Government of the Netherlands

This plan is attached as an annex to the Draft National Water Programme 2022-2027

Flood risk management plan Rhine, Meuse, Ems and Scheldt 2022-2027

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1 Introduction

Flooding can have major consequences for public health and the health of the economy, the environment and cultural heritage. The consequences can extend - directly or indirectly - far beyond national borders. To limit the flooding risks, cross-border cooperation is required. For that reason, the member states of the EU have agreed a common approach in the Floods Directive. An important part of this is the drafting of Flood Risk Management Plans.

Introduction

The Floods Directive (FD) requires that every six years, the EU member states:

- assess the flood risks
- designate areas where the flood risks can be significant
- analyse the consequences of flood events in these areas
- adopt goals and measures to manage the flood risks in the designated areas by reducing the consequences of flooding and, where necessary, the probability of flooding.

The results are recorded in a Flood Risk Management Plan. In the Flood Risk Management Plan, we use the definitions used in the FD*. The main ones are:
Flood: a temporary overflow of water that submerges land that is usually dry.
Flood risk: the probability that flooding occurs in combination with the possible negative consequences of flooding for public health, the environment, cultural heritage and the economy (probability x consequence).

Goal of this document

This document is the Flood Risk Management Plan for the Netherlands for the period 2022-2027. It presents the goals and measures for the designated areas in the river basins** of the Rhine, Meuse, Ems and Scheldt in the Netherlands (see Table 1 and Figure 1). By implementing this plan, the Netherlands will reduce the negative consequences of flooding for public health, the environment, cultural heritage and the economy.

The Netherlands has partly chosen different goals and measures than in past Flood Risk Management Plans***. That is due to new insights, developments in the policy for flood risk management and recommendations by the European Commission (see chapter 3).

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* The exact text of the Directive can be found at https://www.helpdeskwater.nl/onderwerpen/wetgeving-beleid/europese-richtlijn-overstromingsrisico/eu-richtlijn-overstromingsrisico/.

** In this Flood Risk Management Plan the term river basin is used when referring to the Dutch part of the international river basin districts.

*** For the period 2016-2021, the Netherlands has drawn up four separate Flood Risk Management Plans for the Rhine, Meuse, Ems and Scheldt river basins.

Area	Goals	Measures	
General (all designated areas)	The Netherlands is prepared for future developments.	Every year, a long-term Delta Programme will be drafted and implemented Delta Decisions and preferential strategies will be revised every six years Knowledge programme relating to rising sea levels will be implemented Programme Integral River Management (IRM) will be drafted. KNMI scenarios will be updated	
	In 2050, the Netherlands will be climate proof and water robust.	Delta Decision on Spatial Adaptation will be implemented Water assessment will be strengthened, extended and applied	
	The Netherlands is prepared to take adequate action to tackle (potential) flooding.	Crisis and contingency plans are maintained Flood warnings are provided in time Education, Training and Exercises Water awareness and cooperation will be promoted Knowledge development and cooperation	
Area A	Limit substantial local damage.	Set local norms and rules to limit substantial flood damage Inform users of area A about the flood risks	
Area B	By 2050, the risk of flood fatalities is less than 1/100,000 a year (basic protection level).	Assess the condition of the primary flood defence system. Evaluate the standards for primary flood defence systems. Update primary flood defence systems Maintain primary flood defence systems Preserve the drainage and storage capacity of the big rivers Lower the high-water levels of the big rivers Maintain the coastal foundation Reserve space for the long term	
Area C	By 2032 (or earlier as determined the relevant province), the regional flood defence systems which protect area C will meet the standards.	Evaluate and revise the designation and standardisation of regional flood defence systems Assess the state of the regional flood defence systems Update regional flood defence systems Maintain primary flood defence systems Maintain or update drainage and storage capacity regional waters.	
	The flood defence systems along state-operated canals will meet the standard set by the Government by 2032.	Designate and standardise flood defence systems along state-operate canals Assess the condition of the regional flood defence systems along state-operated canals. Update flood defence systems along state-operated canals Maintain flood defence systems along state-operated canals	
Area D1	In D1 areas along the Linge, Roer, Gulp, Geul and Geleenbeek, flood risks will be limited as far as possible in the planning period. For Roer, Gulp, Geul and Geleenbeek, the aim is more specific, which is to meet the standards by 2035.	Linge: Study the flood risks in unprotected area along the Linge Maintain the water storage capacity of the Linge	Roer, Geul, Gulp, Geleenbeek: Assess the flood risks of the Roer, Geul, Gulp and Geleenbeek against the standard Take physical measures along the Roer, Geul, Gulp and Geleenbeek Protect stream valleys of the Roer, Geul, Gulp and Geleenbeek

Table 1 Overview of goals and measures for flood risk management in the Netherlands in the period 2022-2027 (see 4.2 for an explanation of the designated areas)

Status and implementation

This Flood Risk Management Plan is a joint product of the Ministry of Infrastructure and Water Management (coordination), the Ministries of Justice and Security, the Interior and Economic Affairs, the provinces, the municipalities, the water boards and the safety regions. Political decision making took place in the Water Steering Committee. The Minister for Infrastructure and Water Management established the Flood Risk Management Plan.

Input relating to the draft Flood Risk Management Plan is possible from March to September 2021, at the same time as input relating to the river basin management plans for the Water Framework Directive. The Flood Risk Management Plan and the river basin management plans are appendices to the new National Water Programme 2022-2027 which is available for viewing in the same period.

Legislation relating to this Flood Risk Management Plan

The Netherlands has converted the European Floods Directive (FD) into Dutch legislation. With respect to the Flood Risk Management Plans, this was done by incorporating in an implementing decision by the Water Act of 2009 (Water Decision): "The National Water Plan also includes the Flood Risk Management Plans for the river basin areas of the Rhine, Meuse, Scheldt and Ems, insofar as these relate to or partly relate to Dutch territory". The Water Decision defines a Flood Risk Management Plan as a plan as referred to in Articles 7 and 8 of the FD.

Besides the National Water Plan, which outlines the national water policy, the plan system of the Water Act also contains regional water plans describing the general provincial water policy and related aspects of the provincial spatial policy, as well as management plans of the water managers (Water boards and Rijkswaterstaat [Department of Waterways and Public Works]). The Water Act stipulates that the National Water Plan also includes the flood risk management plans for the river basin districts of the Rhine, Meuse, Scheldt and Ems, insofar as these relate to or partly relate to Dutch territory.

The Water Act was essentially a combination of seven 'water laws'. It is the intention of the government that on 1 January 2022, the Environment and Planning Act will come into force. This is essentially a combination of environmental laws. The Water Act is therefore being incorporated in the Environment and Planning Act. The Environment and Planning Act stipulates that the Government draws up several 'programmes'. The Flood Risk Management Plan, referred to in Articles 7 and 8 of the FD, is one of the programmes to be drawn up.

Vital and Vulnerable

As a special part of the Delta Programme, the Government devotes extra attention to the flood risk of vital and vulnerable functions of national importance. National vital and vulnerable functions include drinking water supply, main road network, electricity supply, healthcare and ICT & telecom. With respect to vital and vulnerable functions, besides the risk of casualties, there is also the risk of other problems. These could include evacuation, chain effects and economic or environmental damage when important functions cannot operate for a long period. In the revision of the Delta Programme 2021, it was established that the vulnerability of nationally vital and vulnerable functions should not only be viewed with respect to flooding, but also for excess water, drought and heat. Together, government authorities and the managers of these functions ensure that the nationally vital and vulnerable functions are better protected by 2050. Vulnerability analyses will be conducted by the end of 2021 and at the end of 2023, a realistic ambition must be formulated and adopted in policy and monitoring or in another appropriate form.

How to interpret this document

This Flood Risk Management Plan follows the reasoning of the Floods Directive. It starts with a review of the results of the previous Flood Risk Management Plan. This shows that good progress has been made, but that flood risk management requires continued attention. Chapter 3 explains why the Netherlands has drawn up a new Flood Risk Management Plan for the period 2022-2027. Chapter 4 presents the result of the previous flood risk assessment and the areas designated by the Netherlands because the flood risk there is potentially significant. For these areas, the Netherlands has made maps which are described in chapter 5. The insights from the maps form the basis for the new set of goals for flood risk management (chapter 6) and the measures aimed at achieving these goals (chapter 7). The Floods Directive requests special attention for climate change. Chapter 8 addresses this. Chapter 9 highlights the way in which coordination and participation have taken place in the development of this Flood Risk Management Plan.

Figure 1 Four types of designated areas in the river basins of the Rhine, Meuse, Ems and Scheldt (based on the designation in 2018)

2 Review of the previous Flood Risk Management Plan

In the Flood Risk Management Plan for the period 2016-2021, the Netherlands included 7 objectives and 17 measures to achieve these objectives. Most of the measures have been implemented. As such, progress has been made with respect to achieving the goals. Nevertheless, flood risk management is not yet finished: many goals require continued attention, and many measures are cyclical in nature.

For example, continuous management and maintenance of flood defence systems and waterways is required. It is also necessary to regularly check whether the flood defences meet the standards and how the flood risks are developing. Some of the measures are therefore included again in the new Flood Risk Management Plan for the period 2022-2027 (see chapter 6): they are essential for managing the flood risks in the future too. This chapter also follows the formulation of the goals and measures as these are included in ORBP 2016-2021.

2.1 Progress per objective

Below, by each objective there is a description of the progress of the measures in relation to the planning of the first Flood Risk Management Plan. It is also indicated whether the goal and the measures - adapted or not - are included again in the Flood Risk Management Plan 2022-2027.

Objective 1 The Netherlands follows continuous cycles of standards and assessments of flood defence systems and, where necessary, takes measures to achieve the statutory protection levels.

For this, four measures were included in the Flood Risk Management Plan:

Designate and standardise
The measure has been implemented. In the period 2016-2021, the Netherlands defined new standards for the desired condition of the primary flood defence systems. In 2016, standards were defined and adopted for the regional flood defences managed by the State. The standards were recorded in the Water Act in 2017. For regional flood defence systems, the designation and standardisation were updated where necessary.

Management and maintenance
The measure has been implemented. Throughout the planning period, flood defence systems were maintained with (regular) management and maintenance. The managers of flood defences performed regular inspections, checked the grass surface and where necessary performed repairs.

Assessment
The measure has been implemented. In 2017, the statutory assessment of primary flood defence systems started, based on the new standards. Water defence systems which were known to be a challenge in terms of safety were assessed first. Regional water defence systems were assessed according to the provincial assessment cycles.

Reconciliation

The measure has been implemented or is being implemented. According to the schedule of the High Water Protection Programme for the planning period, primary flood defence systems have been strengthened, except in the vicinity of Venlo. The stress on water defence systems has been reduced through river widening. The programmes Space for the River, Maaswerken and Zandmaas were completed at the start of 2019 (a few projects are still running). In the planning period, the regional water defence systems managed by the water boards were reinforced along a length of 797 kilometres (up to 2019 inclusive).

Conclusion:

Through the implementation of the measures, the cycle of standards, assessments/tests and updating the water defence systems has been completed. Because these measures are permanently required, they are included again in this second Flood Risk Management Plan.

Objective 2 In the river basin of the Meuse, the Netherlands takes measures where necessary to limit the flood risks along waterways without dykes.

For this, one measure was included in the Flood Risk Management Plan:

Assessment/Reconciliation

The measure has been implemented. The programme is running and is on schedule. During the past planning period, it became clear that the future challenge caused by climate change is more extensive and urgent than ever.

Conclusion:

Implementing the measures has limited the flood risks along waterways with no dykes in the Meuse river basin. However, further limitation of the risks is important. For that reason, the objective is included in this second Flood Risk Management Plan in a slightly different form (see chapter 5).

Objective 3 The Netherlands is preparing for future developments which are important for flood protection.

For this objective, one measure was included in the Flood Risk Management Plan:

Delta decisions

The measure has been implemented. In 2014, the Delta Programme Commissioner proposed the Delta Decision on Flood Risk Management to provide all primary flood defence systems in the Netherlands with a basic protection level by 2050. The goal is enshrined in law. In 2020, the delta decision was revised based on new insights into climate change. The Delta Programme Commissioner proposed largely retaining the delta decision.
Conclusion: By taking a delta decision before 2050 and working towards it, the Netherlands is making good preparations for the future developments which are important for flood risk management. By regularly revising the delta decision, the Netherlands can adjust its course based on recent insights. That continues to be important. For that reason, this objective returns in a slightly different form and with updated measures in the second Flood Risk Management Plan.

Objective 4 The Netherlands limits the consequences of flooding through choices in spatial planning.

For this, two measures were included in the Flood Risk Management Plan:

Apply water assessment

The measure has been implemented. In the planning period, the water boards used the water assessment around 40,000 times, particularly for zoning plans and environmental permits

Zoning and setting conditions

The measure has been implemented. The water boards include zonings and conditions, among others from provincial contexts, in the ledgers. The files are regularly updated. The extent to which they are up to date varies.

Conclusion: The application of the Water Assessment has resulted in effects on water - including effects of flooding risks - being explicitly considered in decisions about new initiatives. By recording zonings in ledgers, these zones remain free from developments which could cause great damage in flooding and there is room for future reinforcement of flood defences. As such, the Netherlands has limited the consequences of new developments. Continued attention for limiting consequences remains essential. For this reason, this goal - in an adapted form - is included again in the second Flood Risk Management Plan.

Objective 5 The Netherlands is preparing for future developments which are important for the prevention of the consequences of flooding.

For this objective, one measure was included in the Flood Risk Management Plan:

Delta decisions

The measure has been implemented. In 2016, the Delta Programme Commissioner proposed the delta decision Spatial Adaptation focusing on making the Netherlands water robust and climate proof in 2050. The government departments adopted the delta decision in their policy. In 2017, the Delta Plan Spatial Adaptation came into force to speed up the implementation. Part of this is limiting the consequences of flooding. In 2020, the delta decision was revised. The Delta Programme Commissioner proposed supplementing the delta decision with concrete interim goals.

Conclusion: By taking a delta decision before 2050 and working towards it, the Netherlands is making good preparations for the future developments which are important for limiting the consequences of flooding. By regularly revising the delta decision, the Netherlands can adjust its course based on recent insights. This objective returns in a slightly different form and with updated measures in the second Flood Risk Management Plan.

Objective 6 The Netherlands crisis management ensures the most effective and efficient response before, during and after a (potential) flood disaster

For this, five measures were included in the Flood Risk Management Plan:

Reconciliation with plans

The measure has been implemented. The National Crisis Plan High Water and Flooding and the National Scenario High Water and Flooding were established. The safety regions have adjusted their policy plan and crisis plan, partly based on updated risk profiles. All water managers have contingency plans.

Education, training and exercises

The measure has been implemented. Safety regions have a plan for education, training and exercises Flood defence structures are periodically tested (examples are the annual test closure of the Maeslant Barrier and the flood barrier at Kampen). The general column and the water column organise joint exercises. Examples of bigger crisis exercises in the past planning period were 'Waterwolf' (2016) and 'Deining en doorbraak' (2017).

Predictions and warnings

The measure has been implemented. Water managers and KNMI (Royal Netherlands Meteorological Institute) work together in the Netherlands Water Management Centre (WMCN) which issues flood warnings, among others (see appendix 2).

Adequate response

The measure has been implemented. In the past planning period, no (potential) emergencies occurred. However, new instruments were developed to be able to communicate clearly in the case of (potential) flooding, such as the information provision via the website crisis.nl and via NL-alert.

Recovery, after care and evaluation

It was not necessary to implement this measure: in the past planning period, no (potential) emergencies occurred.

Conclusion: Because no (potential) flooding occurred in the period 2016-2021, the measures for these objectives were only partly necessary. The first three, for the preparation for potential flooding, were implemented and thus contributed to achieving the objective. Adequate preparation continues to be essential and requires continued efforts. In the second Flood Risk Management Plan, this objective therefore returns in a slightly different form.

Objective 7 The Netherlands is preparing for future developments which are important for crisis management against flooding.

For this objective, three measures were included in the Flood Risk Management Plan:

Framework large-scale evacuations

The measure has been implemented. The framework was achieved in 2014 and serves as the starting point for drawing up evacuation strategies in the event of (potential) flooding.

Module large-scale evacuations in the event of flooding

The measure has been implemented. In 2016, the Ministry of Justice and Security and the Ministry of Infrastructure and Water Management completed the Module large-scale evacuations due to floods (MEGO) project. This resulted in advice about the use of the infrastructure and information systems which are open to the public.

Strengthen collaboration

The measure has been implemented. Based on new insights, the Ministries, water managers and safety regions improved the agreements about collaboration in water crises and flooding. The improvement in collaboration in crisis management is recorded in the strategic agenda SMWO (see appendix 2).

Conclusion: The implementation of the measures has ensured that Dutch crisis management is optimally prepared for future developments. In the second Flood Risk Management Plan, this objective therefore returns in a slightly different form.

2.2 Extra measures which were not foreseen

In the period 2016-2022, three extra measures were implemented which were not included in the first Flood Risk Management Plan

- the Climate effect atlas : this digital atlas gives information about climate change, including the (future) threat of flooding and excess water, as a tool for organisations working on climate adaptation.
- the Water & Evacuation programme (2016-2019): this led to a more integral approach and to more collaboration between the regions and between regions and the Government.
- the National Information System Water and Flooding (LIWO, 2016): an information system consisting of different map layers for professionals involved in (preparations for) excess water and flooding in the Netherlands.

3 Why a new Flood Risk Management Plan?

The first planning period of the Flood Risk Directive ends in 2021. The Netherlands has decided to revise the four old Flood Risk Management plans and incorporate the result in a single new plan for the period 2022-2027. This means we again have an up-to-date overview of flood risk management. The considerations below played a role in the decision.

Assessment

The EU Directive asks the member states to assess and, if necessary, amend their Flood Risk Management Plans by 22 December 2021 - at the end of the planning period. The result of the assessment is in chapter 2. Partly based on that, the Netherlands decided to make a new plan

Risk assessment

The Netherlands conducted an interim risk assessment (see chapter 4). Based on that assessment, 'areas of potential significant flood risk' (APSFR) were designated. This was not done for the first plan, because the Netherlands used a transition regulation. The first Flood Risk Management Plan thus related to the Netherlands as a whole. This new Flood Risk Management Plan is limited to the designated areas with a potential significant flood risk.

Maps

For the APSFR, new updated maps were made, with an improved method (see chapter 5). Compared with the first Flood Risk Management Plan, extra maps have been added for scenarios of exceptional events. These maps give new insights into the flood risk.

Recommendations of the European Commission

The European Commission assessed the plans of all the EU countries and made recommendations*. One of the recommendations is to improve the measurability of the objectives.

* https://eur-lex.europa.eu/legal-content/NL/TXT/HTML/?uri=CELEX:52019DC0095&from=nl

Objectives and measures

This new Flood Risk Management Plan includes amended objectives and measures. The seven objectives from the first plan applied to the Netherlands as a whole. These have been replaced by general objectives for all the designated areas and specific objectives per type of area (see chapter 6). For each objective, the plan contains several measures (see chapter 7).

Advanced knowledge

Scientific research has shown that both the sea level and river discharges will rise further in the coming decades. How fast this will happen is still unclear. There are now indications that water levels may rise faster than assumed (see chapter 8).).

New agreements by Rhine Ministers

In February 2020, the Ministers from the countries in the Rhine river basin and the representative of the European Commission agreed that in 2040 an optimal combination of measures must have reduced the flood risk by 15% in relation to 2020. Where possible, these measures must also be linked with nature-friendly solutions and/or ecological recovery. They also adopted the Rhine 2040 Programme. This contains more concrete goals and measures for this reduction of the flood risk (see chapter 9).

Merging of plans

For the first planning period, the Netherlands drew up four separate Flood Risk Management Plans, one for each of the four river basins (Rhine, Meuse, Scheldt and Ems). These plans were largely the same. For the second planning period, the Netherlands therefore drew up one plan for the four river basins together. All the APSFR are in one of these four river basins. It is indicated where this Flood Risk Management Plan does not apply for every river basin

4 Risk assessment and risk areas

For this Flood Risk Management Plan, the Netherlands performed an interim flood risk assessment. Based on this assessment, risk areas were designated: areas of potential significant flood risks.

4.1 Risk assessment

Risk assessment

In December 2018, the Netherlands adopted the interim flood risk assessment* . That is the first step of the EU Directive. Here is a summary of the risk assessment.

Historic flood risks

In the past, measures were taken in the Netherlands after (near) flooding from the former Zuiderzee, the North Sea, the Meuse, the Rhine and the delta waters. The risk of flooding was reduced following the construction of the Afsluitdijk, the Delta Works and the Maaswerken and Space for the River programmes. Large-scale flooding from regional waters - including in the autumn of 1998 - resulted in nationwide measures, such as enlarging the storage and drainage capacity of these waters.

Future flood risks

Current calculation techniques make it possible to analyse the possible risks and consequences of future flooding. The interim risk assessment focuses on flooding which could lead to a significant risk: flooding from the main water system (sea, lakes and rivers) and the regional water system (water outlets and regional rivers). It does not include flooding from groundwater (the consequences are minor in the rare cases that this occurs in the Netherlands) and flooding from sewer systems. Whether flooding caused by intense rainfall in the future will need to play a role in the interim risk assessment will be studied further.

* https://www.rijksoverheid.nl/documenten/rapporten/2018/12/12/overstromingsrisico%E2%80%99s-in-nederland

Risk of flooding

The risk of flooding is derived from the risk of exceeding certain high water levels. Scenarios are elaborated for each area with a risk of flooding of 1:10, 1:100 and 1:1000 and sometimes also 1:10,000 per year. For unprotected areas, the extent of the flooding and the depth of the flood are determined by comparing the water levels with the elevation of the flooded area. Protected areas become flooded when the standardised flood barrier is breached or overflows. When calculating the risk of flooding of protected areas along main waterways, various fail mechanisms are considered, such as overflow, wave overflow, shift of the inner slope, erosion of the dyke revetment and *piping* (aquifer systems under the dyke).

Models are used to calculate the risk of flooding for various locations along the flood defence. The extent of the flooding and water depths follow from the combination of calculations with flood models.

Flood consequences

The consequences for each flood scenario are determined, including the potential economic damage, the number of fatalities and the number of locations with vulnerable nature, historic monuments and IED installations (such as nuclear reactors, chemical industry and storage places of hazardous or contaminated substances). Most of the consequences are calculated based on the national standard damage and casualty module.

Cultural heritage, a comprehensive concept

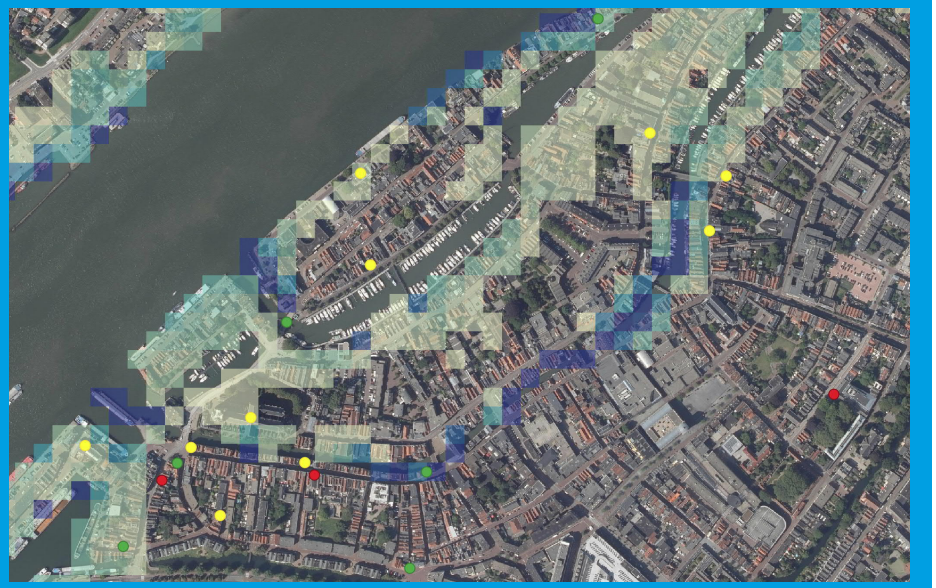
One of the objectives of the Floods Directive is to reduce the potential damage caused by flooding to cultural heritage. Large parts of the Netherlands are protected from flooding, mainly by flood defence systems. This also protects the cultural heritage.

Cultural heritage is a comprehensive concept. For example, it includes stone border posts, but also (parts of) buildings with their gardens, historic interiors and/or wall covering, archaeological monuments, historic cemeteries, historic municipal parks, landscapes, museum collections and archives. Their nature, extent, ownership situation and (monument) status vary considerably.

The position of the protected Dutch monuments is known, as are which objects could be affected by flooding, depending on the water level that occurs. It is not known how extensive the damage will be in such a case, where the priorities for protection lie and who is responsible for that. The Cultural Heritage Agency of the Netherlands has therefore developed a method for national historic buildings. Using this method, national historic buildings can be divided into categories, based on the value density of the monument and its sensitivity to water. The result is the so-called 'sensitive value' of a monument.

The value density is a measure for the concentration of value. Empty and no longer functioning structures and monuments which are not buildings (such as a border post or commemorative stone) have a low value density. The middle category of value density consists of historic buildings with no specific content and non-historic buildings which house a heritage collection. The highest value density applies to a combination of a historic building with a heritage collection or content (such as a valuable historic interior). The sensitivity to water is derived from the sensitivity to water damage of the construction material and the robustness of the construction. The loss of value following flooding is greatest for a monument with both a high value density and high sensitivity for water.

The method was tested in Dordrecht, as part of the Shelter project (EU programme Horizon 2020). This resulted in more research into national monuments in areas outside the dykes which have a high value density as well as high sensitivity to water. The study also reveals exactly where the cultural-historic value of these buildings lies and whether the water really affects this value. The study also looks at the communication used to inform owners of the historic buildings, for example through an information session, folder or municipal website or other means. The aim is to help the owners of these buildings limit loss of value.



In Dordrecht, there are various monuments with values which are sensitive to water (green: low sensitivity, yellow: medium sensitivity, red: high sensitivity). The colours light and dark blue indicate how high the water can rise in the unprotected area of Dordrecht in the event of flooding with a small risk of occurrence (once in 1000 years). This was an initial analysis to test the data and method. Further in-depth studies are currently being conducted.

4.2 Risk areas

Various flood risks

The risk assessment presents the following situation:

- In unprotected areas directly bordering the main water system (sea, big rivers and lakes), the risk of flooding is great, but the consequences are small.
- In areas which are protected from flooding from the main water system, the consequences are by far the greatest. In some scenarios, the economic damage can rise to around € 25 billion and the number affected can vary from hundreds to 250,000.
- In areas which are protected from flooding from the regional water system, the consequences are medium to small. The consequences are higher than in the unprotected areas bordering the main water system.
- Unprotected areas along the regional water system generally have a function for nature, extensive agriculture or regional water storage. The risk of flooding is high. In most cases, the damage caused by flooding here is limited, although there are still exceptions, and the risk of casualties is zero.

Significant flood risks

The European Floods Directive asks countries to draw up plans for significant flood risks. Each member state decides what is significant to them. The Netherlands uses the following criterion: there is a potential significant flood risk if flooding could result in one or more fatalities or if the economic damage is more than € 40 million

Areas with significant flood risks

Based on the flood risk assessment and the above criterion, the Netherlands has designated the following as 'areas of potential significant flood risk' (see Figure 2):

- Type A: unprotected areas along the main water system.
- Type B: protected areas along the main water system.
- Type C: protected areas along the regional water system which are protected by regional flood defence systems with a norm of 1/100 per year or more (the so-called IPO class III, IV and V) or by state-operated canal dykes with a norm of 1/100 per year or more.
- Type D1: unprotected areas along four regional waters in the Meuse river basin and one regional water in the Rhine river basin.

Types A, B and C occur in all four river basins. Type D1 only occurs in the Rhine river basin (along the Linge) and the Meuse river basin (along the Roer, Gulp, Geul and Geleenbeek).

Update areas of potential significant flood risk

After the formal designation of risk areas, it appeared that the flood risk in some small type C areas was not potentially significant*. These areas are therefore not shown on the maps belonging to this Flood Risk Management Plan and the goals and measures of this plan do not apply. Some of these areas (along the Vecht) are in category D2.

For some regional flood defences, new flood calculations have been performed: for the areas along state-operated canals and along some regional flood defences in Noord-Holland. Based on this, the potential significant flood risk area has been updated.

* Drenthe: surroundings of Assen Overijssel: surroundings of Oldemarkt, Kanaal Almelo de Haandrik, Hessum and the Vecht between the border and Ommen (since 1 December 2019, the flood defence systems which protect these areas in Overijssel are no longer designated regional flood defences with a standard of 1:100 or less (IPO category III-V)).

Type D2 for international coordination

The Netherlands has coordinated the interim flood risk assessment and the designated areas in the international river committees and relevant bilateral consultations. According to the Dutch criterion, some cross-border waters do not have a potential significant flood risk. However, they have still been designated to facilitate international coordination of the plans. These areas are designated as type D2 (see Figure 2).

These are areas along seven regional waters without dykes in the Rhine river basin (Oude IJssel, Aastrang, Boven Slinge, Beurzebeek, Berkel, Buurserbeek and Dinkel), and along eight regional waters without dykes in the Meuse river basin (Uffelse Beek, Thornerbeek, Jeker, Voer, Worm, Roode Beek, Kitschbach and Niers).

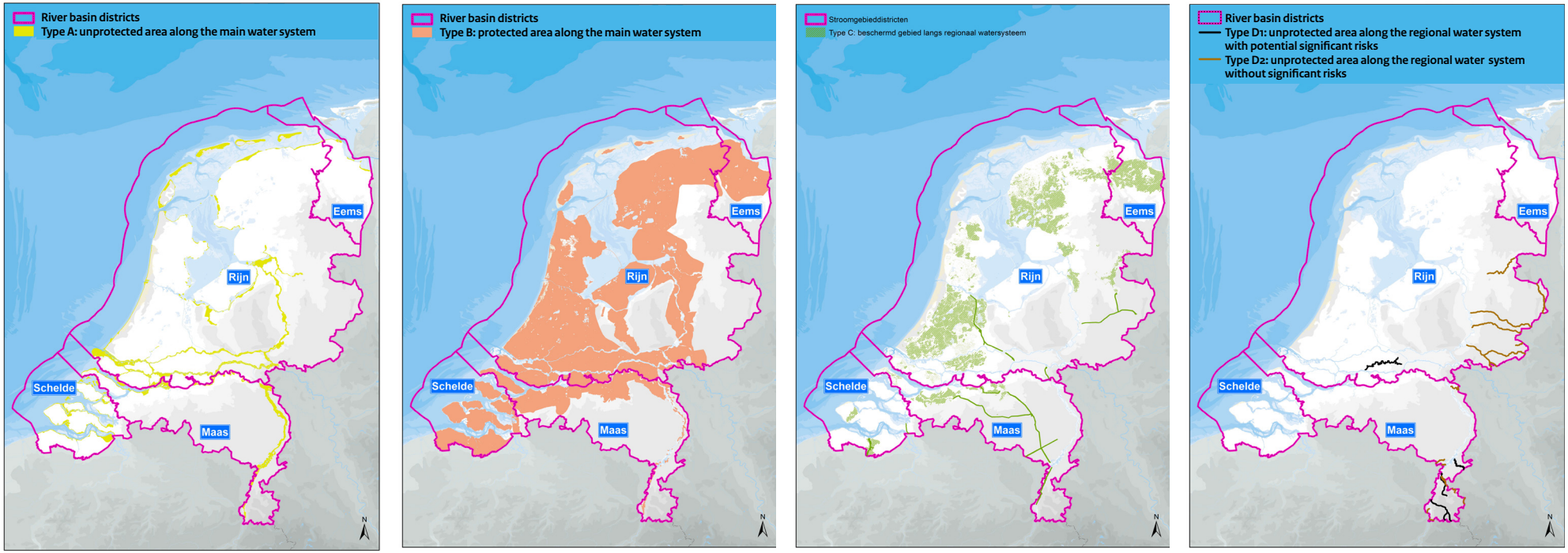


Figure 2 Designated areas A, B, C and D in the framework of the Floods Directive (according to the designation in 2018)

5 Flooding mapped

The Netherlands has made maps for the designated areas with the features of flooding and the consequences of flooding. This provides insight into the nature of the flood risk in the designated areas.

5.1 Information on the source

New maps

For this second Flood Risk Management Plan, the Netherlands has updated the flood danger and flood risk maps from the first cycle. The maps were published in December 2019 on www.risicokaart.nl. * The new set of maps:

- now shows the areas with a potential significant flood risk (the designated areas)**;
- gives a better idea of the dangers and consequences because it is based on the current condition of the primary flood defence systems instead of the minimum required condition. this has consequences for the flood risk in area B.
- as an extra scenario, gives the extremely rare scenario of exceptional events.

Two types of maps

Flood danger maps mainly show the depth of the water during flooding.
Flood risk maps show the potential consequences: the number of residents, the type of economic activity (designated use and soil use), the IED installations (installations which could be dangerous), drinking water extraction locations, swimming water locations and Natura 2000 areas.

* This Flood Risk Management Plan only includes maps, goals and measures for areas with a potential significant flood risk. The Netherlands also manages the flood risks for areas with lower flood risk, particularly by limiting the consequences and adequate preparation for flooding. Maps of these areas area also available. After the publication of the maps, it appeared that the flood risk in some small areas of the designated areas was not potentially significant.

** After the maps were published, it turned out that the flood risk in some small parts of the designated areas was not potentially significant after all.

Flood scenarios

The maps give the following flood scenarios:

1 **high probability** of flooding: around once every 10 years
2. **medium probability** of flooding: around once every 100 years
3. **low probability** of flooding: around once every 1000 years
4. **exceptional events:** around once every 10,000 years or less.

Exceptional events

The Netherlands has added the fourth scenario because flooding in area B usually occurs less frequently than once in 1000 years. The Dutch public can therefore also see this map on the website www.overstroomik.nl (including the risks outside the designated areas).

Considerations

In each scenario, flooding can occur in various ways. The maps for the four risks of flooding show the total area of all possible flood events with the relevant risk of occurrence. In reality, such flood events never occur at the same time.

Some areas may flood from several sources, for example from the main water system when a primary water flood defence system fails or from the regional water system if a regional flood defence system fails. The designated areas B and C (see chapter 4) therefore partially overlap.

The flood danger maps are the result of model calculations and choices surrounded by uncertainties. Occasionally, the maps may therefore not show the water depth, although in practice flooding can occur.

5.2 Insights from the maps

The maps show the flood prone area and the consequences for all possible flood events with the relevant chance of occurrence. Here follows a description of the dangers and consequences in the four scenarios, first per river basin and then per type of designated area

Results per river basin

The Floods Directive follows a river basin approach (see chapter 2). In each of the four scenarios, there are flood dangers and flood risks in the four river basins in the Netherlands (Rhine, Meuse, Ems and Scheldt) (see Table 2 and the detailed tables in appendix 3). The differences between the river basins are mainly related to the differences in size of the river basins, the conveyance routes and the land use.

	Unit	Rhine	Meuse	Ems	Scheldt
Scenario High risk					
Flooded surface area	km²	901	277	38	148
Potentially affected residents	x1000 residents	15	3	0	0
Total damage	million €	595	137	4	17
Scenario Medium risk					
Flooded surface area	km²	6,429	891	471	294
Potentially affected residents	x1000 residents	2,013	107	41	35
Total damage	million €	92,297	6,377	2,543	1,050
Scenario Low risk					
Flooded surface area	km²	15,183	1,638	1,183	639
Potentially affected residents	x1000 residents	5,724	501	150	110
Total damage	million €	316,077	33,514	10,519	6,213
Scenario Exceptional events					
Flooded surface area	km²	17,194	2,084	1,530	1,432
Potentially affected residents	x1000 residents	9,179	702	219	328
Total damage	million €	500,720	50,615	16,978	26,877

Table 2 Potential consequences of flooding per river basin. These consequences never occur at the same time, during one event.

Results per type of area

The Netherlands has designated four types of area: A, B, C and D1 areas (see chapter 3). The potential consequences of flooding with the four risks vary considerably per type of area (see Table 2, Table 3 and appendix 3). These differences are related, among others, with the land use, the flood depth and the extent of the flooding. A consideration is that areas B and C partially overlap.

Here is a description of the potential consequences per risk and per type of area. The consequences mentioned below are the sum of the consequences which could occur with the various flood events with the relevant risk of occurrence. These flood events never occur at the same time, so the consequences will never occur to the extent mentioned during one flood event.

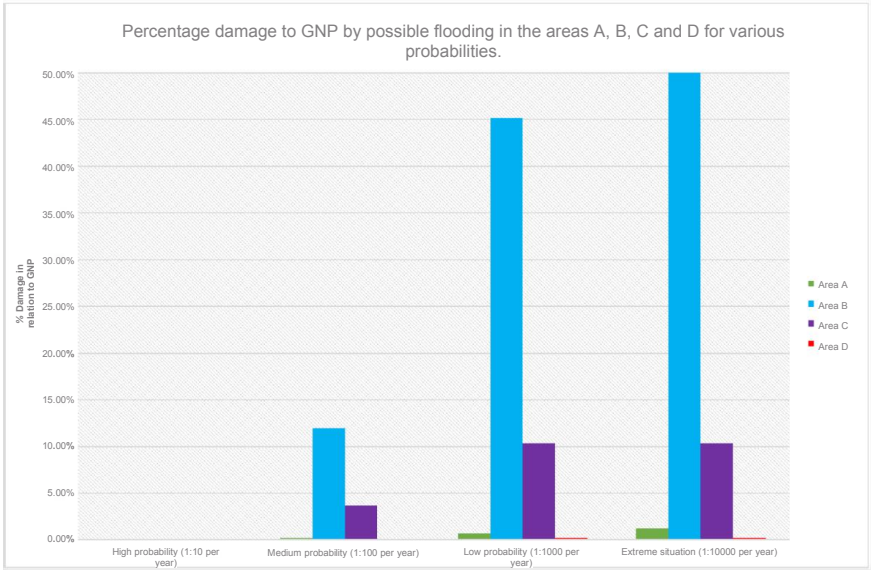


Figure 3 Potential damage caused by flooding as a percentage of the Gross Domestic Product, per risk and per type of area

Scenarios with a high probability (around once every ten years)

Flooding with a high probability is only expected in the unprotected areas A and D1. Areas B and C are protected by flood defence systems.

Area A

In area A, in this scenario a total of around 1,200 km2 can flood (sum of the consequences of different possible flood events with a high probability of occurring). Of this, 70% is Natura 2000 area (800 km2). In the flooded area, there is local built-up area, ports and infrastructure. The damage is small and the potential number of affected residents is low. Around a hundred swimming locations are affected, mainly along the coast and the lakes. These locations are designed to cope with flooding.

Area D1

In area D1, some of the natural stream valleys flood from regional waters in Limburg and the flood plains of the Linge. This area is largely designed to ensure that flooding causes little damage. Around 70 km² (40% of the flooded surface) is Natura 2000 area. Where there is a built-up area, more damage may occur. If all the potential flood events in this scenario occurred at the same time, the total damage in area D1 would be around € 280 million.

Scenarios with a medium probability (around once every 100 years)

Flood events with a medium probability of occurrence can occur in A, B, C and D1 areas. The nature of the consequences varies per type of area (see figure 4)..

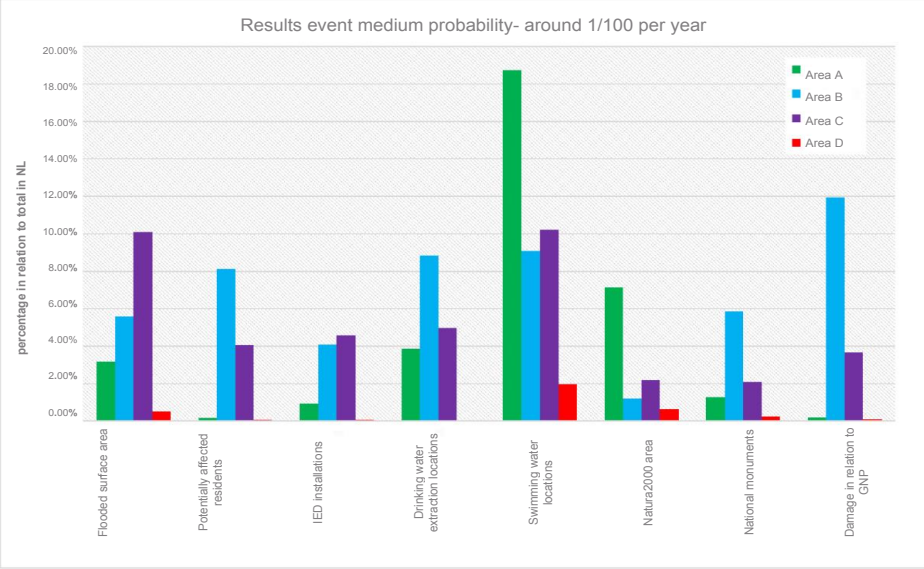
Area A

In this scenario, the consequences of a flood event in area A are slightly greater than in the scenario with a high probability. The flooded area increases to a limited extent, but the potential damage increases from € 480 million to € 1,160 million (sum of the damage occurring with various possible flood events with a medium probability of occurrence). Flood events in this scenario may also affect residents, IED installations and national monuments.

Area B

All primary flood defence systems must fulfil the flood standards in 2050. Currently, some of the flood defence systems do not yet meet the standard. In this scenario, flooding can therefore occur in a large part of area B, including along part of the Rhine subsidiaries, the IJsselmeer and the islands of Zuid-Holland and Zeeland. The river area, the Gelderse Vallei and the area immediately to the west of the Utrechtse Heuvelrug are particularly vulnerable. The total area

Figure 4 Potential consequences in scenarios with medium probability: number of objects affected as percentage of the total number in the Netherlands



that can be affected with this probability is 2,330 km². that is 5% of the Netherlands. Around 1.5 million people live here (nearly 10% of the population of the Netherlands). The total damage can rise to over 10% of the GNP (around € 78 billion). The amount of potentially affected Natura 2000 area is limited. The affected area is home to 10% of the swimming locations (65 locations) and drinking water extraction (16 locations) in the Netherlands.

Area C

Many flood defences which protect area C (regional flood defence systems and flood defences along the state-operated canals) have a standard of 1/100 per year (exceedance probability). In this scenario, a relatively large part of this area C may flood due to the failure of these flood defence systems: around 4,210 km² or around 10% of the Netherlands can flood (sum of the consequences of different possible flood events with a high probability of occurring). The potential damage for the entire area C is less than 5% of the GNP (€ 24 billion). The percentage of potentially affected residents, around 717,000, is also lower than in area B. This mainly concerns

local flood events, for example because a pump has insufficient capacity to drain large amounts of rainwater from a canal or outlet system. A breach of a regional flood defence system or national canal dyke is also possible. Per event, only a small part of area C floods (for example a polder).

Area D1
Flood events in this scenario may cause more damage in the natural river valleys in Limburg and the flood plains along the Linge than in the scenario with high probability. More built-up areas will flood and water depths increase. The total potential damage in area D1 is increasing to around € 620 million and the number of potentially affected residents up to 11,000 (sum of various possible flood events with a medium probability of occurrence).

Scenarios with a low probability (around once in 1,000 years)

Flood events with a low probability of occurrence can occur in A, B, C and D1 areas..

Area A
In the scenario with a low probability, nearly the entire area A can flood (total effect of various possible flood events with a low probability of occurrence). The effects are greater than in the previous scenarios. More residents, IED installations and national monuments can be affected and water depths increase. As a result, the damage is around four times as great as in the scenario with a medium probability: over € 4 billion.

Area B
A large part of area B can flood during flood events with a low probability. That mainly happens with extremely high drainage from the Rhine and the Meuse, an extremely severe storm on the coast or a combination of both in the lower part of the river system. In this scenario, some primary flood defence systems 'may' fail in view of the standardisation. Other primary flood defence systems still do not meet the standard and could also fail in this scenario. In many places, the water may rise to over two metres and locally more than five metres. Such maximum water depths can occur along the Waal, Nederrijn-Lek and IJssel, in the villages protected by dykes and towns along the Meuse in Limburg, in the coastal zone and in the IJsselmeer polders. Together, the flood events in this scenario can affect over 20% of the total area of the Netherlands (9,800 km²) and over 4 million residents (sum of various possible flood events with a low probability of occurrence). Around 20% of the drinking water locations (40 locations) and swimming locations (149 locations) in the Netherlands can be affected. There are 650 potentially affected IED installations, around 20% of the total number in the Netherlands. This scenario can also affect around 15% of all national monuments (over 10,000 monuments), nearly three times as many as in the scenario with a medium probability. The total potential damage in area B is over € 290 billion (around 45% of the GNP).

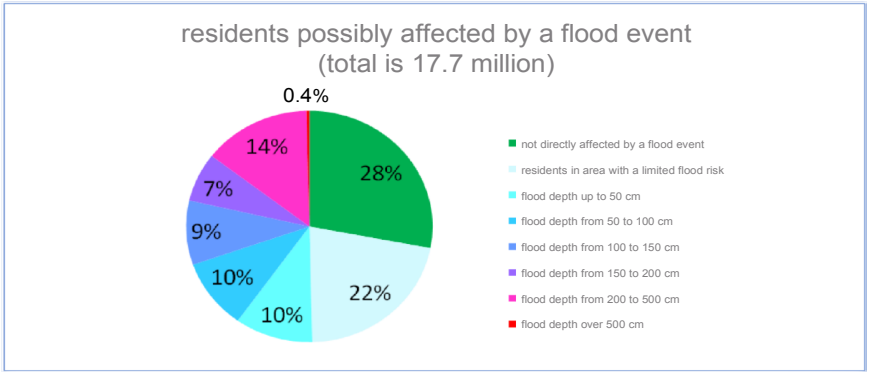
Area C
In area C, regional flood defence systems may also fail in the event of low probability. In this situation, mainly densely built-up areas may flood and flood water may be deeper than in the scenario with medium probability. For example, several polders in western and northern Netherlands may come under several metres of water. The flooded area is not much bigger than in the scenario with medium probability, but the potential damage increases to around 10% of the GNP, or € 67 billion (sum of the damage occurring with various possible flood events with a low probability of occurrence). The number of potentially affected residents is over 2 million. The number of potentially affected IED installations increases to around 250, the number of national monuments affected nearly doubles and around 100 swimming locations may be affected. Per event, only a small part of area C usually floods (for example a polder).

Area D1
The flood events along the regional streams in Limburg and the Linge have greater consequences in this scenario than in the scenario with medium probability. The flooded area has a bigger population (over 26,000 people). The damage in the built-up areas increases to over € 1 billion (sum of various possible flood events with a low probability of occurrence).

Scenario of exceptional events (around once in 10,000 years or less)

The scenarios of exceptional events are only analysed for the areas A and B. In the areas C and D1, the scenario with a low probability already shows an exceptional situation. In the scenario of exceptional events, nearly half of the Dutch population could be affected by a flood event. The depth of the water can vary from a maximally a small layer of water (maximum 50 cm for 10% of the residents) to very deep (more than 5 m of water for 0.4% of the residents).

Figure 5 The percentage of the Dutch population that could be affected by flooding of a certain maximum depth in the scenario of exceptional events



Area A
In the situation of exceptional events, nearly the entire area A is flooded. Only some elevated land remains dry. The potential damage nearly doubles compared with the situation of a low probability, particularly due to flooding of built-up areas outside the dykes and port areas. The number of potentially flooded IED installations doubles to 135. The number of potentially affected residents also increases, to around 180,000. The number of national monuments increases to around 2,000. If all the exceptional events occur at the same time, the damage in area A can rise to around € 8 billion (over 1% of the GNP). The number of drinking water locations and swimming water locations affected and the affected Natura 2000 area remain more or less the same as in the scenario with a low probability.

Area B
In this scenario, some primary flood defence systems fail at the same time. The flooded area increases to around 35% of the Netherlands. This can cause major disruption. The number of potentially affected residents increases to around 8 million people. The affected area is a densely built-up part of the Netherlands with a lot of industry. The total damage therefore soars, to over € 500 billion if all the potential events occurred at the same time (80% of the GNP). Around 35% of all national monuments in the Netherlands are affected and the number of IED installations and drinking water and swimming water locations increases. This is the most serious potential scenario which can only occur in exceptional circumstances. This situation also shows what the Netherlands would look like without any protective measures at all.

Conclusions

Flood dangers and the potential consequences of flooding are particularly great in the scenarios with a low probability and in exceptional events (see table 3). In area B, the dangers and consequences are by far the greatest. In the scenario with medium probability (once a century), the consequences can be considerable.

Area A:
A large part of area B can flood in the scenario with a low probability. This is in line with the use of these areas: they must offer water storage and drainage options to limit the risks in the neighbouring areas B and C. The consequences of a flood event are much lower than in areas B and C. In the scenario with a lower probability, the consequences mainly increase in the built-up areas.

Area B
In the event of a failure of a primary water defence system, there are immediate consequences for the people in the surrounding area. With a lower probability, these consequences quickly become greater. In the scenario of exceptional events, the consequences are extremely serious.

Area C
The failure of a regional flood defence system or national canal dyke causes flooding. There is damage, but the potential number of affected residents is limited. With a lower probability, the consequences increase but are not extremely serious.

Area D1
The consequences in this area are similar to the consequences in area A. With a high probability, the consequences are very limited. In scenarios with a lower probability, the consequences are slightly more serious, but still small compared with the consequences in other areas

flood scenario	Area A	Area B	Area C	Area D1
High probability (1:10 per year)	A large part of area A can be affected, very few consequences for people, the environment and cultural heritage, consequences for vulnerable areas.	No flooding	No flooding	Part of area D1 can be affected, few consequences for people, the environment and cultural heritage and vulnerable areas.
Medium probability (1:100 per year)	A slightly larger area of area A can be affected, very few consequences for people and the environment, few consequences for cultural heritage, consequences for vulnerable areas.	Small part of area B can be affected, consequences for people, vulnerable areas and cultural heritage. Few consequences for the environment.	Large part of area C can be affected, few consequences for people, the environment and vulnerable areas.	Large part of area D1 can be affected, few consequences for people, the environment, cultural heritage and vulnerable areas.
Low probability (1:1000 per year)	A slightly larger area of area A can be affected, very few consequences for people, few consequences for the environment and cultural heritage, consequences for vulnerable areas.	Large part of area B can be affected, serious consequences for people, the environment, cultural heritage and vulnerable areas.	Large part of area C can be affected, serious consequences for people, consequences for the environment, cultural heritage and vulnerable areas.	Large part of area D1 can be affected, few consequences for people, the environment, cultural heritage and vulnerable areas.
Extreme situation (1:10000 per year)	Nearly all of area A can be affected, consequences for people, the environment, cultural heritage and vulnerable areas.	All of area B can be affected, very serious consequences for people, the environment, cultural heritage and vulnerable areas.	the same as situation low probability.	the same as situation low probability.

Table 3 Summary of consequences per type area in the four scenarios. The consequences are compared to each other.

Figure 6 Consequences of flood events in the four scenarios: water depth, potentially affected residents, economic activities and vulnerable areas according to the Water Framework Directive (insofar as situated in the designated areas). Detailed maps are available on www.risicokaart.nl

<table>
<tr><th></th><th>High probability (1:10 per year)</th><th>Medium probability (1:100 per year)</th><th>Low probability (1:1000 per year)</th><th>Exceptional events (1:10,000 per year)</th></tr>
<tr><td>Water depth</td>
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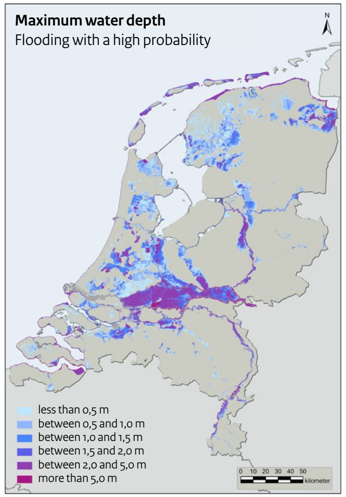
<td> 
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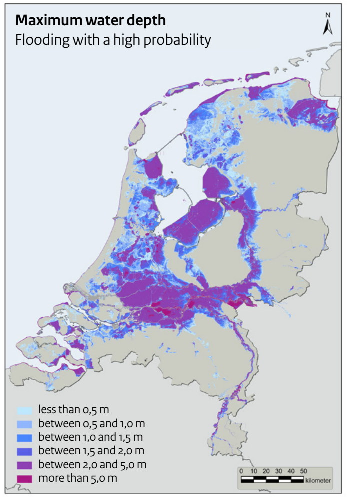
<td> 
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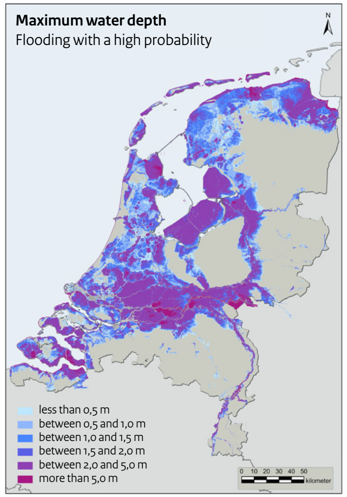
<td> 
</td></tr>
<tr><td>Potentially affected residents</td>
<td> 
</td>
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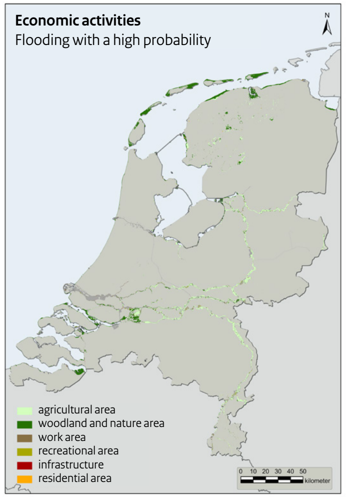
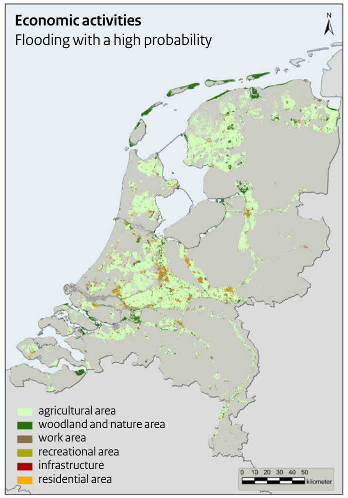
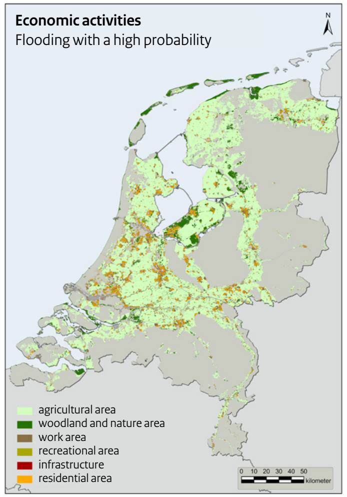
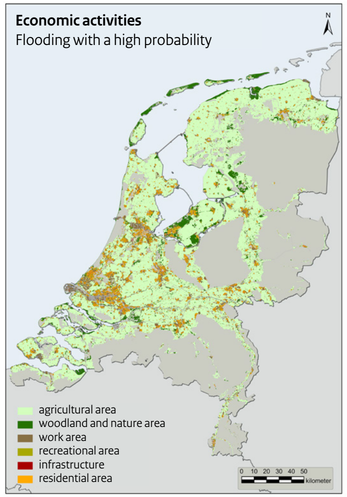
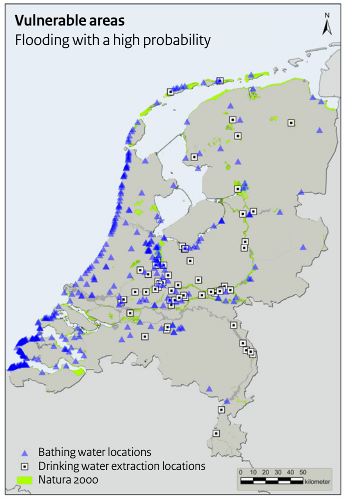
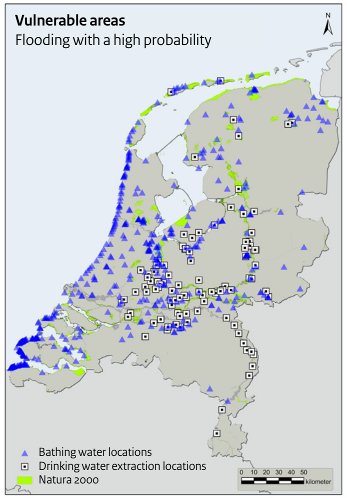
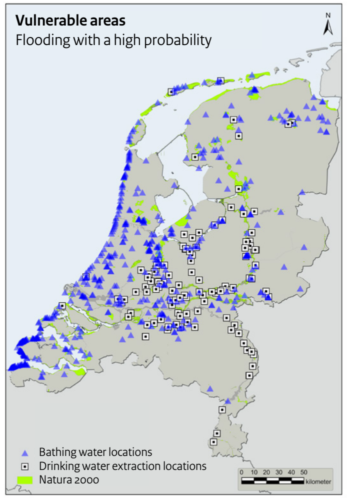
	High probability (1:10 per year)	Medium probability (1:100 per year)	Low probability (1:1000 per year)	Exceptional events (1:10,000 per year)
Economic activities				
Vulnerable areas				

6 Objectives

The Netherlands is striving to achieve sustainable management of the flood risks at a socially acceptable level. This ambition is translated into general objectives for all the designated areas and area-specific objectives per type of designated area.

The objectives in this Flood Risk Management Plan apply to the areas which have been designated due to a potentially significant flood risk: the type A, B, C and D1 areas (see chapter 4). The objectives are not applicable to the type D2 areas where there is no potential significant flood risk (see chapter 4). D2 areas are only designated to promote cross-border coordination (see chapter 9).

6.1 Objectives

Sustainable management as starting point

The Netherlands Water Act describes sustainable management of flood risks as follows: '... prevent and where necessary limit flooding, ... in relation to protection and improvement of the chemical and ecological quality of water systems and the fulfilling of social functions by water systems.' The Netherlands wants to maintain the flood risks at a socially acceptable level. This is democratically established (nationally, regionally and locally), via a dialogue between government authorities, interested parties and organisations.

General objectives

For all designated areas - except for the D2 areas - the following three general objectives apply (the effort required by these objectives may vary per type of area, see chapter 7):

1. The Netherlands is prepared for future developments.
Future developments, such as climate change, changes in spatial organisation and socio-economic and technological developments, affect the flood risks. The Netherlands continues to look far ahead to scenarios for such developments so that it can adjusts goals and measures in time. This objective was also included in the previous plan.

2. In 2050, the Netherlands is climate proof with a water robust organisation.
This objective emerges from the objective "The Netherlands limits the consequences of flooding through choices in spatial planning" from the previous plan. The new formulation is broader and reflects Dutch policy that has been formulated in recent years. Climate-proof and water robust organisation means that the Netherlands knows the vulnerability for flooding and has taken measures to limit the vulnerability as much as possible.

3. The Netherlands is prepared to act adequately in the case of (potential) flooding.

This objective was - in other wording - also part of the previous plan. In the past planning period, no (potential) flooding occurred. Nevertheless, the need remains for well organised crisis management to ensure the most effective and efficient response before, during and after a (potential) flooding emergency.n.

Area-specific objectives

In addition to the general objectives, there are the following area-specific objectives per type of area:

Area A	Limit substantial local damage.
Area B	By 2050, the risk of flood fatalities is less than 1/100,000 a year ("basic protection level").
Area C	By 2032 (or at an earlier moment determined the relevant province), the regional flood defence systems which protect area C will meet the standards. The flood defence systems along state-operated canals will meet the standard set by the Government by 2032.
Area D1	In D1 areas along the Linge, Roer, Gulp, Geul and Geleenbeek, flood risks will be limited as far as possible in the planning period. For Roer, Gulp, Geul and Geleenbeek, the aim is more specific, which is to meet the set standards by 2035.

6.2 Explanation of the process of setting goals and measuring progress

General objective 1: The Netherlands is prepared for future developments

Process of setting goals

Climate change is happening very gradually. The effect in the short term is small, but significant in the long term. Furthermore, the trend is difficult to reverse. Infrastructural measures (such as dyke reinforcements) and spatial developments (like housing) require long preparation and when it comes to implementation, they are almost impossible to change. It is therefore very important to explore the future flood risks as well as possible and align plans to them. The Netherlands wants to be prepared for future developments in flood risk management enshrined with a change in the Water Act. This led to the appointment of a Delta Fund, a Delta Programme Commissioner and an annual Delta Programme (see appendix 2).

Progress measurement

The annual Delta Programme of the Delta Programme Commissioner and De Staat van Ons Water (the annual progress report about water policy) provide insight into the progress of this objective.

General objective 2: In 2050, the Netherlands is climate proof with a water robust organisation

Process of setting goals

In a large part of the Netherlands, the probability of flooding is very low, but the consequences can be very serious. In the past, not enough attention was devoted to the consequences of flooding by spatial developments in general (location choice and organisation) and in particular for vital and vulnerable functions. For that reason, in 2015 the Netherlands established the policy objective that in 2050 the Netherlands will be climate proof with a water robust organisation (delta decision Spatial Adaptation). To achieve that, in 2018 the Delta Plan Spatial Adaptation and the Administrative Agreement Climate Adaptation came into force.

Progress measurement
The annual Delta Programme of the Delta Programme Commissioner and De Staat van Ons Water (the annual progress report about water policy) provide insight into the progress of this objective.

General objective 3: The Netherlands is prepared to act adequately in the case of (potential) flooding.

Process of setting goals
The Dutch partners involved in managing water crises work together in the Management Water Crises and Flooding Steering Committee (SMWO, see appendix 2). The parties drew up a strategic agenda focused on effectively and efficiently managing water crises, within the general Dutch frameworks of crisis management. For (potential) flooding, it is about being prepared to act before, during and after a (potential) flood event. This also includes timely warnings and alerts, taking measures in the water system or in the flood defence systems and promoting the self-reliance of the public and industry.

Progress measurement
The periodic reports of the crisis partners to the SMWO give insight into the progress of this objective. These reports provide overviews of updated crisis plans, exercises and the progress of joint projects, for example. Sections of these reports are included in De Staat van Ons Water (the annual progress report about water policy).

GArea-specific objectives area A: Limit substantial local damage.

Process of setting goals
In area A, the probability of flooding is high. For the area as a whole, the consequences of flooding are fairly limited, particularly in flood events which occur often (once in 10-100 years). Locally, however, substantial damage can occur. It is important to limit subsequent damage in such locations with a tailored approach.

The goal for this area requires a consideration between two aspects of flood risk management. To limit the flood risk in area B, it is essential that area A is optimally available to capture high water (a responsibility of the Government). For area A, there are therefore no statutory protection levels in the Water Act. That imposes limitations on the possibility for area A to restrict the flood risks itself. The general goals 2 and 3, focused on a water robust organisation and crisis management, also apply to area A. Municipalities also have a responsibility to inform residents and other users of area A about the flood risks, so that they can take measures themselves. In addition, it can be desirable to locally limit substantial damage by flooding. Provinces and municipalities can do that by setting standards and rules for built-up areas and the organisation of area A, based on their discretionary authority. Whether and how this goal for area A is exactly implemented can therefore vary in each province and municipality.

Progress measurement
At the end of the planning period, it is known how many of the measures have been implemented to achieve this goal.

Area-specific objective area B: By 2050, the risk of flood fatalities is less than 1/100,000 a year ("basic protection level").

Process of setting goals
Around the turn of the century, the Netherlands wanted to revise the water safety policy. The standards aimed at protecting area B from flooding still dated from the 1950s and no longer reflected the current circumstances: many more people now live there and the economic value which needs to be protected is much greater. In 2014, the Delta Programme Commissioner advised the Dutch government. The key was to establish a basic protection level derived from the limiting value that the Netherlands applies for external safety risks. That limiting value is 1:1,000,000 per year. This value applies for risks caused by people, such as risks relating to chemical plants and LPG stations. Such risks are subject to fairly stringent requirements. A social cost-benefit analysis revealed that refining the fatality risk of flooding to 1:1,000,000 per year was not in proportion to the achieved reduction of the flooding risk (casualties and damage). The Delta Programme Commissioner therefore advised a value which is a factor 10 higher: 1:100,000 per year. This advice was issued after an intensive participation programme with all government authorities responsible for managing flood risks. The government accepted the advice.

Progress measurement
The progress of the objective for area B is measured in relation to the probability of death due to a flood event in 2020 as shown in Figure 7 In the water safety portal, the Netherlands uses various indicators to show whether the objective is being achieved.

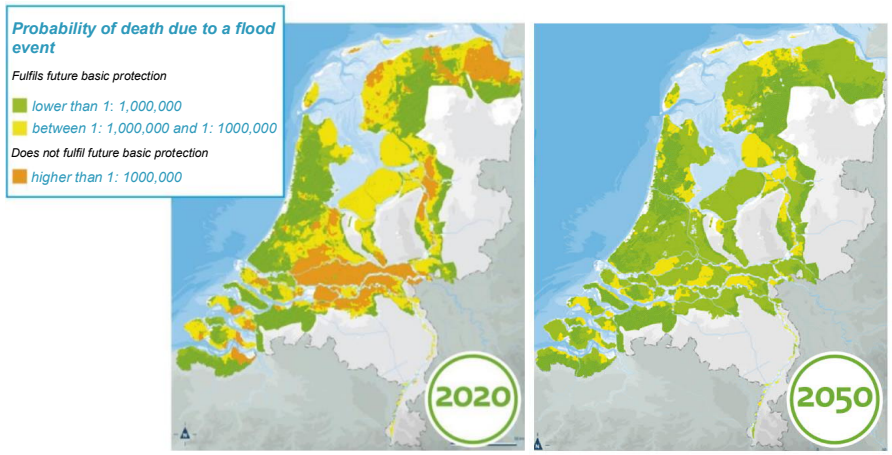


Figure 7 Annual probability of an individual dying as a result of a flood in 2020. Source: Delta Programme 2015

Area-specific objective area C:

1. By 2032 (or at an earlier moment determined the relevant province), the regional flood defence systems which protect area C will meet the standards.
2. The flood defence systems along state-operated canals will meet the standard set by the Government by 2032.

Process of setting goals

Area C may flood if the protecting non-primary flood defence systems are breached. These flood defence systems can be divided into two categories: regional flood defence systems and flood defence systems along state-operated canals. The provinces are authorised by the Water Act to designate and standardise the first category. The second category is the responsibility of the Government.

Regional flood defence systems

In the Development Programme Regional Flood Defences, provinces and water boards have drawn up guidelines for standardising regional flood defence systems along river outlets, regional rivers and compartmentalised flood defences. The standards for these regional flood defence systems are derived from the economic damage, the social disruption and possible damage to the water system caused by a breach of these flood defence systems, taking the spatial developments in the flooded area into account. Different standards may apply to different parts of a flood defence system. The greater the expected consequences of a flood event, the more stringent the standard. Casualties are often not considered here because a flood event in this area progresses relatively slowly and water depth remains limited.* Some low-lying polders in the western Netherlands can flood quickly, however, with higher water levels, but here too the probability of casualties is small.

Every province is free to choose whether they designate and standardise their regional flood defence systems according to these guidelines or take a different (political) decision about the desired safety level. The province records the chosen safety levels in the provincial ordinances and any associated implementing decrees.

The date of the objective to ensure that regional defence systems which protect area C meet the standard is now 2032 at the latest (or at an earlier time established by the relevant province). As a result of assessments of the regional flood defence systems in the planning period, new spatial developments and possible new standardisation systems and new knowledge, the situation may arise that regional flood defence systems do not meet the standard in 2032. In that case, these flood defence systems will meet the standard at a moment decided by the province.

Vision regional flood defence systems

In 2004, the provinces and water boards drafted a vision of regional flood defence systems. The vision was updated in 2016, whereby the joint task for the period up to 2026 was formulated. The task is mainly to optimally protect and manage the regional flood defence systems in an environment which is spatially and socially developing. The aim is to generate an integral approach to the regional flood defence system and the surroundings. In the coming years, the provinces and water boards will further explore whether the new water safety policy chosen for the primary flood defence systems (including standards in the form of flood probabilities) can also be applied to regional flood defence systems. They will also study whether the duty of care for regional flood defence systems can be implemented in the same way as the duty of care for primary flood defence systems. In doing so, they will consider regional differences and the great diversity of regional flood defence systems.

* STOWA-report 20-07 The Safety approach to regional flood defence systems

Flood defence systems along state-operated canals
The total length of the flood defence systems along state-operated canals is 530 km. For the standardisation of these flood defence systems, the Government looked at the standardisation method used by the provinces for regional flood defence systems. Most of the standards for these flood defence systems were established on 1 January 2017 with the amendment of the Water Act and for some flood defence systems with the amendment of the Water Decree of 1 June 2018.

Progress measurement
The progress of the objectives for area C can be derived from the periodic reports by the individual provinces and Rijkswaterstaat. This states how many kilometres or what percentage of the standardises flood defence systems meet the standard and what length of the flood defence systems have been improved. For the regional flood defence systems, the water boards update how many kilometres have been assessed and improved in the benchmark of regional water authorities

Area-specific objective area D1: In D1 areas along the Linge, Roer, Gulp, Geul and Geleenbeek, flood risks will be limited as far as possible in the planning period. For Roer, Gulp, Geul and Geleenbeek, the aim is more specific, which is to meet the set standards by 2035.

Process of setting goals
Area D consists of unprotected areas along regional waters: outlet waterways, streams and small rivers. The probability of flooding is high here, the consequences relatively small. The provinces set frameworks and standards to manage the risks of flooding from these regional waters.

The Linge is a small lowland river in the area between the dykes along the Nederrijn-Lek and the Waal. Along the Linge, there are flood plains and flood defence systems. The flood plains regularly flood. They have the function of draining the river water, but also for housing and industry. Measures which limit the flood risk in this area may negatively affect the storage and drainage capacity of the river and lead to bigger potential risks at other locations. In the flood risk management, it is important to constantly consider the various functions of the area.

Due to their profile and location in a hilly area, the Roer, Geul, Gulp and Geleenbeek can cause flooding with significant consequences, particularly where the river valley is built up. The Province of Limburg has set standards to manage the flood risks along these streams and recorded this standardisation on a map. Where this standardisation is not fulfilled, measures are taken. The Province and water board have agreed that the Limburg D1 area will fulfil this standard by 2035.

Progress measurement
To measure the progress of the objective for area D1, at the end of the planning period an overview of the implemented studies and measures was drawn up, based on information from the water boards Waterschap Rivierenland (Linge) and Waterschap Limburg (Roer, Geul, Gulp and Geleenbeek).

7 Measures

This chapter summarises the measures which the Netherlands is taking in the planning period of this Flood Risk Management Plan to achieve the flood risk management objectives. The chapter addresses consecutively the measures for the general objectives and the area-specific objectives.

In total, 34 measures are planned for the 8 objectives. The set of goals and measures in this second Flood Risk Management Plan is the further development of the 7 goals and 17 measures from the first Flood Risk Management Plan. The measures in the Flood Risk Management Plan are limited to the designated areas, as prescribed by the directive. However, that does not mean that the Netherlands is not taking measures in the non-designated areas to manage flood risks.

Prevention, protection and alertness

The Floods Directive requires member states to devote attention in the Flood Risk Management Plans to prevention, protection and alertness. The Netherlands has a multi-layer safety approach with three layers which correspond with the definitions from the Directive::

Council Directive	Netherlands	Description
protection	layer 1	limit probability of a flood event with dykes, dunes, dams and other flood defence systems, and measures aimed at reducing water levels like river widening and retention and runoff areas
prevention	layer 2	limit the consequences of a flood event by spatial organisation
alertness	layer 3	limit the consequences of a flood event by constantly being alert through adequate crisis management and recovery

Table 4 Multi-layer safety and the definitions from the Floods Directive

The accent of the measures shifts per type of designated area. Areas A and D are not protected by primary or regional flood defence systems. These areas are usually needed to capture high water levels. Measures aimed at achieving the goals for these areas mainly consist of limiting the consequences of flooding (layers 2 and 3). For the areas B and C, the emphasis is on limiting the probability of a flood event (layer 1). From the study 'Matter of fact look at multi-layer safety*, it appears that in area B, protection is nearly always the most efficient way to limit flood risks, because there is already a good flood defence system. A water robust and climate adaptive spatial organisation (layer 2) and being prepared for crisis management (layer 3) are relevant in all four areas.

Priorities

All measures in this Flood Risk Management Plan are necessary to achieve the goals. The measures included have extremely high or high priority: there are no measures with low priority. Measures with top priority are those which set frameworks for other measures for management, measures which prevent the flood risk growing and measures which reduce flood risk.

* Advice from Expertise Network Flood risk management, November 2012

7.1 Measures for the general objectives

The general objectives apply to all areas with a potential significant flood risk (see also chapter 6).

General goal 1: Be prepared for future developments

Measure 1 has top priority for this goal because in implementation programmes this measure makes flood risk management future proof.

Measure 1: Every year, draft and implement a long-term Delta Programme

In recent years, the Netherlands has chosen a pro-active approach in the flood risk management: adaptive delta management. The key to adaptive delta management is looking far ahead (until 2050-2100), taking the uncertainties into account and on that basis, taking the measures that are now necessary. Based on this idea, the Netherlands Delta Programme Commissioner draws up an annual Delta Programme with measures for the coming years. The Delta Programme contains implementation programmes for water safety, freshwater and spatial adaptation.

The aim is to make flood risk management more future proof - taking climate change and socio-economic developments into account - and taking the necessary measures in good time. The Government has reserved funds for this in the Delta Fund. The Delta Programme provides the statutory framework for the Delta Programme, the Delta Programme Commissioner and the Delta Fund.

As a specific part of the Delta Programme, the Government devotes extra attention to the flood risk of vital and vulnerable functions of national importance. National vital and vulnerable functions include drinking water supply, main road network, electricity supply, healthcare and ICT & telecom. With respect to national vital and vulnerable functions, besides the risk of casualties, there are also possible evacuation problems, chain effects and economic or environmental damage if important functions cannot operate for a long time. In the revision of the Delta Programme 2021, it was established that the vulnerability of nationally vital and vulnerable functions should not only be viewed with respect to flooding, but also for excess water, drought and heat. Together, government departments and the managers of these functions ensure that the national vital and vulnerable functions are better protected by 2050. Vulnerability analyses will be conducted by the end of 2021 and at the end of 2023, a realistic ambition must be formulated and adopted in policy and monitoring or in another appropriate form.

Measure 2: Delta Decisions and preferential strategies will be revised every six years

Part of adaptive delta management is to regularly adjust the measures if required due to new insights. This is done by revising the delta decisions and preferential strategies of the Delta Programme every six years based on three questions: is the implementation still on schedule, should the course be adjusted and is the approach integrated and participative? Signal groups - with representatives from knowledge institutions, universities and the government - indicate whether there are any new developments which may affect the course.

Based on the revision, the Delta Programme Commissioner makes proposals to the Minister to adjust the policy (including the policy for flood risk management). If the Minister adopts the proposals, they are enshrined in national policy plans. The regional and local governments enshrine their contribution in their own policy plans.

In the planning period, the proposals of the Delta Programme Commissioner for the first revision are adopted in policy plans. In 2026, the second revision takes place.

Measure 3: Implement knowledge programme relating to rising sea levels

There are signs that sea levels will rise faster in the second half of this century than expected. To be able to take timely measures, in 2020 the Minister for Infrastructure and Water Management and the Delta Programme Commissioner launched the Knowledge Programme Rising Sea Level. This programme has five tracks:

- the consequences of developments in Antarctica for rising sea levels
- the relevance of the Delta Decisions and strategies
- warning system for rising sea levels (climate change)
- action perspectives for the long term (after 2100)
- implementation strategy (communication, participation, behavioural change and transition management)

In the planning period, the initial results will become available, so that they can be used in the revision in 2026 (see measure 2).

Measure 4: Draw up Programme Integral River Management

In the catchment area of the Rhine and the Meuse, there are various challenges, including for water safety, navigability, water quality and nature, water availability, spatial and economic development. Due to climate change (more drainage and longer dry periods) and uneven, large-scale soil changes (such as erosion of the summer bed), some challenges are growing and new challenges are emerging.

For that reason, the Government and the region are working on an integrated approach at river system level in the Integrated River Management programme (IRM). Here they look ahead at the developments up to 2050, and further to 2100. In the planning period, IRM produces the following results:

- perspective on the rivers: the expected developments and resulting challenges
- new policy to retain and expand the drainage capacity and for soil exposure
- approach to identify and consider the challenges for the catchment area
- a programme of measures to tackle the challenges
- proposals for financing arrangements and covering the costs
- advice for the organisation for the implementation phase.

Measure 5: Update KNMI scenarios

In the Netherlands, the climate scenarios of the Netherlands KNMI (Royal Netherlands Meteorological Institute) are the basis for the measures and the course in the Delta Programme (see measure 1). The KNMI scenarios are the Dutch elaboration of the scenarios which the Intergovernmental Panel on Climate Change (IPCC) issues. In 2021, the 6th IPCC report is expected to be published with updated climate scenarios. In the planning period, the Minister for Infrastructure and Water Management will instruct the KNMI to update the KNMI scenarios accordingly. The climate scenarios include climate parameters which affect the flood risks, such as the rise of sea levels, rainfall intensity and rainfall patterns. The Netherlands will also use the new climate scenarios for the next Flood Risk Management Plan to assess whether intense rainfall constitutes a significant flood risk (see also chapter 3).

General goal 2: In 2050, the Netherlands is climate proof with a water robust organisation

Measure 1 has top priority for this goal because this measure provides the framework for the implementation of measures to make the Netherlands climate proof and water robust. Measure 2 is an instrument which can contribute to this..

Measure 1: Implement Delta Decision on Spatial Adaptation

The Netherlands has recorded national ambitions and objectives in the Delta Plan Spatial Adaptation (DPRA) to ensure that the Netherlands is climate proof and water robust in 2050. Climate-proof and water robust means: reduce the vulnerability for water problems, the consequences of flooding, heat and drought. For this Flood Risk Management Plan, excess water and the consequences of flooding are relevant. The DPRA is a joint plan by municipalities, water boards, provinces and the Government.

To reduce the vulnerability, the governments implement the following cycle for their area at least every six years (for more information, see www.ruimtelijkeadaptatie.nl):

1. conduct stress test analyse vulnerabilities
2. conduct risk dialogues talk to all parties involved about the risks and the measures to reduce the risks
3. draw up implementation agenda: agree on measures and who is responsible for what

At the end of 2023, the Government formulates a realistic ambition for the national vital and vulnerable functions, based on stress tests. The ambition is adopted in policy and monitoring or in another appropriate form.

All government authorities incorporate climate proof and water robust measures in their policy and act accordingly, so that it is part of all the activities in spatial organisation (by 2021 in the provincial environmental visions, by 2024 in municipal environmental visions).

Measure 2: Strengthen, extend and apply water assessment

Government authorities are legally obliged to conduct prior consultation about water aspects (including flood risks) when drafting zoning plans, embedding plans and project decisions*. This prior consultation is called the water assessment. The results are included in the so-called water paragraph of the plan and are safeguarded in rules.

Where necessary, provinces set additional conditions to the application of the water assessment for zoning plans, such as the obligation to include a paragraph about flood risks in the zoning plan or to consider flooding when assessing a zoning plan. Water boards can also give their own accent to the water assessment. Government bodies are obliged to take landscape values, nature and cultural historic values into account.

The Netherlands strengthens the water assessment process in the planning period, by including an instruction line in the Environmental quality decree (under the Environment and Planning Act): when adopting environmental plans, the municipalities must take water interests into account. Under the Environment and Planning Act, the water assessment is required for more decisions: also in the case of an environmental ordinance (if the province sets rules about location functions), a project decision by a water board, province or the Government and an environmental permit for an environmental plan activity. The Environmental quality decree will also include instruction rules for the protection of primary flood defence systems and the preservation of water safety of the coast and the big rivers. The strengthening and widening of the water assessment depend on the implementation of the Environment and Planning Act.

General goal 3: The Netherlands is prepared to act adequately in the case of (potential) flooding

For this goal, the Steering committee Management Water Crisis and Flooding (SMWO) plays a crucial role. In this committee, all the Dutch organisations involved in the management of water crises at political level work together, among others to prepare for (potential) flood events. The Minister for Justice and Security plays a coordinating role in tackling disasters and crisis management. He is responsible for the organising, functioning, cohesion and integrated approach of the crisis management policy and the associated system.

Crucial to the joint implementation is the Netherlands Water Management Centre (WMCN) in which the KNMI, the water boards, Rijkswaterstaat and the Ministry of Defence work together on national water news updates and coordination in the case of water crises (see appendix 2). To be prepared for vigorous and effective action before, during and after a (potential) flood event, the partners each work individually and jointly on measures. Most measures are cyclical in nature (Plan-Do-Check-Act). Measure 1 has top priority for this goal because this measure provides the framework for the adequate action in the case of (potential) flood events

Measure 1: Update crisis and contingency plans

The crisis plans describe the tasks, responsibilities and authorisations of the organisations involved, the action required in the case of calamities in water systems and the measures to manage the calamities. The plans are periodically (usually once every four years) adjusted based on the latest insights. There are crisis plans at national and regional level:

- At national level: the generic National Crisis Decision-making Manual, the National Crisis Plan High Water and Flooding (NCPHO) and the National Scenario High Water and Flooding.
- At regional level:
  - the regional crisis plan for the safety regions. This lays the basis for the organisation of the crisis management for the risks present in the region. This is based on a risk profile in which the risk of flooding is established. In the resulting policy plan, the governing body of a safety region sets the priorities of the crisis preparation.
  - the contingency plans of water boards and Rijkswaterstaat for flood situations.

In the planning period, the safety regions and their partners use impact analyses to better analyse the possible consequences of flooding and then adopt action perspectives. A national action plan is also drafted. With this, the crisis partners improve the national and regional crisis plans for the periodical adjustment. Tools are provided to give more attention to recovery actions after a flood event in the plans. In addition, further work is done on strengthening the collaboration between the national level and the safety regions, including support from Defence. The collaboration is processed in the national and regional plans.

* Spatial Planning Act, article 3.1.6

Measure 2: Timely flood warning

In high water and storm flood situations, the water managers and the safety regions issue timely warnings and implement operational measures in the water system or flood defence systems.

- The Netherlands Water Management Centre (WMCN) monitors the water levels in the big rivers, the delta, the IJsselmeer and the coastal zone. The WMCN publishes expectations for these water systems and warns the crisis partners about flood situations. Information is also shared with neighbouring countries.
- In the case of a superregional high water situation, the National Coordination Flood Threat Committee (LCO, part of WMCN) issues a national picture and advises national and regional partners about measures.
- Water boards and Rijkswaterstaat draw up water level expectations for the region, provide information and give warnings about potential flooding. They also take the necessary operational measures.

In the planning period, these parties work on improving the water level expectations (expected timeframe and accuracy) so that crisis partners and those involved can act sooner based on the expectation values and the associated uncertainty margin.

Measure 3: Education, Training and Exercises

These activities of the crisis organisation contribute to preparations for crisis situations. Besides educating and training officials, these also include exercises: small-scale exercises and large exercises involving many parties (sometimes also members of the public and businesses):

- Safety regions draw up an exercise policy plan and an exercise year plan.
- Water boards and Rijkswaterstaat test the measures in their contingency plans and take part in exercises with other government layers.

The experiences are used to improve the crisis and contingency plans. The SMWO gives an overview of all joint multi-exercises in a national exercise calendar. To support civil crisis partners, as structural chain partner Defence is involved in many of these exercises.
In the planning period, in the framework of the Living Lab Hedwige-Prosperpolder, crisis exercises take place with EU subsidy in which crisis partners can also share knowledge in an international context.

Measure 4: Promote water awareness and cooperation

In a water crisis, the public and businesses must also act to prevent damage and casualties. For that reason, water awareness and cooperation are promoted among the public and businesses:

- • The Government and the regional water managers inform the public and businesses about various water aspects, including flooding, among others via a www.onswater.nl.
- • Governments actively communicate about water risks, among others via www.risicokaart.nl and www.overstroomik.nl (with information about flood probability at postcode level and action perspectives). In the crisis communication, NL-alert can be used. Safety regions inform the public and businesses about the possible (flood) dangers and action perspectives in their region. In doing so, they use the tool 'cooperation in flood events'.

In the planning period, the crisis partners use these instruments to strengthen public communication.

Measure 5: Knowledge development and cooperation

Because the Netherlands is relatively well protected from flooding, limited up to date experience knowledge is available. The crisis organisations ensure a good knowledge level by sharing and developing knowledge.

- Water managers work together and share their knowledge in the Netherlands Water Management Centre (WMCN). In the Crisis Expertise Flood Defence Systems Partnership (part of WMCN), water managers, safety regions and the Ministry of Defence share practical knowledge about work on flood defence systems in crisis circumstances.
- Nationally collected flood scenarios are shared with professionals. in the Wiki-Emergency measures, the crisis partners update an overview of possible (emergency) measures for high water situations and flood events.

In the planning period, a study is taking place into the organisation of a facility to combine all knowledge about flood risks (the National facility flood information). Via the international river committees and exchange visits, knowledge is shared with other countries.

During a flood crisis, crisis partners must work closely together. The strategic agenda SMWO is an important basis for the cooperation. In 2021, the agenda is updated with the elaboration of joint goals for 2030.

7.2 Measures for area-specific objectives area A

For area A, the following area-specific objective has been formulated:
Limit substantial local damage.

The measure for this goal relates to prevention (layer 2): limit the consequences of a flood event. Protection (layer 1) is generally not an option in this area. Area A is part of the river (riverbed/ flood plain), the big lakes (bank zone) and the sea (coastal zone). This area - apart from local exceptions - must be able to flood regularly: it forms a buffer for storing large river discharges and damming water due to storm. The measures for alertness (layer 3) emerge from the general objectives (see Measures for the general objectives) are implemented in an area-specific way for area A. The two measures for achieving the area-specific goal both have top priority.

Measure 1: Set local standards and rules to limit substantial flood damage

Provinces and municipalities locally limit the damage by flooding in area A by setting standards and rules for built-up areas and the organisation. Every province and municipality do that in a customised way, based on their discretionary authority. For example, provinces and municipalities can impose demands on new building or the expansion of existing built-up area and infrastructure in area A to limit substantial damage caused by flooding. Examples include elevated or floating building, building in the lee, building vertically, locate valuable designs and installations higher in buildings and make structures dismantlable and movable.

Measure 2: Inform users of area A about the flood risks

In the area outside the dykes, the inhabitants and other users are responsible for any damage caused by flooding. Municipalities are responsible for assessing the safety situation in area A and informing the users accordingly. This enables users to take measures themselves as they see fit to limit damage. .

7.3 Measures for area-specific objectives area B

For area B, the following area-specific objective has been formulated:
By 2050, the risk of flood fatalities is less than 1:100,000 a year ("basic protection level") in 2050.

The measures for this objective all relate to protection (layer 1): limit the consequences of a flood event. This is mainly done by maintaining flood defence systems with cyclic activities: designate and standardise, assess, strengthen and maintain. The measures for prevention (layer 2) and alertness (layer 3) emerge from the general objectives (see Measures for the general objectives). Measures 3 through 7 have top priority because these measures reduce the flood risk or prevent the flood risk increasing.

Measure 1: Assess the condition of the primary flood defence

In 2017, new standards for flood defence systems were adopted in the Water Act. The standards apply to the primary flood defence systems which protect area B from flooding. They are expressed in a maximum acceptable flood probability per dyke trajectory. The standards (lower threshold) are divided into nine categories from 1:100 to 1:1,000,000 per year*.

The level of the standard depends on the values to be protected and the costs of improving the flood defence system. The standards are derived from the objective for area B, which takes evacuation options, economic effectiveness and the group risk into account. If many people live in an area that could flood entirely (group risk), the standard is raised a category.

The water boards and Rijkswaterstaat assess the state of the primary flood defence in 12-year cycles. They then determine whether the flood defence systems meet the standard. The rules for determining the hydraulic load and assessing the strength of the flood defence system are established in a Ministerial regulation. The final date of the current assessment round is 31 December 2022. In the planning period, the new assessment tools will be ready for the second national assessment round which starts in 2023.

The water boards and Rijkswaterstaat report to the Minister for Infrastructure and Water Management about the condition of the primary flood defence by 1 January 2023. In addition, Rijkswaterstaat will report to the Minister for Infrastructure and Water Management by 1 January 2023 about the extent to which changes in the riverbed affect the hydraulic load on the flood defences along the big rivers. The Minister reports to the Senate and the House of Representatives by 1 January 2024 about the national situation of the assessment.

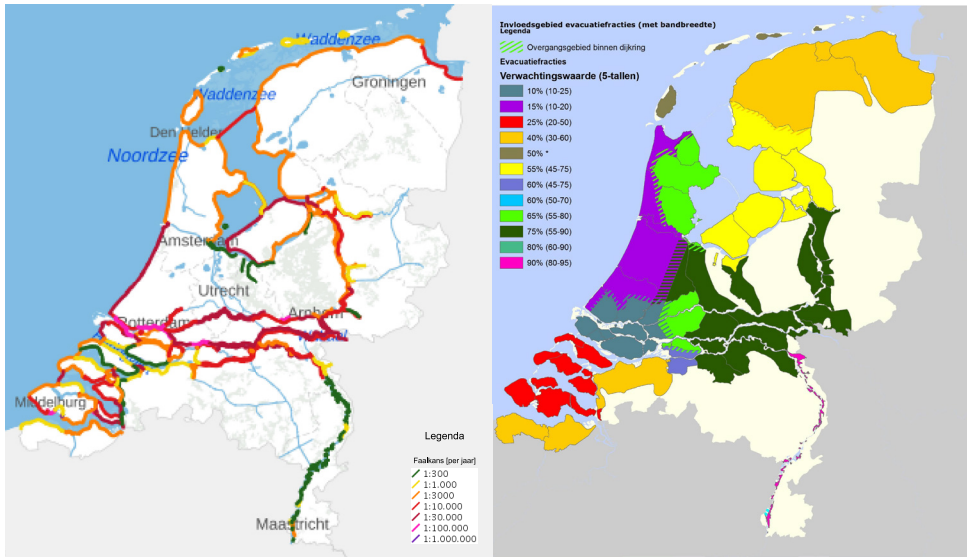


Figure 8 Maximum acceptable flood probability of dyke trajectories (left) and evacuation fractions which are used to establish the standards (right)

* The Diefdijk is a compartmentalised dyke. A different standard applies here: in the case of a flood event, if water reaches the Diefdijk, the probability of a breach of the dyke must not be greater than 1/10.

Measure 2: Evaluate the standards for primary flood defence systems

By 31 December 2024 at the latest, the Minister for Infrastructure and Water Management reports to the Senate and the House of Representatives about the effectiveness and impact of the new water safety policy and the standards for the primary flood defence systems.

Measure 3: Update primary flood defence systems

If the assessment shows that a flood defence system does not meet the standard, measures are taken to ensure that the flood defence will meet the standard. The primary flood defence systems which need improving are recorded in the national High Water Protection Programme (HWBP) (see Appendix 4). The water boards and Rijkswaterstaat establish a continually rolling programme for a period of twelve years. Flood defence systems which deviate most from the standard are given top priority. The priorities are adapted if certain projects would be better done earlier or later to combine them with other projects or measures, such as water quality measures. In the period 2021-2031, an average 50 km dyke reinforcement is completed per year. in the years up to 2024 inclusive, this will be less and in the remaining years more. For the design, management and maintenance of primary flood defence systems, the Minister for Infrastructure and Water Management makes technical guidelines available. In the design of primary flood defence reinforcements, the water boards and Rijkswaterstaat consider future water levels which are expected to be higher due to climate change.

Financing dyke reinforcements

Improving the primary flood defence systems managed by a water board are funded based on co-funding with the Government from the Dijkrekening (Dike Fund). The water boards jointly contribute 40%, the Government 50% and the relevant water board 10% to a dyke reinforcement project. The reinforcement of flood defence systems managed by Rijkswaterstaat is funded 100% by the Government, outside the Dike Fund.

The standards must be met in 2050. In certain cases, for example where dyke reinforcement is expensive, the goal may be achieved with different measures: with measures in layers 2 and 3 or in combination with those.

Measure 4: Maintain primary flood defence systems

Rijkswaterstaat and the water boards keep an overview of the minimum required features of the flood defence systems, such as position, shape and dimensions of the structure and the associated protection zones. This overview is incorporated in the ledger.

The managers regularly inspect whether the flood defences still meet the requirements from the ledger. They ensure the flood defences are satisfactory by regularly performing maintenance work, such as mowing the grass slopes and repairing any damage. Structures are also regularly inspected and maintained, and test closures take place at set times. To ensure that dyke reinforcements are possible in the future, in response to climate change for example, the managers reserve space in the ledger (the 'structure gauge'). Part of the maintenance is also the protection of movable flood defences from cyberattacks.

With the system of permits and enforcement, Rijkswaterstaat and the water boards prevent that activities from taking place or objects being built in the waterworks structures, the protection zones and 'the structure gauge' which negatively affect the flood defence function or its maintenance. For this, there are regulations and policy rules which are elaborated in permit requirements.

Measure 5: Preserve the drainage and storage capacity of the big rivers

Rijkswaterstaat ensures that the big rivers have sufficient space for the storage and drainage of water. This prevents water being pushed up and overloading the flood defence systems. The Vegetation Ledger records what type of plants are allowed in the flood plains to ensure sufficient flow of water. Rijkswaterstaat maintains the space in the riverbed with permits for using the flood plains, based on the Policy Line big rivers. This policy line only allows new developments in flood plains for certain activities and under conditions, to prevent losing space for storage and drainage of water.

Measure 6: Lower the high-water levels of the big

River widening leads to lower water levels, reducing the risk of flooding. River widening can be a (partial) alternative for dyke reinforcement. In the planning period, several widening measures from Delta Plan on Flood Risk Management are being prepared or carried out. Measures include removing obstacles, dyke repositioning, lowering of groynes, digging additional channels and creating retention areas or flood channels. River widening is usually part of an area development focused on different functions.

Measure 7: Maintain the coastal foundation

Along the coast, Rijkswaterstaat and the water boards maintain a sufficiently large buffer of sand, the so-called coastal foundation (the zone from the dunes to the isobath at NAP-20m). That is important to maintain the hydraulic condition of the flood defence systems along the coast. To prevent the coastline moving inland, sand suppletion is regularly performed (around 12 million m3 per year). Every year, Rijkswaterstaat measures the position of the coastline. Based on the result, it establishes the required sand suppletion in the coming four years, in consultation with the provinces, water boards, municipalities and national nature organisations (Coastal Maintenance Programme). The required sand suppletion is recorded in the Coastline Care Implementation Programme. The provinces enforce the zoning which is established as part of the Coastal Pact to guarantee continued sand transport in the coastal zone.

Just like for the rivers, a policy line also applies for the use of the coastal zone (Policy Line Coast). Part of this is that structures along the coast may not negatively influence the sand transport. As managers of the flood defence system, the water boards are responsible for the daily maintenance of the sandy primary flood defence systems along the coast. By means of a system of permits and enforcement, the flood defence managers can impose requirements on owners of beach pavilions, for example, to prevent them negatively influencing the safety of the flood defence system.

Measure 8: Reserve space for the long term

In the river area, the Netherlands has designated several locations which may be available in the longer term to accommodate bigger river discharges (see Figure 9). These areas are now in area B. If it is decided to use a reserved area for river drainage, it will become part of area A. During the term of the reservation, no large-scale or capital-intensive spatial developments are allowed in these areas. The reserved areas are revised in the Integrated River Management programme

Figure 9 Reserved areas along the big rivers

Primary flood defence system Limburg: riverbed status

For most river trajectories, the primary flood defence systems form the border between area A (unprotected) and area B (protected). In Limburg, area A largely corresponds with the natural riverbed of the Meuse. The border of this area is partially formed by primary flood defence systems and partially by higher grounds. The primary flood defence systems, particularly those created after the high water of 1995, have reduced the riverbed's water storage capacity. This leads locally and downstream on the diked Meuse to a limited increase in water level. The new dykes constructed after 1995 are nearly all located within the former and current boundary of the winter bed. As such, the Policy Line Big Rivers still applies inside the dykes.

To compensate the higher water level on the diked river Meuse, the dykes along the Limburg Maasvallei needed to be flooded from a certain water level. The Government therefore sets conditions on the admissibility and location of new (construction) activities (Policy Line Big Rivers).

In the Water Letter of 20 November 2017, the Minister announced the wish to abandon the requirement to flood the dykes in the Limburg Maasvallei. This idea comes from the National Water Plan. That means that the increase in the water level on the diked river Meuse must be compensated in a different way. Measures are now being taken for this: at 12 locations which make an important contribution to the drainage and storage of water from the river Meuse, the current dyke is being repositioned or retention measures are being taken (system operational measures).

Since 2017, new standards have applied for all primary flood defence systems, also along the Maasvallei. In the Water Letter of 18 June 2020, the Minister stated that once a dyke fulfils the new standard, the neighbouring inner dyke area will no longer need to be able to flood to compensate for a water level increase elsewhere. At that time, the riverbed status for the relevant area also ends.

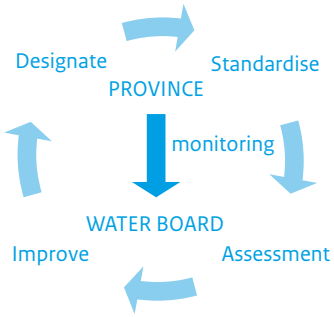
In principle, the section of the flood defence systems in Limburg that does not yet meet the new standards will be raised or improved by 2050. In the planning period of this Flood Risk Management Plan, decisions will be taken about several system operational measures.

7.4 Measures for area-specific objectives area C

Regional flood defence systems

For area C, the following area-specific objective has been formulated for regional flood defence systems: By 2032 (or at an earlier moment determined the relevant province), the regional flood defence systems which protect area C will meet the standards.

The measures for this objective all relate to protection (layer 1): limit the consequences of a flood event. This is mainly done by maintaining flood defence systems with cyclic activities: designate and standardise, assess, improve and maintain see Figure 10). The measures for prevention (layer 2) and alertness (layer 3) emerge from the general objectives (see Measures for the general objectives). Measures 3 and 4 have top priority because these measures reduce the flood risk or prevent the flood risk increasing.



Source: Audit office Eastern Netherlands

Figure 10 Cycle for maintaining the regional flood defence systems with role distribution

Measure 1: Evaluate and revise the designation and standardisation of regional flood defence systems

Provinces designate regional flood defence systems and set the standards after consultation with the water boards. The designation and standardisation depend on the consequences that a flood event can cause if these flood defences are breached. If the consequences change - for example due to climate change or spatial developments - the province will update the designation and standardisation to prevent the flood risk increasing in the hinterland. This can lead to local amendments in the planning period.

In the period up to 2024, a review of the safety approach for the regional flood defence systems will be conducted. In the long term, this may lead to new or amended safety standards.

Measure 2: Assess the state of the regional flood defence systems

The water boards regularly assess whether the flood defence systems along the regional waters still meet the standards. The relevant province establishes how often this happens. The frequency varies between five and twelve years. The provinces also establish the instruments for the assessment of the regional flood defence systems (requirements for the assessment and hydraulic preconditions).

Measure 3: Update regional flood defence systems

Based on the report about the assessment of regional flood defence systems, the water boards indicate which measures are required to ensure that the flood defence system meets the standards. In general, the measure will consist of reinforcing the flood defence system. Measures in the regional water system, such as creating storage areas or increasing the drainage function, may be an alternative. Appendix 5 gives the planning for the necessary measures.

Measure 4: Maintain primary flood defence systems

The water boards have recorded the minimum required features of the flood defence systems (such as position, shape and dimensions of the structure and the associated protection zones) in a ledger. Several times a year, the managers inspect the condition of the flood defence systems and perform maintenance work, such as mowing the grass slopes and repair. Structures are also regularly inspected and maintained, and test closures take place at set times. In dry periods, the water boards inspect the (drought-sensitive) jetties, particularly for cracks and subsidence.

In the future, dyke reinforcements may be possible, for example due to climate change. The managers ensure that is possible at acceptable costs by reserving space in the ledger (the 'structure gauge').

With the system of permits and enforcement, the water boards prevent that activities taking place or objects being built in the waterworks structures, the protection zones and 'the structure gauge' which negatively affect the flood defence function or its maintenance. For this, there are regulations and policy rules which are elaborated in permit requirements

Measure 5: Maintain or update drainage and storage capacity regional waters

The water boards update the storage and drainage capacity of the regional waters by dredging, mowing and maintaining storage areas. They also regulate the water level in the regional waters. This prevents the flood defence systems being too overloaded by high water levels.

Water boards can ban pumping to prevent the water level in the outlets becoming too high. When pumping is stopped, water from one or more polders is no longer pumped to the channels, reducing the stress on the secondary dyke. However, this can mean that locally (more) water problems can occur. Due to climate change, the ban on pumping may be applied more often. Where necessary, water boards take measures to prevent the undesired effects of banning pumping (such as creating more storage in the polder).

Flood defence systems along state-operated canals

For area C, the following area-specific objective has been formulated for state-operated canals: The flood defence systems along state-operated canals will meet the standard set by the Government by 2032. Measures 3 and 4 have top priority because these measures reduce the flood risk or prevent the flood risk increasing.

The measures for this objective all relate to protection (layer 1): limit the consequences of a flood event. This is mainly done by maintaining flood defence systems with cyclic activities: designate and standardise, assess, improve and maintain (see Figure 11). The measures for prevention (layer 2) and alertness (layer 3) emerge from the general objectives (see Measures for the general objectives).

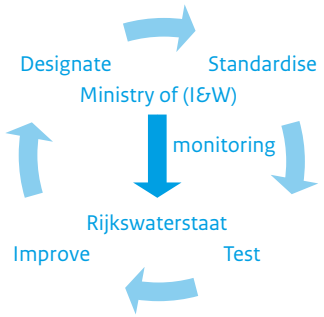


Figure 11 Cycle for maintaining the regional flood defence systems along state-operated canals with role distribution

Measure 1: Designate and standardise flood defence systems along state-operated canals

In 2018, the Minister for Infrastructure and Water Management set standards for the flood defence systems along several state-operated canals. These flood defences are managed by Rijkswaterstaat. In the planning period, no new or different standards are expected to be set.

Measure 2: Assess the condition of the regional flood defence systems along state-operated canals

The hydraulic preconditions for assessing flood defence systems along state-operated canals are given in the Regulation Safety non-primary flood defence systems under government management. In 2020, Rijkswaterstaat assessed the flood defence systems along the state-operated canals as part of the Government Flood Defences programme. Based on the assessment, advice was given relating to each flood defence system for management and maintenance or reinforcement (see measures 3 and 4).

When the Environment and Planning Act comes into force, Rijkswaterstaat will assess the national canal dykes every twelve years. The next assessment round starts in the planning period of this Flood Risk Management Plan.

Measure 3: Update flood defence systems along state-operated canals

Based on the report about the assessment of flood defence systems along state-operated canals, Rijkswaterstaat indicates which measures are required to ensure that the flood defence system meets the standard. The measures consist of reinforcement or more intensive maintenance of the flood defence system.

Measure 4: Maintain flood defence systems along state-operated canals

Rijkswaterstaat has recorded the minimum required features of the flood defence systems (such as position, shape and dimensions of the structure and the associated protection zones) in the ledger. Several times a year, Rijkswaterstaat inspects the condition of the flood defence systems. By performing maintenance, such as mowing the grass slopes and repairing damage, the flood defence remains in good condition.

With the system of permits and enforcement, Rijkswaterstaat prevents that activities taking place or objects being built in the waterworks structures or in the protection zones which negatively affect the flood defence function or its maintenance. The rules are included in the permit requirements.

7.5 Measures for area-specific objectives area D1

For area D1, the following objective has been formulated:
In D1 areas along the Linge, Roer, Gulp, Geul and Geleenbeek, flood risks will be limited as far as possible in the planning period. For Roer, Gulp, Geul and Geleenbeek, the aim is more specific, which is to meet the standards by 2035.

The measures for this objective relate to the probability of a flood event (layer 1) and to limit the consequences of a flood event via de spatial organisation (layer 2). The measures for prevention (layer 2) and the measures for alertness (layer 3) emerge from the general objectives (see Measures for the general objectives).

Various measures are possible to ensure that the national areas of D1 remain free of new developments which could lead to casualties or more damage. When designing the measures, the water boards take climate change into account.

Rhine river basin (area along the Linge)

Like the big rivers, the Linge has flood plains and flood defences. The designated D1 are concerns parts of the flood plains of the Linge. Limiting this risk requires very specific measures. Both measures have high priority.

Measure 1: Study the flood risks in unprotected area along the Linge

In the planning period, Waterschap Rivierenland is studying the flood risks in this area, together with the three provinces and municipalities involved. This study will reveal the weak points in the flood plains of the Linge..

Measure 2: Maintain the water storage capacity of the Linge

In the inspection for the Linge, Waterschap Rivierenland has stipulated that in principle no building will be permitted in the flood plains unless it fulfils the conditions of maintaining the storage capacity in the winter bed. The municipalities involved have included this in the relevant zoning plans. The water board is enforcing this in the planning period.

Meuse river basin (areas along the Roer, Geul, Gulp and Geleenbeek):

In the Meuse river basin, areas along four streams have been designated. These are generally fast draining streams with a large slope. Measure 2 has top priority for this goal because this measure reduces the flood risk.

Measure 1: Assess the flood risks of the Roer, Geul, Gulp and Geleenbeek against the standard

The Province of Limburg applies the standard for water problems to manage the flood risks along these streams. The area-wide standardisation is recorded in an appendix to the ordinance (safety standard). For most areas along the Roer, Geul, Gulp and Geleenbeek, there is a standard for flooding. The level of the standard depends on the land use. No standard has been established for nature areas. Once every six years, an assessment is conducted to check whether the water system fulfils the standard. Where this is not the case, there is a bottleneck.

Measure 2: Take physical measures along the Roer, Geul, Gulp and Geleenbeek

Around 15 locations within the designated area D1 in the river basins of the Roer, Geul, Gulp and Geleenbeek do not yet meet the standard for flooding. In area processes with the environment, the province and the water board are looking for feasible and affordable solutions for these bottlenecks.

Possible measures might include the creation of water storage areas, stream widening (often in combination with nature development) and locally also flood defence facilities around built-up areas (like quay walls). In addition, in both rural and urban areas, source measures are required to limit the supply of water. Implementing these measures requires the input of all the parties involve (water board, municipalities, public, farmers, businesses, site managers) and often takes several years.

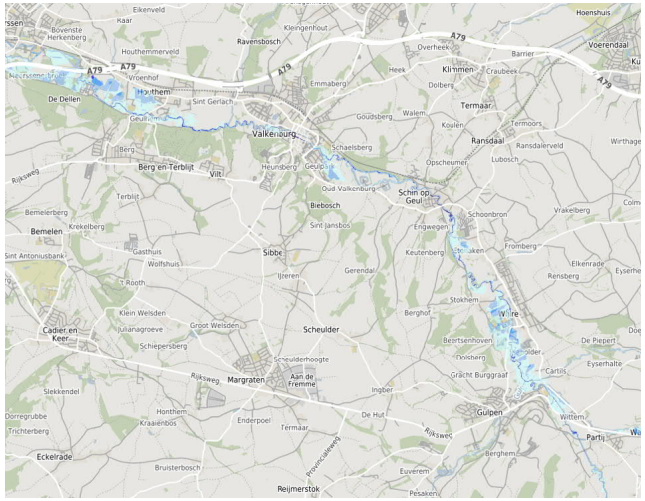
In the planning period, the focus will be on resolving problems with the available resources. The province has agreed with Waterschap Limburg that all the problems that were identified in 2020 must have been resolved in 2035.

Measure 3: Protect stream valleys of the Roer, Geul, Gulp and Geleenbeek

The province of Limburg has given the stream valleys the function of strategic water storage. That means that the current space for natural inundations in stream valleys must be maintained and the storage capacity of the soil must not decline further. Where new paved surface is laid, compensation is required by creating extra space for water storage and infiltration near the intervention. The province is enforcing this in the planning period.

Waterschap Limburg has designated several areas along the Geul and the Roer as inundation areas in the ledger. This concerns rural areas which are periodically flooded. Developments which have a negative effect on the water storage and conveyance capacity are banned here. The water board is enforcing this in the planning period.

Figure 12 Flood maps Geul



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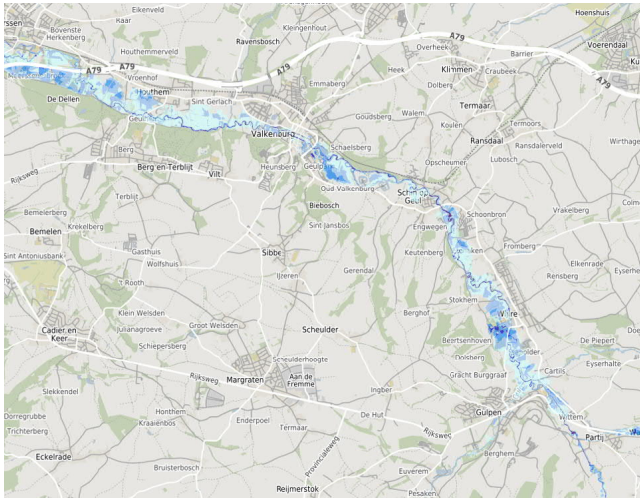

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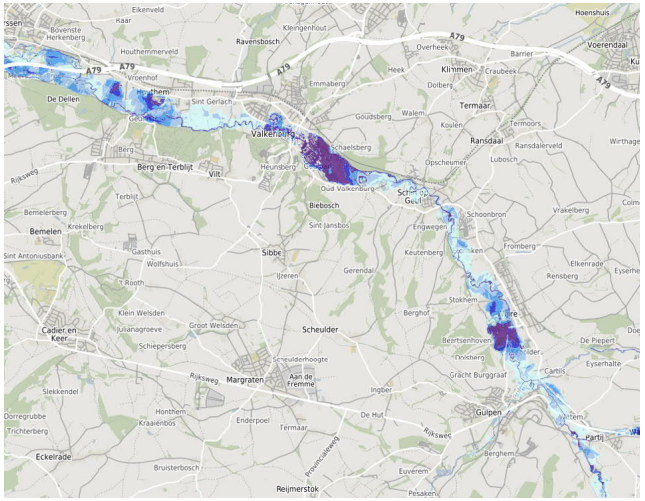

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8 Climate change

Climate change has consequences in the Netherlands for flood risks: the higher temperature leads, among others, to rising sea levels and bigger peak drainage in rivers and streams. The Netherlands has taken these into account when formulating the goals and measures in this Flood Risk Management Plan, so that it can manage flood risks in the long term too.

8.1 National Climate Adaptation Strategy and Delta Programme

In 2017, the Dutch government adopted the National Climate Adaptation Strategy (NAS). The NAS outlines how the Netherlands is adapting to climate change. In the Delta Programme (see appendix 2), this is elaborated for water safety, freshwater availability and spatial adaptation. Some of the measures from the Delta Programme are focused on the flood risk management (see also chapter 6).

In the Delta Act, the Netherlands has stipulated that a Delta Programme Commissioner will advise the government about the programming of measures in the Delta Programme. The aim is that in 2050 the Netherlands will be climate proof and water robust. The Delta Act also guarantees long-term financing of measures via the Delta Fund.

Together with the Dutch government bodies and in consultation with social organisations, businesses and knowledge institutions, the Delta Programme Commissioner has elaborated a course for water safety and spatial adaptation, among others. The cabinet has enshrined that course in the national policy. The course is revised and adapted every six years, based on new insights into climate change and socio-economic changes.

8.2 Scenarios and consequences

The Netherlands bases the strategies and measures for flood risk management on future scenarios: possible prospects for climate and socio-economic developments, looking ahead to 2050 and 2100. By exploring various future scenarios which could all happen, the bandwidth around the water challenges become visible. That fits the working method of the Intergovernmental Panel on Climate Change (IPCC). The climate information in the scenarios comes from the KNMI climate scenarios (see below).

KNMI climate scenarios

The KNMI climate scenarios indicate what effects of climate change may occur in the Netherlands. The KNMI's 14 climate scenarios show a picture of higher temperatures, more rapidly rising sea levels, wetter winters, heavier rainfall and the probability of drier summers. According to the KNMI 14 climate scenarios, in 2050 summers in the Netherlands will become 1 to 2.3°C hotter. The average rainfall in winter in 2050 has increased 3 to 17% and the sea level has risen by 15 to 40 cm.

Deciding factors in the KNMI climate scenarios are (see Figure 13):

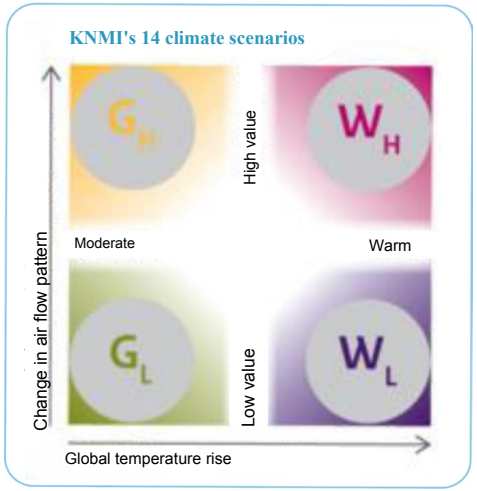
1 The global temperature rise compared to 1981-2010. The KNMI uses two scenarios for this:
   - G scenarios (moderate): temperature rise of 1°C in 2050 and 1.5°C in 2085
   - W scenarios (hot): temperature rise of 2°C in 2050 and 3.5°C in 2085

2 2. The change in the air flow pattern. The KNMI uses the following two scenarios for this:
   - L scenarios (low): small change in the air flow pattern.
   - H scenarios (high): big change in air flow pattern.

In the H scenarios, the winters are milder and wetter (more frequent wind from the west) and the summers are hotter and drier (more frequent wind from the east) than in the L scenarios.

The current KNMI 14 scenarios are based on the IPPC scenarios from 2014. In 2021, the 6th IPCC report is expected to be published. Based on this, the Netherlands will update the KNMI scenarios (see chapter 6, Measures General goal 1).

Figure 13 The four KNMI climate scenarios



Consequences of climate change

The expected climate change will mean that the drainage and water levels that are relevant to the flood risk will increase.

In all KNMI scenarios, the drainage regime of the Rhine and the Meuse will become more erratic during the year. The winter discharges increase, the summer discharges decline. In the Rhine, the decline in the summer is limited because the Rhine river basin is very extensive, and several large lakes reduce the effect. In the Meuse, the difference between winter and summer discharges will be much greater. In the KNMI scenarios, the extreme Meuse scenarios in 2050 are expected to increase by 3-10% and in 2100 by 10-20%. For the Rhine discharges, the expected increase is 3-6% in 2050 and 6-12% in 2100. High water levels will also occur more frequently: a Rhine discharge of over 12,000 m3/s (comparable to the high waters in 1993 and 1995) will now occur on average once every 100 years. In 2050, a similar discharge occurs once every 30 years and in 2100 even once every 10 years. More frequent high water means an increased flood risk.

The sea levels are expected to rise 20-40 cm in 2050 and 30-100 cm in 2100. That has consequences for the flood risks along the coast and along the downstream section of the rivers where both the sea and the river discharge determine the water level.

The ICBR has studied the influence of climate change on the river discharges as basis for the new climate adaptation strategy of the ICBR. The future Rhine discharges in the KNMI climate scenarios fall within the bandwidth used by ICBR.

Rising water levels rivers and coast

Due to climate change, the probability of high water levels at sea and in the big rivers is expected to rise significantly. In areas which are protected with flood defence systems, there are no or very few consequences for flood management, but the probability of a flood event does increase. In unprotected areas, the affected area will be more extensive and flooding will be more frequent.

An important measure for managing the flood risks in protected areas (area B and C) is to strengthen flood defence systems which do not meet the standard (see chapter 6). It takes 5-20 years to prepare and implement a dyke reinforcement or construct a new flood defence. After completion, the dyke will need to remain for 50 years and sometimes longer. The design takes the expected climate effects into account until the end of its life. For the reinforcement of the primary flood defence systems, it is recommended that the KNMI climate scenario with the highest increase in water levels should be used. When reinforcing regional flood defences, the province and the water board agree per location how to manage climate change, taking other (social) developments in the area into account. This might also be river widening, water storage or limitation of the consequences

Greater risk of intense rainfall

Intense rainfall in a short space of time causes problems if the water is not drained quickly enough or can be temporarily stored. In this case, (often local) flooding can occur. A study by the Foundation for Applied Water Research (STOWA) shows that the probability of intense rainfall has already increased due to climate change. Municipalities have conducted stress tests to see how vulnerable the urban environment is for this (see chapter 6, measures for general goal 2). For the third Flood Risk Management Plan, the Netherlands will assess whether intense rainfall constitutes a significant flood risk (see also chapter 3).

Sensitivity analysis Intense Rainfall 2018

Intense rainfall refers to extremely high rainfall in a short space of time. Often, these are summer downpours. These can cause flooding. A national sensitivity analysis provided an initial impression of the consequences of intense rainfall in the Netherlands. The research shows that intense rainfall in exceptional cases can cause a significant flood risk. However, the study is too general to identify areas with a potential significant flood risk caused by intense rainfall. For that reason, flooding caused by intense rainfall is not included in this Flood Risk Management Plan.

The sensitivity study presented the consequences for three situations, whereby 35 mm, 70 mm and 140 mm of rainfall respectively fell in 2 hours. These situations have around a probability of occurring once in 10, 100 and 1000 years, but such downpours have already occurred on several occasions in recent years. In all towns and cities in the Netherlands, there is a flood risk caused by intense rainfall. The extent of the risk is mainly related to the local terrain and storage capacity.

In the framework of the Delta Plan Spatial Adaptations, the Dutch government authorities reveal the vulnerability for rainfall with stress tests. In the coming years, this will provide more insight into the consequences of intense rainfall. As part of the Delta Plan, measures will also be conducted to reduce the vulnerability. In this planning period, the Netherlands is therefore already working on reducing the risks of flooding caused by intense rainfall.

8.3 Knowledge about climate

The Netherlands is investing in knowledge about the effect of climate change on flood risks. The knowledge structure is organised in such a way that government authorities, knowledge institutions and industry can combine their knowledge and to enable a good exchange between research and the implementation of measures. This is done, among others, in the Expertise Network Water Safety, National Knowledge Programme Water and Climate, National Knowledge Programme Rising Sea Levels, Applied Research Water Management Foundation and the Delta Programme.

9 Coordination and participation

The Netherlands has coordinated the efforts to manage the flood risk with other countries in the river basins and with the measures to achieve a good ecological and chemical water quality as intended in the Water Framework Directive. In addition, the partners which play a role in flood risk management participated in drawing up this Flood Risk Management Plan.

9.1 Coordination in the international river basins

The international sections of this Flood Risk Management Plan (part A) and this national section (part B) were drawn up in consultation. When drawing up part A, the Netherlands included the findings of the national Flood Risk Management Plan to guarantee that the goals and measures in both parts are in line and are realistic and feasible. The measures of this national Flood Management Plan contribute to achieving the objectives of the International Flood Risk Management Plans for the Rhine, Meuse, the Ems and the Scheldt (see appendix 6).

The international coordination about goals and measures for the big rivers (main river and subsidiaries) took place in the international river committees:

- Rhine: International Committee for the Protection of the Rhine (ICBR)
- Meuse: International Meuse Committee (IMC)
- Ems: Steering and Coordination Group Ems
- Scheldt: International Scheldt Committee (ISC)

In these committees, the countries also exchanged information about the interim risk assessment, the establishment of designated areas (GPSOR) and the drafting of the flood danger and risk maps. The coordination focused on subjects with a transnational character which require coordination in the entire international river basin. There was also bilateral consultation with the neighbouring countries, for the Rhine for example in the German-Dutch Flooding working group and for the Meuse, among others in the Flemish-Dutch Bilateral Meuse Committee.

Coordination about the goals and measures for smaller cross-border waters also took place in bilateral international consultation, often via the border water committees or Interreg projects. In the Rhine river basin, the Netherlands and German states Lower Saxony and North Rhine Westphalia coordinated in the Rhine Delta working group. A brief report will be drawn up about this coordination. Following that consultation, the Netherlands designated several areas in the Rhine river basin without there being a potential significant risk (D2 areas, see chapter 4).

The countries involved drew up joint maps for the river basin of the Ems and for flooding from the main stream of the Rhine. Due to method differences, the flood danger maps on either side of the German-Dutch border do not yet optimally connect in all places. For that reason, the countries have agreed to coordinate the flood danger and risk maps for the third cycle of the Flood Risk Management Plan based on joint substantive principles for the border area. The bilateral German-Dutch Flooding working group is responsible for this.

In spring 2020, the Ministers of the states bordering the Rhine approved the Rhine 2040 programme. Part of Rhine 2040 is the agreement to reduce the flood risk by 15% in the coming twenty years, pursuant to the Flood Action Plan (1995-2020). The measures in this Dutch Flood Risk Management Plan contribute to that agreement.

Rhine Programme 2040

The Rhine Programme 2040 is called "The Rhine and its river basin: sustainably managed and climate proof". This programme states that the flood risks for the Rhine and its main subsidiaries in 2040 by an optimal combination of measures must be reduced by at least 15% compared with 2020. The programme contains the following concrete goals for 2040:

1. The flood information, expectation and warning are up to date and practised. The countries or states/regions continue to support each other in the event of flooding.
2. The measures aimed at reducing high water levels for 2020 have been implemented by 2030. This achieves an effective reduction of the high water levels in the Rhine, thus clearly reducing the flood risk of the Rhine.
3. On the main stream and subsidiaries of the Rhine, more areas have been designated for high water retention. This has been established in spatial planning and reserved for this use, going further than the measures already planned for 2030.
4. Synergy opportunities between measures to improve the flood risk management and measures to improve the ecological situation on the Rhine and its subsidiaries have been used.
5. Non-urbanised flood areas are kept free from building.
6. New and any existing buildings in urbanised flood areas have been adapted to the flood risk (structural prevention measures).
7. The flood risk awareness and thus the personal prevention measures are strengthened through information, training and awareness.

9.2 Coordination with the Water Framework Directive

The goal of the WFD is to achieve and preserve a good ecological and chemical situation. This is partly related to the goal of the Floods Directive. Both directives involve a river basin approach. For the Water Framework Directive (WFD) and the Floods Directive, the Netherlands has reported to the European Commission which government bodies bear responsibility. These 'competent authorities' are largely the same for both directives.

The Netherlands monitors that measures to achieve the good situation according to the WFD do not have any unacceptable negative effects on the flood risks. In all cases, the measures take the statutory standards for flood risk management into account.

Conversely, the Netherlands wants to prevent new measures for flood risk management having negative effects on the water quality. For major interventions, it is mandatory to draw up an Environmental Impact Assessment and to include the environmental effects in the decision making (including the effects on the ecological and chemical water quality). In some cases, new interventions for managing the flood risks may be necessary, despite the negative effects on the water system. In that case, article 4.7 of the WFD is called on.

Often the measures for both guidelines are combined, because they reinforce each other (see boxes). This creates more space for water along rivers and streams, benefitting both the flood risk management and the quality of the water system. This synergy leads to a more robust, climate-proof system. In addition, the Netherlands is actively looking for measures which also contribute to other social functions, such as recreation.

Dyke reinforcement Zwolle-Olst (Paddenpol)

In 2016, it was found that the IJsseldijk between Zwolle and Olst did not meet the safety standards in force since 2017. In the subsequent exploration phase, it was investigated whether river widening (dyke repositioning) could help achieve the required safety level. The result of the study is that it can, but this must be in combination with dyke reinforcement. By partially resolving water safety issues with river widening, it is also possible to address issues for the Water Framework Directive and the Programmatic Approach to Major Waters, by creating channels, wet nature and nature-friendly banks. For that reason, the dyke repositioning option at the Paddenpol (between Wijhe and Herxen) is being elaborated in the HWBP project Dyke Improvement Zwolle-Olst.

Houtribdijk

The Houtribdijk dyke separates the Markermeer lake from the IJsselmeer and acts as a big breakwater. This dyke thus plays an important role in the protection from flooding around the Markermeer lake and the IJsselmeer. To be able to continue playing this role in the future, the Houtribdijk dyke has been reinforced. The ambition is also to strengthen the nature values and the water quality in the area with sloping sandy banks which break the waves and offer a habitat for various types of plants and animals. With the newly available material, a new nature area was created, the Trintelzand. This 532-hectare area of sandbanks, mud fields and reed fields contributes to achieving the objectives of the Water Framework Directive because it offers a habitat to various Natura 2000 species and contributes to the ecological water quality of Markermeer lake.

Friese Boezem

Many sections of the regional flood defence systems along the Friese Boezem did not meet the standards of the province. Over the past fifteen years, many flood defence systems were therefore reinforced. This took place in an integrated way, stimulated by the province. Bearing in mind the goals of the Water Framework Directive, many nature-friendly banks were created, whereby flood defences were also moved 'back'. This arrangement improves ecological functioning and allows extra water storage, making the water system more climate proof and robust.

9.3 Participation

Participation by government authorities

All government authorities contributed to this Flood Risk Management Plan: the Government, all the provinces and water boards, the municipalities and the safety regions. The Government took the lead. The maps were also created with the cooperation of all the government authorities. For this, the provinces took the lead, while the water boards and Rijkswaterstaat delivered data. As important users of the maps, municipalities and safety regions were consulted about them.

Participation of social parties, businesses and the public

There was no public participation in the development of this Flood Risk Management Plan. The goals and measures in this plan are already adopted in existing laws, policy plans and implementation decisions, with the application of the associated public participation procedures and in some cases also with active participation. However, parties were consulted as part of the participation in the National Water Programme (see below). Conferences where flood risk management is on the programme are regularly organised. One such conference is the annual Delta Congress, which is attended by around 2,000 people from the water world.

Participation in the framework of the National Water Programme

The National Water Programme (NWP) describes the government's water policy for the period 2022-2027. The government sets the strategic goals for water management, and the operational management to achieve these goals in national waters. The Flood Risk Management Plan is an appendix to the NWP. The participation process for the NWP thus also applies to the Flood Risk Management Plan. There are various moments when the public and interested parties are consulted. The way this is done is described in the participation plan. The most important moments are shown in the table below.

When	What
1 November to 28 November 2019	Review procedure about the intention to draw up the National Water Programme 2022-2027 and a Strategic Environmental Assessment (SEA), responses to the participation plan
January 2020	Response memo based on the review procedure
January 2020	Theme sessions with social and lobby organisations
January and February 2020	Area sessions with other government authorities
October 2020	Consultation social and lobby organisations in the Physical Environment Consultative Council (OFL) based on draft texts
March 2021	Approval cabinet with the draft National Water Programme 2022-2027 including appendices with SEA
March- September 2021	Review procedure for the draft National Water Programme 2022-2027 including appendices with SEA (duration: six months)
December 2021	Response memo based on the review procedure Approval by Ministers concerning ORBP and announcement to EU Commission.
March 2021	Adoption National Water Programme 2022-2027 including appendices.

Table 5 Participation and input National Water Programme 2022-2027

Participation in the framework of the Delta Programme

The Flood Risk Management Plan contains several measures which originate in the Delta Programme (see chapter 6). In its preparation, there was a public participation programme, involving social organisations, scientists and businesses. In the framework of the Spatial Adaptation Delta Plan (part of the Delta Programme), local and regional risk dialogues took place. During these dialogues, governments and all the parties involved - including members of the public and entrepreneurs - discuss the risks of climate effects and how to manage them. Flood risks are always part of these risk dialogues. Important goals of the risk dialogues are awareness, reaching shared views about the opportunities and risks of climate effects and drawing up a climate adaptation strategy.

Participation in elaborating separate measures

When elaborating separate measures from this Flood Risk Management Plan, the immediate surroundings are usually intensively involved (environment management), for example through an information session for residents. The input from the residents varies from discussing the prevention of inconvenience during the work to using coproduction and contributing to the exact elaboration of the plan. When projects are submitted to an environmental impact assessment, statutory procedures for input and appeal apply. Via a response memo, the initiator explains how the input was used.

Appendix 1
Competent authorities

Legislation

The FD was mainly implemented in the plan system of the Water Act and the Water Decree*. This was in close alignment with the organisation of the water management as adopted in the Water Act. Any additional statutory provisions required to fulfil specific requirements of the FD are included in the above-mentioned legislation.

The institutional law: Constitution, Royal Decree and additionally specifically for the water boards and Provinces in the Water Board Act and the Provincial Regulation.

Legislation for authorisations and tasks for the FD: the Water Act, Safety Regions Act, Nature Protection Act 1998, Environmental Management Act, Spatial Planning Act. This list only includes formal legislation. Applicable Orders in Council and ordinances by provinces, water boards and municipalities are not included. The texts of the legislation are available via https://wetten.overheid.nl/.

Core tasks relating to the FD

Government

Core tasks FD and the Ministry of Infrastructure and Water Management, where necessary acting together with colleagues from other Ministries, including the Ministry of Justice and Security and the Ministry of Defence:

a) establishing Dutch input in the international flood risk management plan and adopting the flood risk management plan for the Dutch part of the international river basin districts of the Ems, Rhine, Meuse and Scheldt.
b) coordination and partial implementation of the programme of measures.
c) regulate and issue permits for activities relating to water management work.
d) (coordination of) information and consultation with the public.

Water Board

Core tasks FD for the executive boards of the water boards which are located entirely or partially in the district:

a) contribute to the Dutch input in the international flood risk management plan and the flood risk management plan for the Dutch part of the international district.
b) coordination and partial implementation of the programme of measures.
c) regulate and issue permits for activities relating to water management work.
d) draw up, adopt and implement a multidisciplinary policy plan emergencies and crisis management.
e) information and consultation with the public.

* Water Act and water decree are included in the Environment and Planning Act which comes into force on 1/1/2022.

Province

Core tasks FD for the executive boards of the provinces which are located entirely or partially in the district:

a) contribute to the Dutch input in the international flood risk management plan and the flood risk management plan for the Dutch part of the international district.
b) draw up, manage and publish flood danger and flood risk maps for the Dutch part of the river basin district.
c) coordination and partial implementation of the programme of measures.
d) regulate and issue permits for activities relating to water management and spatial organisation.
e) information and consultation with the public.

Safety region

Core tasks safety region:

a) analyse risks of emergencies and crises.
b) draw up and adopt a risk profile, a long-term policy plan, a crisis plan and a moto-policy plan.
c) organise the emergency and crisis management in the region.
d) inform the public about the risks present in a region.
e) warn and alert the population about potential emergencies/crises.
f) advise participating parties with respect to the regional and sectoral pro-action and prevention policy.

Summary of competent authorities

Code	Name	Catchment area district	Website	Change compared with ORBP1
NL_MINIW	Ministry of Infrastructure and Water Management	NLRN, NLMS, NLEM, NLSC	https://www.rijksoverheid.nl/ministeries/ministerie-van-infrastructuur-en-waterstaat	Name change and code change Previously: Ministry of Infrastructure and the Environment (NL_MINIM) (2017)
NL_P61	Province of Groningen	NLRN, NLEM	https://www.provinciegroningen.nl	
NL_P62	Province of Fryslân (Friesland)	NLRN	https://www.fryslan.nl	
NL_P63	Province of Drenthe	NLRN, NLEM	https://www.provincie.drenthe.nl	
NL_P64	Province of Flevoland	NLRN	https://www.flevoland.nl/home	
NL_P65	Province of Noord-Holland	NLRN	https://www.noord-holland.nl	
NL_P66	Province of Overijssel	NLRN	https://www.overijssel.nl	
NL_P67	Province of Utrecht	NLRN	https://www.provincie-utrecht.nl	
NL_P68	Province of Gelderland	NLRN, NLMS	https://www.gelderland.nl	
NL_P69	Province of Zuid-Holland	NLRN, NLMS, NLSC	https://www.zuid-holland.nl	
NL_P70	Province of Zeeland	NLSC	https://www.zeeland.nl	
NL_P71	Province of Noord-Brabant	NLRN, NLMS, NLSC	https://www.brabant.nl	
NL_P72	Province of Limburg	NLMS	https://www.limburg.nl	

Code	Name	Catchment area district	Website	Change compared with ORBP1
NL_W2	Wetterskip Fryslân	NLRN	https://www.wetterskipfryslan.nl	
NL_W59	Waterschap Drents Overijsselse Delta	NLRN	https://www.wdodelta.nl/	Merger of water boards Groot Salland + Reest en Wieden (1-1-2016)
NL_W7	Waterschap Rijn en IJssel	NLRN	https://www.wrij.nl	
NL_W9	Waterschap Rivierenland	NLRN, NLMS	https://www.waterschaprivierenland.nl	
NL_W11	Waterschap Amstel, Gooi en Vecht	NLRN	https://www.agv.nl	
NL_W12	Hoogheemraadschap Hollands Noorderkwartier	NLRN	https://www.hhnk.nl	
NL_W13	Hoogheemraadschap van Rijnland	NLRN	https://www.rijnland.net	
NL_W14	Hoogheemraadschap De Stichtse Rijnlanden	NLRN	http://www.hdsr.nl	
NL_W15	Hoogheemraadschap van Delfland	NLRN	https://www.hhdelfland.nl	
NL_W19	Waterschap Hollandse Delta	NLRN, NLMS, NLSC	https://www.wshd.nl	
NL_W25	Waterschap Brabantse Delta	NLMS, NLSC	https://www.brabantsedelta.nl	
NL_W27	Waterschap De Dommel	NLMS	https://www.dommel.nl	
NL_W33	Waterschap Hunze en Aa's	NLEM	https://www.hunzeenaas.nl	
NL_W34	Waterschap Noorderzijlvest	NLEM, NLRN	https://www.noorderzijlvest.nl	

Code	Name	Catchment area district	Website	Change compared with ORBP1
NL_W37	Waterschap Zuiderzeeland	NLRN	https://www.zuiderzeeland.nl	
NL_W38	Waterschap Aa en Maas	NLMS	https://www.aaenmaas.nl	
NL_W39	Hoogheemraadschap van Schieland en de Krimpenerwaard	NLRN	https://www.schielandendekrimpenerwaard.nl/	
NL_W42	Waterschap Scheldestromen	NLSC	http://www.scheldestromen.nl/	
NL_W43	Waterschap Vallei en Veluwe	NLRN	https://www.vallei-veluwe.nl/	
NL_W44	Waterschap Vechtstromen	NLRN	https://www.vechtstromen.nl/	
NL_W60	Waterschap Limburg	NLMS	https://www.waterschaplimburg.nl/	Merger of water boards Peel en Maasvallei + Roer en Overmaas (1-1-2017)
NL_V1	Safety region Groningen	NLEM	https://www.veiligheidsregiogroningen.nl/	
NL_V2	Safety region Fryslân	NLRN	https://www.veiligheidsregiofryslan.nl/	
NL_V3	Safety region Drenthe	NLEM, NLRN	https://www.vrd.nl/home.html	
NL_V4	Safety region IJsselland	NLRN	https://www.vrijsselland.nl/over-veiligheidsregio-ijsselland/	
NL_V5	Safety region Twente	NLRN	https://www.vrtwente.nl/	
NL_V6	Safety region Noord- en Oost-Gelderland	NLRN	https://www.vnog.nl/	
NL_V7	Safety region Gelderland-Midden	NLRN	https://www.vggm.nl/vggm	

Code	Name	Catchment area district	Website	Change compared with ORBP1
NL_V8	Safety region Gelderland-Zuid	NLRN, NLMS	https://www.vrgz.nl/	
NL_V9	Safety region Utrecht	NLRN	https://www.vru.nl/	
NL_V10	Safety region Noord-Holland-Noord	NLRN	https://www.vrnhn.nl/	
NL_V11	Safety region Zaanstreek-Waterland	NLRN	https://www.veiligheidsregiozaanstreekwaterland.nl/	
NL_V12	Safety region Kennemerland	NLRN	https://www.vrk.nl/	
NL_V13	Safety region Amsterdam- Amstelland	NLRN	https://www.amsterdam.nl/veiligheidsregio/	
NL_V14	Safety region Gooi en Vechtstreek	NLRN	https://www.vrgooienvechtstreek.nl/	
NL_V15	Safety region Haaglanden	NLRN	https://www.vrh.nl/	
NL_V16	Safety region Hollands Midden	NLRN	https://www.vrhm.nl/	
NL_V17	Safety region Rotterdam-Rijnmond	NLRN, NLMS, NLSC	https://vr-rr.nl/	
NL_V18	Safety region Zuid-Holland-Zuid	NLRN, NLMS	https://www.zhzveilig.nl/	
NL_V19	Safety region Zeeland	NLSC	https://www.veiligheidsregiozeeland.nl/	
NL_V20	Safety region Midden- en West-Brabant	NLRN, NLMS, NLSC	https://www.veiligheidsregiomwb.nl	
NL_V21	Safety region Brabant-Noord	NLMS	https://www.vrbn.nl/	
NL_V22	Safety region Brabant-Zuidoost	NLMS	https://www.vrbzo.nl	

Code	Name	Catchment area district	Website	Change compared with ORBP1
NL_V23	Safety region Limburg-Noord	NLMS	https://www.vrln.nl/	
NL_V24	Safety region Zuid-Limburg	NLMS	http://www.vrzuidlimburg.nl	
NL_V25	Safety region Flevoland	NLRN	https://www.veiligheidsregioflevoland.nl/	
NL_NG	Dutch municipalities	NLRN, NLMS, NLEM, NLSC	https://almanak.overheid.nl/Gemeenten/	Individual municipalities

Appendix 2
Organisations in water management

In addition to the competent authorities for the Flood Risk Management Plan (see appendix 1), the following organisations also play a role in flood risk management:

Delta Programme (DP)

The goal of the Delta Programma is that the flood risk management, freshwater supply and the spatial organisation of the Netherlands are climate proof and water robust in 2050. All Dutch government layers work together in national and regional programme units. The management of the programme (Delta Programme Commissioner), the financing (Delta Fund) and the annual update of the Delta Programme are enshrined in law. Some of the measures from the Delta Programme are focused on the flood risk management. The approach consists of a multi-layer safety approach with three layers which correspond with the definitions from the EU Directive: protection (layer 1), prevention (layer 2) and alertness (layer 3).

High Water Protection Programme

The High Water Protection Programme is an alliance of the water boards and Rijkswaterstaat. In this alliance, they work together on reinforcing the primary flood defence systems for a water-safe Netherlands in 2050. The Programme Office HWBP has a directing, facilitating and assessing role in the implementation of the reinforcement measures by water boards and Rijkswaterstaat. Besides issuing subsidies, the HWBP also shares knowledge.

Steering Committee Management Water Crisis and Flooding (SMWO)

The SMWO is the administrative collaboration of all Dutch crisis partners from the water column and the general column. This structural collaboration for crisis management water was set up for the preparation for water crises (too high, too little and too dirty water). An important goal of the SMWO is good preparation for (potential) flooding. The parties involved jointly implement the programme "strategic agenda SMWO". Various products of the WMCN, including the LDHO, are established by the SMWO.

Netherlands water management centre (WMCN)

In the WMCN, the KNMI, water boards, Rijkswaterstaat and Defence work together. The WMCN is responsible for national water reporting and the joint coordination in water crisis. By combining water knowhow and expertise, the WMCN makes an important contribution to the goals - safety and sufficient and clean water - for the Dutch water system. The WMCN is facilitated by Rijkswaterstaat. As one of the distribution centres, the WMCN also contributes to the EU flood forecasting (EFAS)

Appendix 3
Consequences of flood events in the designated areas per river basin

On the following pages, the calculated potential consequences of the four flooding scenarios are presented, as described in 5.1, first by river basin and finally for the Netherlands as a whole.

Consequences in the river basin of the Rhine	Unit	Area A	Area B	Area C	Area D	Total A, B, C and D	Total in river basin (including not flooded)
Grote kans (1:10 per jaar)							
Flooded surface area	surface km²	753	0	0	148	901	28,502
Potentially affected residents	number (x1000)	11	-	-	4	15	7,842
IED installations	number	9	0	0	0	9	1,887
Drinking water extraction locations	number	5	0	0	0	5	290
Swimming water locations	number	96	0	0	6	102	463
Natura 2000 area	surface (ha)	55,541	-	-	6,091	61,632	838,643
National monuments	number	427	0	0	36	463	45,706
Total damage (SSM2017)	million €	398	-	-	197	595	551,000
Medium probability (1:100 per year)							
Flooded surface area	surface km²	825	2,244	3,184	176	6,429	28,502
Potentially affected residents	number (x1000)	22	1,430	553	8	2,013	7,842
IED installations	number	27	181	56	2	266	1,887
Drinking water extraction locations	number	8	33	0	0	41	290
Swimming water locations	number	98	62	57	6	223	463
Natura 2000 area	surface (ha)	55,860	13,808	22,778	6,402	98,847	838,643
National monuments	number	660	3669	900	99	5,328	45,706
Total damage (SSM2017)	million €	791	75,901	15,186	418	92,297	551,000
Low probability (1:1000 per year)							
Flooded surface area	surface km²	930	9,688	4,361	204	15,183	28,502
Potentially affected residents	number (x1000)	38	3,642	2,033	10	5,724	7,842
IED installations	number	45	553	119	3	720	1,887
Drinking water extraction locations	number	8	69	0	0	77	290
Swimming water locations	number	101	147	82	8	338	463
Natura 2000 area	surface (ha)	56,611	50,371	26,436	6,456	139,874	838,643
National monuments	number	988	9304	1949	91	12,332	45,706
Total damage (SSM2017)	million €	1,659	258,173	55,666	579	316,077	551,000

Extreme situation (1:10000 per year)							
Flooded surface area	surface km²	1006	11,623	4,361	204	17,194	28,502
Potentially affected residents	number (x1000)	56	7,080	2,033	10	9,179	7,842
IED installations	number	89	713	119	3	924	1,887
Drinking water extraction locations	number	9	75	0	0	84	290
Swimming water locations	number	104	221	82	8	415	463
Natura 2000 area	surface (ha)	57,554	59,221	26,436	6,456	149,667	838,643
National monuments	number	1239	19,202	1949	91	22,481	45,706
Total damage (SSM2017)	million €	3,331	441,145	55,666	579	500,720	551,000

Consequences in the river basin of the Meuse	Unit	Area A	Area B	Area C	Area D	Total A, B, C and D	Total in river basin (including not flooded)
High probability (1:10 per year)							
Flooded surface area	surface km²	252	0	0	25	277	7,479
Potentially affected residents	number (x1000)	2	-	-	1	3	2,711
IED installations	number	1	0	0	0	1	1,834
Drinking water extraction locations	number	1	0	0	0	1	144
Swimming water locations	number	8	0	0	0	8	143
Natura 2000 area	surface (ha)	9,854	-	-	970	10,824	90,028
National monuments	number	79	0	0	43	122	11,209
Total damage (SSM2017)	million €	57	-	-	80	137	169,000
Medium probability (1:100 per year)							
Flooded surface area	surface km²	309	48	484	50	891	7,479
Potentially affected residents	number (x1000)	8	3	92	3	107	2,711
IED installations	number	8	6	59	2	75	1,834
Drinking water extraction locations	number	8	0	0	0	8	144
Swimming water locations	number	8	7	8	0	23	143
Natura 2000 area	surface (ha)	9,536	8	1,182	1,111	11,836	90,028
National monuments	number	182	57	204	102	545	11,209
Total damage (SSM2017)	million €	314	1,380	4,480	203	6,377	169,000
Low probability (1:1000 per year)							
Flooded surface area	surface km²	388	676	495	79	1,638	7,479
Potentially affected residents	number (x1000)	74	317	93	16	501	2,711
IED installations	number	25	150	59	3	237	1,834
Drinking water extraction locations	number	13	9	0	0	22	144
Swimming water locations	number	8	14	8	0	30	143
Natura 2000 area	surface (ha)	10,664	1,167	1,175	1,195	14,201	90,028
National monuments	number	476	676	207	193	1,552	11,209
Total damage (SSM2017)	million €	2,555	25,680	4,508	772	33,514	169,000

Extreme situation (1:10000 per year)							
Flooded surface area	surface km²	457	1,053	495	79	2,084	7,479
Potentially affected residents	number (x1000)	124	468	93	16	702	2,711
IED installations	number	37	189	59	3	288	1,834
Drinking water extraction locations	number	16	12	0	0	28	144
Swimming water locations	number	8	16	8	0	32	143
Natura 2000 area	surface (ha)	11,181	2,601	1,175	1,195	16,152	90,028
National monuments	number	955	1,589	207	193	2,944	11,209
Total damage (SSM2017)	million €	4,435	40,900	4,508	772	50,615	169,000

Consequences in the river basin of the Ems	Unit	Area A	Area B	Area C	Total A, B and C	Total in river basin (including not flooded)
High probability (1:10 per year)						
Flooded surface area	surface km²	38	0	0	38	2,623
Potentially affected residents	number (x1000)	-	-	-	-	369
IED installations	number	0	0	0	0	280
Drinking water extraction locations	number	0	0	0	0	12
Swimming water locations	number	2	0	0	2	47
Natura 2000 area	surface (ha)	3,435	-	-	3,435	36,230
National monuments	number	1	0	0	1	2,061
Total damage (SSM2017)	million €	4	-	-	4	20,000
Medium probability (1:100 per year)						
Flooded surface area	surface km²	39	0	432	471	2,623
Potentially affected residents	number (x1000)	0.002	0	41	41	369
IED installations	number	0	0	40	40	280
Drinking water extraction locations	number	0	0	0	-	12
Swimming water locations	number	2	0	4	6	47
Natura 2000 area	surface (ha)	3,439	0	1,185	4,624	36,230
National monuments	number	1	0	207	208	2,061
Total damage (SSM2017)	million €	8	0	2,535	2,543	20,000
Low probability (1:1000 per year)						
Flooded surface area	surface km²	40	467	674	1,183	2,623
Potentially affected residents	number (x1000)	0.002	39	111	150	369
IED installations	number	2	56	68	128	280
Drinking water extraction locations	number	0	0	0	-	12
Swimming water locations	number	2	13	6	21	47
Natura 2000 area	surface (ha)	3,438	65	1,272	4,775	36,230
National monuments	number	1	175	322	499	2,061
Total damage (SSM2017)	million €	50	4,212	6,251	10,519	20,000

Extreme situation (1:10000 per year)						
Flooded surface area	surface km²	42	812	674	1,530	2,623
Potentially affected residents	number (x1000)	0	108	111	219	369
IED installations	number	5	86	68	161	280
Drinking water extraction locations	number	0	0	0	-	12
Swimming water locations	number	2	18	6	26	47
Natura 2000 area	surface (ha)	3,445	1,786	1,272	6,502	36,230
National monuments	number	1	558	322	882	2,061
Total damage (SSM2017)	million €	102	10,618	6,251	16,978	20,000

Consequences in the river basin of the Scheldt	Unit	Area A	Area B	Area C	Total A, B and C	Total in river basin (including not flooded)
High probability (1:10 per year)						
Flooded surface area	surface km²	148	0	0	148	3,167
Potentially affected residents	number (x1000)	0	-	-	0	394
IED installations	number	0	0	0	0	75
Drinking water extraction locations	number	0	0	0	0	6
Swimming water locations	number	127	0	0	127	62
Natura 2000 area	surface (ha)	13,440	-	-	13,440	190,066
National monuments	number	3	0	0	3	4,118
Total damage (SSM2017)	million €	17	-	-	17	20,000
Medium probability (1:100 per year)						
Flooded surface area	surface km²	152	35	107	294	3,167
Potentially affected residents	number (x1000)	0.197	5	31	35	394
IED installations	number	0	0	7	7	75
Drinking water extraction locations	number	0	0	0	-	6
Swimming water locations	number	127	0	0	127	62
Natura 2000 area	surface (ha)	13,692	131	255	14,077	190,066
National monuments	number	4	33	50	87	4,118
Total damage (SSM2017)	million €	41	355	653	1,050	20,000
Low probability (1:1000 per year)						
Flooded surface area	surface km²	161	340	138	639	3,167
Potentially affected residents	number (x1000)	0.285	70	40	110	394
IED installations	number	3	19	7	29	75
Drinking water extraction locations	number	0	0	0	-	6
Swimming water locations	number	127	0	0	127	62
Natura 2000 area	surface (ha)	13,957	3,174	254	17,386	190,066
National monuments	number	5	538	53	596	4,118
Total damage (SSM2017)	million €	71	5,310	832	6,213	20,000

Extreme situation (1:10000 per year)						
Flooded surface area	surface km²	161	1,133	138	1,432	3,167
Potentially affected residents	number (x1000)	0	288	40	328	394
IED installations	number	7	48	7	62	75
Drinking water extraction locations	number	0	0	0	-	6
Swimming water locations	number	127	4	0	131	62
Natura 2000 area	surface (ha)	14,349	4,944	254	19,547	190,066
National monuments	number	6	1,546	53	1,605	4,118
Total damage (SSM2017)	million €	290	25,755	832	26,877	20,000

Consequences in the Netherlands	Unit	Area A	Area B	Area C	Area D	Total A, B, C and D	Total in the Netherlands (including not flooded)
High probability (1:10 per year)							
Flooded surface area	surface km²	1,191	0	0	173	1,364	41,771
Potentially affected residents	number (x1000)	13	-	-	5	18	17,686
IED installations	number	10	0	0	0	10	3,997
Drinking water extraction locations	number	6	0	0	0	6	452
Swimming water locations	number	233	0	0	6	239	715
Natura 2000 area	surface (ha)	79,859	-	-	7,061	86,920	1,155,343
National monuments	number	510	0	0	79	589	61,863
Total damage (SSM2017)	million €	476	-	-	278	754	650,000
Medium probability (1:100 per year)							
Flooded surface area	surface km²	1,325	2,327	4,207	226	8,085	41,771
Potentially affected residents	number (x1000)	30	1,438	717	11	2,196	17,686
IED installations	number	35	187	162	4	388	3,997
Drinking water extraction locations	number	16	33	0	0	49	452
Swimming water locations	number	235	69	69	6	379	715
Natura 2000 area	surface (ha)	82,526	13,946	25,399	7,513	129,385	1,155,343
National monuments	number	847	3,759	1,361	201	6,168	61,863
Total damage (SSM2017)	million €	1,155	77,637	23,896	621	103,308	650,000
Low probability (1:1000 per year)							
Flooded surface area	surface km²	1,519	11,171	5,668	285	18,643	41,771
Potentially affected residents	number (x1000)	113	4,068	2,277	27	6,484	17,686
IED installations	number	75	778	253	8	1,114	3,997
Drinking water extraction locations	number	21	78	0	0	99	452
Swimming water locations	number	238	174	96	8	516	715
Natura 2000 area	surface (ha)	84,669	54,778	29,137	7,651	176,235	1,155,343
National monuments	number	1,470	10,693	2,531	285	14,979	61,863
Total damage (SSM2017)	million €	4,335	293,375	67,257	1,357	366,323	650,000

Extreme situation (1:10000 per year)							
Flooded surface area	surface km2	1,666	14,621	5,668	285	22,240	41,771
Potentially affected residents	number (x1000)	181	7,944	2,277	27	10,428	17,686
IED installations	number	138	1,036	253	8	1,435	3,997
Drinking water extraction locations	number	25	87	0	0	112	452
Swimming water locations	number	241	259	96	8	604	715
Natura 2000 area	surface (ha)	86,529	68,551	29,137	7,651	191,868	1,155,343
National monuments	number	2,201	22,895	2,531	285	27,912	61,863
Total damage (SSM2017)	million €	7,868	518,418	67,258	1,357	594,901	650,000

Appendix 4
High Water Protection Programme

Summary of the High Water Protection Programme proposal 2022-2027

Amounts in 1000 €

Meaning of the colour coding	
	pre-exploration phase
	plan development phase
	implementation phase
	'fast lane'

Regular projects

Project name	Length (m)	Number of structures	2020	2021	2022	2023	2024	2025	2026	2027
Approach Structures		7	1,393	12,109						
Den Oever - Den Helder, incl. connection points	17,100			12,599		33,916	33,916	33,916		
Durgerdam connection	560			12,800						
Markermeerdijk connection	1,554									
North Sea canal (D31 to D37)	3,680	2	2,114			3,629	3,629	3,629	3,629	
Wieringermeer C flood defence system	6,000	3		5,358		18,218	18,218	18,218		
Culemborgse Veer-Beatrix Sluis (CUB)	10,347			15,500		15,500	15,500	15,500	15,500	
Irenesluizen-Culemborgs Veer	9,535			9,535			14,303		14,303	14,303
Salmsteke	1,951			3,761	8,000					
Salmsteke Schoonhoven (SAS)	8,339		11,216	-3,214	12,509		12,430	12,430	12,430	12,430
Improve former C flood defence system HDSR (GHIJ)	10,800	47	5,758			7,622		20,740	20,740	20,740
Vreeswijk - Jaarsveld	11,300	1	8,086			16,950		16,950	16,950	16,950
Waaiersluis in Gouda	50	1	800	516						
Wijk bij Duurstede Amerongen (WAM)	9,800	2		14,700		9,847	9,847	9,847	9,847	
IJsseldijk Gouda (VIJG) track 2		3		1,106	2,890	2,890	2,890	2,890		
IJsseldijk Gouda (VIJG) track 4 (GHIJ)	919			410		520		3,896	974	
Kunstwerken Spaarndammerdijk		4	900	-450		450		950		3,333
Improvement IJsseldijk Gouda Stadsfront Forelands track 3	102	2		677		476		3,484		
Krachtige IJsseldijken Krimpenerwaard (KIJK)	10,472		24,000	1,230	25,799	36,366	36,366	36,366	35,136	
Boxmeer - Cuijk (section)	17,000	17				5,000			9,910	
Cuijk - Ravenstein	20,724	10	6,559			10,710		21,944	21,889	21,889
Ravenstein - Lith	26,552	2	13,800	4,589		44,444	44,444	44,444	2,567	
Moerdijk	1,724							556		1,667
Standhazense Dijk	730				750	4,250				

Genemuiden-Hasselt	7,191									
Keersluis Zwolle	283	1				260		700		4,592
Mastenbroek IJssel	14,623				3,900			7,800		22,100
Mastenbroek Zwarte Meer	5,770	1					3,745		3,745	
Stadsdijken Zwolle (15E)	7,651	19	30,000		26,667	26,667	26,667			
Vecht - Stenendijk Hasselt	1,284		3,060	-146	6,780					
Vecht Dalfsen Zwolle	32,000	3					12,248		20,413	20,413
Vecht-Noord			333							
Vecht-Zuid			333							
Zwolle-Olst	28,880	3		27,603		44,444	44,444	44,444	44,444	44,289
Mastenbroek Zwarte Water	11,700	1								
Vecht Zwartewaterland	9,800	2								
Vecht-Oost	10,900	1								
Koehool- Lauwersmeer	47,300		1,128	23,940			44,444	44,444	44,444	44,444
Lauwersmeerdijk	4,394		-2,287	2,287						
Lindekering (former category C flood defence)	15,400	16		1,200		1,500		16,700		
Schiermonnikoog - Waddenzeedijk	3,900	1			1,389	2,222		26,222	6,556	
Schiermonnikoog dunes	1,688				1,000	2,000		19,600	4,900	
Zurich-Koehool	23,000	1							7,100	
Geervliet - Hekelingen 20-3	12,600	1	2,500	1,641	2,500		8,933			
Zettingsvloeiing V3T	6,050				29,254	7,314				
Kerkhovenpolder-Germany LRT3	7,144						2,500		5,001	
Alexanderhaven AB	660									
Neer										
Roermond sub trajectory Zuid	1,712	15			1,764	2,527		14,815		
Eemshaven-Delfzijl	11,770		498							

Lauwersmeer/Vierhuizergat	9,018		10,224			16,245	16,245	16,245	16,245	
IJsselpaviljoen Zuthpen	124									
Spijk-Westervoort; Sub-project 1	9,000			11,106			8,500		20,252	21,652
Spijk-Westervoort Sub-project 2	9,000							6,488		
Gorinchem-Waardenburg (GoWa)	23,450	1	44,444	44,444	44,444	44,444	44,444	44,444	44,444	44,444
Neder-Betuwe	20,200		13,500	10,280		44,444	44,444	44,444	44,444	2,624
Sprok-Sterreschans-Heteren	38,459			4,000	4,200			27,000		
Sprok-Sterreschans-Heteren Crossing A15	404									
Tiel Town excl. Fluvia	2,585		6,413		30,200					
Tiel Town Fluvia	1,000		500							
Streefkerk Ameide Fort Everdingen (SAFE)	11,755		7,973	-160	8,000			40,000		
Tiel - Waardenburg (TiWa)	19,500			44,444	44,444	44,444	44,444	44,444	44,444	30,884
Vianen	925		9,666							
Vianen Hazelaarplein	270		3,855	-159						
Wolferen-Sprok - De Stelt	722									
Wolferen-Sprok incl. DTO	13,175			44,444	44,444	25,022				
Emanuelpolder	2,550									
Zuid-Beveland Oost, Oosterschelde	1,850					440		440		4,620
Zuid-Beveland Oost, Westerschelde	1,100					336		336		3,528
Zuid-Beveland-West, Westerschelde Hansweert	4,507	1			16,887	16,887	16,887	16,885	16,887	
Zuid-Beveland West, Westerschelde S2	24,300				640		640		6,720	
Zuid-Beveland West, Westerschelde S3	1,000				80	80	840			
Apeldoorns canal	2,810			14,547						
Eemdijk-Spakenburg, section Westdijk	360									
Grebbedijk	5,354	2		5,495			36,976	9,244		
Noordelijke Randmeerdijk (incl. WDOD)	977	10	570		3,572					

IJsselmeerdijk	17,600		6,861	-11	11,538		41,527	41,527	41,527	41,527
Oostvaardersdijk	5,100	3								2,000
Zuidermeerdijk/MSMF	1,200			1,600						
Structures Noordoostpolder		3				300	1,700			
TOTAL	**663,234**	**186**	**214,199**	**327,779**	**331,651**	**490,365**	**591,173**	**711,984**	**535,441**	**378,430**

Regularprojects "Bestuursovereenkomst Maas"

Project name	**Length (m)**	**Number of structures**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
Arcen (19J)	5,103	18		5,575		29,178	29,178			
Baarlo (19M)	4,789	23		5,500			19,797			
Beesel (19P)	1,185	5	18,170	7,857						
Belfeld (19Q)	964	11	1,111	9,700						
Blerick de Oude Gieterij (19C)	240									
Blerick-Groot Boller (19S)	1,231	2			3,213			12,934		
Buggenum (19O)	1,270	4	6,776			20,400				
Heel (19I)	3,015	1	17,363	7,067						
Kessel (19R)	147	2								
Nieuw-Bergen (19N)	**1,831**	**4**	**1,111**		**25,208**					
Steyl-Maashoek (19D)	**235**	**3**	**1,827**		**10,100**					
Thorn (19H)	**4,325**	**4**		**5,500**			**40,000**	**8,754**		
Venlo Velden (19L)	**5,672**	**23**			**5,057**			**16,287**	**4,072**	
Well (19K)	**5,167**	**22**		**5,575**		**32,553**	**37,008**			
Willem Alexanderhaven C (23C)	538		2,444		7,800					
TOTAL	**35,712**	**122**	**48,802**	**46,773**	**51,378**	**82,130**	**125,983**	**37,976**	**4,072**	**0**

Rijkswaterstaat [Department of Waterways and Public Works]

Project name	Length (m)	Number of structures	2020	2021	2022	2023	2024	2025	2026	2027
Sluis Bosscherveld connection	150									
Drongelens Canal (P52)	4,950									
IJmuiden Dike	819									
IJmuiden structures		6								
Keerschuif Prs. Marijkesluis		1								
Marken	5,300		510	3,091	11,432	10,358	12,301	4,237	3,714	107
SVK Hollandsche IJsselkering storm surge barrier (gate)		1								
Vlieland	1,000	1								
Voorhavendijken Noordelijke Lekdijk (bestuursovk HDSR)	3,700			6,600	2,300	12,600		9,000	2,400	
Total available budget Government projects			6,580	12,183	13,731	23,557	16,372	32,584	33,950	51,750
TOTAL	**15,919**	**9**	**7,090**	**21,874**	**27,463**	**46,515**	**28,673**	**45,821**	**40,064**	**51,857**

Regular projects "pre-financing"

Project name	Length (m)	Number of structures	2020	2021	2022	2023	2024	2025	2026	2027
Gouwzee & Buiten IJ										
Katwoude	3,100									5,500
Monnickendam Binnenstedelijk	1,750									
Monnickendam Zeedijk	3,750									1,900
Schellingwoude	2,050									
Volendam (Zuideinde)	1,600									1,600
Geertruidenberg/Amertak	7,222									
Willemstad - Noordschans	9,476									1,100
Lob van Gennep	13,844	24	11,500	291						
Industrieterrein Grutbroek	600	5								762
RIDS Phase 1 IJsselkade	161		2,073							
Rijnkade Arnhem	1,204									13,274
Twente canal - regular section - LRT3	200									
Twente canal - Zuid (LBO1)	506			344						
Kop van Ossenisse	2,800									
Sint Annaland	600		320	-320						320
TOTAL	**48,863**	**29**	**13,893**	**316**	**0**	**0**	**0**	**0**	**0**	**24,456**

Appendix 5
Assessment and reinforcement of regional flood defence systems in the planning period

Table A gives the planning of the water boards for assessing the regional flood defence systems which protect area C. Several water boards have recently completed an assessment round. In that case, the dates for the new assessment will be established under the new Environment and Planning Act which is expected to come into force in 2022. The reference date for the number of kilometres regional flood defences with a standardisation of 1/100 per year or more is 1 August 2020.

Water boards:	year-end assessment regional flood defence	kilometres of regional flood defences with a standardisation of 1/100 per year or more
Aa en Meuse	2019	59
Amstel, Gooi en Vecht	2024	591
Brabantse Delta	2019	192
De Dommel	2019	10
De Stichtse Rijnlanden	2024	61
Delfland	2024	438
Drents Overijsselse Delta	2014	114
Fryslân	2022	3,062
Hollands Noorderkwartier	2024	494
Hollandse Delta	2024	5
Hunze en Aa's	2023	606
Limburg	-	3
Noorderzijlvest	2017	477
Rijn en IJssel	2024	20
Rijnland	2024	1,098
Rivierenland	2024	76
Scheldestromen	2021	146
Schieland en de Krimpenerwaard	2024	206
Vallei en Veluwe	2024	27
Vechtstromen	2027	32
Zuiderzeeland	2022	31

Table A The planned year end of assessments per water board (reference date August 2020*)

* The table will be updated during 2021

Table B shows which length of the regional flood defences that protect area C do not meet the standard for the regional flood defences with a standard of 1/100 a year or more and in what year the agreed reinforcements were carried out.

Water Board	How many kilometres of regional flood defences do not meet the standard	In which year must the regional flood defences meet the standard
Aa en Meuse	0	2018
Amstel, Gooi en Vecht	76	2024
Brabantse Delta	21	2023
De Dommel	3	2021
De Stichtse Rijnlanden	51	2024
Delfland	7	2030
Drents Overijsselse Delta	0	2015
Fryslân	172	2027
Hollands Noorderkwartier	264	2020
Hollandse Delta	0	2020
Hunze en Aa's	10	2029
Limburg	n/a	n/a
Noorderzijlvest	111	2020
Rijn en IJssel	1	2024
Rijnland	498	2030
Rivierenland	106	2024
Scheldestromen	6	To be determined
Schieland en de Krimpenerwaard	4	2020
Vallei en Veluwe	0	2019
Vechtstromen	0	2027
Zuiderzeeland	0	2018

Table B Reinforcement of regional flood defences systems in the planning period (reference date August 2020*). The number of kilometres to be reinforced is indicative. determining the sections to be reinforced is a cyclical process in which other spatial developments play a role. Source: Waterschapsspiegel 2020

* The table will be updated during 2021

Appendix 6
Objectives of the International Flood Risk Management Plans for the Rhine, Meuse, the Scheldt and Ems

The International Flood Risk Management Plans for the Rhine, Meuse, the Scheldt and Ems contain the following objectives for flood risk management in the period 2022-2027:

Rhine	Meuse	Ems	Scheldt
Prevent new unacceptable risks	Effective international coordination of measures with cross-border consequences	Prevent new unacceptable risks (in the phase before a flood event)	Strengthen cross-border coordination in the planning and follow up of measures with cross-border impact.
Reduce existing risks to an acceptable level	Improve high water expectation and warning	Reduce existing risks to an acceptable level (in the phase before a flood event)	Better information exchange about high water and flooding
Reduce negative consequences during a flood event	Improve system knowledge of flood risks	Limit negative consequences during a flood event	Better knowledge exchange to explain decisions better
Reduce negative consequences after a flood event		Limit negative consequences after a flood event	

Colofon

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This English translation is suitable for international consultation. However slight differences in the contents between the original Dutch text and this translation might occur, apart from grammatical imperfections. Therefore the only valid document is the Dutch version of the Overstromingsrisicobeheerplan 2022 - 2027

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