESB peat fired power station at Bellacorick, if planning consent is upheld. The application, which is the subject of an appeal to An Bord Pleanála, is for 192 turbines and would be developed over a 10-year period. Construction would begin after decommissioning of the peat-fired power station.

Figure 18.1 shows the location of the proposed developments that are considered in this section.

18.3 Study Methodology

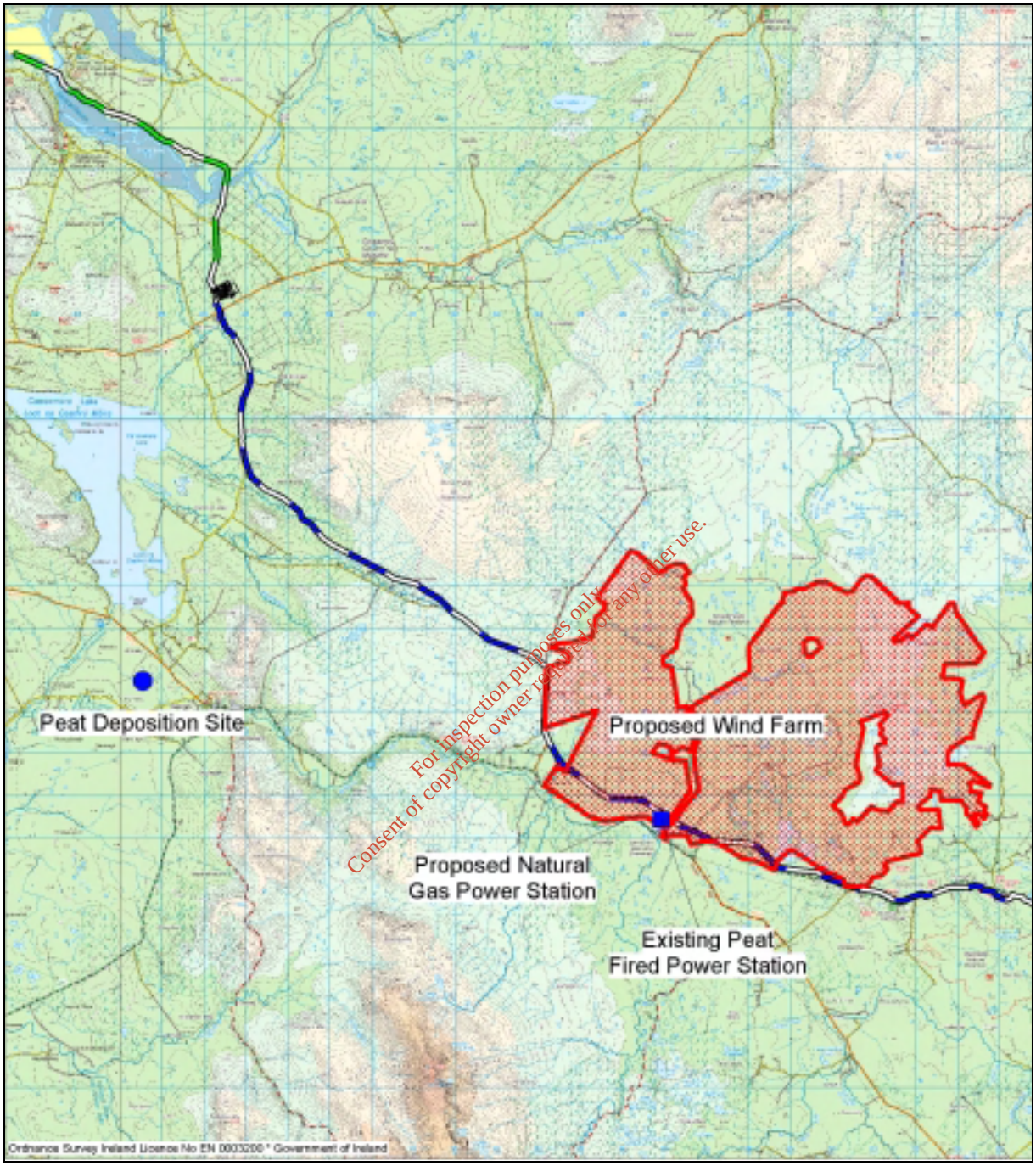
Information about the various large scale developments proposed for the local area were obtained from their respective Environmental Impact Statements and from internet sources. It is not considered that small-scale developments such as new house building, retail or small-scale industrial developments would contribute significantly to the cumulative impacts arising from this development. A review of the proposed construction programmes for each development was undertaken to identify projects that may run concurrently.

The main impacts resulting from the other developments were then assessed for their potential to interact with impacts resulting from construction and operation of the Bellanaboy Bridge Terminal. The assessment used a combination of matrices and expert judgement.

18.4 Potential for Interactions of the Proposed Developments

The offshore and onshore elements of the Corrib project are dependent on the terminal and the associated peat deposition site receiving planning permission. It is possible, however, that BGE will construct in advance the southern portion of the pipe, from Craughwell to a block valve station, which would allow gas to be supplied to Galway City.

Figure 18.1 Future Known Permitted Development in the Vicinity of the Terminal



It is likely that construction of all four phases of the Corrib project will run concurrently. However, construction of the onshore pipeline will take place over two years and it is expected that construction of the section closest to the terminal will be during the second year.

Construction of the gas-fired power station is dependent on the availability of Mayo to Galway pipeline. For the purposes of this assessment, it has been assumed that construction of the power station will run concurrently with construction of the Bellanaboy Bridge Terminal, which represents the worst case scenario.

The peat-fired power station is scheduled for closure by 2005. It is assumed that demolition at Bellacorick will therefore begin sometime after this date but the proposed programme is unknown.

Figure 18.2 Provisional Construction Programmes (Worst Case Scenario)

	2004			2005				2006				2007
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Peat Removal and Deposition Site												
Terminal												
Offshore Facilities and Landfall Pipeline												
Mayo to Galway Pipeline (northern section)												
Gas Fired Power Station							?	?	?	?	?	?
Peat Fired Power Station Demolition				?	?	?						
Wind Farm												

	Construction
	Commissioning
	Operation
?	Timing Uncertain

Construction of the wind farm will spread over a five-year construction period and will begin sometime after decommissioning of the peat-fired power station. In order to assess the worst case scenario it have been assumed that the construction of the wind farm may run in parallel to demolition of the peat-fired power station.

Figure 18.2 shows the above programmes and illustrates the potential for cumulative impacts associated with construction of the projects to be greatest during 2005 when most of the construction schedules may coincide.

The potential for cumulative impacts associated with operation of the Bellanaboy Bridge Terminal will not arise before January 2007. Once the terminal is operational, it is anticipated that only impacts from the proposed gas-fired power station and wind farm will have the potential to interact with impacts from the terminal. This is because the offshore and onshore pipelines will be buried and unmanned, and demolition of the peat-fired power station is likely to be complete.

18.5 Predicted Cumulative Impacts and Interactions

Tables 18.2 and 18.3 illustrate the potential for cumulative impacts for the terminal development as a consequence of its interaction with the other developments. Those environmental aspects for which a potential interaction has been identified are discussed below.

18.5.1 Human Beings

The concurrent construction of the terminal and other projects will result in a greater number of employment opportunities than identified for the terminal alone (see Section 5, and Table 18.1 below). This will create opportunities to enhance the local skills base and to attract training initiatives. Associated positive economic impacts will include significantly increased demand for local services and accommodation.

Once operational, there will be a smaller, but sustained demand for local employees and the projects will continue to contribute to the local economy.

The promoters of the Corrib project, the gas-fired power station and the wind farm have all made commitments to support the local community. Taken collectively, this support is likely to have substantially more impact than the sum of the individual contributions.

Table 18.1 Employment Numbers

Projects	No. of People Employed	
	Construction	Operation
Terminal including peat removal and deposition	500	50
Offshore facilities and landfall pipeline	200 - 300	Specialists periodically
Bellacorick Gas Fired Power Station	130	15 skilled
Power Station demolition	Unknown but assumed to be low	0
Wind Farm	100+ over 5 years	20

Table 18.2 Cumulative Impacts During the Construction Phase

	Offshore Facilities and Landfall Pipeline	Mayo to Galway Pipeline	Gas Fired Power Station	Power Station Demolition	Wind Farm	Peat Removal and Deposition
Humans						
Flora & Fauna						
Geology & Soil						
Hydrology						
Archaeology & Cultural Heritage						
Air						
Noise						
Climate						
Landscape						
Material Assets – waste & aggregates						
Material Assets – traffic & roads						

Key

Significant negative impact
Moderate negative impact
Slight negative impact
Neutral
Slight positive impact
Moderate positive impact
Significant positive impact

Table 18.3 Cumulative Impacts During the Operational Phase

	Gas Fired Power Station	Wind Farm
Humans		
Flora & Fauna		
Geology & Soil		
Hydrology		
Archaeology & Cultural Heritage		
Air		
Noise		
Climate		
Landscape		
Material Assets – waste & aggregates		
Material Assets – traffic & roads		

Key

Significant negative impact
Moderate negative impact
Slight negative impact
Neutral
Slight positive impact
Moderate positive impact
Significant positive impact

18.5.2 Flora and Fauna

The cumulative impacts on flora and fauna will be negligible. There will be a small additive impact in terms of temporary loss of natural habitat, but this will be offset by the extensive peat restoration plans associated with the wind farm development and the habitat creation plans associated with the terminal proposal.

The road to the east of the Carrowmore Lake complex will be used as a haul road to take peat from the terminal site to the proposed peat deposition site at Srahmore and will also be used to provide access to the Mayo-Galway pipeline. However, no cumulative impact on this SAC is anticipated as these activities are unlikely to coincide: peat disposal will be primarily during the first year of terminal construction and construction of the northern section of the Mayo-Galway pipeline is scheduled for the second year of terminal construction.

18.5.3 Hydrology

During construction there will be an increased risk of contaminating local watercourses and Carrowmore Lake, either through sediment run off or fuel/chemical spillage.

Each individual project is committed to stringent pollution prevention measures which are considered sufficient to address any cumulative impact. The presence of several projects in the same locality can provide an opportunity for enhanced spill response through the pooling of resources.

No cumulative impacts are anticipated during operation, as the terminal site is sufficiently remote from the proposed gas-fired power station and the wind farm.

18.5.4 Archaeology and Cultural Heritage

The cumulative impact on the archaeological resource will be additive rather than synergistic. However, the pooled knowledge gained from investigation of each of the development sites will enhance synergistically the understanding of the local area.

18.5.5 Air

During construction, all the projects have the potential to generate dust during dry conditions and all will create vehicle emissions. It is not possible to quantify this cumulative impact, but as it is temporary and relatively short term, it is considered unlikely to be significant.

Once operational, the emissions of NO_2 from the terminal and the power station could potentially interact and could cause a deterioration of air quality. However, the distance between the facilities (10

miles) and the prevailing wind direction (south westerly) will make interactions infrequent. Furthermore, closure of the peat-fired power station will reduce the SOx and PM_{10} emissions in the area and will precede commissioning of the terminal and gas-fired power station.

Operation of the terminal and the gas-fired power station will be subject to monitoring programmes, which will provide the basis for ensuring that emissions are within approved limits irrespective of other developments in the locality.

18.5.6 Climate

Emissions of CO_2 and CH_4 from the terminal and gas-fired power station will jointly contribute to global warming as discussed in Section 14. This contribution will, however, be eclipsed by the reduced CO_2 emissions resulting from closure of the peat-fired power station.

18.5.7 Noise

During construction there will be increased noise and vibration from traffic associated with each of the projects. In terms of cumulative impacts this will be most significant during the period when peat is being taken from the terminal site to the deposition site.

Once operational, the terminal is sufficiently remote from the proposed power station and wind farm to preclude cumulative noise impacts.

18.5.8 Landscape and Visual

The simultaneous construction of the terminal, the two associated pipelines, the gas-fired power station and the wind farm will result in increased disturbance to the local landscape. This impact will be temporary, as the lands in which the pipelines are constructed will be fully reinstated as soon as practical after construction and the terminal and power station sites will be landscaped.

Once operational, the terminal, power station and wind farm will remain visible but cannot be seen together from any viewpoint.

18.5.9 Material Assets

During construction there will be an accelerated depletion of local aggregate resources and filling of waste disposal sites. The total quantities of aggregate used and waste disposed by the individual projects will be additive, and concurrent projects may cause a temporary strain on these resources. Forward planning and effective communication with the aggregate and waste site managers should alleviate this.

Construction traffic associated with all the developments will result in increased traffic volumes. This may cause delays to other road users as well as increased noise and vibration. Increased traffic will be most noticeable during the initial works when the peat is being transferred to the deposition site. The R313, R314 and the Bangor-Bellanaboy L1204 local road will be most significantly affected. There may also be some interaction with traffic using the N59 to access the developments at Bellacorick.

One option for construction of the Mayo-Galway pipeline is to use aggregate for creation of the temporary running strip in areas of soft ground. If this is implemented and the Bunnahowen quarry is used to supply the aggregate, it is estimated that there could be 205 additional HGV movements in each direction, six days a week over a three to six month period. A few of these vehicles would use the R314 but most would use the R313. Construction of this section of the Mayo-Galway pipeline is programmed for the second construction season so is unlikely to coincide with peat movements from the Bellanaboy Bridge Terminal.

18.6 Consequential Development

In addition to the potential for cumulative impacts arising from known developments in the vicinity of the terminal, it is necessary to consider the potential for effects resulting from consequential development. Consequential developments are defined as those that would be unlikely to occur in the absence of the primary development (in this case the Bellanaboy Bridge Terminal). An example of this is the proposed gas fired power station at Bellacorick.

Construction of the terminal and its associated pipelines will make natural gas more widely available within Ireland particularly in the north west region. It is inevitable that there will be further pipeline installation works throughout the country to enable residents and businesses to use natural gas as a fuel.

The terminal may also lead to new commercial developments that use gas as a fuel stock and for modifications at existing premises that currently use other fuels. A range of parameters including market forces, planning policy, land availability, workforce availability and infrastructure will determine the location for any new developments. The majority will be outside the local area; further industrial development in north west Mayo cannot be precluded but will need to be consistent with the local planning framework.

Such developments could change the pattern of land use (primarily through conversion from agricultural to industrial) and increase pressure on natural habitats

and landscape character. However, all such developments will be subject to planning application, and in many cases may require Environmental Impact Assessment. There would be a general increase in employment opportunities, with consequential increased support for local communities and community activities, local businesses and service providers.

18.7 Do Nothing Scenario

If the proposed development did not proceed, there would be no cumulative impacts with other developments. There would be no development of the Craughwell to Bellanaboy gas pipeline, and there would be no development of the Rolls Royce gas-fired power station. The peat deposition site would be rehabilitated in accordance with Bord na Móna's rehabilitation plan (IPCL 505).

18.8 Mitigation Measures

The project team intends to work closely with the project managers of other concurrent development projects to pre-empt and resolve any conflicts in terms of use of aggregates and waste disposal sites and to manage traffic flows.

18.9 Monitoring

It is not proposed that any monitoring will be undertaken specifically for cumulative impacts. However, monitoring will be undertaken, where required, for the individual phases of the Corrib natural gas field project.

18.10 Reinstatement and Residual Impacts

There will be no reinstatement undertaken specifically for cumulative impacts. Reinstatement measures will be implemented where required, for the individual phases of the Corrib natural gas Field project.

Nineteen

Sustainable Development

19 Sustainable Development

19.1 Introduction

The Local Government (Planning and Development) Act, 2000 restricts a Planning Authority, when making a decision in relation to a planning application, to consideration of the proper planning and sustainable development of the area. The compliance of the Corrib terminal project with the principles of sustainable development is reviewed in this section.

Sustainable development is a very broad concept that has become widely used in recent years, particularly following the Earth Summit in Rio de Janeiro in 1992. It was defined in 1987 by the Brundtland Commission report as:

'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

Ireland's National Sustainable Development Strategy, published in 1997, aims "to ensure that the economy and society in Ireland can develop to their full potential within a well protected environment, without compromising the quality of that environment and with responsibility towards present and future generations and the wider international community". The Strategy discusses the meaning of sustainable development, which it states is increasingly recognised as the key to managing economic and environmental interdependence. It is neither a fixed concept nor a narrowly defined process, but an approach in which:

- the exploitation of resources;
- the direction of investments;
- the orientation of technological development; and
- institutional changes are made consistent with future as well as present needs.

Various strategic actions have been identified. Those actions that are relevant to industry include:

- promotion of energy efficiency in industry;
- 14% of energy supply from renewables by 2010;
- total national greenhouse gas emissions limited to 13% above 1990 levels by 2010 – measures introduced to reduce greenhouse gas emissions;
- NOx and SOx emissions limited;
- IPPC introduced;
- increased focus on waste prevention and minimisation;
- producer responsibility to encourage reuse and recycling of wastes; and
- development of a materials and energy balance for industry to determine the full extent of industry's environmental/natural resource impacts and advise on targets for greater eco-efficiency.

Other relevant National strategic priorities include:

- development of a competitive energy supply industry;
- security of indigenous energy supply; and
- balanced regional development.

19.2 Shell Sustainable Development Policy

As well as complying with national goals through the planning process, Shell aims to contribute to sustainable development in their activities in Ireland in full compliance with the requirements of the Shell Group Sustainable Development Principles (July 1999):

- respect and safeguard people;
- engage and work with stakeholders;
- deliver value to customers;
- minimise impact on the environment;
- use resources effectively;
- maximise profitability; and
- maximise benefits to the community.

In order to apply these principles to the Corrib project, a sustainability appraisal has been carried out using a sustainability checklist that has been developed by the Building Research Establishment (BRE) in the UK (in the absence of an equivalent framework having been developed in Ireland).

19.3 BRE Sustainability Checklist

The BRE checklist has been developed for construction of the built environment and applies weightings to different environmental, economic and social impacts in order to assess the sustainability of construction. These weightings, shown in Table 19.1, have been agreed through extensive consultation with the construction industry's main stakeholders.

The BRE issues have been mapped against the Shell Sustainable Development Principles, as shown in Table 19.1. There are two assumptions which have been made for this review:

- Although the checklist has been developed for the built environment, the checklist will be applied to the Corrib project, as a similar checklist for gas infrastructure is unavailable; and

- The weightings have been developed for construction activities. As equivalent weightings have not been developed for gas terminal operations, these construction weightings have also been applied to the operational phase of the project.

19.4 Sustainability Appraisal: Comparison Between "Project" and "No Project" Scenarios

A comparison has been made between the project and "no project" scenarios, as shown in Table 19 3. Impacts against the Shell Sustainable Development Principles and highest weighted BRE issues have been compared.

19.5 Contribution to National Sustainable Development Priorities

A further assessment of the extent to which the project complies with Ireland's National Sustainable Development Objectives has been carried out as follows.

Promotion of Energy Efficiency in Industry

The availability of an alternative gas supply may encourage the development of combined cycle electrical generation plants and combined heat and power plants which are more energy efficient than conventional power plants and steam generation plants.

The terminal equipment installations have been chosen to optimise power generation and minimise power and fuel consumption. Energy management will be incorporated into the environmental management system for the terminal.

Total national greenhouse gas emissions limited to 13% above 1990 levels by 2010 – measures introduced to reduce greenhouse gas emissions

The project supports Ireland's proposed National strategic fuel switch from solid fuel and oil to natural gas and renewables and so contributes to Irelands target to limit national greenhouse gas emissions while ensuring security of energy supply.

NOx and SOx Emissions Limited.

SOx and NOx emissions from the terminal will be mitigated as described in Section 11. As the terminal will serve to encourage a national fuel switch from oil and coal towards gas, this is likely to result in lower NOx and SOx levels nationally.

Increased Focus on Waste Prevention and Minimisation

A waste management plan has been developed for construction and operation phases, implementing Shell's waste hierarchy policy.

During operations, biological sewage treatment will be carried out using a sustainable "Puraflow" system.

The gas from Corrib provides the opportunity to displace the combustion of coal and peat, which produce solid residues requiring disposal.

Producer Responsibility to Encourage Reuse and Recycling of Wastes

The project will reuse excavated peat to regenerate a cutover peat land where it will stabilise and integrate into new wetland habitats.

Maximum reuse of excavated material will be made onsite as fill or for landscaping.

19.6 Impact on Other National Priorities Related to Economic and Social Development

Development of Competitive Energy Supply Industry

The project will increase competitiveness in the domestic energy market.

Security of Indigenous Energy Supply

The project will help ensure security of gas supply for Ireland throughout the life of the field, as the project will provide an alternative supply of gas should the interconnector supply from the UK be interrupted.

By increasing competitiveness in the domestic energy market, this may serve to displace gas imports, further securing long term energy supply.

Balanced Regional Development

The project will serve to promote the development of the Northwest of Ireland, thus promoting more balanced regional development, as follows:

- by providing employment during construction and operation;
- by providing a demand for local and regional services during construction and when in operation; and
- by providing the opportunity for Bord Gáis to supply gas to local towns, thus making the region more attractive to inward investment and

giving local industries the opportunity to become more competitive.

19.7 Outcomes of the Appraisal

This high level appraisal gives an overview of how each scenario impacts on sustainable development. Table 19.3 shows that the project complies more favourably with Shell's sustainable development principles compared to the "no project" option.

Furthermore, the project contributes positively to Ireland's National sustainable development objectives.

Table 19.1 BRE Weightings Against Sustainability Issues (Issues with Highest Weightings Shaded)

Theme	Sub-Theme	Issue	Weighting %	Shell SD Principle
1. Environment	1.1 Global Issues	Climate change	8.4	Minimise impact on the Environment.
		Acid deposition	1.1	
		Ozone depletion	1.8	
		Toxic air pollution	1.4	
		Fossil fuel depletion	2.0	Use resources effectively.
		Marine water pollution	1.2	Minimise impact on the Environment.
		Habitats and eco-systems	3.9	
	1.2 Local and Site Issues	Local air pollution	2.6	
		Water pollution	1.7	
		Contaminated land	1.2	
		Noise pollution	1.2	
		Dust pollution	0.2	
		Minerals extraction	0.8	Use resources effectively.
		Fossil fuel extraction	0.7	
		Water extraction	1.2	
		Waste disposal	1.4	Minimise impact on the Environment.
		Waste recycling	1.8	
		Transport pollution and congestion	3.5	
		Habitats and eco-systems	2.7	
		Forestry	0.6	Use resources effectively.
		Farming	0.4	Maximise benefits to the community.
	1.3 Internal Environment	Health	2.6	Respect and safeguard people.
		Comfort	1.2	
2. Economy	2.1 Construction	Profitability	2.3	Maximise profitability
		Employment	3.3	Maximise benefits to the community.
		Productivity	1.4	Maximise profitability/ Deliver value to customers.
		New build	1.2	N/a
		Refurbishment	2.5	
		Maintenance and repair	2.1	
		Overseas competitiveness	0.8	Maximise profitability
	2.2 Construction materials	Profitability	2.2	Maximise profitability
		Employment	2.6	Maximise benefits to the community.
		Productivity	1.4	Maximise profitability / Deliver value to customers.
		Product Value	2.0	Deliver value to customers.
		Overseas competitiveness	1.2	Maximise profitability
	2.3 Infrastructure	Energy and water	2.7	Maximise benefits to the community.
		Telecommunications	1.7	N/a

Theme	Sub-Theme	Issue		Weighting %	Shell SD Principle
	2.4 Building Stock	Stock value	Housing	1.7	
			Industrial	1.4	
			Commercial	1.4	
			Other	0.3	
3. Social	3.1 Equity	Social exclusion	Affordable housing	1.6	Maximise benefits to the community.
			Healthy housing	1.6	
			Employment	5.6	
			Security	2.3	
			Education	3.2	
			Worship	0.2	
			Transport	1.0	
	3.2 Community	Urban	Identity stewardship	2.5	Maximise benefits to the community.
			Integration	1.4	
			Consultation	0.7	Engage and work with stakeholders.
		Transport	Cities	1.4	N/a
		Town and rural communications		2.7	

Source: BRE Digest 446 Assessing Environmental Impacts in Construction (2000)

Table 19.2: Comparison of GWP Emissions (CO2 equivalents) from the Terminal with Some UK Terminals

Source	Type	Year	GWP (tonnes)	Ratio to Terminal (GWP)	GWP/ mean GWP
Terminal (Corrib)		max	69,480	1.00	0.61
BP Amoco	CATS Terminal, Seal Sands, Teeside	1999	83,827	1.21	0.74
BP Amoco	Natural Gas Terminal, Bacton, Norfolk	1999	52,035	0.75	0.46
BHP Billiton	Point of Ayr Terminal, Talacre, North Wales	1999	68,111	0.98	0.60
BP*	Wytch farm, Poole, Dorset	1999	95,504	1.37	0.84
BP	Easington Shore Terminal, Yorkshire	1999	100,600	1.45	0.88
Conoco Philips	Theddlethorpe Gas Terminal, Maplethorpe, Lincolnshire	1999	130,790	1.88	1.15
Hydrocarbon Resources	Barrow Terminal, Barrow-in-Furness, Cumbria	1999	226,966	3.27	1.99
Phillips Petroleum	Bacton Gas Terminal, Norfolk	1999	277,194	3.99	2.43
Shell	Gas Terminal, Bacton, Norfolk	1999	35,060	0.50	0.31

Table 19.3: Comparison of "Project" Versus "No Project" Scenarios Against Sustainable Development Priorities

SD priorities	Scenario 1 Project - Gas produced locally; local terminal.	Scenario 2 No Project - Gas imported via interconnector from UK. Gas produced either in UK, Europe or non-EU countries. The latter will involve LNG conversion.
Shell SD Principles/ Key BRE issues		
Minimise impact on the Environment. • Climate change • Global habitats & ecosystems • Transport pollution & congestion • Local habitats & ecosystems • Local air pollution	Energy from gas conforms with Ireland's long-term energy switch from solid fuel to gas to renewables. The provision of gas infrastructure will discourage future investment in alternative coal or oil infrastructure. Overall, the local production of gas has a lower environmental impact compared to importation, due to lower transmission energy losses. If Bord Gas decides to supply local towns with gas, this could result in a shift from peat/coal/oil/LPG to natural gas in order to meet energy needs in NW Ireland. Since gas is a cleaner fuel, this will result in lower environmental impacts. HSE in the supply chain - purchasing policy addresses HSE issues by issuing HSE questionnaires to potential contractors. Specific impact against BRE issues: In terms of greenhouse gas emissions, the terminal has a lower Global Warming Potential (GWP) than the average GWP for other terminals shown in Table 19.2. Replanting of trees, including native species, will compensate for local habitats & ecosystems loss. Congestion from construction traffic will be reduced through a detailed traffic management plan and through clear signage of proposed routes. Emissions arising from the project complies with EU environmental legislation. Other mitigation measures listed in rest of EIS.	Importation of gas from Europe and non-EU countries could lead to greater environmental impacts as follows: • Some non-EU countries have less stringent environmental legislation compared to EU • Introduction of further processing through LNG conversion • Added energy loss impacts associated with long distance transport

SD priorities	Scenario 1 Project - Gas produced locally; local terminal.	Scenario 2 No Project - Gas imported via interconnector from UK. Gas produced either in UK, Europe or non-EU countries. The latter will involve LNG conversion.
Shell SD Principles/ Key BRE issues		
Use resources effectively. Fossil fuel depletion	Although the project involves the exploitation of local finite gas resource, it will discourage the use of more carbon intensive fuels and is in line with the National energy switch from solid fuel to gas to renewables. Use of gas close to its source rather than gas transported thousands of km will be more energy-efficient. The resource use associated with terminal construction & operation is discussed in the rest of the EIS: water use, reuse of excavation material.	The "no project" option will still involve exploitation of a finite gas resource. The resource use associated with terminal operation will still apply for overseas gas export terminals. Long distance gas transport and LNG conversion/storage will involve added fossil fuel resource use.
Respect and safeguard people. Employee Health	A risk-based approach will be applied to Health & Safety. In order to manage safety risks, a Major Accident Prevention Policy (MAPP) will be prepared for operation of the terminal. The influx of temporary workers during construction may have a negative impact on the Gaeltacht nature of the area. Longer term during the operation of the terminal, there will be a language plan to foster the Irish language.	The safety risks associated with gas supplied via the interconnector from the UK will be similar to those associated with the project. Risks may be higher for gas imported from non-EU countries due to the possibility of less stringent H&S legislation. No impact on the Gaeltacht status.
Deliver value to customers.	The project will help ensure security of gas supply for Ireland throughout the life of the field, as the project will provide an independent supply of gas that will not be affected if the interconnector supply from the UK is interrupted. The project will also increase competitiveness in the domestic energy market which may keep costs lower than they would be in the absence of such competition.	Ireland is at the very end of the European gas grid, which is supplied to a large extent from Algeria and Siberia. There is risk of interruption of gas supply to Irish customers as Ireland is virtually totally dependent on imported gas.
Maximise profitability. Profitability (construction & supply chain)	The project must be economically viable in order to go ahead. Costs and scheduling are therefore tightly managed.	N/a
Maximise benefits to the community. • Employment (construction & supply	Direct Benefits	If the project does not go ahead, there will be no opportunity to supply gas to local towns in

SD priorities	Scenario 1 Project - Gas produced locally; local terminal.	Scenario 2 No Project - Gas imported via interconnector from UK. Gas produced either in UK, Europe or non-EU countries. The latter will involve LNG conversion.
Shell SD Principles/ Key BRE issues		
chain) • Identity stewardship • Integration with local area • Education/training	The supply of gas from Corrib would effectively enhance security of supply should there be any interruptions to Ireland's gas supply via the interconnector from the UK. The local community will realise both temporary and sustained benefits of increased employment during construction and operation. The employment created during the operation of the terminal will provide the opportunity for some local people to remain in the area rather than have to move to other parts of Ireland or overseas for employment. It is possible that local people will fill not all of the jobs created. These jobs will be filled by people who will move into the area, augmenting the local communities and increasing the support for local schools, shops, other local businesses, sports clubs and other community activities. Other community benefits, impacts and mitigation measures are discussed in Section 5. Use of local contractors - EU legislation requires large projects to be advertised across Europe, which restricts the sole use of Irish contractors. The project has, however, encouraged the further use of local subcontractors by facilitating a workshop in Ireland where contractors were introduced to local Irish suppliers. Indirect Benefits The gas pipeline from the Corrib terminal will create the opportunity for the Bord Gáis to build a distribution system to supply gas to towns and industries along the route of the pipeline. The availability of natural gas could serve to make these towns more attractive for inward investment and boost the economy of the region by providing a supply of clean, relatively cheap fuel. These towns and industries do not have sufficient demand to	N & NW Ireland and therefore no potential inward investment locally. Thus, lagging economic development will continue in the area. There will also be no temporary employment opportunities and no incoming families to augment the local community. All other localised social benefits and impacts will be avoided. Natural gas needs will rely solely on gas imports, with less security of supply. An interruption to supply would result in significant socio-economic impact both for customers and for Ireland.

SD priorities	Scenario 1 Project - Gas produced locally; local terminal.	Scenario 2 No Project - Gas imported via interconnector from UK. Gas produced either in UK, Europe or non-EU countries. The latter will involve LNG conversion.
Shell SD Principles/ Key BRE issues		
	justify the cost of construction of a gas pipeline in the absence of the Corrib project. The project has resulted in a proposed development of a gas fired Rolls Royce power station at Bellacorrick and may result in the development of further regional power station projects and the development of an improved electricity supply system. Consultation with stakeholders showed that on average most people within the wider community were in favour of the project.	
Engage and work with stakeholders. consultation	Community consultation – Since the beginning of the project, the project team has carried out ongoing consultations with the local community in the form of public exhibitions, group meetings and individual consultations where local people were invited to express their views and key concerns relating to the project. Such concerns have been incorporated into the EIS. The project has gained widespread community support in the locality and the Northwest region An Environmental Monitoring Group has been established to continue consultation during the construction & operation phases. Engaging the supply chain - the project team has made efforts to integrate HSE awareness into the supply chain by issuing HSE questionnaires as part of the supplier selection process.	N/a

Key:

Better performance against SD principle or priority		**Lower performance against SD principle or priority**		**Insufficient data to compare performance**	

Twenty

Environmental Management

20 Environmental Management

20.1 Introduction

Shell's approach to Environmental Management is to apply the key principles of environmental protection management to all of their operated oil and gas activities. These principles include:

- prior assessment of environmental impact;
- minimisation of potential impact through design and other mitigation controls;
- monitoring the effectiveness of controls set; and
- auditing of performance.

This section of the EIS documents how these principles have been applied by Shell to the proposed terminal site and the pipeline, umbilical and outfall between the landfall and the terminal.

20.2 Shell HSE Policy and Commitments

Shell's environmental standards are set by the Shell Group's Health, Safety and Environmental (HSE) Policy.

The Shell E&P Ireland Managing Director has signed off against this policy and further commits each member of staff to the duty of living this policy and to halting activities believed to threaten safety, health or the environment.

The Policy commits Shell to:

- pursue the goal of no harm to people;
- protect the environment;
- use material and energy efficiently to provide our products and services;
- develop energy resources, products and services consistent with these aims;
- publicly report our performance;
- play a leading role in promoting best practice in our industries;
- manage HSE matters as any other critical business activity; and
- promote and culture in which all Shell employees share this commitment.

To support these commitments, Shell will:

- have a systematic approach to HSE management designed to ensure compliance with the law and to achieve continuous performance improvement;
- set targets for improvement and measures, appraise and report performance;
- require contractors to manage HSE in line with this policy;
- require joint ventures under its operational control to apply this policy and to use its influence to promote it in other ventures; and
- include HSE performance in the appraisal of all staff and reward accordingly.

These environmental commitments encompass the environmental philosophy that will be applied by Shell to all aspects of the proposed terminal development.

20.3 Construction of Terminal

The approach to the management of the environmental impacts associated with the construction phase of the terminal places a considerable responsibility on the engineering and construction contractors. These responsibilities will be incorporated into the contracts that will be issued for the works.

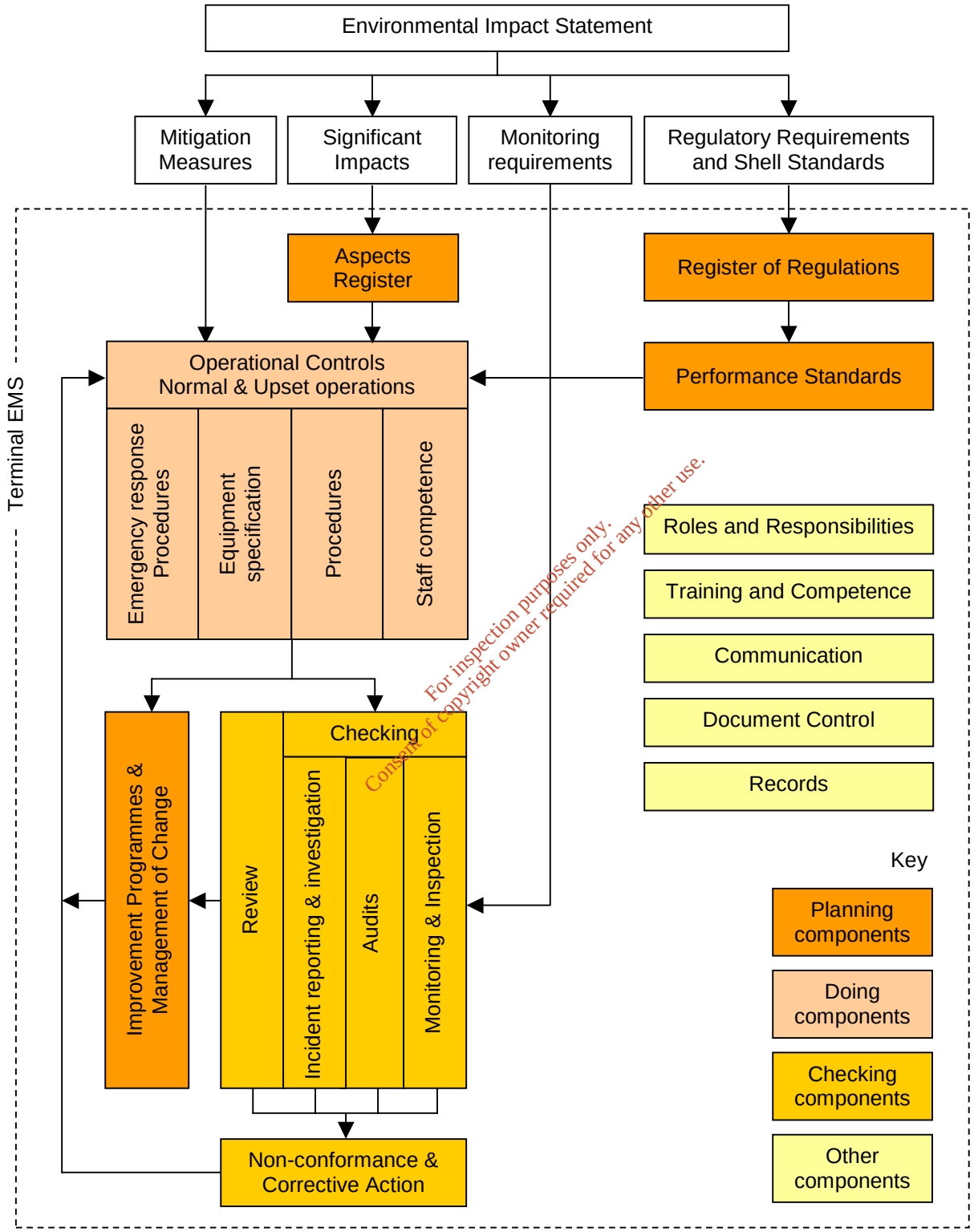
Shell will provide the Contractor with this EIS and require the Contractor to develop and implement an Environmental Management System (EMS) for the construction activities. This EMS will be the means by which the construction phase mitigation measures identified in Section 16 will be implemented.

In addition, Shell will collaborate with the Contractor to develop an HSE Bridging Document. The purpose of this document will be to describe the roles and responsibilities of the Contractor and Shell respectively, and set out the arrangements for assurance (communication, reporting, monitoring and auditing, etc.).

20.4 Terminal Operation

Terminal operation will be the direct responsibility of Shell. Shell will develop and implement an EMS for terminal operations. This will be based on the company's Corporate HSE Management System and meet the environmental standards set out in the Shell Group Health, Safety and Environmental Policy. Figure 20.1 illustrates the relationship between the EIS and the different components of the EMS. The following sections expand on the figure to describe the approach and principles applicable to each part, broadly following the structure of ISO 14001 as a recognised reference for EMSs.

Figure 20.1: Diagram illustrating the Terminal EMS and its relationship with the EIS.



20.4.1 Environmental Impact Statement

The EIS provides four key inputs to the terminal EMS:

- the definition of significant impacts;
- regulatory requirements and Shell standards;
- monitoring requirements; and
- mitigation measures proposed to address the significant impacts.

These will be used to create the Terminal Aspects Register, the Register of Regulations and the Terminal Monitoring Programme. Together with other inputs, including the IPPC Licence conditions, the set of Operational Controls that will manage the terminal activities which might cause environmental impacts, will also be created.

20.4.2 Aspects Register

The EMS will include a documented procedure designed to create and maintain the terminal's Aspects Register. The identified impacts from the EIS will provide an input to this procedure, and it will be maintained as a reference as more detailed information about the operation of the terminal becomes available.

20.4.3 Register of Regulations & Performance Standards

The EMS will include a register of the consents and permits to operate that are required under Irish Law. It will record the operating conditions that apply to the terminal as they relate to its environmental impacts. In addition, the Register will record any other operating requirements applicable to the terminal that may, for example, be a requirement of Shell Policy.

This part of the EMS will define the performance standards that Shell will apply to the activities and processes that have significant environmental impacts.

20.4.4 Operational Controls

The terminal's operational controls will be designed to manage the impacts due to normal operations as well as during plant upset or emergency conditions. The controls will be the means by which the mitigation measures specified in the EIS will be incorporated into the terminal operations. For normal operations, they will be based on a combination of:

- the design of facilities and process equipment;
- Written procedures to control operations to minimise impacts; and
- The competence of the personnel with responsibilities for process control.

The definition of operational controls will not rely exclusively on the mitigation measures identified in the EIS. The results of further HAZID and HAZOP studies will be incorporated into the suite of controls, ensuring that the controls are specified at the appropriate level of detail.

The aspects register will specify the operational controls that apply to each significant aspect.

Control during plant upset or emergency conditions will be detailed in emergency response procedures.

Oil Spill Contingency Planning

The terminal is designed to treat gas; no oil will be produced from Corrib. However, there are other materials at the site with the potential for oil spill scenarios, which include the following:

- diesel;
- lube oils;
- hydraulic oils;
- methanol; and
- condensate.

None of the above is likely to generate large spills, as they will all be located in bunded areas.

In the case of any spill, the response follows three stages:

1. Initial response - ensure safety of personnel and installation and prevent escalation of incident;

2. Characterise spill in terms of size and likely environmental impact (e.g. toxic, harmful); and

3. Develop response tactics based on character of spill.

The terminal will establish a spill contingency plan and hold appropriate response equipment in the case of emergency.

20.4.5 Improvement Programmes and the Management of Change

The purpose of improvement programmes is to:

- drive the Shell policy commitment to continuous improvement, and
- introduce changes that ensure the achievement of performance standards where current performance is below expectations.

The EMS will also make provision for the management of change. Change may occur for a number of reasons, and at a number of levels. A 'management of change' procedure will specify the circumstances when formal control of change is required to ensure that significant impacts remain under control and/or new impacts are identified, evaluated and controlled, e.g. the management of future decommissioning.

20.4.6 Decommissioning

Decommissioning of the Corrib field facilities and the terminal is expected to take place after 2026. It is outside the scope of this EIS to present a detailed assessment of the decommissioning options. This will form an integral component of the decommissioning process. Shell will prepare a Best Practical Environmental Option study that will comparatively assess the technical, cost, health, safety and environmental aspects of each decommissioning option.

Subject to EPA approval as a condition of the IPPC licence, the facilities will be decommissioned in accordance with applicable national and international regulations in force at the time.

An Environmental Management Plan will be prepared to include procedures based upon the outcome of a hazard and operability (HAZOP) study. Procedures will be developed for:

- contingency measures to cope with the worst case scenario identified during the HAZOP and risk assessment; and
- routine environmental issues such as waste management, chemical storage, auditing and monitoring.

An environmental impact assessment will be undertaken to identify any specific impact on the local environment. Any environmental controls that may be found to be necessary to protect the surrounding environment will be implemented.

All recovered equipment and materials will, where suitable, be refurbished and re-used or disposed of in accordance with national and international regulations in force at the time.

At present it has not been decided if any monitoring is required after decommissioning. This will be considered as part of the decommissioning study. Proposals for decommissioning activities will be subject to the approval of the Petroleum Affairs Division, DCMNR, Mayo County Council, the EPA, and the relevant statutory and non-statutory consultees.

20.4.7 Monitoring & Inspection

Checking techniques employed within the EMS will be a combination of monitoring, inspection activities and periodic audits.

The requirement for monitoring and inspection stems from the need to provide information to a number of different stakeholders, including regulators, the local community and Shell management. As such there is a requirement for the results of monitoring and inspection to be integrated with the terminal's internal and external communication programme.

Monitoring and inspection activities will focus on:

- Checks that process parameters remain within design boundaries – *process monitoring;*
- Checks that emissions and discharges remain within specified performance standards – *emissions monitoring; and*
- Checks that the impacts of emissions and discharges are within acceptable limits – *ambient monitoring.*

The monitoring programme for the terminal will take account of the recommendations included in each section of the EIS. Table 20.2 summarises these monitoring recommendations.

20.4.8 Audit

In contrast to monitoring and inspection activities, audits are designed to shed light on the underlying causes of error, and not merely detect the error itself. In addition, audits are the main means by which system and performance improvement opportunities may be identified.

The terminal EMS will include an audit procedure to control the definition of an audit programme and the approach to internal audits and the reporting of findings. The frequency and scope of audits and other checking techniques in the programme will be informed by the relative significance of the impacts and the processes and activities that cause them.

The terminal will also be subject to 3rd party audits, by EPA under the IPPC licence, Shell Group, or in compliance with other external certification programmes (e.g. ISO 14001). The terminal audit programme will record these 3rd party audits and manage their findings in the same way as internal audits.

Audits will focus on both management systems and operational controls.

Table 20.1: Matrix Illustrating a Selection of Possible EMS Roles and Responsibilities for Some Terminal Staff.

	Staff & Teams / EMS Element	Collective responsibilities					Individual responsibilities					
		Shell Board	Terminal Management Team	Production Teams	Maintenance Teams	Contractor Liaison	Terminal Manager	HSE Manager	Prodⁿ & Maintⁿ Supervisors	Operators	Supply Chain Manager	HR Manager
Planning	Policy	S	S				L	S				
	Aspects and Impacts			S	S			S				
	Regulations and Consents			S				L				
	Objectives & Improvement Programmes		L	L	L	S		S		S		
Doing	Operational Control					S		S	L	L	L	
	Emergency Preparedness & Response		S						L	L		
Checking	Monitoring					S		S		L		
	Non-conformance & Corrective Action		S	S	S	S		S		L		
	Records							S		L	L	L
	Audit			S	S	S		L			S	
	Review	S	L	L	L		S	S				
Other	Training & Competence							S	L			S
	Communication & reporting		L	S	S	S		L			L	

L = Lead role; S = Supporting role

20.4.9 Incident reporting & investigation

The terminal EMS will include documented procedures to control the reporting and investigation of incidents.

20.4.10 Non-conformance and Corrective Action

The checking techniques outlined above are the means of detecting error or non-conformances. The EMS will include a procedure for the formal recording and reporting of detected non-conformance, the definition of appropriate corrective action, and the allocation of responsibilities and monitoring of close out.

20.4.11 Review

The terminal EMS will include arrangements for management review. This will provide the means to ensure that the EMS remains an effective tool to

control the environmental impacts of operations, and to re-configure the EMS in the light of internal or external change affecting the scope or significance of the impacts.

Of particular importance is the role management review will play in the definition and implementation of the terminal's improvement programme, and the management of change.

20.4.12 Roles and Responsibilities

Shell will define environmental roles and responsibilities for terminal staff and these will be documented in the EMS and in individual job descriptions. The roles and responsibilities will refer to each component of the EMS. For the purposes of illustration only, Table 20.1 presents a possible allocation of roles and responsibilities without implying any particular management structure for the terminal.

20.4.13 Training and Competence

The competence of staff with environmental responsibilities is a critical means of control. The EMS, in conjunction with Shell Human Resources will ensure the appointment of suitably competent staff and develop and implement training programmes to ensure that environmental control requirements are understood and applied.

20.4.14 Communication

Internal environmental communication will generally employ existing channels such as management meetings, minutes, poster displays, etc.

External communication with interested parties (stakeholders) will be controlled through a communication programme. This will establish links between each stakeholder, the issues (environmental aspects) that are of concern to them, and the information they require to assure them that their concerns and expectations are being addressed. This EIS and the consultation process that informed its production is being used to design the on-going communication programme and a project office is in place in Belmullet. Responsibilities for communication with key stakeholders will be allocated within the EMS, with appropriate means of communication specified.

20.4.15 Document Control

The control of EMS documents will be specifically addressed within the terminal's comprehensive document control system.

20.4.16 Records

Records provide the evidence of conformance with the requirements of the EMS and of the achievement of the objectives and targets in the Improvement Programmes. The EMS will specify those records that are to be generated for these purposes, and control their creation, storage, assess and retention.

An annual environmental report will be prepared in accordance with IPPC Licence conditions. This will include a register of emissions.

Table 20.2 Monitoring Requirements Derived From the EIS

Issue	Emission or Ambient Monitoring	Description
General		• Environmental Monitoring Group to be set up to discuss and monitor results of the environmental monitoring programme. • A programme of audits and inspections.
Flora and Fauna (Terrestrial)	Ambient	• Monitor habitat replacement and habitat creation at appropriate intervals during the initial years of operation. • Monitor adjoining areas, especially designated conservation areas. • Work will be undertaken in consultation with NPW. • All vegetation (shrub/woodland) clearance will be monitored by experts to check for badger setts and otter holts.
Aquatic Ecology		• Contaminants in sediments around sea outfall and in embayments. • Bio-monitoring for contaminant accumulations in selected biota from around the outfall and shoreline or mussels and selected macroalga from around the outfall and shoreline.

Issue	Emission or Ambient Monitoring	Description
		• Freshwater biological monitoring programme of the Bellanaboy River. • Quarterly macro-invertebrate kick sampling/monitoring at Bellanaboy Bridge site. • Benthic invertebrate diversity and abundance. • All monitoring to be agreed with the NWRFB. • Mitigation to be monitored at appropriate intervals during the initial years of operation, including impacts on adjoining areas, including designated conservation areas.

Water	Emission	• Regular flow proportional sampling with spot measurement in the discharge of the produced water and oily water treatment facilities. Monitoring of the process effluents for:
		  • flowrate;
		  • pH;
		  • Temperature; and
		  • TOC (surrogate for COD/BOD).
		• Frequent flow proportional sampling (periods to be determined) for:
		  • Total oil.
		  • oil in water;
		  • ammonical and total nitrogen;
		  • suspended solids;
		  • phenols;
		  • sulphides; and
		  • metals (typically Cd, Hg, Cr, Ni, Zn, Cu and As).
		• A fuller analysis covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits.
		• The monitoring programme will be subject to an IPPC licence agreement.
		• Surface and groundwater monitoring.
		• Mitigation measures to be monitored at appropriate intervals during the initial years of operation.
		• Water quality of silt ponds to be monitored.
		• Daily sampling and analysis of parameters in the treated water stream.
		• Collected rainwater in containment bunds and storage vessels to be analysed prior to discharge.
		• Used firewater collected in firewater retention pond and tested prior to discharge.
		• Continuous monitoring of flow, pH and conductivity together with daily sampling and analyses of other parameters in the treated produced water stream.
		• All settlement ponds will be inspected at least weekly, and initially daily, and de-silted where necessary.
		• Silt ponds will be monitored electronically for turbidity and phosphate to identify any upset condition.
		• Fifteen points for surface water monitoring will be established in consultation with the NWRFB and sampled on a regular basis.
		• Six of the eight groundwater monitoring boreholes to be used to check pollution during construction. These will be left in place as long-term monitoring points.

Air	Ambient	• Possible installation of air quality monitoring equipment in the vicinity of local housing after the terminal has commenced operation.

Issue	Emission or Ambient Monitoring	Description
	Emission	• Stack emissions will be monitored at source in accordance with the requirements of the IPPC licence. • Dust monitoring stations to be erected between the site and local residences during the construction phase.
Noise	Ambient	• Continuous monitoring at a minimum of two locations will be required during construction. This will be hourly and daily data logged, downloaded, summarised and reported weekly. Other investigations will be conducted as required (eg piling vibration). • Comprehensive commissioning survey will be required on plant completion according to IPPC requirements, with snagging actions if required. Plant noise to be audited at 6-month intervals thereafter, or following introduction of any significant plant or process change.
Landscape and Visual Impact	Ambient	• Landscape re-instatement aftercare monitoring to last for up to 5 years. Subject to contractual procedures which should be agreed with the Planning Authority. • Regular inspections at least once every four months during the aftercare period. • Post-planting monitoring as part of a Shell Landscape Management Plan throughout the lifetime of the project.
Cultural Heritage	Ambient	• Monitoring to recognise and record any archaeological feature revealed by the peat extraction. The degree of archaeological monitoring required will be decided in consultation with Mayo County Council and NPW.
Waste	Emission	• A Waste Management Assessment Programme will be set up to control the monitoring and auditing of waste, including waste licensing and consignment notes. • Waste management audits to be carried out weekly. • All waste will be sampled and monitored for classification for hazardous material. The analysis will include •oil content •water content •mercury •copper •zinc •arsenic •cadmium •nickel •chromium •lead •benzene •toluene •xylene •methanol
Traffic	Ambient	• Monitor the route used by heavy vehicles and the load they are carrying. • Mud on roads to be monitored. • Pre and post construction road condition survey.
Climate		• Monitoring as required by the IPPC licence. • Annual emissions calculations prepared as part of the site Annual Environmental Report.
Human Beings		• Monitoring of the local accommodation database to enhance sustainable tourism and minimise impacts.

Issue	Emission or Ambient Monitoring	Description
Soils		• Periodic monitoring of the peat to detect evidence of shrinkage, desiccation and consolidation.
Process Control & Health & Safety		• Alarms designed in to plant to monitor operational parameters such as flow, temperature, pressure and liquid level. • Gas detectors fitted in process areas and air intakes to buildings and on any equipment with ignition sources. • Smoke and fire detectors in all buildings. • CCTV monitoring of site for security purposes. • Emergency Plan to be regularly tested. • Site connected by telemetry to an Emergency Response Centre.
Decommissioning		• All areas to be checked for contamination prior to decommissioning works.

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Glossary

Glossary of Terms & Conversion Tables

Term	Description
µm	Micrometer, 1/1000th of a millimetre
µg/l	Micrograms per litre, or parts per billion (10^9).
µg/m^3	Micrograms per Cubic Metre.
ADMS	Atmospheric Dispersion Modelling System – a software application developed by Cambridge Environmental Research Consultants.
AFFF	Aqueous film- forming foam
Alluvium	Detrital material, commonly composed of sands and gravels, transported and deposited by a river
Ameliorate	Taking measures to diminish a negative impact.
Anticline	Fold or fold system in the form of an arch.
AOD	Above Ordnance Datum.
API	American Petroleum Institute.
Appraisal well	A well drilled to determine the physical extent, reserves and likely production rate of a field.
Artesian	Groundwater that is confined in an aquifer, but which may overflow on to the land surface via artificial boreholes or, sometimes, natural springs, because of the high hydraulic head that may be developed in a confined aquifer
Aquifer	Any stratum or combination of strata that stores or transmits groundwater (Local Government (Water Pollution) Act, 1990). More Commonly: A permeable geological stratum or formation than can both store and transmit water in significant quantities.
Aquitard	A rock with low values conductivity, which allows some movements through it, but at rates of flow lower than those of adjacent aquifers.
Auger	A tool for boring holes.
Back-filled	The filling of a void which was formed as part of a construction activity
Bar	A metric unit of pressure.
Bar g	Bars above atmospheric pressure.
Baseline survey	A survey describing the existing environment, against which future changes can be measured.
BAT	Best Available Techniques
BATNEEC	Best Available Techniques Not Entailing Excessive Costs.
bbl	Barrels.
bbl/s	Barrels per second.
Bedding	Layers within sedimentary rocks characterized by differences in composition, texture or structure.
Benthos	Organisms that live on or in the seabed / the seabed itself.
Bentonite	A naturally occurring clay mineral.
Berm	Bank or bund.
BGE	Bord Gáis Éireann.
BH	Borehole.
Biocides	Chemicals which destroy living organisms within the pipeline during hydrotesting.
Biomonitors	Organisms used to monitor the abundance of contaminants in aquatic environments.
BOD	Biochemical Oxygen Demand.
boepd	Barrels of oil equivalent per day.
BOP	Blowout preventor.
BP	Before the present.
BPEO	Best Practicable Environmental Option.
Bronze Age	c.2300 BC to 500 BC.
Bscf	Billion standard cubic feet, $10^9 ft^3$.

Term	Description
BTEX	Benzene, Toluene, Ethyl Benzene, and Xylene (four light organic compounds).
Bund	An earth embankment.
BWI	BirdWatch Ireland.
Cairn	A burial mound composed of stones, sometimes with internal structures.
Carboniferous	A geological period of time, stretching from 362 to 290 million years before the present.
Catchment Area	The area from which rainfall flows in to a river
Catchment	The collection of rainfall
Cd	Cadmium.
CH_4	Methane.
Children's burial ground	A burial ground used for unbaptised children, and others who could not be buried on consecrated ground. Graves are sometimes marked with simple stones and burials are occasionally set within earlier enclosures, or outside church sites
Choke	A variable valve, used to control flow.
Christmas Tree	The assembly of fittings or valves on the top of the casing which controls the production rate from the well.
Cist	A box-like structure of stone, set into the ground or into a burial monuments, used to contain the burial.
Clean burn	Lean premix combustion system reduces pollution by limiting the formation of nitrogen oxides (NOx) and carbon monoxide (CO).
CO	Carbon monoxide.
CO_2	Carbon dioxide.
COD	Chemical Oxygen Demand.
Commissioning	Bringing a project or process into full operation.
Competent Authority	An agency charged with examining an Environmental Impact Statement, with a view to issuing a Consent to Develop.
Completion	The installation of permanent downhole and wellhead equipment and materials.
Condensate	Hydrocarbons which are in the gaseous state under reservoir conditions and which become liquid when the pressure or temperature is reduced. A mixture of pentanes and up.
Condensate Stabilisation	The mechanism of expansion and heating of condensate. The mechanism of depressurising and heating condensate to evaporate its lighter components such that it will not evaporate further, i.e. is stable, when stored at atmospheric pressure and ambient temperature
Condensed water	See water of condensation, below.
Conductivity	The conductivity of water reflects the mineral salt content of water and is an expression of its ability to conduct an electric current.
Contaminants	Constituents of the treated wastewater discharge with the potential to create impacts on the marine receiving waters. Also, constituents of surface water runoff and ground water discharge with the potential to create impacts on surface water downstream of the Terminal and Peat Repository sites
Corrosion inhibitor	A liquid added to the offshore system in small quantities to prevent corrosion of the steel pipes and equipment.
Court tomb	A megalithic tomb dating to the Early Neolithic period, so called because of its large open court feature with a gallery leading into a long, trapezoidal cairn.
Corrugated plate interceptor (CPI)	A piece of equipment which is part of the waste water treatment process.
Cretaceous	A geological period of time, stretching from 146 to 65 million years before the present.
CRTN	'Calculation of Road Traffic Noise': Department of Transport & The Welsh Office, 1988, is the standard document on which road noise measurement

Term	Description
	and calculations are based.
cSAC	Candidate Special Area of Conservation.
Cuttings	Rock chippings cut out from the formation by the drill bit, and brought to the surface with the mud.
CXT	Conventional christmas tree.
DAF	Dissolved air flotation.
DAFOR	Ecological abundance classification (D - Dominant; A - Abundant; F - Frequent; O – Occasional and R - Rare.)
Daily cover	Material used as a cover on top of a pile of spoil at the end of a working period.
dB $_{LA90}$	The average minimum level of noise, often used to describe the background noise.
dB $_{LAmax}$	The maximum sound pressure level recorded over the period stated.
dB$_{LAeq}$	A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period.
DCQ	Daily Contract Quantity.
Decommissioning	The final closing down of a development, project or process when it has come to the end of its useful life.
Deep-Tine Cultivation	The use of blades pulled behind a tracked vehicle, to loosen compacted soils.
Deluge Systems	Fixed piping systems, located above process equipment, with spray nozzles at regular intervals and fed from the firewater main, which spray water onto the equipment, either to put out a fire or to cool equipment threatened by a nearby fire.
Depletion profile	A production profile that assumes gas from the field is produced as quickly as possible, consistent with proper reservoir management and good oil and gas industry practice.
Deposition site	The site at Srahmore where peat excavated from the Bellanaboy Terminal site will be deposited.
(Well-Point) Dewatering	A method used for artificially lowering groundwater levels via pump extraction.
Dewpointing	Manipulation of the condensation point of gas.
Dip	The angle in degrees between a horizontal plane and an inclined feature such as rock strata.
Drift	A general name for the superficial as distinct from the solid formation of the earth's crust or material deposited by a glacier.
Drilling Rig	A drilling unit that is not permanently fixed to the seabed, e.g. a drillship, a semi-submersible or a jack-up unit or a soil and rock boring machine used for site investigation and monitoring point installation on the Terminal and Peat Repository Sites.
DMRB	'Design Manual for Roads and Bridges - Environmental Assessment' 1993 gives additional information on assessment methodologies for both noise and vibration generated by road transport systems.
Dry Gas	Natural gas composed mainly of methane with only minor amounts of ethane, propane and butane and little or no heavier hydrocarbons in the gasoline range.
DST	Drill stem test.
Earthwork	Any monument made entirely or largely of earth or material removal and filling as part of the site construction.
Earthworks Area	An area within the terminal site and surrounding the terminal footprint in which the topography will be altered during site preparation. It has an area of 24 hectares.
Easement	Permanent wayleave negotiated with the landowner.
EC	European Commission.
EDP	Emergency Disconnect Package.

Term	Description
EEIL	Enterprise Energy Ireland Limited.
Efficiency	The power output of a machine per unit power input. Usually expressed as a percentage.
EIA	Environmental Impact Assessment.
EIS	Environmental Impact Statement.
ELV (Emissions Limit Value)	The concentration of a contaminant which is permitted by the legislation, at the point of final discharge.
EMP	Environmental Management Plan.
EMS	Environmental Management System (e.g. under the ISO 14001 series).
Enclosure	Any monument consisting of an enclosing feature, such as a bank or a ditch, usually earthen, such as barrows or ringforts.
ENVID	Environmental Impact Identification
Environmental Impact Assessment/Statement	A systematic study which identifies and predicts the effects of a project on the bio-geophysical, social and economic environment of a project.
Environmental Quality Standards	see EQS, below.
EPA	Environmental Protection Agency (of Ireland).
EPC	Engineer Procure and Construct.
EPIC	Engineer Procure Install and Commission.
Epifauna	Animal life living on living or non-living surfaces.
EQS (or EQS values)	Environmental Quality Standard(s) – concentrations of contaminants in aquatic environments which are considered sufficiently low to protect against toxic effects or unacceptable levels of bioaccumulation.
ESD	Emergency shut-down.
ESEM	Environmental scanning electron microscope.
ESRI	Economic and Social Research Institute.
EU	European Union.
Evapo-transpiration	The combined water loss by plants, through evaporation and transpiration.
Excavatability	The ease with which a trench can be dug.
Exploration well	A well drilled in an unproven area. Also known as a 'wildcat well'.
FEED	Front End Engineering Design.
Feed/bottoms exchanger	An inlet heater.
FFSM	Full-field simulation model.
Field	see Gas Field, below
Field system	Pattern of fields no longer in current use, usually visible as low earthworks, often associated with medieval or earlier settlements.
Fiscal metering	Auditable, accurate measurement.
Flare or flare stack	An assembly to permit the burning of hydrocarbons.
Flash drum	Expansion vessel.
Floating Production Facility	A vessel tethered to the seabed or dynamically positioned, on which drilling and/or offshore processing can be performed.
Flowline	A steel pipeline between wellheads and the manifold, usually between 6 and 10 inches in diameter.
Formation water	Saline water containing trace amounts of chemicals that may be present in gas formations.
FOSA	Field Operating and Services Agreement.
Fosse	Ditch associated with a ringfort.
Flocculent	Loosely massed
FPO	Floral Protection Order.
Fracturing	A method of breaking down a formation by pumping fluid at very high pressures. The objective is to increase the production rates from a reservoir. Otherwise, referring to broken bedrock under the Terminal and Repository sites.
Ft (or ')	Foot (1 foot = 0.3048meters)

Term	Description
FWL	Free Water Level.
g/GJ	Grams per Gigajoule.
g/J	Grams per Joule.
Gas conditioning	Processing gas to meet an export specification.
Gas Field	An accumulation of natural gas in the underground strata.
Gas Metering	The accurate measurement of gas volumes.
Gas Terminal	An onshore facility for processing natural gas and its associated products.
Gas/gas exchanger	A cooling unit used in dehydration of the gas.
Geotextile sheet / membrane	A permeable synthetic membrane specifically designed to be used as a construction material.
GIIP	Gas initially in place.
GLA	Gas Lifting Agreement.
Glc	Ground level concentration.
Gley soils	Waterlogged soils that develop where the drainage is poor, or the water table is high.
Gneiss	A coarse-grained, banded rock that is >450 million years old. The rock was formed during high-grade regional metamorphism.
GPR	Ground Penetrating Radar.
Groundwater	All water which enters the subsurface of the Terminal and Peat Repository Sites
GRV	Gross rock volume.
GWP	Global Warming Potential.
Ha	Hectare (10,000 square metres).
Habitats Directive	Directive 92/43/EEC of the European Union, as amended by Directive 97/62/EC.
HAZAN	Hazard Analysis
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HCl	Hydrogen Chloride.
HCPT	Hydrocarbon pore thickness.
HCPV	Hydrocarbon pore volume.
HDD	Horizontal Directional Drilling.
HF	Hydrogen Fluoride.
Hg	The chemical abbreviation for mercury.
High Water Mark	The line of high water of ordinary or medium tides.
HIPPS	High integrity pressure protection system.
HOCNF	Harmonized Offshore Chemicals Notification Format.
Holy well	A natural spring or well with an association with a saint, or a tradition of cures. Often found near ecclesiastical or monastic sites.
Horizontal Directional Drilling	A method of drilling and installing pipelines under large features such as rivers, with minimal ecological and environmental impact.
HP	High Pressure.
HSSD	High Sensitivity Smoke Detector
HS&E (or HSE)	Health Safety and the Environment.
Hut site	A small ring of stones representing the foundation of a hut. Can be of any date, usually found in upland or marginal land.
HXT	Horizontal christmas tree.
Hydraulic gradient	A measure of change in the groundwater head over a given distance.
Hydrate	A solid ice-like material formed from gas and water at specific temperatures and pressures.
Hydrate inhibitor	Methanol, added to the wellhead to reduce or eliminate the formation of hydrate, and recovered/recycled at the Terminal.
Hydrocarbons	A general term for organic compounds, which contain carbon and hydrogen in the molecule.

Term	Description
Hydrostatically	Relating to the study of the mechanical properties and behaviour of fluids not in motion.
Hydrotest	Testing the integrity of a pipeline, using water.
Iceberg scour	A seabed feature caused by the tracking of icebergs.
IFA	Irish Farmers Association.
Impact	The degree of change in an environment resulting from a development.
Impermeable	Materials that permit water to pass only with great difficulty or not at all.
Impervious	A description of relatively waterproof soils such as clays through which water percolates at about one millionth of the speed with which it passes though gravel
Infauna	The animal life found within the sediments of the ocean floor, riverbeds, etc.
Inflows	Waste water flowing into the Terminal or generated at the Terminal, requiring treatment before discharge to the marine and other receiving waters.
Inlet separation	The secondary gas / liquid separation
Integrated Pollution Control - IPC	A method of considering, licensing and controlling all impacts upon the environment in concert, in order to minimize pollution of the environment as a whole.
Intelligent PIG	A device used for the measurement of several pipeline parameters and which operates inside a pipe.
IOOA	Irish Offshore Operators Association.
IPC License	Integrated Pollution Control License issued by EPA
IPCC	Irish Peatland Conservation Council.
IPPC License	Integrated Pollution Prevention and Control (the European Union version of IPC) as adopted in principle in Ireland as and from Oct. 1999 for all new facilities.
Iron Age	A period extending from approximately 500 BC to 500 AD.
Jacket	The lower section, or 'legs', of an offshore platform.
Jack-up Rig	A floating vessel with stilts which can be lowered to the seabed and jacked-up clear of the water, to conduct works offshore.
JOA	Joint Operating Agreement.
JT (or J-T)	Joule Thompson.
JT valve (or J-T valve)	Gas expansion valve used to manipulate the gas dewpoint.
Jurassic	A geological period of time, stretching from 208 to 146 million years from the present.
Klove Type Barriers	A barrier or weir through which inclined pipes pass installed in a ditch, to aid the removal of suspended solids from water and to retard the flow of water in ditches.
Km (or km)	Kilometre
Km^2 (or km^2)	Square kilometre
KW	Kilowatt.
Landfall	A point on the coastline where the pipeline transporting natural gas to the terminal comes ashore.
Landscape character	A distinct pattern or combination of elements that occurs consistently in parts of the landscape
Landscape impacts	Change in the fabric, character and quality of the landscape as a result of a development. These can be positive or negative
LAT	Lowest Astronomical Tide.
Lean burn	See clean burn
Linear earthwork	A long bank or ditch, often a territorial boundary such as the Pale. Can be of any date.
Lithostratigraphy	A scheme established using the general characteristics of the rocks as the basis of zonation.
Low NOx burner	A process that reduces the formation of oxides of nitrogen by operating at

Term	Description
	a lower flame temperature and limiting available oxygen in the hottest part of the flame.
LP	Low Pressure.
LPG	Liquid Petroleum Gas.
LRA	Lower Riser Assembly.
LWL	Low Water Level.
M	Metre.
M^3	Cubic meter.
Manifold	An item of subsea equipment that gathers production from each of the wells in the field and acts as a distribution point for the umbilical services.
MAPP	Major Accident Prevention Plan.
MARPOL	An international convention for the prevention of pollution from ships.
Mayo County Council	The local authority of relevance to the Terminal site for the Corrib Field Development.
mD	Millidarcy; a measure of the ability of a fluid to flow through a porous, permeable material (1mD = $9.87x10^{-16}$ m^2)
MDT	Modular Dynamic Tester.
MEG	Monoethyleneglycol
Megalithic tomb	Literally 'large stone' Neolithic tomb.
MeOH	Methanol; CH_3OH
Mercaptan odorant	A chemical added to natural gas to give it odour. Normally 80% tertiary butyl mercaptan (TBM) and 20% dimethyl sulphide (DMS)
Mesolithic	Middle Stone Age (c. 10,000 BC - 4000 BC).
Methanol recovery	The extraction and recycling of methanol added at the wellheads to prevent the formation of hydrates.
Methanol still	A distillation column to extract methanol for recycling.
Mica schist	A >450 million year old regionally metamorphosed rock which is present at the site. The rock is characterized by a parallel arrangement of the bulk of constituent minerals, which in this case are mica minerals.
mg/l	Milligrams per litre.
mg/m^3	Milligrams per cubic metre.
MicroSiemens/cm	µS/cm units of analysis of conductivity
MJ/m^3 or MJ/sm^3	Mega Joules per cubic metre.
ML	Most likely.
MMscfpd	Millions of standard cubic feet per day. (1MMscfd = 0.0283 million cubic metres per day.)
MMscmpd	Million standard cubic metres per day.
MODU	Mobile offshore drilling unit.
Monitoring	The repetitive and continued measurement of environmental data to follow changes over a period of time.
Moored tower (guyed tower)	A tower standing upright in the water column, attached to the seabed by mooring lines.
MSDS	Material Safety Data Sheet.
MSL	Mean Sea Level.
Mud	Colloquial but universally used term for drilling fluid.
MW	Megawatt.
Natural gas	Gaseous forms of petroleum consisting of a mixture of hydrocarbon gasses, the most important of which is methane.
Neolithic	New Stone Age (c. 4000 BC - 2300 BC)
Nephrops	An aquatic animal, commonly known as a Dublin Bay prawn or Norway Lobster.
Net Rated Thermal Input	The power input required by a machine.
Nm3/s	Normal cubic metres per second, where normal refers to 1 atmosphere of pressure and 0°C. Note: this is not the same as 'standard temperature and

Term	Description
	pressure' (STP).
NHA	Natural Heritage Area.
NMI	National Museum of Ireland.
NMVOC	Non-Methane Volatile Organic Compound.
NO	Nitrogen monoxide, also known as nitric oxide.
NO_2	Nitrogen dioxide.
NOx	Oxides of nitrogen.
NORM Waste	Naturally Occurring Radioactive Material.
nth percentile	In any set of numerical data, the value below which n% of the values fall.
Odorisation	The addition of an artificial odour to natural gas, for domestic safety.
Oil	A mixture of liquid hydrocarbons of different molecular weights.
Oil-based mud (OBM)	Drilling fluid used to drill through rock, which can react with water, based materials.
Onshore Injection	The disposal of water, by injecting it into the ground at depth.
Open-cut crossing	A method of pipeline crossing whereby an open trench is dug.
Operator	The participant given day-to-day responsibility for the conduct of operations, by the other owners.
OS(I)	Ordnance Survey (Ireland).
OSPARCOM	Oslo and Paris Commission.
OTU	Onshore Termination Unit
Outfall	The site of discharge of the treated wastewaters from the Terminal.
P&A	Plugged and abandoned.
Packer	A sealing assembly.
PAHs	Polyaromatic hydrocarbons.
PBR	Polished bore receptacle.
PE	Polyethylene.
Pelagic	Organisms that occur in the water column, especially near the surface.
Permeability	The measure of the capacity of a rock to allow fluid flow through it.
Permian	A geological period of time, stretching from 290 to 248 million years from the present.
Petroleum	A generic name for hydrocarbons, including crude oil, natural gas liquids, natural gas, and their products.
Phreatic	The soil or rock below the water table, where all voids are saturated.
PI	Productivity Index.
Piezometric	An imaginary surface at the site above or within the ground at which the water level would settle in a piezometer tube. It indicates the level to which the water from an artesian well would rise.
PIG	Pipeline Integrity Gauge. Cylinders fitted with rubber or neoprene cups which conform and fit the internal bore of the pipe allowing them to be propelled at a controlled speed through the pipe.
PIG launcher	Equipment for sending PIGs through a pipeline.
PIG trap or PIG receiver	Equipment for retrieving PIGs from a pipeline.
Pipeline Landfall	The point at which the offshore pipeline from the Corrib Field arrives at the shore.
Plankton	Small animals and plants which drift with the currents and are incapable of swimming against them.
Platform	A steel or concrete structure fixed to the seabed on which drilling and offshore processing can be performed.
PLEM	Pipeline End Manifold- allows the gas flow from the pipeline to shore to be shut off.
PLONOR	Chemicals that "Present Little Or No Risk" to the marine environment.
PLT	Production Logging Tool.
PM	Particulate matter (in air).
PM_{10}	Particulate matter (in air) with a diameter of less than 10μm.

Term	Description
PNHA	Proposed Natural Heritage Area.
POCP	Photochemical Ozone Creation Potential.
Pollutants	Contaminants which are known to have an adverse impact on the marine environment.
Porosity	A measure of the volume of open cavities within a rock, expressed as a proportion or percentage of the total rock volume. This determines the amount of gas that a set volume of rock can contain.
Portal Tomb	Megalithic tomb dating to the Early Neolithic, so called because of its large door feature, on which a large capstone is balanced. Known also as dolmens or cromlechs. Usually situated near streams and rivers.
Ppm	Parts per million.
Process Duty	The required power output of a machine.
Processing Facilities	Plant and equipment which separate the natural gas and associated products and process these for onward shipment.
Produced Water	Water produced from the Corrib reservoir with the gas. Will include water of condensation and may include formation water.
Production logs	Wireline log data (see below) acquired after the well has been cased.
PRS	Peat Repository Site
psi	Pounds per square inch. 14.5psi = 1bar
PSVs	Pressure Safety Valves.
Quaternary	The most recent part of the Tertiary period, from 2 million years ago to the present day.
RAMSAR	A wetland of international importance designated for one of the following reasons. A unique example of natural or near natural wetland type within the appropriate geographic region. It supports vulnerable, endangered or critically endangered species or threatened ecological communities. It supports populations of plant and/or animal species important for maintaining the biological diversity of a particular bio-geographic region. It supports plant and/or animal species at a critical stage in their life cycles or provides a refuge during adverse conditions. It regularly supports 20,000 or more water birds. It regularly supports 1% of the individuals in a population of one species or sub-species of water bird. It supports a significant proportion of indigenous fish sub-species, species or families, life history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity. Important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks either within the wetland or elsewhere depend.
Receiving waters	The marine waters accepting the discharge of treated wastewater from the Terminal.
Recharge	The downward movement of water from the soil to the water table.
Reservoir	An underground rock formation where oil and/or gas have accumulated.
Riparian	Of or on a river bank
Risk assessment	An analytical study of the probabilities and magnitude of harm to human health or the environment associated with a physical or chemical agent, activity or occurrence.
ROV	Remotely Operated Vehicle – an unmanned underwater vehicle.
RSG	Rockall Studies Group.
Ruderal	Plants which colonize open ground.
Run-off	An amount of rainfall that is carried off an area by streams and rivers
SAC	Special Area of Conservation.
SBM	Synthetic oil based mud.
Scale inhibitor	Chemical that may be added to the offshore system in small quantities to prevent the precipitation of natural mineral salts in the field facilities.
Scf	Standard cubic foot (usually of gas). There are 35.315 scf to one cubic metre.

Term	Description
Schist	Metamorphic rock defined by well-developed parallel orientation of more than 50% of the minerals forming the rock.
Scoping	The process of identifying the significant issues which should be addressed by a particular Environmental Impact Assessment/Statement.
SCSSV	Surface-Controlled Subsea Safety Valve.
SDU	Subsea Distribution Unit - this distributes the hydraulic fluid and chemicals from the umbilical to the wells.
Seismic data	Subsurface data acquired by generating a seismic signal at the sea surface and recording the energy (seismic waves) reflected back off layers of rock below the seabed.
SEM	Scanning electron microscope.
Semi submersible drilling rig	Floating drilling platform which is towed to site in an un-ballasted condition, and ballasted (lowered by partial flooding) for stability upon mooring on location.
Semi-natural habitat	Habitat modified by human activity from its original state but with a vegetation composed of native species similar in structure to natural types and with native animal communities.
Separator	A steel tank (vessel) with internal baffles. This is used to separate liquid from gas.
SEVESO	A directive on accident prevention.
Sheet piling	Vertical supports for trench excavations i.e. wall support.
Slug	A build-up of liquid within the gas pipeline from the field to the terminal that arrives at the terminal as a single pulse.
Slug catcher	Primary gas separation vessel.
Slug test	The measure of the pressure recovery in a borehole after the withdrawal of a known volume of water (slug), or the pressure decline after injection of a known volume of water (slug).
SMR	Sites and Monuments Record.
SO_2	Sulphur dioxide.
Sox	Oxides of sulphur.
SPA	Special Protection Area.
Spot Maximum	The absolute maximum operating condition for a machine.
SSTT	Subsea Test Tree.
SSV	Subsea Safety Valve.
Standard cubic feet	The amount of gas that occupies a volume of one cubic foot at standard conditions (14.7 psia and 60^0F or 101.325kPa and 15.56°C)
Stone circle	A ceremonial ring of stones dated to the Bronze Age, occasionally associated with burials.
STP	Standard Temperature and Pressure (14.7 psia and 60^0F or 101.325kPa and 15.56°C).
Strings (pipe strings)	Assembled lengths of pipe.
Stoichiometric Point	Conditions under which, the gas will burn in ratio with its balanced chemical reaction, based on the law of conservation of mass and the law of definite proportions.
Subgrade	A level or layer below finished ground level
Subsea Manifold	See 'Manifold'
Subsoil	The layer of soil between the topsoil and the bedrock.
Submarine outfall	The discharge pipe taking treated wastewaters from the Terminal to Broadhaven Bay. This follows the route of the incoming gas pipeline.
Surface water	All water which is present on the surface of the Terminal and Peat Repository Sites, and includes water in drains
Suspended Solids	Matter which is suspended in water consisting of finely divided light solids which may never settle or do so only very slowly.
Suspended well	A well that has been capped off temporarily.
Sward	Mixture of grasses forming a turf.

Term	Description
Syncline	A basin-shaped fold or fold system.
Synthetic-based mud (SBM)	Drilling fluid used to drill through rock, which can react with water-based materials.
Tscf	Trillion standard cubic feet or 10^{12} ft^3. (1 Tscf = 28.317x10^9 standard cubic metres.)
Terminal	The plant where the Corrib gas will be separated from any associated liquids to meet BGE export specifications.
Terminal Footprint	The area of land on which the terminal facilities and associate buildings will be erected. It has an area of 13 hectares.
Terminal Site	The area for which Mayo County Council has granted Planning Permission. It has an area of 160 hectares.
Tertiary period	A geological period of time, from 65 million years ago to the present.
THI	Threshold Inhibitor. A type of inhibitor used to prevent the formation of hydrates.
Till/boulder clay	A poorly sorted mixture of sands, clays and boulders produced by the erosion of rocks by moving ice.
TOA	Terminal Operating Agreement.
TOC	Total organic carbon.
Togher	Literally a causeway, usually used to mean a wooden track across a bog.
Topography	The physical features or configuration of a land surface.
TP	Trial Pit.
TPS	Tilted Plates Separator.
Transmission Specification	The criteria to be met before a gas can be exported on to the transmission system.
Trench Stability	Ease of producing trenches (without collapse).
Treated effluents (treated wastewaters)	Liquids arising after advanced treatment at the Terminal, which will be disposed of through the submarine pipeline to the marine receiving waters.
Triassic	A geological period of time, stretching from 248 to 206 million years before the present.
Turlough	This is formed when solution cavities within limestone collapse, to form surface depressions.
TVD SS	True vertical depth subsea.
TWT	Two way time.
Umbilical	A bundle of electrical and hydraulic control lines and chemical transportation lines used to: a) control and monitor the subsea facilities from the terminal; and b) supply methanol and other chemicals to the manifold and wellheads. The bundle is encased in a protective cable.
UNECE	United Nations Economic Commission for Europe.
US EPA	United States Environmental Protection Agency.
Venting	The release of high pressure gas to atmosphere.
Visual amenity	The value of a particular area or view in terms of what is seen
Visual impact	Change in the appearance of the landscape as a result of the development
Visual Intrusion	Degree to which a development intrudes upon the field of view
VOC	Volatile Organic Compound.
Water of condensation (condensed water)	The water in vapour phase contained within the reservoir, which condenses out as the temperature and pressure of the hydrocarbon gas decreases.
Water-based mud (WBM)	A basic drilling fluid, used for drilling uncomplicated section of wells.
Wayleave	Permission or consent to build and maintain the pipeline.
Weathered	The breakdown of rocks and minerals at and below the Earth's surface by the action of physical and chemical processes.
Wedge tomb	Megalithic tomb dating to the Late Neolithic and Early Bronze Age, so called because of a wide high front, sloping and narrowing towards the back.

Term	Description
Weir	A dam built across a river to raise the level of water upstream or to regulate its flow
Well	Either a) a borehole drilled into the Corrib reservoir, through which gas is produced or b) a borehole used to monitor groundwater on the terminal and peat deposition areas.
Wellhead	In the offshore, the part of the well to which the christmas tree is attached. In the context of groundwater monitoring wells, this includes the protection of wells on the Terminal and Repository Sites.
WHO	World Health Organisation.
Work permit or permit to work	Documentation permitting works to be performed, issued under a permit to work scheme, where all works are controlled to prevent conflicting works being conducted simultaneously.
Working width	The area within which the pipeline construction takes place.
Worst case scenario	Principle applied where the environmental impacts may vary e.g. seasonally , to ensure the most severe impact is used
WTP	Water Treatment Plant
Zone of Visual Influence (ZVI)	Extent of visibility to or from the development
ZVI	See 'Zone of Visual Impact'

Imperial/Metric Conversions

Imperial to Metric		Metric to Imperial	
Imperial Unit	**Metric Unit**	**Metric Unit**	**Imperial Unit**
Lengths		**Lengths**	
1 inch	25.4 mm	1 mm	0.0394 in
1 ft	0.3048 m	1 m	3.281 ft
1 mile	1.609 km	1 km	0.6214 miles
1 nautical mile (nm)	1.853 km	1 km	0.5396 nautical miles
Volumes		**Volumes**	
1 standard cubic ft (scf)	0.0283 m^3	1 m^3	35.315 cf
1 million standard cubic feet (mmscf)	28,317 m^3	1 m^3	6.29 barrels
1 barrel	0.159 m^3		
Pressures			
1 barg	1 barg		