

**LAND USE PLANNING
ASSESSMENT FOR
PROPOSED
DERRYGREENAGH POWER
PROJECT, Co. OFFALY**

Technical Report Prepared For

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EXECUTIVE SUMMARY

AWN Consulting Ltd. were instructed by AECOM on behalf of Bord na Móna Powergen Ltd to complete a Land Use Planning assessment of major accident hazards associated with the proposed Derrygreenagh Power Project, Co. Offaly.

Following the completion of the development, the site will be classified as a Lower Tier Seveso site and is subject to the provisions of the Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2015 (COMAH Regulations 2015).

The Land Use Planning assessment was completed in accordance with guidance published by the HSA (HSA, 2023). The following major accident scenarios were assessed:

Installation	LOC scenario	Consequence/Event
Indoor equipment (release in Turbine enclosure)	Instantaneous failure	VCE
	Continuous leak over 10 minutes	VCE
	10 mm pipe leak over 10 minutes	VCE
Natural Gas Pipeline	Rupture of Pipeline	Fireball/Jet fire
		VCE
		Flash fire
	Pipeline Leak of 0.1D	Fireball/Jet fire
		VCE
		Flash fire
LPG Tank	Instantaneous Failure	Fireball
		VCE
		Flash fire
	Continuous Leak over 10 minutes	Jet fire
		VCE
		Flash fire
	10mm pipe leak over 30 minutes	Jet fire
		VCE
		Flash fire
LPG Pipeline	Rupture of Pipeline	Fireball/Jet fire
		VCE
		Flash fire
	Pipeline Leak of 0.1D	Fireball/Jet fire
		VCE
		Flash fire
LPG Tanker	Instantaneous Failure	Fireball
		VCE
		Flash fire
	Loss of entire Contents through Largest Connection	Jet fire
		VCE
		Flash fire

Installation	LOC scenario	Consequence/Event
	Rupture of unloading arm	Jet fire
		VCE
		Flash fire
	Leak of unloading arm of 10% of diameter	Jet fire
		VCE
		Flash fire
		BLEVE (hot)
Hydrogen Storage	Instantaneous failure	VCE/Fireball
	Continuous leak over 10 minutes (total inventory of 1 skid)	VCE, jet fire or flash fire
	10 mm pipe leak over 10 minutes	VCE, jet fire or flash fire
Hydrogen Pipeline	Pipeline rupture	Jet fire/Fireball
		VCE
		Flash fire
	Pipeline leak (10% of diameter)	Jet fire
		VCE
		Flash fire
Distillate Tank	Loss of Containment	MATTE
Aqueous Ammonia Tank	Loss of Containment	MATTE
Sodium Hypochlorite Tank	Loss of Containment	MATTE

Major Accident Scenarios at Proposed Development

Environmental Risk Assessment (MATTE)

An assessment of Major Accidents to the Environment (MATTEs) at the power plant area was completed in accordance with the environmental risk assessment methodology recommended by the Chemical and Downstream Oil Industries Forum (CDOIF, 2017).

The following table summarises the MATTE Scenarios identified.

Scenario	Description	Environmental Receptors	MATTE Category	Tolerability Boundary	Scenario Frequency
MATTE 1	Catastrophic rupture of bulk distillate storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year	6.06E-06 per year
MATTE 2	Catastrophic rupture of ammonia storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year	6.06E-06 per year
MATTE 3	Catastrophic rupture of sodium hypochlorite storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year	6.06E-06 per year

Summary of MATTE Results

The tanks will comply with EN14015 and the pipework to EN13480 (or equivalent) and the maintenance regime will follow good engineering practice.

The event frequency of MATTE Scenario 1, 2 or 3 was calculated as 6.06E-06 per year. This is in the **Broadly Acceptable** region for these MATTE categories. It is concluded no further risk reduction measures are necessary

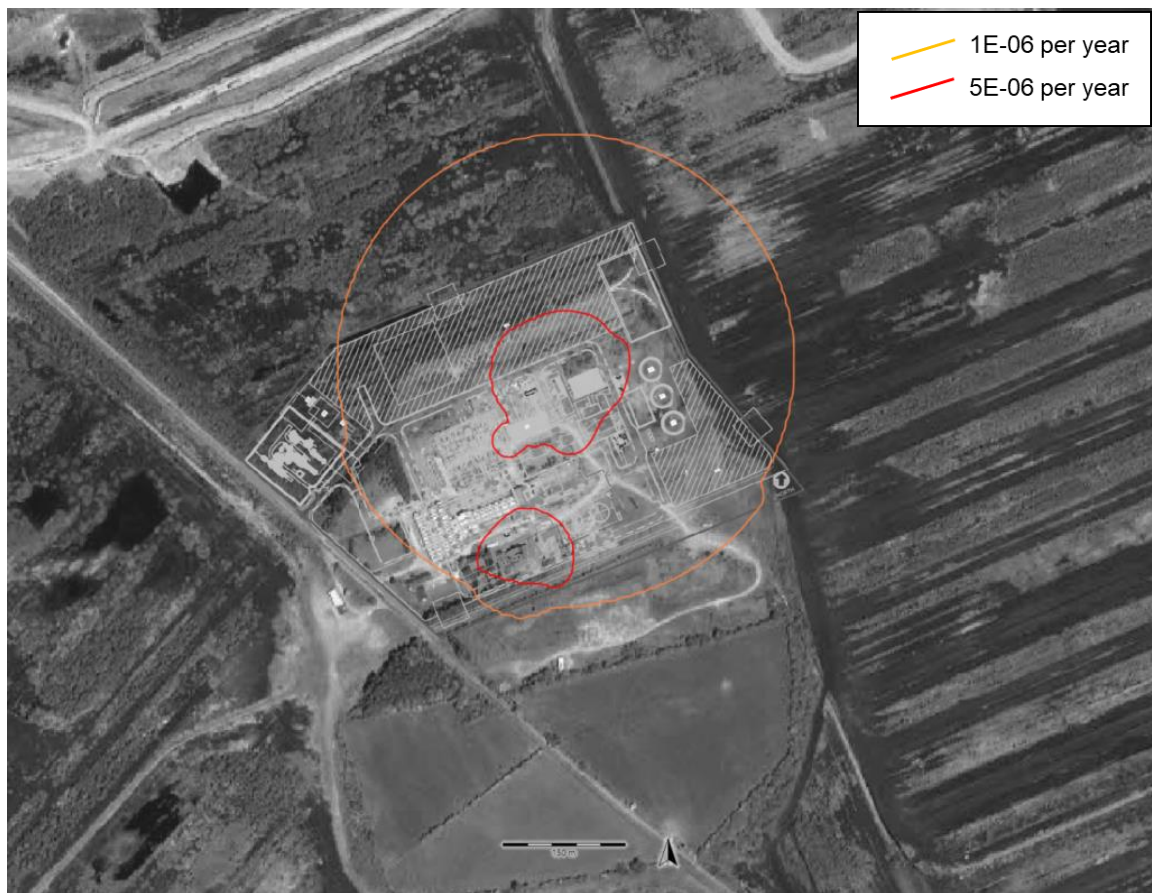
Land Use Planning Contours

Gexcon RiskCurves Version 12.4.0 modelling software was used to model the cumulative risk contours for the establishment. The consequence results, frequencies of major accident hazards and Mullingar wind speed and frequency data were input to the software. Risk contours for the power plant area corresponding to the boundaries of the inner, middle, and outer risk-based land use planning zones are illustrated on the Figure below.

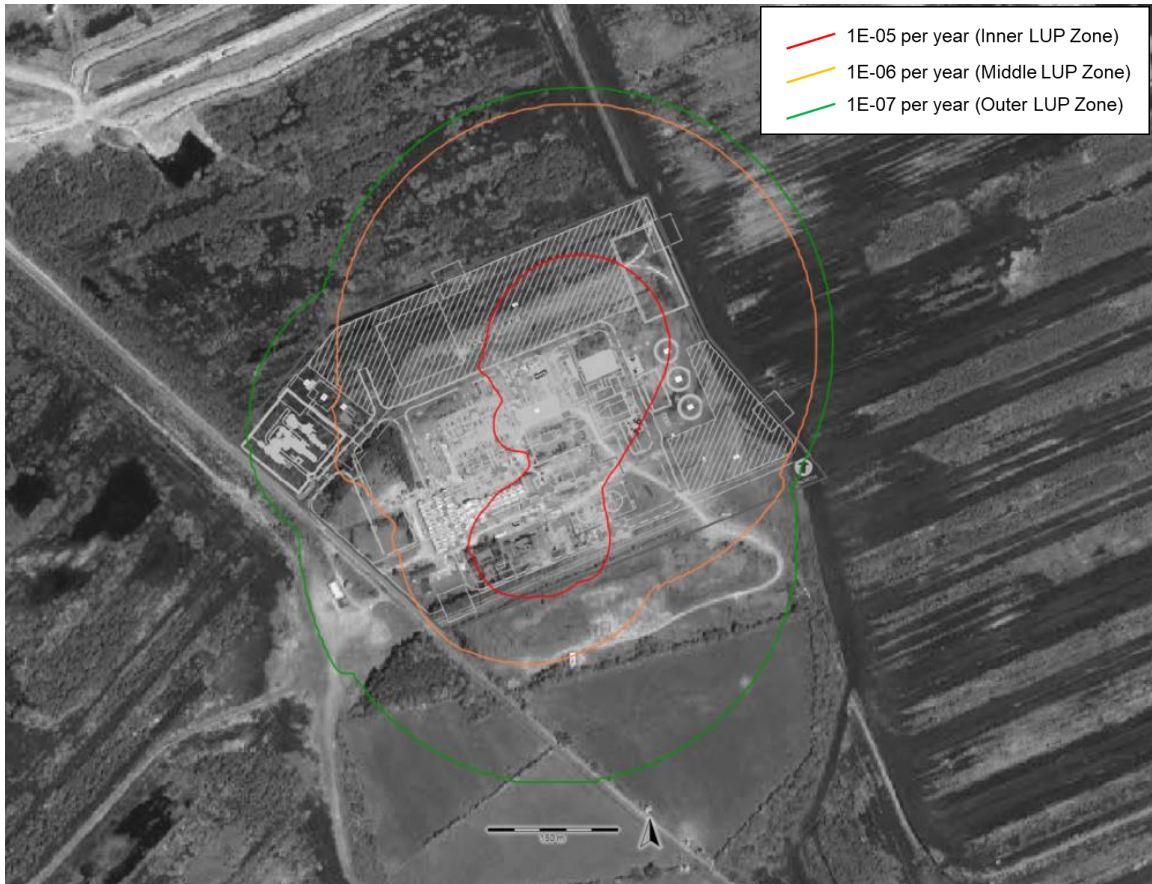
The following figures illustrate the cumulative individual risk for major accidents at the proposed development.



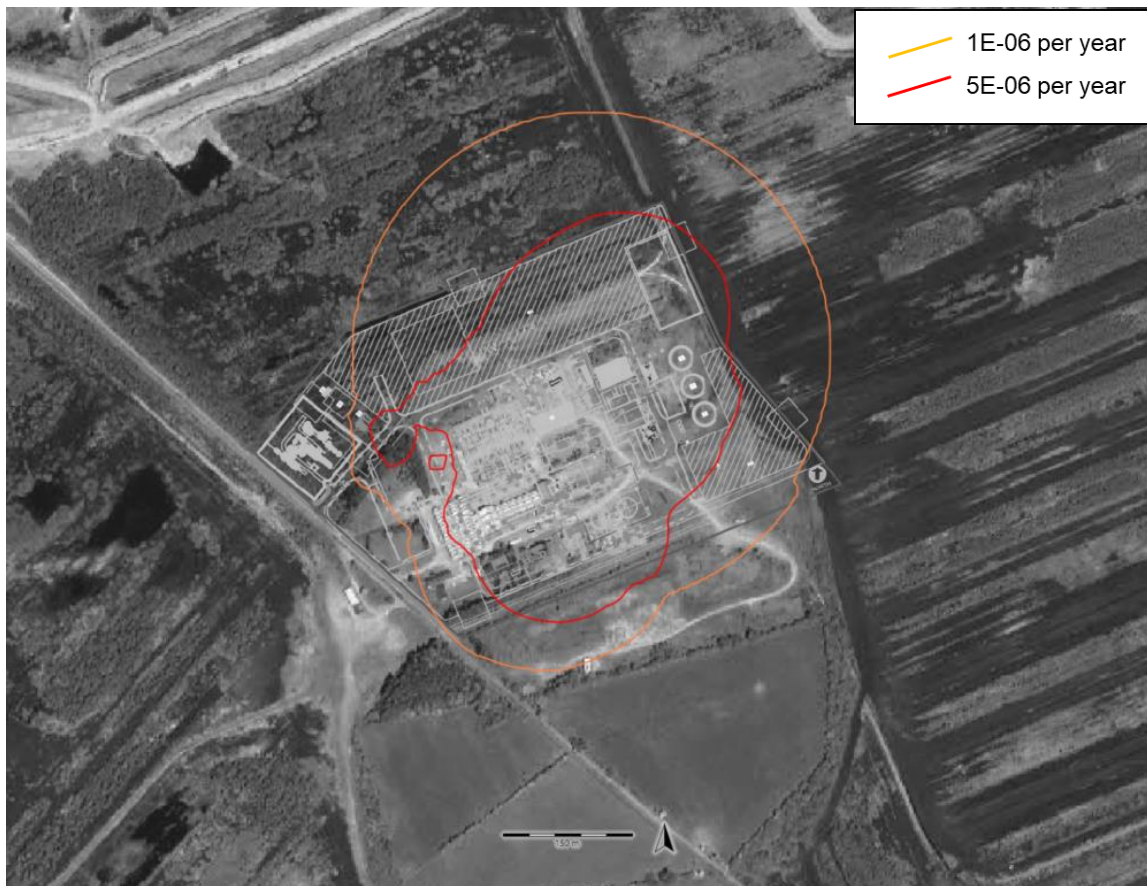
Land Use Planning Risk-based Contours to Persons Outdoors



Individual Location-Based Risk Contours, to Persons Outdoors, for New Establishments



Land Use Planning Risk-based Contours to Persons Indoors CIA Cat. 3



Individual Location-Based Risk Contours, to Persons Indoors CIA Cat. 3, for New Establishments

The following is concluded for the individual risk arising from the power plant area:

- The individual risk contour, to persons outdoors, corresponding to the Middle zone extends over the proposed development boundary to the south, to the west and to the north. These areas are unoccupied land and persons are not typically present.
- The individual risk contour, to persons outdoors, corresponding to the Outer zone extends to the R400 road. This is a Sensitivity Level 2 development; therefore, is permitted within the Outer zone.
- The individual risk contours, to persons indoors CIA Cat. 3, corresponding to the middle and outer zones extend over the proposed development boundary to the south and north. There are no occupied buildings in these areas. The outer zone contour extends to the Communications Mast building and General Stores Buildings; however, these buildings are not occupied.
- The Individual Location-Based Risk Contours, to Persons Indoors CIA Cat. 3 and to persons outdoors, do not extend to the Communication Mast to the south or to Refuelling Station to the west. These contours do not extend to the R400 road.

It is concluded that the individual location-based risk contours do not extend to an off-site work location or to an area where the public are present. Therefore, it is concluded that the criteria in Table 1 of the *Guidance on Technical Land Use Planning advice (HSA, 2023)* is met and level of off-site risk at the proposed development is acceptable.

The R400 road is within the consequence zone of major accidents at the proposed development. Therefore, Societal Risk assessment is required to take account of group risk to the receptors at the proposed development scheme.

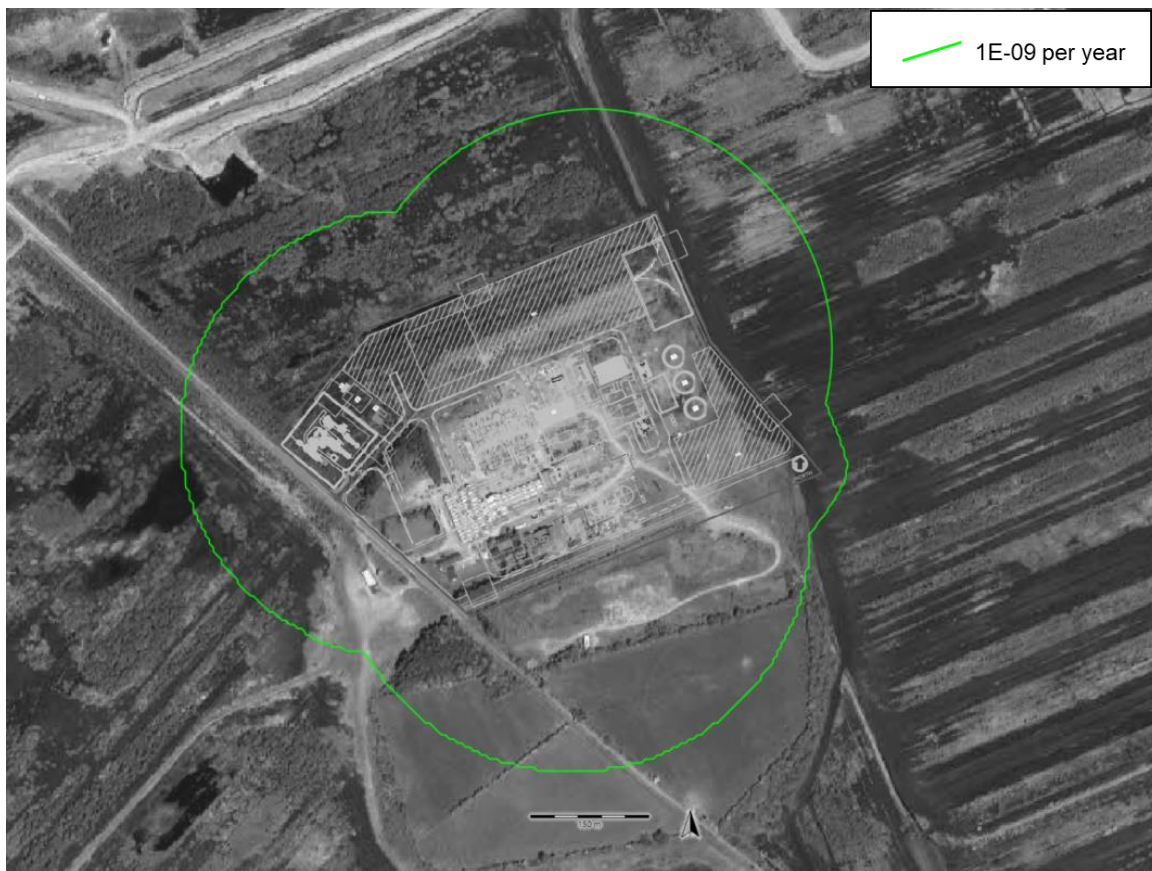
A Societal Risk assessment for the proposed scheme was completed and the Expectation Value (EV) at the proposed scheme is calculated to be **19.5**.

Section 1.7 of the TLUP (HSA, 2023) states:

'for new developments near an establishment, where the calculated off-site EV at the development greater than 2,000, further assessment of societal risk will be required.'

The total Expectation Value (EV) at the proposed scheme is **19.5**. This is <2,000; therefore, no further risk calculation is required.

The Figures below illustrate the individual risk contour corresponding to 1E-09 per year (1 in-a-billion). This is the level of individual risk the HSA have requested for new establishments as a proposed consultation distance.



Individual Risk Contour, to Persons Outdoors, Corresponding to 1E-09 per year (Consultation Distance)



Individual Risk Contour, to Persons Indoors CIA Cat. 3, Corresponding to 1E-09 per year (Consultation Distance)

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1.0 INTRODUCTION

AWN Consulting Ltd. were instructed by AECOM, on behalf of Bord na Móna to complete a Land Use Planning assessment of major accident hazards associated with the proposed Derrygreenagh Power Project, Co. Offaly. The Proposed Development is part consists of the power plant area and the Electricity Grid Connection, while the Overall Project includes the Gas Connection Corridor.

Following the completion of the development, the power plant area will be classified as a Lower Tier Seveso site and is subject to the provisions of the Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2015 (COMAH Regulations 2015).

This report contains the following:

- Description of development.
- Background to risk assessment and land use planning context.
- Land Use Planning assessment methodology and criteria.
- Identification of Major Accident Hazards.
- Land Use Planning Assessment of Major Accident Scenarios.
- Land Use Planning Contours.
- Conclusions.

2.0 DESCRIPTION OF PROPOSED GENERATING PLANT

3.1 Proposed Development Description

The Derrygreenagh power plant proposed development consists of a power plant area with 1 No. Combined Cycle Gas Turbine (CCGT) and 2 No. Open Cycle Gas Turbines (OCGT) operating primarily off natural gas with dual fuel capability to operate off secondary fuel. The power generated will be exported to the national grid electricity network via an Electricity Grid Connection comprising a 220kV substation, with hybrid transmission of Overhead Line (OHL) and Underground Cable (UGC) to a new loop-in 400kV substation at the Oldstreet-Woodland Line (c. 8km south of the power plant area). The Overall Project includes a Gas Connection Corridor connecting the power plant area to the Dublin-Galway high pressure gas network (BGE/77, c. 9.7km to the northwest of the power plant area). The site location of the proposed development is illustrated in Figure 1.

It is proposed to develop a power plant area¹, which will be a responsive power generator to ensure the security of the national electricity networks. The overall project will allow for the replacement of existing conventional generation power stations with lower carbon technology. The plant will operate primarily off natural gas from the national grid pipeline supply and will be backed-up by 'Secondary Fuel'. The boundary of the power plant area will be the COMAH boundary (see Figure 2).

The power plant will be operated from the main control room (MCR), where it will be possible to monitor and control the complete power plant, including emission points. Appropriate computer screens, indications and alarms are provided to allow the plant operators to monitor and adjust the plant systems and equipment (see Figure 2).

The proposed development will be situated within the Bord na Mona landbank with the exception of agricultural land for a section of the Electricity Grid Connection that includes the loop-in substation. The proposed development is situated within a subset of Bogs within the Derrygreenagh bog group and is entirely within the county of Offaly. The Gas Connection Corridor will be on third party lands in the counties of Offaly and Westmeath.

Table 1 details the components of the proposed power plant area.

Proposed Element	Component / Details
Combined Cycle Gas Turbine (CCGT) Plant	CCGT Turbine Hall and buildings Heat Recovery Steam Generator (HRSG) and associated cladding 1 no. Emissions Stack (CCGT) 60m high and CEMS monitoring station and platforms Air Cooled Condensers (ACC) Air Intake (CCGT)
Open Cycle Gas Turbine (OCGT) Plant (2 No. OCGT Plants)	2 No. OCGT Turbine Hall and Buildings 2 No. Air Intake (OCGT) 2 No. Emissions Stack (OCGT) 45m high
Secondary Fuel Storage and Unloading Facility	2 No. Fuel Storage Tanks and unloading area Fuel pumping and cleaning plant

¹ Note – the power plant area, as referred to in this report, does not include the Peat Deposition Area and process and surface water discharge routes falling within the 'Power Plant Area' defined in Ch. 1 of the EIAR.

Proposed Element	Component / Details
	Fuel transfer system
Subsidiary items of plant equipment	Blowdown Tank Boiler Feed pumps Turbine blowdown tank Drains recovery tank Deaerator and feedwater storage tank Auxiliary Boiler Propane Ignition System Transformer Cooling Banks Emergency Distillate Generator Firefighting systems Fire Suppression Skid 2 No. Ammonia storage tanks Raw/Fire Water Tank Process water treatment & pre-treatments infrastructure including water abstraction and discharge 2 No. Demineralised water tanks Main and Auxiliary Transformers Silencers, vents and drains Underground/Overground Services (gas, sewage, process water, storm water drainage, water, secondary fuel, electrical services distribution etc.) Fuel Gas Performance Heater Associated ancillary equipment
Gas Connection Above Ground Infrastructure Compound	Regulator building Boiler and instrumentation houses Gas analyser kiosk Pressure reduction system Security fencing and Boundary Treatment (gates) AGI Site Access - The AGI compound will be served by access point off the R400 road which also serves the power plant area.
Gas Receiving Facility	Gas compressor building Fin fan coolers Pressure reducing station
Associated buildings and infrastructure	Administration Building Workshop Control Room Stores Car Parking Maintenance Compounds Abstraction wells Water Treatment Plant Process Wastewater Treatment Plant Foul Water Treatment System Surface water drainage attenuation Water Discharge Points Firewater Retention and Shutdown Facility power plant area Site Access and Internal roads

Proposed Element	Component / Details
	Security fencing and Boundary Treatment(gates) Utilities (pipes, cables, surface water drainage systems, oil- water separators, including channelling, culverting, crossings etc.) Landscape Mitigation External lighting

Table 1 power plant area Components

Figure 2 illustrates the COMAH boundary and the COMAH site layout. A more detailed Figure 2 is reproduced in Appendix A.

2.1.1 Gas pipeline routing area

Natural gas is piped to the onsite Derrygreenagh Above Ground Installation (AGI) connection from the Gas Networks Ireland (GNI) Dublin-Galway grid network (BGE/77). There will be 3 No. buried natural gas pipelines on site that will feed the CCGT, 2 No. OCGTs and a small auxiliary boiler. Table 2 details the specification of each natural gas pipelines on site.

There is a small 15m section of the CCGT pipeline, immediately after the Gas Receiving Facility (GRF), that will be above ground.

Pipeline	Diameter (mm)	Length (m)	Operating Pressure (barg)
CCGT	500	520	60
OCGT	300	340	38
Auxiliary Boiler	50	150	38

Table 2 Natural Gas Pipeline Specification

2.1.2 Secondary Fuel Storage

The proposed power plant area will be required under the Grid Code to maintain a secondary fuel supply of distillate fuel to be stored in 2 No. 8,350 m³ tanks, each with a working volume of 7,500 m³; within a bunded area on site. The purpose of this secondary fuel is to ensure that power can still be supplied to the Electricity Grid Connection in the event of an interruption to supply from the gas network.

The bund will be reinforced concrete and will have at least 110% the greatest individual tank capacity or 25% overall storage, whichever is greater. The bund will have a leak detection system.

The tanks will comply with EN14015 and the pipework to EN13480 (or equivalent). The fuel will be stored at ambient conditions. The tanks will have high and high-high level alarms. There will be a low power heating system to ensure the fuel is a minimum of 15°C.

The procedure for unloading the distillate will follow these principles:

- The road tanker(s) will park in a dedicated unloading layby.
- Unloading will take place in accordance with the site rules and will be supervised by the station staff.

- The unloading point for each tank will be clearly labelled and there will be indication of the tank level, audio/visual high-level alarms at each unloading point.
- A drip tray will be provided at each filling point and the complete layby forms a retention area and will direct any spills to the appropriate part of the site drainage system

The secondary fuel will be received via road tanker. A dedicated unloading layby is provided. This area will include a drainage system which will link into the power station drainage system with interceptors and containment to capture any potential oil spills. It is estimated that there will be 10 deliveries per year, under normal operation (no natural gas outages) and each delivery will be up to 38m³.

2.1.3 Propane Storage

The gas turbines include the functionality to fire on locally stored secondary fuel during emergencies. However, the gas turbines cannot start directly on secondary fuel and propane gas is required to aid start-up.

Propane will be stored in 2 No. 1-tonne propane tanks, with one tank to be located to the North of the CCGT and the other located to the East of the OCGT (see Figure 2).

2.1.4 Ammonia Storage

As part of the power plant area, the Combined Cycle Gas Turbine (CCGT) has been specified to comply with the emissions requirements of the Industrial Emissions Directive (IED). A selective catalytic reduction system may be required to achieve this.

Therefore, the site will store aqueous ammonia (35%) in 2 No. tanks (operating capacity). These tanks are located in a bund of capacity 186 m³. The tanks have a gross capacity of 136 m³; however, each tanks' operating capacity will be 44 m³ per tank (ca. 39 tonnes per tank). The tank filling line is provided with an automatic failure close valve linked to the tank level measurement system. The tank level is continuously monitored by a level transmitter with the level indicated at the unloading station. The tanks will be filled up to a set level, up to a maximum of 44 m³ per tank. An audible/visual alarm at the tanker unloading station will provide a warning that the fill limit is being approached. Should the fill limit be exceeded the fill valve will be automatically closed.

Aqueous ammonia (35%) has the following hazard phrases:

- H314 Causes severe skin burns and eye damage.
- H335 May cause respiratory irritation.
- H400 Very toxic to aquatic life.
- H411 Toxic to aquatic life with long lasting effects.

2.1.5 Hydrogen Storage

There is potential for hydrogen to be used as coolant for the CCGT. The storage area will be outdoor in a cage or fenced compound. The design of the storage facility will be in-line with regulations, HSA guidance and code of practice 44, the safe storage of gas cylinders published by the British Compressed Gases Association.

The storage area could contain up to 3 No. storage skids containing up to 9 No. individual cylinders manifolded together. Each cylinder will have the capacity to store 7.2 Nm³ of hydrogen at a pressure of 175 barg, a total of 17.5 kg of hydrogen.

There will be a ca. 100m pipeline linking the cylinder storage area to the generator gas panel (within the turbine building). The diameter of this pipeline will be 25mm. The pipework will be fully welded or brazed depending on the piping material used.

Hydrogen (CAS number 1333-74-0) is classified as a Flammable Gas Category 1 with hazard statement H220-extremely flammable gas.

The DIPPR© Database that is referenced in DNV PHAST Version 9.0 gives the following flammable properties for hydrogen:

- Lower flammability limit 40,000 ppm (4% v/v)
- Upper flammability limit 750,000 ppm (75% v/v)
- Maximum surface emissive power 170 kW/m²
- Heat of combustion 241,820 kJ/kmol

2.1.6 Fire Protection

The plant will be protected by a comprehensive fire protection and detection system. This will be based on the fire risk assessment and the basis of design document that will be developed in accordance with the requirements of NFPA 850.

A Fire Emergency Response Plan will also be developed and implemented in consultation with the Fire Service of Offaly County Council.

2.1.7 Surrounding Area

The power plant area is located in the townland of Derrygreenagh, close to the border between Co. Offaly and Co. Westmeath. The power plant area is located to the east of the R400 road (with the exception of process water discharge corridor).

The power plant area is located on a brownfield site known locally as Derrygreenagh Works. There are currently a number of buildings associated with Bord na Móna Derrygreenagh Works, such as workshops, stores, and offices; paved and concreted areas, outhouses, car-parking facilities, and machinery yards. The existing operations at the Derrygreenagh Works site will be decommissioned and demolished prior to the construction of the power plant area.

There are no residential properties located within 500m of the power plant area. The closest are two sets of three properties approximately 1.1km to the south (see Figure 3).

There are several structures in the vicinity of the site. To the south is a water tank, 2 No. General Stores buildings, a communications mast and its associated building, these buildings are not occupied except for occasional maintenance. To the west, adjacent to the R400, is a refuelling station for Bord na Mona. There are 2 No. fuel tanks, a 20 m³ distillate tank for agricultural use and a 4 m³ distillate tank for commercial use. The volume in the tanks is kept to a minimum as there is reduced activity the area. The fuelling station is unmanned.

2.1.8 Surface Water

Surface water runoff will be generated from all surfaces within the facility that are exposed to rainwater. This includes all hardstanding surfaces, roofs, and other impermeable surfaces. Approximately 1.1ha of the site is expected to drain to the proposed surface water system, while 1.8ha of the site will permeate to ground naturally. All surface water runoff will be discharged to the attenuation tank via a hydrocarbon

interceptor and silt trap. Water from roof drains may discharge directly to the attenuation tank. Water in the attenuation tank will be pumped to the consented discharge point on the Mongagh River. The discharge flow is monitored and controlled to maintain the rate within the limits specified in the permit. Discharge to the Mongagh River can be stopped by the plant operators both locally and remotely in the event that there is an event that could lead to the discharge from the attenuation tank breaching the emission limit values. This valve will also close automatically if the monitored water quality approaches the discharge limits.

The water quality monitoring will be discussed and agreed with the EPA and included in the site's environmental consent. The minimum monitoring will be flow (instantaneous and totalised), pH and temperature. If hypochlorite is present on-site residual chlorine levels will also be monitored.

As part of the surface water drainage design strategy, the following items have been included in order to effectively manage surface water at the site:

- Drains from all areas subject to potential oil contamination are routed through a Class 1 Oil Interceptor
- Quality monitoring will be located downstream of the separator and upstream of the attenuation tank to detect a failure of the separator. There will be alarms in the event of oil within the system downstream of the oil separator
- Attenuation Tank – it is proposed to attenuate all storm water accumulated on site within an attenuation tank, this will have a 6600 m³ capacity. The outlet of the attenuation tank will have the means to stop the flow to mitigate the risk of a release leaving the site.

In the event of an emergency, a fuel spill, bund overtop or fire, the flow out of the attenuation tank can be stopped, as the outlet valve will close upon activation of the fire alarm. This valve can also be closed remotely, by operator command from the DCS screens in the control room.

The surface water drainage at the proposed development ensures that any spill of oil or contaminated firewater will be contained on-site by:

- Raising an alarm to the control room in the event oil is detected downstream of the interceptors
- The control room is manned 24/7
- Upon activation of the alarm, the flow out of the attenuation tank will be stopped and the contaminated material within the tank
- This valve will close automatically in the event the fire alarm is activated
- The valve will close automatically in the event of any signal loss from the water quality monitoring devices
- The contaminated material within the attenuation tank will be disposed of appropriately
- The outlet valve will be configured to close in the event of a power loss or, if an electrical valve, will be on the plant emergency generation system. The valves will be arranged to fail close even if the detail design requires the discharge to be pumped.

Tertiary containment is ensured by the tank (primary), bund (secondary) and attenuation tank (tertiary).

The drainage layout is illustrated in Figure 4.

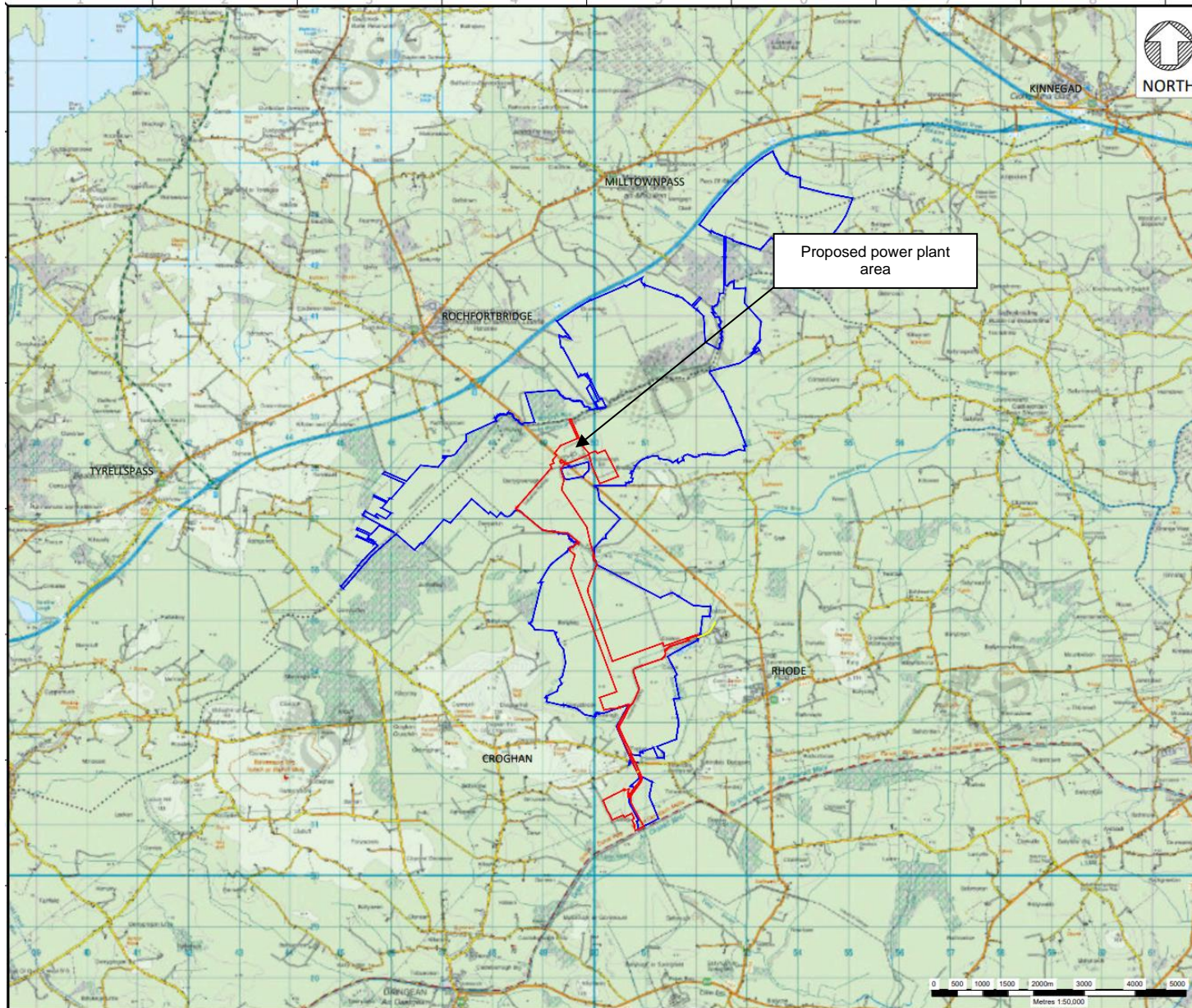


Figure 1 Proposed Planning Application Development (Red Line) Bord Na Mona Ownership Boundary (Blue Line)

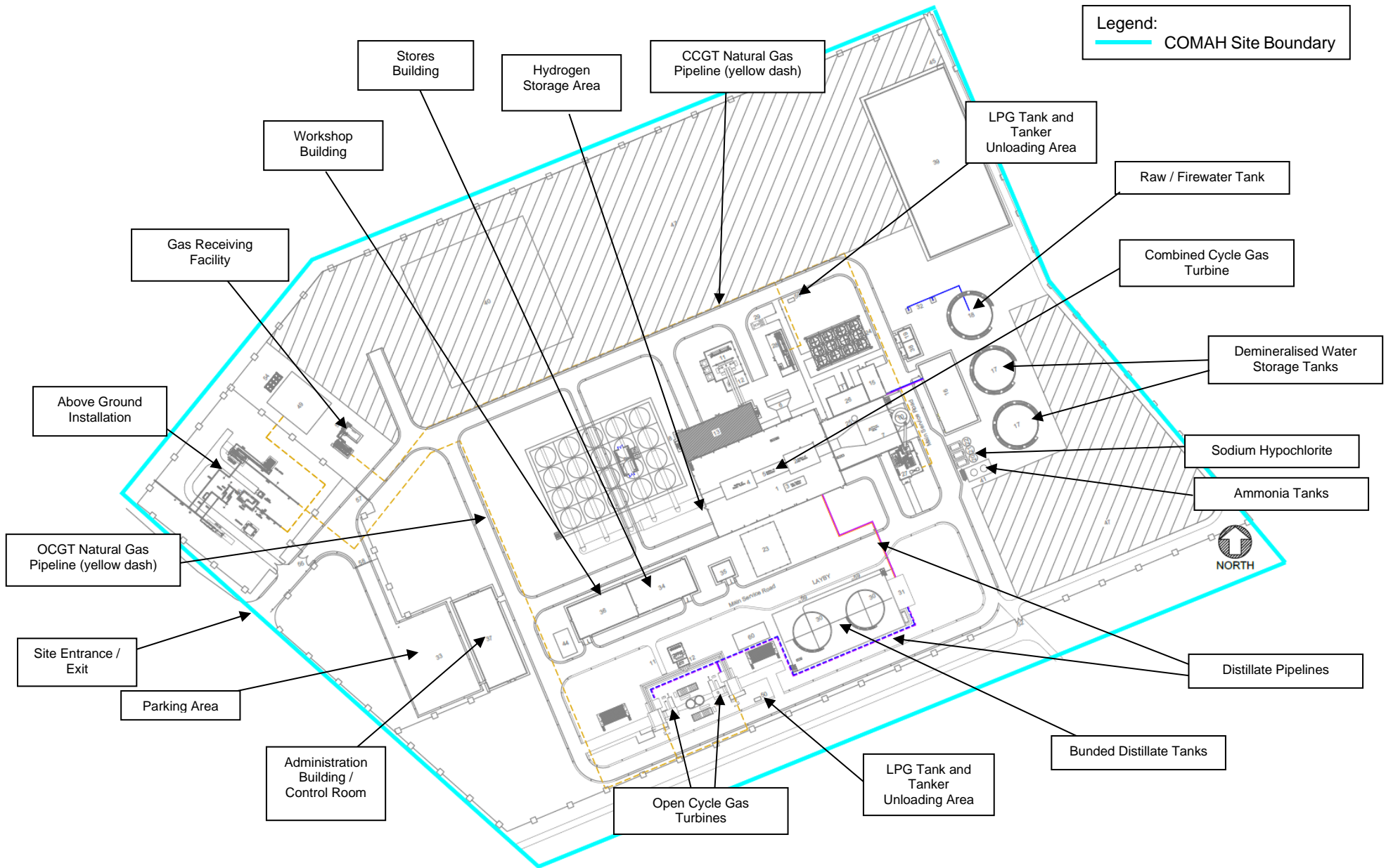


Figure 2 Proposed COMAH Site Layout

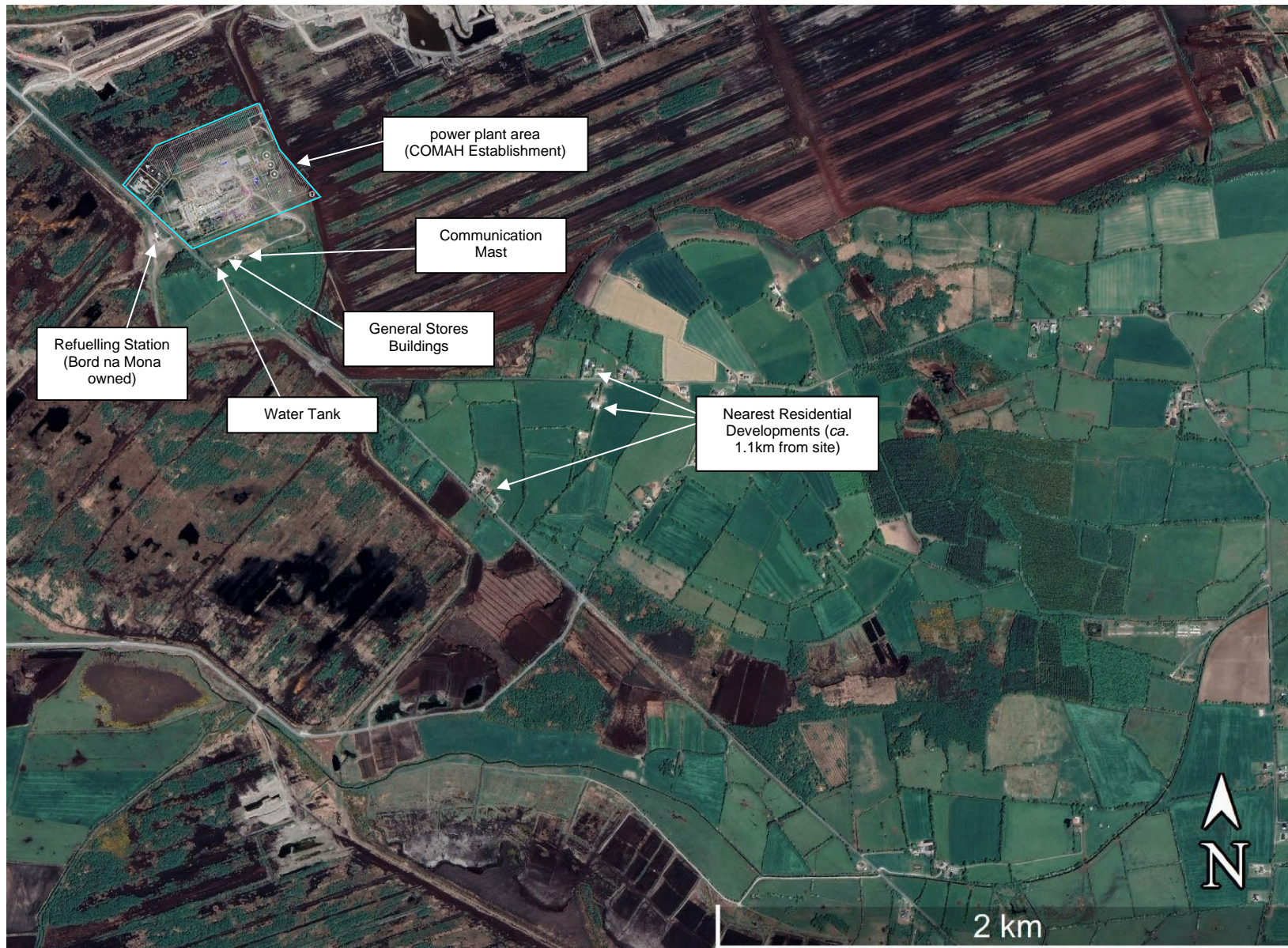


Figure 3 Power plant area and Surrounding Environment

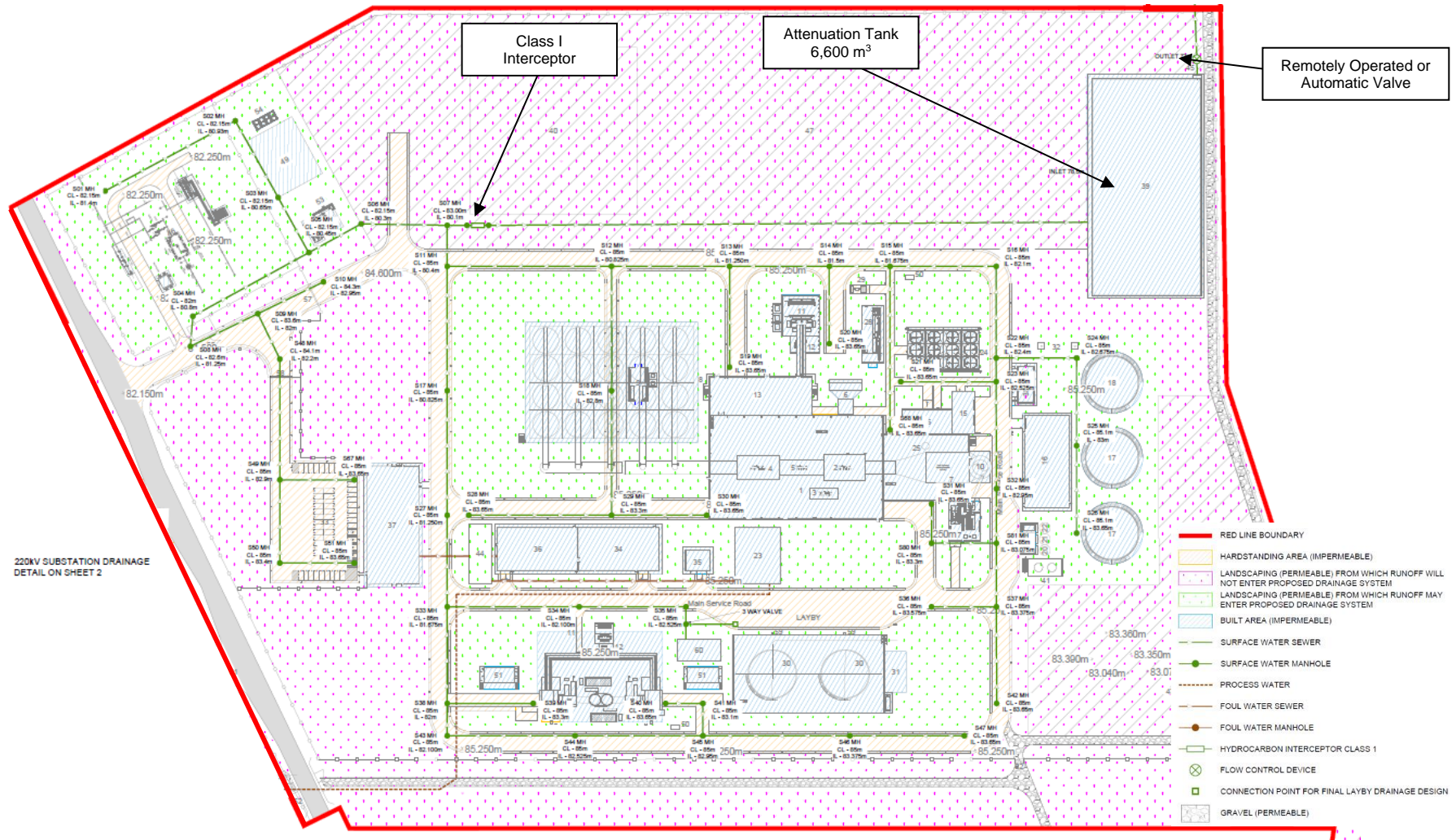


Figure 4 power plant area Surface Water Drainage System

2.2 Properties of Dangerous Substances

Table 3 details the quantity of hazardous material stored at the proposed power plant.

Dangerous substance	COMAH Classification	Quantity	Lower tier threshold	Upper tier threshold	Fraction of Lower tier threshold	Fraction of Upper tier threshold
		tonnes				
Named Substances						
Petroleum products – (Distillate)	E2 - Aquatic Chronic 2	12,750	2500	25000	5.1	0.51
Natural Gas	P2 – Physical	4.3	50	200	0.086	0.022
Liquified flammable gases: LPG	P2 – Physical	2	50	200	0.04	0.01
Hydrogen	P2 – Physical	0.0175	5	50	0.0035	0.00035
Environmental						
Ammonia (35%)	E1 - Aquatic Chronic 1	81	100	200	0.81	0.405
Sodium Hypochlorite (15%)	E1 - Aquatic Chronic 1	15	100	200	0.15	0.075

Table 3 Quantities of Hazardous Substances at the Proposed power plant

Table 4 details the COMAH status calculation.

Group	COMAH Categories	Lower Tier Fraction	Upper Tier Fraction
H (Health)	Part 1: H1, H2, H3 and Part 2: Acute Category 1, 2 or 3 (inhalation route), STOT SE Category 1	0	0
P (Physical)	Part 1: P1 to P8 and Part 2: Explosives, flammable gases, flammable aerosols, oxidising gases, flammable liquids, self-reactive substances and mixtures, organic peroxides, pyrophoric liquids and solids, oxidising liquids and solids	5.23	0.542
E (Environment)	Part 1: E1 and E2 and Part 2: hazardous to the aquatic environment acute category 1, chronic category 1 or chronic category 2	6.06	0.99

Table 4 Calculation of COMAH Status at the Proposed power plant

The proposed power plant stores hazardous substances in excess of the Lower Tier threshold; therefore, following development, the site will be classified as a Lower Tier Seveso facility.

3.0 INTRODUCTION TO RISK ASSESSMENT

3.1 Risk Assessment – An Introduction

The Centre for Chemical Process Safety (CCPS) has defined risk as (CCPS 2000): “Risk is a measure of human injury, environmental damage, or economic loss in terms of both the incident likelihood and the magnitude of the loss or injury.”

Risk is a function of the consequences of an undesired event and how likely it is to occur. It is often expressed as the product of the likelihood and the consequences:

$$\text{Risk} = \text{consequence} \times \text{likelihood}$$

In this form, risk has the units of losses per year.

Risk assessment in the chemical process sector seeks answers to the following questions:

- What are the hazards?
- What can go wrong (scenario)?
- How severe could it be (consequence)?
- How likely is it to happen (frequency)?
- How do consequence and frequency combine (risk)?
- Is the current level of risk tolerable, considering existing safeguards?
- If not, what needs to be done to reduce and manage the risk?

Risk assessment may be qualitative, semi-quantitative or quantitative, with the level of detail and analysis increasing from qualitative through to quantitative approaches. For COMAH establishments, the HSA Safety Report Assessment Guidelines (HSA, 2017) indicate that the depth of analysis should be proportionate to:

- the scale and nature of the major accident hazards presented by the establishment
- the risk posed to neighbouring populations and the environment

3.2 Land Use Planning and Risk Assessment

This land use planning assessment has been carried out in accordance with the HSA’s *Guidance on technical land-use planning advice* (HSA, 2023). This approach involves defining three zones for land use planning guidance purposes, based on the potential risk of fatality from major accident scenarios. The HSA has defined the boundaries of the Inner, Middle and Outer Land Use Planning (LUP) zones as:

1E-05/year	Risk of fatality for Inner Zone (Zone 1) boundary
1E-06/year	Risk of fatality for Middle Zone (Zone 2) boundary
1E-07/year	Risk of fatality for Outer Zone (Zone 3) boundary

The process for determining the distances to the boundaries of the inner, middle and outer zones is outlined as follows:

- Determine the consequences of major accident scenarios using the modelling methodologies described in the HSA’s *Guidance on technical land-use planning advice* (HSA, 2023).
- Determine the severity (probability of fatality) using the Probit functions

specified by the HSA.

- Determine the frequency of the accident (probability of event) using data specified by the HSA.
- Determine the individual risk of fatality as follows:

$$\text{Risk} = \text{Frequency} \times \text{Severity}$$

(Equation 1)

The HSA's Guidance on technical land-use planning advice (HSA, 2023) document provides guidance on the type of development appropriate to the inner, middle and outer LUP zones. The methodology sets four levels of sensitivity, with sensitivity increasing from 1 to 4, to describe the development types in the vicinity of a COMAH establishment.

The Sensitivity Levels used in the Land Use Planning Methodology are based on a rationale which allows progressively more severe restrictions to be imposed as the sensitivity of the proposed power plant area increases. The sensitivity levels are:

- Level 1 Based on normal working population;
- Level 2 Based on the general public – at home and involved in normal activities;
- Level 3 Based on vulnerable members of the public (children, those with mobility difficulties or those unable to recognise physical danger); and
- Level 4 Large examples of Level 3 and large outdoor examples of Level 2 and Institutional Accommodation.

Table 5 details the matrix that is used by the HSA to advise on suitable development for technical LUP purposes:

Level of Sensitivity	Inner Zone (Zone 1)	Middle Zone (Zone 2)	Outer Zone (Zone 3)
Level 1	✓	✓	✓
Level 2	✗	✓	✓
Level 3	✗	✗	✓
Level 4	✗	✗	✗

Table 5 LUP Matrix

3.3 Individual Risk Criteria

The TLUP guidelines (HSA, 2023) state the maximum tolerable risk to a member of the public is 1E-06 per year and the maximum tolerable risk to a person at an off-site work location is 5E-06 per year.

It is noted that these criteria apply to the total risk from all major accident hazards at an establishment.

3.4 Environment and Land Use Planning

The HSA's Generic TLUP Guidelines (HSA, 2023) outlined that the prevention of MATTEs is the primary objective, and it is expected that accident pathways will be prevented. Where this is not practicable, the assessment of major accidents to the environment focuses on the specific risks to sensitive receptors within the local

environment, the extent of consequences to such receptors and the ability of such receptors to recover.

Assessment is based on a Source-Pathway-Receptor model. For new establishments, the Competent Authority will focus on the removal of accident pathways to receptors (through the use of additional technical measures: appropriate containment, within the confines of current good practice and ALARP, for example).

4.0 LAND USE PLANNING ASSESSMENT METHODOLOGY AND CRITERIA

This COMAH land use planning assessment has been completed in accordance with risk-based approach set out in the HSA's *Guidance on technical land-use planning advice* (HSA, 2023). LUP assessments are completed in the following steps:

- Identify major accident scenarios with reference to the HSA guidance document (HSA, 2023).
- Consequence modelling of major accident scenarios with physical consequences.
- Assign frequencies to major accident scenarios with reference to frequency values outlined in the HSA's Guidance document (HSA, 2023).
- Assessment of individual risk and generation of individual risk contours.
- Where necessary, assessment of societal risk using societal risk indices.
- Source-pathway-receptor model for major accident scenarios with environmental consequences, environmental receptor categorisation, assessment of MATTE harm and duration, compare MATTE frequency with tolerability criteria.

4.1 Assessment Methodology

4.1.1 Physical Effects Modelling

The impacts of physical and health effects on workers and the general public outside of the power plant area were determined by modelling accident scenarios using Gexcon Effects version 12.4.0 and DNV Phast Version 9.0 modelling software.

4.1.2 Risk Assessment Methodology

Gexcon RiskCurves version 12.4.0 modelling software is used in this assessment to calculate individual risk of fatality contours and risk-based land use planning zones associated with major accident scenarios.

4.2 Thermal Radiation Criteria

Fire scenarios have the potential to create hazardous heat fluxes. Therefore, thermal radiation on exposed skin poses a risk of fatality.

Potential consequences of damaging radiant heat flux and direct flame impingement are categorised in Table 6 (HSA, 2023).

Thermal Flux (kW/m ²)	Consequences
1 – 1.5	Sunburn
5 – 6	Personnel injured (burns) if they are wearing normal clothing and do not escape quickly
8 – 12	Fire escalation if long exposure and no protection
32 – 37.5	Fire escalation if no protection (consider flame impingement)
31.5	US DHUD, limit value to which buildings can be exposed
37.5	Process equipment can be impacted, AIChE/CCPS
Up to 350	In flame. Steel structures can fail within several minutes if unprotected or not cooled.

Table 6 Heat Flux Consequences

In relation to persons indoors, the HSA have specified the thermal radiation consequence criteria (from an outdoor fire) detailed in Table 7 (HSA, 2023).

Thermal Flux (kW/m ²)	Consequences
> 25.6	Building conservatively assumed to catch fire quickly and so 100% fatality probability
< 25.6	People are assumed to escape outdoors, and so have a risk of fatality corresponding to that of people outdoors
< 12.7	People are assumed to be protected, and therefore there is a 0% fatality probability

Table 7 Heat Flux Consequences Indoors

Thermal Dose Unit (TDU) is used to measure exposure to thermal radiation. It is a function of intensity (power per unit area) and exposure time:

$$\text{Thermal Dose} = I^{1.33} t \quad (\text{Equation 2})$$

where the Thermal Dose Units (TDUs) are (kW/m²)^{4/3}.s, I is thermal radiation intensity (kW/m²), and t is exposure duration (s).

The HSA recommends that the Eisenberg Probit function (HSA, 2023) is used to determine probability of fatality to persons outdoors from thermal radiation as follows:

$$\text{Probit} = -14.9 + 2.56 \ln (I^{1.33} t) \quad (\text{Equation 3})$$

I Thermal radiation intensity (kW/m²)
t exposure duration (s)

Probit (Probability Unit) functions are used to convert the probability of an event occurring to percentage certainty that an event will occur. The Probit variable is related to probability as follows (CCPS, 2000):

$$P = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Y-5} \exp\left(-\frac{u^2}{2}\right) du \quad (\text{Equation 4})$$

where P is the probability of percentage, Y is the Probit variable, and u is an integration variable. The Probit variable is normally distributed and has a mean value of 5 and a standard deviation of 1.

The Probit to percentage conversion equation is (CCPS, 2000):

$$P = 50 \left[1 + \frac{Y-5}{|Y-5|} \operatorname{erf} \left(\frac{|Y-5|}{\sqrt{2}} \right) \right] \quad (\text{Equation 5})$$

The relationship between Probit and percentage certainty is presented in Table 8 (CCPS, 2000).

%	0	1	2	3	4	5	6	7	8	9
0	—	2.67	2.95	3.12	3.25	3.36	3.45	3.52	3.59	3.66
10	3.72	3.77	3.82	3.87	3.92	3.96	4.01	4.05	4.08	4.12
20	4.16	4.19	4.23	4.26	4.29	4.33	4.36	4.39	4.42	4.45
30	4.48	4.50	4.53	4.56	4.59	4.61	4.64	4.67	4.69	4.72
40	4.75	4.77	4.80	4.82	4.85	4.87	4.90	4.92	4.95	4.97
50	5.00	5.03	5.05	5.08	5.10	5.13	5.15	5.18	5.20	5.23
60	5.25	5.28	5.31	5.33	5.36	5.39	5.41	5.44	5.47	5.50
70	5.52	5.55	5.58	5.61	5.64	5.67	5.71	5.74	5.77	5.81
80	5.84	5.88	5.92	5.95	5.99	6.04	6.08	6.13	6.18	6.23
90	6.28	6.34	6.41	6.48	6.55	6.64	6.75	6.88	7.05	7.33
%	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
99	7.33	7.37	7.41	7.46	7.51	7.58	7.65	7.75	7.88	8.09

Table 8 Conversion from Probit to Percentage

For long duration fires, such as pool fires, it is generally reasonable to assume an effective exposure duration of 60 seconds to take account of the time required to escape (HSA, 2023). It is noted that this is a conservative estimation of the time taken to escape and is used in consequence assessment as the maximum exposure duration for heat radiation.

With respect to exposure to thermal radiation outdoors, the Eisenberg Probit relationship implies:

- 1% fatality – 963 TDUs (8.02 kW/m² for 60 s exposure duration)
- 10% fatality – 1450 TDUs (10.9 kW/m² for 60 s exposure duration)
- 50% fatality – 2399 TDUs (15.9 kW/m² for 60 s exposure duration)

4.3 Overpressure Criteria

Explosions scenarios can result in damaging overpressures, especially when flammable vapour/air mixtures are ignited in a congested area.

Combustion of a flammable gas-air mixture will occur if the composition of the mixture lies in the flammable range and if an ignition source is available. When ignition occurs in a flammable region of the cloud, the flame will start to propagate away from the ignition source. The combustion products expand causing flow ahead of the flame. Initially this flow will be laminar. Under laminar or near laminar conditions the flame speeds for normal hydrocarbons are in the order of 5 to 30 m/s which is too low to produce any significant blast over-pressure. Under these conditions, the

vapour cloud will simply burn, causing a flash fire. In order for a vapour cloud explosion to occur, the vapour cloud must be in a turbulent condition.

Turbulence may arise in a vapour cloud in various ways:

- By the release of the flammable material itself, for instance a jet release from a high-pressure vessel.
- By the interaction of the expansion flow ahead of the flame with obstacles present in a congested area.

Table 9 describes blast damage for various overpressure levels (HSA, 2023).

Side-on Overpressure (mbar)	Description of Damage
1.5	Annoying noise
2	Occasional breaking of large windowpanes already under strain
3	Loud noise; sonic boom glass failure
7	Breakage of small windows under strain
10	Threshold for glass breakage
20	“Safe distance”, probability of 0.95 of no serious damage beyond this value; some damage to house ceilings; 10% window glass broken
30	Limited minor structural damage
35 – 70	Large and small windows usually shattered; occasional damage to window frames
>35	Damage level for “Light Damage”
50	Minor damage to house structures
80	Partial demolition of houses, made uninhabitable
70 - 150	Corrugated asbestos shattered. Corrugated steel or aluminium panels fastenings fail, followed by buckling; wood panel (standard housing) fastenings fail; panels blown in
100	Steel frame of clad building slightly distorted
150	Partial collapse of walls and roofs of houses
150-200	Concrete or cinderblock walls, not reinforced, shattered
>170	Damage level for “Moderate Damage”
180	Lower limit of serious structural damage 50% destruction of brickwork of houses
200	Heavy machines in industrial buildings suffered little damage; steel frame building distorted and pulled away from foundations
200 – 280	Frameless, self-framing steel panel building demolished; rupture of oil storage tanks
300	Cladding of light industrial buildings ruptured
350	Wooden utility poles snapped; tall hydraulic press in building slightly damaged
350 – 500	Nearly complete destruction of houses
>350	Damage level for “Severe Damage”
500	Loaded tank car overturned

Side-on Overpressure (mbar)	Description of Damage
500 – 550	Unreinforced brick panels, 25 - 35 cm thick, fail by shearing or flexure
600	Loaded train boxcars completely demolished
700	Probable total destruction of buildings; heavy machine tools moved and badly damaged
830	Damage level for 'total destruction'

Table 9 Blast Damage

The HSA recommends that the Hurst, Nussey and Pape Probit function (HSA, 2023) is used to determine probability of fatality to persons outdoors from overpressure as follows:

$$\text{Probit} = 1.47 + 1.35 \ln P$$

P Blast overpressure (psi)

The Hurst, Nussey and Pape Probit relationship implies:

- 1% fatality – 168 mbar
- 10% fatality – 365 mbar
- 50% fatality – 942 mbar

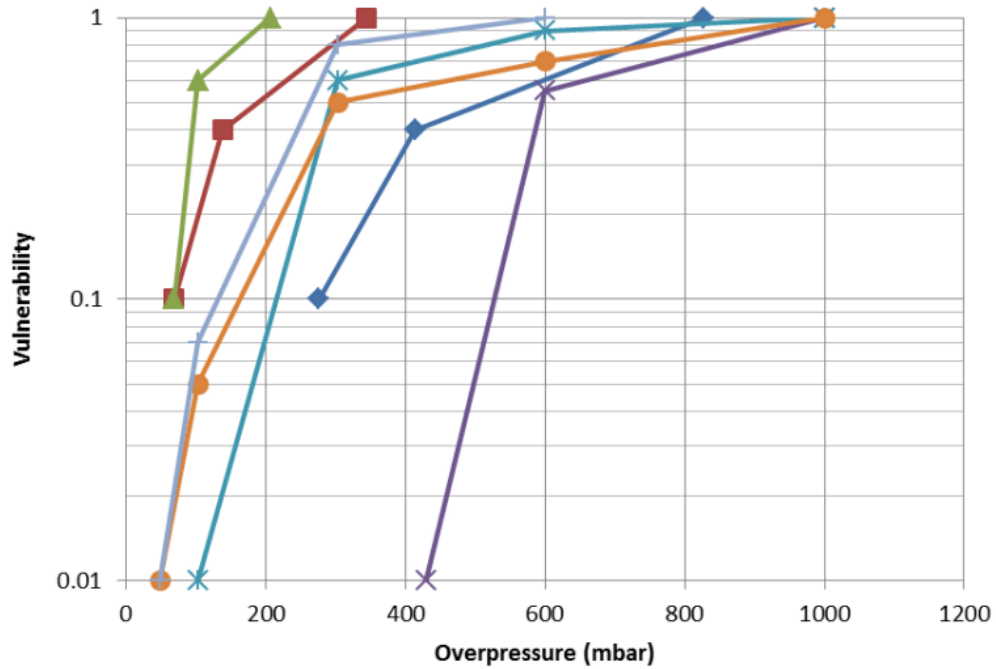
The HSA uses relationships published by the Chemical Industries Association (CIA) and the American Petroleum Institute (API) to determine the probability of fatality for building occupants exposed to blast overpressure. The CIA has developed relationships for 4 categories of buildings (CIA, 2020):

- CIA 1: hardened structure building (special construction, no windows).
- CIA 2: typical office block (four storey, concrete frame and roof, brick block wall panels).
- CIA 3: typical domestic dwelling (two storey, brick walls, timber floors); and
- CIA 4: 'portacabin' type timber construction, single storey.

The API has developed relationships for 5 categories of buildings (EIGA, 2014):

- API B1: Wood frame trailer or shack
- API B2: Steel frame/metal siding or pre-engineered building
- API B3: Unreinforced masonry bearing wall building
- API B4: Steel or concrete reinforced masonry infill or cladding
- API B5: Reinforced concrete or reinforced masonry shear wall building

Figure 5 illustrates the probability of occupant vulnerability to overpressure in CIA building categories CIA 1 – 4 and in API building types B1 – B5.



Graph Key:	
	CIA 1: Hardened structure building: special construction, no windows
	CIA 2: Typical office block: four story, concrete frame and roof, brick block wall panels
	CIA 3: Typical domestic buildings: two story, brick walls, timber floors
	CIA 4: Portacabin: timber construction, single story
	API B5: Reinforced concrete or reinforced masonry shear wall building
	API B3: Unreinforced masonry bearing wall building
	API B1, B2, B4: Wood frame trailer or shack, steel-frame/metal siding or pre-engineered building, steel or concrete reinforced masonry infill or cladding
NOTE—Building key items 1 - 4 are defined by CIA; items B1 - B5 are defined by API RP 752 (2003) [5, 3].	

Figure 5 API Probability of Occupant Vulnerability

The CIA and API relationships imply the overpressure levels corresponding to probabilities of fatality of 1%, 10% and 50% detailed in Table 10 below.

Probability of fatality	Overpressure Level, mbar						
	CIA 1	CIA 2	CIA 3	CIA 4	API B1 B2 and B4	API B3	API B5
1% fatality	435	100	50	50	-	-	-
10% fatality	519	183	139	115	69	69	276
50% fatality	590	284	300	242	172	97	483

Table 10 Blast Overpressure Consequences Indoors

For the purposes of this assessment, it is assumed that the vulnerability of building occupants to side-on overpressure, as a result of a MAH at the proposed development, is CIA Category 3 type structures, representing residential buildings in the vicinity of the proposed development.

4.4 Flash Fire Criteria

A flash fire comprises the combustion of a flammable vapour and air mixture in which the flame passes through that mixture at less than sonic velocity, such that negligible damaging overpressure is generated.

The flash fire envelope is the lower flammable limit (LFL) concentration, determined using the unified dispersion model in PHAST Version 9.0 consequence modelling software.

Outdoor fatality levels of 100% are assumed inside the lower flammable limit (LFL) envelope, with 0% fatalities outside that envelope. Indoor fatality levels are conservatively assumed to be 10% within the flash fire envelope. (HSA, 2023)

4.5 Modelling Parameters

4.5.1 Weather Conditions

Weather conditions at the time of a major accident have a significant impact on the consequences of the event. Typically, high wind speeds increase the impact of fires, particularly pool fires, while the associated turbulence dilutes vapour clouds, reducing the impact of toxic and flammable gas releases.

Atmospheric Stability Class and Wind Speed

Atmospheric stability describes the amount of turbulence in the atmosphere. The stability depends on the wind speed, time of day, and other conditions. Atmospheric stability classes are described in Table 11 (DNV, PHAST Supporting Documentation).

Wind speed (m/s)	Day: Solar Radiation			Night: Cloud Cover		
	Strong	Moderate	Slight	Thin, <40%	Moderate	Overcast, >80%
2	A	A-B	B	-	-	D
2 – 3	A-B	B	C	E	F	D
3 – 5	B	B-C	C	D	E	D
5 – 6	C	C-D	D	D	D	D
6	C	D	D	D	D	D

Table 11 Atmospheric Stability Class

Stability classes are described as follows:

- A very unstable (sunny with light winds)
- B unstable (moderately sunny, stronger winds than class A)
- C slightly unstable – very windy/sunny or overcast/light wind
- D neutral – little sun and high wind or overcast night
- E stable – moderately stable – less overcast and windy than class D
- F very stable – night with moderate clouds and light/moderate winds

The following Pasquill stability/wind speed pairs are specified by the HSA in Ireland for dispersion modelling:

- Average weather conditions are represented by stability category D and a wind speed of 5 m/s, i.e., Category D5.
- Worst case conditions for toxic dispersion are represented by stability category F and a wind speed of 2 m/s, i.e., Category F2.

D5 conditions are assumed to occur 80% of the time, with F2 occurring for the remaining 20%.

Wind Direction and Ambient Temperature

The nearest synoptic meteorological station to the power plant area for which long term meteorological data is available is at Mullingar Synoptic Station.

Figure 6 illustrates a wind rose for Mullingar (1991 – 2021). It can be seen that the prevailing wind direction is from the southwest (220°).

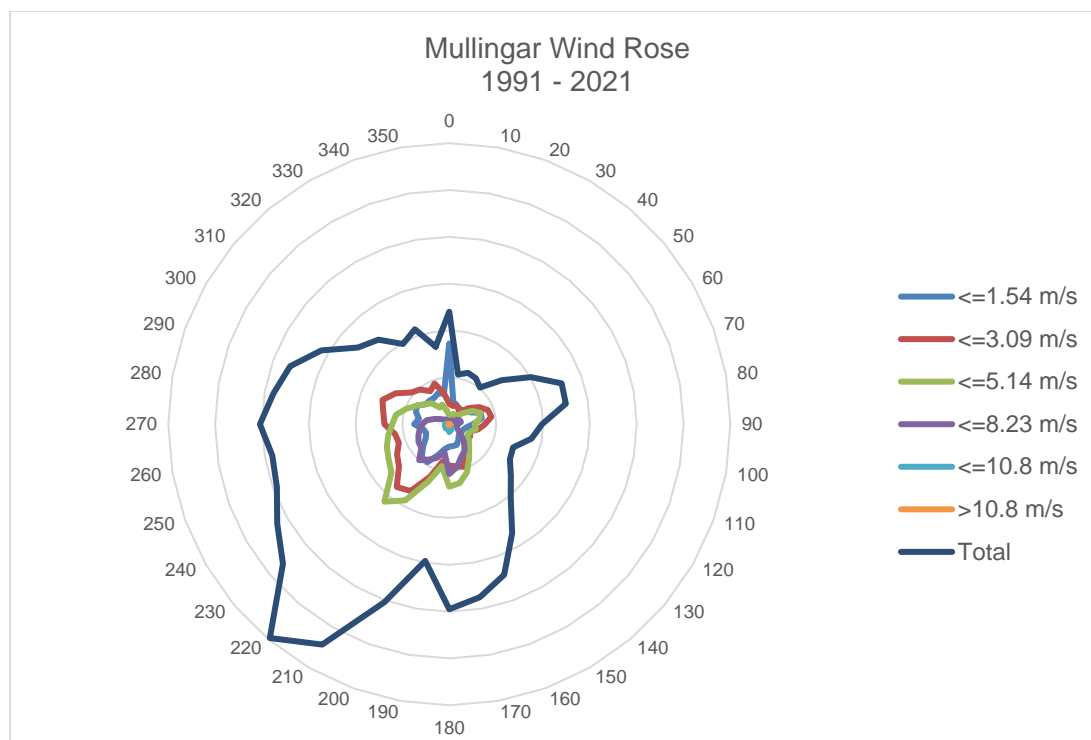


Figure 6 Wind Rose Mullingar 1991 - 2021 (www.met.ie)

Ambient Temperature

The TLUP guidance states that a temperature of 15 °C is used in D5 conditions and 10 °C for F2 conditions.

Ambient Humidity

For this assessment, a representative ambient humidity of 60% has been assumed.

4.5.2 Surface Roughness

Surface roughness describes the roughness of the surface over which the cloud is dispersing. Typical values for the surface roughness are as follows (DNV, PHAST supporting documentation):

Roughness length	Description
0.0002 m	Open water, at least 5 km
0.005 m	Mud flats, snow, no vegetation
0.03 m	Open flat terrain, grass, few isolated objects
0.1 m	Low crops, occasional large obstacles, $x/h > 20$
0.25 m	High crops, scattered large objects, $15 < x/h < 20$
0.5 m	Parkland, bushes, numerous obstacles, $x/h < 15$
1.0 m	Regular large obstacles coverage (suburb, forest)
3.0 m	Town centre with high-rise and low-rise buildings

Table 12 Surface Roughness

The terrain within the vicinity of the power plant area is comprised of mainly lowland blanket bog and wet grassland. A surface roughness length of 0.03 m has been selected for the study.

4.6 Societal Risk Assessment Methodology

Where a large population is potentially exposed to the consequences of a major accident, and there is the potential for multiple fatalities from a single event, societal risk is taken into account.

To take account of societal risk, the HSA will initially obtain an estimate of the expectation value.

Expectation Value and FN Curve

The Expectation Value (EV) is the average number of persons receiving a specified level of harm. Hirst and Carter (Hirst et al., 2000) shows that:

$$EV = F \times N$$

Where F is the cumulative frequency of all events leading to N fatalities

HSE (2001) provides an upper limit value for an intolerable societal risk criterion: for a predicted accident occurring no more frequently than once in 5,000 years, there should be no more than 50 fatalities. This has gained international acceptance as an anchor point for a line (of slope -1) to create an intolerable societal risk criterion for single accidents. HSA Guidance on Technical Land Use Planning recommended using points at 200 cpm / 50 fatalities and 1000 cpm/10 fatalities to create that line. An acceptable societal risk single risk criterion line can then be drawn at frequencies that are two orders of magnitude below the intolerable line (so a frequency of 1×10^{-4} on the intolerable line becomes 1×10^{-6} on the acceptable line).

Some establishments will have the potential for fatalities to arise from a multiplicity of accident scenarios (or there may be other establishments in the vicinity, adding to the EV). In such situations, the total off-site EV should not exceed the criterion upper limit EV of 10,000. Between EVs of 100 and 10,000, it should be demonstrated that all practicable efforts have been made to reduce the risk to a level that is as low as reasonably practicable (above a developmental EV level of 450, an FN curve will be required as part of the demonstration).

5.0 IDENTIFICATION OF MAJOR ACCIDENT HAZARDS

A major accident is defined in the 2015 COMAH Regulations as:

“an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by these Regulations, and leading to serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances”

5.1 Major Accident Hazards at Proposed Gas Turbines within the power plant area

5.1.1 Turbine Vapour Cloud Explosion Scenario

The turbine enclosures, 1 No. CCGT and 2 No. OCGT, will have a leak detection system that will trip the incoming gas supply when the concentration within the enclosure reaches 20% LEL. Therefore, this system has to fail in order for there to be a build-up of natural gas to explosive concentrations.

In the event the leak detection system fails, there is the potential for a confined Vapour Cloud Explosion (VCE) as a result of a leak of natural gas within the turbine enclosures. The HSA TLUP guidance specifies the size of the flammable cloud to be taken as the volume of the region where the release may occur (i.e. turbine enclosure volume).

Individual risks of fatality can be calculated using a Probit of $Y = 1.47 + 1.35 \ln(P)$, with P in psi (Hurst, Nussey and Pape, 1989) for the risk to people outdoors, and the Chemical Industries Association (CIA, 2020) vulnerability curves for the risk to people indoors.

5.1.2 Pipeline Release Scenario

The proposed CCGT and OCGTs will be supplied with natural gas pipelines originating at the AGI. The natural gas pipework will include the provision of a series of Emergency Shutdown Devices (ESDs), in compliance with EN 14382, which will act to block incoming gas flow in the event of a pressure drop. The specification of the ESDs will be finalised at detailed design; however, typical blocking response times are <1 second. However, in the absence of detailed design, the natural gas pipeline will be modelled without an ESD.

5.1.3 Major Accidents to the Environment (MATTE)

The surface water drainage system, detailed in Section 2.1.8, provides tertiary containment in the event of hazardous material release and bund overtop.

The distillate fuel is classified as a Flammable Category 3 material (HSA, 2023). Therefore, there are no flammable hazards associated with distillate as it has an ignition probability of 0, as it is not stored in a bund with other flammable material. The major accident hazards associated with distillate are a potential release to the environment.

The aqueous ammonia or sodium hypochlorite stored on-site does not have any toxic hazard phrases; therefore, the major accidents associated with ammonia are a potential release to the environment.

5.1.4 Major Accident Scenarios

Table 13 details the major accident scenarios arising from the proposed power plant:

Installation	LOC scenario	Consequence/Event
Indoor equipment (release in Turbine enclosure)	Instantaneous failure	VCE
	Continuous leak over 10 minutes	VCE
	10 mm pipe leak over 10 minutes	VCE
Natural Gas Pipeline	Rupture of Pipeline	Fireball/Jet fire
		VCE
		Flash fire
	Pipeline Leak of 0.1D	Fireball/Jet fire
		VCE
		Flash fire
LPG Tank	Instantaneous Failure	Fireball
		VCE
		Flash fire
	Continuous Leak over 10 minutes	Jet fire
		VCE
		Flash fire
	10mm pipe leak over 30 minutes	Jet fire
		VCE
		Flash fire
LPG Pipeline	Rupture of Pipeline	Fireball/Jet fire
		VCE
		Flash fire
	Pipeline Leak of 0.1D	Fireball/Jet fire
		VCE
		Flash fire
LPG Tanker	Instantaneous Failure	Fireball
		VCE
		Flash fire
	Loss of entire Contents through Largest Connection	Jet fire
		VCE
		Flash fire
	Rupture of unloading arm	Jet fire
		VCE
		Flash fire
	Leak of unloading arm of 10% of diameter	Jet fire
		VCE
		Flash fire
BLEVE (hot)	BLEVE	
Hydrogen Storage	Instantaneous failure	VCE/Fireball

Installation	LOC scenario	Consequence/Event
	Continuous leak over 10 minutes (total inventory of 1 skid)	VCE, jet fire or flash fire
	10 mm pipe leak over 10 minutes	VCE, jet fire or flash fire
Hydrogen Pipeline	Pipeline rupture	Jet fire/Fireball
		VCE
		Flash fire
	Pipeline leak (10% of diameter)	Jet fire
		VCE
		Flash fire
Distillate Tank	Loss of Containment	MATTE
Aqueous Ammonia Tank	Loss of Containment	MATTE
Sodium Hypochlorite Tank	Loss of Containment	MATTE

Table 13 Major Accident Scenarios at the Proposed Development

6.0 LAND USE PLANNING ASSESSMENT OF MAJOR ACCIDENT HAZARDS

6.1 Natural Gas Pipeline Release

It is possible that a rupture or leak could occur at any point along any of the natural gas pipelines.

The consequences for the CCGT natural gas pipeline will be shown as a worst-case representative, for all pipelines, as it is the pipeline with the largest diameter, longest length, and highest pressure. The consequences for the OCGT pipeline and auxiliary boiler pipeline will be included in the risk calculation for the power plant area.

The consequences will be centred at the above ground section of the pipeline to represent a worst-case scenario.

Phast Version 9.0 long pipeline model was used to model a release of natural gas following rupture of a pipeline or a leak from a pipeline (10% of diameter).

6.1.1 Natural Gas Pipeline Release Model Inputs

The pipeline model inputs are detailed in Table 14. The natural gas modelling does not include valve closure at the AGI.

Phast Version 9.0 long pipeline model was used to model a release of natural gas following rupture of a pipeline or a leak from a pipeline (10% of diameter).

The current indicative model inputs are provided, these will be confirmed during the detailed engineering design phase. Any significant change to these inputs will be assessed appropriately.

Parameter	Pipeline rupture	Pipeline leak, 10% of diameter	Source/Assumption
Scenario	Pipeline rupture	Pipeline leak, 10% of diameter	-
Material	Methane	Methane	-
Pipeline diameter	500 mm	500 mm	Project Engineer
Hole Size	500 mm	50 mm	Pipeline rupture assumes Guillotine fracture so entire pipeline diameter
Pipe inflow	18.4 kg/s	18.4 kg/s	Maximum Flow to CCGT Project Engineer
Length of pipeline	520 m	520 m	Project Engineer
Pressure	60 barg	60 barg	Pipeline pressure
Averaging time	Flammable – 18.75 s	Flammable – 18.75 s	DNV PHAST
Exposure duration	60 s	60 s	HSA recommended (HSA, 2023)
Release height	1 m	1 m	Above ground pipeline
Release direction	Vertical Horizontal	Vertical Horizontal	HSA TLUP
Effect height	1.5 m	1.5 m	Average height of person
Wind speed	5 m/s 2 m/s	5 m/s 2 m/s	Recommended by HSA as representative modelling conditions
Pasquill Stability Factor	D (daytime conditions) F (stable nighttime conditions)	D (daytime conditions) F (stable nighttime conditions)	
Temperature	10 degC (F2) 15 degC (D5)	10 degC (F2) 15 degC (D5)	HSA TLUP (HSA 2023)

Table 14 Natural Gas Pipeline Full Rupture: Discharge Model Inputs

6.1.2 Pipeline Release Discharge Model Outputs

For a natural gas pipeline release, the long pipeline discharge model is used with a time varying release.

Figure 7 illustrates the Release Rate vs Time of natural gas following pipeline rupture. Figure 8 illustrates the Release Rate vs Time of natural gas following pipeline leak (0.1 x D). The release profile is the same for a vertical or horizontal release. Note the same profile for D5 and F2 weather conditions.

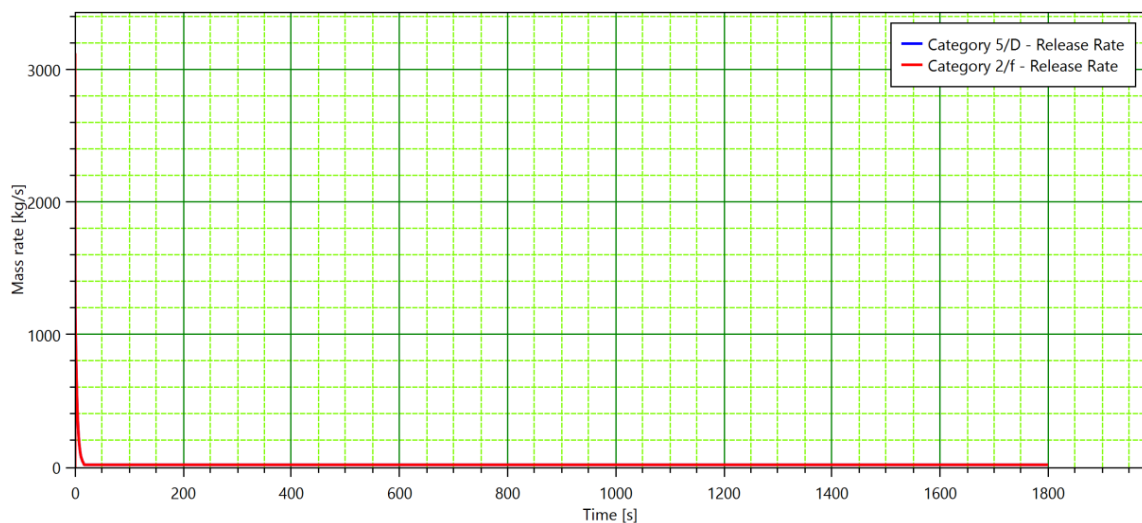


Figure 7 Pipeline Full Rupture: Release Rate vs Time

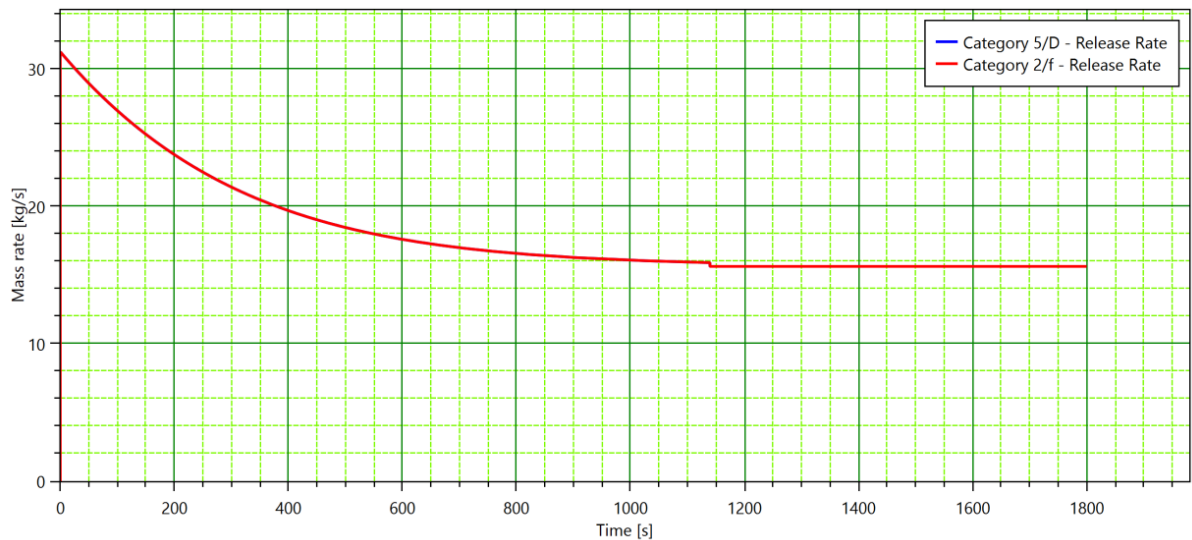


Figure 8 Pipeline Leak (10% of diameter): Release Rate vs Time

6.1.3 Natural Gas Pipeline Release: Predicted Phenomena

The unified dispersion model in DNV PHAST Version 9.0 predicts the following phenomena for each release scenario:

- Pipeline Rupture: Jet fire or fireball (immediate ignition), VCE or flash fire (delayed ignition)
- Pipeline leak, 10% of diameter: Jet fire or fireball (immediate ignition) or flash fire (delayed ignition)

6.1.4 Natural Gas Pipeline Release and Jet Fire

The (DNV Recommended) jet fire cone model was used to calculate the thermal radiation consequences from natural gas jet fires at the power plant area.

As per HSA TLUP guidelines (HSA, 2023), jet fire results are presented for vertical and horizontal releases.

Parameter	Pipeline Rupture and Jet Fire Vertical		Pipeline leak, 10% of diameter and Jet Fire Vertical		Pipeline Rupture and Jet Fire Horizontal		Pipeline leak, 10% of diameter and Jet Fire Horizontal	
	D5	F2	D5	F2	D5	F2	D5	F2
Calculated Mass flow rate (kg/s)	582	582	31	31	582	582	31	31
Flame Length (m)	128	133	29	45	198	253	55	70
Flame Lift-Off Distance (m)	23	31	6	9	35	48	10	13
Flame Diameter (m)	1.1	1.1	0.21	0.21	1.1	1.1	0.21	0.21

Table 15 Pipeline Release Scenarios: Jet Flame Parameters

Figure 9 and Figure 10 illustrate the thermal radiation vs distance profile for a jet fire following pipeline rupture and pipeline leak.

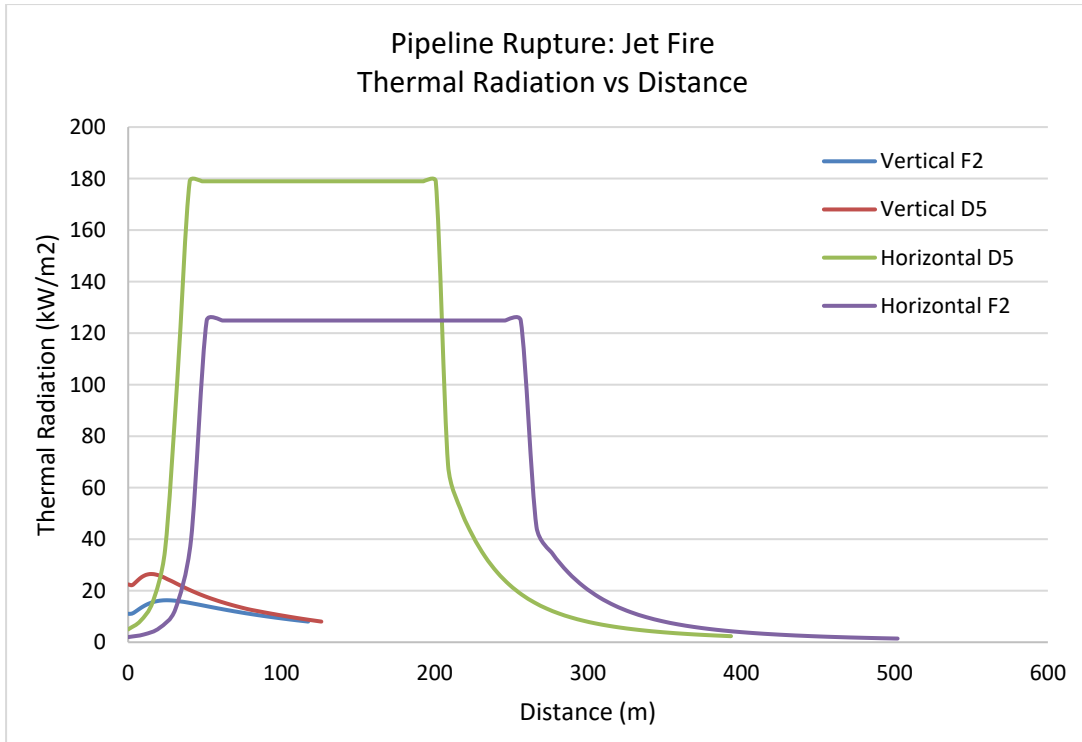


Figure 9 Pipeline Rupture and Jet Fire: Thermal Radiation vs Distance

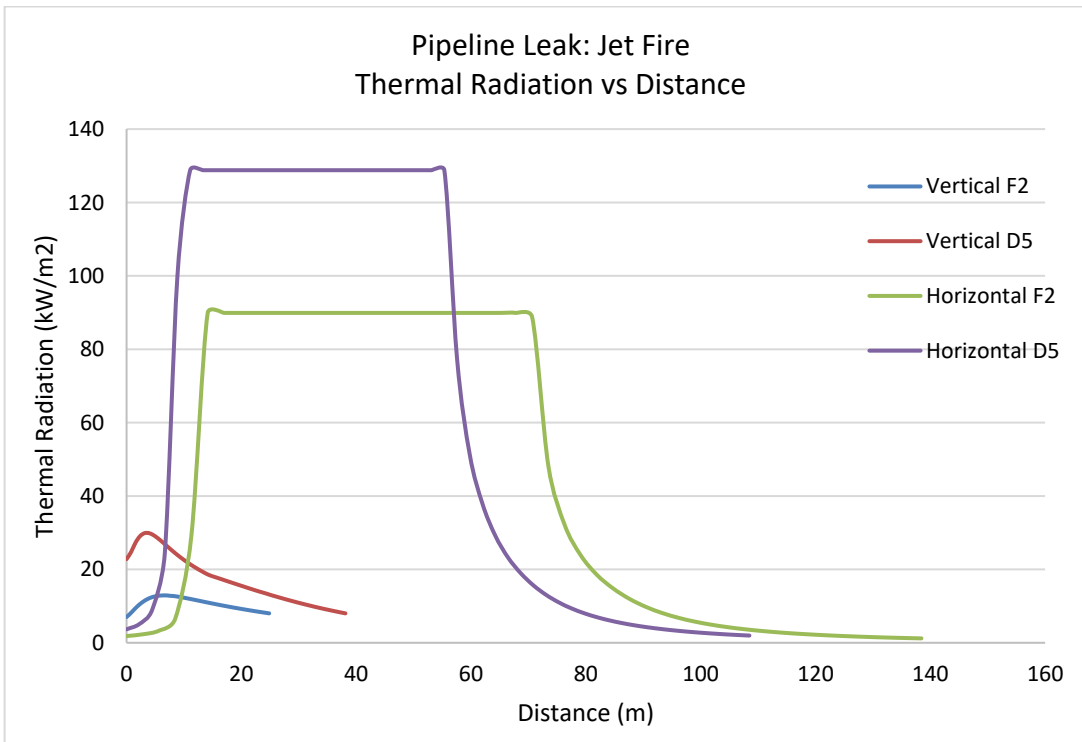


Figure 10 Pipeline Leak and Jet Fire: Thermal Radiation vs Distance

Table 16 details distances to specified thermal radiation levels, at a receiver height of 1.5m, associated with

- 1%, mortality outdoors
- 0% mortality and 100% mortality indoors

Consequence	Thermal Radiation (kW/m ²)	Pipeline Rupture and Jet Fire Vertical		Pipeline leak, 10% of diameter and Jet Fire Vertical		Pipeline Rupture and Jet Fire Horizontal		Pipeline leak, 10% of diameter and Jet Fire Horizontal	
		D5	F2	D5	F2	D5	F2	D5	F2
1% mortality outdoors	8.02	126	117	38	25	300	349	80	93
0% mortality indoors	12.7	79	63	26	8	274	323	73	87
100% mortality indoors	25.6	22	-	8	-	243	273	65	78

Table 16 Pipeline Full Rupture and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

Figure 11 and Figure 12 illustrates the thermal radiation contours and effect areas corresponding to 1% fatality outdoors for a jet fire following pipeline rupture and leak (respectively), for a horizontal release, for a receiver height 1.5m and weather category F2.



Figure 11 Horizontal Pipeline Rupture and Jet Fire: Thermal Radiation Contours Corresponding to 1% Mortality Outdoors



Figure 12 Horizontal Pipeline Leak and Jet Fire: Thermal Radiation Contours Corresponding to 1% Mortality Outdoors

It is concluded that in the event of a jet fire following a release from the above ground section of the pipeline, the thermal radiation level corresponding to 1% mortality outdoors could extend over the power plant area boundary to the north and to the west. It could extend to the R400 road to the west and to the refuelling station. Persons present in this area at the time of a jet fire could be exposed to harmful levels of thermal radiation.

6.1.5 Natural Gas Pipeline Release: Fireball Results

The HSE fireball model is used in this study. This is a static fireball model and assumes that the fireball is located on the ground with no lift-off.

In the event of a pipeline rupture scenario (and direct ignition), the HSE fireball model calculates a fireball radius of 47 m, and a fireball duration is 7.3 s for a vertical release and horizontal release.

In the event of a natural gas pipeline leak scenario (10% of diameter) (and direct ignition), the HSE fireball model calculates a fireball radius of 11 m, and a fireball duration is 1.7 s.

Figure 13 and Figure 14 illustrates the thermal radiation with distance for a fireball following pipeline rupture or leak (0.1D) respectively. The thermal radiation vs distance profile is the same for a vertical or horizontal release. Note the same profile for weather categories D5 and F2.

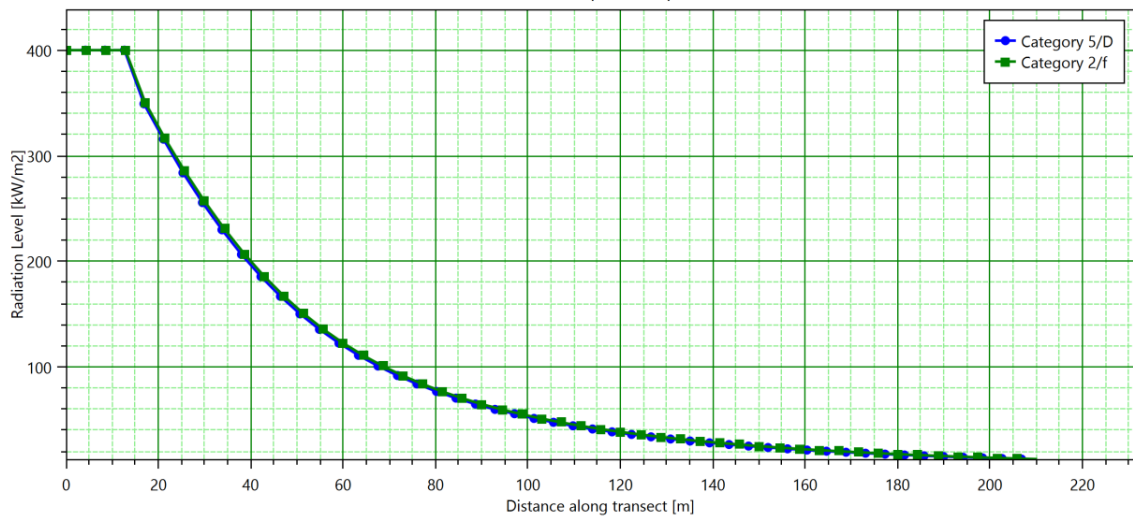


Figure 13 Pipeline Rupture and Fireball: Thermal Radiation vs. Distance

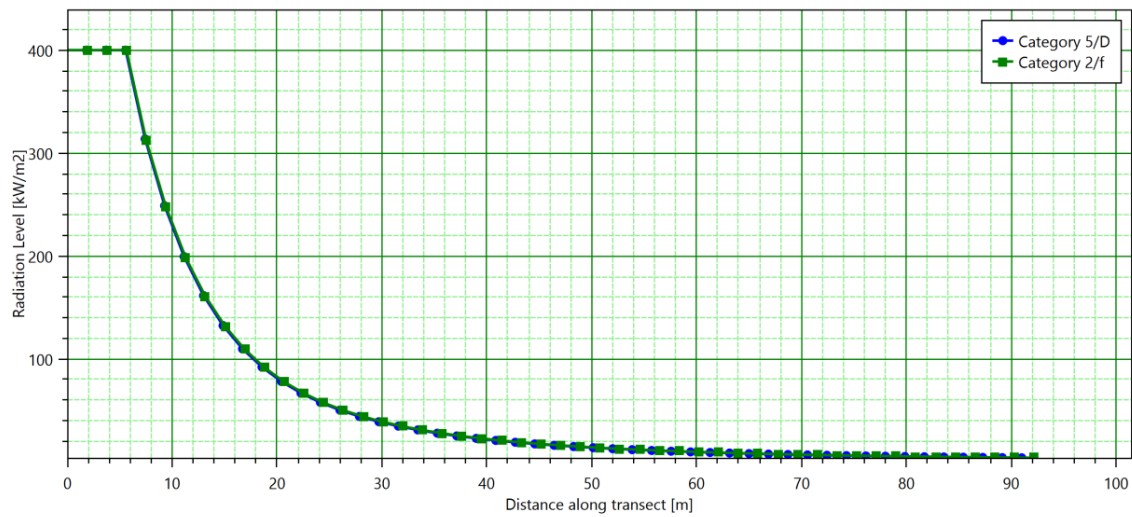


Figure 14 Pipeline Leak (10% Diameter) and Fireball: Thermal Radiation vs. Distance

Figure 15 illustrates thermal dose ($I^{1.33}.t$) based on the exposure duration (t) of the fireball.

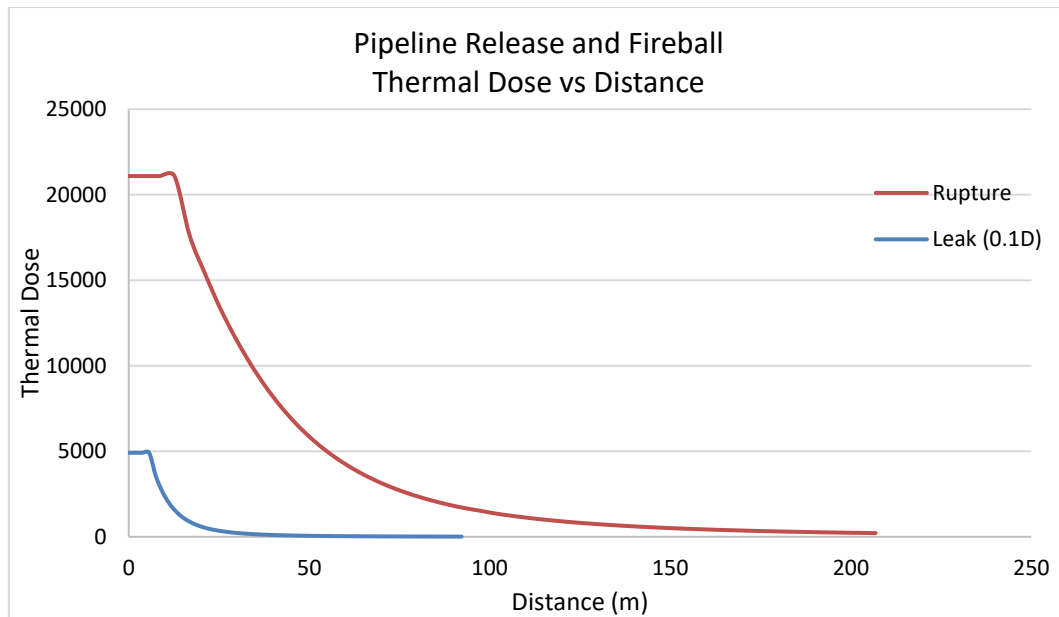


Figure 15 Pipeline Rupture and Fireball: Thermal Dose vs. Distance

Table 17 details the distances to thermal dose levels associated with specified levels of probability of fatality based on the Eisenberg Probit equation described in Section 4.2.

Criterion	Thermal Dose Level	Rupture Distance	Leak (10% Diameter) Distance
	TDU	(m)	(m)
1% fatality (based on a 7.3 s / 1.7 s fireball)	963	118	15
100% fatality	Fireball radius	47	11
Building protected below this level, 0% fatality probability	1777	206	52
Building will catch fire quickly, 100% fatality probability	4527	145	36

Table 17 Pipeline Rupture and Fireball: Distances to Specified Thermal Dose Levels

Figure 16 illustrates the thermal radiation contours corresponding to outdoor lethality levels and Figure 17 illustrates the thermal radiation contours corresponding to indoor lethality levels.



Figure 16 Pipeline Rupture and Fireball: Outdoor Lethality Contours

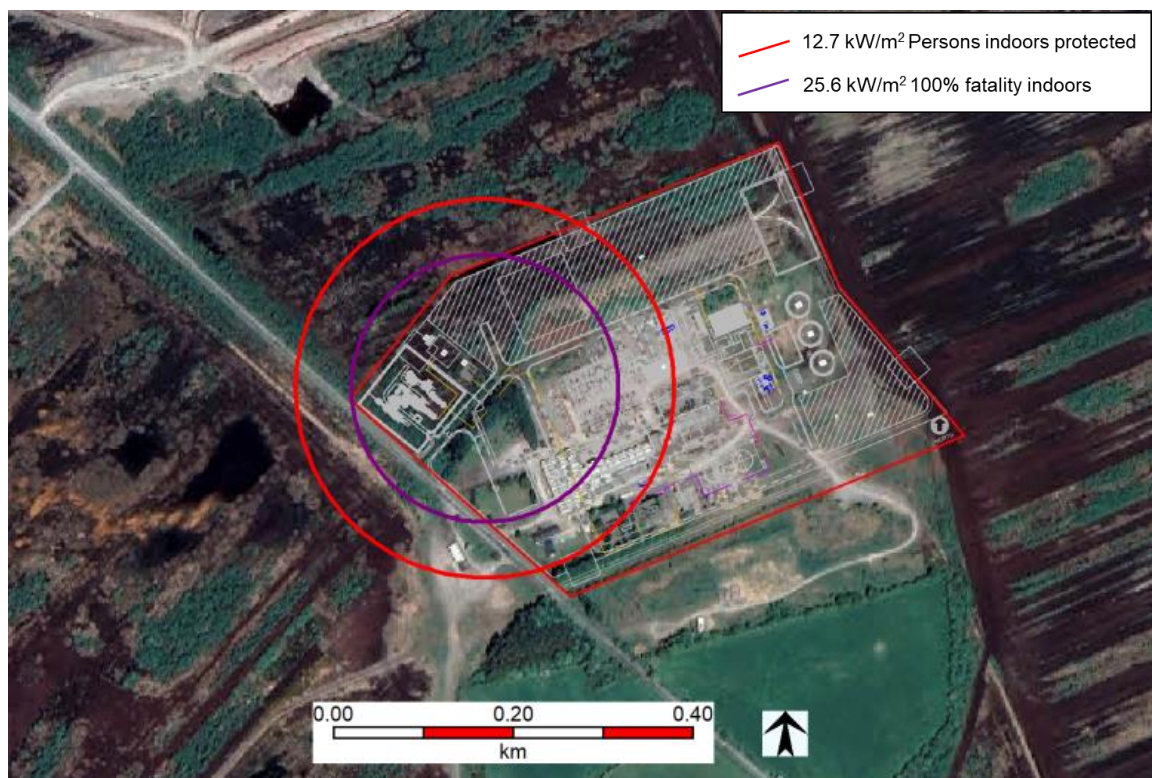


Figure 17 Pipeline Rupture and Fireball: Indoor Lethality Contours

It is concluded that the thermal radiation consequences corresponding to 1% fatality outdoors, following a fireball at the natural gas pipeline, extends slightly over the site boundary to the north and to the west. To the north, the lands are owned by Bord Na Mona and this area is not occupied to the west the 1% fatality contour extends to the

R400 road. Personnel present in this area could be exposed to harmful levels of radiation.

It is concluded that the thermal radiation consequences corresponding to persons protected indoors (12.7 kW/m^2), following a fireball at the natural gas pipeline, extends over the site boundary to the north and west; however, does not extend to any off-site occupied buildings.

6.1.6 Natural Gas Pipeline Release: VCE Results

The TNO Multi Energy model was used to model the overpressure consequences in the event a VCE following rupture of a natural gas pipeline. As the natural gas pipeline is buried the VCE is modelled for a vertical release.

The DNV PHAST Version 9.0 unified dispersion model predicts a maximum flammable mass of 76 kg and 42 kg for a pipeline rupture (horizontal) for weather categories D5 and F2 respectively, 82 kg and 99 kg for a pipeline rupture (vertical) for weather categories D5 and F2 respectively, 15 kg and 9 kg for a pipeline leak (horizontal) for weather categories D5 and F2 respectively, 3 kg and 6 kg for a pipeline leak (vertical) for weather categories D5 and F2 respectively.

Table 18 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Vertical Rupture Distance (m)		Vertical Leak Distance (m)		Horizontal Rupture Distance (m)		Horizontal Leak Distance (m)	
		F2	D5	F2	D5	F2	D5	F2	D5
35	Light damage	151	103	92	82	113	138	108	128
170	Moderate damage	41	39	25	22	31	37	29	35
350	Severe damage	25	24	16	14	19	23	18	22
830	Total destruction	12	12	8	8	10	12	9	11
168	1% mortality outdoors	41	39	16	22	31	37	29	35
50	1% mortality indoors CIA Category 3	109	142	67	59	82	100	79	93

Table 18 Natural Gas VCE following Pipeline Release: Distances to Specified Overpressure Endpoints

Figure 18 illustrates the overpressure contour corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3 following a pipeline rupture (vertical) and VCE and Figure 19 illustrates the overpressure contour corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3 following a pipeline leak (horizontal) and VCE.



Figure 18 Pipeline Rupture (Horizontal) and VCE: 1% Fatality Outdoors and 1% Fatality Indoors CIA. 3 Contours



Figure 19 Pipeline Leak (Horizontal) and VCE: 1% Fatality Outdoors and 1% Fatality Indoors CIA. 3 Contours

It is concluded that the overpressure consequences corresponding to 1% fatality outdoors or 1% fatality indoors, following a VCE at the natural gas pipeline, does not extend over the power plant area boundary.

It is concluded that no off-site fatalities are predicted for a VCE following a rupture or leak in the natural gas pipeline.

6.1.7 Natural Gas Pipeline Release: Flash Fire Results

The DNV PHAST Version 9.0 unified dispersion model predicts the flash fire footprints illustrated on the following figures for natural gas pipeline release scenarios.

The flash fire footprints are illustrated on the following Figures:

- Figure 20 Pipeline Rupture (Horizontal): Flash Fire Footprint
- Figure 21 Pipeline Rupture (Vertical): Flash Fire Footprint
- Figure 22 Pipeline Leak (Horizontal): Flash Fire Footprint
- Figure 23 Pipeline Leak (Vertical): Flash Fire Footprint

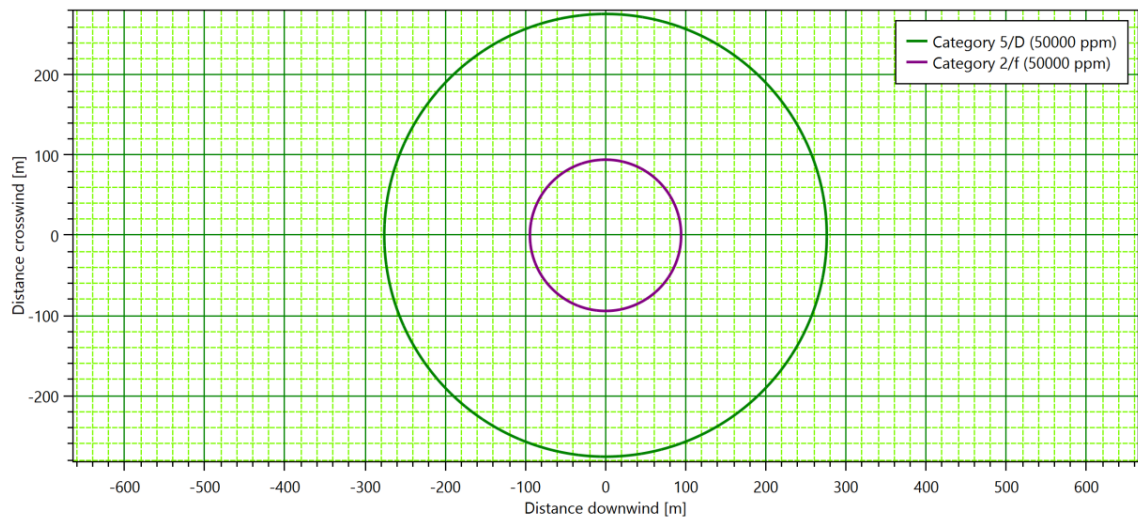


Figure 20 Pipeline Rupture (Horizontal): Flash Fire Footprint

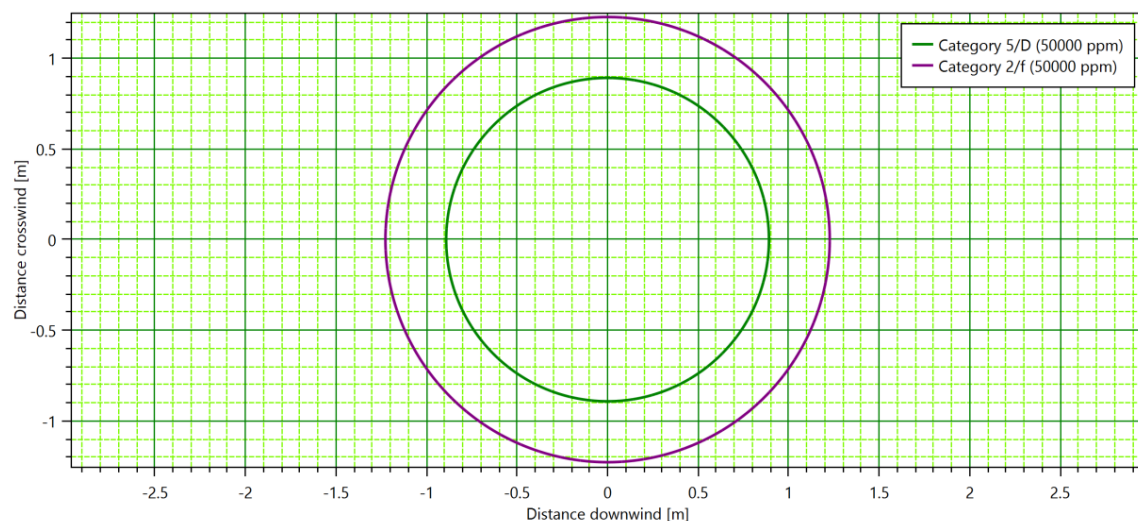


Figure 21 Pipeline Rupture (Vertical): Flash Fire Footprint

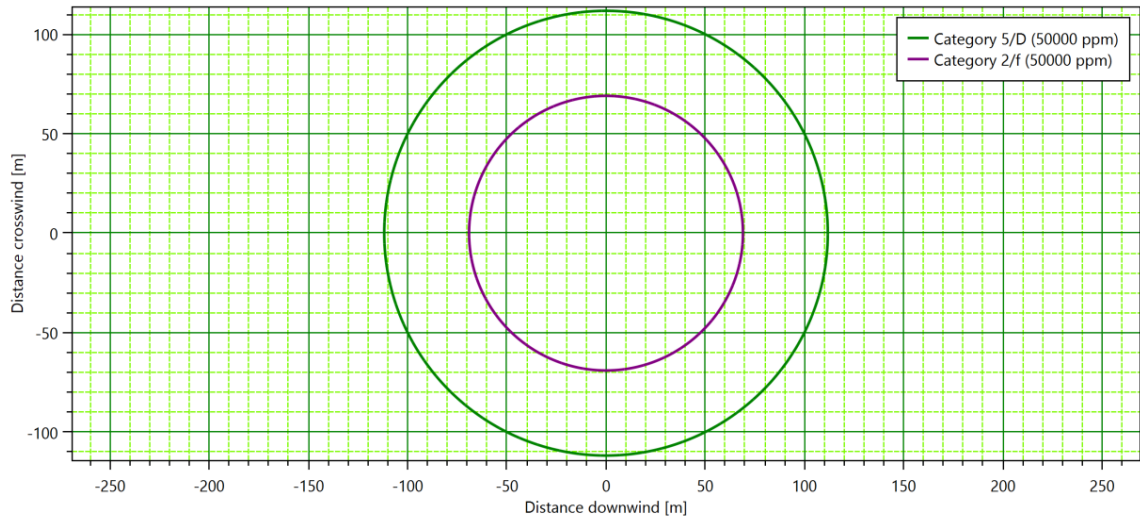


Figure 22 Pipeline Leak (Horizontal): Flash Fire Footprint

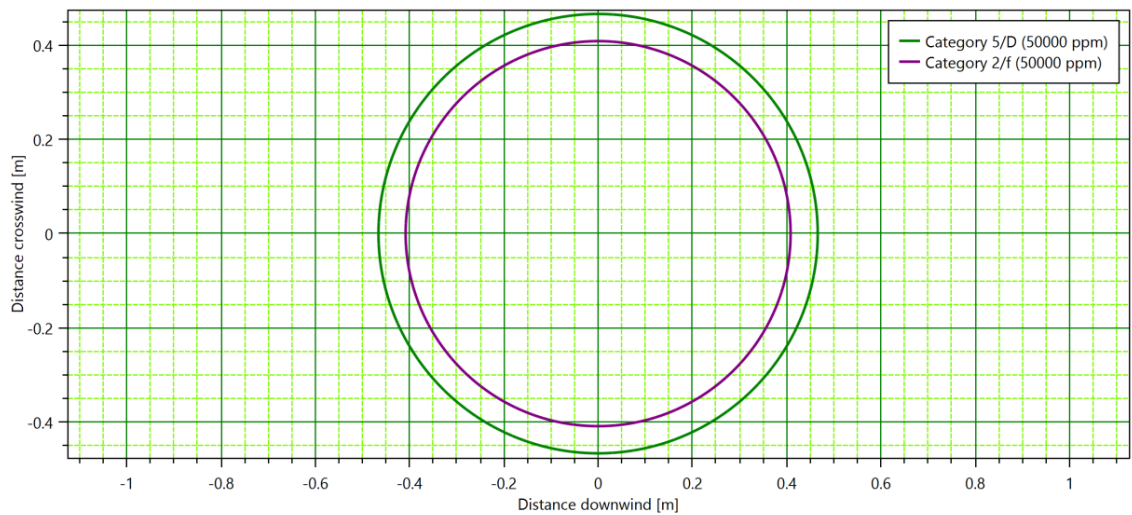


Figure 23 Pipeline Leak (Vertical): Flash Fire Footprint

The flash fire footprint, following pipeline rupture and dispersion could extend up to extends up to 276 m from the pipeline, for a horizontal rupture, at a receiver height of 1.5m.

The flash fire footprint, following pipeline leak and dispersion extends up to 112 m from the pipeline, for a horizontal leak, at a receiver height of 1.5m.

Figure 24 illustrates the flash fire footprint for a pipeline rupture (horizontal) at the pipeline.



Figure 24 Pipeline Rupture (Horizontal): Flash Fire Footprint

It is concluded that the flash fire envelope could extend over the power plant area boundary to the south. This area is not occupied and persons are not typically present. This contour also extends to the R400 road and to the Bord na Mona refuelling station to the west. There is potential for fatality to persons present in these areas in the event of a flash fire.

6.1.8 Event Frequencies

Table 40 of the HSA's TLUP guidelines (HSA, 2023) gives the following pipeline loss of containment frequencies for above ground natural gas pipelines within an establishment of diameter > 150 mm:

- Pipeline rupture frequency: 1E-07 per m per year
- Pipeline leak (10% of diameter) frequency: 5E-07 per m per year

Table 41 of the HSA's TLUP guidelines (HSA, 2023) gives the following pipeline loss of containment frequencies for underground natural gas pipelines within an establishment of diameter > 150 mm:

- Pipeline rupture frequency: 1E-08 per m per year
- Pipeline leak (10% of diameter) frequency: 5E-08 per m per year

Table 41 of the HSA's TLUP guidelines (HSA, 2023) gives the following pipeline loss of containment frequencies for underground natural gas pipelines within an establishment of diameter <75 mm:

- Pipeline rupture frequency: 1E-07 per m per year
- Pipeline leak (10% of diameter) frequency: 5E-07 per m per year

Methane is categorised as of low reactivity and the following ignition probabilities are specified in Table 42 of the HSA's TLUP guidelines (HSA, 2023):

- Fireball/Jet fire: 0.1
- Flash fire: $0.9 \times 0.6 = 0.36$
- VCE: $0.9 \times 0.4 = 0.54$

Table 19 details the natural gas pipeline specifications for the 3 No. buried pipelines on site.

Pipeline	Diameter (mm)	Length (m)	Operating Pressure (barg)
CCGT (above ground)	500	15	60
CCGT (below ground)	500	505	60
OCGT	300	340	38
Auxiliary Boiler	50	150	38

Table 19 Natural Gas Pipeline Specification

Table 20 summarises the event frequencies for a major accident at the natural gas pipeline.

Installation	LOC scenario	LOC frequency		Modifier	LOC frequency /year	Consequence	Conditional probability	Event frequency
Above Ground CCGT Natural Gas Pipeline 60 barg, 15m	Pipeline rupture	1.00E-07	/m/yr	15	1.50E-06	Jet fire/Fireball	0.1	1.50E-07
						VCE	0.54	8.10E-07
						Flash fire	0.36	5.40E-07
	Pipeline leak (10% of diameter)	5.00E-07	/m/yr	15	7.50E-06	Jet fire/Fireball	0.1	7.50E-07
						VCE	0.54	4.05E-06
						Flash fire	0.36	2.70E-06
Below Ground CCGT Natural Gas Pipeline 60 barg, 505m	Pipeline rupture	1.00E-08	/m/yr	505	5.05E-06	Jet fire/Fireball	0.1	5.05E-07
						VCE	0.54	2.73E-06
						Flash fire	0.36	1.82E-06
	Pipeline leak (10% of diameter)	5.00E-08	/m/yr	505	2.53E-05	Jet fire/Fireball	0.1	2.53E-06
						VCE	0.54	1.36E-05
						Flash fire	0.36	9.09E-06
OCGT Natural Gas Pipeline 38 barg, 340m	Pipeline rupture	1.00E-08	/m/yr	340	3.40E-06	Jet fire/Fireball	0.1	3.40E-07
						VCE	0.54	1.84E-06
						Flash fire	0.36	1.22E-06
	Pipeline leak (10% of diameter)	5.00E-08	/m/yr	340	1.70E-05	Jet fire/Fireball	0.1	1.70E-06
						VCE	0.54	9.18E-06
						Flash fire	0.36	6.12E-06

Installation	LOC scenario	LOC frequency		Modifier	LOC frequency /year	Consequence	Conditional probability	Event frequency
Auxiliary Boiler Natural Gas Pipeline 38 barg, 150m	Pipeline rupture	1.00E-07	/m/yr	150	1.50E-05	Jet fire/Fireball	0.1	1.50E-06
						VCE	0.54	8.10E-06
						Flash fire	0.36	5.40E-06
	Pipeline leak (10% of diameter)	5.00E-07	/m/yr	150	7.50E-05	Jet fire/Fireball	0.1	7.50E-06
						VCE	0.54	4.05E-05
						Flash fire	0.36	2.70E-05

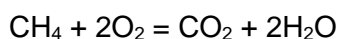
Table 20 Natural Gas Pipeline Event Frequencies

6.2 Natural Gas VCE at CCGT and OCGT Turbine Enclosures

6.2.1 VCE Model Inputs

Gexcon Effects version 12.4.0 was used to calculate the Multi Energy model overpressures resulting from a VCE in one of the turbine enclosures.

It is assumed that an accidental release of natural gas occurs in a turbine enclosure. In order for a vapour cloud explosion to occur, the concentration of natural gas must lie between the lower and upper flammable limits. It is assumed that concentration within the turbine enclosure is a stoichiometric mixture of air and flammable gas. The complete combustion equation for methane is:



The volume of the CCGT enclosure will be 1200 m³ and the volume of the OCGT enclosure will be 562.5. For the purposes of modelling, it is assumed that the entire volume of 1 No. turbine enclosure is available for natural gas accumulation. Therefore, the (mass) fraction of methane within this volume was calculated as 0.056 and the total flammable mass was calculated as 76.61kg at the CCGT and 37.32 kg at the OCGT (see Appendix B for calculation).

The current indicative model inputs are provided, these will be confirmed during the detailed engineering design phase. Any significant change to these inputs will be assessed appropriately.

The VCE model inputs are detailed in Table 21:

Parameter	Units	Value	Source
Chemical name		methane	-
Temperature	°C	10	30-year average at nearest synoptic meteorological station (Mullingar)
Volume of CCGT enclosure Volume of OCGT enclosure	m ³	1200 562.5	CCGT Enclosure Dimensions (15m x 10m x 8m) OCGT Enclosure Dimensions (15m x 7.5m x 5m)
Flammable mass CCGT Flammable mass OCGT	kg	76.61 37.32	See Appendix B for calculation
Fraction of flammable cloud confined	-	1	Confined VCE within turbine enclosure
Curve number	-	7	Very Strong Deflagration: Confined conditions and low ignition energy

Table 21 VCE Model Inputs

6.2.2 VCE Model Outputs

Figure 25 illustrates the overpressure vs distance profile for a VCE in the CCGT turbine.

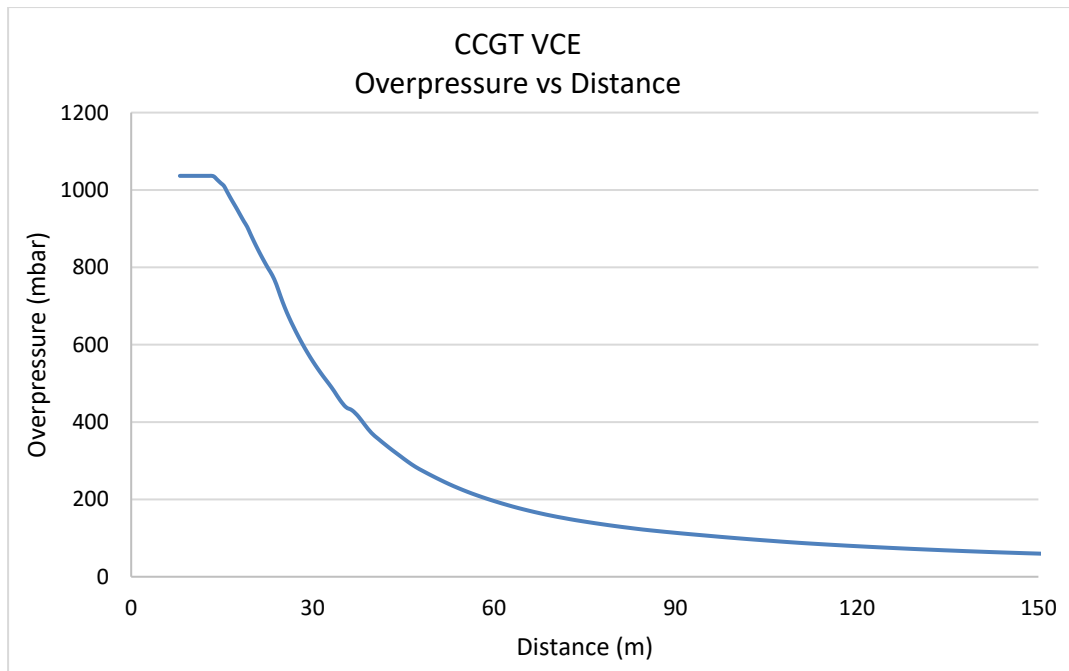


Figure 25 CCGT Natural Gas VCE: Overpressure vs Distance

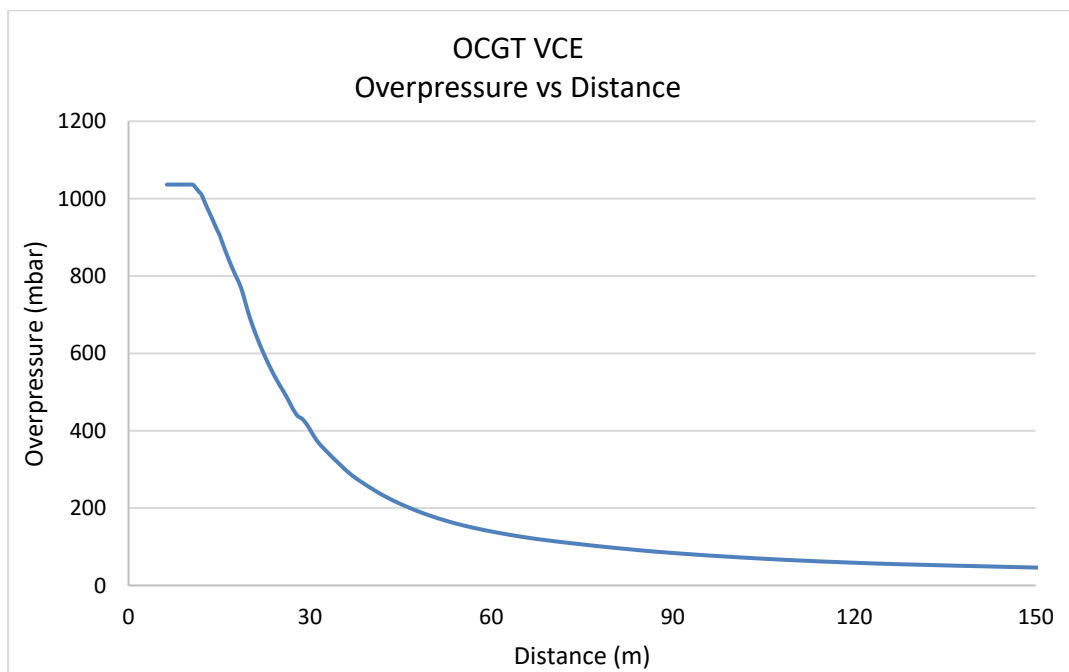


Figure 26 OCGT Natural Gas VCE: Overpressure vs Distance

Table 22 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	CCGT Turbine Distance (m)	OCGT Turbine Distance (m)
35	Light damage	245	192
170	Moderate damage	66	52
350	Severe damage	41	33
830	Total destruction	21	17
168	1% mortality outdoors	67	52
50	1% mortality indoors CIA Category 3	178	140

Table 22 Natural Gas VCE in Turbine Enclosures: Distances to Specified Overpressure Endpoints

The following figures illustrate the overpressure effects following a Natural Gas VCE at a turbine:

- Figure 27 CCGT VCE: Overpressure Contours Corresponding to Fatality Outdoors and Indoors
- Figure 28 OCGT VCE: Overpressure Contours Corresponding to Fatality Outdoors and Indoors

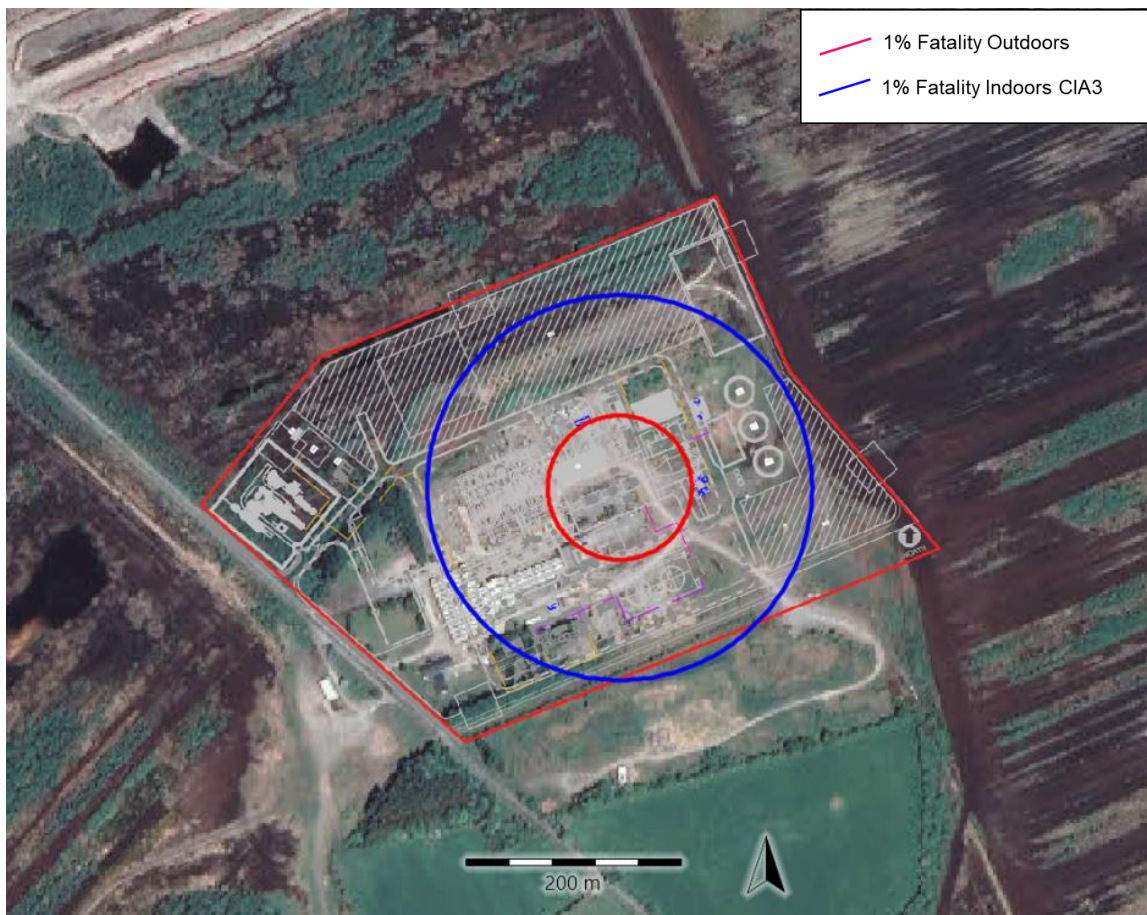


Figure 27 CCGT VCE: Overpressure Contours Corresponding to Fatality Outdoors and Indoors

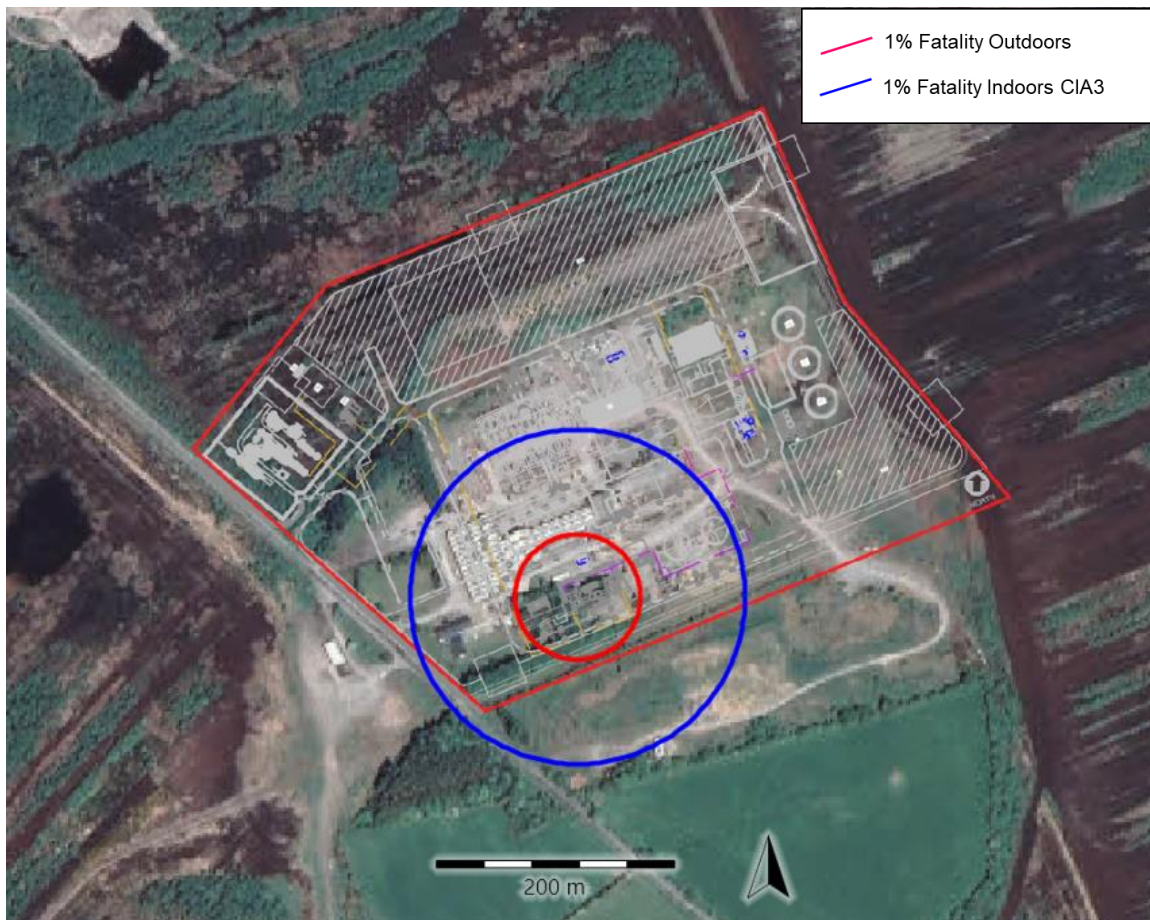


Figure 28 OCGT VCE: Overpressure Contours Corresponding to Fatality Outdoors and Indoors

The following is concluded for a VCE in the CCGT turbine enclosure:

- The overpressure contour corresponding to 1% mortality outdoors (168 mbar) does not extend over the power plant area boundary
- The overpressure contour corresponding to 1% fatality indoors CIA Cat. 3 (representative of residential dwellings) extends over the power plant area but does not extend to any residential dwelling.

The following is concluded for a VCE in the OCGT turbine enclosure:

- The overpressure contour corresponding to 1% mortality outdoors (168 mbar) does not extend over the power plant area boundary
- The overpressure contour corresponding to 1% fatality indoors CIA Cat. 3 (representative of residential dwellings) extends over the power plant area but does not extend to any residential dwelling. The contour extends to the Communications Mast building and General Stores Buildings; however, these buildings are not occupied.

It is concluded that no off-site fatalities are predicted for a VCE in the CCGT or the OCGT's.

6.2.3 VCE Frequency

The HSA specifies a likelihood of 5E-06 per year when assessing an instantaneous release from a process vessel; for modelling purposes, each turbine is 1 No. of process equipment. A 100% ignition probability indoors is to be assumed.

It is conservatively assumed that a natural gas pipe rupture or leak in a turbine enclosure could also lead to a vapour cloud explosion scenario of the magnitude assessed above.

In order for there to be a build-up of natural gas in the enclosure, the leak detection and blocking system has to fail. The purple book (2005) states that the failure on demand of a blocking system, such as the one proposed, is 0.01 per demand. This will be applied to the 'release through a 10mm pipe' scenario as a mitigation measure.

Table 23 details the events and corresponding frequencies that could lead to a VCE within the CCGT enclosure.

Installation	LOC scenario	LOC frequency		Consequence	Conditional Prob.	Event freq. (per turbine)
Indoor equipment (release in Turbine enclosure)	Equipment rupture/leak	5E-06	/yr	VCE	-	5E-06
Indoor equipment (release in Turbine enclosure)	Release over 10 minutes	1E-05	/yr	VCE	-	1E-05
Indoor equipment (release in Turbine enclosure)	Release through 10mm pipe	5E-04	/yr	VCE	0.01	5E-06

Table 23 CCGT Enclosure VCE Event Frequency

Therefore, the total frequency for a VCE within a CCGT enclosure **2.0E-05 per year**.

Table 24 details the events and corresponding frequencies that could lead to a VCE within 1 No. OCGT enclosure. There will be 2 No. OCGT's on-site. The frequency for a VCE will be applied to each turbine for the risk profile of the site.

Installation	LOC scenario	LOC frequency		Consequence	Conditional Prob.	Event freq. (per turbine)
Indoor equipment (release in Turbine enclosure)	Equipment rupture/leak	5E-06	/yr	VCE	-	5E-06
Indoor equipment (release in Turbine enclosure)	Release over 10 minutes	1E-05	/yr	VCE	-	1E-05
Indoor equipment (release in Turbine enclosure)	Release through 10mm pipe	5E-04	/yr	VCE	0.01	5E-06

Table 24 OCGT Enclosure VCE Event Frequency

Therefore, the total frequency for a VCE within an OCGT enclosure is **2.0E-05 per turbine, per year.**

The turbine enclosures will be compliant with EN 21789 (Gas Turbine Applications – Safety) and will have emergency shutdown valves certified to EN14382. The valves are fail closed and will activate, immediately, when gas is detected at a concentration of 20% Lower Explosion Limit (LEL). In order for there to be a build-up of natural gas in the enclosure, the leak detection and emergency shutdown valves have to fail. Therefore, the frequencies associated with a VCE are extremely conservative.

6.3 LPG Tank Release

There will be 2 No. 1000 kg propane tanks on site, serving the CCGT and the OCGTs. The propane tank serving the OCGTs is closer to the power plant area site boundary; therefore, consequence modelling will be shown for this tank as a worst-case representative scenario. The consequences from both LPG tanks will be included in the risk profile for the site.

Instantaneous rupture of an LPG tank has the potential to result in a BLEVE/ (boiling liquid expanding vapour explosion) /fireball, vapour cloud explosion or flash fire event.

The propane tanks are proposed to be situated in a steel frame enclosure. The enclosure has a volume of 24 m³. The LPG tank occupies 2.2 m³ of the space; therefore, there is 21.8 m³ of available volume. The stoichiometric flammable mass that could build-up within the enclosure, upon LPG tank release, is 2.51 kg (see Appendix B for calculation). The flammable mass build-up for an instantaneous release at the LPG tank, with no enclosure, results in a flammable mass of 246 kg (see Section 6.3.3). Therefore, the assessment assumes that there is no enclosure around the LPG tank, as this provides the worst-case consequences.

The location of the OCGT LPG tank is illustrated on Figure 29 and the location of the CCGT LPG tank is illustrated on Figure 30.

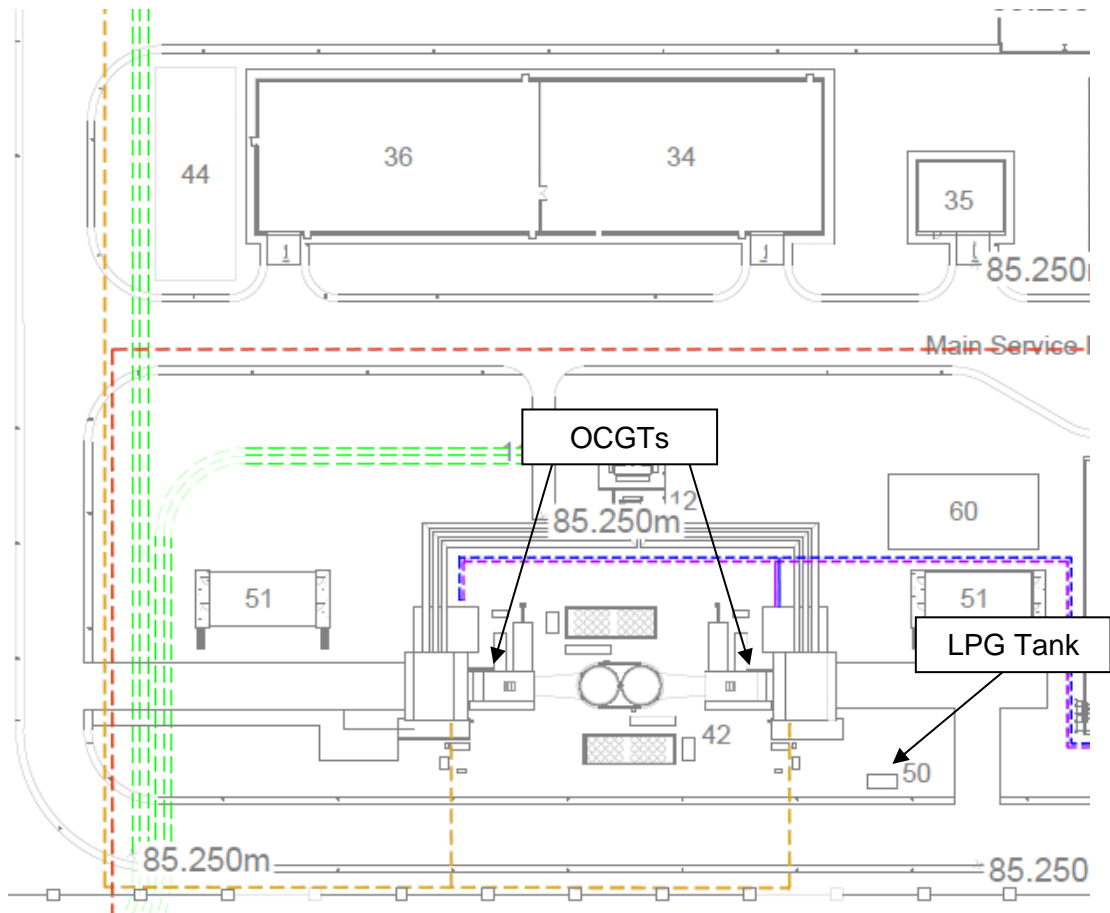


Figure 29 OCGT LPG Tank Location

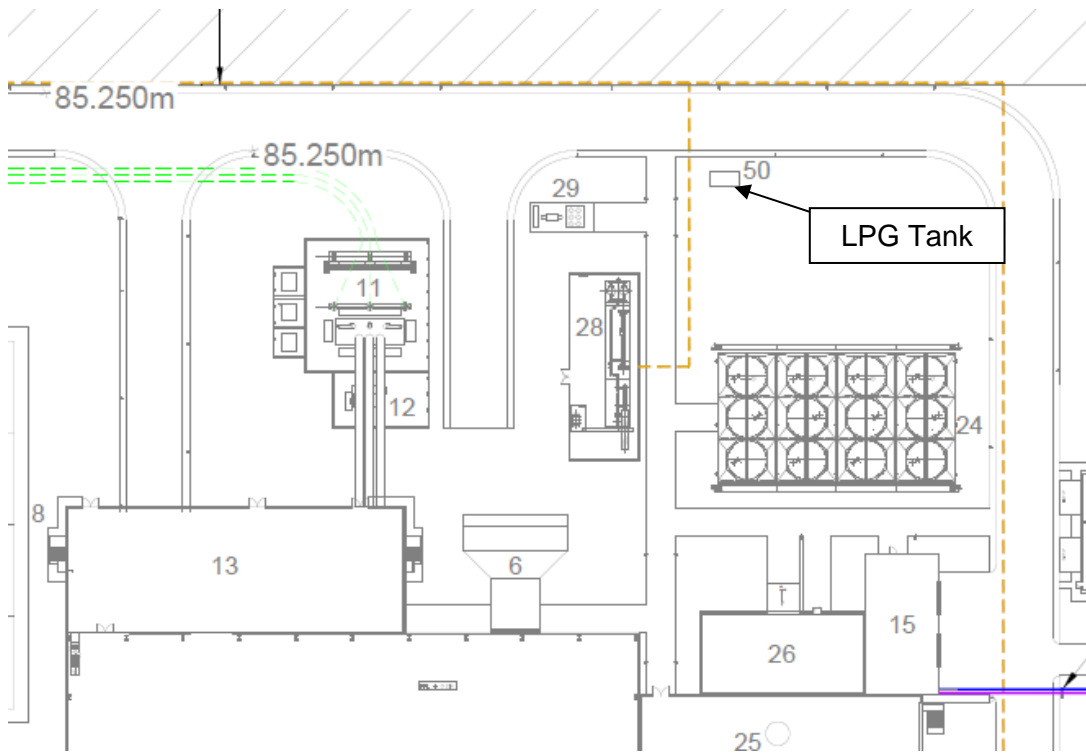


Figure 30 CCGT LPG Tank Location

6.3.1 LPG Tank Instantaneous Failure Model Inputs

Catastrophic rupture model inputs are detailed in Table 25. The flammable mass involved in the fireball is 3 x the adiabatic flash vapour mass fraction as calculated by the discharge/dispersion model. The methodology is detailed in the BLEV (Fireball) Theory Review and Validation supporting DNV PHAST software (DNV, 2024).

The current indicative model inputs are provided, these will be confirmed during the detailed engineering design phase. Any significant change to these inputs will be assessed appropriately.

Parameter	Units	Weather Category	
		F2	D5
Contents	kg	1000	1000
Substance	-	Propane	Propane
Flammable Mass (3 x Vapour mass fraction)	kg	824	824
Temperature	°C	10	15
Mass modification factor	-	3	3
Burst Pressure (3 x design pressure)	barg	42	42
Maximum SEP	kW/m ²	250	250

Table 25 Propane Tank Release: Model Inputs

6.3.2 Tank BLEVE/Fireball Model Outputs

Table 26 details the diameter, radius and fireball duration results obtained using the HSE static fireball model.

Parameter	Units	Weather Category	
		F2	D5
No. of vessels	No.	2	2
Fireball diameter, D	m	27.3	27.1
Fireball radius, R	m	13.65	13.55
Fireball duration, T	s	4.2	4.2

Table 26 LPG Tank Rupture: Fireball Model Outputs

Figure 31 illustrates the thermal radiation vs distance profile for an LPG tank fireball and Figure 32 illustrates the thermal dose vs distance profile for an LPG tank fireball.

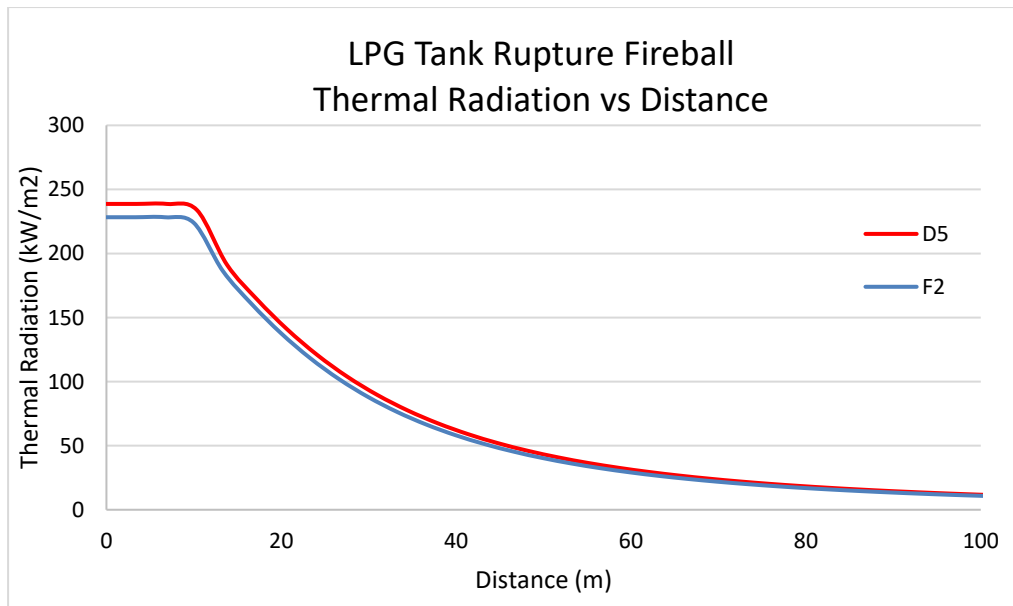


Figure 31 LPG Tank Rupture: Thermal Radiation vs Distance

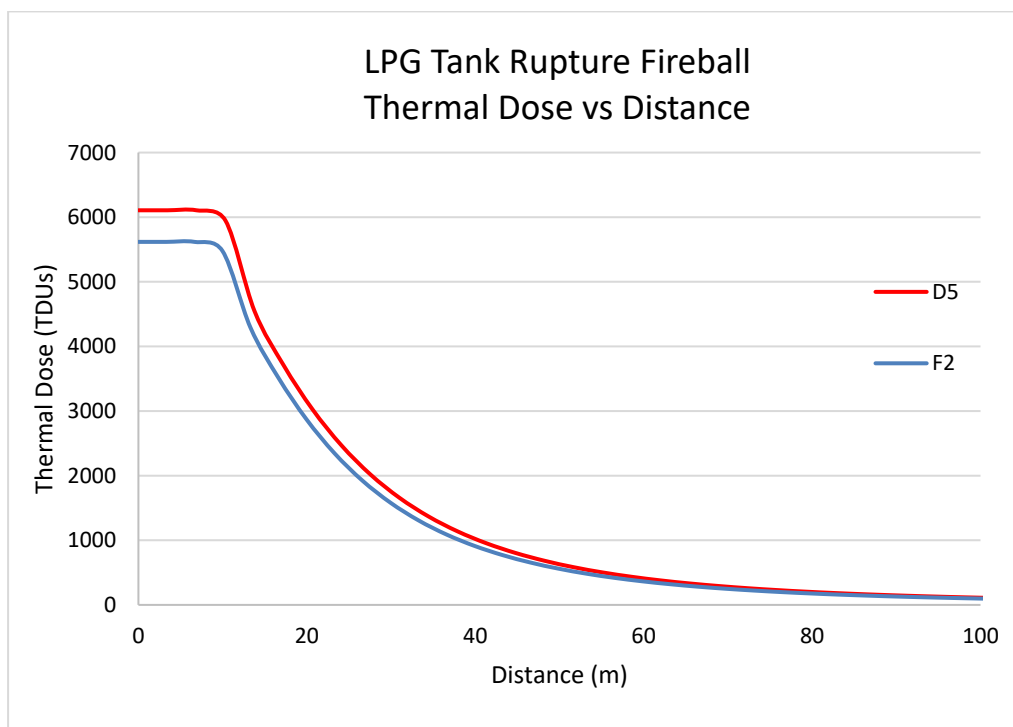


Figure 32 LPG Tank Rupture: Thermal Dose vs Distance

Table 27 details the distances to thermal dose levels associated with specified levels of probability of fatality based on the Eisenberg Probit equation described in Section 4.2.

Criterion	Thermal Dose Level	F2	D5
	TDUs	Distance (m)	Distance (m)
1% fatality (based on a 4.2 s fireball)	963	39	41
100% fatality	Fireball radius	26	27
Building protected below this level, 0% fatality probability	1777	96	96
Building will catch fire quickly, 100% fatality probability	4527	67	67

Table 27 LPG Tank Rupture: Distances to Thermal Radiation Endpoints

Figure 33 illustrates the thermal radiation contours corresponding to outdoor lethality levels.



Figure 33 LPG Tank Rupture and Fireball: Outdoor Lethality Contours



Figure 34 LPG Tank Rupture and Fireball: Indoor Lethality Contours

It is concluded for a fireball, following catastrophic LPG Tank Rupture, that the thermal radiation contour corresponding to 1% fatality outdoors, does not extend over the power plant area boundary.

It is concluded that the thermal radiation consequences corresponding to persons protected indoors (12.7 kW/m^2), following a fireball at the CCGT pipeline, extends over the site boundary; however, does not extend to any off-site buildings.

It is concluded that no off-site fatalities are predicted for a fireball following catastrophic rupture of the LPG Tank.

6.3.3 Tank VCE Model Outputs

The flammable mass for each loss of containment scenario is calculated by the unified dispersion mode in PHAST Version 9.0 modelling software. The model calculates a flammable mass of 246 kg and 242 kg for D5 and F2 weather conditions (respectively).

The explosion strength was specified in the Multi-energy VCE model as 20% of the cloud volume at strength 7 and 80% at strength 2.

The overpressure vs distance profile for a VCE following LPG Tank rupture is illustrated on Figure 35.

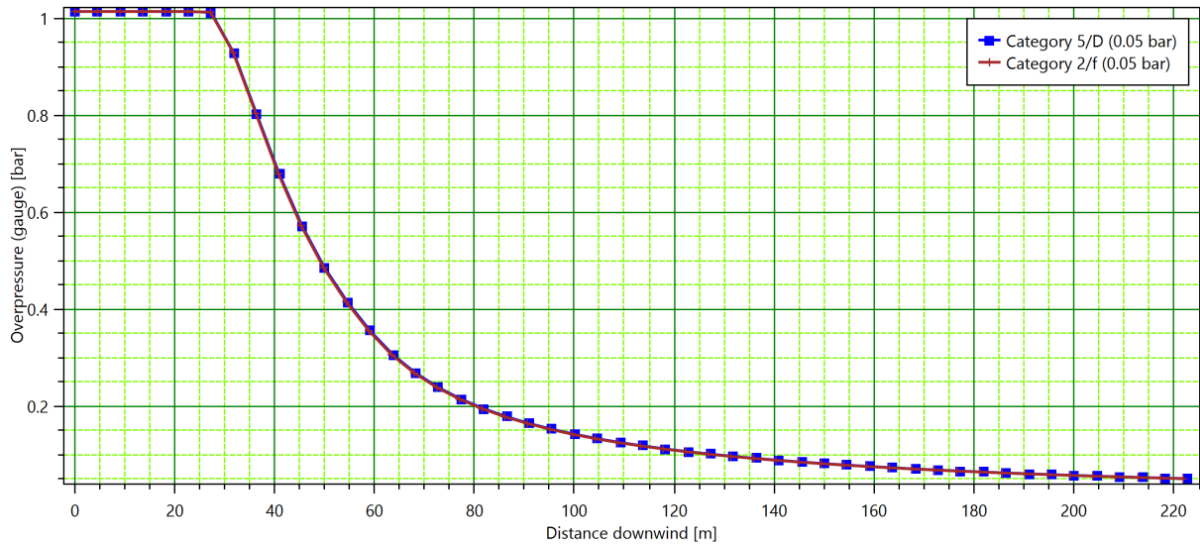


Figure 35 LPG Tank Rupture and VCE: Overpressure vs Distance

Table 28 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Distance (m)	
		F2	D5
35	Light damage	302	303
170	Moderate damage	89	90
350	Severe damage	59	60
830	Total destruction	35	35
168	1% mortality outdoors	89	90
50	1% mortality indoors CIA Category 3	222	223

Table 28 LPG Tank Rupture and VCE: Distances to Specified Overpressure Endpoints

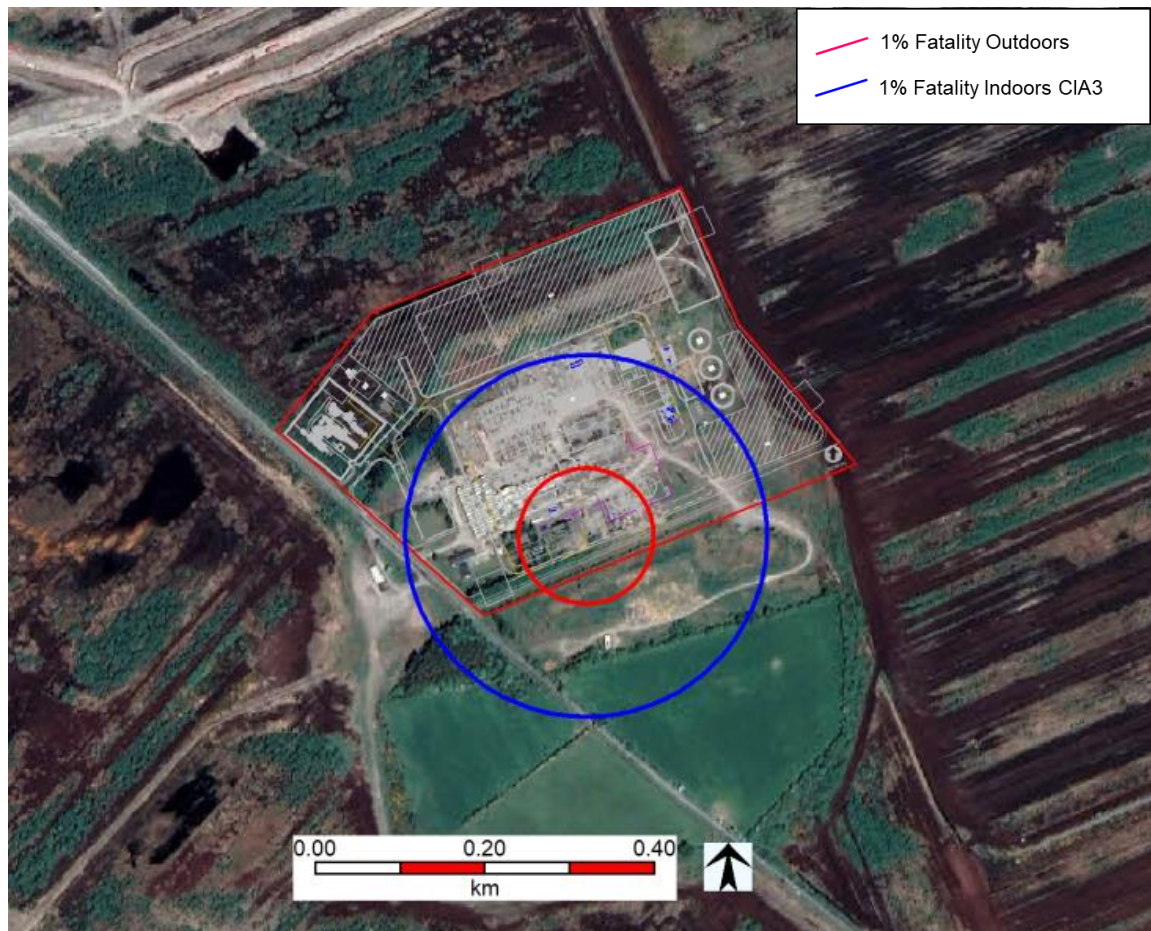


Figure 36 LPG Tank Rupture and VCE: 1% Fatality Outdoors and Indoors Overpressure Contour

It is concluded that the overpressure contour corresponding to 1% mortality outdoors (168 mbar) extends slightly over the power plant area boundary to the south. This area is owned by Bord Na Mona is not occupied and persons are not typically present.

The overpressure contour corresponding to 1% fatality indoors CIA Cat. 3 (representative of residential dwellings) extends over the power plant area but does not extend to any off-site residential dwelling.

It is concluded that no off-site fatalities are predicted for a VCE following an LPG Tank rupture.

6.3.4 Flash Fire Model Outputs

The flash fire envelope was modelled using the unified dispersion model in DNV PHAST Version 9.0 software.

Table 29 details the distance to the LFL concentration (flash fire envelope).

LPG Tank	Flash Fire envelope, distance (m)	
	D5	F2
1000 kg	47	31

Table 29 LPG Tank Rupture and Flash Fire: Flash Fire Envelope

Figure 37 illustrates the flash fire envelope for D5 and F2 weather conditions.



Figure 37 LPG Tank Rupture and Flash Fire: Flash Fire Envelope

It is concluded that the flash fire envelope extends slightly over the power plant area boundary to the south. This area is not occupied and persons are not typically present.

It is concluded that no off-site fatalities are predicted for a Flash fire following an LPG Tank rupture.

6.3.5 LPG Tank Continuous Leak over 10 Minutes: Jet Fire Model Outputs

The model inputs are as detailed in Table 25. The jet fire cone model in DNV PHAST Version 9.0 consequence modelling software was used to model the consequences of a jet fire.

Figure 38 and Figure 39 illustrate the thermal radiation vs distance profile for a horizontal and vertical release (respectively), for a receiver height of 1.5m.

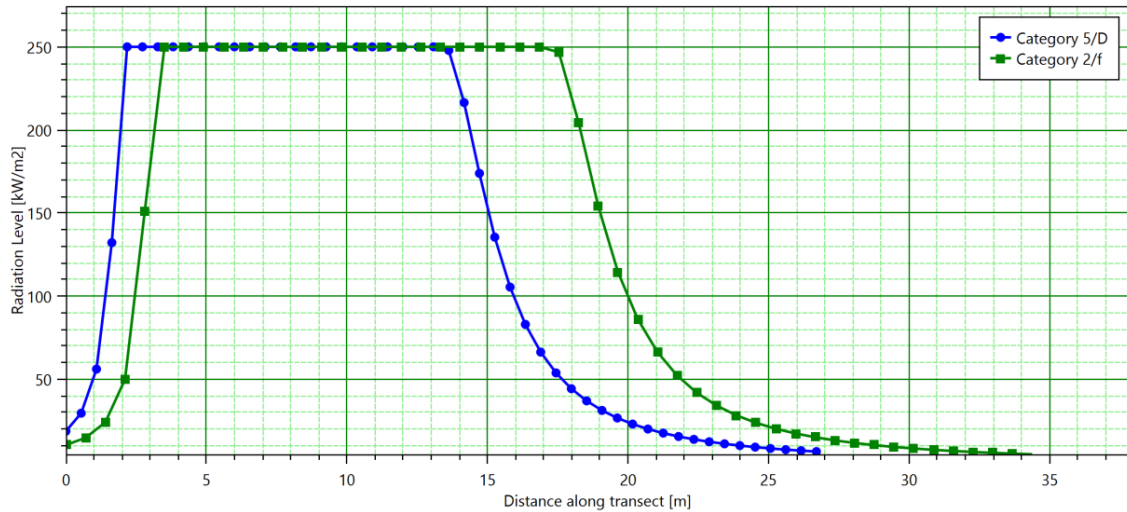


Figure 38 LPG Tank Horizontal Leak Over 10 Minutes and Jet Fire: Thermal Radiation vs Distance

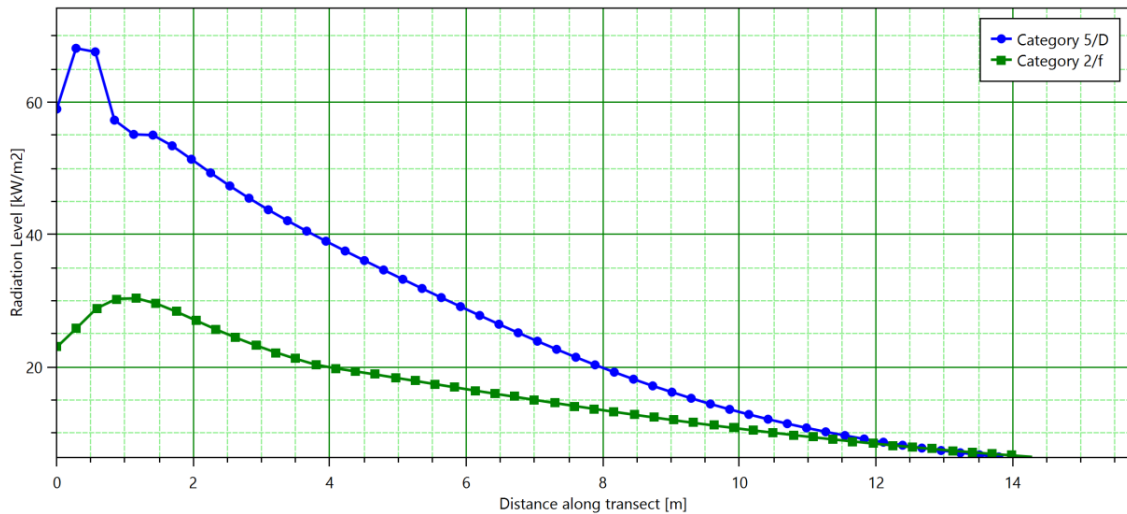


Figure 39 LPG Tank Vertical Leak Over 10 Minutes and Jet Fire: Thermal Radiation vs Distance

Table 30 details distances to specified thermal radiation levels, at a receiver height of 1.5m, associated with

- 1%, mortality outdoors
- 0% mortality and 100% mortality indoors

Consequence	Thermal Radiation (kW/m ²)	Horizontal Release (m)		Vertical Release (m)	
		Cat. D5	Cat. F2	Cat. D5	Cat. F2
1% mortality outdoors	8.02	25	30	12	12
0% mortality indoors	12.7	23	27	10	9
100% mortality indoors	25.6	20	24	7	2

Table 30 LPG Tank Leak Over 10 Minutes and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

Figure 40 illustrates the thermal radiation contour and effect areas corresponding to 1% fatality outdoors for a jet fire following a horizontal tank leak over 10 minutes, for a receiver height 1.5m, for the worst-case weather scenario (F2), as a representative worst-case scenario.



Figure 40 LPG Tank Horizontal Leak Over 10 Minutes and Jet Fire: 1% Fatality Outdoors Contour

It is concluded that the thermal radiation contour corresponding to 1% fatality outdoors does not extend over the site boundary.

It is concluded that no off-site fatalities are predicted for a jet fire following a leak over 10 minutes at the LPG tanks.

6.3.6 LPG Tank Continuous Leak over 10 Minutes: VCE Model Outputs

The TNO Multi Energy model was used to model the overpressure consequences in the event a VCE following leak in the LPG tank.

The DNV PHAST Version 9.0 unified dispersion model predicts a maximum flammable mass of 0.42 kg for a horizontal release, for F2 conditions only. The unified dispersion model does not predict a build-up of flammable mass for a vertical release.

Figure 41 illustrates the overpressure vs distance profile for a VCE following a horizontal LPG tank leak for the weather category F2, at a receiver height of 1.5m.

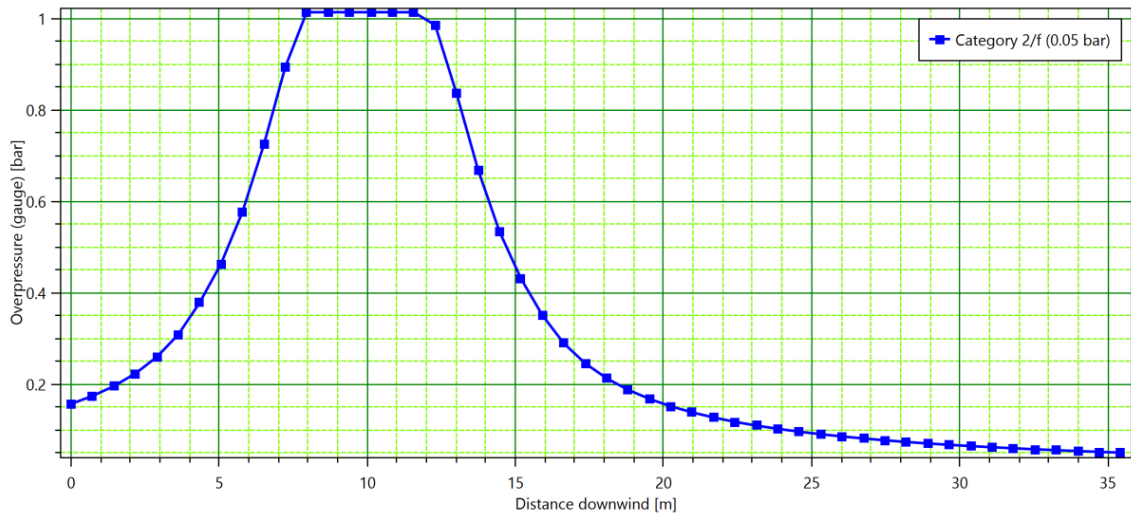


Figure 41 LPG Tank Horizontal Leak Over 10 Minutes and VCE: Overpressure vs Distance

Table 31 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Rupture Distance (m)
		F2
35	Light damage	45
170	Moderate damage	19
350	Severe damage	16
830	Total destruction	13
168	1% mortality outdoors	19
50	1% mortality indoors CIA Category 3	35

Table 31 LPG Horizontal Tank Leak and VCE: Distances to Specified Overpressure Endpoints

Figure 42 illustrates the overpressure contour corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3.

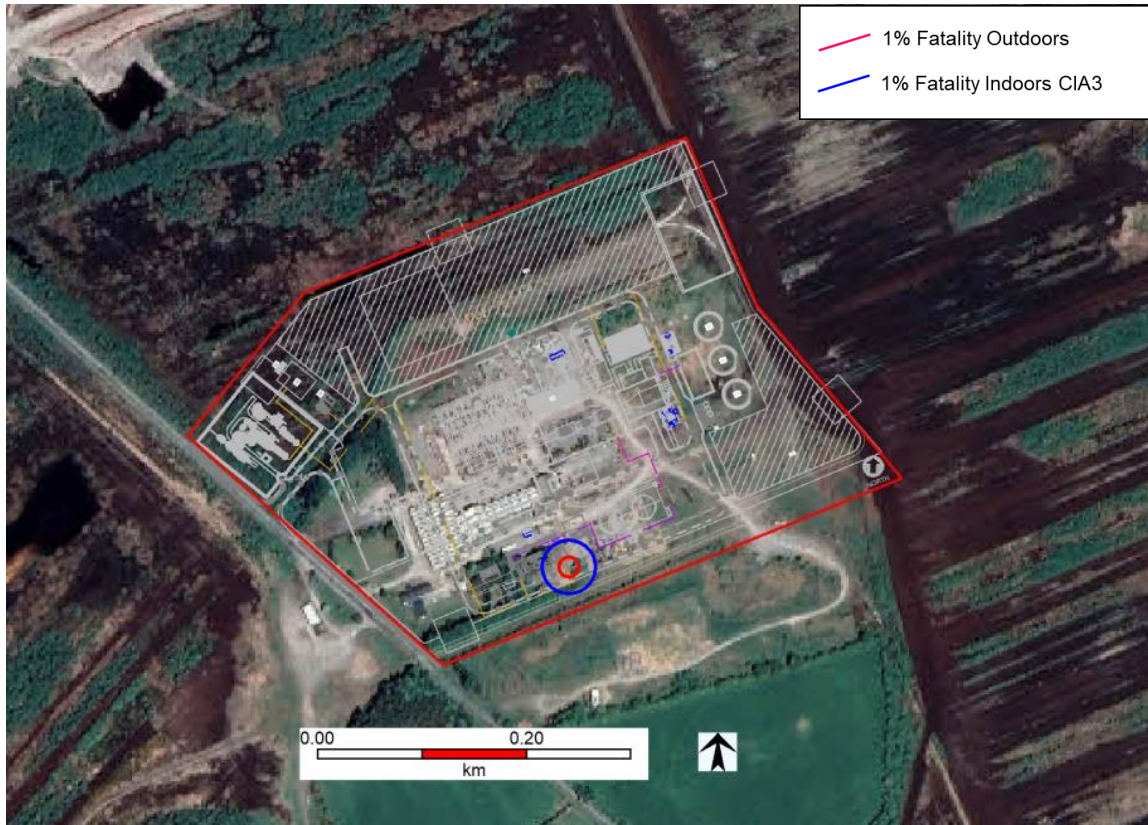


Figure 42 LPG Tank Horizontal Tank Leak and VCE: 1% Outdoors Fatality Contour and 1% Fatality Indoors CIA Cat. 3

It is concluded that the overpressure consequences corresponding to 1% fatality outdoors or 1% fatality indoors CIA Cat. 3, following a VCE at the LPG Tank following a Tank leak over 10 minutes, do not extend over the power plant area boundary.

It is concluded that no off-site fatalities are predicted for a VCE, following a Leak over 10 minutes, at the LPG tanks.

6.3.7 LPG Tank Continuous Leak over 10 Minutes: Flash Fire Model Outputs

The DNV PHAST Version 9.0 unified dispersion model predicts the flash fire footprint for a horizontal release only. Figure 43 illustrates the flash fire envelope for a horizontal leak over 10 minutes at the LPG tank.

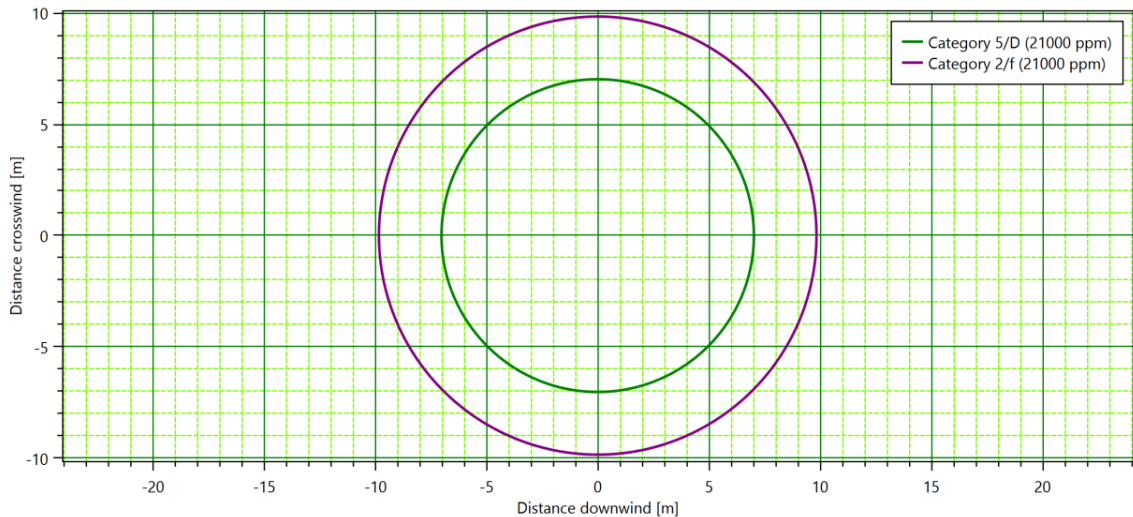


Figure 43 LPG Tank Horizontal Tank Leak and Flash Fire: Flash Fire Envelope

It is concluded that the flash fire envelope extends up to 10m from the LPG tank. The LPG tanks are located ca. 40m and 125m from the site boundary.

It is concluded that no off-site fatalities are predicted for a Flash Fire, following a Leak over 10 minutes, at the LPG tanks.

6.3.8 LPG 10mm Pipe Leak Over 30 Minutes: Jet Fire Model Outputs

The model inputs are as detailed in Table 25. The jet fire cone model in DNV PHAST Version 9.0 consequence modelling software was used to model the consequences of a jet fire.

Figure 44 and Figure 45 illustrate the thermal radiation vs distance profile for a horizontal and vertical release (respectively), for a receiver height of 1.5m.

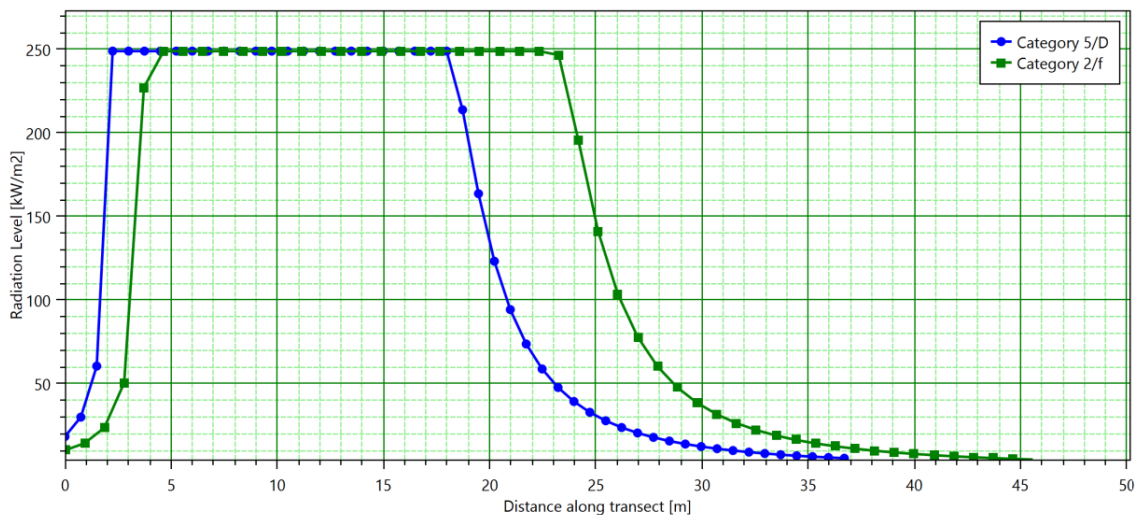


Figure 44 LPG Tank Horizontal 10mm Leak Over 30 Minutes and Jet Fire: Thermal Radiation vs Distance

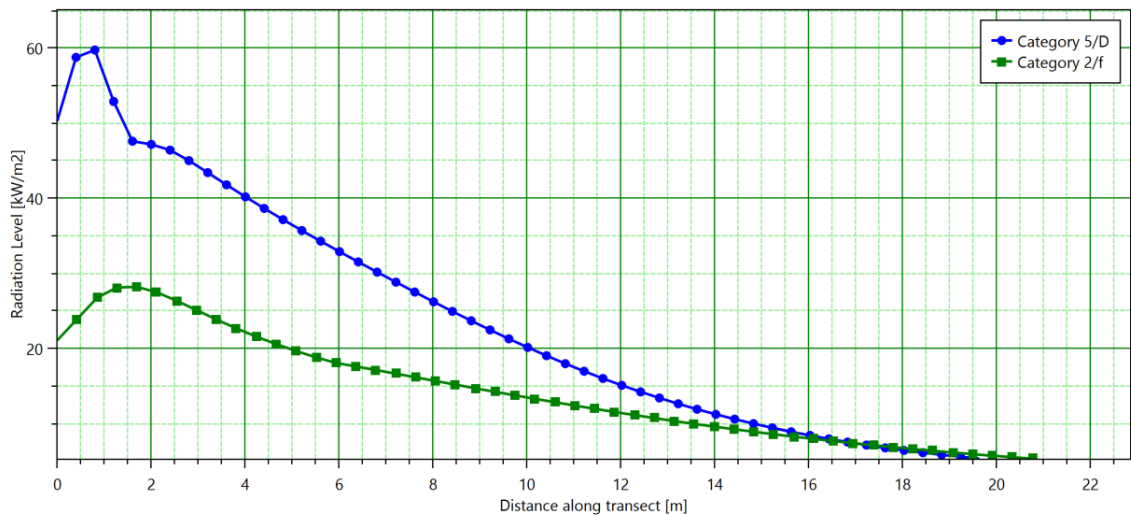


Figure 45 LPG Tank Vertical 10mm Leak Over 30 Minutes and Jet Fire: Thermal Radiation vs Distance

Table 30 details distances to specified thermal radiation levels, at a receiver height of 1.5m, associated with

- 1%, mortality outdoors
- 0% mortality and 100% mortality indoors

Consequence	Thermal Radiation (kW/m ²)	Horizontal Release (m)		Vertical Release (m)	
		Cat. D5	Cat. F2	Cat. D5	Cat. F2
1% mortality outdoors	8.02	33	40	16	16
0% mortality indoors	12.7	30	36	13	11
100% mortality indoors	25.6	26	32	8	3

Table 32 LPG Tank 10mm Leak Over 30 Minutes and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

Figure 46 illustrates the thermal radiation contour and effect areas corresponding to 1% fatality outdoors for a jet fire following a horizontal 10mm tank leak over 30 minutes, for a receiver height 1.5m, for the worst-case weather scenario (F2), as a representative worst-case scenario.



Figure 46 LPG Tank Horizontal 10mm Leak Over 30 Minutes and Jet Fire: 1% Fatality Outdoors Contour

It is concluded that the thermal radiation contour corresponding to 1% fatality outdoors does not extend over the site boundary.

It is concluded that no off-site fatalities are predicted for a jet fire following a 10mm leak over 30 minutes at the LPG tanks.

6.3.9 LPG 10mm Pipe Leak Over 30 Minutes: VCE Model Outputs

The TNO Multi Energy model was used to model the overpressure consequences in the event a VCE following leak in the LPG tank.

The DNV PHAST Version 9.0 unified dispersion model predicts a maximum flammable mass of 0.89 kg / 1.1 kg for a horizontal release, D5 / F2 weather conditions respectively, and a maximum flammable mass of 0.45 kg / 0.82 kg, D5 / F2 weather conditions respectively, for a vertical release.

Figure 47 illustrates the overpressure vs distance profile for a VCE following a horizontal LPG tank leak, at a receiver height of 1.5m.

Figure 48 illustrates the overpressure vs distance profile for a VCE following a vertical LPG tank leak, at a receiver height of 1.5m.

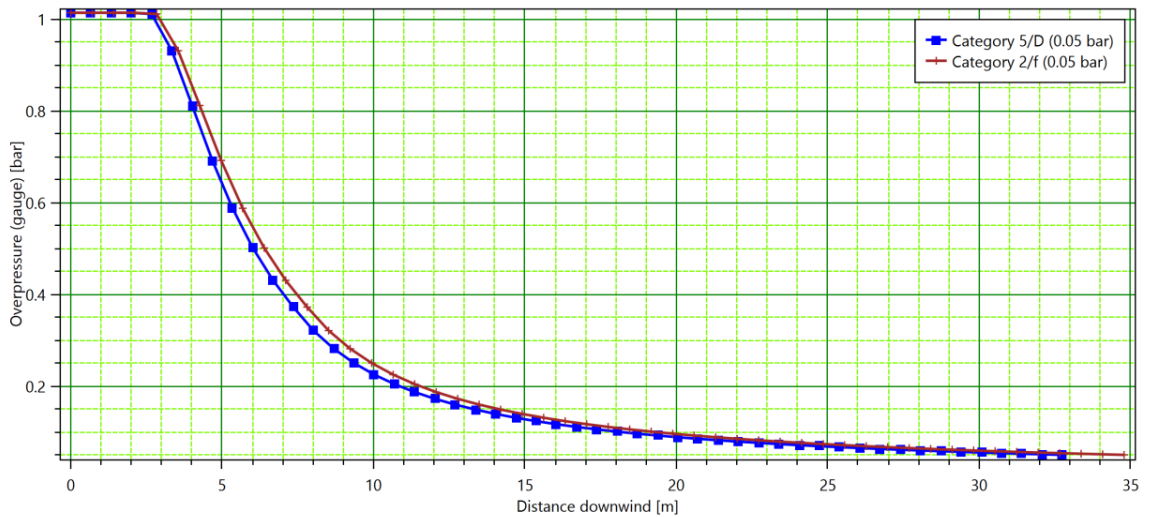


Figure 47 LPG Tank Horizontal 10mm Leak Over 30 Minutes and VCE: Overpressure vs Distance

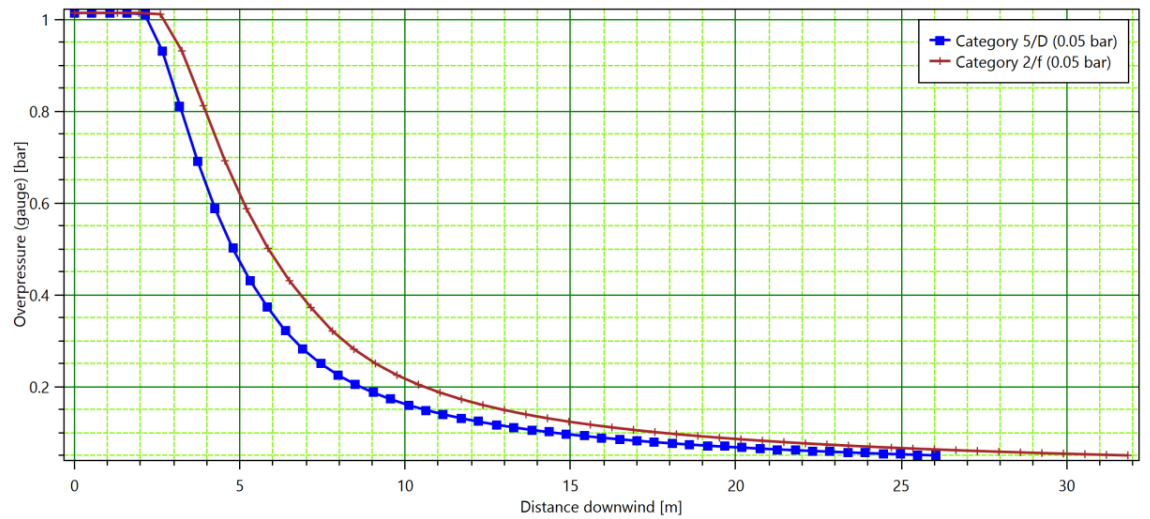


Figure 48 LPG Tank Vertical 10mm Leak Over 30 Minutes and VCE: Overpressure vs Distance

Table 33 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Vertical Release Distance (m)		Horizontal Release Distance (m)	
		F2	D5	F2	D5
35	Light damage	44	36	48	45
170	Moderate damage	12	10	13	12
350	Severe damage	7	6	8	8
830	Total destruction	4	3	4	4
168	1% mortality outdoors	12	10	13	12
50	1% mortality indoors CIA Category 3	32	26	35	33

Table 33 LPG Tank 10mm Leak and VCE: Distances to Specified Overpressure Endpoints

Figure 49 illustrates the overpressure contour corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3.



Figure 49 LPG Tank Horizontal Tank Leak and VCE: 1% Outdoors Fatality Contour and 1% Fatality Indoors CIA Cat. 3

It is concluded that the overpressure consequences corresponding to 1% fatality outdoors or 1% fatality indoors CIA Cat. 3, following a VCE at the LPG Tank following a 10mm tank leak over 30 minutes, do not extend over the power plant area boundary.

It is concluded that no off-site fatalities are predicted for a VCE, following a 10mm Leak over 30 minutes, at the LPG tanks.

6.3.10 LPG 10mm Pipe Leak Over 30 Minutes: Flash Fire Model Outputs

The DNV PHAST Version 9.0 unified dispersion model predicts the flash fire footprint for a horizontal release only. Figure 50 illustrates the flash fire envelope for a horizontal 10mm leak over 30 minutes at the LPG tank.

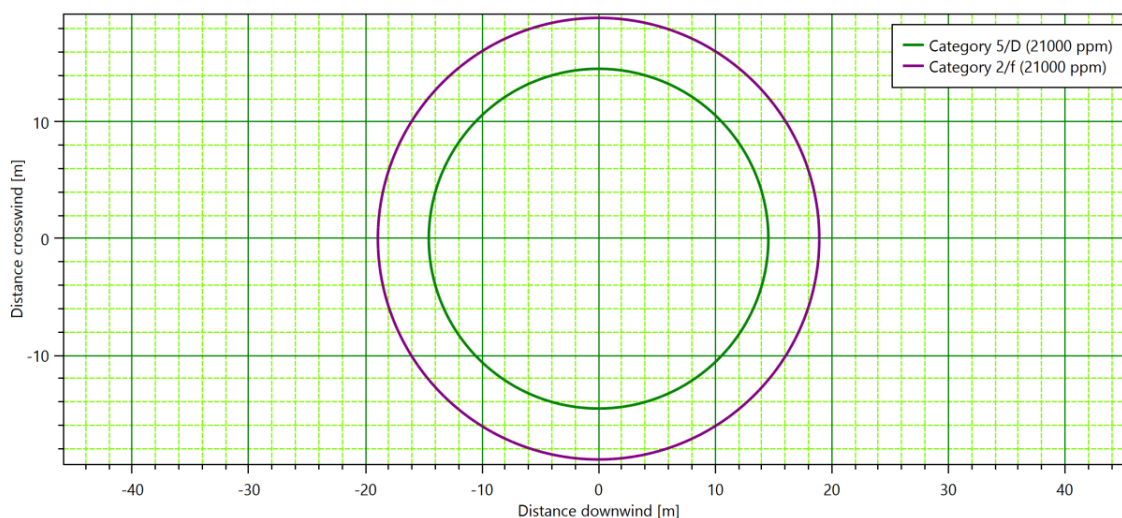


Figure 50 LPG Tank Horizontal Tank 10mm Leak and Flash Fire: Flash Fire Envelope

It is concluded that the flash fire envelope extends up to 19m from the LPG tank. The LPG tanks are located ca. 40m and 125m from the site boundary.

It is concluded that no off-site fatalities are predicted for a Flash Fire, following a 10mm leak over 30 minutes, at the LPG tanks.

6.3.11 LPG Tank Event Frequencies

Table 23 of the TLUP states the frequencies associated with the major accident events for an LPG tank.

Table 34 details the event frequencies associated with the LPG tanks on site.

Installation	LOC scenario	Consequence	Frequency (per year)
Propane Tank	Instantaneous failure (per tank)	BLEVE/Fireball	3.50E-07
		VCE	6.00E-08
		Flash fire	9.00E-08
	Continuous leak over 10 minutes (per tank)	Jet fire	3.50E-07
		VCE	6.00E-08
		Flash fire	9.00E-08
	10 mm pipe leak over 30 minutes (per tank)	Jet fire	7.00E-06
		VCE	1.20E-06
		Flash fire	1.80E-06

Table 34 LPG Tank Event Frequencies

6.4 **LPG Pipeline Release**

Propane gas is required to aid start-up when the turbines are running on secondary fuel. There is a 50 mm diameter pipeline that runs from each LPG tank to the turbines. Figure 51 and Figure 52 illustrate the LPG pipeline route for the OCGT's and CCGT respectively. The longest pipeline is ca. 50m from tank to turbine and this will be used to illustrate the worst-case representative release from an LPG pipeline. The risk profile for the site will include consequence results from each pipeline.

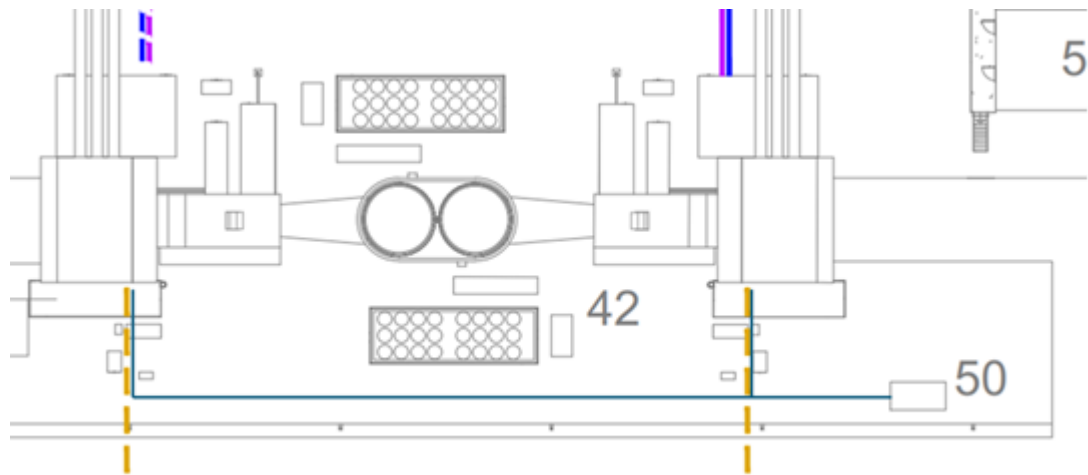


Figure 51 OCGT LPG Pipeline Route

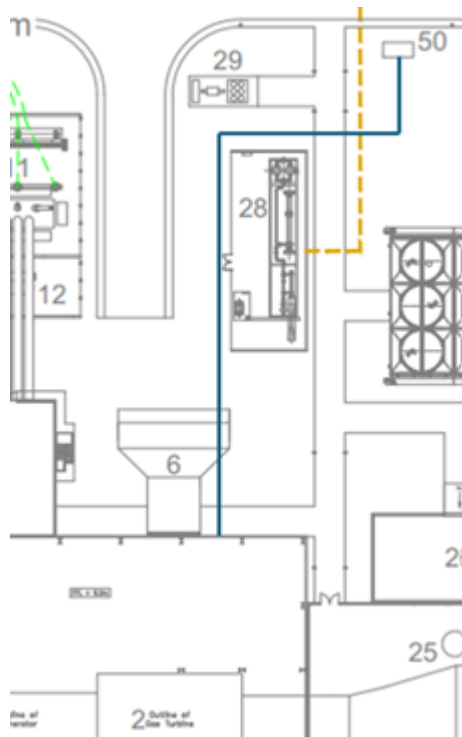


Figure 52 CCGT LPG Pipeline Route

6.4.1 LPG Pipeline Release Model Inputs

Phast Version 9.0 short pipeline model was used to model a release of LPG following rupture of the pipeline. The short pipeline leak models a pipeline rupture scenario. The 10mm pipe leak scenario is modelled in Sections 6.3.8 to 6.3.10 of this report.

The current indicative model inputs are provided, these will be confirmed during the detailed engineering design phase. Any significant change to these inputs will be assessed appropriately.

The pipeline model inputs are detailed in Table 35.

Parameter	Pipeline rupture	Source/Assumption
Scenario	Pipeline rupture	-
Material	LPG	-
Pipeline diameter	50 mm	Project Engineer
Hole Size	50 mm	Pipeline rupture assumes Guillotine fracture so entire pipeline diameter
Length of pipeline	50 m	Project Engineer
Pressure	30 barg	Project engineer
Averaging time	Flammable – 18.75 s	DNV PHAST
Exposure duration	60 s	HSA recommended (HSA, 2023)
Release height	1 m	Above ground pipeline
Release direction	Vertical and Horizontal	HSA TLUP and HSA requested
Effect height	1.5 m	Average height of person
Wind speed	5 m/s 2 m/s	Recommended by HSA as representative modelling conditions
Pasquill Stability Factor	D (daytime conditions) F (nighttime conditions)	
Temperature	10 degC (F2) 15 degC (D5)	HSA TLUP (HSA 2023)

Table 35 LPG Pipeline Full Rupture: Discharge Model Inputs

6.4.2 LPG Pipeline Release: Predicted Phenomena

The unified dispersion model in DNV PHAST Version 9.0 predicts the following phenomena for each release scenario:

- Pipeline Rupture: Jet fire (immediate ignition), VCE or flash fire (delayed ignition)

6.4.3 LPG Pipeline Release: Jet Fire Model Outputs

The model inputs are as detailed in Table 25. The jet fire cone model in DNV PHAST Version 9.0 consequence modelling software was used to model the consequences of a jet fire.

Figure 53 and Figure 54 illustrate the thermal radiation vs distance profile for a horizontal and vertical release (respectively), for a receiver height of 1.5m.

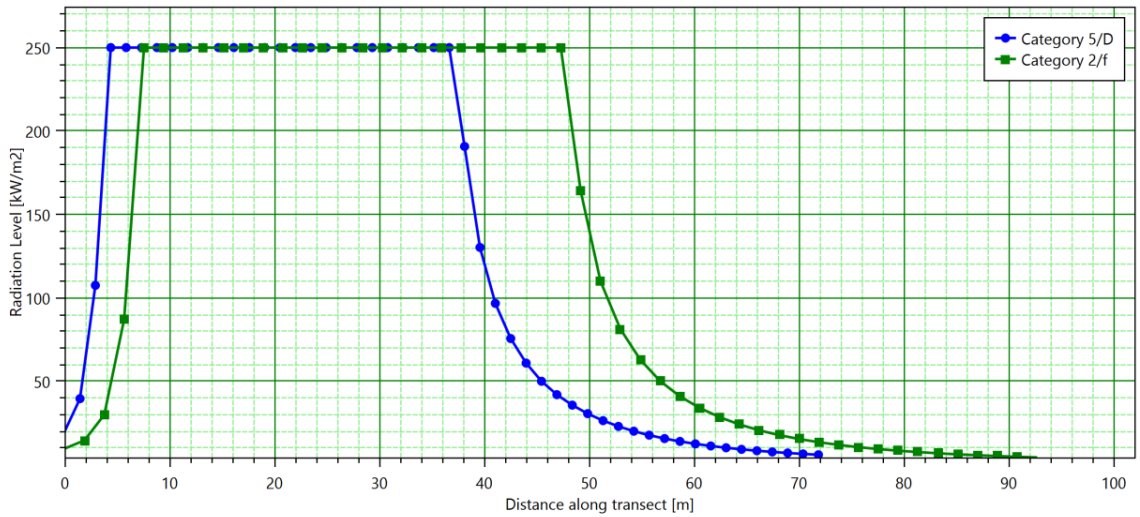


Figure 53 LPG Pipeline Horizontal Release and Jet Fire: Thermal Radiation vs Distance

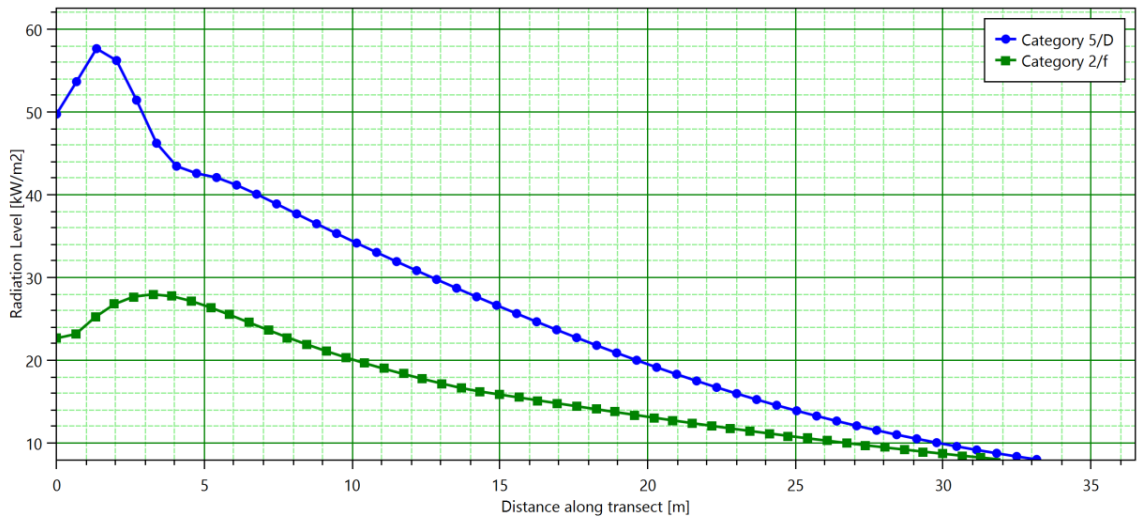


Figure 54 LPG Pipeline Vertical Release and Jet Fire: Thermal Radiation vs Distance

Table 36 details distances to specified thermal radiation levels, at a receiver height of 1.5m, associated with

- 1%, mortality outdoors
- 0% mortality and 100% mortality indoors

Consequence	Thermal Radiation (kW/m ²)	Horizontal Release (m)		Vertical Release (m)	
		Cat. D5	Cat. F2	Cat. D5	Cat. F2
1% mortality outdoors	8.02	67	80	33	32
0% mortality indoors	12.7	60	73	26	21
100% mortality indoors	25.6	52	64	16	6

Table 36 LPG Pipeline Release and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

Figure 55 illustrates the thermal radiation contour corresponding to 1% fatality outdoors for weather category F2.

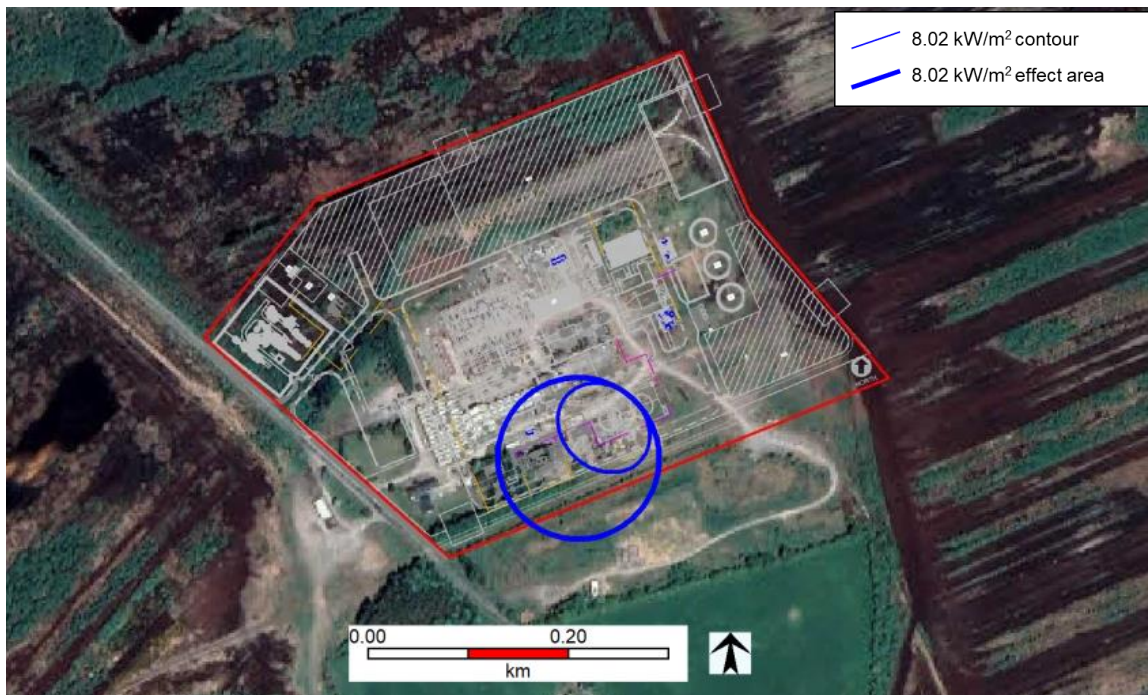


Figure 55 LPG Pipeline Horizontal Release and Jet Fire: 1% Fatality Outdoors Contour

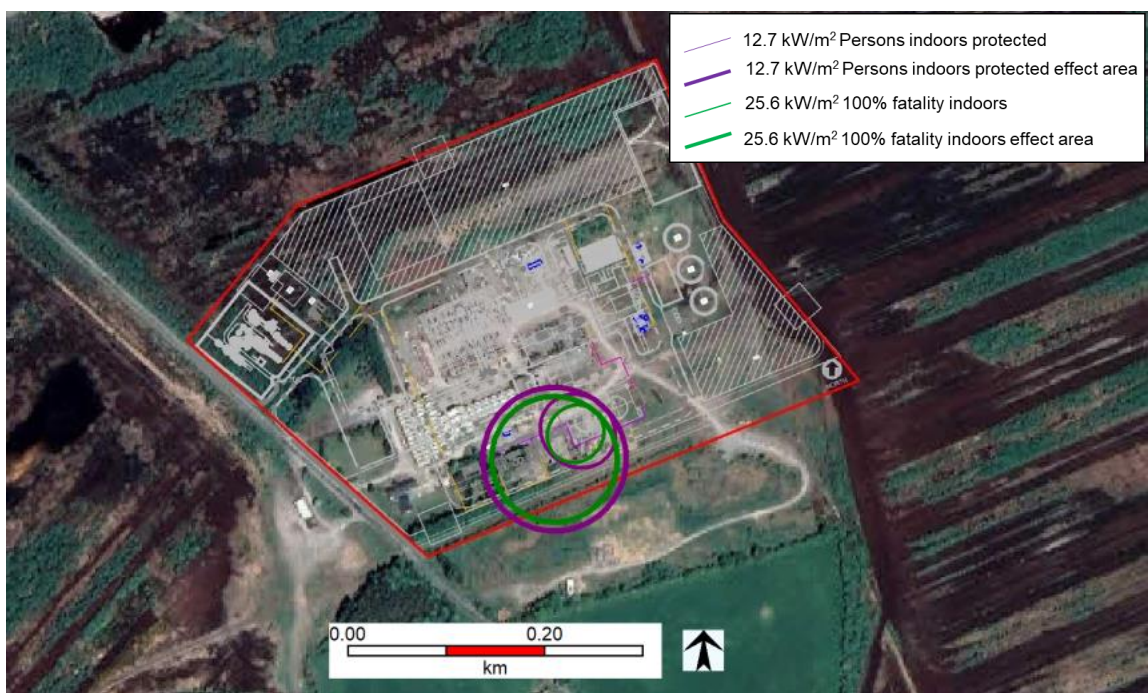


Figure 56 LPG Pipeline Horizontal Release and Jet Fire: 0% Fatality and 100% Fatality Indoors Contours

It is concluded that in the event of a jet fire following a release from an LPG Pipeline:

- The thermal radiation level corresponding to 1% mortality outdoors could extend over the power plant area boundary to the south. This area is not occupied and persons are not typically present.

- The thermal radiation level corresponding to 100% fatality indoors could extend over the power plant area boundary to the south. There are no occupied buildings in this area.

It is concluded that no off-site fatalities are predicted for a jet fire following a rupture in the LPG pipeline.

6.4.4 LPG Pipeline Release: VCE Model Outputs

The TNO Multi Energy model was used to model the overpressure consequences in the event a VCE following a rupture in the LPG pipeline.

The DNV PHAST Version 9.0 unified dispersion model predicts a maximum flammable mass of 8.0 kg / 9.0 kg for a horizontal release, D5 / F2 weather conditions respectively, and a maximum flammable mass of 4.8 kg / 6.1 kg, D5 / F2 weather conditions respectively, for a vertical release.

Figure 57 illustrates the overpressure vs distance profile for a VCE following a horizontal LPG tank leak, at a receiver height of 1.5m.

Figure 58 illustrates the overpressure vs distance profile for a VCE following a vertical LPG tank leak, at a receiver height of 1.5m.

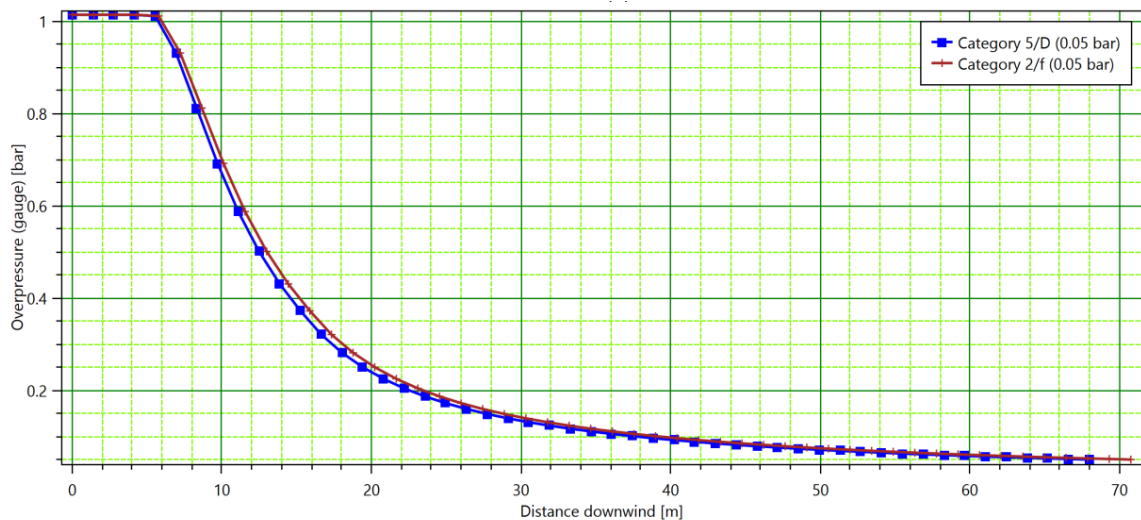


Figure 57 LPG Pipeline Horizontal Release and VCE: Overpressure vs Distance

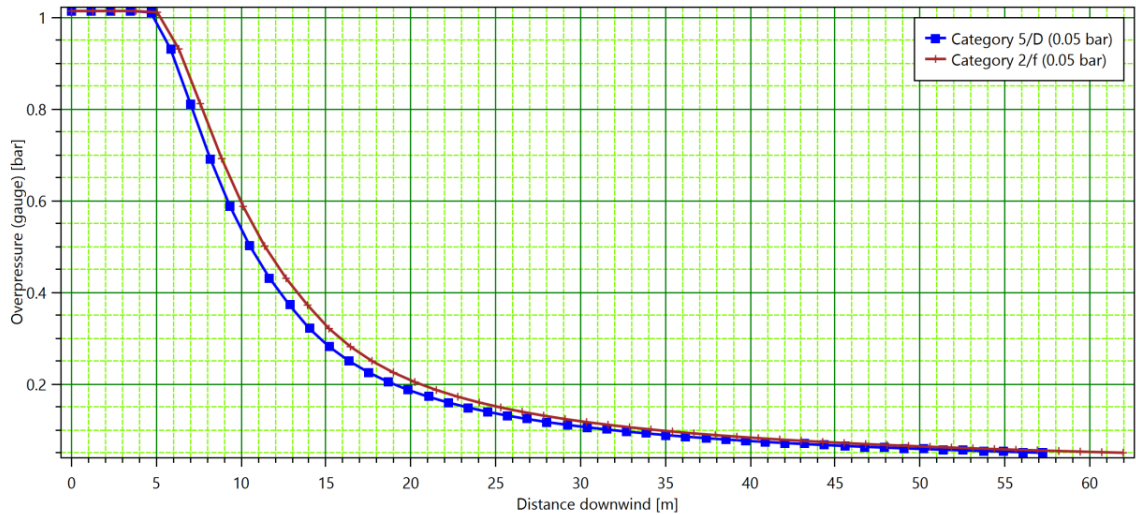


Figure 58 LPG Pipeline Vertical Release and VCE: Overpressure vs Distance

Table 37 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Vertical Release Distance (m)		Horizontal Release Distance (m)	
		F2	D5	F2	D5
35	Light damage	85	79	97	94
170	Moderate damage	23	21	26	25
350	Severe damage	15	13	16	16
830	Total destruction	7	7	8	8
168	1% mortality outdoors	23	21	26	25
50	1% mortality indoors CIA Category 3	62	57	71	68

Table 37 LPG Pipeline Release and VCE: Distances to Specified Overpressure Endpoints

Figure 59 illustrates the overpressure contour corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3.

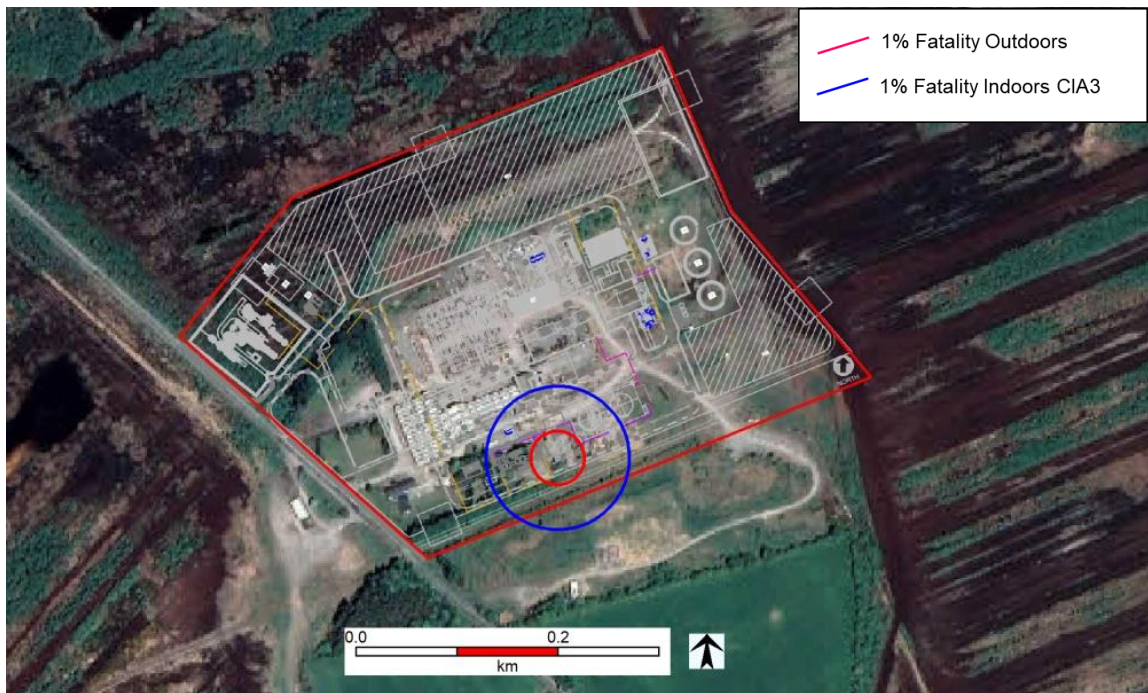


Figure 59 LPG Horizontal Pipeline Release and VCE: 1% Fatality Outdoors and 1% Fatality Indoors CIA Cat. 3

It is concluded that the overpressure contour corresponding to 1% fatality outdoors does not extend over the site boundary. The 1% fatality indoors contour, CIA Cat. 3, extends over the site boundary, but does not extend to any off-site building.

It is concluded that no off-site fatalities are predicted for a VCE following a rupture in the LPG pipeline.

6.4.5 LPG Pipeline Release: Flash Fire Model Outputs

The DNV PHAST Version 9.0 unified dispersion model predicts the flash fire footprint for a horizontal release only. Figure 60 illustrates the flash fire envelope for a horizontal release from the LPG pipeline.

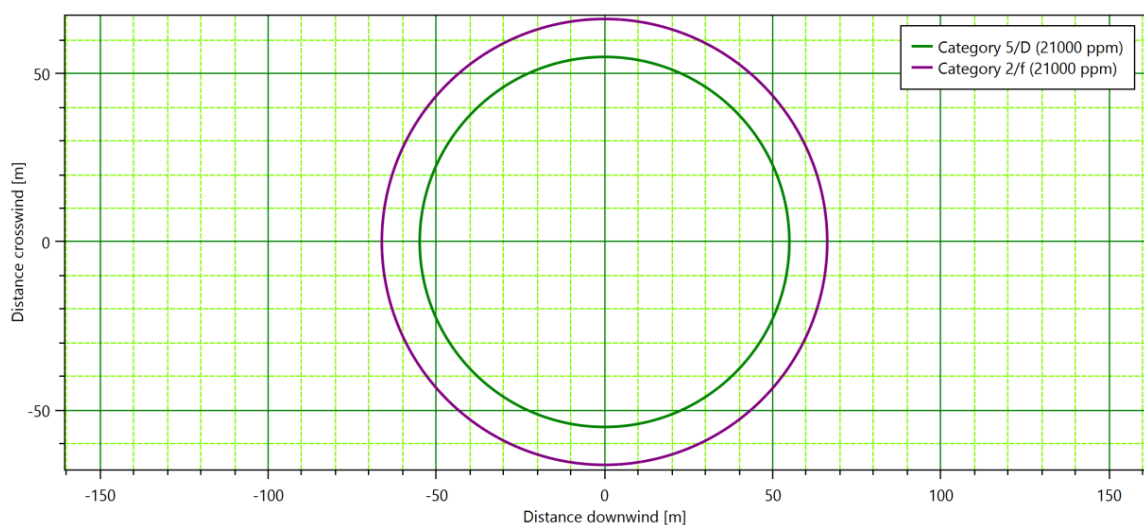


Figure 60 LPG Pipeline Horizontal Release and Flash Fire: Flash Fire Envelope

The flash fire envelope extends up to 66m from the LPG pipeline. The LPG tanks are located ca. 40m and 125m from the site boundary.

Figure 61 illustrates the flash fire envelope at the LPG pipeline associated with the OCGT's.

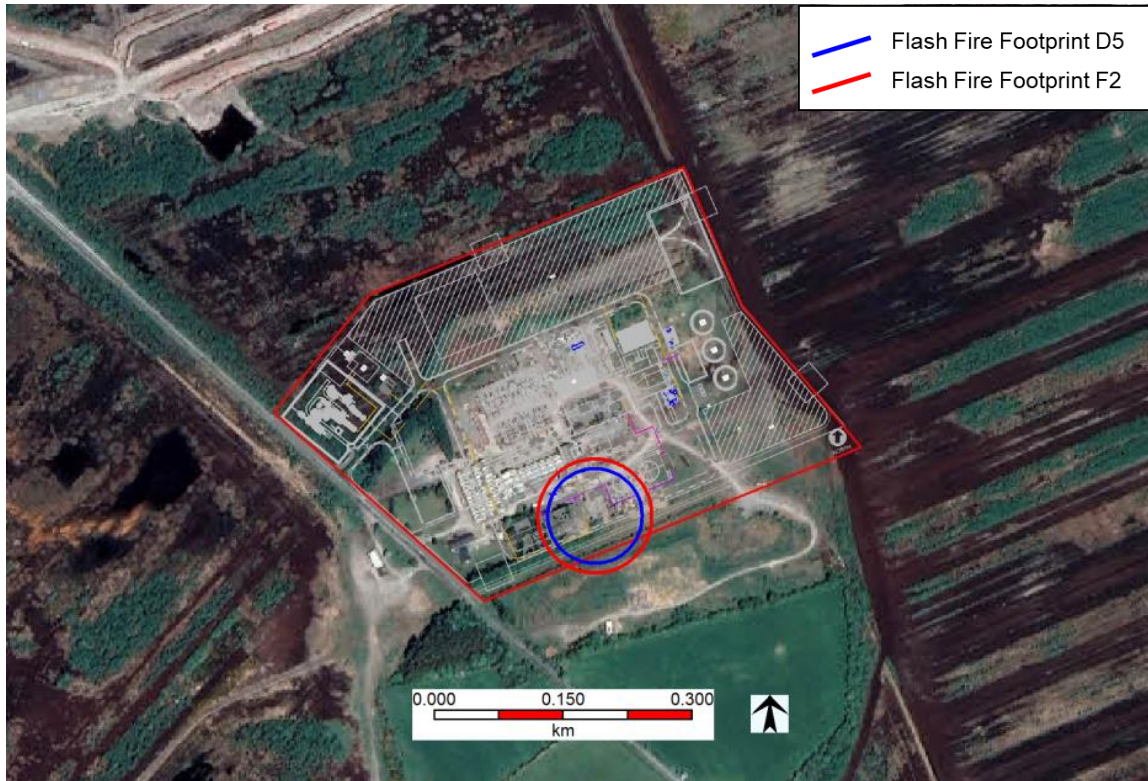


Figure 61 LPG Pipeline Horizontal Release and Flash Fire: Flash Fire Envelope

It is concluded that the flash fire envelope could extend over the power plant area boundary to the south. This area is not occupied and persons are not typically present.

6.4.6 LPG Pipeline Event Frequencies

Table 40 of the HSA's TLUP guidelines (HSA, 2023) gives the following pipeline loss of containment frequencies for overground pipelines within an establishment of diameter <75 mm:

- Pipeline rupture frequency: 1E-06 per m per year

Table 38 details the event frequencies for the LPG pipelines at the proposed development.

Installation	LOC scenario	LOC frequency		Modifier	LOC frequency /year	Consequence	Conditional probability	Event frequency (per year)
LPG Pipeline 1	Pipeline rupture	1.00E-06	/m/yr	45	4.50E-05	Jet fire	0.1	4.50E-06
						VCE	0.54	2.43E-05
						Flash fire	0.36	1.62E-05
LPG Pipeline 2	Pipeline rupture	1.00E-06	/m/yr	50	5.00E-05	Jet fire	0.1	5.00E-06
						VCE	0.54	2.70E-05
						Flash fire	0.36	1.80E-05

Table 38 LPG Pipeline Event Frequencies

6.5 LPG Tanker Release

The road tankers delivering propane to site will have the capacity to store up to 28 tonnes. Road tankers are treated as road transport units and unloading operations will be short due to the low capacity of the on-site LPG tanks. It is estimated that there will be 2 deliveries per year for the OCGTs and 12 deliveries per year for the CCGT.

In the absence of detailed design, the road tanker pressure has been conservatively modelled as 30 bar.

6.5.1 LPG Tanker Instantaneous Failure Model Inputs

Catastrophic rupture model inputs are detailed in Table 39. The flammable mass involved in the fireball is 3 x the adiabatic flash vapour mass fraction as calculated by the discharge/dispersion model. The methodology is detailed in the BLEVE (Fireball) Theory Review and Validation supporting DNV PHAST software (DNV, 2024).

Parameter	Units	Input
Contents	kg	28,000
Flammable Mass	kg	21,786
Substance	-	Propane
Temperature	°C	15
Mass modification factor	-	3
Burst Pressure (3 x design pressure)	Barg	90
Maximum SEP	kW/m ²	250

Table 39 LPG Tanker Release: Model Inputs

6.5.2 LPG Tanker Instantaneous Release BLEVE/Fireball Model Outputs

Table 40 details the diameter, radius and fireball duration results obtained using the HSE static fireball model.

Parameter	Units	Weather Category	
		D5	F2
Fireball diameter, D	m	162	162
Fireball radius, R	m	81	81
Fireball duration, T	s	12.5	12.5

Table 40 LPG Tanker Rupture: Fireball Model Outputs

Figure 62 illustrates the thermal radiation vs distance profile for an LPG tanker fireball and Figure 63 illustrates the thermal dose vs distance profile for an LPG tanker fireball.

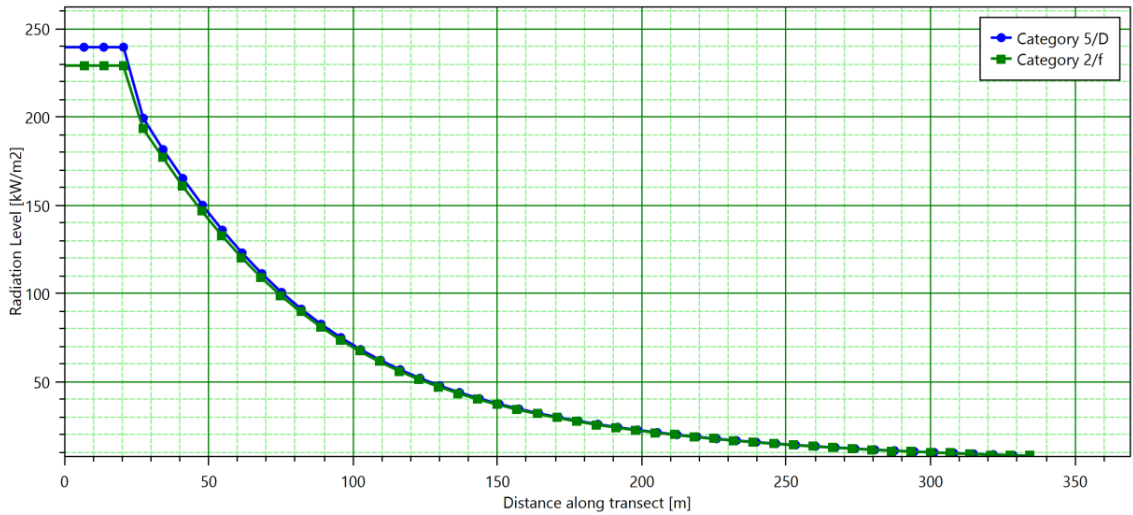


Figure 62 LPG Tanker Rupture and Fireball: Thermal Radiation vs Distance

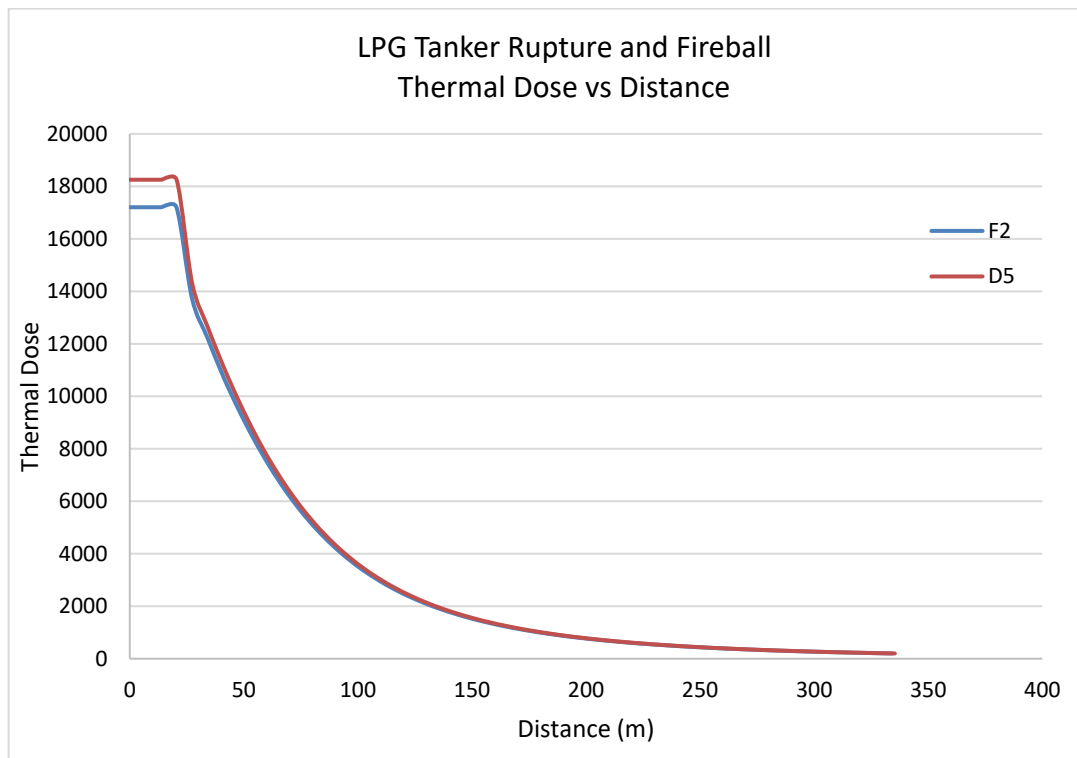


Figure 63 LPG Tanker Rupture: Thermal Dose vs Distance

Table 41 details the distances to thermal dose levels associated with specified levels of probability of fatality based on the Eisenberg Probit equation described in Section 4.2.

Criterion	Thermal Dose Level	D5	F2
	TDU	Distance (m)	Distance (m)
1% fatality (based on a 12.5s fireball duration)	963	182	182
100% fatality	Fireball radius	81	81
Building protected below this level, 0% fatality probability	1777	266	266
Building will catch fire quickly, 100% fatality probability	4527	185	185

Table 41 LPG Tank Rupture: Distances to Thermal Radiation Endpoints

Figure 64 illustrates the thermal radiation contours corresponding to outdoor lethality levels.



Figure 64 LPG Tanker Rupture and Fireball: Outdoor Lethality Contours

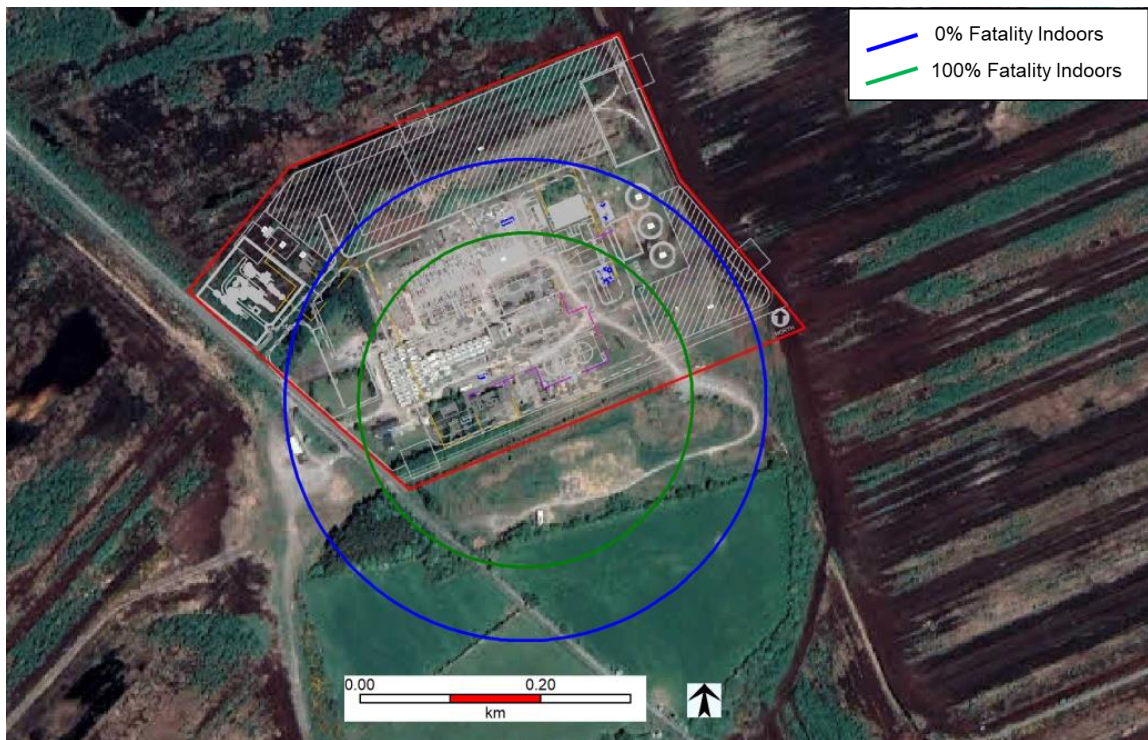


Figure 65 LPG Tanker Rupture and Fireball: Indoor Lethality Contours

It is concluded for a fireball following catastrophic LPG Tanker Rupture that the thermal radiation contour corresponding to 1% fatality outdoors extends over the power plant area boundary to the south. This area is not occupied and persons are not typically present. This contour also extends to the R400 road to the west. There is potential for fatality to road users passing in the event of a fireball.

It is concluded for a fireball following catastrophic LPG Tanker Rupture that the thermal radiation contour corresponding to 100% fatality outdoors extends over the power plant area boundary to the south but does not extend to any off-site occupied building.

It is concluded that no off-site fatalities are predicted for an LPG Tanker Fireball.

6.5.3 LPG Tanker Instantaneous Release VCE Model Outputs

The flammable mass for each loss of containment scenario is calculated by the unified dispersion mode in PHAST Version 9.0 modelling software.

The explosion strength was specified in the Multi-energy VCE model as 20% of the cloud volume at strength 7 and 80% at strength 2.

The overpressure vs distance profile for a VCE following LPG Tanker rupture is illustrated on Figure 66. Note the same profile for weather categories F2 and D5.

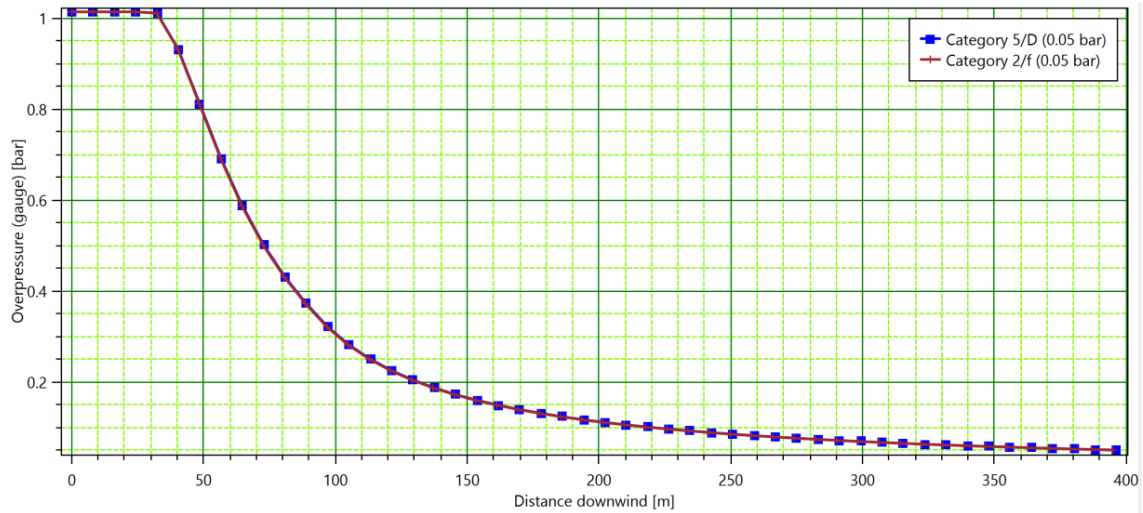


Figure 66 LPG Tanker Rupture and VCE: Overpressure vs Distance

Table 42 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Distance
		m
35	Light damage	546
170	Moderate damage	92
350	Severe damage	147
830	Total destruction	47
168	1% mortality outdoors	148
50	1% mortality indoors CIA Category 3	396

Table 42 LPG Tanker Rupture and VCE: Distances to Specified Overpressure Endpoints

Figure 67 illustrates the overpressure contour corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3.



Figure 67 LPG Tanker Rupture and VCE: 1% Fatality Outdoors and 1% Fatality Indoors Overpressure Contours

It is concluded that the overpressure contour corresponding to 1% fatality outdoors extends over the power plant area boundary to the south. This area is not occupied and persons are not typically present.

The 1% fatality indoors contour, CIA Cat. 3, extends over the power plant area boundary, but does not extend to any off-site occupied building.

It is concluded that no off-site fatalities are predicted for an LPG Tanker VCE.

6.5.4 LPG Tanker Instantaneous Release Flash Fire Model Outputs

The DNV PHAST Version 9.0 unified dispersion model predicts the flash fire footprint for a horizontal release only. Figure 68 illustrates the flash fire envelope following an LPG Tanker rupture.

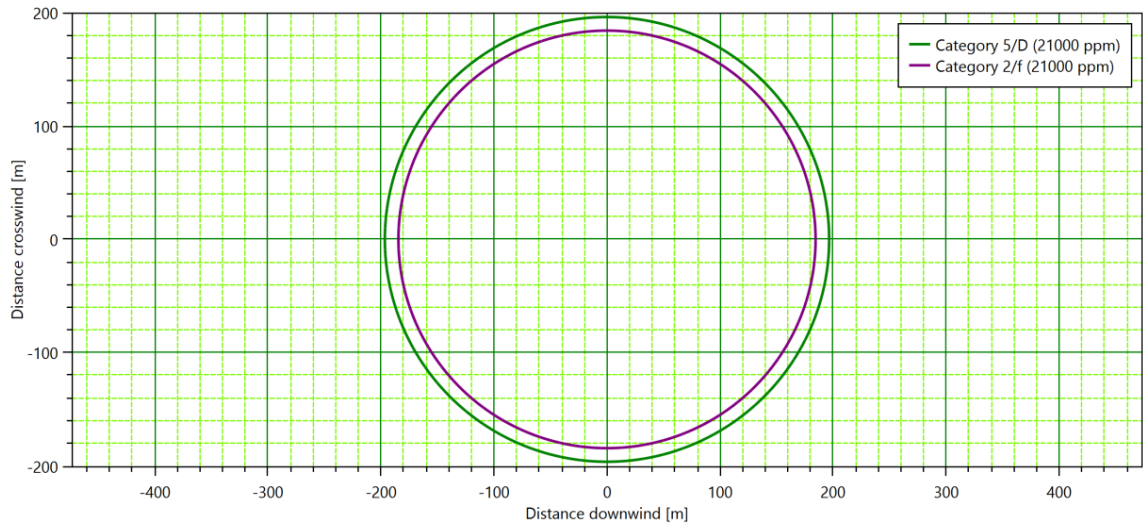


Figure 68 LPG Tanker Rupture and Flash Fire: Flash Fire Envelope

The flash fire envelope extends up to 200m from the LPG tanker. The LPG tanker unloading areas are located ca. 40m and 125m from the site boundary.

Figure 69 illustrates the flash fire envelope following an LPG Tanker rupture.

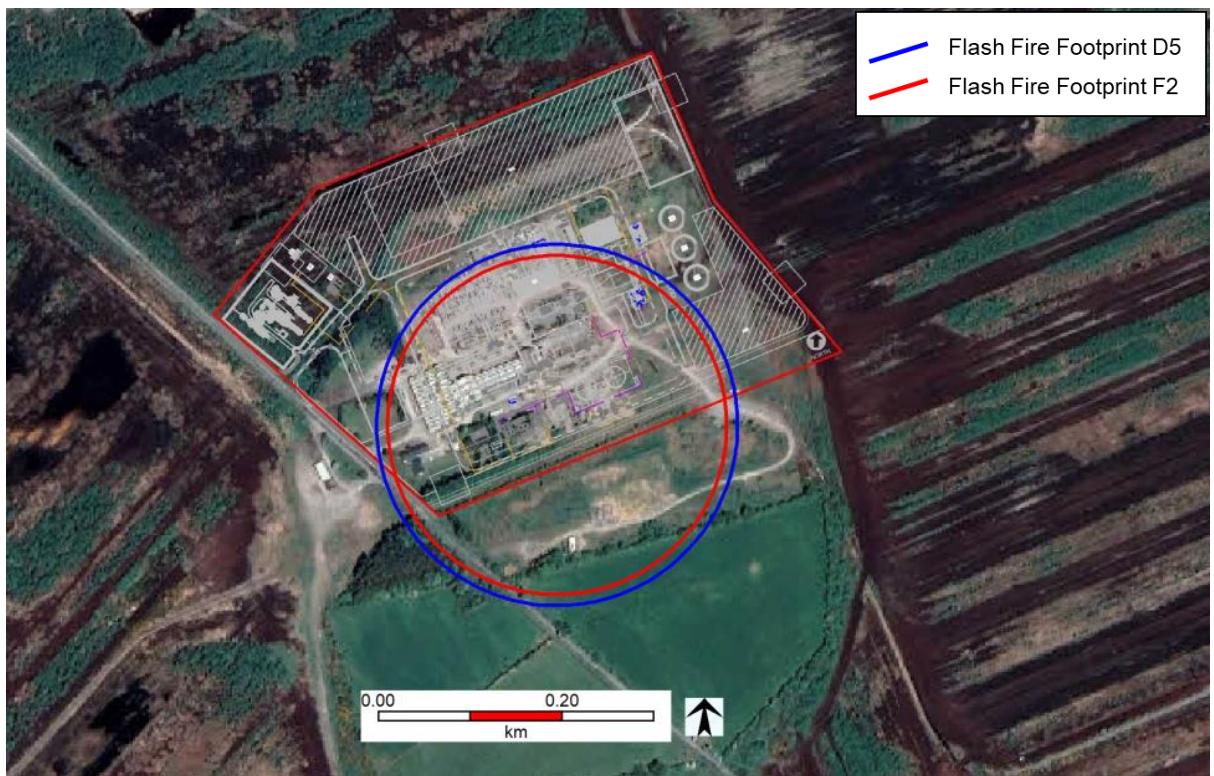


Figure 69 LPG Tanker Release and Flash Fire: Flash Fire Envelope

It is concluded that the flash fire envelope could extend over the power plant area boundary to the south. This area is not occupied and persons are not typically present. This contour also extends to the R400 road to the west. There is potential for fatality to road users passing in the event of a flash fire.

6.5.5 LPG Tanker Release Through Largest Connection Model Inputs

In the absence of detailed design, a 100mm connection will be assumed for modelling the ‘Leak Through Largest Connection’ scenario.

The model inputs are detailed in Table 39.

6.5.6 LPG Tanker Release Through Largest Connection: Jet Fire Model Outputs

The model inputs are as detailed in Table 25. The jet fire cone model in DNV PHAST Version 9.0 consequence modelling software was used to model the consequences of a jet fire.

Figure 70 and Figure 71 illustrate the thermal radiation vs distance profile for a horizontal and vertical release (respectively), for a receiver height of 1.5m.

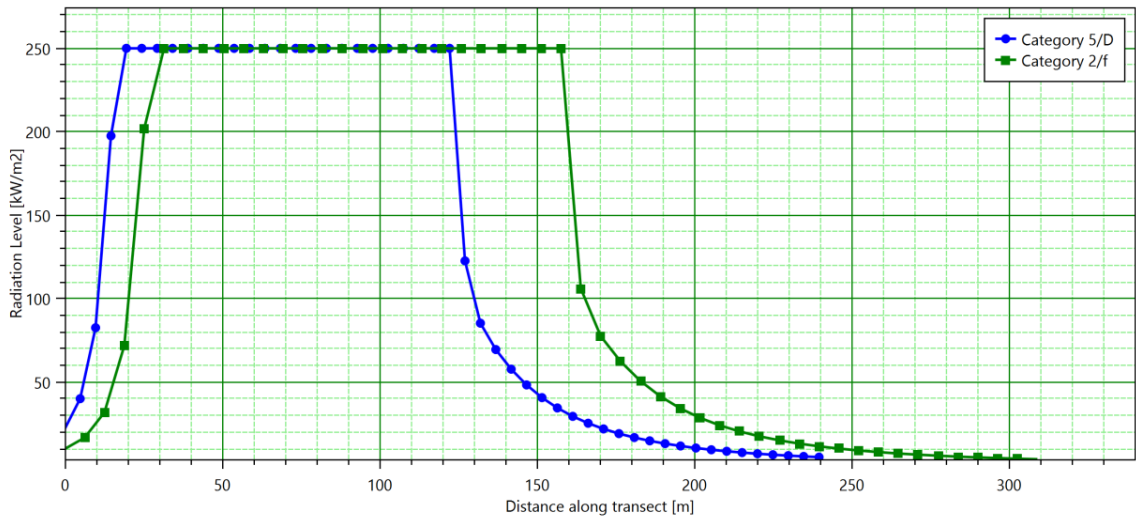


Figure 70 LPG Tanker Connection Horizontal Release and Jet Fire: Thermal Radiation vs Distance

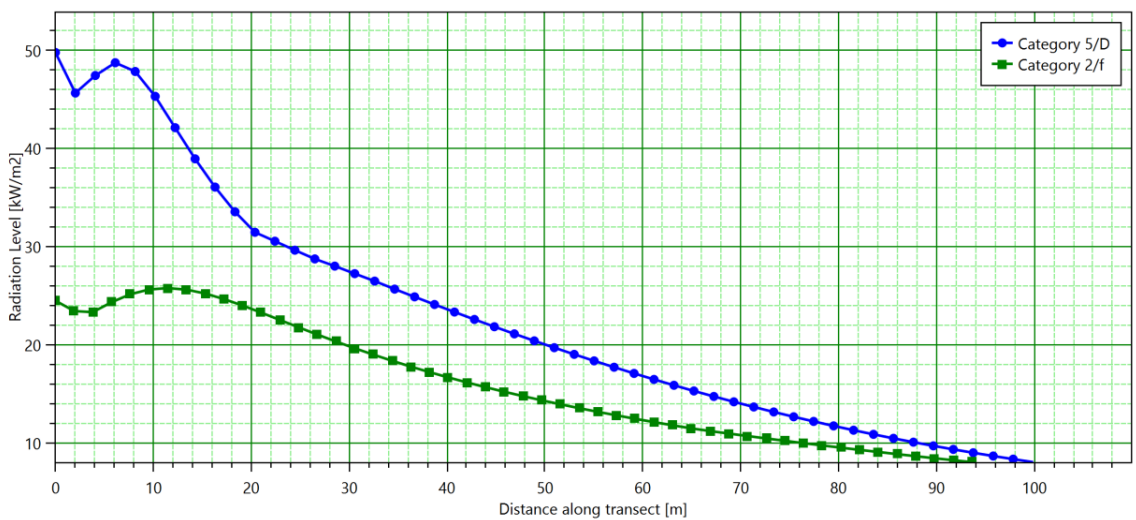


Figure 71 LPG Tanker Connection Vertical Release and Jet Fire: Thermal Radiation vs Distance

Table 36 details distances to specified thermal radiation levels, at a receiver height of 1.5m, associated with

- 1%, mortality outdoors
- 0% mortality and 100% mortality indoors

Consequence	Thermal Radiation (kW/m ²)	Horizontal Release (m)		Vertical Release (m)	
		Cat. D5	Cat. F2	Cat. D5	Cat. F2
1% mortality outdoors	8.02	213	259	100	94
0% mortality indoors	12.7	192	235	75	58
100% mortality indoors	25.6	166	206	35	13

Table 43 LPG Tanker Connection Release and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

Figure 72 illustrates the thermal radiation contour corresponding to 1% fatality outdoors for the weather category F2.

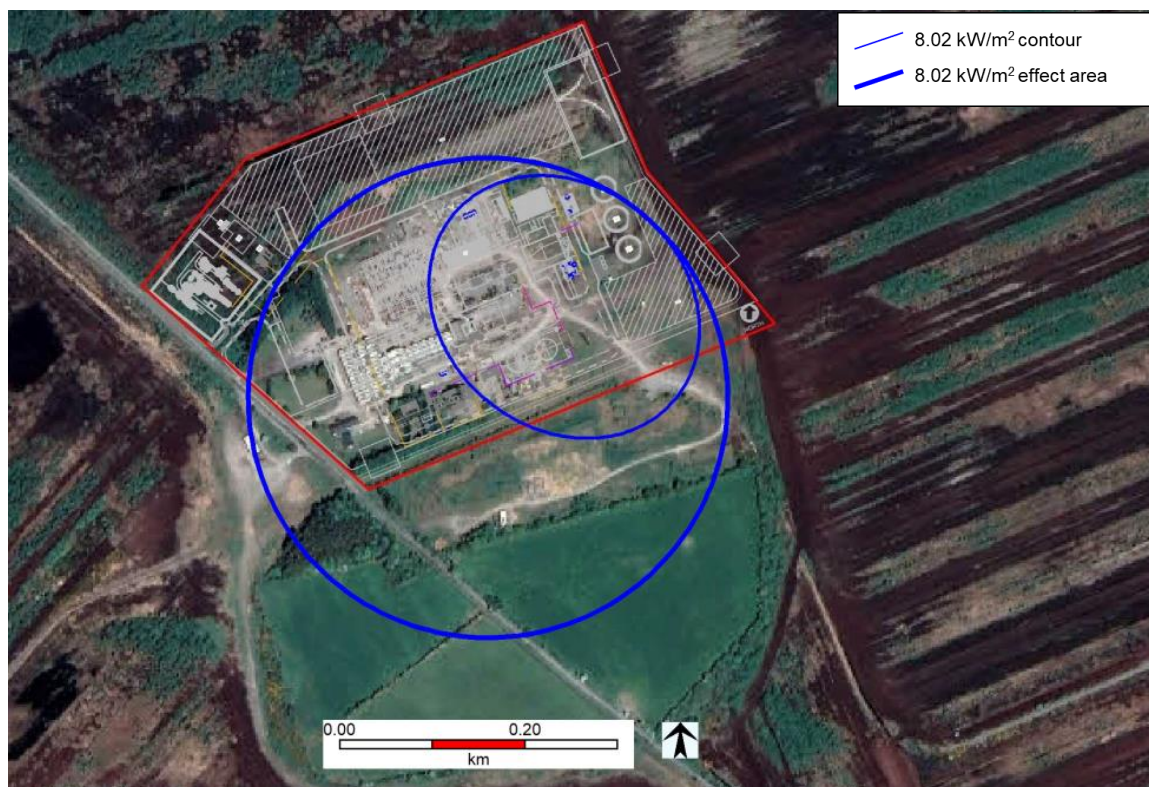


Figure 72 LPG Tanker Connection Release and Jet Fire: 1% Fatality Outdoors Contour

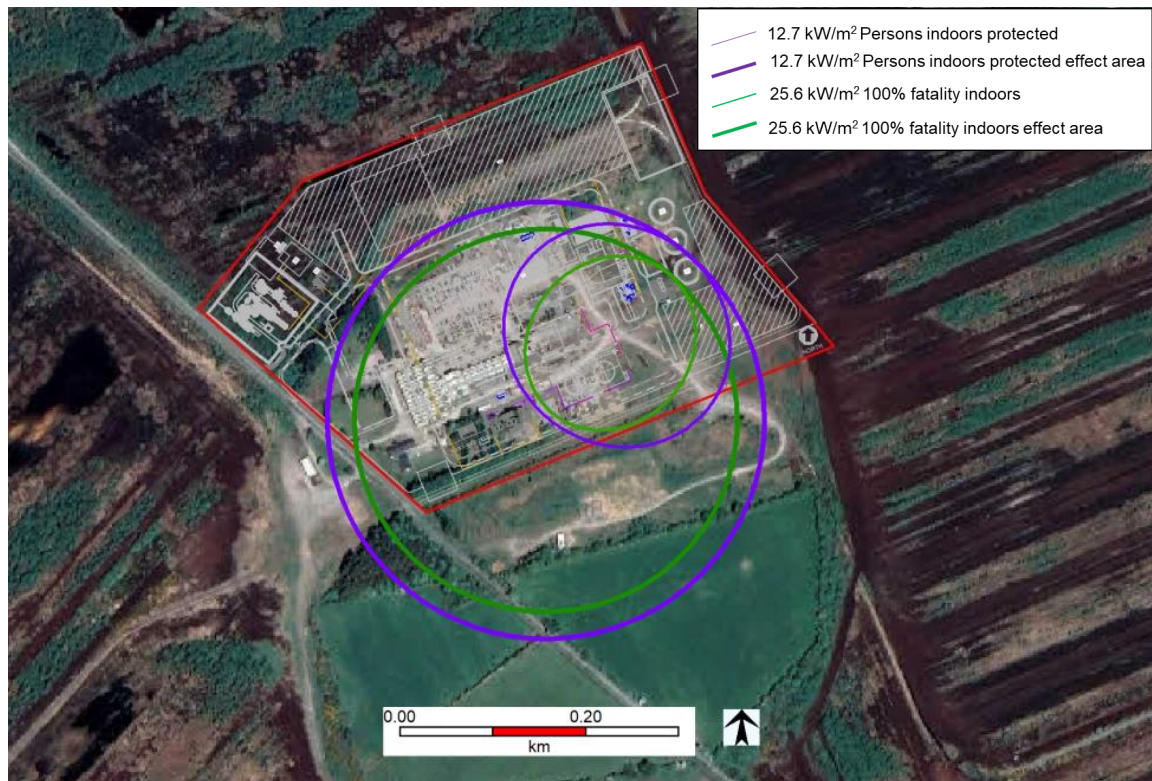


Figure 73 LPG Tanker Connection Release and Jet Fire: 0% Fatality and 100% Fatality Indoors Contours

It is concluded that in the event of a jet fire following an LPG Tanker connection leak:

- The thermal radiation level corresponding to 1% mortality outdoors could extend over the power plant area boundary. This area is not occupied and persons are not typically present. This contour also could extend to the R400 road to the west. There is potential for fatality to road users passing in the event of a jet fire.
- The thermal radiation level corresponding to 100% fatality indoors could extend over the power plant area boundary. There are no occupied buildings in this area.

It is concluded that no off-site fatalities are predicted for a jet fire following a leak in the largest connection at the LPG tanker unloading areas.

6.5.7 LPG Tanker Release Through Largest Connection: VCE Model Outputs

The flammable mass for each loss of containment scenario is calculated by the unified dispersion mode in PHAST Version 9.0 modelling software.

The explosion strength was specified in the Multi-energy VCE model as 20% of the cloud volume at strength 7 and 80% at strength 2.

Figure 74 and Figure 75 illustrate the overpressure vs distance profile for a VCE following LPG Tanker connection horizontal and vertical release (respectively).

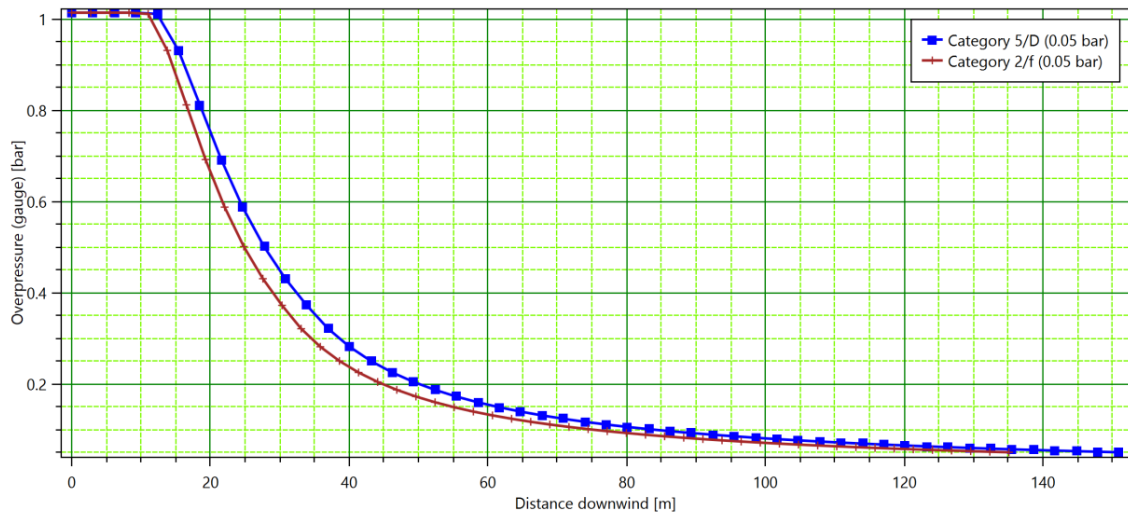


Figure 74 LPG Tanker Connection Horizontal Release and VCE: Overpressure vs Distance

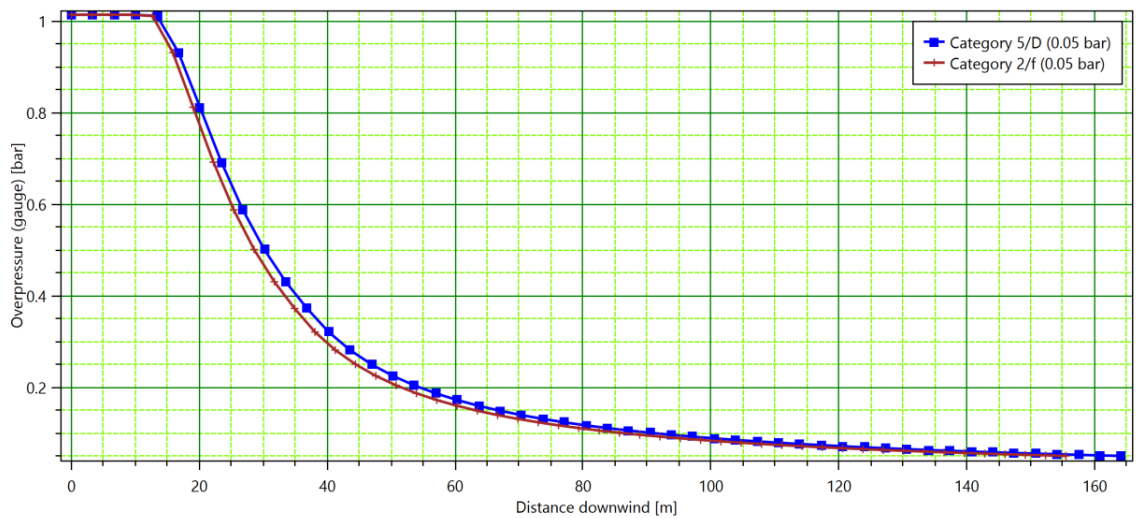


Figure 75 LPG Tanker Connection Vertical Release and VCE: Overpressure vs Distance

Table 44 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Vertical Release Distance (m)		Horizontal Release Distance (m)	
		F2	D5	F2	D5
35	Light damage	214	226	186	208
170	Moderate damage	57	60	49	55
350	Severe damage	36	38	31	35
830	Total destruction	19	20	17	18
168	1% mortality outdoors	58	61	50	56
50	1% mortality indoors CIA Category 3	156	164	135	151

Table 44 LPG Tanker Release and VCE: Distances to Specified Overpressure Endpoints

Figure 76 illustrates the overpressure contour corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3.

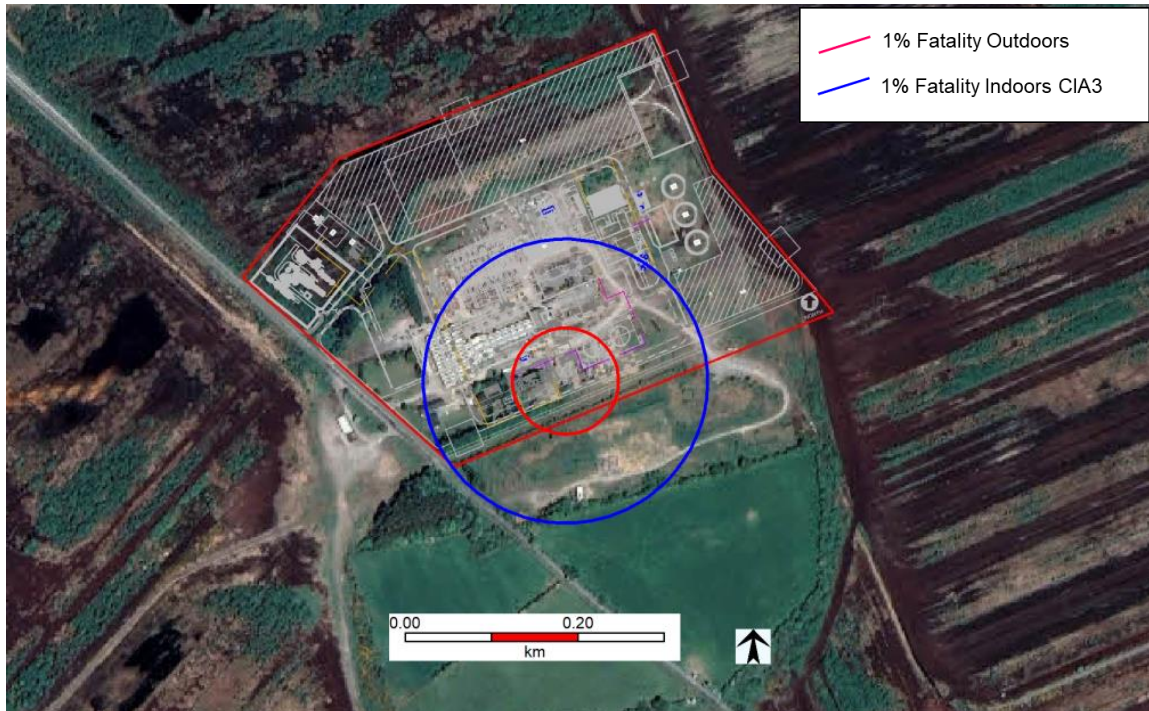


Figure 76 LPG Tanker Connection Leak and VCE: 1% Fatality Outdoors and 1% Fatality Indoors CIA Cat. 3 Overpressure Contours

It is concluded that the overpressure contour corresponding to 1% fatality outdoors extends over the power plant area boundary to the south. This area is not occupied and persons are not typically present.

The 1% fatality indoors contour, CIA Cat. 3, extends over the site boundary, but does not extend to any off-site occupied building.

It is concluded that no off-site fatalities are predicted for an LPG Tanker Connection Leak and VCE.

6.5.8 LPG Tanker Release Through Largest Connection: Flash Fire Model Outputs

The DNV PHAST Version 9.0 unified dispersion model predicts the flash fire footprint for a horizontal release only. Figure 68 illustrates the flash fire envelope following an LPG Tanker rupture.

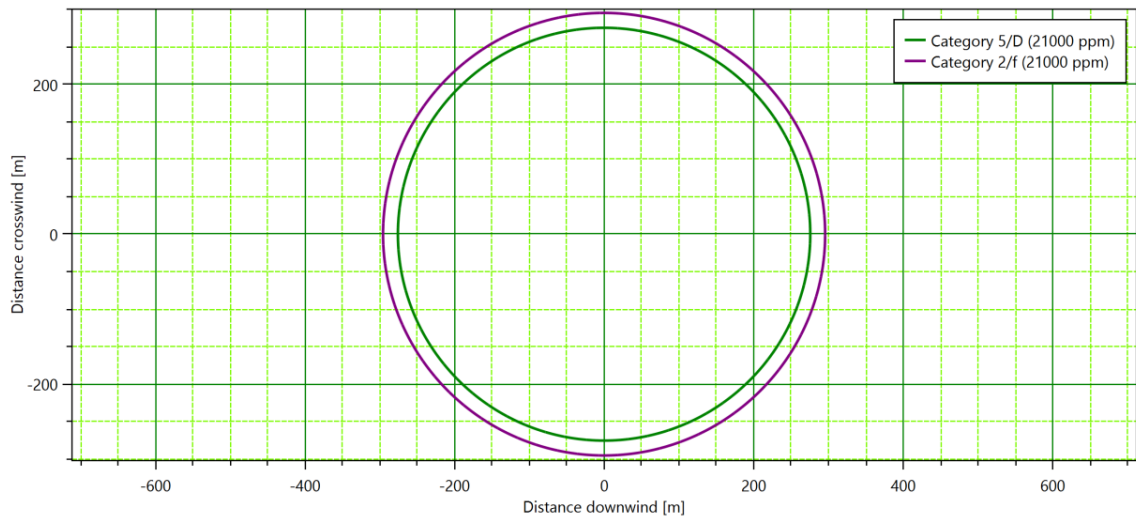


Figure 77 LPG Tanker Connection Leak and Flash Fire: Flash Fire Envelope

The flash fire envelope extends up to 296m from the LPG tanker. The LPG tanker unloading areas are located ca. 40m and 125m from the site boundary.

Figure 78 illustrates the flash fire envelope following an LPG Tanker rupture.

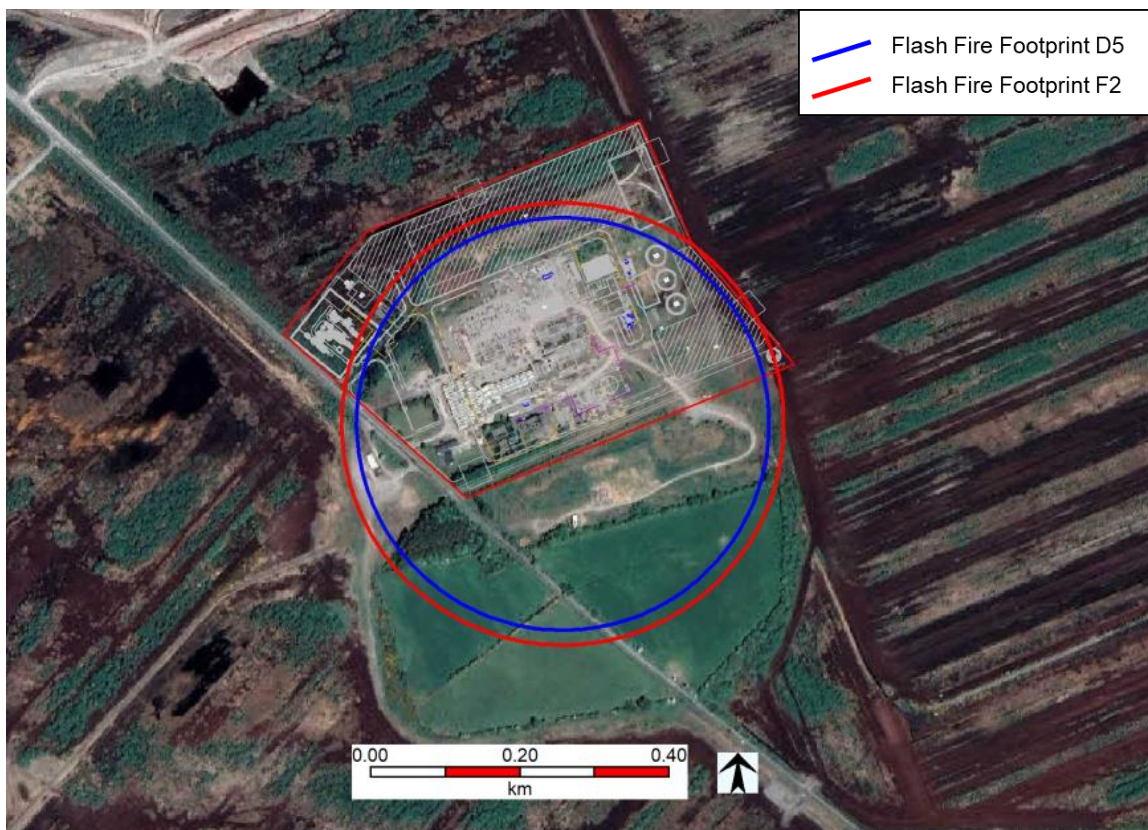


Figure 78 LPG Tanker Connection Leak and Flash Fire: Flash Fire Envelope

It is concluded that the flash fire envelope could extend over the power plant area boundary to the south. This area is not occupied and persons are not typically present. This contour also extends to the R400 road to the west. There is potential for fatality to road users passing in the event of a flash fire.

6.5.9 LPG Tanker Rupture of Loading Hose

In the absence of detailed design, a conservative assumption for the diameter of an LPG loading hose is 100mm.

The consequences of a release through a 100mm connection have been assessed in Section 6.5.5 to Section 6.5.8. The consequences detailed in these sections will be used in the risk profile for the LPG Tanker Rupture of a Loading Hose.

6.5.10 LPG Tanker Leak of Loading Hose (0.1 x Diameter)

In the absence of detailed design, a conservative assumption for the diameter of an LPG loading hose is 100mm; therefore, the leak scenario will a 10mm hole as an input (0.1 x diameter).

6.5.11 LPG Tanker Leak of Loading Hose: Jet Fire Model Outputs

The model inputs are as detailed in Table 25. The jet fire cone model in DNV PHAST Version 9.0 consequence modelling software was used to model the consequences of a jet fire.

Figure 79 and Figure 80 illustrate the thermal radiation vs distance profile for a horizontal and vertical release (respectively), for a receiver height of 1.5m.

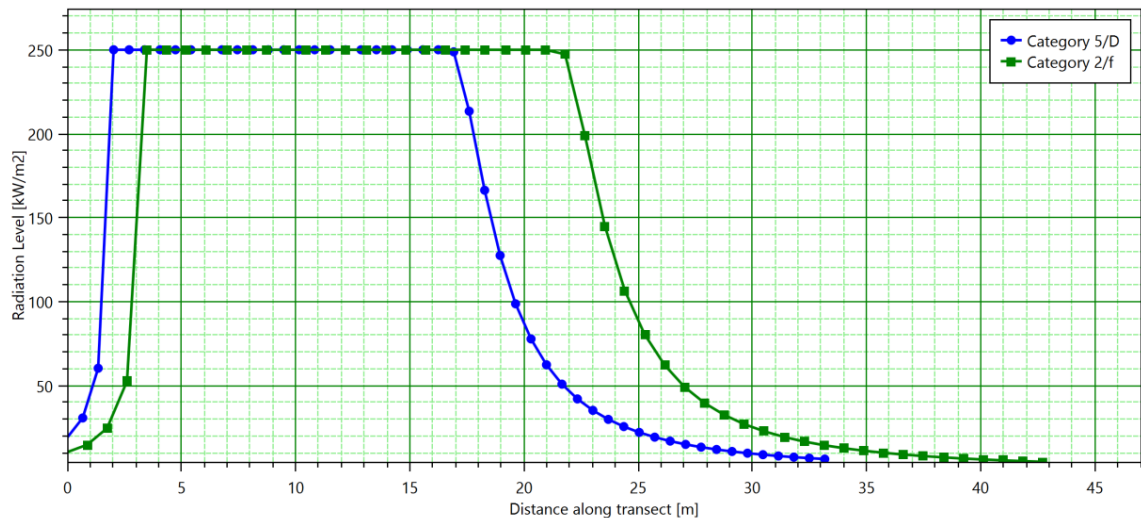


Figure 79 LPG Tanker 10mm Hose Horizontal Release and Jet Fire: Thermal Radiation vs Distance

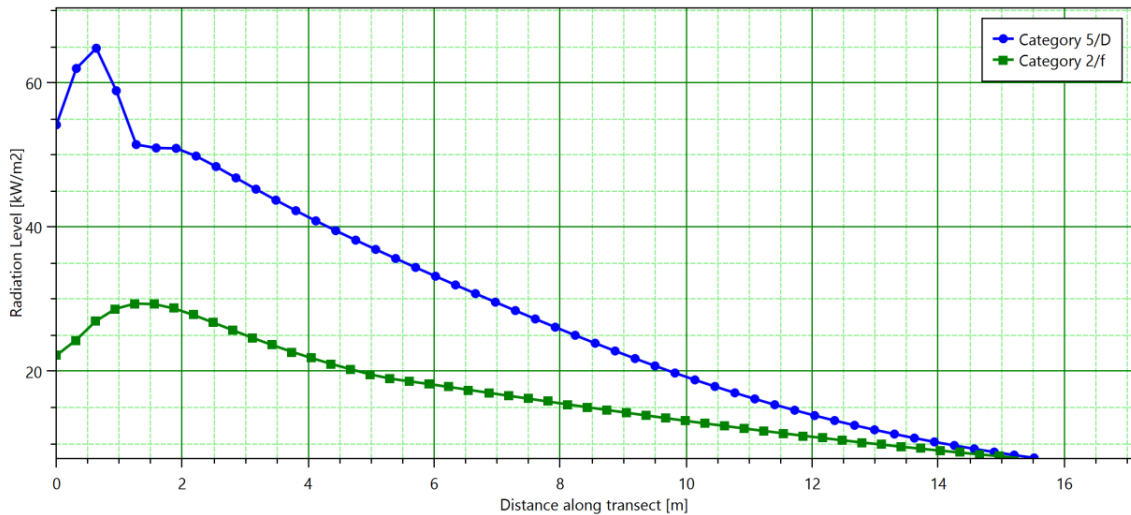


Figure 80 LPG Tanker 10mm Hose Vertical Release and Jet Fire: Thermal Radiation vs Distance

Table 45 details distances to specified thermal radiation levels, at a receiver height of 1.5m, associated with

- 1%, mortality outdoors
- 0% mortality and 100% mortality indoors

Consequence	Thermal Radiation (kW/m ²)	Horizontal Release (m)		Vertical Release (m)	
		Cat. D5	Cat. F2	Cat. D5	Cat. F2
1% mortality outdoors	8.02	31	38	16	15
0% mortality indoors	12.7	28	34	13	10
100% mortality indoors	25.6	24	30	8	3

Table 45 LPG Tanker 10mm Hose Leak and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

Figure 81 illustrates the thermal radiation contour corresponding to 1% fatality outdoors for the weather category F2.



Figure 81 LPG Tanker 10mm Hose Horizontal Release and Jet Fire: 1% Fatality Outdoors Contour

It is concluded that in the event of a jet fire following an LPG Tanker 10mm Hose leak the thermal radiation level corresponding to 1% mortality outdoors does not extend over the power plant area boundary.

It is concluded that no off-site fatalities are predicted for a jet fire following a 10mm hose leak at the LPG tanker unloading areas.

6.5.12 LPG Tanker Leak of Loading Hose: VCE Model Outputs

The flammable mass for each loss of containment scenario is calculated by the unified dispersion mode in PHAST Version 9.0 modelling software.

The explosion strength was specified in the Multi-energy VCE model as 20% of the cloud volume at strength 7 and 80% at strength 2.

Figure 82 and Figure 83 illustrate the overpressure vs distance profile for a VCE following 10mm Hose leak at the LPG Tanker unloading are for horizontal and vertical releases (respectively).

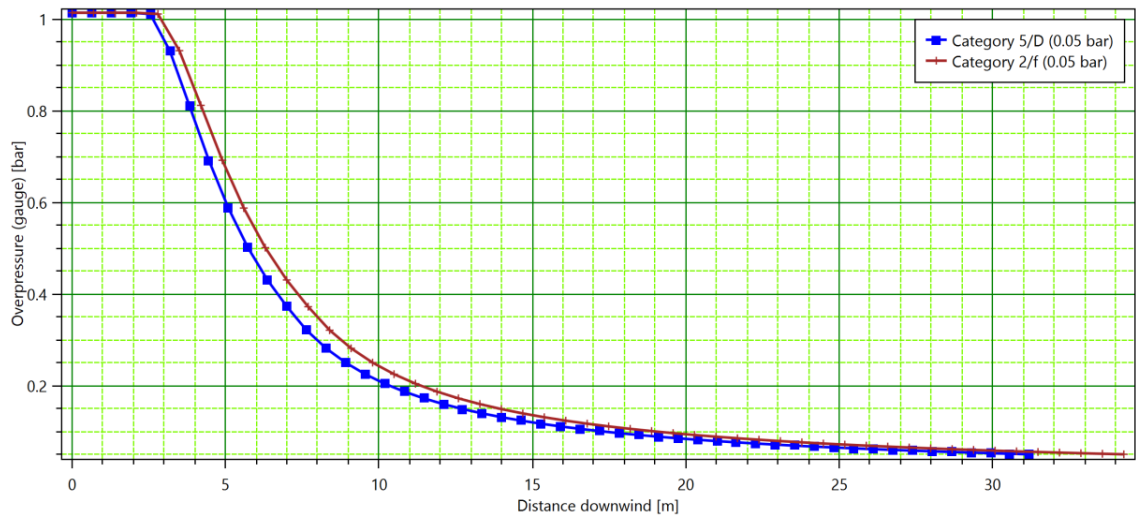


Figure 82 LPG Tanker 10mm Hose Leak Horizontal Release and VCE: Overpressure vs Distance

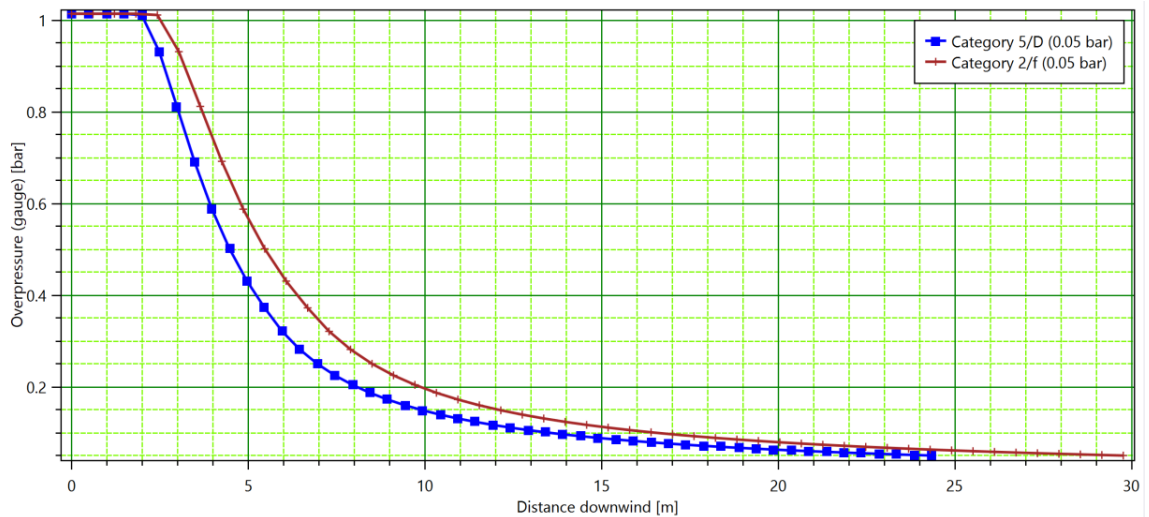


Figure 83 LPG Tanker 10mm Hose Leak Vertical Release and VCE: Overpressure vs Distance

Table 46 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Vertical Release Distance (m)		Horizontal Release Distance (m)	
		F2	D5	F2	D5
35	Light damage	41	34	47	43
170	Moderate damage	11	9	13	12
350	Severe damage	7	6	8	7
830	Total destruction	3	3	4	4
168	1% mortality outdoors	11	9	13	12
50	1% mortality indoors CIA Category 3	30	24	34	31

Table 46 LPG Tanker 10mm Hose Leak and VCE: Distances to Specified Overpressure Endpoints

Figure 84 illustrates the overpressure contours corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3.



Figure 84 LPG Tanker 10mm Hose Leak and VCE: 1% Fatality Outdoors and 1% Fatality Indoors CIA Cat. 3 Overpressure Contours

It is concluded that the overpressure contours corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3 do not extend over the site boundary.

It is concluded that no off-site fatalities are predicted for a VCE following a 10mm hose leak at the LPG tanker unloading areas.

6.5.13 LPG Tanker Leak of Loading Hose: Flash Fire Model Outputs

The DNV PHAST Version 9.0 unified dispersion model predicts the flash fire footprint for a horizontal release only. Figure 85 illustrates the flash fire envelope following an LPG Tanker rupture.

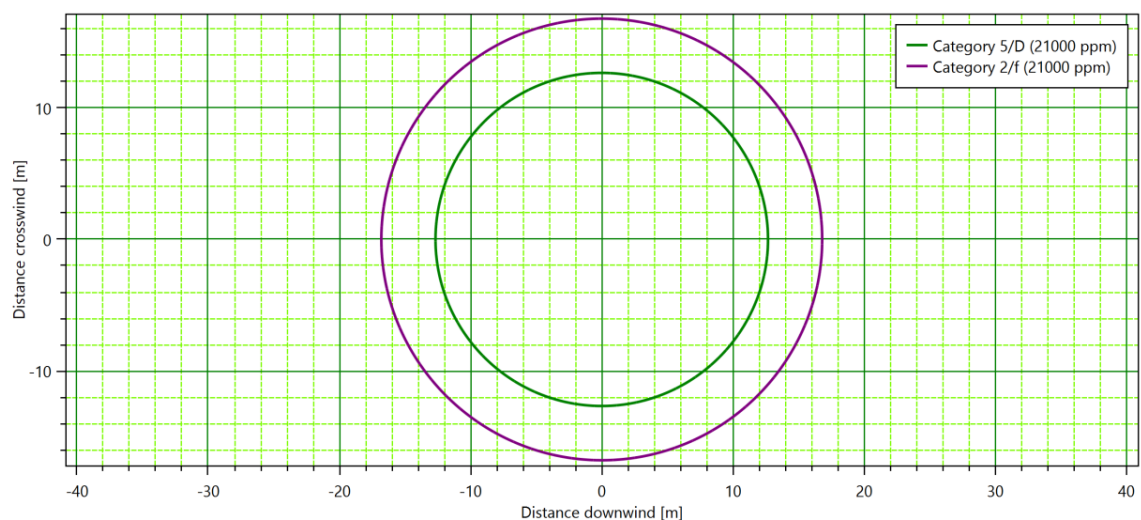


Figure 85 LPG Tanker 10mm Hose Leak and Flash Fire: Flash Fire Envelope

The flash fire envelope extends up to 17 m from the LPG tanker. The LPG tanker unloading areas are located ca. 40m and 125m from the site boundary.

It is concluded that no off-site fatalities are predicted for a Flash Fire, following a 10mm hose leak at the LPG tanker unloading areas.

6.5.14 LPG Tanker BLEVE (hot) Model Inputs

A BLEVE is an explosion which occurs when a storage vessel containing a liquid at a temperature significantly above its boiling point at normal atmospheric pressure, experiences a catastrophic failure. The TLUP states that a fireball will be used exclusively when determining the BLEVE effects.

Parameter	Units	Value
Contents	kg	28,000
Substance	-	Propane
Surface Emissive Power	kW/m ²	275
Burst Pressure (design pressure + 10%)	barg	33

Table 47 LPG Tanker BLEVE: Model Inputs

6.5.15 LPG Tanker BLEVE (hot) Model Outputs

In the event of LPG Tanker BLEVE (Hot), the HSE fireball model calculates a fireball radius of 83 m, and the fireball duration is 12.8 s.

Figure 86 illustrates the thermal radiation vs distance profile for a BLEVE and fireball at the LPG tanker and Figure 87 illustrates the thermal dose vs distance profile for a BLEVE and fireball at the LPG tanker.

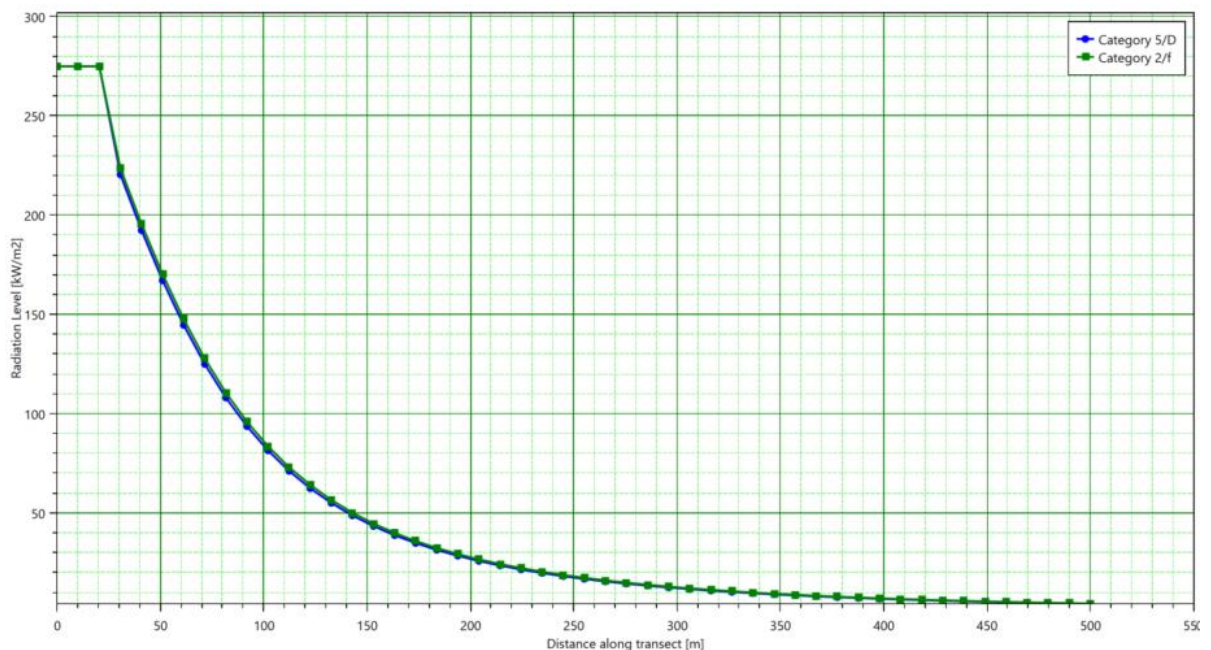


Figure 86 LPG Tanker BLEVE: Thermal Radiation vs Distance

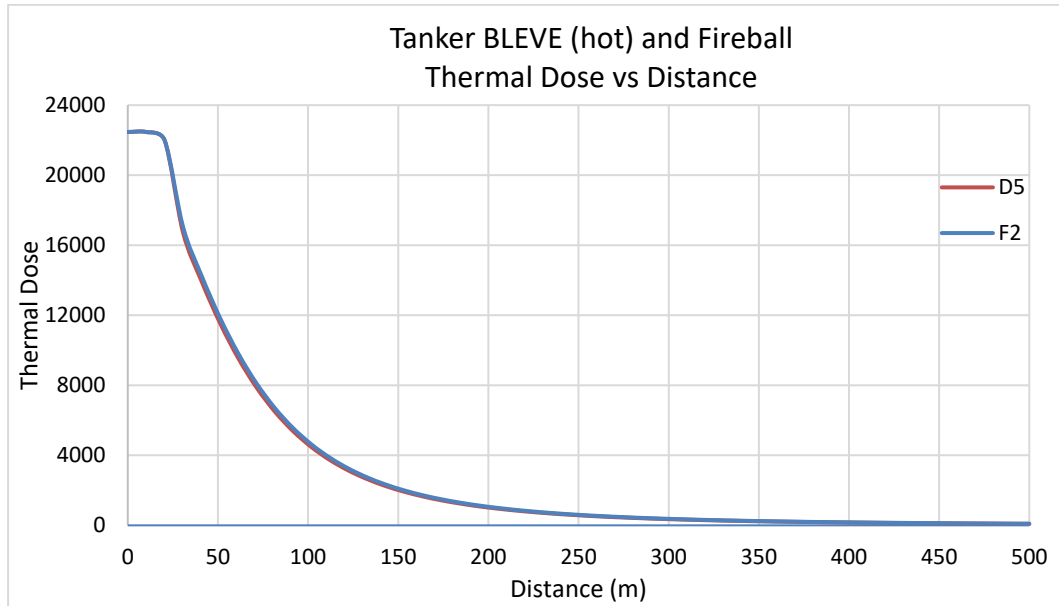


Figure 87 LPG Tanker BLEVE: Thermal Dose vs Distance

Table 48 details the distances to specified overpressure endpoints.

Criterion	Thermal Dose Level	Thermal Radiation	D5	F2
	TDUs	kW/m ²	Distance (m)	Distance (m)
1% fatality (based on a 12.8s fireball duration)	963	-	204	204
100% fatality	Fireball radius	-	83	83
Building protected below this level, 0% fatality probability	-	12.7	295	295
Building will catch fire quickly, 100% fatality probability	-	25.6	201	201

Table 48 LPG Tanker BLEVE: Distances to Specified Thermal Radiation Endpoints

Figure 88 illustrates the overpressure contours corresponding to 1% fatality outdoors and 0% fatality indoors.



Figure 88 LPG Tanker BLEVE and Fireball: 1% Fatality Outdoors Contour

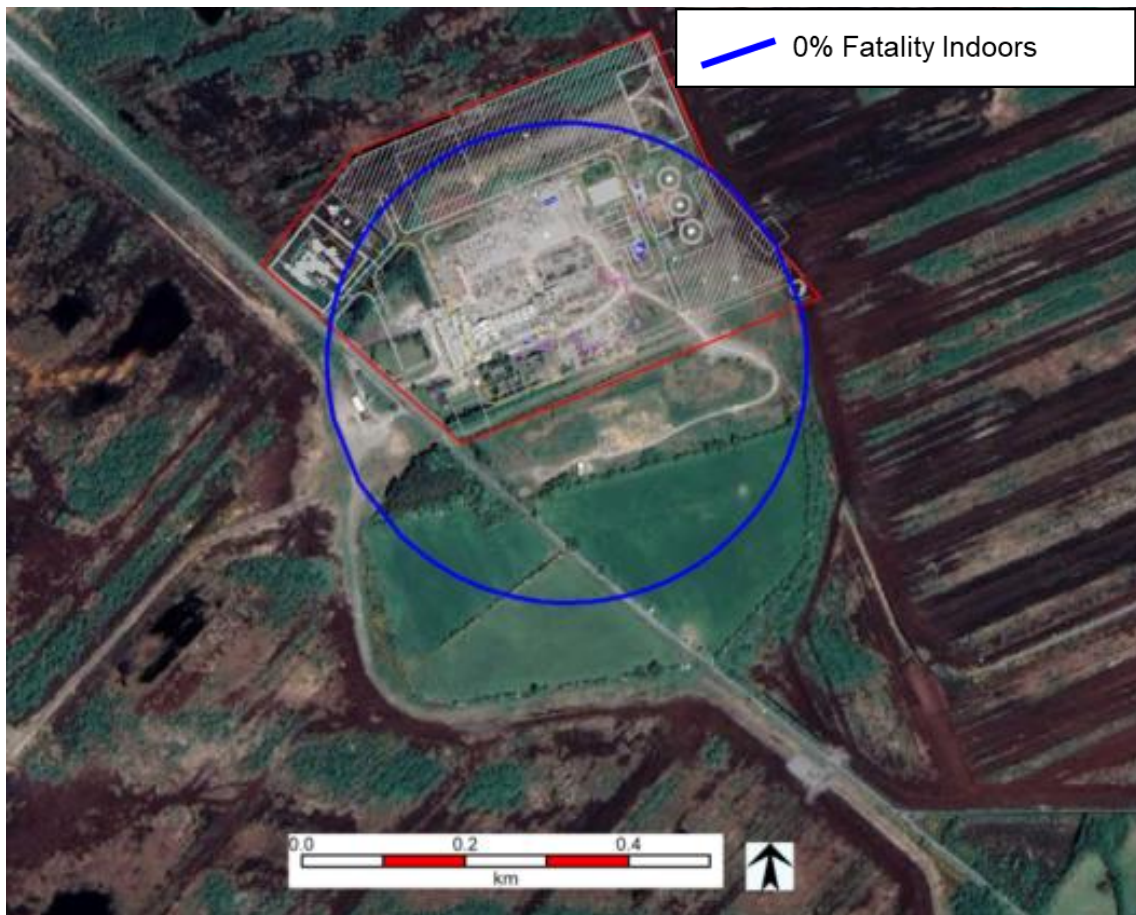


Figure 89 LPG Tanker BLEVE and Fireball: 0% Fatality Indoors Contour

It is concluded for a Road Tanker BLEVE (hot) and Fireball:

- The thermal radiation level corresponding to 1% mortality outdoors could extend over the power plant area boundary. This area is not occupied and persons are not typically present. This contour also could extend to the R400 road to the south and west. There is potential for fatality to road users passing the site in the event of a Fireball.
- The 0% fatality indoors contour, extends over the site boundary, but does not extend to any off-site occupied building.

6.5.16 LPG Tanker Event Frequencies

It is estimated that there will be 2 deliveries per year for the OCGTs and 12 deliveries per year for the CCGT. The delivery vehicle will be on site for 1.5 hours. Therefore, the fraction that the road tanker is on-site for per year is 0.0024 (21 / 8760).

Table 24 of the TLUP states an instantaneous failure frequency and loss of entire contents through largest connection of 5E-07 per year, this is adjusted to account for the time the tanker is on site per year.

Table 25 of the TLUP states a frequency of 4.0E-06 per hour for a rupture of a loading hose and a frequency of 4E-05 per hour for a leak of a loading hose. The delivery vehicle will be on-site for 21 hours per year.

Table 26 of the TLUP states a frequency of a BLEVE (hot) for tanker loading operations as 5.8E-10 per hour. The delivery vehicle will be on-site for 21 hours per year.

The event frequencies for the proposed development are detailed in Table 49.

Installation	LOC scenario	Consequence	Frequency (per year)
LPG Road Tanker	Instantaneous failure	Fireball	4.79E-10
		VCE	2.88E-10
		Flash fire	4.32E-10
	Loss of contents through largest connection	Jet fire	1.20E-10
		VCE	4.32E-10
		Flash fire	6.47E-10
	Rupture of Loading Hose	Jet fire	8.40E-06
		VCE	3.02E-05
		Flash fire	4.54E-05
	Leak of Loading Hose	Jet fire	8.40E-05
		VCE	3.02E-04
		Flash fire	4.54E-04
BLEVE (hot)	BLEVE	1.22E-08	

Table 49 LPG Tanker Event Frequencies

6.6 Hydrogen Release

6.6.1 Hydrogen Cylinder Instantaneous Release: Model Inputs

The DNV Phast Version 9.0 catastrophic rupture and unified dispersion models were used to model the release and dispersion of hydrogen in the event of rupture of a hydrogen cylinder at an outdoor storage skid.

The model inputs are detailed in Table 50 below.

Parameter	Details	Source/Assumption
Scenario	Hydrogen cylinder rupture	-
Material	Hydrogen	-
Mass released	0.65 kg	Contents of 1 no. cylinder
Rupture Pressure	192.5 barg	Operating pressure + 10%
Volume of cloud in explosion and curve strength	40% at Curve no. 7	HSA guidance (HSA, 2023)
Jet fire model	Miller	Recommended by Phast (DNV, 2022)
Wind speed	5 m/s (day time conditions), 2 m/s (night time conditions)	Recommended by HSA as representative modelling conditions
Pasquill Stability Factor	D (day time conditions) F (stable night time conditions)	
Temperature	15 degC (D5) 10 degC (F2)	HSA guidance (HSA 2023)

Table 50 Hydrogen Cylinder Rupture: Model Inputs

6.6.2 Hydrogen Cylinder Instantaneous Release Model Outputs: VCE

Since hydrogen has a wide flammability range and a low minimum ignition energy, it is assumed that ignition occurs at the location of release.

The dispersion model calculates that the maximum flammable mass is 0.52 kg and 0.51 kg for weather categories D5 and F2 (respectively).

The Multi Energy model was used to model the overpressure consequences in the event of rupture of a hydrogen skid.

Figure 90 illustrates the overpressure decay curve following a VCE following hydrogen cylinder rupture.

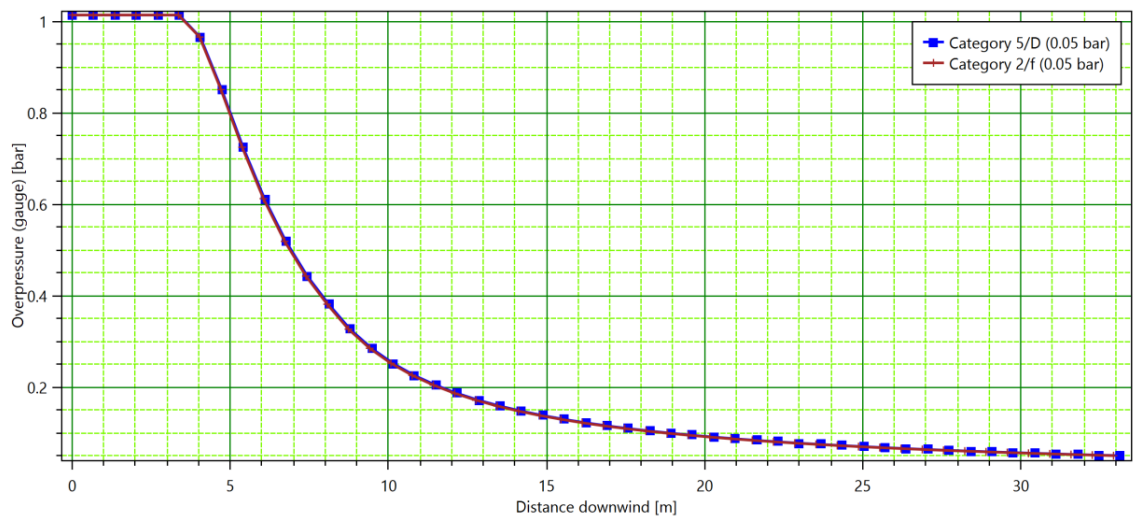


Figure 90 Hydrogen Cylinder Rupture and VCE: Overpressure vs Distance

Table 51 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Rupture Distance (m)	
		F2	D5
35	Light damage	45	45
170	Moderate damage	13	13
350	Severe damage	8	8
830	Total destruction	5	5
168	1% mortality outdoors	13	13
50	1% mortality indoors CIA Category 3	33	33

Table 51 Hydrogen Cylinder Rupture and VCE: Distances to Specified Overpressure Endpoints

The hydrogen storage area is located ca.180m from the power plant area boundary. The overpressures corresponding to 1% fatality outdoors and 1% fatality indoors CIA. Cat. 3 will not extend over the boundary; therefore, it is concluded that no off-site fatalities are predicted for a hydrogen cylinder rupture and VCE.

6.6.3 Hydrogen Cylinder Instantaneous Release Model Outputs: Fireball

The HSE fireball model is used in this study. This is a static fireball model and assumes that the fireball is located on the ground with no lift-off.

The HSE fireball model calculated a fireball radius of 2.5 m and a fireball duration of 0.4s for both weather categories D5 and F2.

Figure 91 illustrates thermal radiation vs distance profile for a fireball following cylinder rupture. Note the same thermal radiation profile is predicted for both weather categories.

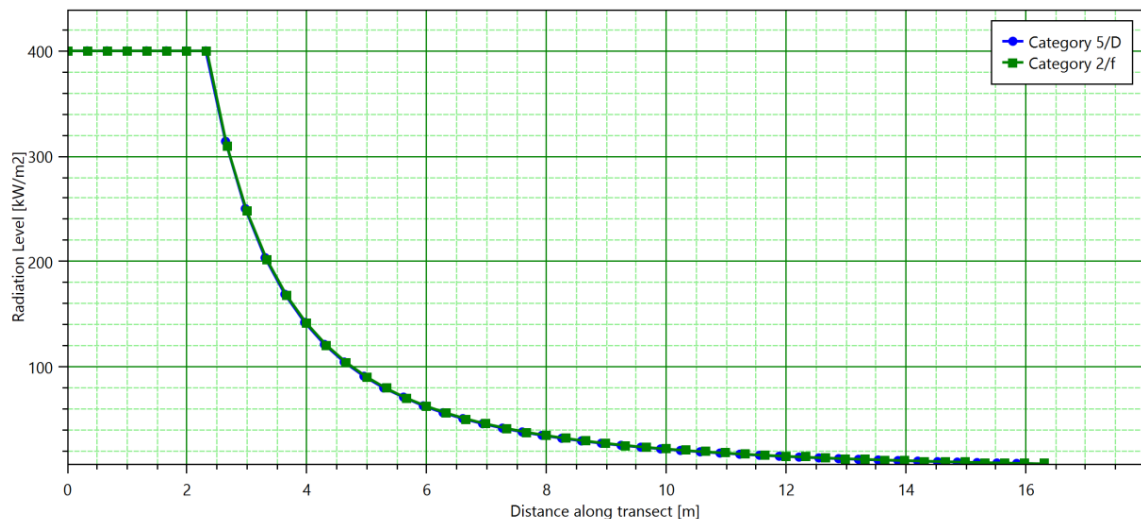


Figure 91 Hydrogen Cylinder Rupture and Fireball: Thermal Radiation vs Distance

Table 52 details the distances to thermal dose levels associated with specified levels of probability of fatality based on the Eisenberg Probit equation described in Section 4.2.

Criterion	D5	F2
	Distance (m)	Distance (m)
1% fatality	16	16
100% fatality (fireball radius)	2.5	2.5
Building protected below this level, 0% fatality probability	13	13
Building will catch fire quickly, 100% fatality probability	9	9

Table 52 Hydrogen Cylinder Rupture and Fireball: Distances to Thermal Radiation Endpoints

The hydrogen storage area is located ca.180m from the power plant area boundary. The thermal radiation corresponding to 1% fatality outdoors and 0% fatality indoors will not extend over the boundary; therefore, it is concluded that no off-site fatalities are predicted for a hydrogen cylinder rupture and fireball.

6.6.4 Hydrogen MCP Leak Scenarios: Model Inputs

The Phast 9.0 fixed duration release and unified dispersion models were used to model a 10-minute release from a hydrogen storage manifolded cylinder pallet resulting in loss of containment of the full contents of the skid.

The Phast 9.0 leak and unified dispersion models were used to model a release through a 10 mm hole over 10 mins from a hydrogen. The model inputs are detailed in Table 53.

Parameter	Full leak over 10 minutes	10 mm leak over 10 minutes	Source/Assumption
Scenario	10 min leak from 1 no hydrogen storage skid	10 mm leak over 10 minutes	-
Material	Hydrogen	Hydrogen	-
Mass released	5.8 kg	5.8 kg	Contents of 1 no. MCP
Pressure	192.5 barg	192.5 barg	Operating pressure + 10%
Averaging time	Flammable – 18.75 s	Flammable – 18.75 s	DNV PHAST
Exposure duration	60 s	60 s	HSA recommended (HSA, 2023)
Release height	1.5 m	1.5 m	Assumed, worst case consequences
Release direction	Vertical and Horizontal	Vertical and Horizontal	HSA guidance and Requested by HSA
Effect height	1.5 m	1.5 m	Average height of person
Wind speed	5 m/s 2 m/s	5 m/s 2 m/s	Recommended by HSA as representative modelling conditions
Pasquill Stability Factor	D (day time conditions) F (stable night time conditions)	D (day time conditions) F (stable night time conditions)	
Temperature	10 degC (F2) 15 degC (D5)	10 degC (F2) 15 degC (D5)	HSA guidance (HSA 2023)

Table 53 Hydrogen MCP Leak Scenarios: Model Inputs

6.6.5 MCP Failure over 10 minutes: Jet Fire Model Outputs

The Jet Fire Miller model was used to calculate the thermal radiation consequences from hydrogen jet fires at the proposed development.

As per HSA TLUP guidelines (HSA, 2023), jet fire results are presented for a vertical release. Results are also presented for a horizontal release.

Jet fire thermal radiation with distance is illustrated on Figure 92 and Figure 93. Results are presented at a receptor height of 1.5 m.

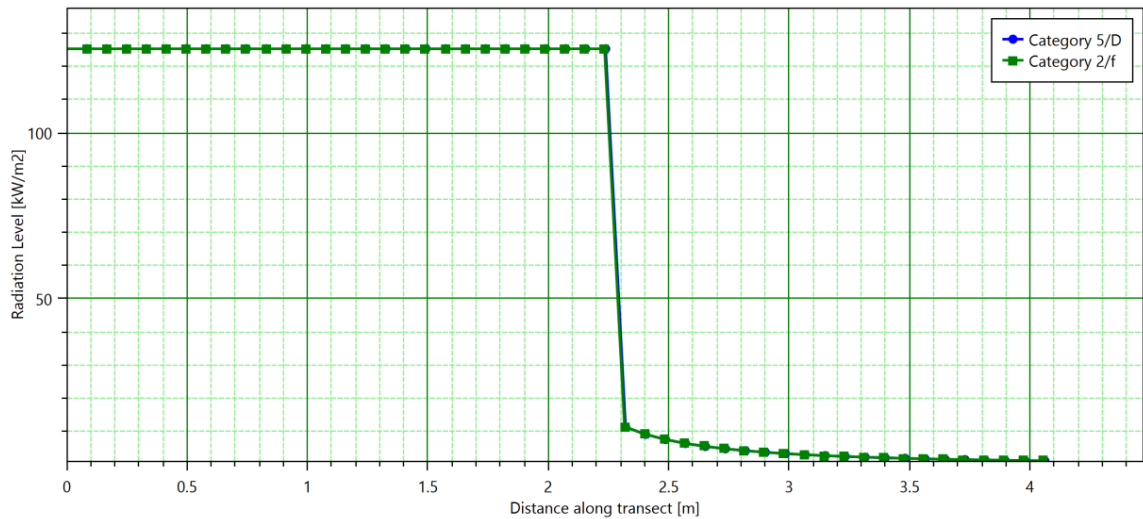


Figure 92 Hydrogen MCP Failure Over 10 Minutes (Horizontal Release): Jet Fire Thermal Radiation vs. Distance Category

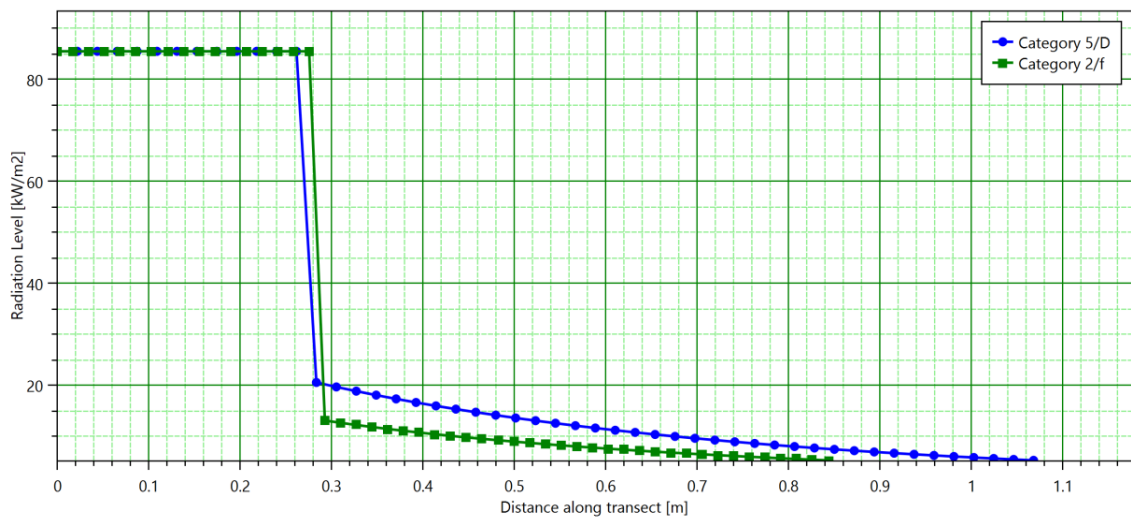


Figure 93 Hydrogen MCP Failure Over 10 Minutes (Vertical Release): Jet Fire Thermal Radiation vs. Distance Category

Table 54 details the distances to thermal radiation endpoints for a jet fire following MCP leak.

Consequence	Thermal Radiation (kW/m ²)	Horizontal Release (m)		Vertical Release (m)	
		Cat. D5	Cat. F2	Cat. D5	Cat. F2
1% mortality outdoors	8.02	2	2	<1	<1
0% mortality indoors	12.7	2	2	<1	<1
100% mortality indoors	25.6	2	2	<1	<1

Table 54 Hydrogen MCP Leak and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

The hydrogen storage area is located ca.180m from the power plant area boundary. The thermal radiation corresponding to 1% fatality outdoors and 0% fatality indoors will

not extend over the boundary; therefore, it is concluded that no off-site fatalities are predicted for a hydrogen cylinder leak and jet fire.

6.6.6 MCP Failure over 10 minutes: VCE Model Outputs

Since hydrogen has a wide flammability range and a low minimum ignition energy, it is assumed that ignition occurs at the location of release.

The dispersion model calculates that the maximum flammable mass is 0.0005 kg and 0.0008 kg for weather categories D5 and F2 (respectively) for a horizontal release and does not predict a build-up of flammable material for a vertical release.

The Multi Energy model was used to model the overpressure consequences in the event of a vapour cloud explosion following skid failure over 10 minutes.

Figure 94 illustrates the overpressure decay curve for a VCE following a hydrogen MCP failure (horizontal release).

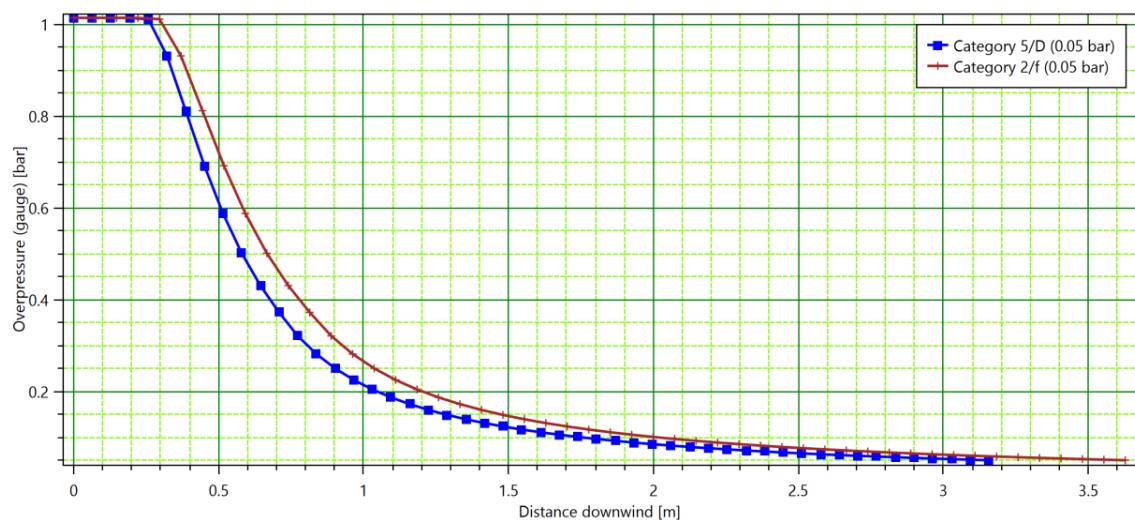


Figure 94 Hydrogen MCP Leak and VCE: Overpressure vs Distance

Table 55 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Rupture Distance (m)	
		F2	D5
35	Light damage	5	5
170	Moderate damage	1	1
350	Severe damage	1	1
830	Total destruction	1	1
168	1% mortality outdoors	1	1
50	1% mortality indoors CIA Category 3	4	4

Table 55 Hydrogen Cylinder Leak and VCE: Distances to Specified Overpressure Endpoints

The hydrogen storage area is located ca.180m from the power plant area boundary. The overpressures corresponding to 1% fatality outdoors and 1% fatality indoors CIA.

Cat. 3 will not extend over the boundary; therefore, it is concluded that no off-site fatalities are predicted for a hydrogen cylinder leak and VCE.

6.6.7 MCP 10mm Leak: Jet Fire Model Outputs

The Jet Fire Miller model was used to calculate the thermal radiation consequences from hydrogen jet fires at the proposed development.

As per HSA TLUP guidelines (HSA, 2023), jet fire results are presented for a vertical release. Results are also presented for a horizontal release.

Jet fire thermal radiation with distance is illustrated on Figure 95 and Figure 96. Results are presented at a receptor height of 1.5 m.

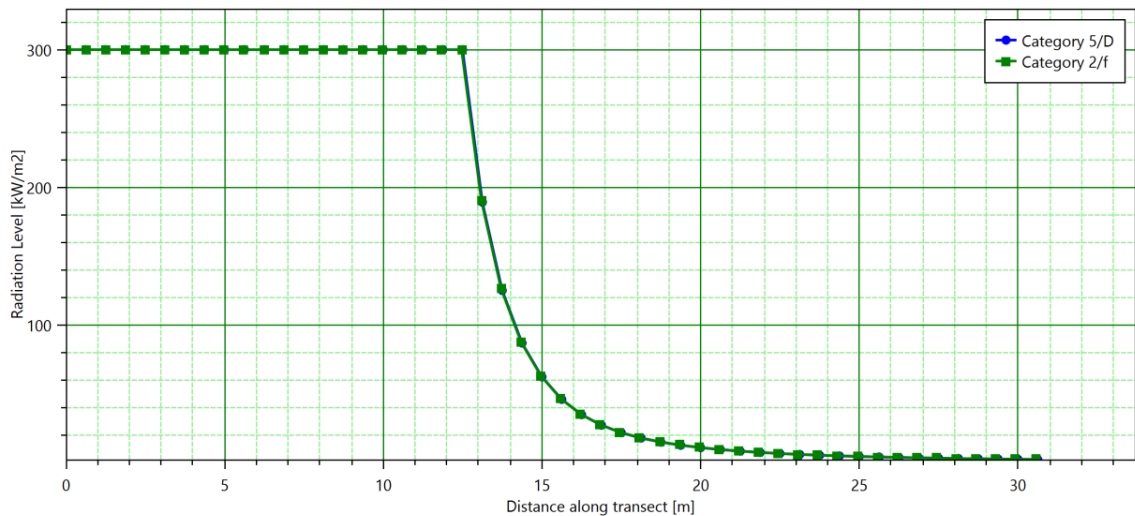


Figure 95 Hydrogen MCP 10mm Leak (Horizontal Release): Jet Fire Thermal Radiation vs. Distance Category

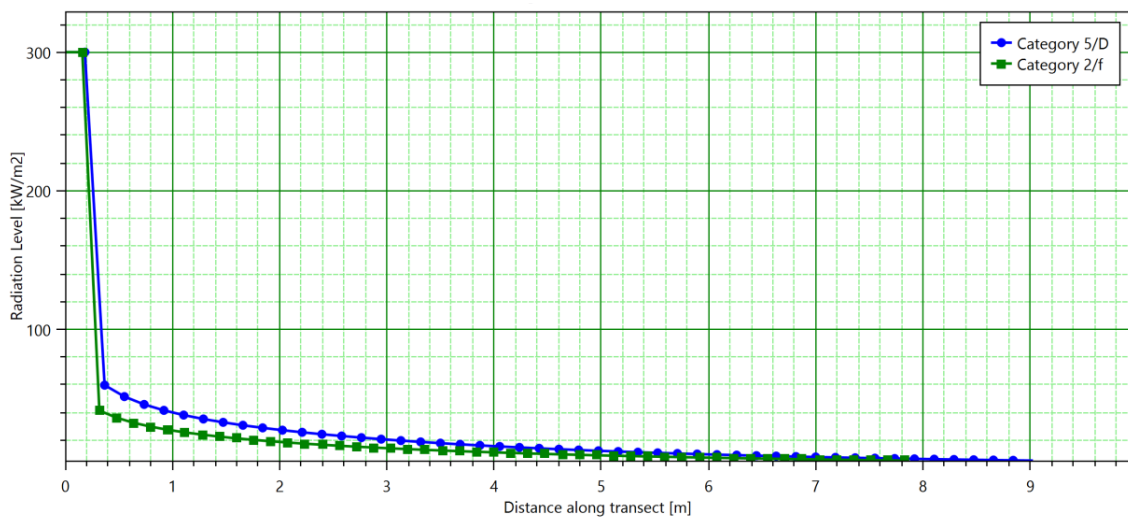


Figure 96 Hydrogen MCP 10mm Leak (Vertical Release): Jet Fire Thermal Radiation vs. Distance Category

Table 56 details the distances to thermal radiation endpoints for a jet fire following MCP leak.

Consequence	Thermal Radiation (kW/m ²)	Horizontal Release (m)		Vertical Release (m)	
		Cat. D5	Cat. F2	Cat. D5	Cat. F2
1% mortality outdoors	8.02	21	21	7	5
0% mortality indoors	12.7	19	19	5	3
100% mortality indoors	25.6	17	17	2	1

Table 56 Hydrogen MCP Leak and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

The hydrogen storage area is located ca.180m from the power plant area boundary. The thermal radiation corresponding to 1% fatality outdoors and 0% fatality indoors will not extend over the boundary; therefore, it is concluded that no off-site fatalities are predicted for a hydrogen cylinder leak and jet fire.

6.6.8 MCP 10mm Leak: VCE Model Outputs

Since hydrogen has a wide flammability range and a low minimum ignition energy, it is assumed that ignition occurs at the location of release.

The dispersion model calculates that the maximum flammable mass is 0.16 kg and 0.18 kg for weather categories D5 and F2 (respectively) for a horizontal release and 0.14 kg and 0.17 kg for weather categories D5 and F2 (respectively) for a vertical release.

The Multi Energy model was used to model the overpressure consequences in the event of a vapour cloud explosion following skid failure over 10 minutes.

Figure 97 illustrates the overpressure decay curve for a VCE following a hydrogen MCP leak for a horizontal release and Figure 98 illustrates the overpressure decay curve for a vertical release.

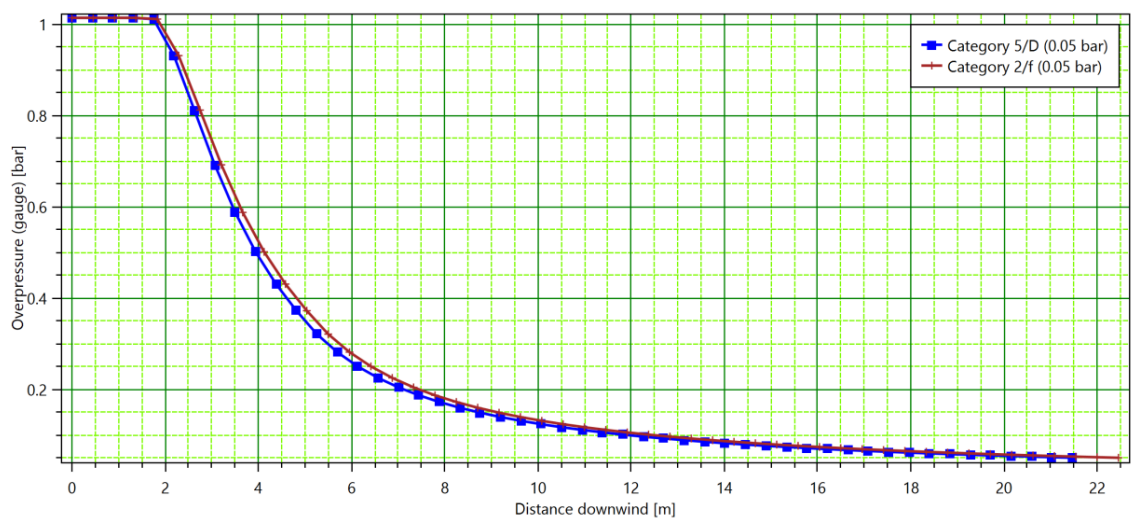


Figure 97 Hydrogen MCP Leak (Horizontal) and VCE: Overpressure vs Distance

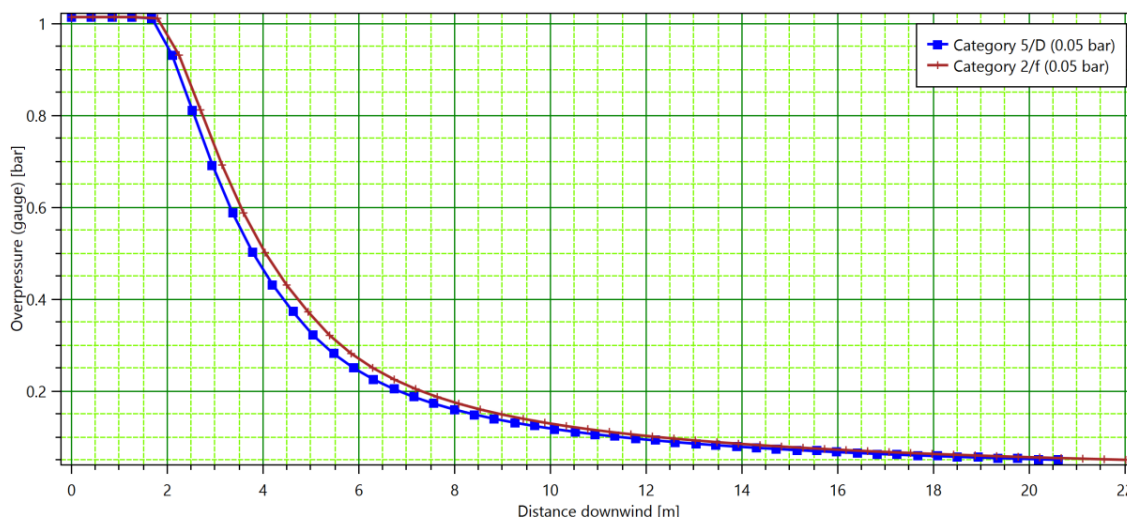


Figure 98 Hydrogen MCP Leak (Vertical) and VCE: Overpressure vs Distance

Table 57 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Vertical Release Distance (m)		Horizontal Release Distance (m)	
		F2	D5	F2	D5
35	Light damage	30	28	31	30
170	Moderate damage	8	8	8	8
350	Severe damage	5	5	5	5
830	Total destruction	3	3	3	3
168	1% mortality outdoors	8	8	8	8
50	1% mortality indoors CIA Category 3	22	21	22	21

Table 57 Hydrogen Cylinder Leak and VCE: Distances to Specified Overpressure Endpoints

The hydrogen storage area is located ca.180m from the power plant area boundary. The overpressures corresponding to 1% fatality outdoors and 1% fatality indoors CIA. Cat. 3 will not extend over the boundary; therefore, it is concluded that no off-site fatalities are predicted for a hydrogen cylinder leak and VCE.

6.6.9 Hydrogen Cylinder Event Frequencies

Frequencies for loss of containment events and top events (fire/explosion etc.) for outdoor hydrogen storage are as detailed in Table 36 of the HSA's TLUP guidance document (HSA, 2023).

The storage area could contain up to 3 No. storage skids containing up to 9 No. individual cylinders manifolded together. Each cylinder will have the capacity to store 7.2 Nm³ of hydrogen at a pressure of 175 barg, a total of 0.65 kg of hydrogen per cylinder.

Table 58 details the event frequencies for the storage of hydrogen at the proposed development. The frequencies in Table 58 will be applied to each skid.

Installation	LOC scenario	LOC frequency / yr	Consequence	Event frequency	
Outdoor hydrogen storage skids	Instantaneous failure (1 No. cylinder)	5.00E-06	VCE/Fireball	5.00E-06	/yr / skid
	Continuous leak over 10 minutes (contents of 1 skid)	1.00E-05	Jet fire	7.00E-06	/yr / skid
			VCE	3.0E-06	
	10 mm pipe leak over 10 minutes (contents of 1 skid)	5.00E-04	Jet fire	3.50E-04	/yr / skid
			VCE	1.5E-04	

Table 58 Hydrogen Event Frequencies

6.7 Hydrogen Pipeline Release

6.7.1 Hydrogen Pipeline Release: Model Inputs

Phast Version 9.0 short pipeline model was used to model a release of hydrogen following rupture of the pipeline. The short pipeline leak models a pipeline rupture scenario. The 10mm pipe leak scenario is modelled in Sections 6.6.7 to 6.6.8 of this report.

The pipeline model inputs are detailed in Table 59.

Parameter	Pipeline rupture	Source/Assumption
Scenario	Pipeline rupture	-
Material	Hydrogen	-
Pipeline diameter	50 mm	Project Engineer
Hole Size	50 mm	Pipeline rupture assumes Guillotine fracture so entire pipeline diameter
Length of pipeline	100 m	Project Engineer
Pressure	175 barg	Project engineer
Averaging time	Flammable – 18.75 s	DNV PHAST
Exposure duration	60 s	HSA recommended (HSA, 2023)
Release height	1 m	Above ground pipeline
Release direction	Vertical and Horizontal	HSA TLUP and HSA requested
Effect height	1.5 m	Average height of person
Wind speed	5 m/s 2 m/s	Recommended by HSA as representative modelling conditions
Pasquill Stability Factor	D (daytime conditions) F (nighttime conditions)	
Temperature	10 degC (F2) 15 degC (D5)	HSA TLUP (HSA 2023)

Table 59 Hydrogen Pipeline Full Rupture: Discharge Model Inputs

6.7.2 Hydrogen Pipeline Release: Predicted Phenomena

The unified dispersion model in DNV PHAST Version 9.0 predicts the following phenomena for each release scenario:

- Pipeline Rupture: Jet fire (immediate ignition), VCE or flash fire (delayed ignition)

6.7.3 Hydrogen Pipeline Release: Jet Fire Model Outputs

The model inputs are as detailed in Table 59. The jet fire cone model in DNV PHAST Version 9.0 consequence modelling software was used to model the consequences of a jet fire.

Figure 99 and Figure 100 illustrate the thermal radiation vs distance profile for a horizontal and vertical release (respectively), for a receiver height of 1.5m.

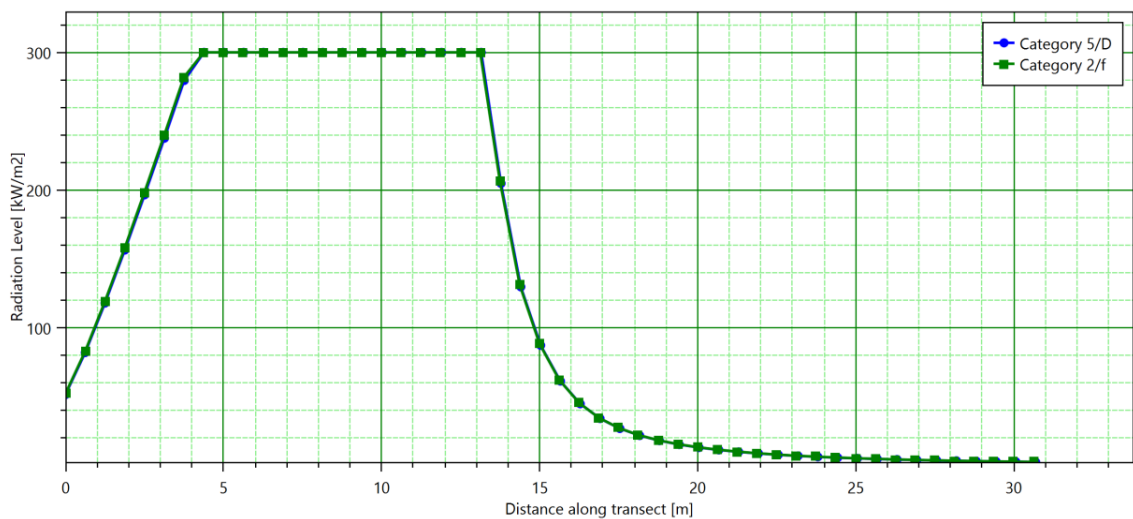


Figure 99 Hydrogen Pipeline Horizontal Release and Jet Fire: Thermal Radiation vs Distance

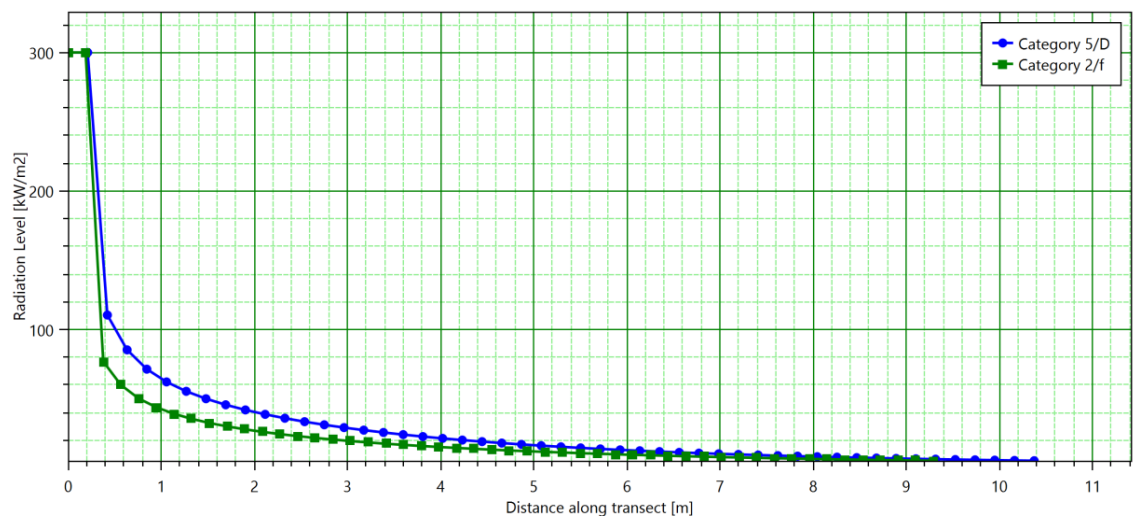


Figure 100 Hydrogen Pipeline Vertical Release and Jet Fire: Thermal Radiation vs Distance

Table 60 details distances to specified thermal radiation levels, at a receiver height of 1.5m, associated with

- 1%, mortality outdoors
- 0% mortality and 100% mortality indoors

Consequence	Thermal Radiation (kW/m ²)	Horizontal Release (m)		Vertical Release (m)	
		Cat. D5	Cat. F2	Cat. D5	Cat. F2
1% mortality outdoors	8.02	23	23	8	7
0% mortality indoors	12.7	20	20	6	5
100% mortality indoors	25.6	18	18	3	2

Table 60 Hydrogen Pipeline Release and Jet Fire: Calculated Distances at Specified Thermal Radiation Levels (receiver height 1.5m)

The closest section of the hydrogen storage pipeline is located ca. 150m from the power plant area boundary. The thermal radiation corresponding to 1% fatality outdoors and 0% fatality indoors will not extend over the boundary; therefore, it is concluded that no off-site fatalities are predicted for a hydrogen pipeline rupture and jet fire.

6.7.4 Hydrogen Pipeline Release: VCE Model Outputs

Since hydrogen has a wide flammability range and a low minimum ignition energy, it is assumed that ignition occurs at the location of release.

The dispersion model calculates that the maximum flammable mass is 0.17 kg and 0.19 kg for weather categories D5 and F2 (respectively) for a horizontal release and 0.15 kg and 0.17 kg for weather categories D5 and F2 (respectively) for a vertical release.

The Multi Energy model was used to model the overpressure consequences in the event of a vapour cloud explosion following skid failure over 10 minutes.

Figure 101 illustrates the overpressure decay curve for a VCE following a hydrogen pipeline rupture for a horizontal release and Figure 102 illustrates the overpressure decay curve for a vertical release.

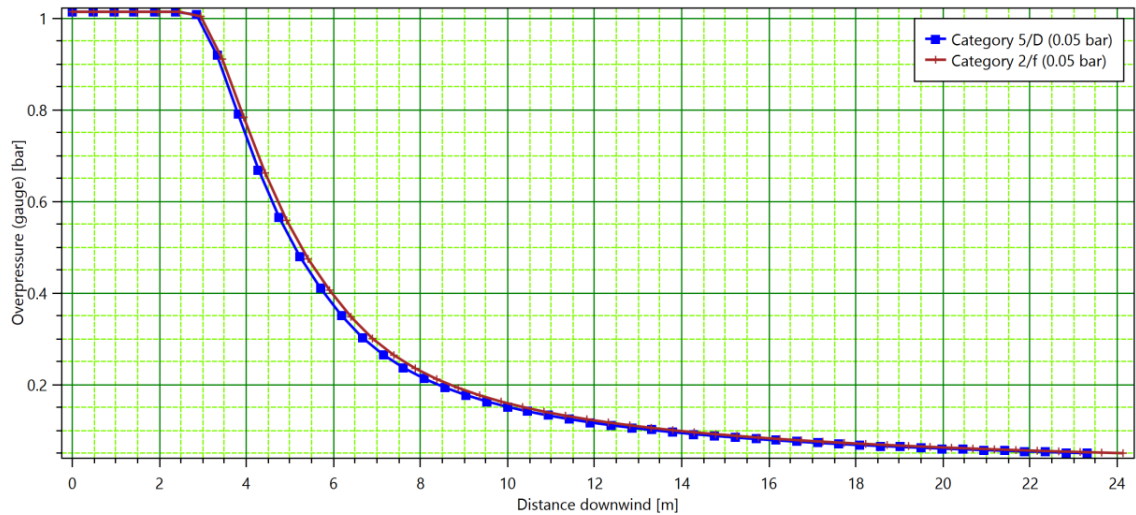


Figure 101 Hydrogen Pipeline Rupture (Horizontal) and VCE: Overpressure vs Distance

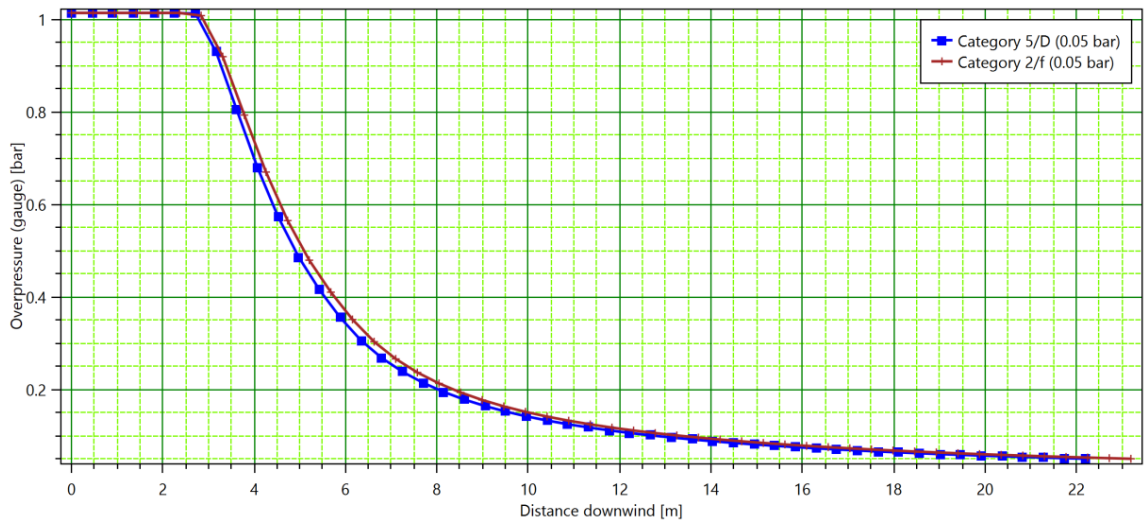


Figure 102 Hydrogen Pipeline Rupture (Vertical) and VCE: Overpressure vs Distance

Table 61 details the distances to specified overpressure endpoints.

Peak overpressure (mbar)	Consequences	Vertical Release Distance (m)		Horizontal Release Distance (m)	
		F2	D5	F2	D5
35	Light damage	33	31	33	32
170	Moderate damage	10	9	10	9
350	Severe damage	6	6	6	6
830	Total destruction	4	4	4	4
168	1% mortality outdoors	10	9	10	9
50	1% mortality indoors CIA Category 3	24	23	24	23

Table 61 Hydrogen Pipeline and VCE: Distances to Specified Overpressure Endpoints

The closest section of the hydrogen storage pipeline is located ca. 150m from the power plant area boundary. The overpressure corresponding to 1% fatality outdoors and 1% fatality indoors CIA Cat. 3, will not extend over the boundary; therefore, it is

concluded that no off-site fatalities are predicted for a hydrogen pipeline rupture and VCE.

6.7.5 Hydrogen Pipeline Release: Flash Fire Model Outputs

The DNV PHAST Version 9.0 unified dispersion model predicts the flash fire footprint for a horizontal release only. Figure 103 illustrates the flash fire envelope for a horizontal release from the Hydrogen pipeline.

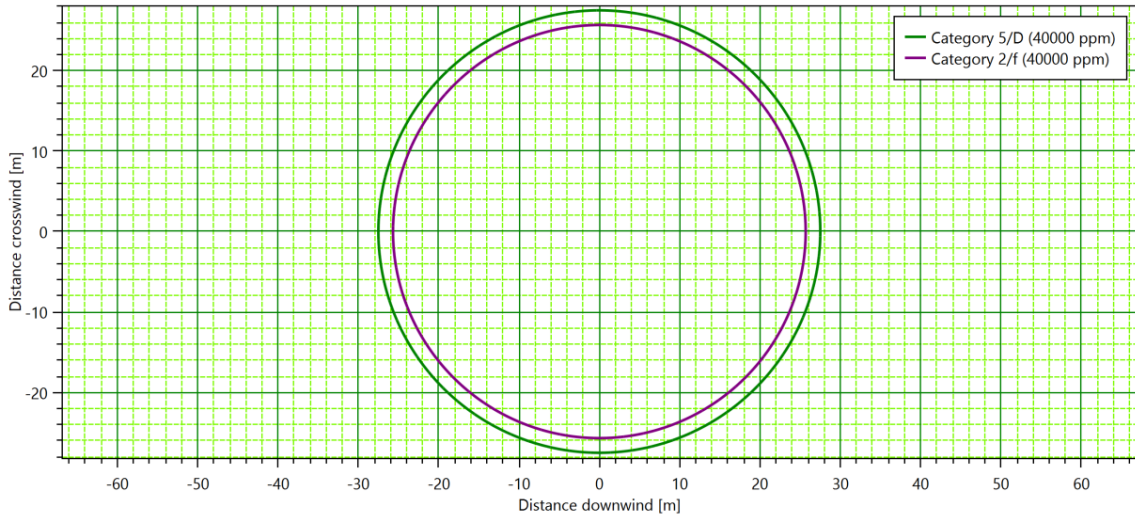


Figure 103 Hydrogen Pipeline Rupture (Horizontal) and Flash Fire: Flash Fire Envelope

The flash fire envelope could extend up to 28m from the hydrogen pipeline. The closest section of the hydrogen storage pipeline is located ca. 150m from the power plant area boundary. Therefore, it is concluded that no off-site fatalities are predicted for a hydrogen pipeline rupture and flash fire.

6.7.6 Hydrogen Pipeline Release Event Frequencies

Table 40 of the HSA’s TLUP guidelines (HSA, 2023) gives the following pipeline loss of containment frequencies for overground pipelines within an establishment of diameter <75 mm:

- Pipeline rupture frequency: 1E-06 per m per year

Table 62 details the event frequencies for the hydrogen pipeline at the proposed development.

Installation	LOC scenario	LOC frequency		Modifier	LOC frequency /year	Consequence	Conditional probability	Event frequency (per year)
Hydrogen Pipeline	Pipeline rupture	1.00E-06	/m/yr	100	1.00E-04	Jet fire	0.7	7.00E-05
						VCE	0.12	1.20E-05
						Flash fire	0.18	1.80E-05

Table 62 Event Frequencies for Hydrogen Pipeline Rupture

7.0 ENVIRONMENTAL RISK ASSESSMENT (MATTE)

7.1 Description of Environmental Receptors

The following sections give a description of the environmental receptors surrounding the site.

7.1.1 Geology

According to the GSI's online map viewer, the entire Site is underlain by Carboniferous limestone and shale of the Lucan Formation (commonly known as 'Calp'). This stratum comprises dark grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. There are rare dark coarser grained calcarenitic limestones, sometimes graded, and interbedded dark-grey calcareous mudstone. There are no GSI-mapped karst bedrock features recorded within 2km of the power plant area; however, previous site investigations interpreted the Limestone gravel with clay bands as deeply weathered karst limestone.

7.1.2 Soils

According to the Teagasc soils map (available on the GSI map viewer), the power plant area is largely underlain by Made Ground (i.e. the existing Derrygreenagh Works site which comprises a workshop, stores and office complex that supports Bord na Móna's peat harvesting activities, including workshops for mobile plant overhaul and for wagon and locomotive maintenance), with adjoining areas underlain by blanket peat (largely cutaway), made ground and deep well drained mineral (mainly basic) soils (to the south and west).

The GSI/Teagasc mapping database of the subsoils in the area of the subject site indicates the power plant area is underlain by Made Ground (Fill) underlain by till derived from limestone and sand and gravels.

7.1.3 Regional Hydrogeology

The GSI has devised a system for classifying the bedrock aquifers in Ireland. The aquifer classification for bedrock depends on a number of parameters including, the area extent of the aquifer (km²), well yield (m³/d), specific capacity (m³/d/m) and groundwater transmissivity (mm³/d). There are three main classifications: regionally important, locally important and poor aquifers. Where an aquifer has been classified as regionally important, it is further subdivided according to the main groundwater flow regime within it. This sub-division includes regionally important fissured aquifers (Rf) and regionally important karstified aquifers (Rk). Locally important aquifers are subdivided into those that are generally moderately productive (Lm) and those that are generally moderately productive only in local zones (LI). Similarly, poor aquifers are classed as either generally unproductive except for local zones (PI) or generally unproductive (Pu).

The bedrock aquifers underlying the power plant area according to the GSI National Draft Bedrock Aquifer Map are classified as "Locally Important Aquifer - Bedrock which is moderately productive only in local zones" and "Locally Important Aquifer - Bedrock which is generally moderately productive".

Based on the most recent data (www.epa.ie) the Athboy GWB (IE_EA_G_001) for which the site is located entirely within, has a WFD status of "Good" (2016-2021) and is "Not at Risk".

In addition, no groundwater source protection zones, which are zones defined by the GSI within which development is limited in order to protect groundwater from potential pollution, are identified beneath the site or in the immediate vicinity. There are no karst features in the area.

7.1.4 Aquifer Vulnerability

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. Due to the nature of the flow of groundwater through bedrock in Ireland, which is almost completely through fissures, the main feature that protects groundwater from contamination, and therefore the most important feature in protection of groundwater, is the subsoil (which can consist solely or of mixtures of peat, sand, gravel, glacial till, clays or silts).

Soil geology and groundwater conditions have been identified using Geological Survey Ireland (GSI) datasets. The soil geology beneath the power plant area is mainly Made Ground and surrounded by cut peat, with some areas of till chiefly derived from limestone also within the Study Area. The power plant area is not located in a groundwater source protection area and the groundwater vulnerability around the power plant area is classified as Low.

7.1.5 Groundwater Wells and Flow Direction

There is no licensing system for wells in Ireland at present and as such no complete data set. The GSI Well Card Index is a record of wells drilled in Ireland, kept by the Geological Survey of Ireland. It is noted that this record is not comprehensive as licensing of wells is not currently a requirement in Ireland and therefore it requires individual drillers to submit details of wells in each area.

There is one well located in the power plant area - 'PW1' – and one well located 80m outside of the Proposed Development - the 'Hostel Well'. These wells are not recorded in the GSI's National Well Database (GSI, 2023). The PW1 well was drilled to 65mbGL into and screened opposite the Lucan Formation. This well was pump tested and was considered capable of supplying 1008 m³/ day on an ongoing basis. It is understood that this well is not currently in use.

7.1.6 Groundwater Quality

The Water Framework Directive (WFD) Directive 2000/60/EC was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters. In addition to protecting said waters, its objectives include the attainment of 'Good Status' in water bodies that are of lesser status at present and retaining 'Good Status' or better where such status exists at present.

The WFD requires 'Good Water Status' for all European waters to be achieved through a system of river basin management planning and extensive monitoring. 'Good status' means both 'good ecological status' and 'good chemical status'.

Based on the most recent data (www.epa.ie) the Athboy GWB (IE_EA_G_001) for which the site is located entirely within, has a WFD status of "Good" (2016-2021) and is "Not at Risk" meaning the GWB has achieved its objectives and has either no significant trends or improving trends.

7.1.7 Surface Water Environment

The power plant area site lies within the Boyne Catchment.

The nearest river to the power plant area is the Castlejordan_020 (EPA Code 07C04) river waterbody (also referred to as the Mongagh River), located immediately adjacent to the northernmost boundary of the power plant area. The Castlejordan_020 is a WFD designated river waterbody (IE_EA_07C040100).

The Yellow River flows into the Boyne_030 (EPA Code 07B04) (also referred to as the River Boyne) a further 2 km downstream. Both the Mongagh and Yellow Rivers are tributaries of the River Boyne WFD river body (IE_EA_07B040400).

The Mongagh River is a tributary of the Yellow [Castlejordan] (EPA Code 07Y02) river waterbody (also referred to as the Yellow River) and flows into this waterbody approximately 15 km downstream of the power plant area. The Yellow [Castlejordan] is a WFD designated river waterbody (IE_EA_07Y020300).

Table 63 details the WFD status of the water surface waterbodies in the vicinity of the power plant.

WATERCOURSE NAME	WFD WATERBODY NAME	WFD ID	WFD STATUS (2016-2021)	WFD AT RISK STATUS (3 RD CYCLE)
Mongagh River	Castlejordan_020	IE_EA_07C040100	Good	Review
Yellow River	Yellow (Castlejordan)_010	IE_EA_07Y020070	Poor	At Risk (Extractive industry significant pressures)
	Yellow (Castlejordan)_020	IE_EA_07Y020100	Good	Not At Risk
	Yellow (Castlejordan)_030	IE_EA_07Y020300	Good	Not At Risk

Table 63 WFD Surface Water Bodies in the Vicinity of the power plant

Surface water quality is monitored periodically by the EPA at various regional locations along with principal and other smaller watercourses. The EPA assess the water quality of rivers and streams across Ireland using a biological assessment method, which is regarded as a representative indicator of the status of such waters and reflects the overall trend in conditions of the watercourse. The biological indicators range from Q5 - Q1. Level Q5 denotes a watercourse with good water quality and high community diversity, whereas Level Q1 denotes very low community diversity and bad water quality.

Table 64 details the latest Q values for rivers in the vicinity of the power plant.

WATERCOURSE NAME	WFD WATERBODY NAME	RIVER STATION NAME	LATEST RIVER Q VALUE (STATUS)	YEAR	DISTANCE FROM SITE (KM)
Mongagh River	Yellow (Castlejordan)_020	Baltinoran Bridge	4 (Good)	2020	6.0
Yellow River	Yellow (Castlejordan)_010	Nr Derryarkin	3 (Poor)	2003	2.0
		Bridge downstream of Big River confluence	3 (Poor)	2020	1.5
	Yellow (Castlejordan)_020	Garr Bridge	4 (Good)	2020	3.5

Table 64 EPA Q Values for Rivers in the Vicinity of the power plant

7.1.8 Flooding

The EU Floods Directive (2007/60/EC) required Member States to undertake a national preliminary flood risk assessment by 2011 to identify areas where significant flood risk exists or might be considered likely to occur. Member States were also required to prepare catchment-based Flood Risk Management Plans by 2018 that will set out flood risk management objectives, actions and measures. The OPW in co-operation with various Local Authorities produced a number of PFRAs which aimed to map out current and possible future flood risk areas and develop risk assessment plans. These have been used to form the Draft Flood Risk Management Plans aimed at identifying possible structural and non-structural measures to improve the flood risk. As part of the CFRAM programme provisional flood maps had been produced by the OPW which have been used in this assessment.

In the FRM Guidelines, the likelihood of a flood occurring is established through the identification of Flood Zones which indicate a high, moderate, or low risk of flooding from fluvial or tidal sources, as defined as follows:

- *Flood Zone A* - Where the probability of flooding is highest (greater than 1% AEP or 1 in 100 for river flooding and 0.5% AEP or 1 in 200 for coastal flooding) and where a wide range of receptors would be vulnerable.
- *Flood Zone B* - Where the probability of flooding is moderate (between 0.1% AEP or 1 in 1000 and 1% AEP or 1 in 100 for river flooding and between 0.1% AEP or 1 in 1000 year and 0.5% AEP or 1 in 200 for coastal flooding); and
- *Flood Zone C* - Where the probability of flooding is low (less than 0.1% AEP or 1 in 1000 for both river and coastal flooding).

According to the OPW flooding maps (available on site www.floodinfo.ie) the power plant area is located within Flood Zone C (i.e., where the probability of flooding from rivers or rainfall is less than 0.1% or 1 in 1000 years – i.e. probability of fluvial flooding is low risk). No historic flooding was identified at the site or surrounding area. No residual risk is foreseen as the development is located outside any flooding zones associated with future scenarios (MRFS and HEFS).

7.1.9 Conservation Areas

The nearest designated land to the power plant area is the Grand Canal pNHA (Site Code: 002104) located c. 7km to the south of the site. The Raheenmore Bog SAC and Raheenmore Bog Proposed Natural Heritage Area are located c. 7.1 km to the West

of the site. The site does not share a hydrological connection with any of the protected sites mentioned above, nor is there any protected site located downstream of site <50km downstream. Furthermore, the canal is a contained feature (fully lined) and there is no potential for a source pathway linkage.

7.2 MATTE Assessment Methodology

The HSA Safety Report Guidelines (HSA, 2017) recommend that the Chemical and Downstream Oil Industries Forum (CDOIF) Guideline on Environmental Risk Tolerability for COMAH Establishments (CDOIF, 2017) should be followed for completing environmental risk assessments of major accidents to the environment.

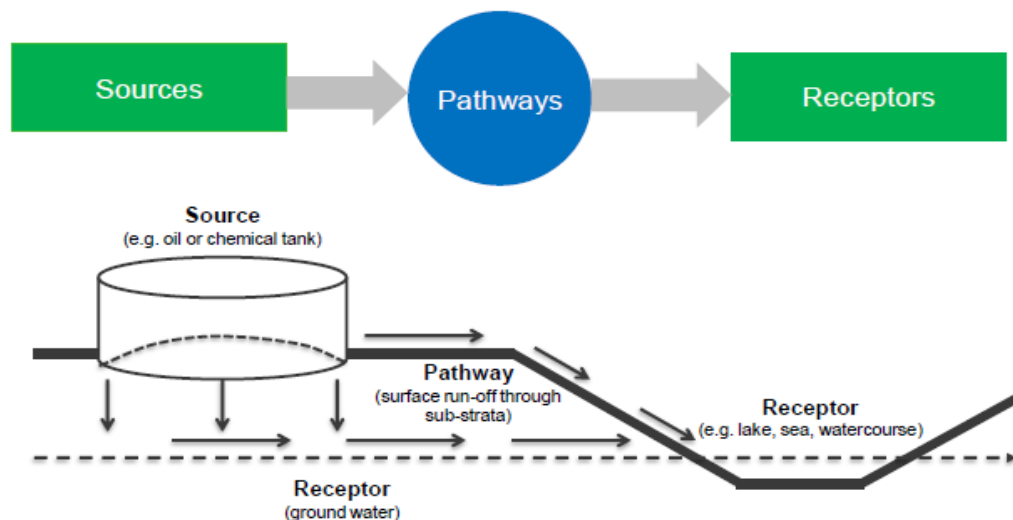
The CDOIF guidance describes a methodology by which environmental risk assessments can be carried out and addresses the following:

Major accidents to the environments (MATTEs) are those that cause:

- Permanent or long-term damage to terrestrial habitats
- Significant or long-term damage to freshwater and marine habitats
- Significant damage to an aquifer or underground water

Harm to species (fauna and flora) and the ecosystem is also a factor.

A source-pathway-receptor approach is taken which is illustrated as follows:



The following steps are involved in the CDOIF methodology:

- Phase 1a: MATTE screening to identify if the hazardous scenario meets the threshold for a MATTE, as set out in the CDOIF guidance document which defines criteria for the extent of harm (the area/distance), the severity of harm (the degree of harm within the impact area), and the duration (the recovery period) that define a MATTE.
- Phase 1b: High level risk screening to identify the (unmitigated) consequence, frequency and risk of credible MATTEs and comparison with target tolerable frequencies.

-
- If a hazard/scenario is screened out due to no MATTE potential (Phase 1a) or the risks are demonstrated to be broadly acceptable through a conservative, high-level assessment (Phase 1b), then Phase 2 detailed assessment is not required
 - Phase 2 detailed risk assessment is completed where there is the potential for a MATTE as follows:
 - Determine unmitigated consequences from credible accident scenarios and use this to establish the tolerability thresholds per receptor per establishment per year (this is from the Appendix 4 risk matrix).
 - Determine the unmitigated aggregated risk to the receptor from all credible scenarios (i.e. risk with no mitigation measures in place).
 - Determine the mitigated risk (with existing measures in place) from all credible scenarios; and
 - Determine if further measures are required to reduce the risk to Broadly Acceptable or Tolerable if As Low As Reasonably Practicable (TifALARP) and ALARP justification where risks are in this region.

7.3 Dangerous Substances

The site layout is illustrated in Figure 2 including bund and tank locations.

Table 65 outlines the hazardous classification of the hazardous materials on site and Table 66 outlines the environmental properties.

Table 65 Dangerous Substances at Derrygreenagh						
Substance	CAS #	Hazard Statement	Classification	COMAH Category/Named Substance	Total volume (m³)	Specific Gravity
Distillate (diesel)	68476-33-5	H226 H411	Flammable Liquid Cat. 3 Aquatic Chronic Cat. 2	Petroleum products	15,000 (2 no. tanks 7,500 m ³ each)	0.8-0.91 @ 15 °C
Ammonia (35%)	1336-21-6	H400 H411	Aquatic Acute Cat. 1 Aquatic Chronic Cat. 2	N/a	88.6 m ³ (2 No. tanks, 44.3m ³ each)	0.88 – 0.91 @ 20 °C
Sodium Hypochlorite (15%)	7681-52-9	H400 H411	Aquatic Acute Cat. 1 Aquatic Chronic Cat. 2	N/a	12.4 m ³	1.2 – 1.3 @ 20°C

Table 66 Environmental Properties Dangerous Substances at Derrygreenagh			
Substance	Persistence and Degradability	Eco toxicity	Mobility in Soil
Distillate (diesel)	Using a mixed culture of estuarine bacteria, Fuel Oil No. 2 was found to be biodegradable (55% in 28 days) with the aromatic components more degraded than the saturated hydrocarbons (5) (TOXNET Website accessed April 2018).	LL50 (4 days) 1.13 - 65 mg/L rainbow trout LL50 (72 h) 21 - 150 mg/L rainbow trout LL50 (48 h) 28 - 180 mg/L rainbow trout LL50 (24 h) 100 - 1 000 mg/L rainbow trout	The log Koc of Fuel Oil No. 2 is reported to range from 3.0 to 5.7 (Koc range of 1,000 to 501,000) (1,2). According to a suggested classification scheme (3), this Koc range suggests that Fuel Oil No. 2 is expected to have low to no mobility in soil (SRC). Addition of Fuel Oil No. 2 to a laboratory marine ecosystem showed that the insoluble, saturated hydrocarbons in the oil were slowly transported to the sediment on suspended particulate (TOXNET Website accessed April 2018).
Ammonia	This substance/mixture contains no components considered to be either persistent, bio accumulative and toxic (PBT), or very persistent and very bio accumulative (vPvB) at levels of 0.1% or higher	LC50 (96 h) 11 mg/l fathead minnow (EPA, 2004) LC50 (48 h) 101 mg/l water flea	Ammonia is strongly adsorbed on soil, and on sediment particles and colloids in water. Ammonia rarely accumulates in soil because bacteria will rapidly convert the ammonium that is not taken up by plant roots into nitrates (nitrification)
Sodium Hypochlorite	This product contains inorganic compounds which are not biodegradable. Reacts with organic substances in soil and sediments and degrades rapidly to chloride salts. Substantially removed in biological treatment processes.	LC50 (96 h) 0.008 mg/l fathead minnow LC50 (48 h) 0.04 mg/l water flea	The volatilisation from water into air and the adsorption of hypochlorite onto soil are very low. Hypochlorite remains in the aqueous phase where it degrades very rapidly to chloride. Therefore, there is low mobility in soil.

7.4 Environmental Receptors

The CDOIF Environmental Risk Assessment Guidelines identify potential environmental receptors including terrestrial habitats, freshwater habitats, marine habitats and groundwater bodies. These guidelines have defined MATTE thresholds based on the extent and severity and duration of harm to different types of receptors. Thresholds have been set for:

1. Designated areas – land/water receptors including National Nature Reserves, Sites of Special Scientific Interest, Marine Nature Reserves (as defined in UK legislation)
2. Designated areas – land/water receptors including Natura 2000 sites (SPAs, SACs) and Ramsar sites
3. Other designated land (as defined in UK legislation) including Environmentally Sensitive Areas, Areas of Outstanding Natural Beauty, Greenbelt land, national Parks, Local Nature Reserves, Wildlife Trust Sites, National Trust land, Common land/country parks
4. Scarce habitats (land/water) including Biodiversity Action Plan habitats and geological features
5. Widespread habitat (land/water) including agricultural land and forestry
6. Aquifers or groundwater
7. Soil or sediment
8. Built heritage
9. Various water receptors including groundwater, drinking water, fish and shellfish water and bathing waters – Appendix 2 of the CDOIF ERA Guidelines state that standards relating to continuous emissions and contained within the relevant European legislation should not be adopted to define a major accident. However, the specific level of exceedance of these standards should be considered in the post-accident remediation and restoration works.
10. Particular species in land/water/air habitats
11. Marine including non-estuarine marine waters, littoral, sub-littoral zone, benthic community adjacent to coast, fish spawning grounds
12. Freshwater and estuarine habitats

Table 67 summarises the environmental receptors in the vicinity of the proposed development and the level of harm corresponding to a MATTE for each.

Table 67 Summary of Environmental Receptors, Potential Impact Pathway and MATTE Thresholds						
ID	MATTE description	Medium	Site receptor description	Distance from Source (km)	Potential Impact Pathway	MATTE Threshold
6	Aquifers or groundwater	Water	Poor aquifer	Under site With varying overburden thickness	Distillate / Ammonia / Sodium Hypochlorite overtopping bund and release of fuel oil to low permeability subsoil. Aquifer beneath the area according to GSI aquifer map. Site is protected by hardstanding areas.	<ul style="list-style-type: none"> Any incident likely to require large-scale and long-term remedial measures or Any incident of contamination/pollution (by persistent compounds) occurring within groundwater protection zone 1
7	Soil or sediment	Land/water	Onsite poor drained mineral soul	On-site	Distillate / Ammonia / Sodium Hypochlorite overtopping bund and release to local ground.	<p>Contamination or pollution of the receptor such that:</p> <ul style="list-style-type: none"> Soil would be regarded as contaminated land by relevant authorities (i.e. contamination such that planned present or future uses could be compromised) or Sediment would become loaded with sufficient material to compromise the chemical or biological quality of underlying waters for any period in excess of a few days
12	Freshwater & estuarine habitats	Water	<p>Mongagh River (19 km length with basin size of 40 km²)</p> <p>Yellow River (21 km length with basin size of 44.5 km²)</p>	<p>Adjacent to site</p> <p>0.2</p>	On-site drainage system, firewater run-off, tank rupture and spill of overtopped fraction to Mongagh River and Yellow River	Effects on a significant part (10 km stretch of a river or 10% of length of watercourse, 2 ha or 10% of area of an estuary) of any estuary receptor.

7.5 Phase 1a MATTE Screen

The following scenarios involve the potential for fuel to be released to off-site environmental receptors:

- A major accident scenario involving catastrophic rupture of a bulk distillate storage tanks (2 No. tanks in bund) with bund overtopping and migration of the overtopped fraction to the ground or surface water environment surrounding the site has the potential to damage groundwater and surface water receptors in the vicinity of the site.
- A major accident scenario involving catastrophic rupture of an ammonia storage tanks (2 No. tanks in bund) with bund overtopping and migration of the overtopped fraction to the ground or surface water environment surrounding the site has the potential to damage groundwater and surface water receptors in the vicinity of the site.
- A major accident scenario involving catastrophic rupture of a sodium hypochlorite storage tanks (1 No. tank in bund) with bund overtopping and migration of the overtopped fraction to the ground or surface water environment surrounding the site has the potential to damage groundwater and surface water receptors in the vicinity of the site.
- A spill in an uncontained area on unmade ground may also drain to the surface water drainage system or to the groundwater resource underlying the site, and eventually to the surface water environment.

Table 68 details the Phase 1a MATTE Screen and identifies the worst-case environmental release scenarios and those that exceed the MATTE Threshold.

Bund overtopping was assumed (by default) to be 50% of the tank volume (HSA, 2023).

An LC50 approach can be used to determine the severity of harm caused by water soluble substances which can exert toxic effects on aquatic life. The median lethal concentration, LC50 (lethal concentration, 50%) is the concentration of a substance required to kill half of the members of a tested population after a specified test duration. The value may be obtained by direct observation or from interpolation. The following simple equation is then used to determine the minimum amount of material which could credibly cause a MATTE scenario:

$$\text{Mass of Material for MATTE potential} = \text{Area of receptor (m}^2\text{)} \times \text{Water depth (m)} \times \text{LC}_{50} \text{ (mg/l)}$$

Table 68 Phase 1a MATTE Screen				
Scenario	Substance	Quantity	Comments/MATTE Screening	MATTE Potential
Catastrophic rupture of bulk distillate storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Distillate (2 No. tanks 7,500 m ³ each).	Overtop volume for one tank: 3,750 m ³	Assuming a minimum slick thickness of 0.0002 m on the surface of the Yellow River (based on the Bonn Agreement Oil Appearance Code BAOAC value for > 200 m ³ spills) and an average river width of 2 m, the worst-case spill would cover 9.4 km of the Mongagh and/or Yellow River. This scenario has the potential to result in a MATTE as >2 km.	Y-MATTE 1
Catastrophic rupture of ammonia storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Ammonia (35%) (2 No. Tanks, 44 m ³ each)	Overtop volume for one tank: 22 m ³	The Mongagh River is 19km long. Assuming an average depth of 0.5m and an average width of 2m. Mass required for potential MATTE is 209 kg. A 22 m ³ release of 35% ammonia would result in a ca. 6300 kg release of ammonia. Therefore, this scenario has the potential to cause a MATTE.	Y-MATTE 2
Catastrophic rupture of sodium hypochlorite storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Sodium Hypochlorite (15%) (1 No. Tank – 12.4 m ³)	Overtop volume for one tank: 6.2 m ³	The Mongagh River is 19km long. Assuming an average depth of 0.5m and an average width of 2m. Mass required for potential MATTE is 0.152 kg. A 6.2 m ³ release of 15% sodium hypochlorite would result in a release of 775 kg of sodium hypochlorite. Therefore, this scenario has the potential to cause a MATTE.	Y-MATTE 3

Table 68 Phase 1a MATTE Screen				
Scenario	Substance	Quantity	Comments/MATTE Screening	MATTE Potential
Catastrophic rupture of bulk distillate storage tank and overtop to uncontained area on hardstanding may drain to the surface water drainage system and eventually to the groundwater resource underlying the site.	Distillate (2 No. tanks 7,500 m ³ each).	Overtop volume for one tank: 3,750 m ³	<p>Assuming a minimum thickness of 0.02 m, (Yellow book Table 3.1 average roughness for rough sandy soils / farmland / grassland), the worst-case spill would cover 18.8 ha of area surrounding site.</p> <p>There are no groundwater protection zones beneath the power plant area. The site is protected by hardstanding areas.</p> <p>Due to large quantity of distillate released, this scenario has the potential to cause a MATTE.</p>	Y – MATTE 4
Catastrophic rupture of ammonia storage tank and overtop to uncontained area on hardstanding may drain to the surface water drainage system and eventually to the groundwater resource underlying the site.	Ammonia (35%) (2 No. Tanks, 44 m ³ each)	Overtop volume for one tank: 22 m ³	<p>There are no groundwater protection zones beneath the power plant area. The site is protected by hardstanding areas.</p> <p>Ammonia released will rapidly convert into nitrates (nitrification). This scenario is unlikely to constitute a MATTE.</p>	N
Catastrophic rupture of sodium hypochlorite storage tank and overtop to uncontained area on hardstanding may drain to the surface water drainage system and eventually to the groundwater resource underlying the site.	Sodium Hypochlorite (15%) (1 No. Tank – 12.4 m ³)	Overtop volume for one tank: 6.2 m ³	<p>There are no groundwater protection zones beneath the power plant area. The site is protected by hardstanding areas.</p> <p>Hypochlorite has low mobility in soil; therefore, this scenario is unlikely to constitute a MATTE.</p>	N

7.6 Phase 1b Risk Screen

The Phase 1b, high level risk screening step identifies the (unmitigated) consequence, frequency and risk of credible MATTEs and compares the frequency and risk with target tolerable frequencies.

Table 69 outlines the Phase 1a MATTE Screening assessment. The severity and duration/recovery period are identified with reference to Table 4.1 and Table 4.2 of Appendix 4 of the CDOIF ERA Guidelines.

The MATTE category and tolerability boundaries are identified with reference to Table 4.3 of Appendix 4 of the CDOIF ERA Guidelines.

Table 69 Phase 1b Risk Screen						
Scenario ID	Scenario Description	Receptor	Severity	Duration/Recovery Category	MATTE Category	Tolerability Boundary
MATTE 1	Catastrophic rupture of bulk distillate storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	Severe (2) WFD Chemical or ecological status lowered by 1 class for 2-10 km of watercourse	Estimated as Long Term (3) WFD hazardous subs > 10 years (unmitigated)	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year
MATTE 2	Catastrophic rupture of ammonia storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	Major (3) Chemical or ecological status lowered by one class for 10-200km of watercourse or 20- 200ha or 50- 90% area of estuaries and ponds	Estimated as Medium Term (2) >1 year (unmitigated)	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year
MATTE 3	Catastrophic rupture of sodium hypochlorite storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	Major (3) Chemical or ecological status lowered by one class for 10-200km of watercourse or 20- 200ha or 50- 90% area of estuaries and ponds	Estimated as Medium Term (2) >1 year (unmitigated)	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year

Table 69 Phase 1b Risk Screen						
Scenario ID	Scenario Description	Receptor	Severity	Duration/Recovery Category	MATTE Category	Tolerability Boundary
MATTE 4	Catastrophic rupture of bulk distillate storage tank and overflow to uncontained area on hardstanding may drain to the surface water drainage system and eventually to the groundwater resource underlying the site.	Groundwater – non-drinking source	Severe (2) 1-100ha of aquifer were water quality standards are breached	Estimated as Long Term (3) WFD hazardous subs > 6yrs (unmitigated)	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year

7.7 Phase 2 Detailed Risk Assessment

The Phase 1a and Phase 1b risk screen detailed in Sections 7.5 and 7.6 identify four potential MATTE scenarios:

- MATTE 1 - Catastrophic rupture of oil tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River or Yellow River.
- MATTE 2 – Catastrophic rupture of ammonia storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River
- MATTE 3 - Catastrophic rupture of sodium hypochlorite storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River
- MATTE 4 - Catastrophic rupture of bulk distillate storage tank and overtop to uncontained area on hardstanding may drain to the surface water drainage system and eventually to the groundwater resource underlying the site.

7.7.1 Frequency of MATTE Scenarios

7.7.1.1 *Unmitigated Frequency*

There are 2 No. bulk storage tanks on site that contain distillate that is classified as hazardous to the aquatic environment and that could cause a MATTE if a significant release occurred.

The design includes for 2 No. bulk storage tanks that contain fuel oil that is classified as hazardous to the aquatic environment and that could cause a MATTE if a significant release occurred. The tanks will comply with EN14015 and the pipework to EN13480 (or equivalent). Fuel storage conditions are at atmospheric temperature and pressure.

There are 2 No. storage tanks containing ammonia and 1 No. storage tank containing sodium hypochlorite.

The HSA's Guidance on Technical Land Use Planning Advice (HSA, 2023) states a frequency of 5E-06 per year for instantaneous failure of a tank (per tank); therefore, 2.5E-05 per year for all of the storage tanks at the proposed development.

The hazardous material storage tanks on-site can also rupture as a result of overpressure effects from an explosion on-site. The overpressure level that could cause tank rupture is 200 mbar (see Table 9). The ammonia and sodium hypochlorite storage tanks are not within the 200mbar contour of any explosion event at the proposed development.

Table 70 details the major accident installations that result in an overpressure of 200 mbar at the proposed storage tanks.

Installation	Frequency
CCGT LPG Tank Instantaneous Failure and VCE	6.00E-08
LPG Tanker (at CCGT) Instantaneous Failure and VCE	2.88E-10
LPG Tanker (at CCGT) Leak over 10 Minutes and VCE	4.32E-10
LPG Tanker (at CCGT) Rupture of Loading Hose and VCE	3.05E-05

Table 70 Domino Effects with Potential to Cause Tank Rupture

Therefore, the total the initiating event frequency for a MATTE scenario is 5.56E-05 per year.

7.7.1.2 Mitigated Frequency

The surface water drainage at the proposed development ensures that any spill of oil or contaminated firewater will be contained on-site by:

- Raising an alarm to the control room in the event oil is detected downstream of the interceptors
- The control room is manned 24/7
- Upon activation of the alarm, the flow out of the attenuation tank will be stopped and the contaminated material will be contained within the tank
- This valve will close automatically in the event the fire alarm is activated
- The valve will close automatically in the event of any signal loss from the water quality monitoring devices
- The contaminated material within the attenuation tank will be disposed of appropriately
- The outlet valve will be configured to close in the event of a power loss or, if an electrical valve, will be on the plant emergency generation system. The valves will be arranged to fail close even if the detail design requires the discharge to be pumped.

The following event tree calculates the frequency of a release of hazardous material from the site that could result in a MATTE.

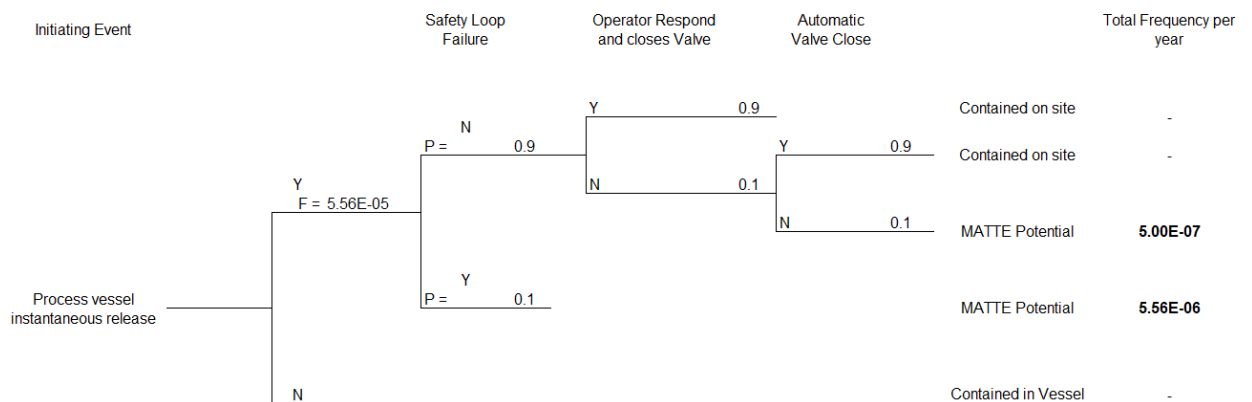


Figure 104 Event Tree for Release of Hazardous Material

The following assumptions and/or probabilities are used in the event tree:

- It is assumed that the bund will overtop and 50% of the tank volume will be released
- Table 5.12 of the Guidelines for Initiating Events and Independent Protection Layers in Layer of Protection Analysis, states the probability of failure on demand of a Safety Control Loop of 0.1 (i.e. failure on demand for alarm to raise in control room) (CCPS, 2015)
- The UK HSE Planning Case Assessment Guide Chapter 6K (Failure Rate and Event Data for Use Within Risk Assessments) (UK HSE, 2017) provides guidance on human factors and states:

'In most cases, a human error potential of 0.1 can be considered a conservative or cautious estimate of the risk of human failure.'

- A conditional conservative probability of failure on demand of automatic valve closure (active safety system) of 0.1 is assumed.

It is noted that the capacity of the attenuation tank is sufficient to contain a 50% bund overtop event from either of the bulk distillate storage tanks. Therefore, the frequency for a release of hazardous material is considered to be conservative.

The event frequency for a release of hazardous material is calculated as **6.06E-06 per year**.

7.7.2 Frequency of Category B MATTE Scenarios

MATTE Scenario 1, 2, 3 and 4 have been identified as a MATTE category B. The tolerability boundaries for Category B MATTE Scenarios are as follows:

- Intolerable > 1E-03 per year
- 1E-05 per year ≤ Tolerable if ALARP ≤ 1E-03 per year
- Broadly Acceptable < 1E-05 per year

The event frequency for MATTE Category B was calculated as 6.06E-06 per year. This is in the **Broadly Acceptable** region for this category. No further risk reduction measures are deemed necessary.

8.0 RISK CONTOURS

Gexcon RiskCurves Version 12.4.0 modelling software was used to model the cumulative risk contours for the establishment.

The HSA specify that D5 conditions are assumed to occur 80% of the time, with F2 occurring for the remaining 20%. The TLUP states that persons are assumed to be indoors 90% of the time and outdoors 10% of the time.

The consequence results, frequencies of major accident hazards and Mullingar wind speed and frequency data (see Figure 6) were input to the software.

Table 71 details the matrix that is used by the HSA to advise on suitable development for technical LUP purposes:

Level of Sensitivity	Inner Zone (Zone 1)	Middle Zone (Zone 2)	Outer Zone (Zone 3)
Level 1	✓	✓	✓
Level 2	✗	✓	✓
Level 3	✗	✗	✓
Level 4	✗	✗	✗

Table 71 LUP Matrix

The HSA has defined the boundaries of the Inner, Middle and Outer Land Use Planning (LUP) zones as:

1E-05/year	Risk of fatality for Inner Zone (Zone 1) boundary
1E-06/year	Risk of fatality for Middle Zone (Zone 2) boundary
1E-07/year	Risk of fatality for Outer Zone (Zone 3) boundary

The TLUP guidelines (HSA, 2023) state the maximum tolerable risk to a member of the public is 1E-06 per year and the maximum tolerable risk to a person at an off-site work location is 5E-06 per year.

The following figures illustrate the cumulative individual risk for major accidents at the proposed development:

- Figure 105 Land Use Planning Risk-based Contours to Persons Outdoors
- Figure 106 Individual Location-Based Risk Contours, to Persons Outdoors, for New Establishments
- Figure 107 Land Use Planning Risk-based Contours to Persons Indoors CIA Cat.
- Figure 108 Individual Location-Based Risk Contours, to Persons Indoors CIA Cat. 3, for New Establishments

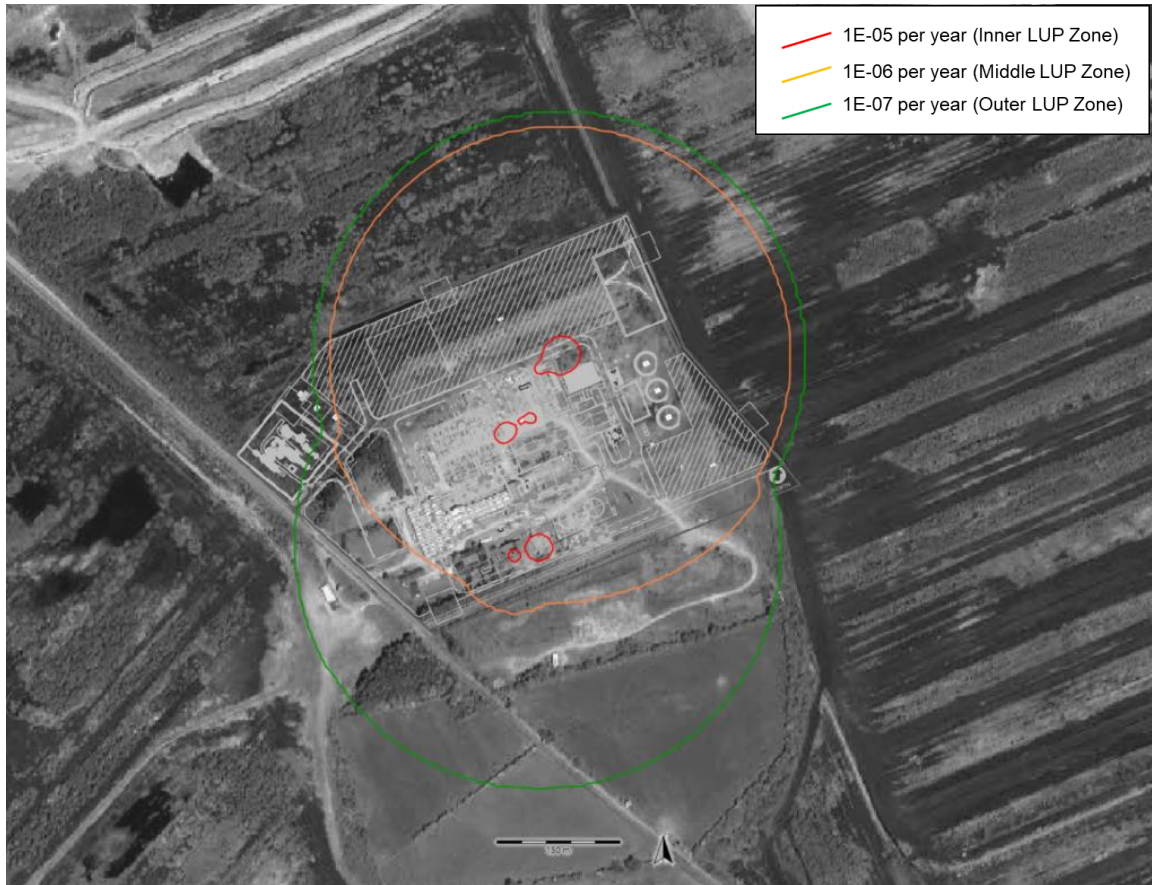


Figure 105 Land Use Planning Risk-based Contours to Persons Outdoors

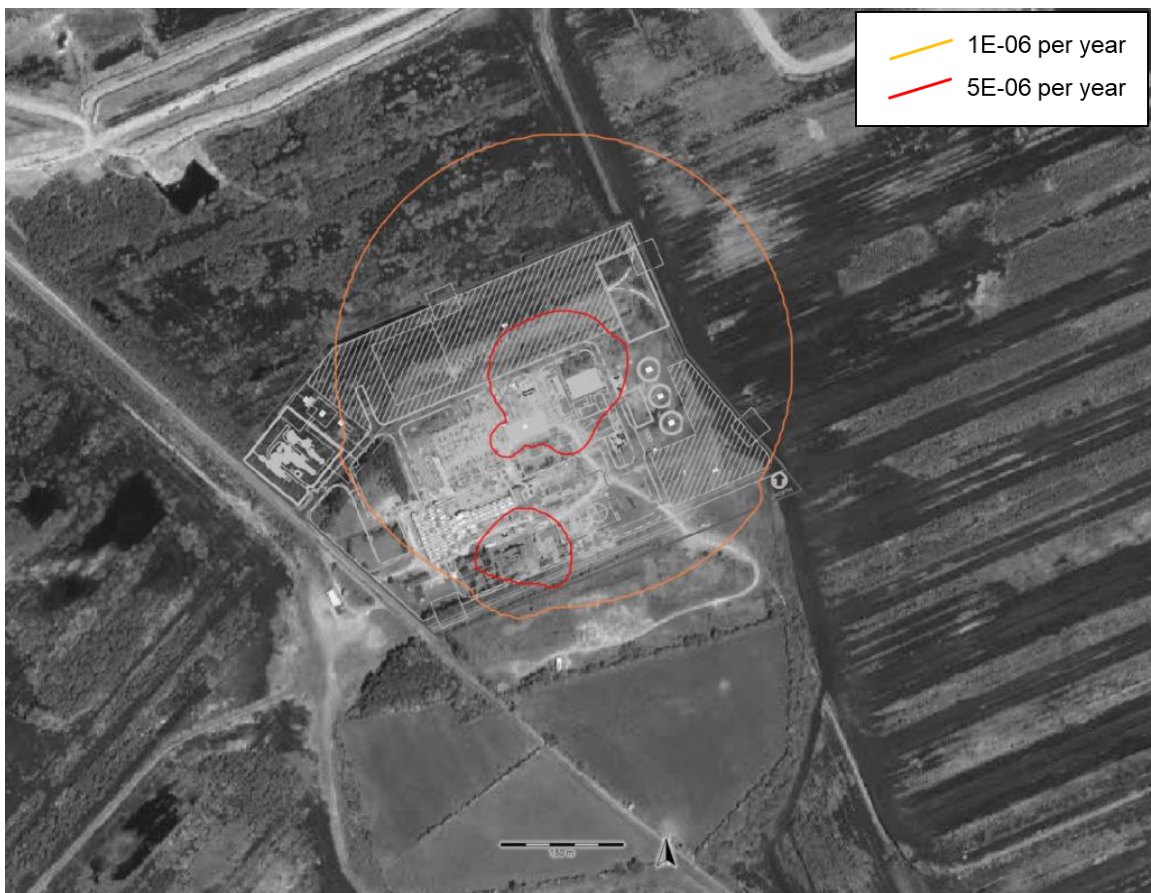


Figure 106 Individual Location-Based Risk Contours, to Persons Outdoors, for New Establishments



Figure 107 Land Use Planning Risk-based Contours to Persons Indoors CIA Cat. 3

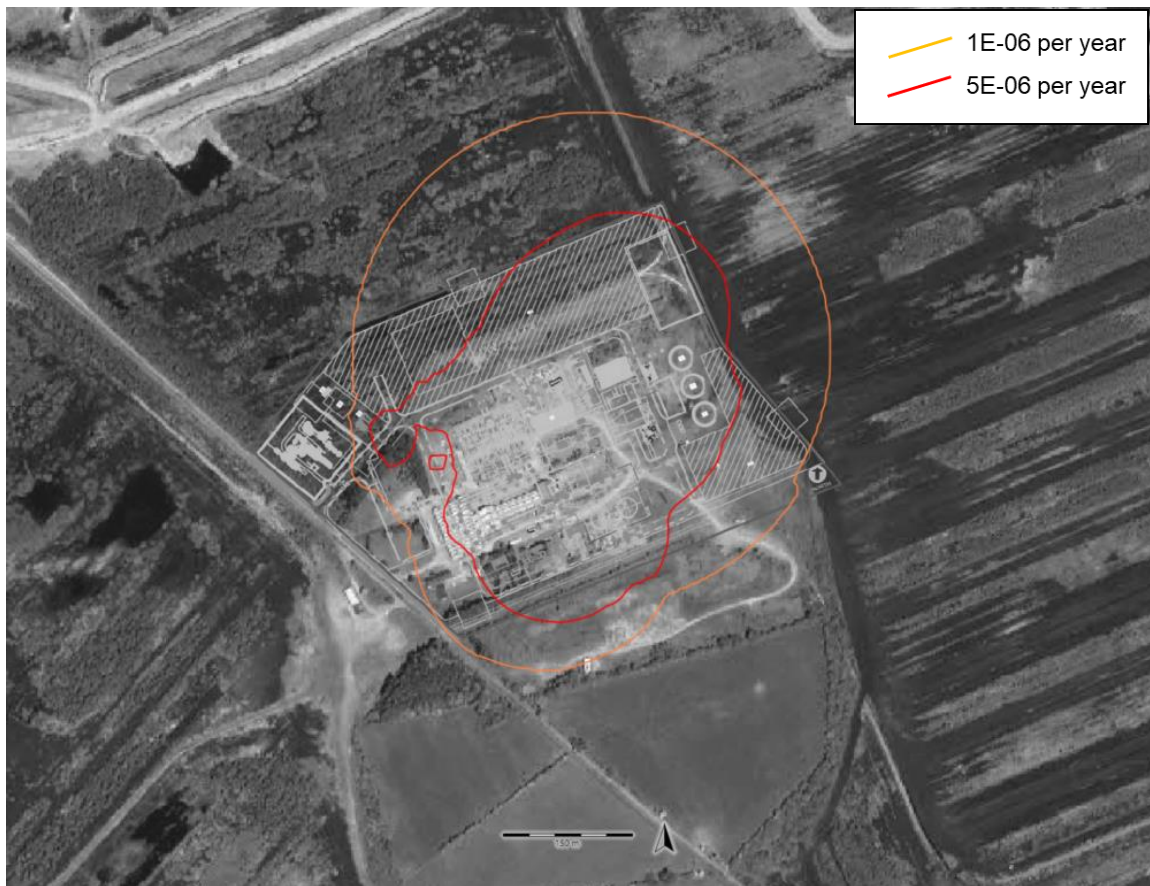


Figure 108 Individual Location-Based Risk Contours, to Persons Indoors CIA Cat. 3, for New Establishments

The following is concluded for the individual risk arising from the power plant area:

- The individual risk contour, to persons outdoors, corresponding to the Middle zone extends over the proposed development boundary to the south, to the west and to the north. These areas are unoccupied land and persons are not typically present.
- The individual risk contour, to persons outdoors, corresponding to the Outer zone extends to the R400 road. This is a Sensitivity Level 2 development; therefore, is permitted within the Outer zone.
- The individual risk contours, to persons indoors CIA Cat. 3, corresponding to the middle and outer zones extend over the proposed development boundary to the south and north. There are no occupied buildings in these areas. The outer zone contour extends to the contour extends to the Communications Mast building and General Stores Buildings; however, these buildings are not occupied.
- The Individual Location-Based Risk Contours, to persons indoors CIA Cat. 3 and to persons outdoors, do not extend to the Communication Mast to the south or to Refuelling Station to the west. These contours do not extend to the R400 road.

It is concluded that the individual location-based risk contours do not extend to an off-site work location or to an area where the public are present. Therefore, it is concluded that the criteria in Table 1 of the *Guidance on Technical Land Use Planning advice (HSA, 2023)* is met and level of off-site risk at the proposed development is acceptable.

9.0 SOCIETAL RISK CONSTRAINTS

The purpose of this societal risk study is to generate advice on the types/nature and scale of development that is likely to be acceptable to the HSA. The R400 road is within the consequence zone of major accidents at the proposed development. Table 72 lists the major accidents at the proposed development with potential for consequence at the R400 road.

Scenarios
Horizontal Pipeline Rupture and Jet fire
Horizontal Pipeline Rupture and Flash Fire
OCGT VCE
LPG Tank Rupture and VCE
LPG Tanker Rupture and Fireball
LPG Tanker Rupture and VCE
LPG Tanker Rupture and Flash Fire
LPG Tanker Release through Largest Connection and Jet Fire
LPG Tanker Release through Largest Connection and Flash Fire
LPG Tanker Hose Rupture and Jet Fire
LPG Tanker Hose Rupture and Flash Fire
LPG Tanker Hot BLEVE and Fireball

Table 72 Major Accident Scenarios with Consequences at R400 Road

A traffic survey, carried out by Innovative Data Solutions in 2023 (see Appendix C), found that there were 2700 passenger car units (PCUs) passing the proposed development on the R400 road in a 12-hour period. This equates to 225 PCUs per hour. The speed limit along the R400 road is 80 km/hr.

The HSA has no guidance on fatality to persons in vehicles from major accidents; therefore, for the purposes of this Societal Risk calculation, a worst-case scenario was used. Consequences, due to thermal radiation, corresponding to fatality outdoors were used and consequences, due to overpressure, corresponding to fatality indoors CIA Cat. 3 were used.

The occupancy of the road is based on the length of the road within the consequence zone and uses the 80 km/hr speed limit to calculate time spent, per PCU, in the zone. The number of vehicles in hazard range value, in Table 74, is the average number of PCUs, at any given moment, in the consequence zone corresponding to the major accident hazard. It is assumed that there are 2 persons per PCU.

Table 73 details the base frequency per year and chances per million (CPM), which incorporate the adjustments for weather conditions, for scenarios with potential fatalities at the R400 road.

Scenario	Base Freq	Modifier (directional)	Modifier (weather)	Total Freq.	CPM
OCGT LPG Tanker Hose Rupture and Flash Fire	6.48E-06			6.48E-06	6.48E+00
OCGT LPG Tanker Hose Rupture and Jet Fire	1.20E-06			1.20E-06	1.20E+00
Horizontal Pipeline Rupture and Flash Fire	5.40E-07	0.5	0.8	2.16E-07	2.16E-01
OCGT VCE	2.00E-05			2.00E-05	2.00E+01
Horizontal Pipeline Rupture and Jet fire	1.50E-07	0.25	1	3.75E-08	3.75E-02
OCGT LPG Tank Rupture and VCE	6.00E-08			6.00E-08	6.00E-02
LPG Tanker Rupture and Fireball	6.85E-11			6.85E-11	6.85E-05
LPG Tanker Rupture and VCE	4.11E-11			4.11E-11	4.11E-05
LPG Tanker Rupture and Flash Fire	6.16E-11			6.16E-11	6.16E-05
LPG Tanker Release through Largest Connection and Jet Fire	1.71E-11			1.71E-11	1.71E-05
LPG Tanker Release through Largest Connection and Flash Fire	9.25E-11			9.25E-11	9.25E-05
OCGT LPG Tanker Hot BLEVE and Fireball	1.74E-09			1.74E-09	1.74E-03

Table 73 Societal Risk Frequencies in Chances per Million (CPM)

Table 74 details the Societal Risk calculation for the proposed scheme. The Expectation Value (EV) at the proposed scheme is calculated to be **19.5**.

Section 1.7 of the TLUP (HSA, 2023) states:

‘for new developments near an establishment, where the calculated off-site EV at the development greater than 2,000, further assessment of societal risk will be required.’

The total Expectation Value (EV) at the proposed scheme is **19.5**. This is <2,000; therefore, no further risk calculation is required.

Major Accident	Distance from road (m)	Road Coverage of 1% Fatality	No. PCUs in Hazard Range	Overpressure (mbar)	Vul to overpressure (CIA 3)	Thermal Radiation (kW/m ²) *Thermal Dose	Vul to Thermal Radiation (Outdoors)	Vul to Flashfire	Occupants	Fatalities	Frequency (cpm)	Expectation Value
OCGT LPG Tanker Hose Rupture and Flash Fire	160	475	1.35	0	0	0	0	1	2.7	2.7	6.5	17.50
OCGT LPG Tanker Hose Rupture and Jet Fire	160	185	0.52	0	0	106	1	0	1.0	1.0	1.2	1.25
Horizontal Pipeline Rupture and Flash Fire	90	505	1.41	0	0	0	0	1	2.8	2.8	0.22	0.61
OCGT VCE	120	85	0.24	50	0.01	0	0	0	0.5	0.0	20.0	0.10
Horizontal Pipeline Rupture and Jet fire	90	315	0.89	0	0	179	1	0	1.8	1.8	0.038	0.07
LPG Tank Rupture and VCE	160	280	0.79	75	0.025	0	0	0	1.6	0.0	0.060	0.00
LPG Tanker Rupture and Fireball	160	160	0.45	0	0	1300*	0.06	0	0.9	0.1	0.0001	0.00
LPG Tanker Rupture and VCE	160	725	2.04	150	0.112	0	0	0	4.1	0.5	0.00	0.00
LPG Tanker Rupture and Flash Fire	160	235	0.66	0	0	0	0	1	1.3	1.3	0.0001	0.00
LPG Tanker Release through Largest Connection and Jet Fire	160	185	0.52	0	0	106	1	0	1.0	1.0	0.00	0.00
LPG Tanker Release through Largest Connection and Flash Fire	160	475	1.34	0	0	0	0	1	2.7	2.7	0.0001	0.00
LPG Tanker Hot BLEVE and Fireball	160	235	0.66	0	0	1300*	0.06	0	1.3	0.1	0.0017	0.00
Total												19.5

Table 74 Societal Risk Calculation

10.0 CONCLUSION

AWN Consulting Ltd. were instructed by AECOM on behalf of Bord na Móna Powergen Ltd to complete a Land Use Planning assessment of major accident hazards associated with the proposed Derrygreenagh Power Project, Co. Offaly.

Following the completion of the development, the site will be classified as a Lower Tier Seveso site and is subject to the provisions of the Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2015 (COMAH Regulations 2015).

The Land Use Planning assessment was completed in accordance with guidance published by the HSA (HSA, 2023). The following major accident scenarios were assessed:

Installation	LOC scenario	Consequence/Event
Indoor equipment (release in Turbine enclosure)	Instantaneous failure	VCE
	Continuous leak over 10 minutes	VCE
	10 mm pipe leak over 10 minutes	VCE
Natural Gas Pipeline	Rupture of Pipeline	Fireball/Jet fire
		VCE
		Flash fire
	Pipeline Leak of 0.1D	Fireball/Jet fire
		VCE
Flash fire		
LPG Tank	Instantaneous Failure	Fireball
		VCE
		Flash fire
	Continuous Leak over 10 minutes	Jet fire
		VCE
		Flash fire
	10mm pipe leak over 30 minutes	Jet fire
VCE		
Flash fire		
LPG Pipeline	Rupture of Pipeline	Fireball/Jet fire
		VCE
		Flash fire
	Pipeline Leak of 0.1D	Fireball/Jet fire
		VCE
Flash fire		
LPG Tanker	Instantaneous Failure	Fireball
		VCE
		Flash fire
	Loss of entire Contents through Largest Connection	Jet fire
		VCE

Installation	LOC scenario	Consequence/Event
	Rupture of unloading arm	Flash fire
		Jet fire
		VCE
		Flash fire
	Leak of unloading arm of 10% of diameter	Jet fire
		VCE
		Flash fire
BLEVE (hot)	BLEVE	
Hydrogen Storage	Instantaneous failure	VCE/Fireball
	Continuous leak over 10 minutes (total inventory of 1 skid)	VCE, jet fire or flash fire
	10 mm pipe leak over 10 minutes	VCE, jet fire or flash fire
Hydrogen Pipeline	Pipeline rupture	Jet fire/Fireball
		VCE
		Flash fire
	Pipeline leak (10% of diameter)	Jet fire
		VCE
		Flash fire
Distillate Tank	Loss of Containment	MATTE
Aqueous Ammonia Tank	Loss of Containment	MATTE
Sodium Hypochlorite Tank	Loss of Containment	MATTE

Table 75 Major Accident Scenarios at Proposed Development

Environmental Risk Assessment (MATTE)

An assessment of Major Accidents to the Environment (MATTEs) at the power plant area was completed in accordance with the environmental risk assessment methodology recommended by the Chemical and Downstream Oil Industries Forum (CDOIF, 2017).

The following table summarises the MATTE Scenarios identified.

Scenario	Description	Environmental Receptors	MATTE Category	Tolerability Boundary	Scenario Frequency
MATTE 1	Catastrophic rupture of bulk distillate storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year	6.06E-06 per year

Scenario	Description	Environmental Receptors	MATTE Category	Tolerability Boundary	Scenario Frequency
MATTE 2	Catastrophic rupture of ammonia storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year	6.06E-06 per year
MATTE 3	Catastrophic rupture of sodium hypochlorite storage tank and overtop, migration of overtopped fraction to surface water drainage system and into the Mongagh River and Yellow River	Fresh water habitats	B	Intolerable > 1E-03 per year Broadly acceptable < 1E-05 per year	6.06E-06 per year

Table 76 Summary of MATTE Results

The tanks will comply with EN14015 and the pipework to EN13480 (or equivalent) and the maintenance regime will follow good engineering practice.

The event frequency of MATTE Scenario 1, 2 or 3 was calculated as 6.06E-06 per year. This is in the **Broadly Acceptable** region for these MATTE categories. It is concluded no further risk reduction measures are necessary

Land Use Planning Contours

Gexcon RiskCurves Version 12.4.0 modelling software was used to model the cumulative risk contours for the establishment. The consequence results, frequencies of major accident hazards and Mullingar wind speed and frequency data were input to the software. Risk contours for the power plant area corresponding to the boundaries of the inner, middle, and outer risk-based land use planning zones are illustrated on the Figure below.

The following figures illustrate the cumulative individual risk for major accidents at the proposed development.



Figure 109 Land Use Planning Risk-based Contours to Persons Outdoors

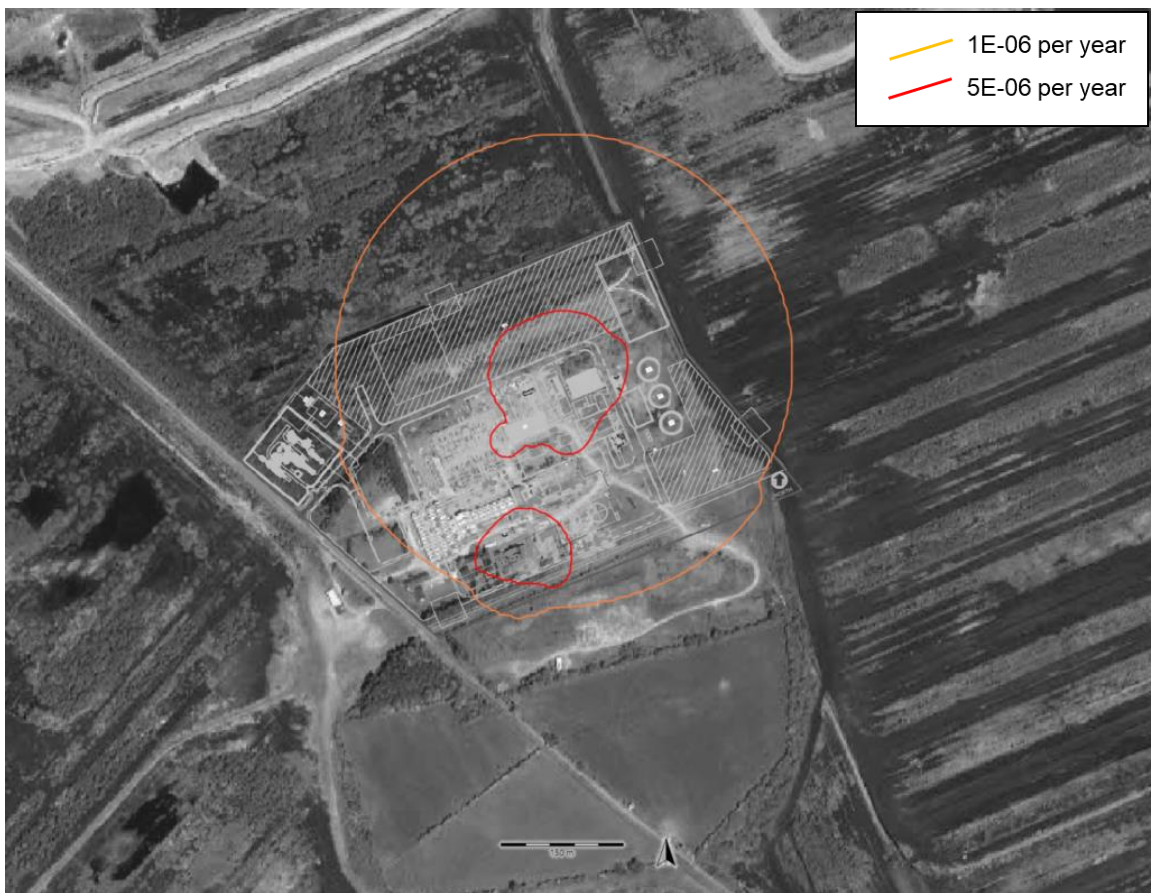


Figure 110 Individual Location-Based Risk Contours, to Persons Outdoors, for New Establishments



Figure 111 Land Use Planning Risk-based Contours to Persons Indoors CIA Cat. 3

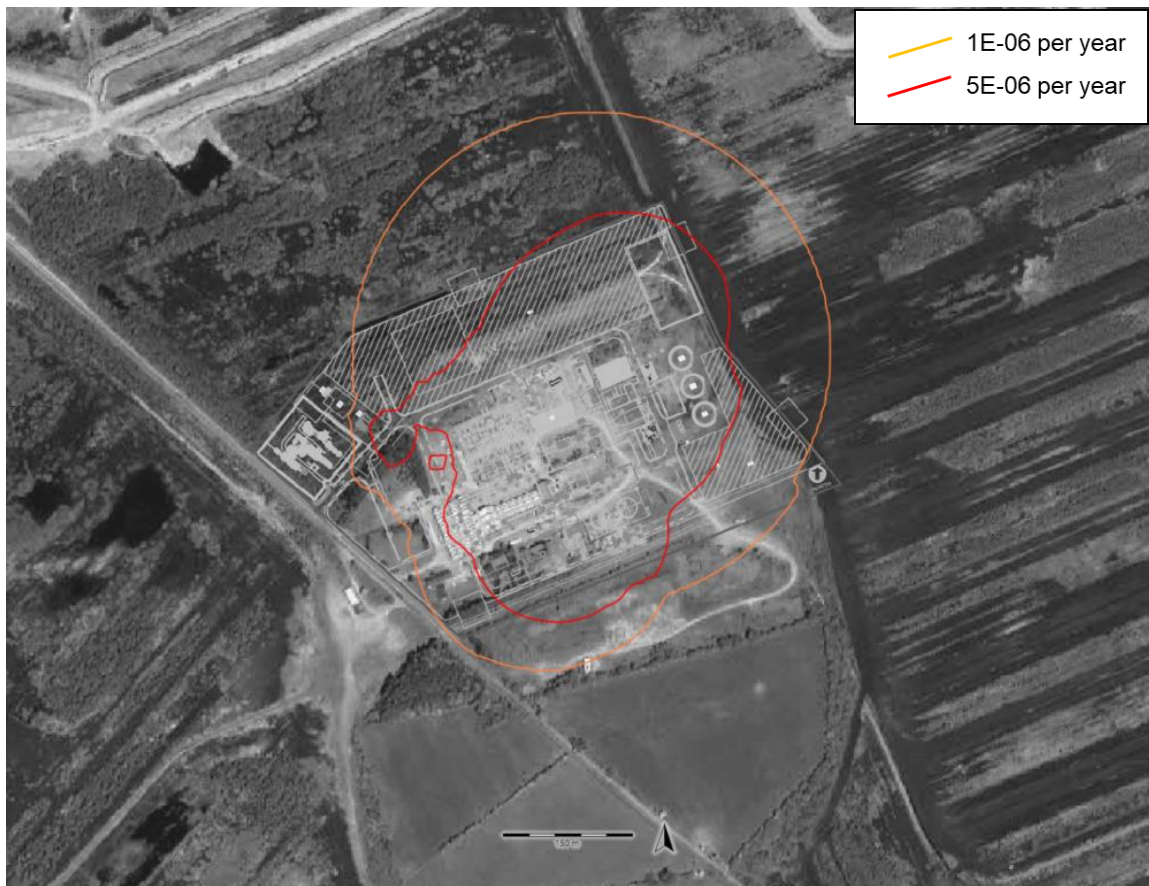


Figure 112 Individual Location-Based Risk Contours, to Persons Indoors CIA Cat. 3, for New Establishments

The following is concluded for the individual risk arising from the power plant area:

- The individual risk contour, to persons outdoors, corresponding to the Middle zone extends over the proposed development boundary to the south, to the west and to the north. These areas are unoccupied land and persons are not typically present.
- The individual risk contour, to persons outdoors, corresponding to the Outer zone extends to the R400 road. This is a Sensitivity Level 2 development; therefore, is permitted within the Outer zone.
- The individual risk contours, to persons indoors CIA Cat. 3, corresponding to the middle and outer zones extend over the proposed development boundary to the south and north. There are no occupied buildings in these areas. The outer zone contour extends to the Communications Mast building and General Stores Buildings; however, these buildings are not occupied.
- The Individual Location-Based Risk Contours, to Persons Indoors CIA Cat. 3 and to persons outdoors, do not extend to the Communication Mast to the south or to Refuelling Station to the west. These contours do not extend to the R400 road.

It is concluded that the individual location-based risk contours do not extend to an off-site work location or to an area where the public are present. Therefore, it is concluded that the criteria in Table 1 of the *Guidance on Technical Land Use Planning advice (HSA, 2023)* is met and level of off-site risk at the proposed development is acceptable.

The R400 road is within the consequence zone of major accidents at the proposed development. Therefore, Societal Risk assessment is required to take account of group risk to the receptors at the proposed development scheme.

A Societal Risk assessment for the proposed scheme was completed and the Expectation Value (EV) at the proposed scheme is calculated to be **19.5**.

Section 1.7 of the TLUP (HSA, 2023) states:

'for new developments near an establishment, where the calculated off-site EV at the development greater than 2,000, further assessment of societal risk will be required.'

The total Expectation Value (EV) at the proposed scheme is **19.5**. This is <2,000; therefore, no further risk calculation is required.

The Figures below illustrate the individual risk contour corresponding to 1E-09 per year (1 in-a-billion). This is the level of individual risk the HSA have requested for new establishments as a proposed consultation distance.

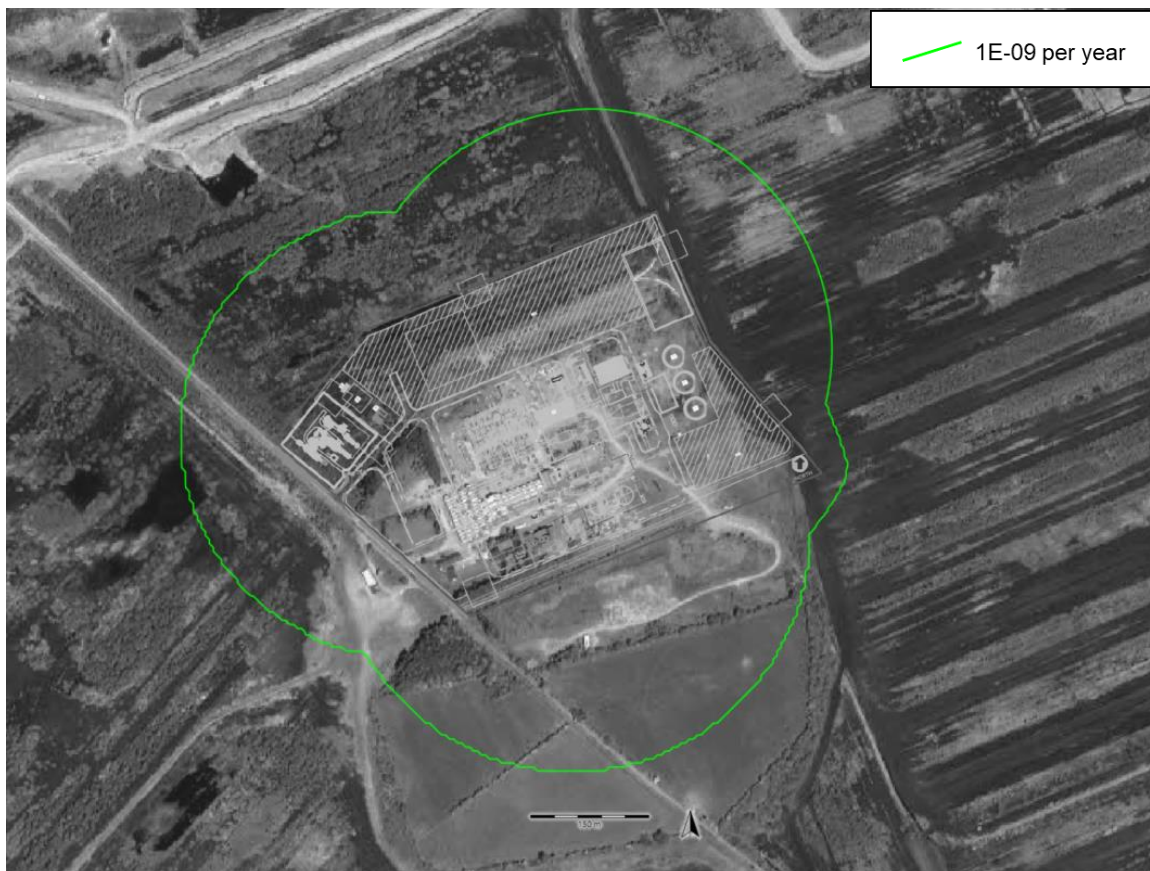


Figure 113 Individual Risk Contour, to Persons Outdoors, Corresponding to 1E-09 per year (Consultation Distance)



Figure 114 Individual Risk Contour, to Persons Indoors CIA Cat. 3, Corresponding to 1E-09 per year (Consultation Distance)

11.0 REFERENCES

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Online:

https://www.sepa.org.uk/media/219154/cdoif_guideline_environmental_risk_assessment_v2.pdf

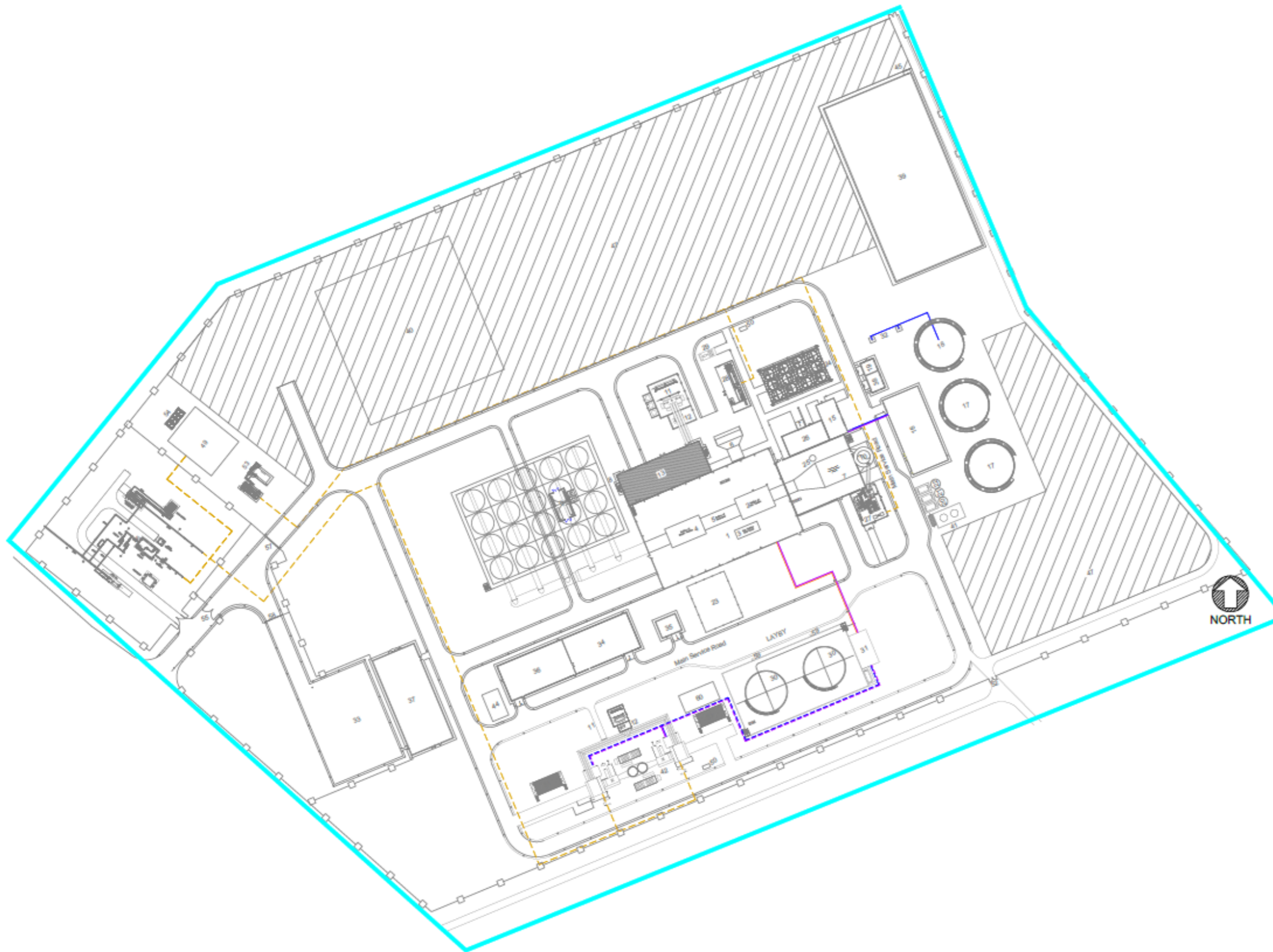
Thurston, R. AND R. Russo. ACUTE TOXICITY OF AMMONIA TO RAINBOW TROUT. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/J-83/155. 2004

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APPENDIX A

Detailed COMAH Site Layout

Reproduction of Figure 2



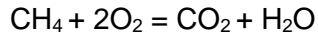
KEY

1. CCGT TURBINE HALL
2. GAS TURBINE
3. MCC ROOM
4. STEAM TURBINE
5. GENERATOR
6. AIR INLET FILTER
7. HEAT RECOVERY STEAM GENERATOR (HRSG)
8. AIR COOLED CONDENSER (ACC)
9. ACC MCC ROOM
10. EXHAUST STACK
11. GENERATOR TRANSFORMER
12. UNIT AUXILIARY TRANSFORMER
13. ELECTRICAL ROOM
14. 220KV SUBSTATION
15. AUXILIARIES BUILDING
16. WATER TREATMENT PLANT
17. DEMIN WATER STORAGE TANK
18. RAW / FIRE WATER TANK
19. RAW WATER PUMPHOUSE
20. CAUSTIC STORAGE TANK
21. CAUSTIC BRINE TANK
22. ACID STORAGE TANK
23. PROCESS WASTE WATER
24. ANCILLARY COOLERS
25. BOILER WASTE WATER DRAIN TANK
26. BOILER FEED PUMPS
27. AUXILIARY BOILER
28. FUEL GAS PERFORMANCE HEATER ROOM
29. EMERGENCY DIESEL GENERATOR
30. DISTILLATE STORAGE TANK IN BUND
31. FUEL FORWARDING BUILDING
32. WATER BOREHOLES & PIPELINE
33. STAFF CAR PARK
34. STORES BUILDING
35. LUBE OIL STORAGE
36. WORKSHOP
37. ADMINISTRATION BUILDING & CONTROL ROOM
38. FIRE PUMPHOUSE
39. SURFACE WATER ATTENUATION TANK
40. AREA FOR OUTAGE CONTRACTORS COMPOUND
41. AMMONIA STORAGE & PUMP HOUSE
42. OPEN CYCLE GAS TURBINE PLANT
43. MAIN ACCESS GATE
44. FOUL WATER TREATMENT PLANT
45. SURFACE WATER DISCHARGE PIPE
46. ABOVE GROUND GAS INSTALLATION (AGI) COMPOUND
47. CONTRACTORS COMPOUND & LAYDOWN AREAS
48. PROCESS & FOUL WATER DISCHARGE ROUTE
49. GAS COMPRESSORS & ANCILLARIES
50. PROPANE STORE
51. ELECTRICAL MODULES
52. SERVICE & CABLE ACCESS
53. PRESSURE REDUCING STATION
54. FIN FAN COOLERS
55. POWER PLANT AREA ACCESS
56. 220KV SUBSTATION ACCESS
57. POWER PLANT AREA ACCESS (SLIDING GATE)
58. POWER PLANT AREA ACCESS (RISING ARM BARRIER)
59. SECONDARY FUEL UNLOADING STATION
60. HOLDING TANK (BURIED)

APPENDIX B

Natural Gas VCE Calculation

Complete combustion equation for Methane:



Stoichiometric Mass Fraction Calculation:

Compound	Mol	Mol fraction	Molecular weight (kg/kmol)	Mass (kg)	Mass fraction
CH ₄	1	0.096	16.040	1.54	0.056
O ₂	2	0.192	31.999	6.13	0.222
N ₂	7.44	0.713	28.014	19.96	0.723
Total	10.44	1		27.63	1.000

Volume of CCGT Turbine Enclosure: 1200 m³

Volume of OCGT Turbine Enclosure: 562.5 m³

Density of Natural Gas Mixture at 10°C (calculated from DNV PHAST 9.0): 1.193 kg/m³

Mass of Flammable Mixture in OCGT: 671.06 kg (562.5 m³ x 1.193 kg/m³)

Mass of Flammable Mixture in CCGT: 1431.6 kg (1200 m³ x 1.193 kg/m³)

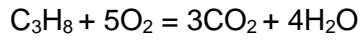
Compound	CCGT Mass (kg)	OCGT Mass (kg)
CH ₄	79.61	37.32
O ₂	317.62	148.88
N ₂	1034.38	484.86

Flammable Mass of Methane in CCGT Turbine Enclosure: **79.61 kg**

Flammable Mass of Methane in OCGT Turbine Enclosure: **37.32 kg**

LPG VCE Calculation

Complete combustion equation for Propane:



Stoichiometric Mass Fraction Calculation:

Compound	Mol	Mol fraction	Molecular weight (kg/kmol)	Mass (kg)	Mass fraction
LPG	1	0.041	44.097	1.79	0.061
O ₂	5	0.203	31.999	6.50	0.221
N ₂	18.6	0.756	28.014	21.18	0.719
Total	24.6	1		29.48	1.000

Volume of Enclosure: 21.8 m³

Density of Propane / Air Mixture at 10°C (calculated from DNV PHAST 9.0): 1.89 kg/m³

Mass of Flammable Mixture in Enclosure: 41.2 kg (21.8 m³ x 1.89 kg/m³)

Compound	Mass (kg)
Propane	2.51
O ₂	9.09
N ₂	29.61

Flammable Mass of Propane in Enclosure: **2.51 kg**

APPENDIX C

Traffic Survey

Appendix 14A
Traffic Survey Data

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IDASO
Innovative Data Solutions

Idaso Ltd
National Science Park,
Dublin Road, Mullingar,
Co Westmeath, Ireland

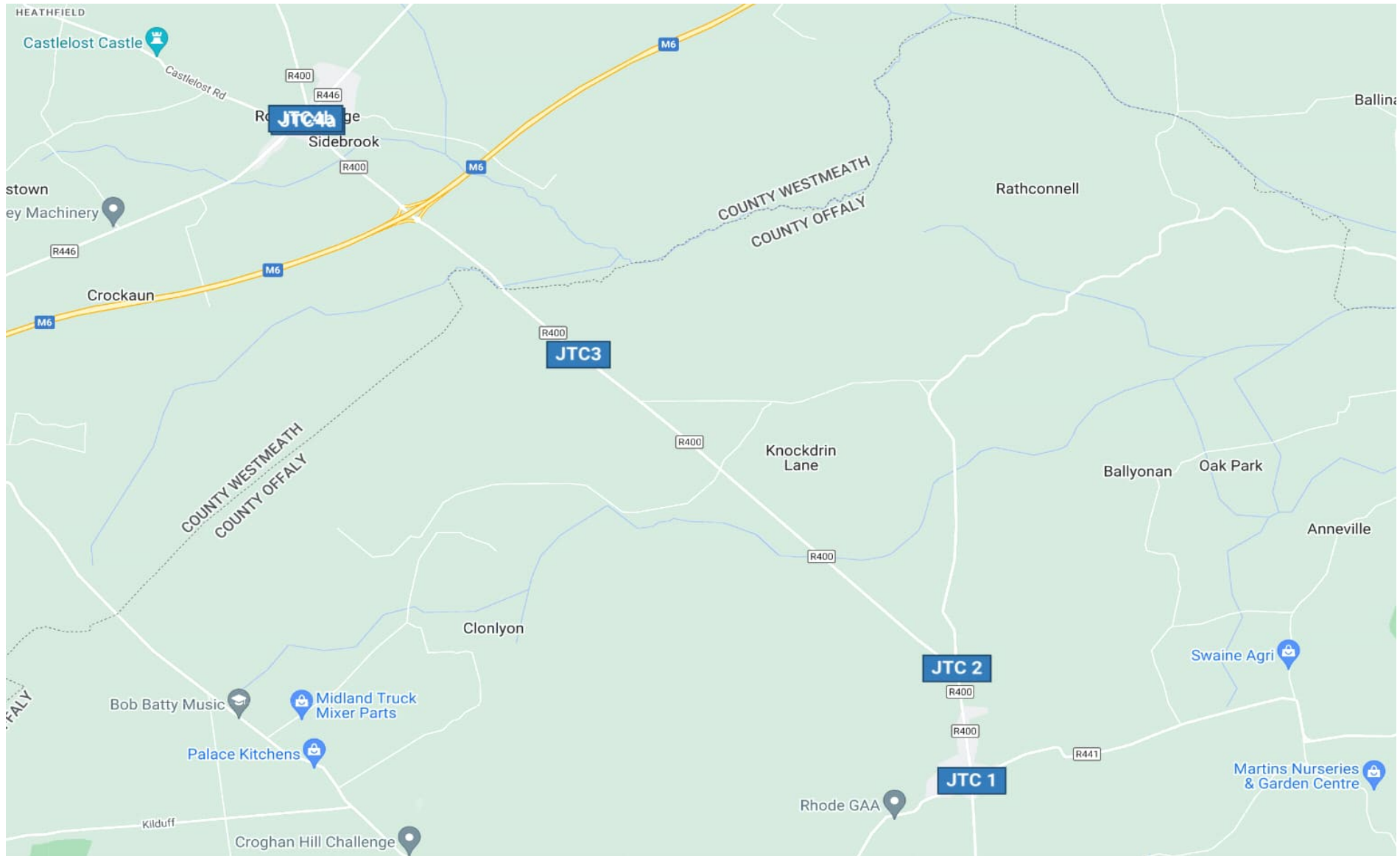
Office
Ph: +353 (0) 4493 18019
Email: info@idaso.ie

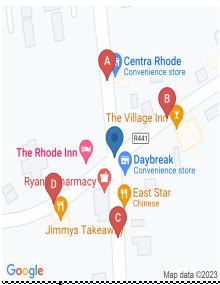
www.idaso.ie

Data Analysis Services
Traffic-Transportation- Commercial-Innovation

079 23043 Derrygreenagh, Co.
Offaly-Westmeath v2

with compliments





IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly-Westmeath v2
 Site: Site 1
 Location: R400 / R441 crossroads at Rhode, Offaly
 Date: Wed 22-Mar-2023

TIME	A ==> A								A ==> B								A ==> C										
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0	0	0	7	5	0	2	0	14	16.6	0	0	9	5	1	1	0	16	17.8
07:15	0	0	0	0	0	0	0	0	0	0	0	4	6	1	1	0	12	13.8	0	0	11	3	1	4	0	19	24.7
07:30	0	0	0	0	0	0	0	0	0	0	0	17	2	0	2	0	21	23.6	0	0	10	4	0	0	0	14	14
07:45	0	0	0	0	0	0	0	0	0	0	0	17	5	1	0	0	23	23.5	0	0	9	3	1	5	0	18	25
H/TOT	0	0	0	0	0	0	0	0	0	0	0	45	18	2	5	0	70	77.5	0	0	39	15	3	10	0	67	81.5
08:00	0	0	0	0	0	0	0	0	0	0	0	11	2	0	0	0	13	13	0	0	6	5	0	3	0	14	17.9
08:15	0	0	0	0	0	0	0	0	0	0	0	24	5	1	1	0	31	32.8	0	0	16	2	0	1	0	19	20.3
08:30	0	0	0	0	0	0	0	0	0	0	0	17	5	0	1	0	23	24.3	0	0	14	5	0	2	0	21	23.6
08:45	0	0	0	0	0	0	0	0	0	0	0	20	0	1	0	0	21	21.5	0	0	10	5	0	1	0	16	17.3
H/TOT	0	0	0	0	0	0	0	0	0	0	0	72	12	2	2	0	88	91.6	0	0	46	17	0	7	0	70	79.1
09:00	0	0	0	0	0	0	0	0	0	0	0	6	1	1	0	0	8	8.5	0	0	28	3	0	3	0	34	37.3
09:15	0	0	0	0	0	0	0	0	0	0	0	14	6	0	1	0	21	22.3	0	0	12	1	2	1	0	16	18.3
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09:45	0	0	1	0	0	0	0	1	1	0	1	4	4	0	1	0	10	10.7	0	0	8	0	2	0	0	10	11
H/TOT	0	0	1	0	0	0	0	1	1	0	1	30	14	2	2	0	49	52	0	0	55	6	4	5	0	70	78.5
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H/TOT	0	0	1	0	0	0	0	1	1	0	0	25	11	3	1	0	40	42.8	1	0	30	3	1	5	0	40	46.2
11:00	0	0	0	0	0	0	0	0	0	0	0	11	2	0	0	0	13	13	0	0	10	0	0	1	0	11	12.3
11:15	0	0	0	0	0	0	0	0	0	0	0	8	3	1	0	0	12	12.5	0	0	10	3	0	2	0	15	17.6
11:30	0	0	0	0	0	0	0	0	0	0	0	5	2	1	0	0	8	8.5	0	0	6	2	1	0	0	9	9.5
11:45	0	0	0	0	0	0	0	0	0	0	0	5	3	0	0	0	8	8	0	0	7	1	0	3	0	11	14.9
H/TOT	0	0	0	0	0	0	0	0	0	0	0	29	10	2	0	0	41	42	0	0	33	6	1	6	0	46	54.3
12:00	0	0	0	0	0	0	0	0	0	0	0	11	3	1	2	0	17	20.1	0	0	9	2	2	2	0	15	18.6
12:15	0	0	0	0	0	0	0	0	0	0	0	9	3	2	0	0	14	15	0	0	5	1	0	3	0	9	12.9
12:30	0	0	0	0	0	0	0	0	0	0	0	7	2	0	1	0	10	11.3	0	0	4	2	0	4	0	10	15.2
12:45	0	0	0	0	0	0	0	0	0	0	0	3	0	2	1	0	6	8.3	0	0	9	1	0	0	0	10	10
H/TOT	0	0	0	0	0	0	0	0	0	0	0	30	8	5	4	0	47	54.7	0	0	27	6	2	9	0	44	56.7
13:00	0	0	0	0	0	0	0	0	0	0	0	9	9	0	2	0	20	22.6	0	0	6	3	1	0	0	10	10.5
13:15	0	0	0	0	0	0	0	0	0	0	0	8	1	0	0	0	9	9	0	0	9	2	1	2	0	14	17.1
13:30	0	0	0	0	0	0	0	0	0	0	0	10	3	0	0	0	13	13	0	0	8	1	0	2	0	11	13.6
13:45	0	0	0	0	0	0	0	0	0	0	0	5	5	1	0	0	11	11.5	0	0	16	1	1	1	0	19	20.8
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15:45	0	0	0	0	0	0	0	0	0	0	0	10	1	1	0	0	12	12.5	0	0	15	1	0	1	0	17	18.3
H/TOT	0	0	0	0	0	0	0	0	0	0	0	41	11	5	3	0	60	66.4	0	0	42	5	1	3	0	51	55.4
16:00	0	0	0	0	0	0	0	0	0	0	0	15	1	1	1	0	18	19.8	0	0	7	2	0	1	0	10	11.3
16:15	0	0	0	0	0	0	0	0	0	0	0	15	3	2	1	0	21	23.3	0	0	9	1	0	0	0	10	10
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16:45	0	0	0	0	0	0	0	0	0	0	0	15	2	0	0	0	17	17	0	0	10	4	0	1	0	15	16.3
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18:45	0	0	0	0	0	0	0	0	0	0	0	16	2	0	0	1	19	20	0	0	10	3	2	0	0	15	16
H/TOT	0	0	0	0	0	0	0	0	0	0	0	71	3	0	0	1	75	76	0	0	40	10	2	0	0	52	53
12 TOT	0	0	3	0	0	0	0	3	3	0	1	529	131	27	24	2	714	760	1	0	477	108	22	66	0	674	770

TIME	A->D								TOT	PCU	B->A								TOT	PCU	B->B								TOT	PCU
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	P/C			M/C	CAR	LGV	OGV1	OGV2	PSV	P/C	M/C			CAR	LGV	OGV1	OGV2	PSV					
07:00	0	0	0	1	0	0	0	1	1	0	0	4	2	1	0	0	7	7.5	0	0	0	0	0	0	0	0	0	0	0	0
07:15	0	0	2	1	0	0	0	3	3	0	0	10	3	0	1	0	14	15.3	0	0	0	0	0	0	0	0	0	0	0	
07:30	0	0	2	0	0	0	0	2	2	0	0	9	4	1	1	0	15	16.8	0	0	0	0	0	0	0	0	0	0	0	
07:45	0	0	3	2	0	0	0	5	5	0	0	11	2	1	0	1	15	16.5	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	7	4	0	0	0	11	11	0	0	34	11	3	2	1	51	56.1	0	0	0	0	0	0	0	0	0	0	0	
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08:15	0	0	4	1	1	0	0	6	6.5	0	0	12	4	0	1	0	17	18.3	0	0	0	0	0	0	0	0	0	0	0	
08:30	0	0	2	0	1	1	0	4	5.8	0	0	8	2	0	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	
08:45	0	0	5	0	0	0	0	5	5	0	0	18	1	2	1	0	22	24.3	0	0	0	0	0	0	0	0	0	0	0	
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09:00	0	0	7	0	0	0	0	7	7	0	0	12	4	1	0	0	17	17.5	0	0	0	0	0	0	0	0	0	0	0	
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09:30	0	0	4	1	1	0	0	6	6.5	0	0	8	0	0	0	0	8	8	0	0	1	0	0	0	0	0	1	1	1	
09:45	0	0	5	2	0	0	0	7	7	0	0	5	3	0	0	0	8	8	0	0	0	1	0	0	0	0	1	1	1	
H/TOT	0	0	19	6	1	0	0	26	26.5	0	0	31	10	2	0	0	43	44	0	0	1	1	0	0	0	0	2	2	2	
10:00	0	0	5	2	0	0	0	7	7	0	0	8	3	1	2	0	14	17.1	0	0	0	0	0	0	0	0	0	0	0	
10:15	0	0	3	0	0	0	0	3	3	0	0	14	6	0	0	0	20	20	0	0	0	0	0	0	0	0	0	0	0	
10:30	0	0	9	1	0	0	0	10	10	0	0	6	3	1	2	0	12	15.1	0	0	1	0	0	0	0	0	1	1	1	
10:45	0	0	5	4	0	2	0	11	13.6	0	0	9	2	0	1	0	12	13.3	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	22	7	0	2	0	31	33.6	0	0	37	14	2	5	0	58	65.5	0	0	1	0	0	0	0	0	1	1	1	
11:00	0	0	3	0	1	1	0	5	6.8	0	0	3	2	3	0	0	8	9.5	0	0	1	0	0	0	0	0	1	1	1	
11:15	0	0	2	1	0	0	0	3	3	0	0	8	1	1	0	0	10	10.5	0	0	0	0	0	0	0	0	0	0	0	
11:30	0	0	6	1	0	1	0	8	9.3	0	0	4	1	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	
11:45	0	0	8	2	0	0	0	10	10	0	0	6	2	1	0	0	9	9.5	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	19	4	1	2	0	26	29.1	0	0	21	6	5	0	0	32	34.5	0	0	1	0	0	0	0	0	1	1	1	
12:00	0	0	7	1	0	0	0	8	8	1	0	5	3	0	0	0	9	8.2	0	0	0	0	0	0	0	0	0	0	0	
12:15	0	0	6	2	0	0	0	8	8	0	0	14	2	1	0	0	17	17.5	0	0	0	0	0	0	0	0	0	0	0	
12:30	0	0	2	0	1	1	0	4	5.8	0	0	4	2	2	0	0	8	9	0	0	0	0	0	0	0	0	0	0	0	
12:45	0	0	5	0	0	0	0	5	5	0	0	6	2	2	0	0	10	11	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	20	3	1	1	0	25	26.8	1	0	29	9	5	0	0	44	45.7	0	0	0	0	0	0	0	0	0	0	0	
13:00	0	0	10	1	0	0	0	11	11	0	0	8	2	1	0	0	11	11.5	0	0	0	1	0	0	0	0	1	1	1	
13:15	0	0	5	1	0	0	0	6	6	0	0	9	1	0	1	0	11	12.3	0	0	2	0	0	0	0	0	2	2	2	
13:30	0	0	7	2	0	0	0	9	9	0	0	20	5	0	1	0	26	27.3	0	0	0	0	0	0	0	0	0	0	0	
13:45	0	0	10	0	0	1	0	11	12.3	0	0	11	3	0	1	1	16	18.3	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	32	4	0	1	0	37	38.3	0	0	48	11	1	3	1	64	69.4	0	0	2	1	0	0	0	0	3	3	3	
14:00	0	0	4	1	0	0	0	5	5	0	0	17	1	1	0	0	19	19.5	0	0	0	0	0	0	0	0	0	0	0	
14:15	0	0	7	1	0	0	0	8	8	0	0	15	3	0	0	0	18	18	0	0	0	0	0	0	0	0	0	0	0	
14:30	0	0	2	1	0	0	0	3	3	0	0	8	2	1	1	0	12	13.8	0	0	0	0	0	0	0	0	0	0	0	
14:45	0	0	5	0	1	0	0	6	6.5	0	0	14	3	2	0	0	19	20	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	18	3	1	0	0	22	22.5	0	0	54	9	4	1	0	68	71.3	0	0	0	0	0	0	0	0	0	0	0	
15:00	0	0	6	0	0	0	0	6	6	0	0	21	4	2	0	0	27	28	0	0	0	0	0	0	0	0	0	0	0	
15:15	0	0	2	0	0	0	0	2	2	0	0	10	5	2	1	0	18	20.3	0	0	0	0	0	0	0	0	0	0	0	
15:30	0	0	0	0	0	0	0	0	0	0	0	8	4	0	0	0	12	12	0	0	1	0	0	0	0	0	1	1	1	
15:45	0	0	7	1	0	0	1	9	10	0	0	11	2	0	0	0	13	13	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	15	1	0	0	1	17	18	0	0	50	15	4	1	0	70	73.3	0	0	1	0	0	0	0	0	1	1	1	
16:00	0	0	4	0	0	0	0	4	4	0	0	7	3	1	1	0	12	13.8	0	0	1	0	0	0	0	0	1	1	1	
16:15	0	0	10	2	0	0	0	12	12	0	0	14	3	0	1	0	18	19.3	0	0	0	0	0	0	0	0	0	0	0	
16:30	0	0	8	1	0	0	0	9	9	0	0	7	2	0	2	0	11	13.6	0	0	0	0	0	0	0	0	0	0	0	
16:45	0	0	5	0	0	0	0	5	5	0	0	13	5	1	0	0	19	19.5	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	27	3	0	0	0	30	30	0	0	41	13	2	4	0	60	66.2	0	0	1	0	0	0	0	0	1	1	1	
17:00	0	0	10	3	0	0	0	13	13	0	0	15	6	1	0	0	22	22.5	0	0	1	0	0	0	0	0	1	1	1	
17:15	0	0	7	0	0	0	0	7	7	0	0	19	5	0	2	0	26	28.6	0	0	0	0	0	0	0	0	0	0	0	
17:30	0	0	6	3	0	0	0	9	9	0	0	12	4	0	2	0	18	20.6	0	0	0	0	0	0	0	0	0	0	0	
17:45	0	0	6	3	0	0	0	9	9	0	0	21	4	0	0	0	25	25	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	29	9	0	0	0	38	38	0	0	67	19	1	4	0	91	96.7	0	0	1	0	0	0	0	0	1	1	1	
18:00	0	0	11	2	0	0	0	13	13	0	0	14	1	0	0	0	15	15	0	0	0	0	0	0	0	0	0	0	0	
18:15	0	0	13	2	0	0	0	15	15	0	0	8	4	0	0	0	12	12	0	0	0	0	0	0	0	0	0	0	0	
18:30	0	0	8	1	0	0	0	9	9	0	0	20	3	0	0	0	23	23	0	0	0	0	0	0	0	0	0	0	0	
18:45	0	0	8	2	0	0	0	10	10	0	0	18	2	0	0	0	20	20	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	40	7	0	0	0	47	47	0	0	60	10	0	0	0	70	70	0	0	0	0	0	0	0	0	0	0	0	
12 TOT	0	0	264	52	6	7	2	331	345	1	0	522	138	32	24	2	719	767	0	0	8	2	0	0	0	0	10	10	10	

TIME	B->C							TOT	PCU	B->D							TOT	PCU	C->A							TOT	PCU
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV			P/C	M/C	CAR	LGV	OGV1	OGV2	PSV			P/C	M/C	CAR	LGV	OGV1	OGV2	PSV		
07:00	0	0	0	3	0	0	0	3	3	0	0	1	0	0	0	1	1	0	0	5	4	0	1	0	10	11.3	
07:15	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0	0	2	2	0	0	8	3	0	1	0	12	13.3
07:30	0	0	3	0	1	0	1	5	6.5	0	0	4	0	0	0	1	5	6	0	0	7	7	0	2	0	16	18.6
07:45	0	0	2	1	0	0	0	3	3	0	0	6	0	0	0	1	7	8	0	0	14	3	0	0	0	17	17
H/TOT	0	0	6	4	1	0	1	12	13.5	0	0	12	1	0	0	2	15	17	0	0	34	17	0	4	0	55	60.2
08:00	0	0	10	2	0	0	0	12	12	0	0	3	0	1	0	0	4	4.5	0	0	9	0	1	1	0	11	12.8
08:15	0	0	2	1	0	0	0	3	3	0	0	4	0	0	0	0	4	4	0	0	9	2	0	0	0	11	11
08:30	0	0	2	1	0	0	0	3	3	0	0	5	3	0	0	0	8	8	0	0	10	3	1	2	0	16	19.1
08:45	0	0	3	0	1	0	0	4	4.5	0	0	7	0	0	0	0	7	7	0	0	13	2	1	1	0	17	18.8
H/TOT	0	0	17	4	1	0	0	22	22.5	0	0	19	3	1	0	0	23	23.5	0	0	41	7	3	4	0	55	61.7
09:00	0	0	4	2	0	0	0	6	6	0	0	11	1	0	0	0	12	12	0	0	19	1	1	0	0	21	21.5
09:15	0	0	7	2	0	0	0	9	9	0	0	3	2	0	0	0	5	5	0	0	9	3	1	0	0	13	13.5
09:30	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4	0	0	6	2	0	1	0	9	10.3
09:45	0	0	3	2	0	0	0	5	5	0	0	4	0	0	0	0	4	4	0	0	9	3	1	2	0	15	18.1
H/TOT	0	0	14	6	0	0	0	20	20	0	0	22	3	0	0	0	25	25	0	0	43	9	3	3	0	58	63.4
10:00	0	0	5	1	0	0	0	6	6	0	0	1	1	0	0	0	2	2	0	0	5	1	0	0	0	6	6
10:15	0	0	1	1	0	0	0	2	2	0	0	3	1	1	0	0	5	5.5	0	0	8	1	1	1	0	11	12.8
10:30	0	0	2	1	0	0	0	3	3	0	0	3	0	0	0	1	4	5	0	0	7	0	1	0	0	8	8.5
10:45	0	0	4	1	0	0	0	5	5	0	0	2	2	2	0	0	6	7	0	0	9	0	1	1	0	11	12.8
H/TOT	0	0	12	4	0	0	0	16	16	0	0	9	4	3	0	1	17	19.5	0	0	29	2	3	2	0	36	40.1
11:00	0	0	3	0	1	0	0	4	4.5	0	0	2	0	0	0	0	2	2	0	0	12	2	2	0	0	16	17
11:15	0	0	5	0	0	0	0	5	5	0	0	6	0	0	0	0	6	6	0	0	11	1	0	1	0	13	14.3
11:30	0	0	2	0	1	0	0	3	3.5	0	0	5	0	0	0	0	5	5	0	0	9	1	0	0	0	10	10
11:45	0	0	3	1	1	0	0	5	5.5	0	0	9	1	2	0	0	12	13	0	0	8	2	1	0	0	11	11.5
H/TOT	0	0	12	1	3	0	0	17	18.5	0	0	22	1	2	0	0	25	26	0	0	40	6	3	1	0	50	52.8
12:00	0	0	2	2	0	0	0	4	4	0	0	4	0	1	0	0	5	5.5	0	0	6	3	0	0	0	9	9
12:15	0	0	4	0	0	0	0	4	4	0	0	6	1	2	0	0	9	10	0	0	6	3	1	1	0	11	12.8
12:30	0	0	1	0	0	0	0	1	1	0	0	8	2	0	0	0	10	10	0	0	5	0	1	2	0	8	11.1
12:45	0	0	2	0	0	0	0	2	2	0	0	4	0	0	0	0	4	4	0	0	4	0	0	1	0	5	6.3
H/TOT	0	0	9	2	0	0	0	11	11	0	0	22	3	3	0	0	28	29.5	0	0	21	6	2	4	0	33	39.2
13:00	0	0	3	0	0	0	0	3	3	0	0	3	1	0	0	0	4	4	0	0	10	0	0	1	0	11	12.3
13:15	0	0	3	0	0	0	0	3	3	0	0	3	0	0	0	0	3	3	0	0	8	0	1	0	0	9	9.5
13:30	0	0	7	3	1	0	1	12	13.5	0	0	7	0	1	0	2	10	12.5	0	0	4	3	0	1	0	8	9.3
13:45	0	0	2	1	0	0	0	3	3	0	0	6	0	0	0	0	6	6	0	0	9	0	0	0	0	9	9
H/TOT	0	0	15	4	1	0	1	21	22.5	0	0	19	1	1	0	2	23	25.5	0	0	31	3	1	2	0	37	40.1
14:00	0	0	2	0	0	0	0	2	2	0	0	5	0	0	0	0	5	5	0	0	17	1	1	1	0	20	21.8
14:15	0	0	5	0	0	0	0	5	5	0	0	6	0	0	0	0	6	6	0	0	10	0	0	1	0	11	12.3
14:30	0	0	4	0	0	0	0	4	4	0	0	4	1	0	0	0	5	5	0	0	13	0	1	2	0	16	19.1
14:45	0	0	7	1	0	1	0	9	10.3	0	0	1	2	0	0	0	3	3	0	0	13	3	1	1	0	18	19.8
H/TOT	0	0	18	1	0	1	0	20	21.3	0	0	16	3	0	0	0	19	19	0	0	53	4	3	5	0	65	73
15:00	0	0	6	1	0	0	0	7	7	0	0	10	1	0	0	0	11	11	0	0	32	4	0	1	0	37	38.3
15:15	0	0	4	0	0	0	0	4	4	0	0	6	2	0	0	0	8	8	0	0	9	1	2	1	0	13	15.3
15:30	0	0	5	0	0	0	0	5	5	0	0	2	2	0	0	0	4	4	0	0	7	5	1	1	0	14	15.8
15:45	0	0	5	0	0	0	0	5	5	0	0	5	2	0	0	0	7	7	0	0	16	1	0	0	0	17	17
H/TOT	0	0	20	1	0	0	0	21	21	0	0	23	7	0	0	0	30	30	0	0	64	11	3	3	0	81	86.4
16:00	0	0	6	0	0	0	0	6	6	0	0	3	1	0	0	0	4	4	0	0	8	4	1	1	0	14	15.8
16:15	0	0	4	0	0	0	0	4	4	0	0	4	1	0	0	0	5	5	0	0	14	6	3	0	0	23	24.5
16:30	0	0	2	0	0	0	0	2	2	0	0	14	1	2	0	0	17	18	0	0	7	4	0	0	0	11	11
16:45	0	0	4	2	0	0	0	6	6	0	0	1	1	0	0	1	3	4	0	0	14	3	0	1	0	18	19.3
H/TOT	0	0	16	2	0	0	0	18	18	0	0	22	4	2	0	1	29	31	0	0	43	17	4	2	0	66	70.6
17:00	0	0	2	0	0	0	0	2	2	0	0	6	1	0	0	0	7	7	0	0	10	2	0	0	0	12	12
17:15	0	0	1	0	0	0	0	1	1	0	0	7	2	0	0	0	9	9	0	0	13	4	0	0	0	17	17
17:30	0	0	4	0	0	0	0	4	4	0	0	5	3	0	0	0	8	8	0	0	11	1	0	0	0	12	12
17:45	0	0	3	0	0	1	0	4	5.3	0	0	10	0	0	0	0	10	10	0	0	12	1	0	1	0	14	15.3
H/TOT	0	0	10	0	0	1	0	11	12.3	0	0	28	6	0	0	0	34	34	0	0	46	8	0	1	0	55	56.3
18:00	0	0	3	1	0	0	0	4	4	0	0	14	1	0	0	0	15	15	0	0	12	2	1	0	0	15	15.5
18:15	0	0	4	0	0	0	0	4	4	0	0	12	1	0	0	0	13	13	0	0	9	3	0	3	0	15	18.9
18:30	0	0	3	1	0	0	0	4	4	0	0	5	1	0	0	0	6	6	0	0	6	4	0	0	0	10	10
18:45	0	0	5	0	0	0	0	5	5	0	0	5	1	0	0	0	6	6	0	0	4	3	1	0	0	8	8.5
H/TOT	0	0	15	2	0	0	0	17	17	0	0	36	4	0	0	0	40	40	0	0	31	12	2	3	0	48	52.9
12TOT	0	0	165	31	6	2	2	206	214	0	0	250	40	12	0	6	308	320	0	0	476	102	27	34	0	639	697

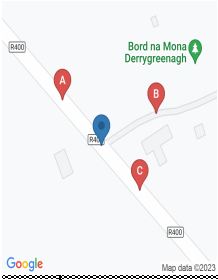
TIME	D=>A								TOT	PCU	D=>B								TOT	PCU	D=>C								TOT	PCU
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	P/C			M/C	CAR	LGV	OGV1	OGV2	PSV	P/C	M/C			CAR	LGV	OGV1	OGV2	PSV					
07:00	0	0	2	1	0	0	0	3	3	0	0	2	2	0	0	0	4	4	0	0	1	0	0	0	1	1	1	1		
07:15	0	0	3	1	0	0	0	4	4	0	0	3	0	0	0	0	3	3	0	0	1	0	0	0	1	1	1	1		
07:30	0	0	3	1	0	0	0	4	4	0	0	3	3	1	0	0	7	7.5	0	0	1	0	0	0	1	1	1	1		
07:45	0	0	5	2	0	0	0	7	7	0	0	11	0	0	0	1	12	13	0	0	2	0	0	0	2	2	2	2		
H/TOT	0	0	13	5	0	0	0	18	18	0	0	19	5	1	0	1	26	27.5	0	0	5	0	0	0	5	5	5	5		
08:00	0	0	8	1	0	0	1	10	11	0	0	3	2	0	0	0	5	5	0	0	4	0	0	0	4	4	4	4		
08:15	0	0	6	2	1	0	0	9	9.5	0	0	5	0	0	0	0	5	5	0	0	2	0	0	0	2	2	2	2		
08:30	0	0	6	1	1	0	0	8	8.5	0	0	6	0	1	0	0	7	7.5	0	0	2	1	0	0	3	3	3	3		
08:45	0	0	5	2	0	0	0	7	7	0	0	6	1	0	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	
H/TOT	0	0	25	6	2	0	1	34	36	0	0	20	3	1	0	0	24	24.5	0	0	8	1	0	0	9	9	9	9		
09:00	0	0	5	0	0	0	0	5	5	0	0	12	2	0	0	1	15	16	0	0	5	0	0	0	5	5	5	5		
09:15	0	0	7	3	1	0	0	11	11.5	0	0	6	1	0	0	0	7	7	0	0	5	1	0	0	6	6	6	6		
09:30	0	0	0	1	1	1	0	3	4.8	0	0	1	0	0	0	0	1	1	0	0	4	0	0	0	4	4	4	4		
09:45	0	0	4	0	1	0	0	5	5.5	0	0	2	0	0	0	0	2	2	0	0	4	0	0	0	4	4	4	4		
H/TOT	0	0	16	4	3	1	0	24	26.8	0	0	21	3	0	0	1	25	26	0	0	21	1	0	0	22	22	22	22		
10:00	0	0	7	0	0	0	0	7	7	0	0	1	0	0	0	0	1	1	0	0	3	0	0	0	3	3	3	3		
10:15	0	0	13	2	0	0	0	15	15	0	0	10	0	0	0	0	10	10	0	0	5	0	0	0	5	5	5	5		
10:30	0	0	2	2	0	0	0	4	4	0	0	4	0	0	0	0	4	4	0	0	1	0	1	0	2	2.5	2.5	2.5		
10:45	0	0	2	1	0	0	0	3	3	0	0	5	1	0	0	0	6	6	0	0	6	0	2	0	8	9	9	9		
H/TOT	0	0	24	5	0	0	0	29	29	0	0	20	1	0	0	0	21	21	0	0	15	0	3	0	18	19.5	19.5	19.5		
11:00	0	0	3	1	0	0	0	4	4	0	0	6	1	0	0	0	7	7	0	0	3	0	0	0	3	3	3	3		
11:15	0	0	1	2	0	0	0	3	3	0	0	4	2	0	0	0	6	6	0	0	3	0	1	0	4	4.5	4.5	4.5		
11:30	0	0	5	2	1	0	0	8	8.5	0	0	2	1	1	0	0	4	4.5	0	0	5	0	0	0	5	5	5	5		
11:45	0	0	4	0	0	1	0	5	6.3	0	0	5	2	0	0	0	7	7	0	0	4	0	0	0	4	4	4	4		
H/TOT	0	0	12	5	1	1	0	20	21.8	0	0	17	6	1	0	0	24	24.5	0	0	15	0	1	0	16	16.5	16.5	16.5		
12:00	0	0	14	0	0	0	0	14	14	0	0	12	0	0	0	1	13	14	0	0	3	0	1	0	4	4.5	4.5	4.5		
12:15	0	0	7	0	0	0	0	7	7	0	0	4	0	0	0	0	4	4	0	0	7	0	0	0	7	7	7	7		
12:30	0	0	7	4	0	0	0	11	11	0	0	5	0	0	0	0	5	5	0	0	1	0	0	0	1	1	1	1		
12:45	0	0	5	2	0	0	0	7	7	0	0	2	0	1	0	0	3	3.5	0	0	2	0	0	0	2	2	2	2		
H/TOT	0	0	33	6	0	0	0	39	39	0	0	23	0	1	0	1	25	26.5	0	0	13	0	1	0	14	14.5	14.5	14.5		
13:00	0	0	6	0	0	0	0	6	6	0	0	7	0	0	0	0	7	7	0	0	3	1	0	0	4	4	4	4		
13:15	0	0	4	0	0	0	0	4	4	0	0	4	1	1	0	0	6	6.5	0	0	0	0	0	0	0	0	0	0	0	
13:30	0	0	6	2	0	0	0	8	8	0	0	5	0	0	0	0	5	5	0	0	4	0	0	0	4	4	4	4		
13:45	0	0	5	1	0	0	0	6	6	0	0	4	1	0	0	1	6	7	0	0	4	0	0	0	4	4	4	4		
H/TOT	0	0	21	3	0	0	0	24	24	0	0	20	2	1	0	1	24	25.5	0	0	11	1	0	0	12	12	12	12		
14:00	0	0	5	1	0	0	0	6	6	0	0	5	2	0	0	0	7	7	1	0	0	0	0	0	1	0.2	0.2	0.2		
14:15	0	0	7	1	0	0	0	8	8	0	0	7	1	0	0	0	8	8	0	0	7	1	1	0	9	9.5	9.5	9.5		
14:30	0	0	6	0	0	1	0	7	8.3	0	0	6	0	0	0	0	6	6	0	0	3	0	0	0	3	3	3	3		
14:45	0	0	2	0	2	0	0	4	5	0	0	3	0	0	0	0	3	3	0	0	6	0	0	0	6	6	6	6		
H/TOT	0	0	20	2	2	1	0	25	27.3	0	0	21	3	0	0	0	24	24	1	0	16	1	1	0	19	18.7	18.7	18.7		
15:00	0	0	4	1	0	0	0	5	5	0	0	6	1	0	0	1	8	9	0	0	4	1	0	0	5	5	5	5		
15:15	0	0	6	1	0	0	0	7	7	0	0	5	1	0	0	0	6	6	0	0	4	0	0	0	4	4	4	4		
15:30	0	0	4	0	0	0	0	4	4	0	0	7	0	0	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	
15:45	0	0	5	0	0	0	1	6	7	0	0	3	0	1	0	0	4	4.5	0	0	2	0	0	0	2	2	2	2		
H/TOT	0	0	19	2	0	0	1	22	23	0	0	21	2	1	0	1	25	26.5	0	0	10	1	0	0	11	11	11	11		
16:00	0	0	1	1	0	0	0	2	2	0	0	3	1	0	0	0	4	4	0	0	1	0	0	0	1	1	1	1		
16:15	0	0	5	0	0	0	0	5	5	0	0	9	3	0	0	0	12	12	0	0	1	1	0	0	2	2	2	2		
16:30	0	0	4	1	0	0	0	5	5	0	0	5	0	0	0	0	5	5	0	0	3	0	0	0	3	3	3	3		
16:45	0	0	4	1	1	0	0	6	6.5	0	0	4	1	0	0	0	5	5	0	0	4	0	0	0	4	4	4	4		
H/TOT	0	0	14	3	1	0	0	18	18.5	0	0	21	5	0	0	0	26	26	0	0	9	1	0	0	10	10	10	10		
17:00	0	0	9	0	0	0	0	9	9	0	0	9	0	1	0	0	10	10.5	0	0	7	0	0	0	7	7	7	7		
17:15	0	0	5	0	0	0	0	5	5	0	0	4	1	0	0	0	5	5	0	0	4	0	0	0	4	4	4	4		
17:30	0	0	4	2	0	0	0	6	6	0	0	7	0	0	0	0	7	7	0	0	2	0	0	0	2	2	2	2		
17:45	0	0	10	3	0	0	0	13	13	0	0	7	1	0	0	0	8	8	0	0	2	0	1	0	3	3.5	3.5	3.5		
H/TOT	0	0	28	5	0	0	0	33	33	0	0	27	2	1	0	0	30	30.5	0	0	15	0	1	0	16	16.5	16.5	16.5		
18:00	0	0	2	2	0	0	0	4	4	0	0	5	0	0	0	0	5	5	0	0	2	0	0	0	2	2	2	2		
18:15	0	0	7	1	0	0	0	8	8	0	0	7	1	0	0	1	9	10	0	0	5	1	0	0	6	6	6	6		
18:30	0	0	10	0	1	0	0	11	11.5	0	0	8	1	0	0	0	9	9	0	0	2	0	0	0	2	2	2	2		
18:45	0	0	6	0	0	0	0	6	6	0	0	3	0	0	0	0	3	3	0	0	2	0	0	0	2	2	2	2		
H/TOT	0	0	25	3	1	0	0	29	29.5	0	0	23	2	0	0	1	26	27	0	0	11	1	0	0	12	12	12	12		
12 TOT	0	0	251	49	10	3	2	315	326	0	0	253	34	7	0	6	300	310	1	0	149	7	7	0	164	167	167	167		

D->D									
TIME	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0
07:15	0	0	0	0	0	0	0	0	0
07:30	0	0	0	0	0	0	0	0	0
07:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
08:00	0	0	0	0	0	0	0	0	0
08:15	0	0	0	0	0	0	0	0	0
08:30	0	0	0	0	0	0	0	0	0
08:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
09:00	0	0	0	0	0	0	0	0	0
09:15	0	0	0	0	0	0	0	0	0
09:30	0	0	0	0	0	0	0	0	0
09:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0
10:15	0	0	0	0	0	0	0	0	0
10:30	0	0	1	0	0	0	0	1	1
10:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	1	0	0	0	0	1	1
11:00	0	0	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0
12:15	0	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	0	0
13:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	0	0
14:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0
15:15	0	0	0	0	0	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0
18:15	0	0	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
12 TOT	0	0	1	0	0	0	0	1	1

TIME	B=>C							TOT	PCU	B=>D							TOT	PCU	C=>A							TOT	PCU	
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV			P/C	M/C	CAR	LGV	OGV1	OGV2	PSV			P/C	M/C	CAR	LGV	OGV1	OGV2	PSV			
07:00	0	0	0	0	1	0	0	1	1.5	0	0	0	0	1	0	0	0	1	1.5	0	0	1	0	0	0	0	1	1
07:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
07:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
07:45	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	3.3	0	0	4	0	1	0	0	5	5.5	
H/TOT	0	0	0	0	1	0	0	1	1.5	0	0	1	0	1	1	0	3	4.8	0	0	6	1	1	0	0	9	8.5	
08:00	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	4	6.6	0	0	2	1	0	0	0	3	3	
08:15	0	0	2	0	0	0	0	2	2	0	0	1	0	0	4	0	5	10.2	0	0	3	1	0	0	0	4	4	
08:30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	3	5.6	0	0	3	0	0	0	0	3	3	
08:45	0	0	1	0	0	0	0	1	1	0	0	0	0	0	2	0	2	4.6	0	0	4	0	1	0	0	5	5.5	
H/TOT	0	0	3	0	0	0	0	3	3	0	0	4	0	0	10	0	14	27	0	0	12	2	1	0	0	15	15.5	
09:00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2.3	0	0	2	1	0	0	0	3	3		
09:15	0	0	1	0	0	0	0	1	1	0	0	2	0	1	1	0	4	5.8	0	0	1	1	0	0	0	2	2	
09:30	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	1	2.3	0	0	3	1	0	0	0	4	4	
09:45	0	0	0	0	1	1	0	2	3.8	0	0	0	0	0	3	0	3	6.9	0	0	1	0	0	0	0	1	1	
H/TOT	0	0	2	0	1	1	0	4	5.8	0	0	2	0	1	6	0	9	17.3	0	0	7	3	0	0	0	10	10	
10:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	4	7.9	0	0	3	0	0	0	0	3	3	
10:15	0	0	0	0	0	1	0	1	2.3	0	0	0	1	0	2	0	3	5.6	0	0	5	2	1	1	0	9	10.8	
10:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3	0	0	7	8.5	
10:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3	
H/TOT	0	0	0	0	0	1	0	1	2.3	0	0	1	1	0	5	0	7	13.5	0	0	14	3	4	1	0	22	25.3	
11:00	0	0	0	0	0	1	0	1	2.3	0	0	0	0	0	2	0	2	4.6	0	0	0	0	1	0	0	1	1.5	
11:15	0	0	1	0	1	0	0	2	2.5	0	0	0	0	0	1	0	1	2.3	0	0	3	4	0	0	0	7	7	
11:30	0	0	1	1	0	0	0	2	2	0	0	1	0	0	3	0	4	7.9	0	0	4	1	0	0	0	5	5	
11:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2.3	0	0	1	0	0	0	0	1	1	
H/TOT	0	0	2	1	1	1	0	5	6.8	0	0	1	0	0	7	0	8	17.1	0	0	8	5	1	0	0	14	14.5	
12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2.3	0	0	3	0	1	0	0	4	4.5		
12:15	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	3	4.3	0	0	2	0	0	0	0	2	2	
12:30	0	0	0	0	1	0	0	1	1.5	0	0	0	0	0	1	0	1	2.3	0	0	6	0	1	0	0	7	7.5	
12:45	0	0	0	0	1	0	0	1	1.5	0	0	0	0	0	1	0	1	2.3	0	0	1	1	1	0	0	3	3.5	
H/TOT	0	0	0	0	2	0	0	2	3	0	0	1	1	0	4	0	6	11.2	0	0	12	1	3	0	0	16	17.5	
13:00	0	0	2	0	0	0	0	2	2	0	0	0	0	0	2	0	2	4.6	0	0	4	0	0	0	0	4	4	
13:15	0	0	1	0	0	0	0	1	1	0	0	1	0	0	2	0	3	5.6	0	0	3	0	0	0	0	3	3	
13:30	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	3	3.5	0	0	1	1	1	0	0	3	3.5	
13:45	0	0	1	0	0	0	0	1	1	0	0	0	0	0	2	0	2	4.6	0	0	4	0	0	0	0	4	4	
H/TOT	0	0	4	0	0	0	0	4	4	0	0	3	0	1	6	0	10	18.3	0	0	12	1	1	0	0	14	14.5	
14:00	0	0	1	0	0	0	0	1	1	0	0	1	0	0	3	0	4	7.9	0	0	5	0	0	0	0	5	5	
14:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	3	5.6	0	0	3	2	0	0	0	5	5	
14:30	0	0	0	0	0	0	0	0	0	0	0	2	1	1	2	0	6	9.1	0	0	1	0	1	0	0	2	2.5	
14:45	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	3	5.6	0	0	2	0	1	0	0	3	3.5	
H/TOT	0	0	1	0	0	0	0	1	1	0	0	5	1	1	9	0	16	28.2	0	0	11	2	2	0	0	15	16	
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4.6	0	0	7	2	1	0	0	10	10.5	
15:15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	3.8	0	0	2	1	0	0	0	3	3	
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4.6	0	0	1	2	0	0	0	3	3	
15:45	0	0	3	1	0	0	0	4	4	0	0	1	0	0	3	0	4	7.9	0	0	7	0	1	0	0	8	8.5	
H/TOT	0	0	3	1	0	0	0	4	4	0	0	1	0	1	8	0	10	20.9	0	0	17	5	2	0	0	24	25	
16:00	0	0	0	0	0	1	0	1	2.3	0	0	0	0	0	2	0	2	4.6	0	0	1	0	0	0	0	1	1	
16:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	3.3	0	0	6	0	0	0	0	6	6	
16:30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	4	6.6	0	0	1	2	1	0	0	4	4.5	
16:45	0	0	2	1	0	0	0	3	3	0	0	0	0	0	1	0	1	2.3	0	0	2	0	0	0	0	2	2	
H/TOT	0	0	2	1	0	1	0	4	5.3	0	0	3	0	0	6	0	9	16.8	0	0	10	2	1	0	0	13	13.5	
17:00	0	0	3	0	0	0	0	3	3	0	0	0	0	0	3	0	3	6.9	0	0	3	1	0	0	0	4	4	
17:15	0	0	3	0	0	0	0	3	3	0	0	2	1	0	0	0	3	3	0	0	1	0	0	0	0	1	1	
17:30	0	0	1	1	0	0	0	2	2	0	0	1	0	0	0	0	1	1	0	0	5	2	0	0	0	7	7	
17:45	0	0	2	1	0	0	0	3	3	0	0	3	0	0	1	0	4	5.3	0	0	3	1	0	0	0	4	4	
H/TOT	0	0	9	2	0	0	0	11	11	0	0	6	1	0	4	0	11	16.2	0	0	12	4	0	0	0	16	16	
18:00	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3	3	
18:15	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1	0	0	2	2	0	0	0	4	4	
18:30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	5	1	0	0	0	7	6.4	
18:45	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	5	
H/TOT	0	0	3	0	0	0	0	3	3	0	0	2	0	0	0	0	2	2	0	1	13	5	0	0	0	19	18.4	
12 TOT	0	0	29	5	5	4	0	43	50.7	0	0	30	4	5	66	0	105	193	0	1	134	34	16	1	0	186	195	

TIME	D=>A								TOT	PCU	D=>B								TOT	PCU	D=>C								TOT	PCU
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	P/C			M/C	CAR	LGV	OGV1	OGV2	PSV	P/C	M/C			CAR	LGV	OGV1	OGV2	PSV					
07:00	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	4	7.9	0	0	10	7	0	4	0	21	26.2		
07:15	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	6	9.9	0	0	9	4	0	4	0	17	22.2		
07:30	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	4	4.5	0	0	20	6	3	4	0	33	39.7		
07:45	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	3.3	0	0	15	6	0	3	1	25	29.9		
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	6	2	1	7	0	16	25.6	0	0	54	23	3	15	1	96	118		
08:00	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	5	8.9	0	0	12	5	0	3	0	20	23.9		
08:15	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	4	5.3	0	0	23	3	2	2	0	30	33.6		
08:30	0	0	0	0	0	1	0	1	2.3	0	0	0	3	0	0	2	0	5	7.6	0	0	27	8	1	4	0	40	45.7		
08:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	6.9	0	0	14	2	0	2	0	18	20.6		
H/TOT	0	0	0	0	0	1	0	1	2.3	0	0	0	8	0	0	9	0	17	28.7	0	0	76	18	3	11	0	108	124		
09:00	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	5	8.9	0	0	15	5	2	3	0	25	29.9		
09:15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	3.3	0	0	14	4	3	2	0	23	27.1		
09:30	0	0	0	0	1	0	0	1	1.5	0	0	0	0	0	0	2	0	2	4.6	0	0	6	4	0	1	0	11	12.3		
09:45	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	7	6	0	1	0	14	15.3		
H/TOT	0	0	0	0	1	0	0	1	1.5	0	0	0	4	0	0	6	0	10	17.8	0	0	42	19	5	7	0	73	84.6		
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4.6	1	0	5	2	1	3	0	12	15.6		
10:15	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	4	6.6	0	0	10	3	1	2	0	16	19.1		
10:30	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	4	0	4	9.2	0	0	13	4	0	0	0	17	17		
10:45	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	3.3	0	0	8	4	0	4	0	16	21.2		
H/TOT	0	0	1	0	0	0	0	1	1	0	0	0	2	1	0	9	0	12	23.7	1	0	36	13	2	9	0	61	72.9		
11:00	0	0	0	0	1	0	0	1	1.5	0	0	0	0	0	0	1	0	1	2.3	0	0	11	0	0	2	0	13	15.6		
11:15	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	3	4.3	0	0	13	2	0	3	0	18	21.9		
11:30	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	4	3	0	1	0	8	9.3		
11:45	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	0	5	10.2	0	0	9	3	0	2	0	14	16.6		
H/TOT	0	0	0	0	1	0	0	1	1.5	0	0	0	3	1	0	6	0	10	17.8	0	0	37	8	0	8	0	53	63.4		
12:00	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	3	5.6	0	0	7	3	1	4	0	15	20.7		
12:15	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	17	1	0	4	0	23	27.6	
12:30	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	6	4	0	5	0	15	21.5		
12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2.3	0	0	10	1	1	1	0	13	14.8		
H/TOT	0	0	1	0	0	0	0	1	1	0	0	0	3	0	0	3	0	6	9.9	0	1	40	9	2	14	0	66	84.6		
13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4.6	0	0	7	10	0	2	0	19	21.6		
13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4.6	0	0	13	3	0	3	0	19	22.9		
13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4.6	0	0	8	2	0	2	0	12	14.6		
13:45	0	0	0	0	1	0	0	1	1.5	0	0	0	1	0	0	2	0	3	5.6	0	0	18	6	1	2	0	27	30.1		
H/TOT	0	0	0	0	1	0	0	1	1.5	0	0	0	1	0	0	8	0	9	19.4	0	0	46	21	1	9	0	77	89.2		
14:00	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	11	3	0	1	1	16	18.3		
14:15	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	4	6.6	0	0	9	3	0	5	0	17	23.5		
14:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	3	6.1	0	0	5	2	0	2	0	9	11.6		
14:45	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	4	0	5	10.2	0	0	12	2	1	2	0	17	20.1		
H/TOT	0	0	0	1	0	0	0	1	1	0	0	0	4	0	1	8	0	13	23.9	0	0	37	10	1	10	1	59	73.5		
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4.6	0	0	14	2	3	2	0	21	25.1		
15:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	6.9	0	0	11	1	0	0	0	12	12		
15:30	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	3.3	0	0	14	4	1	4	0	23	28.7		
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4.6	0	0	17	2	0	0	1	20	21		
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	8	0	9	19.4	0	0	56	9	4	6	1	76	86.8		
16:00	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	2	0	3	6.1	0	0	22	5	0	1	0	28	29.3		
16:15	0	0	1	0	0	0	0	1	1	0	0	0	2	0	0	2	0	4	6.6	0	0	20	3	2	3	0	28	32.9		
16:30	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1	1.5	0	0	23	7	1	1	0	32	33.8		
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	9.2	0	0	16	4	0	1	0	21	22.3		
H/TOT	0	0	3	0	0	0	0	3	3	0	0	0	2	0	2	8	0	12	23.4	0	0	81	19	3	6	0	109	118		
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	5	0	2	0	30	32.6		
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	7	1	2	0	32	35.1		
17:30	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	27	4	0	0	0	31	31		
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	5	1	1	0	32	33.8		
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	97	21	2	5	0	125	133		
18:00	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	24	3	0	0	0	27	27		
18:15	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	17	2	0	0	0	19	19		
18:30	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	24	1	0	0	0	25	25		
18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	4	1	0	1	21	22.5		
H/TOT	0	0	2	1	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	80	10	1	0	1	92	93.5		
12 TOT	0	0	7	2	3	1	0	13	15.8	0	0	0	35	4	4	72	0	115	211	1	1	682	180	27	100	4	995	1141		

D=>D									
TIME	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0
07:15	0	0	0	0	1	0	0	1	1.5
07:30	0	0	0	0	0	0	0	0	0
07:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	1	0	0	1	1.5
08:00	0	0	0	0	0	0	0	0	0
08:15	0	0	0	0	0	0	0	0	0
08:30	0	0	0	0	0	0	0	0	0
08:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
09:00	0	0	0	0	0	0	0	0	0
09:15	0	0	0	0	0	0	0	0	0
09:30	0	0	0	0	0	0	0	0	0
09:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0
10:15	0	0	0	0	0	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0
10:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0
12:15	0	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	0	0
13:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	0	1	0	1	2.3
14:30	0	0	0	0	0	0	0	0	0
14:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	1	0	1	2.3
15:00	0	0	1	0	0	0	0	1	1
15:15	0	0	0	0	0	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	1	0	0	0	0	1	1
16:00	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0
18:15	0	0	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	0	0	0	0	0	0
12 TOT	0	0	1	0	1	1	0	3	4.8



IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly-Westmeath v2
 Site: Site 3
 Location: R400 / Bord na Mona entrance
 Date: Wed 22-Mar-2023

TIME	A ==> A								A ==> B								A ==> C										
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	4	4	0	0	10	7	0	5	0	22	28.5
07:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	3	1	8	0	27	37.9
07:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	3	2	5	0	36	43.5	
07:45	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3	0	0	16	4	0	5	1	26	33.5
H/TOT	0	0	0	0	0	0	0	0	0	0	0	6	1	0	0	0	7	7	0	0	67	17	3	23	1	111	143
08:00	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	0	0	18	5	1	3	0	27	31.4
08:15	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0	0	25	4	1	4	0	34	39.7
08:30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	29	3	1	4	0	37	42.7
08:45	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	13	2	2	3	0	20	24.9
H/TOT	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	6	6	0	0	85	14	5	14	0	118	139
09:00	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	0	0	11	5	0	1	0	18	19.3
09:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	14	2	1	4	0	21	26.7
09:30	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	10	5	0	3	0	18	21.9
09:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	5	1	3	0	15	19.4	
H/TOT	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	4	4	0	0	41	18	2	11	0	72	87.3
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	0	8	0	15	25.4	
10:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	6	1	5	0	21	28	
10:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	3	0	4	0	15	20.2	
10:45	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	3.3	0	0	7	2	0	3	0	12	15.9
H/TOT	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	3.3	0	0	30	12	1	20	0	63	89.5
11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	2	0	3	0	15	18.9	
11:15	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	11	4	0	9	0	24	35.7
11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	3	0	10	13.9	
11:45	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	7	4	0	3	0	14	17.9
H/TOT	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4	0	0	33	12	0	18	0	63	86.4
12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	3	1	5	0	17	24	
12:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	15	2	0	2	0	20	22
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	1	3	0	16	20.4	
12:45	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	10	5	0	3	0	18	21.9
H/TOT	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0	1	41	14	2	13	0	71	88.3
13:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	6	4	0	1	0	11	12.3
13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	5	0	2	0	21	23.6	
13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	4	0	15	20.2	
13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	6	1	7	0	29	38.6	
H/TOT	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	45	16	1	14	0	76	94.7
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	1	2	0	13	16.1	
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	3	0	5	0	15	21.5	
14:30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2.3	0	0	6	2	0	6	0	14	21.8
14:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	2	2	5	0	28	35.5	
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2.3	0	0	38	11	3	18	0	70	94.9
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	2	3	3	0	19	24.4	
15:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	2	1	8	0	21	31.9	
15:30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	16	5	0	2	1	24	27.6
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	2	0	6	0	24	31.8	
H/TOT	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	53	11	4	19	1	88	116
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	3	1	3	0	32	36.4	
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	3	1	7	0	38	47.6	
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	5	2	4	0	28	34.2	
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	7	0	0	0	27	27	
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	89	18	4	14	0	125	145	
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	4	1	2	0	27	30.1	
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	7	0	0	0	41	41	
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	5	0	0	0	29	29	
17:45	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	27	3	0	2	0	32	34.6	
H/TOT	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	105	19	1	4	0	129	135	
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	2	0	0	0	24	24	
18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	2	0	0	0	26	26	
18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	3	0	0	1	29	30	
18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	3	2	0	0	27	28	
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	10	2	0	1	106	108	
12 TOT	0	0	1	0	0	0	0	1	1	0	0	18	8	0	2	0	28	30.6	0	1	720	172	28	168	3	1092	1327

C→A									C→B									C→C								
P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU
0	0	10	7	0	1	0	18	19.3	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
0	0	18	6	1	4	0	29	34.7	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
0	0	15	5	0	3	0	23	26.9	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	
0	0	22	9	1	0	1	33	34.5	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	
0	0	65	27	2	8	1	103	115.3	0	0	7	0	0	0	0	7	7	0	0	0	0	0	0	0	0	
0	0	27	3	0	3	1	34	38.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	25	8	2	2	0	37	40.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	31	2	1	4	0	38	43.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	25	6	1	3	0	35	39.4	0	0	1	1	1	0	0	3	3.5	0	0	0	0	0	0	0	0	
0	0	108	19	4	12	1	144	163	0	0	1	1	1	0	0	3	3.5	0	0	0	0	0	0	0	0	
0	0	17	5	3	3	0	28	33.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	12	3	0	1	0	16	17.3	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
0	0	11	2	0	1	0	14	15.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	8	1	0	3	0	12	15.9	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	
0	0	48	11	3	8	0	70	81.9	0	0	1	1	0	0	0	2	2	0	0	0	0	0	0	0	0	
0	0	12	1	0	3	0	16	19.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	17	1	1	1	0	20	21.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	9	3	0	6	0	18	25.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	7	2	1	5	0	15	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	45	7	2	15	0	69	89.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	8	1	1	5	0	15	22	0	0	0	2	0	0	0	2	2	0	0	0	0	0	0	0	0	
0	0	7	2	2	2	0	13	16.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	7	3	0	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	7	2	1	3	0	13	17.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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0	0	10	1	0	1	0	12	13.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	11	7	1	3	0	22	26.4	0	0	1	1	0	0	0	2	2	0	0	0	0	0	0	0	0	
1	0	11	2	1	0	0	15	14.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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0	0	13	0	2	3	0	18	22.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	10	0	1	3	0	14	18.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	10	2	0	3	0	15	18.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	11	3	0	1	0	15	16.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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0	0	18	4	1	4	0	27	32.7	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	
0	0	15	3	0	4	0	22	27.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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0	0	13	2	2	3	0	20	24.9	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
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0	0	15	5	0	5	0	25	31.5	0	0	0	1	0	1	0	2	3.3	0	0	0	0	0	0	0	0	
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0	0	11	9	3	3	1	27	33.4	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
0	0	15	8	4	8	0	35	47.4	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	
0	0	15	5	1	4	0	25	30.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	16	6	0	4	0	26	31.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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0	0	27	4	0	5	0	36	42.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	19	7	0	4	0	30	35.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	16	4	0	0	0	20	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	78	19	0	10	0	107	120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	24	1	1	1	0	27	28.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	21	3	0	1	0	25	26.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	17	3	0	0	0	20	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	10	0	0	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	72	7	1	2	0	82	85.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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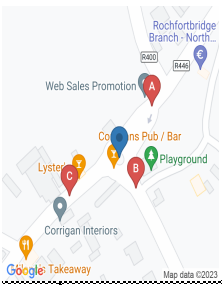


IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly-Westmeath v2
 Site: Site 4a
 Location: Rochfortbridge R400/Rahanine Junction
 Date: Wed 22-Mar-2023

TIME	A=>A										A=>B										A=>C									
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU			
07:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	28.3		
07:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	4	0	1	0	33	34.3		
07:30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1.5	0	0	28	3	2	1	0	34	36.3			
07:45	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	29	3	0	1	1	34	36.3			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	2.5	0	0	105	16	2	1	1	128	135			
08:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	9	3	1	0	36	38.8			
08:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	27	6	0	0	0	33	33			
08:30	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	3	3.5	0	0	27	4	0	1	0	32	33.3			
08:45	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0	0	14	1	4	0	0	19	21			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	4	1	1	0	0	6	6.5	0	0	91	20	7	2	0	120	126			
09:00	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	22	4	0	0	0	26	26			
09:15	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3	0	0	22	3	2	2	0	29	32.6			
09:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2.3	1	0	23	4	1	0	0	29	28.7			
09:45	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	0	5	6.3	0	0	14	3	1	0	0	18	18.5			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	7	2	0	2	0	11	13.6	1	0	81	14	4	2	0	102	106			
10:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	8	1	1	0	0	10	10.5			
10:15	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	3	3	0	0	16	2	3	1	0	22	24.8			
10:30	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	2.5	0	0	19	4	1	1	0	25	26.8			
10:45	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	13	4	2	0	0	19	20			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	6	1	1	0	0	8	8.5	0	0	56	11	7	2	0	76	82.1			
11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	4	1	2	0	23	26.1			
11:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	2	1	2	1	20	24.1			
11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	2	0	1	0	13	14.3			
11:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	2	3	1	0	19	21.8			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	10	5	6	1	75	86.3			
12:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	12	6	3	1	0	22	24.8			
12:15	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	1	16	3	0	0	0	20	19.4			
12:30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	14	1	1	0	0	16	16.5			
12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	4	2	0	0	19	20			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	5	0	1	55	14	6	1	0	77	80.7			
13:00	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	16	2	0	0	0	18	18			
13:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	22	2	0	2	0	26	28.6			
13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1.5	0	0	14	0	1	0	0	15	15.5			
13:45	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	15	5	0	3	0	23	26.9			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	5	0	1	0	0	6	6.5	0	0	67	9	1	5	0	82	89			
14:00	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	2.5	0	0	10	4	0	0	0	14	14			
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	6	1	1	0	18	19.8			
14:30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	11	2	0	1	0	14	15.3			
14:45	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	3	2.2	0	0	14	2	2	0	0	18	19			
H/TOT	0	0	0	0	0	0	0	0	0	1	0	5	0	1	0	0	7	6.7	0	0	45	14	3	2	0	64	68.1			
15:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	15	0	2	0	0	17	18			
15:15	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	11	2	2	0	0	15	16			
15:30	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	6	0	0	27	2	0	2	1	32	35.6			
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	2	0	0	0	18	18			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	9	9	0	0	69	6	4	2	1	82	87.6			
16:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	23	0	2	1	0	26	28.3			
16:15	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0	0	20	3	1	1	0	25	26.8			
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1	1	0	0	15	15.5			
16:45	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	0	0	19	3	0	0	0	22	22			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	5	5	0	0	75	7	4	2	0	88	92.6			
17:00	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	2.5	0	0	17	6	0	1	0	24	25.3			
17:15	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	3	4.3	0	0	28	1	0	0	0	29	29			
17:30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	24	2	0	0	0	26	26			
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	1	0	0	21	21.5			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	4	0	1	1	0	6	7.8	0	0	89	9	1	1	0	100	102			
18:00	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	20	3	0	0	0	23	23			
18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	1	0	0	0	23	23			
18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	2	0	0	0	22	22			
18:45	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	18	3	0	0	0	21	21			
H/TOT	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3	0	0	80	9	0	0	0	89	89			
12 TOT	0	0	0	0	0	0	0	0	0	1	0	52	6	6	3	0	68	74.1	1	1	866	139	44	29	3	1083	1144			

C→A								C→B								C→C										
P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU
0	0	8	3	0	1	0	12	13.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	8	2	1	0	0	11	11.5	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	16	2	1	0	0	19	19.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	10	2	0	0	0	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	42	9	2	1	0	54	56.3	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	15	2	1	0	0	18	18.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	20	5	0	1	1	27	29.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	34	4	1	1	0	40	41.8	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1
0	0	30	3	3	0	0	36	37.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	99	14	5	2	1	121	127	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
1	0	15	5	4	0	0	28	29.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	14	5	1	0	0	20	20.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	16	1	1	1	0	19	20.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	15	3	0	2	0	20	22.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	60	17	6	3	0	87	93.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	9	1	0	1	0	11	12.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	9	1	0	0	0	10	10	0	0	0	0	1	0	0	1	1.5	0	0	0	0	0	0	0	0	0
0	0	8	4	1	0	0	13	13.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	12	1	4	0	0	17	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	38	7	5	1	0	51	54.8	0	0	0	0	1	0	0	1	1.5	0	0	0	0	0	0	0	0	0
0	0	10	3	1	1	0	15	16.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	7	3	2	0	0	12	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	8	2	2	0	0	12	13	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	11	2	0	3	0	16	19.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	36	10	5	4	0	55	62.7	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	10	0	2	1	0	13	15.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	14	3	1	1	0	19	20.8	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0
0	0	22	4	1	0	0	27	27.5	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	12	1	0	0	0	13	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	58	8	4	2	0	72	76.6	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0
0	0	12	1	1	1	0	15	16.8	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	16	2	1	1	1	21	23.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	16	3	2	0	0	21	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	5	3	2	1	0	11	13.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	49	9	6	3	1	68	75.9	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	14	2	0	2	0	18	20.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	20	2	1	0	0	23	23.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	20	1	0	0	0	21	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	22	0	0	2	0	24	26.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	76	5	1	4	0	86	91.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	18	3	2	2	0	25	28.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	18	3	2	2	0	25	28.6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1
0	0	21	6	0	1	0	28	29.3	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	18	5	0	0	0	23	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	75	17	4	5	0	101	110	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	1	1
0	0	19	4	1	1	1	26	28.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	18	8	2	1	0	29	31.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	29	7	1	0	0	38	37.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	22	9	0	2	0	33	35.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	88	28	4	4	1	126	134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	18	6	0	1	0	25	26.3	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	24	5	0	2	0	31	33.6	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	34	9	0	1	0	44	45.3	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	28	6	0	1	0	35	36.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	104	26	0	5	0	135	142	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0
0	0	23	4	0	0	0	27	27	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
0	0	26	3	0	0	0	29	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	28	5	0	0	0	33	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	19	3	0	0	0	22	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	96	15	0	0	0	111	111	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
1	1	821	165	42	34	3	1067	1134	0	0	10	1	1	0	0	12	12.5	0	0	1	1	0	0	0	2	2



IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly-Westmeath v2
 Site: Site 4b
 Location: Rochfortbridge R400/R446 Roundabout
 Date: Wed 22-Mar-2023

TIME	A=>A								A=>B								A=>C										
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0	0	0	17	4	0	1	0	22	23.3	0	0	6	1	0	0	1	8	9
07:15	0	0	0	0	0	0	0	0	0	0	0	24	5	0	0	0	29	29	0	0	7	4	0	0	2	13	15
07:30	0	0	0	0	0	0	0	0	0	0	0	21	3	2	1	0	27	29.3	0	0	8	1	0	0	0	9	9
07:45	0	0	1	0	0	0	0	1	1	0	0	21	3	0	1	1	26	28.3	0	0	16	7	1	0	1	25	26.5
H/TOT	0	0	1	0	0	0	1	1	1	0	0	83	15	2	3	1	104	110	0	0	37	13	1	0	4	55	59.5
08:00	0	0	0	0	0	0	0	0	0	0	0	18	9	3	1	0	31	33.8	0	0	21	0	1	0	3	25	28.5
08:15	0	0	2	0	0	0	0	2	2	0	0	22	5	0	0	0	27	27	0	0	47	1	0	0	9	57	66
08:30	0	0	5	0	0	0	0	5	5	0	0	17	3	1	1	0	22	23.8	0	0	70	5	1	0	1	77	78.5
08:45	0	0	1	0	0	0	0	1	1	0	0	9	1	3	0	0	13	14.5	0	0	31	4	0	0	2	37	39
H/TOT	0	0	8	0	0	0	0	8	8	0	0	66	18	7	2	0	93	99.1	0	0	169	10	2	0	15	196	212
09:00	0	0	1	0	1	0	0	2	2.5	0	0	16	4	0	0	0	20	20	0	0	70	3	2	1	0	76	78.3
09:15	0	0	0	0	1	0	0	1	1.5	0	0	19	1	2	2	0	24	27.6	0	0	25	4	0	2	0	31	33.6
09:30	0	0	0	0	0	0	0	0	0	0	0	19	3	1	0	0	23	23.5	0	0	25	2	0	0	0	27	27
09:45	0	0	0	0	0	0	0	0	0	0	0	9	6	1	0	0	16	16.5	0	0	22	2	1	0	0	25	25.5
H/TOT	0	0	1	0	2	0	0	3	4	0	0	63	14	4	2	0	83	87.6	0	0	142	11	3	3	0	159	164
10:00	0	0	1	0	0	0	0	1	1	0	0	7	1	1	0	0	9	9.5	0	0	13	1	0	0	0	14	14
10:15	0	0	0	0	0	0	0	0	0	0	0	12	4	1	1	0	18	19.8	0	0	14	3	1	1	1	20	22.8
10:30	0	0	1	0	0	0	0	1	1	0	0	12	5	1	1	0	19	20.8	1	0	10	1	4	1	0	17	19.5
10:45	0	0	0	0	0	0	0	0	0	0	0	9	3	0	0	0	12	12	0	0	12	3	1	0	0	16	16.5
H/TOT	0	0	2	0	0	0	0	2	2	0	0	40	13	3	2	0	58	62.1	1	0	49	8	6	2	1	67	72.8
11:00	0	0	0	0	0	0	0	0	0	0	0	10	3	1	2	0	16	19.1	0	0	15	0	0	1	0	16	17.3
11:15	0	0	1	0	0	0	0	1	1	0	0	9	2	1	0	1	13	14.5	0	0	17	3	3	0	1	24	26.5
11:30	0	0	1	0	0	0	0	1	1	0	0	7	2	0	1	0	10	11.3	0	0	14	2	1	0	0	17	17.5
11:45	0	0	0	0	0	0	0	0	0	0	0	8	2	4	1	0	15	18.3	0	0	12	3	0	0	1	16	17
H/TOT	0	0	2	0	0	0	0	2	2	0	0	34	9	6	4	1	54	63.2	0	0	58	8	4	1	2	73	78.3
12:00	0	0	0	0	0	0	0	0	0	0	0	11	5	2	1	0	19	21.3	0	0	9	0	0	0	0	9	9
12:15	0	0	0	0	0	0	0	0	0	0	0	11	2	0	0	0	13	13	0	0	24	5	0	0	0	29	29
12:30	0	0	1	0	0	0	0	1	1	0	0	12	1	1	0	0	14	14.5	0	1	16	2	0	1	0	20	20.7
12:45	0	0	0	0	0	0	0	0	0	0	0	10	4	1	0	0	15	15.5	0	0	18	2	0	0	0	20	20
H/TOT	0	0	1	0	0	0	0	1	1	0	0	44	12	4	1	0	61	64.3	0	1	67	9	0	1	0	78	78.7
13:00	0	0	1	0	0	0	0	1	1	0	0	13	3	0	0	0	16	16	0	0	25	2	0	0	1	28	29
13:15	0	0	1	0	0	0	0	1	1	0	0	14	1	0	2	0	17	19.6	0	0	21	0	0	1	0	22	23.3
13:30	0	0	1	0	0	0	0	1	1	0	0	4	0	2	0	0	6	7	0	0	20	1	1	1	0	23	24.8
13:45	0	0	0	0	0	0	0	0	0	0	0	13	3	0	2	0	18	20.6	0	0	35	3	1	0	0	39	39.5
H/TOT	0	0	3	0	0	0	0	3	3	0	0	44	7	2	4	0	57	63.2	0	0	101	6	2	2	1	112	117
14:00	0	0	0	0	0	0	0	0	0	0	0	1	7	3	1	0	12	11.9	0	0	22	4	2	1	0	29	31.3
14:15	0	0	0	0	0	0	0	0	0	0	0	9	4	0	1	0	14	15.3	0	0	30	3	1	0	0	34	34.5
14:30	0	0	0	0	0	0	0	0	0	0	0	5	1	0	1	0	7	8.3	0	0	45	0	0	1	0	46	47.3
14:45	0	0	1	0	0	0	0	1	1	0	0	10	2	2	0	0	14	15	0	0	32	6	0	0	0	38	38
H/TOT	0	0	1	0	0	0	0	1	1	0	0	31	10	3	2	0	47	50.5	0	0	129	13	3	2	0	147	151
15:00	0	0	5	0	0	0	0	5	5	0	0	10	0	2	0	0	12	13	0	0	32	2	0	0	9	43	52
15:15	0	0	1	0	0	0	0	1	1	0	0	10	1	0	0	0	11	11	0	0	26	5	0	0	5	36	41
15:30	0	0	11	0	0	0	0	11	11	0	0	13	2	0	1	0	16	17.3	0	0	14	6	0	1	1	22	24.3
15:45	0	0	1	0	0	0	0	1	1	0	0	10	1	0	0	0	11	11	0	0	16	1	1	2	1	21	25.1
H/TOT	0	0	18	0	0	0	0	18	18	0	0	43	4	2	1	0	50	52.3	0	0	88	14	1	3	16	122	142
16:00	0	0	0	0	0	0	0	0	0	0	0	17	0	1	0	0	18	18.5	0	0	16	3	0	0	0	19	19
16:15	0	0	0	1	0	0	0	1	1	0	0	15	3	0	0	0	18	18	0	0	24	6	0	0	0	30	30
16:30	0	0	0	0	0	0	0	0	0	0	0	8	1	0	0	0	9	9	0	0	26	6	1	1	0	34	35.8
16:45	0	0	0	0	0	0	0	0	0	0	0	14	3	0	0	0	17	17	0	0	33	1	1	0	1	36	37.5
H/TOT	0	0	0	1	0	0	0	1	1	0	0	54	7	1	0	0	62	62.5	0	0	99	16	2	1	1	119	122
17:00	0	0	0	0	0	0	0	0	0	0	0	11	4	0	1	0	16	17.3	0	0	22	6	0	1	0	29	30.3
17:15	0	0	1	0	0	0	0	1	1	0	0	25	1	0	0	0	26	26	0	0	33	7	0	0	0	40	40
17:30	0	0	0	0	0	0	0	0	0	0	0	17	2	0	0	0	19	19	0	0	32	4	0	0	2	38	40
17:45	0	0	0	0	0	0	0	0	0	0	0	17	0	1	0	0	18	18.5	0	0	42	2	0	0	1	45	46
H/TOT	0	0	1	0	0	0	0	1	1	0	0	70	7	1	1	0	79	80.8	0	0	129	19	0	1	3	152	156
18:00	0	0	0	0	0	0	0	0	0	0	0	20	1	0	0	0	21	21	0	0	38	0	0	0	1	39	40
18:15	0	0	0	0	0	0	0	0	0	0	0	18	1	0	0	0	19	19	0	0	25	1	0	0	1	27	28
18:30	0	0	0	0	0	0	0	0	0	0	0	14	1	0	0	0	15	15	0	0	19	4	0	0	1	24	25
18:45	0	0	0	0	0	0	0	0	0	0	0	13	2	0	0	0	15	15	0	0	27	5	0	0	1	33	34
H/TOT	0	0	0	0	0	0	0	0	0	0	0	65	5	0	0	0	70	70	0	0	109	10	0	0	4	123	127
12 TOT	0	0	38	1	2	0	0	41	42	0	1	637	121	35	22	2	818	866	1	1	1177	137	24	16	47	1403	1481

TIME	B=>A								TOT	PCU	B=>B								TOT	PCU	B=>C								TOT	PCU					
	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	P/C			M/C	CAR	LGV	OGV1	OGV2	PSV	P/C	M/C			CAR	LGV	OGV1	OGV2	PSV										
07:00	0	0	8	0	0	1	0	9	10.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2							
07:15	0	0	4	1	1	0	0	6	6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	6								
07:30	0	0	11	1	0	0	0	12	12	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	6								
07:45	0	0	9	1	0	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3								
H/TOT	0	0	32	3	1	1	0	37	38.8	0	0	0	0	1	1.5	0	0	12	5	0	0	0	0	0	0	17	17								
08:00	0	0	16	2	1	0	0	19	19.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1								
08:15	0	0	11	3	0	0	0	14	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	2	16.3								
08:30	0	0	19	4	1	1	0	25	26.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	17								
08:45	0	0	21	4	1	0	0	26	26.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	2	14								
H/TOT	0	0	67	13	3	1	0	84	86.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	3	2	1	1	46	49.3				
09:00	0	0	12	4	3	0	0	19	20.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	3	1	0	0	9	8.1		
09:15	0	0	8	5	1	0	0	14	14.5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	5	0	0	0	5	5	
09:30	0	0	11	0	1	1	0	13	14.8	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	6	1	0	0	7	7	
09:45	0	0	15	2	0	3	0	20	23.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	4		
H/TOT	0	0	46	11	5	4	0	66	73.7	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	19	4	1	0	0	25	24.7
10:00	0	0	6	0	1	1	0	8	9.8	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	3	1	0	0	4	4	
10:15	0	0	8	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	
10:30	0	0	8	4	1	0	0	13	13.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	
10:45	0	0	7	2	2	0	0	11	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	2	0	0	9	10	
H/TOT	0	0	29	6	4	1	0	40	43.3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	11	3	2	0	0	16	17
11:00	0	0	4	1	1	1	0	7	8.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	0	0	8	8	
11:15	0	0	6	2	2	0	0	10	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3	
11:30	0	0	8	1	1	0	0	10	10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	0	0	6	7	
11:45	0	0	10	2	0	3	0	15	18.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	4	4	
H/TOT	0	0	28	6	4	4	0	42	49.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	2	2	0	0	21	22	
12:00	0	0	10	0	2	1	0	13	15.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	
12:15	0	0	12	1	1	1	0	15	16.8	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	5	
12:30	0	0	19	2	1	0	0	22	22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	5	5	
12:45	0	0	8	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	6	6	
H/TOT	0	0	49	3	4	2	0	58	62.6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	3	0	0	0	17	17	
13:00	0	0	7	1	1	1	0	10	11.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	6	
13:15	0	0	10	3	1	1	1	16	18.8	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7	
13:30	0	0	13	1	1	0	0	15	15.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	1	0	0	8	8.5	
13:45	0	0	3	2	1	1	0	7	8.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	0	0	5	5.5	
H/TOT	0	0	33	7	4	3	1	48	54.9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	3	2	0	0	26	27	
14:00	0	0	14	0	0	1	0	15	16.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	1	0	6	7.3	
14:15	0	0	17	2	2	0	0	21	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	6	6	
14:30	0	0	13	1	0	0	0	14	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7	
14:45	0	0	14	0	0	2	0	16	18.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	10	10	
H/TOT	0	0	58	3	2	3	0	66	70.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	3	0	1	0	29	30.3	
15:00	0	0	10	3	1	2	0	16	19.1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	1	0	0	7	7.5	
15:15	0	0	13	3	2	2	0	20	23.6	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	0	0	0	7	7	
15:30	0	0	18	4	0	0	0	22	22	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	3	0	1	0	13	13.7
15:45	0	0	13	2	0	0	0	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	3	0	0	0	8	8	
H/TOT	0	0	54	12	3	4	0	73	79.7	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	24	8	1	1	0	35	36.2
16:00	0	0	16	3	1	0	1	21	22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	1	0	6	7.3	
16:15	0	0	15	6	1	1	0	23	24.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	1	0	0	7	7.5	
16:30	0	1	19	7	2	0	0	29	29.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1	0	0	0	9	9	
16:45	0	0	19	9	0	2	0	30	32.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	4	4	
H/TOT	0	1	69	25	4	3	1	103	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	5	1	1	0	26	27.8	
17:00	0	0	17	4	0	0	0	21	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	1	0	6	7.3	
17:15	0	0	20	6	0	2	0	28	30.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3	
17:30	0	0	24	9	0	0	0	33	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	2	0	1	0	12	13.3	
17:45	0	0	19	7	0	1	0	27	28.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	2	1	0	0	13	13.5	
H/TOT	0	0	80	26	0	3	0	109	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	6	1	2	0	34	37.1	
18:00	0	0	15	4	0	0	0	19	19	0	0	0	0	0																					

C→A									C→B									C→C								
P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU	P/C	M/C	CAR	LGV	OGV1	OGV2	PSV	TOT	PCU
0	0	5	3	0	0	1	9	10	0	0	2	1	0	0	0	3	3	0	0	0	0	0	0	0	0	0
0	0	17	2	0	0	2	21	23	0	0	4	0	0	1	0	5	6.3	0	0	0	0	0	0	0	0	0
0	0	14	2	1	0	0	17	17.5	0	0	8	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0
0	0	12	7	0	0	2	21	23	0	0	7	0	0	0	0	7	7	0	0	0	1	0	0	0	1	1
0	0	48	14	1	0	5	68	73.5	0	0	21	1	0	1	0	23	24.3	0	0	0	1	0	0	0	1	1
0	0	16	5	1	0	1	23	24.5	0	0	6	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0
0	0	26	3	0	1	9	39	49.3	0	0	6	2	0	0	0	8	8	0	0	0	0	0	0	0	0	0
0	0	40	6	0	0	3	49	52	0	0	11	0	0	0	0	11	11	0	0	5	0	0	0	0	5	5
0	0	35	1	0	0	1	37	38	0	0	7	1	1	0	0	9	9.5	0	0	1	0	0	0	0	1	1
0	0	117	15	1	1	14	148	164	0	0	30	3	1	0	0	34	34.5	0	0	6	0	0	0	0	6	6
0	0	46	5	0	1	0	52	53.3	0	0	10	0	0	0	0	10	10	0	0	1	0	0	0	0	1	1
0	0	34	7	0	1	0	42	43.3	0	0	4	2	0	0	0	6	6	0	0	0	0	0	0	0	0	0
0	1	15	1	0	2	0	19	21	1	0	5	1	0	1	0	8	8.5	0	0	0	0	0	0	0	0	0
0	0	14	2	1	1	1	19	21.8	0	0	5	1	0	1	0	7	8.3	0	0	1	0	0	0	0	1	1
0	1	109	15	1	5	1	132	139	1	0	24	4	0	2	0	31	32.8	0	0	2	0	0	0	0	2	2
0	0	6	1	1	1	1	10	12.8	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0
0	0	19	5	0	0	0	24	24	0	0	5	0	2	0	0	7	8	0	0	0	0	0	0	0	0	0
0	0	13	2	2	0	1	18	20	0	0	9	1	2	0	0	12	13	0	0	1	0	0	0	0	1	1
0	0	15	4	0	0	0	19	19	0	0	6	0	1	0	0	7	7.5	0	0	0	0	0	0	0	0	0
0	0	53	12	3	1	2	71	75.8	0	0	22	1	5	0	0	28	30.5	0	0	1	0	0	0	0	1	1
0	0	14	0	0	0	0	14	14	0	0	7	2	0	1	0	10	11.3	0	0	1	0	0	0	0	1	1
0	0	14	3	0	1	0	18	19.3	0	0	3	0	0	1	0	4	5.3	0	0	3	0	0	0	0	3	3
0	0	14	4	1	1	0	20	21.8	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0
0	0	17	4	1	0	0	22	22.5	0	0	6	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0
0	0	59	11	2	2	0	74	77.6	0	0	19	2	0	2	0	23	25.6	0	0	4	0	0	0	0	4	4
0	0	16	3	0	0	0	19	19	0	0	2	1	0	0	0	3	3	0	0	0	0	0	0	0	0	0
0	0	18	4	0	0	1	23	24	0	1	7	0	0	0	0	8	7.4	0	0	1	0	0	0	0	1	1
0	0	23	4	1	0	0	28	28.5	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0
0	1	13	2	0	1	0	17	17.7	0	0	4	1	1	0	0	6	6.5	0	0	0	1	0	0	0	1	1
0	1	70	13	1	1	1	87	89.2	0	1	16	2	1	0	0	20	19.9	0	0	1	1	0	0	0	2	2
1	0	20	3	1	0	0	25	24.7	0	0	4	1	0	0	0	5	5	0	0	1	1	0	0	0	2	2
0	0	26	0	1	0	0	27	27.5	0	0	11	0	0	0	0	11	11	0	0	0	0	0	0	0	0	0
0	0	24	1	0	0	0	25	25	0	0	9	0	0	0	0	9	9	0	0	0	0	0	0	0	0	0
1	0	26	2	0	0	1	30	30.2	0	0	4	2	0	1	0	7	8.3	0	0	0	0	0	0	0	0	0
2	0	96	6	2	0	1	107	107	0	0	28	3	0	1	0	32	33.3	0	0	1	1	0	0	0	2	2
0	0	24	0	1	0	0	25	25.5	0	0	3	2	0	0	0	5	5	0	0	1	1	0	0	0	2	2
1	0	18	2	1	1	1	24	26	0	0	2	2	1	0	0	5	5.5	0	0	0	1	0	0	0	1	1
0	0	20	2	1	0	1	24	25.5	0	0	8	1	0	0	0	9	9	0	0	0	0	0	0	0	0	0
0	0	75	1	0	0	0	76	76	1	0	6	0	0	0	0	7	6.2	0	0	1	0	0	0	0	1	1
1	0	137	5	3	1	2	149	153	1	0	19	5	1	0	0	26	25.7	0	0	2	2	0	0	0	4	4
0	0	21	3	0	0	0	24	24	0	0	5	0	0	0	0	5	5	0	0	1	0	0	0	0	1	1
0	0	13	3	1	0	0	17	17.5	0	0	2	0	2	0	0	4	5	0	0	2	0	0	0	0	2	2
0	0	57	2	0	0	1	60	61	0	0	20	1	0	1	1	23	25.3	0	0	1	1	0	0	0	2	2
0	0	21	3	0	0	0	24	24	0	0	6	1	0	0	0	7	7	0	0	1	0	0	0	0	1	1
0	0	112	11	1	0	1	125	127	0	0	33	2	2	1	1	39	42.3	0	0	5	1	0	0	0	6	6
0	0	30	3	1	0	0	34	34.5	0	0	6	0	1	1	0	8	9.8	0	0	0	0	0	0	0	0	0
0	0	26	2	0	0	0	28	28	0	0	7	1	1	1	0	10	11.8	0	0	1	0	0	0	0	1	1
0	0	24	1	0	1	2	28	31.3	0	0	4	0	1	0	0	5	5.5	0	0	0	0	0	0	0	0	0
0	0	23	2	0	2	1	28	31.6	0	0	5	1	0	0	0	6	6	0	0	1	0	0	0	0	1	1
0	0	103	8	1	3	3	118	125	0	0	22	2	3	2	0	29	33.1	0	0	2	0	0	0	0	2	2
0	0	41	2	0	0	0	43	43	0	0	7	2	1	0	0	10	10.5	0	0	1	0	0	0	0	1	1
0	0	27	4	0	0	1	32	33	0	0	7	0	0	1	0	8	9.3	0	0	0	0	0	0	0	0	0
0	0	13	5	0	0	0	18	18	0	0	8	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0
0	0	31	2	0	0	1	34	35	0	0	2	1	1	0	0	4	4.5	0	0	0	0	0	0	0	0	0
0	0	112	13	0	0	2	127	129	0	0	24	3	2	1	0	30	32.3	0	0	1	0	0	0	0	1	1
0	0	31	1	0	0	0	32	32	0	0	4	1	0	0	0	5	5	0	0	1	0	0	0	0	1	1
0	0	47	3	0	0	1	51	52	0	0	5	0	0	0	0	5	5	0	0	3	1	0	0	0	4	4
0	0	20	2	0	0	0	22	22	0	0	7	1	0	0	0	8	8	0	0	1	1	0	0	0	2	2
0	0	34	1	0	0	1	36	37	0	0	6	1	0	0	0	7	7	0	0	1	0	0	0	0	1	1
0	0	132	7	0	0	2	141	143	0	0	22	3	0	0	0	25	25	0	0	6	2	0	0	0	8	8
3	2	1148	130	16	14	34	1347	1404	2	1	280	31	15	10	1	340	359	0	0	31	8	0	0	0	39	39



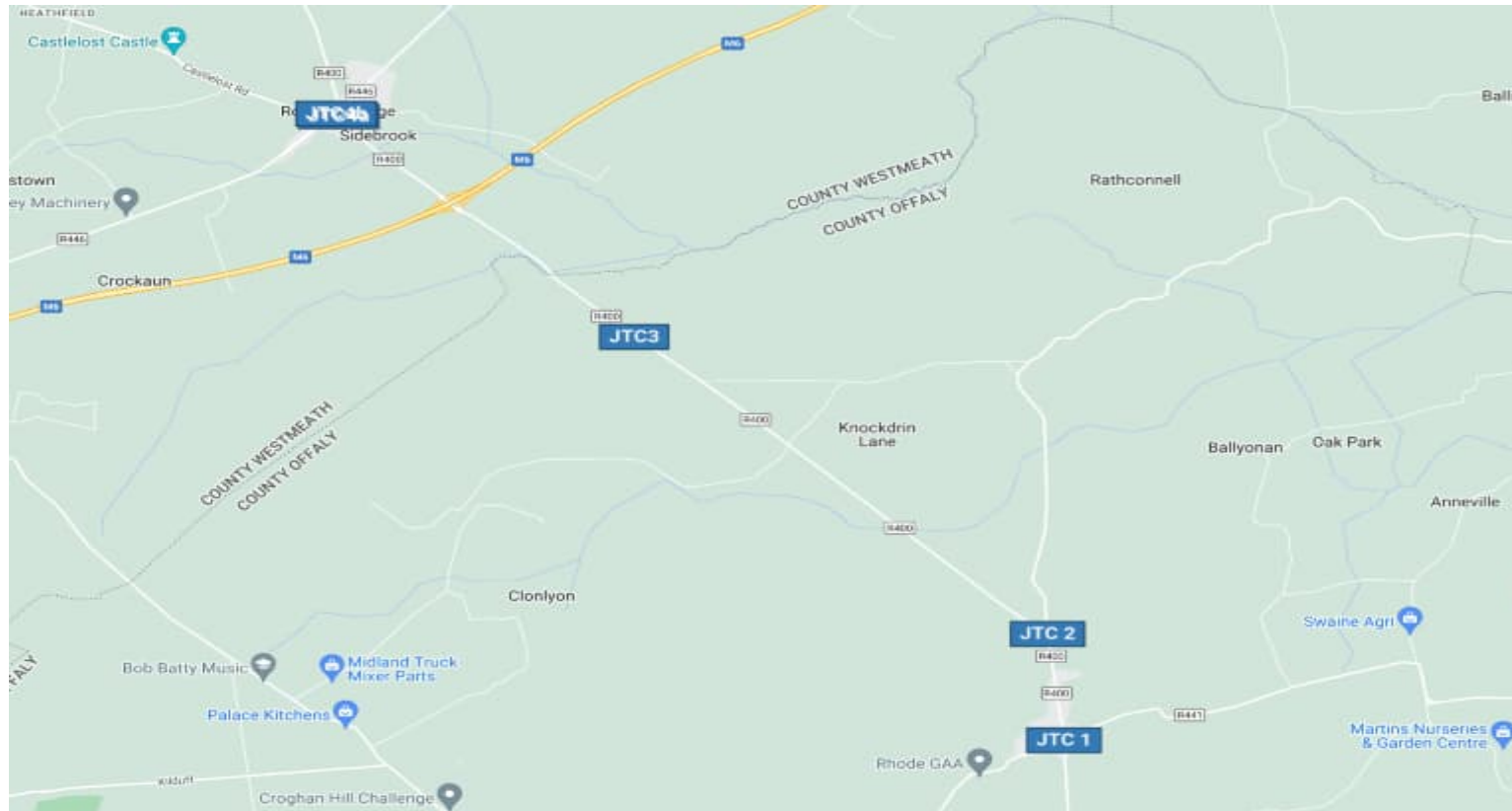
Data Analysis Services
Traffic Transportation - Commercial Innovation

079 23043 Derrygreenagh, Co. Offaly-Westmeath v2 Queue Report

with compliments

IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly-Westmeath v2 Queue Report
Date: Wed 22 Mar 2023





IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly - Westmeath v2 Queue Report
 Site: Site 1
 Location: R400 / R441 crossroads at Rhode, Offaly
 Date: Wed 22-Mar-2023

TIME	A	B	C	D
07:00	0	0	0	0
07:05	0	0	0	5
07:10	0	0	0	5
07:15	0	0	0	0
07:20	0	0	0	0
07:25	0	5	0	5
07:30	0	0	0	5
07:35	0	5	0	0
07:40	20	20	0	15
07:45	0	25	0	0
07:50	0	5	0	5
07:55	0	25	0	15
08:00	0	5	0	10
08:05	0	0	0	0
08:10	0	0	0	0
08:15	0	0	0	10
08:20	0	5	0	10
08:25	0	5	0	5
08:30	0	10	0	10
08:35	0	5	0	5
08:40	0	0	0	5
08:45	0	10	0	5
08:50	0	0	0	5
08:55	0	0	0	5
09:00	0	5	0	10
09:05	0	10	0	15
09:10	0	10	0	10
09:15	0	10	0	5
09:20	0	5	0	10
09:25	0	15	0	5
09:30	0	5	0	0
09:35	0	5	0	5
09:40	0	5	0	5
09:45	0	10	0	5
09:50	0	0	0	5
09:55	0	0	0	0

TIME	A	B	C	D
10:00	0	0	0	0
10:05	0	0	0	0
10:10	5	20	0	0
10:15	0	5	0	5
10:20	0	20	0	10
10:25	0	5	0	5
10:30	0	5	0	0
10:35	0	5	0	5
10:40	0	20	20	0
10:45	0	0	0	5
10:50	0	30	0	0
10:55	0	5	0	20
11:00	0	10	0	10
11:05	0	5	0	5
11:10	0	10	0	5
11:15	0	0	0	5
11:20	0	15	0	10
11:25	0	5	0	0
11:30	0	5	0	5
11:35	0	5	0	5
11:40	0	20	0	5
11:45	0	5	0	0
11:50	0	5	0	20
11:55	0	5	0	5
12:00	20	10	0	20
12:05	0	0	0	5
12:10	0	0	5	15
12:15	0	5	0	5
12:20	0	10	0	10
12:25	0	0	0	5
12:30	0	10	0	10
12:35	0	10	0	0
12:40	0	5	0	5
12:45	0	0	0	0
12:50	0	10	0	0
12:55	0	0	0	5

TIME	A	B	C	D
13:00	5	5	0	5
13:05	0	15	0	5
13:10	0	10	0	5
13:15	0	5	0	0
13:20	0	5	0	0
13:25	0	0	0	10
13:30	0	15	0	10
13:35	0	10	0	5
13:40	0	20	5	10
13:45	0	5	0	10
13:50	0	10	0	10
13:55	0	10	0	5
14:00	0	10	0	5
14:05	5	10	0	5
14:10	15	10	0	10
14:15	0	10	0	0
14:20	0	10	0	10
14:25	5	15	5	10
14:30	0	5	0	5
14:35	0	5	0	5
14:40	0	5	0	5
14:45	0	15	0	5
14:50	0	10	0	10
14:55	0	20	0	5
15:00	0	10	0	5
15:05	20	10	15	30
15:10	0	20	0	5
15:15	0	10	0	5
15:20	0	5	0	5
15:25	0	10	0	5
15:30	0	15	0	5
15:35	0	5	0	5
15:40	0	5	0	5
15:45	0	10	0	5
15:50	0	5	0	0
15:55	0	5	0	0

TIME	A	B	C	D
16:00	0	10	0	5
16:05	0	5	0	0
16:10	0	15	0	5
16:15	0	10	0	5
16:20	0	20	0	10
16:25	5	5	0	5
16:30	30	15	0	15
16:35	0	5	0	5
16:40	0	10	0	5
16:45	0	10	0	5
16:50	0	5	0	5
16:55	0	15	0	15
17:00	0	10	0	10
17:05	0	10	0	10
17:10	0	10	0	15
17:15	0	25	0	5
17:20	0	10	0	5
17:25	0	30	5	5
17:30	0	10	0	10
17:35	0	10	0	5
17:40	0	10	0	5
17:45	0	10	0	10
17:50	15	5	0	5
17:55	0	10	0	5
18:00	0	5	0	0
18:05	0	15	0	5
18:10	0	20	0	5
18:15	0	20	0	20
18:20	0	15	0	5
18:25	0	10	0	5
18:30	0	10	0	5
18:35	0	15	0	15
18:40	0	10	0	5
18:45	0	5	0	5
18:50	0	15	0	5
18:55	0	10	0	0

Queue's are measured in meters

- ⋮⋮⋮⋮⋮⋮ Cannot be seen from camera
- + Signifies queue stretches to a minimum length of x and beyond the view of the camera
- # Signifies queue stretches to the next significant junction
- * Indicates an estimated queue length due to obscured vision.
- M Indicates that the lane ends and the vehicles queuing merged into another lane to queue.

Queue lengths are compiled from CCTV observations and are therefore subject to the limitations of the camera view.



IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly-Westmeath v2 Queue Report
 Site: Site 2
 Location: R400 / Castlejordan Roundabout junction , Offaly
 Date: Wed 22-Mar-2023

TIME	A	B	C	D
07:00	0	0	0	0
07:05	0	0	0	5
07:10	0	0	0	0
07:15	0	0	0	0
07:20	0	0	0	0
07:25	0	0	0	0
07:30	0	0	0	0
07:35	0	0	0	0
07:40	0	0	0	5
07:45	0	0	0	0
07:50	0	0	0	0
07:55	0	0	0	0
08:00	0	0	0	0
08:05	0	5	0	0
08:10	0	0	0	0
08:15	0	0	0	0
08:20	0	0	0	0
08:25	0	0	0	0
08:30	0	0	0	0
08:35	0	0	0	0
08:40	0	0	0	0
08:45	0	0	0	0
08:50	0	5	0	0
08:55	0	0	0	0
09:00	5	0	5	0
09:05	0	0	0	0
09:10	0	0	0	0
09:15	0	0	0	0
09:20	0	0	0	0
09:25	0	0	0	0
09:30	0	0	0	0
09:35	0	0	0	0
09:40	0	0	0	0
09:45	0	0	0	0
09:50	0	0	0	0
09:55	0	0	0	0

TIME	A	B	C	D
10:00	0	0	0	0
10:05	0	0	0	0
10:10	0	0	0	0
10:15	0	0	0	0
10:20	0	15	0	0
10:25	0	0	0	0
10:30	0	0	0	0
10:35	10	0	0	0
10:40	0	0	0	0
10:45	0	0	0	0
10:50	0	0	0	0
10:55	0	0	0	0
11:00	0	0	0	0
11:05	0	15	0	0
11:10	0	0	0	0
11:15	10	0	0	0
11:20	0	0	0	0
11:25	0	5	0	0
11:30	0	15	0	0
11:35	0	0	0	0
11:40	0	0	0	0
11:45	0	0	0	0
11:50	0	0	0	0
11:55	0	0	0	0
12:00	0	0	0	0
12:05	0	0	0	0
12:10	5	0	0	0
12:15	5	0	0	0
12:20	0	0	0	0
12:25	0	0	0	0
12:30	0	0	0	0
12:35	0	0	0	0
12:40	0	0	0	0
12:45	0	0	0	0
12:50	0	0	0	0
12:55	0	0	0	0

TIME	A	B	C	D
13:00	0	0	0	0
13:05	0	0	0	0
13:10	0	0	0	0
13:15	0	0	0	0
13:20	0	0	0	5
13:25	0	0	0	0
13:30	0	0	0	0
13:35	0	0	0	0
13:40	0	0	0	0
13:45	0	0	0	0
13:50	5	0	0	0
13:55	5	0	0	0
14:00	0	0	0	0
14:05	0	0	0	0
14:10	0	0	0	0
14:15	0	0	0	0
14:20	0	0	0	0
14:25	0	0	0	0
14:30	0	0	0	0
14:35	0	0	0	0
14:40	0	0	0	0
14:45	5	0	0	0
14:50	0	0	0	0
14:55	0	0	0	0
15:00	0	0	0	0
15:05	0	0	0	0
15:10	0	0	0	0
15:15	0	0	0	0
15:20	0	10	0	0
15:25	0	0	0	0
15:30	0	0	0	0
15:35	0	0	0	0
15:40	0	0	0	0
15:45	0	0	0	0
15:50	0	15	0	0
15:55	0	0	0	0

TIME	A	B	C	D
16:00	0	15	0	0
16:05	0	0	0	0
16:10	0	0	0	0
16:15	0	0	0	0
16:20	0	0	0	0
16:25	0	0	0	0
16:30	0	0	0	0
16:35	0	0	0	0
16:40	0	0	0	0
16:45	0	15	0	0
16:50	0	0	0	0
16:55	0	5	0	0
17:00	0	0	0	0
17:05	0	0	0	0
17:10	0	0	0	0
17:15	0	0	0	0
17:20	0	0	0	0
17:25	0	5	0	0
17:30	0	0	0	0
17:35	0	0	0	0
17:40	0	0	0	0
17:45	0	0	0	0
17:50	0	0	0	0
17:55	0	0	0	0
18:00	0	0	0	0
18:05	0	0	0	0
18:10	0	0	0	0
18:15	0	0	0	0
18:20	0	0	0	0
18:25	0	0	0	0
18:30	0	0	0	0
18:35	0	0	0	0
18:40	0	0	0	0
18:45	5	0	0	0
18:50	0	5	0	0
18:55	0	0	0	0

Queue's are measured in meters

- ⋯⋯⋯⋯⋯ Cannot be seen from camera
- + Signifies queue stretches to a minimum length of x and beyond the view of the camera
- # Signifies queue stretches to the next significant junction
- * Indicates an estimated queue length due to obscured vision.
- M Indicates that the lane ends and the vehicles queuing merged into another lane to queue.

Queue lengths are compiled from CCTV observations and are therefore subject to the limitations of the camera view.



IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly-Westmeath v2 Queue Report
 Site: Site 3
 Location: R400 / Bord na Mona entrance
 Date: Wed 22-Mar-2023

TIME	A	B	C
07:00	0	0	0
07:05	0	0	0
07:10	0	0	0
07:15	0	0	0
07:20	0	0	0
07:25	0	0	0
07:30	0	0	0
07:35	0	0	0
07:40	0	0	0
07:45	0	0	0
07:50	0	0	0
07:55	0	0	0
08:00	0	0	0
08:05	0	0	0
08:10	0	0	0
08:15	0	0	0
08:20	0	0	0
08:25	0	0	0
08:30	0	0	0
08:35	0	0	0
08:40	0	0	0
08:45	0	0	0
08:50	0	0	0
08:55	0	5	0
09:00	0	0	0
09:05	0	0	0
09:10	0	0	0
09:15	0	0	0
09:20	0	0	0
09:25	0	0	0
09:30	0	0	0
09:35	0	0	0
09:40	0	0	0
09:45	0	0	0
09:50	0	5	0
09:55	0	0	0

TIME	A	B	C
10:00	0	0	0
10:05	0	0	0
10:10	0	5	0
10:15	0	0	0
10:20	0	0	0
10:25	0	0	0
10:30	0	0	0
10:35	0	0	0
10:40	0	0	0
10:45	0	0	0
10:50	0	0	0
10:55	0	0	0
11:00	0	0	0
11:05	0	0	0
11:10	0	0	0
11:15	0	0	0
11:20	0	0	0
11:25	0	0	0
11:30	0	0	0
11:35	0	0	0
11:40	0	0	0
11:45	0	0	0
11:50	0	0	0
11:55	0	0	0
12:00	0	0	0
12:05	0	0	0
12:10	0	0	0
12:15	0	0	0
12:20	0	0	0
12:25	0	0	0
12:30	0	0	0
12:35	0	0	0
12:40	0	0	0
12:45	0	0	0
12:50	0	0	0
12:55	0	0	0

TIME	A	B	C
13:00	0	5	0
13:05	0	0	0
13:10	0	0	0
13:15	0	5	0
13:20	0	0	0
13:25	0	0	0
13:30	0	0	0
13:35	0	0	0
13:40	0	0	0
13:45	0	0	0
13:50	0	0	0
13:55	0	0	0
14:00	0	0	0
14:05	0	5	0
14:10	0	0	0
14:15	0	0	0
14:20	0	0	0
14:25	0	0	0
14:30	0	0	0
14:35	0	0	0
14:40	0	0	0
14:45	0	0	0
14:50	0	0	0
14:55	0	5	0
15:00	0	0	0
15:05	0	0	0
15:10	0	0	0
15:15	0	0	0
15:20	0	0	0
15:25	0	0	0
15:30	0	0	0
15:35	0	0	0
15:40	0	0	0
15:45	0	0	0
15:50	0	0	0
15:55	0	0	0

TIME	A	B	C
16:00	0	0	0
16:05	0	0	0
16:10	0	0	0
16:15	0	0	0
16:20	0	0	0
16:25	0	5	0
16:30	0	5	0
16:35	0	5	0
16:40	0	0	0
16:45	0	0	0
16:50	0	0	0
16:55	0	0	0
17:00	0	0	0
17:05	0	0	0
17:10	0	0	0
17:15	0	0	0
17:20	0	0	0
17:25	0	0	0
17:30	0	0	0
17:35	0	0	0
17:40	0	0	0
17:45	0	0	0
17:50	0	0	0
17:55	0	0	0
18:00	0	0	0
18:05	0	0	0
18:10	0	0	0
18:15	0	0	0
18:20	0	0	0
18:25	0	0	0
18:30	0	0	0
18:35	0	0	0
18:40	0	0	0
18:45	0	0	0
18:50	0	0	0
18:55	0	0	0

Queue's are measured in meters

- ⋮⋮⋮⋮⋮⋮: Cannot be seen from camera
- + Signifies queue stretches to a minimum length of x and beyond the view of the camera
- # Signifies queue stretches to the next significant junction
- * Indicates an estimated queue length due to obscured vision.
- M Indicates that the lane ends and the vehicles queuing merged into another lane to queue.

Queue lengths are compiled from CCTV observations and are therefore subject to the limitations of the camera view.



IDASO

Survey Name: 079 23043 Derrygreenagh, Co. Offaly-Westmeath v2 Queue Report
 Site: Site 4a
 Location: Rochfortbridge R400/Rahanine Junction
 Date: Wed 22-Mar-2023

TIME	A	B	C
07:00	0	0	0
07:05	0	0	0
07:10	0	0	0
07:15	0	0	0
07:20	0	0	0
07:25	0	0	0
07:30	0	0	0
07:35	0	0	0
07:40	0	0	0
07:45	0	0	0
07:50	0	0	0
07:55	0	0	0
08:00	0	0	0
08:05	0	0	0
08:10	0	0	0
08:15	0	0	0
08:20	0	0	0
08:25	0	0	0
08:30	0	0	0
08:35	0	0	0
08:40	0	0	0
08:45	0	0	0
08:50	0	0	0
08:55	0	5	0
09:00	0	0	0
09:05	0	0	0
09:10	0	5	0
09:15	0	0	0
09:20	0	0	0
09:25	0	5	0
09:30	0	0	0
09:35	0	0	0
09:40	0	5	0
09:45	15#	5	0
09:50	0	15	0
09:55	0	5	0

TIME	A	B	C
10:00	0	0	0
10:05	0	0	0
10:10	0	0	0
10:15	0	5	0
10:20	0	0	0
10:25	0	0	0
10:30	0	0	0
10:35	0	0	0
10:40	0	0	0
10:45	0	15	0
10:50	0	0	0
10:55	0	0	0
11:00	0	0	0
11:05	0	0	0
11:10	0	0	0
11:15	0	0	0
11:20	0	0	0
11:25	0	0	0
11:30	0	0	0
11:35	0	10	0
11:40	0	0	0
11:45	0	0	0
11:50	0	0	0
11:55	0	0	0
12:00	0	0	0
12:05	0	0	0
12:10	0	0	0
12:15	0	0	0
12:20	0	0	0
12:25	0	0	0
12:30	0	0	0
12:35	0	0	0
12:40	0	5	0
12:45	0	0	0
12:50	0	0	0
12:55	0	0	0

TIME	A	B	C
13:00	0	0	0
13:05	0	0	0
13:10	0	0	0
13:15	0	0	0
13:20	0	5	0
13:25	0	0	0
13:30	0	0	0
13:35	0	0	0
13:40	0	0	0
13:45	0	0	0
13:50	0	0	0
13:55	0	0	0
14:00	0	0	0
14:05	0	0	0
14:10	0	0	0
14:15	0	0	0
14:20	0	0	0
14:25	0	0	0
14:30	0	0	0
14:35	0	0	0
14:40	0	0	0
14:45	0	5	0
14:50	0	5	0
14:55	0	0	0
15:00	0	5	0
15:05	0	0	0
15:10	0	0	0
15:15	0	0	0
15:20	0	0	0
15:25	0	0	0
15:30	0	5	0
15:35	0	5	0
15:40	0	5	0
15:45	0	0	0
15:50	0	0	0
15:55	0	0	0

TIME	A	B	C
16:00	0	0	0
16:05	0	0	0
16:10	0	0	0
16:15	0	0	0
16:20	0	0	0
16:25	0	0	0
16:30	0	0	0
16:35	0	0	0
16:40	0	0	0
16:45	0	0	0
16:50	0	0	0
16:55	0	5	0
17:00	0	0	0
17:05	0	5	0
17:10	0	0	0
17:15	0	0	0
17:20	0	0	0
17:25	0	0	0
17:30	0	0	0
17:35	0	0	0
17:40	0	0	0
17:45	0	5	0
17:50	0	0	0
17:55	0	0	0
18:00	0	0	0
18:05	0	0	0
18:10	0	0	0
18:15	0	5	0
18:20	0	0	0
18:25	0	0	0
18:30	0	5	0
18:35	0	0	0
18:40	0	0	0
18:45	0	0	0
18:50	0	0	0
18:55	5	0	0

Queue's are measured in meters

- ⋮⋮⋮⋮⋮⋮: Cannot be seen from camera
- + Signifies queue stretches to a minimum length of x and beyond the view of the camera
- # Signifies queue stretches to the next significant junction
- * Indicates an estimated queue length due to obscured vision.
- M Indicates that the lane ends and the vehicles queuing merged into another lane to queue.

Queue lengths are compiled from CCTV observations and are therefore subject to the limitations of the camera view.

TIME	A1	A2	B1	B2	C1	C2
13:00	0	0	0	0	0	0
13:05	0	0	5	0	10	0
13:10	0	10	0	0	0	0
13:15	0	0	0	0	0	0
13:20	0	0	0	0	0	0
13:25	0	0	0	0	0	0
13:30	0	0	0	0	0	0
13:35	0	0	0	0	0	0
13:40	0	0	5	0	0	0
13:45	0	0	0	0	0	0
13:50	0	0	0	0	0	0
13:55	0	0	0	0	0	0
14:00	0	0	0	5	0	0
14:05	0	0	0	0	0	0
14:10	0	0	0	0	0	0
14:15	0	0	0	10	0	0
14:20	0	0	0	0	0	0
14:25	0	0	0	0	0	5
14:30	0	0	0	0	0	0
14:35	0	0	0	0	0	5
14:40	0	0	0	0	0	0
14:45	0	0	0	0	0	0
14:50	0	0	0	0	5	10
14:55	0	0	0	0	0	0
15:00	5	0	0	10	0	0
15:05	0	0	0	0	0	5
15:10	0	0	0	0	0	0
15:15	0	0	5	5	5	0
15:20	0	0	0	0	0	0
15:25	0	0	0	0	0	0
15:30	0	0	5	5	10	0
15:35	0	0	0	0	0	0
15:40	0	0	0	0	0	0
15:45	0	0	5	0	5	0
15:50	0	0	0	0	0	0
15:55	0	5	0	0	0	0

TIME	A1	A2	B1	B2	C1	C2
16:00	0	0	0	0	0	0
16:05	0	0	0	0	0	0
16:10	0	0	0	0	0	0
16:15	0	0	0	0	0	0
16:20	0	0	0	0	0	0
16:25	0	0	0	0	5	0
16:30	0	0	0	5	0	0
16:35	0	0	0	5	0	0
16:40	0	0	0	0	0	0
16:45	0	0	0	5	0	0
16:50	0	0	0	0	0	0
16:55	0	0	0	15#	0	0
17:00	5	0	0	0	0	0
17:05	0	0	0	5	0	0
17:10	0	0	0	0	5	0
17:15	0	0	0	0	0	0
17:20	0	0	0	10	0	0
17:25	0	0	0	0	0	0
17:30	0	0	0	0	0	5
17:35	0	0	0	5	0	0
17:40	0	0	0	0	0	0
17:45	0	0	0	0	5	0
17:50	0	0	5	0	0	0
17:55	0	0	0	5	0	0
18:00	0	0	0	0	0	0
18:05	0	0	0	5	0	0
18:10	0	0	0	0	0	0
18:15	0	0	0	0	0	0
18:20	0	0	5	0	0	0
18:25	0	0	0	0	0	0
18:30	0	0	0	0	0	0
18:35	0	0	0	10	0	0
18:40	0	0	0	0	0	0
18:45	0	0	5	0	0	0
18:50	0	0	0	0	0	0
18:55	0	0	0	0	5	0