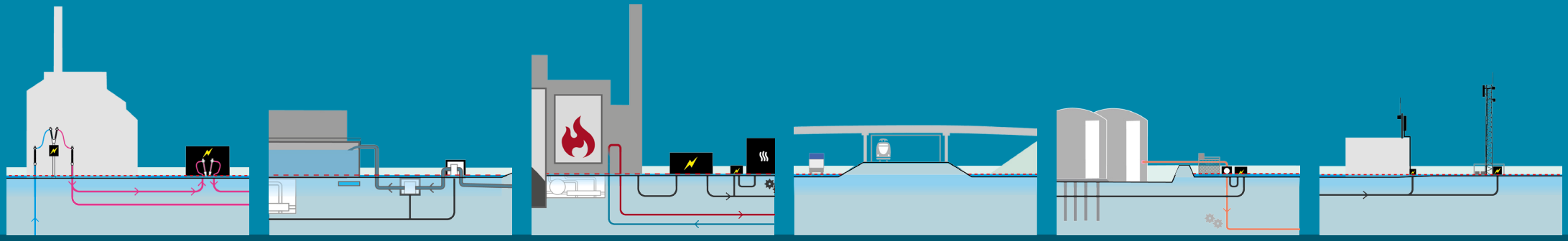
Water Resilient Westpoort

Adaptation Strategy for Critical Infrastructure in the Port of Amsterdam



Ministry of Infrastructure
and Water Management

City of
Amsterdam

regional public water authority
amstel gooi en vecht

Port of Amsterdam
Port of partnerships

Provincie
Noord-Holland

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Water Resilient Westpoort

Adaptation Strategy for Critical Infrastructure in the Port of Amsterdam

Commissioned by
Ministry of Infrastructure and Water Management,
City of Amsterdam,
Regional Public Water Authority Amstel, Gooi en Vecht,
Amsterdam Port Authority
and province of Noord-Holland


DeKWEKER
VOOR PROFESSIONALS IN FOOD

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Foreword

This adaptation strategy for Westpoort, drawn up within the framework of the Delta Programme on Spatial Adaptation, signifies a real step towards improving the water resilience of Amsterdam in event of flooding. The adaptation strategy offers clear perspectives for specific action to be taken by the responsible stakeholders in the short term. Although developed for Westpoort, both the strategy and the methodology have been designed so they can be applied in other areas and at different scales. Beyond Amsterdam, the strategy is relevant for any city or stakeholder that wants to work towards better protection of critical and vulnerable infrastructure. Therefore, we are pleased to provide an English translation of what we believe to be a helpful perspective on water resilience.

The adaptation strategy follows from the Water Resilient Westpoort Programme, which aims to better prepare Westpoort and eventually the whole of Amsterdam for the consequences of climate change. We have investigated what the consequences would be if critical and vulnerable functions in Westpoort were to be submerged as a result of flooding, and, more importantly, how the consequences of such flooding can be contained.

Even though Amsterdam and the industrial harbour area of Westpoort are well-protected by dykes along the Lek River and the sea lock at IJmuiden, the possibility of flooding can never be eliminated entirely. The chance of flooding due to a dyke breach is very slim, but the consequences could be catastrophic. By increasing awareness of the risks and taking precautions a large scale damage of assets and high numbers of victims can be avoided. The project has resulted in a set of measures based on the principle of 'small chance / big effect'. Attention has been paid to the cost-effectiveness of the measures, with an emphasis on smart linkage with spatial developments and major investments in companies.

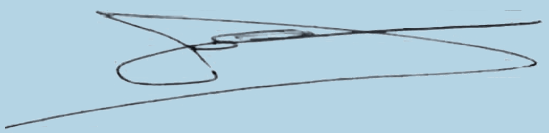
Important lessons were learnt from the pilot regarding both content and process. In terms of content, a new method was developed to bring clarity to the complexity of critical and vulnerable infrastructure and infrastructure interdependency chains, and to identify weak links. Regarding processes, it became clear that working on flood resilience is a responsibility that needs to be shared by all the public and private stakeholders involved. Linked critical networks mean extensive interdependencies. The question of who is taking the lead is crucial

for successful follow-up steps. The results and lessons learnt from the pilot are already being put to broader use, for example, in the Approach to national and vulnerable functions (Aanpak nationale en kwetsbare functies) in the Delta Programme, the Netherlands Climate Adaptation City Deal, and the C40 international city network. In the City Deal, cooperation takes place at national level with various government authorities and private partners, with new concepts for dealing with critical and vulnerable infrastructure being discussed. In C40, the approach to climate adaptation of critical and vulnerable functions in five different cities has been compared[1], with Amsterdam as one of the pioneers.

This adaptation strategy, with its practical points of action, is the product of an intensive and meticulous process headed by the City of Amsterdam, the Regional Public Water Authority Amstel, Gooi en Vecht, Amsterdam Port Authority, the province of Noord-Holland and the Ministry of Infrastructure and Water Management. This involved close cooperation between a large number of public and private stakeholders, including Rijkswaterstaat (West-Nederland Noord region), the Amsterdam-Amstelland security region, the Environment Agency for the North Sea Canal Area, Entrepreneurs Association ORAM and various businesses and utility companies. We would like to thank all the participating stakeholders for their contributions and commitment.

The adaptation strategy is but the beginning. The next step for us is to implement the strategy, together with s, in order to improve the flood resilience of Westpoort, and with it, the entire Amsterdam region. We believe moreover, that this strategy can serve as an example for broader, nationwide deployment and that the results can be used for national policy development.

In addition, we see opportunities for action in other parts of the Amsterdam Metropolitan Area, armed with the insights gained from the pilot and the developed strategy.



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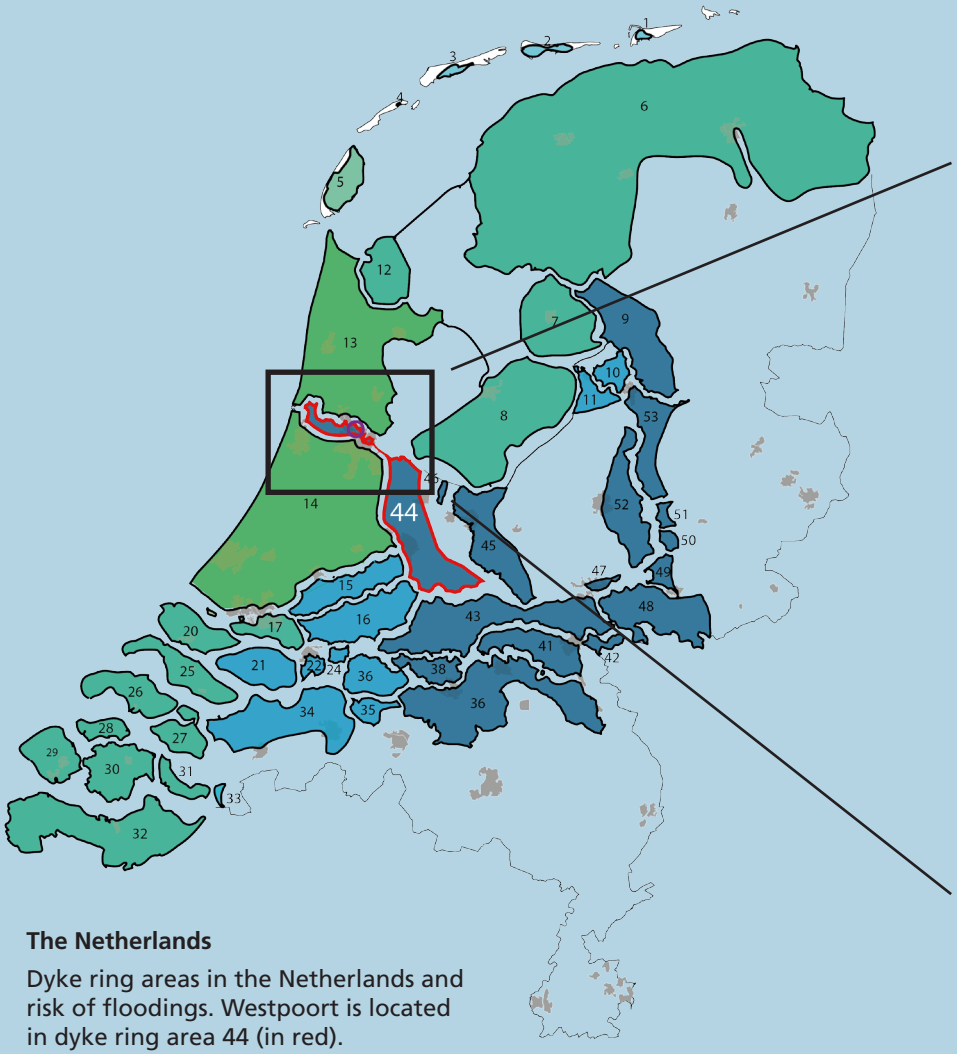
[1] C40 Infrastructures Interdependencies + Climate Risks Report (http://www.c40.org/blog_posts/c40-cities-take-action-to-increase-resiliency-to-climate-risk)



The Netherlands

Dyke ring areas in the Netherlands and risk of floodings. Westpoort is located in dyke ring area 44 (in red).

1/10.000 per year | 1/4.000 per year | 1/2.000 per year | 1/1.250 per year

Amsterdam and Westpoort

- main defence
- area within dyke ring 44
- built-up area
- Westpoort

Contents

Summary

Much of the Netherlands is below sea level. This means that flooding remains a risk, regardless of the dykes and dunes that protect us. The Water Resilient Westpoort adaptation strategy is a pilot within the framework of the national Delta Programme, which aims at climate proofing the Netherlands. The pilot investigated ways to improve the water resilience of the critical and vulnerable functions in the Port of Amsterdam's Westpoort area. This has resulted in a practical and area based approach that can also serve as an example for other regions.

The chance of flooding in Westpoort is fairly slim: about 1/10,000 per year for a property at 1.15m above Normal Amsterdam Level (N.A.P.). This corresponds to a chance of 1% in a human lifetime. In the event of flooding, the Westpoort area would be submerged by about half a metre. But that could have far-reaching consequences, not only for the area itself but for the entire city and region.

This is due to the critical and vulnerable functions present in Westpoort and the manner in which they are interdependent. Critical functions are functions that are crucial to the functioning of the city and region. They include, for instance, the electrical power supply, wastewater treatment, city heating, and telecommunications. Vulnerable functions are ones that can have a severe impact on public health, the environment and the economy in the event of flooding – for instance, chemical companies and waste processing. The interdependencies of these functions can lead to chain reactions: if one function fails, other functions will malfunction too. Within the framework of the Delta Programme, the central government makes agreements regarding national critical and vulnerable functions to ensure that these functions will be better protected against flooding by 2050. Studies have been done at Westpoort about critical and vulnerable functions and their significance for Westpoort, the City of Amsterdam and the Amsterdam Metropolitan Area.

The Water Resilient Westpoort adaptation strategy is aimed at better protection of the critical and vulnerable functions in the area. The adaptation strategy seeks to capitalise on opportunities offered by spatial developments and investments by companies, in order to adapt existing assets and to make adaptation agreements between public and private stakeholders. Westpoort is undergoing a constant metamorphosis. In many cases, if risks of flooding

are taken into account on time, extra protection does not necessarily lead to extra costs.

The adaptation strategy is comprised of three tracks.

Aware focuses on creating awareness of the risks of flooding so that chain partners, government authorities and companies are equipped to assess water resilience of existing situations and new developments and investments. Adequate information provision and creating awareness of risks and consequences of flooding are key to achieve this. Westpoort stakeholders are encouraged to use this knowledge in decision-making on developments and investments in the area. Importantly, Aware is also dedicated to the timely establishment of process agreements between the stakeholders involved.

Bottom Line is about containing a disaster and what is needed for this. This involves three objectives. First, to prevent an emergency from causing a disaster or cascading disasters. Second, to limit life-threatening situations and large-scale social upheaval in the city and region insofar as possible. Third, to safeguard the rapid recovery of critical functions after the disaster. The crucial question here is what minimum arrangements do we want to have in place in our joint approach as government authorities, also taking into account chain reaction effects.

Bottom Line consists of operational agreements as well as physical measures, particularly concerning crisis management.

Resilient Projects identifies and promotes smart solutions for a resilient and robust structuring of the area. Projects are dealt with as they occur. Water resilient solutions are sought within individual spatial developments, both regarding physical structure and choice of location.

Resilient Projects does not have fixed targets or completion deadlines. Rather, the ultimate result depends on economic and spatial developments, the understanding of the chains and relationships between chains, political decisions at various scale levels, the link to other processes, feasibility and affordability. For example, could roads be raised during major maintenance work so that they can serve as part of an evacuation route?

The three tracks can be followed separately. Each track requires different efforts and timeframes for implementation. Work can start immediately on Aware. Bottom Line first needs further coordination with central government and the agreements it makes with the critical sectors. Resilient Projects particularly calls for action whenever developments take place in Westpoort that offer opportunities for simultaneously improving water resilience.

The adaptation strategy focuses on Westpoort, but can serve as a step towards an approach for the city as a whole, for the North Sea Canal Area, the Amsterdam Metropolitan Area or the province.

The strategy should be seen in context with other challenges regarding climate adaptation. In particular measures dealing with pluvial flooding can possibly be taken simultaneously with measures concerning flooding due to a dyke breach.

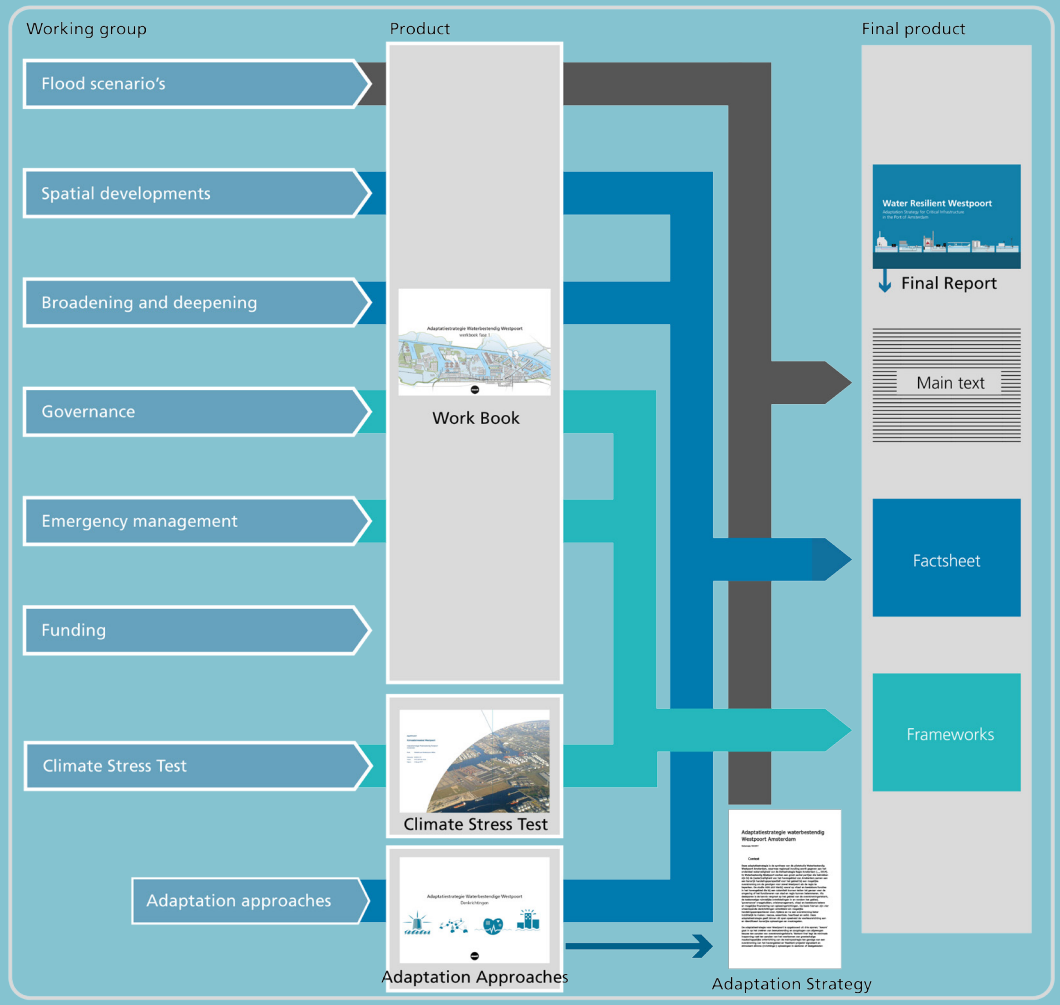
Adaptation strategy process

In this final adaptation strategy report, the findings and conclusions from previous stages are defined in various ways. The adjacent diagram shows where and how the various components play their part.

The adaptation strategy began with investigating: Flood scenarios, spatial developments in Westpoort, the operation of critical and vulnerable functions and interdependency chains, governance, and the possibilities for emergency management and funding were all examined in detail by working groups. The results were collected in a Work Book (Werkboek). The Work Book presents the conclusions in the form of frameworks, or in the Factsheet (kenniskatern). The knowledge gained about the risks of flooding has been included in the main text.

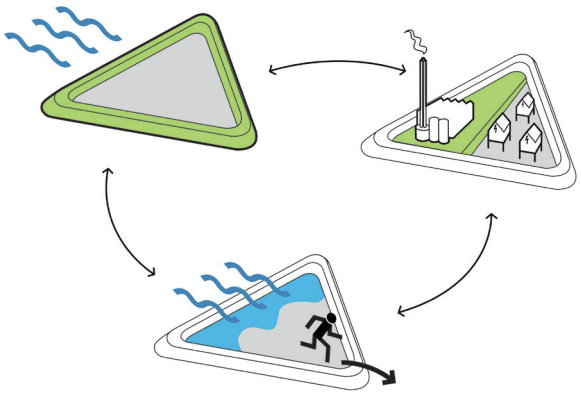
Alongside the working groups, Royal Haskoning,DHV and TAUW investigated with a climate stress test how measures against heat, drought and pluvial flooding relate to measures against other types of flooding. This resulted in a report entitled Climate Stress Test Westpoort (Klimaatstresstest Westpoort). The conclusions are presented in the box 'Pluvial flooding, heat and drought'.

Finally, possible approaches to adaptation were explored, and it was investigated which of these are currently the most desirable and promising. On this basis, the first version of the adaptation strategy was written.



Process diagram: adaptation strategy

1 The need for an adaptation strategy



Multi-layer flood risk management

In a large part of the Netherlands, people are living and working below sea level. Dykes, dunes and other water defences protect us against the surrounding water. They are protecting us so well that we do not take the possibility of flooding seriously enough. However slim the chance, things could go wrong one day. The floods in New Orleans and New York have shown the kind of havoc that can be wrought.

Interviews with representatives of companies located in Westpoort have revealed a widespread lack of awareness of the risks of flooding. The interviewees indicated that these risks generally do not play a role in decisions regarding investments. As a result, opportunities to contain the potential consequences of flooding are often lost. For example, emergency facilities are still too often accommodated in basements. That makes us unnecessarily vulnerable.

Since the start of the National Delta Programme in 2010, the Netherlands has been working on multi-layer flood risk management. Water defences such as dykes constitute the first layer, the purpose of which is to prevent flooding. If something goes wrong in this first layer – for instance, if a dyke breaks – smart spatial planning can limit damage and the number of victims in the event of flooding. That is the second layer. The third layer concerns crisis management, allowing people and animals to brought to safety as quickly as possible, and minimising undesirable effects. Multi-layer flood risk management therefore not only reduces the chance but also the consequences of flooding.

The Amsterdam region is also committed to multi-layer flood risk management. Within the Water Resilient Amsterdam programme, various pilots were conducted to investigate how Amsterdam can improve its water resilience in the various layers. In 2014, the findings were incorporated into the Amsterdam Region Delta Strategy.

Collaboration

Climate adaptation of critical and vulnerable infrastructure is a new topic with which relatively little experience has thus far been gained. For this reason, collaboration has been sought from the outset with comparable initiatives. In the Netherlands, this concerns pilots in Botlek and the IJssel-Vecht delta. The collaboration is aimed at the exchange of knowledge and coordination with the national Critical and Vulnerable track of the Delta Programme. In addition, we are working together to increase awareness by holding workshops and presentations at Delta Programme conferences and meetings. Since 2016, exchange between the pilots has been formalised in the City Deal.

International collaboration has been sought, including with New York and Toronto. Toronto and Amsterdam have jointly taken the initiative to put the topic on the agenda within C40, an international network of cities committed to addressing climate change. This collaboration resulted report titled, "C40 Infrastructure Interdependencies + Climate Risks" (2017), summarizing the efforts of a sample of five city governments and other public agencies around the world to understand the cascading impacts of climate change on interconnected infrastructure systems at the urban scale. It highlights how the identification of infrastructure interdependencies and climate impacts can serve as a essential considerationin reducing risks to systems. The project was well-received in the C40 network. A follow-up to the project will aim to put the topic on the agenda for mayors of the affiliated cities and to seek collaboration with the private sector.

The Amsterdam Region Delta Strategy mentions the following points of action aimed at flood protection:

1. The chance of flooding must be reduced, based on an economically optimal protection level. Integral account must be taken of safety throughout the region, taking account of the three main sources of danger regarding flooding (North Sea, Lek River, Markermeer Lake). The Lek Dyke has the highest priority.
2. Also seek to limit damage and social upheaval by:
   a. Providing extra protection for critical infrastructure and vulnerable objects (water-resistant planning).
   b. Maintaining the flood defences in inner city Amsterdam as extra protection.

The Amsterdam Region Delta Strategy is embedded in the policy plans of the various organisations in the region and used as a building block for the National Delta Decisions of 2014. The Lek Dyke is to be accorded a higher protection level and the lock gates at IJmuiden are to be reinforced. Further decisions on the inner city defences were taken in the Central Holland dyke improvements project (Project Dijkversterking Centraal Holland). The region is focusing on the critical infrastructure and vulnerable objects. If these were to be flooded, this could set off chain reactions and lead to social upheaval in an area much larger than the area actually submerged.

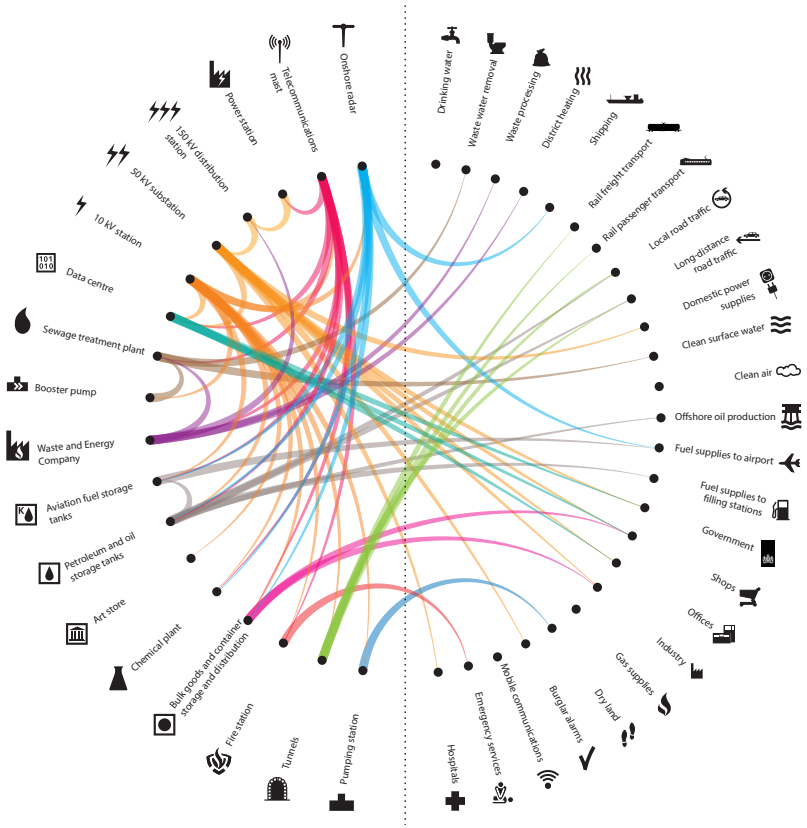
The Water Resilient Westpoort adaptation strategy fleshes out point 2a of the Amsterdam Region Delta Strategy. Adaptation here means adapting in order to be less vulnerable to flooding. To this end, the Water Resilient Westpoort adaptation strategy seeks to capitalise on the opportunities offered by spatial developments and investments in companies, to adapt existing objects and to make agreements between public and private stakeholders. In many cases, if risks of flooding are taken into account in time, extra protection need not necessarily lead to extra costs.

Adaptation here means adapting in order to be less vulnerable to flooding

Flooding is not the only risk, but has the most far-reaching consequences for the networks in which Westpoort plays a role. By minimising the consequences of flooding, the resilience of the area and the critical networks are improved. For instance, even in the event of flooding, Westpoort can then continue to fulfil its important role for the region, in a time in which the country and region have to deal with the consequences of a large-scale disaster.

The adaptation strategy focuses on Westpoort, but can serve as a step towards an approach for the city as a whole, for the North Sea Canal Area, the Metropolitan Area or the province. The strategy can also be seen in context with other tasks related to climate adaptation. In particular measures dealing with pluvial flooding can possibly be taken simultaneously with measures concerning flooding due to a dyke breach

The Delta Programme is also developing policy for adapting critical and vulnerable infrastructure. Water Resilient Westpoort and several other pilots are contributing towards this as examples of a concrete and area-based approach.



Chain dependencies

2 Westpoort: a crucial link for Amsterdam

Westpoort is essential for the functioning of the city and its environs

The adaptation strategy was developed for Westpoort, Port of Amsterdam.
Flooding could have far-reaching consequences, not only for the area itself but also for the entire city and region.

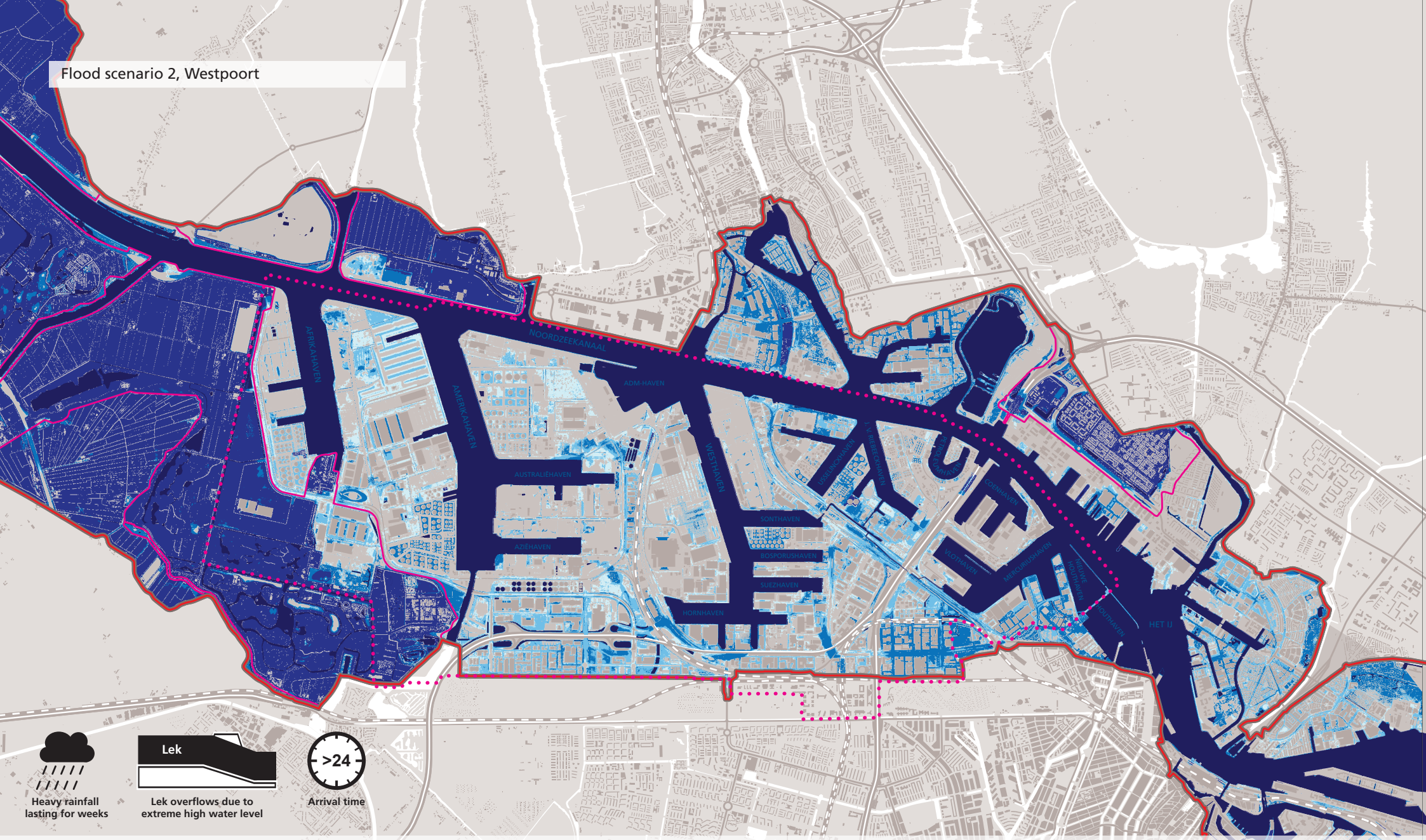
The fourth largest port in Western Europe, Westpoort is home to many companies and facilities that are crucial to the functioning of the City of Amsterdam and its environs. Apart from the power station, Westpoort is the location of the link to the national network and distribution of electricity to the city. Westpoort is also the location of the Waste and Energy Company (Afval Energie Bedrijf, or AEB), which processes waste from the city and provides large parts of the city with electricity and heating. In addition, most of Amsterdam's wastewater is treated in Westpoort.

As Westpoort also accommodates companies in the highest environmental risk category, which, for example, are permitted to store hazardous substances, flooding in Westpoort could also pose a danger to the city.

An additional reason to select Westpoort as a pilot area is its considerable economic importance. It is the world's biggest port for petrol and cocoa. From the port, Schiphol airport is supplied with jet fuel via a pipeline. Data centres are showing interest in Westpoort as a potential business location. The area is also undergoing a constant metamorphosis. For example, the eastern part of the Sloterdijken (the "dry" part of Westpoort), is part of the planning area of Haven-Stad (Port City), which is transforming from an industrial area into a mixed working and residential area.

Westpoort is relatively high-lying (between 0.4 and 1.4 metres above the Amsterdam Ordnance Level (NAP)). In the event of flooding, the area would be submerged by about a half a metre. This means that the flood resilience can be improved with relatively simple interventions.

Flood scenario 2, Westpoort



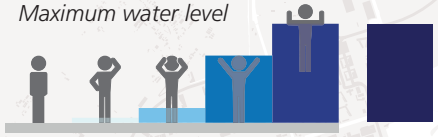
Flood scenario 2, Westpoort

+1,3 meter NAP

max. water level scenario 2
once per 10.000 years

(Levels based on AHN3, up-to-date height model of the Netherlands)

Maximum water level



Legend

- *Westpoort boundary*
- *Main defence (dyke ring 44)*
- *Secondary defence*
- *Area within dyke ring 44*
- *Area outside dyke ring 44*
- *Buildings*

Scale
1 : 40.000

0 0,5 1 2 km

3 How probable is the chance of flooding?

The chance of flooding in Westpoort is small. The consequences are major

Westpoort is situated in dyke ring (area) 44. Flooding in this area can occur from two sides. First, from the south east, if the Lek dyke breaches as a result of high water levels following weeks of heavy rainfall in the Rhine catchment area. In that case, it would take at least one day before the water reached Westpoort, but it could also take considerably longer. It depends largely on where the Lek Dyke breaks. If the water defences break at the Beatrix or Irene locks, the water will reach Westpoort within a day (due to the direct open connection of the Lek Canal/Amsterdam-Rhine Canal with the North Sea Canal). If defences break at other locations along the Lek, it will take several days, because the dyke ring area to the south east of Amsterdam will flood first. If the Lek Dyke breaks, a large area will be flooded and it will take months before the water has receded again everywhere. The consequences of this would be huge.

The second possible cause is located on the western side, if part of the water defences at IJmuiden give way or if water goes over the top. In the latter case, Westpoort would not be affected. The first would only be possible due to construction failure, and an extremely heavy storm with wind force 11 to 13 Bft from a north-westerly direction. In that event, the water would reach Westpoort very quickly. A fifty-metre breach in the IJmuiden lock complex would mean that the water would reach Westpoort within an hour, but would disappear again after one or two days. However, as it would be salt water, the damage would be great.

Because of the proximity of the Markermeer lake, you would expect that a breach of the lake would also pose a threat to Westpoort, but that is not the case. The water level in the North Sea Canal would then rise, but not enough to cause flooding in Westpoort. The consequences of the different types of flooding have been charted in flood scenarios, which show the resultant water levels in Westpoort and the locations that would be flooded. The scenarios also show the consequences of flooding

both in the current situation and when the dykes meet the new flood protection standards – which all dykes must meet by 2050 at the latest.

Scenario 1: Lek Dyke at current safety level. The chance of flooding is roughly once per 250 years. In this scenario, Westpoort would stay almost completely dry in the event of a breach - unlike the rest of the dyke ring area.

Scenario 2: Lek Dyke at 2050 safety level. The chance of flooding is roughly once per 10,000 years. The dyke will only break in the event of high, extreme water levels. In that case, Westpoort would be flooded if the Lek breached. However, there would be a relatively large amount of time to prepare Westpoort for the flooding. In nearly all these cases, it would take several days before the water reached Westpoort.

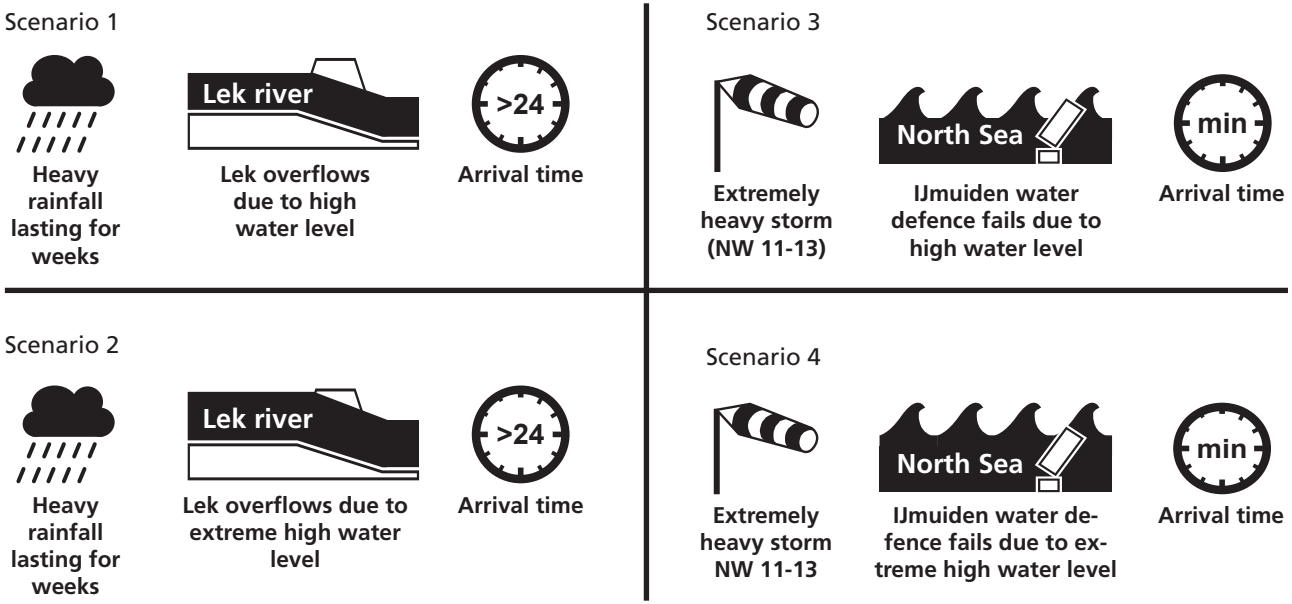
Scenario 3: IJmuiden at current safety level. In this scenario, the chance of flooding is roughly once per 10,000 years. A breach at IJmuiden will lead to part of Westpoort being submerged. In that case, the water would reach Westpoort within an hour.

Scenario 4: IJmuiden at 2050 safety level. The chance of flooding is roughly once per 100,000 years. In this scenario, failure of the water defence at IJmuiden will mean that the whole of Westpoort is inundated extremely quickly.

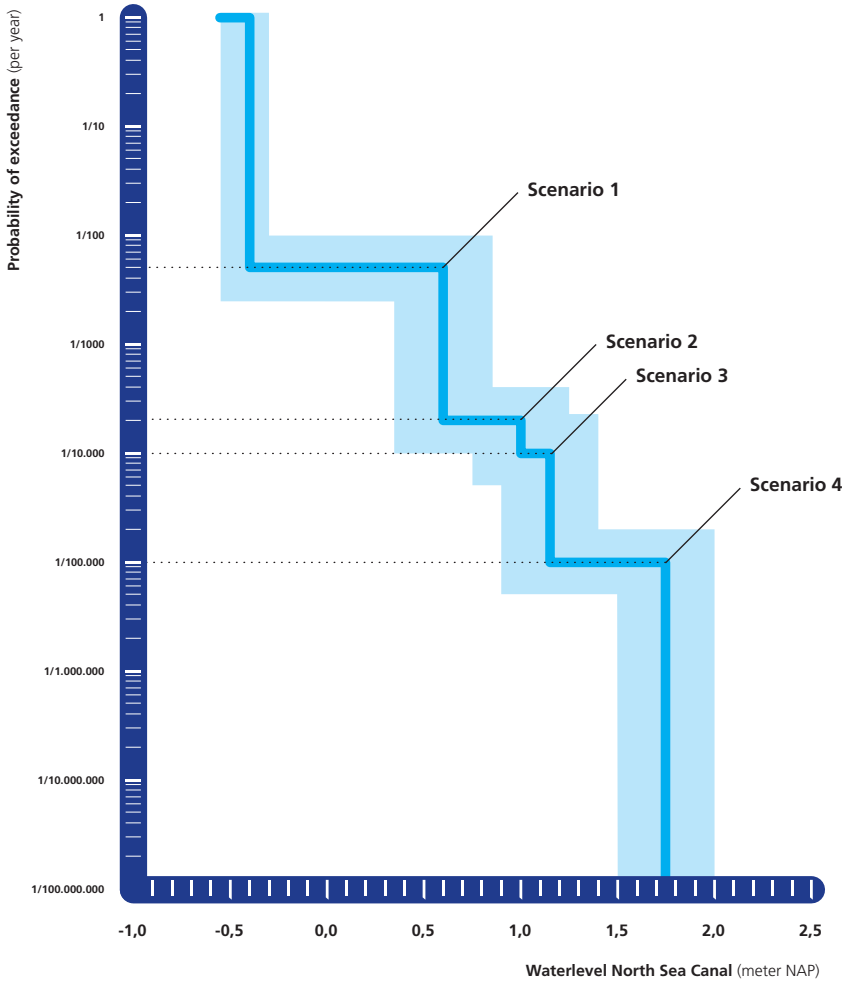
The flood scenarios are based on scenarios that were developed and used for the Delta Programme. The national approach to critical and vulnerable functions is also based on these scenarios, which, however, do not predict precise water levels. They are model calculations which do not take wind effects, for instance, into account. Ultimately, the location of the breach, the size of the breach in the dyke, and the duration of the high water level

period will be decisive. Particularly in the case of a breach in the Lek Dyke, which is quite far away from Westpoort; this makes the predications more uncertain. For this reason, a bandwidth of at least fifty centimetres should be applied to the water depth predictions.

The chance of flooding in Westpoort is therefore slim: currently about 1/5,000 per year for a property at 1.15m above Normal Amsterdam Level (N.A.P.) This corresponds to a chance of 1% in a human lifetime.



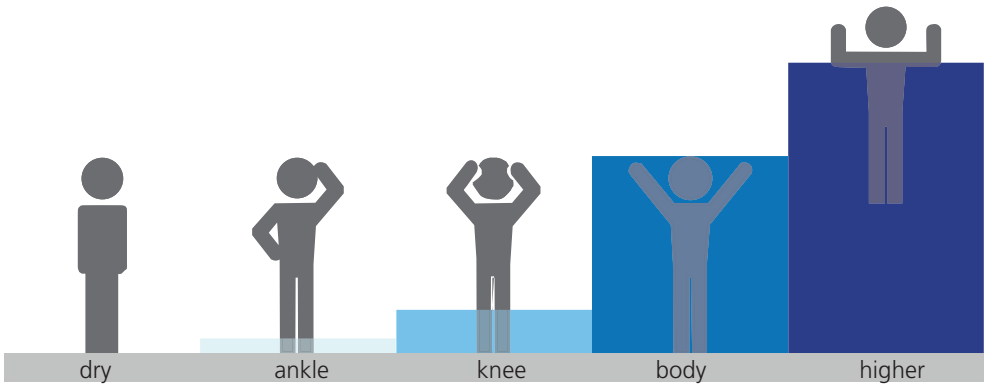
Flood scenarios: cause and arrival time



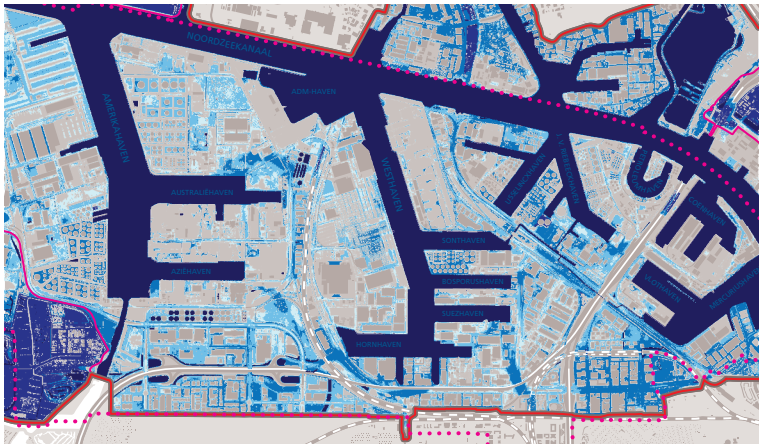
Water levels for North Sea Canal and flood probabilities

	2015		2050	
	Probability	Water level North Sea Canal	Probability	Water level North Sea Canal
Lek River				
• Scenario 1	1/250	0,4 - 0,9 meter NAP	-	-
• Scenario 2	1/10.000	0,8 - 1,3 meter NAP	1/10.000	2015 level + ??
North Sea				
• Scenario 3	1/10.000	0,9 - 1,4 meter NAP	-	-
• Scenario 4	1/100.000	1,5 - 2,0 meter NAP	1/100.000	2015 level + ??

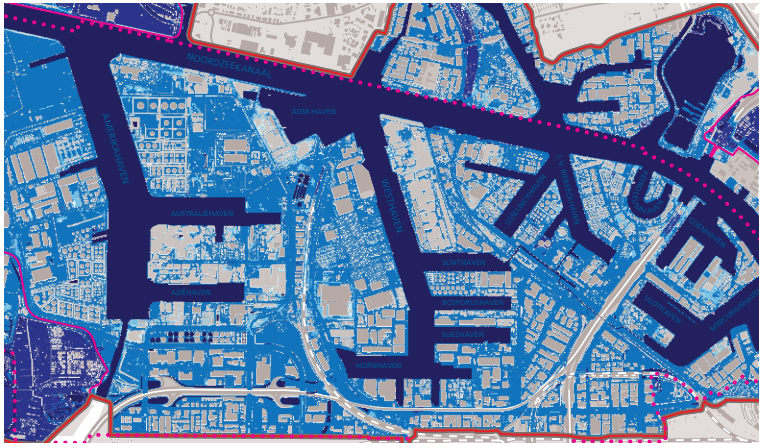
Flood information for Westpoort



Detail: flood scenario 1



Detail: flood scenario 3



Detail: flood scenario 4

Pluvial flooding, heat and drought

A climate stress test was conducted to map the consequences of heavy rainfall, drought and heat for Westpoort. The test also looked for overlaps with the consequences of flooding due to a dyke breach.

Clear overlaps were found between the consequences of pluvial flooding and flooding, both between the locations affected and the measures designed to limit the consequences. Low-lying locations affected by flooding after recent downpours, such as tunnels and streets, will also quickly be inundated in the event of other types of flooding. Regarding critical and vulnerable functions, the most important overlaps were found in parts of the electricity and road traffic network and in goods storage. Here, combined measures can reduce the risks, and that is what the adaptation strategy is aiming for. For instance, installing electricity distribution stations at higher levels means a reduced chance of failure and damage in the event of pluvial and other types of flooding. Also, building elevated junctions and access roads, or marking main routes with high-level signs will be helpful in the event of all types of flooding.

No correlations were found between the causes and consequences of heat and drought and those of flooding. Given that Westpoort does not have wooden foundations and that the area has been raised with a thick layer of sand, it is not vulnerable to subsidence as a consequence of drought. However, Westpoort is sensitive to heat. During warm periods, the temperature can rise to more than 8 degrees Celsius higher than in surrounding areas, although this is not expected to pose a threat to critical infrastructure or vulnerable objects. In principle, there is enough cooling water available in the harbour basins.

Further climate change may necessitate measures to prevent problems regarding quality of life, accessibility and goods storage.

As there are no direct opportunities for linking risk reduction measures, the adaptation strategy does not pay further attention to heat and drought.

Critical and vulnerable functions in Westpoort

Electricity

Wastewater

District heating

Infrastructure

Pipelines (gas receiving station)

Telecommunications

4 Critical and vulnerable functions in Westpoort

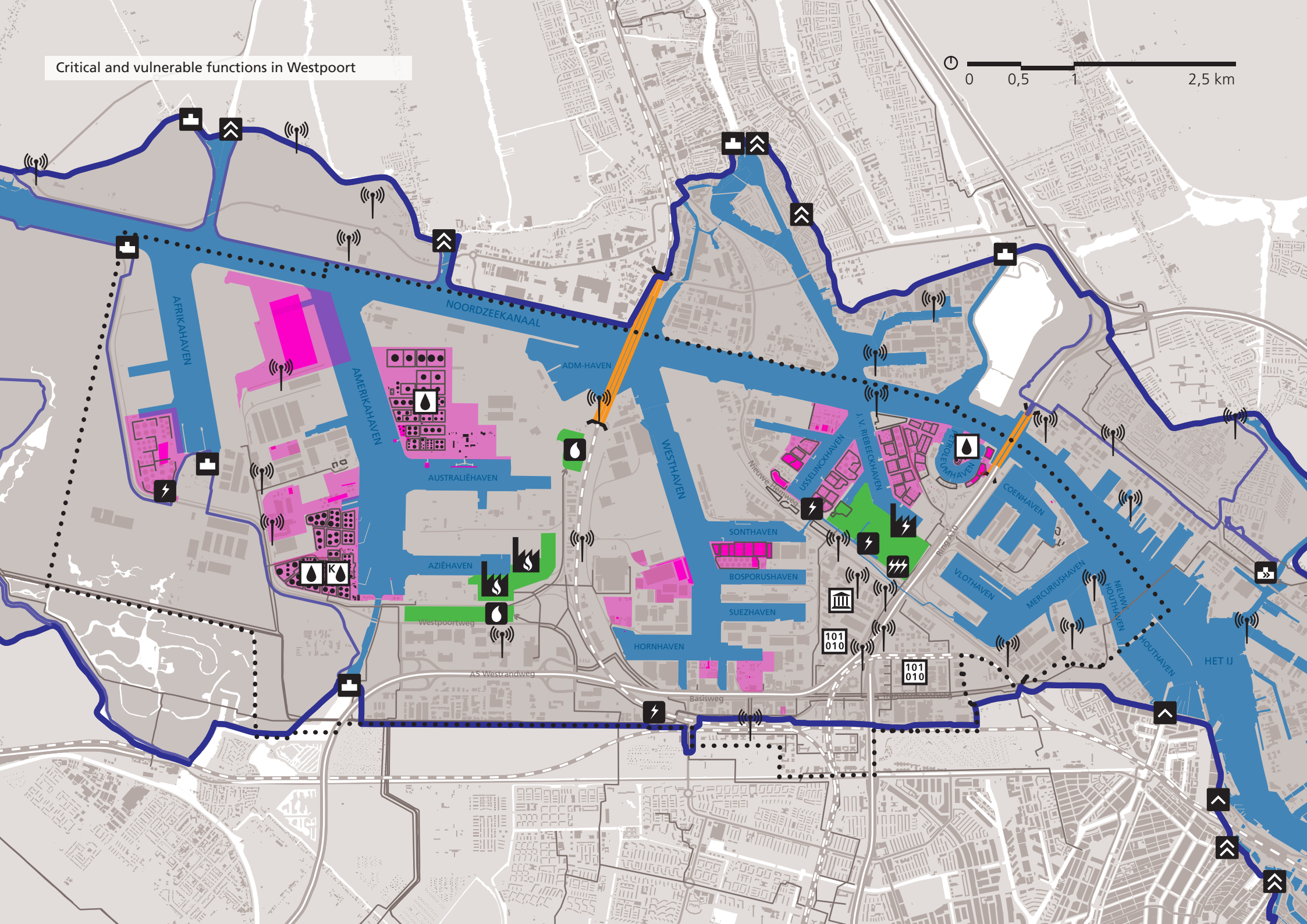
You don't want flooding of Westpoort to be a disaster for areas that are not flooded themselves

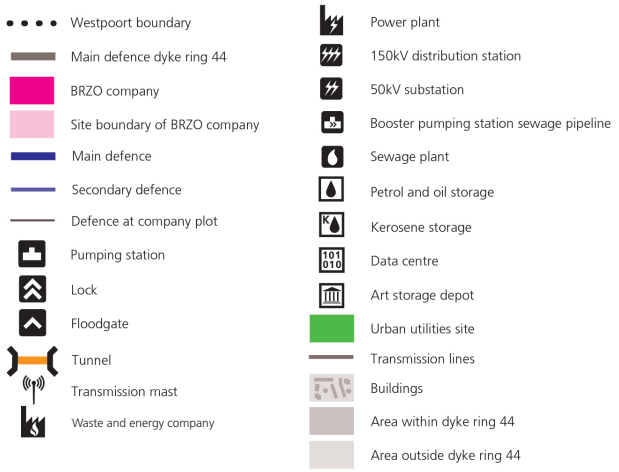
The strategy focuses on the critical and vulnerable functions present in Westpoort. These are functions that are crucial for disaster management in the event of flooding, or functions that could result in serious damage to people, the environment or the economy in the event of flooding. Crucial functions are functions such as the electricity supply, wastewater treatment plants, and the Waste and Energy Company (AEB), which processes waste and provides the city with power and heating. It is essential for the safety and fast recovery of the region that such a function continues to operate to the extent possible during a disaster, or at least be restored as quickly as possible afterwards. An example of functions that can cause serious damage are companies that have large quantities of chemicals stored on their premises.

The central government is to ensure that the national critical and vulnerable functions will be better protected against flooding by 2050 at the latest.

The national critical and vulnerable functions include power supplies, telecommunications and IT, water supply and wastewater facilities, health care, flood defences and pumping stations, main infrastructure and chemical and nuclear substances. Initially, the adaptation strategy was based on this list of critical and vulnerable functions. It has been investigated for Westpoort whether these functions exist, and if so where they are located, and what their significance is for the functioning of Westpoort, the city and the region. It is important to make sure that flooding of Westpoort will not result in a disaster for other areas that are not flooded, like a power failure that prevents hospitals in the area from functioning.

It was also investigated whether there are any functions that are not on the national list but which are critical and vulnerable from a regional perspective. To this end, an estimate was made of the social upheaval that would occur if a function were to fail, either temporarily or permanently. The impact


Critical and vulnerable functions in Westpoort
0
0,5
1
2,5 km
AFRIKAHAVEN
AMERIKAHAVEN
NOORDZEEKANAAL
ADM-HAVEN
AUSTRALIËHAVEN
AZIËHAVEN
WESTHAVEN
SONTHAVEN
BOSPORUSHAVEN
SUEZHAVEN
HORNHAVEN
USSELINCXHAVEN
J.V. RIEBEECKHAVEN
PETROLEUMHAVEN
COENHAVEN
VLOTHAVEN
MERCURIUSHAVEN
NIEUWE HOUTHAVEN
HOUTHAVEN
HET IJ
Nieuwe Hemweg
Westpoortweg
A5 Westrandweg
Basisweg
Ring A10
101
010



of the failure, the damage suffered as a result of the failure, and the capacity of society to deal with the damage were all considered. The position of the function in the various chains, the interdependencies with other functions and the possibility to compensate for failing components elsewhere also play a role. The consequences are not assessed from the perspective of a person or a company but from the perspective of the community in the region as a whole. If the consequences of a function failing are unacceptably severe, the function is classed as "critical and vulnerable". District heating, for example, is a critical function that is of crucial regional importance. If flooding occurs during the winter, and evacuation is no longer an option, heating is an essential basic facility to ensure survival in a flooded area. From a regional perspective, the storage depot of the Stedelijk Museum Amsterdam in Westpoort is an example of a vulnerable function.

Emergency management

The approach to and organisation of regional emergency management is embedded in the regional emergency plan of the Amsterdam-Amstelland emergency management organisation. The objective here is to deploy people, resources and expertise of the fire services, Ministry of Defence, regional medical assistance (GHOR) and the police efficiently in the event of large-scale disasters. Flooding could impede implementation of the plan in various ways. For example, the crisis plan assumes that roads will be passable, but they could well be submerged during flooding. As a consequence, the fire services, police and ambulances may be unable to access the location of an emergency.

A power failure will also cause problems. For example, by making it difficult to inform companies about measures that need to be taken, or to provide emergency workers with the information they need.

Although flooding will result in specific problems, no immediate need is felt to adjust the Regional Emergency Management Plan because the plan allows for flexible, ad hoc responses to situations that may occur. However, there is a need for better coordination of the emergency plans of the various companies with government plans. This co-ordination should take account of possible chain effects.

Interviews with the various emergency and support services resulted in the following recommendations for crisis management in the event of flooding at Westpoort:

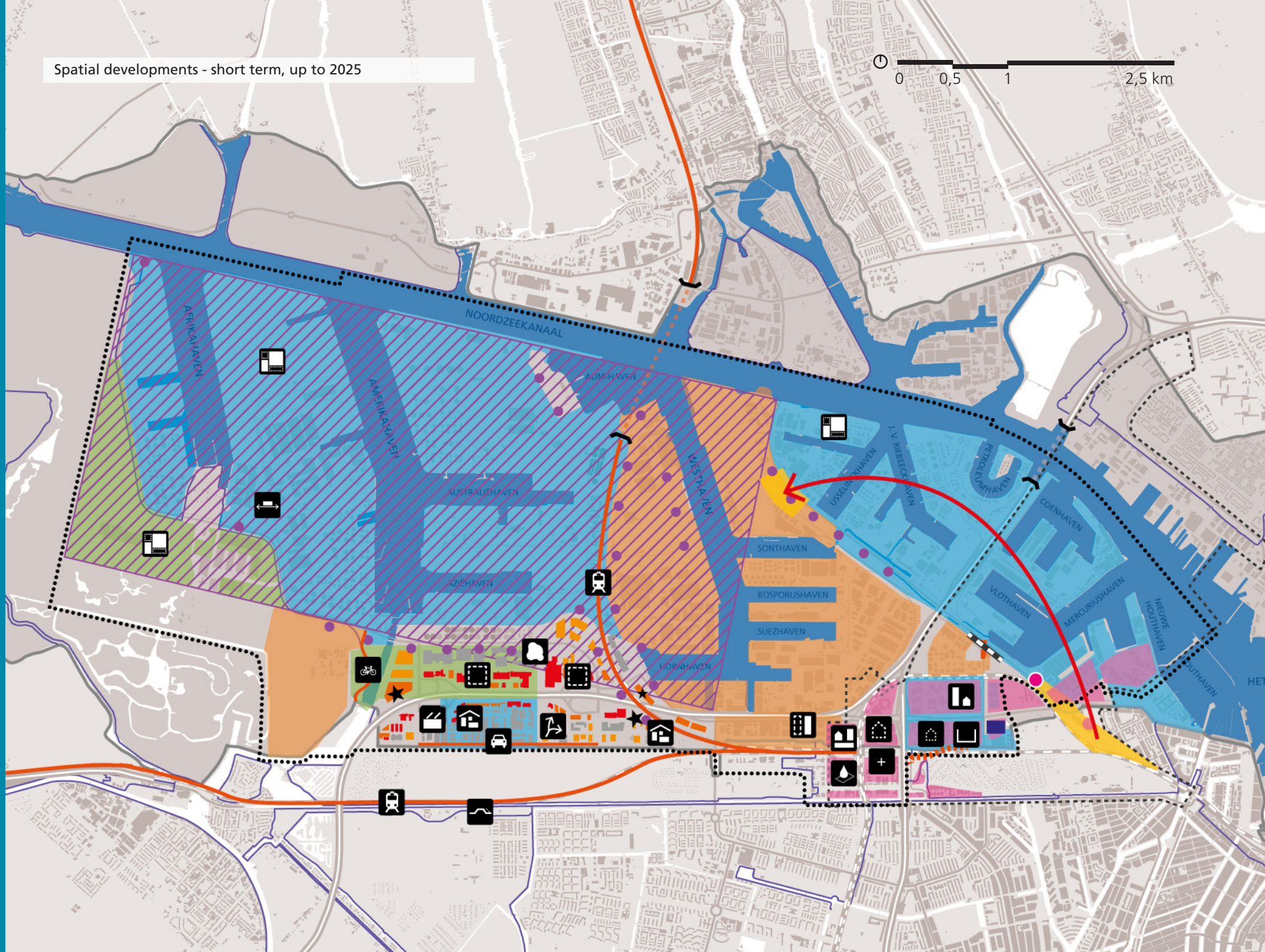
1. Appeal to the self-reliance of companies and involved stakeholders. In the event of flooding in the Amsterdam region, priority will normally be given to areas with a high population density and/or much more low-lying areas. For example, Westpoort has arelatively higher elevation compared to the Science Park. In Westpoort, the most attention will be paid to environmental threats, such as the dispersal of hazardous chemicals.
2. Within Westpoort, priority must be given to functions that could cause damage or failure in the rest of the Amsterdam region.
3. Prevent power supply failure in the event of flooding.

In the adaptation strategy, emergency management therefore focuses on creating awareness and setting up emergency power supplies and eventual restoration of the power grid.


CTVREDE - STEINWEG B.V.

Factsheet
Spatial Developments and Interdependency Chains

Spatial developments - short term, up to 2025



Sources:
> *Zoning plans (ruimtelijkeplannen.nl)*
> *Factsheets Sloterdijk area*
> *Climate resistance Waternet assets*
> *Report of interview with AEBA (Waste and Energy Company Amsterdam)*
> *Vulnerable companies 2013 (Port)*
> *MRA agenda,* **adopted by MRA on 4 January 2016**
> *Noord-Holland structural vision,* **established by Provincial Executive, 28 September 2015**
> *Welkom Westrandweg area strategy for Sloterdijk III,* **established by Municipal Executive, 27 November 2012, for inspection and discussion in BWK (building, living, quality**
> *Snoeien om te kunnen groeien (pruning to allow for growth), PLABEKA,* **adopted by administrators involved from the MRA (Amsterdam Metropolitan Area), 23 June 2011**

Spatial developments

- Westpoort is undergoing various spatial developments. These developments offer opportunities for simultaneously improving water resilience. Examples:

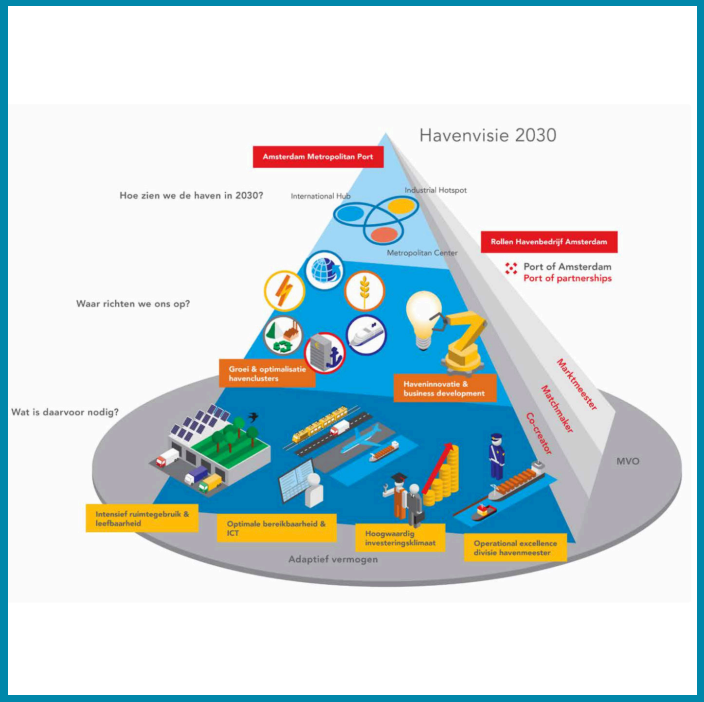
- Continuous management and maintenance. Up to 2020, much of the road and cycle path network in Westpoort is to be resurfaced. By not only resurfacing, but by also raising the road level, the water resilience of the infrastructure can be increased in small steps.

- The allocation of land plots presents a good opportunity to raise awareness of companies new to the area of the risks and possible measures that can be taken. Vacant land plots in the vicinity of existing vulnerable functions can be used to cluster vulnerable functions. It will be easier to take extra safety measures around such a cluster. However, it will be necessary to investigate whether it is desirable to cluster high-risk companies in the interests of safety and manageability in the event of emergencies.

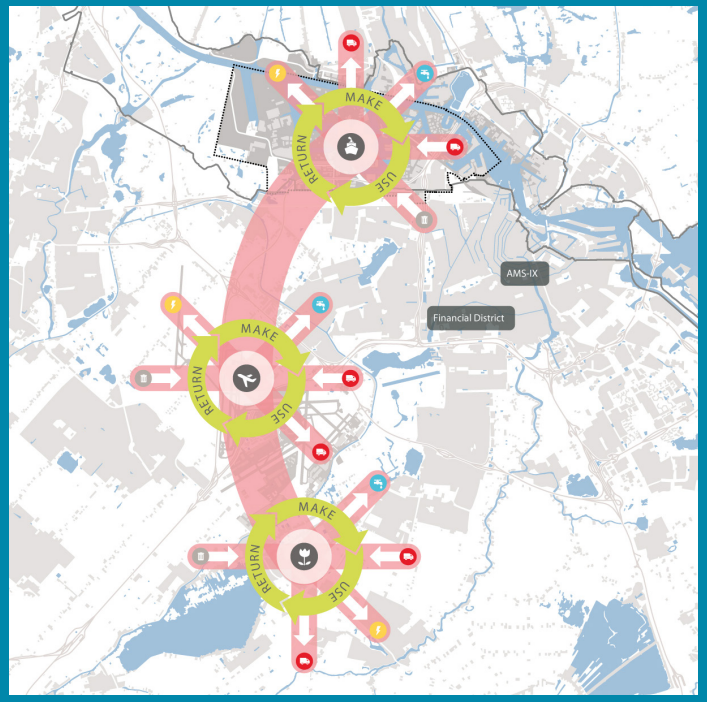
- In the case of adaptations at land plot level, companies can improve water resilience by placing their sensitive equipment or hazardous substances in a more elevated position, for example.

Multi-annual investment programme

Source: *Meerjaren Investerings Programma - fysieke ingrepen in de openbare ruimte 2016-2019* (Multi-annual investment programme - physical interventions in public spaces 2016-2019.) City of Amsterdam / *Stadsregie* (city management)



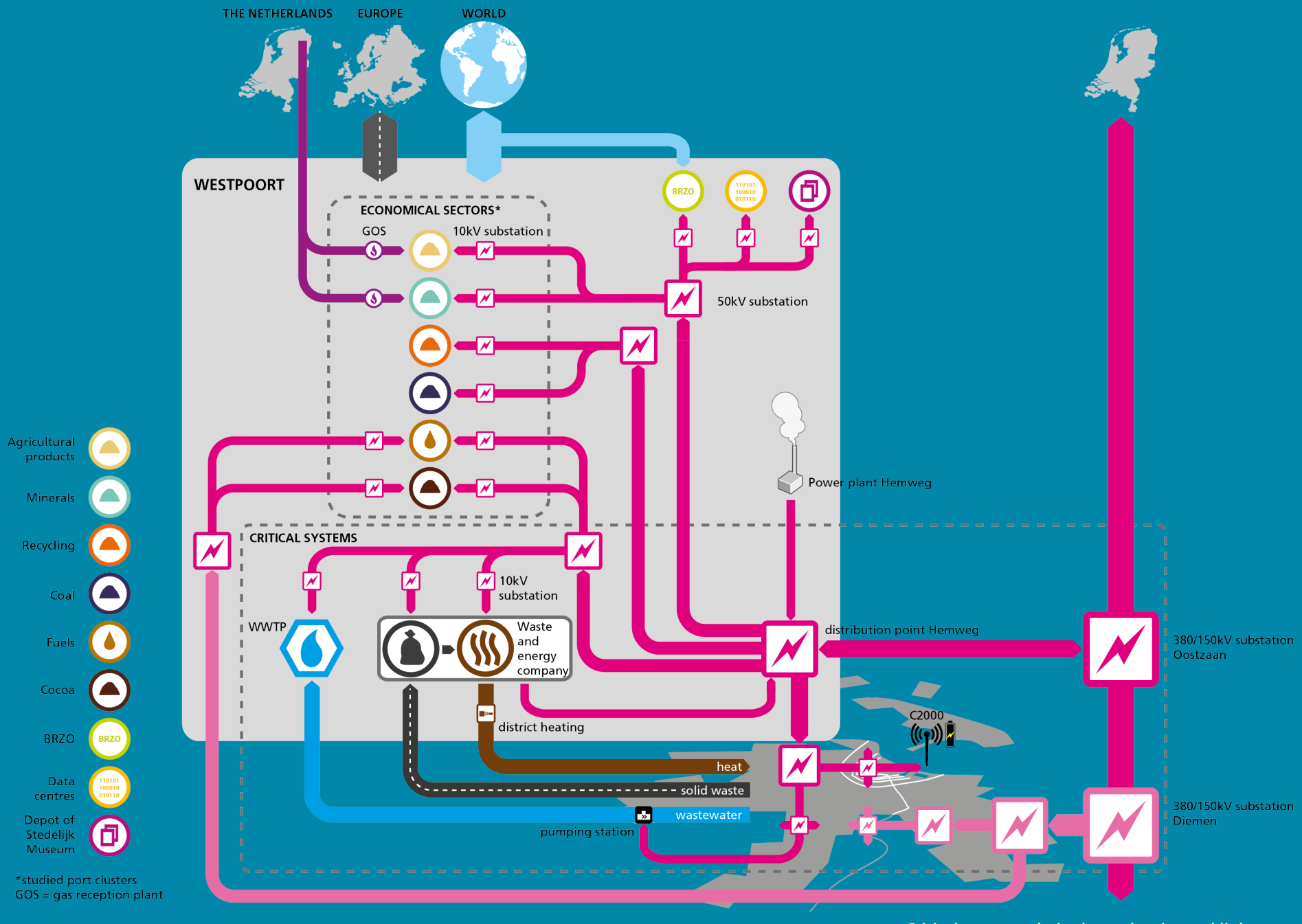
Port Vision 2030



Westas Manifesto

- The AEB Waste and Energy Company is considering installing an above-ground steam network, to which an emergency power supply could be linked for companies in Westpoort.
- Within the Port City planning area, Sloterdijk 1 and Sloterdijk Centre will be the first to be transformed into a mixed residential-working area. Sloterdijk 1 is relatively low-lying, and subject to flooding in various places as a result of heavy rainfall. Adaptations to limit the effects of pluvial flooding could also improve water resilience. In addition, Sloterdijk 1 faces the interesting question of how land plot-based transformation can go hand in hand with making an area more water resilient.
- In the longer term, the switch from fossil raw materials to renewable raw materials and a circular economy will play a significant role in the logistics of the port. When chains are transformed into circularity, water resilience can be taken into account.

Critical and vulnerable chains



Critical systems, chain dependencies and links

Critical and vulnerable chains

Westpoort is home to important components and links of critical chains that affect the functioning of the city and region. Six networks discussed below have been analysed to gain a better understanding of the vulnerability and dependencies of these chains.

Electricity
Westpoort houses the electricity distribution point (the switching field and 150 kV station) that provides two thirds of Amsterdam with power. Because the distribution point is at relatively higher elevation, there is little chance of this provision failing due to flooding. The substations (50 kV and 10 kV) are mostly at ground level, making them more vulnerable. As many critical chains and companies are dependent on electricity, there will be a considerable knock-on effect in the event of failure. For example, electricity is essential in some cases to halt production processes or prevent fire. If there is no flood-resilient emergency power supply, failure of the electricity supply can lead to an escalation of the disaster.

Wastewater (treatment and sewage)
All the wastewater from Amsterdam and environs goes to the Wastewater Treatment Plant (WWTP) in Westpoort. Industrial wastewater is also treated there. In the event of flooding, wastewater treatment would come to a halt, in part because of power supply failure. If the booster pumping stations in the city continue to function, transportation of wastewater to the WWTP will continue, and the port will be contaminated with untreated wastewater.

District heating / Waste and Energy Company
The Waste and Energy Company (AEB) is a major supplier of heating for the Amsterdam district heating network, to which 20,000 homes are connected. This number is set to increase considerably in the future. The heat buffer of the heat network is located adjacent to the AEB. If Westpoort floods, the AEB will come to a halt, and heat production will stop. Because district heating is largely dependent on the AEB, large parts of Amsterdam West will find themselves without heating.

Infrastructure
Westpoort is accessible via a number of important regional connections, such as the A5 / Westrandweg road, the A10 / Coen Tunnel and the rail connection under the North Sea Canal to Zaanstad. The height of the tunnel mouths will be crucial in the event of flooding. Moreover, the functioning of the safety systems in the tunnels depend on electricity. Embankments are another point of special interest. These could be weakened by flooding because they first become saturated with water and then undergo compacting when the water subsides.

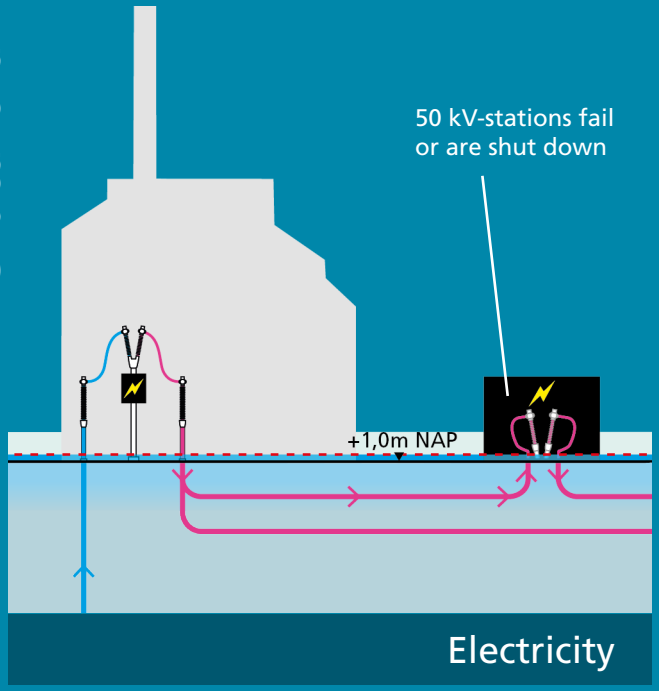
Pipelines
In general, pipelines are not so sensitive to flooding. However, pumping installations will be out of service. This means, for instance, that the transport of jet fuel from Westpoort to Schiphol airport will stop.

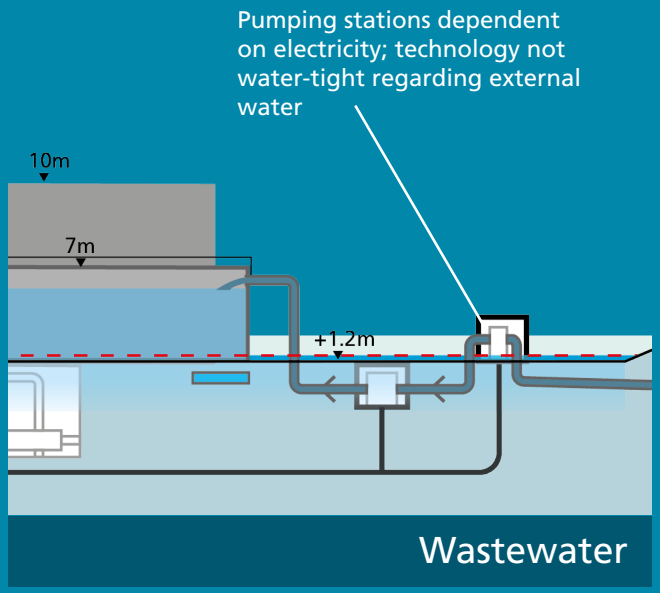
Telecommunications
There are various telecommunication antennas and masts in Westpoort. The technology and electricity supply are mostly at ground level, making them vulnerable. In the event of flooding, telecommunications will fail in the flooded area. The masts that serve the C2000 emergency network are located outside of Westpoort. The emergency network in Westpoort will therefore remain available.

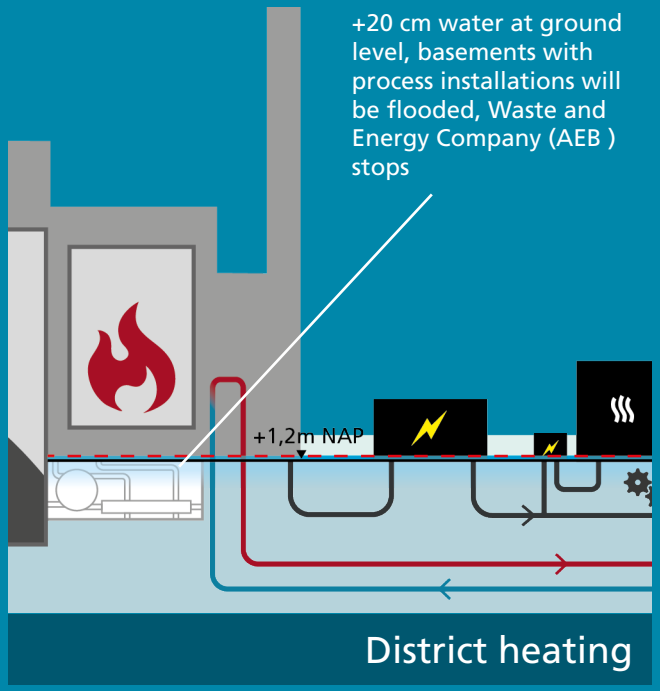
Port clusters

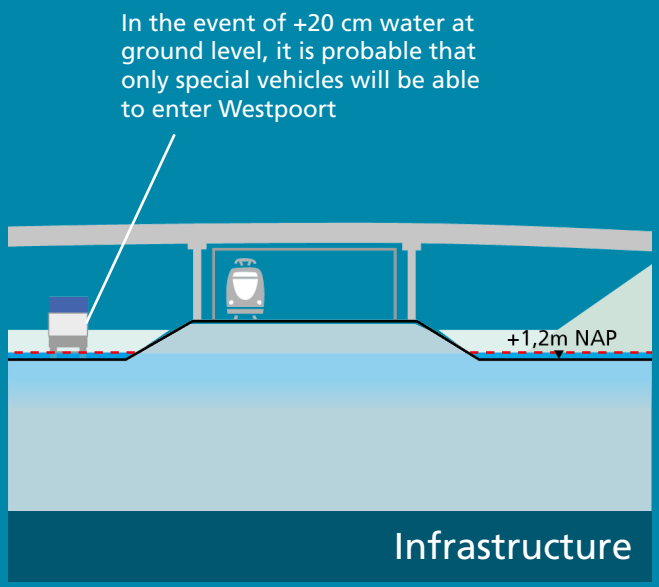
The port of Amsterdam has an important function supplying the national and European hinterland. As a strategic pivot in the worldwide trade of petrol and cocoa, among other things, reliability and supply guarantee are always crucial. Apart from the immediate material damage to plant and stocks, the consequences of flooding in Westpoort will also have a major impact on worldwide production and trade. To better understand the consequences and risks of flooding, the port clusters of agricultural products and fertilizers, minerals, recycling, coal, fuel and cocoa have been systematically investigated.

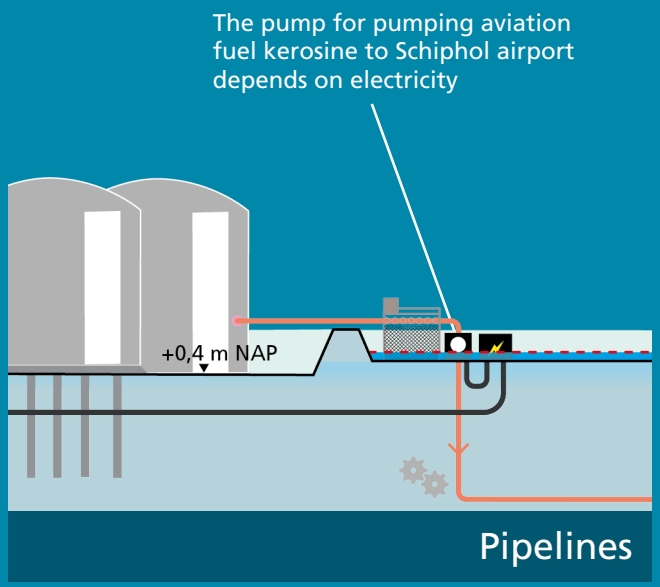
Critical chains

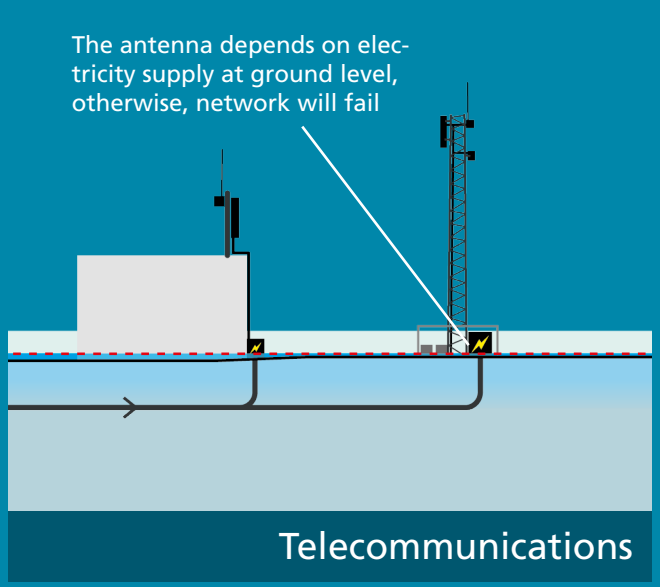


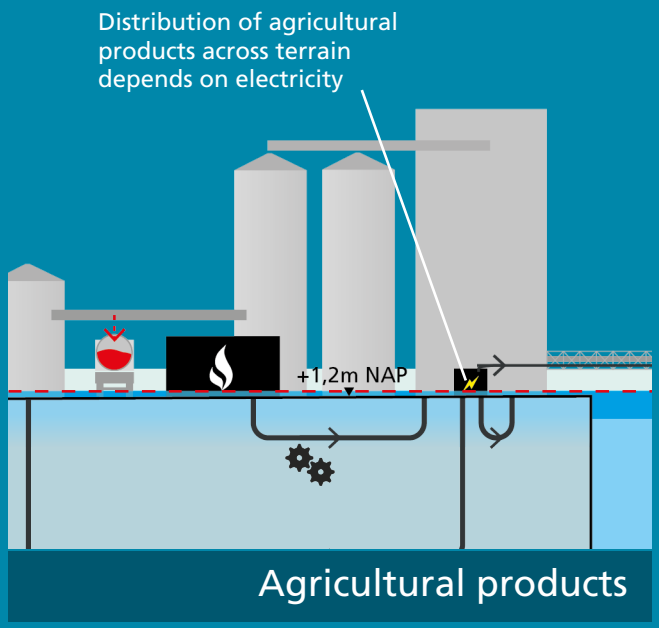


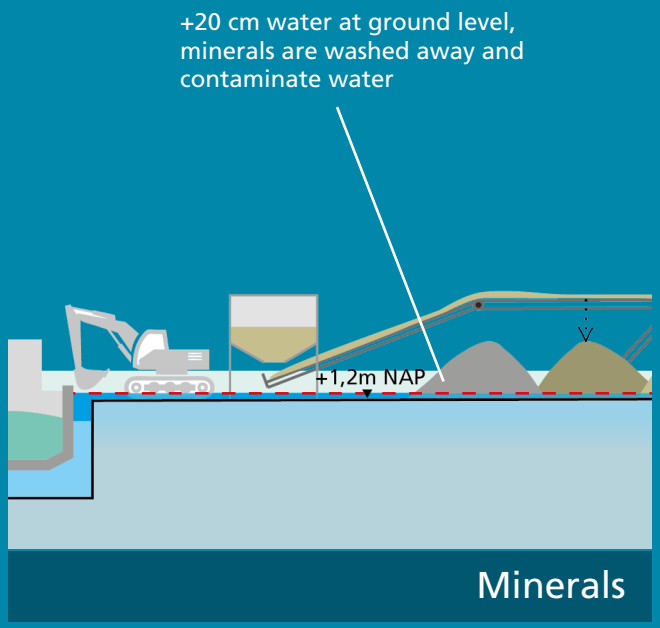


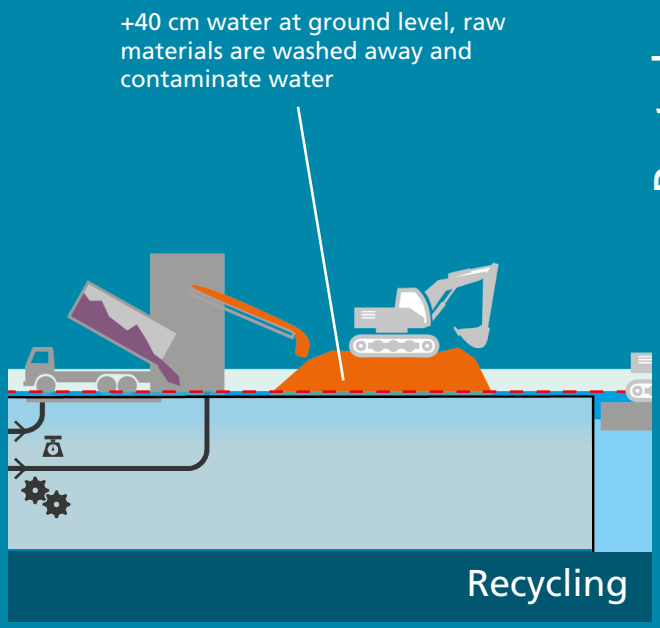


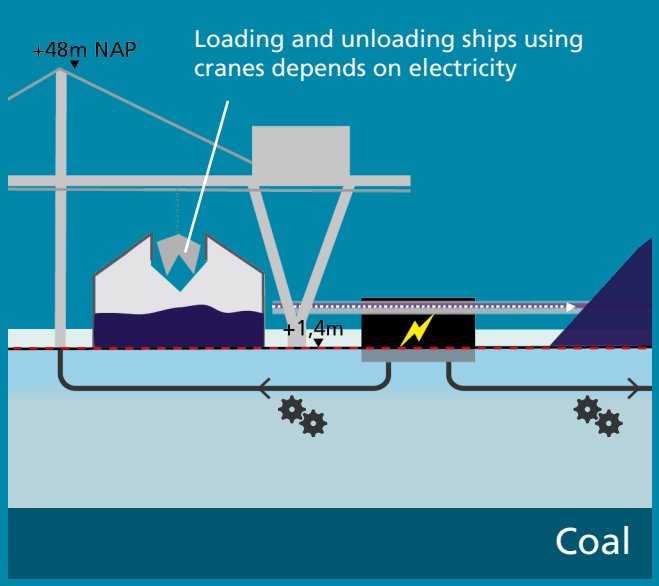


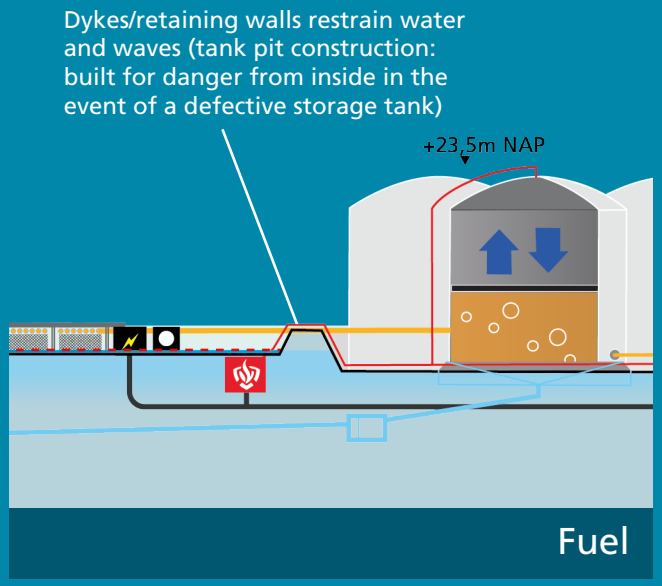


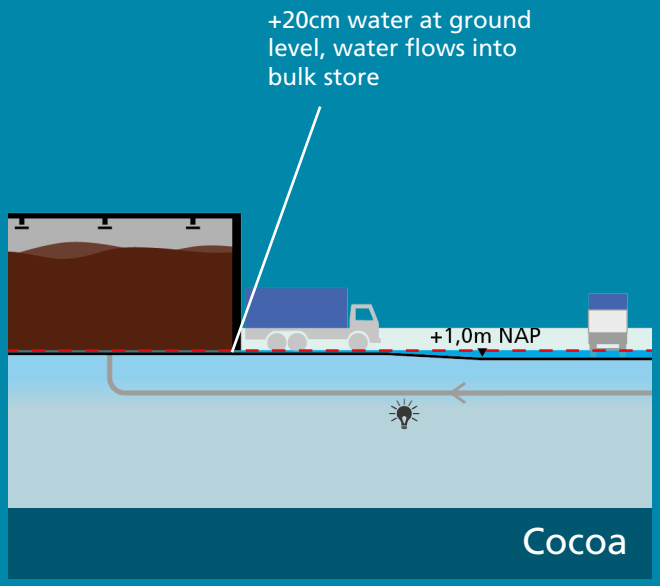

Distribution of agricultural products across terrain depends on electricity
+1,2m NAP
Agricultural products

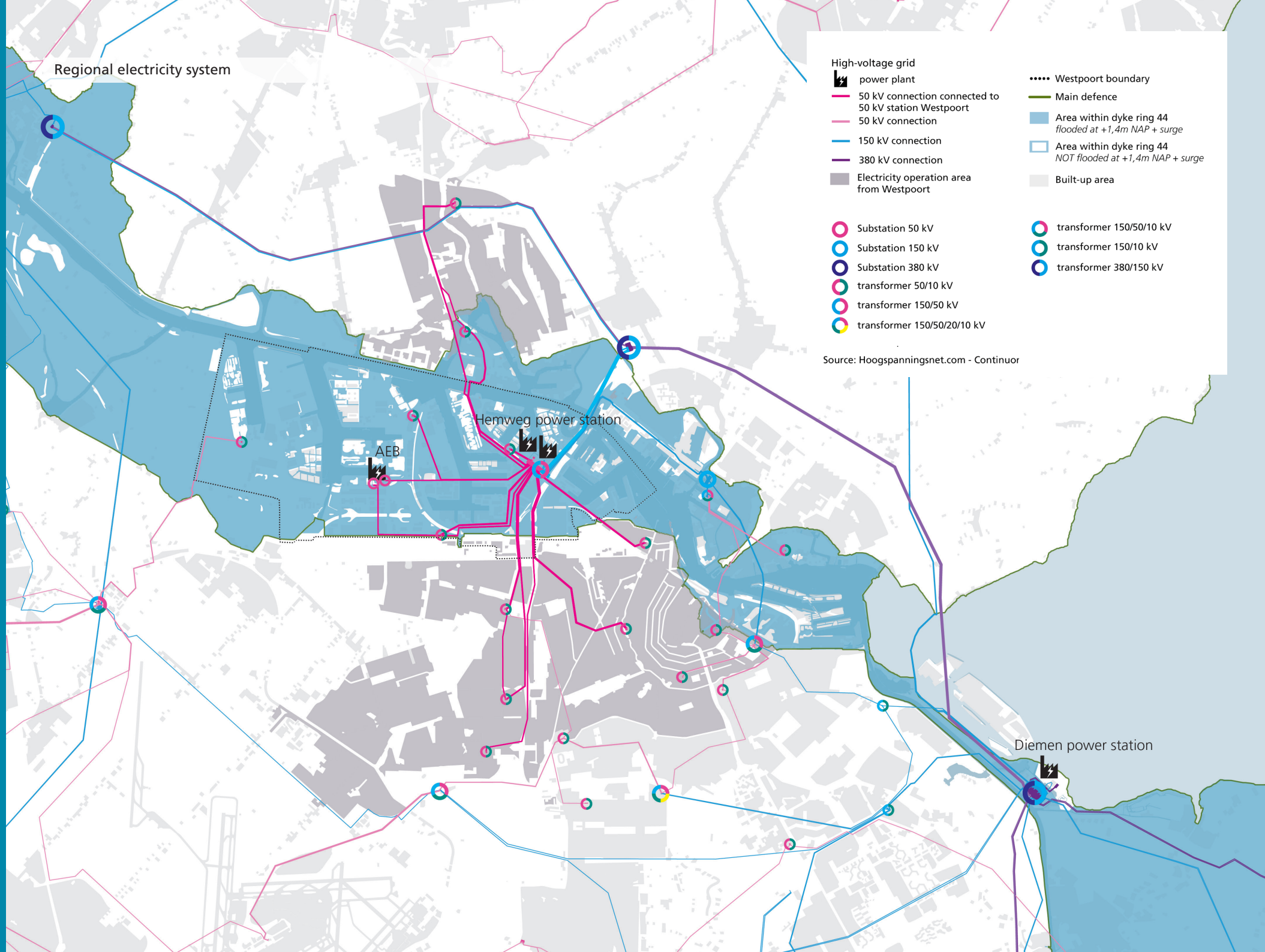

+20 cm water at ground level, minerals are washed away and contaminate water
+1,2m NAP
Minerals


+40 cm water at ground level, raw materials are washed away and contaminate water
Recycling

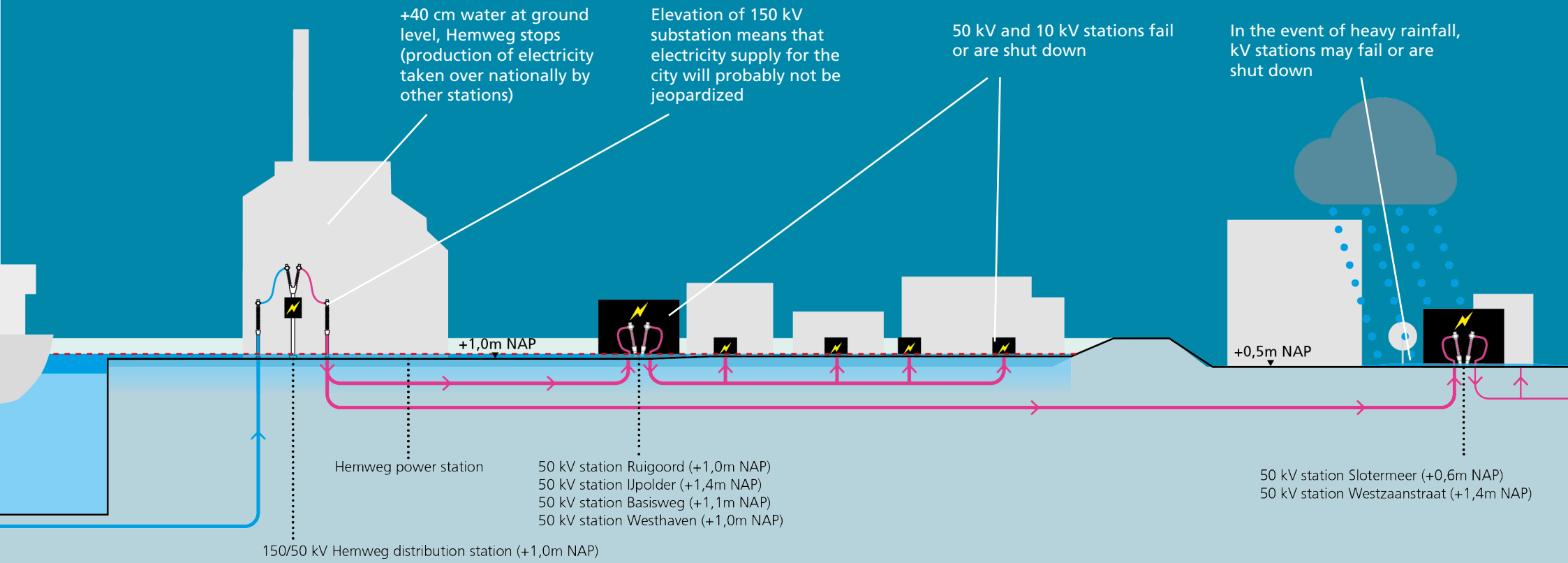

+48m NAP
Loading and unloading ships using cranes depends on electricity
+1,4m
Coal

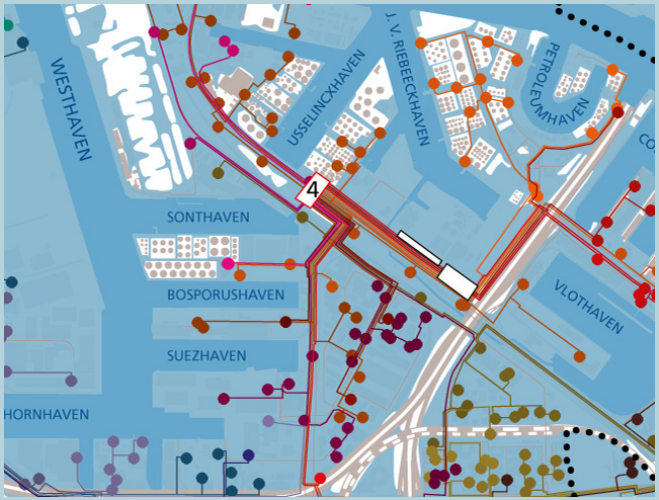

Dykes/retaining walls restrain water and waves (tank pit construction: built for danger from inside in the event of a defective storage tank)
+23,5m NAP
Fuel


+20cm water at ground level, water flows into bulk store
+1,0m NAP
Cocoa

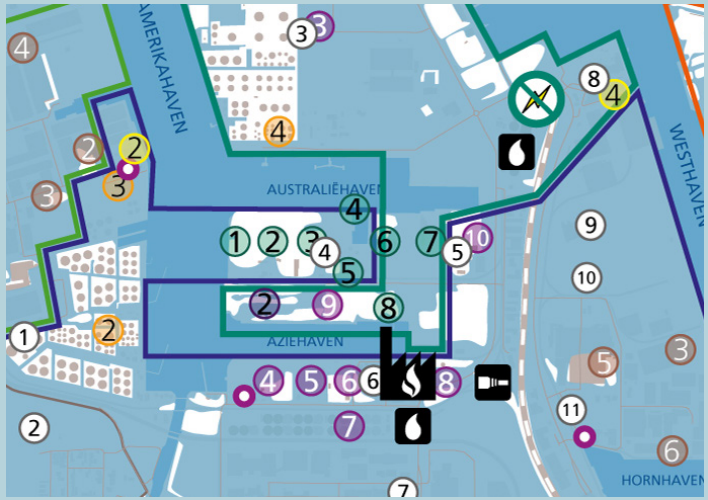

Regional electricity system
High-voltage grid
power plant
50 kV connection connected to 50 kV station Westpoort
50 kV connection
150 kV connection
380 kV connection
Electricity operation area from Westpoort
Westpoort boundary
Main defence
Area within dyke ring 44
flooded at +1,4m NAP + surge
Area within dyke ring 44
NOT flooded at +1,4m NAP + surge
Built-up area
Substation 50 kV
Substation 150 kV
Substation 380 kV
transformer 50/10 kV
transformer 150/50 kV
transformer 150/50/20/10 kV
transformer 150/50/10 kV
transformer 150/10 kV
transformer 380/150 kV
Source: Hoogspanningsnet.com - Continuor
Hemweg power station
AEB
Diemen power station

Cross section: electricity supply Amsterdam region via Westpoort +1.4 m NAP flood level





Electricity to end user



Dependencies of electricity distribution for Westpoort

Basisweg 50 kV station

Fuel

Supply

over water
- Oil products

Outflow

over water
- Petrol
- Petrol to Salland Kampen

over land
- kerosene to Schiphol

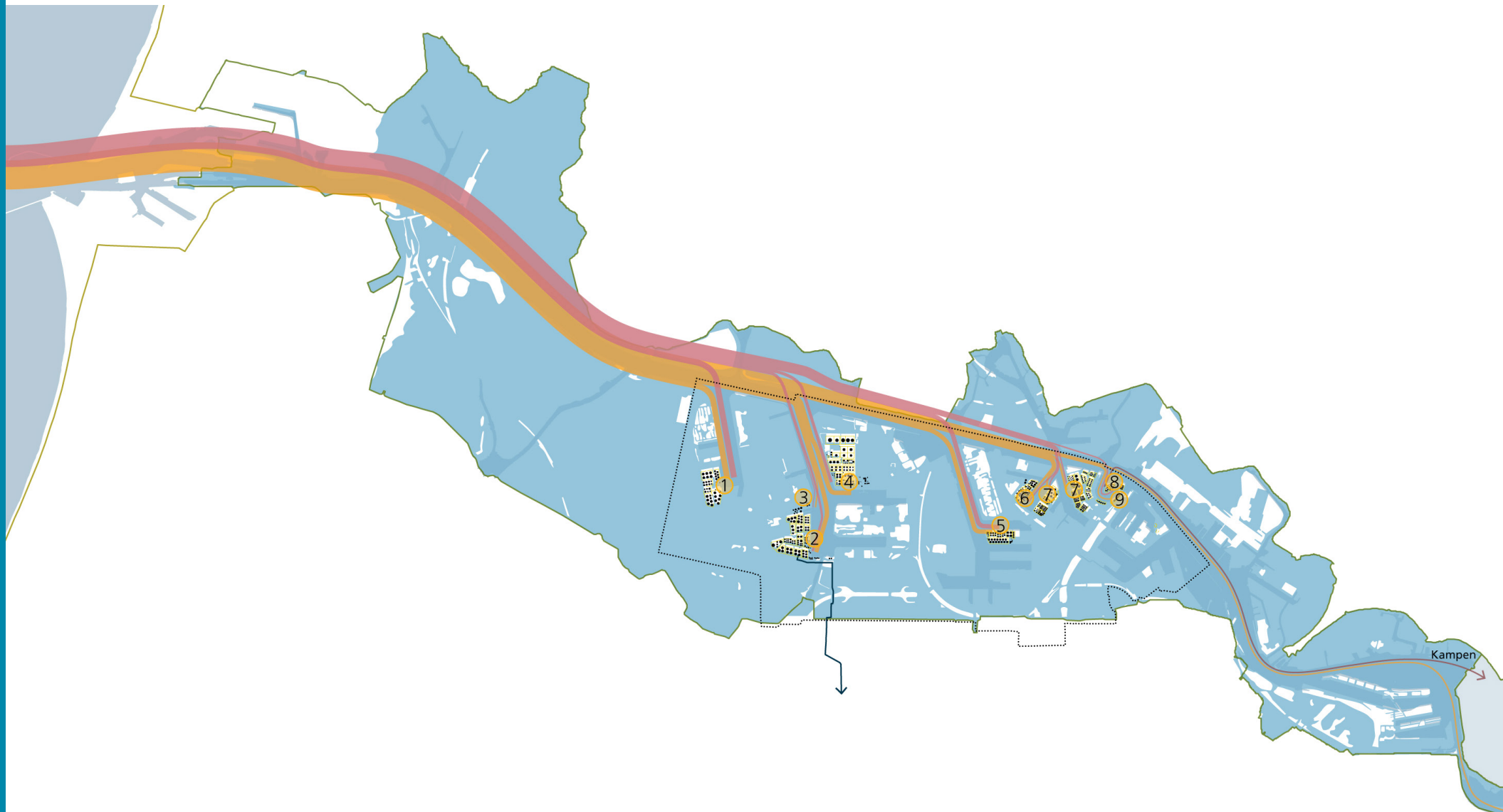
- Oil and petrol storage

Storage

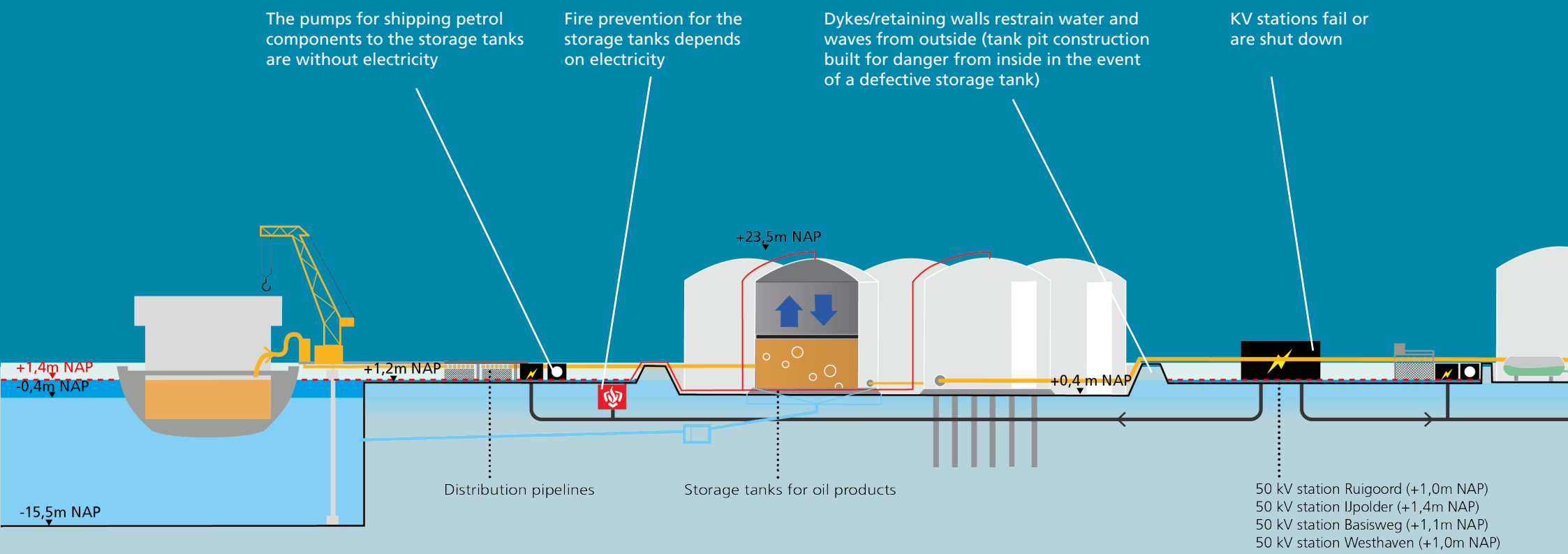
1	Vopak	*mineral fuel, blending*	*1.216.180m³*
2	Oiltanking	*mineral fuel, blending*	*1.600.000m³*
3	Hydrocarbon Hotel BV	*mineral fuel, blending + biofuel*	*140.000m³*
4	Zenith Energy	*mineral fuel, blending*	*1.000.000m³*
5	Nustar	*mineral fuel, blending*	*600.000m³*
6	Koole	*mineral fuel, blending + biofuel*	*117.731m³*
7	VTTI / Eurotank	*mineral fuel, blending*	*1.328.000m³*
8	Main BV	*mineral fuel*	
9	FinCo Terminal Amsterdam	*mineral fuel, blending + biofuel*	*74.000m³*

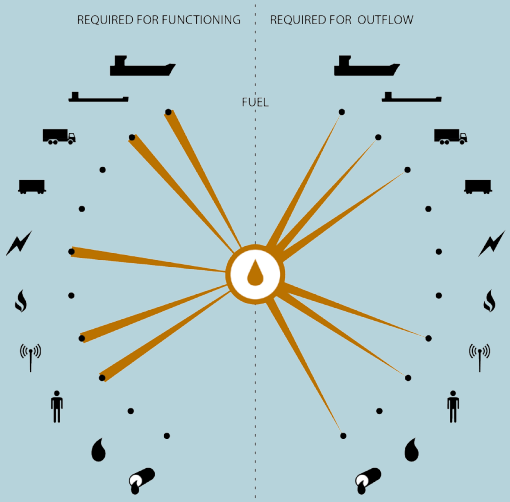
ARA- *The harbour area of the cities Amsterdam, Rotterdam and Antwerp. For the booking of freight capacity a reference rate will be set for these locations. (wikipedia)*
- Rotterdam
- Antwerp
- United Kingdom

- Westpoort boundary
- Main defence
- Area within dyke ring 44 *flooded at +1,4m NAP + surge*
- Area within dyke ring 44 *NOT flooded at +1,4m NAP + surge*



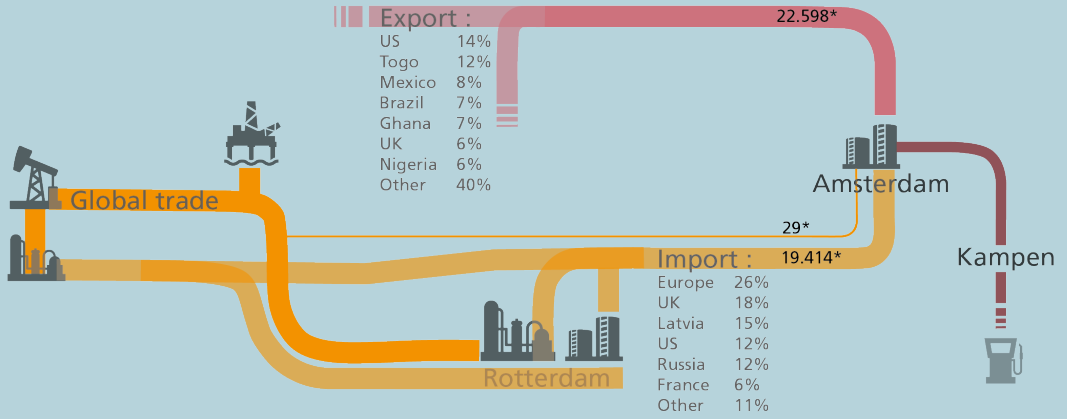
Cross-section: port fuel activities in Westpoort (+1.4m NAP flood level)





Fuel chain dependencies

Fuel storage in Westpoort



Incoming and outgoing fuel in Westpoort

Adaptation approaches

Rescue

Solid

Essentials

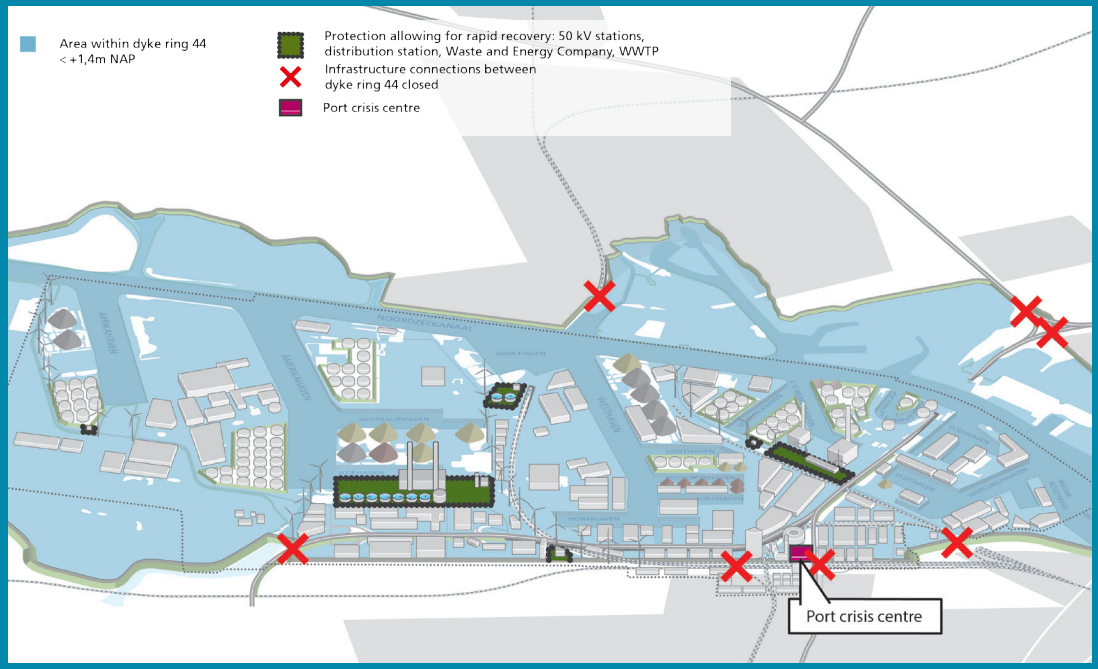
Heartbeat

Long-term compass

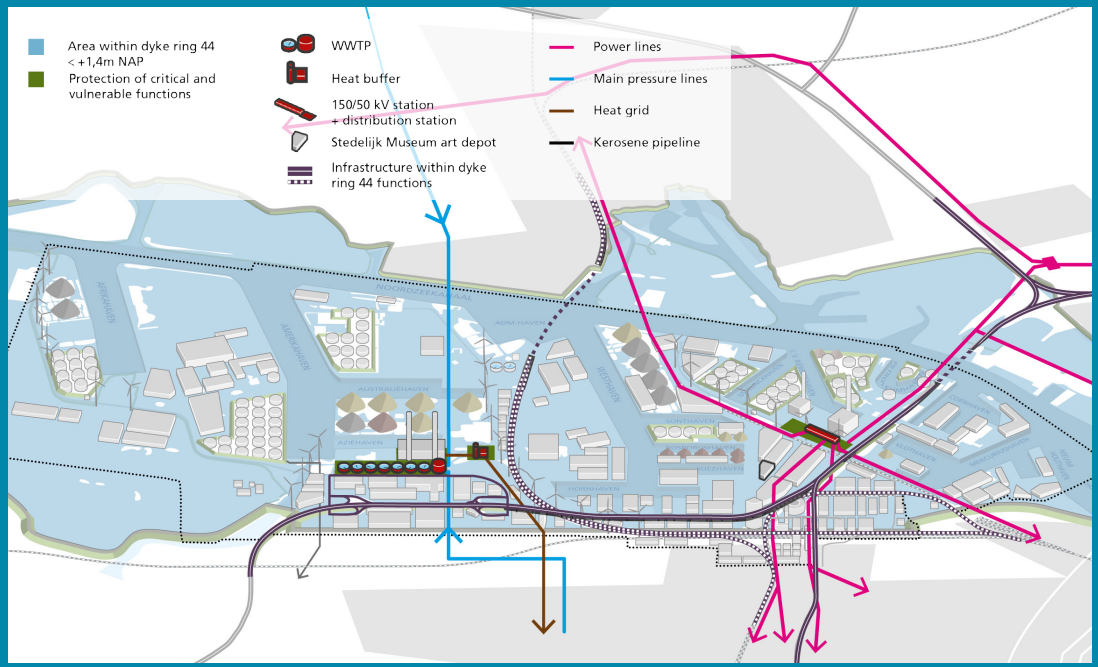
Four approaches with different key questions were explored to arrive at a common adaptation strategy. Would it be sufficient for Westpoort to be quickly evacuated and shut down in the event of flooding (Rescue)? Should Westpoort provide the city with basic services in the event of flooding (Heartbeat)? Is water resilience mainly about strong critical chains in the region as a whole (Essentials)? Should the whole of Westpoort be water resilient (Solid)?

These various approaches to adaptation are all conceivable, but each implies a different mindset and different principles. They can be helpful in talks about long-term preferences as directions on a compass. For example, the role of public and private stakeholders in the implementation of the adaptation strategy is an important distinction between the adaptation approaches. Will the government play a leading role, is there an active and organised business environment, do the various stakeholders accept the calculated risks?

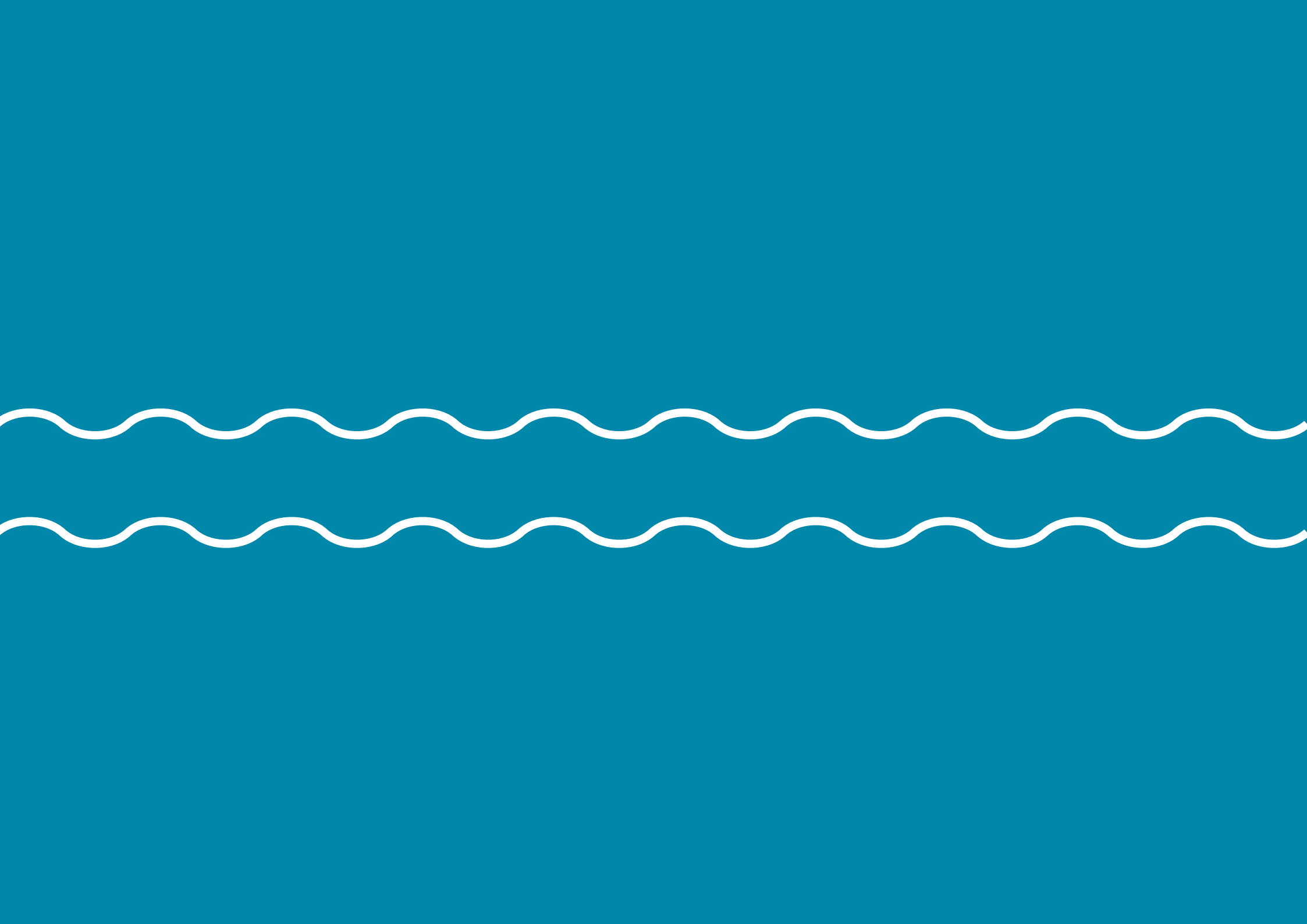
As ideas about ambitions and strategies are liable to change over time, it is advisable to regularly review the adaptation strategy using the compass so that the strategy remains adjustable to current insights. At the moment, the compass is pointing between Rescue (always be well-prepared) and Essentials (towards resilient regional networks).



Rescue



Essentials




PRIME LILY


urbanism
stedebouw
urbanisme
städtebau
urbanismo
must
Witteveen Bos
Waterbestendige Westpoort
Pilotstudie vitaal en kwets-
bare functies in de haven
van Amsterdam
34,8 m
12 m
2 m
1,4 m
22 m
3,8 m
3,8 m
0,7m
Pilot study for Water Resilient Westpoort

5 A triple-track strategy

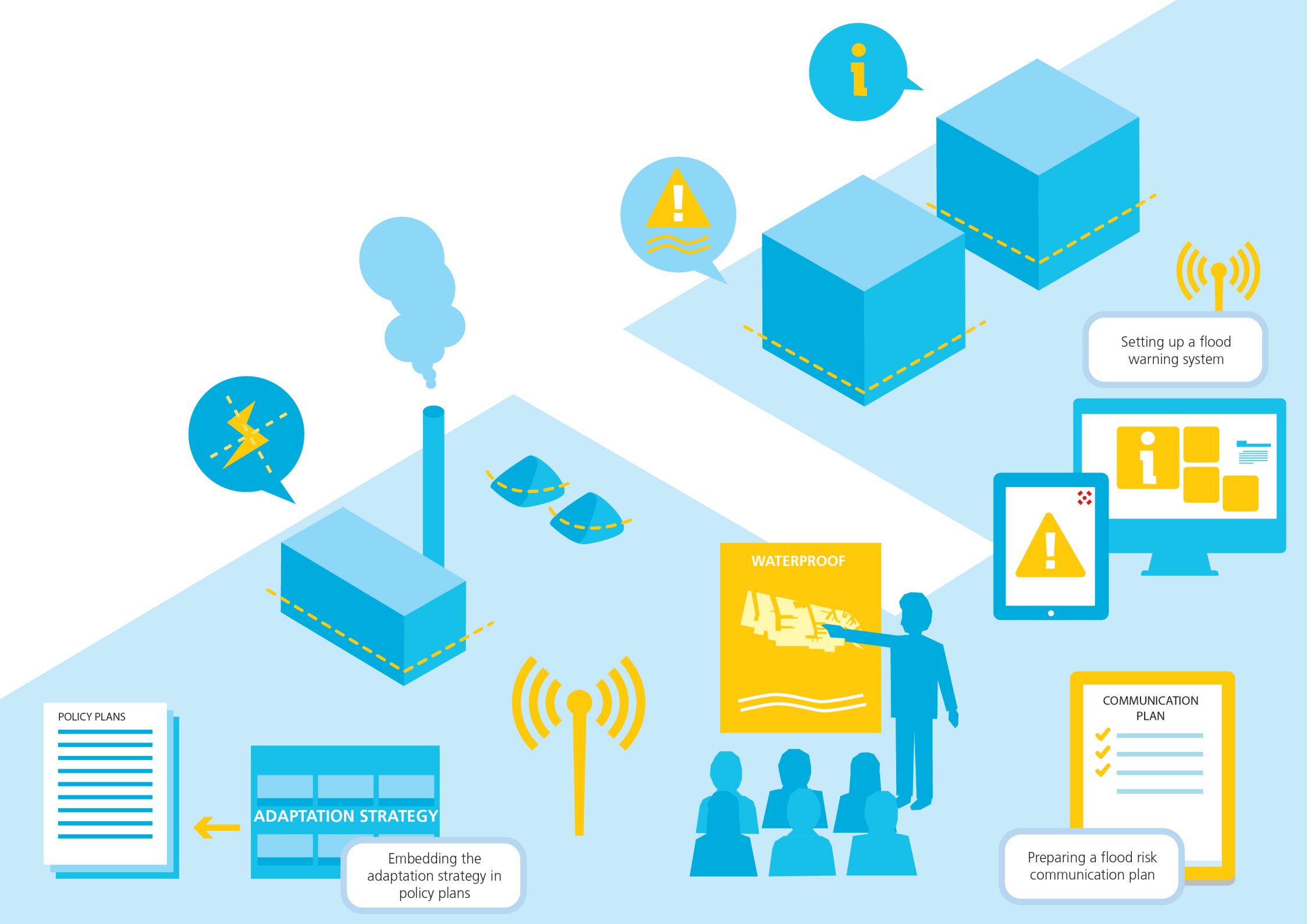
Each track requires different efforts and time frames

What adaptation strategy is best suited to an area such as Westpoort? Westpoort accommodates a number of critical and vulnerable functions that are of great importance for the city and region, while the chance of flooding is relatively small. What steps should be taken while there is still little awareness of the risks of flooding, and government authorities have few control options to enforce flood risk management?

The adaptation strategy for Westpoort was developed with these questions in mind. In addition, the long-term compass (see factsheet) was used to determine the current approach to the strategy. The adaptation strategy offers promising solutions and measures, and comprises three tracks:

1. 'Aware' is about creating awareness and ensuring carefully considered choices with regard to the risks of flooding.
2. 'Bottom Line' is aimed at minimising large-scale societal disruption in the Metropolitan Area as a result of flooding in Westpoort.
3. 'Resilient Projects' identifies and promotes smart planning solutions in sectors or sub-areas where opportunities present themselves for arriving at a resilient and robust organisation of the Amsterdam port area in the long term.

The three tracks can be followed separately. The tracks each require different efforts and time frames. Work can start immediately on Aware. Bottom Line first needs further coordination with central government and the agreements it settles with the critical sectors. Resilient Projects particularly calls for action whenever developments take place in Westpoort that simultaneously offer opportunities for improving water resilience.


Setting up a flood warning system
WATERPROOF
COMMUNICATION PLAN
Preparing a flood risk communication plan
POLICY PLANS
ADAPTATION STRATEGY
Embedding the adaptation strategy in policy plans

Aware

Aware focuses on creating awareness so that companies and government authorities are well-equipped to assess water resilience regarding existing situations, developments and investments. To achieve this, adequate information provision and the creation of awareness of the risks and consequences of flooding are key. In addition, stakeholders in Westpoort are encouraged and helped to use this knowledge in the decisions they take on developments and investments in the area. Last but not least, Aware is devoted to the timely establishment of process agreements between the stakeholders involved.

Objective:
Providing information and creating awareness
This is about making information available about the risks of flooding, the possible consequences, and potential solutions. This information will enable the various stakeholders to make their own decisions regarding measures to limit risk and damage.

The approach here is to inform the stakeholders as good as possible about all water-related risks. Information must at any rate be provided about the chance of flooding, the arrival time of the water, and the effects and the duration of the flooding. The possible flooding considered could be due to a breach in the Lek Dyke, a breach or overtopping at IJmuiden, or extremely heavy rainfall.

We can distinguish between three main stakeholder groups with different information requirements.

a. Government authorities. A vision on water resilience must be an integral part of the policy plans elaborated by the various government authorities involved. For instance, environmental visions, water management plans, zoning plans and concrete area plans such as, for example, Haven-Stad (Port City) and the transformation of Sloterdijk 1. The government authorities must have access to accurate information about the risks of flooding, have insight into the potential consequences, and be able to build on the latest knowledge regarding possible solutions. In addition, it is imperative that there is sufficient awareness and alertness regarding the risks of flooding in all layers of the government authorities so that water resilience is included in planning processes as a matter of course.

b. Chain partners. Chain partners ensure the functioning of the various critical chains in the city and region, such as power supply, waste water treatment, district heating, telecommunications and data traffic. Chain partners aim to design and organise chains in such a way that they can respond adequately to possible emergencies, such as flooding. Examples of this are securing the main electricity distribution cables, increasing the number of heat distributors (apart from AEB and NUON) to ensure a more robust district heating, and redundancy at data centres so that

Consulting with companies

The Water Resilient Westpoort adaptation strategy came about as a result of consultations with companies in Westpoort. Talks took place with companies that manage critical and vulnerable chains as well as with companies from the main economic sectors.

These consultations served two purposes. First, by providing information on the risks of flooding and possible measures, awareness was increased among companies. Second, the project obtained information from the companies on the extent to which they have already prepared themselves for flooding.

The vulnerable links were mapped out in work meetings for each critical chain. What are the critical chains dependent on and how can they be better protected in the event of flooding? We are referring here to the following chains: electricity, wastewater, heating and fuel supply for the petrol stations in the Netherlands, and specifically for Schiphol airport.

The main economic sectors in the port are energy, agricultural products and fertilizers / minerals / recycling, and logistics. Apart from an initial general information meeting with the members of the ORAM entrepreneurs association, in-depth talks were held for each sector. These talks ensued in two important conclusions:

1. Companies are apparently taking few if any mitigating measures or measures to protect themselves with regard to potential flooding. They are not properly aware of the risks, and assume that the Dutch government will take care of their safety regarding water.
2. Companies are far more concerned about a comparable but local disaster ensuing from flooding due to extremely heavy rainfall. Although the consequences of this would be less severe, the threat is more acute and tangible. For companies in Westpoort, it is important to gain awareness and cooperate with each other regarding the impact, consequences and measures to be taken in both disaster scenarios (pluvial and other types of flooding).

In 2013, fifteen interviews were held with companies from the area about the consequences of flooding and the awareness of companies regarding the risks of flooding. These companies were contacted again by telephone in 2016. It transpired that the companies were aware of the risks of flooding, and were willing to help develop ways to improve the water resilience of Westpoort. However, it also transpired that they see insufficient reason to take action of their own accord, partly because they feel a need for clarity and guidance from the government.

it is not a problem if one of them fails. The chain partners need access to current information on the risks of flooding so that this can be incorporated into the analysis of the vulnerability and crucial links of the chains. It is important here that organisations not only look at their own chains but that they are encouraged to have a good understanding of the interdependencies as well.

c. Business sector individual companies must be equipped to make a well-founded assessment of the risks of flooding, the resultant damage and the necessary investments to avoid this. Information provision focuses on individual properties and land plots. In addition, companies are dependent on various services, such as telecommunications and electricity. It is crucial for a company to understand the reliability of these services before, during and after a flooding incident. For example, when land plots are newly allocated, it

is conceivable that a "flood resilience passport" could be issued, which would include this information.

Process

Aware does not make it obligatory for physical measures to be taken. However, agreements will be made on the form information provision will take, and what process agreements are needed to arrive at a careful and timely assessment. The object of the agreements is to ensure that all the critical and vulnerable functions in Westpoort can and will arrive at a well-founded assessment with regard to water resilience.

- The stakeholders involved will jointly establish how they will ensure that assessments are made regarding water resilience for all developments and investments. One way to achieve this is could be to draw up a joint declaration of intent.

Before flooding occurs, it must be clear to all stakeholders involved who is responsible for what and what they can expect of each other. Clear administrative agreements are needed in which careful assessments are made regarding water resilience.

- The stakeholders involved will make further agreements regarding roles and responsibilities and will see to the implementation of these in their own policy (for example, in the environmental visions).

Scale

Creating awareness transcends the scale level of Westpoort. If flooding occurs in this area, all the areas within dyke ring 44 will face consequences of flooding. Most of the critical and vulnerable functions are situated in the North Sea Canal area. This opens up possibilities for further implementation of Aware at the level of the entire North Sea Canal area, the Amsterdam Metropolitan Area or the province of Noord-Holland. Westpoort offers a starting point for this.

Creating awareness extends beyond the scale level of Westpoort

Aware follow-up steps

A1. Embedding the Water Resilient Westpoort adaptation strategy in policy plans

Relevant for: *province of Noord-Holland, City of Amsterdam, AGV water authority*

Objective: *Embedding the proposed Water Resilient Westpoort adaptation strategy in the policy of the organisations involved (environmental visions, water management plan)*

A2. Preparing a flood risk communication plan for government authorities and chain partners

Possible initiator: *AGV water authority (in cooperation with the City of Amsterdam, the Ministry of Infrastructure and Water Management, the province of Noord-Holland, chain partner representatives)*

Objective: *Creating awareness about flood risks among government authorities and managers of critical infrastructure and vulnerable functions so that these risks can be taken into account in policy development, investments, spatial developments and restructuring.*

Elaboration:

- *Analysing needs and expectations among target groups supplementary to the information already available from the pilot.*
- *Providing information about the risks of flooding (likelihood, depth, arrival time of water, duration, salt or freshwater)*
- *Combined provision of information on risks of fluvial and pluvial flooding (coordination with Amsterdam Rainproof)*
- *The plan is designed in such a way that it is easy to set up comparable plans for other regions or a larger scale level.*

A3. Preparing a flood risk communication plan for the business sector

Possible initiator: *Amsterdam Port Authority (in cooperation with the City of Amsterdam, Ministry of Infrastructure and Water Management, AGV water authority, province of Noord-Holland, representatives from the business sector)*

Objective: *Creating awareness about the risks of flooding among companies in Westpoort and within the Amsterdam Port Authority itself so account can be taken of these risks when new business investments are made and land plots allocated.*

Elaboration:

- *Analysing needs and expectations among target groups supplementary to the information already available from the pilot.*
- *Providing information about the risks of flooding (likelihood, depth, arrival time of water, duration, salt or freshwater)*
- *Combined provision of information on risks of pluvial and fluvial flooding (coordination with Amsterdam Rainproof)*
- *The plan is designed in such a way that it is easy to compile comparable plans for a larger scale level (North Sea Canal area).*

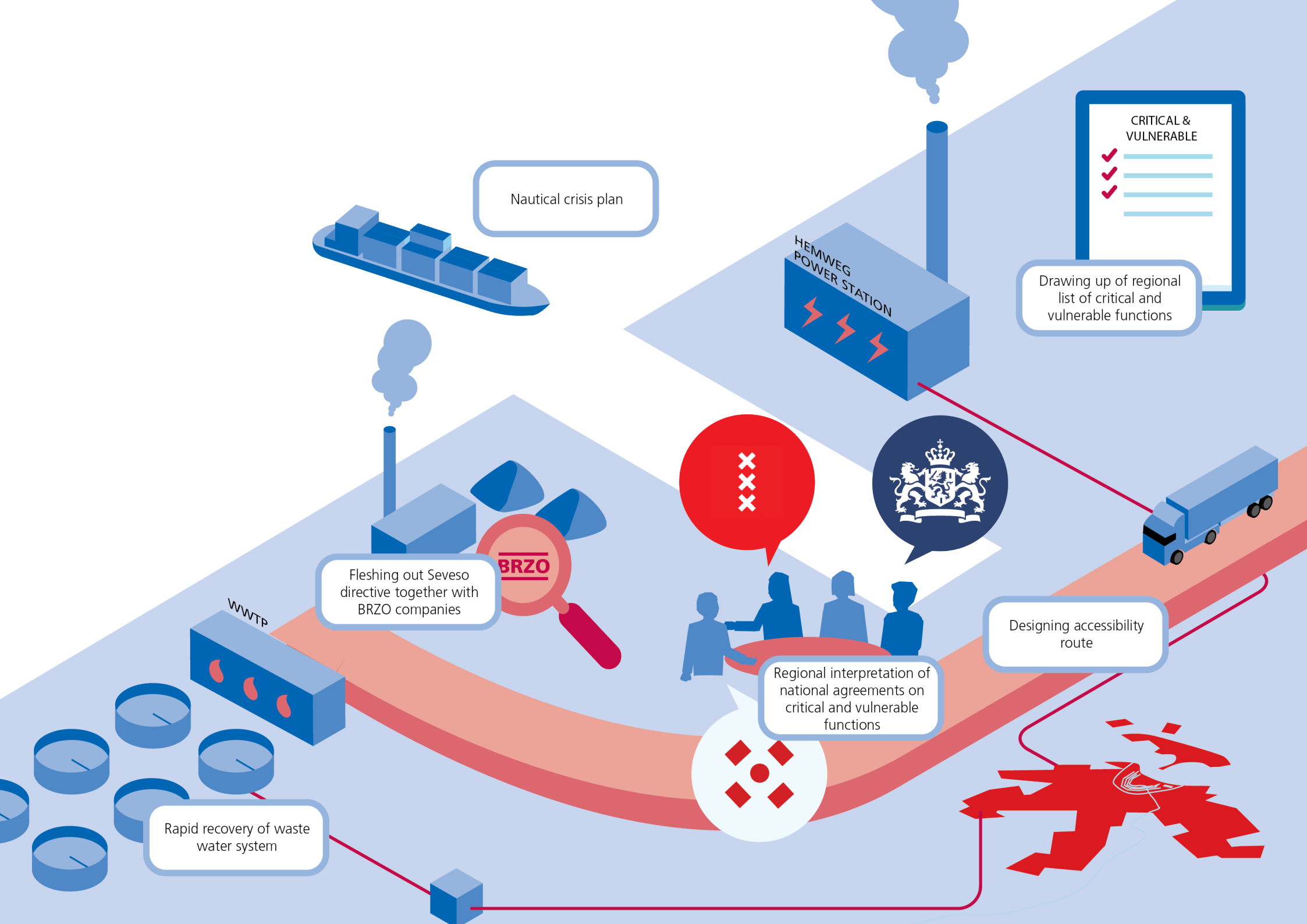
A4. Setting up a flood warning system

Possible initiator: *Emergency Management Organisation(in cooperation with the Amsterdam Port Authority, Environment Agency and Ministry of Infrastructure and Water Management)*

Objective: *Setting up a flood warning system for managers of critical and vulnerable functions and possibly other companies so that they can take timely measures in the event of a flood threat.*

Elaboration: *During interviews with companies, it was indicated that timely warning will enable them to safeguard valuable equipment, shut down processes in a controlled manner and prevent the dispersal of chemicals. There are examples from abroad of warning systems developed specifically for businesses (New York).*

This project will further identify the wishes and requirements of companies and investigate the feasibility and added value of such a system, also in relation to the standard warning systems.


Nautical crisis plan
HEMWEG POWER STATION
CRITICAL & VULNERABLE
Drawing up of regional list of critical and vulnerable functions
BRZO
Fleshing out Seveso directive together with BRZO companies
WWTP
Regional interpretation of national agreements on critical and vulnerable functions
Designing accessibility route
Rapid recovery of waste water system

Bottom line

Bottom Line is about limiting the scale of a disaster and what is needed for this. Bottom Line has three objectives: to prevent a disaster from setting off subsequent disasters, to limit life-threatening situations and large-scale societal disruption in the city and region insofar as possible, and to safeguard the quick recovery of critical functions after a disaster. The crucial question here is what are the minimum arrangements that we want to have in place in our joint approach as government authorities? What is the minimum safety level suitable for Westpoort? (Here account must be taken of the place the functions in Westpoort take in the chains.)

Within the framework of the Delta Programme, central government makes agreements with the sectors on critical and vulnerable objects and functions. The region has to assess whether a supplementary package of agreements and measures is needed in order to better protect the urban and regional interests and vulnerabilities – for example, district heating.

Bottom Line consists both of operational agreements and physical measures, aimed in particular at emergency management. The recommendation is to keep as closely as possible to the terminology used by the emergency management organisation and the way in which the region is organised, and to observe what is and is not included in disaster management and contingency plans, at both regional and national scale level.

Objective:

1. **Preventing one disaster leading to another**
   A flood could have various consequences, such as fire, the dispersal of poisonous substances, or an outbreak of diseases, for example. If such a knock-on effect is prevented, emergency management organisations can concentrate fully on the direct consequences of the flood and focus primarily on saving victims elsewhere in the region. For Bottom Line, it is important in the event of a disaster that potential further disasters arising from the initial disaster are prioritised according to the need for intervention.

The situation where one disaster leads to another must be avoided

When permits are granted to companies to which the Major Accidents (Risks) Decree (BRZO) applies, additional requirements are now set for including flood risks in choices relating to business operations. To be able to shut down processes safely, it is essential for many companies to have access to (emergency) power and telecommunications. Further elaboration of Bottom Line will focus on realising this. Examples include, for instance, emergency power

facilities for individual companies or a collective emergency network linked to a flood resilient cluster surrounding the AEB waste and energy company.

It will also be assessed whether a safe access route is needed in Westpoort which could keep certain critical and vulnerable functions accessible for workers and maintenance staff during flooding.

2. **Minimising societal disruption**
   What is needed to ensure that the city and region continue to function as well as possible if Westpoort is flooded? Bottom Line is committed to preventing large-scale societal disruption and limiting economic damage. For Westpoort, this means at the very least that the power supply for the city needs to be guaranteed and the the 150 kV station and the 50 kV stations need to be further examined with regard to flood resilience. In the elaboration of Bottom Line, measures for limiting damage will be further detailed in cooperation with the chain partners. It will also be considered what policy is needed for this.

3. **Rapid recovery**
   Another aspect of Bottom Line is an action plan aimed at accelerating the recovery of critical and vulnerable functions following a flood event. For instance, through temporary measures to protect these functions during a disaster in order to prevent damage. Resources must be available for companies that need extra protection. For

The aim is to prevent severe societal disruption

instance, sandbags that can be placed as a preventive measure prior to a disaster.

Process

In view of the great importance for society, the government will assume responsibility for the necessary agreements and projects.
Bottom Line must be elaborated in accordance with the government's Delta Programme, and coordinated with the agreements made by the government with sectors with critical and vulnerable functions.
It will be investigated how the implementation of these can be promoted in the region, and whether regional supplementation is desirable. Subsequently, measures will be prioritised.

Scale

Initially, Bottom Line will be designed for Westpoort. The intention is then to scale up to the urban and regional chains.

Governance

The government has various instruments at its disposal for making agreements about flood risk management:

- The Provincial Spatial Regulation (PRV). The PRV prescribes that the explanatory notes to zoning and environmental plans must specify in what way account is taken of the risks of, and in the event of, flooding, and what measures and facilities are used to prevent or limit these risks.
- The water assessment of the Ministry of Infrastructure and Water Management and Regional Public Water Authority Amstel, Gooi en Vecht. This issues a recommendation for the municipal authorities.
- The central government's Major Accidents (Risks) Decree (BRZO) for companies with considerable external safety risks. Companies to which the BRZO applies are obliged to draw up a safety report that takes into account the risks of flooding. They are also required to specify possible measures that could prevent damage ensuing from flooding. Within the legislation of the BRZO, the EU Seveso directive is used for flood risks. This is therefore EU legislation.

These are all instruments that contribute towards awareness, but they are not mandatory. For example, a municipality may opt to deviate from a recommendation given in a water assessment. In order to make such a recommendation mandatory, agreement is needed about what are acceptable and unacceptable risks. There is currently no agreement about what risks are acceptable.

Aware is about awareness through communication and the transfer of knowledge. By making companies and other stakeholders aware of the risks, they can decide for themselves whether to take measures. Companies have their own responsibility for this. Nearly all sectors have broad legal responsibilities, which include protection against the risk of flooding. In practice, however, this does not automatically lead to better protection against the risks of flooding.

Bottom Line is based on the line between what is and is not acceptable: the lower limit. This limit still needs to be defined. New, mandatory policy may well be necessary to ensure this limit is reached.

Bottom Line follow-up steps

B1. Fleshing out the Seveso directive together with companies to which the BRZO applies

Possible initiator: *NZKG Environment Agency (in cooperation with Amsterdam Port Authority, BRZO companies)*
Objective: *Supporting companies to which the BRZO applies by effectively interpreting the EU Seveso directive, on the basis of which BRZO companies must provide insight into their potential risks of flooding from the surrounding area, and describe their measures to limit the danger of flooding.*
Elaboration: *Actively approaching companies and advising them to implement the Seveso directive in an effective manner.*
Time frame: *Can start immediately.*

B2. Strategy for action perspective

Possible initiator: *Amsterdam Amstelland Emergency Management Organisation / OOV (Public Order and Safety inspectorate)*
Objective: *The draft Delta Programme 2018 states that the safety regions are required to work together with a number of other public stakeholders in the coming years to chart the effects of water crises. This is a result of the Water and Evacuation project. Every safety region is required to have made an impact assessment by 2018. Based on this, a Strategy for Action Perspectives will be established in 2020, aimed at, evacuation and rescue, for example.*
Elaboration: *OOV Amsterdam regards Water Resilient Westpoort as the impact analysis for the Westpoort area. In the period up to 2018, impact analyses will also be drawn up for the polders around Amsterdam. The action perspective will be further fleshed out in the following period. Westpoort will then not be considered as a separate entity, but rather as part of the region. The residential areas, including the city of Amsterdam, have priority regarding safety. Westpoort will probably be expected to show a large degree of self-reliance.*
Time frame: *2020*

B3. Rapid recovery of the wastewater system

Possible initiator: *Waternet (in cooperation with the Ministry of Infrastructure and Water Management)*
Objective: *To establish what is needed to arrange the wastewater system in such a way that it can quickly be put back into operation after a flood.*
Elaboration: *Within the framework of the 1st Water Resilient Westpoort pilot project, an initial inventory was made of the water resilience of the West Wastewater Treatment Plant (RWZI). In 2015, a quickscan was conducted at Waternet to explore the water resilience of all Waternet assets in Westpoort and Amsterdam South-East (Zuid-Oost). This project specifies what is needed to arrange the wastewater system in such a way that it can be quickly put back into operation after a flood.*
Time frame: *Can be started immediately as a pilot together with the Ministry of Infrastructure and Water Management, or as soon as it is clear from the national programme exactly what is meant by rapid recovery of the wastewater chain.*

B4. Compiling a supplementary list of critical and vulnerable functions

Possible initiator: *province of Noord-Holland and/or City of Amsterdam (in cooperation with the Ministry of Infrastructure Water Management)*
Objective: *Determining what functions are considered to be critical and vulnerable, supplementary to the national categorisation. Engaging in talks with central government about which of these functions should be designated as national and which as regional. Mainstreaming this in policy, including in the visions concerning the spatial environment.*
Elaboration: *Based on the pilot, functions are designated as critical and/or vulnerable which are not mentioned on the national list of critical and vulnerable functions (e.g. the storage depot of Stedelijk Museum Amsterdam and the jet fuel pipeline to Schiphol airport). It will be determined in consultation with the central government which of these functions should feature on the national list and which on a supplementary regional list. This makes it possible to apply suitable regional measures for their protection in addition to central government measures. A list was already drawn up for the pilot, which the province of Noord-Holland adopted in the Guide to water-resistant planning (Handreiking Waterrobuuste inrichting). This project aims at national and regional clarity and uniformity regarding the measures, to include the results in the visions concerning the spatial environment, and if necessary, to develop policy for this.*
Time frame: *Can start immediately. Cohesion with development of environmental visions.*

B5. A more precise definition of 'consecutive disaster' situations which need to be prevented

Possible initiator: *Emergency Management Organisation (in cooperation with Amsterdam Port Authority, City of Amsterdam, Ministry of Infrastructure and Water Management)*
Objective: *Further specification of the concept of 'consecutive disaster' situations and prioritisation of such situations so as to precisely define*
the aims of Bottom Line.
Elaboration: *Needs further concretisation. There is a connection with action B2.*
Time frame: *Can start immediately*

B6. Access routes

Possible initiator: *Amsterdam Port Authority (in cooperation with the Emergency Management Organisation, businesses, City of Amsterdam, Ministry of Infrastructure and Water Management)*
Objective: *Indicating the most suitable physical route for keeping crucial critical objects accessible for operating and maintenance staff in the event of high water levels; identifying the physical measures that need to be taken to keep the route passable, and exploring the possibilities and impossibilities of using the route in conjunction with the practices and requirements of the authoritative stakeholders in the area in the event of flooding (particularly: emergency services, the Ministry of Infrastructure and Water Management and the companies with critical functions).*
Elaboration: *Contact will be sought with the other relevant stakeholders in the area to further develop the project. It will be determined which critical objects need to remain accessible. A route will then be defined that gives access to these objects, and agreements made about the use of the route in the event of flooding, and the roles of the various stakeholders at that time. It will also be investigated what physical measures should be taken to keep the route accessible.*
Time frame: *The project can be started. An initial investigation has taken place.*

B7. Nautical emergency plan

Possible initiator: *Amsterdam Port Authority (in cooperation with the Ministry of Infrastructure and Water Management, Emergency Management Organisation)*
Objective: *Setting up an action perspective for shipping in the event of flooding for various scenarios and with the underlying objective of minimising damage to and by tankers.*
Elaboration: *Contact will be sought in any case with the Ministry of Infrastructure and Water Management and the safety organisations involved in the North Sea Canal area. Based on the various scenarios, perspectives for action will be set up for shipping traffic. The perspectives for action will be coordinated with the practices of other stakeholders active in the North Sea Canal area.*
Time frame: *The project can be started.*

B8. Coordination of national and regional agreements on critical and vulnerable functions, and further elaboration of details

Possible initiator: *City of Amsterdam and province of Noord-Holland (in cooperation with Water Authority and Ministry of Infrastructure and Water Management)*
Objective: *Coordination of regional strategy and national agreements, incorporation of pilot results into national policy-making and implementation of the national agreements with the critical and vulnerable sectors in the region. Investigating whether additional action is required at national or regional level.*
Elaboration: *Actively monitoring policy developments in the Delta Programme regarding the approach to critical and vulnerable functions. As soon as the approach has been determined and the agreements with the critical and vulnerable sectors have been made, we will assess what is needed to implement the agreements in the region. We will promote implementation of the agreements from within the region, and also determine whether any supplementary regional measures are needed for the Bottom Line track.*
Time frame: *2017-2020: following policy developments; from 2020: promoting implementation and any supplementary measures.*

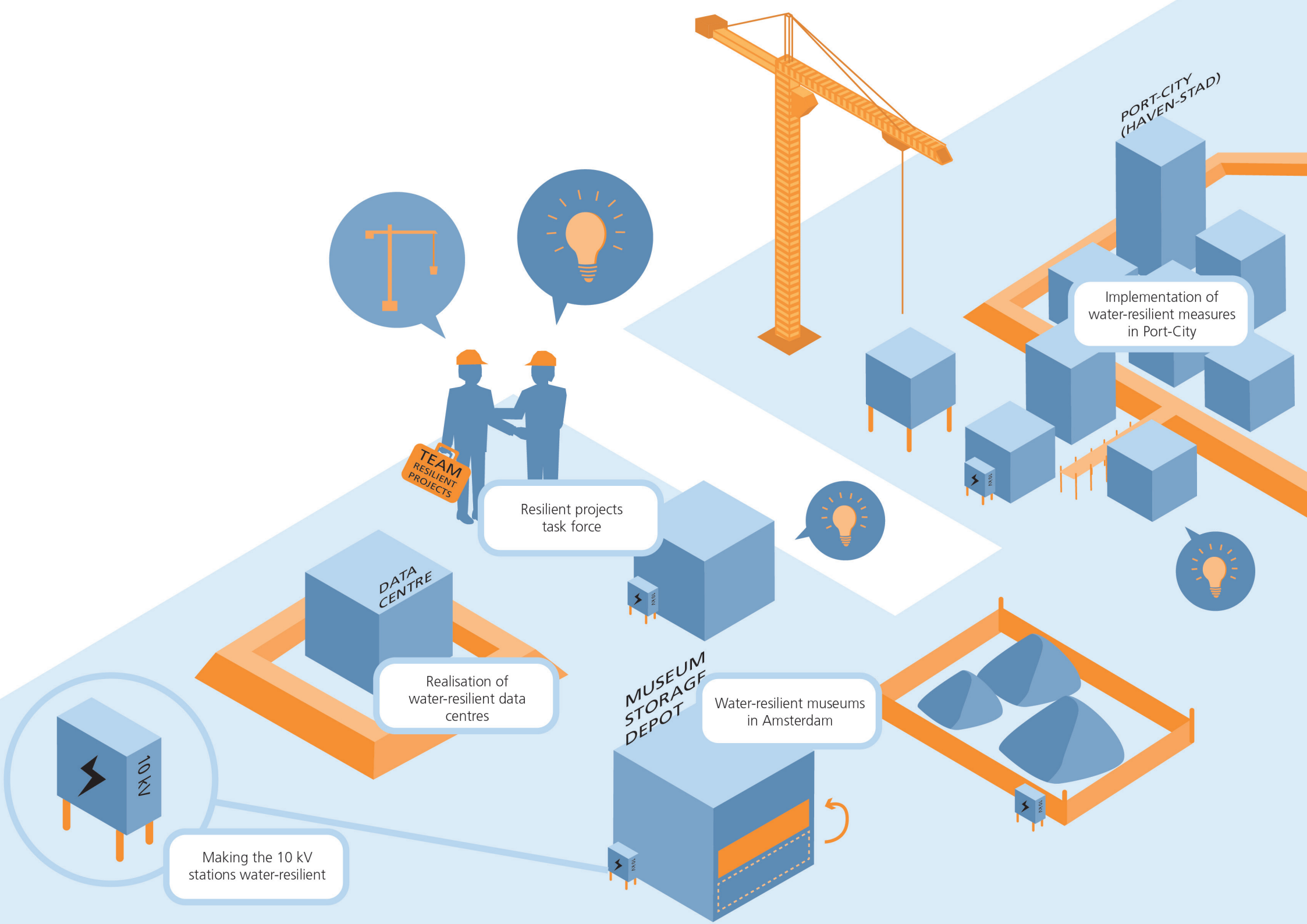
B9. Analysis of water resilience of 150 kV and 50 kV stations in Westpoort

Possible initiator: *Liander (in cooperation with City of Amsterdam and Delta Programme)*
Objective: *Determining the degree of water resilience of the 50 and 150 kV stations in Westpoort, and what is needed to safeguard their continued functioning in the event of flooding.*
Elaboration: *The substations in Westpoort serve not only Westpoort but other parts of the city as well. If the substations in Westpoort fail due to flooding, parts of the city that have not been flooded will also be without power. The critical and vulnerable functions approach of the Delta Programme aims to safeguard the continued supply of electricity to areas outside the flooded area. In anticipation of the definitive policy, we are investigating what will be needed for this in Westpoort itself.*
Time frame: *2018*

B10. Analysis of measures needed to keep AEB in operation.

Possible initiator: *AEB Amsterdam.*
Objective: *Identifying the measures that would be needed to keep AEB fully or partly in operation in the event of an on-site flood level of 50 cm, thereby limiting the scale of a disaster and supporting emergency management and recovery.*
Elaboration: *Identifying all the necessary adjustments (physical, procedural and operational), both internal and external, that would be needed to keep parts of AEB in operation in the event of flooding. This will take place in the form of several think-tank sessions, involving external stakeholders where necessary. The actual measures will not yet be taken.*
Time frame: *can start in the 2nd half of 2017.*


JUMBO
BRYAN


PORT-CITY
(HAVEN-STAD)
Implementation of water-resilient measures in Port-City
TEAM
RESILIENT
PROJECTS
Resilient projects task force
DATA
CENTRE
Realisation of water-resilient data centres
MUSEUM
STORAGE
DEPOT
Water-resilient museums in Amsterdam
10 kV
Making the 10 kV stations water-resilient

Resilient projects

Supplementary to Aware and Bottom Line, Resilient Projects identifies and promotes opportunities for flood resilient projects and design. Via this track, Westpoort can incrementally become an even stronger and most resilient port. Resilient Projects is project-based: based on individual projects, combinations of spatial developments and water resilient solutions can be tackled and implemented.

Objective

Resilient Projects does not have fixed targets or completion deadlines. Rather, the process will adapt to the circumstances. The ultimate result depends on economic and spatial developments, a better understanding of the chains and relationships between chains, political decisions at various scale levels, the link to other processes, feasibility and affordability. In addition, interventions in Westpoort will also depend on strategy at city, regional or national level.

Within Resilient Projects, projects are dealt with as they occur. One example is the construction of a new fire station. How can it be built and present itself as a flood resilient fire station? Another example is, can roads be raised during major maintenance work so that they can serve as part of an evacuation route? In addition, the development of Haven-Stad (Port City) within dyke ring 44 requires further attention. With the transformation into an urban working and residential area, many more people will take up residence within the flood control area.

Process

The long-term perspective of Resilient Projects will need regular review. The defined adaptation approaches on the compass help to determine the envisaged perspective. Currently, a middle course has been sought between Rescue and Essentials (see long-term compass on page 40).

Projects are dealt with as they occur

Within Amsterdam, a task force can keep a watchful eye on the developments taking place in Westpoort and the opportunities that these developments afford for directly improving water resilience.

Scale

Resilient Projects actively seeks out opportunities for increasing water resilience whenever interventions take place. This requires a thorough knowledge of the spatial dynamics of Westpoort. In addition, the port can use the Resilient Projects track to emphasize sectors with which it aims to distinguish itself in the future, such as biofuels, circular economy, data and/or cocoa.

Resilient Projects follow-up steps

R1. Resilient Projects task force

Possible initiator: *City of Amsterdam (in cooperation with Amsterdam Port Authority, Waternet, ORAM entrepreneurs association)*
Objective: *Setting up a team that will actively seek opportunities for Resilient Projects by monitoring and actively participating in activities in the port.*
Elaboration: *Setting up a team of designers and experts. In addition, establishing a system for continuously checking and seeking out spatial developments that are suitable for Resilient Projects, actively putting the water resilience task on the agenda, and providing support in the development of flood resistant solutions to 1) make a concrete contribution to flood resilience and 2) gain experience in this area.*
Time frame: *Can begin immediately.*

R2. Haven-Stad (Port City)

Possible initiator: *City of Amsterdam (in cooperation with Waternet)*
Objective: *Realising water resilient measures as part of the development of Port City*
Elaboration: *Contributing knowledge and experience from Water Resilient Westpoort, the other multi-layer flood risk management pilots, and Amsterdam Rainproof in Port City through active participation in the project group.*
Time frame: *Already started in March 2017.*

R3. Making the 10 kV stations water resilient

Possible initiator: *Liander (in cooperation with City of Amsterdam, Waternet)*
Objective: *Realisation of water resilient 10 kV stations*
Elaboration: *The climate stress test revealed that a number of 10 kV stations are vulnerable to pluvial and other types of flooding. Under the current regulations, it is not possible to raise the level of these stations. Liander and the City of Amsterdam will jointly seek solutions for this.*
Time frame: *2017-2018.*

R4. Setting up an incentive scheme

Possible initiator: *Resilient Projects task force*
Objective: *Exploring the possibilities of setting up an incentive scheme.*
Elaboration: *Based on the initial experiences of the task force, it will be assessed whether there is a need for an incentive scheme to boost Resilient Projects, and what the possibilities are for this. At the same time, the possibilities within the Spatial Adaptation Delta Programme will be investigated.*
Time frame: *2018*

R5. Data centres

Possible initiator: *City of Amsterdam (in cooperation with Waternet)*
Objective: *Realisation of water resilient data centres*
Elaboration: *In recent years, the Amsterdam Smart City innovation platform has looked at the extent to which the city's critical networks are climate proof, leading to the intention to devote attention to this in the coming years. The focus will initially be on data centres because that particular branch is undergoing many developments. The request has come from the project Resilient Infrastructures to develop this further using knowledge gained from Water resilient Westpoort and Amsterdam Rainproof.*
Time frame: *2017-2020.*

R6. Water resilient museums in Amsterdam (not specifically Westpoort, but including the storage depot of Stedelijk Museum Amsterdam in Westpoort)

Possible initiator: *Museums and/or City of Amsterdam (in cooperation with Waternet)*
Objective: *Water resilient museums in Amsterdam*
Elaboration: *Various Amsterdam museums have expressed a wish to be better informed about the water-related risks they face. Talks have already been held with a number of them. It has*

been proposed to organise a broadly based knowledge session for museums in the city, involving knowledge institutions and consultancies.

Time frame: *2017*

Background documents

De Waterbestendige Stad

Multi-layer flood risk management approach applied to the Amsterdam Region.

DHV, DE URBANISTEN, Deltares, City of Amsterdam, Spatial Planning Department, March 2012

(also available in English: The water-resistant city)

Waterbestendige Westpoort

Pilot study into critical and vulnerable functions in the port of Amsterdam

MUST / Witteveen & Bos, July 2013

(brochure available in English)

Deltastrategie Amsterdam (in Dutch)

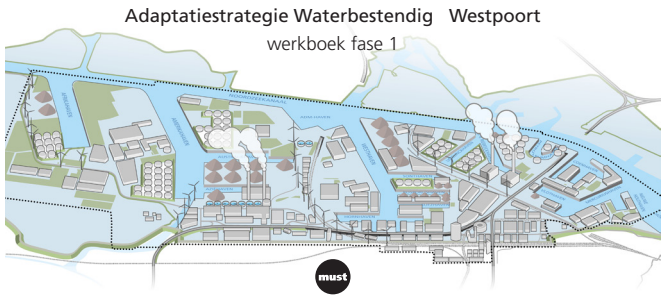
Application of the Delta Programme to the Amsterdam region

Waternet, Ministry of Infrastructure and Water Management – WNN, DRO Spatial Planning Office, City of Amsterdam, June 2014

Adaptatiestrategie Waterbestendig Westpoort (in Dutch)

Work book

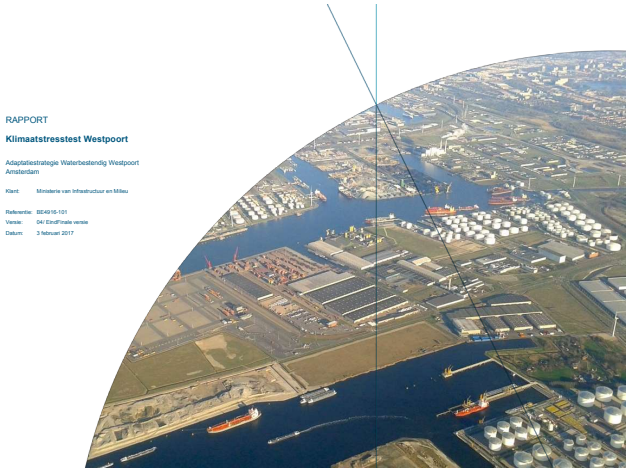
MUST, Regional Public Water Authority Amstel, Gooi en Vecht, City of Amsterdam, province of Noord-Holland, Amsterdam Port Authority and Ministry of Infrastructure and Water Management, 2017



Adaptatiestrategie Waterbestendig Westpoort (in Dutch)

Climate stress test

RHDHV / TAUW, 2017



Adaptatiestrategie Waterbestendig Westpoort (in Dutch)

Compass of adaptation approaches

MUST, 2017

Other stakeholders involved

Rein Aarts	ORAM
Pieter-Jan van Agtmaal	City of Amsterdam
Mariëtte van Baaren	City of Amsterdam
Wim Bakker	Environment Agency: Omgevingsdienst NZKG
Jochiem Hendriksen	province of Noord-Holland
Elina Bekking	Waternet
Vincent Dijkdrenth	Waternet
Tessie Dijkers	province of Noord-Holland
Gerda Dinkelman	province of Noord-Holland
Nanco Dolman	Royal HaskoningDHV
Sadaf Dostzada	VU University Amsterdam
Giacomo Gallo	MUST Urbanism
Annemarieke Grinwis	Ministry of Infrastructure and Water Management
Ingrid van Grootveld	Hoogheemraadschap van Rijnland
Robert Haarman	City of Amsterdam
Thea Helmerhorst	Rijkswaterstaat
Tanja Heringa	Regional Water Authority: Hoogheemraadschap Hollands Noorderkwartier
Thijs Janssen	Rijkswaterstaat
Wouter Janssen Lok	Amsterdam Port Authority
Dagmar Keim	City of Amsterdam
Jos Ketelaars	Waternet
Marius Kiers	Arcadis
Elco Koks	VU Amsterdam
Jelle Kootstra	Regional Water Authority: Hoogheemraadschap Hollands Noorderkwartier
Ymke Koperberg	Rijkswaterstaat
Corien Kuiper	Rijkswaterstaat
Arne Langendoen	Projectbureau Noordzeekanaalgebied
Anne van Loenen	MUST Urbanism
Sophie van der Meer	VU Amsterdam
Hans de Moel	VU Amsterdam
Ellen Monchen	City of Amsterdam
Durk Riedstra	Rijkswaterstaat
Joke Schalk	Rijkswaterstaat
Teun Timmermans	Emergency Management Organisation: Veiligheidsbureau Amsterdam
Berend Temme	Emergency Management Organisation: Veiligheidsregio Amsterdam / Amstelland
Olga van de Ven	City of Amsterdam
Dirk van der Woude	City of Amsterdam

Talks were held with the following companies during the pilot:

AEB
AMS-IX
Liander¬
ORAM
Waternet

Icova
Katoen Natie
Koopman Car Terminal
Oiltanking Amsterdam
Rotim
USA
Voorbij Beton
Vopak
VCK
VTTI

Ministry of Infrastructure
and Water Management

City of
Amsterdam

regional public water authority
amstel gooi en vecht

Port of Amsterdam
Port of partnerships

Provincie
Noord-Holland