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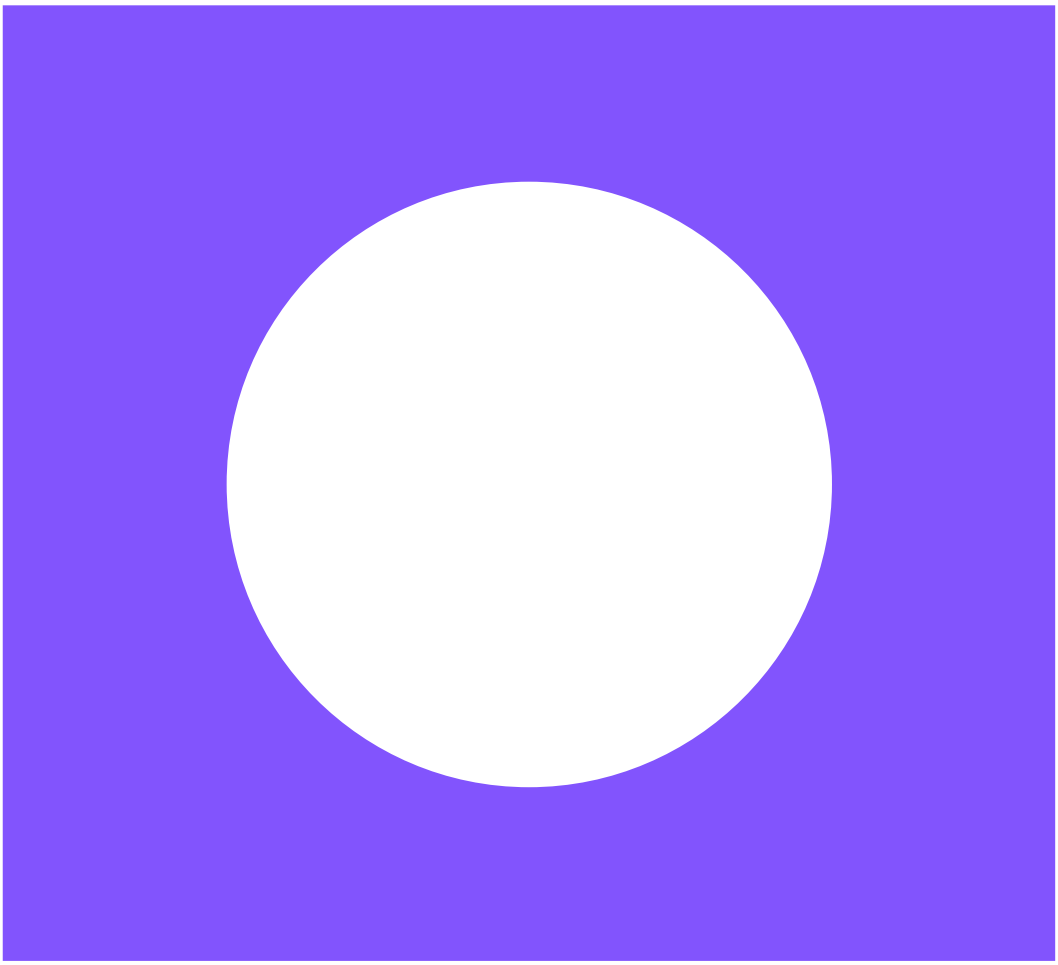

Report External Safety

April 2026

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Report External Safety

April 2026

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	26-08	D. Brinkerink S. Krakers	N. Harrison	Unapproved Draft	Unapproved draft shared for information on progress.
B	07-11	D Brinkerink S Krakers G Allan R Meester	B Wiegand	J Bolck	2nd draft shared for information on progress, including qualitative risk assessment. Detail on hazards now in Appendices. Assessment for Maasvlakte, Sloegebied and Terneuzen to be completed
C	14-11	D Brinkerink S Krakers G Allan R Meester	B Wiegand N Harrison	J Bolck	Approved draft for client review
D	01-05-26	D Brinkerink S Krakers G Allan R Meester	B Wiegand N Harrison	J Bolck	Final submission

Document reference:

Contents

Executive summary

The Ministry of Climate Policy and Green Growth (KGG) is undertaking a site selection process to identify a preferred site for the development of a twin-unit gigawatt scale nuclear plant, henceforth referred to as the Large Nuclear Power Plant (LNNP) programme. Seven sites (with two alternatives) are currently under consideration across four geographical locations. To inform the site selection process this report presents a high-level qualitative assessment of human-induced external hazards and risks in the vicinity of the candidate sites currently being considered. Specifically, this study covers:

- Identification, screening and description of nearby hazardous activities and human-induced events that could arise from these activities.
- A qualitative risk assessment regarding human-induced events that could potentially impact the safety and licensing of a nuclear power plant, using available data and information in the public domain.
- Assigning an overall level of risk to each site regarding human-induced events, and an outline of the possible mitigating actions that should be considered as a priority to lower the risk levels.

The results of the study are presented in Table 1, showing the risk level to each site, the key actions that should be investigated to lower risk, and the key residual risks that will need to be considered in the future evaluation and characterisation of a preferred site. The qualitative risk assessment represents an initial overview of risks, and we strongly recommend that relevant stakeholders, including reactor vendors, developers and regulators, are consulted at the earliest possible stage to build upon this review.

Table 1: Risk level and mitigation

Site	Assumptions	Current risk (after assumptions)	Priority considerations for mitigating risk	Mitigation challenge	Residual risk (after priority considerations) and other licensing risks for later consideration
Eemshaven 1a	- Removal of Vopak, including pipelines and quay infrastructure. - Removal of wind turbines - Removal of PMO Eemshaven (DVVO)	**MEDIUM**	- Relocation of Heliport - Investigation of rail line risk and whether the line needs to be re-routed (or can be accommodated in the design) can be retained. - Site layout & configuration	**MODERATE** - Stakeholder engagement - Commercial negotiation - Decommissioning and reconstruction	**MEDIUM** - All hazardous facilities, including temporary LNG facility - Hazardous transport
Eemshaven 1b	- Removal of wind turbines	**MEDIUM**	- Regulatory engagement and conditional acceptance on proximity of Seveso site (Vopak) and whether physical barriers or spatial separation may be required, and implications for licensing - Site layout & configuration - Relocation of Heliport	**MODERATE** - Stakeholder engagement - Commercial negotiation - Decommissioning and reconstruction (may be CHALLENGING) if Vopak is considered too close and requires removal and relocation)	**LOW** - All hazardous facilities, including temporary LNG facility and PMO Eemshaven - Hazardous transport, including the railway line
Eemshaven 2	- Removal of wind turbines - RWE coal fired power station removed	**VERY HIGH**	- Confirmation of LNG terminal life expectancy - Removal and/or rerouting of existing gas pipelines (providing existing functionality) - Mitigation for pipelines close to Main Area boundary and implications for licensing - Site layout & configuration - Confirmation on whether helipad would need removal or flightpath restrictions - Assessment of Support Area protection measures	**CHALLENGING** - Stakeholder engagement - Commercial negotiation - Decommissioning and reconstruction (may be VERY CHALLENGING if relocation of pipelines is not feasible and RWE Magnumcentrale is no longer viable)	**MEDIUM** - All hazardous facilities - Hazardous transport

Site	Assumptions	Current risk (after assumptions)	Priority considerations for mitigating risk	Mitigation challenge	Residual risk (after priority considerations) and other licensing risks for later consideration
Eemshaven 3	- Removal of wind turbines - Removal of ENGIE Eemscentrale and associated pipelines	**MEDIUM**	- Mitigation for pipelines in proximity to Main Area boundary, or possible relocation is required - Site layout & configuration - Toxic cloud protection design and management measures - Confirmation on whether helipad would need removal or flightpath restrictions - Assessment of Support Area protection measures area	**MODERATE** - Design - Stakeholder engagement - Commercial negotiation - Decommissioning and construction /reconstruction	**LOW** - All hazardous facilities, in particular the temporary LNG facility - Hazardous transport (residual risk LOW assuming LNG facility is confirmed as closed prior to operation)
Maasvlakte II	- Removal of wind turbines	**HIGH**	- Whether physical barriers might be required to mitigate transport explosion risk (space to do this may be challenging), or spatial separation can be achieved through site layout & configuration - Toxic cloud protection design and management measures	**CHALLENGING** - Design - Stakeholder engagement - Commercial negotiation - Construction	**MEDIUM** - All hazardous facilities - Hazardous transport
Sloegebied 1	- Removal of wind turbines	**VERY HIGH**	- Removal /rerouting of hazardous pipeline, rail and road, providing existing functionality, not transferring risk to other locations - Regulatory opinion and conditional acceptance on proximity to Zeeland Refinery -- - Physical barriers or spatial separation through site layout to reduced explosion and fire risk from Zeeland Refinery - Site layout & configuration	**VERY CHALLENGING** - Stakeholder engagement - Commercial negotiation - Decommissioning and construction /reconstruction	**MEDIUM** - All hazardous facilities - Hazardous transport

Site	Assumptions	Current risk (after assumptions)	Priority considerations for mitigating risk	Mitigation challenge	Residual risk (after priority considerations) and other licensing risks for later consideration
Sloegebied 2	- Removal of wind turbines	**VERY HIGH**	- Protection from explosion risk from the VOPAK terminal, the use of barriers and licensing implications of that. Regulatory opinion and conditional acceptance on proximity to Vopak - Site layout & configuration - Removal and relocation of hazardous pipelines that service Sloe Central, ensuring safety to LNNP and existing functionality (or if not closure) - Assessment of Support Area protection measures	**VERY CHALLENGING** - Stakeholder engagement - Commercial negotiation - Decommissioning and construction /reconstruction	**MEDIUM** - All hazardous facilities, including munitions storage - Hazardous transport
Terneuzen 1a		**VERY HIGH**	- Physical barriers required for protection against risks from the Alto and Evos sites, or potential removal of these sites - Protection against explosion and toxic cloud risk from Dow, and regulatory opinion and conditional acceptance on proximity to this site - Site layout & configuration - Assessment of Support Area protection measures	**CHALLENGING** - Stakeholder engagement - Commercial negotiation - Decommissioning and construction /reconstruction	**MEDIUM** - All hazardous facilities, including munitions storage - Hazardous transport
Terneuzen 1b		**MEDIUM**	- Site layout, moving LNNP out of explosion attention area - Toxic cloud protection measures for design and management	**EASY** - Design	**LOW** - All hazardous facilities, including munitions storage - Hazardous transport

Table 2: Future development risks

Site	Future Development Risks	Comments
Eemshaven 1a	Very High	Hydrogen pipelines on or close to site boundaries
Eemshaven 1b	High	Hydrogen pipeline close to one site boundary
Eemshaven 2	Very High	Hydrogen pipelines and other infrastructure including an electrolyser on and/or close to site boundaries
Eemshaven 3	Very High	Hydrogen pipeline on and/or close to site boundaries
Maasvlakte II	Medium	No hydrogen infrastructure close to site but planned for wider area
Sloegebied 1	Very High	Hydrogen pipelines on or close to site boundaries
Sloegebied 2	Very High	Hydrogen pipelines and other infrastructure including on and/or close to site boundaries
Terneuzen 1a	Low	No planned hydrogen infrastructure
Terneuzen 1b	Low	No planned hydrogen infrastructure

1 Introduction

The Ministry of Climate Policy and Green Growth (KGG) is undertaking a site selection process to identify a preferred site for the development of a twin-unit gigawatt scale nuclear plant, henceforth referred to as the Large Nuclear Power Plant (LNNP) programme. Seven sites (with two alternatives) are currently under consideration across four geographical locations. To inform the site selection process this report presents a high-level qualitative assessment of human-induced external hazards and risks in the vicinity of the candidate sites currently being considered. Specifically, this study covers:

- Identification, screening and description of nearby hazardous activities and human-induced events that could arise from these activities.
- Qualitative risk assessment of human-induced events that could potentially impact the safety and licensing of a nuclear power plant, using available data and information.
- Assigning an overall level of risk to each site regarding human-induced events, and an outline of the possible mitigation that may be required to lower this risk.

Section 2 provides an overview of hazardous activities and human-induced events, including the categories of events typically considered (such as fire, explosion, toxic gases and mechanical risks) and examples of accidents within the last 20 years that highlight the potential severity of events that could occur. The data and information used in the study is explained, including the use of the Dutch database on external safety hazards, the 'Atlas Leefomgeving'[1], and international guidance on siting of LNNPs. Finally, the approach and scoring used to give sites a qualitative risk level are explained, along with general types of mitigation that could be employed for key risks, noting this will only be fully understood once further detailed site evaluation and characterisation studies are undertaken.

Section 3 reviews and assesses the risk level for each site, using GIS generated maps to illustrate the interaction of the proposed sites' boundaries with published hazard and risk contours. Key actions that should be considered to reduce present risk levels are provided, as well as the estimated effort to enact these. Key residual risks are highlighted that should be resolved during further site evaluation. Finally, risks concerning future planned (or unplanned) developments are summarised[2].

Section 4 presents the results of the study, stating the risk level to each site, the key actions that should be investigated and the key residual risks that will need to be considered in the future evaluation and characterisation on a preferred site.

The assessment excludes human-induced events concerning accidents because of disturbance to foundations for neighbouring facilities (from work carried out to construct a nuclear power station) as well as failure of structures that may lead to flooding, e.g. the collapse of a dam or dyke. It is understood these events are being assessed elsewhere by KGG in the site selection process.

Human-induced events are also an important consideration for other topics in the siting process, including emergency planning and cooling water infrastructure location. These are also being covered elsewhere in the siting process and are outside the scope of this report.

[1] Refer to: https://www.atlasleefomgeving.nl/thema/veilige-omgeving/externe-veiligheid

[2] These developments concern hydrogen infrastructure. Other developments will also need to be reviewed and assessed at a later stage of development.

2 Human-Induced Events

2.1 Introduction

The siting process is intended to prevent accidents occurring on site arising from hazardous activities, screening out sites for which hazards are significant or could become significant, and sites for which the additional safety measures in design would be excessively demanding to implement. Sites where knowledge is not sufficient to define the hazard or mitigation may also be screened out.[3]

This section describes hazardous activities and human-induced events, outlines how these are screened during a site selection process, and how the available data and information are used to undertake a qualitative assessment of the risks from human-induced events at each site.

2.2 Hazardous activities

The sources of human-induced events can be both stationary and mobile. Hazardous activities relevant to this study include:

- Other nuclear installations
- Oil and gas operations
- Chemical plants
- Processing of hazardous materials, including manufacture and storage of munitions
- Military facilities, permanent or temporary, and especially shooting ranges and arsenals
- High energy rotating equipment
- Hydraulic engineering [4]
- Surface transportation
- Airport zones and harbour zones (military and civilian)
- Air traffic corridors and flight paths
- Mining and quarrying[5]

Electromagnetic interference is also considered a human-induced hazard. In normal circumstances general compliance with EMC Directive 2014/30/EU should mean that the risks are negligible. There is some risk from deliberate action (outside the scope of this study) to create EM interference (sabotage/terrorism/hostile states). Electromagnetic risks should be considered in the plant design and key safety equipment is tested in accordance with IEC 62003:2009 and other standards.

2.3 Human-induced events

Human induced events are potential hazards to the nuclear power station, due to accidents resulting from industrial and commercial activities in the vicinity of the proposed power station. These events are briefly described below.

[3] The availability of information across all nine sites is considered even

[4] It is understood that potential impacts from failure of hydraulic structures are to be considered elsewhere in the site selection programme

[5] Geology and geotechnics criteria are considered in a separate workstream, including any impact on the foundations of neighbouring facilities from the construction and operation of a LNNP

Fires

Where large quantities of flammable or combustible material are present there is a risk of fire. A fire could produce high levels of thermal radiation which could damage the reactor or its auxiliaries or make the site untenable for the operational staff. Fire can also generate smoke clouds which often contain toxic gases which could make the power station untenable for operational staff. There are several types of fire that should be considered:

- **Pool Fire** – occurs when a pool of flammable liquid e.g. petroleum is ignited. Pool fires can be very long lasting.
- **Jet fire** – when a pressurised pipe is damaged and produces a directed jet of flaming gas which can extend over a long distance.
- **Flash fire** – caused when a release of flammable material disperses before igniting. This results in a fast-moving flame front that typically lasts only a few seconds and results in a short burst of intense heat. If the release of flammable material is still on-going a jet fire can result.
- **Fireball** – results from a sudden and widespread release of a flammable gas or volatile liquid that is stored under pressure, coupled with immediate ignition. As with a flash fire the peak effects are short lived.
- **Forest/vegetation fires** – can be included as a human-induced event as they are often started either accidently or deliberately by people.

Explosion

If flammable vapours are released there could be a vapour cloud explosion. For most flammable vapours some form of containment is needed for the release to result in an explosion rather than a fire. The effects of an explosion are:

- **Overpressure** – an explosion can produce a ‘shock wave’ which gives a short duration increase of pressure. This can damage structures and equipment and injure personnel.
- **Missiles** – the explosion can create airborne missiles (projectiles) which can damage equipment and injure personnel.

Explosions can also originate from liquids and solids. In the context of this study the sources of explosion are not considered in any further detail, only the extent of the explosion attention areas provided in the public domain via the ‘Atlas Leefomgeving’ (explained in Section 2.7).

Toxic gases

Where a toxic vapour is released, there is a risk to the personnel operating the nuclear power station. This is of most concern where the toxic vapour is heavier than air (e.g. chlorine) where in certain weather conditions the vapour cloud can drift along the ground over a long distance.

Mechanical risks

Where there is rotating machinery, a failure could lead to missile generation with consequent risk of damage to the power station or auxiliaries. The most apparent risk is wind turbine blade shedding, but steam and gas turbine failure (via disintegration or explosion) could also generate missiles.

Transportation

The potential for transport related accidents that could impact plant and personnel should be considered, particularly related to aircraft but also road, rail and shipping transport modes.

Combination

A combination of explosion, fire, toxic gases, transport and mechanical risks could occur within individual establishments or industrial area as a result of an initiating event spreading across multiple facilities (for example across an industrial zone). Cumulative risk from human-induced hazards for each site is considered in this study to the extent that the quantum of hazards in a location is identified and reviewed, giving a potential indicator of cumulative risk. In the Atlas Leefomgeving', location-based risk contours provide a cumulative risk for fatalities (see Section 2.7). Further assessment at the site characterisation stage would need to consider in detail the cumulative and in-combination risks associated with hazardous facilities and activities.

2.4 Specific Human-induced Events

There are specific risks associated with some of the sites under consideration and surrounding activities that may require special attention.

LNG Terminals and floating storage and regasification units (FSRUs). An accidental release at these facilities could result in a large explosion and fire. In the case of FSRUs liquid natural gas could spread across the sea so that a fire or explosion could affect a larger area.

Hydrogen Generation and Storage Facilities. Hydrogen is generated from electrolysis of water into hydrogen and oxygen. Hydrogen is readily ignited and there is a risk of explosion and/or fire from the electrolysers and hydrogen storage. Hydrogen explosions have a potential to affect a large area.

Hazardous Gas Pipelines. Pipelines that transport hazardous fluids such as natural gas and, in the future, hydrogen have their own safety substantiation and hazardous zones (like Seveso sites) alongside the pipelines.

2.5 Consequences of Fires, Explosions and Toxic gases

The consequences of fires and explosions to people and structures have been investigated by many organisations. There are numerous references that provide standards on levels of thermal radiation and blast over pressure that can be tolerated by people and structures, e.g. TNO Yellow[6] and Green[7] books, USA National Fire Protection Association report NFPA 59A[8] and the International Oil and Gas Producers Association (OGP)[9]. The OGP Risk Assessment Data Directory Report 434-14.1. Table 3 presents information on the effects to personnel and equipment from thermal radiation, and Table 4 presents information on effects from explosion overpressure.

[6] https://repository.tno.nl/DocList?find=ID%20%3E%200&sort=JVP:DESC

[7] https://repository.tno.nl/SingleDoc?find=UID%20b1a78c99-eaba-4e74-9d5e-981a6093fe2e

[8] https://nfpanorm.com/wp-content/preview/59A%202023.pdf

[9] https://www.iogp.org/

Table 3 - Thermal Radiation Effects to Personnel and Equipment

Thermal Radiation (kW/m^2)	Effect
1.2	Received from the sun at noon in summer
2	Minimum to cause pain after 1 minute
Less than 5	Will cause pain in 15 to 20 seconds and injury after 30 seconds' exposure
Greater than 6	Pain within approximately 10 seconds; rapid escape only is possible
12.5	• Significant chance of fatality for medium duration exposure. • Thin steel with insulation on the side away from the fire may reach thermal stress level high enough to cause structural failure. • Wood ignites after prolonged exposure.
25	• Likely fatality for extended exposure. • Spontaneous ignition of wood after long exposure. • Unprotected steel will reach thermal stress temperatures that can cause failure.
35	• Significant chance of fatality for people exposed instantaneously. • Cellulosic material will pilot ignite within one minute's exposure.

Table 4 - Explosion Damage to Structures not Specifically Designed for Blast Resistance

Zone	Damage Level	Over pressure (kPa)
A	Total Destruction	>83
B	Heavy Damage	>35
C	Moderate Damage	>17
D	Minor Damage	>3.5

The level of toxicity of gaseous releases depends on the specific gas involved. Toxicity is usually expressed in terms of maximum safe concentration (Occupational Exposure Limit - OEL) that a worker can be exposed to over a specified period. E.g. OEL -15 is the maximum safe concentration for a 15-minute exposure. In the Netherlands, public set OELs are based on factors like EU directives, risk assessments, and recommendations from the Dutch Health Council. The Social and Economic Council (SER) of the Netherlands maintains a database of OELs. Further details on chemical properties are obtainable from the European Chemical Agency database of registered chemicals.

2.6 Examples of human-induced accidents

There are numerous examples of stationary and mobile human-induced events over the last two decades, a selection of which are presented in Table 5. Whilst the likelihood of such events occurring should be considered low, especially in developed nations where regulation is rigorous (for example via the Seveso III Directive), accidents do continue to occur and with potentially significant consequences. Whilst each of the below events has very specific causes, they illustrate the severity of accidents that can occur, including the risks that missiles and projectiles may present (for which there is no publicly available assessment information in the Netherlands).

Table 5 - Selected accidents originating from hazardous activities.

Site	Event	Key characteristics	Outcomes
Shell Chemical Plant, Moerdijk, NL, 2015	Hydrogeneration Reactor Catastrophic Failure	Explosion, fire and toxic cloud	2 minor injuries
Chemie-Pack, Moerdijk, NL, 2011	Fire outbreak	Fire, explosion, toxic cloud	Disruption to shipping traffic
Philadelphia Energy Solutions refinery, USA, 2019	Leak and subsequent ignition of vapour cloud, resulting in Boiling Liquid Expanding Vapour Explosion (BLEVE)	Multiple explosions, fire (24hrs) and projectiles of fragments up to 17 tonnes, travelling to 610m.	5 minor injuries
Borgo Panigale LPG road tanker, Italy, 2018	Road collision resulting in BLEVE	Explosion and blast overpressure (500 kPa), fireball (170m diameter, 130m height) thermal radiation	2 fatalities, 145 injuries, extensive damage to viaduct and motorway
Hertfordshire Oil Storage Terminal, Buncefield, UK, 2005	Explosion	Multiple explosions, fire (48hrs +), smoke cloud	43 injuries, widespread and significant blast damage, closure of adjacent motorway
Gas pipeline, Ghislenghien, Belgium, 2004	Gas leak from buried pipeline and subsequent explosion	Explosion, fireball and flare (150-200m, temperature up to 3,000º C), spreading fire, projectile of 1 tonne 10m pipeline travelling 150m	24 fatalities, including emergency services, 132 injuries, devastation of industrial zone over a 200m radius. Note that the accident took place next to a construction site where 10s of workers were present.
Research Facility, South Korea, 2019	Oxygen permeating onto hydrogen storage tank, ignition of hydrogen / oxygen mixture with tank	Explosion, fire	2 fatalities, 6 injuries
Enschede, The Netherlands, 2000	Fireworks explosion	Multiple explosions, spreading from building to illegal shipping containers, the largest of which was felt 50km away	23 fatalities, 950 injuries, 400 homes destroyed, 1,500 damaged.

2.7 Data

In this study the 'Atlas Leefomgeving' has been used to provide information across all sites for explosion, fire and toxic cloud events, complimented by available information in the public domain as well as online imagery.

Location-based risk contours

Location-based (or place-based) risk contours are provided by the 'Atlas Leefomgeving' for Seveso sites, hazardous transportation routes and pipelines, and wind turbines. These contours provide the probability per year that a person who is always present at that place, dies because of an accident from a hazardous activity or substance. These contours are generated from a combination of fixed distances and modelling.

The 10^{-6} contour represents the contour where the risk of fatality is greater than 10^{-6} (1 in a million years). Housing is not allowed within the 10^{-6} contour (which could impact any accommodation requirements on sites[10]). Workplaces for up to 50 people are allowed and no occupied development where the risk is greater than 10^{-5}. This has potential implications for both the construction site (where there may be up to 8,000 workers at peak, including office and welfare facilities for at least 10 years) as well as the permanent site where the workforce is likely to the in the region of 1,000.

Attention areas

Attention areas (or focus areas) indicate areas in which people in buildings may not be sufficiently protected against the consequences of accidents of accidents involving hazardous substances without additional measures.

- The explosion contour represents an overpressure of 10kPA (see Table 4, could shatter windows, buckling of steel).
- The fire contour represents thermal radiation of 10kW/m^2 (see Table 3, lower limit of damage to buildings; more than a person could reasonably be expected to escape from).
- Hazardous substances transport attention areas are fixed at 200m for explosion, 30m for fire and 300m for toxic cloud.

Data limitations

The 'Atlas Leefomgeving' does not provide any information on the risks from missiles and projectiles that may occur (because of an explosion). This presents a limitation to the study given the highlighted significance of missiles and projectiles (see Table 5), albeit a limitation that is consistent across all the sites. In this study the explosion attention area is taken as the limit for missiles and projectiles. There is also no information provided on values within the attention areas, which is of importance as in some instances these areas envelope significant parts of the sites.

The information available is not generated specifically for the nuclear industry and may not represent the worst-case scenarios used for nuclear safety case purposes, however it does provide an initial indication as to the level of risk presented by hazardous activities and subsequent events at each site. More detailed evaluation and characterisation will be required once a preferred site (or sites) is identified.

[10] Rules for temporary accommodation for construction projects will need to be confirmed

2.8 Screening and selection criteria

There are no specific Dutch regulations for the siting of LNNPs. As described above there are regulations for siting of residential and workplace buildings. For the screening of hazardous activities, international guidance has therefore been adopted for this study.

2.8.1 IAEA Safety Standards and Guides

IAEA SSR-1 (Site Evaluation for Nuclear Installations)[11] states that potential external hazards associated with natural phenomena, human-induced events and human activities that could affect the site shall be identified through a screening process. It provides guidance on how the external hazards should be evaluated and the types of human-induced events that should be considered in site evaluation. However, it does not give any specific guidance as to the safe distances from such human-induced hazards.

IAEA SSG-35 (Site Survey and Site Selection for Nuclear Installations)[12] provides screening values (distances) for different characteristics of a site that could be used as exclusionary or discretionary criteria at the site survey and selection stage. These are reproduced in Table 6 and represent typical values (values may differ between member states of the IAEA). If a site does not satisfy any one or a combination of screening values, it may still be considered acceptable provided that practicable engineering solutions are available, i.e. design features, measures for physical protection or separation of the site, and administrative procedures.

IAEA SSG-79 (Hazards Associated with Human Induced External Events in Site Evaluation for Nuclear Installations)[13] provides typical generic screening distance values used by some member states for large nuclear power plants with standardised designs. These are also shown in Table 6.

The associated guidance states that these screening values can be used as a basis for identifying source regions centred on a nuclear installation site. These screening distance values are intended to be conservative. When using these values, it needs to be ensured that they are appropriate for the likely human-induced external events that could occur at each source considered.

Table 6 - Typical Screening Values for Human-Induced External Events, IAEA SSG-35 / SSG-79

Characteristic	Screening Value		Criterion
	SSG-35	SSG-79	
Distance from small airports	10km	Not stated	Discretionary
Distance from large airports	16km[14]	Not stated	Discretionary
Distance from military installations or air space usage such as practice, bombing and firing ranges	30km	30km	Discretionary
Distance from military installations storing ammunition	8km	8km	Discretionary

[11] https://www.iaea.org/publications/13413/site-evaluation-for-nuclear-installations

[12] https://www.iaea.org/publications/10696/site-survey-and-site-selection-for-nuclear-installations

[13] https://www-pub.iaea.org/MTCD/Publications/PDF/PUB2036_web.pdf

[14] The value can be less than or greater than 16km depending on the volume of flight operations

Characteristic	Screening Value		Criterion
Distance from facilities for storing or handling flammable, toxic, corrosive or explosive material	5km	5-10km	Discretionary
Sources of hazardous clouds, vapours or gases	8km	8-10km	Discretionary
Sources of fire including facilities that store and produce hydrocarbons, woods or plastics	na	1-2km	Not stated

2.8.2 UK Office of Nuclear Regulation Consultation Zones

The UK Office for Nuclear Regulation (ONR)[15] provides advice to UK planning authorities about certain development applications within consultation zones on and around nuclear sites. Though this is intended advice as to the acceptability of new developments in the vicinity of existing nuclear power stations, it could also be used as guidance as to the acceptability of the siting of a new nuclear power station in close to existing potentially hazardous infrastructure. This guidance has been reviewed[16] . Recommendations arising from ONR guidance are summarised in Table 7 .

ONR recommendations are based on the worst-case consequences of a potential accident. For example, this is different to the consultation zones around SEVESO facilities, which are risk based.

Table 7 - UK ONR Guidance on Developments Near Nuclear Power Stations

Zone	Radius	Excluded Activities
Consultation Zone	3km	Non-SEVESO industrial facilities, major housing developments etc. Energy storage e.g. battery facilities, Explosives. Hydrogen facilities (non-SEVESO), Mining and quarrying (use of explosives etc.). Piling and Tunnelling and major construction and demolition. Major transport infrastructure. Power stations (non-SEVESO). Wind Turbines[17]
Special Development Exclusion	12km	SEVESO sites including LNG Facilities, hazardous pipelines including Carbon Dioxide
Special Case Developments	To be determined based on the development	Major Airports, launch sites, military airspace use and hydraulic fracturing

2.8.3 Criteria to be Used for Site Selection study Screening

Based on the IAEA and ONR guidance above, the screening criteria to be used for the potential nuclear sites are as described in the table below. These are split into the following two zones, with distances given for each type of development in Table 8:

1. Siting priority – The site may potentially unacceptable if hazardous activities are within this zone without further mitigation. This is the focus of this study; hazardous activities and human-induced events within this zone will be identified and qualitatively assessed.
2. Site characterisation – If a hazardous activity is within this zone the development will need to be assessed in detail to ensure that the risks to the future nuclear power station

[15] The ONR is the UK's independent body for regulating nuclear safety and security. The Dutch equivalent of the ONR is the ANVS (Autoriteit Nuclaire Veiligheid en Stralingsbescherming).

[16] Refer to: ONR Ref RRR-099 issue 1.1

[17] There is an assessment provided to show that the maximum hazard distance from current wind turbines is <2km.

are acceptable. However, this is not the focus for the site selection study and would need to be carried out at a later stage as part of site evaluation and characterisation.

Table 8 - Zones for Nuclear Power Station Site Screening Used in the Study

Type of Development	Siting priority (km)	Site Characterisation (km)[18]	Comments
Small Airport/Heliport	8km	16km	
Large Airport	See comment	See comment	Large airports (e.g. Schiphol) have established risk zones – Nuclear power station shall not be built within those zones.
Seveso Site (excluding LNG)	3km	10km	SEVESO sites vary greatly in the nature of the risk. It may be possible to justify closer distances for specific sites.
Major Industrial Site (non-Seveso)	2km	5km	
LNG storage/regasification	5km	10km	
LNG Shipping Routes	2km	5km	
Military Sites where explosives are handled	8km	25km	
Major Transport Links and Ports	2km	5km	Exclusion zone applies to transport systems used for hazardous cargoes
Wind Turbines	2km	4km	Maximum risk radius from current turbine designs is <2km
Hazardous Pipelines	2km	10km	Risks from pipelines vary greatly dependant on the nature of the fluid transported and the operating pressure.
Nuclear Sites	none	30km	Nuclear power stations are often built in close proximity to existing nuclear facilities. But the risks should be evaluated
Wildfires (moor/woodland)	2km	10km	Risk mostly from smoke

2.9 Qualitative Assessment

All sites under consideration in this siting study have some hazardous activities in proximity. Human-induced events are typically classed as discretionary and the existence of these with the siting study zone does not automatically mean that a candidate site should be discounted. Risks at each site will be assessed qualitatively to provide an indicative risk level for each site.

Risk is a combination of likelihood and impact. In this study is it assumed that the likelihood of an accident is very low given regulation of hazardous activities, and therefore the level of risk assigned to each site is a measure of potential impact on the plant, personnel and licencing. The level of impact will be based on professional judgement, combining the following components into a composite level of risk.

[18] The assessment zones, excluding airports, are primarily based on the indicative worst case consequences of accident for the type of man-made hazard. It would be expected that detailed examination of the particular hazards would show that the worst-case consequences would extend to a much shorter distance.

- Proximity to the site – for example a Seveso site 1km from a proposed site is likely to be considered higher risk than if it was 5km from the same site.
- The available information on risk to human life and fire, explosion and toxic cloud attention areas and the extent to which these cover the Main Area for each site (with Support Area and Cooling Water Area both considered too).
- Site context
- Professional judgement for hazards for which there is no available information regarding place-based risk and attention areas, including for future developments.

A risk level will be assigned to each site on a four-category basis (taking account of project assumptions). Given the complexity at some sites, their different contexts, and the number of variables involved, it is difficult to provide definitive definitions for these categories, however general descriptions of these are as follows:

- Very High – hazardous facilities and activities are located within the defined siting study zone, with associated attention area and location-based risk contours covering over 50% of the indicated Main Area (based on visual analysis).
- High – hazardous facilities and activities are located within the defined siting study, with associated attention areas and location-based risk contours covering less than 50% but still significant (e.g. central parts of the Main Area).
- Medium – hazardous facilities and activities are located within the siting study zone, with attention area and location-based contours bordering/covering small or peripheral parts of the site.
- Low – hazardous facilities and activities are located within the siting study zone, but there are no associated attention area or location-based risk contours close to or covering any part of the site.

It should be noted that some flexibility of these definitions is applied in the report, and these are explained in the respective sections below covering the seven sites. As an example, toxic-cloud attention areas cover some sites however there is likely to be a time delay prior to such an event interacting with a site, as opposed to the more instantaneous impacts from explosions and some types of fires. Even this would need site-by-site review if for example the source of toxic cloud was directly adjacent to a site as opposed to several kilometres away.

Considerations to reduce risk will be outlined and the challenge to do so will be estimated (easy, moderate, challenging or very challenging). The measure of effort to enact key mitigation will be based on professional judgement, considering a range of factors, including cost, programme schedule, site layout and impacts on third parties. Given the current uncertainty regarding mitigations required it is not possible to provide estimates for design, cost and schedule impacts. For example, the cost to close a third-party facility, relocate it and /or provide financial compensation may involve lengthy commercial negotiation, the quantum of which is beyond the scope of this study. The report instead highlights such considerations for further investigation in the site evaluation process.

A residual risk level is provided for each site. This assumes that for each site there is confidence that the key considerations for reducing risk can be achieved, resulting in either a medium or low residual risk, based upon a view of the quantum and nature of hazardous facilities and activities that would still need to be thoroughly investigated at detailed site evaluation and characterisation stage, stated in each separate site (and alternative) conclusion.

A limitation in this approach and study is that neither the potential vendors nor the Dutch Nuclear regulator have been involved in this qualitative risk assessment. Ultimately the developer and then operator will need to provide safety cases to the Dutch Nuclear regulator, ANVS, that demonstrates risk from human-induced events is As Low As Reasonably Practicable (ALARP).

2.10 Mitigation for Human Induced Events

The primary containment systems of modern nuclear power stations are designed to resist most external hazards. The risks from human-induced external hazards to the potential nuclear power station are generally related to either:

- Power Station Auxiliaries – potentially effecting the power station grid connections and/or heat sink.
- Operational Staff - potentially effecting the ability to control the power station including safe shut down.

Protection of Power Station Auxiliaries

Redundancy of grid connections and heat sink arrangements would be expected to be incorporated into the power station design to make it unlikely that a single incident would cause a nuclear accident. Passive physical protection measures, such as fire/blast walls could be included (where buildings are not already blast resistant), where relevant, to prevent a fire or explosion outside the site boundary posing a threat to the station auxiliaries. Blast walls are typically constructed of steel or concrete and constructed close enough to contain the original blast (whilst taking care not to create a confined space that could turn what would otherwise be a flash fire into an explosion). This means that the optimum location for any such protection might be on third-party land and not within the site boundary. Continuous physical barriers are able to stop thermal radiation, or alternative active management features could be used, for example water curtains to prevent fires from gas pipeline leaks.

Protection of Site Staff

The ability to operate the power station could be impaired if the operational staff were to be exposed to fire (including smoke), explosion or toxic gas. Preventative measures could be provided in the form of designing control rooms to resist fire and explosion and as toxic refuges. Remote off-site incident management facilities could also be provided. It is expected too that the site would be integrated with wider emergency plans (e.g. for industrial facilities and ports) and the use of alerts and alarms.

Internal Hazards

Protection measures will be required to mitigate against internal hazards, i.e. those hazards from the power station itself. Such internal hazards include fire safety, explosion, internal flooding, steam release, rotating machinery and toxic or corrosive gas releases. The power station design will include measures to protect engineering systems and equipment from damage from these hazards.

These measures are primarily designed to safeguard the public and workers against the possibility of a release of radiation. However, these mitigation measures will also potentially serve to provide protection for the power station from external hazards. For example, structures resistant to internal explosion would have some resistance to external explosion.

Restrictions on Developments Close to a New Nuclear Power Station

When a site has been identified for the new power station it will be necessary to impose restrictions on the area around the power station site to prevent new hazards to the power station being introduced. The UK ONR Consultation Zones (see section 2.5) are examples of zones that are used to control developments in the vicinity of nuclear power stations. The existence of these zones does not necessary prevent all development within the zones, however, the risks from any development to the nuclear power station have to be shown to be sufficiently tolerable and ALARP prior to the development being allowed to proceed. Appropriate consultation zones should be established around the selected power station site as agreed with the regulator.

Licence compliance

The design and mitigation required for demonstration of nuclear safety and compliance with site licence conditions should be the responsibility of the licensee and is not transferrable to a third party. This has implications for example on the use and maintenance of physical barriers that may be deemed necessary to control an explosion originating from a neighbouring facility. Another example may be on-going inspection and maintenance of third-party pipelines that run close to or with the LNNP site boundary, if those pipelines have some impact on site safety.

3 Human Induced Events at the Proposed Power Station Locations

3.1 Eemshaven

Figure 1 shows the location of key hazardous activities identified in relation to the four potential sites in the Eemshaven area. These activities are described below (alongside some other facilities which are not shown on the map) with further details on hazardous activities within the 'siting priority' and 'site characterisation' screening zones contained in the appendices. The implications of these activities for site selection are investigated in subsequent site-specific sections.

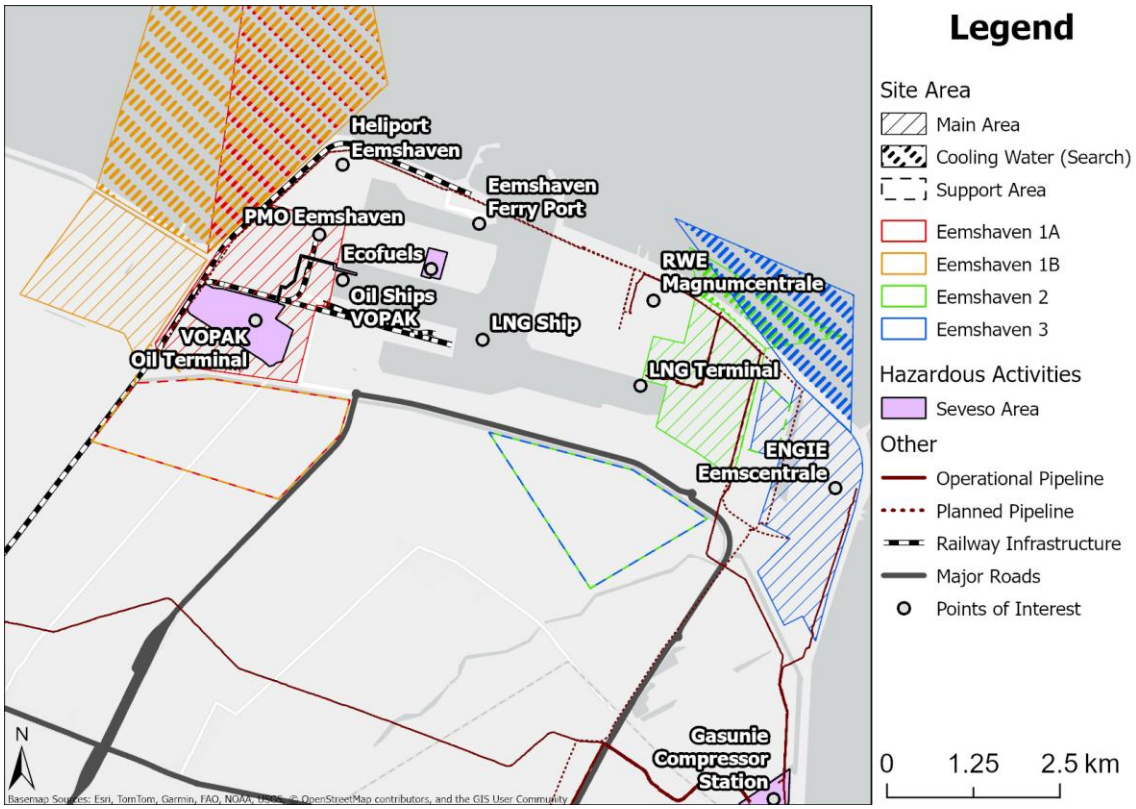

Figure 1 - Hazardous activities, Eemshaven area

Vopak Oil Terminal. The terminal consists of 11 tanks (10 diesel and one petrol) with a capacity of 681,115 m^3. The facility is a Seveso site and includes a pipeline connecting the storage area to an offloading facility in the Julianahaven. There are explosion, fire and toxic cloud attention areas associated with the plant, as well as a 10^{-6} place-based risk to persons. The facility sits within the footprint of the Eemshaven 1a Main Area.

Heliport Eemshaven. The heliport serves offshore vessels, offshore windfarms and oil & gas industry, with around 15 flights per day[19]. The proximity of the heliport to some of the proposed sites increases the risk associated with helicopter accidents on the site.

Ecofuels is a bio-fuel production facility with a production capacity of 160,000 tonnes per annum. It is a Seveso site with an offloading point in the Julianahaven for raw materials delivered by ship. Placed-based risk contours and an attention area for fire are provided for the facility.

Temporary LNG Terminal and LNG ships. The temporary facility consists of two Floating Storage Regasification Units (FSRU's) and is directly adjacent to the Eemshaven 2 Main Area. Maximum capacity is 8 billion m^3 of natural gas per year[20] (the total natural gas consumption Netherlands is approximately 30 billion m^3/year). The total amount of natural gas within the facility is a maximum of 88 tonnes. Approximately 100 LNG carriers per year arrive to the LNG terminal[21]. The largest LNG carrier in the world has a capacity of 266,000m^3 LNG[22].

The closing date of the LNG terminal is not yet decided; further decision making is expected in 2026 on continuation of operations beyond September 2027, which would require a final investment decision [23]. Whilst it is currently considered unlikely that the facility would overlap with the operation of a LNNP in the Eemshaven, this needs confirmation, and it may be a consideration during the construction period. Assessment areas for fire and explosion are provided for the LNG terminal (but are not shown in figures). These areas both have a radius of around 550m from the terminal.

PMO Eemshaven. A military facility which appears to be for offloading equipment rather than used for any type of munitions store or shooting range. The facility sits within the footprint of Eemshaven 1a. Neither risk contours nor attention areas are available for the facility.

Roads and rail. Hazardous substances are transported along the Kwelderweg (which runs along the port's southern boundary). Although only the Kwelderweg is officially listed as a 'risk' zone for road transport (place-based risk contours and attention areas are available) other nearby roads could also present risks if hazardous substances are being transported, including roads within and outside the port. There are no attention areas connected to the railway lines in the Eemshaven area. The passenger line runs northeast along the boundaries of Eemshaven 1a and 1b to the ferry port, whilst a branch line runs to the Julianahaven and Emmahaven.

Gasunie Compressor Station. The compressor station (4 compressors) supplies a natural gas pipeline and is categorised as a Seveso site. Place-based and attention area risk contours are available for the pipelines associated with the facility.

RWE Magnumcentrale. Gas fired power plant (1.300MW_{el}). It is understood that this can be converted to use hydrogen in the future. Place-based and attention area risk contours are not available for the station.

ENGIE Eemscentrale. Gas fired power plant (1.750MW_{el}). Place-based and attention area risk contours are available for the station, and for the connecting pipelines. It is assumed this station would be removed if Eemshaven 3 is taken forward.

[19] https://www.groningen-seaports.com/wp-content/uploads/Offshore-wind-brochure-versie-9.pdf

[20] Source: https://www.gasunie.nl/projecten/eemsenergyterminal

[21] Source: https://www.rtvnoord.nl/nieuws/1067027/lng-terminal-ligt-een-jaar-in-eemshaven-het-verloopt-perfect

[22] Source: https://www.lngindustry.com/lng-shipping/31102016/nakilat-takes-over-management-of-mozah-lng-carrier/

[23] Source: https://www.eemsenergyterminal.com/nl/laatste-nieuws/open-season-voor-verlenging-eemsenergyterminal-afgerond

Existing pipelines. There are existing gas pipelines in the eastern part of Eemshaven, connecting the Gasunie compressor station, RWE Magnumcentrale, the floating LNG terminal and ENGIE Eemscentrale. Place-based contours and attention area risk contours are available

Wind turbines. Figure 2 illustrates the number of wind turbines present across the Eemshaven area. Subsequent sections outline the number of turbines that interact with each site at the 10^{-6} place-based contour and that would therefore need to be removed. Further detail on individual turbines for each location is presented in the appendices.

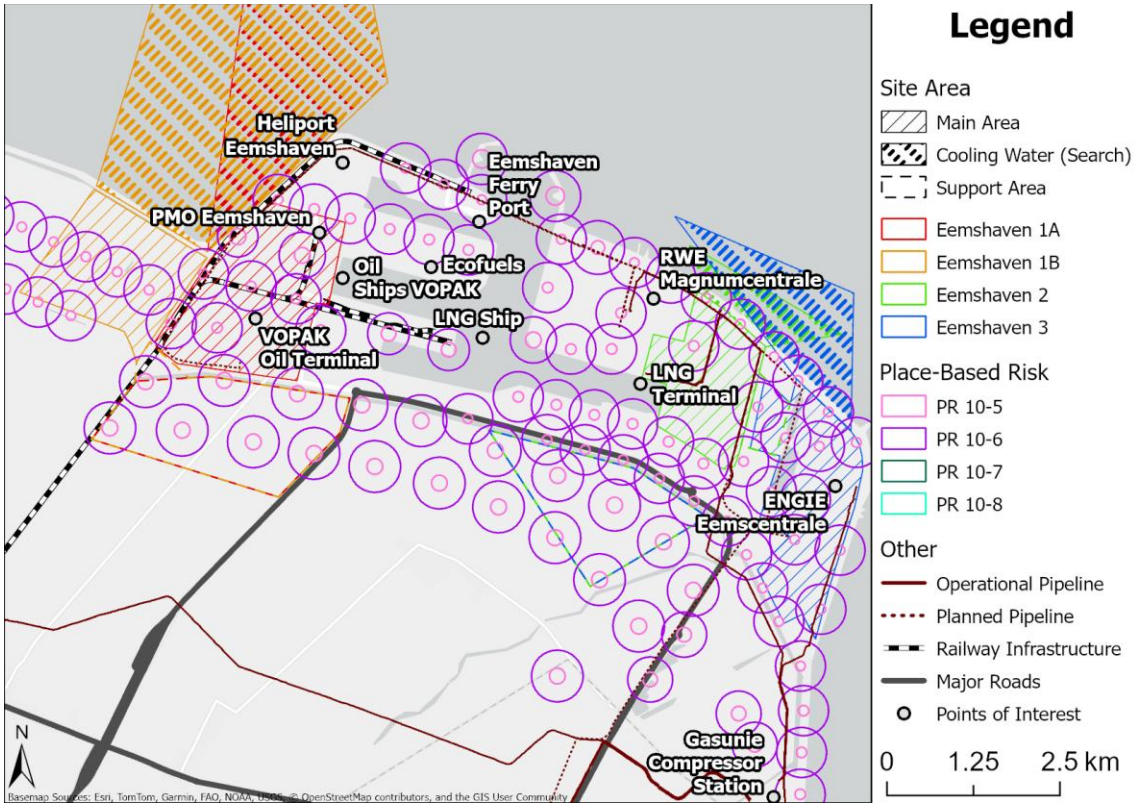

Figure 2 - Wind turbines in the Eemshaven area

Future Activities

- **RWE Eemscentrale** is a coal fired power plant (1,560MW_{el}) that sits within the footprint of the Eemshaven 2 site. The use of coal is to be banned in the Netherlands from 1 January 2030. There is the possibility of converting the station to biomass[24] and/or the planned **Eemshydrogen** 50MW electrolyser.
- **Planned pipelines**. Gasunie has planned new hydrogen pipelines in areas, either close to or within proposed sites boundaries[25]. Based on available information[26], this pipeline will form part of the Dutch hydrogen backbone and will be operated at a 66.2 bar(g) pressure. Further details are not known at this moment. Risk contours are not available for these pipelines.
- **RWE Magnumcentrale.** It is understood that this can be converted to use hydrogen in the future.

[24] https://benelux.rwe.com/locaties-en-projecten/eemshavencentrale/

[25] Source: https://www.gasunie.nl/omgevingsloket/voor-organisaties

[26] Source: https://www.rvo.nl/sites/default/files/2025-02/Bijlagedocument-Externe-Veiligheid-Waterstofnetwerk-Drenthe-Overijssel.pdf

3.1.1 Eemshaven 1a

Figure 3 shows the key hazardous industry and activity in the vicinity of the Eemshaven 1a site. An expanded list is included within Appendix A.1. Figure 4 shows the place-based 10^{-6} contour and Figure 5 shows the attention areas for explosion, fire and toxic clouds.

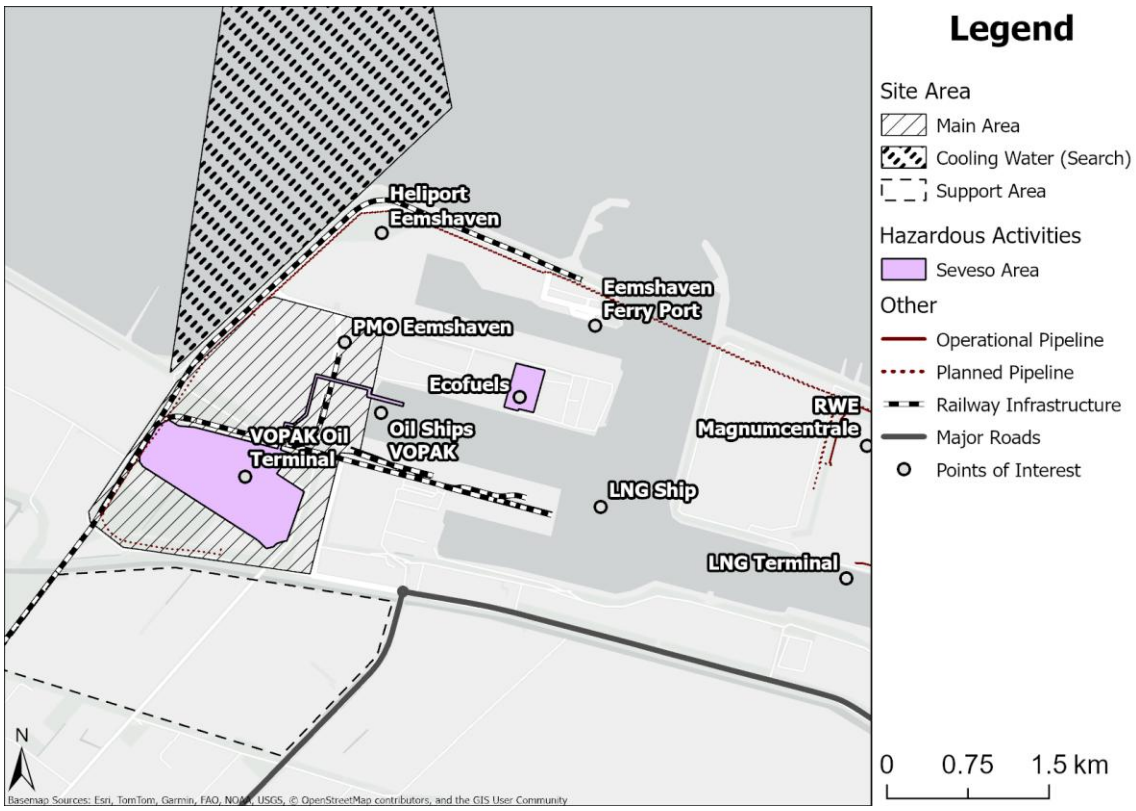

Figure 3: Hazardous activities, Eemshaven 1a

Vopak Oil Terminal. The Vopak terminal occupies a significant proportion of the Main Area. The 10^{-6} placed-based risk contour covers a large part of the site, whilst attention areas for explosion, fire and toxic clouds also cover a large proportion of the site, particularly in the central part. The terminal would require complete removal for the site to be viable, and so it is assumed that it will be removed if the site is selected, also removing risks concerning ships delivering oil to the terminal.

Heliport Eemshaven. Approximately 600m from the site boundary (well within the 8km screening zone). The risk of a helicopter failure and accident that could impact the site both during construction (significant with workforce numbers and cranes) and operation may not be tolerable. Relocation of the heliport to another site within the Eemshaven may then be required.

Ecofuels. The extent of the place-based contours and attention areas suggest the Ecofuels facility presents a low risk to the Main Area. There may be some risk associated with ships delivering raw materials to the site via an offloading pipeline serving the facility (c. 1km).

Temporary LNG Terminal and LNG ships. The temporary facility is approximately 2.7km from the Main Area site boundary (and 2.3km from the Support Area). Fire and explosion attention areas do not overlap with either the Main Area or Support Area (approximately 2km distance between the attention areas Eemshaven 1a) and is therefore not considered a high risk. Given the terminal's location it is unlikely LNG ships will pass closer to site than the distances outlined for transport attention areas in Section 2.7.

PMO Eemshaven. The military facility is within the Main Area footprint and would likely need to be removed and/or relocated as part of the site development[27].

Roads and rail. The explosion, fire and toxic cloud attention areas for hazardous substances transport along the Kwelderweg do not extend to the Main Area and are therefore not considered a high risk. Explosion and toxic cloud contours do overlap a small section of Support Area, and this would need to be further considered along with any potential for missiles/projectiles to impact that area. Other road (and rail) infrastructure, including the N46 would need further consideration at a later stage (for example transport of raw materials to Ecofuels), including any new roads constructed to service the site.

The railway line runs along the western boundary of the Main Area. Although it is not thought this line carries any hazardous substances (it runs to the ferry terminal and no risk contours or attention areas are provided), accidents would need to be assessed if the site is taken forward (rail line may need to move anyway, as part of the site development). The branch line running to the Julianahaven and Emmahaven would likely need to be rerouted around the site

Wind turbines. There are 14 wind turbines where the 10^{-6} contour has some interference with the Main Area, and a further 5 with some interference with the Support Area. It is assumed that these would need to be removed.

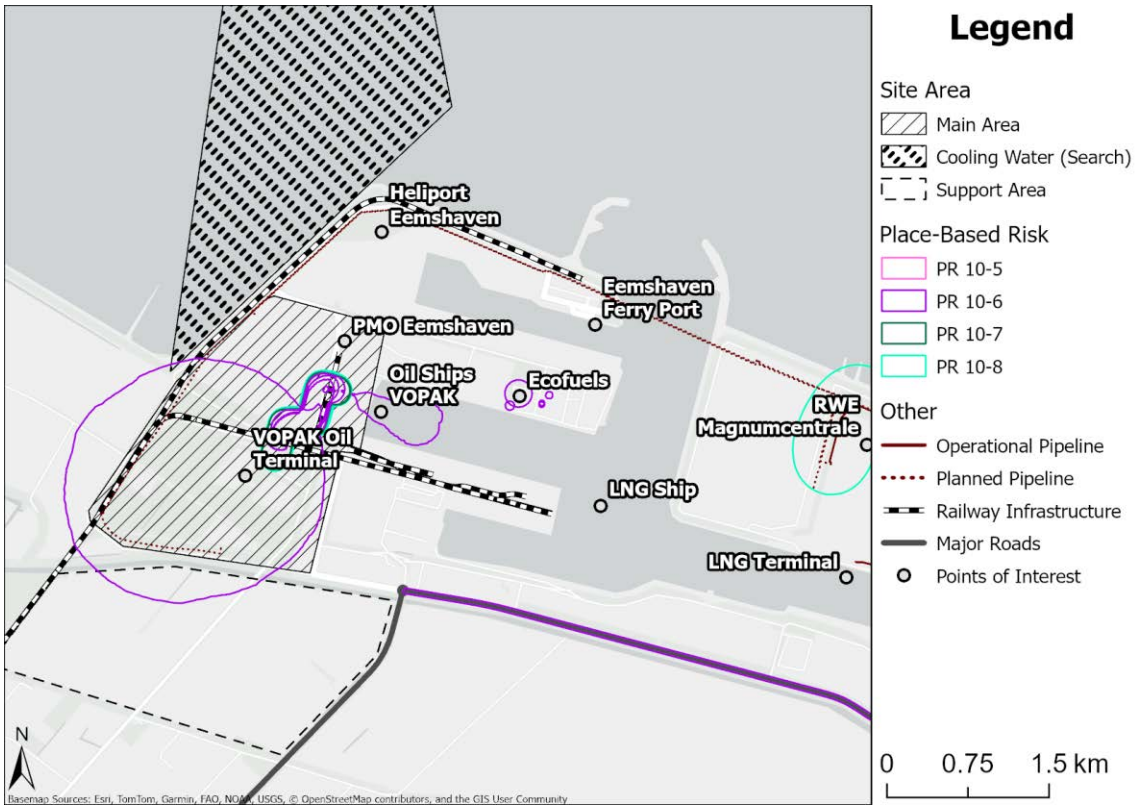

Figure 4 – Place-based risk, Eemshaven 1a

[27] The presence of a military site may require consideration from a security perspective

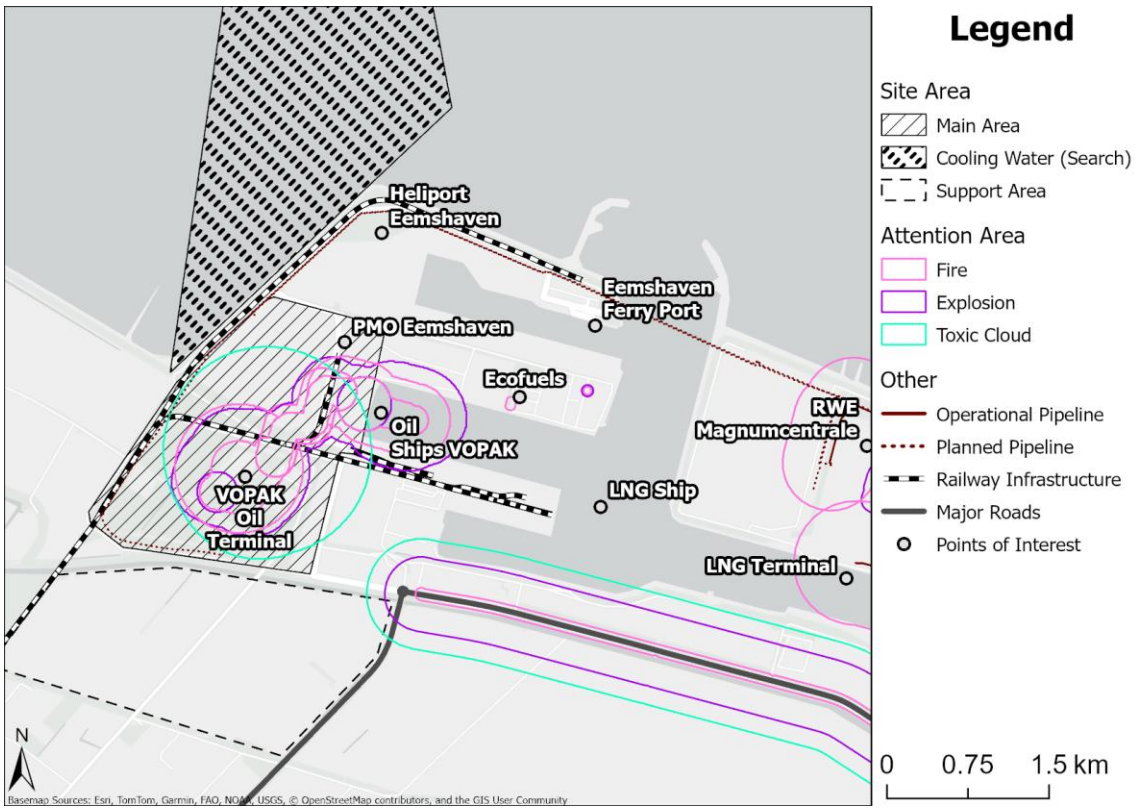

Figure 5: Attention areas, Eemshaven 1a

Conclusion

Assuming the Vopak terminal is removed along with PMO Eemshaven and all wind turbines, the remaining hazardous activities in the area are likely to present a **medium risk** to the Main Area and permanent development. This level of risk could be reduced by considering the following key points:

- Removal and relocation of the heliport.
- Investigation of rail line risks (e.g. derailing) and whether the line would need rerouting (to the ferry port).

The above actions would require engagement with necessary stakeholders, with planning, commercial negotiation and reconstruction required and would likely represent a **moderate level of effort**.

Residual risk is considered medium. Residual risks that would need to be addressed later in the programme including:

- Appropriate assessment and management of road, rail and shipping risks (given the site's proximity to the port, the wider road network and the rail lines serving the port)
- Further assessment of the few hazardous activities within the 'siting study', and activities within the wider 'site characterisation' zone, for detailed site evaluation and characterisation, including and particularly the LNG terminal if its operation continues.

Future activities

- **Planned pipelines.** Gasunie has planned a new hydrogen pipeline close (<0.05km) to the site's western boundary[28]. Exact details are not known at this moment however this development could present a **very high risk** to the Main Area (and if in place, to parts of the Support Area), particularly from ignition and subsequent explosion. The route of the pipeline may clash with features such as cooling water infrastructure, critical to the safe and commercial operation of the plant and therefore would likely need to be rerouted.

3.1.2 Eemshaven 1b

Figure 6 shows the key hazardous industry and activity in the vicinity of the Eemshaven 1b site. An expanded list with details is included within Appendix A.2. Figure 7 shows the place-based 10^{-6} risk contour and Figure 8 shows the attention areas for explosion, fire and toxic clouds.

Figure 6: Hazardous activities, Eemshaven 1b

Vopak Oil Terminal. Unlike for Eemshaven 1a, it is not assumed that the Vopak terminal would automatically require complete removal for site viability. The terminal is adjacent to the Main Area with the storage tanks around 0.5km from the site boundary. The site is also approximately 0.5km from the Support Area boundary. The placed-based 10^{-6} risk contour extends into a small section of the eastern part of the Main Area. Attention areas for explosion, fire and toxic clouds do not extend to either the Main Area or Support Area, and it is considered unlikely that missile/projectiles would extend significantly further than the approximate 350m radius for fire or

[28] Source: https://www.gasunie.nl/omgevingsloket/voor-organisaties

explosion attention areas (although this would need further assessment at site characterisation stage). There is also a 25MW solar farm on the Vopak site (based on review of online imagery). Solar farms are associated with some hazards, specifically fire due to panel malfunction.

Given the information available the terminal should be considered a medium risk at present, requiring further evaluation at site characterisation stage to assess whether mitigation such as spatial or physical barriers would be required. The size and location of the Main Area may mean there is scope to locate the LNNP further to the west providing further an adequate degree of separation if required.

Heliport Eemshaven. Approximately 1.5km from the Main Area boundary, the risk of helicopter failure and accident that could impact the site both during construction (potentially more significant with workforce numbers and multiple crane) and operation may not be tolerable. Relocation of the heliport to another location within the Eemshaven may therefore be necessary.

Ecofuels. 2km from the Main Area, the available information suggests Ecofuels presents a low risk, including any risk from ships delivering raw materials to the facility.

Temporary LNG Terminal and LNG ships. The temporary facility is approximately 3.75km from the Main Area, and fire and explosion attentions areas are approximately 3.25km away. Given the terminal's location it is unlikely LNG ships will pass closer to site than the distances outlined for transport attention areas in Section 2.7.

PMO Eemshaven. The facility is approximately 1km from the Main Area. It is likely to present a low-level risk but should be assessed further at site characterisation stage[29].

Roads and Rail. The explosion, fire and toxic cloud attention areas for hazardous substances transport along the Kwelderweg do not extend to the Main Area and are not considered high risk. The explosion and toxic cloud contours do overlap a small section of Support Area, and this would need to be further considered along with any potential for missiles and projectiles (the latter could be mitigated by appropriate barriers). Other road (and rail) infrastructure, including the N46 would need further consideration at a later stage of development (for example transport of raw materials to Ecofuels), including any new roads constructed to service the site. The railway line runs along the eastern boundary of the Main Area and although it is not thought this line carries any hazardous substances (it runs to the ferry terminal), train accidents such as derailing would need to be assessed if the site is taken forward. Moving site layout to the west would reduce likely any risk associated with the rail line.

Wind turbines. There are 9 wind turbines for which the 10^{-6} contours have some interference with the Main Area, and a further 8 with some interference with the Support Area. It is assumed that these would need to be removed.

[29] The presence of this facility may require attention from a security perspective.

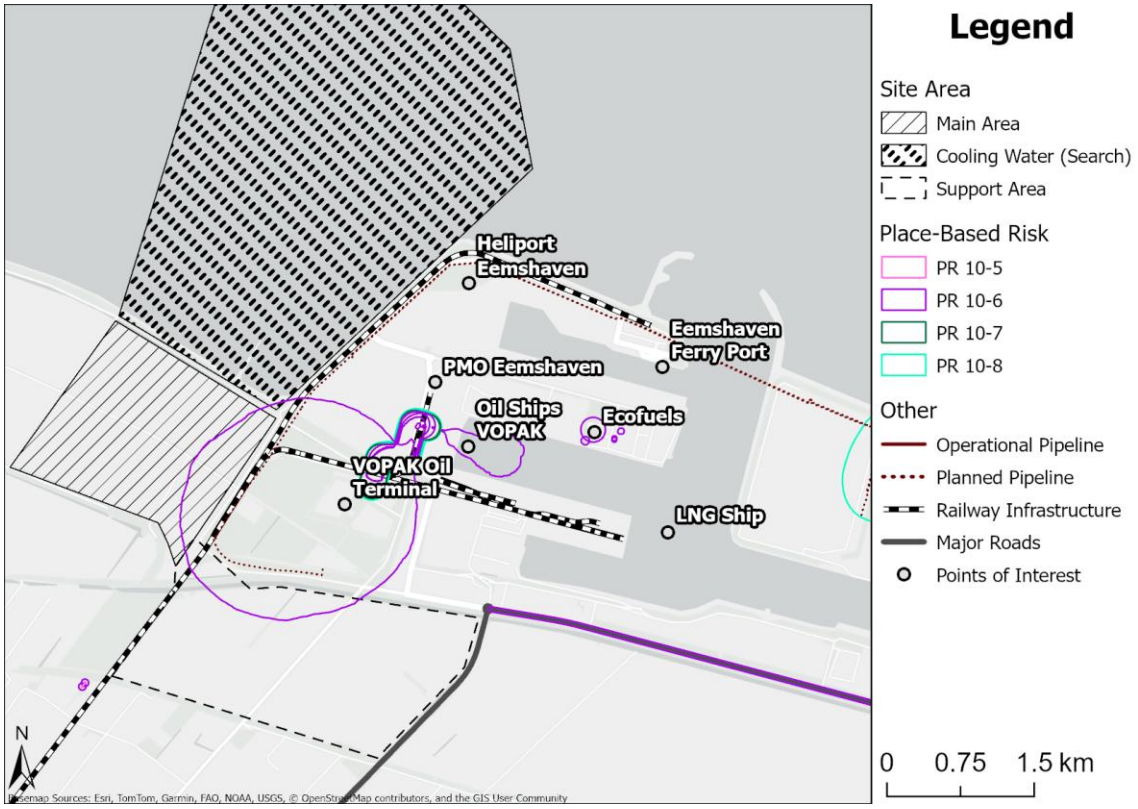

Figure 7: Place-based risk, Eemshaven 1b

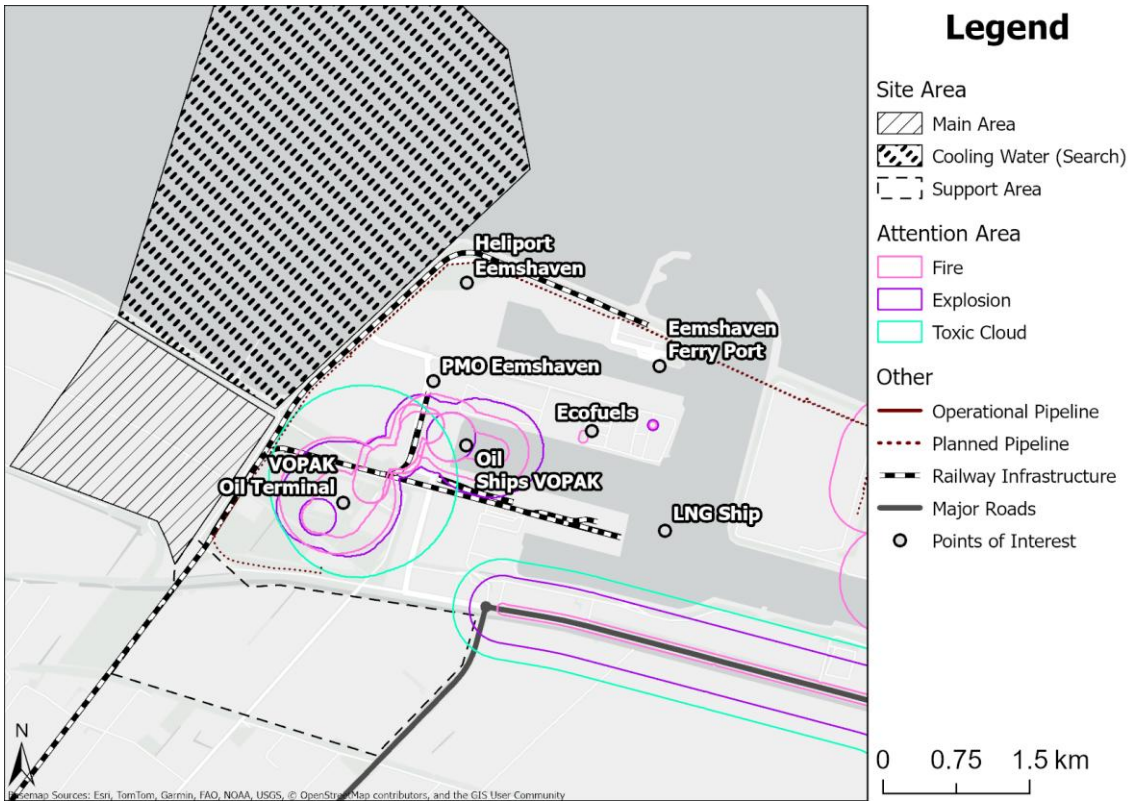

Figure 8 - Attention areas, Eemshaven 1b

Conclusion

Assuming all wind turbines are removed the remaining hazardous activities in the area are likely to present a **medium risk** to the Main Area. This level of risk could be reduced by considering the following key points:

- Regulatory advice on building in proximity of the Vopak terminal.
- Implementation of barriers as mitigation between the Vopak terminal and the LNNP. Spatial separation by locating the LLNP to the west of the Main Area would be preferrable as opposed to use of physical barriers whose optimum location may be on third-party land. Use of barriers on third-party land would need regulatory advice.
- Removal and relocation of the heliport.

The above actions would require engagement with necessary stakeholders, planning, commercial negotiation and reconstruction and would likely represent a **moderate level of effort**.

Residual risk is considered low. Residual risks that that would need to be addressed later in the programme include:

- Appropriate assessment and management of road, rail and shipping risks (the alternative site is farther away than Eemshaven 1a from the main road network, rail network serving the port and ships entering the port).
- Further assessment of the few hazardous activities with the ‘siting study’ zone, and activities within the site characterisation zone, for detailed site evaluation and characterisation.

Future activities

- **Planned pipelines.** Gasunie has planned a new hydrogen pipeline close (<0.05km) to the Main Area’s eastern boundary[30]. Exact details are not known at this moment however this development could present a **high risk** to parts of the Main Area (and if in place, to parts of the Support Area), particularly from ignition and subsequent explosion. The route of the pipeline may clash with features such as cooling water infrastructure, critical to the safe and commercial operation of the plant. Relocation of the planned pipeline may be required or site layout moving to the west of the Main Area.

3.1.3 Eemshaven 2

Figure 9 shows the key hazardous industry and activity in the vicinity of the Eemshaven 2 site. An expanded list with detail is included within Appendix A.3. Figure 10 shows the place-based 10^{-6} place-based contour and Figure 11 shows the attention areas for explosion, fire and toxic clouds.

[30] Source: https://www.gasunie.nl/omgevingsloket/voor-organisaties

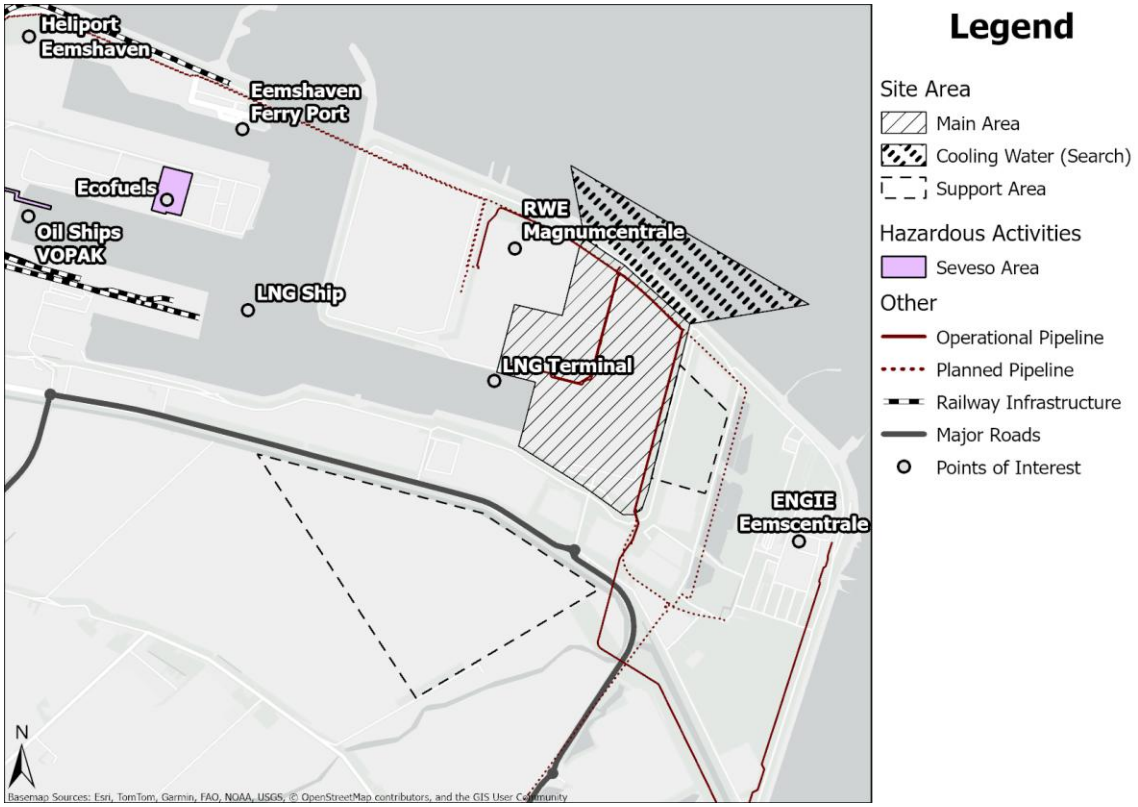

Figure 9: Hazardous activities, Eemshaven 2

Heliport. Approximately 3.25km from the site boundary, the risk of helicopter failure and accident that could impact the site both during construction and operation may not be tolerable. Relocation of the heliport to another location within the Eemshaven may therefore be necessary, or appropriate flight restrictions put in place.

LNG Terminal, ships and pipeline. The temporary facility is directly adjacent to the Main Area (and less than 1km from the Support Area). Fire and explosion attention areas (not shown in Figure 11) cover a large section of the Main Area and should be considered very high risk, almost certainly needing removal (if not already shut down). The pipeline serving the facility has a fire attention area covering most of the Main Area and would require removal (would likely be redundant once LNG terminal is shut).

RWE Magnumcentrale. The gas-fired station is directly adjacent (c. 0.25km) to the Main Area**.** There are no location-based risk or attention area contours specific to this facility, although there are contours associated with the pipelines serving the station, the fire attention area of which covers a large part of the Main Area. The risk from gas turbine explosion is considered low but would need to be assessed and barriers put in place (if deemed necessary) during later site evaluation and characterisation.

Engie Eemscentrale. The gas fired station is less than 1km from the Main Area and Support Area. No risk contours are provided for the station, and it may be sufficiently far away not to present a high risk. The risk from gas turbine explosion is considered low but would need to be assessed at a later stage of development and appropriate mitigation, such as physical barriers or spatial separation, deployed if required.

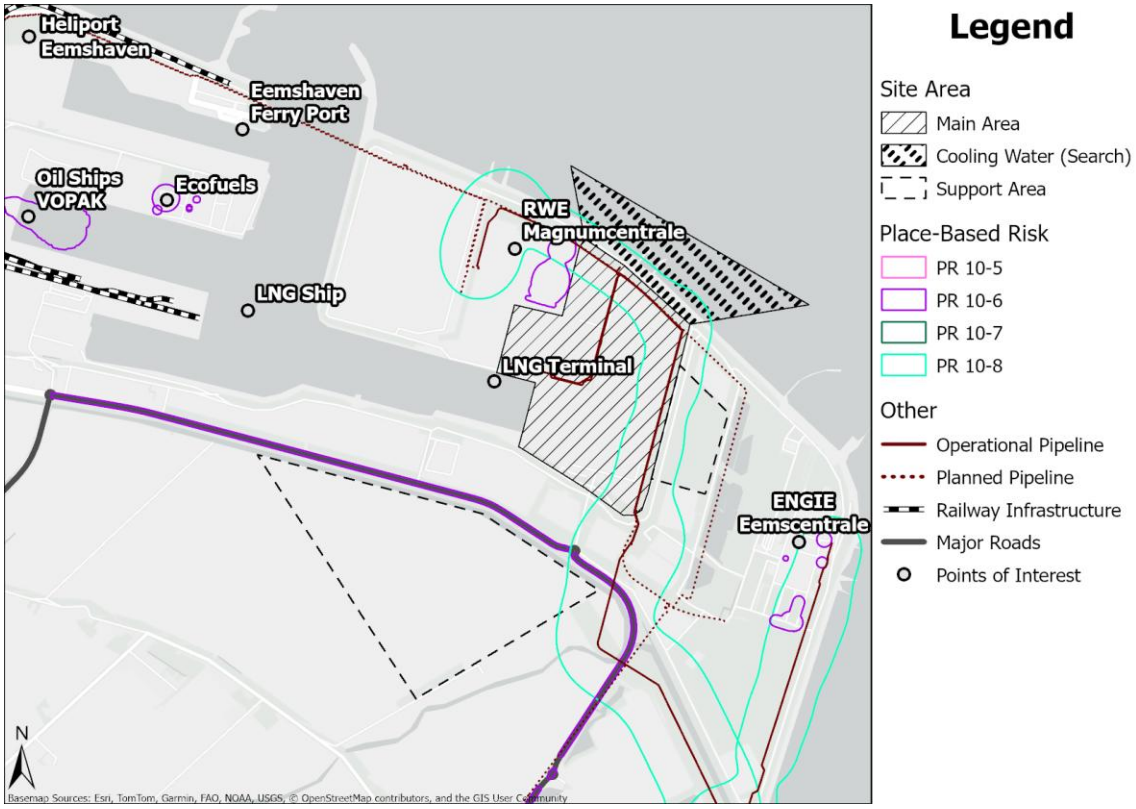

Figure 10: Place-based risk, Eemshaven 2

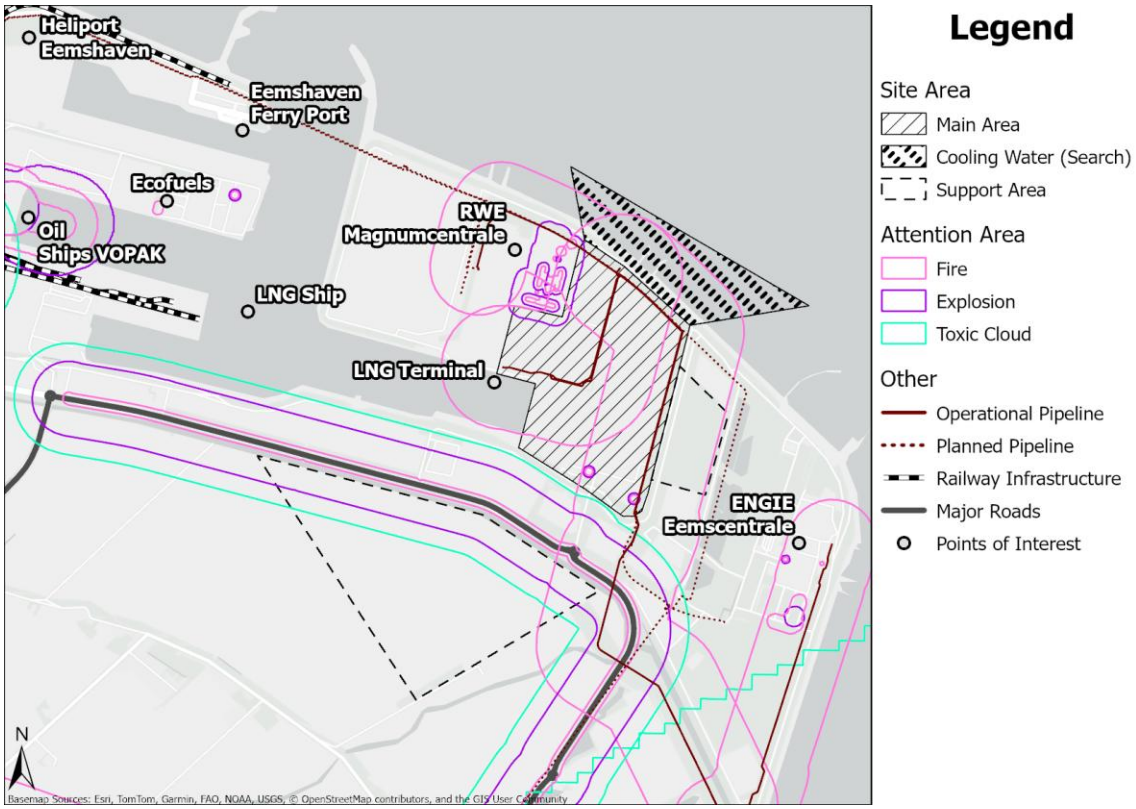

Figure 11: Attention areas, Eemshaven 2

Existing Pipelines. As described above. It is also evident that the attention area for fire from the pipeline running from the Gasunie compressor station covers a corner of the Support Area.

Ecofuels. 2km from the Main Area, the available information suggests Ecofuels presents a low risk, including from ships delivering raw materials to the facility.

Roads. Attention areas related to the N33/Kwelderweg do not interact with the site but do cover a large part of the Support Area, with the potential for barriers required. Other road infrastructure will need further consideration at a later stage including any new roads constructed to service the site.

Wind Turbines. Eight turbines would require removal from the Main Area, and potentially a further 13 that interact with the currently proposed Support Area

Conclusion

Assuming all wind turbines are removed the remaining hazardous activities in the area are likely to present a **very high risk** to the Main Area. This level of risk could be lowered by considering the following key actions:

- Confirmation of closure of the temporary floating LNG facility.
- Removal of all existing pipelines within the Main Area boundary, with rerouting of these to continue the connection to RWE Magnumcentrale.
- Measures to reduce risk from existing pipelines outside of the Main Area but still in proximity of the site.

Even if operation of the temporary LNG facility discontinues, the rerouting of existing pipelines may be **challenging** with respect to the challenge of finding available of space around the Main Area boundaries. This would require planning, commercial negotiation and likely needed to be done ahead of construction to enable continuation of RWE Magnumcentrale. Rerouting these lines around the Main Area may still result in fire attention areas overlapping the Main Area.

Residual risk is considered medium. Residual risks that would need to be addressed later in the programme include:

- Further assessment of the heliport risks, and the potential for flight path restrictions.
- Appropriate assessment and management of road, rail and shipping risks (noting the site has a direct waterside interface with the port).
- Further assessment of the many hazardous activities with the ‘siting study’, and activities wider ‘site characterisation’ zone, for detailed site evaluation and characterisation, including assessment of turbine explosion risks.
- Further assessment of the Support Area and protective measures required.

Future activities

There are several future developments concerning hydrogen infrastructure. Collectively these future developments represent a **very high level of risk** to Eemshaven 2.

- **Eemshydrogen.** RWE has planned a 50MW electrolyser[31] at the RWE coal fired powerplant plot (distance approx. 800m). Consequences for external safety depend on exact technical details of this development which are not presently known. Further examination of this risk would be required, and at present this should be considered a very high risk.
- **Planned pipelines**. Gasunie has planned a new hydrogen pipeline running close to (<50m) and in places through Main Area, as well as less than 1km to the east. This would

[31] https://www.rwe.com/en/research-and-development/hydrogen-projects/eemshydrogen/

present a very high risk (explosion) to the Main Area, the route also potentially interfacing with cooling water infrastructure. The planned pipelines would almost certainly need to be relocated.

- **RWE Magnumcentrale.** Changes in risk level (potentially an increase) if the plant is converted to use hydrogen should also be considered. Removal of pipelines serving the station may reduce the station's commercial viability.
- There is an explosion attention area associated with a facility to the east of the RWE Magnumcentrale, which overlaps with the Main Area. Online images suggest this is currently a solar farm (which would present a fire risk through panel malfunction); however, the Atlas states the attention areas are associated with a (possibly future) multi-fuel (including hydrogen) development. This would need to be investigated further at a later stage of development.

3.1.4 Eemshaven 3

Figure 12 shows the key hazardous industry and activity in the vicinity of the Eemshaven 3 site. An expanded list is included within Appendix A.4. Figure 13 shows the place-based 10^{-6} contour and Figure 14 shows the attention areas for explosion, fire and toxic clouds.

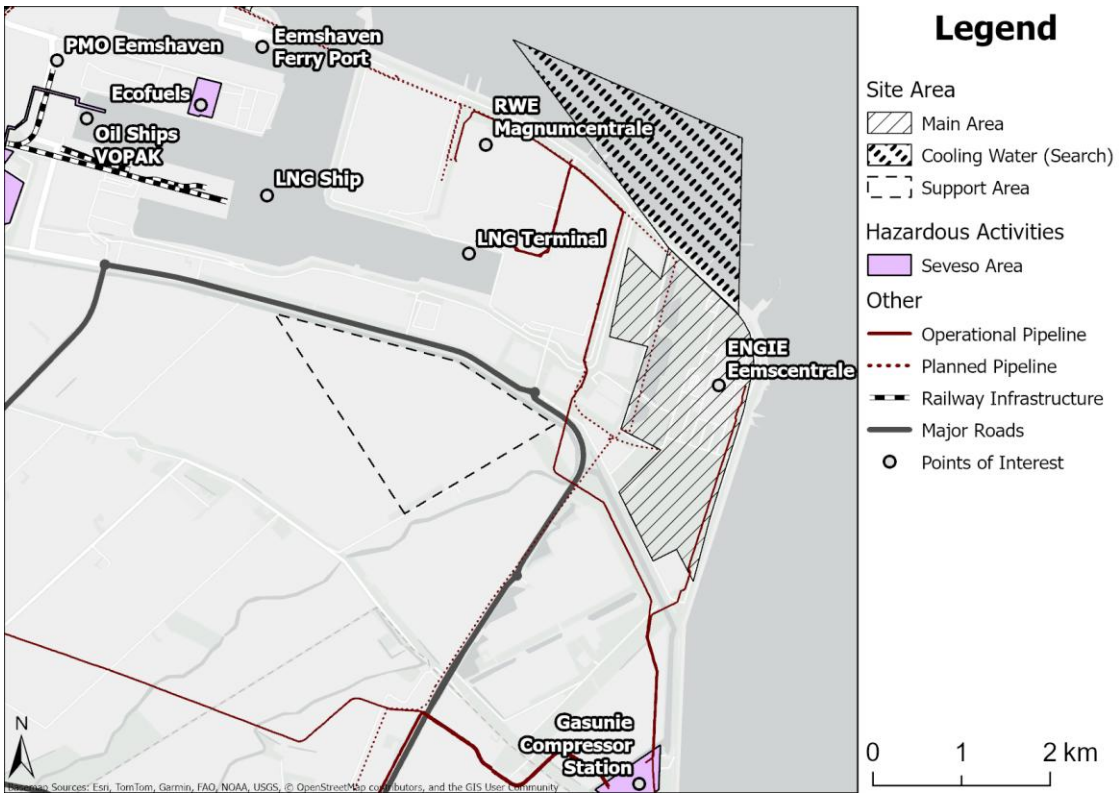

Figure 12 - Hazardous activities, Eemshaven 3

Heliport. Approximately 4.1km from the site boundary. The risk of helicopter failure and accident that could impact the site both during construction (potentially more significant with workforce numbers) and operation may not be tolerable. Relocation of the heliport to another location within the Eemshaven may therefore be necessary or flight restrictions put in place.

LNG Terminal, ships and pipeline. The temporary facility is approximately 1km from the Main Area (and less than 1km from the Support Area). Fire and explosion attention areas do not overlap with the Main Area, although there may remain some residual risk.

Gasunie compressor station. The station is 1.7km from the Main Area. The main risk from this is fire associated with the pipeline running to Engie Eemscentrale. Given that pipeline would need to be removed for Eemshaven 3 then this risk will disappear.

RWE Magnumcentrale. The gas-fired station is approximately 1.25km from the Main Area**.** There are contours associated with the pipelines serving the station, the fire attention area of which covers parts of the Main Area (although these areas could be considered peripheral so not high risk). The risk around gas turbine explosion would need to be assessed but is unlikely to be a high risk.

Engie Eemscentrale. It is assumed the station must be removed, along with the pipeline from the Gasunie compressor station, so any present risk would disappear.

Existing Pipelines. As described above. It is also evident that the attention area for fire from the pipeline running from the Gasunie compressor station covers a corner of the Support Area. Furthermore, transport from the Support Area to the Main Area would cross existing pipelines and therefore strengthening of these pipelines may be required for heavy trucks and AILs.

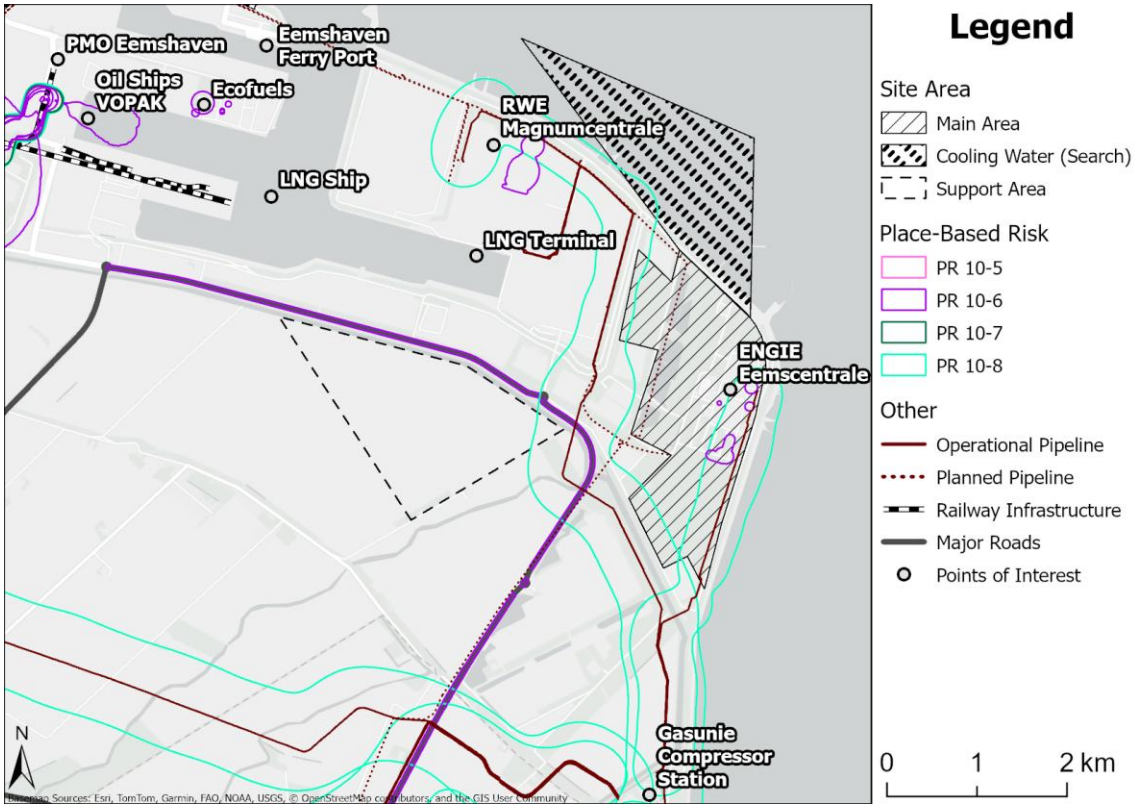

Figure 13: Place-based risk, Eemshaven 3

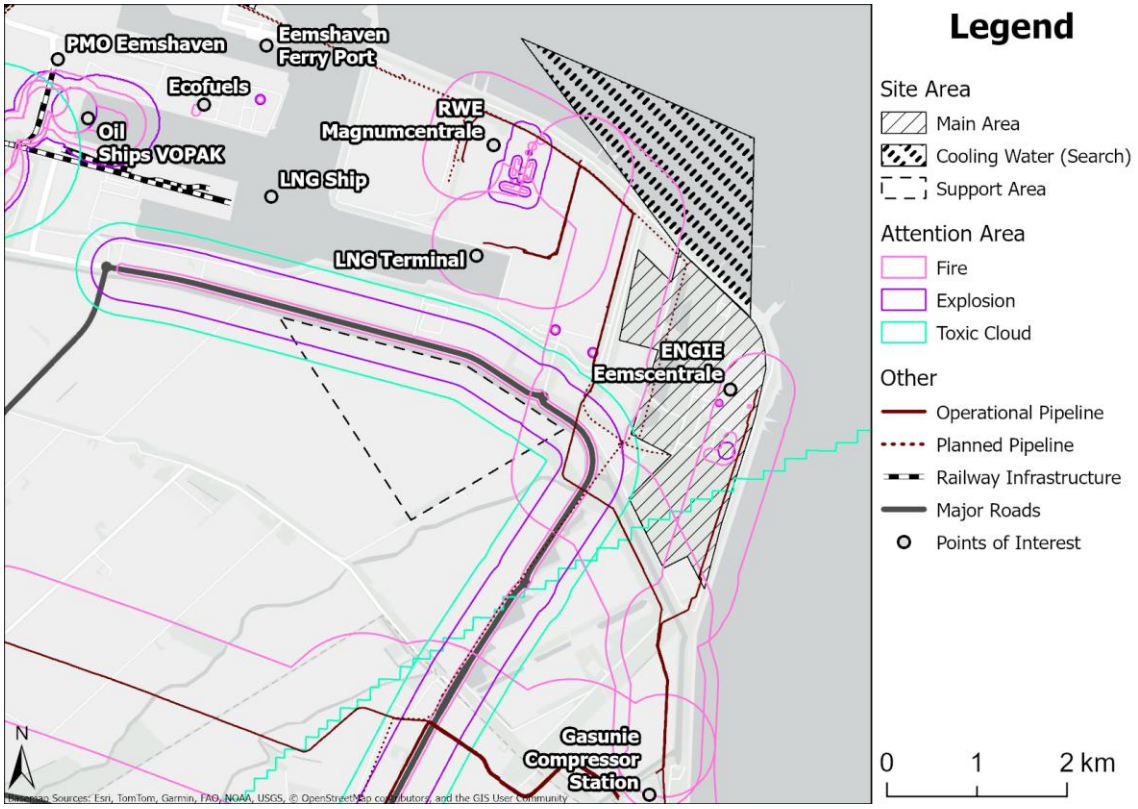

Figure 14: Attention areas, Eemshaven 3

Seveso sites. Both the Vopak terminal and Ecofuels are likely to be sufficiently far away not to present a high level of risk, although would need assessment at a later stage of development, particularly Vopak. Part of the site is within a toxic cloud assessment area, though to originate from a Seveso facility at Delfzijl, however this is not considered to present a high level of risk and could be considered at a later stage of development.

Roads. Attention areas related to the N33/Kwelderweg do not interact with the site but do cover a large part of the Support Area. Other road infrastructure would need further consideration at a later stage including any new roads constructed to service the site.

Wind Turbines. Eight turbines would require removal from the Main Area, and potentially a further 13 that interact with the currently proposed Support Area.

Conclusion

Assuming all wind turbines and Engie Eemscentrale are removed the remaining hazardous activities in the area are likely to present a **medium risk** to the Main Area. This level of risk could be lowered by considering these key points:

- Protection to mitigate the fire risk to the site from nearby gas pipelines or rerouting these to provide greater spatial separation.
- Ensuring that protection for personnel against toxic clouds is incorporated into the design and management the LNNP.
- Site layout
- Confirmation that the temporary LNG terminal will close ahead of operation.

These activities are likely to represent a **moderate effort**, including engagement with the pipeline owner, and costs associated with mitigation and/or potential relocation of pipelines. Regulatory advice should be sought on any potential reliance on mitigation required on third-party assets.

Residual risk is considered to be low. Residual disks that would need to be addressed later in the programme include:

- Appropriate assessment and management of road, rail and shipping risks (noting that the site does not directly interface with marine elements of the port and has no rail network in the vicinity of it).
- Further assessment of hazardous activities with the 'siting study', and activities within the 'site characterisation' zone, for detailed site evaluation and characterisation.
- Further assessment of the Support Area and protective measures required **for workers.**

Future activities

There are future developments concerning hydrogen infrastructure. Collectively these future developments represent a **very high level of risk** to Eemshaven 3, particularly the Eemshydrogen project and planned pipelines.

- **Eemshydrogen** RWE has planned a 50MW electrolyser[32] at the RWE coal fired powerplant plot (distance approx. 800m). Consequences for external safety depend on exact technical details of this development which are not presently known. Further examination of this risk would be required however this should currently be considered a very high risk
- **Planned pipelines**. Gasunie has planned a new hydrogen pipeline running close to (<50m) and in places through Main Area, as well as less than 1km to the east. This would present a very high risk (explosion) to the Main Area, the route also potentially interfacing with cooling water infrastructure. The planned pipelines would almost certainly need to be relocated.
- **RWE Magnumcentrale.** Changes in risk level (potentially an increase) if the plant is converted to use hydrogen should also be considered. Removal of pipelines serving the station may reduce the station's commercial viability.
- There is an explosion attention area associated with a facility to the east of the RWE Magnumcentrale. Online images suggest this is currently a solar farm, however the Atlas states the attention areas are associated with a (future) multi-fuel (including hydrogen) development. This would need to be investigated further at a later stage of development.

[32] https://www.rwe.com/en/research-and-development/hydrogen-projects/eemshydrogen/

3.2 Maasvlakte II

Figure 15 shows the key hazardous industry and activity in the vicinity of the Maasvlakte II site. These are further described below (along with some other facilities), with further details listed in Appendix A.5 . Figure 16 shows the place-based 10^{-6} place-based contour and Figure 17 shows the attention areas for explosion, fire and toxic clouds.

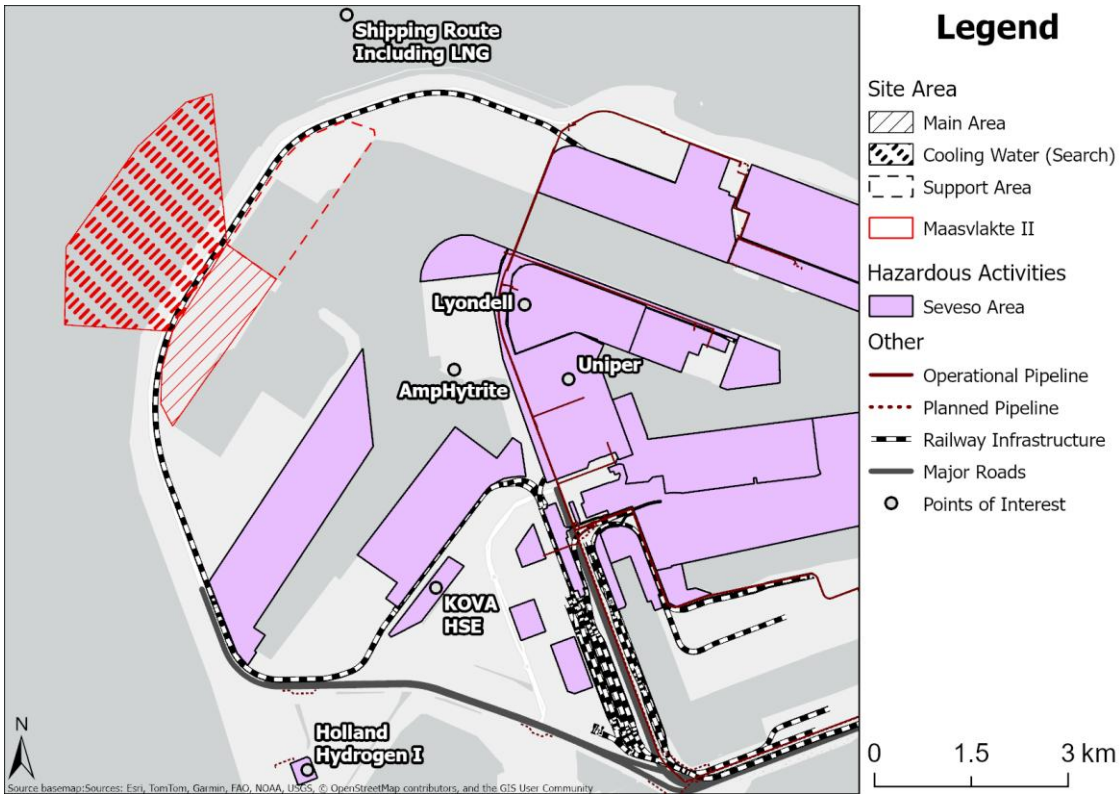

Figure 15: Hazardous activities, Maasvlakte II

Seveso sites. As shown in Figure 15 there are numerous Seveso sites within 5km of the proposed Main Area, any many more within the Port of Rotterdam. These are briefly described below.

- **Lyondell Chemie Nederland B.V.** Large scale chemical processing and storage, situated 2.5km from the Main Area, however it is understood that this site will close at the end of 2026.
- **Uniper Benelux N.V.** Power generation site (1,000MW_{el}), approximately 3km from the Main Area. Includes biomass co-firing and hazardous substance storage.
- **Neste Netherlands B.V.** Production of renewable diesel and sustainable aviation fuel, approximately 4km from the Main Area. Renewable diesel capacity: ~1.2 million tons/year; SAF capacity: ~500,000 tons/year.
- **Kova HSE B.V.** Hazardous waste treatment and storage, approximately 2.8km from the Main Area. Handles various industrial hazardous waste streams. The capacity is not publicly disclosed.
- **Neele-Vat Maasvlakte B.V.** Largest container degassing site in the Netherlands, approximately 3.8km. 4500 m2 warehouse for repackaging fumigated cargo[33].

[33] Source: Largest container degassing site opens on Maasvlakte

- **Broekman Logistics Europoort B.V.** Located on a 66,000 m² plot with approx. 39,000 m² of warehouse space. Designed for ADR-classified hazardous materials. Approximately 4.4km from the Main Area.
- **Maasvlakte Olie Terminal N.V.** One of the largest crude oil terminals in the world. Storage capacity: ~1,085,786 m³. Tank sizes: 110,000–120,000 m³ each. Connected to refineries via pipeline infrastructure[34]. Approximately 4km from the Main Area.
- **Gate Terminal.** Storage and regasification of Liquified Natural Gas (LNG), three 180,000m3 tanks. Approximately 5km from the Main Area.

The Seveso sites do not appear to present a high level of risk to the Main Area (or Support Area). The placed-based 10^{-6} contours from the Seveso sites do not overlap with the Main Area (or Support Area), neither do the explosion or fire attention areas. There is a toxic cloud attention area that originates from the Kova HSE site and that cover both the Main Area and Support Area and would need to be accommodated into design, management and emergency arrangements.

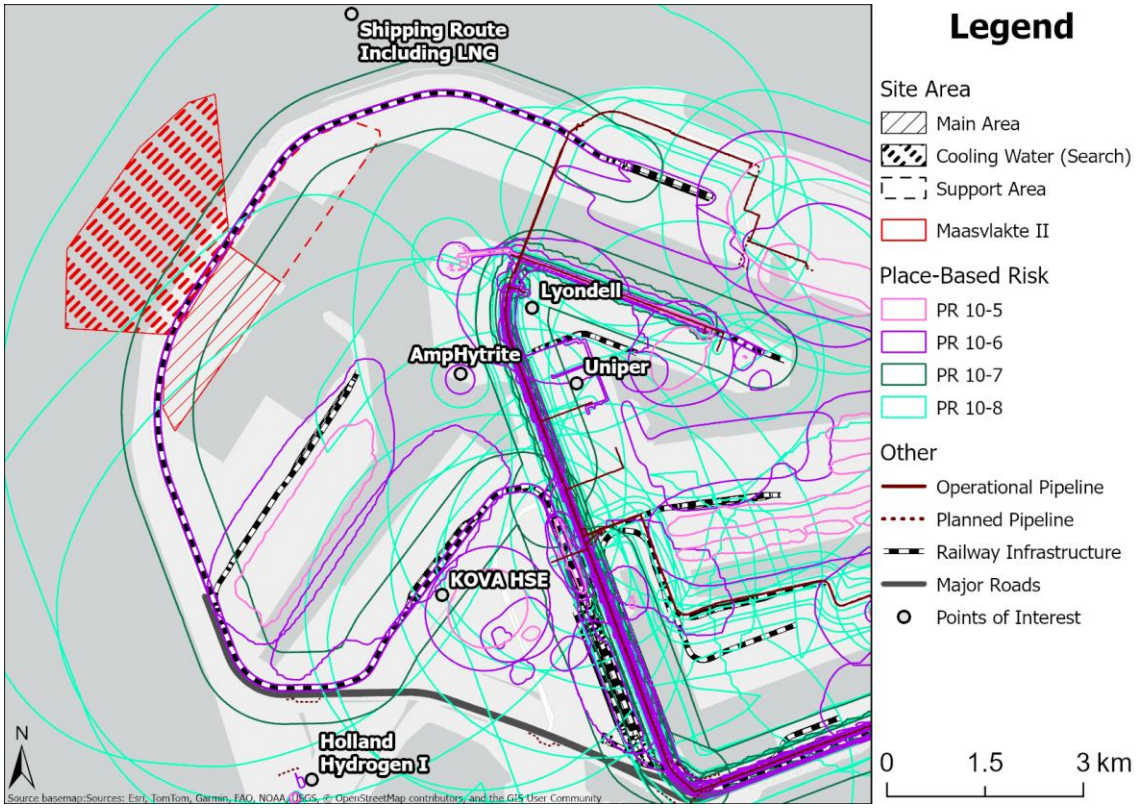

Figure 16: Place-based risk, Maasvlakte II

Freight terminals. Euromax C.V, Rotterdam World Gateway B.V. and APM Terminals are highlighted as storage areas for hazardous substances outside a Seveso facility. These are assigned 10^{-6} contours, as well as explosion and fire attention areas. The closest of these facilities is the Rotterdam World Gateway B.V. storage area, approximately 1.25km from Main Area. The information provided shows that the risk contour and fire and explosion attention areas do not overlap with the Main Area (or Support Area) so are not likely to represent a high

[34] Source: Maasvlakte Olie Terminal (Rotterdam) | Royal Vopak

risk. There are toxic clouds covering the site that appear to originate from some of these facilities (and the wider Port of Rotterdam) that would need to be accounted for in detailed design.

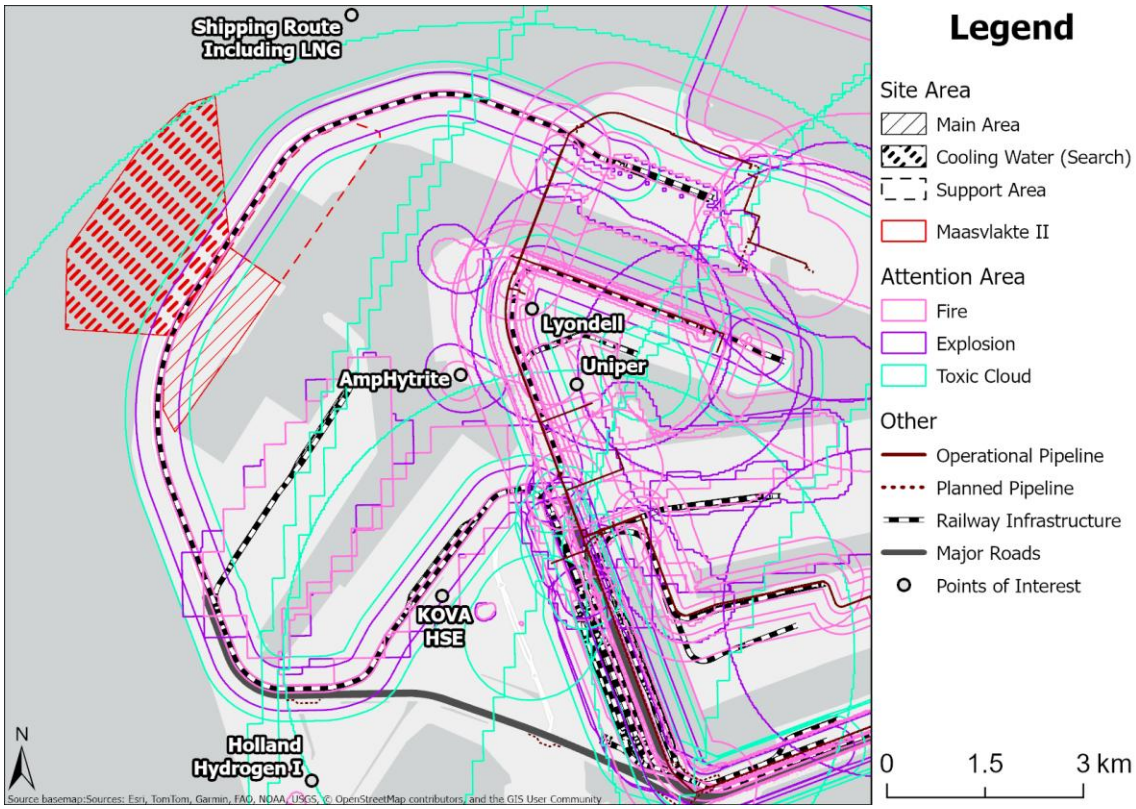

Figure 17: Attention areas, Maasvlakte II

Marine. There are potential risks from shipping hazardous cargo inside and outside of the port, including crude oil, petrochemicals, LNG and other substances. Shipping to the Gate LNG terminal, the Maasvlakte Oil terminal and Neste Netherlands does not appear to require coming within 2km of the Main Area (based upon a review of online imagery). Shipping to the freight terminals in the vicinity of the site may come closer, approximately 1km. Shipping does not appear to present a high level of risk, although future restrictions on ship movements may need to be considered both inside and outside of the port (there are no attention areas given for the approaches to the Port of Rotterdam).

Heliport Maasvlakte. The heliport lies just outside of the siting study zone (8.5km) but is included here as it is primarily used as airport for helicopters to serve offshore platforms and ships. As these destinations are mainly located west of the proposed Maasvlakte II site, it could be that the flightpaths cross the site location. This would require further investigation at site characterisation, with the potential requirement for flight path restrictions.

Rail. The railway runs along the western boundary of the site, moving freight, and has explosion and toxic cloud attention areas that overlap with a significant part of the Main Area (and Support Area). This currently presents a very high risk. This may require mitigation, for example blast walls along a portion of the track to contain any explosion, whilst spatial separation between the hazard and the site may be challenging.

Wind Turbines. Figure 18 shows four wind turbines for the 10^{-6} contour has some overlap with Main Area or cooling water infrastructure zone. These are assumed to need removal, along with another three that overlap with the Support Area.

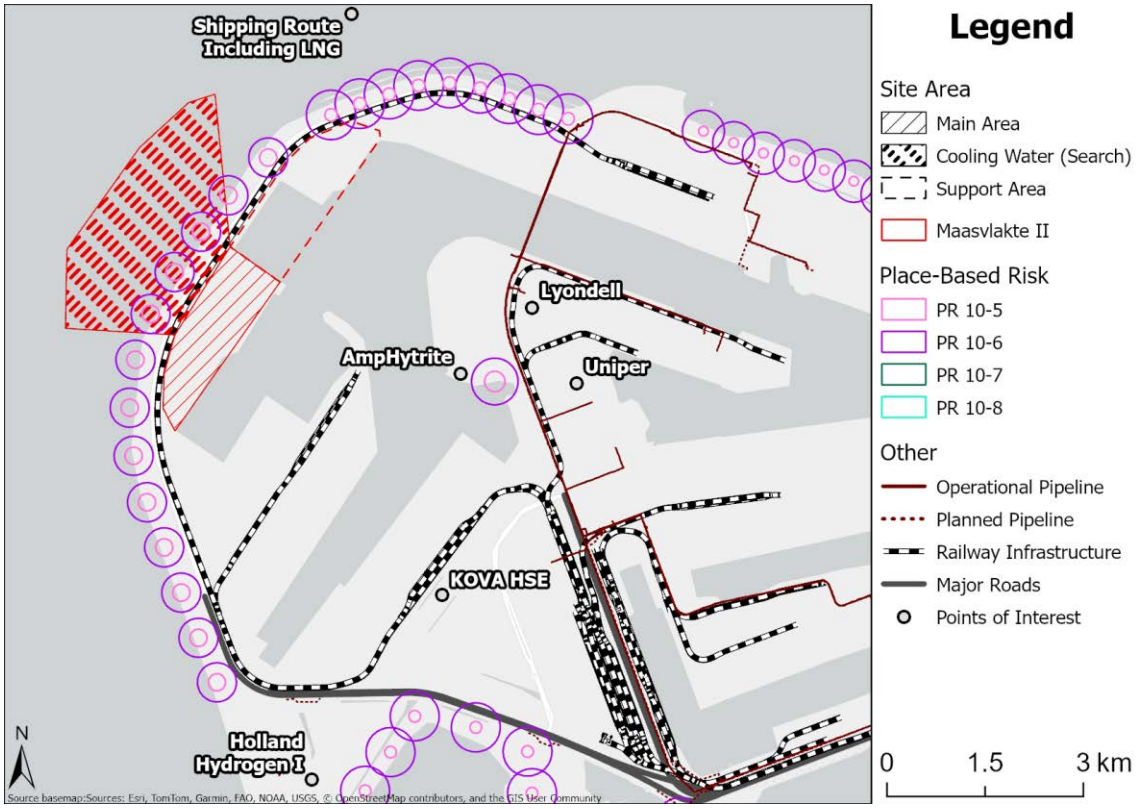

Figure 18 – Wind turbines, Maasvlakte II

Holland Hydrogen I[35]**.** Shell is constructing Holland Hydrogen I (HH1) approximately 3.6km from the site boundary of Maasvlakte II. This plant will produce hydrogen from electricity (Power to Gas facility) and will have a capacity of 200MW. The facility will produce approx. 60 tonnes of Hydrogen per day[36], which will be injected into the hydrogen backbone of the Port of Rotterdam. The plant is planned to become operational by the end of 2026[37]. Because of the volume of hydrogen in this location this could be considered in this study as a Seveso site however it is likely sufficiently far away not to present a high level of risk.

AmpHytrite is a proposed 10MW green hydrogen production demonstrator unit, generating approximately 770 tonnes of green hydrogen per year. Commercial Operation Date is due Q4 2025. There is an explosion and fire attention area around this facility, however it is not clear if this relates to an existing installation on the Sif Netherlands B.V site. The proposed unit will be approximately 2km from the site and not likely to present a high level of risk.

[35] Source: https://www.missieh2.nl/nieuws/holland-hydrogen-1-een-grote-waterstofambitie/

[36] Source: https://www.shell.nl/over-ons/wat-wij-doen/waterstof.html

[37] Source: https://www.processcontrol.nl/53942-shell-holland-hydrogen-1-nadert-voltooiing/

Conclusion

The main risk to both the Main Area (and Support Area) originates from hazardous substances transported along the railway that runs adjacent to the site boundary. The explosion and toxic cloud attention areas extend to a large part of both Areas and represent a **high risk**. This level of risk could be lowered by considering these key points:

- Implementation of physical or spatial barrier to protect the Main Area and Support Area from explosion risk originating from rail transport.
- Site layout
- Incorporation of toxic cloud protective measures into design and management arrangements.

Given the Main Area is relatively narrow in depth, physical barriers along the railway may be the preferential option. Consideration would need to be given to the space available to do this safely and how any such protection required interfaces with temporary and permanent site access arrangements. Consultation with the rail operators and users would be required. It is considered presently to be **challenging in terms effort**.

Residual risk is considered to be medium. Key residual risks to address later in the programme include:

- Appropriate detailed assessment and management of remaining road, rail and shipping risks, and flightpath considerations (given position within the port and proximity to rail and road infrastructure.
- Further assessment of the many hazardous activities with the ‘siting study’, and activities within the wider ‘site characterisation’ zone, for detailed site evaluation and characterisation, especially from toxic clouds.

Future activities

Porthos[38] aims to transport CO_2 produced by industry in the port area of Rotterdam to former natural gas fields in the North Sea. Porthos aims to store approx. 37Mton of CO_2 (2.5Mton per year for 15 years). The compressor station is located approx. 4.7km from the site location of Maasvlakte II. At the end of the Porthos project this compressor station will compress CO_2 up to 135barg. Because of the operating pressure at this site location, this study will consider the compressor station as a Seveso site. A next CCUS (Carbon, Capture, Utilization, Storage) Project called Aramis is proposing a compressor station located at approximately the same location as Porthos. The planned facility is likely to present a medium level of risk but would require further assessment at a later stage.

[38] Source: https://www.porthosco2.nl/project/

3.3 Sloegebied

Figure 19 shows the key hazardous industry and activity in Sloegebied area. These are further described below (along with some other facilities not shown in the map) and in Appendices A.6 and A.7.

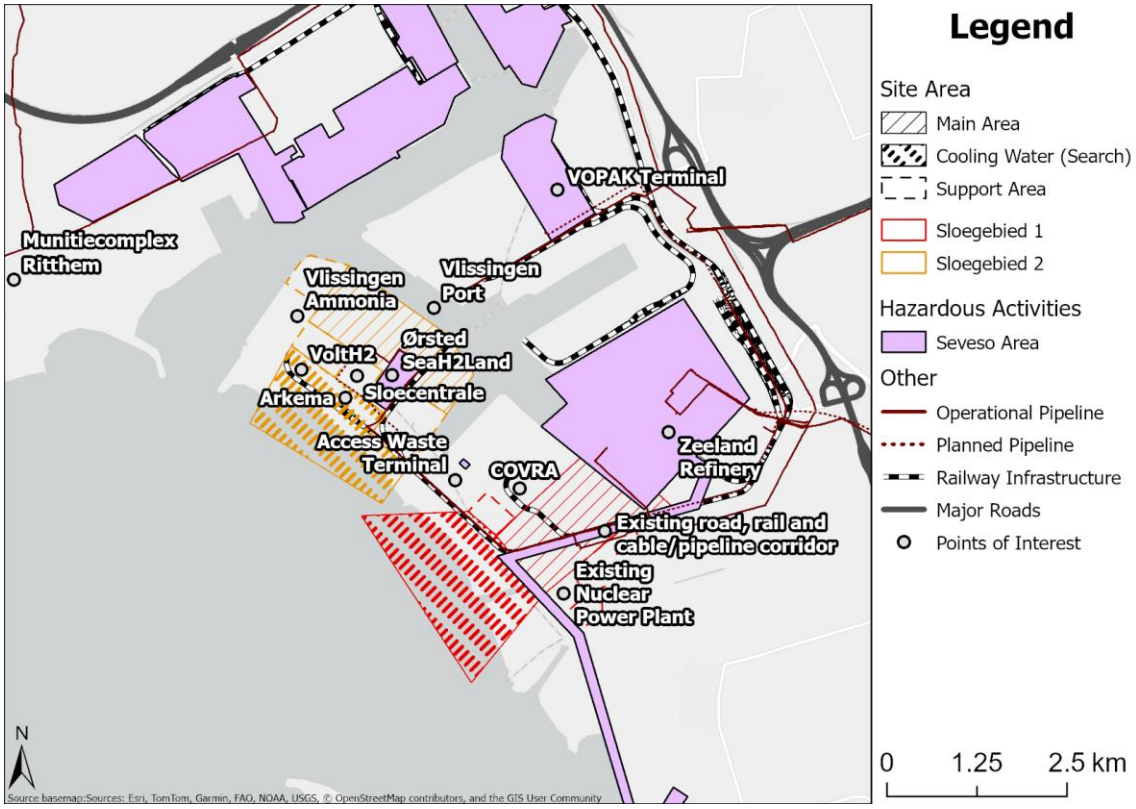

Figure 19 - Hazardous activities, Sloegebied

Vliegveld Midden-Zeeland Airport (not shown on map) is mainly used for small business aviation and recreational flights, with up to 15 flights per day.

Seveso sites:

- **Zeeland Refinery** is one of the six major oil refineries in the Netherlands, processing crude oil into fuels and feedstock. Place-based risk contours as well as attention areas for explosion, fire and explosion are provided[39].
- **Access World Terminals B.V.** Storage, transhipment and processing of bulk products, including non-ferrous metals, ores, minerals and iron. Has a capacity of approximately 370,000 tonnes. Place-based risk contours as well as attention areas for explosion, fire and toxic clouds are not provided and for this reason the risk presented to the two sites within Sloegebied are negligible.
- **Arkema B.V.** specialises in the production of organic peroxides, used in polymer manufacturing and chemical synthesis. The facility includes chemical reactors, bulk storage tanks, and controlled temperature zones. Place-based risk contours as well as attention areas for explosion, fire and toxic clouds are provided.

[39] Note that in Figure 21 the explosion attention area is mistakenly labelled at toxic cloud

- **Vopak Terminal.** Storage and transhipment of liquefied gases and chemical gases. Tank sizes from 3,370 m³ to 55,000 m³. Services include barge purging, product chilling, and ship-to-ship transfer. Place-based risk contours as well as attention areas for explosion, fire and toxic clouds are provided.
- **Ørsted SeaH2Land** is a 1GW electrolyser due to be operational by 2030, powered by a 2GW offshore windfarm. It will be one of the largest renewable hydrogen facilities in Europe. Although not yet operational it is classified on the 'Atlas' as a Seveso site, although no risk contours or attention areas are available.

Freight terminals. The Verbrugge Zeeland Terminal (not shown in the figures, situated in the northern area of the port) is a storage area for hazardous substances outside a Seveso facility. It is assigned a 10^{-6} place-based risk contour.

Munitiecomplex Rittem is a military munitions store to the west of the port, approximately 2.5km east of Oost-Souburg. The exact nature of the site is not known, although there is a suggestion that it might be nominated for closure[40]. The are multiple small 'bunkers' the design of which is understood to reduce the potential for a domino effect and multiple explosions.

Borssele Nuclear Power has a closure date of 2033. However, there are currently studies going on to extend the lifetime of this reactor[41]. Although these studies have not been fully completed and no official announcement has been made by the government, in this study it is assumed that the Borssele Nuclear Power Plant remains open after 2033 and hence could potentially overlap with the construction and operation of a new LNNP.

COVRA is the only Dutch nuclear waste processing and storage company. It stores waste produced at the Borssele plant after reprocessing by Areva NC in La Hague, France. COVRA also stores radioactive waste from hospitals and laboratories.

Existing Road, Rail and Pipelines currently run through the Sloegebied 1 site and towards the Slogebied 2 site. The are place-based contours and fire attention areas associated with the existing pipelines but not for the road and railway.

Marine. The shipping route to the harbour of Antwerp has attention areas assigned to it. Shipping within the port of Vlissingen does not have any risk contours or attention areas allocated to it. This harbour serves multiple facilities (including the facilities in Section 3.6.2) and is thus assumed to accommodate ships with dangerous goods which could be a general threat. The Zeeland refinery as several quays/jetties associated located in its south-west corner. Shipping within the port does not have any risk contour further is the harbour of Vlissingen approx. 100m away from the site boundary.

Wind turbines in the area are shown in Figure 20.

Other industrial activities. Smaller industrial hazards not shown in Figure 19 exist within the area, mostly for the storage of propane, propene, and some asphyxiant gases.

Future Development

- **Lion Storage**[42] is planning to construct a battery storage facility at approx. 0.5km from Sloegebied 2. The capacity of this facility will be 1,400MWh at 350MW. It is planned to become operational in 2027.

[40] Wild stories, worries and unrest: Ritthem wants more clarity about ammunition depot - Omroep Zeeland

[41] Lifetime extension Borssele nuclear power plant | Report | Rijksoverheid.nl

[42] Source: https://www.lion-storage.nl/mufasa L

- **VoltH2** is planning to construct an electrolyser (Power-to-Gas) facility at the harbour of Vlissingen Oost. The electrolyser is aimed to have a capacity of 125MW and should become operational by 2027.
- **Hydrogen network**[43] (subsidiary of Gasunie) is planning to construct a hydrogen network in the Vlissingen port (which will connect e.g., VoltH2). An exact location of this future pipeline is not known at this moment.
- **LBC Vlissingen**[44] is planning to convert existing diesel storage tanks into ammonia storage for hydrogen production. A building permit of a quay wall and jetty has been successfully received. Future plans include rail connectivity for ammonia distribution and an industrial-scale ammonia cracking facility to convert ammonia into hydrogen.

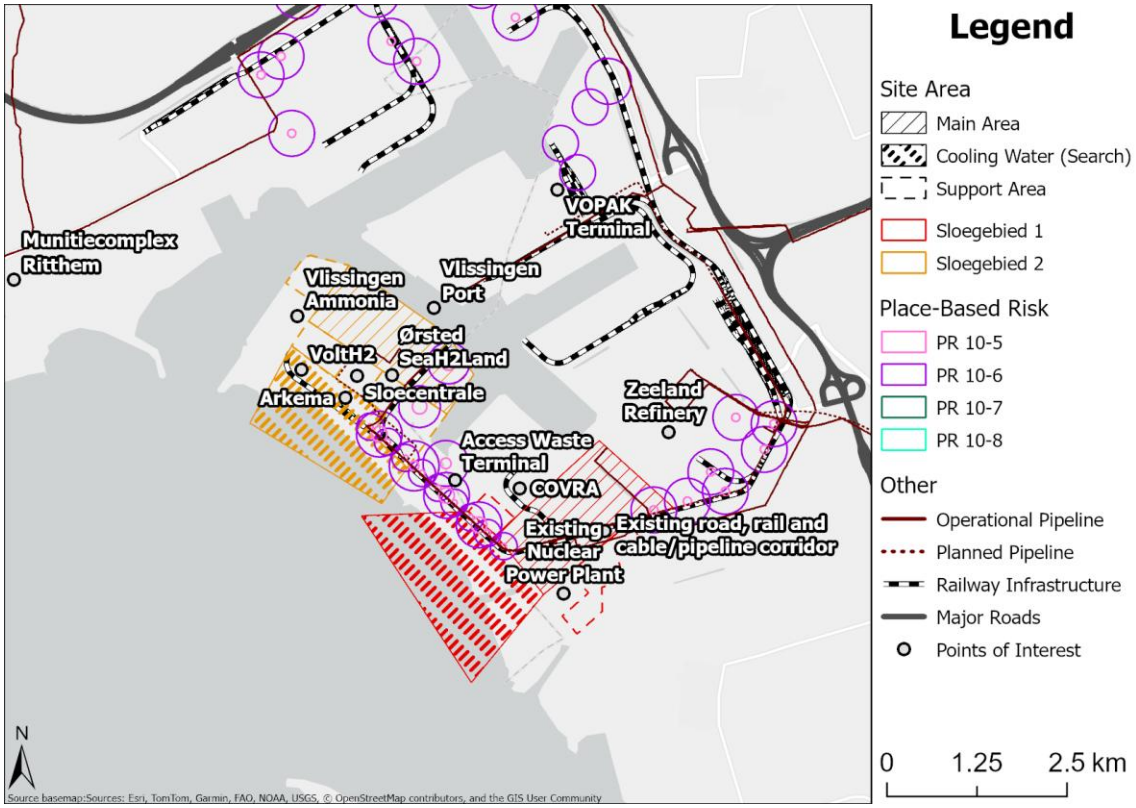

Figure 20 - Wind turbines, Sloegebied

[43] Source: https://www.rvo.nl/onderwerpen/bureau-energieprojecten/lopende-projecten/waterstofnetwerk-zwn

[44] https://www.lbctt.com/news/launch-of-open-season-for-ammonia-storage-and-ammonia-cracking-capacity-at-lbc-vlissingen/

3.3.1 Sloegebied 1

Place-based risks and attention areas for Sloegebied 1 are shown in Figure 21 and Figure 22 respectively.

Vliegveld Midden-Zeeland Airport is approximately 8km from the Main Area and given the nature of the facility and aircraft is unlikely to present a high risk but would need further assessment at site characterisation stage.

Zeeland Refinery is directly adjacent to the northern boundary of the Main Area. The proximity of the refinery should be considered a very high risk. The 10^{-6} contour overlaps with an area in the northern part of the Main Area. The fire attention area covers a similar area, including a potential point for offloading aggregate and AILs. Fire resistant barriers may be required during construction and operation. The explosion attention area from the refinery covers a wider part of the Main Area[45]. This would need to be considered in the design and management of the site with potential physical barriers or spatial separation required.

Other Seveso Sites' 10^{-6} contours and attention areas for other Seveso sites do not overlap with the Main Area and are unlikely therefore to present a high risk, although the explosion attention area for the Vopak terminal does cover a wide area, within 500m of the Main Area, as well as the shipping channel that may be used to deliver bulk materials and AILs.

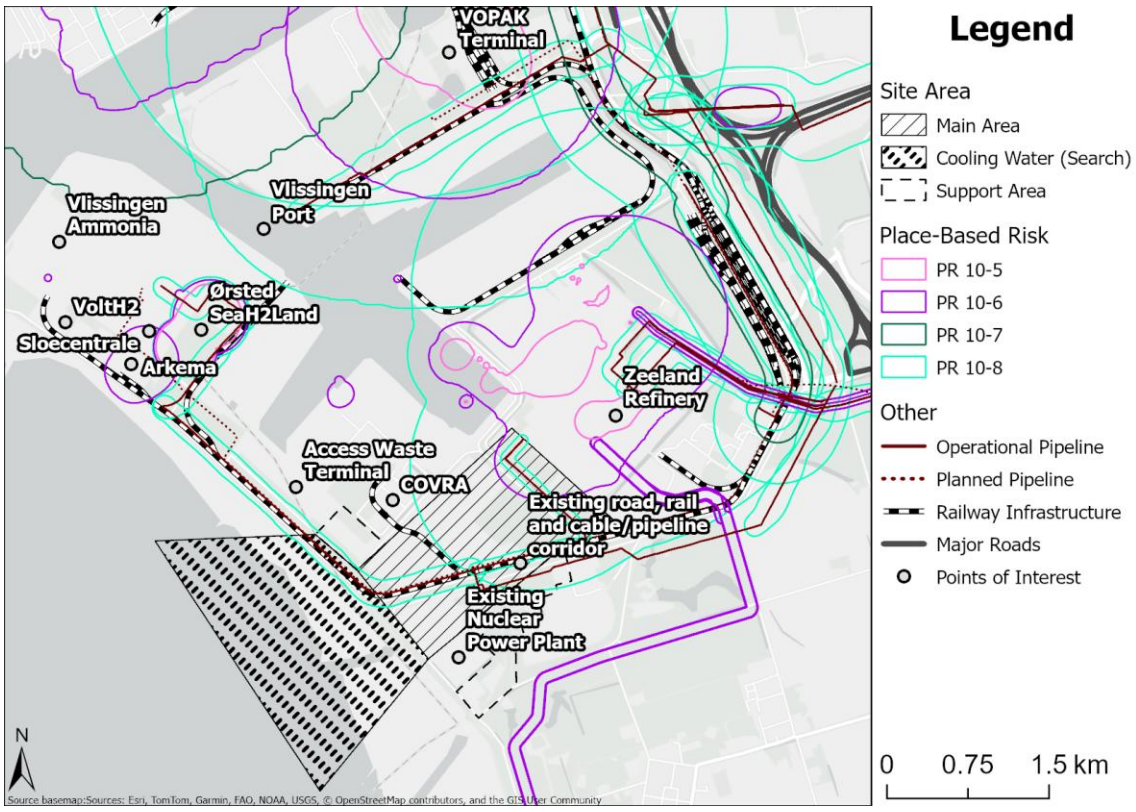

Figure 21: Place-based risk, Sloegebied 1

[45] Note that in Figure 21 the explosion attention area is mistakenly labelled at toxic cloud

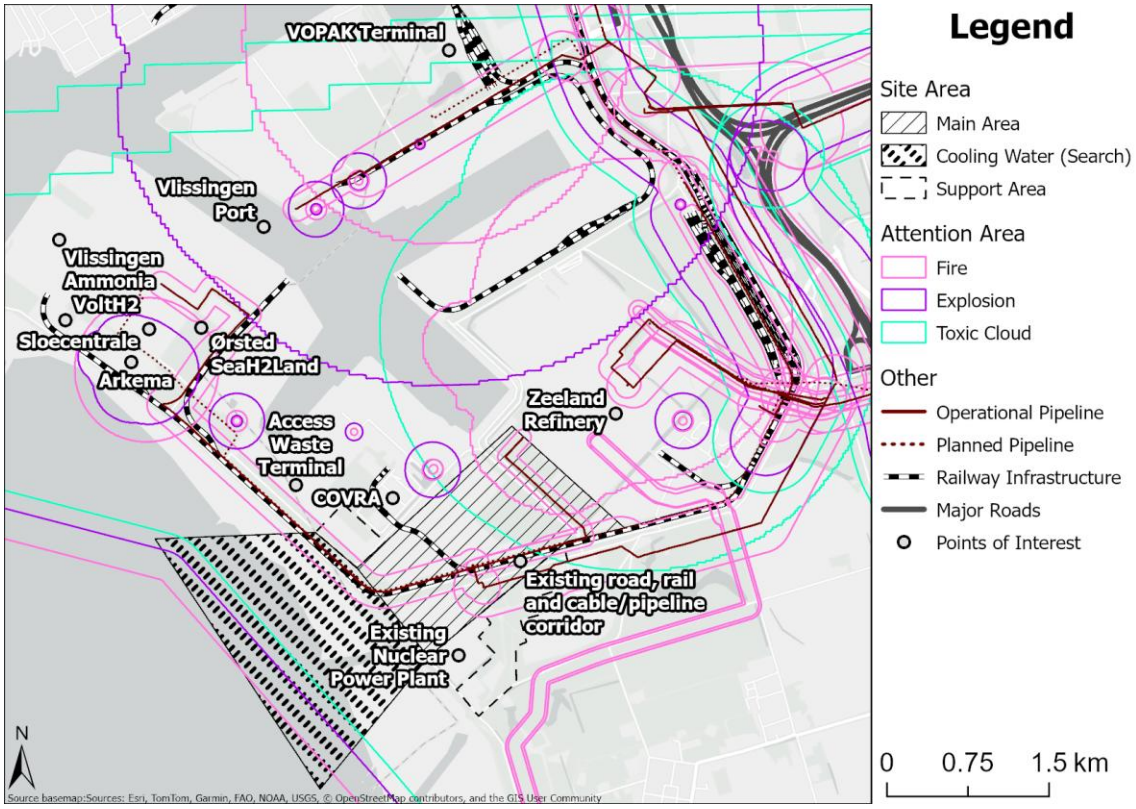

Figure 22: Attention areas, Sloegebied 1

Pipelines and transport routes. There are fire attention areas associated with existing pipelines that run through the Main Area. These should be considered a very high risk and may need to be removed and rerouted away from the construction and later operational site, which given the availability of space may be challenging and transfer risk to other parts of the Main Area and/or to neighbouring facilities. The latter point is also applicable to road and rail transport, although these have no risk contours or attention areas. Accommodating existing pipelines and transport routes in the site layout could result in moving the permanent development closer to the Zeeland Refinery.

Marine shipping to and from Antwerp is approximately 800m away and is unlikely to be a high risk. Transport with the port includes shipping to and from the Zeeland Refinery which would be within 100m of the Main Area's north-western boundary. This could present a risk to that area and would need the fully assessed at a later stage.

Other industrial activities there is an explosion attention area that overlaps the Main Area western boundary (Heerema Vlissingen). Whilst not considered high risk it would require assessment a later stage of the site evaluation process.

Borssele and COVRA are both adjacent to the Main Area, less than 0.5km. It is not uncommon for LNNPs to be built in proximity to existing nuclear infrastructure (see current development in the UK) and is not considered to be high risk at this stage. During site characterisation, the new development and existing operators will need to establish a good working relationship that ensures relevant information is made available to the interested parties. This will be relevant whether Borssele is operational or going through decommissioning.

Conclusion

The Zeeland Refinery and existing pipelines running through the Main Area present a **very high risk**, with fire and explosion attention areas covering a significant proportion of the site (visually estimated to be over 50%). The road and railway routes through the site should also be considered a risk, although no attention areas are attributed to these. Key actions to be considered that could lower risk are:

- Regulatory advice on proximity to the Zeeland Refinery.
- Physical barriers to constrain the explosion and fire risk from the Zeeland Refinery, or spatial separation.
- Rerouting of existing gas pipelines and transport routes.
- Site layout

These are considered **very challenging** given the constrained nature of this site, with potential for considerable negotiation and costs. If pending further assessment at site characterisation stage it is decided that physical barriers would be required then these may need to be established on third party land, if safe to do so, and regulatory advice would be required on this. Rerouting pipelines and transport infrastructure would have to be done in a manner that does not transfer risk to other locations, whilst also providing existing functionality to existing users (for example the export and import of wastes to COVRA).

Residual risk is considered to be medium. Key residual risks to address later in the programme include:

- Appropriate assessment and management of remaining road, rail and shipping risks (that will remain close to the site even after re-routing).
- Further assessment of the many hazardous activities with the ‘siting study’, and activities within the ‘site characterisation’ zones for detailed site evaluation and characterisation.

Future developments

The planned hydrogen pipeline follows the same route as the existing gas pipeline and should be considered **very high risk**. Rerouting would be required and face the same challenges as the described above for existing pipelines.

3.3.2 Sloegebied 2

Place-based risks and attention areas for Sloegebied 2 are shown in Figure 23Figure 21 and Figure 24 respectively.

Vliegveld Midden-Zeeland Airport is approximately 8km from the Main Area and given the nature of the facility and aircraft is unlikely to present a high risk but would need further assessment at site characterisation stage.

Arkema is less than 0.5km from the Main Area. The 10^{-6} risk contour does not overlap with the Main Area but does so with the Cooling Water Area as well as small section of the Support Area. The fire attention area covers a small area of the Main Area. Both the fire and explosion attention areas overlap with a part of the Support Area and the Cooling Water Area. Taken on its own it presents a medium to high risk at present.

Vopak Terminal. The Vopak terminal is approximately 1.5km from the Main Area. The explosion attention area covers a large section of the Main Area (estimated to be between 40-50%) and therefore is considered very high risk.

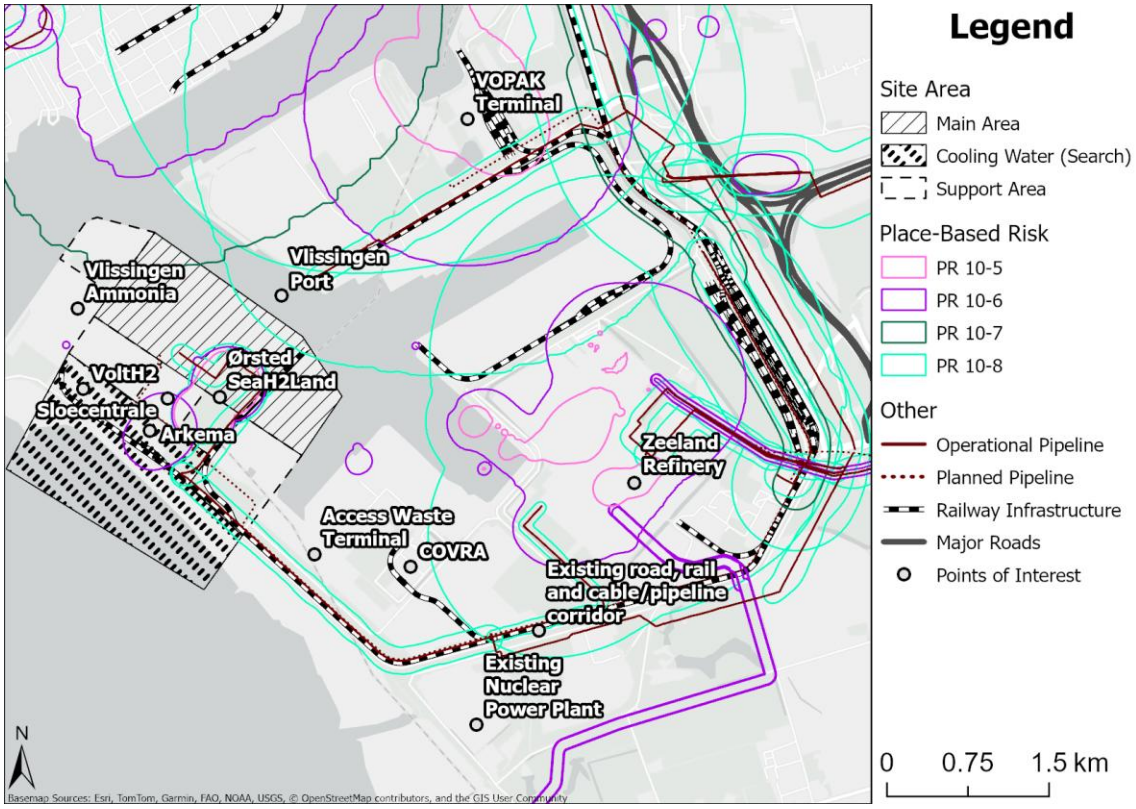

Figure 23 Place-based risk, Sloegebied 2

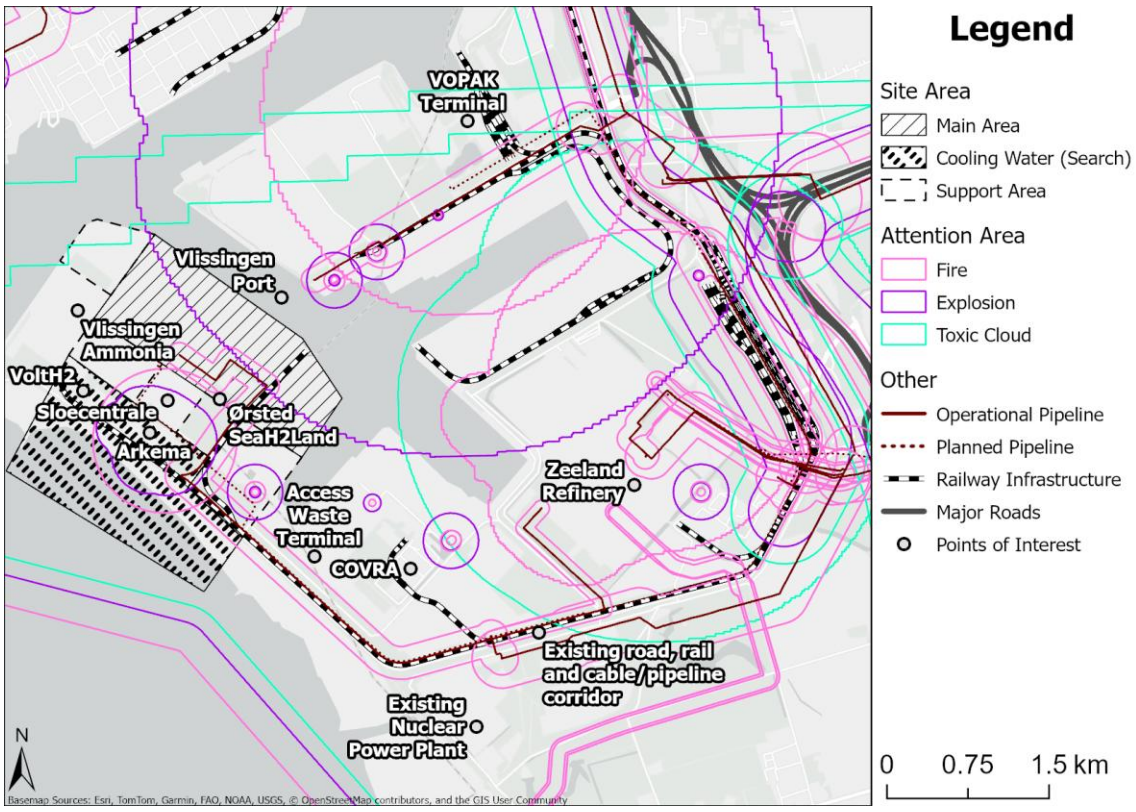

Figure 24 - Attention areas, Sloegebied 2

Zeeland Refinery is approximately 1.25km from the Main Area. Neither the 10^{-6} contour nor explosion and fire attention areas overlap with the Main Area.

Pipelines. There are gas pipelines on the Main Area that connect to the Sloe centrale gas-fired power plant. These run through the Support Area and cover a small but central part of the Main Area, with associated 10^{-6} contours and fire attention areas. These would likely need to be rerouted.

Marine shipping to and from Antwerp is approximately 800m away and is unlikely to be a high risk. Transport within the port includes shipping to and from the Zeeland Refinery which pass close to the Main Area's north-eastern boundary. This could present a risk to that area and would need the fully assessed at a later stage.

Road and rail. Neither the road nor rail in the vicinity of the site have place-based risk contours or attention areas. However, it is possible these routes could involve transportation of hazardous substances and would need to be assessed at a later stage.

Borssele and COVRA are both within 2km of the Main Area. It is not uncommon for LNNPs to be built in proximity to existing nuclear infrastructure (see current development in the UK) and is not considered to be high risk at this stage. During site characterisation the new development and existing operators will need to establish a good working relationship that ensures relevant information is made available to the interested parties. This will be relevant whether Borssele is operational or going through decommissioning.

Conclusion

Combined hazards from Arkema, existing pipelines and the Vopak terminal result in a **very high level of risk**. Key actions to consider for reducing risk include:

- Implementation of physical barriers to contain an explosion and/or fire originating from Arkema and the Vopak terminals.
- Spatial separation from risks through site layout.
- Rerouting existing gas pipelines connecting to the Sloe centrale gas-fired station.

These measures are likely be **very challenging**, with negotiation required for the potential erection, inspection and maintenance of physical barriers on third party land, as well as regulatory approval. Site layout flexibility to provide spatial separation may be challenging given the surrounding infrastructure. Rerouting of gas pipelines would need negotiation and need to ensure continuation of connection to the Sloe centrale station, whilst at the same time reducing risks to the LNNP as ALARP.

Residual risk is considered medium. Key residual risks to address later in the programme include:

- Appropriate assessment and management of remaining road, rail and shipping risks
- Further assessment of the many hazardous activities within the 'siting study', and activities within the 'site characterisation' zone, for detailed site evaluation and characterisation

Future developments

Planned hydrogen (explosion risk) and ammonia (toxic gas risk) infrastructure should be considered **very high risk**. Further detailed assessment of how these developments could safely co-exist will be required

3.4 Terneuzen

Key hazardous activities relevant to Terneuzen 1 and 2 are shown in Figure 25. Further details on facilities and activities are provided in Appendices A.8 and A.9.

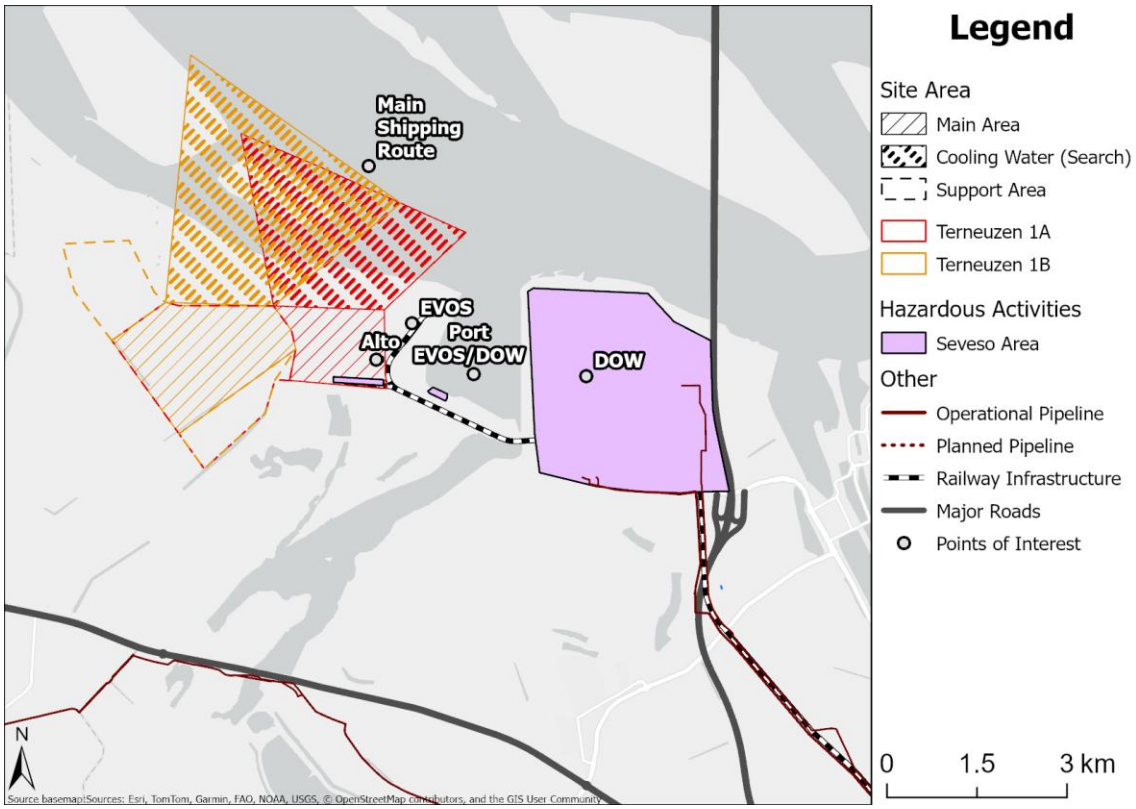

Figure 25 - Hazardous activities, Terneuzen

Seveso sites:

- **Evos Terneuzen B.V.** [46] is a multimodal industrial terminal specialising in the storage, blending, and handling of naphtha, bio-naphtha, pyrolysis oil and other petrochemical feedstocks. 10^{-6} risk contours and fire and explosion attention areas are provided for the facility.
- **Alto Carbon Technologies**[47] is a to-be-built pilot plant that will convert CO_2 into green cyclic and linear carbonates, which are then used in electrolytes for lithium batteries and other green chemical applications.
- **Dow Benelux B.V.**[48],[49] produces over 800 chemical products used in plastics, coatings, adhesives, and consumer goods. Includes ethylene oxide, polyethylene, and styrene production units and hosts the ValuePark Terneuzen, a 140-hectare industrial park for chemical-related businesses.

Marine. The shipping route to the harbour of Antwerp is approximately 1.5km away from the Main Area, with attention areas provided for explosion and fire. The Braakmanhaven, to the east

[46] Source: https://www.evos.eu/terneuzen/

[47] This Seveso site is considered to be demolished if Terneuzen 1A is chosen as preferred location.

[48] Source: https://nl.dow.com/en-us.html

[49] This site is known to have three Seveso sites on the whole perimeter of the facility, which is approx. 320ha surface area.

of Terneuzen 1, services the Dow and Evos sites and given the nature of these industrial sites, it is assumed that hydrocarbons and other chemical products are transported via this port.

Rail. A private railway line runs from the Dow plant towards the Evos and Alto sites. Neither location-based risk contours nor attention areas are provided for this rail.

Pipelines. There are no gas pipelines highlighted on the Atlas however a review of visual imagery shows an overground pipeline running from along the same route as the railway. The status of this pipeline is not known.

3.4.1 Terneuzen 1a

Place-based risk contours are shown in Figure 26, and attention areas shown in Figure 27.

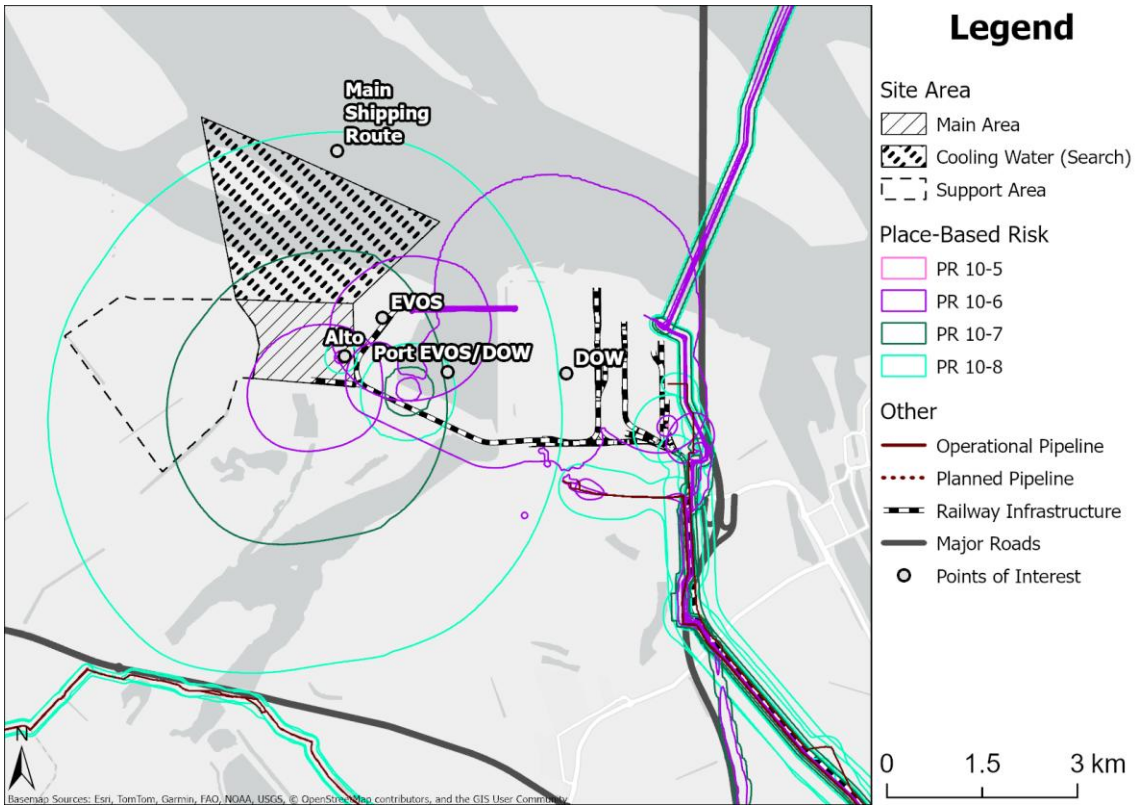

Figure 26: Place-based risk, Terneuzen 1a

Alto sits within the footprint of the Main Area. The 10^{-6} contour covers approximately half of the Main Area as does the toxic cloud (potential asphyxiant) attention area, with a smaller overlapping fire attention area. This should be considered a very high risk and may require removal (or cessation of current construction).

Evos is less than 0.5km from the Main Area boundary. Explosion and fire attention areas overlap the Main Area's eastern boundary, estimated to be about 20% of the site. The 10^{-6} contour overlaps a section of the Main Area. This facility is considered a very high risk, and effective barriers may need to be introduced need to be enacted.

Dow is approximately 1.5km away from the Main Area. Whilst the attention areas (and sources of) appear complex in this region the information available suggests that the explosion attention area covers the whole of the Main Area (as well as parts of the Cooling Water Area and Support

Area). A toxic cloud attention area (though to originate from within the Dow complex) also covers the whole Main Area and a significant part of the Support Area. The facility is considered a very high risk.

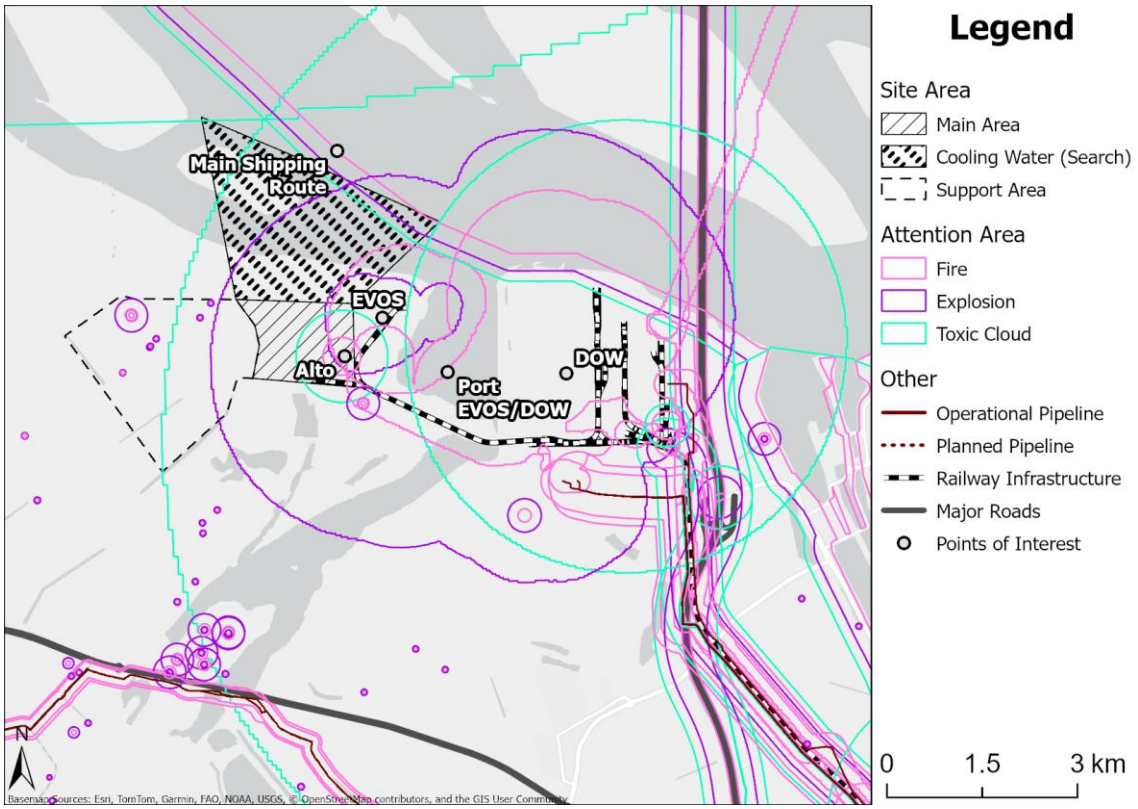

Figure 27: Attention areas, Terneuzen 1a

Road and rail. Whilst possible that hazardous substances could be transported along the causeway connecting the Evos and Dow facilities, it is unlikely these would be high risk to the Main Area, and any risk could be mitigated through appropriate management controls.

Pipelines. The status of the overground pipeline that also runs across the causeway connecting the Evos and Davos is unknown but not considered to represent a high given it has no attention areas attributed to it.

Marine. The shipping route to the harbour of Antwerp is approximately 1.5km away, whilst the Braakmanhaven servicing the Dow and Evos sites is around 750m from the Main Area. At these distances it is not thought marine shipping present a high level of risk.

Conclusion

Combined, the Evos and Alto Seveso sites present a **very high risk** to Terneuzen 1a, including the Main Area, Support Area and Cooling Water search area. Key actions that could be taken to reduce risk include:

- Given the extent of the attention areas, investigation into whether physical barriers could be feasibly implemented to protect against hazards from Alto, Evos and Dow, that are acceptable from a licensing perspective and that do not transfer risk to other locations.

- Removal of both Alto and Evos facilities, thereby removing hazard and risk from these sites.
- Regulatory advice on proximity to the Dow industrial complex.
- Incorporation of appropriate design and management measures, including through construction to mitigate risks from toxic clouds.

Removal of these facilities would likely be **challenging**, potentially including costs associated with decommissioning and removal of the facilities, loss of revenue and possible reconstruction. Priority should therefore be given to undertaking further assessment as to the feasibility of physical barriers, seeking regulatory advice where needed.

Residual risk is considered medium. Key residual risks to address later include:

- Appropriate assessment and management of remaining road, rail and shipping risks (in this location mainly concerning ships docking to the east of the site).
- Further assessment of the many hazardous activities with the 'siting study', and activities within the wider 'site characterisation' zone, for detailed site characterisation. In this instance the many activities are largely related to the Dow industrial complex.

3.4.2 Terneuzen 1b

Hazardous activities are shown in Figure 28, place-based risk contours in Figure 29Figure 26 and attention areas in Figure 30.

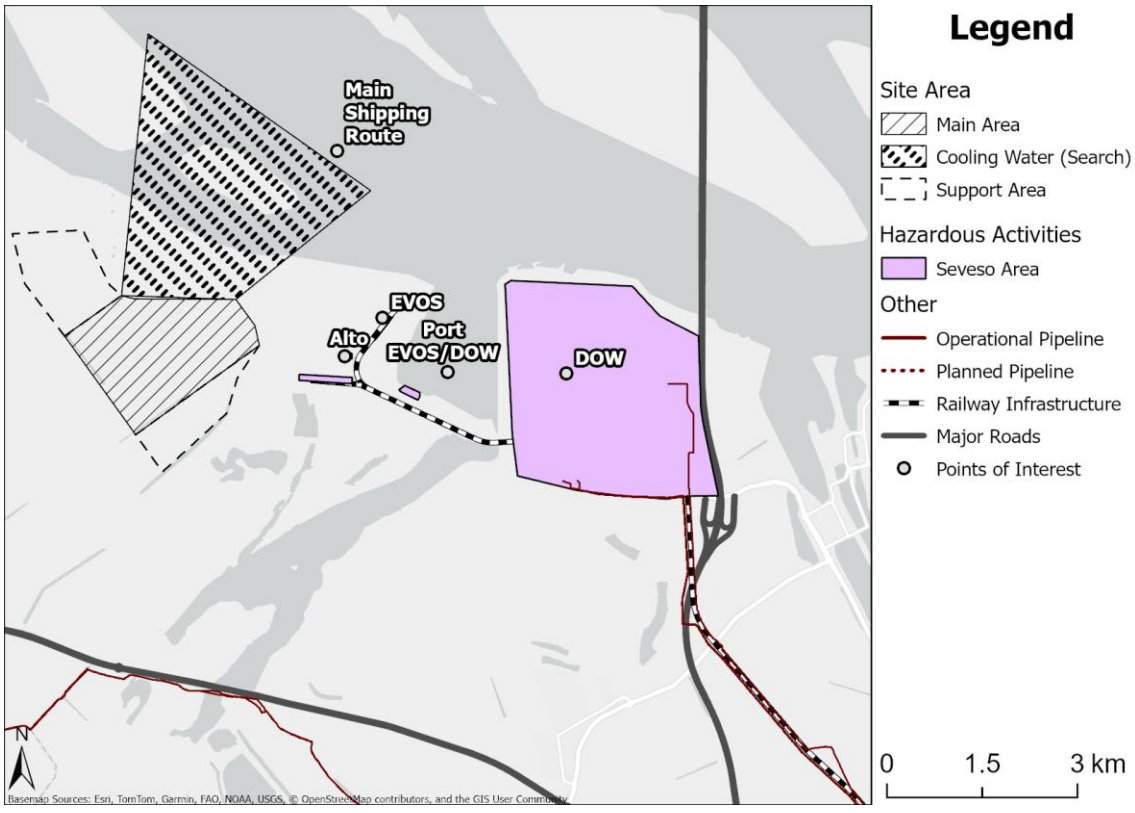

Figure 28: Hazardous activities, Terneuzen 1B

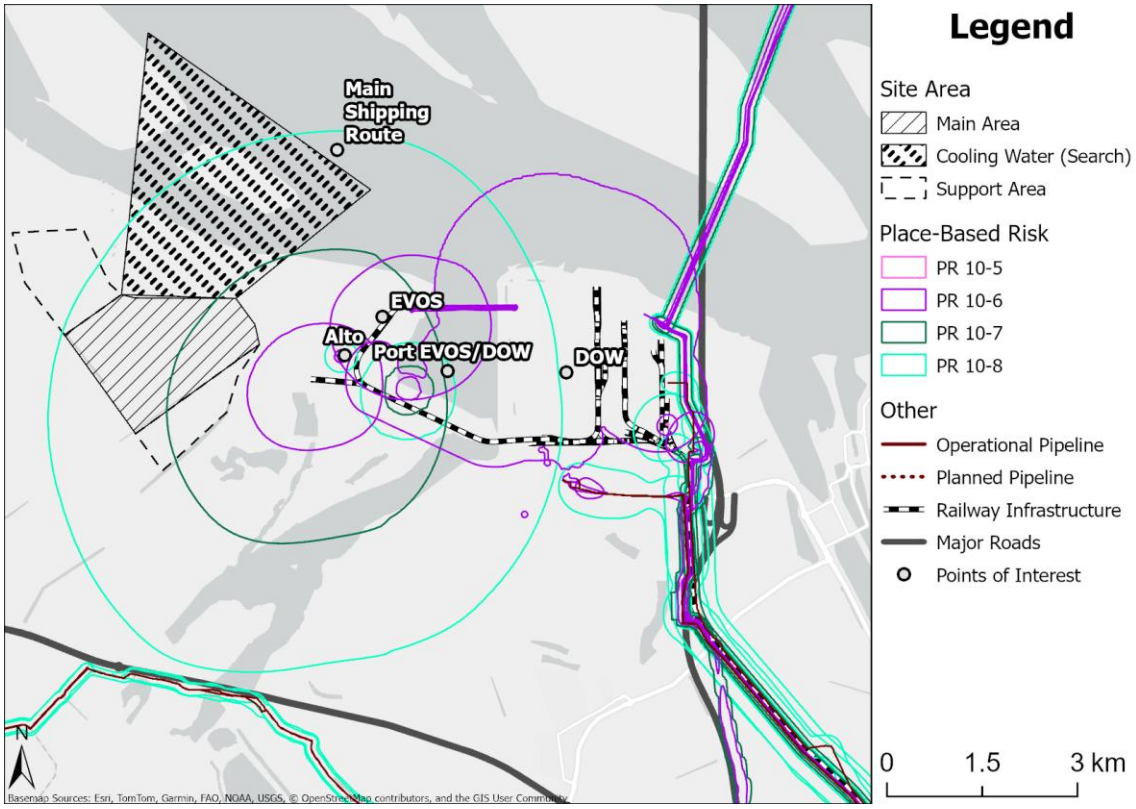

Figure 29: Place Based Risks Identified for Terneuzen 1b

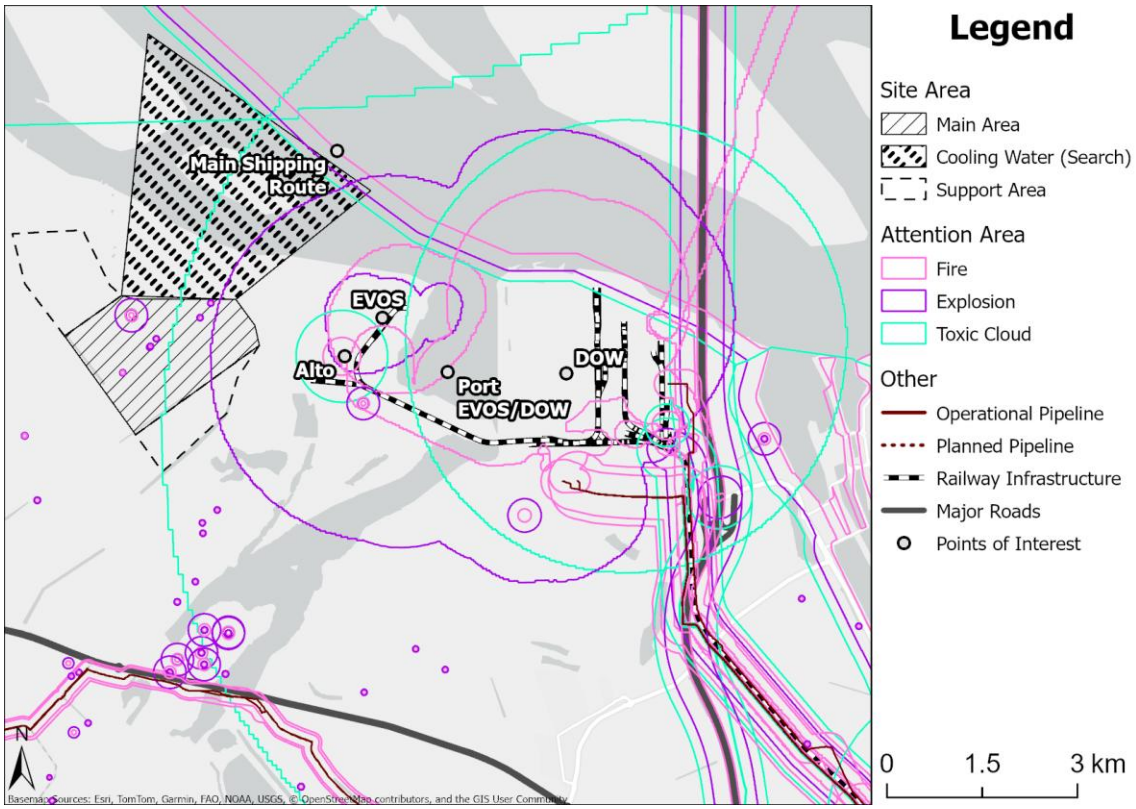

Figure 30: Hazard Zones Identified for Terneuzen 1b

Alto and Evos. Neither the 10^{-6} risk contour nor the attention areas for these two facilities overlap with the Main Area and are therefore not considered a high risk.

Dow. The facility is approximately 2.75km from the Main Area. Attention areas for explosion and toxic cloud cover a part of the Main Area (approximately 20% for the explosion area and 40% for the toxic cloud) as well as parts of the Support Area and Cooling Water area. This facility is considered to present a high risk. Physical or spatial barriers may be required to mitigate the explosion risk, whilst the toxic cloud would need to be considered in plant design and management arrangements.

Transport. Risks from land based or marine transport are considered low.

Other. Figure 30 highlights some small facilities within the Main Area. These are not considered a high risk but would need to be removed.

Conclusion

Due to the extent of the attention explosion and toxic cloud attention areas, the site is considered as **medium**. The key actions that could be taken to reduce risk are

- Consider site layout and position with the Main Area to take it out of the attention areas, particularly the explosion area.
- Incorporation of appropriate design and management measures, including through construction to mitigate risks from toxic clouds.

These measures are considered to represent an **easy level of effort**

Residual risk is considered low. Key residual risks to address later in the programme include:

- Appropriate assessment and management of remaining road, rail and shipping risks (noting the site is removed from any direct interface with shipping, road and rail routes).
- Further assessment of hazardous activities with the ‘siting study’, and activities within the wider ‘site characterisation’ zone, for detailed site evaluation and characterisation.

4 Conclusions

4.1 Summary of the Site Issues

Table 9 provides a summary of the key risks at each site, actions to facilitate reduction of this risk and the challenge of doing this, and the residual risk after these actions have been successfully completed. Table 10 summarises future development risks

Table 9 - Site summary for current risk

Site	Assumptions	Current risk (after assumptions)	Priority considerations for mitigating risk	Mitigation challenge	Residual risk (after priority considerations) and other licensing risks for later consideration
Eemshaven 1a	- Removal of Vopak, including pipelines and quay infrastructure. - Removal of wind turbines - Removal of PMO Eemshaven (DVVO)	**MEDIUM**	- Relocation of Heliport - Investigation of rail line risk and whether the line needs to be re-routed (or can be accommodated in the design) can be retained. - Site layout & configuration	**MODERATE** - Stakeholder engagement - Commercial negotiation - Decommissioning and reconstruction	**MEDIUM** - All hazardous facilities, including temporary LNG facility - Hazardous transport
Eemshaven 1b	Removal of wind turbines	**MEDIUM**	- Regulatory engagement and conditional acceptance on proximity of Seveso site (Vopak) and whether physical barriers or spatial separation may be required, and implications for licensing - Site layout & configuration - Relocation of Heliport	**MODERATE** - Stakeholder engagement - Commercial negotiation - Decommissioning and reconstruction (may be CHALLENGING) if Vopak is considered too close and requires removal and relocation)	**LOW** - All hazardous facilities, including temporary LNG facility and PMO Eemshaven - Hazardous transport, including the railway line

Site	Assumptions	Current risk (after assumptions)	Priority considerations for mitigating risk	Mitigation challenge	Residual risk (after priority considerations) and other licensing risks for later consideration
Eemshaven 2	**-** Removal of wind turbines - RWE coal fired power station removed	**VERY HIGH**	- Confirmation of LNG terminal life expectancy - Removal and/or rerouting of existing gas pipelines (providing existing functionality) - Mitigation for pipelines close to Main Area boundary and implications for licensing - Site layout & configuration - Confirmation on whether helipad would need removal or flightpath restrictions - Assessment of Support Area protection measures	**CHALLENGING** - Stakeholder engagement - Commercial negotiation - Decommissioning and reconstruction (may be VERY CHALLENGING if relocation of pipelines is not feasible and RWE Magnumcentrale is no longer viable)	**MEDIUM** - All hazardous facilities - Hazardous transport
Eemshaven 3	- Removal of wind turbines - Removal of ENGIE Eemscentrale and associated pipelines	**MEDIUM**	-Mitigation for pipelines in proximity to Main Area boundary, or possible relocation is required -Site layout & configuration -Toxic cloud protection design and management measures - Confirmation on whether helipad would need removal or flightpath restrictions -Assessment of Support Area protection measuresarea	**MODERATE** - Design - Stakeholder engagement - Commercial negotiation - Decommissioning and construction /reconstruction	**LOW** - All hazardous facilities, in particular the temporary LNG facility - Hazardous transport (residual risk LOW assuming LNG facility is confirmed as closed prior to operation)
Maasvlakte	-Removal of wind turbines	**HIGH**	- Whether physical barriers might be required to mitigate transport explosion risk (space to do this may be challenging), or spatial separation can be achieved through site layout & configuration - Toxic cloud protection design and management measures	**CHALLENGING** - Design - Stakeholder engagement - Commercial negotiation - Construction	**MEDIUM** - All hazardous facilities - Hazardous transport

Site	Assumptions	Current risk (after assumptions)	Priority considerations for mitigating risk	Mitigation challenge	Residual risk (after priority considerations) and other licensing risks for later consideration
Sloegebied 1	- Removal of wind turbines	**VERY HIGH**	- Removal /rerouting of hazardous pipeline, rail and road, providing existing functionality, not transferring risk to other locations - Regulatory opinion and conditional acceptance on proximity to Zeeland Refinery -- - Physical barriers or spatial separation through site layout to reduced explosion and fire risk from Zeeland Refinery - Site layout & configuration	**VERY CHALLENGING** - Stakeholder engagement - Commercial negotiation - Decommissioning and construction /reconstruction	**MEDIUM** - All hazardous facilities - Hazardous transport
Sloegebied 2	-Removal of wind turbines	**VERY HIGH**	- Protection from explosion risk from the VOPAK terminal, the use of barriers and licensing implications of that. Regulatory opinion and conditional acceptance on proximity to Vopak - Site layout & configuration - Removal and relocation of hazardous pipelines that service Sloe Central, ensuring safety to LNNP and existing functionality (or if not closure) - Assessment of Support Area protection	**VERY CHALLENGING** - Stakeholder engagement - Commercial negotiation - Decommissioning and construction /reconstruction	**MEDIUM** - All hazardous facilities, including munitions storage - Hazardous transport
Terneuzen 1a		**VERY HIGH**	- Physical barriers required for protection against risks from the Alto and Evos sites, or potential removal of these sites - Protection against explosion and toxic cloud risk from Dow, and regulatory opinion and conditional acceptance on proximity to this site - Site Layout - Assessment of Support Area protection	**CHALLENGING** Stakeholder engagement - Commercial negotiation - Decommissioning and construction /reconstruction	**MEDIUM** - All hazardous facilities, including munitions storage - Hazardous transport
Terneuzen 1b		**MEDIUM**	- Site layout, moving LNNP out of explosion attention area - Toxic cloud protection measures for design and management	**EASY** - Design	**LOW** - All hazardous facilities, including munitions storage - Hazardous transport

Table 10 - Site summary of future development risk

Site	Future Development Risks	Comments
Eemshaven 1a	Very High	Hydrogen pipelines on or close to site boundaries
Eemshaven 1b	High	Hydrogen pipeline close to one site boundary
Eemshaven 2	Very High	Hydrogen pipelines and other infrastructure including an electrolyser on and/or close to site boundaries
Eemshaven 3	Very High	Hydrogen pipeline on and/or close to site boundaries
Maasvlakte	Medium	No hydrogen infrastructure close to site but planned for wider area
Sloegebied 1	Very High	Hydrogen pipelines on or close to site boundaries
Sloegebied 2	Very High	Hydrogen pipelines and other infrastructure including on and/or close to site boundaries

Terneuzen 1a	Low	No planned hydrogen infrastructure
Terneuzen 1b	Low	No planned hydrogen infrastructure

A. Appendix

Figure 31: Hydrogen network Netherlands

A.1 Summary of human-induced events, Eemshaven 1a

Table 11: Summary of Associated Risks for Eemshaven 1a

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Heliport Eemshaven	1.6km	Helicopter base to serve offshore vessels, offshore wind farms and any Oil & Gas premises in the North Sea. 15 flights / day.[50]	Den Helder Support Service (DHSS).	Helipad and helicopter movements within close proximity to the site.	helicopter failure crash into site.	Take out power lines, switch stations, ancillary buildings Injuries and/or fatalities to workers, including through construction	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features. Ensure emergency plan accounts for air crash/multiple casualties/ joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Borkum Airport	18km	Small airport serving mainly small aircraft (e.g., Cesna) for hobby purposes and helicopters for industry. Small aircraft and helicopters. (N/A regarding flights movements).	Stadt Borkum (local Borkum city authorities).	Not considered due to the type of aircraft and distance.			
Temporary LNG terminal.[51]	2.5 km closest distance of the LNG carriers to the	Temporary floating LNG terminal containing two Floating Storage Regasification Units (FSRU's).	Energiebedrijf Gasunie	The total amount of natural gas within the facility is maximum 88.2 tonnes. The LNG is transported via approximately 100 LNG	Gas turbine explosion. High pressure blast waves Gas/LNG/Cryogenic release.	Power, communication, or logistical failures. Cascading failure. Impact on neighbouring infrastructure / operations.	Blast resistant containment structures. Containment systems. Separate critical systems and resources.

[50] Source: https://www.groningen-seaports.com/wp-content/uploads/Offshore-wind-brochure-versie-9.pdf

[51] Source: https://bestanden.provinciegroningen.nl/bestanden-openbaar/publicatievoorstel/KIWI_PublicatieVoorstel_IPPC_000000400001/D2024-018270%20GEANONIMISEERD%20-%20A1a_Beperkt_VR_-EET-1_-_rev2.1_gasketels.pdf

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
	site is c.1.7km.			carriers / year to the LNG terminal.		Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
VOPAK terminal Eemshaven.[52]	0km	Oil storage terminal, 11 tanks. Total capacity 681,115m^3.	Vopak	N/A Oil storage terminal, 11 tanks.	Fire / explosion. Contamination. Leaks / spills. Utility/logistical failures due to incident at terminal.	Damage to infrastructure. Loss of power. Potential to contaminate / flood / mechanical impact to site if structural collapse. Leaks / spills. Toxic gas release. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk.	Blast resistant containment structures. Containment systems Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews.

[52] The VOPAK Terminal Eemshaven will need to be removed if this alternative is chosen.

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
						Security breach.	Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Ecofuels Netherlands	2km	Biofuel production facility. Production capacity: 160 tonnes of bio diesel / annum.	Ecofuels	The permit[53] of Ecofuels contains following specific hazards: Methanol storage: maximum 633.4kg. KM32 storage: maximum 154.2kg. (Maximum amount of KM32 in the facility is 368m^3). Oxidation stabilisation: maximum 2.kg. ADR 8 goods: maximum 2000kg.	Fire / explosion. Chemical leaks / toxic release. Shared infrastructure.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage.

[53] Source: https://repository.officiele-overheidspublicaties.nl/externebijlagen/exb-2021-16715/1/bijlage/exb-2021-16715.pdf

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
							Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Gasunie compressor station Spijk.	6km	Compressor station for natural gas pipeline (4 compressors).	Gasunie	Compressor station for natural gas.	Fire / explosion. Chemical leaks / toxic release. Shared infrastructure. Combined incident.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Holland Malt B.V.	2km	Beer brewery - Ammonia storage facility.[54]	Hollan Malt	Ammonia storage facility. Malt dust.	Malt dust – explosive / flammable. Can burn and explode.	Damage to infrastructure.	Blast resistant containment structures. Containment systems

[54] Source: https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Vergunningen_en_Ontheffingen/Ontheffingen_en_vergunningen_2018/448760-_-DEFINITIEF-besluit-Westlob-4-Eemshaven-D2020-064557.pdf

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
				6,000-volt transformer.	Toxic Vapour. Airborne / groundwater contamination.	Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Separate critical systems and resources. Rapid response procedures. Advanced leak detection Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Bakker Cold Stores B.V.	3km	Ammonia storage facility.	Bakker Transport & Warehousing.	Ammonia storage facility.	Fire, spontaneous combustion, explosion. Water Contamination. Security threats. Major chemical release.	Damage to infrastructure. Loss of power. Potential to contaminate. Toxic gas release. Utility/logistical failures due to incident. Coordinated threats. Pollution of site and interference with emergency water systems.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews.

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
							Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
BKV Nederland B.V. Concrete batching plant.	3.5km	Concrete batching plant.	BKV Nederland B.V.	Storage of chemicals (including admixtures) and fuel.	Fire / explosion. Chemical spills.	Damage to infrastructure. Loss of power. Potential to contaminate. Toxic gas release. Utility/logistical failures due to incident Coordinated threats Pollution of site and interference with emergency water systems.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Routine environmental monitoring / audits and cross-site communication.
RWE Magnum Power Plant.	3.3km	Gas fired power plant ($1.3MW_{el}$).	RWE	Supply station for natural gas. Gas turbine explosion.	Gas turbine fire, spontaneous combustion, explosion, and smoke.	Fire / explosion. Gas leak. Airborne emissions. Impact on emergency preparedness and monitoring equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts;	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals.

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
						complexity in response; reputational risk. Coordinated threats.	Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
RWE Eemscentrale	3.8km	Coal fired power plant ($1.56MW_{el}$).	RWE	Coal storage facility.	Fire, spontaneous combustion, explosion, and smoke in coal storage facility. Water / air pollution. Structural failure. Dust.	Impact on emergency preparedness, equipment integrity. Impact filters / equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Eemscentrale	5km	Gas fired power plant ($1.75MW_{el}$).	Engie	Supply station for natural gas.	Gas turbine fire, spontaneous	Fire / explosion. Gas leak. Airborne emissions.	Blast resistant containment structures. Secondary containment.

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
					combustion, explosion, and smoke.	Impact on emergency preparedness and monitoring equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Coordinated threats.	Rapid response procedures. Independent and redundant power systems. Backup systems Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Military Sites.	No operational military site within a 25km.[55]						
Adjacent Nuclear Sites.	The Eemshaven area is not within the safety zone of any nuclear facility.						
Wildfires	The Eemshaven area is not within close proximity (<25km) risk area of wildfires.						
Missiles	The proposed site has 14 Wind Turbine Generators (WTGs) with direct interference[56] to the proposed site.						
Kwelderweg.	c.0.5km	Road system.		Main road. Dangerous goods transport route.	Safety hazard. Road transport incident.	Exposure to dangerous substances. Environmental contamination.	Controlled access points; road safety audits; clear signage and routing.

[55] Source: https://nprd.inspraak.defensiedichtbij.nl/

[56] Direct interference is defined as: the 10^5 and/or 10^6 contour for external safety of the WTG interferes with the site. However, it should be noticed that several failure mechanisms (e.g., Nacelle failure or blade failure) might cause further safety distances depending on factors as wind speed, hub height and WTG power.

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
					Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Security issues.	Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
Meeuwenstraatweg, Ramselgatweg, Borkumkade and Westlob.		Local road system.		Main road. Dangerous goods transport route.	Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport.	Exposure to dangerous substances. Environmental contamination. Contamination of critical. infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
N46	c.0.7km	Main road.		Main road Dangerous goods transport route.	External safety risk. Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services.

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
					Regulatory oversight of hazardous goods transport.	Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
Rail system network.	Adjacent.	Rail system network.		Rail system connected to the National Dutch Railway System.	Rail accident. Security event. Derailment. Fire.	Damage to infrastructure. Potentially dangerous goods. Evacuation routes blocked. Security breach. Disruption to plant operations.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control. Robust physical barrier between site and rail. Monitoring of rail operations. Emergency response plan. Ensure rail tracks are well maintained. Alternative evacuation paths.
Ecofuels.	1km from quay to site.		Ecofuels.	Biodiesel and methanol transport.	Various hazardous goods - biodiesel methanol. Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power.

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
							Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
Temporary LNG terminal.[57]	2.7km quay site to boundary.	Temporary floating LNG terminal containing two Floating Storage Regasification Units (FSRU's).	Energiebedrijf Gasunie	Transport of LNG.	Gas turbine explosion. High pressure blast waves. Gas/LNG/Cryogenic release.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach. Cascading failure.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
RWE Eemscentrale.	3km from quay to site.	Coal fired power plant ($1.56MW_{el}$).	RWE	Transport of coal.	Fire, spontaneous combustion, explosion, and smoke in coal storage facility. Water / air pollution. Structural failure. Dust.	Impact on emergency preparedness, equipment integrity Impact filters / equipment. Damage to infrastructure.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures.

[57] Source: https://bestanden.provinciegroningen.nl/bestanden-openbaar/publicatievoorstel/KIWI_PublicatieVoorstel_IPPC_000000400001/D2024-018270%20GEANONIMISEERD%20-%20A1a_Beperkt_VR_-EET-1_-_rev2.1_gasketels.pdf

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
						Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Coordinated threats.	Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
Gasunie Gas Pipeline.	2.5km to safety zone[58]. 2.6km to Site.	Natural gas pipeline.	Gasunie	Natural gas pipeline.	Pipeline leak / spill. Fire. Major pipeline rupture / explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols.

[58] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
							Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Gasunie Gas Pipeline.	1.5km to safety zone[59] 2km to Site.	Natural gas pipeline.	Gasunie	Natural gas pipeline.	Pipeline leak / spill. Fire. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations. Advanced leak detection. Rapid isolation valves.
Future Hydrogen Backbone.[60]	<0.05km	Hydrogen pipeline.	Gasunie	Hydrogen backbone to be operated at a 66,2 bar(g) pressure.	Hydrogen leak Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response. Security threat.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems.

[59] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[60] Source: https://www.gasunie.nl/omgevingsloket/voor-organisaties

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
						Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency. management; greater public safety, environmental, reputational impact. Security breach.	Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression. systems. Advanced leak detection. Rapid isolation valves.
Eemshydrogen 50MW electrolyser.[61]	3km	50MW electrolyser.	RWE	50MW electrolyser at coal fired power plant.	Fire / explosion Hydrogen leak/explosion. Electrolyser cell thermal runaway. Grid/power failure. Release of hazardous substances. Water contamination. Sabotage / terrorism. Release of hazardous substance. Incident affecting emergency response.	Fire / explosion. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Potential radiological safety risk. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety,	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols.

[61] Source: https://www.rwe.com/en/research-and-development/hydrogen-projects/eemshydrogen/

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
						environmental, reputational impact. Security breach.	Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Rapid isolation valves.

A.2 Summary of human-induced events Eemshaven 1b

Table 12: Summary Associated Risks for Eemshaven 1b

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Heliport Eemshaven	1.5km	Helicopter base to serve offshore vessels, offshore wind farms and any Oil & Gas premises in the North Sea. 15 flights / day.[62]	Den Helder Support Service (DHSS).	Helipad and helicopter movements within close proximity to the site.	Increased risk of helicopter failure crash into site.	Take out power lines, switch stations.	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features. Ensure emergency plan accounts for air crash/multiple casualties, joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Borkum Airport	16km	Small airport serving mainly small aircraft (e.g., Cesna) for hobby purposes and helicopters for industry.	Stadt Borkum (local Borkum city authorities).	Not considered due to the type of aircraft and distance.			
Temporary LNG terminal[63]	3.8km	Temporary floating LNG terminal containing two Floating Storage	Energiebedrijf Gasunie	The total amount of natural gas within the facility is maximum 88.2 tonnes. The LNG is	Gas turbine explosion. High pressure blast waves.	Power, communication, or logistical failures. Cascading failure.	Blast resistant containment structures. Containment systems

[62] Source: https://www.groningen-seaports.com/wp-content/uploads/Offshore-wind-brochure-versie-9.pdf

[63] Source: https://bestanden.provinciegroningen.nl/bestanden-openbaar/publicatievoorstel/KIWI_PublicatieVoorstel_IPPC_000000400001/D2024-018270%20GEANONIMISEERD%20-%20A1a_Beperkt_VR_-EET-1_-_rev2.1_gasketels.pdf

		Regasification Units (FSRU's).		transported via approximately 100 LNG carriers / year to the LNG terminal.	Gas/LNG/Cryogenic release.	Impact on neighbouring infrastructure / operations. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
VOPAK terminal Eemshaven[64]	0.5km	Oil storage terminal 11 tanks. Total capacity 681,115m^3.	Vopak	Crude oil and petrochemical products.	Fire / explosion. Contamination. Leaks / spills. Utility/logistical failures due to incident at terminal.	Damage to infrastructure. Loss of power. Potential to contaminate / flood / mechanical impact to site if structural collapse, leaks / spills. Toxic gas release. Escalation of emergency; combined public health /environmental impacts;	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance.

[64] The VOPAK Terminal Eemshaven will need to be removed if this alternative is chosen.

						complexity in response; reputational risk. Security breach.	Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Ecofuels Netherlands	2km	Biofuel production facility Production capacity: 160 tonnes of bio diesel / annum.	Ecofuels	The permit[65] of Ecofuels contains following specific hazards: Methanol storage: maximum 633.4kg KM32 storage: maximum 154.2kg. (Maximum amount of KM32 in the facility is 368m^3). Oxidation stabilisation: maximum 2kg. ADR 8 goods: maximum 2000kg.	Fire / explosion. Chemical leaks / toxic release. Shared infrastructure.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedure. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems.

[65] Source: https://repository.officiele-overheidspublicaties.nl/externebijlagen/exb-2021-16715/1/bijlage/exb-2021-16715.pdf

							Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Gasunie compressor station Spijk	7.1km	Compressor station for natural gas pipeline (4 compressors).	Gasunie	Compressor station for natural gas.	Fire / explosion. Chemical leaks / toxic release. Shared infrastructure. Combined incident.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedure. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans Backup systems

Holland Malt B.V.	2km	Beer brewery - Ammonia storage facility.	Hollan Malt	Ammonia storage facility.[66] Malt dust. 6,000-volt transformer.	Malt dust – explosive / flammable. Can burn and explode. Toxic vapour. Airborne / groundwater contamination.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedure. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Bakker Cold Stores B.V.	3km	Ammonia storage facility.	Bakker Transport & Warehousing.	Ammonia storage facility.	Ammonia storage facility. Fire, spontaneous combustion, explosion. Water. Contamination. Security Threats. Major chemical release.	Damage to infrastructure. Loss of power. Potential to contaminate. Toxic gas release. Utility/logistical failures due to incident. Coordinated threats. Pollution of site and interference with	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedure. Advanced leak detection. Enhanced inspection & maintenance.

[66] Source: https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Vergunningen_en_Ontheffingen/Ontheffingen_en_vergunningen_2018/448760-_-DEFINITIEF-besluit-Westlob-4-Eemshaven-D2020-064557.pdf

						emergency water systems.	Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
BKV Nederland B.V. Concrete batching plant.	2.2km	Concrete batching plant.	BKV Nederland B.V.	Storage of chemicals (including admixtures) and fuel.	Fire / explosion. Chemical spills.	Damage to infrastructure. Loss of power. Potential to contaminate. Toxic gas release. Utility/logistical failures due to incident. Coordinated threats. Pollution of site and interference with emergency water systems.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Routine environmental monitoring / audits and cross-site communication.
RWE Magnum Power Plant	3.8km	Gas fired power plant ($1.3MW_{el}$).	RWE	Supply station for natural gas. Gas turbine explosion.	Gas turbine	Fire / explosion. Gas leak. Airborne emissions. Security vulnerability (shared infrastructure).	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedure. Advanced leak detection.

							Routine environmental monitoring / audits and cross-site communication.
RWE Eemscentrale	4.1km	Coal fired power plant ($1.56MW_{el}$).	RWE	Coal storage facility.	Fire, spontaneous combustion, explosion, and smoke in coal storage facility. Water / air pollution. Structural failure. Dust.	Impact on emergency preparedness, equipment integrity Impact filters / equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Coordinated threats.	Blast resistant containment structures. Secondary containment. Rapid response procedure. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Eemscentrale	5.7km	Gas fired power plant ($1.75MW_{el}$).	Engie	Supply station for natural gas.	Gas turbine fire, spontaneous combustion, explosion, and smoke	Fire / explosion. Gas leak. Airborne emissions. Impact on emergency preparedness and monitoring equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Coordinated threats.	Blast resistant containment structures. Secondary containment. Rapid response procedure. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring.

							Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Military Sites	No operational military site within a 25km.						
Adjacent Nuclear Sites	The Eemshaven area is not within the safety zone of any nuclear facility.						
Wildfires	The Eemshaven area is not within close proximity (<25km) risk area of wildfires.						
Missiles	The proposed site has 9 Wind Turbine Generators (WTGs) with direct interference[67] to the proposed site.						
Kwelderweg	c.1.8km	Road		Road	Main road. Dangerous goods transport route.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.

[67] Direct interference is defined as: the 10^5 and/or 10^6 contour for external safety of the WTG interferes with the site. However, it should be noticed that several failure mechanisms (e.g., Nacelle failure or blade failure) might cause further safety distances depending on factors as wind speed, hub height and WTG power.

Meeuwenstraatweg, Ramselgatweg, Borkumkade and Westlob.		Local road system.		Local road system. Dangerous goods transport route.	Main road. Dangerous goods transport route.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Controlled access points; road safety audits; clear signage and routing Barrier protection around site perimeter; spill containment; rapid incident response Alternate access for emergency services Joint emergency planning, integrated drills, communication protocols Enhanced monitoring and surveillance Comprehensive security, restricted access
N46	c.1.8km			Main road. Dangerous goods transport route.	Main road. Dangerous goods transport route.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
Ecofuels	2km from quay to site.	Biodiesel and methanol transport.	Ecofuels	Biodiesel and methanol transport.	Various hazardous goods - Biodiesel methanol. Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring.

					Ships as vector for targeted attacks or unauthorized access.	Delayed emergency response. Supply chain disruption. Strain on local. emergency resources. Security breach.	Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
RWE Eemscentrale	4.2km from quay to site	Coal fired power plant (1.560MW_{el})	RWE	Transport of coal.	Fire, spontaneous combustion, explosion, and smoke in coal storage facility. Water / air pollution. Structural failure. Dust.	Impact on emergency preparedness, equipment integrity. Impact filters / equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
VOPAK Oil Terminal	1.8km from quay to site.	Crude oil. Petrochemical products.	Vopak	Dangerous transported good.	Various hazardous goods – crude oil / petrochemical products. Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures.

					Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
Gasunie Gas Pipeline	2.5km to safety zone.[68] 2.6km to Site.	Natural gas pipeline.	Gasunie	Natural gas pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection.

[68] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

							Rapid isolation valves.
Gasunie Gas Pipeline	1.5km to safety zone.[69] 2km to Site.	Natural gas pipeline.	Gasunie	Natural gas pipeline.	Pipeline leak / spill. Fire. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations. Advanced leak detection. Rapid isolation valves.
Temporary LNG terminal[70]	3.7km from quay to site boundary.	Temporary floating LNG terminal containing two Floating Storage Regasification Units (FSRU's).	Energiebedrijf Gasunie	The total amount of natural gas within the facility is maximum 88.2 tonnes. The LNG is transported via approximately 100 LNG carriers / year to the LNG terminal	Gas Turbine explosion. High pressure blast waves. Gas/LNG/Cryogenic release.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security.

[69] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[70] Source: https://bestanden.provinciegroningen.nl/bestanden-openbaar/publicatievoorstel/KIWI_PublicatieVoorstel_IPPC_000000400001/D2024-018270%20GEANONIMISEERD%20-%20A1a_Beperkt_VR_-EET-1_-_rev2.1_gasketels.pdf

						Strain on local emergency resources. Security breach. Cascading failure.	Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
Rail system network	Adjacent	Rail system network.		Rail system connected to the National Dutch Railway System.	Rail accident. Security event. Derailment. Fire.	Damage to infrastructure. Potential dangerous goods. Evacuation routes blocked. Security breach. Disruption to plant operations.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control. Robust physical barrier between site and rail. Monitoring of rail operations, emergency response plan. Ensure rail tracks are well maintained. Alternative evacuation paths.
Future Hydrogen Backbone	<0.5km[71]	Hydrogen pipeline.	Gasunie	Hydrogen backbone to be operated at a 66,2 bar(g) pressure.	Hydrogen leak Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response. Security threat.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals.

[71] Source: https://www.gasunie.nl/omgevingsloket/voor-organisaties

						Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Eemshydrogen 50MW electrolyser	3km	50MW electrolyser.[72]	RWE	50MW electrolyser at coal fired power plant.	Fire / explosion Hydrogen leak/explosion. Electrolyser cell thermal runaway. Grid/power failure. Release of hazardous substances. Water contamination. Sabotage / terrorism. Release of hazardous substance. Incident affecting emergency response.	Fire / explosion. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Potential radiological safety risk. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.

[72] Source: https://www.rwe.com/en/research-and-development/hydrogen-projects/eemshydrogen/

A.3 Summary of human-induced events Eemshaven 2

Table 13: Summary of Associated Risks for Eemshaven 2

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Heliport Eemshaven	3.3km	Helicopter base to serve offshore vessels, offshore wind farms and any Oil & Gas premises in the North Sea. 15 flights / day.[73]	Den Helder Support Service (DHSS).	Helipad and helicopter movements within close proximity to the site.	Increased risk of helicopter failure crash into site.	Take out power lines, switch stations.	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features. Ensure emergency plan accounts for air crash/multiple casualties, joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Borkum Airport	18km	Small airport serving mainly small aircraft (e.g., Cesna) for hobby purposes and helicopters for industry	Stadt Borkum (local Borkum city authorities)	Not considered due to the type of aircraft and distance.			
Temporary LNG terminal[74]	0.17 km	Temporary floating LNG terminal containing two Floating Storage	Energiebedrijf Gasunie	The total amount of natural gas within the facility is maximum 88.2 tonnes. The LNG is transported via	Gas turbine explosion. High pressure blast waves.	Power, communication, or logistical failures. Cascading failure.	Blast resistant containment structures. Containment systems.

[73] Source: https://www.groningen-seaports.com/wp-content/uploads/Offshore-wind-brochure-versie-9.pdf

[74] Source: https://bestanden.provinciegroningen.nl/bestanden-openbaar/publicatievoorstel/KIWI_PublicatieVoorstel_IPPC_000000400001/D2024-018270%20GEANONIMISEERD%20-%20A1a_Beperkt_VR_-EET-1_-_rev2.1_gasketels.pdf

		Regasification Units (FSRU's).		approximately 100 LNG carriers / year to the LNG terminal.	Gas/LNG/Cryogenic release.	Impact on neighbouring infrastructure / operations. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
VOPAK terminal Eemshaven[75]	3.3km	Oil storage terminal 11 tanks. Total capacity 681,115m^3.	Vopak	Crude oil and petrochemical products.	Fire / explosion. Contamination. Leaks / spills. Utility/logistical failures due to incident at terminal.	Damage to infrastructure. Loss of power. Potential to contaminate / flood / mechanical impact to site if structural collapse, leaks / spills. Toxic gas release. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning.

[75] The VOPAK Terminal Eemshaven will need to be removed if this alternative is chosen.

						Security breach.	Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Ecofuels Netherlands	2.3km	Biofuel production facility Production capacity: 160.000 tonnes of bio diesel / annum	Ecofuels	The permit[76] of Ecofuels contains following specific hazards: Methanol storage: maximum 633.4kg KM32. storage: maximum 154.2kg. (Maximum amount of KM32 in the facility is 368m^3). Oxidation stabilisation: maximum 2kg. ADR 8 goods: maximum. 2000kg.	Fire / explosion. Chemical leaks / toxic release. Shared infrastructure.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing.

[76] Source: https://repository.officiele-overheidspublicaties.nl/externebijlagen/exb-2021-16715/1/bijlage/exb-2021-16715.pdf

							Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Gasunie compressor station Spijk	3km	Compressor station for natural gas pipeline (4 compressors).	Gasunie	Compressor station for natural gas.	Fire / explosion. Chemical leaks / toxic release. Shared infrastructure. Combined incident.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Holland Malt B.V.	2km	Beer brewery - Ammonia storage facility.[77]	Hollan Malt	Ammonia storage facility Malt dust	Malt dust – explosive / flammable.	Damage to infrastructure.	Blast resistant containment structures.

[77] Source: https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Vergunningen_en_Ontheffingen/Ontheffingen_en_vergunningen_2018/448760-_-DEFINITIEF-besluit-Westlob-4-Eemshaven-D2020-064557.pdf

				6,000-volt transformer.	Can burn and explode. Toxic vapour. Airborne / groundwater contamination.	Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Bakker Cold Stores B.V.	0.35km	Ammonia storage facility.	Bakker Transport & Warehousing.	Ammonia storage facility.	Can burn and explode. Chemical spills.	Damage to infrastructure. Loss of power. Potential to contaminate. Toxic gas release. Utility/logistical failures due to incident. Coordinated breach. Pollution of site and interference with emergency water systems.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems.

							Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
BKV Nederland B.V. Concrete batching plant.	1.8km	Concrete batching plant.	BKV Nederland B.V.	Storage of chemicals (including admixtures) and fuel.	Fire / explosion. Chemical spills.	Damage to infrastructure. Loss of power. Potential to contaminate. Toxic gas release. Utility/logistical failures due to incident. Security breach. Pollution of site and interference with emergency water systems.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Routine environmental monitoring / audits and cross-site communication.
RWE Magnum Power Plant	0.25km	Gas fired power plant ($1.3MW_{el}$).	RWE	Supply station for natural gas. Gas turbine explosion.	Gas turbine fire, spontaneous combustion, explosion, and smoke.	Fire / explosion. Gas leak. Airborne emissions. Impact on emergency preparedness and monitoring equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources.

							Enhanced security protocols. Automatic suppression systems.
Eemscentrale	0.9km	Gas fired power plant ($1.75MW_{el}$)	Engie	Supply station for natural gas.	Gas turbine fire, spontaneous combustion, explosion, and smoke.	Fire / explosion. Gas leak. Airborne emissions. Impact on emergency preparedness and monitoring equipmen.t Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Military Sites	No operational military site within a 25km.[78]						
Adjacent Nuclear Sites	The Eemshaven area is not within the safety zone of any nuclear facility.						
Wildfires	The Eemshaven area is not within close proximity (<25km) risk area of wildfires.						
Missiles	The proposed site has 8 Wind Turbine Generators (WTGs) with direct interference[79] to the proposed site.						

[78] Source: https://nprd.inspraak.defensiedichtbij.nl/

[79] Direct interference is defined as: the 10^5 and/or 10^6 contour for external safety of the WTG interferes with the site. However, it should be noticed that several failure mechanisms (e.g., Nacelle failure or blade failure) might cause further safety distances depending on factors as wind speed, hub height and WTG power.

N33 / Kwelderweg	0.4km	Road		Road. Dangerous goods transport route.	Safety hazard Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Security issues.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
Temporary LNG terminal[80]	2.7km quay site to boundary.	Temporary floating LNG terminal containing two Floating Storage Regasification Units (FSRU's).	Energiebedrijf Gasunie	The total amount of natural gas within the facility is maximum 88.2 tonnes. The LNG is transported via approximately 100 LNG carriers / year to the LNG terminal.	Gas turbine explosion. High pressure blast waves Gas/LNG/Cryogenic release.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach. Cascading failure.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.

[80] Source: https://bestanden.provinciegroningen.nl/bestanden-openbaar/publicatievoorstel/KIWI_PublicatieVoorstel_IPPC_000000400001/D2024-018270%20GEANONIMISEERD%20-%20A1a_Beperkt_VR_-EET-1_-_rev2.1_gasketels.pdf

Ecofuels	1km from quay to site	Biodiesel and methanol transport.	Ecofuels	Biodiesel and methanol transport.	Various hazardous goods – biodiesel, methanol. Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
VOPAK Oil Terminal	2.3km from quay to site. 2.3km from site to pipeline. 2.5km to safety zone.[81]	Crude oil. Petrochemical products.	Vopak	Dangerous transported good.	Various hazardous goods – crude oil / petrochemical products. Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems.

[81] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

							Automatic suppression systems. Design considerations.
Rail system network	4.4km	Rail system network.		Rail system connected to the National Dutch Railway System.	Rail accident. Security event. Derailment. Fire.	Damage to infrastructure. Potential dangerous goods. Evacuation routes blocked. Security breach. Disruption to plant operations.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control Robust physical barrier between site and rail Monitoring of rail operations, emergency response plan Ensure rail tracks are well maintained Alternative evacuation paths
Gasunie Gas Pipeline	Into safety zone.[82] 0.5km to Site.	Natural gas pipeline	Gasunie	Natural gas pipeline	Pipeline leak / spill. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols.

[82] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

							Automatic suppression systems.
Gasunie Gas Pipeline	0.93km to safety zone.[83] 1.1km to site.	Natural gas pipeline	Gasunie	Natural gas pipeline	Pipeline leak / spill. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Future Hydrogen Backbone[84]	<0.05km	Hydrogen pipeline	Gasunie	Hydrogen backbone to be operated at a 66,2 bar(g) pressure.	Hydrogen leak. Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems.

[83] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[84] Source: https://www.gasunie.nl/omgevingsloket/voor-organisaties

						Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Eemshydrogen 50MW electrolyser	It is assumed that this plant needs to be removed if Eemshaven 2 is chosen. [85]						

[85] Source: https://www.rwe.com/en/research-and-development/hydrogen-projects/eemshydrogen/

A.4 Summary of human induced events Eemshaven 3

Table 14: Summary of associated risks for Eemshaven 3

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Heliport Eemshaven	4.1km	Helicopter base to serve offshore vessels, offshore wind farms and any Oil & Gas premises in the North Sea. 15 flights / day.[86]	Den Helder Support Service (DHSS).	Helipad and helicopter movements within close proximity to the site.	Increased risk of helicopter failure crash into site.	Take out power lines, switch stations.	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features. Ensure emergency plan accounts for air crash/multiple casualties, joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Borkum Airport	18km	Small airport serving mainly small aircraft (e.g., Cesna) for hobby purposes and helicopters for industry.	Stadt Borkum (local Borkum city authorities).	Not considered due to the type of aircraft and distance.			
VOPAK terminal Eemshaven[87]	4km	Oil storage terminal 11 tanks. Total capacity 681,115m^3.	Vopak	Crude oil and petrochemical products.	Fire / explosion. Contaminatio.n Leaks / spills.	Damage to infrastructure. Loss of power. Potential to contaminate / flood / mechanical impact to site	Blast resistant containment structures. Containment systems.

[87] The VOPAK Terminal Eemshaven will need to be removed if this alternative is chosen.

					Utility/logistical failures due to incident at terminal.	if structural collapse, leaks / spills. Toxic gas release. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Ecofuels Netherlands	2.3km	Biofuel production facility Production capacity: 160 tonnes of bio diesel / annum.	Ecofuels	The permit[88] of Ecofuels contains following specific hazards: Methanol storage: maximum 633.4kg. KM32 storage: maximum 154.2kg. (Maximum amount of KM32 in the facility is 368m^3).	Fire / explosion. Chemical leaks / toxic release. Shared infrastructure.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance.

[88] Source: https://repository.officiele-overheidspublicaties.nl/externebijlagen/exb-2021-16715/1/bijlage/exb-2021-16715.pdf

				Oxidation stabilisation: maximum 2kg. ADR 8 goods: maximum 2000kg.			Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Gasunie compressor station Spijk	1.7km	Compressor station for natural gas pipeline (4 compressors).	Gasunie	Compressor station for natural gas.	Fire / explosion. Chemical leaks / toxic release. Shared infrastructure. Combined incident.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review.

							Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Holland Malt B.V.	2.9km	Beer brewery - Ammonia storage facility.[89]	Hollan Malt	Ammonia storage facility. Malt dust. 6,000-volt transformer.	Malt dust – explosive / flammable. Can burn and explode. Toxic vapour. Airborne / groundwater contamination.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.

[89] Source: https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Vergunningen_en_Ontheffingen/Ontheffingen_en_vergunningen_2018/448760-_-DEFINITIEF-besluit-Westlob-4-Eemshaven-D2020-064557.pdf

Bakker Cold Stores B.V.	1.5km	Ammonia storage facility.	Bakker Transport & Warehousing	Ammonia storage facility.	Fire, spontaneous combustion, explosion. Water contamination. Security threats. Major chemical release.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
BKV Nederland B.V. Concrete batching plant.	2.8km	Concrete batching plant.	BKV Nederland B.V.	Storage of chemicals (including admixtures) and fuel.	Fire / explosion. Chemical spills.	Damage to infrastructure. Loss of power. Potential to contaminate. Toxic gas release. Utility/logistical failures due to incident. Coordinated threats. Pollution of site and interference with emergency water systems.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Routine environmental monitoring / audits and cross-site communication.

RWE Magnum Power Plant	0.35km	Gas fired power plant ($1.3MW_{el}$).	RWE	Supply station for natural gas. Gas turbine explosion.	Gas turbine fire, spontaneous combustion, explosion, and smoke.	Fire / explosion. Gas leak. Airborne emissions. Impact on emergency preparedness and monitoring equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems
RWE Eemscentrale	1.1km	Coal fired power plant ($1.56MW_{el}$).	RWE	Coal storage facility.	Fire, spontaneous combustion, explosion, and smoke in coal storage facility. Water / air pollution. Structural failure. Dust.	Impact on emergency preparedness, equipment integrity. Impact filters / equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring.

							Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Military Sites	No operational military site within a 25km.[90]						
Adjacent Nuclear Sites	The Eemshaven area is not within the safety zone of any nuclear facility.						
Wildfires	The Eemshaven area is not within close proximity (<25km) risk area of wildfires.						
Missiles	The proposed site has 14 [91] Wind Turbine Generators (WTGs) with direct interference to the proposed site.						
N33 / Kwelderweg	0.3km	Road		Road	Main road. Dangerous goods transport route.	Safety hazard. Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Security breach.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.

[90] Source: https://nprd.inspraak.defensiedichtbij.nl/

[91] Direct interference is defined as: the 10^5 and/or 10^6 contour for external safety of the WTG interferes with the site. However, it should be noticed that several failure mechanisms (e.g., Nacelle failure or blade failure) might cause further safety distances depending on factors as wind speed, hub height and WTG power.

Temporary LNG terminal[92]	1km quay site to boundary.	Temporary floating LNG terminal containing two Floating Storage Regasification Units (FSRU's).	Energiebedrijf Gasunie	The total amount of natural gas within the facility is maximum 88.2 tonnes. The LNG is transported via approximately 100 LNG carriers / year to the LNG terminal.	Gas turbine explosion. High pressure blast waves. Gas/LNG/Cryogenic release.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach. Cascading failure.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
Eems-Dollard shipping route	2.8km from quay to site boundary.	Shipping transport route.	Dutch and German governments.	Shipping transport route.	Various hazardous goods. Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination. Rapid response procedures. Spill containment equipment, wind and water quality monitoring. Route restrictions. Buffer zones. Sufficient surveillance and security. Intelligence sharing. Design considerations.

[92] Source: https://bestanden.provinciegroningen.nl/bestanden-openbaar/publicatievoorstel/KIWI_PublicatieVoorstel_IPPC_000000400001/D2024-018270%20GEANONIMISEERD%20-%20A1a_Beperkt_VR_-EET-1_-_rev2.1_gasketels.pdf

Ecofuels	2.8km from quay to site.	Biodiesel and methanol transport.	Ecofuels	Biodiesel and methanol transport.	Various hazardous goods – Biodiesel, methanol. Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
RWE Eemscentrale	0.7km from quay to site boundary.	Coal fired power plant (1.56MW_{el}).	RWE	Coal storage facility.	Fire, spontaneous combustion, explosion, and smoke in coal storage facility. Water / air pollution. Structural failure. Dust.	Impact on emergency preparedness, equipment integrity. Impact filters / equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones.

							Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
VOPAK Oil Terminal	3km from quay to site. 4km from site to pipeline. 3.1km to safety zone.[93]	Crude oil. Petrochemical products.	Vopak	Dangerous transported good.	Various hazardous goods – crude oil / petrochemical products. Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
Rail system network	5.0km	Rail system network.		Rail system connected to the National Dutch Railway System.	Rail accident. Security event. Derailment. Fire.	Damage to infrastructure. Potential dangerous goods. Evacuation routes blocked. Security breach. Disruption to plant operations.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control. Robust physical barrier between site and rail. Monitoring of rail operations, emergency response plan.

[93] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

							Ensure rail tracks are well maintained. Alternative evacuation paths.
Gasunie Gas Pipeline	0km to safety zone.[94] 0km to Site.	Natural gas pipeline.	Gasunie	Natural gas pipeline.	Pipeline leak / spill. Major pipeline rupture/ explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked. routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Gasunie Gas Pipeline	0km to zone[95] (crosses	Natural gas pipeline.	Gasunie	Natural gas pipeline.	Pipeline leak / spill. Major pipeline rupture/explosion.	Air/water/soil contamination. Damage to infrastructure.	Blast resistant containment structures. Secondary containment.

[94] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[95] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

	into the site). 0.1km to site.				Pipeline maintenance / disruption Pipeline incident affecting evacuation route. Combined incident.	Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk.	Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Future Hydrogen Backbone[96]	<0.45km	Hydrogen pipeline	Gasunie	Hydrogen backbone to be operated at a 66,2 bar(g) pressure.	Hydrogen leak Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and

[96] Source: https://www.gasunie.nl/omgevingsloket/voor-organisaties

						Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Eemshydrogen 50MW electrolyser	0.8km	50MW electrolyser.[97]	RWE	50MW electrolyser at coal fired power plant.	Fire / explosion. Hydrogen leak/explosion. Electrolyser cell thermal runaway. Grid/power failure. Release of hazardous substances. Water contamination. Sabotage / terrorism. Release of hazardous substance. Incident affecting emergency response.	Fire / explosion. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Potential radiological safety risk. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact.	Blast resistant containment structures. Secondary containment Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources.

[97] Source: https://www.rwe.com/en/research-and-development/hydrogen-projects/eemshydrogen/

							Enhanced security protocols. Automatic suppression systems.

A.5 Summary of human-induced events Maasvlakte II

Table 15: Summary of Associated Risks for Maasvlakte II

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Heliport Maasvlakte[98]	8.5km	The airport's task is to facilitate helicopter flights from the Pilotage Service to ships near the port of Rotterdam.	Loodswezen	Helipad and helicopter movements within close proximity to the site.	Increased risk of helicopter failure crash into site.	Take out power lines, switch stations.	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features. Ensure emergency plan accounts for air crash/multiple casualties, joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Mc Haaglanden Heliport	25km	It is a heliport used by trauma helicopters to quickly transport injured patients to the hospital's emergency room.	N/A	Not considered due to the type of aircraft and distance.			
Lyondell Chemie Nederland B.V.	2.5km	Large-scale chemical processing and storage.	LyondellBasell	Production of propylene oxide (PO), tert-butyl alcohol (TBA), and butanediol (BDO); the exact production capacity is no longer relevant for future	Fire / explosion. Contamination. Major chemical release. Leaks / spills. Security threat. Caustic wastewater.	Damage to infrastructure. Loss of power. Potential to contaminate. Toxic gas release. Water contamination. Escalation of emergency; combined public health	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection.

[98] Heliport Maasvlakte is primarily used as airport for helicopters to serve the offshore platforms. As these destinations are mainly located west of the proposed Maasvlakte II site, it could be that the flightpaths cross the site location. This would require further investigation in a follow-up stage of the Programme.

				planning due to the announced closure and demolition by the end of 2026.		/environmental impacts; complexity in response; reputational risk. Security breach.	Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Uniper Benelux N.V	3km	Power generation site.	Uniper	Includes biomass co-firing and hazardous substance storage. Electrical output capacity: ~1,000MW (combined assets).	Fire / combustion. Chemical leaks / toxic release. Grid instability. Combustion by-products, hazardous substance leaks.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Security breach. Loss of power.	Blast resistant containment structures. Containment systems Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.

Neste Netherlands B.V.	4km	Production of renewable diesel and sustainable aviation fuel.	Gasunie	Renewable diesel capacity: c.1.2 million tons/year; SAF capacity: c.500,000 tons/year	Fire / explosion. Chemical leaks / toxic release. Security threats. Shared infrastructure. Methanol, renewable diesel vapours, inert gases used in storage and processing (e.g. nitrogen).	Damage nuclear infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Coordinated threats. Possible contamination.	Maintain robust emergency communication between sites. Buffer zones. Real time monitoring. Containment Systems. Separate critical systems and resources. Back-up systems Enhanced security protocols, coordination Joint hazard assessment, robust planning. Regular audits.
Kova HSE B.V.	2.8km	Hazardous waste treatment and storage.	Kova HSE B.V	Handles various industrial hazardous waste streams; Capacity not publicly disclosed.	Toxic and corrosive waste residues. Major chemical release. Can burn and explode. Toxic / vapour. Airborne / groundwater contamination. Security threats.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.

Neele-Vat Maasvlakte B.V.	3.8km	Largest container degassing site in the Netherlands.	Neele-Vat Logistics	4500 m2 warehouse for repackaging fumigated cargo.[99]	Fumigants (e.g. phosphine, methyl bromide) from imported containers. Residual vapours from solvent-treated goods. Fire / explosion. Chemical spills. Toxic gas release. Security threat.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment Separate critical systems and resources. Rapid response procedures. Advanced leak detection Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Broekman Logistics Europoort B.V..	4.4km	Designed for ADR-classified hazardous materials Located on a 66,000m² plot with c.39,000m² of warehouse space.	Broekman Logistics (site sold to HighBrook Investors, still operated under Broekman brand).	Equipped with dedicated compartments for hazardous goods. 39,000m² warehouse; Designed for ADR Class 2.1, 3, 6, 8 material Seveso.[100]	Flammable: ADR Class 2.1 (flammable gases), Class 3 (flammable liquids). Toxic: ADR Class 6. Corrosive: ADR Class 8. Fire / explosion. Chemical spills. Toxic gas release. Security threat.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems.

[99] Source: Largest container degassing site opens on Maasvlakte

[100] Source: Sale of strategic logistics complex Europoort Rotterdam: successful transaction for Broekman Logistics | BRiQ

						management; greater public safety, environmental, reputational impact. Security breach.	Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Maasvlakte Olie Terminal N.V.	4km	One of the largest crude oil terminals in the world.	Joint venture (including Vopak, Shell, BP, ExxonMobil, TotalEnergies, Lukoil, and Saudi Aramco).	Storage capacity: c.1,085,786m³ Tank sizes: 110,000m³ – 120,000m³ each. Connected to refineries via pipeline infrastructure.	Crude oil vapours (especially during loading/unloading). Volatile organic compounds (VOCs) from crude oil. Hydrocarbon gases in confined spaces. Fire and explosion risks. Pipeline leak / spill. Major pipeline rupture/explosion. Airborne Emissions. Security vulnerability. (shared infrastructure) Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Robust emergency notification and regional response coordination. Regular risk assessments, scenario planning, and information sharing between facilities. Rapid response procedures. Routine regulatory compliance and site security reviews. Enhanced inspection & maintenance. Route planning. Coordination with pipeline operators, scheduled reviews. Remote monitoring. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Rapid response procedures.
Gate Terminal	5.1km	Storage and regasification of liquified Natural Gas (LNG) Storage in three 180m³ tanks.	Gasunie, VOPAK	Annual LNG capacity: 12bcm/year. Maximum ship capacity: 270m³.	Fire, spontaneous combustion, explosion. LNG release & vapor cloud. Cryogenic spills. Water contamination. Security threats.	Impact on emergency preparedness, equipment integrity, may impact filters / equipment. Damage to infrastructure. Air/water/soil contamination. Toxic/flammable cloud.	Blast resistant containment structures. Independent and redundant power systems. Emergency backup systems. Real-time safety monitoring-Automated shutdown and containment.

						Cryogenic damage to infrastructure. Effects on nuclear site's cooling/emergency water. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk Security breach.	Joint emergency response drills and comprehensive evacuation plan. Continuous environmental monitoring. Comprehensive communications between sites. Enhanced security protocols, coordination Automatic suppression systems. Rapid response procedures.
N.V. Nederlandse Gasunie	6.7km	Operates a liquefied natural gas (LNG) installation known as the Peakshaver.	Gasunie	Storage capacity: c. 78 million m³ of LNG. Maximum gasification capacity: 1.3 million m³/hour.	Fire, spontaneous combustion, explosion LNG release & vapor Cloud. Cryogenic spills. Water contamination. Security threats.	Impact on emergency preparedness, equipment integrity, may impact filters / equipment. Damage to infrastructure. Air/water/soil contamination. Toxic/flammable cloud. Cryogenic damage to infrastructure. Effects on nuclear site's cooling/emergency water. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Independent and redundant power systems. Emergency backup systems Real-time safety monitoring-Automated shutdown and containment. Communication protocols. Joint emergency response drills and comprehensive evacuation plan. Continuous environmental monitoring. Comprehensive communications between sites. Enhanced security.protocols, coordination. Automatic suppression systems. Rapid response procedures.
Indorama Ventures Europe B.V.	7.2km	Purified Terephthalic Acid (PTA) production facility.	Indorama Ventures	Supplies raw materials for PET (polyethylene terephthalate) production. c.700,000 tons/year; Shares a utility island (heat and power cogeneration) with a co-located PET facility.	Vapours from PTA and associated solvents. Toxic: Potential emissions from PTA production processes. Asphyxiant: Inert gases used in processing or storage Fire, spontaneous combustion, explosion	Impact on emergency preparedness, equipment integrity, may impact filters / equipment. Damage to infrastructure. Air/water/soil contamination. Toxic/flammable cloud. Cryogenic damage to infrastructure.	Blast resistant containment structures. Independent and redundant power systems. Emergency backup systems. Real-time safety monitoring-Automated shutdown and containment. Communication protocols.

					Water Contamination Security Threats Major chemical release	Effects on nuclear site's cooling/ emergency water. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Joint emergency response drills and comprehensive evacuation plan. Continuous environmental monitoring. Comprehensive communications between sites. Enhanced security protocols, coordination. Automatic suppression systems. Rapid response procedures.
Thermotraffic B.V.	4km	Temperature-controlled logistics.	Thermotraffic	Temperature-controlled logistics Ammonia storage facility.[101]	Fire, spontaneous combustion, explosion. Water contamination. Security threats. Major chemical release.	If exploded could be missiles / shrapnel. Pollution of site Interference with emergency water systems. Toxic/flammable cloud. Effects on nuclear site's cooling/emergency water. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Coordinated threats.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Kloosterboer Delta Terminal B.V.	4km	Cold and frozen storage for food products.	Kloosterboer Vastgoed	Ammonia storage facility.	Fire, spontaneous combustion, explosion. Water contamination. Security threats. Major chemical release.	Damage to infrastructure. Impact plant safety or affect monitoring. Failure / disruption of area infrastructure. Escalation of emergency; combined public health	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection.

[101] Source: https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Vergunningen_en_Ontheffingen/Ontheffingen_en_vergunningen_2018/448760-_-DEFINITIEF-besluit-Westlob-4-Eemshaven-D2020-064557.pdf

						/environmental impacts; complexity in response; reputational risk. Security breach.	Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Borssele (KCB)	62km	Nuclear site	Elektriciteits Produktiemaat schappij Zuid-Nederland (EPZ).	Nuclear site – safety zone 3 Iodine prophylaxis (children up to 18 years and pregnant women).			
Doel (KCD)	74km	Nuclear site	Engie SA	Nuclear site – safety zone 3[102] Iodine prophylaxis (children up to 18 years and pregnant women).			
Military Sites	No operational military site within a 25km[103]						
Wildfires - Strand & Duingebied Hoek van Holland	10km	National Park		National Park	Dune area.		

[102] The safety zones are defined by the RIVM (Source: Inventarisatie en classificatie van maatregelzones bij kernongevallen | RIVM) and based upon general legislation by the IAEA. Zone 1 corresponds to a 5km radius zone around the nuclear facility. Zone 2 corresponds to a 20km radius zone around the nuclear facility and zone 3 corresponds to a 100km radius zone around the nuclear facility.

[103] Source: https://nprd.inspraak.defensiedichtbij.nl/

Missiles	The proposed site has 6 Wind Turbine Generators (WTGs) with direct interference[104] to the proposed site.						
Maasvlakteweg	Adjacent	Road		Road	Main road. Dangerous goods transport route.	Safety hazard. Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Security breach.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
Port	1.5km from port entrance to site boundary.	Port /transport route.	The Port of Rotterdam Authority.	Port /transport route.	Various hazardous goods (Crude oil, Petrochemical products (e.g., Diesel, gasoline, etc.) Methanol, LNG)). Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination. Spill containment equipment, rapid response teams, wind and water quality monitoring. Route restrictions. Buffer zones. Sufficient surveillance and security. Intelligence sharing. Design considerations.
Rail system network	Next to Maasvlakteweg	Rail system network.		Rail system network connected to Havenspoorlijn Rotterdam.	Rail accident. Security event. Derailment. Fire.	Security threats. Damage to site infrastructure. Evacuation routes blocked.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control.

[104] Direct interference is defined as: the 10^5 and/or 10^6 contour for external safety of the WTG interferes with the site. However, it should be noticed that several failure mechanisms (e.g., Nacelle failure or blade failure) might cause further safety distances depending on factors as wind speed, hub height and WTG power.

				Used for freight rail transport.			Robust physical barrier between site and rail. Monitoring of rail operations, emergency response plan. Ensure rail tracks are well maintained. Alternative evacuation paths. Rapid response procedure.
Gasunie Gas Pipeline	2.9km to safety zone.[105] 2.2km to Site.	Natural gas pipeline.	Gasunie	Natural gas pipeline.	Pipeline leak / spill Major pipeline rupture/explosion Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Gasunie Gas Pipeline	1.9km to safety zone.[106] 2.2km to site.	Propylene	Gasunie	Propylene gas pipeline.	Pipeline leak / spill. Major pipeline rupture/explosion. Pipeline maintenance / disruption.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations.	Blast resistant containment structures. Secondary containment. Rapid response procedures.

[105] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[106] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

					Pipeline incident affecting evacuation route. Gas release. Water contamination. Combined incident. Security threat.	Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Lyondell Chemie Nederland B.V	1.9km to safety zone.[107] 2.2km to Site.	Nitrogen pipeline	Lyondell Chemie Nederland B.V.	Nitrogen pipeline	Pipeline leak / spill. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Asphyxiation. Security.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection.

[107] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

							Rapid isolation valves.
Air Liquide Industrie B.V.	1.9km to safety zone.[108] 2.2km to site.	Hydrogen pipeline	Air Liquide Industrie B.V.	Hydrogen pipeline	Hydrogen leak. Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Future Hydrogen Backbone	<0.45km	Hydrogen pipeline	Gasunie	Hydrogen backbone to be operated at a 66,2 bar(g) pressure.	Hydrogen leak. Rupture / explosion. Maintenance / disruption. Combined incident Incident affecting emergency response. Security threat.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources.

[108] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

						management; greater public safety, environmental, reputational impact. Security breach.	Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Holland Hydrogen I[109]	3.6km	200MW capacity	Shell	200MW capacity Will produce c.60 tonnes hydrogen per day.[110]	Fire / explosion. Hydrogen leak/explosion. Electrolyser cell thermal runaway Grid/power failure. Release of hazardous substances. Water contamination. Sabotage / terrorism. Release of hazardous substance. Incident affecting emergency response.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection Rapid isolation valves.
Porthos[111] **Aramis**	4.7km	CO_2 transport and compressor station.	Porthos Aramis also propose a compressor at same site.	CO_2 transport and compressor station. Store 2.5M tonnes of CO_2per year for 15 years Compress CO_2 up to 135barg.	Leak/explosion. CO_2 plume. Asphyxiation. Release of hazardous substances. Sabotage / terrorism. Release of hazardous substance. Incident affecting emergency response.	Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Environmental contamination.	Leak detection sensors, regular inspection. Pressure relief devices, remote monitoring, Rapid shutdown procedures. Backup generators / independent grid feeds Security screening.

[109] Source: https://www.missieh2.nl/nieuws/holland-hydrogen-1-een-grote-waterstofambitie/

[110] Source: https://www.shell.nl/over-ons/wat-wij-doen/waterstof.html

[111] Source: https://www.porthosco2.nl/project/

						Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Defined protocols, regular drills, coordinated emergency response. Regular inspection. Sufficient surveillance and security. Site access controls, gas detection. Emergency spill response plans. Communication with operators.

A.6 Summary of human-induced events Sloegebied 1

Table 16:Summary of Associated Risks for Sloegebied 1

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Vliegveld Midden-Zeeland	8km	The airport is mainly used for small business aviation and recreational flights. 15 flights / day.	Zeeland Airport B.V	Small business aviation and recreational flight movements within close proximity to the site.	Increased risk of aviation failure crash into site.	Take out power lines, switch stations.	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features. Ensure emergency plan accounts for air crash/multiple casualties, joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Zeeland Refinery	0.7km	One of the six major oil refineries in the Netherlands.	Zeeland Refinery N.V.	Production of propylene oxide (PO), tert-butyl alcohol (TBA), and butanediol (BDO); the exact production capacity is no longer relevant for future planning due to the announced closure and demolition by the end of 2026.	Processes crude oil into fuels and feedstock. Hydrocarbon vapours from crude oil and fuel processing VOCs, sulphur compounds, and combustion by-products. Methane and other light hydrocarbons in confined spaces. Chemicals used in refining and maintenance. Fire / explosion.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources.	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing.

					Contamination. Major chemical release. Leaks / spills. Security threat.	Security breach. Cascading failure.	Integrity review. Multiple evacuation routes Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Access World Terminals B.V[112]	0.5km	Storage, transshipment, and processing of bulk products.	Access World Group	(non-)ferrous metals, ores, minerals, and iron Storage capacity: c.370,000 ton.	Possible combustion from stored metal powders or associated chemicals Dust and vapours from ore and metal handling Inert gases used in preservation or fumigation. Fire / combustion. Chemical leaks / toxic release. Grid instability. Caustic wastewater.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach. Cascading failure.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems. Automatic suppression systems. Design considerations.
Ørsted SeaH2Land[113]	1km	One of the largest renewable hydrogen production facilities in Europe.	Ørsted	1 GW electrolyser by 2030 Powered by a 2 GW offshore wind farm.	Hydrogen leak Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems.

[112] Source: https://www.accessworld.com/

[113] Source: https://orsted.nl/duurzame-energie/groene-waterstof/seah2land

						Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Arkema B.V[114]	1.5km	Specializes in the production of organic peroxides, used in polymer manufacturing and chemical synthesis.	Arkema	Facility includes chemical reactors, bulk storage tanks, and controlled temperature zones.	Organic peroxides and solvents used in production. Vapours from peroxide decomposition or accidental release. Toxic and corrosive waste residues. Major chemical release. Explosion / fire Airborne / groundwater contamination. Security threats.	Air/water/soil contamination. Flammable gas. cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols.

[114] Source: https://www.arkema.com/benelux/nl/

						Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Vopak Terminal[115]	2.5km	Storage and transshipment of liquefied gases and chemical gases.	Royal Vopak	Liquefied petroleum gas (LPG), chemical gases. LPG and ammonia in confined or poorly ventilated areas. Tank sizes: from 3,370m³ to 55,000m³ Services include barge purging, product chilling, and ship-to-ship transfer.	LPG / ammonia vapours or accidental release. Toxic and corrosive waste residues. Major chemical release. Explosion / fire. Airborne / groundwater contamination. Security threats.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Synthmomer Middelburg B.V	7.5km	Produces over 80 types of hydrocarbon and modified natural	Synthomer group	Products used in adhesives, paints, paper, food, and automotive industries.	Hydrocarbon vapours (especially during loading/unloading).	Air/water/soil contamination. Flammable gas cloud formation; risk of	Blast resistant containment structures. Secondary containment. Rapid response procedures.

[115] Source: https://www.vopak.com/terminals/vopak-terminal-vlissingen

		resins hazardous materials. Located on a 66,000m² plot with c.39,000m² of warehouse space.		Flammable: Hydrocarbon vapours from resin production. Toxic: Emissions from chemical processing. Asphyxiant: Inert gases used in storage or fire suppression. Corrosive: Cleaning and maintenance chemicals.	Volatile organic compounds (VOCs) from Hydrocarbon gases in confined spaces. Fire and explosion risks. Pipeline leak / spill. Major rupture/ explosion. Airborne Emissions. Security vulnerability. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Vesta Terminal Flushing B.V	7km	Handles middle distillates, biofuels, lubricants, dark products, and feedstocks.		Total storage capacity: 388,553m³ Future development: Green ammonia hub with 2 × 30,000m³ refrigerated ammonia tanks. Planned throughput: 1 million metric tonnes/year of ammonia. Flammable: Petroleum vapours, biofuel components. Toxic: Ammonia (NH_3) – highly toxic and irritating. Asphyxiant: Nitrogen (used for blanketing), ammonia in confined spaces.	Flammable vapours (especially during loading/unloading). Fire and explosion risks. Leak / spill. Airborne emissions. Toxic and corrosive waste residues. Security threats.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones.

				Corrosive: Ammonia and certain stored chemical products.		Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Heerema Vlissingen B.V.	0km	Storage Oxidising Asphyxiant Gas, Propane Propene Storage Tank.	Heerema	Storage Oxidising Asphyxiant Gas, Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security threats. Heat radiation Environmental contamination. Restricted access/evacuation routes. Major chemical release. Asphyxiation.	Air/water/soil contamination. Flammable gas. cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Ovet B.V.; Vlissingen-Oost	0.8km	Propane Propene Storage Tank.	Ovet	Bulk Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud.	Flammable gas cloud formation; risk of ignition/explosion;	Blast resistant containment structures. Secondary containment. Separate critical systems and resources.

					Toxic exposure (decomposition products). Security threats. Heat radiation Environmental contamination Restricted access/evacuative. Major chemical release.	staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Verbrugge Scaldia Terminals Noord B.V.	1.5km	Propane Propene Storage Tank.	Verbrugge	Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion Vapor cloud Toxic exposure (decomposition products). Security threats. Heat radiation Environmental contamination Restricted access/evacuation. Major chemical release.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage.

						Security breach.	Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Istimewa Elektro	1.5km	System integrator	Istimewa Elektro	Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security threats. Heat radiation Environmental contamination. Restricted access/evacuation. Major chemical release.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Overlasko Konstructie B.V.	1.5km	Construction plant	Overlasko	Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security threats. Heat radiation.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties Operational delays / shutdown.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning.

					Environmental contamination. Restricted access/evacuation. Major chemical release.	Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
RWE Magnum Power Plant	3.3km	Gas fired power plant (1.3MW_{el}).	RWE	Supply station for natural gas. Gas turbine explosion.	Gas Turbine	Fire / explosion. Gas leak. Airborne emissions. Impact on emergency preparedness and monitoring equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
RWE Eemscentrale	3.8km	Coal fired power plant (1.56MW_{el}).	RWE	Coal storage facility	Fire, spontaneous combustion, explosion, and smoke in coal storage facility.	Impact on emergency preparedness, equipment integrity.	Blast resistant containment structures. Secondary containment. Rapid response procedures.

					Water / air pollution. Structural failure. Dust.	Impact filters / equipment. Damage to infrastructure Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Eemscentrale	5km	Gas fired power plant (1.750MW_{el}).	Engie	Supply station for natural gas. Gas turbine explosion.	Gas Turbine	Fire / explosion. Gas leak. Airborne Emissions. Impact on emergency preparedness and monitoring equipment. Damage to infrastructure. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems.
Borssele (KCB)	1.5 km	Nuclear site	Elektriciteits Produktiemaatschappij Zuid-Nederland (EPZ).	Nuclear site – safety zone 1	Common cause failure/ incident. Radiological release (Offsite).	Compounding environmental effects. Combined radiological impact could exceed public safety limits.	Independent safety systems, robust site separation, shared risk analysis. Coordinated emergency planning, enhanced

					Evacuation/Restricted Access Interference with Emergency Services. Infrastructure failure. Regulatory/ Community Scrutiny.	Simultaneous safety system failure or major accident. Overlapping evacuation zones complicate logistics. Resource competition. Shared infrastructure (e.g., grid, transport, water) failure impacts both facilities simultaneously. Increased attention, complex licensing processes, reputational impact. Cross-site contamination. Combined security breach.	monitoring, shared information protocols. Redundant and independent supply lines, contingency assets. Transparent reporting. Joint environmental monitoring, advanced waste management, regular independent review. Strict access control, personal decontamination protocols, segregation of resources. Rapid response procedure.
Doel (KCD)	40km	Nuclear site	Engie SA	Nuclear site – safety zone 3 Iodine prophylaxis (children up to 18 years and pregnant women).			
COVRA	0.25km	Nuclear waste storage facility.	Owned by the State.				
Military Sites	No operational military site within a 25km [116]						
Schotsman	15km	Nature Reserve	Staatsbosbeheer	Nature Reserve	Mixed forest (hardwood/coniferous).		
Manteling Walcheren	18km	Natura 2000	Managed under beheerplan	Natura 2000	Mixed forest (hardwood/coniferous)		
Missiles	The proposed site has 14 Wind Turbine Generators (WTGs) with						

[116] Source: https://nprd.inspraak.defensiedichtbij.nl/

	direct interference[117] to the proposed site.						
Europaweg zuid	Crossing site	Road		Road	Major safety hazard. Road transport incident. Dangerous goods transport route.	Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security.

[117] Direct interference is defined as: the 10^5 and/or 10^6 contour for external safety of the WTG interferes with the site. However, it should be noticed that several failure mechanisms (e.g., Nacelle failure or blade failure) might cause further safety distances depending on factors as wind speed, hub height and WTG power.

						Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	
Europaweg zuid	Access road to the Borssele power plant	Road		Road	Major safety hazard. Road transport incident. Dangerous goods transport route.	Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.

						Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	
Shipping route to the harbour of Antwerp	0.8km from port entrance to site boundary.	Shipping route for dangerous goods to the harbour of Antwerp.	Port of Antwerp-Burges	Shipping route for dangerous goods to the harbour of Antwerp.	Various hazardous goods (Crude oil, Petrochemical products (e.g., Diesel, gasoline, etc.) Methanol, LNG)). Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Navigational controls, traffic monitoring, exclusion zones, emergency response. coordination. Spill containment equipment, rapid response teams, wind and water quality monitoring. Route restrictions. Buffer zones. Sufficient surveillance and security. Intelligence sharing. Design considerations.
Harbour of Vlissingen	0.1km from port entrance to site boundary	Ships with dangerous goods	Cross-boarder group of shareholders	Ships with dangerous goods	Various hazardous goods (Crude oil, Petrochemical products (e.g., Diesel, gasoline, etc.) Methanol, LNG). Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption.	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination. Spill containment equipment, rapid response teams, wind and water quality monitoring. Route restrictions. Buffer zones. Sufficient surveillance and security. Intelligence sharing. Design considerations.

						Strain on local emergency resources. Security breach.	
Rail system network	Adjacent	Rail system network connected to the National Dutch Railway System.		Rail system connected to the National Dutch Railway System. Potential dangerous goods.	Rail accident. Security event. Derailment. Fire.	Security breach. Damage to site infrastructure. Evacuation routes blocked.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control Robust physical barrier between site and rail. Monitoring of rail operations, emergency response plan. Ensure rail tracks are well maintained. Alternative evacuation paths.
Railway Siding	2.2km	Railway Siding		Railway Siding	Rail accident. Security event. Derailment. Fire / explosion.	Security threats Damage to site infrastructure. Evacuation routes blocked.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control. Robust physical barrier between site and rail. Monitoring of rail operations, emergency response plan. Ensure rail tracks are well maintained. Alternative evacuation paths.

PZEM Energy B.V.	0km to safety zone.[118] 0km to site.	Methane pipeline	PZEM Energy B.V.	Methane pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
N.V. EPZ	0km to safety zone.[119] 0km to site	Carbon monoxide pipeline.	N.V. EPZ	Carbon monoxide pipeline.	Pipeline leak / spill. Fire. Toxicity. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Gas release.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones.

[118] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[119] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

					Water contamination. Combined incident. Asphyxiation. Security threat.	Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Gasunie Transport Services B.V>	0km to safety zone.[120] 0km to site.	Natural gas pipeline	Gasunie	Natural gas pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Future Lion Storage[121]	c.2km	Battery storage facility.	Lion Storage	Battery storage facility 1,400MWh at 350MW.	Thermal runaway/fire smoke/toxic gas release. Electrical Failure/ARC. Explosion.	Air/water/soil contamination. Damage to infrastructure.	Blast resistant containment structures. Secondary containment. Rapid response procedures.

[120] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[121] Source: https://www.lion-storage.nl/mufasa L

					Environmental contamination.	Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach. Power surges or faults propagate into nuclear plant grid.	Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves. Electrical isolation, surge protection, automatic disconnect. Backup generators / independent grid feeds. Routine inspections. Thermal monitoring.
VoltH2[122]	2km	125MW electrolyser.	VoltH2	125MW electrolyser at coal fired power plant.	Fire / explosion. Hydrogen leak/explosion. Electrolyser cell thermal runaway. Grid/power failure. Release of hazardous substances. Water contamination. Sabotage / terrorism. Release of hazardous substance.	Air/water/soil contamination Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones.

					Incident affecting emergency response.	Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Hydrogen network[123]	Vlissingen port	Hydrogen pipeline	Hynetwork	Hydrogen network	Hydrogen leak. Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.

[123] Source: https://www.rvo.nl/onderwerpen/bureau-energieprojecten/lopende-projecten/waterstofnetwerk-zwn

A.7 Summary of human-induced events Sloegebied 2

Table 17: Summary of Associated Risks for Sloegebied 2

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Vliegveld Midden-Zeeland	8km	The airport is mainly used for small business aviation and recreational flights. 15 flights / day.	Zeeland Airport B.V	Small business aviation and recreational flight movements within close proximity to the site.	Increased risk of aviation failure crash into site.	Take out power lines, switch stations.	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features Ensure emergency plan. accounts for air crash/multiple casualties, joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Zeeland Refinery	0.7km	One of the six major oil refineries in the Netherlands	Zeeland Refinery N.V.	Production of propylene oxide (PO), tert-butyl alcohol (TBA), and butanediol (BDO); the exact production capacity is no longer relevant for future planning due to the announced closure and demolition by the end of 2026.	Processes crude oil into fuels and feedstock. Hydrocarbon vapours from crude oil and fuel processing VOCs, sulphur compounds, and combustion by-products. Methane and other light hydrocarbons in confined spaces. Chemicals used in refining and maintenance.	Exposure to dangerous substances. Environmental contamination Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources	Blast resistant containment structures. Containment systems. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning.

					Fire / explosion. Contamination. Major chemical release. Leaks / spills. Security threat. Caustic wastewater.	Security breach. Cascading failure.	Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans Backup systems.
Access World Terminals B.V[124]	0.5km	Storage, transshipment, and processing of bulk products.	Access World Group	(Non-)ferrous metals, ores, minerals, and iron Storage capacity: c.370,000 ton	Possible combustion from stored metal powders or associated chemicals Dust and vapours from ore and metal handling Inert gases used in preservation or fumigation. Fire / combustion. Chemical leaks / toxic release. Grid instability. Caustic wastewater.	Exposure to dangerous substances. Environmental contamination. Contamination / loss of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach. Cascading failure.	Blast resistant containment structures. Navigational controls and monitoring. Spill/secondary containment equipment. Rapid response procedures. Environmental monitoring. Route and buffer zones. Surveillance and enhanced security. Intelligence sharing. Backup/independent power. Proper chemical storage. Public alert protocols. Separate critical systems.

[124] It should be noted that this facility is assumed to be demolished if Sloegebied 2 is chosen as location because of space constraints.

							Automatic suppression systems. Design considerations.
Ørsted SeaH2Land[125]	1km	One of the largest renewable hydrogen production facilities in Europe.	Ørsted	1 GW electrolyser by 2030 Powered by a 2 GW offshore wind farm.	Hydrogen leak. Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Arkema B.V[126]	1.5km	Specializes in the production of organic peroxides, used in polymer	Arkema	Facility includes chemical reactors, bulk storage tanks, and controlled temperature zones.	Organic peroxides and solvents used in production.	Air/water/soil contamination. Flammable gas cloud formation; risk of	Blast resistant containment structures. Secondary containment.

[125] It should be noted that this facility is assumed to be demolished if Sloegebied 2 is chosen as location because of space constraints.

[126] Source: https://www.arkema.com/benelux/nl/locations/

		manufacturing and chemical synthesis.			Vapours from peroxide decomposition or accidental release. Toxic and corrosive waste residues. Major chemical release. Explosion / fire Airborne / groundwater contamination. Security threats.	ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Vopak Terminal	1.9km	Storage and transshipment of liquefied gases and chemical gases	Royal Vopak	Liquefied petroleum gas (LPG), chemical gases. LPG and ammonia in confined or poorly ventilated areas. Tank sizes: from 3,370m³ to 55,000m³. Services include barge purging, product chilling, and ship-to-ship transfer.	LPG / ammonia vapours or accidental release. Toxic and corrosive waste residues. Major chemical release. Explosion / fire. Airborne / groundwater contamination. Security threats.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown.	Blast resistant containment structures. Secondary containment Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring.

						Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Synthmomer Middelburg B.V	7.5km	Produces over 80 types of hydrocarbon and modified natural resins hazardous materials. Located on a 66,000m² plot with c.39,000m² of warehouse space.	Synthomer group	Products used in adhesives, paints, paper, food, and automotive industries. Flammable: Hydrocarbon vapours from resin production. Toxic: Emissions from chemical processing. Asphyxiant: Inert gases used in storage or fire suppression. Corrosive: Cleaning and maintenance chemicals.	Hydrocarbon vapours (especially during loading/unloading). Volatile organic compounds (VOCs) from Hydrocarbon gases in confined spaces. Fire and explosion risks Pipeline leak / spill. Airborne Emissions. Security vulnerability (shared infrastructure). Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection.

							Rapid isolation valves.
Vesta Terminal Flushing B.V	7km	Handles middle distillates, biofuels, lubricants, dark products, and feedstocks.	Vesta Terminals B.V.	Total storage capacity: 388,553m³ Future development: Green ammonia hub with 2 × 30,000m³ refrigerated ammonia tanks. Planned throughput: 1 million metric tons/year of ammonia. Flammable: Petroleum vapours, biofuel components. Toxic: Ammonia (NH_3) – highly toxic and irritating. Asphyxiant: Nitrogen (used for blanketing), ammonia in confined spaces. Corrosive: Ammonia and certain stored chemical products.	Flammable vapours (especially during loading/unloading) Fire and explosion risks Leak / spill Airborne Emissions. Toxic and corrosive waste residues Security threats	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Heerema Vlissingen B.V.	0km	Storage Oxidising Asphyxiant Gas, Propane Propene Storage Tank.	Heerema	Storage Oxidising Asphyxiant Gas, Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security Threats. Heat radiation. Environmental contamination. Restricted access/evacuative Major chemical release	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response. Advanced leak detection. Enhanced inspection & maintenance. Route planning.

						Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Ovet B.V.; Vlissingen-Oost[127]	0.8km	Propane Propene Storage Tank.	Ovet	Bulk Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security Threats. Heat radiation. Environmental contamination. Restricted access/ evacuation. Major chemical release.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review.

[127] It should be noted that this facility is assumed to be demolished if Sloegebied 2 is chosen as location because of space constraints.

							Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Verbrugge Scaldia Terminals Noord B.V.	1.5km	Propane Propene Storage Tank.	Verbrugge	Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security threats. Heat radiation. Environmental contamination. Restricted access/ Evacuation. Major chemical release.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Istimewa Elektro	1.5km	System integrator	Istimewa Elektro	Propane Propene Storage Tank	Fire, spontaneous combustion, explosion. Vapor cloud.	Flammable gas cloud formation; risk of ignition/explosion;	Blast resistant containment structures. Secondary containment.

					Toxic exposure (decomposition products). Security threats Heat radiation. Environmental contamination. Restricted access/ evacuation. Major chemical release.	staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Overlasko Konstructie B.V.	1.5km	Construction plant	Overlasko	Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security threats. Heat radiation. Environmental contamination. Restricted access/ evacuation. Major chemical release.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews.

						Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
RWE Magnum Power Plant	3.3km	Gas fired power plant ($1.3MW_{el}$)	RWE	Supply station for natural gas. Gas turbine explosion.	Gas Turbine	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security.

							Emergency spill response plans. Backup systems.
RWE Eemscentrale	3.8km	Coal fired power plant (1.56MW_{el})	RWE	Coal storage facility.	Fire, spontaneous combustion, explosion, and smoke in coal storage facility. Water / air pollution. Structural failure. Dust.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection. Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans Backup systems.
Gas station in SL2	km	Gas fired power plant (XXMW_{el})		Supply station for natural gas. Gas turbine explosion.	Gas Turbine	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Casualties.	Blast resistant containment structures. Secondary containment. Separate critical systems and resources. Rapid response procedures. Advanced leak detection.

						Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Enhanced inspection & maintenance. Route planning. Coordination with operators, scheduled reviews. Robust monitoring/ control systems. Coordinated emergency response. Robust distancing. Integrity review. Multiple evacuation routes. Clear signage. Sufficient surveillance and security. Emergency spill response plans. Backup systems.
Borssele (KCB)	2 km	Nuclear site	Elektriciteits Produktiemaatschappij Zuid-Nederland (EPZ).	Nuclear site – safety zone 1	Common cause failure/incident. Radiological release (Offsite). Evacuation/restricted access interference with Emergency Services. Infrastructure failure. Regulatory/ community scrutiny.	Compounding environmental effects. Combined radiological impact could exceed public safety limits. Simultaneous safety system failure or major accident. Overlapping evacuation zones complicate logistics. Resource competition. Shared infrastructure (e.g., grid, transport, water) failure impacts both facilities simultaneously. Increased attention, complex licensing processes, reputational impact.	Independent safety systems, robust site separation, shared risk analysis. Coordinated emergency planning, enhanced monitoring, shared information protocols. Redundant and independent supply lines, contingency assets. Transparent reporting. Joint environmental monitoring, advanced waste management, regular independent review. Strict access control, personal decontamination

						Cross-site contamination. Combined security breach.	protocols, segregation of resources.
Doel (KCD)	40km	Nuclear site	Engie SA	Nuclear site – safety zone 3 Iodine prophylaxis (children up to 18 years and pregnant women).			
COVRA	0.25km	Nuclear waste storage facility	Owned by the State				
Military Sites	No operational military site within a 25km. [128]						
Schotsman	15km	Nature Reserve	Staatsbosbeheer	Nature Reserve	Mixed forest (hardwood/coniferous)		
Manteling Walcheren	18km	Natura 2000	Managed under beheerplan	Natura 2000	Mixed forest (hardwood/coniferous)		
Missiles	The proposed site has 2 Wind Turbine Generators (WTGs) with direct interference[129] to the proposed site.						
Europaweg zuid	0.25km	Road		Road	Major safety hazard. Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Security issues.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security threats.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance.

[128] Source: https://nprd.inspraak.defensiedichtbij.nl/

[129] Direct interference is defined as: the 10^5 and/or 10^6 contour for external safety of the WTG interferes with the site. However, it should be noticed that several failure mechanisms (e.g., Nacelle failure or blade failure) might cause further safety distances depending on factors as wind speed, hub height and WTG power.

							Comprehensive security, restricted access.
Europaweg zuid	Access road to the Borssele power plant	Road		Road	Major safety hazard. Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Security issues.	Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
Shipping route to the harbour of Antwerp	0.8km from port entrance to site boundary	Shipping route for dangerous goods to the harbour of Antwerp	Port of Antwerp-Burges	Shipping route for dangerous goods to the harbour of Antwerp	Various hazardous goods (Crude oil, Petrochemical products (e.g., Diesel, gasoline, etc.) Methanol, LNG)). Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down.	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination. Spill containment equipment, rapid response teams, wind

					Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Delayed emergency response. Supply chain disruption. Strain on local emergency resources Security breach.	and water quality monitoring. Route restrictions. Buffer zones. Sufficient surveillance and security. Intelligence sharing. Design considerations.
Harbour of Vlissingen	Direct port access	Ships with dangerous goods.	Cross-border group of shareholders.	Ships with dangerous goods.	Various hazardous goods (Crude oil, Petrochemical products (e.g., Diesel, gasoline, etc.) Methanol, LNG)). Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination. Spill containment equipment, rapid response teams, wind and water quality monitoring. Route restrictions. Buffer zones. Sufficient surveillance and security. Intelligence sharing. Design considerations.
Rail system network	Crosses into site	Rail system network connected to the National Dutch Railway System.		Rail system connected to the National Dutch Railway System. Damage to infrastructure. Potential dangerous goods.	Rail accident. Security event. Derailment. Fire.	Security breach. Damage to site infrastructure. Evacuation routes blocked.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control. Robust physical barrier. between site and rail. Monitoring of rail operations, emergency response plan. Ensure rail tracks are well maintained. Alternative evacuation paths.

PZEM Energy B.V.	0km to safety zone.[130] 0km to site	Methane pipeline	PZEM Energy B.V.	Methane pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/ explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
N.V. EPZ	0km to safety zone.[131] 0km to site.	Carbon monoxide pipeline	N.V. EPZ	Carbon monoxide pipeline	Pipeline leak / spill. Fire. Toxicity. Major pipeline rupture/explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Gas release.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems.

[130] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[131] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

					Water contamination. Combined incident. Security threat.	Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Gasunie Transport Services B.V>	0km to safety zone[132] 0km to Site	Natural gas pipeline	Gasunie	Natural gas pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/ explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident Security.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones.

[132] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

						public safety, environmental, reputational impact. Security breach.	Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Future Lion Storage[133]	~0.2km	Battery storage facility	Lion Storage	Battery storage facility 1,400MWh at 350MW	Thermal runaway/fire. Smoke/toxic gas release. Electrical failure/ARC. Explosion. Environmental contamination.	Air/water/soil contamination. Damage to infrastructure. Loss of access to main infrastructure / resource. Disruption to plant operations. Limited/blocked routes for evacuation or emergency response / complications to response actions. Escalation of emergency; combined public health /environmental impacts; complexity in response; reputational risk. Security breach. Power surges or faults propagate into nuclear plant grid.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves. Electrical isolation, surge protection, automatic disconnect. Backup generators / independent grid feeds Routine inspections. Thermal monitoring.
VoltH2[134]	0.2km	125MW electrolyser	VoltH2	125MW electrolyser at coal fired power plant.	Fire / explosion. Hydrogen leak/explosion.	Air/water/soil contamination.	Blast resistant containment structures.

[133] Source: https://www.lion-storage.nl/mufasa L

					Electrolyser cell thermal runaway. Grid/power failure. Release of hazardous substances. Water contamination. Sabotage / terrorism. Release of hazardous substance. Incident affecting emergency response.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Hydrogen network[135]	Vlissingen port	Hydrogen pipeline	Hynetwork	Hydrogen network	Hydrogen leak Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals.

[135] Source: https://www.rvo.nl/onderwerpen/bureau-energieprojecten/lopende-projecten/waterstofnetwerk-zwn

						Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.

A.8 Summary of human-induced events Terneuzen 1a

Table 18: Summary of Associated Risks for Terneuzen 1a

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Vliegveld Midden-Zeeland	19km	The airport is mainly used for small business aviation and recreational flights. 15 flights / day.	Zeeland Airport B.V	Small business aviation and recreational flight movements within close proximity to the site.	Increased risk of aviation failure crash into site.	Take out power lines, switch stations.	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features. Ensure emergency plan. accounts for air crash/multiple casualties, joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Evos Terneuzen B.V. [136]	0.1km	Functions as a multimodal industrial terminal and (bio)naphtha blending hub. Specializes in storage, blending, and handling of: Naphtha. Bio-naphtha. Pyrolysis oil.	Evos Group	Flammable: Naphtha vapours, biobased. hydrocarbons. Toxic: VOCs from petrochemical storage and transfer. Asphyxiant: Nitrogen used for blanketing and purging.	Hydrocarbon vapours from crude oil and fuel processing VOCs, and combustion by-products. Light hydrocarbons in confined spaces. Chemicals used in refining and maintenance. Asphyxiation Fire / explosion. Contamination. Major chemical release.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals . Continuous environmental monitoring.

[136] Source: https://www.evos.eu/terneuzen/

		Other petrochemical feedstocks.			Leaks / spills. Security threat. Caustic wastewater. Pipeline incident affecting evacuation route. Combined incident.	Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Alto Carbon Technologies[137]	0.1km	Converts CO_2 into green cyclic and linear carbonates. Products are used in electrolytes for lithium batteries and other green chemical applications.	Alta Group	Toxic: Potential exposure to CO_2 in confined spaces (asphyxiant risk). Flammable: Depending on solvents or reagents used in carbonate synthesis. Asphyxiant: CO_2 in high concentrations.	Leak/explosion. CO_2 plume. Asphyxiation. Release of hazardous substances. Sabotage / terrorism. Release of hazardous substance. Incident affecting emergency response. Fire / combustion. Chemical leaks / toxic release. Grid instability. Caustic wastewater.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.

[137] This Seveso site is considered to be demolished if Terneuzen 1A is chosen as preferred location.

Dow Benelux B.V.[138],[139]	1.5km	Produces over 800 chemical products used in plastics, coatings, adhesives, and consumer goods.	Dow Inc	Includes ethylene oxide, polyethylene, and styrene production units. Hosts the ValuePark Terneuzen, a 140-hectare industrial park for chemical-related businesses. Flammable: Ethylene, propylene, styrene, and other hydrocarbons. Toxic: Ethylene oxide, VOCs, and by-products from chemical synthesis. Asphyxiant: Inert gases (e.g. nitrogen) and hydrogen in confined spaces. Corrosive: Process chemicals and cleaning agents.	Leak. Rupture / explosion. Maintenance / disruption. Combined incident Incident affecting emergency response. Toxic Release. Asphyxiation.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Indaver IWS B.V.[140]	3.5km	Specializes in industrial hazardous	Indaver Group	Handles a wide range of hazardous and	Vapours from wastes or accidental release.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion;	Blast resistant containment structures. Secondary containment. Rapid response procedures.

[138] Source: https://nl.dow.com/en-us.html

[139] This site is known to have three Seveso sites on the whole perimeter of the facility, which is approx. 320ha surface area.

[140] Source: https://indaver.com/nl/locaties/nederland

		waste treatment and logistics.		non-hazardous waste streams. Focus on material recovery, including solvents, acids, metals, and energy. Flammable: Solvent vapours and waste residues. Toxic: Emissions from chemical waste handling and storage. Asphyxiant: Inert gases used in blanketing or purging. Corrosive: Acids and bases from industrial waste streams.	Toxic and corrosive waste residues and emissions. Asphyxiation. Major chemical release. Explosion / fire. Airborne / groundwater contamination. Security threats.	staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
ICL-IP Terneuzen B.V.[141]	8km	Focus on chemical manufacturing, storage, and logistics.	Israel Chemicals Ltd (ICL Group)	Toxic: Bromine vapours and other halogenated emissions. Flammable: Certain brominated solvents and reactive intermediates. Asphyxiant: Potential oxygen	Vapours /accidental release. Toxic and corrosive residues and emissions. Asphyxiation. Major chemical release. Explosion / fire. Airborne / groundwater contamination. Security threats.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring.

[141] Source: https://www.iclip-terneuzen.nl/

				displacement in confined spaces due to gas leaks. Corrosive: Bromine and other halogens causing damage to skin, eyes, and respiratory system.		Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
TPT Holding B.V.[142]	8.5km	Provides services for chemical logistics, blending, and distribution. Specializes in tank storage and transshipment of liquid bulk chemicals. Handles a variety of hazardous and non-hazardous liquid products, including solvents and petrochemicals.	TPT Holding B.V.	Flammable: Vapours from stored solvents, fuels, and petrochemical products. Toxic: Emissions from volatile organic compounds (VOCs) and chemical residues. Asphyxiant: Inert gases used in blanketing or purging of tanks (e.g., nitrogen).	Leak. Rupture / explosion. Maintenance / disruption. Combined incident. Incident affecting emergency response. Toxic Release. Asphyxiation.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Rudz	1km	Propane Propene Storage Tank.	RUDZ	Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security threats.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems.

[142] Source: https://tpt.nl/nl/

					Heat radiation. Environmental contamination. Restricted access/ evacuation. Major chemical release.	Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Mts, van Wijck- de Bruijne	4km	Propane Propene Storage Tank.	J.J. van Wijck	Bulk Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security threats. Heat radiation. Environmental contamination. Restricted access/ evacuation. Major chemical release.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment procedures. Rapid response. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Borssele (KCB)	10 km	Nuclear site	Elektriciteits Produktiemaatschappij Zuid-Nederland (EPZ)	Nuclear site – safety zone 2.	Common cause failure/incident.	Compounding environmental effects.	Independent safety systems, robust site separation, shared risk analysis.

				Sheltering and iodine prophylaxis (adults 18-40 years).	Radiological release (offsite). Evacuation/ restricted Access. Interference with Emergency Services. Infrastructure failure. Regulatory/Community Scrutiny.	Combined radiological impact could exceed public safety limits. Simultaneous safety system failure or major accident. Overlapping evacuation zones. Complicated logistics. Resource competition. Shared infrastructure (e.g., grid, transport, water) failure impacts both facilities simultaneously. Increased attention, complex licensing processes, reputational impact. Cross-site contamination. Combined security breach.	Coordinated emergency planning, enhanced monitoring, shared information protocols Redundant and independent supply lines, contingency assets. Transparent reporting. Joint environmental monitoring, advanced waste management, regular independent review Strict access control, personal decontamination protocols, segregation of resources. Rapid response procedures.
Doel (KCD)	33km	Nuclear site	Engie SA	Nuclear site – safety zone 3. Iodine prophylaxis (children up to 18 years and pregnant women).			
Military Sites	No operational military site within a 25km.						
Wildfire	The Terneuzen area is not within close proximity (<25km) to a risk area for wildfires.						
Missiles	The proposed site has no direct interference with Wind Turbine Generators (WTGs).						
Westerscheldetunnel	3.5km	Road		Road. There may be hazardous cargoes moved along the Corridorweg and	Safety hazard. Road transport incident. Hazardous material release / fuel chemical spill.	Road transport incident. Hazardous material release / fuel / chemical spill. Fire. Cascading failure.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response.

				Elementenweg to and from the Evos Terneuzen and SGS-Netherlands site.	Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Security issues.	Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
Shipping route to the harbour of Antwerp	1.5km from port entrance to site boundary.	Shipping route for dangerous goods to the harbour of Antwerp.	Port of Antwerp-Burges	Shipping route for dangerous goods to the harbour of Antwerp	Various hazardous goods (Crude oil, Petrochemical products (e.g., Diesel, gasoline, etc.) Methanol, LNG) Fire, explosion, chemical release Vessel accident, possibly carrying hazardous cargo Chemical or fuel spill Ships as vector for targeted attacks or unauthorized access	Exposure to dangerous substances Environmental contamination Contamination of critical infrastructure, evacuation, operational shut-down Delayed emergency response Supply chain disruption Strain on local emergency resources Security breach	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination Spill containment equipment, rapid response teams, wind and water quality monitoring Route restrictions Buffer zones Sufficient surveillance and security Intelligence sharing Design considerations
Braakmanhaven	0.5km	Ships with dangerous goods.	North Sea Port	Ships with dangerous goods. Large quantities of hydrocarbons and other	Various hazardous goods (Crude oil, Petrochemical products (e.g., diesel, gasoline, etc.) methanol, LNG)).	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down.	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination. Spill containment equipment, rapid response teams, wind and water quality monitoring.

				chemical products.	Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Route restrictions. Buffer zones. Sufficient surveillance and security. Intelligence sharing. Design considerations.
Rail system network	Adjacent	Rail system network connected to the National Dutch Railway System.	DOW	Rail system connected to the National Dutch Railway System. Potential dangerous goods.	Rail accident. Security event. Derailment. Fire.	Security breach. Damage to site infrastructure. Evacuation routes blocked.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control. Robust physical barrier between site and rail. Monitoring of rail operations, emergency response plan. Ensure rail tracks are well maintained. Alternative evacuation paths. Rapid response procedures.
Gasunie Gas Pipeline	2.5km to safety zone.[143] 2.6km to site.	Hydrogen pipeline	Gasunie	Hydrogen pipeline	Pipeline leak / spill. Major pipeline rupture/ explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources.

[143] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

						safety, environmental, reputational impact. Security breach.	Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Zebra Gasnetwerk BV	2.3km to safety zone.[144] 2.7km to site.	Methane pipeline	Zebra Gasnetwerk BV	Methane pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/ explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Gasunie Gas Pipeline	3.3km to safety zone.[145] 3.5km to site.	Natural Gas pipeline	Gasunie	Natural Gas pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/ explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals.

[144] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[145] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

						Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
DOW Benelux B.V.	2.9km to safety zone.[146] 3.1km to site.	Ethylene pipeline	DOW Benelux B.V.	Ethylene pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/ explosion. Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
DOW Benelux B.V.	2.9km to safety zone.[147]	Propylene pipeline	DOW Benelux B.V.	Propylene pipeline	Pipeline leak / spill. Fire. Major pipeline rupture/ explosion.	Flammable gas cloud formation; risk of ignition/explosion;	Blast resistant containment structures. Secondary containment. Rapid response procedures.

[146] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[147] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

	3.1km to site.				Pipeline maintenance / disruption. Pipeline incident affecting evacuation route. Combined incident. Security threat.	staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.

A.9 Summary of human-induced events Terneuzen 1b

Table 19: Summary of Associated Risks for Terneuzen 1b

Site / Location	Proximity	Purpose / Characteristics	Owner	Specific Hazards	Risk	Impact	Indicative Mitigation
Vliegveld Midden-Zeeland	19km	The airport is mainly used for small business aviation and recreational flights. 15 flights / day.	Zeeland Airport B.V.	Small business aviation and recreational flight movements within close proximity to the site.	Increased risk of aviation failure crash into site.	Take out power lines, switch stations.	Routine review of flight paths and crash risk impact assessments. Rapid response procedures. Strict airspace controls. Crash-resistant design features. Ensure emergency plan accounts for air crash/multiple casualties, joint emergency planning. Coordination with helipad for mass evacuation scenarios; shared regional crisis protocols. Notify/coordinate with aviation authorities. Joint emergency drills. Backup systems.
Evos Terneuzen B.V.	1.3km	Functions as a multimodal industrial terminal and (bio)naphtha blending hub. Specializes in storage, blending, and handling of: Naphtha Bio-naphtha Pyrolysis oil Other petrochemical feedstocks.	Evos Group	Flammable: Naphtha vapours, bio-based hydrocarbons. Toxic: VOCs from petrochemical storage and transfer. Asphyxiant: Nitrogen used for blanketing and purging.	Hydrocarbon vapours from crude oil and fuel processing VOCs, and combustion by-products. Light hydrocarbons in confined spaces. Chemicals used in refining and maintenance. Asphyxiation. Fire / explosion. Contamination. Major chemical release. Leaks / spills. Security threat.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols.

					Caustic wastewater. Pipeline incident affecting evacuation route. Combined incident.		Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Alto Carbon Technologies	1km	Converts CO_2 into green cyclic and linear carbonates. Products are used in electrolytes for lithium batteries and other green chemical applications.	Alta Group	Toxic: Potential exposure to CO_2 in confined spaces (asphyxiant risk). Flammable: Depending on solvents or reagents used in carbonate synthesis. Asphyxiant: CO_2 in high concentrations.	Leak/explosion. CO_2 plume. Asphyxiation. Release of hazardous substances. Sabotage / terrorism. Release of hazardous substance. Incident affecting emergency response. Fire / combustion. Chemical leaks / toxic release. Grid instability. Caustic wastewater.	Air/water/soil. contamination Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Dow Benelux B.V.	2.7km	Produces over 800 chemical products used in plastics, coatings, adhesives, and consumer goods.	Dow Inc	Includes ethylene oxide, polyethylene, and styrene production units. Hosts the ValuePark Terneuzen, a 140-hectare industrial park	Leak. Rupture / explosion. Maintenance / disruption. Combined incident Incident affecting emergency response.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems.

				for chemical-related businesses. Flammable: Ethylene, propylene, styrene, and other hydrocarbons. Toxic: Ethylene oxide, VOCs, and by-products from chemical synthesis. Asphyxiant: Inert gases (e.g. nitrogen) and hydrogen in confined spaces. Corrosive: Process chemicals and cleaning agents.	Toxic release. Asphyxiation.	Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Indaver IWS B.V.	1.3km	Specializes in industrial hazardous waste treatment and logistics.	Indaver Group	Handles a wide range of hazardous and non-hazardous waste streams. Focus on material recovery, including solvents, acids, metals, and energy. Flammable: Solvent vapours and waste residues.	Vapours from wastes or accidental release. Toxic and corrosive waste residues and emissions. Asphyxiation. Major chemical release. Explosion / fire Airborne / groundwater contamination. Security threats.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones.

				Toxic: Emissions from chemical waste handling and storage. Asphyxiant: Inert gases used in blanketing or purging. Corrosive: Acids and bases from industrial waste streams.		Security breach.	Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
ICL-IP Terneuzen B.V.	8.6km	Focus on chemical manufacturing, storage, and logistics.	Israel Chemicals Ltd (ICL Group)	Toxic: Bromine vapours and other halogenated emissions. Flammable: Certain brominated solvents and reactive intermediates. Asphyxiant: Potential oxygen displacement in confined spaces due to gas leaks. Corrosive: Bromine and other halogens causing damage to skin, eyes, and respiratory system.	Vapours /accidental release. Toxic and corrosive residues and emissions. Asphyxiation. Major chemical release. Explosion / fire. Airborne / groundwater contamination. Security threats.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
TPT Holding B.V.	9km	Provides services for chemical	TPT Holding B.V.	Flammable: Vapours from stored solvents,	Leak. Rupture / explosion.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion;	Blast resistant containment structures. Secondary containment.

		logistics, blending, and distribution. Specializes in tank storage and transshipment of liquid bulk chemicals. Handles a variety of hazardous and non-hazardous liquid products, including solvents and petrochemicals.		fuels, and petrochemical products. Toxic: Emissions from volatile organic compounds (VOCs) and chemical residues. Asphyxiant: Inert gases used in blanketing or purging of tanks (e.g., nitrogen).	Maintenance / disruption. Combined incident Incident affecting emergency response. Toxic release. Asphyxiation.	staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Rudz	1km	Propane Propene Storage Tank.	RUDZ	Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure (decomposition products). Security threats. Heat radiation. Environmental contamination. Restricted access/ evacuation. Major chemical release.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.

Mts, van Wijck- de Bruijne	4km	Propane Propene Storage Tank.	J.J. van Wijck	Bulk Propane Propene Storage Tank.	Fire, spontaneous combustion, explosion. Vapor cloud. Toxic exposure. (decomposition products). Security threats. Heat radiation. Environmental contamination. Restricted access/ evacuation. Major chemical release.	Air/water/soil contamination. Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation. Damage to infrastructure and equipment. Local infrastructure. damage impacting operations. Casualties. Operational delays / shutdown. Blocked evacuation routes / complicated access. Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact. Security breach.	Blast resistant containment structures. Secondary containment. Rapid response procedures. Independent and redundant power systems. Backup systems. Appropriate and well-maintained storage and containment of chemicals. Continuous environmental monitoring. Public alert and evacuation protocols. Buffer zones. Separate critical systems and resources. Enhanced security protocols. Automatic suppression systems. Advanced leak detection. Rapid isolation valves.
Borssele (KCB)	10 km	Nuclear site	Elektriciteits Produktiemaatschappij Zuid-Nederland (EPZ).	Nuclear site – safety zone 2. Sheltering and iodine prophylaxis (adults 18-40 years).	Common cause failure/incident. Radiological release (offsite). Evacuation/ restricted access. Interference with Emergency Services. Infrastructure failure. Regulatory/ community Scrutiny.	Compounding environmental effects. Combined radiological impact could exceed public safety limits. Simultaneous safety system failure or major accident. Overlapping evacuation zones complicate logistics. Resource competition. Shared infrastructure (e.g., grid, transport, water) failure impacts both facilities simultaneously Increased attention, complex licensing processes, reputational impact. Cross-site contamination. Combined security breach.	Independent safety systems, robust site separation, shared risk analysis. Coordinated emergency planning, enhanced monitoring, shared information protocols. Redundant and independent supply lines, contingency assets. Transparent reporting. Joint environmental monitoring, advanced waste management, regular independent review. Strict access control, personal decontamination protocols, segregation of resources.
Doel (KCD)	33km	Nuclear site	Engie SA	Nuclear site – safety zone 3.			

				Iodine prophylaxis (children up to 18 years and pregnant women).			
Military Sites	No operational military site within a 25km.						
Wildfire	The Terneuzen area is not within close proximity (<25km) to a risk area for wildfires.						
Missiles	The proposed site has no direct interference with Wind Turbine Generators (WTGs).						
Westerscheldetunnel	4.5km	Road		Road. There may be hazardous cargoes moved along the Corridorweg and Elementenweg to and from the Evos Terneuzen and SGS-Netherlands site.	Safety hazard. Road transport incident. Hazardous material release / fuel chemical spill. Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Security issues.	Road transport incident. Hazardous material release / fuel chemical spill Fire. Cascading failure. Shared infrastructure disruption. Regulatory oversight of hazardous goods transport. Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Unclear responsibility. Delayed remediation. Security breach.	Controlled access points; road safety audits; clear signage and routing. Barrier protection around site perimeter; spill containment; rapid incident response. Alternate access for emergency services. Joint emergency planning, integrated drills, communication protocols. Enhanced monitoring and surveillance. Comprehensive security, restricted access.
Shipping route to the harbour of Antwerp	1.5km from port entrance to site boundary.	Shipping route for dangerous goods to the harbour of Antwerp.	Port of Antwerp-Burges	Shipping route for dangerous goods to the harbour of Antwerp.	Various hazardous goods (Crude oil, Petrochemical products (e.g.,	Exposure to dangerous substances. Environmental contamination.	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination.

					Diesel, gasoline, etc.) Methanol, LNG)). Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Spill containment equipment, rapid response teams, wind and water quality monitoring. Route restrictions. Buffer zones. Sufficient surveillance and security. Intelligence sharing. Design considerations.
Braakmanhaven	1.5km	Ships with dangerous goods	North Sea Port	Ships with dangerous goods Large quantities of hydrocarbons and other chemical products.	Various hazardous goods (Crude oil, Petrochemical products (e.g., Diesel, gasoline, etc.) Methanol, LNG)). Fire, explosion, chemical release. Vessel accident, possibly carrying hazardous cargo. Chemical or fuel spill. Ships as vector for targeted attacks or unauthorized access.	Exposure to dangerous substances. Environmental contamination. Contamination of critical infrastructure, evacuation, operational shut-down. Delayed emergency response. Supply chain disruption. Strain on local emergency resources. Security breach.	Navigational controls, traffic monitoring, exclusion zones, emergency response coordination. Spill containment equipment, rapid response teams, wind and water quality monitoring. Route restrictions. Buffer zones. Sufficient surveillance and security Intelligence sharing. Design considerations.
Rail system network	0.5km	Rail system network connected to the National Dutch Railway System.	DOW	Rail system connected to the National Dutch Railway System.	Rail accident. Security event. Derailment. Fire.	Security breach. Damage to site infrastructure. Evacuation routes blocked.	Blast resistant containment structures. Surveillance, close collaboration with rail authorities, access control. Robust physical barrier between site and rail.

				Potential dangerous goods			Monitoring of rail operations, emergency response plan. Ensure rail tracks are well maintained. Alternative evacuation paths.
Gasunie Gas Pipeline	3.5km to safety zone[148] 3.6km to Site	Hydrogen pipeline	Gasunie	Hydrogen pipeline	Pipeline leak / spill Major pipeline rupture/explosion Pipeline maintenance / disruption Pipeline incident affecting evacuation route Combined incident	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation Damage to infrastructure and equipment Local infrastructure damage impacting operations Casualties Operational delays / shutdown Blocked evacuation routes / complicated access Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact Security breach	Blast resistant containment structures. Secondary containment Rapid response Independent and redundant power systems. Backup systems Appropriate and well-maintained storage and containment of chemicals Continuous environmental monitoring Public alert and evacuation protocols Buffer zones Separate critical systems and resources. Enhanced security protocols Automatic suppression systems Advanced leak detection Rapid isolation valves
Zebra Gasnetwerk BV	3.3km to safety zone[149] 3.7km to Site	Methane pipeline	Zebra Gasnetwerk BV	Methane pipeline	Pipeline leak / spill Fire Major pipeline rupture/explosion Pipeline maintenance / disruption Pipeline incident affecting evacuation route Combined incident	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation Damage to infrastructure and equipment Local infrastructure damage impacting operations Casualties Operational delays / shutdown Blocked evacuation routes / complicated access	Blast resistant containment structures. Secondary containment Rapid response Independent and redundant power systems. Backup systems Appropriate and well-maintained storage and containment of chemicals Continuous environmental monitoring Public alert and evacuation protocols

[148] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[149] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

						Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact Security breach	Buffer zones Separate critical systems and resources. Enhanced security protocols Automatic suppression systems Advanced leak detection Rapid isolation valves
Gasunie Gas Pipeline	4.3km to safety zone[150] 4.5km to Site	Natural Gas pipeline	Gasunie	Natural Gas pipeline	Pipeline leak / spill Fire Major pipeline rupture/explosion Pipeline maintenance / disruption Pipeline incident affecting evacuation route Combined incident Security	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation Damage to infrastructure and equipment Local infrastructure damage impacting operations Casualties Operational delays / shutdown Blocked evacuation routes / complicated access Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact Security breach	Blast resistant containment structures. Secondary containment Rapid response Independent and redundant power systems. Backup systems Appropriate and well-maintained storage and containment of chemicals Continuous environmental monitoring Public alert and evacuation protocols Buffer zones Separate critical systems and resources. Enhanced security protocols Automatic suppression systems Advanced leak detection Rapid isolation valves
DOW Benelux B.V.	3.9km to safety zone[151] 4.1km to Site	Ethylene pipeline	DOW Benelux B.V.	Ethylene pipeline	Pipeline leak / spill Fire Major pipeline rupture/explosion Pipeline maintenance / disruption Pipeline incident affecting evacuation route	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation Damage to infrastructure and equipment Local infrastructure damage impacting operations Casualties Operational delays / shutdown	Blast resistant containment structures. Secondary containment Rapid response Independent and redundant power systems. Backup systems Appropriate and well-maintained storage and containment of chemicals

[150] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

[151] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone

					Combined incident Security	Blocked evacuation routes / complicated access Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact Security breach	Continuous environmental monitoring Public alert and evacuation protocols Buffer zones Separate critical systems and resources. Enhanced security protocols Automatic suppression systems Advanced leak detection Rapid isolation valves
DOW Benelux B.V.	3.9km to safety zone[152] 4.1km to Site	Propylene pipeline	DOW Benelux B.V.	Propylene pipeline	Pipeline leak / spill Fire Major pipeline rupture/explosion Pipeline maintenance / disruption Pipeline incident affecting evacuation route Combined incident Security	Flammable gas cloud formation; risk of ignition/explosion; staff/public health risk; possible evacuation Damage to infrastructure and equipment Local infrastructure damage impacting operations Casualties Operational delays / shutdown Blocked evacuation routes / complicated access Escalation of impacts, complex emergency management; greater public safety, environmental, reputational impact Security breach	Blast resistant containment structures. Secondary containment Rapid response Independent and redundant power systems. Backup systems Appropriate and well-maintained storage and containment of chemicals Continuous environmental monitoring Public alert and evacuation protocols Buffer zones Separate critical systems and resources. Enhanced security protocols Automatic suppression systems Advanced leak detection Rapid isolation valves

[152] The Larger pipelines in the area include a safety zone, the distance provided here is the distance between the site boundary and the closest edge of the safety zone