Report

Risk assessment

# The risk of rail transport of dangerous substances in South-Holland South

This project has been made possible with contribution from the Civil Protection Financial Instrument from the European Union

# Contents

**Colophon**
All rights reserved
Safety Region South-Holland South
Dordrecht, The Netherlands, 2013

Published as part of the
PRISMA project
www.prismaproject.eu

This risk assessment report has no formal status. It was written as part of a demonstration test for the PRISMA project. It is meant to show how the MiSRaR approach plays out in an actual case. No rights can be derived from this report or the information therein.

# 1. Introduction

## 1.1 Risk setting of South-Holland South

The Safety Region South Holland South (in Dutch Veiligheidsregio Zuid-Holland Zuid, abbreviated as VRZHZ) is situated in the south-western part of the Netherlands. The region is situated close to Rotterdam and it consists of 17 municipalities of which Dordrecht is the largest. Due to its strategic location, the regions logistics and transport sector is of national importance. Two major rivers flow through the region and Dordrecht has an inland seaport. The A15 and A16 are two important transportation hubs for the transport of dangerous goods and other goods from the port of Rotterdam to Belgium and Germany. Also in the field of rail transport the region is critical, with the 'Betuwe' railway line and the north-south connection between Rotterdam and Antwerp. Both lines are intensively used for the transport of dangerous substances. At the junction of both lines lies the municipality of Zwijndrecht and its shunt yard Kijfhoek, the largest of its kind in Europe. In Kijfhoek freight trains are shunted from the Rotterdam and Antwerp port, reconstituted and finally distributed over the whole of Western Europe, using the Betuwe line and the Brabant Line.

## 1.2 "Spoorzone"

Substantial quantities of hazardous materials are transported in the categories of flammable and toxic gases and liquids. The railway zone ("spoorzone") also runs through a very densely populated area. All this creates a substantial safety risk. Within the national network for transport of dangerous goods by rail is the "railway zone Dordrecht, Zwijndrecht" the biggest bottleneck. The orientation value for the "societal risk" (literally from Dutch: "group risk") is exceeded many times. As a consequence, in the risk profile of the Safety Region South Holland South, the "spoorzone" emerged as one of the main risks within the region, in addition to flooding and pandemic influenza. The government is taking various safety measures on the track to reduce the risk of an accident. The likelihood, however, cannot be completely reduced to zero. This would be possible only if the transport of hazardous substances is completely stopped. However, that is not an option, because transportation is economically indispensable. The State government has therefore given money to the local government, the municipalities Dordrecht and Zwijndrecht, to improve the emergency response services along the track. These activities are bundled in the project Spoorzone.

## 1.3 Long term

The project Spoorzone aims to improve the assistance and disaster relief given the current risk of hazardous materials transportation. However, it provides no structural solution to this fundamental problem in the basic network. On the basis of the risk profile the safety region has indicated in it's policy paper the intention to develop a risk management plan for the Spoorzone, with a time frame going beyond the currently ongoing project. The concrete objectives for the long term have yet to be determined. The safety region overall goal is to optimize both safety by preventing and reducing risks and by properly preparing the actual assistance as well. This is the raison d'être of the safety region. However, optimum safety is not the same as ever striving for more or a maximum safety. Indeed, the level of risk is achieved by a continuous balancing of security interests against other societal interests, such as economic development. For example it's a fact transport (including hazardous materials) is crucial for the Dutch economy. Other partners can thus have different goals for the long-term strategy for the railway zone. This difference in interests is a given. Where partners may be able to find each other is the pursuit of sustainable safe solutions - transparent democratic legitimacy - which provide safety for residents, but also space for economic and spatial development.

## 1.4 MiSRaR and PRISMA

In the period 2010-2012, the Safety Region South Holland South worked together with six partners in five other EU Member States in the so-called MiSRaR project (Mitigation Spatial Relevant Risks in European Regions and Towns). This project focused on knowledge exchange between local authorities on ways to reduce spatial planning risks. The exchanged lessons are defined in a joint handbook. Following on the MiSRaR project, the VRZHZ together with four European partners, launched a follow-up project to test the lessons learned in practice. This is the PRISMA project (Promoting and Implementing Strategies for Risk Management and Assessment). In this project, each of the international partners had to develop a strategy for risk management for a specific risk in its own territory. The first objective of the project was to test the cross-sectoral implementation of the risk assessment and risk management (prevention) strategies as described in the brochures and handbook of the InterregIVC project MiSRaR (Mitigation Spatial Relevant Risks in European Regions and Towns). The partners tested these strategies on the following priority risks:

- rail transport of dangerous substances (VRZHZ)
- risks of dangerous substances in SEVESO industries and its road and rail transport (Aveiro)
- urban fires in the historic city centre (Mirandela)
- fires in the urban area with protected wooden houses (Tallinn)
- forest fires (SZREDA).

The second objective was to promote risk management and organize knowledge exchange between other local, regional and provincial governments and cross-sectoral risk management partners within the European Union (and associated states) on:

- the concepts, strategies, best practices and lessons learnt on risk assessment, risk management and the relation with disaster preparedness as described in the aforementioned handbook;
- the practical experiences with the implementation of the handbook as described under objective 1;

- the consequences of the ‘EU staff working paper on Risk Assessment and Mapping Guidelines for Disaster Management’ for local, regional and provincial governments and the possibilities for connecting national and decentralized risk assessment and risk management policies.

During the project each partners have:
- built a risk management network
- performed a risk assessment
- performed a capability assessment
- developed an implementation strategy

and together the partners organized 3 international conferences, developed and maintained a website and published newsletters and press releases.

During the implementation of the project, the partners have supported each other and exchanged their experiences in four ‘partner advice and counselling meetings”. A “virtual office” was available to work together on the project like colleagues in ‘real life” The partners assisted each other and presented their findings at the end of three international conferences. For the Safety Region South-Holland South the PRISMA project has been an opportunity to develop a risk management plan for the Spoorzone. This allowed smart use of international lessons for a risk that was a priority for the region anyway. Moreover, the PRISMA project provided an environment to experiment with the approach, without direct far-reaching consequences. The project is in fact a test of the possible risk management strategies. The actual implementation of measures is not planned within the project. The results of PRISMA can set the agenda for our work towards the future, but are non-contractual.

## 1.5 Cooperation

In the PRISMA project cooperation is key. Internationally, but also locally. Each of the five PRISMA partners have created a local network for its own specific risk. In the case of South Holland South, the basis for this network is project Spoorzone. The steering committee Spoorzone also acted as a steering committee for the Dutch activities of PRISMA. The core staff of the local working group was composed of experts of the Safety Region, fire services, municipal health, the environment department and the municipalities of Dordrecht and Zwijndrecht.

## 1.6 Status of this plan

This risk assessment report has no formal status. It was written as part of a demonstration test for the PRISMA project. No rights can be derived from this report or the information therein. The goal of PRISMA has been to test, learn and disseminate methods for risk assessment and risk management. The assessment is meant to show how the MiSRaR approach plays out in an actual case, but not to influence the actual risk or have actual consequences for the risk management in this case.  Because of the limited time of the project, the assessment was performed on the basis of existing information and expert judgement of the local working group. The assessment includes several assumptions which could not be validated or researched in detail. This means that the assessments and outcomes do not have to be taken literally, but as examples and show cases for the general approach to risk management.

# 2. Process

## 2.1 Risk assessment as part of the MiSRaR/PRISMA approach

The approach of the European PRISMA partners consists of four main steps. First, an analysis of the network for that risk will be made. Achieving a strategy for risk management by definition requires cooperation between a large number of public and private partners. On the basis of this analysis a strong network will be created in which all relevant partners can play their role. After the creation of the network the risk will be analysed. For Spoorzone this means that existing risk assessments of recent years are brought together. This risk assessment provides targets for the search of possible measures for the future. Question is whether these should be found in attributable risk reduction, impact reduction or vulnerability reduction? And what about the preparation, response and follow-up? A good risk analysis is essential in order to understand what the most important risk factors are and where the main bottlenecks are located. This is the basis for the third step: the capacity analysis, in which all possible concrete measures are explored and compared with each other. Finally, in the last stage concerns working on a possible strategy to ensure the most relevant implementation. All these stages are being implemented as part of an overall experiment.

## 2.2 The concept of 'risk'

The understanding of mitigation starts with the understanding of risk. In practice the participating partners of MiSRaR use different definitions of risk, derived from international literature. Comparison has shown that the various definitions ultimately amount to the same thing. The definitions only put different elements of the risk concept on the foreground. The two main definitions are:

**Risk = probability x impact**

**Risk = hazard x vulnerability**

An important distinction is that between the English terms *risk* and *hazard*, which in several languages both translate into the same word. Given the second definition the difference between a risk and a hazard lies in the vulnerability of the risk recipients: a potential hazard involves only the (likely) negative effect of an incident (disaster or crisis). The degree of vulnerability of people and the environment for such an effect determines whether this also amounts to a significant risk. To illustrate: a flooding itself can be seen as a *hazard*. However, if this occurs in an uninhabited area, without economic or ecological value, there is no or little *risk*.

*Vulnerability* is a composite concept, which consists of *exposure* and *susceptibility*. To illustrate: the extent to which buildings are vulnerable to a flood, depends both on the extent of the exposure (what is the height of the water?) and the degree to which it is actually truly affected by water (of what material and how solid is it built?).

The difference between the two definitions lies in the grouping of concepts. Combining these concepts creates the following aggregate definition:

$$\textbf{Risk} = \underbrace{\textbf{probability x } \mathrlap{\overbrace{\phantom{\textbf{effect x exposure x susceptibility}}}^{\textbf{impact}}}\textbf{effect}}_{\textbf{hazard}} \textbf{ x } \underbrace{\textbf{exposure x susceptibility}}_{\textbf{vulnerability}}$$

## 2.3 The steps in risk assessment

The mitigation process begins with understanding the nature of risks. This risk assessment consists of three phases:

- *Risk identification*. Risk identification is defined as “the process of finding, identifying and describing existing and future risk situations.” Identifying risks requires both the identification of risk causes (risk sources) and risk receivers (vulnerabilities). The combination of both provides insight into the spatial distribution of risk, or in other words the presence of high-risk locations or situations.
- *Risk analysis*. This step can be defined as “the process to determine the nature and relative magnitude of risks.” The goal is to prioritize which risks need most policy attention.
- *Risk evaluation*. In this phase, the conclusions of the risk identification and risk analysis are submitted to the (political) decision-makers. The aim is transparent and accountable decision-making: assessments are made as objectively as possible, but in the end politicians decide upon the priorities.

## 2.4 Checklist for risk assessment

For the execution of the risk assessment the following checklist from the MiSRaR handbook was followed:

- ☑ Obtain the necessary information on current risk sources and vulnerabilities.
- ☐ *Secure the continuous updating of risk information directly from the primary information sources.*
- ☑ Produce risk maps and risk inventory lists.
- ☑ Determine which risk analysis method (single hazard or multi hazard) meets the needs of the mitigation process.
- ☑ Involve the relevant experts within the risk management network in the actual execution of the risk analysis.
- ☑ Produce a risk assessment report in which the political perspectives for risk evaluation are taken into account.
- ☐ *Obtain clear political choices on the prioritization of risks and on political objectives.*

The second and the last checkpoints are outside the scope of the PRISMA project. The continuous updating of the risk information is a general process of the safety region, which cannot be part of a temporary project. The obtaining of political choices is not part because it is a demonstration project. The project is meant to test and disseminate the MiSRaR approach, but not to actually implement the outcome. Therefore actual political choices cannot be made as part of the project.

## 2.5 The actual working process

The risk assessment has been performed by different means:

- *Desk study*. In the past many different studies have been performed for the Spoorzone area.
- *Expert judgement*. The local working group has had several meetings (plenary and in sub committees) to perform the assessment together.
- *Software calculations*. To be able to project effect zones on the risk maps the EFFECTS software was used.
- *Mapping*. Different maps were made for probability, effects and vulnerability. Combined these provide insights for the assessment.

# 3. Risk identification

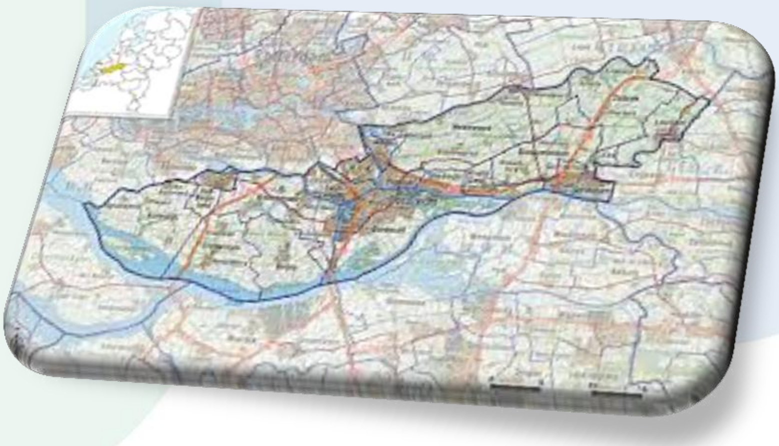
## 3.1 Approach to risk identification

Following the definition of risk the term *risk identification* is preferred above the more common *hazard identification*. Identifying risks requires both the identification of risk causes (risk sources) and risk receivers (vulnerabilities). The combination of both provides insight into the spatial distribution of risk, or in other words the presence of high-risk locations or situations. Risk identification is therefore defined as "the process of finding, identifying and describing existing and future risk situations."

In the following paragraphs first a general characterisation of the area is given. Secondly, the rail transport risk is placed in the broader perspective of the all hazard risk assessment that has been performed in South-Holland South in 2010. In the two paragraphs thereafter the risk sources and vulnerabilities are described. The chapter is concluded with a paragraph about the focus of the risk assessment.

## 3.2 General characteristics

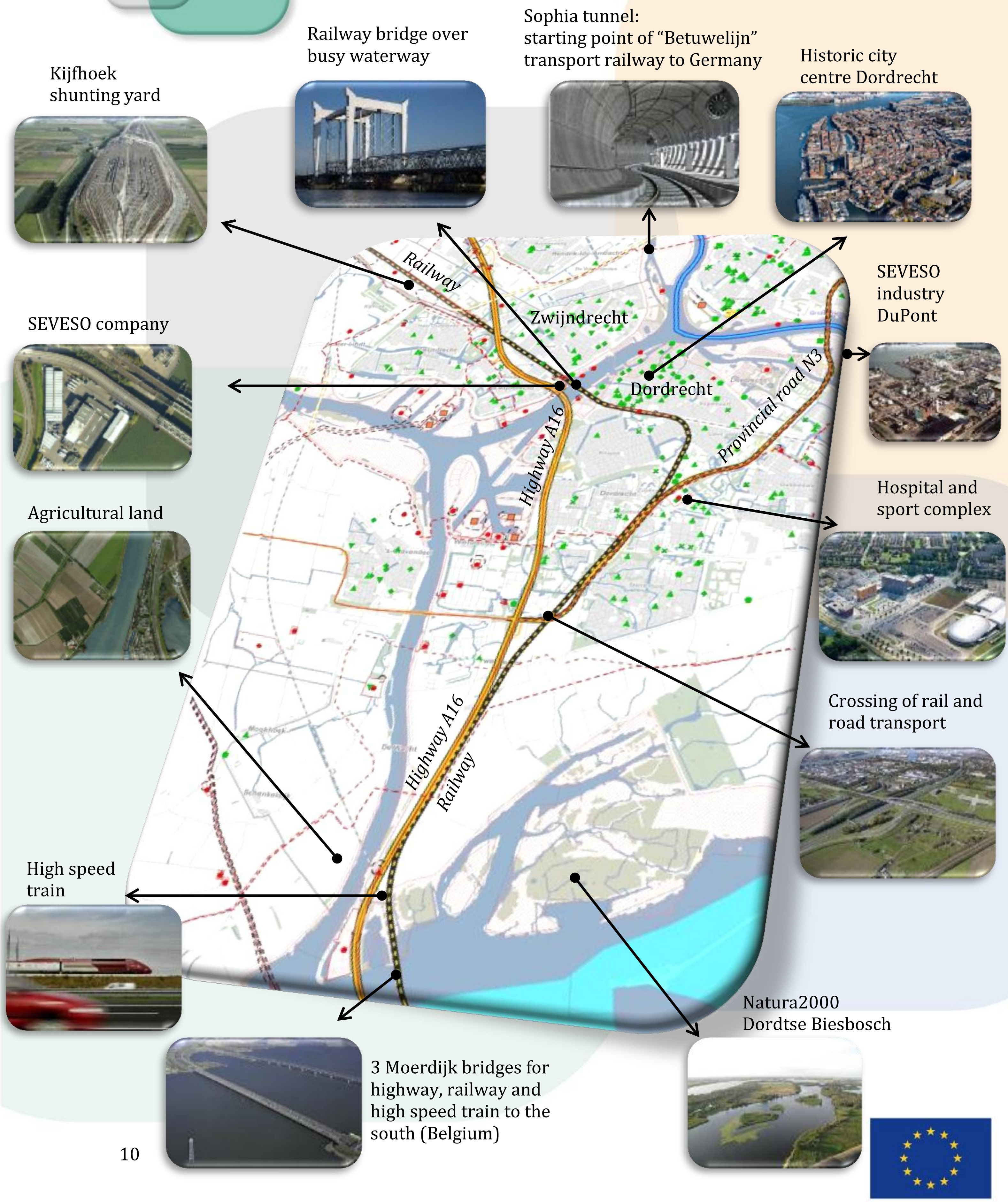
The Safety Region South-Holland South is situated in the South West part of The Netherlands. The region consists of 17 municipalities with together around 480.000 inhabitants. The historic city of Dordrecht (120.000 inhabitants) is the main municipality and its Mayor is chairman of the region. Because of its location the region is a logistic and transport hub of national importance. Directly adjacent to the territory is the Rotterdam-Rijnmond region, with the international harbour of Rotterdam (one of the biggest in the world) and a lot of (petro-)chemical industries (around 150 SEVESO industries). To the south there are the petrochemical industries and harbours of the Dutch cities Moerdijk, Vlissingen and Terneuzen. At longer distances are located the Belgian city of Antwerp (around 80 km), with its own big harbour and (petro-)chemical industry and the German Ruhr area (around 180 km), with its enormous industrial complexes. The result are intensively used transport axes which connect these harbours and industries with each other. In consequence the region South-Holland South has to deal with vast quantities of dangerous substances transport, which are transported by water, road and rail.



*Territory of the Safety Region South-Holland South*

Two of the main rivers in The Netherlands flow through the region. The water system is in direct connection with the North Sea, leading to a substantial flooding risk in case of high water discharge from the rivers and in case of high sea levels (and the

*General characteristics of Dordrecht and Zwijndrecht*



combination of the two). The rivers are used for transport of goods to and from the Rotterdam Harbour. This means the waterfront of Dordrecht city centre is one of the busiest waterways in Europe. For road transport two major highways across the area are used: the A15 to the east (Germany) and the A16 to the south (Belgium). Directly adjacent to Dordrecht the A16 highway passes the river by means of a tunnel. This tunnel is closed to dangerous substances, meaning the transports to and from the south have to pass by means of the A15 (which also includes a tunnel) and the provincial road N3, close to the Dordrecht city centre. Finally, there is the transport of dangerous substances by rail, which is defined as a high priority risk in the regional risk profile of South-Holland South.

## 3.3 'All hazard' regional risk profile of South-Holland South

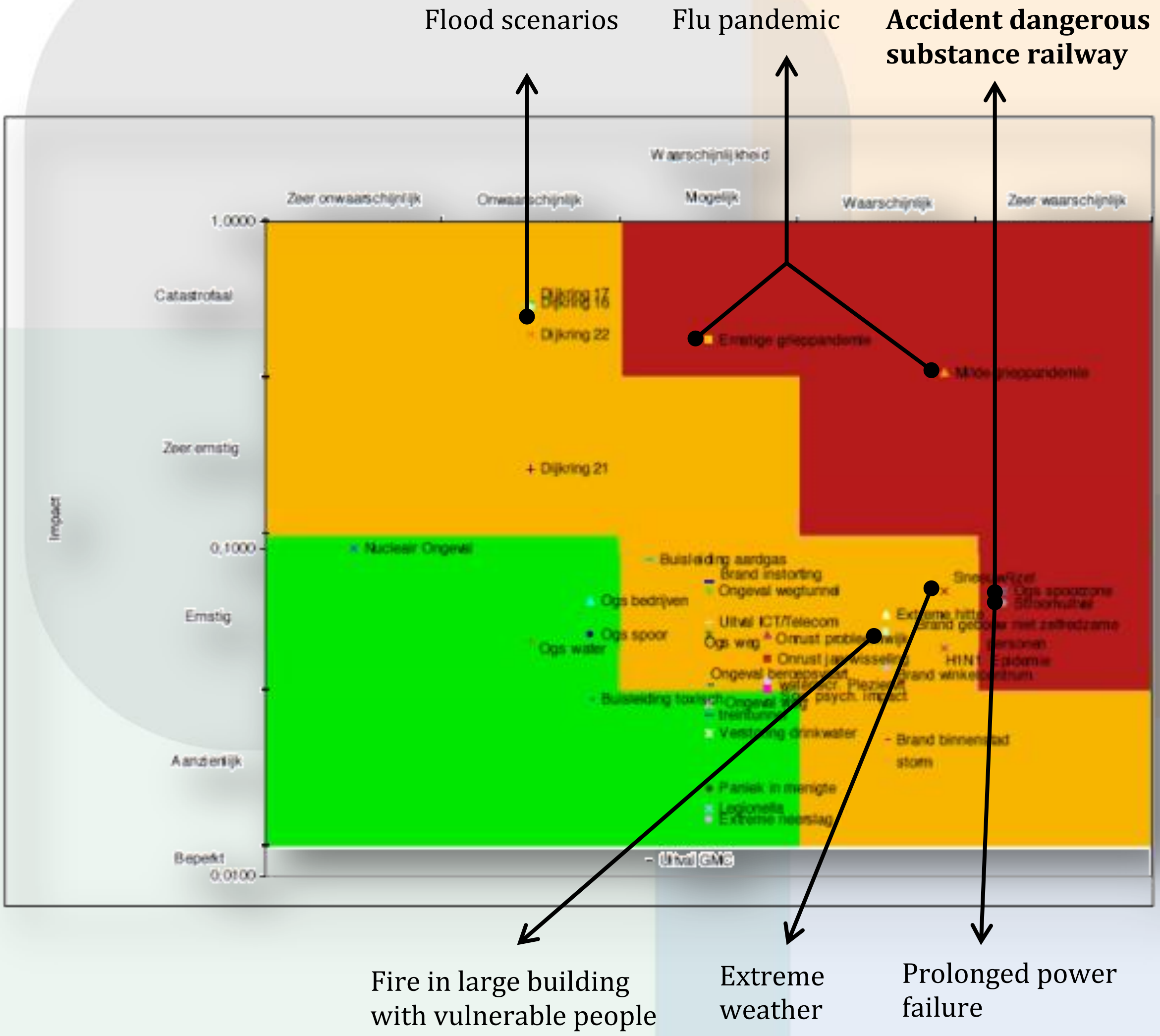
In The Netherlands the national Safety Region Act requires the 25 regions to develop (and continuously revise) a so-called regional risk profile ("regionaal risicoprofiel"), as a basis for the policies on risk and crisis management. These risk profiles are "all hazard", meaning the risk assessment contains issues ranging from natural disasters (like floods, extreme weather and earthquakes), to technological driven disasters with hazardous materials (like explosions, toxic fumes) or transport (like planes, trains, pipelines) and ultimately also man-made disasters like terrorism. Moreover this all hazard approach brings together all these kinds of 'classical' disasters with 'modern' crises like long-term failures of utility supplies, political instability, polarization of populations and health crises like the flu pandemic.

In South-Holland South the all hazard risk assessment resulted in 6 priorities of which rail transport of dangerous substances is one (see risk diagram). Based upon the risk assessment in the policy plan for the Safety Region one of the main objectives of the region is defined as "taking measures to contain the risks and ensure the accesibility in the Spoorzone, as commisioned by the municipalities Dordrecht and Zwijndrecht".[1] In cooperation with the Ministry for Infrastructure and Environment for the Spoorzone a special project has been started. Furthermore the Safety Region has committed itself to play an intermediary role between the municipalities and the national ministries, to ensure that all previous agreements on risk and crisis management are implemented according to plan.

---

[1] Policy plan (beleidsplan) Safety Region South-Holland South, 2012-2015.

*Risk diagram South-Holland South with 6 priorities*[2]

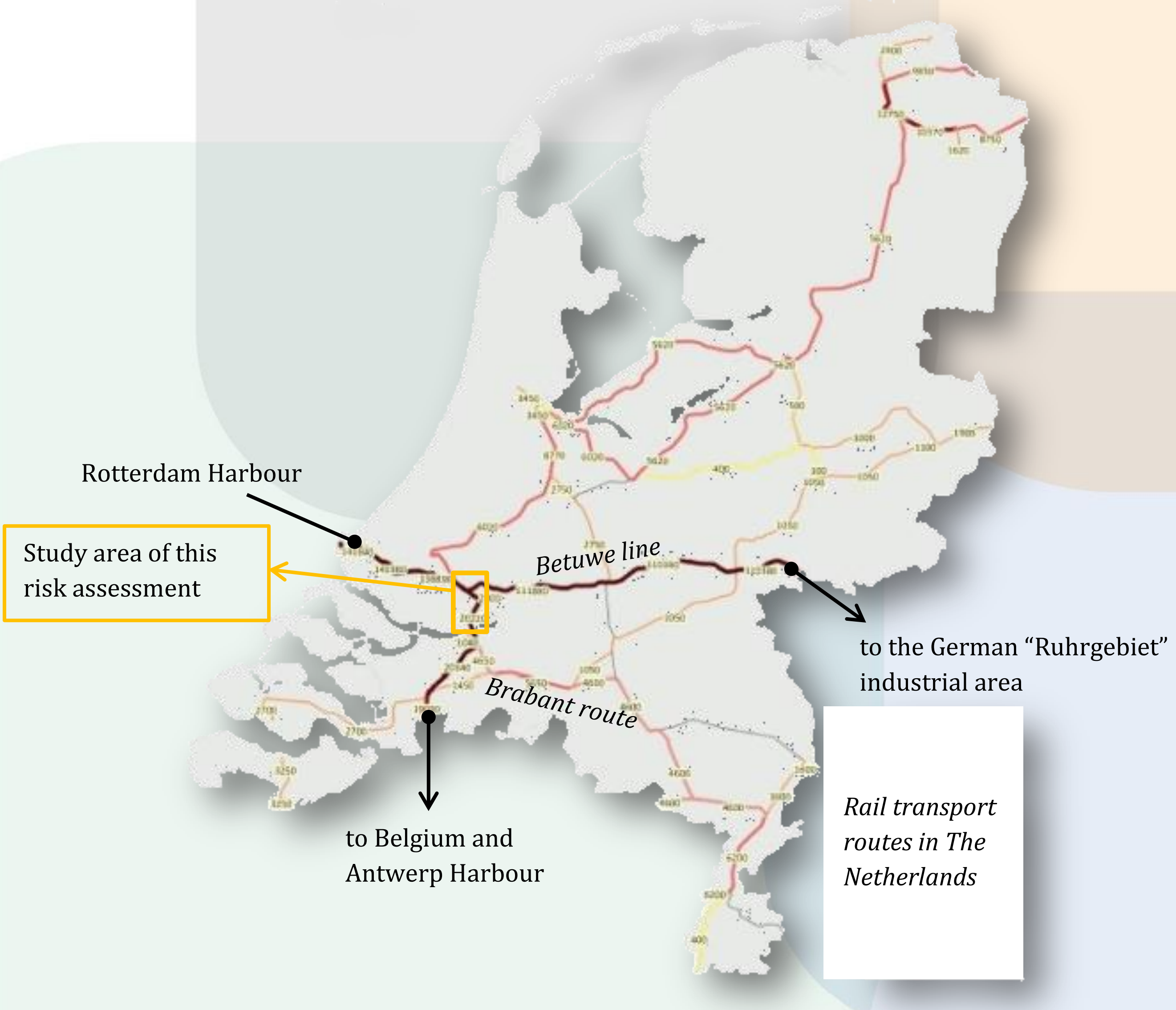


---

[2] Regional risk profile Safety Region South-Holland South, March 2011.

## 3.4 Risk sources: rail transport of dangerous substances

The region South-Holland South is situated at a key point in the Dutch railway system: the connection of the railway from the Rotterdam Harbour with the Betuweline to Germany and the southern transport to Belgium (Antwerp Harbour) and the 'Brabant route' to Germany through the Dutch southern province of Brabant.



*Rail transport routes in The Netherlands*

7 of the 17 municipalities in South-Holland South have transport of dangerous substances by rail on their territory. The transport routes in South-Holland South are divided into 5 subsections, which all come together on the territory of the municipalities of Dordrecht and Zwijndrecht.

*Rail transport routes in the study area of Dordrecht and Zwijndrecht*

*Kijfhoek shunting yard*

In the municipality of Zwijndrecht (45.000 inhabitants) the railways from the Rotterdam Harbour enter the region. In the municipality is located the Kijfhoek shunting yard. This shunting yard consists of 43 tracks and covers 50 acres. In the year 2012 a total of 50,050 wagons with dangerous substances passed through Kijfhoek. The shunting yard is the turntable for the rail transport in Western Europe and in consequence the most intensively used shunting yard in Europe. The shunting yard is the starting point of the so-called "Betuwe route" railway to Germany, which in the region South-Holland South passes through the municipalities of Hendrik-Ido-Ambacht, Papendrecht, Sliedrecht, Hardinxveld-Giessendam and Gorinchem. This railway was specially built in the nineties for transport from the Rotterdam Harbour to the rest of Europe, mainly to the German industrial Ruhr area. It is only used for transport of goods and not for passengers. The Kijfhoek shunting yard is the place where all transports from the ships and industries in the Rotterdam area are recombined into trains to their final destinations to the east and south. Also the shunting yard is used for the recombination of trains from the Antwerp Harbour in Belgium. This means that trains come from the south to be recombined and after that travel on to the east (Betuwe route), but in many cases also back to the south (to Belgium, or to Germany through the Dutch province of Brabant, the so-called Brabant Route). In consequence the railway in the municipalities of Zwijndrecht and Dordrecht is one of the most intensively used in Europe. The maximum allowed number of goods trains on this stretch is 7 an hour in both directions (14 in total). In addition there pass 16 passenger trains an hour.

From Kijfhoek the transport routes go in four directions. To the north there are the (Rotterdam) "Harbour line" and the on-going railway to North-Rotterdam. To the east there is the Betuwe route. To the south the railway goes through Zwijndrecht to Dordrecht (Central) Station. From Dordrecht Station the main route is southwards to the Moerdijk bridge. However, there is a small amount of local transport to DuPont, a SEVESO industry.

### *Transported substances*

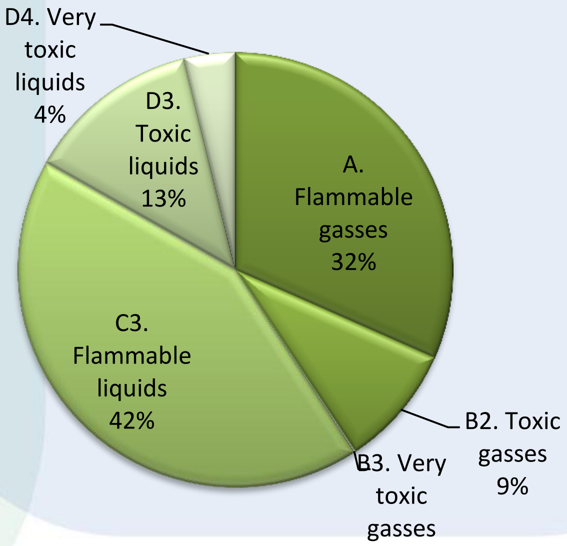
In The Netherlands the transport of dangerous substances by rail is by Law divided into 6 categories.

| **Label** | **Category** | **Example substances** |
|---|---|---|
| A. | Flammable gas | Propane or LPG (mix of propane and butane) |
| B2. | Toxic gas | Ammoniac (under pressure) |
| B3. | Very toxic gas | Chlorine |
| C3. | Flammable liquid | Pentane, hexane or petrol (mix of pentane and hexane) |
| D3. | Toxic liquid | Acrylonitrile |
| D4. | Very toxic liquid | Hydrogene fluoride or acrolein |

The number of different substances which are actually transported within these 6 categories is not exactly know at this moment. Substances within each category might differ greatly in their characteristics and behaviour after a spill. The effects of the example substances are partially representative for the categories, but not completely. There are specific substances which might have much bigger effects. Also unexpected domino effects might occur in case of simultaneous spillage of different substances. The choice of example substances has been made nationally (national guideline rail transport risk analysis) taking into account the representativeness but also the transport volume. Recently a system has been implemented in the command centre of Keyrail at Kijfhoek, in which the content of all wagons will be registered. In future this might provide additional insights in which specific substances are transported most within each substance category.

### *Transport volumes*

The transport volumes of dangerous substances on the Spoorzone route are the highest ones in The Netherlands and presumably one of the highest (if not *the* highest) in Western-Europe. The largest part of the transport concerns flammable liquids (42%) and flammable gasses (32%), as depicted in the pie chart.



*Relative volume of substance categories (as predicted for 2020)*

In the table beneath the transport volumes in 2012 for all 5 subsections of the transport in Dordrecht and Zwijndrecht are presented.

*Number of wagons with dangerous substances in 2012*

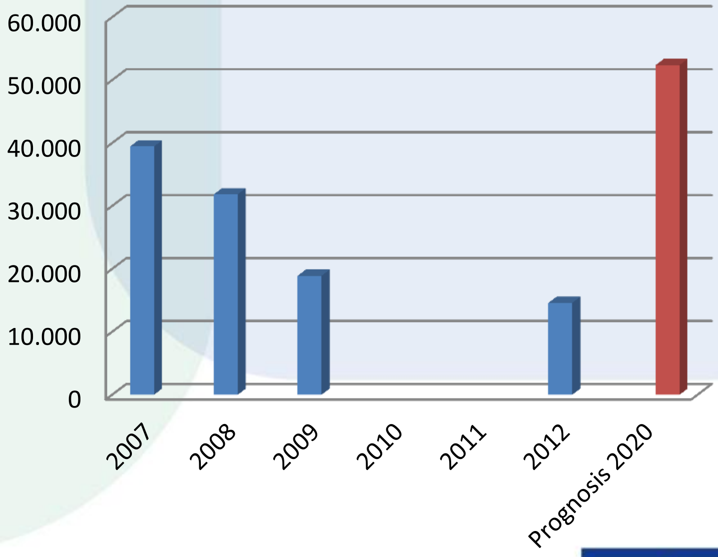
| Substance category | Betuwe route | Kijfhoek North | Kijfhoek-Dordrecht station | Dordrecht station - Moerdijk bridge | Dordrecht station - SEVESO |
|---|---|---|---|---|---|
| A. Flammable gas | 4,460 | 2,230 | 3,490 | 5,580 | |
| B2. Toxic gas | 770 | 1,630 | 1,160 | 1,280 | |
| B3. Very toxic gas | | | | | |
| C3. Flammable liquid | 8,210 | 14,960 | 7,220 | 5,850 | 1,370 |
| D3. Toxic liquid | 360 | 1,750 | 1,950 | 2,920 | |
| D4. Very toxic liquid | 430 | 650 | 780 | 390 | |
| Total | **14,230** | **21,220** | **14,600** | **16,020** | **1,370** |

This shows that the largest quantity is transported on the North side of Kijfhoek: in 2012 an average of almost 60 wagons a day (taking in mind the transport has decreased dramatically since 2007). This is logical because this is the main route to and from the Rotterdam Harbour, connecting to both the Betuwe route and the south-bound transport to Antwerp Harbour and the Brabant route. However, the subsection passing through the city centre of Dordrecht and Zwijndrecht (Kijfhoek-Dordrecht Station) also has very significant transport.

### *Future developments in transport*

Due to the international crisis the transport has significantly decreased during the last years. In 2012 (the most recent available numbers) the transport was as much as 63% lower than in 2007 (the last year before the start of the economic crisis). The decrease in transport is illustrated for the Kijfhoek-Dordrecht Station stretch. The transport decreased from an average of about 110 wagons in 2007 a day to 40 wagons a day in 2012.[3]

*Development of transport volumes (Kijfhoek-Dordrecht Station)*



---

[3] No figures were available for 2010 and 2011.

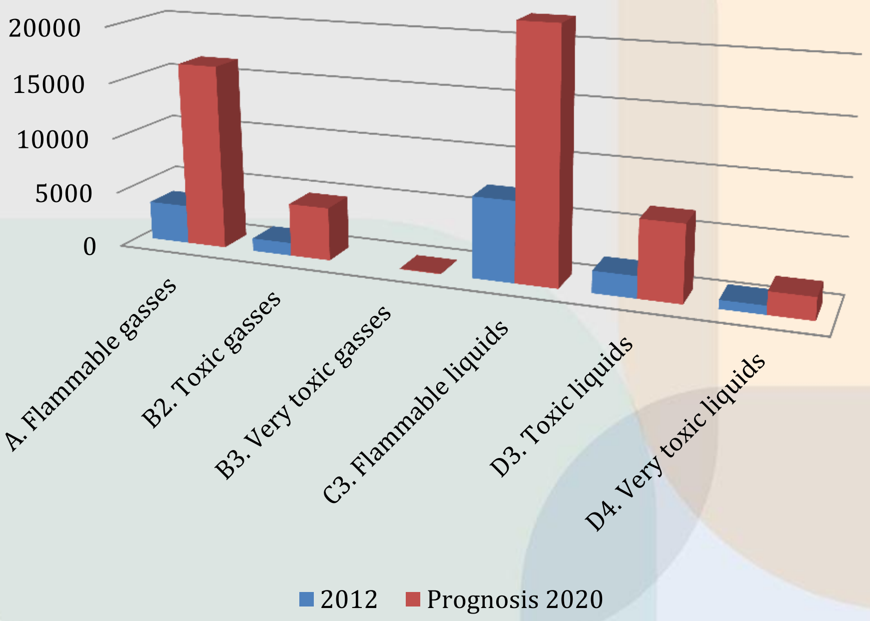
The national government of The Netherlands has plans for more intensive use of the railway system. This is the so-called Program High-frequency Rail (“Programma Hoogfrequent Spoor” – PHS). This program is directed at more intensive use of the railway system in the west (most urbanized area) of The Netherlands for commuting trains, but also has consequences for transport of (dangerous) goods. On the 1st of July 2014 the Law Base-net Transport of Dangerous Substances will be enacted. This Law is meant to ensure the possibility for further growth of railway transport and at the same time protect the safety of inhabitants along the railways. In the Law new maximum transport volumes have been set, based upon the prognosis for transport in the year 2020. The aim is to make optimal use of the Betuwe line to Germany and thereby disburden the Brabant route through several city centres in the south.

*Prognosis number of wagons with dangerous substances in 2020*

| Substance category | Betuwe route | Kijfhoek North | Kijfhoek-Dordrecht station | Dordrecht station - Moerdijk bridge | Dordrecht station - SEVESO |
|---|---|---|---|---|---|
| A. Flammable gas | 50,920 | 34,440 | 16,560 | 16,560 | |
| B2. Toxic gas | 6,240 | 18,650 | 4,760 | 4,760 | |
| B3. Very toxic gas | 730 | 560 | 50 | 50 | |
| C3. Flammable liquid | 111,880 | 151,780 | 22,220 | 20,220 | 2,000 |
| D3. Toxic liquid | 6,380 | 12,910 | 6,810 | 6,810 | |
| D4. Very toxic liquid | 3,920 | 4,590 | 1,990 | 1,290 | 700 |
| **Total** | **180,070** | **222,930** | **52,390** | **49,690** | **2,700** |
| **Increase 2012→2020** | x12.7 | x10.5 | x3.6 | x3.1 | x2.0 |

However, for the railways in the region South-Holland South the transport may increase dramatically (see table). The coming years a new growth of transport is foreseen, mainly because of the completion of the *Tweede Maasvlakte* (literally: second Meuse plain): a whole new area of container handling and docks in the Rotterdam Harbour. The prognosis for 2020 is an increase of over 3 times more transport through the city centres of Dordrecht and Zwijndrecht and over 10 times more transport on the Betuwe route. For the city centres this might result in an increase from about 40 to 140 wagons a day. This increase is predicted for all substance categories, although the increase will be biggest for flammable and toxic gasses (see figure).

*Expected increase of transport of different substance categories from 2012 to 2020 (Kijfhoek-Dordrecht Station)*



A reservation has to be made concerning this prognosis: the impact of the ongoing economic crisis is difficult to predict. Up to now the transport is still much less than before the crisis. Whether the transport will pick up the coming years remains a question. Recently the national government has decided to postpone further actions to enable transport to the north of Germany (the so-called north branch of the Betuwe line), because it is uncertain whether this will be needed in the near future. Furthermore there are concerns about overcapacity in the Rotterdam Harbour. However, this risk assessment is based upon the prognosis figures for the year 2020, because the goal is to establish policies for the middle-long term. Until further notice the figures for 2020 remain the basis for the national policy and therefore also should be the basis for the regional and local policies.

## 3.5 Vulnerabilities

For the identification of vulnerabilities the general classification of impacts is used from the Dutch national Guideline for Regional Risk Assessment. This guideline distinguishes between 6 kinds of “vital interest of society”, which in general can be translated into the following kinds of vulnerabilities:

1. Territorial impact: the territory in general

2. Physical impact: people and vital infrastructures
3. Economic impact: the man-made environment in general (damage), businesses and vital infrastructures
4. Ecologic impact: nature areas
5. Social-political impact: people and vital infrastructures
6. Impact on cultural heritage: cultural heritage objects.

Furthermore it is important to consider potential domino scenarios.

### *Vulnerabilities: the territory in general*

The study area of the railway (the ongoing track in the municipalities of Dordrecht and Zwijndrecht) encompasses a stretch of 16 kilometre in length, with a sharp bend (90 degrees) more or less halfway. Taking into account a maximum influenced area of up to 5 kilometre[4], there is a territory of approximately 200 square kilometres which might be affected, although certainly not the whole at the same time. The maximum territory directly affect by one incident is approximately around 10 square kilometres, plus a wider area in which the (temporary) loss of vital infrastructures might result in the loss of "functional use" of the territory.

### *Vulnerabilities: people*

In the region South-Holland South the railway transport passes directly through the city centres of Dordrecht (120.000 inhabitants) and Zwijndrecht (45.000 inhabitants). Furthermore the Betuwe line passes alongside the inhabitation of Papendrecht (32.000 inhabitants), Sliedrecht (25.000 inhabitants), Hardinxveld-Giessendam (18.000 inhabitants) and Gorinchem (35.000 inhabitants). However, the identification of vulnerabilities is limited to the municipalities of Dordrecht and Zwijndrecht, because of the scope of the PRISMA test (see paragraph 3.6). The population densities along the railway are high: up to and above 500 people per square kilometre. In the city centres of both municipalities the housing is built as close as 20 meters from the railway (see images). Near the Kijfhoek shunting yard the distance is bigger, up to 500 meters.

---

[4] Maximum influence area of a chloride incident. *Voorbeelduitwerking incident vervoer toxische stoffen per spoor*, platform risicoprofiel, juli 2010.

*Closeness of buildings in Dordrecht*

*Closeness of buildings in Zwijndrecht*

### *Vulnerabilities: economic activities and value*

Several areas directly alongside the railway are allocated for businesses. This includes smaller businesses like garages, larger office buildings, several hotels and several bigger (SEVESO) companies. Not as close, but still within the potential effect zones are the Dordrecht Harbour and the DuPont SEVESO industry. In The Netherlands the property values are relatively high, although the housing and office market have been subject to recent problems. Because of the density of building and high value there is always quite a lot of potential damage within the zone of an incident scenario. Another factor to take into consideration is the agricultural areas in the west (Hoeksche Waard) and at the southeast of Dordrecht. The crops grown there might be affected by emission of dangerous substances, an issue which has been very manifest during the chemical incidents in Moerdijk in January 2011 and June 2014.

### *Vulnerabilities: vital infrastructures*

The railway passes several times alongside or over important ongoing roads: the highway A16 from Rotterdam to the south and the highway A15 from Rotterdam to the east. A temporary closing of one or both of these highways directly results in a gridlock in the whole Rotterdam area. For transport of dangerous substances by road (and for local access from Dordrecht) both highways are connected by the provincial road N3. The N3 is used for transport of dangerous goods by road, because these transports are prohibited in the two tunnels, one in each highway. This means that in case of an railway incident close to the N3 not only the rail transport, but also the road transport of dangerous substances is seriously impaired. Furthermore, on the Dordrecht bridge and Moerdijk bridge the railway passes directly over main water transport routes in The Netherlands. In case of an incident on one of the bridges the water transport might be disrupted and there might also be environmental impact.

Alongside the railway there are also situated various hubs in the electricity network. Within the potential effect zones there are also water intakes for drinking water. The ditches and canals directly alongside the railway are in several ways connected to the broader water system the sewage system

### *Vulnerabilities: ecology*

Within the vicinity of the railway there are two main ecological concerns: the water ways and Natura2000 areas. The railway passes 2 main rivers, which have tides from the sea and are connected to many other water systems. This means that a spill of a (eco)toxic liquid in these rivers might travel in several directions. Upstream (but because of the tides still within reach) there are the important Natura2000 areas of Dordtse Biesbosch (1 km) and Biesbosch (4 km). These are wetlands with large bird populations. Finally there is also the general air and soil quality to consider, as with any chemical incident.

*Closeness of Natura2000*

*Vulnerabilities: social-political stability*

It is impossible to identify specific locations which are connected to impact on social-political stability. This is in general terms related to the population (psychological impact) and disruption of daily life. It can be said that incidents with dangerous substances in general have a high potential psychological impact, because of public culpability (it is a man-made risk). In Dordrecht and Zwijndrecht the impact might be even higher because of the general awareness about the large volume of transport and because it is known for many years that it is a principal risk. The disruption of daily life can be related to the loss of vital functions like shops, schools, offices, but also because of the geographic layout of the road infrastructure: an incident can very easily result in a gridlock within the cities and even in the whole southwest of The Netherlands.

*Vulnerabilities: cultural heritage*

Dordrecht is officially the oldest city in The Netherlands and scenery for several historical events. The city centre has a (late) Medieval layout with the typical Dutch canals. Large parts of the city centre are protected heritage, including several museums. The edges of the city centre are located within half a kilometre of the railway. This means that it will not suffer the heaviest impact, but certainly can be affected by overpressure (breaking windows) and corrosive effects of toxic gasses. However, this is in no comparison with the potential impact on people and on the areas closer to the railway.

*Vulnerabilities: potential domino*

In the municipality of Zwijndrecht a SEVESO storage company is directly adjacent to the railway. Also in Dordrecht Harbour a SEVESO company is located, but only on the outermost effect zone. On both sides of the Dordrecht railway bridge a LPG gas station is located, close to the railway. Furthermore an ice skating ring is located close to the railway (and N3), which might lead to a domino scenario with the ammoniac installation used for the cooling of the ice. Also swimming pools have large quantities of ammoniac for their climate systems, one of which is located approximately 150 to 200 metres from the railway in Zwijndrecht. Furthermore the Kijfhoek area contains several pipelines for transport of dangerous substances. Finally, an incident might have direct impact on several vital infrastructures, resulting in domino effects on for example energy and water supply.

### *Future developments in vulnerabilities*

Due to the financial crisis the spatial and economic development has significantly slowed down the last few years. This means that in the railway zone only limited developments of new or changed vulnerabilities are expected. The maps show the expected sites of spatial development. The spots close to the railway are important to take into consideration in the formulation of mitigation policies.

*Locations of expected spatial development*

## 3.6 Empirical evidence: incidents in the past

For the identification of risks it is also important to consider empirical evidence of incidents in the past. In the study area and its direct vicinity at least 4 incidents with trains filled with dangerous substances have taken place during the last 30 years.

### *1986: chloride*

In 1986 at Kijfhoek shunting yard a wagon of chloride collided into a train, possibly with LPG. However, no dangerous substances were emitted.[5] The potential impact of an emission could have been huge. Perhaps the direct effects of a LPG BLEVE would not have huge impact on residents because the nearest housing is located approximately 500 meters away, but at the same time it would have caused domino effects on the chloride wagon and other trains on the shunting yard, resulting in very large effect zones of lethal concentrations of the very toxic chloride gas. Even the more likely event of a smaller breach in the chloride wagon would have certainly caused casualties, the number depending in the wind direction. Since then the transport of chloride has been terminated, after a long political and public debate.

### *2009: head-on collision of 2 cargo trains*

On September 24th 2009 two cargo trains had a head-on collision directly underneath the highway A15 in the municipality of Barendrecht. This was approximately 2 kilometres from the border of Zwijndrecht municipality, on the tracks directly leading to/from Kijfhoek shunting yard, with alongside the on-going tracks for both normal passenger trains and high speed trains. At the moment of collision the trains had respective speeds of 68 km/h and around 40 km/h. One of the cargo trains contained wagons with dangerous substances: the third to twelfth wagons contained natural gas condensate (extremely flammable), hydrogen peroxide (toxic) en monochloroacetic acid (toxic).[6] No emission of dangerous substances occurred, but one of the machinists was killed and the other injured. Some of the wagons ended up on the on-going railway track for passenger trains, but a further catastrophe could be avoided because the machinist of a passing passenger train from Brussels could break just in time. The potential domino effects of a combined emission of the 3

---

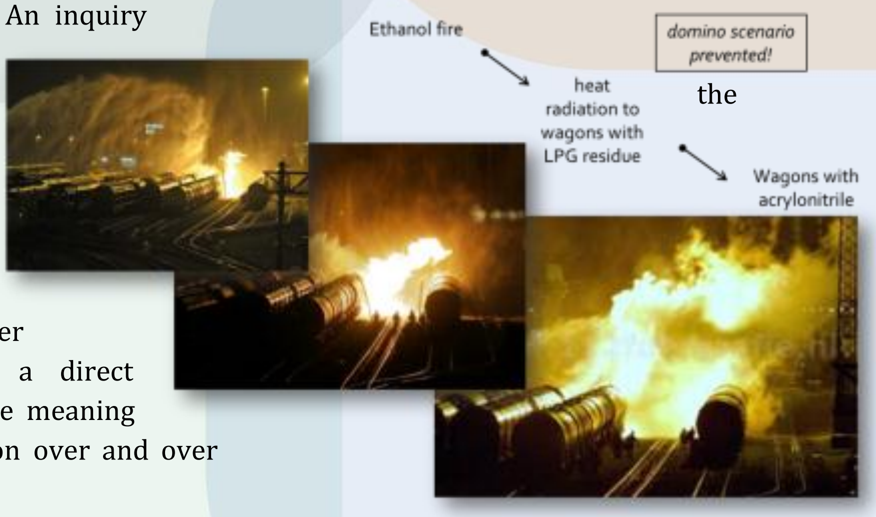
[5] More information about this incident could not be found.

[6] Dutch Safety Board, *Inquiry into the train collision near Barendrecht*, published January 2011.

dangerous substances would have been huge, with the closed housing only 10s of meters away and the very busy highway A15 directly overhead. After investigation it was concluded that the cause of the incident was a human mistake (ignoring a red sign) combined with a structural systems fault (automatic breaking in case of a red sign does not work at speeds below 40 km/h). In the end a tank from the military had to be used to remove the wreckage from beneath the highway.

### *2011: a domino scenario prevented*

On January 15th 2011 a wagon filled with ethanol breached and caught fire at Kijfhoek shunting yard. Next to this train was another trained with containers filled with highly explosive LPG residue. Further on in the train were situated one or more wagons with the toxic liquid acrylonitrile. The wagon(s) with acrylonitrile were situated far enough from the ethanol fire, however, the LPG wagons were not. The heat radiation to the LPG wagons could potentially lead to a so-called "warm BLEVE": an instantaneous LPG explosion triggered by the external heat source. This explosion, in turn, would have caused direct damage to other cargo trains in the vicinity, including the wagon(s) with acrylonitrile. The acrylonitrile in turn would have caught fire, causing toxic smoke and toxic fumes. The fire brigade could prevent this domino scenario by cooling the LPG train and driving it away from the scene of the accident. It is widely agreed the municipality had a narrow escape. An inquiry showed that the direct trigger for the incident was a malfunction in the automatic breaking system for the shunting process. However, the more fundamental cause was a problem in the safety culture of the shunting yard personnel: because they could go home after finishing their work, there was a direct incentive to work faster, in this case meaning they ignored the systems malfunction over and over again.



### *2014: leaking wagon* *[added later]*

On February 6th 2014 employees of the rail maintenance company ProRail smelled a chemical substance near a train with acrylonitrile on Kijfhoek shunting yard. During the first reconnaissance at the site the fire brigade measures concentrations of acrylonitrile near one of the wagons. Fire men in chemical protective suits perform further measurements, but cannot find any concentrations anymore. After further inquiry it is concluded that a sealing ring under high pressure has caused the small emission. During the incident the traffic of passenger trains on the on-going track is terminated, but in the end it proves to be a minor incident.

Besides these incidents in (and very near) the study area, there is also international empirical evidence of the effects of train incidents with dangerous substances. Most recent examples are the BLEVE of a LPG train in Viareggio, Italy (2009), causing 31 fatalities and 17 wounded, and the acrylonitrile incident in Wetteren, Belgium (2013), causing 1 fatality and 100 wounded.

## 3.7 Focus of the risk assessment

This risk assessment is focused on the on-going railway from the north(-west) to the south, meaning only within the municipalities of Dordrecht and Zwijndrecht. This means the following parts of the rail transport routes are not taken into account:

- The **Betuwe route** is not part of this assessment, because this railway line is built especially for transport of dangerous substances. This means that the risk levels and mitigation measures have been thoroughly taken into account during the construction, rendering an additional assessment useless and anyway not possible within the project period of PRISMA.
- Furthermore the **Kijfhoek shunting yard** is not part of the risk assessment. According to national legislation Kijfhoek is considered a SEVESO (“BRZO”) location, to which all specific SEVESO regulations apply. Kijfhoek is a major risk and receives specific attention from the Zwijndrecht municipality and the Safety Region. It was deemed impossible to include all aspects of this specific risk location in the risk assessment during the relatively short project period of PRISMA. However, this does not mean it is of less consequence or should be a lesser priority then the transport on the on-going railway tracks.
- Finally, the specific line to the **SEVESO industry DuPont** is not taken into account, because the transport volumes there are significantly lower than on the other route (10 times less) and are expected to have the lowest increase to 2020 (only 2 times more). This lower volume does not mean there is no risk at all, but for the purpose of the PRISMA testing during the limited project time a focus had to be made.

# 4. Risk analysis

## 4.1 Different methods

The second phase in risk assessment is the risk analysis. This step can be defined as "the process to determine the nature and relative magnitude of risks." The goal is to prioritize which risks need most policy attention. What underlying concept of risk is used, determines the approach to this step. The United Nations, for example, argues that risk assessment is aimed at determining hazard and vulnerability.[7] The European Union refers to this definition, but focuses on assessing the probability and impact.[8] As previously outlined, both definitions of risk actually share the same underlying factors. The choice of a definition does, however, have consequences for the presentation of a risk analysis. In one case, risks are ranked in classes of hazard and vulnerability, in the case of other classes of probability and impact. Within the MiSRaR project examples of both approaches have been found. One approach is not necessarily better than another, but when choosing a method, it is important to take the differences into consideration. In general, the approach of hazard and vulnerability is especially useful for separate analysis (*single hazard approach*) of natural disasters, because man cannot influence these *hazards*, such as earthquakes, volcanic eruptions and extreme weather. For those risks it is particularly useful to focus on a proper analysis of the vulnerabilities (people, economy, ecology), because those hold the only options for risk reduction. On the other hand, the approach to probability and impact is particularly useful for simultaneous analysis of different types of risks, because it is possible to present the outcome by means of a risk diagram, which enables decision-makers to compare the relative severity of various risks transparently. This is also referred to as an *all hazard approach*.

For the analysis of the rail transport risk in South-Holland South 3 different approaches have been used, in order to obtain as much insight in the risk as possible:

A. All hazard approach: regional risk assessment
   The first method is the all hazard approach of the Dutch national Guideline for Regional Risk Assessment. This method analyses on impact and probability. Impact in this case is defined by 10 different criteria for the different vital interests of society. In this case the all hazard methodology is applied to several scenarios for a *single* hazard.

B. Single hazard approach: societal risk
   The second method is the single hazard approach as defined in the External Safety Decree ('BEVI'). This decree requires calculations for the so-called 'local risk' and 'societal risk', which take into account only fatal casualties and no other kinds of impacts. This means that this single hazard method also uses the risk definition of probability and impact.

C. Mapping approach: probability, effect zones and vulnerabilities
The third method is the mapping of risks in order to obtain concrete insight in the spatial distribution of probabilities, effects and vulnerabilities. This method concerns the full width of the risk definition, so also vulnerability.

In the next paragraphs each of these 3 risk analysis methods and the analysis outcomes are elaborated.

## A. All hazard approach: impact and probability

### 4.2 Methodology regional risk profiles

In an all hazard approach in principle, all conceivable safety risks (from the list presented above) could be considered simultaneously. This means that risks like explosions must be made comparable to social unrest, or major infectious diseases to disruption of public utilities. To be able to compare completely different risks in an *all hazard approach* some sort of 'yardstick' is needed, with which the consequences of a risk for the various types of "vital interests" of society may be measured in a comparable way. The concept of *vital interests* has long been used by several countries and is now also part of the joint approach to national risk assessment within the EU, as proposed in the '*Staff Working Paper on Risk Assessment and Mapping Guidelines for Disaster Management*', in which also the MiSRaR project is mentioned.[9] The Safety Region South Holland South has obtained practical experience with such an all hazard method of risk analysis. This method is described in the National Risk Assessment[10], used by the national government, and in the guideline for Regional Risk Assessment[11], which is used by the 25 Dutch Safety Regions.

The Dutch method for all-hazard analysis is a form of *scenario analysis*. Insight in actual and future hazardous situations does not automatically translate into a risk analysis. It is impossible to try to separately analyse the hundreds or even thousands identified hazardous situations. Instead, in a scenario analysis a representative scenario is made for every relevant risk category. The main reason for the use of scenarios as an instrument for risk assessment is the possibility to define the critical elements in the development of a disaster or crisis, as a basis for strategic policies. A scenario analysis enables the identification of the most important factors with which the outcome of a disaster or crisis can be influenced positively, by means of both risk reduction (probability, effect and vulnerability) and disaster preparedness.

To enable a scenario analysis the identified hazards have to be described in terms of potential disaster or crisis scenarios. For every of the 25 types of disasters and crises the experts of the

Safety Regions have to determine which scenarios could realistically occur on their territory. This is called the first 'funnel': from many hazardous situations to a limited number of scenarios. In the Dutch approach the concept of 'risk' is de-fined as a composition of the 'impact' (total of the consequences) and 'probability' (a forecast about the occurrence) of a disaster or crisis scenario. As said before, to be able to compare totally different risks in an all hazard approach some sort of 'yardstick' is needed: a predefined model that makes it possible to measure risks in a comparable manner. In order to compare the completely different kinds of risks, that 'yardstick' needs to distinguish be-tween the different sorts of consequences for the various kinds of 'risk recipients'. In The Netherlands these different sorts of impacts are clustered in six so-called 'vital interests of the society':

1. *Territorial security*, defined as the actual or functional loss of use of parts of the Dutch territory for a longer period of time. Functional loss is mainly deemed to mean the loss of the use of buildings, homes, infrastructures and agricultural land.
2. *Physical safety*, defined as the disruption of the functioning of the people of the Netherlands. This impact is measured in terms of fatal injuries (immediate or premature death), seriously injured and chronically ill, physical suffering in terms of lack of basic necessities of life.
3. *Economical safety*, defined as the disruption of the functioning of the Netherlands as an effective and efficient economy. This is measured in euro's in terms of repair costs for damage sustained, costs for the disaster relief and loss of income.
4. *Ecological safety*, defined as the disruption of the continued existence of the natural environment in and around the Netherlands. This is measured by the long-term impact on the environment and on nature (flora and fauna), in terms of harm to designated wildlife and scenery conservation areas (Natura 2000), and harm to the environment in the broad sense.
5. *Social and political stability*, defined as the disruption of the continuing existence of a social climate in which individuals can function undisturbed and groups of people can live together peacefully within the framework of the Dutch democratic constitutional state and shared values. The impact is measured by means of 3 criteria: disruption to everyday life; violation of the local and regional democratic system; and social psychological impact (public rage and anxiety).
6. *Safety of cultural heritage*, defined as the disruption of the continued existence of the physical remains of the past that are valued by society because of collective memories, national identity, scientific research and/or education of future generations. The value of cultural heritage is explicitly separated from the commercial value. The value instead is measured in terms of uniqueness, loss of national identity, limited possibilities for restoration and importance as source for science and education.

So, in the Dutch guideline for regional risk assessment these six kinds of impacts are measured by in total 10 different criteria, based upon the method of the Dutch National Safety and Security

Strategy, as shown in table 3. The colours in this table correspond to the impact components in the event tree analysis of the capability assessment (separate report).

*Table 3. The 10 impact criteria of the Dutch national Guideline for Regional Risk Assessment*

| **Vital interest** | **Criteria** |
|---|---|
| 1. Territorial security | 1.1 Infringement of the territorial integrity |
| 2. Physical safety (public health) | 2.1 Number of fatalities<br>2.2 Number of seriously injured and chronically ill<br>2.3 Physical suffering (lack of basic necessities of life) |
| 3. Economic safety | 3.1 Financial costs |
| 4. Ecological safety | 4.1 Long-term damage to the ecosystem |
| 5. Social and political stability | 5.1 Disruption of everyday life<br>5.2 Violation of the democratic system and rule of law<br>5.3 Social psychological impact: public outrage and anxiety |
| 6. Safety of cultural heritage | 6.1 Damage to cultural heritage |

For each criterion the impact is expressed in an ordinal scale: A to E (A being limited impact and E being catastrophic impact). The total of the 10 criteria delivers an overall impact score of A to E. Also for the determination of the probability this division into five categories is used. Category A represents an incident scenario which is deemed very unlikely, while E represents a very likely scenario. If possible the probability is calculated quantitatively (% chance of occurrence in the next 4 years), if not it is estimated by the experts qualitatively.

As said before, this risk analysis method is used in The Netherlands for the prioritization between different risks (all hazard). The outcome for the region South-Holland South has been depicted in figure 1 on page 12. However, in this case the same method is also used on the 'single risk' of transport of dangerous substances. In fact, because there are so many different potential scenarios with dangerous substances, it can be argued that it is not a single risk. Moreover, the all hazard methodology with 10 different impact criteria really helps to provide insight in the differences in probability and impact (and the different kinds of impacts) for the variety of scenarios within the broader risk of dangerous substances transport. In other words, the method helps to answer research questions about the prioritization of risks (as a starting point for the focus of mitigation policies):

- Which scenario types have the highest probability?
- Which scenario types have the highest (accumulated) impact?
- Which scenario types have the highest overall risk?
- Which impacts are biggest?

## 4.3 Scenarios

Based upon the 6 substance categories and their example substances (see paragraph 3.4) several primary scenarios have been selected. In the table beneath the scenarios are presented, along with the assumptions for the calculation of effects.

| Substance category | Selected substance | Scenarios | Specific assumptions |
|---|---|---|---|
| **A. Flammable gas** | LPG | Instantaneous Boiling Liquid Expanding Vapor Explosion (BLEVE) after a puncture or rupture of a wagon | Pressure in vessel 25 bar<br>Temperature in vessel 10 degrees<br>Outside temperature 10 degrees<br>Humidity 80%<br>Exposure of people to heat radiation for 16 seconds |
| | | A delayed BLEVE caused by heat radiation of a pool fire (a so-called 'hot' BLEVE) | |
| **B2. Toxic gas** | Ammoniac (under pressure) | Instantaneous breech of a whole wagon with gas under pressure | *See standard assumptions* |
| | | High pressure release of gas through a large puncture | 75 kg/second |
| | | High pressure release of gas through a smaller puncture | 10 kg/second |
| **B3. Very toxic gas** | *This scenario has not been taken into account, because at this moment there is no transport within this category, except for very occasional single transports of chloride. For 2020 there is 'room' for transport, but up to now there is now indication of expected transport, because transport of chloride is mitigated for the whole country by combining the production and use in one chemical plant. The same choice has been made in the Scenario book External Safety of Amsterdam-Amstelland (2011).* | | |
| **C3. Flammable liquid** | Petrol | A large spillage of petrol followed by an ignition leading to a so-called 'pool fire' | 750 $m^2$ surface of spilled liquid |
| **D3. Toxic liquid** | *This scenario (example substance acrylonitrile) has not been taken into account, because the volume of transport of very toxic liquids (D4) is relatively close to that of toxic liquids (D3). In this case when the probabilities are more or less comparable it is customary to take into account the scenario with the higher impact, so D4. The same choice has been made in the Scenario book External Safety of Amsterdam-Amstelland (2011).* | | |
| **D4.Very toxic liquid** | Hydrogene fluoride (HF) | A large spillage of HF through a puncture, resulting in an | 89 $m^3$ spilled in 10 minutes |

|  |  |  |  |
|---|---|---|---|
|  |  | evaporating pool |  |
|  |  | A smaller spillage of HF through a puncture, resulting in an evaporating pool | 7,5 mm hole |

*Standard assumptions (unless otherwise)*

|  |  |
|---|---|
| **Wagon volume LPG** | 48.000 kilo |
| **Wagon volume toxic** | 89 $m^3$ |
| **Average annual temperature** | 15 degrees Centigrade |
| **Atmospheric pressure** | 101.325 $N/m^2$ |
| **Relative humidity** | 77% |
| **Annual average wind speed** | 3 meters per second |
| **Weather type** | D5 |
| **Averaging time** | 600 seconds |

Furthermore the following 3 miscellaneous scenarios have been selected:

| **Miscellaneous scenarios** |
|---|
| Ecological scenario of spillage of petrol into the water surface |
| Scenario of a small emission of a dangerous substance (less than 100kg) with no direct health threat, but leading to societal impact like social unrest and disruption of daily life. |
| Scenario of an accident with a cargo train with dangerous substances, with no emission at all, but still leading to societal impact like social unrest and disruption of daily life. |

Domino scenarios have not been taken into account. Because of the limited time of the PRISMA project (meant to test and demonstrate the methodology, not to be 100% complete), this was not possible. As a first example the effects have been calculated of a combination scenario of a pool fire (petrol) with a toxic liquid (acrylonitrile), based upon 89 $m^3$ outflow, but because of the limited time this scenario could not been taken into account in the further risk analysis. The choice to specifically leave out domino scenarios was made, because on the one hand their analysis is very time intensive and requires a lot of specific information and expertise and on the other hand the probability of domino scenarios is a fraction of the 'primary scenarios'. However, a specific analysis of domino scenarios, especially on Kijfhoek shunting yard and also with respect to nearby SEVESO companies and other locations with dangerous substances (see map 6, page 24), is advisable for the future. It is noteworthy that up to now the EU SEVESO directive requires domino analysis internally and with respect to other adjacent SEVESO companies, but not with respect to nearby transport axes. From the perspective of low probability (the probability of a domino is a fraction of that of the initial incident) this is understandable, but domino scenarios cannot be ruled out altogether.

Combination scenarios of a cargo train colliding with a passenger train have also not been taken into account. Again one reason has been the limited time of the PRISMA project. However, there is another problem with this. The national guideline for risk analysis of dangerous substances transport by rail (Ministry of Infrastructure and Environment) does not take this scenario into account. Further research in future is recommended, especially concerning the potential impact of an incident at Kijfhoek on passing passenger trains.

## 4.4 Probability

In the method for regional risk assessment the probability is divided into 5 main categories, with subcategories:

| **Classes of risk assessment** | | | **% probability each 5 year** | **Once every .. year** | | **10 to the power of minus..** |
|---|---|---|---|---|---|---|
| | | | | **Lower** | **Upper** | |
| **A** | Very unlikely | A-low | < 0,005 | | 100.000 | **$10^{-5}$** |
| | | A-middle | 0,005 – 0,02 | 100.000 | 25.000 | |
| | | A-high | 0,02 – 0,05 | 25.000 | 10.000 | **$10^{-4}$** |
| **B** | Unlikely | B-low | 0,05 – 0,1 | 10.000 | 5.000 | |
| | | B-middle | 0,1 – 0,25 | 5.000 | 2.000 | |
| | | B-high | 0,25 – 0,5 | 2.000 | 1.000 | **$10^{-3}$** |
| **C** | Possible | C-low | 0,5 – 1 | 1.000 | 500 | |
| | | C-middle | 1 – 2,5 | 500 | 200 | |
| | | C-high | 2,5 – 5 | 200 | 100 | **$10^{-2}$** |
| **D** | Probable | D-low | 5 – 10 | 100 | 50 | |
| | | D-middle | 10 – 25 | 50 | 20 | |
| | | D-high | 25 – 50 | 20 | 10 | **$10^{-1}$** |
| **E** | Very probable | E | 50 – 100 | 10 | 5 | |

For the probability calculations a national method has been developed by the Ministry of Infrastructure and Environment, the so-called "HART" (*manual for analysis of transport risks*). In this manual the following function is set for the probability calculations (p=probability and c=correction):

$$\mathbf{P_{wagonkilometre} = (P_{base} \times C_{speed}) + C_{switch}}$$

$P_{base} = 2.2 \times 10^{-8}$

$C_{speed}$ = 1.26 in case of speed > 40km/h and 0.62 in case of speed < 40km/h

$C_{switch} = 3.30 \times 10^{-8}$ in case a switch is present in the track

This function results in 4 base probability figures per wagon per kilometre.[7]

| | Without switch | With switch |
|---|---|---|
| **Speed < 40 km/h** | $1.36 \times 10^{-8}$ | $4.66 \times 10^{-8}$ |
| **Speed > 40 km/h** | $2.77 \times 10^{-8}$ | $6.07 \times 10^{-8}$ |

As a first step to get a grasp on the estimated probability a calculation has been made with general assumptions: 'high speed' and 'switch present' for the transport volume of 52,390 wagons estimated for the stretch Kijfhoek-Dordrecht Station in the year 2020. This is transposed to the whole 16 kilometre of ongoing railway within the municipalities of Dordrecht and Zwijndrecht. This results in the following general calculation:

$$P_{\text{all wagons/all kms}} = 6{,}072 \times 10^{-8} \text{ times } 52{,}390 \text{ wagons times } 16\text{km} = \mathbf{5{,}09 \times 10^{-2}}$$

This outcome means a probability of 5,09% each year or, in other words, **once every 20 years an incident**. This is the probability of an incident with one or more dangerous substances wagons, like a derailment or collision[8]. However, this does not mean there is an actual emission of a dangerous substance. It is merely the base probability of an incident involving a wagon with dangerous substances. For the calculation of the probability of an incident with an actual emission and the consecutive scenario (like a BLEVE, fire or toxic fume) several sub fractions are distinguished. With the general assumptions for the base probability and the transport volumes, this results in the following calculations.

| Substance category | Probability of an incident resulting in an emission | % of the total transport | % of total incidents leading to an emission |
|---|---|---|---|
| **A. Flammable gas** | 0.28% | 31.6% | 0.09% |
| **B2. Toxic gas** | 0.28% | 9.1% | 0.03% |
| **B3. Very toxic gas** | 0.28% | 0.1% | 0.0003% |
| **C3. Flammable liquid** | 56% | 42.4% | 23.75% |
| **D3. Toxic liquid** | 5.6% | 13.0% | 0.73% |
| **D4.Very toxic liquid** | 5.6% | 3.8% | 0.21% |
| | | | **24.8%** |

This means there is a 24.8% probability that an incident (like a derailment or collision) results in the emission of a dangerous substance. In other words, one out of four incidents leads to an

---

[7] The national probability calculations model of HART suggests a level of certainty which cannot be guaranteed. The validity of the assumptions behind these figures could not be found. There is no European uniform methodology for probability calculations.

[8] Not taking into account the probability of sabotage or terrorism.

emission, so if there is an incident once every 20 years, there is **an emission once every 80 years** (79 years to be more precise). Furthermore it can be deduced that there is a 96% probability it will be an emission of a flammable liquid (like petrol).

The HART method also enables the calculation of probabilities for each of the substance categories. The first "rough" calculation – with basic assumptions about the railway layout and using the transport volumes of the track between Kijfhoek and Dordrecht Station – provided enough insight to make a first risk diagram for the different scenarios, as a basis for the prioritization and the capability assessment. However, in second instance the calculations were performed more precise, using the specific railway layouts and transport volumes for each part of the railway and calculating the probability of each sub-scenario in an excel file. See annex I for the calculations for all subparts of the railway track.

*Totals of the probability calculation*[9]

| | **TOTAL Region ZHZ** | | | **TOTAL Region ZHZ without Betuwe line** | | |
|---|---|---|---|---|---|---|
| **Substance category** | Probability per year | Probability once every .. years[10] | Probability class | Probability per year | Probability once every .. years | Probability class |
| A. Flammable gasses | $2.30 \times 10^{-4}$ | 4,339 | B-middle | $4.81 \times 10^{-5}$ | 20,796 | A-high |
| B2. Toxic gasses | $3.77 \times 10^{-5}$ | 26,553 | A-middle | $1.53 \times 10^{-5}$ | 65,317 | A-middle |
| B3. Very toxic gasses | $5.67 \times 10^{-7}$ | 1,762,173 | A-low | $4.45 \times 10^{-8}$ | 22,449,616 | A-low |
| C3. Flammable liquids | $3.37 \times 10^{-2}$ | 30 | D-middle | $5.68 \times 10^{-3}$ | 176 | C-high |
| D3. Toxic liquids | $2.97 \times 10^{-4}$ | 3,368 | B-middle | $1.37 \times 10^{-4}$ | 7,303 | B-low |
| D4. Very toxic liquids | $1.36 \times 10^{-4}$ | 7,356 | B-low | $3.77 \times 10^{-5}$ | 26,557 | A-middle |
| **Total incidents with significant release** | **$3.44 \times 10^{-2}$** | **29** | **D-middle** | **$5.92 \times 10^{-3}$** | **169** | **C-high** |
| Small scenarios (<100kg) | $7.29 \times 10^{-2}$ | 14 | D-high | $1.24 \times 10^{-2}$ | 81 | D-low |
| **Total incidents with release** | **$1.07 \times 10^{-1}$** | **9** | **E** | **$1.83 \times 10^{-2}$** | **55** | **D-low** |
| Incidents without release | $1.93 \times 10^{-1}$ | 5 | E | $4.38 \times 10^{-2}$ | 23 | D-middle |
| **Total all incidents** | **$3.00 \times 10^{-1}$** | **3** | **E** | **$6.21 \times 10^{-2}$** | **16** | **D-high** |

This more detailed calculations affirm the conclusions of the initial more rough probability analysis, although the final figures indicate a slightly higher probability: the total of incidents for

---

[9] All calculations are only for the ongoing railway tracks, so without the probability of Kijfhoek shunting yard.

[10] The figures for the "probability per year" can be added to a resulting total probability. All figures can also be expressed as a "probability once every … years". However these figures cannot be added because they are a fraction (1/x).

the railway in Dordrecht and Zwijndrecht (without the Betuwe route) is calculated at once every 16 years (instead of initially 20) and the total of incidents with emission of dangerous substances is calculated at once every 55 years (instead of initially 79).

During the capability assessment it was concluded that it is also important to know the probability of sets of scenarios which might be mitigated by the same kind of measures or the same strategy, because the probability has direct consequences for the outcome of the Cost-Benefit Analysis on potential measures. These sets of scenarios are related to the primary effects they cause.

| | **TOTAL Region ZHZ** | | | **TOTAL Region ZHZ without Betuwe line** | | |
|---|---|---|---|---|---|---|
| **Scenario** | Probability per year | Probability once every .. years | Probability class | Probability per year | Probability once every .. years | Probability class |
| Scenarios for which windows and airco have to be closed (all scenarios with release) | 1.07 x $10^{-1}$ | 9 | E | 1.83 x $10^{-2}$ | 55 | D-low |
| Scenarios with overpressure (BLEVE, explosion) | 1.08 x $10^{-4}$ | 9,288 | B-low | 2.25 x $10^{-5}$ | 44,516 | A-middle |
| Scenarios with fire and heat | 2.46 x $10^{-2}$ | 41 | D-middle | 4.23 x $10^{-3}$ | 236 | C-middle |

This means for example that if you want to take measures against fire and heat risk alongside the whole railway track in Dordrecht and Zwijndrecht, the investment has to be “earned back” by the prevention of an incident once every 236 years. On the other hand, measures to close air-conditioning statistically are expected to be useful every 9 years (that is: it is not known at which exact location this incident once every 9 years might occur).

Finally, the probability calculations can also be specified to specific locations along the route. This is particularly useful for incidents with a potential impact on ecology, in other words, toxic liquids being spilled into the water.

| **Scenarios with toxic and flammable liquid release into water (>100kg)** | Probability per year | Probability once every .. years | Probability class |
|---|---|---|---|
| On Dordrecht bridge | 2.75 x $10^{-4}$ | 3,637 | B-middle |
| On Moerdijk bridge | 2.50 x $10^{-4}$ | 3,996 | B-middle |

| | | | |
|---|---|---|---|
| Into canals alongside the whole track[11] | 8.54 x 10$^{-3}$ | 117 | C-high |
| **Total** | 9.07 x 10$^{-3}$ | **110** | **C-high** |

## 4.5 Impact

The impact of the selected scenarios is analysed on the 10 criteria set in the Dutch national guideline for regional risk assessment. The be able to score these criteria, as a first step the magnitude of the scenarios had to be calculated. What are the primary effects? To what distance can they travel? The calculations for the effects of the selected scenarios (see paragraph 4.3) have first been made using the EFFECTS software. The calculations have been performed on 3 different “roughness lengths”: field, suburb and central business district. This was done to see the significance of potential different outcomes. Using the EFFECTS software, the effect distances were calculated for the following reference values (in the open air/outside):

| |
|---|
| 100% lethality |
| 70% lethality |
| 20% lethality |
| 1% lethality (Life Threatening Value or LBW) |
| 3 times Alarm Threshold Value (3AGW)[12] |
| Alarm Threshold Value (AGW) [13] |
| Information Orientation Value (VRW)[14] |

All the outcomes of EFFECTS have been compared to:

- the distances as calculated by TNO in 2004[15];
- the distances as calculated for the societal risk advice on the Leerpark site[16];
- the distances provided in the scenario book external safety[17] of the safety region Amsterdam-Amstelland c.s., which is based upon casualty calculations of annex 3 of the

---

[11] The probability of a liquid (C3, D3 and D4) spilling into a water body alongside the railway track is roughly estimated at 25% (taking into account that the canals are not alongside the whole track).

[12] This value of 3AGW is selected in conformity with RIVM report 609035001/2007, M.J.M. van Raaij et al, *Een werkwijze voor slachtofferberekeningen voor incidenten met toxische stoffen; verkenning voor gebruik in de preventieve fase*.

[13] This is the concentration of a substance for which people should be warned to go indoors.

[14] This is the concentration of a substance for which people have the informed, because they can smell it or can be affected.

[15] *Assessment framework external safety Spoorzone Dordrech/Zwijndrecht*.

[16] *Advice pre-design zoning 2nd review Leerpark*, page 9.

[17] *Scenarioboek externe veiligheid*.

guideline responsible prevention advice by the fire brigade[18] for implementation of the Decree for External Safety;

- the distances as provided in the damage scenario book[19];
- the remarks in the exploration of the application and uniformation of effect calculation models.[20]

This has revealed an encouraging level of similarities in the calculated effect distances. However, there are also differences due to different assumptions and different software. After comparing the different outcomes the most representative values (and in some cases averages) were selected as a basis for the further risk assessment (see the following tables). The indication of zones (red, orange etc.) is based upon the same method as the scenario book external safety and presents both damages and casualties.

**!**

*Warning about the interpretation of effect distances*

*The reader must be aware the process of the PRISMA project was not meant to achieve full-proof scientific evidence of the exact effect distances, but merely as a test of how the assessment process works and what insights you can get from them. For this a deviation of several (tens of) meters more or less is irrelevant. The aim was to obtain effect distances which are 'realistic enough' to be able to perform further research into potential mitigation measures. This means that the presented effect distances have to be interpreted carefully. They should not be regarded as beyond doubt. Depending on assumptions and the used software, other outcomes might be generated. Moreover it is important to realize that calculated effect distances are no guarantee that effects will certainly reach a certain distance, nor that it is safe beyond a specific point. Calculations are made with mathematical assumptions in software trying to model the real world. Each scenario in real-life can be different. The scenarios presented are 'credible worst case scenarios', meaning in most actual cases the effects should be smaller, but at the same time bigger effects are not completely ruled out. This is especially the case for scenarios with toxic substances, because they are based upon the nationally set 'example substances', whilst other substances in that same category might behave differently. In any case the actual weather conditions (mainly wind direction and force) can greatly influence the magnitude of these scenarios.*

---

[18] *Handreiking verantwoorde brandweeradvisering.*

[19] *Schadescenarioboek*.

[20] *Verkenning van de toepassing en mogelijke uniformering van effectberekeningsmodellen.*

| **BLEVE (LPG)** | | | |
|---|---|---|---|
| Dark red zone | < 160m | Irreparable damage and fires | 100% lethality people in open air |
| Red zone | < 250m | Heavy damage and secondary fires | 20% lethality people in open air |
| Orange zone | < 360m | Medium damage and occasional secondary fires | 2% lethality people in open air |
| Yellow zone | < 600m | Light damage | 0% lethality people in open air |

| **Pool fire (petrol)** | | | |
|---|---|---|---|
| Dark red zone | < 40 m | Irreparable damage and fires | 100% lethality people in open air |
| Red zone | < 50 m | Heavy damage and secondary fires | 20% lethality people in open air |
| Orange zone | < 60 m | Medium damage and occasional secondary fires | 2% lethality people in open air |
| Yellow zone | < 75 m | Light damage | 0% lethality people in open air |

| **Toxic gas (ammoniac)** | | |
|---|---|---|
| Dark red zone | < 400 m | 100% lethality people in open air |
| Red zone | < 750 m | 70% lethality people in open air |
| Orange zone | <1.000m | 20% lethality people in open air |
| Yellow zone | <2.000m | 1% lethality people in open air ('Life threatening value') |

| **Toxic liquid (hydrogen fluoride)** | | |
|---|---|---|
| Dark red zone | < 200 m | 100% lethality people in open air |
| Red zone | < 450 m | 70% lethality people in open air |
| Orange zone | < 800 m | 20% lethality people in open air |
| Yellow zone | <2.000m | 1% lethality people in open air ('Life threatening value') |

Using these effect distances a scenario analysis was made, using the Guideline for Regional Risk Assessment. The scenario analysis provided the following kinds of outcome for the 10 impact criteria.

| | |
|---|---|
| **1.1 Infringement of the territorial integrity** | Number of square kilometres not useable for a specific time because of safety limitations (toxic fumes) or because of destruction. |
| **2.1 Number of fatalities** | Calculated number of fatalities according to TNO safety study of 2004.[21] |
| **2.2 Number of seriously injured and chronically ill** | Calculated number of injured according to TNO safety study of 2004 (see last page of annex II). |
| **2.3 Physical suffering** | *Not applicable to these scenarios.* |
| **3.1 Financial costs** | The material damage (housing, infrastructure), the health damage (lost life years, health care, disability[22]), financial costs (loss of economic use) and disaster relief costs. [23] |
| **4.1 Long-term damage to the ecosystem** | This concerns the square kilometres of area which might be contaminated/polluted. It is assumed that there will be no significant impact longer than 10 years and that the affected area does not concern Natura2000 or other conservation areas, except for the 'ecological toxic' scenario. |
| **5.1 Disruption of everyday life** | This concerns the number of people affected in their daily life, the timespan and the kinds of impact. It is assumed that in most scenarios the inhabitants cannot go to school and work for a short period and that roads and railway be destroyed/obstructed. In case of the small scenarios and threat of emission the number of passengers a day using the Dordrecht railway is used (20.000). |
| **5.2 Violation of the democratic system and rule of law** | Some of the scenarios are expected to have impact on the political representatives and civil servants, because of public outrage. The other aspects, like system of justice and human rights, are not affected. |
| **5.3 Social psychological impact: public outrage and anxiety** | Because the scenarios are man-made and the risk is known and discussed for many years, a serious social psychological impact can be expected for most scenarios. This concerns i.e. the culpability of government for the risk, the uncertainty of health impacts and limited options to avoid impact during an incident (resilience). |
| **6.1 Damage to cultural heritage** | Damage to heritage might occur due to overpressure and fire, but also due to acidic effects of toxic substances on collections. Because most of the heritage is located at some distance, the expected impact is mostly limited. |

---

[21] The EFFECTS software did not provide enough basis to do new calculations of numbers of fatalities and injured. New calculations would have demanded detailed insight in the expected number of people in certain areas. This might have been possible, but due to the limited time available for the PRISMA project, it was decided to use the figures TNO calculated in 2004 for the year 2010.

[22] For the cost calculation it is assumed that one third of the seriously injured will be permanently disabled. There is no direct scientific evidence for this percentage, but the assumption for the exact number/percentage has no significant influence on the total score on impact criterion 3.1, because material costs and the costs of fatalities outweigh the costs of the disabled.

[23] The national method for risk assessment does not include specific (medium and long term) damage to the Dutch economy as a whole. For example longer obstruction to the transport and the potential resulting loss of international position are not taken into account. In the chapter risk evaluation extra attention is paid to this aspect.

The actual scenario analysis resulted in the following impact scores (see table 7). The detailed impact analysis for each scenario is presented in annex II.

*Overview of impact scores*

| | **B2. Toxic gas: ammoniac** | | | **D4. Very toxic liquid: HF** | | **A. Flammable gas: LPG** | | **C3. Flam. liquid: petrol** | **Miscellaneous scenarios** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Instantaneous release | Big outflow | Small outflow | Big outflow | Small outflow | BLEVE | Hot BLEVE[24] | Pool fire | Threat of emiss. | Spillage of eco toxic | Small emiss. |
| 1.1 Infringement of the territorial integrity | A | A | A | B | A | C | C | B | 0 | 0 | A |
| 2.1 Number of fatalities | E | E | D | E | Dhigh | E | E | Dhigh | 0 | 0 | 0 |
| 2.2 Number of seriously injured & chronically ill | Dhigh | Dhigh | D | E | E | E | E | E | 0 | 0 | A |
| 2.3 Physical suffering (basic necessities) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3.1 Financial costs | D | C | C | D | D | D | E | D | A | B | A |
| 4.1 Long-term damage to the ecosystem | A | A | A | A | A | 0 | 0 | 0 | 0 | C | 0 |
| 5.1 Disruption of everyday life | E | E | C | E | C | E | E | C | C | 0 | A |
| 5.2 Violation democr. system and rule of law | D | C | C | C | C | D | D | C | 0 | 0 | 0 |
| 5.3 Social psychological impact (outrage/anx.) | E | E | D | E | D | C | D | C | B | B | B |
| 6.1 Damage to cultural heritage | C | C | 0 | 0 | 0 | B | B | B | 0 | 0 | 0 |
| **Total impact** | **E** | **E** | **D** | **E** | **D** | **E** | **E** | **D** | **B** | **B** | **A** |

---

[24] The national government of The Netherlands has developed a national scenario for a hot BLEVE of a train wagon (2010). A significant difference between the national assessment and this regional/local assessment is the number of casualties. The national government expects only 10 to 100 fatalities and seriously injured, while the PRISMA assessment is based upon the TNO scenario (2004) for Dordrecht Station, which includes more than ten times more casualties (which also means ten times more financial health impact). Furthermore there is a difference in the relative scales of the national and regional assessment methods: even if the scenarios would be exactly the same, the regional/local impact is much higher than the impact on national safety/security.

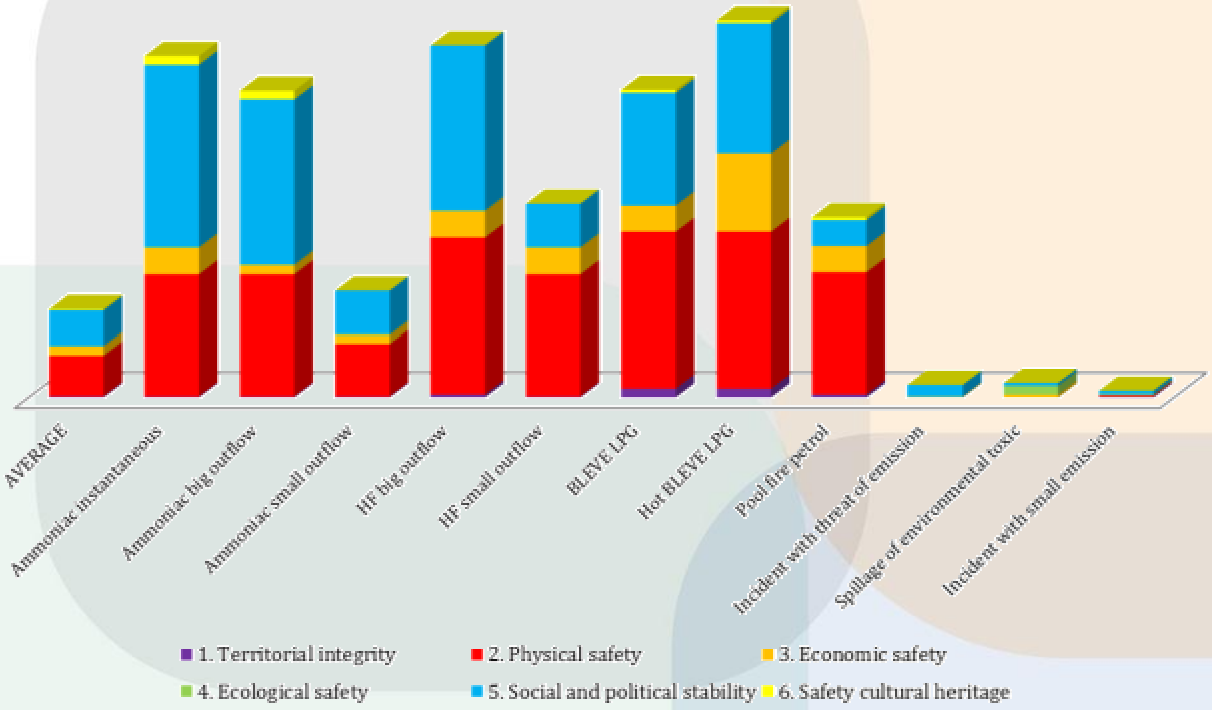
The impact analysis shows that the scenarios with toxic gasses and liquids and with flammable gas have the highest impact. However, the impact of flammable liquids is not far behind. The smaller, miscellaneous scenarios clearly have smaller impact. Of the ten impact criteria the physical impact (injured and fatalities) at average score highest, followed by social-political stability (disruption of daily life and social psychological impact) and costs. The ranking of the ten impact criteria according to average score is as follows.

**Ranking of the 10 impact criteria according to level of impact**
*based upon the average of the impact scores of all scenarios*

| | | **Average score** |
|---|---|---|
| **1.** | 2.2 Number of seriously injured and chronically ill | **D** |
| **2.** | 2.1 Number of fatalities | **D** |
| **3.** | 5.1 Disruption of everyday life | **D** |
| **4.** | 5.3 Social psychological impact: public outrage and anxiety | **D** |
| **5.** | 3.1 Financial costs | **D** |
| **6.** | 5.2 Violation of the democratic system and rule of law | **C** |
| **7.** | 1.1 Infringement of the territorial integrity | **B** |
| **8.** | 6.1 Damage to cultural heritage | **B** |
| **9.** | 4.1 Long-term damage to the ecosystem | **A** |
| **10.** | 2.3 Physical suffering (lack of basic necessities of life) | *N/A* |

These conclusions are supported by the overview of the relative contribution of the 6 vital societal interests to the total impact score (see diagram on the next page). This shows that the physical safety and social political stability contribute the most, followed by the costs/economic impact. The relative higher contribution of the first two vital interests can partly be explained by the methodology itself (they are measures by three criteria which all contribute, as opposed to just one criterion for costs), but also the previous ranking of the ten criteria shows that financial costs at average is ‘only’ the fifth highest criterion. The pool fire scenario has a significant different profile (which is important for the capability assessment): the physical impact is much more significant than the impact social and political stability.

*Contribution of the 6 vital societal interests to the total impact score*



## 4.6 Risk diagram

The following table shows the combination of probability scores and impact scores.

| | **Scenario** | | **Impact** | **Probability** (total VRZHZ without Betuwe route) |
|---|---|---|---|---|
| **Category** | **Substance** | **Incident** | | |
| A. Flammable gasses | LPG | BLEVE | E | A-high |
| | LPG | 'Hot' BLEVE | E | A-low[25] |
| B2. Toxic gasses | Ammoniac | Instantaneous breech | E | A-low[26] |
| | Ammoniac | Big outflow | E | A-low[18] |
| | Ammoniac | Small outflow | D | A-middle |
| C3. Flammable liquids | Petrol | Pool fire | D | C-high |
| D4. Very toxic liquids | HF | Big outflow | E | A-high[27] |
| | HF | Small outflow | D | B-low |
| Miscellaneous | Diverse | Threat of emission | B | D-middle |
| | Diverse | Ecological toxic | B | C-high |
| | Diverse | Small emission | A | D-low |

Using the excel calculation file of the Guideline for Regional Risk Assessment the a risk diagram was generated (seen next page). The probability analysis and impact analysis combined provide the insight that in general terms there are 3 categories of scenarios:

- *High impact-low probability scenarios*. All the serious (maximum credible) incidents have a relatively low probability, approximately between once every several thousand up to millions of years. The potential impact of these scenarios is catastrophic, meaning several hundreds to thousands killed and injured and very high costs.
- *Low impact-high probability scenarios*. These are the scenarios smaller than 100kg release and with 'just' the threat of a release after a derailment or collision, as well as the ecological toxic scenarios. These have significantly smaller impact on physical and economic safety, mostly impacting on the social and political stability (outrage and anxiety and the consequent impact on the democratic system). However, the probability is significantly higher, up to once 20 to 80 years, so once or more in a lifetime.

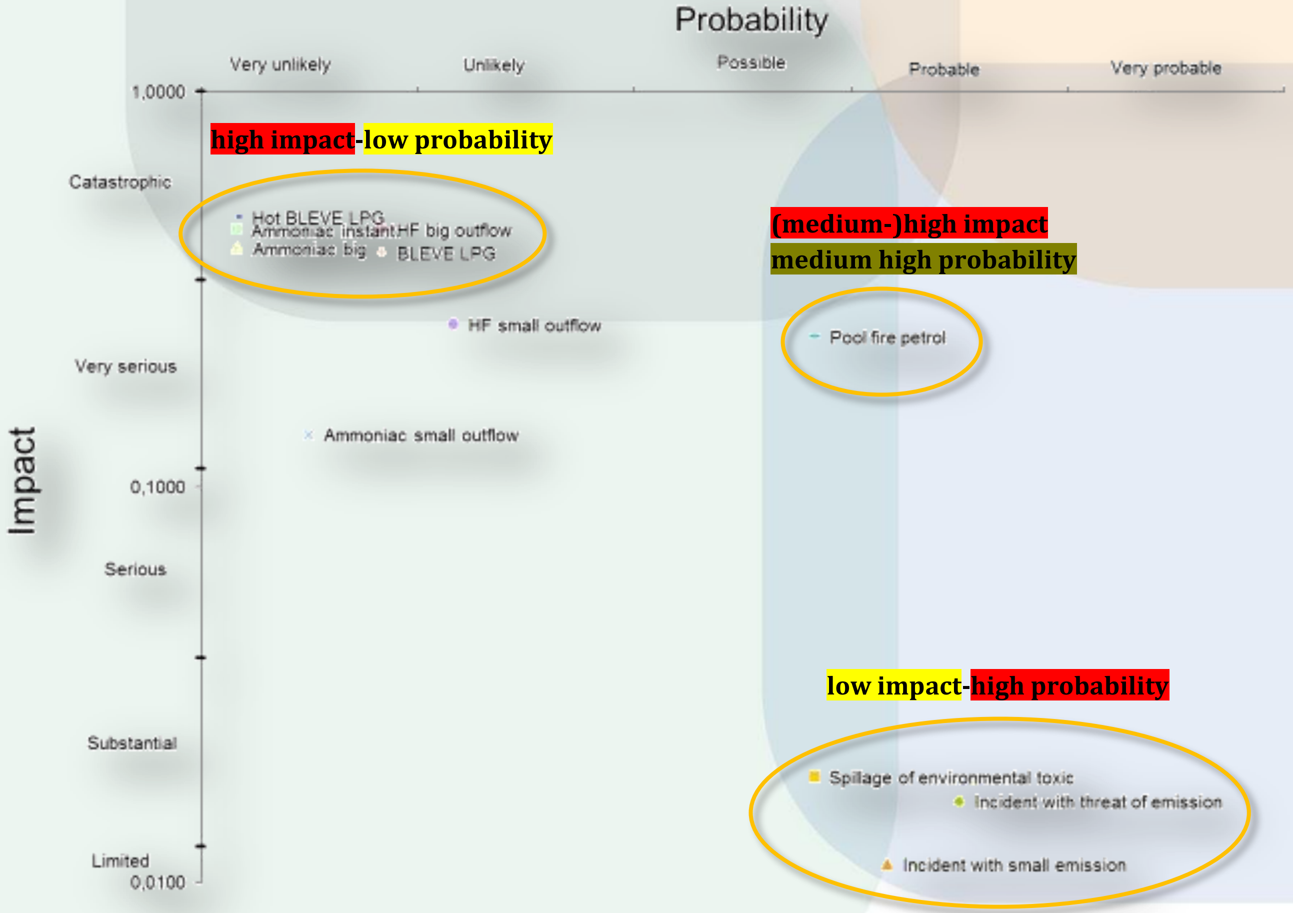
---

[25] The probability of a hot BLEVE is estimated at the lowest possible level, because of the national measure to separate flammable gasses and flammable liquids in the same train.

[26] The total probability of all scenarios within substance category B2 is calculated 1.53 x $10^{-5}$ or A-middle. It is assumed that the smaller scenarios (small outflow of ammoniac, but bigger than 100kg) are the most substantial part of this probability and the bigger scenarios (instantaneous release and big outflow) score one probability class lower, meaning the lowest probability class (A-low).

[27] For HF the same assumption is made as for ammoniac (see previous note), so the probability class of the bigger scenario is estimated at one class less than the total probability as calculated according to the guideline HART.

- *Medium-high impact and medium-high probability*. This concerns only the flammable liquid scenarios (i.e. pool fire). These have a higher probability than the other substance categories, both due to the large transport volume and the higher inherent probability of failure (rupture, puncture) in case of a derailment or collision (56% as opposed to 0,28% in case of flammable and toxic gasses).[28] At the same time the potential impact is significant ('serious impact'), although smaller than in case of a BLEVE or toxic scenarios. Although the risk assessment method specifically states that impact and probability should not be multiplied to one aggregated score – and should be considered as separate factors contribution to the (political) prioritization – the risk diagram directly seems to support the choice of the national government to declare prevention of pool fires a specific priority. In the chapter risk evaluation further recommendations for the prioritization are given.



---

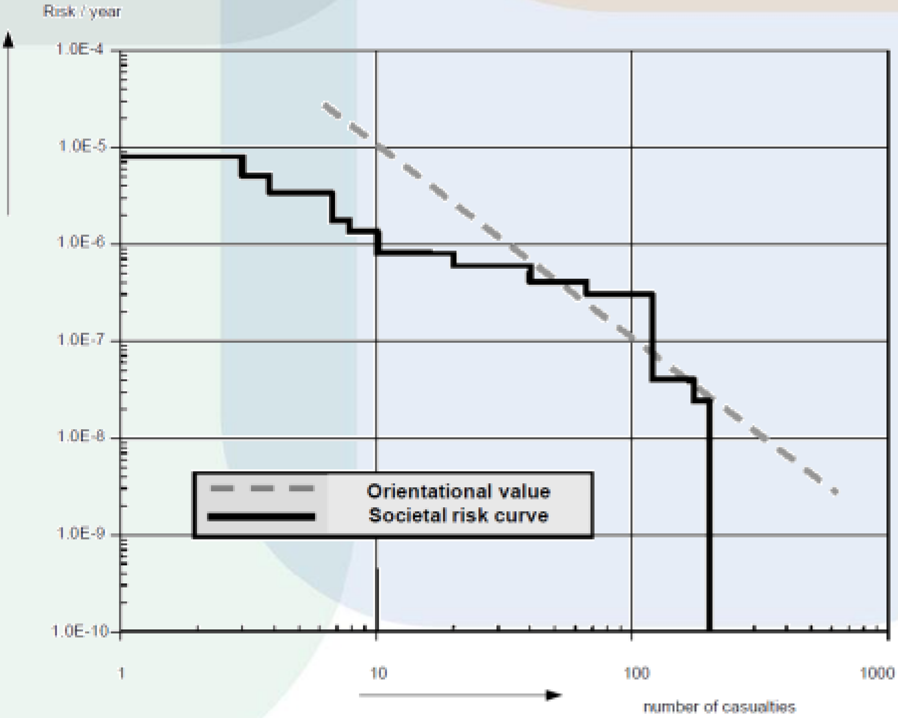
[28] *Handleiding Risicoanalyse Transport – HART* (Guideline Risk assessment transport), p.55.

# B Single hazard approach

## 4.7 Societal risk

In The Netherlands the (single hazard) risk analysis for external safety of industries and transport of dangerous substances is regulated by Law and Decree. Municipalities and provinces are required to calculate the so-called “localised risk” and “societal risk” and ask for advice by the fire services on mitigation and prevention policies. The localised risk is defined as the probability that a person, which is present continuously and unprotected, will die as a direct consequence of an occurrence involving a hazardous substance. By Law the localised risk may not exceed once every million years ($10^{-6}$). The localised risk is presented as a “hard distance” at which people may not live (or work) permanently, indicating a safety zone from the industry or transport axis in which it is not allowed to build. The societal risk is defined as the cumulative annual probability that at least 10, 100 or 1000 persons will die as a direct consequence of their presence within the area of influence of an installation or transport axis due to an unusual occurrence involving a hazardous substance.[29] The societal risk is expressed as a curve, the so-called fN curve (frequency-numbers) with the number of persons on the x-axis (10, 100, 1,000 and 10,000) and the probability of simultaneous death due to an incident on the y-axis (see figure). In fact this fN curve can be regarded as a *risk diagram*, which differs in two ways from the risk diagram used for the regional risk assessment:

- the x- and y-axis are the other way around, because for the regional risk assessment the x-axis indicates probability (opposed to impact i.e. number of fatalities) and the y-axis denotes impact (opposed to probability).
- the societal risk only takes into account fatalities and not all the other kinds of impact, like wounded, costs, ecology etc.



For the societal risk the legislator has consciously adopted a non-normative approach, only

---

[29] Decree on External Safety of Installations, 2004.

providing a holdfast in the form of the so-called “orientational value”. This orientational value is expressed in the fN curve as a straight line: $10^{-5}$ for 10 persons, $10^{-7}$ for 100 and $10^{-9}$ for 1,000. Any exceeding of the orientational value and even any substantial growth of the fN curve below the orientational value should be “justified” by the responsible government (municipalities and provinces), meaning they are publicly accountable for their decision to accept the societal risk under the condition of specific measures. The fire services provide advices on how to lower the societal risk, by means of prevention and preparation.

For the “base net transport of dangerous substances” the societal risk has been calculated nationally. The figure below shows that the Dordrecht-Zwijndrecht area has the highest societal risk in this part of the country (in fact in the whole country): 11 times above the orientational value in the year 2008.[30]

The localised risk for the railway zone Dordrecht-Zwijndrecht has been calculated on several occasions, leading to for example specific measures for the rebuilding of the Thureborgh elderly home. In example: for the development of the so-called Leerpark area next to the Dordrecht curve (the largest bottleneck in the country), the absolute safety distance of the localised risk ($10^{-6}$) has been calculated at 25 metres for 2008 and 99 metres for the forecasted transport in 2020.[31] Also the societal risk has been calculated for the separate “kilometre sections” of the railway zone. The societal risk for the Leerpark area has originally been calculated at 43 times higher than the orientational value in the year 2008, growing to an (at time) expected 61 times higher in the year 2020.[32] The fN curve for the Leerpark area is presented in the figure below. This shows the significant elevation of the curve above the orientational value in the original calculations of 2008.

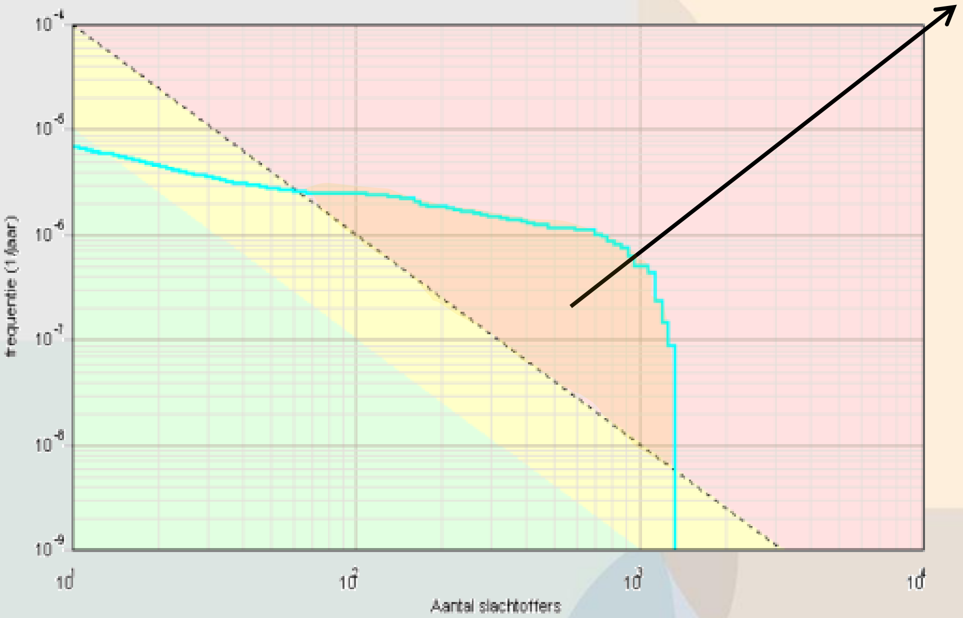
---

[30] *Base net transport of dangerous substances*.

[31] *Analysis external safety Leerpark*, page 9.

[32] *Advice pre-design zoning 2nd review Leerpark*, page 10 and *Analysis external safety Leerpark*, page 11.

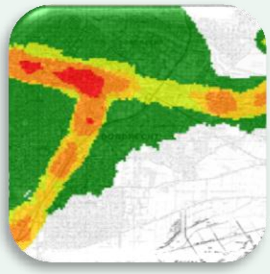
*fN curve for the Leerpark area as calculated in 2008*



Exceeding of orientational value

In 2013 the municipality of Dordrecht has presented a new spatial plan for the Leerpark area. Using the new Law on the Basenet rail transport (enacted in 2012) a new societal risk calculation was made, taking into account the changes made in the spatial plan after the previous calculations. The new situation generated 'only' an exceeding of the orientational value of 5.3 times, showing the added value of risk analysis.[33]

In 2007 the railway zone Dordrecht-Zwijndrecht has been a test case for an attempt to map the societal risk. This resulted in several experimental maps showing the height of the societal risk for respective areas and the relative contribution of specific areas to the calculation of the societal risk. The following figures show three different ways to project the overall societal risk based upon the figure for the year 2020.[34]

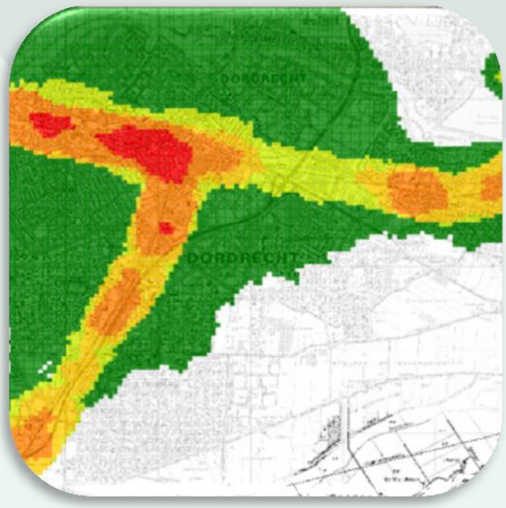


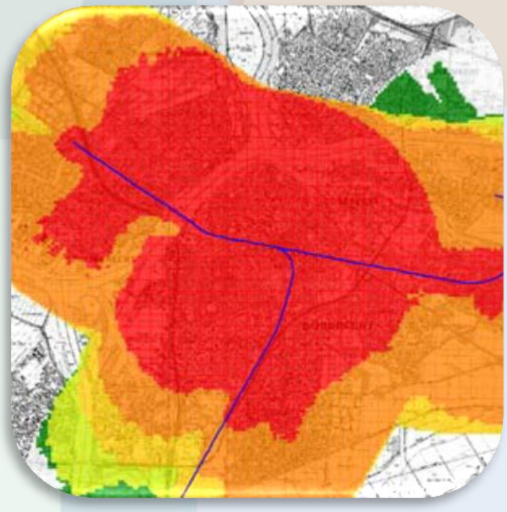
---

[33] *Gewijzigd vaststellen bestemmingsplan 2e Herziening Leerpark* (changed enactment of 2nd revision spatial plan Leerpark), letter from the Mayor to the city council, April 22nd 2014.

[34] *The societal risk mapped*, page 58.

The figures show clearly that the area around the Dordrecht Station and the Dordrecht curve have the highest societal risk. However, in the same experimental mapping study an attempt was made to gain more insight in the relative contribution of the different substance categories to the total societal risk. Using the experimental mapping at first it was concluded that the flammable gasses (like LPG) have to largest contribution to the societal risk. However, after taking into account the full population, instead of just the population in the first 500 metres, it was concluded that the influence of toxic liquids is much larger than estimated in the first approach. At a distance of 350 metre the influence of the flammable gasses is significantly lower, whilst the influence of the toxic liquids and gasses remains the same (and therefore relatively larger). Even at 1350 meter the toxic liquids still have a large influence.[35] This is easily explained by the effect distances: a BLEVE scenario has much smaller effect distances than the toxic scenarios. Main conclusion was that the normal approach of taking into account the population up to 500 metres, is not valid in case there is a substantial transport volume of toxic substances, because those have a significant larger area of influence. The whole population should be considered in the calculations, although by Law beyond 200 metres in principle no spatial limitations have to be made. The difference is best illustrated by the comparison of the mapped societal risk on the basis of the limited population (up to 500 meter) and the whole population (see figures).[36]





It is very striking that the prescribed methodology has such a different outcome if the scope of the analysis is widened. Instead of a focus on preventive measures for BLEVE scenarios around the station area, the second maps indicates a focus on preventive measures for toxic scenarios in the whole city.

---

[35] Ditto, page 65.
[36] Ditto, page 64.

## C. Mapping approach: probabilities, effect zones and vulnerabilities

The third and final approach used to analyse the transport risk is that of “mapping” in order to obtain concrete insight in the spatial distribution of probabilities, effects and vulnerabilities, to be able to prioritize risk areas and spatial planning measures. This method concerns the full width of the risk definition, so also vulnerability. The main research question – which areas should have priority? – can be divided into three sub questions:

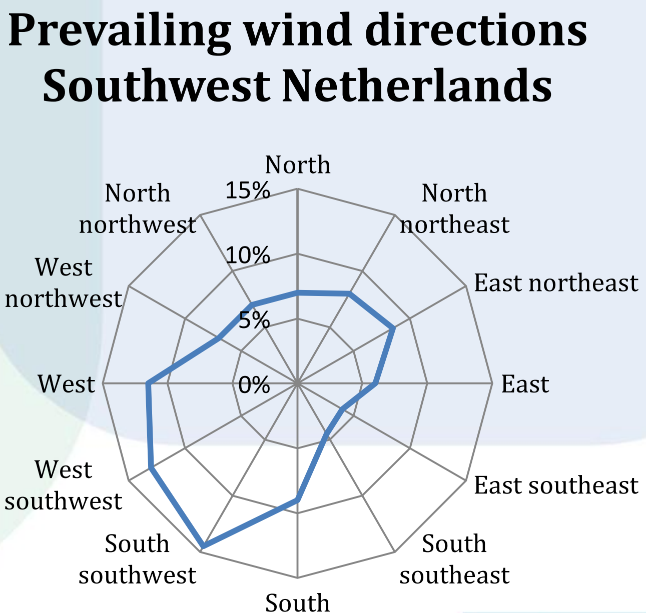
- at what places is the probability highest?
- at what places are the effects the biggest?
- at what places is the vulnerability highest?

## 4.8 Spatial distribution of probability

To gain insight in the spatial components of the risk (as a basis for mitigation), the probability can be specified to spatial dimensions up to a certain point. First of all the inherent probability of incidents on specific parts of the transport routes has been calculated (see paragraph 4.4 and annex I). On the map the calculated probabilities are projected. Although not in the national methodology for probability calculations, specific higher probability points can be identified:

- Dordrecht Station, because of the many tracks and switches with corresponding signs and the crossing of passenger trains and goods trains;
- the Dordrecht curve, because it is one of the sharpest curves in Europe meaning an inherent higher probability of derailment in case of too high a speed, whilst at the same time trains coming from Kijfhoek and Rotterdam towards the curve have to speed up to clear the Dordrecht bridge;
- Kijfhoek shunting yard, because of the large amounts of wagons and because of the inherent risks of shunting.

Another specification of the spatial distribution of probability concerns the effects. More specifically the probability of toxic fumes (from a toxic gas or toxic liquid release, but also the toxic fumes of flammable liquids) travelling downwind to a specific direction. The second probability map shows the percentage of the time during which a specific zone is downwind of the railway tracks (only the ongoing railway, so with exception of the Kijfhoek shunting yard). This is based upon the percentages for prevailing wind directions (see figure) and a

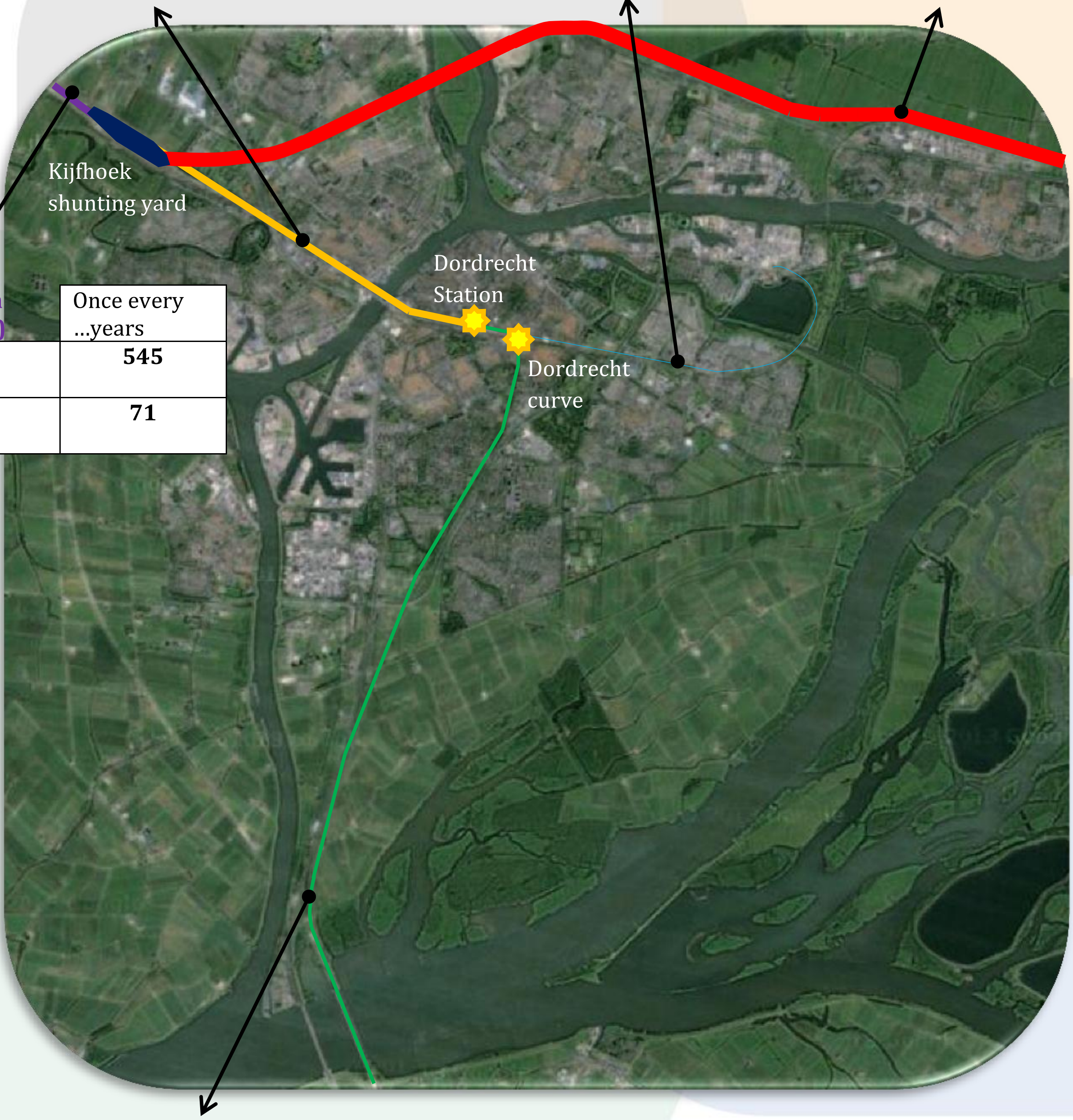


*Probability of incidents on different transport routes*

| **Kijfhoek to Dordrecht Station** | Once every ...years |
|---|---|
| Incident with release >100kg | **718** |
| All incidents | **62** |

| **Dordrecht Station to SEVESO** | Once every ...years |
|---|---|
| Incident with release >100kg | **6.765** |
| All incidents | **975** |

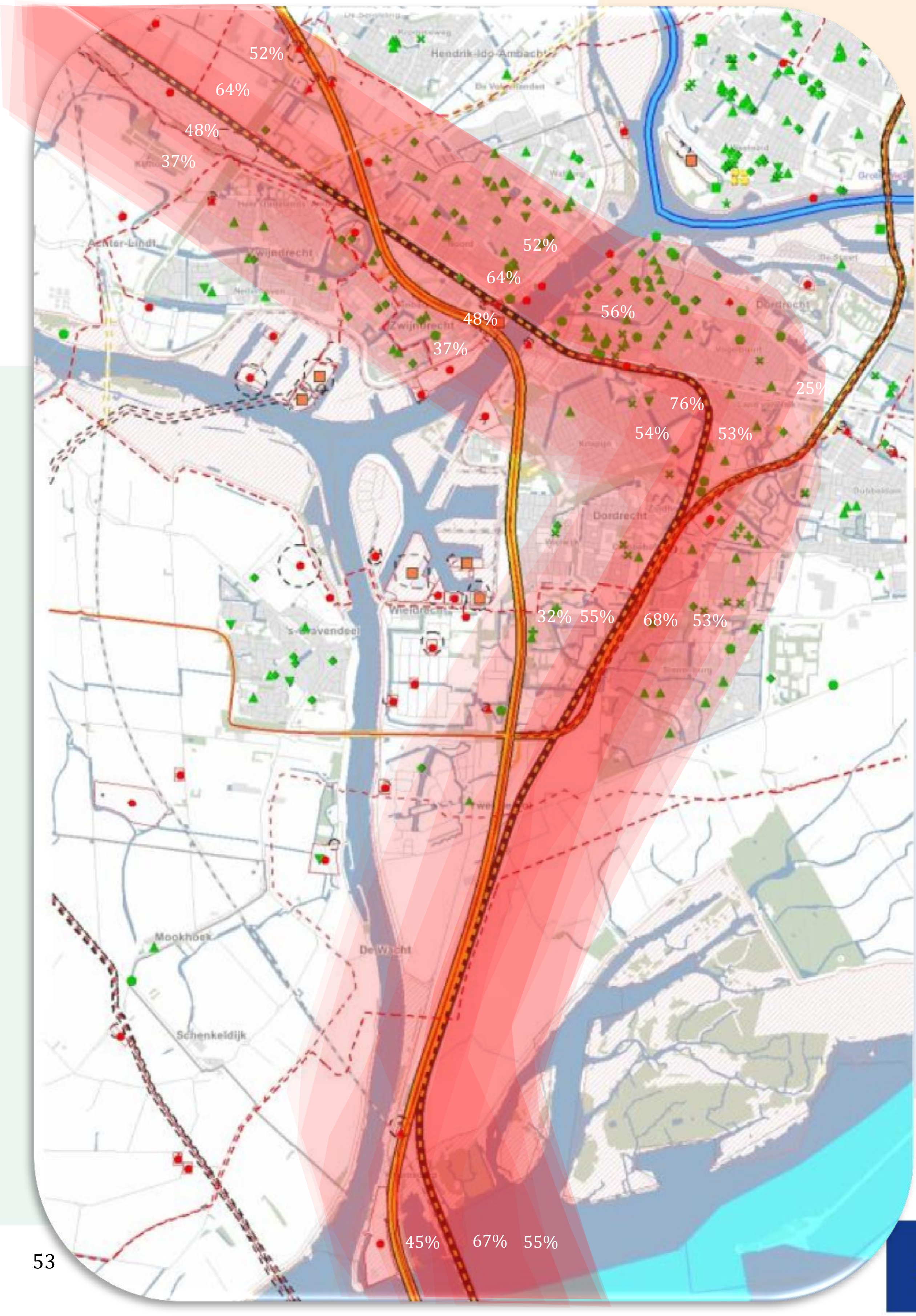
| **Betuwe route** | Once every ...years |
|---|---|
| Incident with release >100kg | **35** |
| All incidents | **4** |



| **Kijfhoek North (to Rotterdam)** | Once every ...years |
|---|---|
| Incident with release >100kg | **545** |
| All incidents | **71** |

| **Dordrecht Station to Moerdijk bridge** | Once every ...years |
|---|---|
| Incident with release >100kg | **394** |
| All incidents | **32** |

*Distribution of probability of toxic scenario effects*



standardized toxic scenario with effects up to 2 kilometres in a 45 degree spreading angle. The map does not take into account the difference in severity of the effect within the 2 kilometre zone (this is projected on the effect maps). This probability map only displays the variety in expected probabilities for the effects of toxic scenarios being blown by the wind to a specific side of the railway. This applies to the dispersion of toxic gas, vapor of toxic liquid (including toxic flammable liquids like petrol) and smoke and ash of chemical fires. However, the outside perimeter is limited to the 2 kilometre zone connected to the 1% lethality for the ammoniac and hydrogen fluoride scenarios.

Naturally, the dispersion of smoke (as of toxic fumes) reaches much bigger distances, but this map is meant only for the relation with spatial planning. This map is not applicable to explosions (BLEVE), because these have simultaneous effects on both sides, for which the influence of the wind direction is limited. Another limitation to this model is that an instantaneous release of compressed toxic gas (like ammoniac) at first travels equally to both sides and only after the complete dispersion will travel downwind.

The map consists of 14 overlays (one for each wind direction), for which the intensity of the red colour corresponds with the percentage (of time for this wind direction). The accumulation of the 14 overlays shows that on the straight parts of the railway the probability is higher on the north side (on the west-east track) and the east side (on the north-south track), because the winds in this part of The Netherlands are prevailing from the directions west to south (mainly south-southwest). However, in the area around the sharp “railway curve” the probability is highest at the inside of the corner, because this is surrounded by the railway tracks (within 2 km) on 12 of the 14 wind directions (although with exception of the prevailing directions west-southwest and south-southwest).

In the direct vicinity of the railway the percentages vary between 45% and 48% (west of the railway near the Moerdijk bridge and south of the railway in Zwijndrecht) up to 64% and 68% (north and east of the railway). This means the probability on the north and east side is at average relatively 40% higher than on the other side.[37] However, the highest accumulation is in the inside corner: 76% of the time this area is downwind of the railway tracks.

Nota bene: the percentages on both sides of the railway cannot be added up to 100%, because several wind directions affect both sides. This is the case for the wind directions more or less parallel with the railway and also for areas near the railway bend where the wind from an incident at one place also passes the tracks at the other side of the corner. The percentage does not indicate the probability of the wind blowing in the different directions for a specific incident on a specific location, but the probability for an area being downwind (within 2 kilometre) of any part of the railway track (so different incidents on different locations). The map is drawn

---

[37] 40%, not 40 percentage points.

from the perspective of the 'vulnerabilities', rather than from the 'risk source', because of the desired connection with spatial planning.

The previous remark also means that the second map does not provide an absolute number for the probability, because for this the inherent probability of the risk source itself should be taken into consideration. For this the probability map for the wind dispersion of toxic effects could be combined with the probability map for the scenarios themselves (inherent probability of failure of the risk source), related to the difference in transport volumes. This combined map would show the higher probability of incidents on the ongoing tracks west of the bifurcation to the Betuwe line railway (because on that side there is more transport), combined with the higher probability of south-southwest and west-southwest wind directions. The inherent probability of incidents at the Kijfhoek shunting yard (not taken into consideration in this assessment) further increases the probability on that side. However, because the focus of the risk assessment is on the stretch between Kijfhoek and Moerdijk bridge (see parapgraph 3.7), this combined map has less relevance.

## 4.9 Spatial distribution of effects

To help the understanding of the nature of the risk (and as a potential basis for spatial planning) the effect distances as calculated (see paragraph 4.5) can be projected as potential effects zones on a map. For further insight the potential effects of an actual singular incident can be projected.

**!**

*Warning about the interpretation of effect distances*

*The reader must be aware the process of the PRISMA project was not meant to achieve full-proof scientific evidence of the exact effect distances, but merely as a test of how the assessment process works and what insights you can get from them. For this a deviation of several (tens of) meters more or less is irrelevant. The aim was to obtain effect distances which are 'realistic enough' to be able to perform further research into potential mitigation measures. This means that the presented effect distances have to be interpreted carefully. They should not be regarded as beyond doubt. Depending on assumptions and the used software, other outcomes might be generated. Moreover it is important to realize that calculated effect distances are no guarantee that effects will certainly reach a certain distance, nor that it is safe beyond a specific point. Calculations are made with mathematical assumptions in software trying to model the real world. Each scenario in real-life can be different. The scenarios presented are 'credible worst case scenarios', meaning in most actual cases the effects should be smaller, but at the same time bigger effects are not completely ruled out. This is especially the case for scenarios with toxic substances, because they are based upon the nationally set 'example substances', whilst other substances in that same category might behave differently. In any case the actual weather conditions (mainly wind direction and force) can greatly influence the magnitude of these scenarios.*

*Effect zones for BLEVE*

| BLEVE (LPG) | | | |
|---|---|---|---|
| Dark red zone | < 160m | Irreparable damage and fires | 100% lethality people in open air |
| Red zone | < 250m | Heavy damage and secondary fires | 20% lethality people in open air |
| Orange zone | < 360m | Medium damage and occasional secondary fires | 2% lethality people in open air |
| Yellow zone | < 600m | Light damage | 0% lethality people in open air |

*Example of effect zones of a BLEVE scenario at the eastside of Dordrecht station*

*Effect zones pool fire*

| **Pool fire (petrol)** | | | |
|---|---|---|---|
| Dark red zone | < 40 m | Irreparable damage and fires | 100% lethality people in open air |
| Red zone | < 50 m | Heavy damage and secondary fires | 20% lethality people in open air |
| Orange zone | < 60 m | Medium damage and occasional secondary fires | 2% lethality people in open air |
| Yellow zone | < 75 m | Light damage | 0% lethality people in open air |

*Example of effect zones of a pool fire scenario at the eastside of Dordrecht station*

*Effect zones toxic gas (ammoniac)*

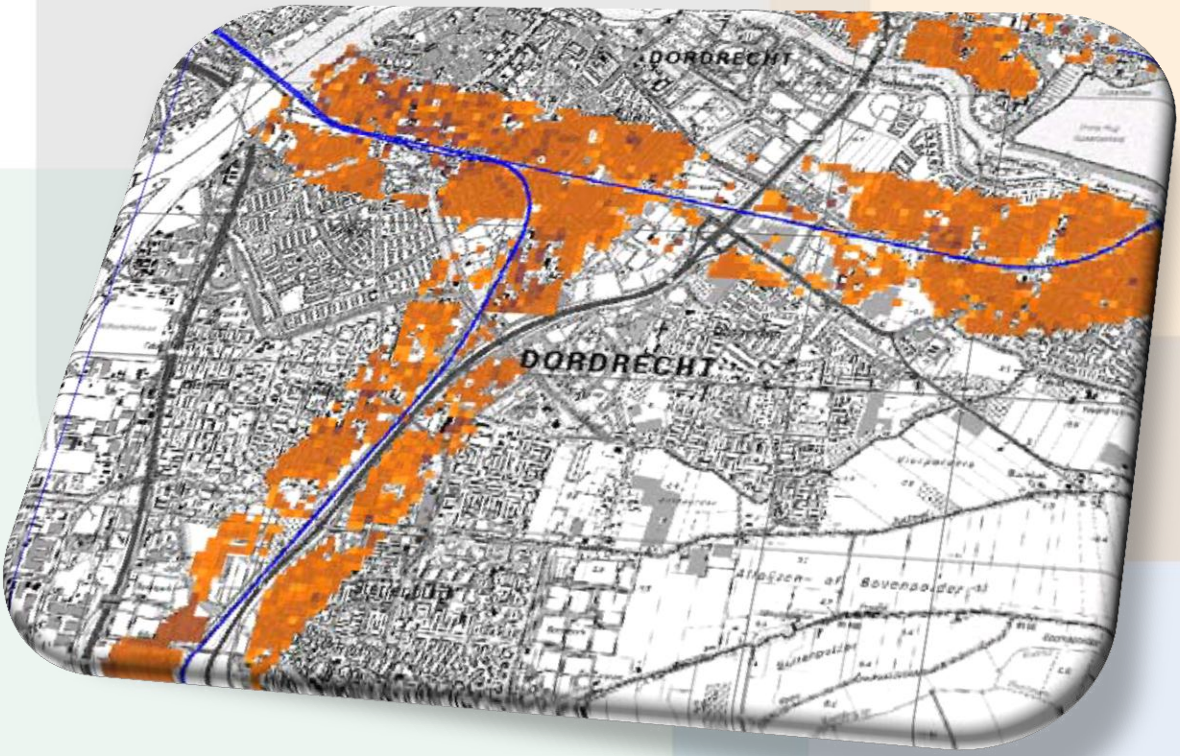
| **Toxic gas (ammoniac)** | | |
|---|---|---|
| Dark red zone | < 400 m | 100% lethality people in open air |
| Red zone | < 750 m | 70% lethality people in open air |
| Orange zone | <1.000m | 20% lethality people in open air |
| Yellow zone | <2.000m | 1% lethality people in open air<br>(‘Life threatening value’) |

*Effect zones very toxic liquid (hydrogen fluoride)*

| **Very toxic liquid (hydrogen fluoride)** | | |
|---|---|---|
| Dark red zone | < 200 m | 100% lethality people in open air |
| Red zone | < 450 m | 70% lethality people in open air |
| Orange zone | < 800 m | 20% lethality people in open air |
| Yellow zone | <2.000m | 1% lethality people in open air<br>(‘Life threatening value’) |

## 4.10 Spatial distribution of vulnerability

The risk identification has shown different kinds of vulnerabilities. First of all the population itself. The population density within the direct zone of 200 metres used to calculated the societal risk (see the fundamental remarks in paragraph 4.7) is shown in the following figure.[38]



---

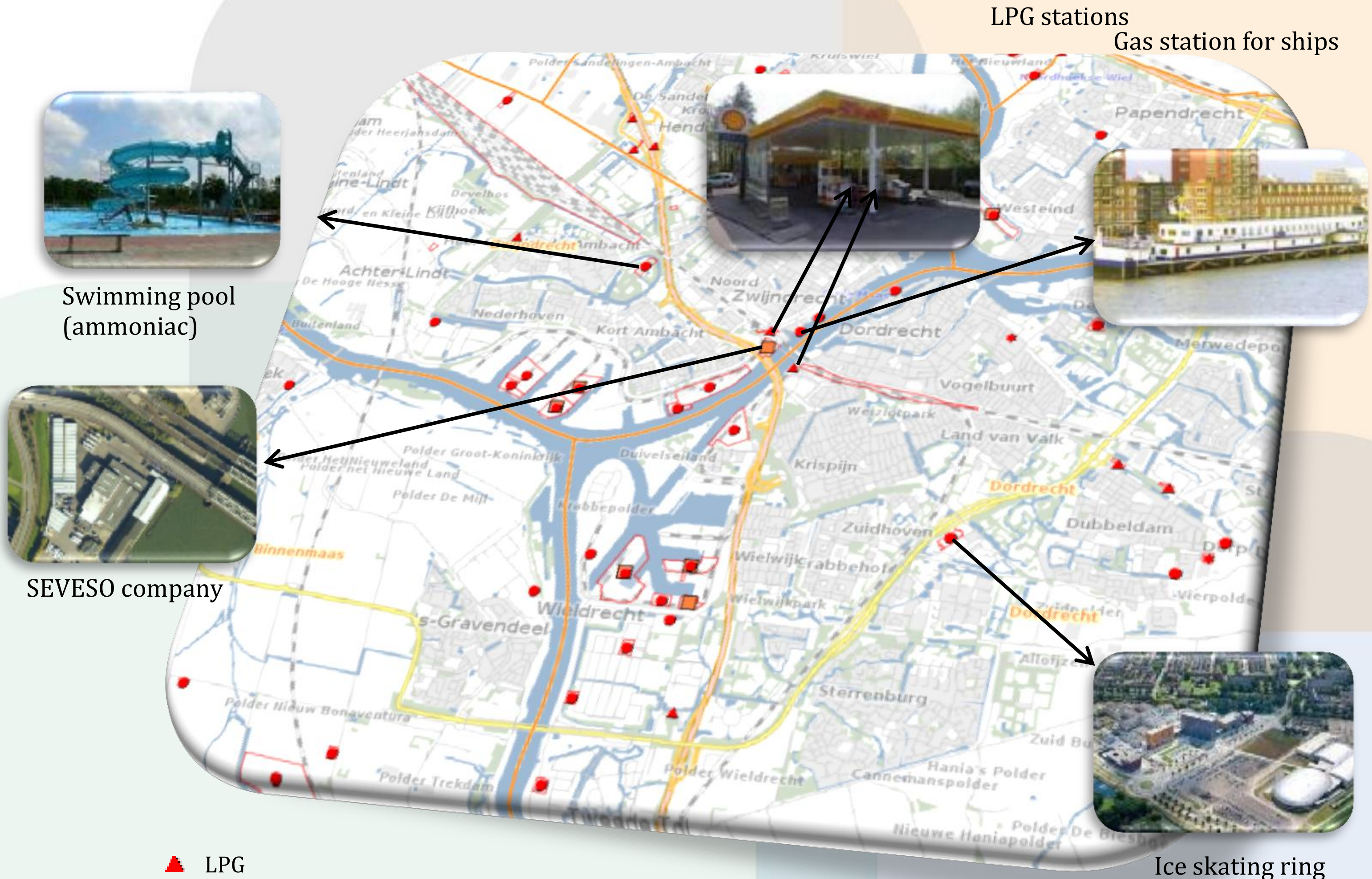
[38] The societal risk mapped, page 22.

The following map shows the vulnerable objects in the proximity of the railway. Vulnerable objects are defined in the legislation about the provincial risk maps. The total number of vulnerable objects within the potential effect zones of the railway exceed 300.[39]

---

[39] *Provincial risk map*, province South-Holland.

The following map contains an overview of the objects in the direct vicinity of the railway which potentially might lead to a domino scenario.[40]



▲ LPG
● Storage or miscellaneous
✸ Fire works
🟧 SEVESO company

---

[40] *Provincial risk map*, province South-Holland.

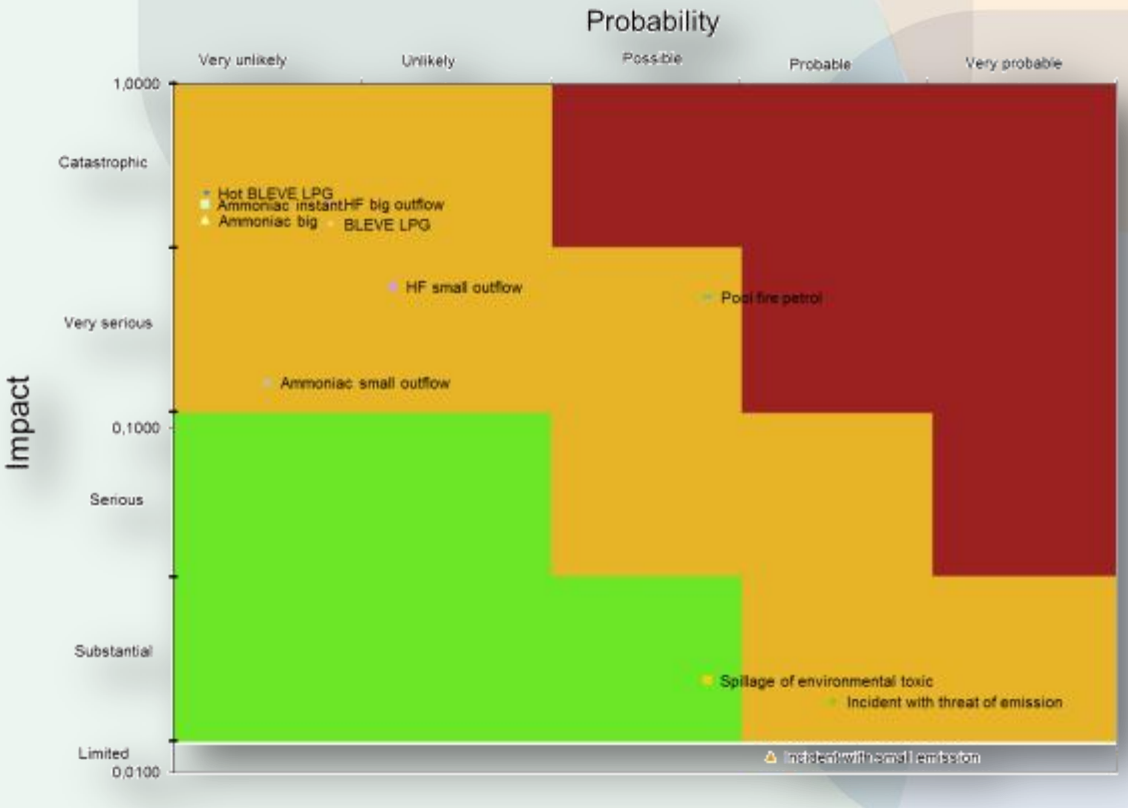
## 4.11 Concluding remarks on risk mapping

It was deemed impossible to aggregate the probability, effects and vulnerability maps into a single, overall *risk* map (meaning a map which combines all aspects of the risk concept into one overview of the spatial distribution of the risk). For this step the mapping in The Netherland has not yet been developed far enough. In comparison to other countries, the mapping capabilities of the Dutch safety regions is underdeveloped and the importance is underestimated. This actually is one of the an important lessons of PRISMA. The inherent wish to gain insight in the spatial distribution of risks seems the be lacking, perhaps partly due to the fact that the provinces instead of the safety regions are responsible for risk mapping.

## 5.1 Recommendations for risk evaluation

The third and final phase of risk assessment is called risk evaluation. In this phase, the conclusions of the risk identification and risk analysis are submitted to the (political) decision-makers. Risk and crisis management is not intended to achieve absolute security, but is part of a political-social assessment process, taking into account the public interest of risky activities. For example, modern society can simply not do without hazardous substances. Ultimately the aim must be to achieve a level of safety which is acceptable for both politicians and citizens. This means that the political and administrative decision-makers always shall have to evaluate the outcome of a risk analysis on basis of their own values and preferences. The aim is transparent and accountable decision-making: assessments are made as objectively as possible, but in the end politicians decide upon the priorities.

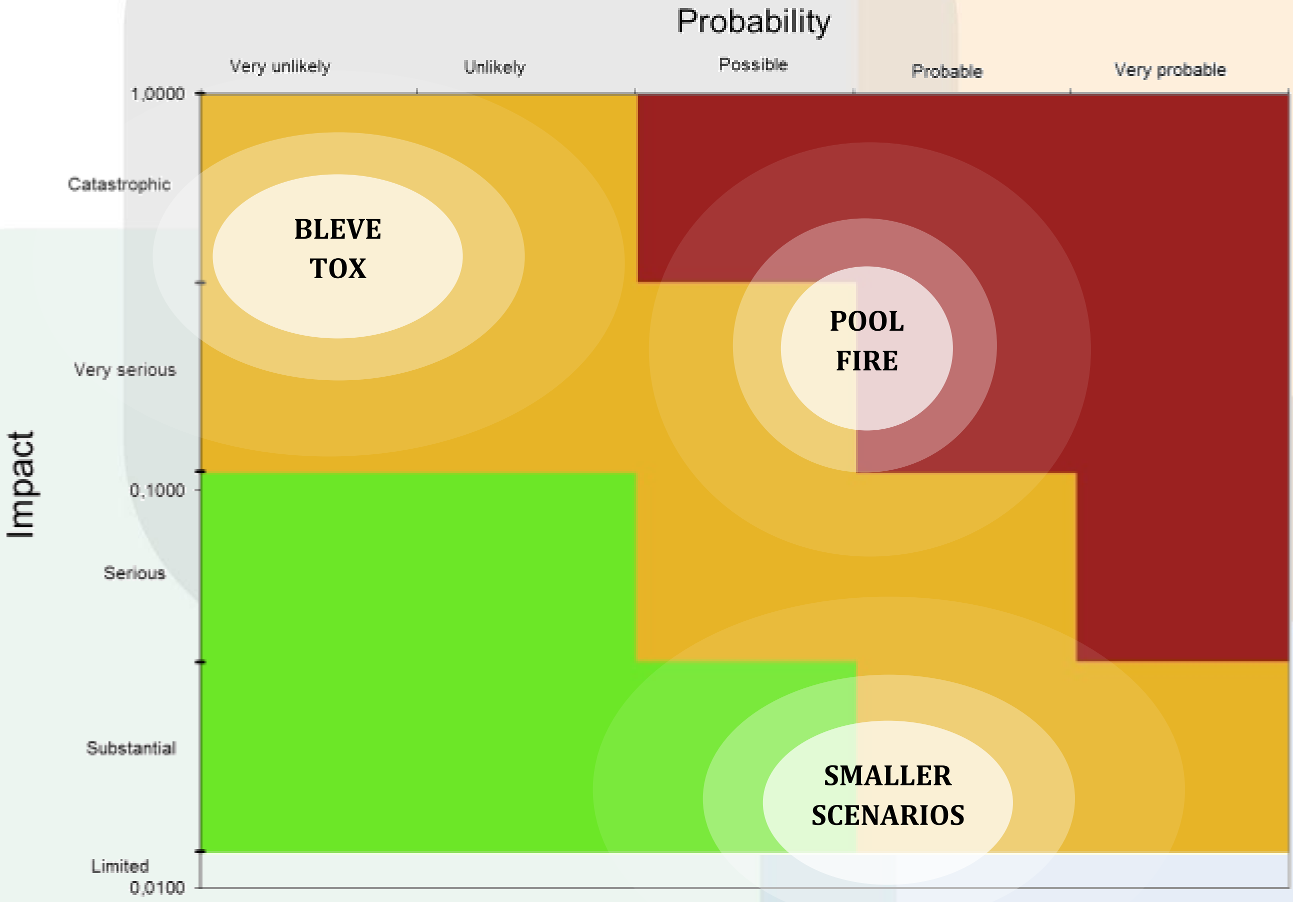
A first way of helping politicians to decide on priorities is to literally ‘colour’ the risk diagram in order to depict different risk levels. In the figure below the risk diagram for the railway scenarios is coloured to give an indication for potential prioritization.[41]



---

[41] The colouring is the same as that in the risk diagram of the regional risk profile of South-Holland South.

Generalizing from these specific scenarios to more aggregate priorities and taking into account some margins of error for the risk calculations, the following clusters can be defined (see next page). However, in both cases the colours should not be interpreted rigidly: the borderlines are no hard discriminations and orange or green does not automatically mean it is "okay" or that a risk should be accepted.



*Regional risk profile method*

The risk diagram and the regional risk profile method supports the following first recommendations for prioritization:

1. **Give specific priority to pool fire scenarios**, because they both have a medium-high impact and a medium-high probability. This supports the previously made national choice to focus on the so-called "pool fire attention area" in which mitigation measures might be required.[42]

---

[42] However, the distance of the pool fire attention area in which legally specific safety demands might be set, is too small. It concerns only an area which might completely burn down despite (expensive) mitigation measures. The effectiveness of this area is a real concern. For more discussion about this topic, see the separate capability assessment report.

2. **Give priority to reduction of injured, fatalities, disruption of daily life, psychological impact and costs/economic impact**, because those vital interests of society are threatened the most.
3. **For BLEVE and toxic scenarios give extra priority to effect and vulnerability reduction**, because their probability is low already, but the potential impact is catastrophic.
4. **For the smaller scenarios (small emission, threat of emission and eco toxic) give extra priority to probability reduction**, because their high probability is the main concern.
5. **Give priority to toxic effects (of toxic liquids and toxic gasses, but also of flammable liquids and smoke and ash from fires)**, because accumulated that is the primary effect that has highest probability.
6. **Give priority to preparedness measures which are helpful for all scenarios for the whole region**, because the combined probability of all scenarios in the whole region is very high (a transport train incident once every 3 years, a serious incident involving a substance emission of more than 100kg once every 29 years).

*Societal risk analysis*

The societal risk analysis supports other/additional recommendations:

7. **Give priority to BLEVE**, because it has the highest contribution to the societal risk according to the formal calculation method (only taking into account the inhabitants up to 500 metres).
8. **Give priority to toxic scenarios**, because they have the highest contribution to the societal risk if the whole potentially affected population is taken into account.
9. **Give priority to the areas of Dordrecht Station and the Dordrecht curve (Leerpark)**, because at those sites the societal risk is highest. Although not part of the actual risk analysis (as described in paragraph 3.7), also the **Kijfhoek shunting yard** should be a priority, because even without a detailed analysis it is certain that there the risk is high due to the high transport volumes, the concentration of many trains (with different substances) on the same location and the inherent risk of the shunting process.
10. **For measures against the toxic scenarios give extra priority the whole city centre of Dordrecht**, because also at a larger distance from the railway the population still contributes to the societal risk.

*Mapping approach*

From the mapping analysis the following priorities can be added:

11. **Give priority to all tracks, except the line to DuPont**, because on that line the transport is substantially lower.
12. **For measures against the toxic scenarios give extra priority to the inside of the Dordrecht curve and more in general the north side of the railway**, because of the higher probability of toxic effects being blown in that direction by the wind.

13. **For measures against BLEVE scenarios give priority to the areas (at least) up to 360 metres from the railway**, because up to that distance there might be significant effects.[43]
14. **For measures against pool fire scenarios give priority to the areas (at least) up to 60 metres from the railway**, because up to that distance there might be significant effects.
15. **For measures against toxic scenarios give priority to the areas (at least) up to 2,000 metres from the railway**, because up to that distance there might be significant effects.
16. **Within these zones give extra priority to the protection of buildings with vulnerable people**, because there are a lot of them.
17. **Give attention to industries and installations within the BLEVE zone (up to 360 metres)**, because they might lead to a domino scenario.[44]

These different perspectives give different and sometimes (more or less) opposing priorities. For example: the risk diagram supports the (already nationally set) focus on pool fires, whilst the societal risk places the emphasis on BLEVE and toxic scenarios. Therefore it is advised not to use the one priority to exclude the other, but to accumulate the priorities, meaning that you take them all into account.

## 5.2 Perspectives for risk evaluation

Safety professionals have to perform objective risk analysis, but must be well aware that the decision-makers will interpret the outcomes on basis of their own subjective political preferences. To evaluate which of the analysed risks should be chosen as a priority, many different evaluation criteria can be taken into account. Therefore, an option is to ask the decision-makers to explicit their subjective evaluation criteria during the decision process. The actual involvement of politicians was not part of the PRISMA project, because it was only meant for *testing* the process and methodologies. The potential priorities concluded from the "technical" analysis have not been presented to or discussed with actual politicians in the region. However, several perspectives are provided below.

### *The relative importance of the vital interests*

One perspective is that of the (conflicting) vital interests of society. For example, for one decision-maker risks with potentially a lot of casualties might be most important, whilst another might want to give priority to risks with severe economic or ecological consequences. Directly related to the "vital interests of society" as defined by the national government the following perspectives can be distinguished:

- **Physical safety perspective**. The physical safety (fatalities and injured) is the traditional perspective of the rescue services and the Mayors which are legally responsible for crisis

---

[43] Distances measured from the outside perimeter of the railway track and not from the central transport axis, as is done in the external safety policy.

[44] As specified in paragraph 4.3 the probability and combined effect of domino scenarios could not be taken into account during the limited project period of PRISMA. However, the risk identification supports the conclusion that further attention should be given to the analysis domino scenarios, to determine whether they should be an additional priority.

management. Only taking into account the physical safety primarily leads to priorities as set from the perspective of the societal risk: focus on pool fire and BLEVE, although from the broader perspective of the whole area also on toxic scenarios. For these scenarios the traditional perspective is that of probability reduction and general preparation, in combination with specific demands for buildings close to the railway. An important addition is the focus on vulnerability reduction.

- **Economic perspective**. For the country as a whole the economic benefit of the rail transport is very important, because it connects the Rotterdam harbour and the (petro-chemical) industrial area of Rotterdam, Moerdijk, Terneuzen etc. with the European hinterland. This perspective might lead to risk acceptance, but might also place emphasis on the prevention of incidents (probability reduction) or the prevention of social impact (effect and vulnerability reduction). After all, an incident might lead to a disruption of the rail transport network with direct economic damage. Moreover, a serious incident might result in a lower risk acceptance and even a public debate about banning or seriously limiting transport of dangerous substances.[45]
- **Psychological perspective**. The social-political impact of the different scenarios is potentially very serious and has a much higher probability than other kinds of impacts. Important distinction from the physical safety perspective is the probability: whilst fatalities and injured only occur in the case of actual larger emissions, psychological impact (anxiety, public outrage, social unrest and potentially civil disorder and riots) might also occur in case of smaller incidents, with small emissions (leakage), small amounts of casualties or even only the threat of an emission after a derailment or collision. The chemical fire in Moerdijk (2011) and the explosion at Shell Moerdijk (2014) have shown the societal impact in case of uncertainty about potential health impacts and the corresponding negative (social) media attention. This perspective not only places emphasis on other kinds of scenarios than the physical safety perspective, but also may result in other kinds of objectives for mitigation, like early warning and crisis communication, but also protection against toxic fumes. Because these smaller incidents have a much higher probability (accumulating to once every 3 years an incident of some sort somewhere in the region), the perspective of a cost-benefit analysis is also completely different.
- **Ecological perspective.** At average the impact of the different scenarios on ecology and the environment is limited. However, specific scenarios might have serious consequences, especially for the aquatic environment but also the agricultural grounds. These scenarios have a quite high probability, for example once every 110 years a release of a toxic liquid into the water system. Because environmental damage has proven to be serious and with high costs in the past (for example the Moerdijk chemical fire), and at the same time not that well prepared, this might be another perspective for prioritization. However, the probability of a spill of a specific *aqua toxic* liquid (disastrous for the aquatic ecosystem) directly in one of the rivers (from the bridges) is deemed too little to take into account, both because these

---

[45] It is important to realize that the criterion for economic security as defined by the national government does not include (structural) damage to the economy, but only direct costs of an incident. If this definition would be widened, the impact scores of the scenarios on the economy might be higher than up to now.

specific toxics are transported very little and because it only affects the water if it happens on the small distances of the bridges. Furthermore, the volume of just one rail container is very little compared to for example a potential incident with a ship.

The perspectives of “territorial security” and “cultural heritage” are left aside, because the impact analysis has shown those criteria are negligible compared to the others.

Because no actual political judgement has been made about the risk evaluation, all these different perspectives have been taken into account in the next step of capability assessment (see separate report).

*Public risk awareness and concerns of inhabitants*

A totally different perspective is that of public risk awareness. When comparing different risks (all hazard) to one another, the public concerns might be a relevant factor. The rail transport as such is a known issue and generates public concerns, although not always very outspoken. There are no direct indications there is a difference in the feelings about the different subscenarios for rail transport. Sociological, psychological or cultural research about the risk awareness concerning these specific scenarios could not be found. In general it might be said that probability reduction will mostly be preferred above impact reduction or disaster preparedness (“prevention is better than cure”). Also it can be assumed that people prefer good rescue services and disaster relief above being left to their own resilience. From the spatial angle a hypothesis is that people living close to the railway have higher awareness and more concerns and therefore will press more for mitigation and will be more willing to play their own part in prevention and preparation. Overall, the perspective of public risk awareness has no clear leads to prioritize mitigation policies towards specific scenarios or impacts. For this more research or a clear public participation process would be necessary. However, one general option results from this perspective: risk acceptance. If there is no real public concern, even if there would be transparent awareness, a policy option is the acceptance of the risk. Because this should always be accompanied by transparent risk communication, it can be doubted whether in the end there will be real acceptance if people realize the hypothetical political choice “not to do anything”. Because acceptance also is directly related to the costs of prevention, it is advised to postpone this option until after the capability assessment.

*Existing policy priorities and political programs*

The need for prevention is also derived from existing programs already in place. For this we have to refer to two perspectives:

- **Probability reduction**. The national government, together with the transport companies and railway maintenance company (ProRail) is responsible for measures to ensure the inherent safety of the transport and to monitor and enforce (inspection agency and police). This encompasses measures for the rail infrastructure itself (like normal and electronic signs, safety systems and general state of maintenance), for the trains (pressure resistance of wagons, linking of trains, maintenance of seals), for shunting yards and their systems and for the personnel involved (training, procedures, safety culture). Especially the safety breaking system has long been an important discussion in the national parliament, resulting in the upgrading from ATB to ATB-vv and in some years to ERTMS. However, all these policies are a national responsibility and have already been subject to improvement and have been discussed between the national government and the municipalities of Dordrecht and Zwijndrecht. From this perspective further probability reduction as a whole is not a priority for the local risk mitigation policy which is the focus of PRISMA.

- **Disaster preparedness**. Also the disaster preparedness for the Railzone is an existing policy. With national money the project Railzone is aimed at improving the disaster preparedness by several means. The project includes measures to ensure accessibility of the railway for emergency services, the water supply for the fire brigade, early warning and surveillance with cameras, a special fire truck with foam for chemical fires and specific risk communication to the inhabitants. Because of this existing project disaster preparedness is supposed to be optimized and is therefore not a priority for the risk mitigation plan of PRISMA.

### *Prestigious projects*

Sometimes prestigious projects might be part of risk prioritization. Mostly this has a negative impact: projects concerning economical and spatial development very often obtain priority above risk mitigation or even prevention of an increasing level of risk. In case of the railway zone the so-called Maas terrace might have been such an example. This is a site on the waterside directly next to the Dordrecht railway brigde, where a housing project was envisaged. However, external safety certainly was a main concern in the design, showing the willingness of the responsible politicians to take risk issues into account, even though the site at itself is certainly not ideal. Because of the financial and economic crisis for the moment this kinds of projects is not expected, although it cannot be ruled out that the options for future developments also will play a part in the decision about risk mitigation priorities.

### *Imbalance between the risk level and the actual potential to save people*

A final risk evaluation perspective (although more perspectives are possible) is that of a fundamental imbalance between the risk and the potential or capabilities of the emergency services to battle an incident and rescue people. Disaster preparedness measures only can achieve so much. In the end there are always scenarios possible which transcend the capabilities of disaster relief and therefore lead to high impact. Because most of these scenarios have a low probability, in most case the risk is just accepted. However, in some cases this fundamental discrepancy between the potential impact and the preparedness is an indication for targeted mitigation measures. In this case this is particularly so for the toxic scenarios. Their impact is potentially catastrophic, whilst the options for disaster relief are limited. From this perspective a priority can be given to combination strategies of mitigation measures, disaster preparedness and risk communication for toxic scenarios.

## 5.3 Recommendations for setting objectives

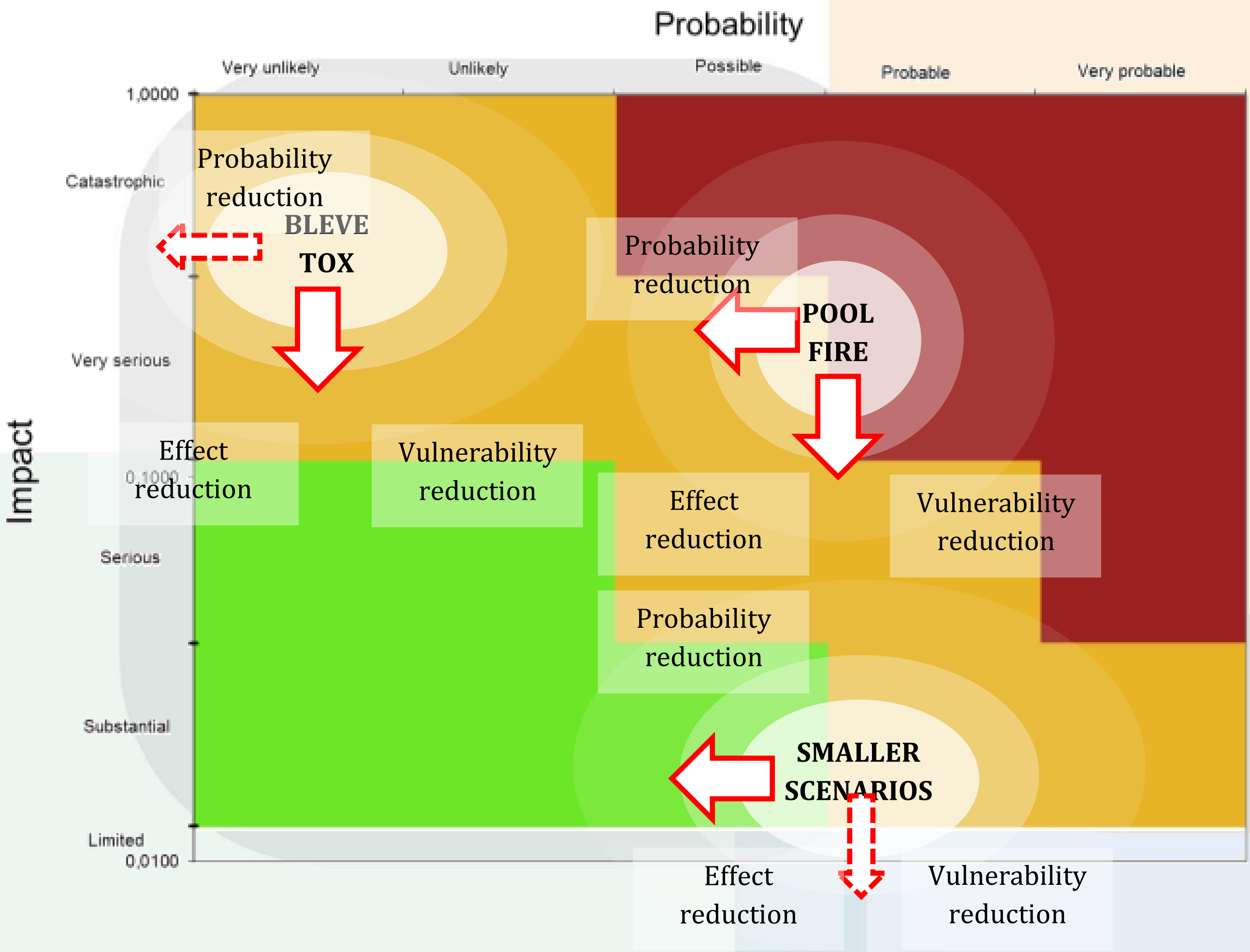
The MiSRaR/PRISMA partners believe that the step of political consultation (risk evaluation) also should include a second aspect. Once insight is gained in the nature of risks and the political preferences regarding the prioritization of risks, the following step is to set general objectives for each of the chosen priority risks. In the context of MiSRaR an objective is defined as a (political) decision on a concrete policy for mitigation (and also disaster preparedness), in terms of a desired, measurable outcome on society. These objectives should be SMART:

- Specific: it addresses a concrete priority risk and contains a concrete objective.
- Measurable: the outcome on society can be measured, for example in percentage of risk reduction.
- Acceptable: the objective is acceptable for the decision-makers and stakeholders.
- Realistic: the objective can realistically be realized.
- Time bound: the objective is set for a concrete period.

This kind of political objectives is deemed necessary as a guideline for further identification and (cost benefit) analysis of mitigation measures, resulting in a concrete mitigation plan. Without insight in the political objectives there is a serious risk that the further technical assessment of mitigation measures is directed at the wrong kinds of policies. For example, in case of tunnel safety the experts might do research into lifesaving mitigation measures, while for the politicians maybe the most important is to prevent a tunnel from collapsing and thus inflicting serious damage to transportation and industries and the national economy in general. Without political consultation beforehand the technical research and expert judgement on mitigation might become useless.

On the other hand the expectations of such a political consultation on objectives should not be to high: without knowing the financial consequences of the final mitigation strategy it is not certain whether the chosen political objectives will prevail till the end of the mitigation process. Preferences might shift and even more so when the costs of the objectives prove to be high. Moreover, before the assessment of mitigation measures it cannot be known for certain which kind of measures will be most (cost) effective. The setting of objectives therefore must not limit the further technical research too much. There must be room for assessing other mitigation measures which not directly address the set objectives, for they might prove to be more desirable in the end. For this reason the setting of objectives should be restricted to the desired societal outcome and should not include actual concrete mitigation measures.

The risk diagram again provides the first insight for the setting of objectives. It clearly indicates the relative importance of probability reduction as opposed to effect and vulnerability reduction for the different categories of scenarios (see figure).



With the insight derived from the different perspectives of the risk evaluation, the following objectives have been selected as the starting point for the capability assessment (see separate report). As said before, during the PRISMA project these priorities and objectives have not been politically consulted, because it is a testing project.

*Short term*

1. Improvement of disaster relief: already part of project "Spoorzone"
2. Risk communication: already part of project "Spoorzone"
3. Vulnerability reduction of new buildings: the formal "societal risk" policy
4. National rail safety measures to decrease probability:
    - ➢ Safety breaking system: implementation of ATB-vv and ERTMS[46]

---

[46] The national policy for probability reduction is a very current topic in The Netherlands. The deputy Minister for Infrastructure has decided to implement an update of the rail safety system on all railway signals. However, an undesirable side effect will probably be that the Ministry will decide to lower the probability estimates for train incidents. Because the zoning alongside the railway is directly related to the probability calculations, the safety zoning might become smaller, leaving more room for housing projects closer to the railway, whilst the effect distances of an actual incident stay the same. In this case future incidents (though maybe lower in probability) will cause more fatalities, injuries and damage.

- Hot BLEVE prevention policy (no flammable liquids next to flammable gas)

*Middle term*

5. Vulnerability reduction in spatial planning (in combination with their consequences for preparation like early warning, protocols etc.)
6. Probability reduction through re-routing (rail junction Meteren)

*Long term*

7. Proaction through alternative routes around the Spoorzone Dordrecht-Zwijndrecht: the national government and the municipalities of Dordrecht and Zwijndrecht have already agreed a research will be performed in 2018 to investigate options for a structural solution of the Spoorzone bottleneck (alternative routes).

The capability assessment (separate report) should therefore be focused on *vulnerability reduction in spatial planning*, because [1] probability reduction is a national responsibility for which already several policies exist, [2] preparation already is being improved in the project 'Spoorzone' and [3] fundamental proaction on the long term still has to be investigated nationally. The focus on vulnerability reduction means the capability assessment is mainly focused on measures to reduce exposure and susceptibility of humans, the man-made environment and the natural environment.

# Index annexes

## Annex I.

# Probability analysis

| TOTALS | Betuwe line | | Kijfhoek-Dordrecht Station | | Dordrecht Station-Moerdijk Bridge | | Kijfhoek North | | Dordrecht Station-DuPont SEVESO | |
|---|---|---|---|---|---|---|---|---|---|---|
| A. Flammable gasses | 1,82E-04 | 5.483 | 1,41E-05 | 71.036 | 2,82E-05 | 35.518 | 5,86E-06 | 170.784 | | |
| B2. Toxic gasses | 2,24E-05 | 44.742 | 4,05E-06 | 247.134 | 8,09E-06 | 123.567 | 3,17E-06 | 315.378 | | |
| B3. Very toxic gasses | 5,23E-07 | 1.912.276 | 8,50E-09 | 117.635.987 | 1,70E-08 | 58.817.994 | 1,90E-08 | 52.516.066 | | |
| C3. Flammable liquids | 2,81E-02 | 36 | 1,32E-03 | 756 | 2,41E-03 | 416 | 1,81E-03 | 554 | 1,43E-04 | 7.002 |
| D3. Toxic liquids | 1,60E-04 | 6.252 | 4,05E-05 | 24.677 | 8,10E-05 | 12.339 | 1,54E-05 | 65.086 | | |
| D4. Very toxic liquids | 9,83E-05 | 10.175 | 1,18E-05 | 84.448 | 1,54E-05 | 65.136 | 5,46E-06 | 183.063 | 5,00E-06 | 200.061 |
| **Total** | **2,85E-02** | **35** | **1,39E-03** | **718** | **2,54E-03** | **394** | **1,84E-03** | **545** | **1,48E-04** | **6.765** |
| Small scenarios (release <100kg) | **6,05E-02** | **17** | **2,90E-03** | **345** | **5,27E-03** | **190** | **3,90E-03** | **257** | **3,17E-04** | **3.157** |
| Incident without release | **1,49E-01** | **7** | **1,20E-02** | **84** | **2,30E-02** | **44** | **8,31E-03** | **120** | **5,61E-04** | **1.781** |
| Total incidents | **2,38E-01** | **4** | **1,63E-02** | **62** | **3,08E-02** | **32** | **1,40E-02** | **71** | **1,03E-03** | **975** |

**Scenarios in relation to prevention**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Scenarios for which windows and AC have to be closed (all scenarios with release) | 8,90E-02 | 11 | 4,29E-03 | 233 | 7,81E-03 | 128 | 5,73E-03 | 174 | 4,65E-04 | 2.153 |
| Scenarios with overpressure (BLEVE, explosion) | 8,52E-05 | 11.737 | 6,58E-06 | 152.065 | 1,32E-05 | 76.033 | 2,74E-06 | 365.593 | 0 | |
| Scenarios with fire and heat | 2,04E-02 | 49 | 9,96E-04 | 1.004 | 1,82E-03 | 551 | 1,31E-03 | 763 | 1,06E-04 | 9.471 |

| **Scenarios with toxic and flammable liquid release into water (>100kg)** | | | Probability class risk assessment | |
|---|---|---|---|---|
| On Dordrecht bridge | 2,75E-04 | 3.637 | B-middle | |
| On Moerdijk bridge | 2,50E-04 | 3.996 | B-middle | |
| Into canals alongside track | 8,54E-03 | 117 | C-high | *** |
| **Total** | 9,07E-03 | 110 | C-high | |

Calculations based on Dutch guideline HART
Calculations model with thanks to Safety Region Rotterdam-Rijnmond, spatial safety department

| **TOTAL VRZHZ** | | Probability class risk assessment | **TOTAL without Betuwe line** | | Probability class risk assessment | **TOTAL Dordrecht urban area *** | | Probability class risk assessment | **TOTAL Zwijndrecht urban area **** | | Probability class risk |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,30E-04 | 4.339 | B-middle | 4,81E-05 | 20.796 | A-high | 2,25E-05 | 44.398 | A-middle | 8,45E-06 | 118.394 | A-low |
| 3,77E-05 | 26.553 | A-middle | 1,53E-05 | 65.317 | A-middle | 5,66E-06 | 176.525 | A-low | 2,43E-06 | 411.891 | A-low |
| 5,67E-07 | 1.762.173 | A-low | 4,45E-08 | 22.449.616 | A-low | 1,19E-08 | 84.025.705 | A-low | 5,10E-09 | 196.059.979 | A-low |
| 3,37E-02 | 30 | D-middle | 5,68E-03 | 176 | C-high | 1,71E-03 | 585 | C-low | 7,93E-04 | 1.261 | B-high |
| 2,97E-04 | 3.368 | B-middle | 1,37E-04 | 7.303 | B-low | 5,67E-05 | 17.627 | A-high | 2,43E-05 | 41.129 | A-middle |
| 1,36E-04 | 7.356 | B-low | 3,77E-05 | 26.557 | A-middle | 1,16E-05 | 86.357 | A-middle | 7,10E-06 | 140.747 | A-low |
| **3,44E-02** | **29** | D-middle | **5,92E-03** | **169** | C-high | **1,80E-03** | **554** | C-low | **8,36E-04** | **1.197** | B-high |
| **7,29E-02** | **14** | D-high | **1,24E-02** | **81** | D-low | **3,74E-03** | **267** | C-middle | **1,74E-03** | **575** | C-low |
| **1,93E-01** | **5** | E | **4,38E-02** | **23** | D-middle | **1,62E-02** | **62** | D-low | **7,18E-03** | **139** | C-high |
| **3,00E-01** | **3** | E | **6,21E-02** | **16** | D-high | **2,17E-02** | **46** | D-middle | **9,75E-03** | **103** | C-high |
| *1,07E-01* | *9* | | *1,83E-02* | *55* | *all incidents with release* | | | | | | |
| **1,07E-01** | **9** | E | **1,83E-02** | **55** | D-low | **8,82E-03** | **113** | C-high | **4,29E-03** | **233** | C-middle |
| **1,08E-04** | **9.288** | B-low | **2,25E-05** | **44.516** | A-middle | **9,21E-06** | **108.618** | A-low | **3,95E-06** | **253.442** | A-low |
| **2,46E-02** | **41** | D-middle | **4,23E-03** | **236** | C-middle | **1,29E-03** | **776** | C-low | **5,98E-04** | **1.673** | B-high |

Assumptions

* The Dordrecht urban area affected by the railway is estimated at a 6 kilometer length of the 10 km stretch from Dordrecht station to Moerdijk, leaving aside the small

** The Zwijndrecht urban area affected by the railway is estimated at a 3 kilometer length

*** The probability of a liquid (C3, D3 and D4) spilling into a water body alongside the

**Combined Dordrecht and Zwijndrecht urban area**

| | | |
|---|---|---|
| **1,31E-02** | **76** | D-low |
| **1,32E-05** | **76.033** | A-middle |
| **1,89E-03** | **530** | C-low |

Calculations based on Dutch guideline HART
Calculations model with thanks to Safety Region Rotterdam-Rijnmond, spatial safety department

# Betuwe line    (from starting point to the border of VRZHZ)

| Probability per wagon per kilometer | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| | | |
| Speed > 40 km/h | 1,50E-08 | 3,28E-08 |

Betuwe line figures!

| Chloride subtraction |
|---|
| 5 |

| Track lay out (in kilometers) | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| | | |
| Speed > 40 km/h | 0 | 39 |

| Number of transports | | | | | |
|---|---|---|---|---|---|
| A | B2 | B3 | C3 | D3 | D4 |
| flammable gasses | toxic gasses | very toxic gasses | flammable liquids | toxic liquids | very toxic liquids |
| 50.920 | 6.240 | 730 | 111.880 | 6.380 | 3.920 |

| Probability of release at low speed (<40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,00032 | 0,00047 | 0,99921 |
| Toxic gasses | B2 | | | 0,00032 | 0,00047 | 0,99921 |
| Very toxic gasses | B3 | | | 0,00032 | 0,00047 | 0,99921 |
| Flammable liquids | C3 | 0,032 | 0,047 | | | 0,921 |
| Toxic liquids | D3 | 0,0032 | 0,0047 | | | 0,9921 |
| Very toxic liquids | D4 | 0,0032 | 0,0047 | | | 0,9921 |

| Probability of release at high speed (>40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,0011 | 0,0017 | 0,9972 |
| Toxic gasses | B2 | | | 0,0011 | 0,0017 | 0,9972 |
| Very toxic gasses | B3 | | | 0,0011 | 0,0017 | 0,9972 |
| Flammable liquids | C3 | 0,22 | 0,34 | | | 0,44 |
| Toxic liquids | D3 | 0,022 | 0,034 | | | 0,944 |
| Very toxic liquids | D4 | 0,022 | 0,034 | | | 0,944 |

| | |
|---|---|
| G1 L | Instanteneous release of whole container volume of liquid |
| G2 L | Continuous release |
| G1 G | Instanteneous release of whole container volume of gas |
| G2 G | Release of gas from a hole of 75 mm diameter |

| Corection voor type of wagon and substance | |
|---|---|
| Toxisch | 0,1 |
| Brandbaar | 1 |

| Ontstekingskans | | | | |
|---|---|---|---|---|
| Brandbaar gas | | Instantaan (direct) | 0,8 | Koude BLEVE |
| | | Instantaan (vertraagd) | 0,2 | Wolkbrand, gasexplosie |
| | | Continu (direct) | 0,5 | Fakkel |

| | | | | |
|---|---|---|---|---|
| | | Continu (vertraagd) | 0,5 | Wolkbrand, gasexplosie |
| | Explosie | Ja | 0,4 | Explosie |
| | | Nee | 0,6 | Wolkbrand |
| Zeer brandbare vloeistof | | Plas | 0,25 | Plasbrand |
| | | | 0,75 | Geen scenario |

| **A. Flammable gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas instantaneous | Cold BLEVE | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,73E-05 | 5,73E-05 | 17.446 |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,73E-06 | 5,73E-06 | 174.458 |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 8,60E-06 | 8,60E-06 | 116.305 |
| G2 Gas continuous | Torch fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,54E-05 | 5,54E-05 | 18.062 |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,21E-05 | 2,21E-05 | 45.154 |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,32E-05 | 3,32E-05 | 30.103 |
| | | | | | **Total** | **1,82E-04** | **5.483** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,50E-02 | **6,50E-02** | **15** |

| **B2. Toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 8,78E-06 | 8,78E-06 | 113.890 |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,36E-05 | 1,36E-05 | 73.693 |
| | | | | | **Total** | 2,24E-05 | 44.742 |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,96E-03 | **7,96E-03** | **126** |

| **B3. Very toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,05E-07 | 2,05E-07 | 4.867.613 |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,17E-07 | 3,17E-07 | 3.149.632 |
| | | | | | **Total** | **5,23E-07** | **1.912.276** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 9,31E-04 | **9,31E-04** | **1.074** |

| **C3. Flammable liquid scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,15E-03 | **3,15E-03** | **318** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,87E-03 | **7,87E-03** | **127** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,36E-02 | 2,36E-02 | 42 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,87E-03 | **4,87E-03** | **206** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,22E-02 | **1,22E-02** | **82** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,65E-02 | 3,65E-02 | 27 |
| | | | | | **Total** | **2,81E-02** | **36** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,30E-02 | **6,30E-02** | **16** |

| | | | |
|---|---|---|---|
| **Total incidents with release <100kg** | **Total** | **6,01E-02** | **17** |

| **D3 toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,80E-05 | 1,80E-05 | 55.695 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,49E-05 | 4,49E-05 | 22.278 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,35E-04 | 1,35E-04 | 7.426 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,77E-05 | 2,77E-05 | 36.038 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,94E-05 | 6,94E-05 | 14.415 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,88E-05 | 2,88E-05 | 34.760 |
| | | | | | **Total** | **1,60E-04** | **6.252** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,70E-03 | **7,70E-03** | **130** |
| **Total incidents with release <100kg** | | | | | **Total** | **1,63E-04** | **6.119** |

| **D4 very toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,10E-05 | 1,10E-05 | 90.647 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,76E-05 | 2,76E-05 | 36.259 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 8,27E-05 | 8,27E-05 | 12.086 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,70E-05 | 1,70E-05 | 58.654 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,26E-05 | 4,26E-05 | 23.462 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,28E-04 | 1,28E-04 | 7.821 |
| | | | | | **Total** | **9,83E-05** | **10.175** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,73E-03 | **4,73E-03** | **211** |
| **Total incidents with release <100kg** | | | | | **Total** | **2,11E-04** | **4.748** |

| | |
|---|---|
| 🟥 | scenarios > 100kg emission |
| 🟧 | scenarios < 100kg emission |
| 🟩 | scenarios without emission |

| **Totals** | **Betuwe line** | |
|---|---|---|
| A. Flammable gasses | 1,82E-04 | 5.483 |
| B2. Toxic gasses | 2,24E-05 | 44.742 |
| B3. Very toxic gasses | 5,23E-07 | 1.912.276 |
| C3. Flammable liquids | 2,81E-02 | 36 |
| D3. Toxic liquids | 1,60E-04 | 6.252 |
| D4. Very toxic liquids | 9,83E-05 | 10.175 |
| **Total** | **2,85E-02** | **35** |
| Small scenarios (release <100kg) | **6,05E-02** | **17** |
| Incident without release | **1,49E-01** | **7** |
| Total incidents | **2,38E-01** | **4** |

# Kijfhoek-Dordrecht Station

| | |
|---|---|
| Base probability | 2,20E-08 |
| Switch addition | 3,30E-08 |
| < 40 km/h | 0,62 |
| > 40 km/h | 1,26 |

| **Probability per wagon per kilometer** | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| Speed < 40 km/h | 1,36E-08 | 4,66E-08 |
| Speed > 40 km/h | 2,77E-08 | 6,07E-08 |

| Chloride subtraction |
|---|
| 5 |

| **Track lay out (in kilometers)** | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| Speed < 40 km/h | 0 | 0 |
| Speed > 40 km/h | 0 | 5 |

| Number of transports | | | | | |
|---|---|---|---|---|---|
| A | B2 | B3 | C3 | D3 | D4 |
| flammable gasses | toxic gasses | very toxic gasses | flammable liquids | toxic liquids | very toxic liquids |
| 16.560 | 4.760 | 50 | 22.220 | 6.810 | 1.990 |

| Probability of release at low speed (<40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,00032 | 0,00047 | 0,99921 |
| Toxic gasses | B2 | | | 0,00032 | 0,00047 | 0,99921 |
| Very toxic gasses | B3 | | | 0,00032 | 0,00047 | 0,99921 |
| Flammable liquids | C3 | 0,032 | 0,047 | | | 0,921 |
| Toxic liquids | D3 | 0,0032 | 0,0047 | | | 0,9921 |
| Very toxic liquids | D4 | 0,0032 | 0,0047 | | | 0,9921 |

| Probability of release at high speed (>40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,0011 | 0,0017 | 0,9972 |
| Toxic gasses | B2 | | | 0,0011 | 0,0017 | 0,9972 |
| Very toxic gasses | B3 | | | 0,0011 | 0,0017 | 0,9972 |
| Flammable liquids | C3 | 0,22 | 0,34 | | | 0,44 |
| Toxic liquids | D3 | 0,022 | 0,034 | | | 0,944 |
| Very toxic liquids | D4 | 0,022 | 0,034 | | | 0,944 |

| | |
|---|---|
| G1 L | Instanteneous release of whole container volume of liquid |
| G2 L | Continuous release |
| G1 G | Instanteneous release of whole container volume of gas |
| G2 G | Release of gas from a hole of 75 mm diameter |

| Corection voor type of wagon and substance | |
|---|---|
| Toxisch | 0,1 |
| Brandbaar | 1 |

| Ontstekingskans | | | | |
|---|---|---|---|---|
| Brandbaar gas | | Instantaan (direct) | 0,8 | Koude BLEVE |
| | | Instantaan (vertraagd) | 0,2 | Wolkbrand, gasexplosie |

| | | | | |
|---|---|---|---|---|
| | | Continu (direct) | 0,5 | Fakkel |
| | | Continu (vertraagd) | 0,5 | Wolkbrand, gasexplosie |
| | Explosie | Ja | 0,4 | Explosie |
| | | Nee | 0,6 | Wolkbrand |
| Zeer brandbare vloeistof | | Plas | 0,25 | Plasbrand |
| | | | 0,75 | Geen scenario |

| **A. Flammable gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas instantaneous | Cold BLEVE | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,42E-06 | 4,42E-06 | 226.024 |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,42E-07 | 4,42E-07 | 2.260.243 |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,64E-07 | 6,64E-07 | 1.506.829 |
| G2 Gas continuous | Torch fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,27E-06 | 4,27E-06 | 234.002 |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,71E-06 | 1,71E-06 | 585.004 |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,56E-06 | 2,56E-06 | 390.003 |
| | | | | | **Total** | **1,41E-05** | **71.036** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,01E-03 | **5,01E-03** | **199** |

| **B2. Toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,59E-06 | 1,59E-06 | 629.069 |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,46E-06 | 2,46E-06 | 407.045 |
| | | | | | **Total** | 4,05E-06 | 247.134 |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,44E-03 | **1,44E-03** | **694** |

| **B3. Very toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,34E-09 | 3,34E-09 | 299.437.058 |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,16E-09 | 5,16E-09 | 193.753.391 |
| | | | | | **Total** | **8,50E-09** | **117.635.987** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,51E-05 | **1,51E-05** | **66.061** |

| **C3. Flammable liquid scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,48E-04 | **1,48E-04** | **6.738** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,71E-04 | **3,71E-04** | **2.695** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,11E-03 | 1,11E-03 | 898 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,29E-04 | **2,29E-04** | **4.360** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,73E-04 | **5,73E-04** | **1.744** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,72E-03 | 1,72E-03 | 581 |
| | | | | | **Total** | **1,32E-03** | **756** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Incident without release** | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,97E-03 | **2,97E-03** | **337** |
| **Total incidents with release <100kg** | | | | **Total** | **2,83E-03** | **353** |

| **D3 toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,55E-06 | 4,55E-06 | 219.851 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,14E-05 | 1,14E-05 | 87.940 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,41E-05 | 3,41E-05 | 29.313 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,03E-06 | 7,03E-06 | 142.257 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,76E-05 | 1,76E-05 | 56.903 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,29E-06 | 7,29E-06 | 137.212 |
| | | | | | **Total** | **4,05E-05** | **24.677** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,95E-03 | **1,95E-03** | **512** |
| **Total incidents with release <100kg** | | | | | **Total** | **4,14E-05** | **24.153** |

| **D4 very toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,33E-06 | 1,33E-06 | 752.354 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,32E-06 | 3,32E-06 | 300.942 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 9,97E-06 | 9,97E-06 | 100.314 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,05E-06 | 2,05E-06 | 486.818 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,14E-06 | 5,14E-06 | 194.727 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,54E-05 | 1,54E-05 | 64.909 |
| | | | | | **Total** | **1,18E-05** | **84.448** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,70E-04 | **5,70E-04** | **1.753** |
| **Total incidents with release <100kg** | | | | | **Total** | **2,54E-05** | **39.409** |

| **Totals** | **Kijfhoek-Dordrecht Station** | |
|---|---|---|
| A. Flammable gasses | 1,41E-05 | 71.036 |
| B2. Toxic gasses | 4,05E-06 | 247.134 |
| B3. Very toxic gasses | 8,50E-09 | 117.635.987 |
| C3. Flammable liquids | 1,32E-03 | 756 |
| D3. Toxic liquids | 4,05E-05 | 24.677 |
| D4. Very toxic liquids | 1,18E-05 | 84.448 |
| **Total** | **1,39E-03** | **718** |
| Small scenarios (release <100kg) | **2,90E-03** | **345** |
| Incident without release | **1,20E-02** | **84** |
| Total incidents | **1,63E-02** | **62** |

# Dordrecht Station-Moerdijk Bridge

| | |
|---|---|
| Base probability | 2,20E-08 |
| Switch addition | 3,30E-08 |
| < 40 km/h | 0,62 |
| > 40 km/h | 1,26 |

| Probability per wagon per kilometer | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| Speed < 40 km/h | 1,36E-08 | 4,66E-08 |
| Speed > 40 km/h | 2,77E-08 | 6,07E-08 |

| Chloride subtraction |
|---|
| 5 |

| Track lay out (in kilometers) | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| Speed < 40 km/h | 0 | 0 |
| Speed > 40 km/h | 0 | 10 |

| Number of transports | | | | | |
|---|---|---|---|---|---|
| A | B2 | B3 | C3 | D3 | D4 |
| flammable gasses | toxic gasses | very toxic gasses | flammable liquids | toxic liquids | very toxic liquids |
| 16.560 | 4.760 | 50 | 20.220 | 6.810 | 1.290 |

| Probability of release at low speed (<40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,00032 | 0,00047 | 0,99921 |
| Toxic gasses | B2 | | | 0,00032 | 0,00047 | 0,99921 |
| Very toxic gasses | B3 | | | 0,00032 | 0,00047 | 0,99921 |
| Flammable liquids | C3 | 0,032 | 0,047 | | | 0,921 |
| Toxic liquids | D3 | 0,0032 | 0,0047 | | | 0,9921 |
| Very toxic liquids | D4 | 0,0032 | 0,0047 | | | 0,9921 |

| Probability of release at high speed (>40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,0011 | 0,0017 | 0,9972 |
| Toxic gasses | B2 | | | 0,0011 | 0,0017 | 0,9972 |
| Very toxic gasses | B3 | | | 0,0011 | 0,0017 | 0,9972 |
| Flammable liquids | C3 | 0,22 | 0,34 | | | 0,44 |
| Toxic liquids | D3 | 0,022 | 0,034 | | | 0,944 |
| Very toxic liquids | D4 | 0,022 | 0,034 | | | 0,944 |

| | |
|---|---|
| G1 L | Instanteneous release of whole container volume of liquid |
| G2 L | Continuous release |
| G1 G | Instanteneous release of whole container volume of gas |
| G2 G | Release of gas from a hole of 75 mm diameter |

| Corection voor type of wagon and substance | |
|---|---|
| Toxisch | 0,1 |
| Brandbaar | 1 |

| Ontstekingskans | | | | |
|---|---|---|---|---|
| Brandbaar gas | | Instantaan (direct) | 0,8 | Koude BLEVE |
| | | Instantaan (vertraagd) | 0,2 | Wolkbrand, gasexplosie |

| | | | | |
|---|---|---|---|---|
| | | Continu (direct) | 0,5 | Fakkel |
| | | Continu (vertraagd) | 0,5 | Wolkbrand, gasexplosie |
| | Explosie | Ja | 0,4 | Explosie |
| | | Nee | 0,6 | Wolkbrand |
| Zeer brandbare vloeistof | | Plas | 0,25 | Plasbrand |
| | | | 0,75 | Geen scenario |

| **A. Flammable gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas instantaneous | Cold BLEVE | 0,00E+00 | 0,00E+00 | 0,00E+00 | 8,85E-06 | 8,85E-06 | 113.012 |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 8,85E-07 | 8,85E-07 | 1.130.122 |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,33E-06 | 1,33E-06 | 753.414 |
| G2 Gas continuous | Torch fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 8,55E-06 | 8,55E-06 | 117.001 |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,42E-06 | 3,42E-06 | 292.502 |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,13E-06 | 5,13E-06 | 195.001 |
| | | | | | **Total** | **2,82E-05** | **35.518** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,00E-02 | **1,00E-02** | **100** |

| **B2. Toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,18E-06 | 3,18E-06 | 314.535 |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,91E-06 | 4,91E-06 | 203.522 |
| | | | | | **Total** | 8,09E-06 | 123.567 |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,88E-03 | **2,88E-03** | **347** |

| **B3. Very toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,68E-09 | 6,68E-09 | 149.718.529 |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,03E-08 | 1,03E-08 | 96.876.695 |
| | | | | | **Total** | **1,70E-08** | **58.817.994** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,03E-05 | **3,03E-05** | **33.031** |

| **C3. Flammable liquid scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,70E-04 | **2,70E-04** | **3.702** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,75E-04 | **6,75E-04** | **1.481** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,03E-03 | 2,03E-03 | 494 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,17E-04 | **4,17E-04** | **2.396** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,04E-03 | **1,04E-03** | **958** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,13E-03 | 3,13E-03 | 319 |
| | | | | | **Total** | **2,41E-03** | **416** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,40E-03 | **5,40E-03** | **185** |
| **Total incidents with release <100kg** | | | | | **Total** | **5,16E-03** | **194** |

| **D3 toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 9,10E-06 | 9,10E-06 | 109.925 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,27E-05 | 2,27E-05 | 43.970 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,82E-05 | 6,82E-05 | 14.657 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,41E-05 | 1,41E-05 | 71.128 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,51E-05 | 3,51E-05 | 28.451 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,46E-05 | 1,46E-05 | 68.606 |
| | | | | | **Total** | **8,10E-05** | **12.339** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,90E-03 | **3,90E-03** | **256** |
| **Total incidents with release <100kg** | | | | | **Total** | **8,28E-05** | **12.077** |

| **D4 very toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,72E-06 | 1,72E-06 | 580.304 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,31E-06 | 4,31E-06 | 232.122 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,29E-05 | 1,29E-05 | 77.374 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,66E-06 | 2,66E-06 | 375.491 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,66E-06 | 6,66E-06 | 150.196 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,00E-05 | 2,00E-05 | 50.065 |
| | | | | | **Total** | **1,54E-05** | **65.136** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,39E-04 | **7,39E-04** | **1.352** |
| **Total incidents with release <100kg** | | | | | **Total** | **3,29E-05** | **30.397** |

**Totals** **Dordrecht Station-Moerdijk Bridge**

| | | |
|---|---|---|
| A. Flammable gasses | 2,82E-05 | 35.518 |
| B2. Toxic gasses | 8,09E-06 | 123.567 |
| B3. Very toxic gasses | 1,70E-08 | 58.817.994 |
| C3. Flammable liquids | 2,41E-03 | 416 |
| D3. Toxic liquids | 8,10E-05 | 12.339 |
| D4. Very toxic liquids | 1,54E-05 | 65.136 |
| **Total** | **2,54E-03** | **394** |

| | | |
|---|---|---|
| Small scenarios (release <100kg) | **5,27E-03** | **190** |

| | | |
|---|---|---|
| Incident without release | **2,30E-02** | **44** |

| | | |
|---|---|---|
| Total incidents | **3,08E-02** | **32** |

# Kijfhoek North

| | |
|---|---|
| Base probability | 2,20E-08 |
| Switch addition | 3,30E-08 |
| < 40 km/h | 0,62 |
| > 40 km/h | 1,26 |

| **Probability per wagon per kilometer** | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| Speed < 40 km/h | 1,36E-08 | 4,66E-08 |
| Speed > 40 km/h | 2,77E-08 | 6,07E-08 |

| Chloride subtraction |
|---|
| 5 |

| **Track lay out (in kilometers)** | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| Speed < 40 km/h | 0 | 0 |
| Speed > 40 km/h | 0 | 1 |

| Number of transports | | | | | |
|---|---|---|---|---|---|
| A | B2 | B3 | C3 | D3 | D4 |
| flammable gasses | toxic gasses | very toxic gasses | flammable liquids | toxic liquids | very toxic liquids |
| 34.440 | 18.650 | 560 | 151.780 | 12.910 | 4.590 |

| Probability of release at low speed (<40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,00032 | 0,00047 | 0,99921 |
| Toxic gasses | B2 | | | 0,00032 | 0,00047 | 0,99921 |
| Very toxic gasses | B3 | | | 0,00032 | 0,00047 | 0,99921 |
| Flammable liquids | C3 | 0,032 | 0,047 | | | 0,921 |
| Toxic liquids | D3 | 0,0032 | 0,0047 | | | 0,9921 |
| Very toxic liquids | D4 | 0,0032 | 0,0047 | | | 0,9921 |

| Probability of release at high speed (>40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,0011 | 0,0017 | 0,9972 |
| Toxic gasses | B2 | | | 0,0011 | 0,0017 | 0,9972 |
| Very toxic gasses | B3 | | | 0,0011 | 0,0017 | 0,9972 |
| Flammable liquids | C3 | 0,22 | 0,34 | | | 0,44 |
| Toxic liquids | D3 | 0,022 | 0,034 | | | 0,944 |
| Very toxic liquids | D4 | 0,022 | 0,034 | | | 0,944 |

| | |
|---|---|
| G1 L | Instanteneous release of whole container volume of liquid |
| G2 L | Continuous release |
| G1 G | Instanteneous release of whole container volume of gas |
| G2 G | Release of gas from a hole of 75 mm diameter |

| Corection voor type of wagon and substance | |
|---|---|
| Toxisch | 0,1 |
| Brandbaar | 1 |

| Ontstekingskans | | | | |
|---|---|---|---|---|
| Brandbaar gas | | Instantaan (direct) | 0,8 | Koude BLEVE |
| | | Instantaan (vertraagd) | 0,2 | Wolkbrand, gasexplosie |

| | | | | |
|---|---|---|---|---|
| | | Continu (direct) | 0,5 | Fakkel |
| | | Continu (vertraagd) | 0,5 | Wolkbrand, gasexplosie |
| | Explosie | Ja | 0,4 | Explosie |
| | | Nee | 0,6 | Wolkbrand |
| Zeer brandbare vloeistof | | Plas | 0,25 | Plasbrand |
| | | | 0,75 | Geen scenario |

| **A. Flammable gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas instantaneous | Cold BLEVE | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,84E-06 | 1,84E-06 | 543.403 |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,84E-07 | 1,84E-07 | 5.434.035 |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,76E-07 | 2,76E-07 | 3.622.690 |
| G2 Gas continuous | Torch fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,78E-06 | 1,78E-06 | 562.582 |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,11E-07 | 7,11E-07 | 1.406.456 |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,07E-06 | 1,07E-06 | 937.637 |
| | | | | | **Total** | **5,86E-06** | **170.784** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,09E-03 | **2,09E-03** | **480** |

| **B2. Toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,25E-06 | 1,25E-06 | 802.780 |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,93E-06 | 1,93E-06 | 519.446 |
| | | | | | **Total** | 3,17E-06 | 315.378 |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,13E-03 | **1,13E-03** | **886** |

| **B3. Very toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,48E-09 | 7,48E-09 | 133.677.258 |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,16E-08 | 1,16E-08 | 86.497.049 |
| | | | | | **Total** | **1,90E-08** | **52.516.066** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,39E-05 | **3,39E-05** | **29.492** |

| **C3. Flammable liquid scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,03E-04 | **2,03E-04** | **4.932** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,07E-04 | **5,07E-04** | **1.973** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,52E-03 | 1,52E-03 | 658 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,13E-04 | **3,13E-04** | **3.191** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,83E-04 | **7,83E-04** | **1.277** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,35E-03 | 2,35E-03 | 426 |
| | | | | | **Total** | **1,81E-03** | **554** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,06E-03 | **4,06E-03** | **247** |
| **Total incidents with release <100kg** | | | | | **Total** | **3,87E-03** | **258** |

| **D3 toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,72E-06 | 1,72E-06 | 579.855 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,31E-06 | 4,31E-06 | 231.942 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,29E-05 | 1,29E-05 | 77.314 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,67E-06 | 2,67E-06 | 375.200 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,66E-06 | 6,66E-06 | 150.080 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,76E-06 | 2,76E-06 | 361.895 |
| | | | | | **Total** | **1,54E-05** | **65.086** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,40E-04 | **7,40E-04** | **1.351** |
| **Total incidents with release <100kg** | | | | | **Total** | **1,57E-05** | **63.704** |

| **D4 very toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,13E-07 | 6,13E-07 | 1.630.921 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,53E-06 | 1,53E-06 | 652.368 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,60E-06 | 4,60E-06 | 217.456 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 9,48E-07 | 9,48E-07 | 1.055.302 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,37E-06 | 2,37E-06 | 422.121 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,11E-06 | 7,11E-06 | 140.707 |
| | | | | | **Total** | **5,46E-06** | **183.063** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,63E-04 | **2,63E-04** | **3.801** |
| **Total incidents with release <100kg** | | | | | **Total** | **1,17E-05** | **85.429** |

| **Totals** | **Kijfhoek North** | |
|---|---|---|
| A. Flammable gasses | 5,86E-06 | 170.784 |
| B2. Toxic gasses | 3,17E-06 | 315.378 |
| B3. Very toxic gasses | 1,90E-08 | 52.516.066 |
| C3. Flammable liquids | 1,81E-03 | 554 |
| D3. Toxic liquids | 1,54E-05 | 65.086 |
| D4. Very toxic liquids | 5,46E-06 | 183.063 |
| **Total** | **1,84E-03** | **545** |
| Small scenarios (release <100kg) | **3,90E-03** | **257** |
| Incident without release | **8,31E-03** | **120** |
| Total incidents | **1,40E-02** | **71** |

# Dordrecht Station-DuPont SEVESO

| | |
|---|---|
| Base probability | 2,20E-08 |
| Switch addition | 3,30E-08 |
| < 40 km/h | 0,62 |
| > 40 km/h | 1,26 |

| **Probability per wagon per kilometer** | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| Speed < 40 km/h | 1,36E-08 | 4,66E-08 |
| Speed > 40 km/h | 2,77E-08 | 6,07E-08 |

| Chloride subtraction |
|---|
| 5 |

| **Track lay out (in kilometers)** | | |
|---|---|---|
| Speed ↓ switch → | Without switch | With switch |
| Speed < 40 km/h | 0 | 0 |
| Speed > 40 km/h | 0 | 6 |

| Number of transports | | | | | |
|---|---|---|---|---|---|
| A | B2 | B3 | C3 | D3 | D4 |
| flammable gasses | toxic gasses | very toxic gasses | flammable liquids | toxic liquids | very toxic liquids |
| 0 | 0 | 0 | 2.000 | 0 | 700 |

| Probability of release at low speed (<40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,00032 | 0,00047 | 0,99921 |
| Toxic gasses | B2 | | | 0,00032 | 0,00047 | 0,99921 |
| Very toxic gasses | B3 | | | 0,00032 | 0,00047 | 0,99921 |
| Flammable liquids | C3 | 0,032 | 0,047 | | | 0,921 |
| Toxic liquids | D3 | 0,0032 | 0,0047 | | | 0,9921 |
| Very toxic liquids | D4 | 0,0032 | 0,0047 | | | 0,9921 |

| Probability of release at high speed (>40kmh) per substance category | | LOC | | | | |
|---|---|---|---|---|---|---|
| | | G1 L | G2 L | G1 G | G2 G | No release |
| Flammable gasses | A | | | 0,0011 | 0,0017 | 0,9972 |
| Toxic gasses | B2 | | | 0,0011 | 0,0017 | 0,9972 |
| Very toxic gasses | B3 | | | 0,0011 | 0,0017 | 0,9972 |
| Flammable liquids | C3 | 0,22 | 0,34 | | | 0,44 |
| Toxic liquids | D3 | 0,022 | 0,034 | | | 0,944 |
| Very toxic liquids | D4 | 0,022 | 0,034 | | | 0,944 |

| | |
|---|---|
| G1 L | Instanteneous release of whole container volume of liquid |
| G2 L | Continuous release |
| G1 G | Instanteneous release of whole container volume of gas |
| G2 G | Release of gas from a hole of 75 mm diameter |

| Corection voor type of wagon and substance | |
|---|---|
| Toxisch | 0,1 |
| Brandbaar | 1 |

| Ontstekingskans | | | | |
|---|---|---|---|---|
| Brandbaar gas | | Instantaan (direct) | 0,8 | Koude BLEVE |
| | | Instantaan (vertraagd) | 0,2 | Wolkbrand, gasexplosie |
| | | Continu (direct) | 0,5 | Fakkel |

| | | | | |
|---|---|---|---|---|
| | | Continu (vertraagd) | 0,5 | Wolkbrand, gasexplosie |
| | Explosie | Ja | 0,4 | Explosie |
| | | Nee | 0,6 | Wolkbrand |
| Zeer brandbare vloeistof | | Plas | 0,25 | Plasbrand |
| | | | 0,75 | Geen scenario |

| **A. Flammable gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas instantaneous | Cold BLEVE | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| G2 Gas continuous | Torch fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | Explosion | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | Cloud fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | | | | | **Total** | **0,00E+00** | **#DEEL/0!** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | **0,00E+00** | **#DEEL/0!** |

| **B2. Toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | | | | | **Total** | 0,00E+00 | #DEEL/0! |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | **0,00E+00** | **#DEEL/0!** |

| **B3. Very toxic gas scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Gas | Toxic gas cloud (instantaneous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| G2 Gas | Toxic gas cloud (continuous) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | | | | | **Total** | **0,00E+00** | **#DEEL/0!** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | **0,00E+00** | **#DEEL/0!** |

| **C3. Flammable liquid scenarios** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,60E-05 | **1,60E-05** | **62.383** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,01E-05 | **4,01E-05** | **24.953** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,20E-04 | 1,20E-04 | 8.318 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,48E-05 | **2,48E-05** | **40.365** |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,19E-05 | **6,19E-05** | **16.146** |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,86E-04 | 1,86E-04 | 5.382 |
| | | | | | **Total** | **1,43E-04** | **7.002** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 3,21E-04 | **3,21E-04** | **3.119** |
| **Total incidents with release <100kg** | | | | | **Total** | **3,06E-04** | **3.268** |

| **D3 toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | #DEEL/0! |
| | | | | | **Total** | **0,00E+00** | **#DEEL/0!** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | **0,00E+00** | **#DEEL/0!** |
| **Total incidents with release <100kg** | | | | | **Total** | **0,00E+00** | **#DEEL/0!** |

| **D4 very toxic liquids** | | Without switch | | With switch | | Total | |
|---|---|---|---|---|---|---|---|
| | | low speed | high speed | low speed | high speed | **Total** | **Once every ..** |
| G1 Liquid big | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 5,61E-07 | 5,61E-07 | 1.782.363 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,40E-06 | 1,40E-06 | 712.945 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 4,21E-06 | 4,21E-06 | 237.648 |
| G2 Liquid small | Toxic effect | 0,00E+00 | 0,00E+00 | 0,00E+00 | 8,67E-07 | 8,67E-07 | 1.153.294 |
| | Pool fire | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,17E-06 | 2,17E-06 | 461.318 |
| | No scenario (less then 100kg) | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,50E-06 | 6,50E-06 | 153.773 |
| | | | | | **Total** | **5,00E-06** | **200.061** |
| **Incident without release** | | 0,00E+00 | 0,00E+00 | 0,00E+00 | 2,41E-04 | **2,41E-04** | **4.154** |
| **Total incidents with release <100kg** | | | | | **Total** | **1,07E-05** | **93.362** |

**Totals** **Dordrecht Station-DuPont SEVESO**

| | | |
|---|---|---|
| A. Flammable gasses | | |
| B2. Toxic gasses | | |
| B3. Very toxic gasses | | |
| C3. Flammable liquids | 1,43E-04 | 7.002 |
| D3. Toxic liquids | | |
| D4. Very toxic liquids | 5,00E-06 | 200.061 |
| **Total** | **1,48E-04** | **6.765** |

| | | |
|---|---|---|
| Small scenarios (release <100kg) | **3,17E-04** | **3.157** |

| | | |
|---|---|---|
| Incident without release | **5,61E-04** | **1.781** |

| | | |
|---|---|---|
| Total incidents | **1,03E-03** | **975** |

Annex II.

# Impact analysis

*(in Dutch)*

## Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

| | |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |

**Scenario** Ammoniac instantaneous

**WAARSCHIJNLIJKHEID** 1

| Waarschijnlijkheidsklassen | | | % waarschijnlijkheid elke 5 jaar | Nummerieke code voor invulveld | Eens in de … jaar | |
|---|---|---|---|---|---|---|
| | | | | | Ondergrens | Bovengrens |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

**IMPACT** E

**(totaalscore)**

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | A |
| 2.1 | Doden | E |
| 2.2 | Ernstig gewonden en chronisch zieken | Dhoog |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | D |
| 4.1 | Langdurige aantasting milieu & natuur | A |
| 5.1 | Verstoring van het dagelijks leven | E |
| 5.2 | Aantasting positie bestuur | D |
| 5.3 | Sociaal psychologische impact | E |
| 6.1 | Aantasting van cultureel erfgoed | C |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

| | | | | | |
|---|---|---|---|---|---|
| **A** | **Oppervlakte (km²)** | 1 | **Duur** | 2-6 dagen | |

| | **wijk/dorp max. 4 km²** | **lokaal 4-40 km²** | **gemeentelijk 40 - 400 km²** | **regionaal > 400 km²** |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

| | | | | |
|---|---|---|---|---|
| **E** | **Aantal** | 1250 | **Vervroegd of direct** | Direct |

| | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

| | | |
|---|---|---|
| **Dhoog** | **Aantal** | 350 |

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

| | | | | |
|---|---|---|---|---|
| **0** | **Aantal** | 0 | **Duur** | NVT |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

D

| | |
|---|---|
| **Totaal** | **€ 322.258.333** |
| **Materiële schade** | € 0 |
| **Gezondheidschade** | € 316.800.000 |
| **Financiële schade** | € 458.333 |
| **Bestrijdingskosten** | € 5.000.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 0 | Eengezinswoningen |
| 0 | Boerderijen |
| 0 | Overige woningen |
| 0 | Brug/viaduct |
| 0 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 0 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 1250 | Doden |
| 350 | Zwaargewonden (T1/T2) |
| 1280 | Lichtgewonden (T3) |
| 116 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 5000 | m2 bedrijfsoppervlak |
| 2 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

A

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**

1

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| E | Aantal getroffenen | 10.000 | Tijdsduur | 1 week tot 1 maand | Aantal indicatoren | 3 | score plus 1! |

| | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | |
|---|---|---|---|---|---|---|
| D | Aantal indicatoren | 2 | Eindgradatie aantasting | AANZIENLIJK | Tijdsduur | Aantal weken |

**Indicatoren van toepassing**

Aantasting van…

| | |
|---|---|
| **AANZIENLIJK** | functioneren politieke vertegenwoordiging |
| **BEPERKT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

## 5.3 Sociaal psychologische impact

**E**

**Aantal significante categorieën** 3

**Eindgradatie** HOOG

| **Eindgradatie ↓** | **0 significante categorieën** | **1 significante categorie** | **2 significante categorieën** | **3 significante categorieën** |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | | | X |
| 1b onzekerheid | | | | | X |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 1 | 2 |

**Categorie 1 is significant** **JA**

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | | | X |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | | | X |
| 2c vertrouwensverlies in hulp-diensten | | | | | X |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 0 | 3 |

**Categorie 2 is significant** **JA**

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | NVT | 'geen' | 'beperkt' | 'gemiddeld' | 'aanzienlijk' |
| **3 Handelingsperspectief** | | | | | |
| 3a onwetendheid | | | | X | |
| 3b geen zelfredzaamheid | | | | | X |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 1 | 1 |

**Categorie 3 is significant** **JA**

## 6. Veiligheid cultureel erfgoed

### 6.1 Aantasting van cultureel erfgoed

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | **C** | **Aantal getroffen instellingen of objecten** | **1 of 2** | **Aantal indicatoren** | 0 | **Hoogste score gegeven door 2 of meer soorten erfgoed** | **NEE** |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

| | **Indicatoren van toepassing (JA/NEE)** |
|---|---|
| **NEE** | Genomen preventieve beschermingsmaatregelen |
| **NEE** | Geborgde mogelijkheden voor zelfredzaamheid |
| **NEE** | Geborgde mogelijkheden voor bereddering door hulpdiensten |

## Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

| | |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |

| | |
|---|---|
| **Scenario** | Ammoniac big outflow |

| | |
|---|---|
| **WAARSCHIJNLIJKHEID** | **1** |

| **Waarschijnlijkheidsklassen** | | | **% waarschijnlijkheid elke 5 jaar** | **Nummerieke code voor invulveld** | **Eens in de … jaar** | |
|---|---|---|---|---|---|---|
| | | | | | **Ondergrens** | **Bovengrens** |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

| | |
|---|---|
| **IMPACT**<br>**(totaalscore)** | **E** |

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | A |
| 2.1 | Doden | E |
| 2.2 | Ernstig gewonden en chronisch zieken | Dhoog |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | C |
| 4.1 | Langdurige aantasting milieu & natuur | A |
| 5.1 | Verstoring van het dagelijks leven | E |
| 5.2 | Aantasting positie bestuur | C |
| 5.3 | Sociaal psychologische impact | E |
| 6.1 | Aantasting van cultureel erfgoed | C |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

| | | | | |
|---|---|---|---|---|
| A | Oppervlakte (km$^2$) | 1 | Duur | 2-6 dagen |

| | wijk/dorp max. 4 km$^2$ | lokaal 4-40 km$^2$ | gemeentelijk 40 - 400 km$^2$ | regionaal > 400 km$^2$ |
|---|---|---|---|---|
| 2-6 dagen | A | A | B | C |
| 1-4 weken | A | B | C | D |
| 1 tot 6 maanden | B | C | D | E |
| 1/2 jaar of langer | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

| | | | | |
|---|---|---|---|---|
| E | Aantal | 500 | Vervroegd of direct | Direct |

| | 1 | 2-4 | 4-16 | 16-40 | 40-160 | 160-400 | >400 |
|---|---|---|---|---|---|---|---|
| Direct | A | B | C | Choog | D | Dhoog | E |
| Vervroegd | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

| | | |
|---|---|---|
| Dhoog | Aantal | 320 |

| Aantal | 1 | 2-4 | 4-16 | 16-40 | 40-160 | 160-400 | >400 |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

| | | | | |
|---|---|---|---|---|
| 0 | Aantal | 0 | Duur | NVT |

| | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| 2-6 dagen | A | B | C | D |
| 1-4 weken | B | C | D | E |
| 1 maand of langer | C | D | E | E |

# 3. Economische veiligheid

## 3.1 Kosten

C

| | |
|---|---|
| **Totaal** | **€ 185.595.833** |
| **Materiële schade** | € 0 |
| **Gezondheidschade** | € 183.550.000 |
| **Financiële schade** | € 45.833 |
| **Bestrijdingskosten** | € 2.000.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 0 | Eengezinswoningen |
| 0 | Boerderijen |
| 0 | Overige woningen |
| 0 | Brug/viaduct |
| 0 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 0 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 500 | Doden |
| 320 | Zwaargewonden (T1/T2) |
| 400 | Lichtgewonden (T3) |
| 107 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 1000 | m2 bedrijfsoppervlak |
| 1 | Aantal maanden niet bruikbaar |

# 4. Ecologische veiligheid

## 4.1 Langdurige aantasting van milieu en natuur

A

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**

1

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **E** | **Aantal getroffenen** | 10.000 | **Tijdsduur** | **1 week tot 1 maand** | **Aantal indicatoren** | **3** | **score plus 1!** |

| | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | |
|---|---|---|---|---|---|---|
| **C** | **Aantal indicatoren** | 2 | **Eindgradatie aantasting** | **GEMIDDELD** | **Tijdsduur** | Aantal weken |

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **GEMIDDELD** | functioneren politieke vertegenwoordiging |
| **BEPERKT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

## 5.3 Sociaal psychologische impact

**E**

**Aantal significante categorieën** 3

**Eindgradatie** HOOG

| **Eindgradatie ↓** | **0 significante categorieën** | **1 significante categorie** | **2 significante categorieën** | **3 significante categorieën** |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **‘geen’** | **‘beperkt’** | **‘gemiddeld’** | **‘aanzienlijk’** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | | | X |
| 1b onzekerheid | | | | | X |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 1 | 2 |

**Categorie 1 is significant** **JA**

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **‘geen’** | **‘beperkt’** | **‘gemiddeld’** | **‘aanzienlijk’** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | | | X |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | | | X |
| 2c vertrouwensverlies in hulpdiensten | | | | X | |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 1 | 2 |

**Categorie 2 is significant** **JA**

|  | irrelevant | relevant en dus van toepassing, treedt al dan niet op |  |  |  |
|---|---|---|---|---|---|
|  | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **3 Handelingsperspectief** |  |  |  |  |  |
| 3a onwetendheid |  |  |  | X |  |
| 3b geen zelfredzaamheid |  |  |  |  | X |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 1 | 1 |
|  |  |  |  | **Categorie 3 is significant** | **JA** |

## 6. Veiligheid cultureel erfgoed

### 6.1 Aantasting van cultureel erfgoed

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | C | **Aantal getroffen instellingen of objecten** | **1 of 2** | **Aantal indicatoren** | 0 | **Hoogste score gegeven door 2 of meer soorten erfgoed** | **NEE** |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

|  | **Indicatoren van toepassing (JA/NEE)** |
|---|---|
| **NEE** | Genomen preventieve beschermingsmaatregelen |
| **NEE** | Geborgde mogelijkheden voor zelfredzaamheid |
| **NEE** | Geborgde mogelijkheden voor beredderding door hulpdiensten |

# Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

| | |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |

**Scenario** Ammoniac small outflow

**WAARSCHIJNLIJKHEID** 2

| Waarschijnlijkheidsklassen | | | % waarschijnlijkheid elke 5 jaar | Nummerieke code voor invulveld | Eens in de … jaar | |
|---|---|---|---|---|---|---|
| | | | | | Ondergrens | Bovengrens |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

**IMPACT** D

**(totaalscore)**

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | A |
| 2.1 | Doden | D |
| 2.2 | Ernstig gewonden en chronisch zieken | D |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | C |
| 4.1 | Langdurige aantasting milieu & natuur | A |
| 5.1 | Verstoring van het dagelijks leven | C |
| 5.2 | Aantasting positie bestuur | C |
| 5.3 | Sociaal psychologische impact | D |
| 6.1 | Aantasting van cultureel erfgoed | 0 |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

| | | | | | |
|---|---|---|---|---|---|
| **A** | **Oppervlakte ($km^2$)** | 1 | **Duur** | 2-6 dagen | |

| | **wijk/dorp max. 4 $km^2$** | **lokaal 4-40 $km^2$** | **gemeentelijk 40 - 400 $km^2$** | **regionaal > 400 $km^2$** |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

| | | | | |
|---|---|---|---|---|
| **D** | **Aantal** | 50 | **Vervroegd of direct** | Direct |

| | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

| | | |
|---|---|---|
| **D** | **Aantal** | 50 |

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

| | | | | |
|---|---|---|---|---|
| **0** | **Aantal** | 0 | **Duur** | NVT |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

**C**

| | |
|---|---|
| **Totaal** | **€ 25.945.833** |
| **Materiële schade** | € 0 |
| **Gezondheidschade** | € 23.900.000 |
| **Financiële schade** | € 45.833 |
| **Bestrijdingskosten** | € 2.000.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 0 | Eengezinswoningen |
| 0 | Boerderijen |
| 0 | Overige woningen |
| 0 | Brug/viaduct |
| 0 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 0 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 50 | Doden |
| 50 | Zwaargewonden (T1/T2) |
| 100 | Lichtgewonden (T3) |
| 16 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 1000 | m2 bedrijfsoppervlak |
| 1 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

**A**

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**: 1

**Meer dan 10 jaar**: NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| C | **Aantal getroffenen** | 1.000 | **Tijdsduur** | **3 dagen tot 1 week** | **Aantal indicatoren** | **3** | **score plus 1!** |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | |
|---|---|---|---|---|---|---|
| C | **Aantal indicatoren** | 2 | **Eindgradatie aantasting** | **GEMIDDELD** | **Tijdsduur** | Aantal weken |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **GEMIDDELD** | functioneren politieke vertegenwoordiging |
| **BEPERKT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

## 5.3 Sociaal psychologische impact

D

**Aantal significante categorieën** 2

**Eindgradatie** HOOG

| **Eindgradatie ↓** | **0 significante categorieën** | **1 significante categorie** | **2 significante categorieën** | **3 significante categorieën** |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **‘geen’** | **‘beperkt’** | **‘gemiddeld’** | **‘aanzienlijk’** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | | | X |
| 1b onzekerheid | | | | | X |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 1 | 2 |

**Categorie 1 is significant** **JA**

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **‘geen’** | **‘beperkt’** | **‘gemiddeld’** | **‘aanzienlijk’** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | | | X |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | | X | |
| 2c vertrouwensverlies in hulp-diensten | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 1 | 1 |

**Categorie 2 is significant** **JA**

|  | irrelevant | relevant en dus van toepassing, treedt al dan niet op |  |  |  |
|---|---|---|---|---|---|
|  | NVT | 'geen' | 'beperkt' | 'gemiddeld' | 'aanzienlijk' |
| **3 Handelingsperspectief** |  |  |  |  |  |
| 3a onwetendheid |  |  |  | X |  |
| 3b geen zelfredzaamheid |  |  |  | X |  |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 2 | 0 |
|  |  |  |  | **Categorie 3 is significant** | **NEE** |

## 6. Veiligheid cultureel erfgoed

### 6.1 Aantasting van cultureel erfgoed

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| **0** | **Aantal getroffen instellingen of objecten** | **GEEN** | **Aantal indicatoren** | 0 | **Hoogste score gegeven door 2 of meer soorten erfgoed** |  |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

**Indicatoren van toepassing (JA/NEE)**

|  |  |
|---|---|
|  | Genomen preventieve beschermingsmaatregelen |
|  | Geborgde mogelijkheden voor zelfredzaamheid |
|  | Geborgde mogelijkheden voor bereddering door hulpdiensten |

# Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

| | |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |

**Scenario** HF big outflow

**WAARSCHIJNLIJKHEID** 3

| Waarschijnlijkheidsklassen | | | % waarschijnlijkheid elke 5 jaar | Nummerieke code voor invulveld | Eens in de ... jaar | |
|---|---|---|---|---|---|---|
| | | | | | Ondergrens | Bovengrens |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

**IMPACT** E

**(totaalscore)**

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | B |
| 2.1 | Doden | E |
| 2.2 | Ernstig gewonden en chronisch zieken | E |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | D |
| 4.1 | Langdurige aantasting milieu & natuur | A |
| 5.1 | Verstoring van het dagelijks leven | E |
| 5.2 | Aantasting positie bestuur | C |
| 5.3 | Sociaal psychologische impact | E |
| 6.1 | Aantasting van cultureel erfgoed | 0 |

## 1. Territoriale veiligheid

**1.1 Aantasting van de integriteit van het grondgebied** B

**Oppervlakte (km$^2$)** 5

**Duur** 1-4 weken

| | wijk/dorp max. 4 km$^2$ | lokaal 4-40 km$^2$ | gemeentelijk 40 - 400 km$^2$ | regionaal > 400 km$^2$ |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

**2.1 Doden** E

**Aantal** 1000

**Vervroegd of direct** Direct

| | 1 | 2-4 | 4-16 | 16-40 | 40-160 | 160-400 | >400 |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

**2.2 Ernstig gewonden en chronisch zieken (T1, T2)** E

**Aantal** 2000

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

**2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)** 0

**Aantal** 0

**Duur** NVT

| | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

**D**

| | |
|---|---|
| **Totaal** | **€ 797.595.833** |
| **Materiële schade** | € 0 |
| **Gezondheidschade** | € 795.550.000 |
| **Financiële schade** | € 45.833 |
| **Bestrijdingskosten** | € 2.000.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 0 | Eengezinswoningen |
| 0 | Boerderijen |
| 0 | Overige woningen |
| 0 | Brug/viaduct |
| 0 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 0 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 1000 | Doden |
| 2000 | Zwaargewonden (T1/T2) |
| 400 | Lichtgewonden (T3) |
| 667 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 1000 | m2 bedrijfsoppervlak |
| 1 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

**A**

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**

1

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

|  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
| **5.1 Verstoring van het dagelijks leven** | **E** | **Aantal getroffenen** | 10.000 | **Tijdsduur** | **1 week tot 1 maand** | **Aantal indicatoren** | **3** | **score plus 1!** |

|  | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

|  |  |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| **5.2 Aantasting van positie van het lokale en regionale bestuur** | **C** | **Aantal indicatoren** | 2 | **Eindgradatie aantasting** | **GEMIDDELD** | **Tijdsduur** | Aantal weken |

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

**Indicatoren van toepassing**

Aantasting van…

|  |  |
|---|---|
| **GEMIDDELD** | functioneren politieke vertegenwoordiging |
| **BEPERKT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

## 5.3 Sociaal psychologische impact

**E**

**Aantal significante categorieën** 3

**Eindgradatie** HOOG

| **Eindgradatie ↓** | **0 significante categorieën** | **1 significante categorie** | **2 significante categorieën** | **3 significante categorieën** |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | | | X |
| 1b onzekerheid | | | | | X |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 1 | 2 |

**Categorie 1 is significant** **JA**

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | | | X |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | | | X |
| 2c vertrouwensverlies in hulp-diensten | | | | | X |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 0 | 3 |

**Categorie 2 is significant** **JA**

|  | irrelevant | relevant en dus van toepassing, treedt al dan niet op |  |  |  |
|---|---|---|---|---|---|
|  | NVT | 'geen' | 'beperkt' | 'gemiddeld' | 'aanzienlijk' |
| **3 Handelingsperspectief** |  |  |  |  |  |
| 3a onwetendheid |  |  |  | X |  |
| 3b geen zelfredzaamheid |  |  |  |  | X |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 1 | 1 |

**Categorie 3 is significant** **JA**

## 6. Veiligheid cultureel erfgoed

### 6.1 Aantasting van cultureel erfgoed

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | **0** | **Aantal getroffen instellingen of objecten** | **GEEN** | **Aantal indicatoren** | 0 | **Hoogste score gegeven door 2 of meer soorten erfgoed** | |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

| | **Indicatoren van toepassing (JA/NEE)** |
|---|---|
| | Genomen preventieve beschermingsmaatregelen |
| | Geborgde mogelijkheden voor zelfredzaamheid |
| | Geborgde mogelijkheden voor bereddering door hulpdiensten |

## Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

| | |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |
| **Scenario** | HF small outflow |

| | |
|---|---|
| **WAARSCHIJNLIJKHEID** | 4 |

| **Waarschijnlijkheidsklassen** | | | **% waarschijnlijkheid elke 5 jaar** | **Nummerieke code voor invulveld** | **Eens in de … jaar** | |
|---|---|---|---|---|---|---|
| | | | | | **Ondergrens** | **Bovengrens** |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

| | |
|---|---|
| **IMPACT**<br>**(totaalscore)** | D |

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | A |
| 2.1 | Doden | Dhoog |
| 2.2 | Ernstig gewonden en chronisch zieken | E |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | D |
| 4.1 | Langdurige aantasting milieu & natuur | A |
| 5.1 | Verstoring van het dagelijks leven | C |
| 5.2 | Aantasting positie bestuur | C |
| 5.3 | Sociaal psychologische impact | D |
| 6.1 | Aantasting van cultureel erfgoed | 0 |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

| | | | | | |
|---|---|---|---|---|---|
| **A** | **Oppervlakte (km$^2$)** | 1 | **Duur** | 2-6 dagen |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

| | | | | |
|---|---|---|---|---|
| **Dhoog** | **Aantal** | 350 | **Vervroegd of direct** | Direct |

| | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

| | | |
|---|---|---|
| **E** | **Aantal** | 500 |

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

| | | | | |
|---|---|---|---|---|
| **0** | **Aantal** | 0 | **Duur** | NVT |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

D

| | |
|---|---|
| **Totaal** | **€ 217.595.833** |
| **Materiële schade** | € 0 |
| **Gezondheidschade** | € 216.550.000 |
| **Financiële schade** | € 45.833 |
| **Bestrijdingskosten** | € 1.000.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 0 | Eengezinswoningen |
| 0 | Boerderijen |
| 0 | Overige woningen |
| 0 | Brug/viaduct |
| 0 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 0 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 350 | Doden |
| 500 | Zwaargewonden (T1/T2) |
| 400 | Lichtgewonden (T3) |
| 167 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 1000 | m2 bedrijfsoppervlak |
| 1 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

A

*Hoogste score geldt!*

| | **Aantal hectare aangetast natuurgebied** |
|---|---|
| Broedgeb. | |
| EHS | |
| Natura2000 | |

**Aantal km2 verontreinigd oppervlak regio**

1

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 $km^2$** | **lokaal 4-40 $km^2$** | **gemeentelijk 40 - 400 $km^2$** | **regionaal > 400 $km^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

# 5. Sociale en politieke stabiliteit

## 5.1 Verstoring van het dagelijks leven

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **C** | **Aantal getroffenen** | 1.000 | **Tijdsduur** | **3 dagen tot 1 week** | **Aantal indicatoren** | **3** | **score plus 1!** |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

## 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **C** | **Aantal indicatoren** | 2 | **Eindgradatie aantasting** | **GEMIDDELD** | **Tijdsduur** | Aantal weken | |

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **GEMIDDELD** | functioneren politieke vertegenwoordiging |
| **BEPERKT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

## 5.3 Sociaal psychologische impact

| | | | | |
|---|---|---|---|---|
| D | **Aantal significante categorieën** | 2 | **Eindgradatie** | HOOG |

| **Eindgradatie ↓** | **0 significante categorieën** | **1 significante categorie** | **2 significante categorieën** | **3 significante categorieën** |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | | | X |
| 1b onzekerheid | | | | | X |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 1 | 2 |
| | | | | **Categorie 1 is significant** | **JA** |

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | | | X |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | | X | |
| 2c vertrouwensverlies in hulpdiensten | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 1 | 1 |
| | | | | **Categorie 2 is significant** | **JA** |

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | NVT | 'geen' | 'beperkt' | 'gemiddeld' | 'aanzienlijk' |
| **3 Handelingsperspectief** | | | | | |
| 3a onwetendheid | | | | X | |
| 3b geen zelfredzaamheid | | | | X | |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 2 | 0 |
| | | | | **Categorie 3 is significant** | **NEE** |

## 6. Veiligheid cultureel erfgoed

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | **0** | **Aantal getroffen instellingen of objecten** | **GEEN** | **Aantal indicatoren** | 0 | **Hoogste score gegeven door 2 of meer soorten erfgoed** | |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| | Genomen preventieve beschermingsmaatregelen |
| | Geborgde mogelijkheden voor zelfredzaamheid |
| | Geborgde mogelijkheden voor bereddering door hulpdiensten |

# Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

|  |  |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |

**Scenario** BLEVE LPG

## WAARSCHIJNLIJKHEID

**2**

| **Waarschijnlijkheidsklassen** |  |  | **% waarschijnlijkheid elke 5 jaar** | **Nummerieke code voor invulveld** | **Eens in de … jaar** |  |
|---|---|---|---|---|---|---|
|  |  |  |  |  | **Ondergrens** | **Bovengrens** |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 |  | 100.000 |
|  |  | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
|  |  | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
|  |  | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
|  |  | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
|  |  | C-middel | 1 – 2,5 | 8 | 500 | 200 |
|  |  | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
|  |  | D-middel | 10 – 25 | 11 | 50 | 20 |
|  |  | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag |  | 13 | 10 | 5 |
|  |  | E-middel | 50 – 100 | 14 | 5 | 2 |
|  |  | E-hoog |  | 15 | 2 |  |

## IMPACT

**(totaalscore)**

**E**

|  |  |  |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | C |
| 2.1 | Doden | E |
| 2.2 | Ernstig gewonden en chronisch zieken | E |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | D |
| 4.1 | Langdurige aantasting milieu & natuur | 0 |
| 5.1 | Verstoring van het dagelijks leven | E |
| 5.2 | Aantasting positie bestuur | D |
| 5.3 | Sociaal psychologische impact | C |
| 6.1 | Aantasting van cultureel erfgoed | B |

## 1. Territoriale veiligheid

| | | | | | |
|---|---|---|---|---|---|
| **1.1 Aantasting van de integriteit van het grondgebied** | C | **Oppervlakte (km$^2$)** | 1 | **Duur** | 1/2 jaar of langer |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

| | | | | | |
|---|---|---|---|---|---|
| **2.1 Doden** | E | **Aantal** | 1200 | **Vervroegd of direct** | Direct |

| | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

| | | | |
|---|---|---|---|
| **2.2 Ernstig gewonden en chronisch zieken (T1, T2)** | E | **Aantal** | 2520 |

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

| | | | | | |
|---|---|---|---|---|---|
| **2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)** | 0 | **Aantal** | 0 | **Duur** | NVT |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

**D**

| | |
|---|---|
| **Totaal** | **€ 1.047.895.833** |
| **Materiële schade** | € 45.350.000 |
| **Gezondheidschade** | € 1.000.500.000 |
| **Financiële schade** | € 45.833 |
| **Bestrijdingskosten** | € 2.000.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 50 | Eengezinswoningen |
| 0 | Boerderijen |
| 100 | Overige woningen |
| 1 | Brug/viaduct |
| 1 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 10.000.000 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 1200 | Doden |
| 2520 | Zwaargewonden (T1/T2) |
| 2100 | Lichtgewonden (T3) |
| 840 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 1000 | m2 bedrijfsoppervlak |
| 1 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

**0**

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**

0

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

**E**

**Aantal getroffenen** 10.000
**Tijdsduur** **1 week tot 1 maand**
**Aantal indicatoren** **3**
**score plus 1!**

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

**D**

**Aantal indicatoren** 2
**Eindgradatie aantasting** **AANZIENLIJK**
**Tijdsduur** Aantal weken

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **AANZIENLIJK** | functioneren politieke vertegenwoordiging |
| **BEPERKT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

## 5.3 Sociaal psychologische impact

| | | | | | |
|---|---|---|---|---|---|
| C | Aantal significante categorieën | 1 | Eindgradatie | HOOG | |

| Eindgradatie ↓ | 0 significante categorieën | 1 significante categorie | 2 significante categorieën | 3 significante categorieën |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | | X | |
| 1b onzekerheid | | | | X | |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 3 | 0 |
| | | | | **Categorie 1 is significant** | **NEE** |

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | | | X |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | | | X |
| 2c vertrouwensverlies in hulp-diensten | | | | | X |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 0 | 3 |
| | | | | **Categorie 2 is significant** | **JA** |

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | NVT | 'geen' | 'beperkt' | 'gemiddeld' | 'aanzienlijk' |
| **3 Handelingsperspectief** | | | | | |
| 3a onwetendheid | | | X | | |
| 3b geen zelfredzaamheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 2 | 0 | 0 |
| | | | | **Categorie 3 is significant** | **NEE** |

## 6. Veiligheid cultureel erfgoed

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | **B** | **Aantal getroffen instellingen of objecten** | **1 of 2** | **Aantal indicatoren** | 1 | **Hoogste score gegeven door 2 of meer soorten erfgoed** | **NEE** |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

| | **Indicatoren van toepassing (JA/NEE)** |
|---|---|
| **JA** | Genomen preventieve beschermingsmaatregelen |
| **NEE** | Geborgde mogelijkheden voor zelfredzaamheid |
| **NEE** | Geborgde mogelijkheden voor bereddering door hulpdiensten |

## Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

**Maatschappelijk thema** 3. Technologische omgeving
**Crisistype** 3.2 Ongevallen met giftige stof in open lucht
**Incidenttype** 3.2.30 Incident spoorvervoer

**Scenario** Hot BLEVE LPG

**WAARSCHIJNLIJKHEID** 1

| Waarschijnlijkheidsklassen | | | % waarschijnlijkheid elke 5 jaar | Nummerieke code voor invulveld | Eens in de … jaar | |
|---|---|---|---|---|---|---|
| | | | | | Ondergrens | Bovengrens |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

**IMPACT** E
**(totaalscore)**

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | C |
| 2.1 | Doden | E |
| 2.2 | Ernstig gewonden en chronisch zieken | E |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | E |
| 4.1 | Langdurige aantasting milieu & natuur | 0 |
| 5.1 | Verstoring van het dagelijks leven | E |
| 5.2 | Aantasting positie bestuur | D |
| 5.3 | Sociaal psychologische impact | D |
| 6.1 | Aantasting van cultureel erfgoed | B |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

| | | | | | |
|---|---|---|---|---|---|
| **C** | **Oppervlakte (km$^2$)** | 1 | **Duur** | 1/2 jaar of langer |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

| | | | | |
|---|---|---|---|---|
| **E** | **Aantal** | 2775 | **Vervroegd of direct** | Direct |

| | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

| | | |
|---|---|---|
| **E** | **Aantal** | 9525 |

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

| | | | | |
|---|---|---|---|---|
| **0** | **Aantal** | 0 | **Duur** | NVT |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

**E**

| | | |
|---|---|---|
| **Totaal** | **€ 3.553.895.833** | |
| **Materiële schade** | € 45.350.000 | |
| **Gezondheidschade** | € 3.506.500.000 | |
| **Financiële schade** | € 45.833 | |
| **Bestrijdingskosten** | € 2.000.000 | (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 50 | Eengezinswoningen |
| 0 | Boerderijen |
| 100 | Overige woningen |
| 1 | Brug/viaduct |
| 1 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 10.000.000 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 2775 | Doden |
| 9525 | Zwaargewonden (T1/T2) |
| 9250 | Lichtgewonden (T3) |
| 3175 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 1000 | m2 bedrijfsoppervlak |
| 1 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

**0**

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**

0

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 $km^2$** | **lokaal 4-40 $km^2$** | **gemeentelijk 40 - 400 $km^2$** | **regionaal > 400 $km^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| E | Aantal getroffenen | 10.000 | Tijdsduur | 1 week tot 1 maand | Aantal indicatoren | 3 | score plus 1! |

| | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| D | Aantal indicatoren | 2 | Eindgradatie aantasting | AANZIENLIJK | Tijdsduur | Aantal weken | |

| Mate van aantasting ↓ | 1 indicator | 2 indicatoren | 3 of meer indicatoren |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **AANZIENLIJK** | functioneren politieke vertegenwoordiging |
| **BEPERKT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

## 5.3 Sociaal psychologische impact

**D**

**Aantal significante categorieën** 2

**Eindgradatie** HOOG

| **Eindgradatie ↓** | **0 significante categorieën** | **1 significante categorie** | **2 significante categorieën** | **3 significante categorieën** |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

|  | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** |  |  |  |
|---|---|---|---|---|---|
|  | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** |  |  |  |  |  |
| 1a onbekendheid |  |  |  | X |  |
| 1b onzekerheid |  |  |  |  | X |
| 1c onnatuurlijkheid |  |  |  | X |  |
| 1d onevenredigheid |  |  | X |  |  |
| Gesommeerd per intensiteit: | 0 | 0 | 1 | 2 | 1 |
|  |  |  |  | **Categorie 1 is significant** | **JA** |

|  | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** |  |  |  |
|---|---|---|---|---|---|
|  | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** |  |  |  |  |  |
| 2a verwijtbaarheid |  |  |  |  | X |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties |  |  |  |  | X |
| 2c vertrouwensverlies in hulp-diensten |  |  |  |  | X |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 0 | 3 |
|  |  |  |  | **Categorie 2 is significant** | **JA** |

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | NVT | 'geen' | 'beperkt' | 'gemiddeld' | 'aanzienlijk' |
| **3 Handelingsperspectief** | | | | | |
| 3a onwetendheid | | | X | | |
| 3b geen zelfredzaamheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 2 | 0 | 0 |
| | | | | **Categorie 3 is significant** | **NEE** |

## 6. Veiligheid cultureel erfgoed

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | **B** | **Aantal getroffen instellingen of objecten** | **1 of 2** | **Aantal indicatoren** | 1 | **Hoogste score gegeven door 2 of meer soorten erfgoed** | **NEE** |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

| | **Indicatoren van toepassing (JA/NEE)** |
|---|---|
| **JA** | Genomen preventieve beschermingsmaatregelen |
| **NEE** | Geborgde mogelijkheden voor zelfredzaamheid |
| **NEE** | Geborgde mogelijkheden voor bereddering door hulpdiensten |

## Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

| | |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |

| | |
|---|---|
| **Scenario** | Pool fire petrol |

| | |
|---|---|
| **WAARSCHIJNLIJKHEID** | 8 |

| Waarschijnlijkheidsklassen | | | % waarschijnlijkheid elke 5 jaar | Nummerieke code voor invulveld | Eens in de … jaar | |
|---|---|---|---|---|---|---|
| | | | | | Ondergrens | Bovengrens |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

| | |
|---|---|
| **IMPACT** | D |

**(totaalscore)**

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | B |
| 2.1 | Doden | Dhoog |
| 2.2 | Ernstig gewonden en chronisch zieken | E |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | D |
| 4.1 | Langdurige aantasting milieu & natuur | 0 |
| 5.1 | Verstoring van het dagelijks leven | C |
| 5.2 | Aantasting positie bestuur | C |
| 5.3 | Sociaal psychologische impact | C |
| 6.1 | Aantasting van cultureel erfgoed | B |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

| | | | | | |
|---|---|---|---|---|---|
| B | Oppervlakte (km$^2$) | 1 | Duur | 1 tot 6 maanden | |

| | wijk/dorp max. 4 km$^2$ | lokaal 4-40 km$^2$ | gemeentelijk 40 - 400 km$^2$ | regionaal > 400 km$^2$ |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

| | | | | |
|---|---|---|---|---|
| Dhoog | Aantal | 330 | Vervroegd of direct | Direct |

| | 1 | 2-4 | 4-16 | 16-40 | 40-160 | 160-400 | >400 |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

| | | |
|---|---|---|
| E | Aantal | 1650 |

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

| | | | | |
|---|---|---|---|---|
| 0 | Aantal | 0 | Duur | NVT |

| | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

**D**

| | |
|---|---|
| **Totaal** | **€ 606.045.833** |
| **Materiële schade** | € 20.450.000 |
| **Gezondheidschade** | € 583.550.000 |
| **Financiële schade** | € 45.833 |
| **Bestrijdingskosten** | € 2.000.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | 🟥 D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 10 | Eengezinswoningen |
| 0 | Boerderijen |
| 10 | Overige woningen |
| 1 | Brug/viaduct |
| 1 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 10.000.000 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 330 | Doden |
| 1650 | Zwaargewonden (T1/T2) |
| 1650 | Lichtgewonden (T3) |
| 550 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 1000 | m2 bedrijfsoppervlak |
| 1 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

**0**

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**

0

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C | **Aantal getroffenen** | 1.000 | **Tijdsduur** | **3 dagen tot 1 week** | **Aantal indicatoren** | **3** | **score plus 1!** |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | |
|---|---|---|---|---|---|---|
| C | **Aantal indicatoren** | 2 | **Eindgradatie aantasting** | **GEMIDDELD** | **Tijdsduur** | Aantal weken |

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **GEMIDDELD** | functioneren politieke vertegenwoordiging |
| **BEPERKT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

## 5.3 Sociaal psychologische impact

| | | | | | |
|---|---|---|---|---|---|
| 5.3 Sociaal psychologische impact | C | Aantal significante categorieën | 2 | Eindgradatie | GEMIDDELD |

| Eindgradatie ↓ | 0 significante categorieën | 1 significante categorie | 2 significante categorieën | 3 significante categorieën |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT ☐

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | X | | |
| 1b onzekerheid | | | X | | |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 3 | 1 | 0 |
| | | | | **Categorie 1 is significant** | **JA** |

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | | | X |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | | | X |
| 2c vertrouwensverlies in hulpdiensten | | | | X | |
| Gesommeerd per intensiteit: | 0 | 0 | 0 | 1 | 2 |
| | | | | **Categorie 2 is significant** | **JA** |

|  | irrelevant | relevant en dus van toepassing, treedt al dan niet op |  |  |  |
|---|---|---|---|---|---|
|  | NVT | 'geen' | 'beperkt' | 'gemiddeld' | 'aanzienlijk' |
| **3 Handelingsperspectief** |  |  |  |  |  |
| 3a onwetendheid |  |  | X |  |  |
| 3b geen zelfredzaamheid |  |  | X |  |  |
| Gesommeerd per intensiteit: | 0 | 0 | 2 | 0 | 0 |

**Categorie 3 is significant** NEE

## 6. Veiligheid cultureel erfgoed

### 6.1 Aantasting van cultureel erfgoed

B

|  |  |
|---|---|
| **Aantal getroffen instellingen of objecten** | 1 of 2 |
| **Aantal indicatoren** | 1 |
| **Hoogste score gegeven door 2 of meer soorten erfgoed** | NEE |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

**Indicatoren van toepassing (JA/NEE)**

|  |  |
|---|---|
| JA | Genomen preventieve beschermingsmaatregelen |
| NEE | Geborgde mogelijkheden voor zelfredzaamheid |
| NEE | Geborgde mogelijkheden voor bereddering door hulpdiensten |

# Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

| | |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |

| | |
|---|---|
| **Scenario** | Incident with threat of emission |

## WAARSCHIJNLIJKHEID

**11**

| **Waarschijnlijkheidsklassen** | | | **% waarschijnlijkheid elke 5 jaar** | **Nummerieke code voor invulveld** | **Eens in de ... jaar** | |
|---|---|---|---|---|---|---|
| | | | | | **Ondergrens** | **Bovengrens** |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

## IMPACT

**(totaalscore)**

**B**

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | 0 |
| 2.1 | Doden | 0 |
| 2.2 | Ernstig gewonden en chronisch zieken | 0 |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | A |
| 4.1 | Langdurige aantasting milieu & natuur | 0 |
| 5.1 | Verstoring van het dagelijks leven | C |
| 5.2 | Aantasting positie bestuur | 0 |
| 5.3 | Sociaal psychologische impact | B |
| 6.1 | Aantasting van cultureel erfgoed | 0 |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

| | | | | | |
|---|---|---|---|---|---|
| **0** | **Oppervlakte (km$^2$)** | 0 | **Duur** | NVT |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

| | | | | |
|---|---|---|---|---|
| **0** | **Aantal** | 0 | **Vervroegd of direct** | NVT |

| | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

| | | |
|---|---|---|
| **0** | **Aantal** | 0 |

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

| | | | | |
|---|---|---|---|---|
| **0** | **Aantal** | 0 | **Duur** | NVT |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

**A**

| | |
|---|---|
| **Totaal** | **€ 54.583** |
| **Materiële schade** | € 0 |
| **Gezondheidschade** | € 0 |
| **Financiële schade** | € 4.583 |
| **Bestrijdingskosten** | € 50.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 0 | Eengezinswoningen |
| 0 | Boerderijen |
| 0 | Overige woningen |
| 0 | Brug/viaduct |
| 0 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 0 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 0 | Doden |
| 0 | Zwaargewonden (T1/T2) |
| 0 | Lichtgewonden (T3) |
| 0 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 1000 | m2 bedrijfsoppervlak |
| 0,1 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

**0**

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**

0

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C | Aantal getroffenen | 10.000 | Tijdsduur | 1-2 dagen | Aantal indicatoren | 3 | score plus 1! |

| | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| **JA** | Geen onderwijs kunnen volgen |
| **JA** | Niet naar het werk kunnen gaan |
| **NEE** | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| **NEE** | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | Aantal indicatoren | 1 | Eindgradatie aantasting | NVT | Tijdsduur | Aantal weken |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **BEPERKT** | functioneren politieke vertegenwoordiging |
| **NVT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

## 5.3 Sociaal psychologische impact

| | | | | |
|---|---|---|---|---|
| B | Aantal significante categorieën | 1 | Eindgradatie | GEMIDDELD |

| Eindgradatie ↓ | 0 significante categorieën | 1 significante categorie | 2 significante categorieën | 3 significante categorieën |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | | | X |
| 1b onzekerheid | | | | X | |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | X | | | |
| Gesommeerd per intensiteit: | 0 | 1 | 0 | 2 | 1 |
| | | | | **Categorie 1 is significant** | **JA** |

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | X | | |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | X | | |
| 2c vertrouwensverlies in hulpdiensten | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 3 | 0 | 0 |
| | | | | **Categorie 2 is significant** | **NEE** |

|  | irrelevant | relevant en dus van toepassing, treedt al dan niet op |  |  |  |
|---|---|---|---|---|---|
|  | **NVT** | **‘geen’** | **‘beperkt’** | **‘gemiddeld’** | **‘aanzienlijk’** |
| **3 Handelingsperspectief** |  |  |  |  |  |
| 3a onwetendheid |  |  | X |  |  |
| 3b geen zelfredzaamheid |  |  | X |  |  |
| Gesommeerd per intensiteit: | 0 | 0 | 2 | 0 | 0 |
|  |  |  |  | **Categorie 3 is significant** | **NEE** |

## 6. Veiligheid cultureel erfgoed

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | **0** | **Aantal getroffen instellingen of objecten** | **GEEN** | **Aantal indicatoren** | 0 | **Hoogste score gegeven door 2 of meer soorten erfgoed** |  |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

| | **Indicatoren van toepassing (JA/NEE)** |
|---|---|
|  | Genomen preventieve beschermingsmaatregelen |
|  | Geborgde mogelijkheden voor zelfredzaamheid |
|  | Geborgde mogelijkheden voor bereddering door hulpdiensten |

# Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

| | |
|---|---|
| **Maatschappelijk thema** | 3. Technologische omgeving |
| **Crisistype** | 3.2 Ongevallen met giftige stof in open lucht |
| **Incidenttype** | 3.2.30 Incident spoorvervoer |

| | |
|---|---|
| **Scenario** | Spillage of environmental toxic |

| | |
|---|---|
| **WAARSCHIJNLIJKHEID** | 9 |

| Waarschijnlijkheidsklassen | | | % waarschijnlijkheid elke 5 jaar | Nummerieke code voor invulveld | Eens in de … jaar | |
|---|---|---|---|---|---|---|
| | | | | | Ondergrens | Bovengrens |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

| | |
|---|---|
| **IMPACT** | B |

**(totaalscore)**

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | 0 |
| 2.1 | Doden | 0 |
| 2.2 | Ernstig gewonden en chronisch zieken | 0 |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | B |
| 4.1 | Langdurige aantasting milieu & natuur | C |
| 5.1 | Verstoring van het dagelijks leven | 0 |
| 5.2 | Aantasting positie bestuur | 0 |
| 5.3 | Sociaal psychologische impact | B |
| 6.1 | Aantasting van cultureel erfgoed | 0 |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

|  |  |  |  |  |
|---|---|---|---|---|
| 0 | Oppervlakte (km$^2$) | 0 | Duur | NVT |

|  | wijk/dorp max. 4 km$^2$ | lokaal 4-40 km$^2$ | gemeentelijk 40 - 400 km$^2$ | regionaal > 400 km$^2$ |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

|  |  |  |  |  |
|---|---|---|---|---|
| 0 | Aantal | 0 | Vervroegd of direct | NVT |

|  | 1 | 2-4 | 4-16 | 16-40 | 40-160 | 160-400 | >400 |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

|  |  |  |
|---|---|---|
| 0 | Aantal | 0 |

| Aantal | 1 | 2-4 | 4-16 | 16-40 | 40-160 | 160-400 | >400 |
|---|---|---|---|---|---|---|---|
|  | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

|  |  |  |  |  |
|---|---|---|---|---|
| 0 | Aantal | 0 | Duur | NVT |

|  | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

**B**

| | |
|---|---|
| **Totaal** | **€ 5.000.000** |
| **Materiële schade** | € 0 |
| **Gezondheidschade** | € 0 |
| **Financiële schade** | € 0 |
| **Bestrijdingskosten** | € 5.000.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 0 | Eengezinswoningen |
| 0 | Boerderijen |
| 0 | Overige woningen |
| 0 | Brug/viaduct |
| 0 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 0 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 0 | Doden |
| 0 | Zwaargewonden (T1/T2) |
| 0 | Lichtgewonden (T3) |
| 0 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 0 | m2 bedrijfsoppervlak |
| 0 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

**C**

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 10 |

**Aantal km2 verontreinigd oppervlak regio**

0

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **0** | **Aantal getroffenen** | 0 | **Tijdsduur** | **NVT** | **Aantal indicatoren** | **0** | **score minus 1** |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| | Geen onderwijs kunnen volgen |
| | Niet naar het werk kunnen gaan |
| | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **0** | **Aantal indicatoren** | 1 | **Eindgradatie aantasting** | **NVT** | **Tijdsduur** | Aantal weken | |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **BEPERKT** | functioneren politieke vertegenwoordiging |
| **NVT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

| **Mate van aantasting ↓** | **1 indicator** | **2 indicatoren** | **3 of meer indicatoren** |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

## 5.3 Sociaal psychologische impact

| | |
|---|---|
| **5.3 Sociaal psychologische impact** | **B** |
| **Aantal significante categorieën** | 1 |
| **Eindgradatie** | GEMIDDELD |

| **Eindgradatie ↓** | **0 significante categorieën** | **1 significante categorie** | **2 significante categorieën** | **3 significante categorieën** |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | X | | |
| 1b onzekerheid | | | X | | |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | X | | | |
| Gesommeerd per intensiteit: | 0 | 1 | 2 | 1 | 0 |
| | | | | **Categorie 1 is significant** | **JA** |

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | X | | |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | X | | |
| 2c vertrouwensverlies in hulp-diensten | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 3 | 0 | 0 |
| | | | | **Categorie 2 is significant** | **NEE** |

|  | irrelevant | relevant en dus van toepassing, treedt al dan niet op |  |  |  |
|---|---|---|---|---|---|
|  | NVT | 'geen' | 'beperkt' | 'gemiddeld' | 'aanzienlijk' |
| **3 Handelingsperspectief** |  |  |  |  |  |
| 3a onwetendheid |  | X |  |  |  |
| 3b geen zelfredzaamheid |  | X |  |  |  |
| Gesommeerd per intensiteit: | 0 | 2 | 0 | 0 | 0 |
|  |  |  |  | **Categorie 3 is significant** | **NEE** |

## 6. Veiligheid cultureel erfgoed

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | **0** | **Aantal getroffen instellingen of objecten** | **GEEN** | **Aantal indicatoren** | 0 | **Hoogste score gegeven door 2 of meer soorten erfgoed** |  |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

| | **Indicatoren van toepassing (JA/NEE)** |
|---|---|
|  | Genomen preventieve beschermingsmaatregelen |
|  | Geborgde mogelijkheden voor zelfredzaamheid |
|  | Geborgde mogelijkheden voor bereddering door hulpdiensten |

## Scenarioanalyse

**18. Veiligheidsregio Zuid-Holland Zuid**

**Maatschappelijk thema** 3. Technologische omgeving
**Crisistype** 3.2 Ongevallen met giftige stof in open lucht
**Incidenttype** 3.2.30 Incident spoorvervoer

**Scenario** Incident with small emission

**WAARSCHIJNLIJKHEID** 10

| Waarschijnlijkheidsklassen | | | % waarschijnlijkheid elke 5 jaar | Nummerieke code voor invulveld | Eens in de … jaar | |
|---|---|---|---|---|---|---|
| | | | | | Ondergrens | Bovengrens |
| A | Zeer onwaarschijnlijk | A-laag | < 0,005 | 1 | | 100.000 |
| | | A-middel | 0,005 – 0,02 | 2 | 100.000 | 25.000 |
| | | A-hoog | 0,02 – 0,05 | 3 | 25.000 | 10.000 |
| B | Onwaarschijnlijk | B-laag | 0,05 – 0,1 | 4 | 10.000 | 5.000 |
| | | B-middel | 0,1 – 0,25 | 5 | 5.000 | 2.000 |
| | | B-hoog | 0,25 – 0,5 | 6 | 2.000 | 1.000 |
| C | Mogelijk | C-laag | 0,5 – 1 | 7 | 1.000 | 500 |
| | | C-middel | 1 – 2,5 | 8 | 500 | 200 |
| | | C-hoog | 2,5 – 5 | 9 | 200 | 100 |
| D | Waarschijnlijk | D-laag | 5 – 10 | 10 | 100 | 50 |
| | | D-middel | 10 – 25 | 11 | 50 | 20 |
| | | D-hoog | 25 – 50 | 12 | 20 | 10 |
| E | Zeer waarschijnlijk | E-laag | | 13 | 10 | 5 |
| | | E-middel | 50 – 100 | 14 | 5 | 2 |
| | | E-hoog | | 15 | 2 | |

**IMPACT** A
**(totaalscore)**

| | | |
|---|---|---|
| 1.1 | Aantasting integriteit grondgebied | A |
| 2.1 | Doden | 0 |
| 2.2 | Ernstig gewonden en chronisch zieken | A |
| 2.3 | Lichamelijk lijden | 0 |
| 3.1 | Kosten | A |
| 4.1 | Langdurige aantasting milieu & natuur | 0 |
| 5.1 | Verstoring van het dagelijks leven | A |
| 5.2 | Aantasting positie bestuur | 0 |
| 5.3 | Sociaal psychologische impact | B |
| 6.1 | Aantasting van cultureel erfgoed | 0 |

## 1. Territoriale veiligheid

### 1.1 Aantasting van de integriteit van het grondgebied

| | | | | | |
|---|---|---|---|---|---|
| **1.1 Aantasting van de integriteit van het grondgebied** | **A** | **Oppervlakte (km$^2$)** | 1 | **Duur** | 2-6 dagen |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| **2-6 dagen** | A | A | B | C |
| **1-4 weken** | A | B | C | D |
| **1 tot 6 maanden** | B | C | D | E |
| **1/2 jaar of langer** | C | D | E | E |

## 2. Fysieke veiligheid

### 2.1 Doden

| | | | | | |
|---|---|---|---|---|---|
| **2.1 Doden** | **0** | **Aantal** | 0 | **Vervroegd of direct** | NVT |

| | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| **Direct** | A | B | C | Choog | D | Dhoog | E |
| **Vervroegd** | A | A | B | C | Choog | D | Dhoog |

### 2.2 Ernstig gewonden en chronisch zieken (T1, T2)

| | | | |
|---|---|---|---|
| **2.2 Ernstig gewonden en chronisch zieken (T1, T2)** | **A** | **Aantal** | 1 |

| **Aantal** | **1** | **2-4** | **4-16** | **16-40** | **40-160** | **160-400** | **>400** |
|---|---|---|---|---|---|---|---|
| | A | B | C | Choog | D | Dhoog | E |

### 2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)

| | | | | | |
|---|---|---|---|---|---|
| **2.3 Lichamelijk lijden (gebrek aan primaire levensbehoeften)** | **0** | **Aantal** | 0 | **Duur** | NVT |

| | **< 400 getroffenen** | **< 4.000 getroffenen** | **< 40.000 getroffenen** | **> 40.000 getroffenen** |
|---|---|---|---|---|
| **2-6 dagen** | A | B | C | D |
| **1-4 weken** | B | C | D | E |
| **1 maand of langer** | C | D | E | E |

## 3. Economische veiligheid

### 3.1 Kosten

**A**

**Totaal** **€ 615.000**

| | |
|---|---|
| **Materiële schade** | € 0 |
| **Gezondheidschade** | € 115.000 |
| **Financiële schade** | € 0 |
| **Bestrijdingskosten** | € 500.000 (inclusief opruimen en herstel natuur en milieu) |

| **Kosten** | **< 2 miljoen** | **< 20 miljoen** | **< 200 miljoen** | **< 2 miljard** | **> 2 miljard** |
|---|---|---|---|---|---|
| | A | B | C | D | E |

**Materiële schade**

Aantal

| | |
|---|---|
| 0 | Eengezinswoningen |
| 0 | Boerderijen |
| 0 | Overige woningen |
| 0 | Brug/viaduct |
| 0 | Kilometer spoorlijn |

Bedrag

| | |
|---|---|
| € 0 | Materiële schade inventaris, voertuigen |

**Gezondheidsschade**

Aantal

| | |
|---|---|
| 0 | Doden |
| 1 | Zwaargewonden (T1/T2) |
| 3 | Lichtgewonden (T3) |
| 0 | Permanent arbeidsongeschikten |

**Financiële schade**

| | |
|---|---|
| 0 | m2 bedrijfsoppervlak |
| 0 | Aantal maanden niet bruikbaar |

## 4. Ecologische veiligheid

### 4.1 Langdurige aantasting van milieu en natuur

**0**

*Hoogste score geldt!*

**Aantal hectare aangetast natuurgebied**

| | |
|---|---|
| Broedgeb. | 0 |
| EHS | 0 |
| Natura2000 | 0 |

**Aantal km2 verontreinigd oppervlak regio**

0

**Meer dan 10 jaar**

NEE

| | **< 3%** | **3-10%** | **> 10%** |
|---|---|---|---|
| Broedgebieden weidevogels | A | B | C |
| EHS gebieden | B | C | D |
| Natura2000 | C | D | E |

| | **wijk/dorp max. 4 km$^2$** | **lokaal 4-40 km$^2$** | **gemeentelijk 40 - 400 km$^2$** | **regionaal > 400 km$^2$** |
|---|---|---|---|---|
| Milieu verontreiniging | A | B | C | D |

## 5. Sociale en politieke stabiliteit

### 5.1 Verstoring van het dagelijks leven

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A** | **Aantal getroffenen** | 20.000 | **Tijdsduur** | **1-2 dagen** | **Aantal indicatoren** | **1** | **score minus 1** |

| | < 400 getroffenen | < 4.000 getroffenen | < 40.000 getroffenen | > 40.000 getroffenen |
|---|---|---|---|---|
| 1-2 dagen | A | A | B | C |
| 3 dagen tot 1 week | A | B | C | D |
| 1 week tot 1 maand | B | C | D | E |
| 1 maand of langer | C | D | E | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| | Geen onderwijs kunnen volgen |
| | Niet naar het werk kunnen gaan |
| | Geen gebruik kunnen maken van maatschappelijke voorzieningen |
| **JA** | Verminderde bereikbaarheid door blokkade van wegen en uitval openbaar vervoer |
| | Niet kunnen doen van noodzakelijke aankopen wegens winkelsluiting |

### 5.2 Aantasting van positie van het lokale en regionale bestuur

| | | | | | | |
|---|---|---|---|---|---|---|
| **0** | **Aantal indicatoren** | 1 | **Eindgradatie aantasting** | **NVT** | **Tijdsduur** | Aantal weken |

**Indicatoren van toepassing**

Aantasting van...

| | |
|---|---|
| **BEPERKT** | functioneren politieke vertegenwoordiging |
| **NVT** | functioneren openbaar bestuur |
| **NVT** | functioneren openbare orde en veiligheidssysteem |
| **NVT** | functioneren onafhankelijke rechtsspraak |
| **NVT** | vrijheden en/of rechten zoals vastgelegd in de Grondwet |
| **NVT** | kernwaarden democratische rechtsstaat |

| Mate van aantasting ↓ | 1 indicator | 2 indicatoren | 3 of meer indicatoren |
|---|---|---|---|
| Beperkt | A | B | C |
| Gemiddeld | B | C | D |
| Aanzienlijk | C | D | E |

## 5.3 Sociaal psychologische impact

| | | | | | |
|---|---|---|---|---|---|
| B | **Aantal significante categorieën** | 1 | **Eindgradatie** | GEMIDDELD | |

| **Eindgradatie ↓** | **0 significante categorieën** | **1 significante categorie** | **2 significante categorieën** | **3 significante categorieën** |
|---|---|---|---|---|
| Laag | A | - | - | - |
| Gemiddeld | A | B | C | D |
| Hoog | - | C | D | E |

*Indien alle 3 de categorieën op alle indicatoren NVT scoren, dan scoort dit hele criterium NVT (0)*

NVT

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **1 Perceptie** | | | | | |
| 1a onbekendheid | | | | | X |
| 1b onzekerheid | | | | X | |
| 1c onnatuurlijkheid | | | | X | |
| 1d onevenredigheid | | X | | | |
| Gesommeerd per intensiteit: | 0 | 1 | 0 | 2 | 1 |
| | | | | **Categorie 1 is significant** | **JA** |

| | **irrelevant** | **relevant en dus van toepassing, treedt al dan niet op** | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **2 Verwachtingspatroon** | | | | | |
| 2a verwijtbaarheid | | | X | | |
| 2b vertrouwensverlies in overheid/ bedrijven/ instanties | | | X | | |
| 2c vertrouwensverlies in hulp-diensten | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 3 | 0 | 0 |
| | | | | **Categorie 2 is significant** | **NEE** |

| | irrelevant | relevant en dus van toepassing, treedt al dan niet op | | | |
|---|---|---|---|---|---|
| | **NVT** | **'geen'** | **'beperkt'** | **'gemiddeld'** | **'aanzienlijk'** |
| **3 Handelingsperspectief** | | | | | |
| 3a onwetendheid | | | X | | |
| 3b geen zelfredzaamheid | | | X | | |
| Gesommeerd per intensiteit: | 0 | 0 | 2 | 0 | 0 |

**Categorie 3 is significant** NEE

## 6. Veiligheid cultureel erfgoed

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **6.1 Aantasting van cultureel erfgoed** | 0 | **Aantal getroffen instellingen of objecten** | GEEN | **Aantal indicatoren** | 0 | **Hoogste score gegeven door 2 of meer soorten erfgoed** | |

| **Aantal instellingen en/of objecten ↓** | **3 indicatoren** | **2 indicatoren** | **1 indicator** | **Geen indicatoren** |
|---|---|---|---|---|
| 1 of 2 | 0 | A | B | C |
| 3 tot 5 | A | B | C | D |
| 6 of meer | B | C | D | E |

**Indicatoren van toepassing (JA/NEE)**

| | |
|---|---|
| | Genomen preventieve beschermingsmaatregelen |
| | Geborgde mogelijkheden voor zelfredzaamheid |
| | Geborgde mogelijkheden voor bereddering door hulpdiensten |

*Tabel 5-20 Schadeontwikkeling bij vrijkomen van brandbare gassen.*

| | | **Huidige situatie** | | **2010** | |
|---|---|---|---|---|---|
| **Aantal aanwezigen Dordrecht, station CS** | | **Spits 750** | **Buiten spits 150** | **Spits 1200** | **Buiten spits 250** |
| Aantal slachtoffers in het station | Koude BLEVE | | | | |
| | Doden | 525 | 70 | 780 | 130 |
| | T1+T2gewonden | 225 | 80 | 420 | 120 |
| | T3 gewonden | - | - | - | - |
| | Warme BLEVE | | | | |
| | Doden | 610 | 100 | 925 | 175 |
| | T1+T2 gewonden | 140 | 50 | 275 | 75 |
| | T3 gewonden | - | - | - | - |
| | gaswolkbrand | | | | |
| | Doden | 525 | 75 | 750 | 130 |
| | Fakkel | | | | |
| | Doden | 480 | 55 | 670 | 100 |
| | T1+T2 gewonden | 270 | 95 | 530 | 150 |
| | T3 gewonden | - | - | - | - |
| Aantal slachtoffers in de omgeving | Koude BLEVE | | | | |
| | Doden | 410 | | 420 | |
| | T1+T2gewonden | 2050 | | 2100 | |
| | T3 gewonden | 2050 | | 2100 | |
| | Warme BLEVE | | | | |
| | Doden | 1750 | | 1850 | |
| | T1+T2 gewonden | 8750 | | 9250 | |
| | T3 gewonden | 8750 | | 9250 | |
| | gaswolkbrand | | | | |
| | Doden | 220 | | 220 | |
| | Fakkel | | | | |
| | Doden | 15 | | 15 | |
| | T1+T2 gewonden | 75 | | 75 | |
| | T3 gewonden | 75 | | 75 | |
| Tijdsverloop ongevalontwikkeling | Koude BLEVE, Gaswolkbrand en fakkel: (vrijwel) direct | | | | |
| | Warme BLEVE na circa 30 minuten | | | | |
| Detectie | via Railverkeersleiding of op station via 112, benodigde tijd 2-10 minuten | | | | |
| Zelfredzaamheid | Koude BLEVE, Gaswolkbrand: niet; in fakkel niet, daarbuiten wel;<br>Warme BLEVE alleen indien tijdig instructies worden gegeven, aantal slachtoffers kan dan tot 0 worden gereduceerd. | | | | |

*Tabel 5-23 Schade-ontwikkeling bij vrijkomen van toxische gassen.*

| **Aantal aanwezigen** | | **Huidige situatie** | | **2010** | |
|---|---|---|---|---|---|
| | **Dordrecht, station CS** | **Spits 750** | **Buiten spits 150** | **Spits 1200** | **Buiten spits 250** |
| Aantal slachtoffers zonder effect zelfredzaamheid en hulpverlening in het station | Ammoniak, instantaan | | | | |
| | doden | 735 | 145 | 1170 | 240 |
| | T1+T2 gewonden | 15 | 5 | 30 | 10 |
| | T3 gewonden | - | - | - | - |
| Aantal slachtoffers zonder effect zelfredzaamheid en hulpverlening in de omgeving | Ammoniak, instantaan | | | | |
| | doden | 80 | | 80 | |
| | T1+T2 gewonden | 320 | | 320 | |
| | T3 gewonden | 1280 | | 1280 | |
| Tijdsverloop ongevalontwikkeling | (vrijwel) direct, binnen 30 minuten maximale schadegebied | | | | |
| Detectie | Via Railverkeersleiding of op station via 112, benodigde tijd 2-10 minuten | | | | |
| Zelfredzaamheid | Mogelijkheden zijn beperkt aanwezig, noodzaak misschien niet duidelijk, ingeschatte effect 0 % red zich zelf tijdig | | | | |

drecht CS), tussen perron 2 en 3. De slachtofferaantallen staan vermeld in , waarbij zowel het aantal slachtoffers is gegeven uitgaande van de huidige aantal aanwezigen als het aantal aanwezigen volgens prognoses voor 2010.

*Tabel 5-11 Schade-ontwikkeling bij een plasbrand (plasgrootte 600m$^2$).*

| **Scenario Instantane uitstroming Plasgrootte 600 m$^2$** | | **Huidige situatie (dag)** | | **2010 (dag)** | |
|---|---|---|---|---|---|
| | | **Spits** | **Buiten spits** | **Spits** | **Buiten spits** |
| Aantal aanwezigen station Dordrecht | | 750 | 150 | 1200 | 250 |
| Schade zonder effect zelfredzaamheid en hulpverlening op station DORDRECHT CS | doden | 310 | 15 | 330 | 30 |
| | T1+T2 gewonden | 1550 | 75 | 1650 | 150 |
| | T3 gewonden | 1550 | 75 | 1650 | 150 |
| Omvang schadegebied [ha] | Beschadiging aan gebouwen: 100 % / 50% / overig: 0.1 / 0.2 / 0.5 | | | | |
| Tijdsverloop ongevalontwikkeling | Binnen 0-5 minuten volledige brandontwikkeling | | | | |
| Detectie | Via Railverkeersleiding of op station via 112, benodigde tijd 2-10 minuten | | | | |
| Zelfredzaamheid | In principe tijdig mogelijk | | | | |
| Schade met effect zelfredzaamheid op station DORDRECHT CS | doden | Ca. 0-300* | Ca. 0-15* | Ca. 0-300* | Ca. 0-25* |
| | 2$^e$ graads-brandwonden | Ca. 0-2 | Ca. 0-2 | Ca. 0-2 | Ca. 0-2 |
| | 1$^e$ graads-brandwonden | Ca. 0-2 | Ca. 0-2 | Ca. 0-2 | Ca. 0-2 |

* Het aantal slachtoffers wordt hier bepaald door het aantal inzittenden in een stilstaande trein op spoor 1/15, ervan uitgaande dat de stilstaande trein zich precies binnen de plas bevindt. Voor de mensen buiten de trein zal het in principe goed mogelijk zijn om tijdig te ontvluchten.

# Annex III.

# References

*Analyse externe veiligheid Leerpark gemeente Dordrecht* (analysis external safety Leerpark), Arcadis, 2009.

*Basisnet vervoer gevaarlijke stoffen* (base net transport dangerous substances)

*Besluit externe veiligheid inrichtingen* (Decree on External Safety of Installations), 2004.

*Besluit transportroutes externe veiligheid* (Decree transport routes external safety)

*Groepsrisico op de kaart gezet* (the societal risk mapped), RIVM, TNO, 2007.

*Guidance on the Duty of Accountability for Societal Risk*, Ministry of Infrastructure and Environment, 2004.

*Handleiding Risicoanalyse Transport – HART* (Guideline Risk assessment transport), Ministry of Infrastructure, The Hague, The Netherlands, 2011

*Handreiking verantwoorde brandweeradvisering* (guideline responsible prevention advice by the fire brigade), IPO, 2008.

Houdijk, R. et al., *Handreiking regionaal risicoprofiel* (Guideline regional risk assessment safety regions), 2009

Houdijk, R., *Handbook Mitigation Spatial Relevant Risks in European Regions and Towns*, Project MiSRaR, 2012

*Interventiewaarden gevaarlijke stoffen* (intervention values dangerous substances), Ministries of VROM and VenW, 2007.

*Provinciale risicokaart* (Provincial risk map), Province of South-Holland, 2013 (www.risicokaart.nl)

*Scenarioboek externe veiligheid* (Scenario book external safety), Safety Region Amsterdam-Amstelland, 2011

*Scenario spoor ten behoeve van de nationale risicobeoordeling* (Scenario railway (hot BLEVE) for the national risk assessment), Project13, Ministry of Security and Justice, 2010

*Schadescenarioboek* (damage scenario book), Netherlands Institute for Physical Safety.

*Toelichting advies voorontwerp-bestemmingsplan 2e herziening Leerpark gemeente Dordrecht* (Advice pre-design zoning 2nd review Leerpark), Safety Region South-Holland South, 2011.

*Toetskader externe veiligheid Spoorzone Dordrech/Zwijndrecht* (assessment framework external safety Spoorzone Dordrech/Zwijndrecht), TNO, 2004

Torn, P. v/d, *Voorbeelduitwerking vervoer gevaarlijke stoffen over het spoor* (Example scenario transport dangerous substances by rail), 2010

*Veiligheidsstudie Spoorzone Dordrecht* (Safety study Spoorzone Dordrecht), TNO, 2004

*Verkenning van de toepassing en mogelijke uniformering van effectberekeningsmodelle n* (exploration of the application and uniformation of effect calculation models), Netherlands Institute for Physical Safety, 2008.

# Partners of PRISMA

**Safety Region South-Holland South**
The Netherlands

**Municipality of Tallinn**
Estonia

**Stara Zagora Regional Development Agency**
Bulgaria

**Municipality of Mirandela**
Portugal

**Municipality of Aveiro**
Portugal

This project has been made possible with contribution from the Civil Protection Financial Instrument from the European Union