



Delta Programme 2014

Working on the delta

Promising solutions for tasking and ambitions





Safety



Freshwater



New Urban Development and Restructuring



Rhine Estuary-Drechtsteden



Southwest Delta



IJsselmeer Region



Rivers



Coast



Wadden Region

The Delta Programme is a national programme, in which the central government, provinces, municipal councils and water boards work together, involving social organisations and the business community. The objective is to protect the Netherlands from flooding and to secure a sufficient supply of freshwater for the generations ahead.

The Delta Programme mapped out Situation 2014



Projects and implementation programmes

Project numbers refer to programmed measures in the Delta Programme (see tables 5 up to 11 inclusive in Section 2)

Delta Programme MIKT Studies

- 100 project number
- Generic sub-programmes**
- Safety (not a MIKT Study)
 - Freshwater
 - New Urban Development and Restructuring

Area-based sub-programmes

- Rhine Estuary-Drechtsteden
- Southwest Delta
- IJsselmeer Region
- Rivers
- Coast
- Wadden Region

New Flood Protection Programme (HWBP)

- 200 project number
- project (any colour inside indicates plan phase)
 - general project (early 2014)

Second Flood Protection Programme (HWBP-2)

- 500 project number
- improvements to dyke, dune or dam
 - improvements to structures
 - dyke section
 - Weak Links on the Coast project

Room for the River (RfR)

- 600 project number
- project location

Further elaboration of area around the major rivers (NURG)

- 700 project number
- project location

Meuse Projects: Grensmaas and Zandmaas

- 800 project number
- project location

Repairs of stone-cladding in Oosterschelde and Westerschelde

- 900 project number
- stone-cladding (coloured line indicates plan phase)

Management and maintenance

Deposits for Zeeland coastal management

- deposit location
- Sand replenishment location
- beach replenishment
- shoreface replenishment

Other projects

- 300/400 project number
- project location
 - Waal/Veelde
 - Current status per project**
 - exploration
 - plan elaboration
 - realisation
 - finished (as of 1/1/14)
 - research

Basic map

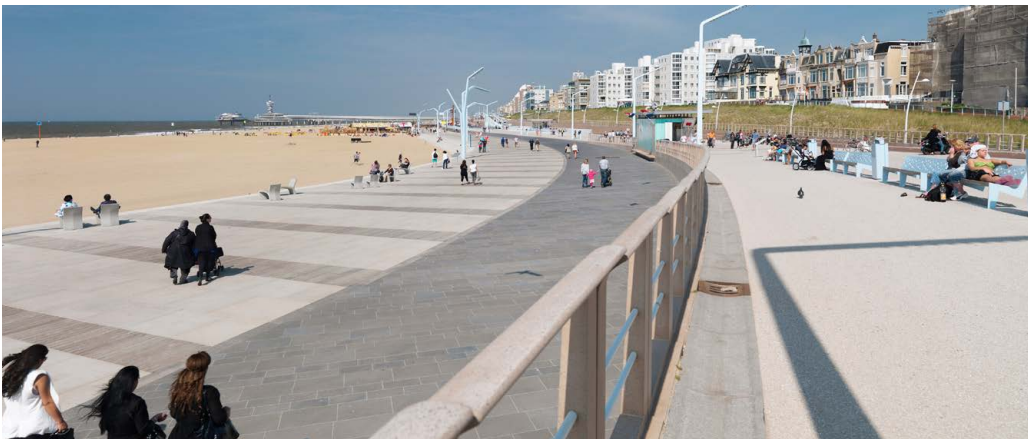
- primary flood defence system / elevated soils
- areas outside the dykes
- basic coastline
- urban area
- dyke rings susceptible to flooding
- dunes
- elevated (sandy) soils

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Scheveningen coastal reinforcement.
More sand and a strong dyke in a newly designed boulevard make Scheveningen safe as well as attractive.

Photo cover: March 2013. The 'Sand Engine' off the coast between Ter Heijde and Kijkduin is an innovative way of protecting and maintaining the coast. Nature helps protect us against the sea ([🔗](#) see page 110).

Photo page 2: April 2009. Walcheren coastal reinforcement – province of Zeeland.

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A high-resolution version of the maps in this publication is available [online](#).

1 Introductory summary

“(…) issues that are fundamental to our country, such as a sound way of dealing with water.” So said King Willem-Alexander during his inaugural address on 30 April 2013. The Delta Programme is a good example of this: fundamental to the physical safety and economy of our low-lying country, now and in the longer term. Since 1 January 2012, the statutory foundation of our work is based on the Water Act as amended by the Delta Act on flood risk management and freshwater supplies.

We have to protect more people and more economic value now than we did 60 years ago, when the 1953 flood disaster took many casualties and caused considerable damage. The climate is also changing, with sea levels rising and soil subsiding: that has been measured over a number of years now. We want to be ready for the future in good time. While we know what direction things are going, we do not know at what rate. The (revised) Delta Scenarios point to (four) possible futures, for which the Delta Programme has drawn up a response. The massive floods in Austria, the Czech Republic, Germany and Poland in June of this year underline the importance of a safe delta.

In the past, water policy was often drawn up in response to a disaster. Now we want to avoid any disasters, and, given the uncertainties, that requires an adaptive and flexible approach. This is precisely the approach the Delta Programme has gone for, in terms of both flood risk management and freshwater supplies. Doing nothing or too little or responding too late is risky and not the preferred option. Doing too much is inefficient. In the Delta Programme, we collaborate with all stakeholders from the outset – government authorities, businesses, knowledge institutes and social organisations – on the two national objectives from the Water Act as amended by the Delta Act: flood risk management and freshwater supplies. In that way, all the relevant facts can be collected, investigated and shared. We carry out the analyses together and then establish and discuss the viable and promising solutions with each other. Sensible and dynamic. This approach provides new insights, creates widespread support for the decisions and measures to be taken later, and presents opportunities to link other (spatial and economic) developments. Efficient and effective. The Delta

Programme Commissioner directs this process on behalf of the government and monitors progress. As in previous years, this report, the Delta Programme 2014 (DP2014), includes the Delta Programme Commissioner’s proposal and the Cabinet’s response.

The Delta Programme started in 2010 with working on a safe and attractive Netherlands, now and tomorrow. The programme covers both tasking and ambitions. The timeline presented at the time still applies, and we are very much on schedule. This DP2014 contains the draft proposals for the Delta Decisions and the promising strategies for all the relevant areas in the Delta Programme. Next year, DP2015 will contain the final proposal for the five cohesive and structuring Delta Decisions and the preferential strategies for flood risk management and freshwater supplies in the Netherlands. After four years of intensive work on the Delta Programme by a host of stakeholders, this will provide the basis and framework for working on the delta in the future. This work will be carried out immediately after the projects which are currently ongoing along the coast, rivers and lakes and which will be finalised in the next few years. This allows us to avoid wasting any time and to already anticipate future developments. That’s what is happening in the new Flood Protection Programme (*Hoogwaterbeschermingsprogramma* (HWBP) in Dutch), for instance, which can be regarded as the first new implementation programme of the Delta Programme and whose initial programming is clear from this DP2014. It is an enormous task. The programme office of the Directorate-General for Public Works and Water Management (*Rijkswaterstaat* in Dutch) and the water boards are leading the way.

Once adopted, the Delta Decisions will be specified and translated into concrete explorations, plan elaborations and realisations in accordance with the Multi-Year Programme for Infrastructure, Space and Transport (*Meerjarenprogramma Infrastructuur, Ruimte en Transport* (MIRT) in Dutch) system. The Delta Programme’s successful, programme-based approach will be retained and continued, modified to suit the next phase. A proposal to this end is being developed and will be worked out for DP2015. The Delta Decisions will then be permanently embedded in the follow-up to the National Water Plan.

What is already clear is that we still have decades of work to do on our delta to reach the goals set. Every year, there is approximately € 1 billion available from the Delta Fund for flood risk management and freshwater measures and the requisite maintenance. Approximately € 600 million of that is available for investments. The horizon of the Delta Fund is currently 2028. The available annual budget of the Delta Fund determines the period of time required to implement all the essential measures. Based on the resources currently available and extrapolated, the Delta Programme Commissioner believes that implementing the necessary measures in good time, i.e. before 2050, is a challenge. He considers this to be a long period of time.

In any case, over the next few decades, there will be plenty of space and opportunity in the 'Netherlands home market' for a steady stream of investments in our delta, and as such opportunities for innovations in the business community that can help us achieve our goals and that the business community can then export (Top Sector Water). *'Bring in the Dutch'* and *'The Dutch Delta Approach'* are expressions you often hear, especially in the US, but also in many other delta countries, such as Vietnam, Indonesia, Singapore and Bangladesh.

DP2014 outline

Within the Delta Programme new standards for flood risk management are being developed and elaborated, in accordance with the April 2013 policy letter from the Minister for Infrastructure and the Environment,¹ elaborating on the 2012 parliamentary decision.² The new standards have been made possible by the new insights and methods that have become available. The current, legally embedded overtopping probability standard for dykes will be replaced in a few years by a flood probability standard based on a risk-based approach, which will address the likelihood of a flood as well as the consequences of a flood. The proposal is to have this new approach accompanied by the principle of tolerable individual risk (i.e. a basic safety level regarding individual loss of

life due to flooding) (10^{-5}) for everyone living or working in an area that is protected by dykes, dunes or dams. In some areas (with a lot of people and/or significant economic value), opting for a higher level of protection may be preferable and more cost-effective. As a result, more customisation will be possible, also in the dyke ring, allowing financial investments to contribute to safety in a more efficient manner. Three areas require particular attention because protection there has to be increased: the area around the major rivers, parts of the Rhine Estuary-Drechtsteden and the area around Almere. By implementing the new approach, the potential number of fatalities and economic damage caused by floods in the Netherlands will decrease over time, and everyone in the Netherlands living behind a dyke, dune or dam will be able to rely on the same basic safety level. The proposal for the new standards will be determined by way of an interactive process with the regions. They will provide recommendations based on their area. This will create support for the new standards and for the necessary measures. Significant investment is required in those areas where safety levels have to be increased, creating the greatest tasking for the area around the major rivers. Where relevant, a combined approach with existing flood risk management tasking can be taken to deal with this. This 'combined work' approach will deliver a synergistic advantage and ensure that the work required creates less nuisance to citizens and businesses. In those areas where, according to the new standards, safety levels are satisfactory, the situation will for the time being primarily be one of properly managing and maintaining the flood defence systems. The new safety approach is fundamentally different to the current approach. Our delta is a safe delta and will remain so. Where required, it will be made even safer.

Expectations are that our country will get drier and that salinisation will increase. Freshwater users are already experiencing this. Over the coming years, new policy will be formulated with a number of specific government investments as well as regional agreements on supply levels. By doing this, the ambitions up to 2050 can be achieved and it is expected that more far-reaching measures can be postponed.

¹ Parliamentary document 33400 J, no. 19.

² Van Veldhoven-Lucas motion, Parliamentary document 27625, no. 262.

The cost-effectiveness of measures is an important aspect of this. The Delta Programme will present the results next year. As regards the distribution of the fresh river water, we are aiming for a water supply that is as predictable as possible, in the form of ranges of supply levels on which users can depend. Further agreements with users on their commitment to reducing demand will be made. Given their responsibility for the spatial economy, the provinces can steer these regional agreements. Social organisations such as Vewin (the Association of Dutch Water Companies, *Vereniging van waterbedrijven in Nederland* in Dutch) and VEMW (the Association for Energy, the Environment and Water, *Vereniging voor Energie, Milieu en Water* in Dutch) are already actively involved. Under the guidance of the LTO (the Dutch Federation of Agriculture and Horticulture, *Land- en Tuinbouw Organisatie* in Dutch), the agricultural sector has included cutting freshwater consumption, water conservation per area and a smarter distribution and buffering of water in the Delta Plan on Agricultural Water Management, which is a fine example of social participation in the Delta Programme. Innovations are also required for the freshwater supply, from users as well as from the government. Examples include bubble plumes for decreasing salt intrusion in the Nieuwe Waterweg or level-driven drainage on the elevated (sandy) soils. In doing so, the Delta Programme contributes to the economic development of sectors and businesses dependent on freshwater and to a sustainable use of water. The Ministry of Economic Affairs is involved in this.

Safety measures will include ‘classic’ dyke improvements as well as spatial solutions (room for the river). The choice will depend on the local situation and the costs and benefits. An integral approach is also an option for dyke improvements, as the Prins Hendrik dyke on Texel and the Sophia beach in Noord-Beveland have demonstrated.

Next year’s DP2015 will include the concrete decisions for protection provided by dyke improvements and/or river widening. These decisions will affect the Rhine-Meuse delta: along the rivers (Meuse, Waal and IJssel) and the important transitional area between sea and river on the east side of the Rhine Estuary-Drechtsteden. This involves customisation per area, which

will provide opportunities to tie in other interests to maximum effect. A further exploration is being conducted in ‘Central Holland’ into the best way to protect this hinterland area in the future. Major investment in the various dykes (category-c dykes³) is required. It is already clear that investing in certain parts of the Lek dyke is more cost-effective than tackling the so-called category-c dykes in the area. This exploration will be finished prior to DP2015. In the Southwest Delta, parties are preparing a central government framework vision for the future of the Grevelingen and the Volkerak-Zoommeer lakes. This will be finished next year and should provide an answer to the issues of storing fresh river water in the Grevelingen lake, salt water in the Volkerak-Zoommeer lake and/or return of the tides in the Grevelingen lake. An integral area development is the key part of this. This is important for the regional economy and the ecology. With a view to safety, there will be alignment with the measures in the Rhine Estuary. This will be done in the Delta Decision on the Rhine-Meuse delta.

Multi-layer flood risk management can contribute to achieving the safety level if standard solutions only involving dykes and/or room for the river (i.e. prevention) are not or barely socially or financially viable. This is the case in Marken and Dordrecht. Next year, the sub-programmes will develop the options of multi-layer flood risk management into concrete pilots, on which DP2015 will report.

Disaster management will be given more attention and will next year also focus on an action strategy for citizens and businesses in the event of imminent or actual flooding. The Ministry of Security and Justice, Rijkswaterstaat and the security regions are all closely involved in this.

If possible, ‘Building with nature’ will be rolled out as one of the solutions for creating physical safety. Experience with this concept has already been gained: with the ‘Sand Engine’, shorefaces and salt marshes, and climate buffers. Furthermore, compared with the

³ Category-c dykes are primary flood defence systems that provide compartmentalisation between the dyke rings or only retain enclosed water systems.

past, we are increasingly looking at varied use of the flood defence systems, as with the boulevard in Scheveningen. ICT will also play a more sizeable role (e.g. IJkdijk or Livedijk and new, faster computer technology such as 3Di). This will establish a 'new way of working on our delta' to protect our country and make it more robust.

The National Coastal Vision will be presented at the same time as DP2014. This vision has been drawn up by all the government authorities in the sub-programme **Coast** in consultation with numerous parties. The safety of the coast must be guaranteed and it is an important tourist attraction. The integral approach has proved successful here, also for the economic development along the coast. Where possible, measures for both objectives can be combined.

The Delta Programme develops proposals for climate-proof spatial organisation: a water-robust design. The general points of this are presented in DP2014. Coalitions of public and private parties are preparing an approach with which municipal councils, housing associations and project developers can make better preparations for pluvial flooding, major drought or heat stress in developed areas. In the future, spatial plans will have to pay more heed to flood risk management by making a more conscious choice of locations and employing adapted construction where necessary and worthwhile. A policy framework in which water and spatial organisation will be systematically linked together will be ready next year. Special attention will be paid to vital uses such as power plants and hospitals. In some cases, these have to be better protected. Flood risk management in the **Wadden Region**, for instance, requires special attention because of the nationally important role that Groningen plays in terms of energy supply.

In the **IJsselmeer Region**, work will be done on making the water levels of the lake more flexible and designing the area above that to increase water supplies and to be able to anticipate current meteorological conditions in a flexible manner. This also presents opportunities for nature. Installing pumps in the (revamped) IJsselmeer Closure Dam is essential for the flood risk management of the IJsselmeer Region.

The IJsselmeer Closure Dam project has already made a start on this. There is no need to expand the supply area of the IJsselmeer lake with (water for) the western part of the Netherlands as there are better solutions available for that.

A dynamic implementation of the Delta Programme is not only important to provide people with the requisite protection; it also has an important economic impact. Implementation of the Delta Programme, for example, ensures the safe continued existence of our country, creating a business climate that attracts international companies. Working on a robust freshwater supply and making it more transparent also contribute to the economic strength and appeal of the Netherlands. With DP2014, we are once again taking an important step towards achieving the goals into which all the partners in the Delta Programme are putting their backs: a country that is safe in the short and long term and enjoys good freshwater supplies.

2

The Delta Programme's programmed measures

(photo) May 2013. First measure of the four Nederrijn projects as part of Room for the River: flood plain excavation in Middelwaard.



The Delta Programme's annual report provides an overview of all programmed measures in the field of flood risk management and freshwater supplies. New this year is the first programming of the new Flood Protection Programme. This programme is a key part of the Delta Programme and should be regarded as the first implementation programme.

2.1 Introduction

Overview of programmed measures

This section outlines all programmed projects and implementation programmes under the Delta Programme funded by the Delta Fund (☞ table 1). To this end, the projects and programmes have been arranged according to the stages of the MIRT system: studies, explorations, plan elaborations and realisation. The projects and programmes for management, maintenance and replacement have also been included.

The programming for each project or implementation programme has been included for the next six years, with a look ahead to the next twelve years where possible and applicable (in accordance with Section 4.9 (5) of the Water Act as amended by the Delta Act).⁴ The information is based on the Delta Fund's 2014 draft budget, the MIRT Projects Book and available progress reports. These documents provide more information on the projects referred to and their financing.

The projects and implementation programmes have also been literally mapped out: the map ☞ 'Delta Programme mapped out' on the inside cover provides an overview of

all the measures that are currently being implemented, prepared or researched. The numbering and colour of the measures on the map are the same as the numbering and colours of the projects in the ☞ tables included in this section.⁵

Delta Plans on Flood Risk Management and Freshwater

In line with the wishes of the House of Representatives⁶ and in accordance with the Administrative Agreement on Water, the Cabinet has collected all the Delta Programme measures and projects in the Delta Plan on Flood Risk Management and the Delta Plan on Freshwater. Both Delta Plans do not only comprise national measures but may also include regional measures. The Delta Plans contain measures that are being researched, prepared (i.e. exploration or plan elaboration) or implemented (realisation). Other types of measures that are not related to the physical system can also be covered, e.g. spatial reservations for future measures and instruments to encourage intended behaviour. The plans provide a look ahead at the major investment decisions that will need to be addressed after 2050. The measures are based on the Delta Decisions and the area-based preferential strategies that the Delta Programme Commissioner will propose next year and which the Cabinet will adopt in 2014/2015.

Next year, the Delta Plans on Flood Risk Management and Freshwater will be part of the Delta Programme's annual report for the very first time. After that, there will be an annual update ('ongoing programme'). A key part of the Delta Plan on Flood Risk Management is the new Flood Protection Programme. This section should be seen as a prelude to the Delta Plans on Flood Risk Management and Freshwater.

The Delta Plan on Freshwater will include the measures, instruments and agreements concerning freshwater. This programme will not be as exhaustive as the Delta Plan on Flood Risk Management. ☞ Sub-section 3.2 provides examples of the measures that could be included here.

The programming of the Delta Plan on Flood Risk Management and the Delta Plan on Freshwater will be interconnected to ensure synergy between the measures. The Delta Programme Commissioner will monitor this

⁴ Projects that have already been completed are not in the tables.

⁵ This map also shows completed projects. Information on completed projects can be found in 'Water mapped out', Parliamentary document 27625, no. 290.

⁶ Van Veldhoven motion, Parliamentary document 33000-XII, no. 81.

2.2 Studies

interconnectivity and oversee the progress of implementation. Political responsibility lies with the Minister for Infrastructure and the Environment.

New Flood Protection Programme

The new Flood Protection Programme (HWBP) is the new and as such de facto first implementation programme of the Delta Programme. Room for the River (RfR, *Ruimte voor de Rivier* in Dutch), the Meuse Projects and the Second Flood Protection Programme (HWBP-2) are also part of the Delta Programme, but were already being implemented when the Delta Programme started. These programmes still have their own organisation, direction and financing, and will for the most part be completed in 2017 or thereabouts. The Delta Programme aims to prepare and implement the flood risk management measures required over the next few decades alongside those programmes already being implemented. The tasking arising from the Third Assessment of the primary flood defence systems (2011) is the first to be considered for implementation. The water boards and Rijkswaterstaat supplement this within the HWBP by reinforcing the flood defence systems that failed inspection and/or exploring other solutions. [Section 2.3](#) provides further details on the first programming of the HWBP.

Delta Programme MIRT Studies⁷

The Delta Programme studies to prepare the Delta Decisions and preferential strategies are carried out in the nine sub-programmes. Eight of these studies are MIRT Studies: the sub-programmes New Urban Development and Restructuring, Freshwater, Coast, Rivers, Rhine Estuary-Drechtsteden, Wadden Region, IJsselmeer Region and Southwest Delta. These studies result in a proposal for interconnected and structuring Delta Decisions and area-based preferential strategies. [Section 3](#) provides an outline of the results and the progress of these studies.

⁷ Projects 101-108 on [The Delta Programme mapped out](#).

Table 1 Projects and implementation programmes of the Delta Programme

MIRT Studies (2.2)	Exploration (2.3 and 2.4)	Plan elaborations (2.5)	Realisation (2.6)	Management, maintenance and replacement (2.7)
Delta Programme MIRT Studies	New Flood Protection Programme (HWBP)	IJsselmeer Closure Dam	Second Flood Protection Programme (HWBP-2, including Weak Links on the Coast)	Management, maintenance and water management
Government's framework vision Grevelingen and Volkerak-Zoommeer	Oosterschelde sand demand	WaalWeelde	Room for the River (including IJssel delta and IJsselsprong)	Replacement Tasking for Hydraulic Structures
	TBES Markermeer: Hoornse Hop sheltering measures	Vlieland and Terschelling dyke boundary	Further elaboration of river region	
		Ooijen-Wanssum area development	Meuse Projects (Grensmaas and Zandmaas)	
			Repair stone cladding Oosterschelde and Westerschelde	

Table 2 Programming of Delta Programme MIRT Studies

Delta Programme MIRT Studies		2014	2015	2016	2017	2018	2019	>
101	New Urban Development and Restructuring							
102	Freshwater							
103	Coast							
104	Rivers							
105	Rhine Estuary-Drechtsteden							
106	Wadden Region							
107	IJsselmeer Region							
108	Southwest Delta							

MIRT study
 Exploration
 Plan elaboration
 Realisation

Government framework vision on the Grevelingen and Volkerak-Zoommeer lakes⁸

In 2012, the central government decided to draw up a framework vision for the interconnected development of the Grevelingen and Volkerak-Zoommeer lakes as a follow-up to the Grevelingen MIRT exploration and the project memorandum on water quality in the Krammer-Volkerak. The House of Representatives was updated on the initial decision in early 2013.⁹

The government framework vision on the Grevelingen-Volkerak-Zoommeer lakes will provide a definitive answer on the direction of developments for the Grevelingen and Volkerak-Zoommeer lakes.

The key points are:

- whether or not to reintroduce limited tides in the Grevelingen (tackling oxygen deficiency, generating tidal energy);
- whether or not to have flood storage in the Grevelingen (flood risk management of the Rhine-Meuse delta);
- whether or not to introduce salt into the Volkerak-Zoommeer (tackling excessive blue algae and water plant growth, utilise economic potential, freshwater supply measures; bearing in mind the agreements on the Roode Vaart).

The Rhine Estuary-Drechtsteden and Southwest Delta sub-programmes are closely involved in the creation of the government's framework vision. Where possible, the results of the government's framework vision will be included in the Delta Decision on the Rhine-Meuse delta and the preferential strategy for the Southwest Delta.

⁸ Project 121 on [The Delta Programme mapped out](#).

⁹ Parliamentary document 33531, no. 1.

Administrative Agreement on Water

The new Flood Protection Programme (HWBP) is the de facto first implementation programme of the Delta Programme. The HWBP aims to have the flood defence systems that failed the (extended) Third Assessment once again meet the flood risk management standards. The programming is based on the agreements that the central government, the provinces, the municipal councils, the water boards and drinking water companies laid down in 2011 in the Administrative Agreement on Water. These agreements concern such things as a clear division of responsibilities, less administrative pressure, a manageable programme for the flood defence systems, a smart combination of work, and effectiveness and transparency. The administrative agreement also includes agreements on properly embedding the HWBP in the Delta Programme. The central government and the water boards have agreed that, from 2014, they will pay an equal share (50:50) of the costs of current and future flood protection measures. They will each contribute € 131 million in 2014 and € 181 million annually from 2015. The Administrative Agreement on Water also states that for the purpose of effectiveness, part of the water boards' contribution will be project-related. As such, the fee that the water boards pay comprises a solidarity fee of 40%, which is split across all the water boards, and an effectiveness incentive in the shape of a project-related share of 10% of the costs of an improvement measure. This agreement has already been laid down in the bill Amendment to the Water Act (effectiveness and financing of flood protection) that was adopted unanimously.¹¹ The legislative amendment is expected to come into effect on 1 January 2014.

Ambitions and basic principles

The new HWBP has different ambitions and it will take a different approach than the previous flood protection programmes. By utilising the experience gained from, for example, the Second Flood Protection Programme (HWBP-2), the HWBP has been organised differently with ongoing programming and other innovative basic principles for implementation. More time will be taken to prepare the programme and the projects, there will be more room for innovation and innovative solutions, and the approach will be in line with the MIRT framework.

Interconnectivity between the short and long term and between the various tasking and ambitions is of utmost importance. Investments in the HWBP will be made relatively soon, but apart from any partial reinforcements that have shorter lifecycles, the measures (i.e. investments in infrastructure) will generally have to be long term, often extending into the late 21st century. For an effective approach then, it is important that all tasking and ambitions be considered and other types of solutions investigated. This requires an adaptive approach ([\[\]](#) sub-section 4.2) by explicitly linking short-term decisions to long-term tasking, setting the best time for investment opportunities and connecting different investment agendas.

Like the Delta Programme as a whole, the programming is ongoing. The programme will be updated every year. In accordance with the Water Act as amended by the Delta Act, the programming of the measures has been laid down in detail for the next six years and roughly outlined for the subsequent twelve years. This approach allows the latest insights to be incorporated into the programming every year. This is especially important for the next few years because decision-making on the Delta Decisions and preferential strategies may affect the programming of the HWBP. Due to the ongoing nature, safety can be maximised using the financial resources available. This increases the effectiveness of the HWBP.

In line with the Van Veldhoven-Lucas¹² motion, the new safety approach being developed in the Delta Programme will be included where possible in the prioritisation and implementation of the HWBP ([\[\]](#) sub-section 3.2).

In line with the new approach, the urgency of the various projects has determined the first programming of the HWBP. In other words, the likelihood of a flood and the extent of the consequences of a flood determine the priorities in the implementation. In the first few years, the emphasis in the HWBP will be on explorations and plan elaborations. That is standard at the start of an implementation programme, and in this case also necessary, because over the next few years increasingly larger budgets will become available, especially after 2020. This run-up also presents a good opportunity to anticipate the Delta Decisions and the area-based preferential strategies.

¹⁰ Projects 201-234 on [\[\]](#) The Delta Programme mapped out.

¹¹ Parliamentary document 33465.

¹² Parliamentary document 27625, no. 262.

A joint programme office comprising the water boards and Rijkswaterstaat has prepared and drafted the first programming. The water boards have had their say at an administrative level, in accordance with the unanimously adopted amendment to the Water Act. The programming was then discussed in the regional steering groups of the area-based sub-programmes, a joint HWBP steering group comprising the water boards and central government, and the Delta Programme National Water Consultation Committee (*Nationaal Bestuurlijk Overleg Deltaprogramma* (NBO) in Dutch), respectively. Following the discussions in the regional steering groups and finally in the NBO, the provinces were involved in the programming in line with the agreements from the Administrative Agreement on Water. This is a good approach because it brings together all tasking in the (regional steering groups of the) area-based sub-programmes. This programming was finally adopted in the Council of Ministers as part of DP2014.

HWBP tasking requires a dynamic implementation with room for customisation. With a view to implementing the Delta Programme, the Delta Programme Commissioner called on the water boards and Rijkswaterstaat to set up ‘an *implementation organisation* that anticipates the need to safeguard knowledge, expertise and direction centrally and offers the space for actual area-based and decentralised implementation’. The experience that the HWBP programme office gains will be used to further develop an implementation organisation for the Delta Programme as a whole ([\[2\]](#) sub-section 4.5).

Evaluation framework and budget

When prioritising programme aspects, three elements played a key role. The urgency of a dyke improvement was the first thing to determine the priority. Urgency was decided by mapping out the risk of failure (i.e. severity of the shortcomings) and the consequences (i.e. damage). This criterion led to projects in the area around the major rivers in particular being programmed. Secondly, the priorities of the managers also played a role. In total, 731 km of flood defence systems were rejected. Their managers registered approximately 415 km of these for the first programming period (2014-2019). And thirdly, the budget for the 2014-2019 period and the period after that is a prerequisite for the programming. € 350 million is available for the 2014-2019 period. That is significantly less than the entire budget available for flood protection measures in this period. After all, the lion's share of the money for flood protection will

continue to go to the ongoing HWBP-2 up until 2020. From 2021, there will be considerably more space for the new HWBP: there will be five times more budget available in the 2020-2025 period than there is for the first period. [\[2\]](#) Figure 22 provides an overview of this.

Programming contents

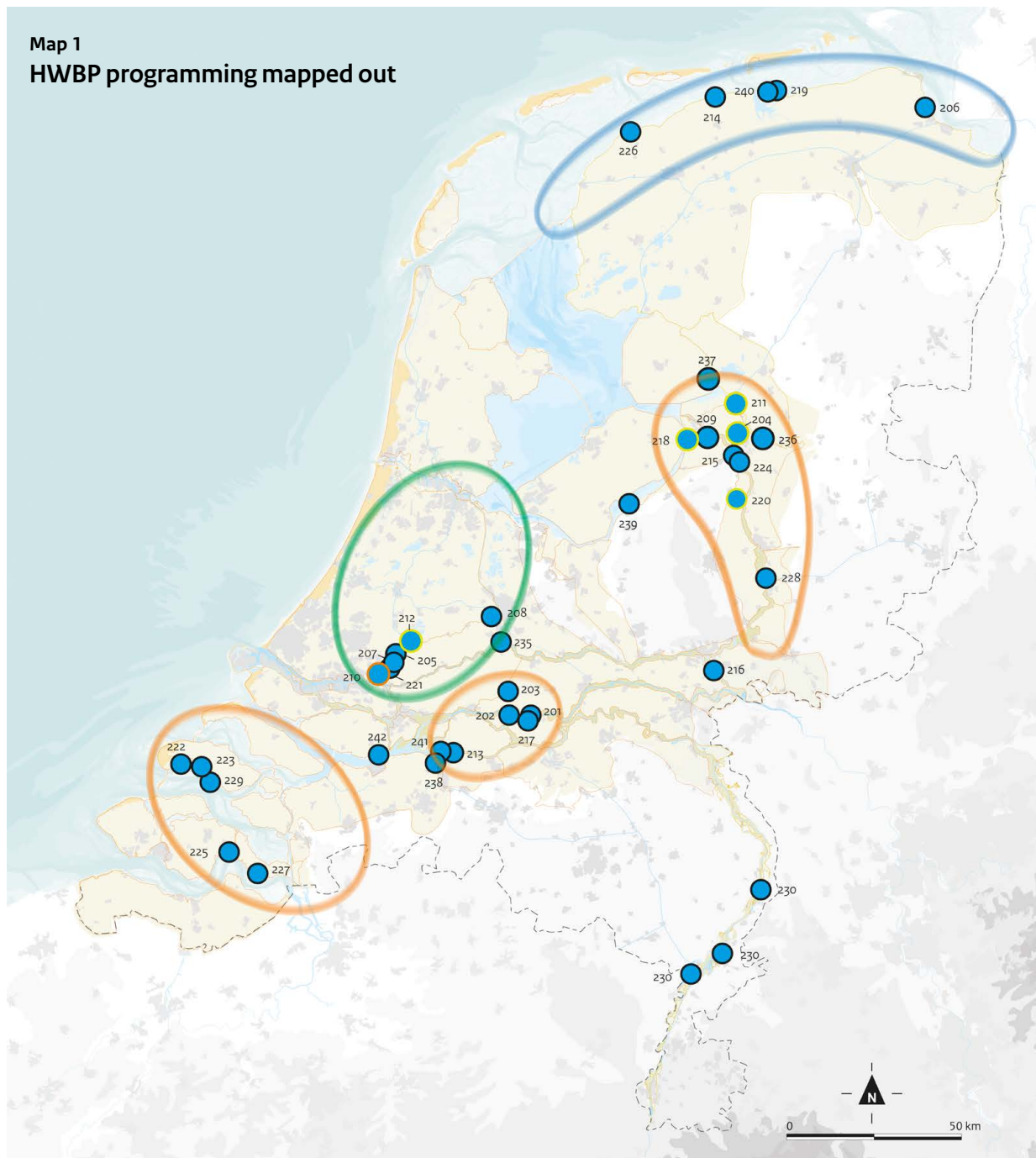
The water boards have registered more than 100 projects for the first programming, corresponding to 415 km. Budget for the first period (2014-2019) will allow a start to be made on the 34 most urgent projects, 180 km in total, most of which will be explored and some projects will be realised ([\[2\]](#) table 3).

All the projects not covered by the first programming have been included in the 2020-2025 period. These are projects with a lower priority, including projects that are ready for implementation or that can be implemented in combination with a HWBP-2 tasking. Seven water boards have put forward a total of eight projects, which will be eligible for a subsidy in the 2020-2025 period, that they want to finance and implement at an earlier stage. These projects are: Bank Erosion at 't Klaphek (Stichtse Rijnlanden), Dalfsen (Groot Salland), ZZL-DR7 and DR8 (Zuiderzeeland), Amertak (Brabantse Delta), Vierhuizergat (Noorderzijlvest), Jannezeand (Rivierenland) and Strijensas (Hollandse Delta).

There are three new and innovative general explorations in the above programming: the Central Holland exploration, the piping issue and the Wadden Sea dykes. These explorations are each linked to one or more of the most urgent projects, and multiple managers and regional government authorities are involved in each exploration. This approach can deliver more efficient solutions and provide additional opportunities for innovation.

- **Central Holland:** as announced in DP2013, a pilot project called 'Safety Central Holland' was launched to find an efficient solution for the safety of dyke rings 14, 15 and 44. There will be a follow-up general exploration to this pilot in the new HWBP in collaboration with the Rivers and Rhine Estuary-Drechtsteden sub-programmes. In Central Holland, several so-called category-c dykes along the Hollandsche IJssel river and the Amsterdam-Rijnkanaal canal failed the Third Assessment. Reinforcing these flood defence systems is expensive, which is why other, more efficient solutions will be explored instead. The exploration will address measures to increase the strength of the Lek dykes (e.g. risk-based approach as an

Map 1 HWBP programming mapped out



● project

● project being explored

● project being realised

General explorations

— Nederrijn-Lek/Central Holland

— Wadden Sea

— piping

Basic map

— primary flood defence system / elevated soils

— areas outside the dykes

— urban area

— dyke rings susceptible to flooding

— dunes

— elevated (sandy) soils

alternative to reinforcing failed category-c dykes) and reduce the load. The exploration will also consider the desired spatial developments and the possible solution strategies for the freshwater tasking (for more information on Central Holland, [\[\]](#) sub-section 3.3).

- **Piping:** piping is a failure mechanism where seepage flows through or under the dyke, taking soil with it and thereby reducing the stability of the dyke. The danger of piping is an issue for many of the dykes that failed inspection. There are also numerous uncertainties where piping is concerned. As such, additional research into the extent of the issue is required. The general exploration will address this and also aims to find innovative and efficient solutions.

- **Wadden Sea:** this general exploration is aimed at finding optimal and efficient solutions for all Wadden Sea flood defence systems in Fryslân and Groningen that failed inspection. The objective is to combine a variety of tasking in the area, e.g. combining dyke improvements with salt marshes, overtopping resistance, innovative dykes and sand replenishments ([\[\]](#) sub-section 3.3).

Table 3 provides an overview of the schedule for the projects in the first programming period (2014-2019). This comprises a financial programming. When they opt to prefinance programmed projects, water boards can start implementing these projects one or more years earlier. The accompanying [\[\]](#) map 1 provides a visual representation of the programmed projects: the circles indicate the projects and the lines indicate the general explorations. [\[\]](#) Appendix B (in Dutch) provides further details on all the programmed projects.

Table 3 – Programming of measures for Flood Protection Programme

Flood Protection Programme		2014	2015	2016	2017	2018	2019	>
Budget: total of € 3,768 million, excl. project-related part (10%), of which € 3,751 million from 2014 onwards (until 2028 inclusive)								
Available budget ex project-related part (10%) in millions of € per year in the 2014-2019 period		18,6	19,9	46,3	47,3	127,3	130,1	
201	Waardenburg-Opijnen							
202	Vuren-Haaftern							
203	Diefdijk							
204	Zwolle							
205	Gouderak							
206	Delfzijl-Eemshaven							
207	Krimpen/Ouderkerk							
208	Central Holland							
209	Around Kampen							
210	Capelle/Moordrecht							
211	Genemuiden							
212	IJsseldijk Gouda							
213	Peerenboom-Genderen							
214	West Holwerderpolder-Lauwersmeer							

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Table 3 – Programming of measures for Flood Protection Programme (continued)

Flood Protection Programme		2014	2015	2016	2017	2018	2019	>
215	IJssel 1 sections							
216	Pannerden/Loo							
217	Gameren							
218	Randmeerdijk							
219	Lauwersmeerdijk							
220	IJssel 2 sections							
221	Capelle/Zuidplas							
222	Burghsluis-Schelphoek							
223	Boerderij de Ruyter							
224	Loswal Hattem and Apeldoorns kanaal							
225	Zuid-Beveland-West							
226	Koehool-West Holwerderpolder							
227	Emanuelpolder							
228	IJssel 3 sections							
229	Zierikzee-Bruinisse							
230	Meuse agreement projects							
231	Explorations following Extended Assessment							

General HWBP explorations		2014	2015	2016	2017	2018	2019	>
232	Piping							
233	Wadden Sea							
234	Central Holland							

Pre-financing for second wave of projects

235	Bank Erosion at 't Klaphek
236	Dalfsen
237	ZZL-DR7
238	Amertak (part of)
239	ZZL-DR8
240	Vierhuizergat
241	Jannezand
242	Strijensas

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2.4

Other explorations

Oosterschelde sand demand¹³

As expected, less water flows into and out of the Oosterschelde since the construction of the Oosterschelde works. Because the tide channels are too large for the smaller amount of water, the water does not flow as quickly as it did and it is not powerful enough to shift sediment from the channels to the intertidal area. While the water still has an eroding effect, it no longer has any constructive effect. This process is known as 'sand demand' and it negatively affects flood risk management, designated uses and the environmental value of this Natura 2000 area. The erosion of the shoals, mud flats and salt marshes impacts the wave attack on the dykes and, therefore, the lifecycle of the dykes. At present, approximately 50 hectares of intertidal area is eroded every year, and this erosion is expected to continue. Of the current 11,200 hectares of intertidal area, only approximately 7,200 hectares will remain in 2060 or thereabouts, and in 2100 this will only be about 4,700 hectares. As such, the erosion negatively impacts the tidal nature, while the storm surge barrier in the Oosterschelde was in fact meant to protect this nature area.

The exploration was started in 2007 to gain an understanding of the effects of continuing the current policy (doing nothing) and the possible measures to manage the sand demand. Running trials is part of the exploration; this includes trials with replenishment to test whether the measures are effective. This year, the Sand Demand exploration will lead to a government framework vision that includes a preferred approach to the sand demand.

The Ministry of Infrastructure and the Environment is carrying out this exploration together with the Ministry of Economic Affairs, with involvement from the province of Zeeland, the Southwest Delta steering group and the Oosterschelde National Park.

TBES Markermeer: Hoornse Hop exploration¹⁴

The policy letter on major projects in the Amsterdam-Almere-Markermeer region (*RAAM-brief* in Dutch) announced that a set of measures is being drawn up for Markermeer-IJmeer to achieve a Future-Proof Ecological System (*Toekomstbestendig Ecologisch Systeem* (TBES) in Dutch). One of the projects in this set is an exploration of the construction of sheltering measures in the Hoornse Hop.

¹³ Project 301 on [The Delta Programme mapped out](#).

¹⁴ Project 321 on [The Delta Programme mapped out](#).

2.5

Plan elaborations

IJsselmeer Closure Dam (formerly called Future of the IJsselmeer Closure Dam and Additional Discharge Capacity of IJsselmeer Closure Dam)¹⁵

The Future of the IJsselmeer Closure Dam project aims to improve the safety of this flood defence system, to increase the discharge capacity from the IJsselmeer lake to the Wadden Sea and, at the same time, to create space for other ambitions. The Second Assessment of the primary flood defence systems (2006) showed that the IJsselmeer Closure Dam no longer meets the statutory flood risk management requirements. In late 2011, the Cabinet took the decision on a preferential solution, adopting the framework vision for the Future of the IJsselmeer Closure Dam. The framework vision ensures a phased approach to flood risk management, by strengthening the top layer of the dyke across its entire length (i.e. making it 'overtopping-resistant') and reinforcing the discharge sluices and navigation locks.

Following the framework vision, the State Secretary for Infrastructure and the Environment and the administrators of the provinces of Fryslân and Noord-Holland and the municipal councils of Wieringen (which is the municipal council of Hollands Kroon since 1 January 2012) and Südwest Fryslân signed the Administrative Agreement on the Future of the IJsselmeer Closure Dam for the division of roles and responsibilities when elaborating the framework vision. Regional governments will work on achieving the ambitions related to sustainability, nature, recreation and tourism. On that occasion, the then State Secretary promised a maximum amount of € 20 million to encourage sustainable and innovative initiatives, provided that the region would match this amount.

In connection with the Future of the IJsselmeer Closure Dam project, Rijkswaterstaat was involved in the Additional Discharge Capacity of the IJsselmeer Closure Dam project, the aim of which is to increase the dam's discharge capacity. This is necessary because the target level of the IJsselmeer lake in winter (NAP -0.40 m) is exceeded increasingly often and increasingly more. The project's first objective was to look into the construction of an additional discharge sluice complex in the IJsselmeer Closure Dam. From 2011, the use of pumps was looked into as an alternative. Installing pumps appears to be the best and most efficient solution, and this was adopted in 2012 as a decision on a preferred solution. A decision was made to install the pumps in the Den Oever discharge sluice complex in stages.

¹⁵ Project 341 on [The Delta Programme mapped out](#).

Given that the reinforcement of the IJsselmeer Closure Dam and the increase in the discharge capacity of the IJsselmeer Closure Dam are closely connected, a decision was made to combine the two projects into one IJsselmeer Closure Dam project. The common plan elaboration started in 2012. It is expected to be realised in the 2017-2021 period (☞ table 4). The IJsselmeer Region sub-programme safeguards the interconnectivity of the combined project and other parts of the Delta Programme that overlap with this project.

WaalWeelde¹⁶

In WaalWeelde, regional parties, the central government, the business community and private citizens, headed by the province of Gelderland, work together on a safe, natural and economically strong Waal river. A MIRT Study was carried out in 2011. This showed that a number of projects which contribute to the water tasking as well as spatial development can start before 2015. The central government and the province of Gelderland are both investing € 30 million in these promising projects (☞ table 5). This will be used to implement at least the projects in Heesselt and Hurwenen, the plan studies for which have already been completed. A plan for Beuningen will be developed under direction of the province. The central government and the region are also jointly working out a soil strategy for WaalWeelde and for the sustainable and effective management of the flood plains.

The MIRT Study on WaalWeelde concluded that WaalWeelde can make a major contribution to the flood risk management tasking. The research also clearly showed that the Rhine-Meuse Delta and Flood Risk Management Delta Decisions will impact WaalWeelde. As such, WaalWeelde plays a key role in the Rivers sub-programme MIRT Study (☞ sub-section 2.2). Following the Delta Decisions, the central government and the region will consider for which elements of WaalWeelde an exploration can be initiated.

Vlieland and Terschelling dyke boundary¹⁷

A portion of the built-up area on the island of Vlieland is located outside the dykes. These are holiday homes and a 1970s extension of the village of Oost-Vlieland. The then State Secretary of Transport and Water Management promised to bring this area inside the dykes by rerouting

the primary flood defence system. Alongside Vlieland, the island of Terschelling would also prefer that the primary flood defence system be relocated.

To meet the wishes of the municipal councils and the province of Fryslân, the central government launched a study to explore potential solutions for the location of the primary flood defence system. The decision on a preferred solution was taken in 2012. It was decided to relocate the primary flood defence systems on Vlieland and Terschelling. Plan elaboration started in 2013. In consultation with the parties involved, i.e. the municipal councils of Vlieland and Terschelling and the province of Fryslân, a detailed elaboration will be drawn up for the preferred routes. Depending on the final location, the appendix to the Water Act will be revised, after which realisation can start. The project decision is expected to be taken in 2014 and will mark the start of realisation. The project can be completed in 2015 (☞ table 6).

Ooijen-Wanssum area development¹⁸

Budget: € 210 million for the entire area plan; a maximum of € 135 million from the central government and € 75 million from the province of Limburg and the municipal council. The central government's budget comprises € 10 million from the Meuse Projects budget and a reservation of € 125 million (now increased to € 129 million) in the Delta Fund from 2021 onward. The central government's contribution is earmarked for flood risk management purposes.

Ooijen-Wanssum is located on the west bank of the river Meuse in northern Limburg. The 10 km tributary of the Oude Maas that is located here plays an important role in discharging high water into the Meuse. After the floods in 1993 and 1995, a decision was taken to build embankments in this area, offering a protection level of approximately 1/50 a year (Delta Plan for the Major Rivers). These embankments hold back the natural overflow of the Meuse, in anticipation of more sustainable solutions.

On 10 November 2011, the central government, the province of Limburg, the Roer and Overmaas water board and the Peel and Maasvallei water board concluded the administrative agreement on Flood Risk Management in the Meuse, containing agreements on sustainable solutions. The House of Representatives was updated on this.¹⁹

¹⁶ Projects 361 and 362 on ☞ The Delta Programme mapped out.

¹⁷ Project 381 on ☞ The Delta Programme mapped out.

¹⁸ Project 401 on ☞ The Delta Programme mapped out.

¹⁹ Parliamentary document 18 106, no. 208.

After this, the MIRT exploration started, which was completed in mid-2012. A decision on a preferred solution was taken on 2 November 2012. The then State Secretary for Infrastructure and the Environment and the administrators of the province of Limburg, the municipal councils of Venray and Horst aan de Maas and the Peel and Maasvallei water board signed the administrative agreement on the Ooijen-Wanssum Plan Elaboration. Plan elaboration is being carried out using the Provincial Zoning Plan. The required level of flood protection will be reached in 2020.

In terms of flood risk management, the project includes reactivating the Oude Maas tributary, excavating two flood channels (lowering the flood plain), and implementing embankment measures. The plan will provide for the realisation of the safety tasking for the short term (protection level 1/250 a year in 2020). It will also make a key contribution to the long-term objective for flood risk management (decreasing water level), not only in the area itself, but also upstream to beyond Venlo.

Table 4 Programming of measures for IJsselmeer Closure Dam

IJsselmeer Closure Dam		2014	2015	2016	2017	2018	2019	>
Budget: € 602 million for improving IJsselmeer Closure Dam and € 211 million for increasing discharge capacity								
341	IJsselmeer Closure Dam							2021

Table 5 Programming of measures for WaalWeelde

WaalWeelde		2014	2015	2016	2017	2018	2019	>
Budget: € 30 million from the central government (from NURG and the National Waters Improvement Programme) and € 30 million from the province of Gelderland.								
Central government projects								
361	Heesseltsche flood plains							
362	Hurwenensche flood plains							
Province of Gelderland projects								
363	Ruyterwaard							
364	Fluvia Tiel							
365	Loenensche Buitenpolder							
366	Beuningen flood plains							
367	Oosterhout flood plains							
368	Stadswaard							
369	Gendtsche Polder							

Table 6 Programming of measures for Vlieland and Terschelling dyke boundary

Vlieland and Terschelling dyke boundary		2014	2015	2016	2017	2018	2019	>
Budget: € 3 million								
381	Vlieland and Terschelling dyke boundary							

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2.6

Realisation of ongoing implementation programmes

All flood risk management projects in this section are part of an implementation programme. The House of Representatives has classified three of these programmes as 'Major Projects': the Second Flood Protection Programme, Room for the River and Meuse Projects. The Cabinet uses progress reports on the Major Projects to update the House of Representatives every six months.

The Second Flood Protection Programme²⁰

The Second Flood Protection Programme (HWBP-2) mainly comprises projects stemming from the First and Second Assessments of the primary flood defence systems (9 and 71 projects respectively). The aim of these projects is to ensure that flood defence systems that failed inspection comply with flood risk management standards again. The Weak Links on the Coast approach is also part of this programme (eight of the nine projects have been completed or are nearing completion). All in all, HWBP-2 includes 89 projects, which together amount to 366.2 km of dykes and 18 structures. With 79 projects, the water boards will carry out the majority; Rijkswaterstaat will be in charge of eight projects and the province of Groningen will have two. By the end of 2012, 58 projects met the standard, 9 were ongoing and 22 were in the plan elaboration phase.

The majority of the projects will be finished in 2017 (☞ table 7). Five projects are expected to be finished at a later stage. To help the projects finish on time, the central government and the water boards have increased administrative collaboration in the programme. The parties have committed themselves to the timely adoption of the remaining preferential alternatives. For more information, see the third progress report.²¹

Room for the River²²

This programme comprises 34 measures (originally 39, but five have been cancelled) set out in the 2006 Room for the River Key Planning Decision (*Planologische Kernbeslissing* (PKB) in Dutch). These measures are intended to reach the Rhine tributary discharge target of 16,000 m³/s (measured at Lobith) in accordance with the statutory level of protection by 2015. Measures in the downstream section of the Meuse are also part of the programme. The second objective is to enhance spatial quality in the area around the major rivers. Where

necessary, measures are coordinated with the Rivers and Southwest Delta sub-programmes.

A project decision was taken for 32 measures on 31 December 2012, which means that plan elaboration has been completed and the realisation phase has started. Realisation of these projects will take up 97% of the PKB budget. A project decision is expected for all 34 measures by 2014 (☞ table 8). A few of the measures will have already been completed by then.

The majority of measures for Room for the River will be finished in 2015. Seven measures will not be completely finished by then, primarily because of the complexity of these projects. These concern the Kampen bypass combined with lowering of the summer bed in the Beneden-IJssel (at the end of 2012, these two projects were merged into one: IJssel delta), the flood channel in Veessen-Wapenveld, two dyke relocations along the IJssel (Cortenoever and Voorsterklei), a dyke improvement along the Nederrijn (Nederrijn/Betuwe/Tieler- and Culemborgerwaard) and two dyke improvements along the Lek (Alblasserwaard and De Vijfheerenlanden and Betuwe/Tieler- and Culemborgerwaard). In addition to the two dyke relocations at Cortenoever and Voorsterklei, the IJsselsprong plan at Zutphen will make an additional contribution to flood risk management with money from the Policy Document on Spatial Planning by altering the riverbank.

The Flood Plains Vegetation Management project (*Stroomlijn* in Dutch) aims to organise and uphold vegetation management on the flood plains. The project is closely affiliated with Room for the River and the Meuse Projects: proper vegetation management is a prerequisite for achieving the lower water levels that these programmes intend to achieve. As such, the project contributes to the general aims of water policy in the area around the major rivers: the safe processing of a normative discharge of 16,000 m³/s at Lobith. Management of vegetation on sites managed by private persons, companies, government authorities and various nature conservation organisations is overdue. In 2007, a start was made to tackle this. In October 2012, the Minister for Infrastructure and the Environment embedded the approach to catch up on vegetation management in a policy letter.²³

²⁰ Projects 501-529 on ☞ The Delta Programme mapped out.

²¹ Parliamentary document 32698, no. 9.

²² Projects 601-631 on ☞ The Delta Programme mapped out.

²³ Parliamentary document 31710, no. 27.

The further elaboration of the river region (*Nadere uitwerking rivierengebied* (NURG) in Dutch, see next paragraph) contributes to the flood risk management objective being achieved in good time. Further information on Room for the River, Flood Plains Vegetation Management and NURG can be found in the progress reports.²⁴

Further elaboration of area around the major rivers (NURG in Dutch)²⁵

NURG is a joint programme of the Ministry of Economic Affairs and the Ministry of Infrastructure and the Environment. The programme comprises measures that enhance the safety of the river region and produce 7,000 hectares of new nature in the flood plains of the Rhine tributaries and the Bedijkte Maas. Those projects with a flood risk management objective, as stated in the Room for the River PKB, must be completed by 2015 at the latest (☞ table 9). The ministries are exploring whether the Afferdensche and Deestsche flood plain excavation project can be accelerated to ensure that it is finished in good time.

Meuse Projects (Zandmaas and Grensmaas)²⁶

The Meuse Projects comprise 52 projects in the Grensmaas and Zandmaas; more than 20 of these have been completed. The programme's combined objectives are flood risk management, nature development and mineral extraction. According to the schedule, the projects for the flood protection objective in the Zandmaas should be completed by 2015 at the latest and those for the Grensmaas by 2017, except for the final element embankments (☞ table 10).

In late 2011, the central government and the region concluded an administrative agreement on the completion of the Meuse Projects and its successor. This administrative agreement primarily lays down agreements on the Ooijen-Wanssum area development, the necessary remaining construction or increase of embankments after completion of Zandmaas and Grensmaas and resolving the financial issues in the Grensmaas as a result of the declining market for gravel. Consequently, the schedule for completing the projects

for the flood protection objective in the Grensmaas in 2017 has not changed. Until 2020, a normative budget will also be used to realise the prioritised part of the required embankments, as the 'final element' for flood protection alongside fluvial measures.

The decentralisation of policy on the natural environment and the re-evaluation of the ecological main structure (*Ecologische Hoofdstructuur* (EHS) in Dutch) have led to a number of projects being revised; the House of Representatives has been updated on this.²⁷ The Meuse Projects programme is expected to be completed by 2024.²⁸

Repairs of stone-cladding in Oosterschelde and Westerschelde²⁹

The dykes along the Oosterschelde and Westerschelde are clad in placed stones. The Repairs of stone-cladding project covers reinforcing this cladding along a total length of 321 km (181 km along the Oosterschelde and 140 km along the Westerschelde), so that this dyke cladding once again meets the statutory standards. The work will be finished in 2015 (☞ table 11). The project will not only be completed within the set time, but, thanks to economical contracts, within budget too.

²⁴ The 21st progress report is the last one, Parliamentary document 30080, no. 64.

²⁵ Projects 701-704 on ☞ The Delta Programme mapped out.

²⁶ Projects 801-808 on ☞ The Delta Programme mapped out.

²⁷ Parliamentary document 18106, no. 216.

²⁸ For more information, see the 23rd progress report, Parliamentary document 18106, nr. 217.

²⁹ Projects 901-911 on ☞ The Delta Programme mapped out.

Table 7 Programming of measures for Second Flood Protection Programme

Second Flood Protection Programme		2014	2015	2016	2017	2018	2019	>
Budget: total of € 3,218 million, of which € 2,348 million from 2014 onwards								
501	Lekdijk-KIS							
502	Coastal reinforcement at Katwijk							
503	Markermeerdijk Hoorn-Edam-Amsterdam							2021
504	Waddenzeedijk at Texel							
505	Koegraszeedijk							
506	Dyke improvement at Spui-West							
507	Dyke improvement at Spui-Oost							
508	Flood defence system at Den Oever							
509	Dyke improvement at Hoeksche Waard-Zuid							
510	Flow slide at Spui							
511	Houtribdijk							
512	Ipenslotersluis and Diemerdamersluis sluices							
513	Weak links in the province of Noord-Holland							
514	Waddenzeedijk, Frisian coast							
515	Eem dijken and Zuidelijke Randmeren							
516	Noorderstrand Schouwen							
517	Markermeerdijk at Marken, south and west embankment							
518	Dyke improvement at Eiland van Dordrecht-West							
519	Ameland, Wadden Sea storm surge barrier							
520	Dyke improvement at Hellevoetsluis							
521	Dyke improvement at Hoeksche Waard-Noord							
522	Dyke improvement at Krimpen							
523	Merwedelijk in Werkendam							
524	Dyke improvement at Eiland van Dordrecht-Oost							
525	Dyke improvement at Oostmolendijk near Ridderkerk							
526	West-Zeeuws-Vlaanderen							
527	Wieringermeerdijk and rerouted Stonteldijk							
528	Bergambacht-Ammerstol-Schoonhoven (BAS)							
529	Guard lock in Meppelerdiep Zwartsluis							

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Table 8 Programming of measures for Room for the River

Room for the River		2014	2015	2016	2017	2018	2019	>
<i>Budget: total of € 2,306 million, of which € 1,242 million from 2014 onwards</i>								
601	Additional flood plain excavation at Millingerwaard							
602	Dyke realignment at Lent							
603	Groyne lowering at Waal Fort St. Andries							
604	Groyne lowering at Beneden-Waal							
605	Flood plain excavation and dyke relocation at Munnikenland							
606	Depoldering of Noordwaard							
607	Depoldering of Overdiepse Polder							
608	Dyke improvement along Amer/Donges							
609	Dyke improvement at Steurgat/Land van Altena							
610	Dyke improvement at Bergsche Maas/Land van Altena							
611	Dyke improvement at Oude Maas/Hoeksche Waard							
612	Dyke improvement at Oude Maas/Voorne Putten							
613	Flood storage at Volkerak-Zoommeer							
614	Flood plain excavation in Huissensche Waarden							
615	Flood plain excavation in Meinerswijk							
616	Flood plain excavation in Doorwertsche Waarden							
617	Flood plain excavation in Middelwaard							
618	Flood plain excavation in De Tollewaard							
619	Obstacle removal near Elst							
620	Flood plain excavation in Honswijkerwaarden, weir island at Hagestein, Hagesteinse Uiterwaard and Heerenwaard							
621	Dyke improvement at Nederrijn/Betuwe/Tieler- and Culemborgerwaard							
622	Dyke improvement at Lek/Betuwe/Tieler- and Culemborgerwaard							
623	Dyke improvement along river Lek/Alblasserwaard and Vijfheerenlanden							
624	Dyke relocation at Cortenoever							
625	Dyke relocation at Voorsterklei							
626	Flood plain excavation in Bolwerksplas, Worp and Ossenwaard							
627	Flood plain excavation in Keizers- and Stobbenwaarden and Olsterwaarden							
628	Flood channel in Veessen-Wapenveld							
629	Flood plain excavation in Scheller and Oldener Buitenwaarden							
630	Dyke relocation at Westenholte							
631	IJssel delta							

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Table 9 Programming of measures for NURG

Further elaboration of river region (I&M projects)		2014	2015	2016	2017	2018	2019	>
Budget: total of € 188 million, of which € 58 million from 2014 onwards								
701	Flood plain excavation of Rijnwaardense flood plains							
702	Flood plain excavation in Millingerwaard							
703	Flood plain excavation Afferdensche and Deestsche plains							
704	Flood plain excavation in Welsumerwaarden and Formonderwaarden nature							

Table 10 Programming of measures for Meuse Projects

Meuse Projects		2014	2015	2016	2017	2018	2019	>
Zandmaas								
Budget Zandmaas: total of € 403 million, of which € 153 million from 2014 onwards								
801	Peak storage Lateraalkanaal West, southern part +							
802	Deepening at Sambeek							
803	Flood channel at Lomm							
804	Flood channel at Well Aijen							
Grensmaas								
Budget Grensmaas: total of € 151 million, of which € 79 million from 2014 onwards								
805	Grensmaas project (11 locations) ^a							2024
806	Final embankment elements Roer and Overmaas water board							2020
807	Final embankment elements Peel and Maasvallei water board							2020
808	Permanent Fluvial Measures (Berg a/d Maas)							

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 Exploration
 Plan elaboration
 Realisation

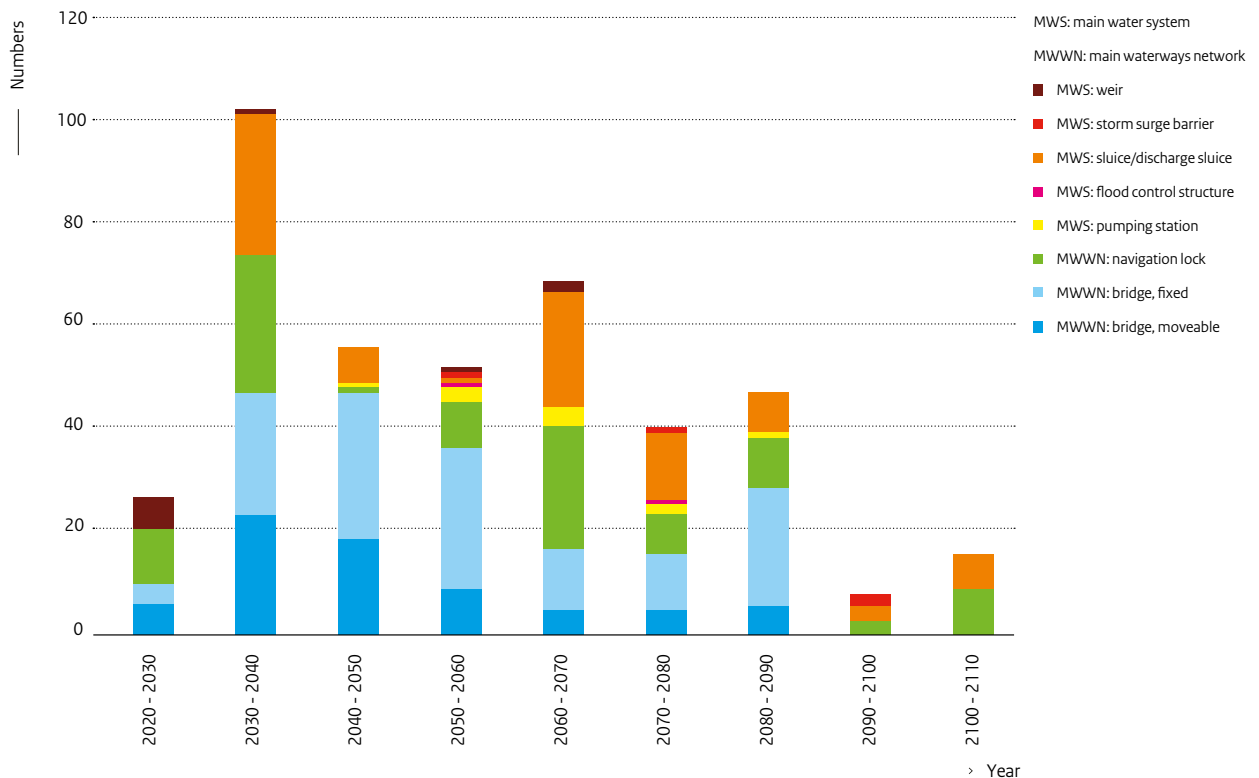
^a This concerns the following 11 project locations: Visserweert, Koeweide, Grevenbicht, Nattenhoven, Urmond, Maasband, Meers, Aan de Maas, Itteren, Borgharen and Bosscherveld.

Table 11 Programming of measures for repairs of stone-cladding in Oosterschelde and Westerschelde

Repairs of stone-cladding in Oosterschelde and Westerschelde		2014	2015	2016	2017	2018	2019	>
Budget: total of € 851 million, of which € 178 million from 2014 onwards								
901	Burghsluis							
902	Zuidhoek Zierikzee							
903	Viane							
904	Philipsdam-Zuid							
905	Krabbenkreekdam							
906	St. Annaland							
907	Moggershil							
908	Stavenisse							
909	St. Pieterspolder							
910	Zandkreekdam / Wilhelminapolder-West							
911	Roompot							

MIRT study
 Exploration
 Plan elaboration
 Realisation

Figure 1 Estimated replacement period of hydraulic structures based on construction year category and design lifecycle



Management, maintenance and replacement

Management, maintenance and water management

The management and maintenance of the main water system include such aspects as water management, regular management and maintenance, and renovation and replacement. Management and maintenance also comprise sand replenishments to maintain the coastline, stone deposits and vegetation management in the flood plains, as well as asset management (including flood defence systems and structures for flood protection and the supply and discharge of water, such as storm surge barriers, weirs, discharge sluices and pumping stations). In doing so, Rijkswaterstaat primarily keeps flood risk management and freshwater supplies in good order, with other roles of the main water system, such as shipping and nature development, linking into this.

Replacement Tasking for Hydraulic Structures (VONK)

A key tasking for this century is replacing the infrastructure in the main water system, also known as ‘wet infrastructure’ or ‘hydraulic structures’. Some examples of the structures that Rijkswaterstaat will be renovating or replacing over the next few years are: De Zaan (Wilhelminasluis) and IJmond sea entrance (financing from the Infrastructure fund) and the weirs in the Nederrijn and Lek rivers and the replacement/maintenance of the Volkerak locks’ salt separation installation (financing from the Delta Fund).

The number of structures that qualify for renovation or replacement will increase over the next few decades. Furthermore, salt leakage at a number of structures also needs to be addressed because a lot of freshwater is needed to wash the salt away. Rijkswaterstaat intends to identify the replacement tasking for the longer term in conjunction with the Delta Programme. To that end, it launched the VONK project (Replacement Tasking for Hydraulic Structures, *Vervangingsopgave Natte Kunstwerken* (VONK) in Dutch) last year. The objective is to develop a system for well-substantiated decision-making on the replacement of (hydraulic) structures in line with the current programming cycle of the Ministry of Infrastructure and the Environment. Linking the replacement tasking for hydraulic structures to other Delta Programme tasking is a concrete example of adaptive delta management ([\[2\]](#) sub-section 4.2).

Background to replacement tasking

Properly functioning structures, such as discharge sluices, navigation locks, weirs, pumping stations and storm surge barriers, are indispensable for flood risk management, freshwater supplies and shipping (water quantity). A large number of these structures were built at the start or in the mid-20th century and are now nearing the end of their lifecycle. These structures will have to be replaced or renovated at a given point in time. The related cost will increase significantly over the next few decades.

A reliable answer to the question of *which* structures are reaching the end of their lifecycle *and when exactly that will be* is required to be able to set the budget for the entire replacement tasking in good time. DP2013 used figure 1 to provide a rough estimate of this ([\[2\]](#) page 28).

Rijkswaterstaat intensified its approach last year by means of the susceptibility test for hydraulic structures. The aim of the susceptibility test is to forecast the end of the lifecycle of all 650 hydraulic structures that Rijkswaterstaat manages (so-called ‘windows of time for lifecycle end of hydraulic structures’) as accurately as possible. A proper forecast of when the lifecycle will end requires insight into such things as the changed circumstances since the structure was constructed, changed operating requirements, the multifunctional nature of the structures, and uncertainties. These issues are covered in the susceptibility test (for further information, [\[2\]](#) Appendix C (in Dutch)).

Structures play an important role in the strategies that the Delta Programme is developing for flood risk management and freshwater supplies. As such, the results of the susceptibility test will influence the preferential strategies and vice versa. These processes will ultimately jointly determine the replacement strategy for the structures: what has to be replaced when and why? For the Delta Programme, it is also important to determine whether the structure being replaced needs new functionality, and if so, what.

3

Delta Decisions and promising strategies

(photo) June 2013, flood water. Weir at Hagestein opened.



How will we maintain the Netherlands' favourable position in the delta of northwest Europe if sea levels rise more, soil subsides further and the climate changes? How can we ensure safety and how will we be able to provide enough freshwater in dry periods? The solutions are becoming clearer and clearer. New standards for flood risk management, a systematic link between space and water and clear agreements on freshwater. And on that basis: customisation in each area.

3.1 Interconnectivity

Excellent shipping routes, favourable port locations and a plentiful supply of freshwater from the rivers Rhine and Meuse even in dry periods; the Netherlands' unique location at the mouth of four major rivers has brought great prosperity and partly determined our characteristic landscape and natural environment. It is an advantage that everyone living in the Netherlands benefits from daily, whether consciously or not. However, there is another side to being located in this delta. Over time, the ubiquitous water may be damaging and even threatening. More than half of the Netherlands would be regularly submerged if there were no dykes, dunes and dams. Nine million people live in this area, where 70% of the gross national product is earned.

While this water offers us many advantages, it also comes with ongoing efforts to protect us against it. That, too, has made the Netherlands a unique place: Dutch knowledge

and expertise in the field of water is widely known. For centuries, water has been a top economic sector here. This sector ensures that the Netherlands remains a safe and habitable place according to the latest insights, and the Top Sector Water members also use these insights as an export item on the global market.

Since the Delta Works were built, the Netherlands is one of the best protected deltas in the world. Nevertheless, the Netherlands will have to work on this now and in the future to be able to continue to reap the benefits that the water brings and to keep the country habitable and safe. We are vulnerable too. Climate change may increase the risk of (pluvial) flooding, and towns and cities in particular may experience more heat-related issues. Moreover, the Netherlands can also optimise its favourable freshwater supplies even further and use them even more as a competitive advantage.

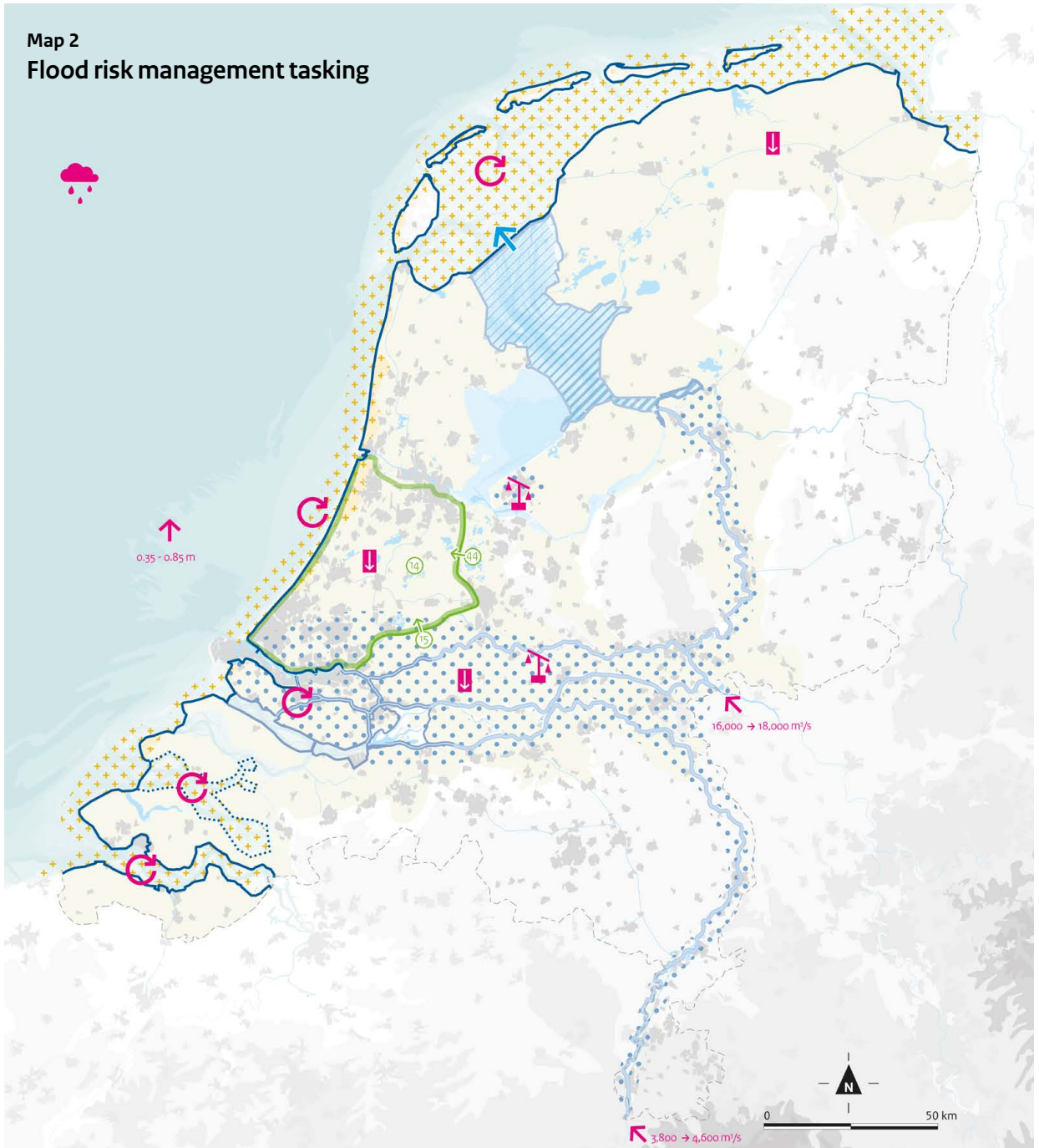
Tasking

In total, there is about 3,700 km of dykes, dunes and dams along the major rivers, lakes and the sea which protect the Netherlands from flooding. According to the most recent assessment of the so-called 'primary flood defence systems', approximately 30% do not meet the current statutory norms. The tasking to bring these flood defence systems up to scratch and to keep them that way is an urgent one. Work on this is already underway ([\[2\]](#) section 2).

In addition to this, there is tasking related to climate change and subsidence. These developments are evident from measurements and will be confirmed again in the IPCC report due in March 2014. Sea levels are rising, as are temperatures. Precipitation is on the increase and we expect drier and wetter periods with decreased and increased river discharges. We do not know precisely, however, how rapidly this will develop in the 21st century. The most recent information has been incorporated into the Delta Scenarios, on which the Delta Programme bases its strategies ([\[2\]](#) sub-section 4.1), and multiple future scenarios are taken into account.

Above all, the Netherlands has changed enormously over the past 50 years. The population and economic interests have both increased. As such, a re-evaluation of the flood protection standards is essential. We know more about the strength of the dykes and the possible consequences of a flood. This combination of factors has meant that we have

Map 2 Flood risk management tasking



Tasking

Preserve dykes, dams and dunes

- coastal area: protect dunes, dykes and sea defence systems*
- area around the major rivers: preserve primary flood defence systems for rivers and IJsselmeer lake*, accommodate peak discharge
- transitional area: preserve primary defence systems for rivers in the transitional area between sea and river influence*
- ... protect the dykes and flood defence systems in the Oosterschelde*
- preserve other primary defence systems*

* flood defence systems (work through backlog of dykes that failed inspection, tasking from new insights and climate changes)

- * preserve sandy coastal system (prevent drowning of shoals, erosion, protect dunes)
- ↗ maintain water discharge from IJsselmeer lake to Wadden Sea
- develop a comprehensive strategy for dyke rings 14, 15 and 44
- ▨ protect IJssel and Vecht delta against surges in the case of water level increases

Switch to risk-based approach

- ▨ protect area liable to flooding
- ... area of attention, additional tasking expected based on tolerable individual risk and social disruption


Causes

- ☔ increase in precipitation
- ↑ rising sea levels: 0.35 - 0.85 m
- ↻ erosion and sedimentation
- ↗ higher peak discharge of rivers:
Rhine: 16,000 → 18,000 m³/s
Meuse: 3,800 → 4,600 m³/s
- ↓ soil settlement (soil subsidence)
- ⚖ imbalance in protection level and consequences

opted for a modern risk-based approach: an approach based on the probability and consequences of a flood. New insights and methods that have become available have made this possible. This new approach and associated new standards lead to an additional tasking.

Despite the freshwater supply from the major rivers, certain sectors are impacted by water scarcity and salinisation during (very) dry years. In the agricultural sector, for instance, drought impacts turnover to the tune of € 0.4 billion annually. Shortages in freshwater can also have an impact on shipping, drinking water and energy supplies, and industry. Dutch towns and cities are already dealing with damage due to pluvial flooding and long-term dry and hot spells. The damage to buildings and infrastructure caused by pile rot and differential settlement already totals approximately € 5 billion. The tasking, therefore, is to minimise further damage in the future. Climate change is expected to cause (very) dry periods this century. The Netherlands can continue to make good use of its favourable location in the delta by optimising its freshwater supply, by making changes in its main water system and the regional water system and by users in particular being increasingly economical with water.

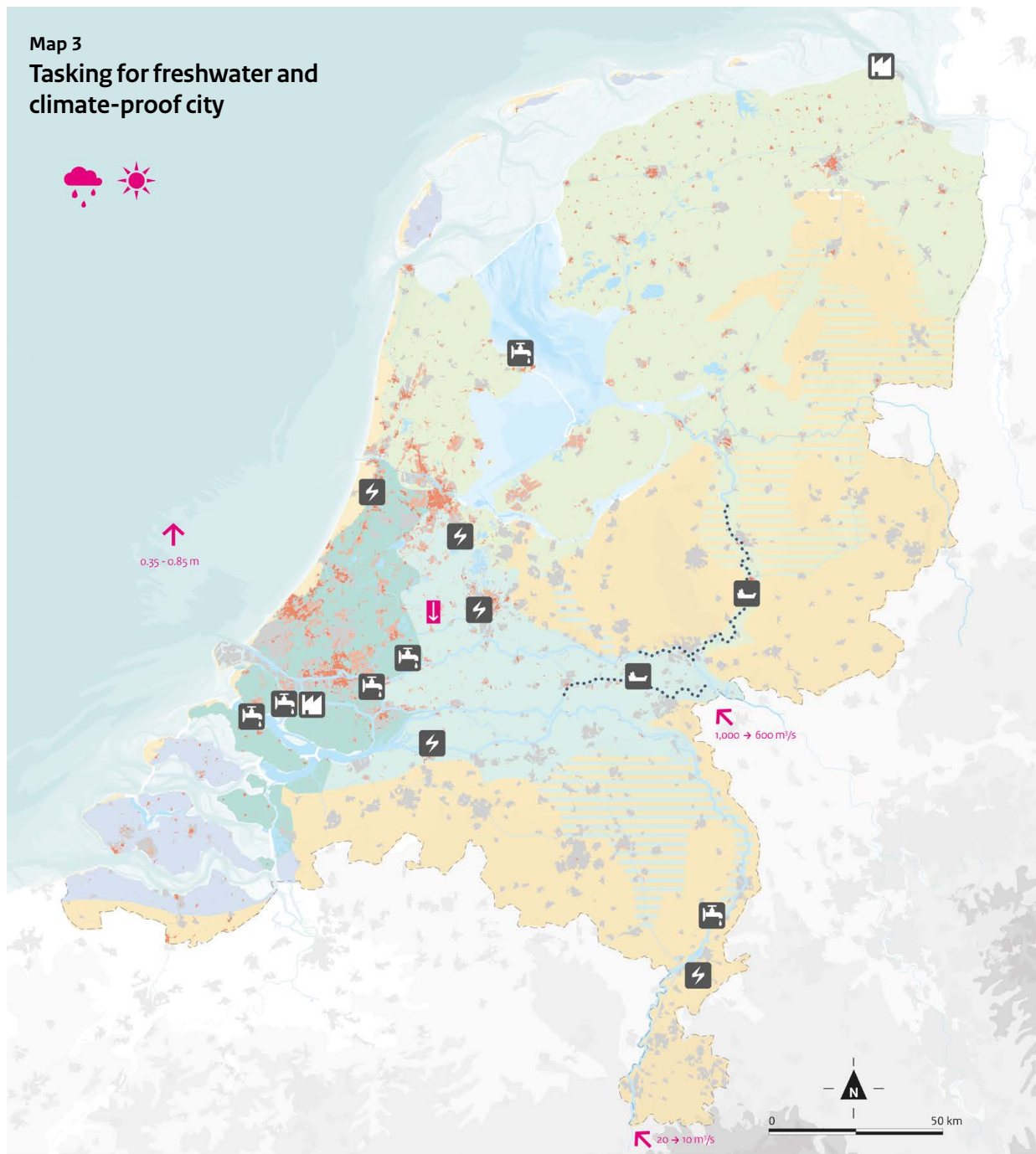
Interconnectivity in solutions

The major rivers, the river deltas and the major lakes are all directly linked and are all part of the international catchment areas of the rivers Rhine, Meuse, Scheldt and Ems. If a lot of water flows into the Netherlands via the rivers, it will have to flow out of the country to the sea via the IJsselmeer lake, the Nieuwe Waterweg and Haringvliet, which may pose a problem if there is a persistent storm at sea at the same time. The main water system and the regional (ground)water system are also connected in a number of ways ( map 4). Something that provides a good solution for the tasking in one area may then have disadvantages for a neighbouring area and vice versa. DP2013 provided an outline of all key aspects of interconnectivity in the Dutch water system, as part of the possible strategies. Over the past year, further insight has been gained in that interconnectivity with the elaboration of promising strategies and draft Delta Decisions.

The Delta Programme is looking for promising strategies that tie in with the traits of the different regions and also demonstrate robust interconnectivity for the tasking in the Netherlands as a whole. This requires constant interaction between regional elaboration and national agreement. The Delta Programme's nine sub-programmes are connected with each other in a number of different ways. As such, the Safety and New Urban Development and Restructuring sub-programmes are looking into multi-layer flood risk management together with the area-based sub-programmes, while the Freshwater and IJsselmeer Region sub-programmes explore the role the IJsselmeer lake will play in terms of future freshwater supply. Rivers, Rhine Estuary-Drechtsteden and Southwest Delta literally come together in the tidal rivers area. Together these sub-programmes have laid down the basic principles for their strategies. The southern part of the Southwest Delta, the Coast and the Wadden Region are linked by the continuous flow of sand along the Dutch coast. These sub-programmes have laid the foundations for their possible solution strategies with indicative options for the sandy coastal system.

Map 3

Tasking for freshwater and climate-proof city



Freshwater tasking

- possible excessive demand on IJsselmeer Region water buffer
- falling groundwater levels and no water supply
- falling groundwater levels and limited water supply
- intake points become salinised (e.g. Gouda and Bernisse)
- water levels in rivers and canals are too low
- no water supply possible and salinisation



shipping: safeguard navigability in the case of low water



drinking water: protect intake points



industry: reduce delivery issues



energy: safeguard cooling water discharge

Tasking for a climate-proof city

high-density urban areas with a significant amount of paving run a higher risk of damage

- urbanisation until 1940, probability of pile rot
- risk of differential settlement
- other urbanised areas

Causes

- temperature increases
- increase in precipitation
- rising sea levels: 0.35 - 0.85 m
- low-water discharge: (in the case of W+ 2050 1/10 years)
Rhine: 1,000 → 600 m³/s
Meuse: 20 → 10 m³/s
- soil settlement (soil subsidence)

3.2 Draft Delta Decisions

Next year's Delta Programme (DP2015) will contain a proposal for Delta Decisions: main decisions for flood risk management and freshwater supplies in the Netherlands in the long and short term. These structure the approach to tasking, while providing direction for the measures to be taken in subsequent decades. This section covers the provisional content of and the current thinking on the five Delta Decisions: Flood Risk Management, Spatial Adaptation, Freshwater Strategy, Rhine-Meuse Delta and IJsselmeer Region.

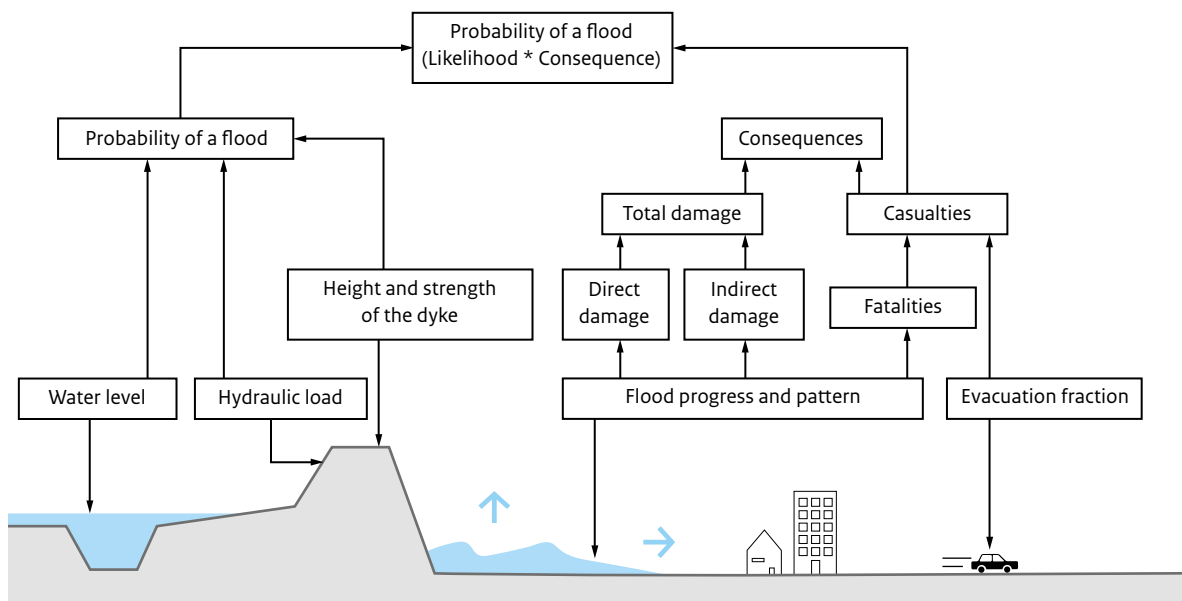
The crux of the Delta Decisions is a new approach to flood risk management and freshwater supplies. Accordingly, we will systematically link space and water by ensuring that the design of the Netherlands is as water-robust as possible in the future. Finally, the Delta Decisions and the strategic

decisions provide a direction to go in with regard to the solutions for flood risk management and freshwater supplies in the Rhine-Meuse delta and the IJsselmeer Region. A proposal will also be made for the sandy coastal system.

Risk-based approach for Flood Risk Management

Flood risk management in the Netherlands will be given a much more robust foundation: a risk-based approach. Both the likelihood and the possible consequences of a flood will determine the desired level of safety. The first Delta Committee already aspired to do this but there was insufficient technical knowledge at that time. There is more knowledge now on what influences the strength of a dyke and what the possible consequences of a flood could be for the area behind the dyke.

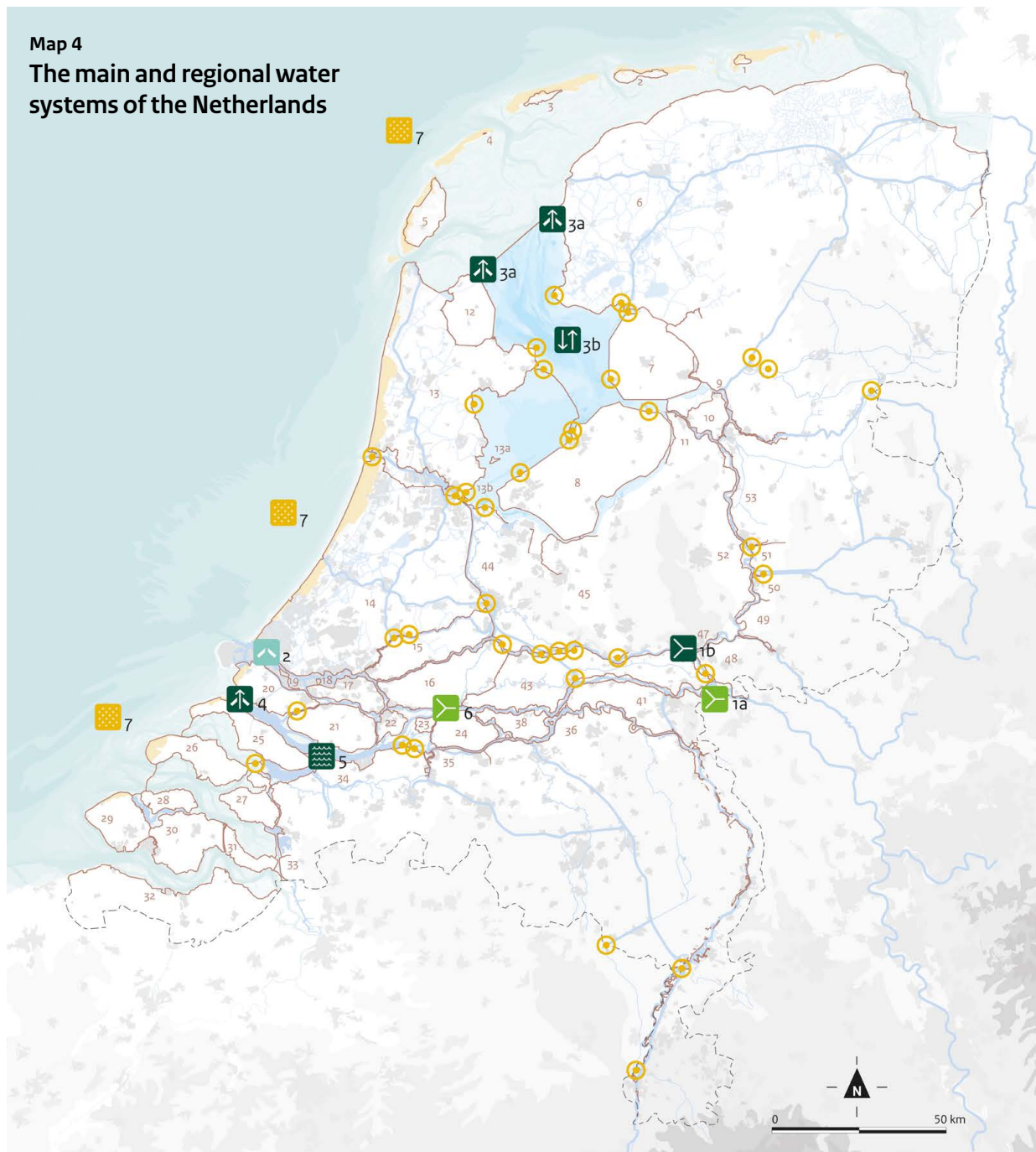
Figure 2 Risk-based approach



The risk-based approach will examine the likelihood of a flood and the possible consequences of a flood.

Map 4

The main and regional water systems of the Netherlands



Primary 'controls' in the main water management system

discharge distribution across the Rhine tributaries (1)

• discharge distribution at Pannerdensch Kop (1a)

not controllable

• discharge distribution at IJsselkop, weir at Driel (1b)

controllable at high and low water

Maeslantkering, Nieuwe Waterweg (2)

controllable at high water

IJsselmeer lake (3)

• discharge capacity of IJsselmeer Closure Dam (3a)

controllable at high and low water

• water level management of IJsselmeer lake (3b)

controllable at high and low water

Haringvliet sluices (4)

controllable at high and low water

storage in Southwest Delta (5)

controllable at high and low water

discharge distribution at southern edge of Rhine Estuary-Drechtsteden (6)

not controllable

sand replenishment (7)

controllable at high and low water

Secondary 'controls' in the main water management system

connection point between main and regional water systems

main water system - saltwater

main water system - freshwater

regional water system

urban area

elevated (sandy) soils

dunes

primary flood defence systems and associated dyke ring number

Desired level of safety

The new policy on flood risk management is based on three goals:

1. Tolerable individual risk for everyone behind the dyke.
The basic principle is to set the probability of dying from a flood at no more than 1/100,000 a year (10^{-5}) for everyone in the Netherlands who is protected by a dyke, dune or dam. The current system does not provide that tolerable risk level. The 10^{-5} probability is smaller than the probability of dying in a traffic accident, but greater than the probability of dying due to external safety causes; the standard for that is 10^{-6} . 10^{-5} was chosen because of the nature of the threat. The risks where external safety is concerned come from human behaviour, which is more easily controlled. The risks where flood risk management is concerned stem from an environmental threat, plus they occur in large parts of the Netherlands. As such, these risks are more difficult to reduce.³⁰
2. Avoid social disruption as a consequence of a flood where possible. Social disruption occurs if there are large groups of casualties where the flood occurs or if there is a lot of economic damage caused by a flood.
3. Prevent the failure of vital infrastructure and vulnerable uses in an area, such as utilities or hospitals, where possible. During and after a disaster, these are crucial for the area, region or even the entire country to function well.

All three goals are relevant and jointly determine the desired level of safety against floods.

The analyses of the area-based sub-programmes show that the goals for flood risk management can be specified further in a recommendation on new standards. This will then be considered for the country as a whole, after which a proposal will be presented in DP2015. The analyses also confirm the areas of attention that were included in DP2013: The desired level of safety in the area around the major rivers (including the IJssel-Vecht delta), parts of the Rhine Estuary-Drechtsteden and Almere is higher than the current level of safety. There are also a few locations outside the areas of attention that do not meet basic safety, such as a number of places in Zeeland and Noord-Holland. Moreover, the protection of vital uses in these areas needs to be

addressed (power plant in Borssele, gas plants and energy complexes in Noord-Groningen).

Three types of measures will be implemented to reach the goals for flood risk management:

1. layer 1: preventive measures to limit the probability of a flood;
2. layer 2: spatial organisation of an area to limit the consequences of a flood and, in specific cases, to contribute directly to the desired level of safety;
3. layer 3: disaster management to limit the consequences of a flood in terms of casualties.

This is called multi-layer flood risk management.


Layer 1: new standards for flood defence systems

Robust flood defence systems still determine safety. However, dyke requirements are no longer based on the probability of overtopping (normative water levels) as was done in the past, but on the probability of a flood occurring.


As such, new standards will be set for the dykes based on the probability of a flood. The new standard will no longer apply to a dyke ring, as is currently the case, but to a dyke section. Previous assumptions were that the consequences of a flood were the same for the entire area behind a dyke. Current insights show that that is not the case. Flood risk scenarios for Gelderse Vallei (dyke ring 45) illustrate this: a breach in the Grebbedijk on the south side of this dyke ring would lead to significantly more casualties and economic damage than a breach of the dyke along the Zuidelijke Randmeren lakes (Gooi and Eemmeer). As consequences can differ per dyke section, the standards per dyke section can also differ.


Spatial organisation (layer 2) and disaster management (layer 3) also play a role when determining the standard for the dyke. In the case of significant consequences (a lot of damage and casualties), there should be a stricter standard for dykes (small probability of a flood). In the case of less significant consequences, a less strict standard for dykes is acceptable. The basic safety for everyone in the Netherlands living inside the dykes, dunes and dams always applies, which is based in part on the measures in layers 2 and 3.

³⁰ Furthermore, revising to achieve a tolerable individual risk of 10^{-6} for all of the Netherlands is not cost-effective according to the MKBA. The resources required for this could be used in a more efficient manner in areas where they contribute to reducing social disruption.

Sub-section 3.3 contains  tables illustrating the bandwidth of possible new standards per area of attention. These standards are based on tolerable individual risk principles and on preventing social disruption. These bandwidths provide input for the processes in the areas, as part of which a lot of attention will be given to feasibility and support. The recommendation on standards that the area-based sub-programmes will ultimately issue may therefore deviate from the values presented in sub-section 3.3. DP2015 will include a final proposal. The Minister for Infrastructure and the Environment outlined this in the 'April letter'³¹. Once the Cabinet has decided on the Delta Decisions, the probabilities of a flood per section of dyke ring will be embedded in legislation. As such, the probability of a flood can serve as a basic principle for the Fourth Assessment of safety, which is expected to start in 2017.

Layer 2: spatial organisation

The spatial organisation of an area is important to minimise the consequences of a flood. Spatial measures can contribute directly to flood risk management. To gain experience, pilot projects are being carried out for a number of promising locations. These pilot projects concern concrete elaborations of modifications to the spatial organisation. They also examine how these measures can be safeguarded legally and administratively speaking ( Smart combinations).

To ensure that the system is kept in order in the long term, aspects of flood risk management will also have to play a role in the integrated spatial evaluation concerning all development projects. The elaboration of a water-robust design is outlined later in the text under  Delta Decision on Spatial Adaptation.

Layer 3: disaster management

The new standards assume a certain effectiveness of evacuations in the case of a flood: the less effective the evacuation, the stronger the flood defence systems have to be to meet the desired level of safety. The evacuation fraction³² and the standard for the flood defence system (probability of a flood) are explicitly related. The studies

behind the new standards³³ are based on the available knowledge about the effectiveness of evacuations. This year, the security regions will be looking into and assessing whether the evacuation fractions used are a realistic assumption for developing strategy. If other assumptions are required or are possible, these will be translated into the standards for the flood defence systems and incorporated into the recommendations on standards. The contribution from this evacuation fraction, including the argumentation for and safeguarding of this fraction, are explicitly considered in the administrative discussions on the recommendations on standards. In collaboration with the security regions, the Delta Programme will map out the probabilities and hindrances to improving the evacuation options with spatial measures by 1 February 2014.

The Ministry of Infrastructure and the Environment, the Ministry of Security and Justice, the water boards, the provinces, the security regions and the Rijkswaterstaat crisis organisation work together to ensure that disaster management is at the required level. The priorities are implementing a national and regional evacuation strategy, national plans regarding the distribution of (drinking) water, energy and security and safety staff during scarcity, introducing a national communication system (LCMS) at Rijkswaterstaat and the water boards, and conducting a study into essential additional resources from the Ministry of Defence in the case of a major flood disaster. Supporting the population to be able to cope for themselves by way of such things as mobile messaging will also be looked at. The aim is to develop an action strategy per postal code for citizens and businesses as a way to prepare for floods. DP2015 will discuss this in more detail. The Ministry of Security and Justice is responsible for coordinating these activities.

³¹ Parliamentary document 33400 J, no. 19.

³² The evacuation fraction is the percentage of people in an area that can safely leave the area in the case of an evacuation.

³³ This concerns the 2011 studies 'Social cost-benefit analysis of 21st century flood risk management' (MKBA WV21) and 'Casualty risk analysis of 21st century flood risk management' (SLA WV21) from Deltares, appendices to parliamentary document 31710, no. 22.

Figure 3 Draft Delta Decision on flood risk management

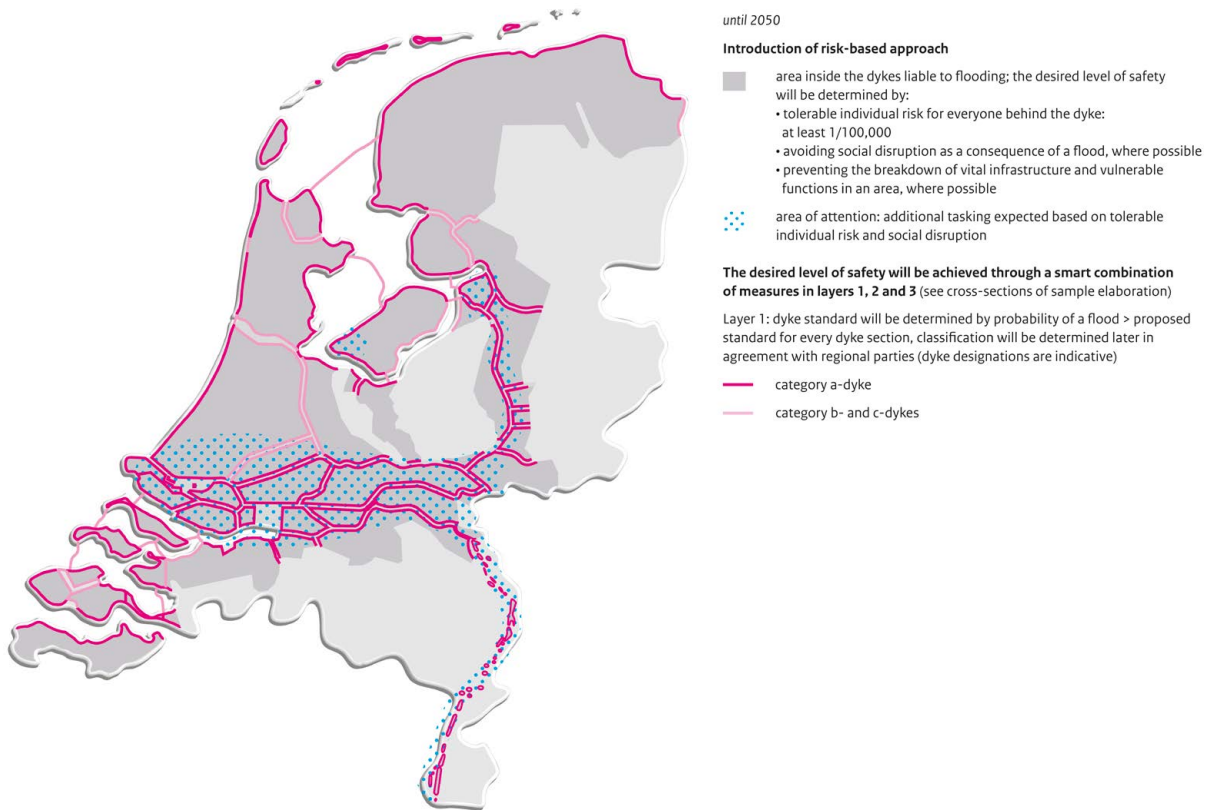
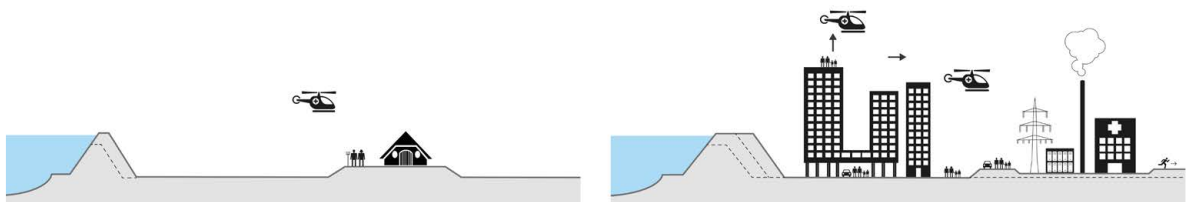


Figure 4 Image of tolerable individual risk and countering social disruption



The aim is that everyone in the Netherlands living behind a dyke can count on a tolerable individual risk. Smart combinations of measures (layers 1, 2 and 3) will ensure that the annual risk of dying is no greater than 1:100,000.

In addition to this tolerable individual risk, targeted efforts should be made to protect those areas where there is a relatively high risk of major economic damage and large groups of casualties. Smart combinations of measures (layers 1, 2 and 3) will ensure that social disruption will be countered where possible.

Smart combinations

At certain locations, the desired level of safety can be achieved with smart combinations of measures from the three safety layers: protection against floods (layer 1), limiting the consequences of a flood via spatial organisation (layer 2) and disaster management (layer 3). With the dykes and Room for the River, the preventive approach of layer 1 remains the top priority. However, a combination with spatial planning or additional disaster management may be appealing for areas where dyke improvement proves very costly or where other solutions for important social considerations are required. Spatial organisation, for instance, can be about adapted construction or not building in certain areas. The measures in layer 3 supplement the measures that the security regions have already taken to realise the evacuation fractions, which have been factored into the standards.

The sub-programmes have mapped out these smart options over the past year and will continue to elaborate these next year. [\[?\] Sub-section 3.3](#) provides an overview of the results per sub-programme. If the desired level of safety can be achieved by way of multi-layer flood risk management, timely decisions on the necessary measures and the safeguarding thereof need to be taken. That requires elaboration of responsibilities, financing and the enforceability and adopting of the resulting standard for the probability of a flood for the flood defence system at the site in question. This is expected to concern new combinations of existing responsibilities. Achieving the desired level of safety solely by way of preventive measures will also always remain an option.

The responsibilities that have been laid down in the Administrative Agreement on Water also act as the foundation for multi-layer flood risk management. The initiative for multi-layer flood risk management rests with the defence system manager, who consults the province, the municipal council(s), the central government and/or the security regions. In their role in the spatial domain, provinces and municipal councils can also propose options for a multi-layer approach. The current area-based structure of the Delta Programme, in which all the government authorities in one area are involved, facilitates this process. If a multi-layer flood risk management approach is chosen following an exploration in the plan elaboration phase, then an administrative agreement is required with agreements on 'who does what and when'. On certain conditions, funds are

Disaster management and social media

The floods in Brisbane (Australia) in 2011 and in New York (hurricane Sandy) in 2012 demonstrated how social media can increase the ability of citizens to cope during a crisis. Via Facebook and Twitter, relatives could keep in touch and citizens organised emergency aid amongst themselves. Government agencies were also able to communicate more quickly and in a more targeted fashion using these social media, e.g. by connecting people via online notice boards, by refuting rumours and instructing the population what to do. To be able to utilise social media effectively in times of disasters, the electricity supply and telecommunications network have to function continuously. The Ministry of Security and Justice will include these international experiences in its crisis communication policy and recommendations on communication during a crisis.

available from the Delta Fund for developing multi-layer flood risk management solutions; the amount is comparable to the cost of an efficient solution in layer 1 (e.g. dyke improvement). The Minister for Infrastructure and the Environment can decide on this on a case-by-case basis. The use of HWBP funds for multi-layer flood risk management requires coordination with the water boards.

It is important to gain experience with applying multi-layer flood risk management and to gain insight into the likelihood of achieving the desired level of safety that way. As such, a concrete elaboration in the shape of pilot projects is being carried out for a number of promising locations: Eiland van Dordrecht, Alblasserwaard-Vijfheerenlanden, Marken, the IJssel-Vecht delta, the Ems delta, West Maas and Waal and Limburgse Maas. The pilot projects are being run to gain knowledge, but also to take decisions on the actual creation of multi-layer solutions. The overview of the pilot projects is not exhaustive: other pilot projects can be added.

The progress and results of the pilot projects concern 'measures and provisions' for flood risk management. As from next year, the annual Delta Programme will include the progress and results of the pilot projects. Pilot projects concerning HWBP-2 sections are also accounted for according to existing HWBP-2 processes.

Progress of pilot projects in DP2015

DP2015 will, in any case, report on the following pilot projects:

- **Marken, Alblasserwaard-Vijfheerenlanden and Eiland van Dordrecht**

Improvements for these dyke rings (13-b, 16 and 22) have been incorporated into HWBP-2. Pilot projects highlight whether there are opportunities to employ multi-layer flood risk management here. For Marken, the primary issue being explored is whether multi-layer flood risk management can be used to limit the spatial impact of the planned dyke improvement by way of specific spatial policy and evacuation options. This may also present good opportunities for protecting sites of cultural-historical value. Although there is major tasking for dyke improvements in Alblasserwaard and Vijfheerenlanden, there is barely any space for that. The pilot project aims to find creative solutions for a long-term spatial design and disaster management, e.g. by way of delta dykes, compartmentalisation and shelters. For more information on the Eiland van Dordrecht, see [\[\]](#) the specific box in this section.

- **IJssel-Vecht delta**

The IJssel-Vecht delta area development is also one of the pilot projects for multi-layer flood risk management. The Rivers and the IJsselmeer Region sub-programmes are investigating the options for multi-layer flood risk management for a number of different areas and projects. For more information on the IJssel-Vecht delta, see [\[\]](#) the specific box in this section.

- **Limburgse Maas at Roermond**

The Limburgse Maas pilot project is firstly carrying out an exploration into the options for flood defence systems, spatial planning and disaster management. This is being done in conjunction with the government authorities in charge and via joint ventures such as the security region. After that, variants will be weighed up based on different criteria, such as cost-effectiveness.

- **Ems delta**

The objective for this area is to be able to guarantee safety in the future too and to limit the consequences of floods. An integral exploration of the different design variations is being carried out for the area in the triangle formed by Eemshaven, Delfzijl and the city of Groningen. As part of this, the options to link up with freshwater supplies, landscape, ecology, the economy, liveability and pluvial flooding are also being considered. The elaboration concerns two traditional forms of coastal defence and a number of alternatives, such as a foreland, a secondary dyke in a wide zone along the coastal flood defence system, an additional flood defence system, (additional) protection of vital and vulnerable buildings and risk reduction through restructuring (northern part of Delfzijl).

- **West-Maas**

This pilot project will conduct an exploration into the flood risk management issues in the Land van Maas en Waal and the options for multi-layer flood risk management. The area inside the dykes is so deep that it is difficult to propose spatial solutions in layer 2. This is all the more the case given that there are no major new construction or restructuring plans here. As such, the emphasis is on solutions in layer 3, for which the evaluation of the 1995 evacuation may be of use. Shelters would seem to be a suitable solution for this area, also in the long term. What is new is the insight that the difference in water level caused by a flood from the river Waal may cause the Maasdijk to collapse. This calls for a long-term solution.

Implementation

The new approach means that in due course the casualties and the economic damage caused by floods will decrease, and that everyone in the Netherlands living inside the dykes, dams and dunes can count on the new tolerable individual risk level (10^{-5}).

Over the next few years, significant investment will be required in those areas where safety levels have to increase. The desired level of safety will make tasking for the area around the major rivers the most extensive. In those areas where safety is already at the required level, the emphasis over the next few years will be primarily on the proper management and maintenance of the dykes.

The current and new approaches to flood risk management are very different. In terms of numbers, they cannot and should not be compared. The current approach only looks at a flood water level being exceeded. The new approach looks at the probability and consequences of floods. The application of multi-layer flood risk management is also new. The way in which multi-layer flood risk management can contribute to efficiently limiting the consequences of floods will still need to be outlined in more detail. In that way, we will get a full picture, in accordance with the risk-based approach, of how we can minimise social disruption by managing the probabilities and the consequences. This approach ensures that the Netherlands remains a safe delta and, where necessary, is made even safer.

The proposal for the new standards will be included in DP2015 as part of the proposals for the Delta Decisions. The intended Cabinet decision will be announced in DP2015 and the subject included in the follow-up to the National Water Plan (draft in December 2014). The Delta Decisions will already have been embedded in legislation when the follow-up to the National Water Plan is decided in 2015. The process of being embedded in legislation will start immediately after the Cabinet has made its decision on the Delta Decisions. The aim is to have the new standards legally effective by 2017, so that the Fourth Assessment can be carried out on the basis of the new standards. It is essential that the instruments associated with the new standards, e.g. the set of assessment and design tools, be available when the new standards come into effect.

As per the wishes of the House of Representatives, the risk-based approach is already being introduced in practice in the new Flood Protection Programme ([\[2\]](#) sub-section 2.3),

in anticipation of it being embedded in legislation. There are three different phases for this:

- **2013-2015:** the phase prior to the decision-making on the Delta Decisions. The new approach will be shaped by prioritising the measures based on the greatest risk reduction. The possible new standards will be included in explorations as a variant.
- **2015-2017:** the phase between the decision-making on the Delta Decisions and the new standards being embedded in legislation. Having the new standards embedded in policy before it is embedded in legislation is enough of a foundation to be able to apply it to the dyke improvements in practice. When formulating the design, the defence system managers should consider the new standards and cannot deviate from them without providing good reason for doing so. A revised subsidy scheme may be required for this transitional period.
- **na 2017:** phase after embedding in legislation. Defence system managers can register dyke sections for the new HWBP directly because a continuous assessment is now in place. Sections registered will be included in the annual prioritisation and programming of the HWBP. Once all the primary flood defence systems have been tested against the new standards, which is expected in 2023, there will be a full picture of the dyke sections that need improving.

The aim is to have all flood defence systems meet the new standards by 2050 at the latest, in accordance with the National Water Plan. This period is comparable to the implementation period of the Delta Plan in the southwest of the Netherlands. While there are no acute risks to flood risk management, the Delta Programme Commissioner does think that it is a long period of time.

The new Environmental Planning Act incorporates all legislation for the physical living environment, including the Water Act. The draft bill does not yet include all subjects from the Water Act, such as the Delta Act on flood risk management and freshwater supplies. The Delta Programme Commissioner recommends including in the Environmental Planning Act all the parts from the Water Act that are fundamental to those living in the Netherlands, e.g. the system for flood risk management (standards and associated matters in the legislature because flood risk

management is fundamental to the physical safety and economy of our lowlands and cannot be compared with other environmental values) and the Water Test (as a governmental decree or *Algemene Maatregel van Bestuur*, abbreviated to AMvB in Dutch). The Delta Programme Commissioner also recommends – as the Association of Regional Water Authorities (*Unie van Waterschappen* in Dutch) also indicates – including the core elements from the Delta Act (effective as of 1 January 2012) in the next phase of the Environmental Planning Act.

The Cabinet has opted to uphold the core elements from the Delta Act in the Water Act and to verify whether these elements will be included in this in the next phase of the Environmental Planning Act.

The bill for the Environmental Planning Act is currently being prepared. The Cabinet intends to lay down the flood risk management standards not at a statutory level but at an AMvB level with a proper foundation in the Environmental Planning Act, because this will ensure that all the standards in the Environmental Planning Act, e.g. all the environmental standards as well, are laid down in a clear and straightforward manner. This will prevent any seeming hierarchy arising among the areas and their objectives. This also ties in with the integrated ambition and objective employed in the Environmental Planning Act. Standards are currently spread across a number of acts and decrees, and under the Environmental Planning Act these will be collated in as clear a manner as possible, which ensures that the Environmental Planning Act provides a structured way of alleviating the government's concerns about the living environment. The objective of the Water Test (broad consideration, collaboration between government authorities) is laid down in general terms in the draft Environmental Planning Act. This can be elaborated at AMvB level.

Areas outside the dykes

A small part of the Netherlands lies outside the dykes. The most densely populated area outside the dykes is the Rhine Estuary-Drechtsteden region. This is also where the economic interests are the greatest. Relatively few people live in the other areas outside the dykes. The flood risks for the people living and working outside the dykes are generally limited because most of these areas are located on accretionary ground. In areas outside the dykes, the individual risk of dying depends on how high the area is, how it is physically organised and the disaster management. Making changes

to the spatial organisation and disaster management may increase the safety in an area outside the dykes.

In September 2011, the government authorities involved jointly concluded that it would not be necessary to change current roles and responsibilities for these areas. This conclusion was included in DP2013. The basic coastline for the areas outside the dykes on the coast will be maintained.

The responsibilities for areas outside the dykes do not need to change to be able to apply the risk-based approach. Risk communication with residents and businesses outside the dykes can be supported using information for municipal councils and security regions. Furthermore, an evaluation framework for a water-robust design will be drafted that can also be used in areas outside the dykes. The protection of vital and vulnerable infrastructure and uses will be given explicit attention in the evaluation framework (for further information, [\[7\]](#) 'Vital and vulnerable'). Thanks to the evaluation framework, various tools will be available to support local and regional spatial considerations. The municipal council and province can incorporate these into their own plans where necessary. In accordance with the agreed policy, provinces and municipal councils provide residents and businesses outside the dykes with information on the risk situation and the measures that these residents and businesses can take themselves to minimise damage from pluvial flooding or floods. The province of Zuid-Holland has set an individual risk of 10^{-5} as a performance goal. This province is going to work towards this with other regional government authorities involved by providing information on the possible measures in layers 2 and 3. The province of Flevoland has set standards for the areas outside the dykes that are protected by regional flood defence systems. The central government (i.e. Rijkswaterstaat) facilitates this by providing parties with information on (current) water levels and making agreements on such things as the level at which the Maeslant storm surge barrier (*Maeslantkering* in Dutch) should close, and water level management of the IJsselmeer lake.

While policy for areas outside the dykes will not change, the government authorities involved will this year explore the possibilities within the Delta Programme to improve safety in the areas outside the dykes in line with the risk-based approach. This involves customisation for each area, for which, where possible, the same set of tools will be used for each area.

Scheveningen Boulevard: an example of a multifunctional dyke

The Netherlands' most famous seaside resort has undergone a great change thanks to a collaborative venture between the municipal council of The Hague, the Delfland water board, the province of Zuid-Holland and the central government. The tasking involved constructing a new boulevard that was both safe and aesthetically pleasing. Over the last three and half years, the beach has been widened and a kilometre-long (sand covered) dyke constructed, on top of which lies a brand-new boulevard linking Scheveningen-Haven to Scheveningen-Dorp and Scheveningen-Bad. Scheveningen can once again welcome millions of visitors and protect the hinterland against the sea for the next 100 years.

Delta Dykes

Delta Dykes are very robust dykes that significantly reduce the risk of flooding. The wider parts of these dykes allow for a multifunctional design. Delta Dykes can already be found at a number of places, mostly in urban areas that contribute to the strength of the dyke. Besides these advantages, the downsides to Delta Dykes are that the investment costs are higher compared to a standard dyke improvement and that they sometimes need more space. As such, they cannot be built everywhere.

Strict standards will apply to those dyke sections where the consequences of a dyke breach would be extraordinary. Delta Dykes can be a way of realising such strict standards since they limit the probability of dyke breaching and thus also the consequences of long and deep flooding. If a Delta Dyke provides a more economical and efficient elaboration of the standard, this can be financed in the same way as other dyke improvements without a separate arrangement being required. In the case of a multifunctional design, the other stakeholders will have to contribute to any additional costs. This can be financed under the experimental article in the Delta Fund. Parties that want to construct (and finance) a Delta Dyke themselves must agree on the design with the defence system manager.

How to deal with excess height and excess strength

Area-based analyses have shown that in some places the current flood defence systems are higher than required by law. This is considered 'excess height'. In some cases, there is 'excess strength' as well. The sub-programmes take into account new insights related to excess height and excess strength when elaborating promising strategies. The basic principle is that excess height can be included if it is accompanied by excess strength. In most cases, that can be inferred from the dyke ring studies conducted by Flood Risk in the Netherlands (*Veiligheid Nederland in Kaart* (VNN) in Dutch). In the case of dyke rings for which this kind of information is not yet available, an expert opinion can serve as the basic premise.

Forelands

High forelands in front of flood defence systems reduce the waves, thereby minimising the hydraulic load on the flood defence system. Assessments often do not factor this in. As a result, primary flood defence systems sometimes fail an inspection, while in actual fact they are safe. The Safety sub-programme has looked into the options in the set of statutory review tools to actually factor in the forelands. The sub-programme has found that forelands can be factored in in assessments. The flood defence manager reaches agreements with owners and managers and can carry out the assessment again if the forelands change. This means that the parties in the area-based sub-programmes already have the option to reach agreements together if preferable. The Safety sub-programme is having studies carried out into how to encourage including forelands in the next assessment. This may lead to the set of assessment tools being amended by supplementing it with agreements between parties or utilising the spatial set of tools. Once the Fourth Assessment has been conducted, there will be a continuous review process. This will provide the option of amending the evaluation when a foreland changes.

Water-robust design - Spatial Adaptation

Future developments, such as the construction of new residential areas, industrial estates and other capital intensive investments, may increase the consequences of a flood over time. Therefore, the Delta Programme encourages a water-robust spatial organisation. The importance of flood risk management must be fully incorporated into future spatial planning. This will ensure that closer attention is paid to vital and vulnerable uses, the spatial aspects of disaster management and the climate-proof city.

Minimising risks by way of water-robust design

It is important to consider future flood risks in plans on spatial planning, which requires that an evaluation framework be developed in the Delta Programme that becomes an essential part of considerations on spatial planning (e.g. framework visions, regulations, zoning plans). As such, the Delta Programme has included an evaluation framework in the Delta Decision on Spatial Adaptation, with which the impact of spatial investments on flood risks can be properly considered. The evaluation framework will provide a clear framework for the choice of location, issuing permits and investment decisions, and can therefore also be used for building design and area development. Provinces and municipal councils will remain responsible for these considerations. The Water Test ensures that the evaluation framework is actually used in spatial development. Although the Water Test does not actually change as a result, its position in terms of content is improved. The point at which the Water Test is used and then embedded is also important.

The evaluation framework can also be used in the areas outside the dykes, in the regional water system and in the areas reserved for future measures for flood risk management or freshwater supplies.

Completing the evaluation framework will always concern local customisation. The guiding factor is the level of ambition, which can range from 'optimal functioning in the case of a flood' to 'complete evacuation and rapid recovery after a flood'. The sub-programme develops tools to support the evaluation, such as a decision tree, maps detailing flood characteristics, principles for a water-robust design, an overview of possible measures and a manual for risk communication in areas outside the dykes. How a water-robust design can improve evacuation options will also be looked at.

Vital and vulnerable

In the case of water-robust design, vital and vulnerable uses require special attention. These uses include products, services and underlying processes that could cause social disruption if they were to fail.³⁴ e.g. vital networks (such as those for electricity, gas extraction, drinking water, communication facilities and IT), vital objects (such

as hospitals) and facilities which could have serious consequences for an area in the case of a flood (such as nuclear or chemical plants).

At present, flood risks play a limited role in decisions on spatial organisation and investments in these uses. Not enough is known about the risks, and sectors encounter resistance when trying to include flood risks in their evaluation. The Water-resistant Westpoort project, which the New Urban Development and Restructuring sub-programme and the municipal council of Amsterdam are carrying out together, shows that major damage during a flood can be prevented by investing in a more water-robust organisation because this will allow vital and vulnerable uses to continue operating.

In terms of flood risks, vital and vulnerable uses can be divided into the following categories:

- uses important for relieving the consequences of a flood (e.g. particular utilities, transport, communication tools and hospitals);
- uses that could cause massive damage to the environment or public health if affected by a flood (e.g. chemical companies and nuclear plants);
- uses which, if they fail, impact consumers (e.g. loss of turnover, damage to image) and whose damage goes beyond the interests of the region (e.g. electricity, natural gas extraction and IT);
- uses that are not of supraregional interest, but which may cause a lot of damage locally if they fail.

In due course, policy will be formulated per sector for the first three categories (uses with a supraregional interest). This will be done in close collaboration with the government authorities in charge and the sectors to ensure that the new policy is in line with existing policy and future investment decisions. Consultation will address such subjects as delineating the categories and the desired ambition levels, deciding who is responsible for implementing policy and the measures to be taken, the tools and the interconnectivity between the location-specific approach and the standards recommendation. The 'vital and vulnerable' approach will, therefore, primarily go down the route of the water-robust organisation. In a number of areas, the issue of whether vital and vulnerable uses need additional protection in the form of a fine-tuned protection standards recommendation, e.g. for the gas production, storage and transport facilities in Groningen or the nuclear plant near Borssele, is also

³⁴ This description is part of the definition of vital infrastructure from the Ministry of Security and Justice (formerly Domestic Affairs) (Parliamentary document 26643, no. 75).

being looked into. The next phase of the Delta Programme will highlight which area-specific cases this concerns.

There will be different levels of ambition for the four categories. The idea is for category 1 to be classed as 'continue operating', for category 2 to be classed as 'prevent damage to the environment and public health' and category 3 as 'minimise direct or indirect damage'. Category 4 also aims to minimise damage, but given that the interests here are not supraregional, the region is the first to decide the level of ambition. The New Urban Development and Restructuring sub-programme will facilitate this using the evaluation framework for a water-robust design.

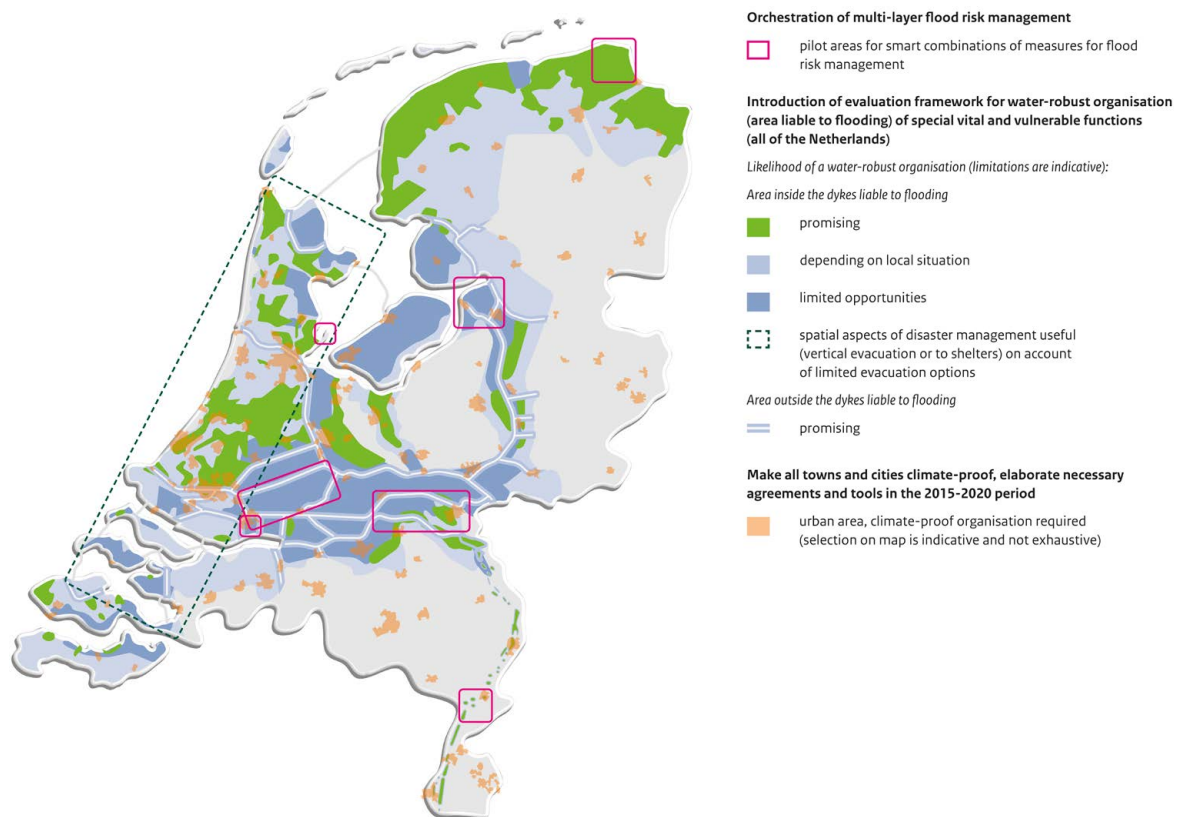
The map shows which areas of the Netherlands would benefit the most from a more water-robust design. Criteria include the water level in the case of a flood and the duration of a flood.

Climate-proof city

Towns and cities drive the Dutch economy and the majority of people living in the Netherlands live in towns and cities. As such, a good quality of life in urban areas is very important. Dutch towns and cities are already dealing with damage due to pluvial flooding and prolonged dry and hot spells.

The Delta Programme aims for Dutch towns and cities to be climate-proof by 2050. Climate-proof means that they can weather changes such as increasing precipitation and dry and hot spells. The New Urban Development and Restructuring sub-programme has set up public private partnerships to formulate practical recommendations for the following four areas: urban water, public space and green areas, construction, and urban development and infrastructure. These partnerships issued their recommendations in the summer of 2013. DP2015 will include concrete recommendations for the Delta Decision

Figure 5 Draft Delta Decision on Spatial Adaptation



on Spatial Adaptation. These will then be elaborated and implemented in the years after so that the parties will tackle matters in a climate-proof manner from 2020 at the latest.

Initial results show that tasking and promising measures for climate-proof cities are already known and government authorities have sufficient tools. Nevertheless, interventions are not getting off the ground properly. The partnerships recommend that the government authorities set a 'point on the horizon', i.e. an ambition, targets and implementation strategy. The aim is to enable the government authorities, market parties and citizens to implement their own ambitions. That can be done in different ways: sharing knowledge, developing tools, reaching agreements, applying financial incentive tools and setting legal frameworks. Regional government authorities should indicate in their long-term plans how they are going to act in a climate-proof manner in the short term. In the case of decisions on sewerage, road infrastructure and public space, the total cost of construction and management (i.e. the total cost of ownership) should be assumed as a basic principle. The partnerships advise viewing the groundwater, surface water, rainwater, drinking water and waste water as an interconnected whole – the urban water system – so that more solutions can be highlighted.

If towns and cities have clear ambitions and goals, residents and businesses can also take an adaptive approach. Government authorities should support initiatives for this and set clear indicators (e.g. the extent of paving in gardens for rainwater to filter through). Such indicators allow benchmarking as well as a comparison of the widely varied risk analyses of, for example, the infrastructure network administrators. The responsibilities of government authorities and private individuals for such things as groundwater levels need to be explained so that it is clear who can do what to prevent damage to the foundations of buildings and infrastructures.

The partnerships suggest concluding a broad initial agreement in which all the stakeholders rally behind the objective of developing the city so that it becomes climate-proof. One of the arrangements in this agreement could be that the government authorities gradually set up adaptation strategies, as part of which they voluntarily – but not free of any obligations – formulate goals.

Supply level – Freshwater strategy

Having freshwater available is crucial to the liveability and the economic position of the Netherlands. The Netherlands' unique position in the delta also presents opportunities for efficient improvement of the freshwater supplies. At present, policy aims to meet users' needs optimally under normal circumstances. In times of water shortages, water will be distributed according to the Sequence of Water Demand³⁵ and the damage to be minimised. The work being done on the freshwater supplies and the division of risks in the case of freshwater shortages have not been clearly evaluated and are often not transparent for users.

This is all set to change considering the huge importance of freshwater, also from an economic point of view. The draft Delta Decision on Freshwater Strategy proposes the following national objectives for freshwater:

- to protect essential social uses (avoiding social disruption);
- to promote the competitive position of the Netherlands;
- to strive for a healthy and balanced water system;
- to use the available water as effectively and as economically as possible;
- to encourage water-related knowledge, expertise and innovation.

These national objectives are based on the ambitions set by the central government, the regions and the users. The aim is not only to resolve bottlenecks, but to utilise opportunities as well.

The objectives require a strategy that capitalises on the main water system, the regional water system and the users. A number of targeted measures in the main water system and the regional water system are making the freshwater system more robust. As a result, drastic measures can be deferred, which, given the uncertainty about future developments, may be preferable. As water is not as easily available everywhere and does not provide the same added value everywhere, the freshwater strategy will be elaborated on a regional level.

Supply levels

There are bottlenecks in freshwater supply already and these are expected to increase because of climate change.

³⁵ National Water Plan, page 83, Parliamentary document 31710, no. 12.

The government is already unable to meet all demand for freshwater in every situation. It is important, therefore, for water users to have insight in what they can count on under normal circumstances and in times of drought, so that they can anticipate this by innovating, for instance. Government authorities (central government, province and water board) will set supply levels that will indicate the extent of the government's responsibilities and what work and residual risk that entails, under both normal and extreme circumstances. The supply level is based on the national policy goals, is considered to be a performance obligation and is reviewed periodically, enabling users to know what they can count on, so that they can include the risk of water shortages in considerations for their future plans.

The supply level will be elaborated for each region and for each use. It would be better for all uses to prevent freshwater shortages from happening rather than implementing emergency measures to deal with shortages. That said, water shortages cannot be avoided entirely, nor can damage caused by drought. The aim in situations like these, therefore, is to minimise the damage for all uses as much as possible. The elaboration will also consider what is required to keep the vital uses up and running for as long as possible, based on the national freshwater objectives. When vital uses are jeopardised, this will entail widespread disruption to society and extensive or irreparable damage. This is the case, for instance, when the stability of the dykes is compromised because of a water shortage, when there is irreversible damage to the natural environment or when the delivery reliability of drinking water and electricity is threatened.

The key issue is what is feasible in relation to the supply level and how detailed the agreements on supply levels have to be. These three points will be worked out in more detail for DP2015 in three pilot projects with all stakeholders involved and the area-based sub-programmes (i.e. region West, region East - in combination with South - and IJsselmeer Region). Rijkswaterstaat is exploring what the main water system as a whole can contribute to water supply for the designated uses. Based on the pilots, the central government will develop a national framework together with the provinces, water boards and users. This framework will provide clarity and direction for the regional elaboration of the supply level. The national framework and the governance of the supply level will be included in DP2015.

Reaching and maintaining the supply levels will require intervention in the main water system, the regional water system and the designated uses. In many areas, the main water system takes care of the supply of freshwater. The regional water system takes care of such things as the distribution of water in an area. More often than not, users can contribute to minimising damage in the case of drought. Dealing with the available water in a smarter and more economical fashion is the basic principle for determining supply levels. Therefore, the designated uses will be factored in when drawing up the supply levels. The IJsselmeer Region and Southwest Delta sub-programmes provide ideas for that ([\[\] Promising strategies for the IJsselmeer Region](#) and [\[\] Promising strategies for the Southwest Delta](#)).

Main water system and regional water system

The aim is to tackle the current bottlenecks in the water system in the short term by investing in no-regret measures, as a result of which the system will become more flexible and less vulnerable. With the investments stated below in the main water system, the regional water system and for the benefit of users, it would seem that the national goals – which are based on the ambitions of the central government, the regions and the users – will be achievable almost everywhere up to 2050, also in the Delta Scenarios that assume rapid climate change and major socio-economic development. Next year, the actual cost-effectiveness of these measures will be studied as well as whether these measures are sound, flexible and sustainable – all core values of the Delta Programme.

Until 2050, the main decisions for the main water system will comprise a selection of the following investments: setting a more flexible water level in the IJsselmeer and Markermeer lakes (larger freshwater buffer); introducing bubble plumes in the Nieuwe Waterweg (to minimise salt intrusion) and measures in the main water system to extend the KWA (*Kleinschalige Water Aanvoer*: small-scale water supply) to a KWA+ (e.g. more water from the Amsterdam-Rijnkanaal via the Betuwepand); transferring water from the river Waal to the river Meuse via the Maas-Waalkanaal or at St. Andries; and/or improved freshwater-seawater separation at locks and sluices.

The investments in the regional system vary for each region. In the part of the Netherlands below sea level, the regional freshwater supply depends on investments in the regional water system (KWA+). Up until 2050, there is no need to

extend the KWA into a permanent supply route for freshwater supplies, but it does present opportunities for safety, nature, the economy and shipping. If there are linkage opportunities in the short term, the option to have the supply via the KWA become permanent before 2050 will remain open. Other promising investments in the regional system of the lowlands of the Netherlands are: water conservation in the surface water (e.g. by having flexible water level management) and in the groundwater, increasing the moisture buffer in the root zone and limiting flushing. The focus in the part of the Netherlands above sea level is on increasing groundwater buffers. This is done by countering falls in groundwater levels and increasing groundwater levels in the spring. Furthermore, investments

could focus on increasing the moisture buffer in the root zone. The supply of water from the Meuse via the Noordervaart is of importance to the water supply in the Peel region. Studies into water supply via the Maas-Waalkanaal or at St. Andries are ongoing for other parts of this region. Haringvliet, Hollandsch Diep and Biesbosch are strategic parts of the freshwater buffer for parts of the Southwest Delta. The adaptation of the Roode Vaart, with a link to Hollandsch Diep and the Mark river, is important to farmers and nature in West-Brabant and may also play a role for the Southwest Delta. The former Cabinet already made agreements on this.

For the long term (i.e. after 2050), it would be wise to keep a number of options open, such as greater fluctuations in the

Figure 6 Draft Delta Decision on Freshwater



water level of the IJsselmeer lake and a greater discharge of water via the river IJssel in the case of low water levels. This will take into account the Delta Scenarios and seek possible linkage with other ambitions (▢ sub-section 3.4).

The supply level will be used to elaborate the tasks that the government (central government, province, water board) wants to take on. As such, the supply level is a key tool in freshwater strategy. The elaboration of the supply level helps decide which of the above investments will actually be implemented.

Investment programme – Delta Plan on Freshwater

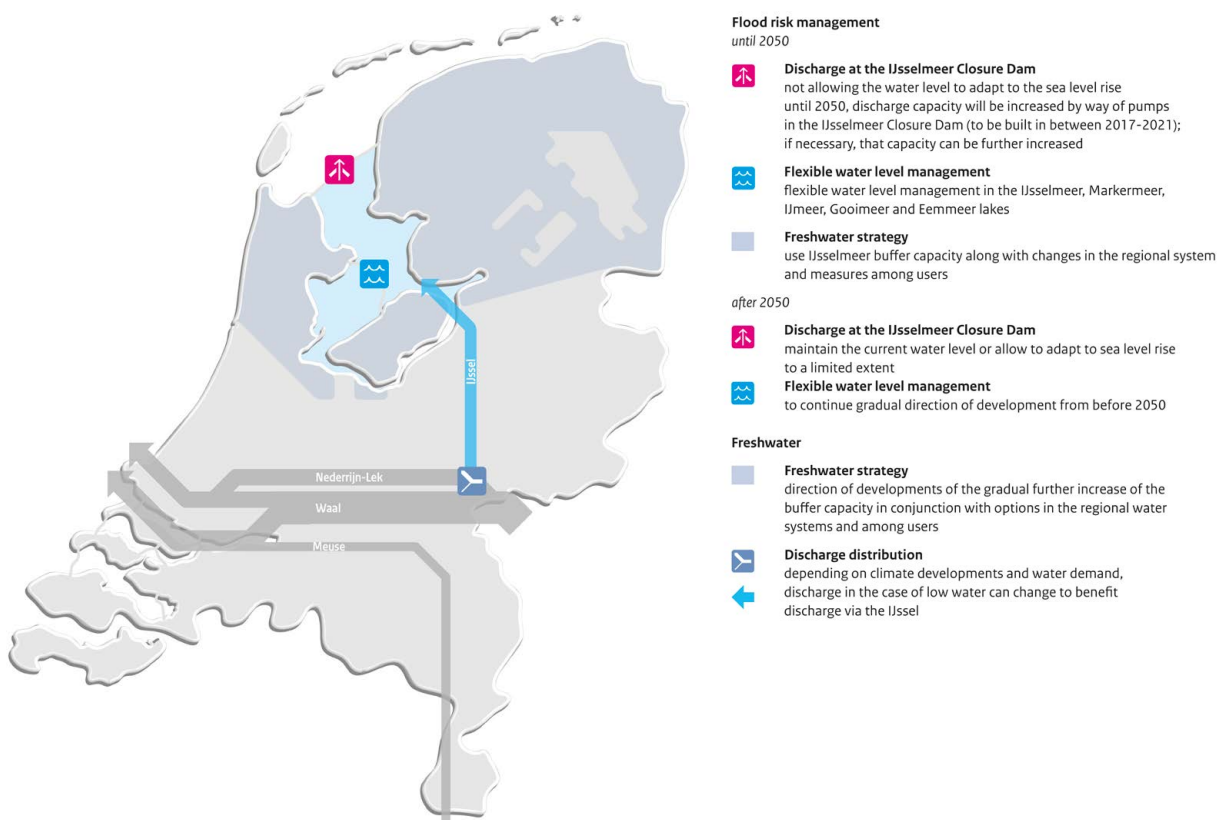
For DP2015, the extent to which the above measures could be included in the investment programme for the next few years is being studied. The content of the investment programme will be drawn up next year based on the promising sets of measures that are being worked out by

the Freshwater sub-programme together with the regions (▢ sub-section 3.3) and whose cost-effectiveness (i.e. costs and benefits) has been evaluated. The sub-programme assesses the measures against the development paths to ensure that the short-term measures do not impede the long-term ambitions. This short-term investment programme forms the basis for the Delta Plan on Freshwater (▢ sub-section 2.1). The Delta Plan on Freshwater also aims to encourage innovations and changes related to dealing with water in an economical and effective manner. Collaboration between government authorities and sectors is essential for the Delta Plan on Freshwater to be implemented. The plan will include agreements on this.

Strategic decisions IJsselmeer Region

The water level in the IJsselmeer Region determines flood risk management around the lake. The area is home to the largest freshwater buffer in the Netherlands. There are three

Figure 7 Draft Delta Decision on the IJsselmeer Region



strategic decisions to be made in the Delta Decision on the IJsselmeer Region: the discharge of excess water to the Wadden Sea, the water level management and the freshwater strategy. The IJsselmeer Region, the Rivers and the Freshwater sub-programmes have already provided the basis for these decisions; the decisions depend in part on the Delta Decisions on flood risk management, freshwater strategy and spatial adaptation.

Discharge at the IJsselmeer Closure Dam

If the water level in the IJsselmeer Region rises, gravity discharge to the Wadden Sea will be utilised. Gravity discharge is becoming increasingly difficult to do on account of rising sea levels. Broadly speaking, there are two ways to regulate the water level in the future: allow the water level in the IJsselmeer Region to gradually rise in tandem with the rising sea level or maintain the water level more or less at the current level and discharge the excess water by large pumps. Over the past year, the second option has emerged as the less expensive one by far, in part because it creates no additional flood risk management tasking in the hinterland. Because rising sea levels over the past few decades have reduced the discharge capacity of the sluices in the IJsselmeer Closure Dam, capacity as part of the IJsselmeer Closure Dam project has been increased. This is being done by building additional pumps, which will be ready in 2021. Additional pumping capacity will be built in the next few decades depending on how fast sea levels rise. By doing this, the current winter water level can be maintained up to c. 2050. The Delta Programme proposes not allowing the water level to adapt to the rising sea level until 2050. In 2050, the current discharge sluice complexes will need to be replaced. There are various options for the second half of the century: take a decision now on maintaining the current water level, take a decision now on allowing the water level to adapt to the sea level rise to a limited extent, or do not take a decision now and keep both options open in the next few decades. DP2015 will provide a definitive answer on this. Allowing the water level to largely adapt to rising sea levels is not a realistic option after 2050 either.

Flexible water level management

The current target levels for summer and winter are increasingly difficult to maintain. There are more and more very wet and very dry periods. The current combination of water level management and spatial organisation will not easily accommodate this development. Furthermore, there is the increasing water demand to consider and the option to use pumps to discharge water to the Wadden Sea. As such,

the Delta Programme proposes a more flexible water level management with a corresponding organisation of the area. In that way, the water manager will be better equipped to bring water level management in line with the weather conditions, freshwater demand and the interests of other uses, such as nature and recreation. Flexible water level management is also important in flood water situations.

Freshwater strategy

Following studies in the IJsselmeer Region and the Freshwater sub-programmes, the Delta Decision on the IJsselmeer Region has been supplemented with a freshwater strategy. This has shown that the above-mentioned developments can be gradually anticipated by using a coherent approach to the main system, the regional system and users. In this way, a large enough freshwater buffer can be created up to 2050 and beyond that will satisfy water demand during dry periods. Depending on climate developments, the option of having more water flow via the river IJssel in case of low water levels could also be considered after 2050. In that way, freshwater buffer levels can be maintained. By using this coherent approach, significant water level increases will not be needed in the future as a way to resolve tasking.

A look ahead

The IJsselmeer Region sub-programme is looking into what interventions and agreements are needed to be able to implement the Delta Decision. The results will be included in DP2015. One of the things that the sub-programme is going to do is to take a closer look at whether the water level can be allowed to adapt to rising sea levels, to a limited extent or otherwise, after 2050. The design of flexible water level management will also be elaborated further, with special attention being paid to the link with regional water systems and a flexible organisation of the areas outside the dykes and the bordering areas. The government authorities involved will reach agreements on the implementation, the way of collaborating (also with other social partners involved) and the organisation. DP2015 will address this too.

Strategic decisions Rhine-Meuse delta

The Rhine-Meuse delta is the area where the rivers Rhine and Meuse flow out into the northern basins of the Southwest Delta and the Nieuwe Waterweg: the transitional area between the sea and the rivers. The Delta Programme explored whether system interventions, such as a dam with

sea lock in the Nieuwe Waterweg or a ring of river flood gates, are required to better protect this area. This exploration has shown that these interventions are not necessary: a solid foundation for flood risk management has been built up over the past few decades and this provides a good basis for further improvements.

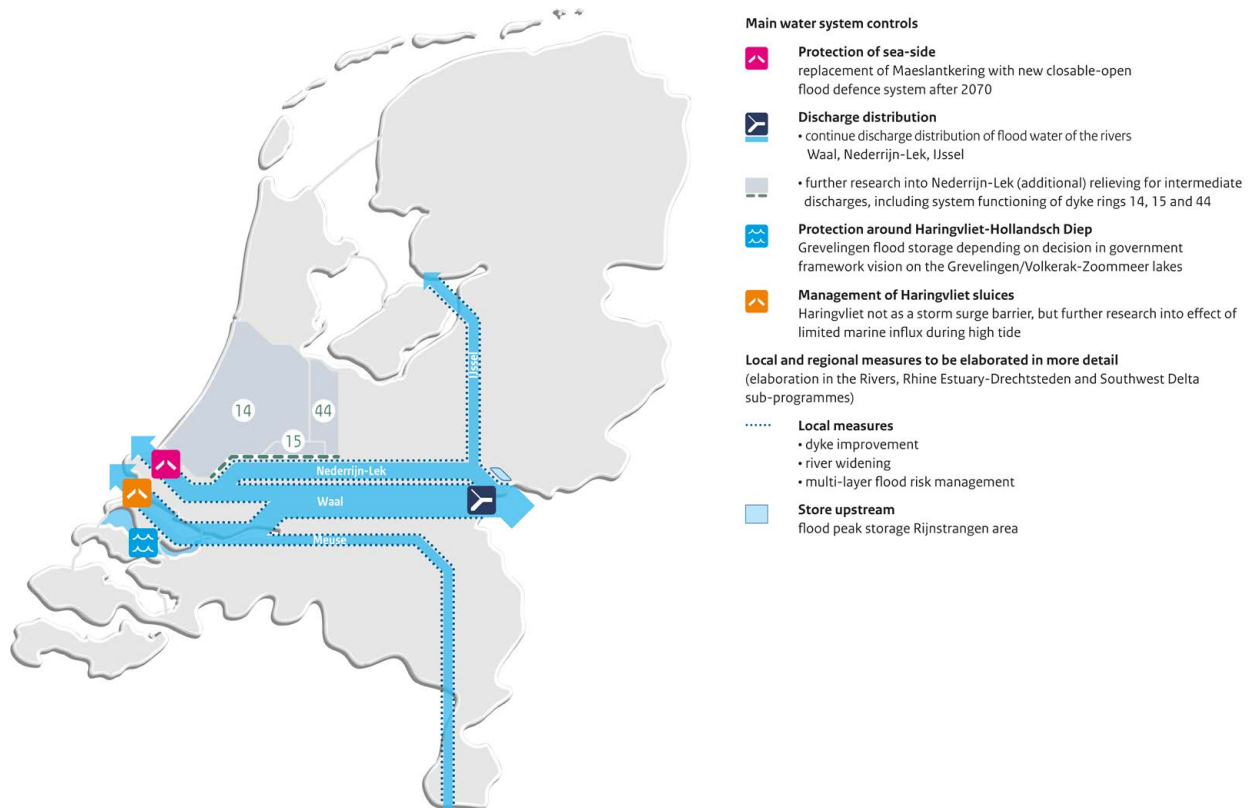
Flood risk management

The Delta Programme will propose continuing to protect the delta in the long term as well with a closable-open storm surge barrier in the Nieuwe Waterweg. This decision can serve as the basic principle for all spatial and economic developments in the area of the Nieuwe Waterweg. DP2013 announced a follow-up study into the partial working and the failure probability of the Maeslantkering. The outcomes of the already completed study provide an answer to some of

the questions that formed the basis for the supplementary study ([DP2013]). These answers are sufficient for the Delta Decision on the Rhine-Meuse delta. It has been agreed that a separate process, to be started in 2014 under the guidance of the Ministry of Infrastructure and the Environment, will study the way in which the Maeslantkering can be improved in the medium term (i.e. until replaced in 2070). This will answer the questions that have yet to be answered.

Current knowledge does not provide enough grounds to take a decision on changing the discharge distribution across the Rhine tributaries for flood water. Further research is required for the Nederrijn-Lek (in the case of discharges from 8,000 up to 16,000 m³/s) and the discharge distribution across Rhine tributaries for volumes exceeding 16,000 m³/s, partly in view of climate change and future new standards.

Figure 8 Draft Delta Decision on the Rhine-Meuse delta



There are two steps to this follow-up study. Joint fact-finding will be done first to collate all available information related to discharge distribution. After that, the purpose and necessity of conducting a further study into relieving the river Nederrijn-Lek more will be assessed and shared among administrative bodies. The conclusions will be included in the proposal for the Delta Decision on the Rhine-Meuse delta in DP2015. For the ongoing regional processes, we have assumed the current discharge distribution. The above studies may, however, lead to a robustness review of the preferential strategies.

At present, a further study is being carried out into the cost-effectiveness of flood storage in the Grevelingen lake for flood risk management purposes and its added value for the ecological and economic objectives (e.g. the effect on water quality, a tidal power plant, recreation, the fishing industry). The study is being conducted as part of the government's framework vision on the Grevelingen and Volkerak-Zoommeer lakes. The results will be available next year and will be input for the Delta Decisions in DP2015.

Freshwater supplies

The Delta Decision on the Rhine-Meuse delta will also include options for freshwater supplies. The KWA emergency supply facility will be expanded. This allows freshwater from the Amsterdam-Rijnkanaal and the river Lek to be discharged to the mid-western part of the Netherlands if the intake point at Gouda becomes saline. This promising solution comprises a phased expansion by increasing capacity and facilitating more rapid action in conjunction with combating salinisation in the Nieuwe Waterweg. This will ensure that the west of the Netherlands has a more robust freshwater supply, and may also benefit the freshwater supplies in the Southwest Delta. The option of having a freshwater or a saltwater Volkerak-Zoommeer may impact the freshwater supply in the main water system in the Rhine-Meuse delta. This will be looked into as part of the government framework vision on the Grevelingen and Volkerak-Zoommeer lakes. The results of this exploration will be included in DP2015.

The management regime of the Haringvliet sluices has also been looked at for the Delta Decision on the Rhine-Meuse delta. Experience with leaving the Haringvliet sluices ajar is required first before further steps can be taken in this area. The Kierbesluit (i.e. the decision to leave the Haringvliet sluices ajar to facilitate more marine influx during high

tide) states that the sluices will be left ajar to encourage fish migration. The Kierbesluit can only be implemented once the agreed set of measures for alternative freshwater supplies has been implemented. The Cabinet has decided that the Kierbesluit is a separate decision that does not prelude a further recovery of the estuarine dynamics. The option of opening up the sluices even more³⁶ may arise because of other interests, but will require considerably more insight into the effects on freshwater supply and safety. By monitoring the effects of the Kierbesluit, a lot of information will become available in the medium to long term.

The proposed interventions in the main water system will have an effect on the water tasking in various regions and will, together with the other Delta Decisions, form a coherent framework for the area-based preferential strategies of the Rivers, Rhine Estuary-Drechtsteden and Southwest Delta sub-programmes.

Strategic decisions on a sandy coastal system

The Dutch coast is primarily made up of sand, which forms a natural defence of the coast. This sand is constantly on the move because of the tides and waves. This movement means that the sandy parts of the Southwest Delta, the Dutch coast and the Wadden Region form a single whole: a sandy coastal system. The Westerschelde, Oosterschelde, Wadden Sea and the Ems estuary, each of which has an open connection to the North Sea, are all part of the sandy coastal system.³⁷ Since 2000, an average of 12 million m³ of sand has been replenished. This has ensured that, on average, the coastline has stayed where it is (with the basic coastline as a reference point) and the coastal foundation zone can adapt partially to the rising sea levels.

Adaptation Agenda for Sand

The Delta Programme has drawn up an Adaptation Agenda for Sand to use sand replenishment to contribute to a safe, economically robust, ecologically sound and attractive coast. The primary objective is to safeguard against floods in the short and long term. The proposal for options concerning the sandy system and the associated agreements on responsibilities will be included in DP2015.

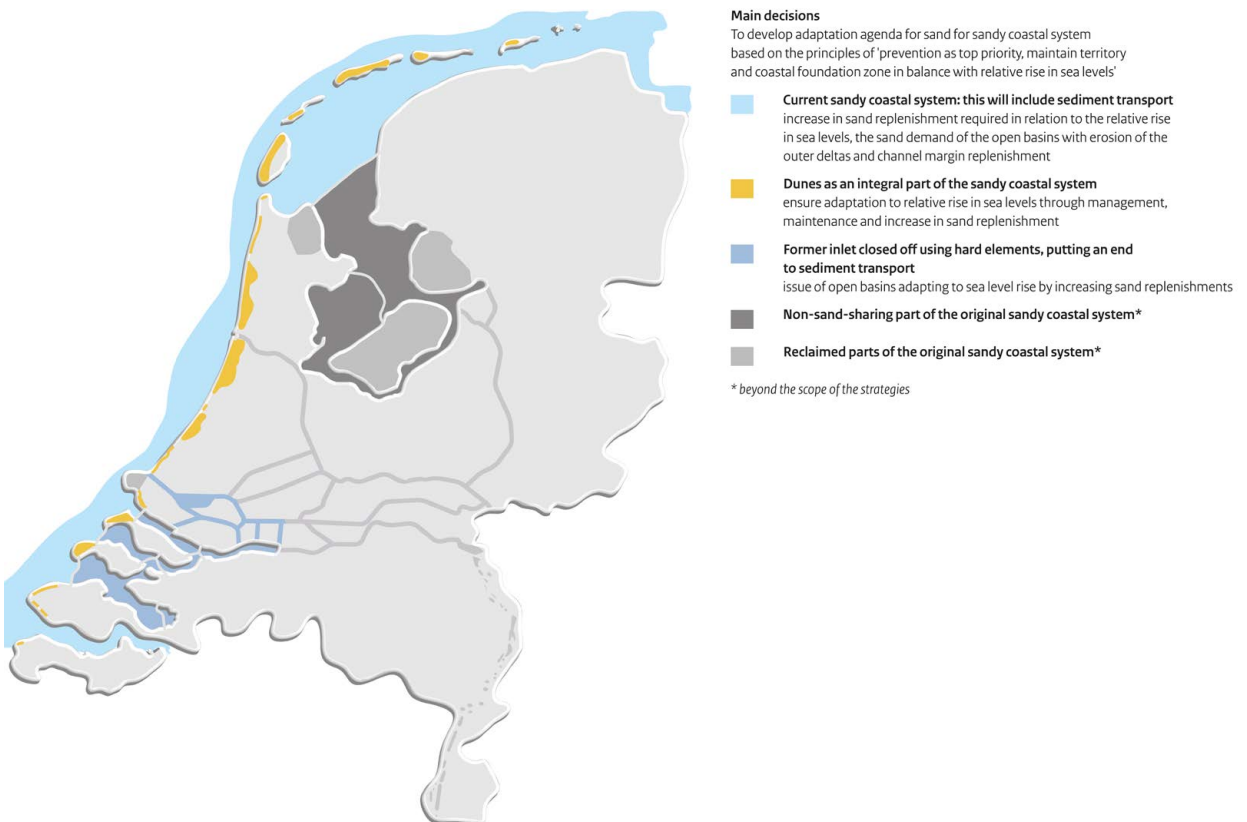
³⁶ As proposed by the World Wildlife Fund.

³⁷ Although the Oosterschelde is in open connection with the North Sea, the storm surge barrier prevents the exchange of sand.

The Adaptation Agenda for Sand contains proposals for continuing and innovating the current policy for sand replenishment. Safety along the coast by way of prevention is the main priority. The Adaptation Agenda for Sand factors in the sand demand of the open basins. The aim is to maintain territory and to keep the coastal foundation zone balanced in relation to the relative rise in sea levels. This is important to safety in the long term, keeping space for designated uses along the coast, and innovations with sand. To keep the coastal foundation zone balanced in relation to rising sea levels, sand replenishments have to gradually increase in the 2020-2050 period, depending on the extent of the sea level rises and further knowledge development. A multi-year programme of knowledge development and monitoring will form part of the agenda; this programme will be implemented by way of pilot

projects and other measures. A proposal for sand replenishments along the coast has been made based on the results of the programme for knowledge development and monitoring, and joint considerations from the Southwest Delta, Coast and Wadden Region sub-programmes. Under the motto 'soft where possible, hard where necessary', the use of sand replenishment to maintain the sandy and 'hard' flood defence systems will have to be considered, bearing in mind cost-effectiveness and economic interests. Where cost-effective, sand replenishments will be combined with regional ambitions. The experimental article in the Water Act as amended by the Delta Act can be used for integral solutions which also contribute to the additional regional or national ambitions. DP2015 will include a final proposal.

Figure 9 Sandy coastal system



3.3

Promising strategies

DP2013 highlighted the possible strategies³⁸ or solutions for the tasking of the Delta Programme for each sub-programme. Based on that, a number of promising strategies were developed last year. Promising means that the objectives for flood risk management and freshwater are achieved in an effective and efficient manner with as many benefits as possible. The strategies connect long-term tasking with short-term decisions. Concrete projects and policy measures are plotted on a timeline, visualising multiple options. The 'adaptation paths' developed in this way show when linkage to other developments and policy objectives is possible, which forms the basis for coordination with other investment agendas. In general, the sub-programmes have developed promising possible solutions in relation to each other. These follow up on the draft Delta Decisions, while simultaneously providing input for them. The final measures and projects arising from this will be incorporated into the Delta Plan on Flood Risk Management and the Delta Plan on Freshwater ([↗](#) sub-section 2.1).

Promising strategies for Freshwater

The Freshwater sub-programme elaborates strategies for the freshwater supplies. In the past year, the sub-programme has worked with all parties from each region to draw up a set of promising measures and tools. The set of measures will always comprise a combination of measures in the main water system, the regional water system and among users. The latter two types of measures make regions and users less dependent on supply from the main water system and less vulnerable to shortages when the Sequence of Water Demand comes into effect. Where necessary and effective, the work should be: as self-supporting for the region and designated uses as possible. Agreement will be reached on supply levels based on the chosen freshwater strategy for each area. Businesses in each sector know what they can count on then and where they have to contribute themselves.

Promising sets of measures: main decision for each area

Combining measures in the main water system, the regional system and among users is essential to achieve the objectives. Measures are also important in the regional system and among users even if supply from the main water system is possible because they contribute to reducing damage and also

make freshwater supply more robust and can set aside more time for measures in the main water system. Measures such as these also encourage innovations and solidarity among users. Areas without supply from the main water system depend on their own, regional water. The emphasis here is on the self-sufficiency of the regional system and water saving among users. Innovations can contribute to a robust water supply. There is a logical development path for each set of measures, which includes promising no-regret measures for the short term and several options for the long term. The sets of measures have been elaborated separately for each region, as outlined in the following paragraphs.

For the **IJsselmeer Region**, a gradual introduction of measures in the main system (e.g. flexible water level, larger freshwater buffer), the regional system and among users would be promising, after 2050 as well. Depending on climate developments and water demand, the option of discharging more water via the river IJssel in the case of low water comes into view for the period after that. In this case, supply on the IJsselmeer lake can be maintained as an alternative to increasing buffer capacity even further. Over the next year, the Freshwater sub-programme will look into what is needed to keep the option of an increased low water discharge via the river IJssel after 2050 open. Another option is to simply accept the damage caused by shortages ([↗](#) the sub-section on Promising strategies for the IJsselmeer Region).

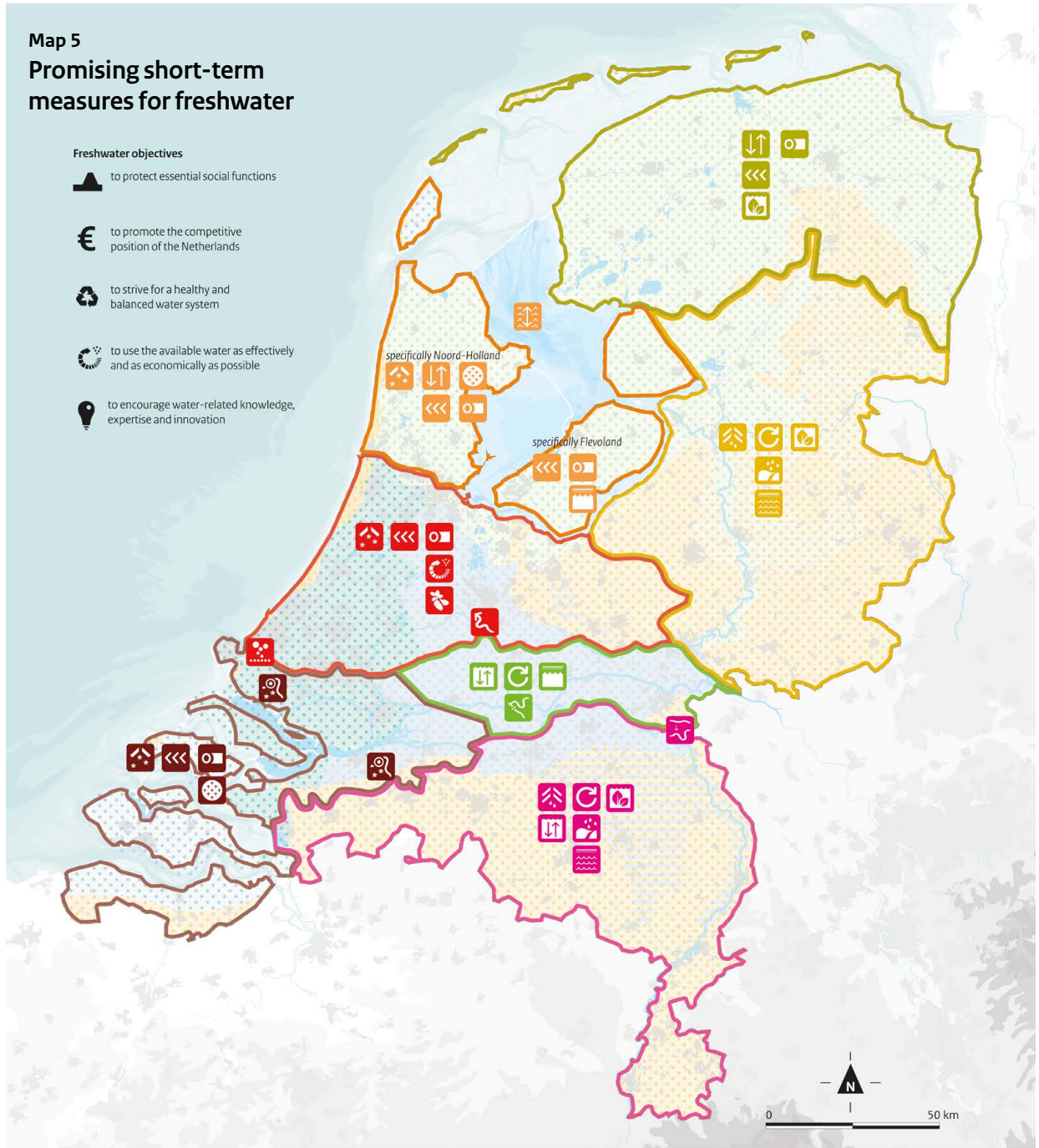
For **Elevated sandy soils** the focus should be on how to deal with water in an economical manner and increasing regional self-sufficiency. Besides the measures that are already possible, modifications to how the regional water system is organised will have to be considered in due course, especially to establish a new balance between discharge and more stock forming in groundwater and surface water. Innovations may contribute to this, which requires a better alignment between nature and agriculture in particular, as these two uses place very different demands on the water system. There are, however, shared interests and opportunities for collaboration (e.g. in climate buffers). Of the areas that can receive water from the main water system, it is the southern part of the river Meuse that requires a main decision: a study needs to be carried out into whether additional measures are possible for the canals in Brabant and Midden-Limburg (e.g. Maas-Waalkanaal and Noordervaart) or whether shortages here should simply be accepted.

³⁸ By strategy the Delta Programme means a combination of objectives, associated measures and the associated development path.








Map 5 Promising short-term measures for freshwater

Freshwater objectives








-  to protect essential social functions
-  to promote the competitive position of the Netherlands
-  to strive for a healthy and balanced water system
-  to use the available water as effectively and as economically as possible
-  to encourage water-related knowledge, expertise and innovation



Administrative regions with water demand ambitions

-  Region North
-  Region East
-  Region South
-  Region Rivers
-  Region Noord-Holland and Flevoland
-  Region West
-  Region Southwest Delta

Main water system

-  smart locking (minimise loss of water through leakage)
-  flexible weir management
-  water from Waal via the Maas-Waalkanaal to Meuse
-  make IJsselmeer / Markermeer water buffer flexible
-  minimise salt leakage at locks
-  bubble plumes
-  extending the Kleinschalige Water Aanvoer (KWA+)

Regional water system

-  flexible water level management
-  optimise flushing
-  create water buffers in (large) nature areas
-  reorganisation of the regional water system
-  increase ground water level in brook valleys
-  subsoil buffers
-  reservoir management in dammed Meuse
-  supply via Roode Vaart and optimise the Bernisse-Brielsemeer system

Users

-  optimise drainage (buffers)
-  create water buffers in (large) nature areas
-  utilise freshwater seepage
-  utilise rainwater lenses
-  reuse effluent (from wastewater purification plant)
-  increase efficiency and robustness of high-quality cultivation

-  possible excessive demand on IJsselmeer Region water buffer
-  falling groundwater levels and no water supply
-  falling groundwater levels and limited water supply
-  intake points become salinised (e.g. Gouda and Bernisse)
-  water levels in rivers and canals are too low
-  no water supply possible and salinisation

Extending the emergency discharge to the west of the Netherlands (KWA+)

What is KWA?

The water boards and Rijkswaterstaat have agreed on using the KWA (Kleinschalige Water Aanvoer: small-scale water supply) as an (emergency) water supply for the mid-western part of the Netherlands. If the usual water intake point from the Hollandsche IJssel at Gouda has to be closed off because of drought and salinisation, 6.9 m³/s water can be transferred via the Amsterdam-Rijnkanaal via Bodegraven to the west of the Netherlands. Delfland can also supply 4 m³/s from the Brielsemeer.

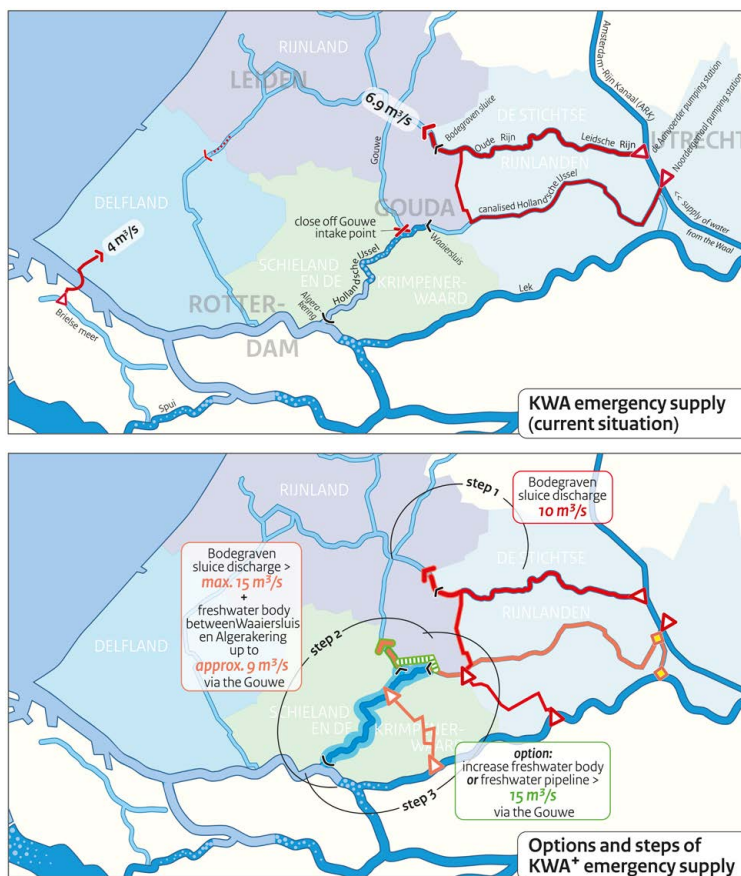
Future

Climate changes and an increasing water demand in the west of the Netherlands mean that the KWA will have to be used more frequently and for longer periods of time. In the W+ climate scenario, water demand during a dry summer may increase to 30 m³/s after 2050. Given the uncertainties, a phased and flexible approach is required when extending the KWA.

Phased KWA+ approach

In *step 1*, using the existing system, supplemented with the Lopikerwaardroute and the use of emergency pumps, will make upgrading the existing KWA to approx. 10 m³/s relatively easy.

Step 2 will first see the discharge capacity of the sluice in Bodegraven being used fully, as a result of which supply will increase to a maximum of 15 m³/s. A second supply route can be opened by creating a freshwater body in the Hollandsche IJssel



Source: Bureau Nieuwe Gracht

(in part via the Krimpenerwaard). One option here is to close the Algerakering temporarily to prevent salt water intrusion. As a result, the KWA supply will increase to a total of 24 m³/s. A study of the effectiveness of such a freshwater body is yet to be conducted.

Step 3, which will see supply increasing even further to 30 m³/s, only comes into play in the long term. There is a range of options on the table for this.

Every step requires additional investment in the regional waterways and structures to facilitate increased discharge.

A systematic eastern supply?

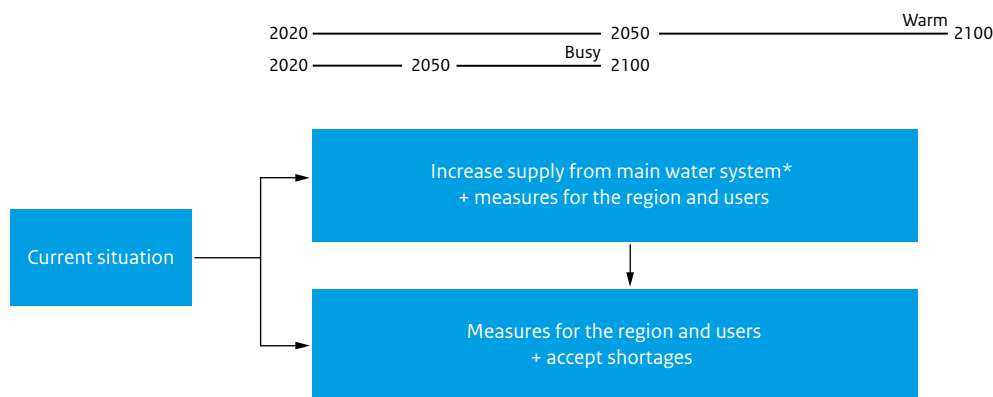
The KWA+ does not need to be immediately extended into a permanent supply route for freshwater supplies to the west of the Netherlands, but it does present opportunities for safety, nature, the economy and shipping.

For the **west of the Netherlands**, and the part of the **Southwest Delta** that is connected to the main water system, a phased extension of the KWA until 2050 is promising, along with measures to counter the salt intrusion in the Nieuwe Waterweg (🔗 box). The KWA does not need to be extended into a permanent supply route for freshwater supplies before 2050, but it does present opportunities for safety, nature, the economy and shipping. If there are opportunities for linkage in the short term, the option to have the supply become permanent before 2050 will remain open. The effectiveness of the above measures will be enhanced by measures in the regional water system to limit brackish seepage and flushing out. Furthermore, users have the opportunity to make their crops more tolerant to salt water and to utilise the available water more effectively. The robustness of the intake point at Bernisse can be increased by optimising the management of the Bernisse-Brielse Meer lake. Alternative freshwater routes for Zuid-Holland-Zuid are technically feasible, but realisation will be particularly complicated and will require extensive investment. The decision between a freshwater or a saltwater Volkerak-Zoommeer will have direct consequences for regional freshwater supplies around the lake. The decision has to be in line with the basic principle that Haringvliet, Hollandsch Diep and Biesbosch form a strategic source of freshwater for the region. This decision will be prepared as part of the government framework vision on the Grevelingen and Volkerak-Zoommeer lakes.

A part of the **Southwest Delta** receives no freshwater from the main water system: the areas bordering the freshwater delta waterways. The tasking and measures for these areas are very specific for each island (🔗 Promising strategies for the Southwest Delta). There are a number of initiatives ongoing to elaborate the measures even further, e.g.: water conservation in the soil; better use of the groundwater by filling up and increasing freshwater lenses; private initiatives for freshwater supply via pipelines for agriculture and industry; and options for water savings and water conservation at business or property level.

The **area around the major rivers** which relies directly or indirectly on water from the river Rhine may, in theory, also have more than enough water in the future. Limitations to the inflow of water from the Rhine primarily occur in the case of falling water levels in rivers. The region can anticipate climate change by facilitating water intake in the case of lower water levels or by constructing longitudinal dams between groynes to retain the navigable depth for shipping. In the future, bottlenecks will occur in the southern part of the area around the major rivers because of tapping from the river Meuse. Options for dealing with this include using the Maas-Waalkanaal or (in the long term) relocating intake points to the river Waal.

Figure 10 Adaptation path for Freshwater - Elevated sandy soils



* Options are: water transfer from the river Waal to the river Meuse, additional supply via Panheel (including Noordervaart) and supply to the de Liemers area

Figure 11 Adaptation path for Freshwater – The west of the Netherlands and the Southwest Delta with supply

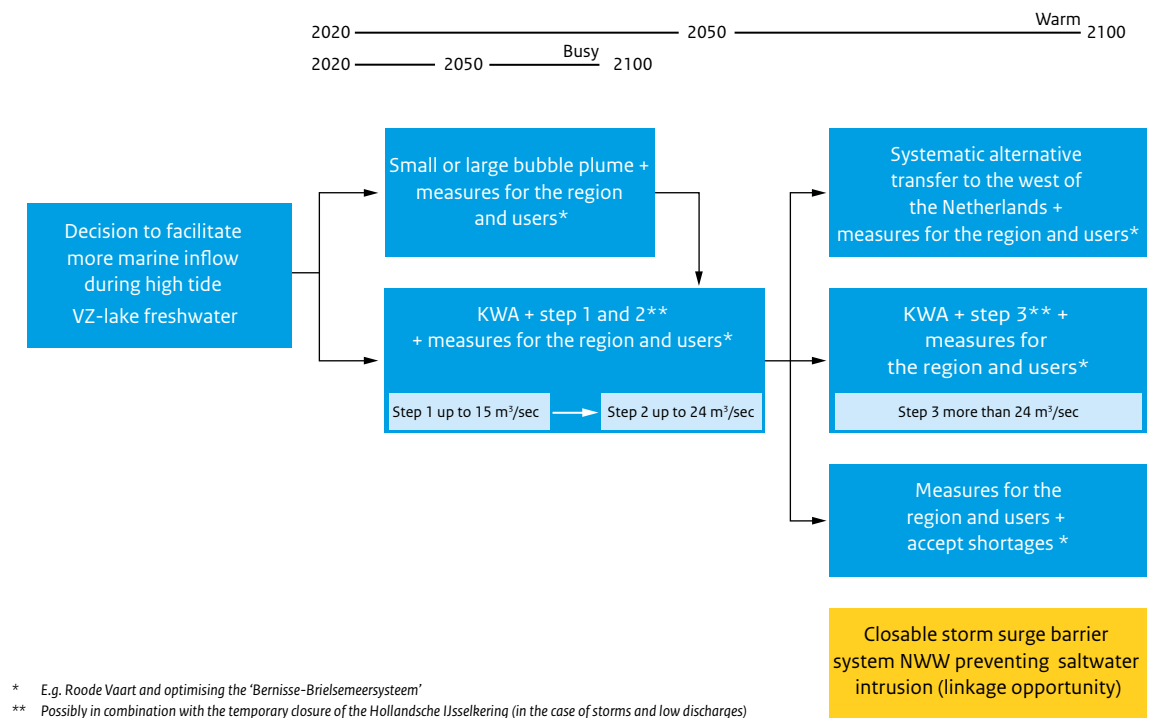
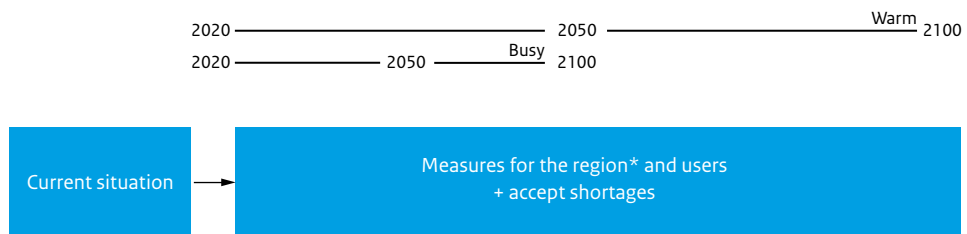
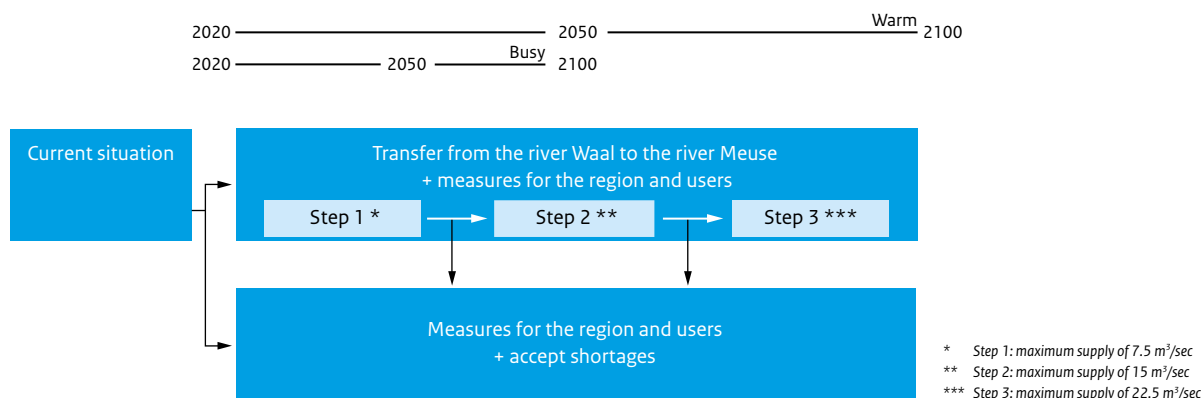


Figure 12 Adaptation path for Freshwater – Southwest Delta without supply



* E.g.: increase subsoil freshwater body

Figure 13 Adaptation path for Freshwater – Area around the major rivers



It appears that the national objectives and regional ambitions can be realised virtually everywhere using the promising sets of measures for each area, also in the Delta Scenarios with rapid climate change and major socio-economic development. The economic analysis has not yet been finalised. Not all of the benefits have been quantified and the analysis does not yet include all the promising strategies. The initial findings from the economic analysis of the promising freshwater measures are:

- It seems to be more cost-effective to supply additional water via the IJssel (at the expense of the Waal) after 2050 than to further increase buffer capacity in the IJsselmeer Region. The side effects for shipping and salt intrusion have yet to be mapped out further.
- When the Maeslantkering has to be replaced (in 2070 at the earliest) constructing a dam in the Nieuwe Waterweg is not cost-effective. The costs for extending the KWA are a little bit less, as a result of which water demand can also be met in the long term.
- One option to counter salt intrusion would be to build an inflatable rubber dam in the Spui. According to estimates, the effectiveness of this measure is comparable to repairing the stepped river bed, if a little bit more expensive. As such, the option appears to be less promising.
- Those regional measures and agricultural measures that score well in terms of cost-effectiveness are: flood storage in surface water, reduction of flushing, conservation of groundwater (especially in the Southwest Delta) and increasing irrigation efficiency.

A set of policy tools is important for realising the goals set and forms part of the freshwater strategy. A set of policy tools can encourage the desired behaviour of target groups or create conditions for the implementation of measures, e.g. fine-tuned water agreements or incentive schemes to limit water demand. In general, the current set of tools

appears to be sufficient for freshwater supplies in the short to medium term. However, the options that the current set of tools present could be used to better effect. This applies in particular to the areas and situations where bottlenecks cannot be resolved or are difficult to resolve with measures in the water system. Depending on the area, a different focus may be preferable, e.g. more attention to self-sufficiency. The financing of sustainable water management and long-term use will be looked into in terms of the preferential strategy. As part of this, the introduction of the water market tool will also be considered. What's more, links will be established with other water policy areas and developments such as the Blueprint and the Water Framework Directive. One thing to consider is the time between introducing a set of tools and the point at which this tool has an effect. This period of time ranges from a few years to more than ten years in the case of spatial developments.

Towards the preferential strategy

Next year, the Freshwater sub-programme will elaborate the promising sets of measures into a set of measures for each region with specific national and regional goals. This will be done together with the freshwater regions, the area-based sub-programmes and freshwater users, and will be based on the main decisions for the main water system and the regional system, as stated in [\[2\]](#) sub-section 3.2. This elaboration forms the basis for an investment programme for the short term ([\[2\]](#) sub-section 3.2, Freshwater supply level) and for the Delta Plan on Freshwater.

Over the past year, a number of measures have been deemed not promising. These measures no longer play a role in developing preferential strategies:

- There will be no (large-scale) supply of freshwater to the elevated sandy soils and the parts of the Southwest

Delta that are not connected to the main water system. This is in line with the ambitions of this area.

- No saline water will be let into the west of the Netherlands. This decision is also in line with the ambition of the region.
- The IJsselmeer Region will play no role in the freshwater supply of the west of the Netherlands, for which there appear to be more appealing alternatives.
- Closing off the Nieuwe Waterweg is not a promising measure.
- By using the coherent step-by-step approach, as outlined below under 'Promising strategy for the IJsselmeer Region', significant increases in water levels in the future will not be required as a solution to the tasking.
- Closing off the Hollandsche IJssel with a dam is not very advantageous for freshwater and will result in a considerable number of unfavourable side effects.
- Placing weirs in the rivers Waal or IJssel to benefit shipping is not promising compared with nautical measures and measures set by the shipping industry itself.

Promising strategy for the IJsselmeer Region

The IJsselmeer Region sub-programme is elaborating a coherent strategy to tackle both the tasking for flood risk management and the tasking for freshwater in the IJsselmeer lake, the Markermeer lake and the neighbouring lakes together. The objective is: to establish a safe and resilient IJsselmeer Region.

Over the past year, the strategy for the IJsselmeer Region has been extended and become more integrated. A coherent strategy has been developed for the main water system, the surrounding regional water systems and the users. Drastic measures in the main water system, e.g. increasing buffer capacity even further, can be deferred or possibly even become superfluous. Studies have also shown that adjusting the discharge distribution across the Rhine tributaries in the case of low water, with a greater discharge via the river IJssel, may be considered an alternative to increasing the supply in the IJsselmeer Region in the long term. This will only come into play after 2050 at the earliest.

Promising strategies

The IJsselmeer Region sub-programme has translated the new insights into a single integrated promising strategy, which keeps sufficient options open to anticipate future developments. There are five main features to the promising strategy:

- **Feature 1: discharge if possible, pump if necessary**

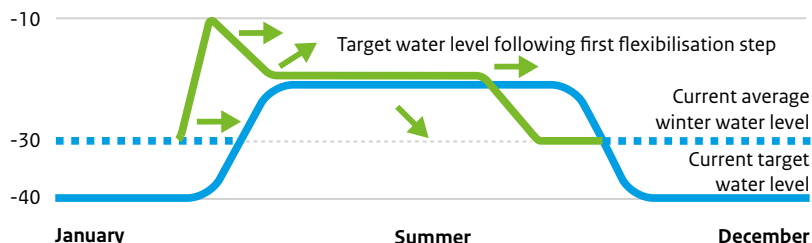
In terms of flood risk management, excess water will always have to be discharged from the IJsselmeer lake to the Wadden Sea. Until 2050, that can be done through a combination of sluicing and pumping. If sea levels and the weather permit, gravity driven discharge through opened sluices can be used, which is less expensive and more effective than pumping. If sluicing is not possible, using pumps will still guarantee sufficient discharge. The first pumps will be up and running in 2021. These pumps are essential to protect the IJsselmeer Region against floods and form an important basis for the other features of the strategy. In 2050 or thereabouts, the current discharge sluice complexes in the IJsselmeer Closure Dam will need to be replaced. It is expected that sluicing and pumping can be combined for some time to come, eventually in combination with a limited increase in the water level of the lake. It is only in the very long term that a complete switch to pumping will be essential.

- **Feature 2: flexible water level management and flexible organisation of the lakes**

Flexible water level management in the IJsselmeer Region means that climate change and the interests of designated uses can be anticipated better. To do this, the areas outside the dykes and the bordering areas also have to be flexibly organised. Some of the advantages of flexible water level management are that the freshwater buffer can be gradually increased, nature benefits from this, and the water manager can use the options of sluicing and pumping more effectively. Flexible water level management means that the current situation can be capitalised on because the water level does not always have to be the same. A precondition is that changes in water level do not lead to additional safety tasking. Flexible water level management and a flexible organisation require clear administrative agreements on such aspects as whether water levels are permitted to be higher or lower, and if so, when and for which designated uses that should be done.

Combined with the focus on the regional system (feature 3) and savings among users (feature 4), a 20-cm buffer capacity in the main water system is sufficient. This will, in theory, ensure that the entire water demand from the region until 2050 can be met, also in the case of rapid climate change and during a dry year (on average once every ten years). In an extremely dry year (on average once

Figure 14 Flexible water level management



every 100 years), the capacity will not be sufficient and the Sequence of Water Demand comes into effect. In that situation, there will be sufficient freshwater available for the essential designated uses (categories 1 and 2). This approach can be continued after 2050 as well. Depending on climate developments and water demand, a change to the Rhine discharge may come into play in that period as an alternative so that more water flows via the river IJssel to the IJsselmeer Region in the case of low water. Another alternative would be to accept the damage caused by freshwater shortages.

A 20-cm buffer capacity can be achieved without making any changes to how the area outside the dykes and the dykes themselves are organised. That said, a larger buffer will require changes to the areas outside the dykes, and in the case of a further increase in size (of more than 40-50 cm), dykes will have to be raised. Administratively speaking, it has been agreed that such a significant increase in water level should be avoided by way of innovations, reducing consumption, and by combining measures in the regional water system with flexible water level management in the lakes. New developments in the areas outside the dykes and in the areas bordering the lakes should factor in an increased fluctuation in water level in the future, both in the summer and in the winter.

- **Feature 3: a flexible management and flexible organisation of the surrounding water systems**

Some of the freshwater from the IJsselmeer lake, the Markermeer lake and the neighbouring lakes flows into waterways in the surrounding area. It would be preferable to reduce the use of water from the IJsselmeer lake by the surrounding water systems. That can be done by making the management and the organisation more flexible here too. An exploration by the water boards shows that they can already take the first steps in the short term by such measures as optimising the flushing of their systems.

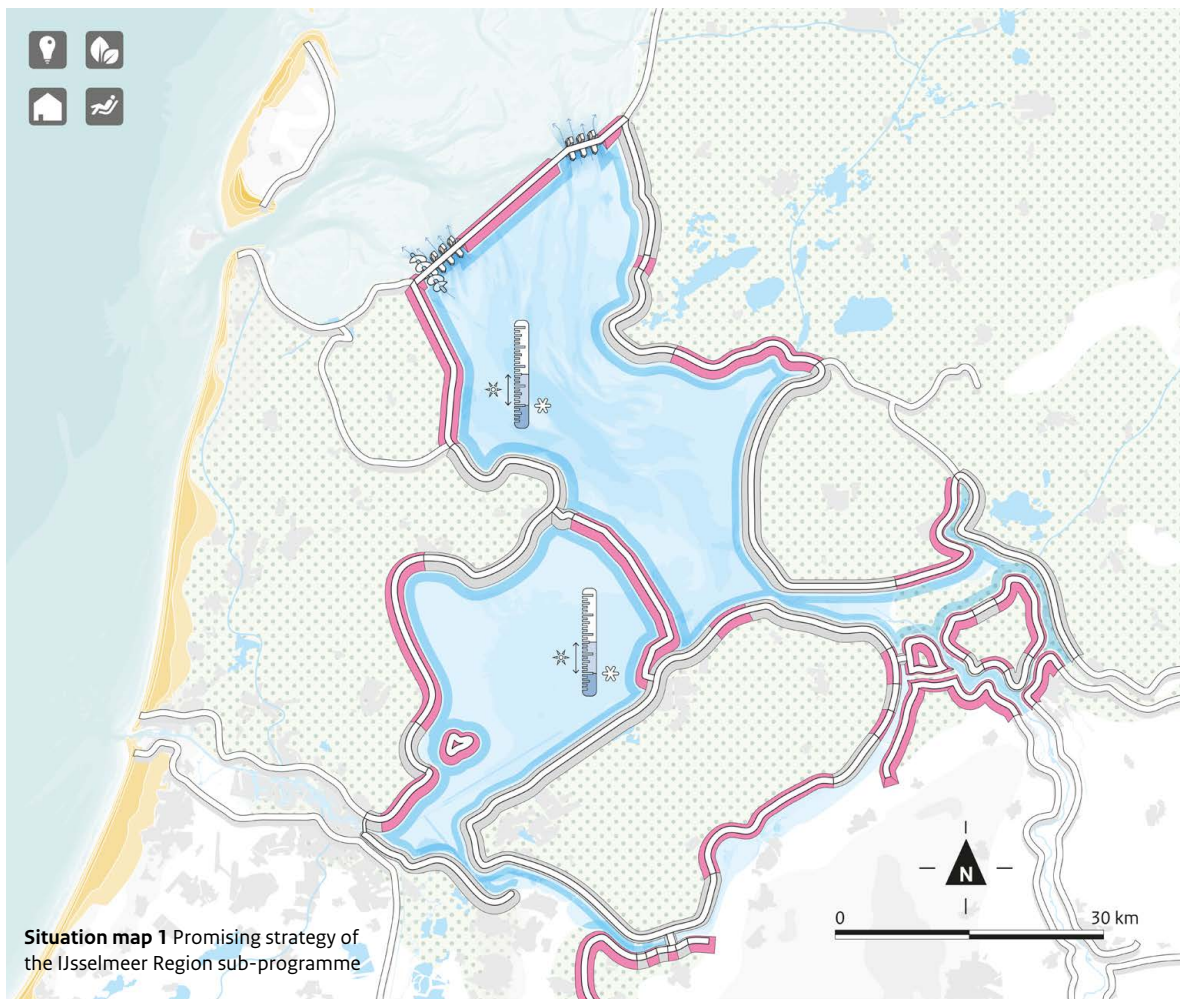
Furthermore, keeping back salty seawater at the locks in IJmuiden requires a lot of freshwater. A new, larger navigation lock will probably require even more freshwater. A study will map this out in more detail. The design of this navigation lock will factor in the results of this study, where possible. The various water systems in the IJsselmeer Region are very closely connected. If the water level in the IJsselmeer lake is high, the water boards cannot just discharge the water properly. The water managers are working on optimising interconnectivity.








- **Feature 4: reducing consumption**

At present, users can often make unlimited use of the freshwater from the IJsselmeer Region and have become accustomed to that. They are also currently exploring the future situation in which the availability of water may be less of a given. The agricultural sector, for example, has linked water tasking to the tasking for an economically stronger agricultural and horticultural sector. The outcomes are documented in the Delta Plan on Agricultural Water Management, which includes such aspects as cutting back on freshwater consumption, water conservation per area and a smarter distribution and buffering of water at a national level. Reducing consumption is the best way to encourage innovation.

- **Feature 5: continue to invest in flood risk management**

Dykes along the IJsselmeer lake, the Markermeer lake and the neighbouring lakes offer protection against floods. Maintaining this protection also requires major investment over the next few decades. It would be wise to invest more in flood risk management in a number of places to avoid social disruption in the case of a flood (see sub-section 3.2, Risk-based approach for Flood Risk Management). Dyke improvements across the entire area can be combined with interventions to organise the areas outside the dykes in a flexible manner to facilitate additional water level changes. The sub-programme is



-  discharge if possible, pump if necessary
-  flexible water level management
-  flexible organisation of the lakes (main water system)
-  a flexible management and flexible organisation of the surrounding water systems
-  reducing consumption
-  continue investing in flood risk management (dyke improvement)
-  dykes

Linkage opportunities (indicative and not exhaustive)

-  innovation
-  nature
-  living
-  recreation

looking into how the consequences of a flood or dyke breach can be minimised.

The combined work in the main water system, the surrounding water systems and among the users makes the strategy cost-effective, robust and flexible. By opting to pump in addition to sluicing, it is possible to gradually anticipate new developments. There are enough options for the long term. The focus on the five features forms the basis for a safe and resilient IJsselmeer Region. In that way, future climate developments can be addressed with measures that will prevent any drastic measures being required for the value of the IJsselmeer Region.

This integral approach will involve various parties so that the desired end result can be met. That requires a new form of administrative agreement on shared ambitions and goals, the division of responsibilities, implementation and financing. This is already underway.

New safety levels and multi-layer flood risk management

The consequences of switching to the risk-based approach will be mapped out over the next year. Based on that,

the IJsselmeer Region sub-programme will issue a recommendation on updating the standards. The Local Individual Risk (LIR) and, related to that, the tolerable individual risk of 10^{-5} and the economically optimal safety level (i.e. the social cost-benefit analysis, MKBA) determine the bandwidth of possible new standards. [2] Table 12 shows the bandwidth of the flood probabilities, as inferred from the LIR and the MKBA. These flood probabilities have been calculated for flood threats from the lakes (and not from the rivers). The figures for the dyke rings may therefore differ from the figures from, for instance, the Rivers sub-programme (threat from the IJssel). This applies to dyke rings 10, 11, 44 and 45. The IJsselmeer Region and Rivers sub-programmes will work together on the standards recommendation for these dyke rings during the next phase. The table does not yet provide an administrative point of view on the new standards, and should be viewed as an illustration of the current status. The LIR is not expected to lead to major new tasking in the IJsselmeer Region. The IJsselmeer Region sub-programme is looking into the extent to which the desired level of safety can be attained with a mix of prevention, spatial organisation and disaster management (multi-layer flood risk management). This has

Figure 15 Adaptation path for the IJsselmeer Region – flood risk management (feature 1)

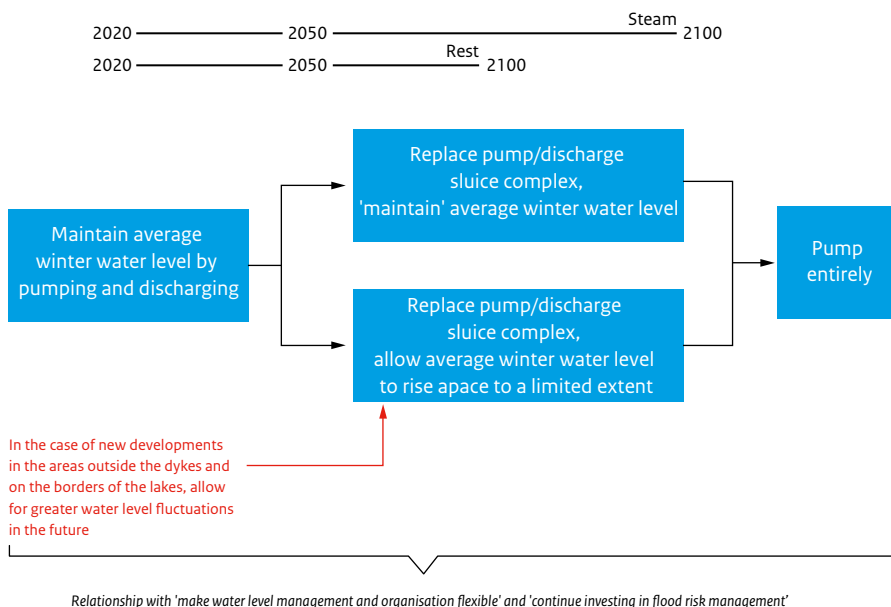


Figure 16 Adaptation path for the IJsselmeer Region – Freshwater (features 2, 3 and 4)

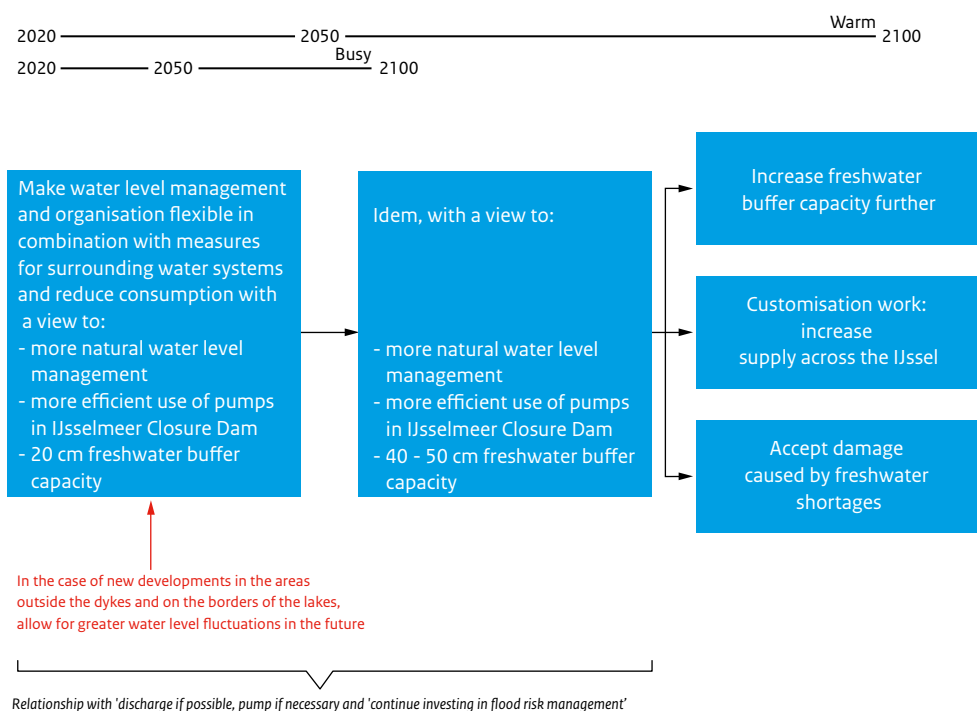
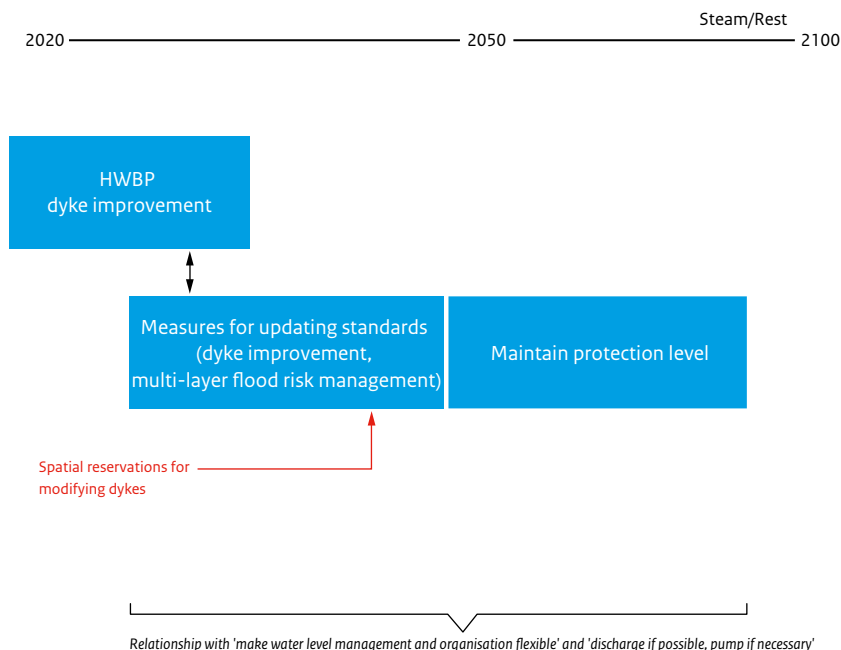


Figure 17 Adaptation path for the IJsselmeer Region – flood risk management (feature 5)



been incorporated into feature 5 of the promising strategies. For the IJssel-Vecht delta, this study will be done in the pilot projects for multi-layer flood risk management (🔗 sub-section 3.2).

Towards the preferential strategy

Next year, the IJsselmeer Region sub-programme will be elaborating the promising strategy into a preferential strategy. The starting point will be the updated safety tasking, based on the new risk-based approach. The sub-programme will elaborate concrete measures and an accompanying timeline. The sub-programme will also map out what agreements between the stakeholders are required on preparing and implementing the measures and what is required to take future steps and keep options open. A number of subjects will undergo additional research: the possible water level increase in late winter, the optimal water level regime in the winter where pumping is used, a first review of the flexible water level management in terms of environmental legislation, and ways to document administrative agreements on integral strategy

(governance) on such things as keeping the option open of allowing the water level of the IJsselmeer lake to rise along with rising sea levels to a limited extent after 2050.

Based on the new insights, a number of strategies (or parts thereof) have been scrapped:

- **Allowing the water level in the IJsselmeer lake to rise apace with the sea levels**

The cost-effectiveness analysis (*kosteneffectiviteitsanalyse* (KEA) in Dutch) shows that it is cost-effective not to allow the water level in the IJsselmeer lake to rise in tandem with the rise in sea levels. This is twice as cheap as allowing it to rise commensurately. Commensurate rising levels do not result in any significant advantages and this scores poorly in terms of cost, safety, liveability, landscape, economic uses, nature and feasibility. Allowing the water level to rise in tandem with the sea levels to a limited extent (after 2050) may be cost-effective. This will be looked into in more detail during the next phase.

Table 12 Illustration of the bandwidth for possible new standards, expressed in annual probability of a flood, based on: Analysis of casualties of flood risk management in the 21st century and the MKBA on flood risk management in the 21st century (🔗 Appendix B (in Dutch)). This concerns the threat from the lakes.*

Dyke ring	Name	Minimum standard level (probability of a flood/year)	Maximum standard level (probability of a flood/year)
6	Fryslân	200	500
7	Noordoostpolder	400	4,000
8	Flevoland	500	10,000
9	Vollenhove	200	4,000
10	Mastenbroek	600	2,000
11	IJsseldelta	300	1,250
12	Wieringen	400	2,000
13	Noord-Holland	900	2,000/4,000
13b	Marken	200	500
44	Kromme Rijn lakes	100	1,250
45	Gelderse Vallei lakes	200	500
46	Eempolder	200	1,250

* The figures based on the MKBA in the table above cannot be directly compared to the figures based on the SLA studies. While the MKBA calculates median probabilities, the SLA figures are based on the maximum allowable flood probabilities. This is corrected for arithmetically in the follow-up process.

- **A major increase in the spring water level**

This strategy has consequences comparable to allowing the water level in the IJsselmeer lake to rise along with rising sea levels to a great extent. Although the strategy does present opportunities for freshwater supplies, it would have major consequences for the areas outside the dykes and the borders of the lakes opposite.

- **Allowing the water level in the summer to fall to below the current target winter water level**

Allowing the summer water level to fall by more than a few decimetres for the benefit of freshwater supplies will have a very negative impact on liveability, economic uses and feasibility. This negative impact includes possible damage to foundations in the urban area and a limited navigable depth.

Promising strategies for the Rivers

The Rivers sub-programme is elaborating strategies for flood risk management along the river Meuse and the Rhine tributaries. The tasking for freshwater will be worked out in collaboration with the Freshwater sub-programme ([\[\] Promising strategies for Freshwater](#)).

The Rivers sub-programme has elaborated the promising strategies in close collaboration with six regions in the area around the major rivers: Maasvallei, Bedijkte Maas, Waal, Nederrijn-Lek, IJsselvallei-Zuid and IJsselvallei-Noord. Both government authorities and social parties were closely involved in this. Dyke improvement and river widening together would seem to be the ideal mix for flood risk management in the area around the major rivers. Each tributary can then retain its own characteristics.

Promising strategies

Collaboration with the regions has led to a wide understanding of the urgency of the flood risk management tasking and the idea that this tasking is about sustainable spatial and economic development. The switch to a risk-based approach based on the probability of a flood is supported. The parties have agreed to embed the tasking and the measures in regional plans (environmental vision, environmental plan, regional framework vision, MIRT area agendas) to maximise the opportunities for spatial and economic development.

Two promising strategies have been elaborated for each region: Getting More out of Dykes and Room for the River+.

The regional reports have been combined in the report 'Promising strategies for the Rivers Delta Programme' (see Appendix A4, [\[\] part I](#) and [\[\] part II](#), in Dutch). The two strategies are viewed as the corners of the playing field and (primarily) provide an initial insight into the effectiveness of the separate measures: target range, (side) effects and costs. The piping approach is included in each strategy. As such, the two strategies can be characterised as follows:

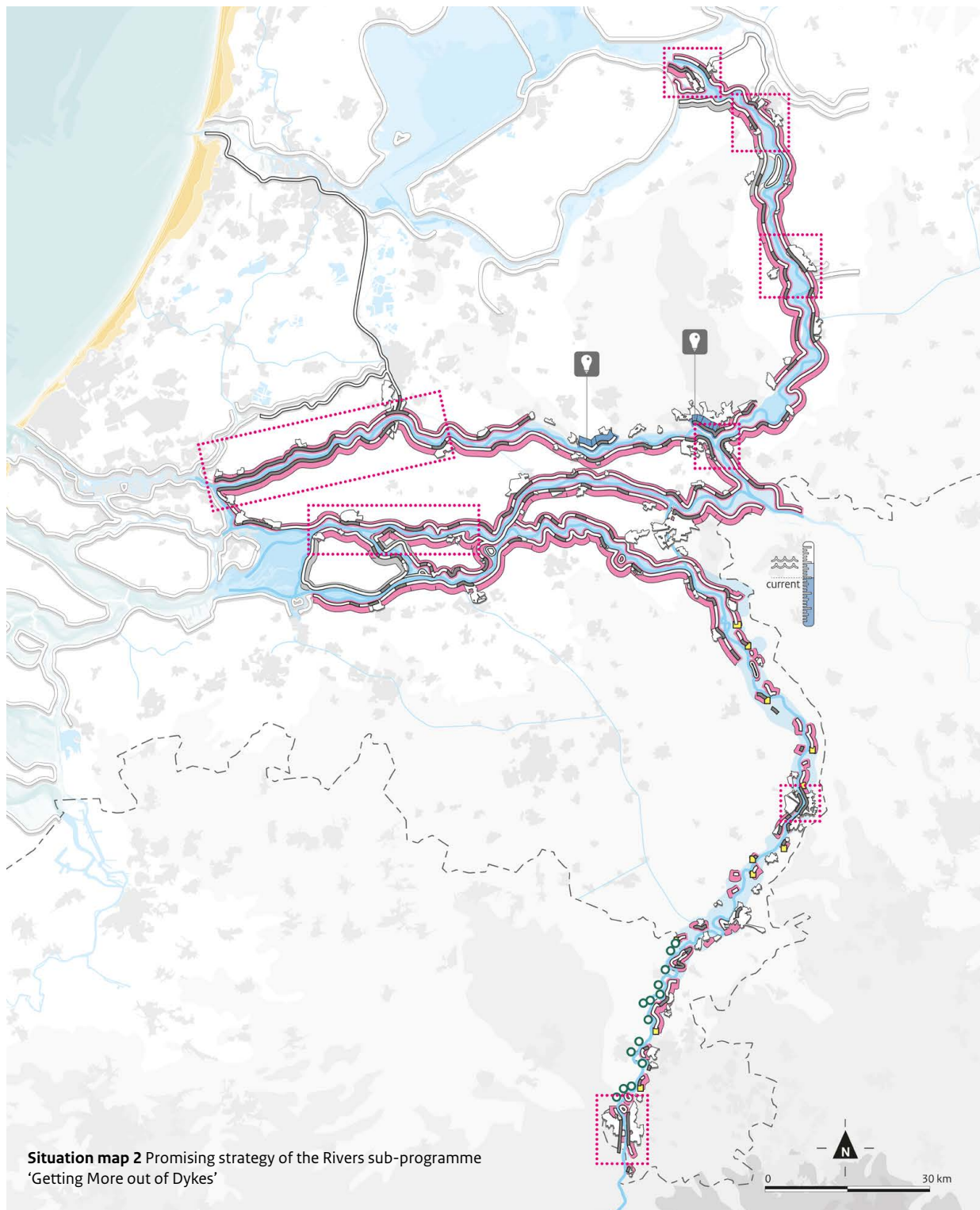
- **Getting More out of Dykes**

This strategy comprises using higher and stronger dykes as a solution for the flood risk management tasking. From a technical standpoint, all flood risk management tasking can be resolved with the Getting More out of Dykes strategy. The most urgent ones are the Waal and the area around the IJsselkop (Arnhem) because a large number of the dykes here failed inspection. This is also a promising strategy for the Nederrijn-Lek because of the opportunities to use an innovative approach in a number of places (Grebbeoordijk Delta Dyke). Realising the strategy is particularly difficult along a number of other river sections and in certain areas, e.g. where a narrow river bed runs right through an urban area (the so-called 'bottlenecks' like those in Maastricht and Venlo), in the downstream section of the Lek, where the dykes are being intensively built on, and along the downstream section of the Waal because of the extent of the tasking, the buildings and the other values present.³⁹

At many locations, dyke improvement requires a customised approach to preserve or improve values related to cultural history, landscape or perception. Examples can be found in the Hanseatic towns and cities and along the dyked river Meuse. Dyke improvement projects can lead to linkage opportunities at a local level, for instance because they are easy to combine with nature development projects for which excavation work is required.

Dyke improvements along the Grensmaas are not a realistic option because the Flemish side has opted for river widening. A number of local flood defences in the Limburg Maasvallei need to be extended to retain a proper connection with elevated soils. Along the dyked river Meuse, the strategy has resulted in a few bottlenecks as a result of consequences for liveability, landscape or cultural

³⁹ The bottlenecks at Nijmegen and Arnhem are currently being dealt with in the ongoing implementation programme of Room for the River.



history. In this phase, the opportunities for innovative dykes, such as Delta dykes, throughout the entire area around the major rivers have only been explored to a limited degree.

The measures from the Getting More out of Dykes strategy can be programmed in a flexible manner and areas requiring urgent attention can be addressed first. Furthermore, the strategy is not or hardly dependent on other developments. However, the strategy will have considerable consequences for landscape, nature and cultural history at some locations and will not be able to count on social support across the board. These consequences concern such things as (historic) towns and cities, ribbon development on dykes and places where the river will disappear from view because of dyke improvements. This strategy will gradually increase water levels, assuming the expected increase in discharge in the Delta Scenarios. As a result, the consequences of a flood either outside the dykes or inside the dykes may increase in some cases and the user options of the areas outside the dykes may decline. Improving flood defence systems can be a complex task because of spatial restrictions and in some areas because of 'soft' subsoil. This ties in with the policy change that has been rolled out with Room for the River.

• Room for the River+

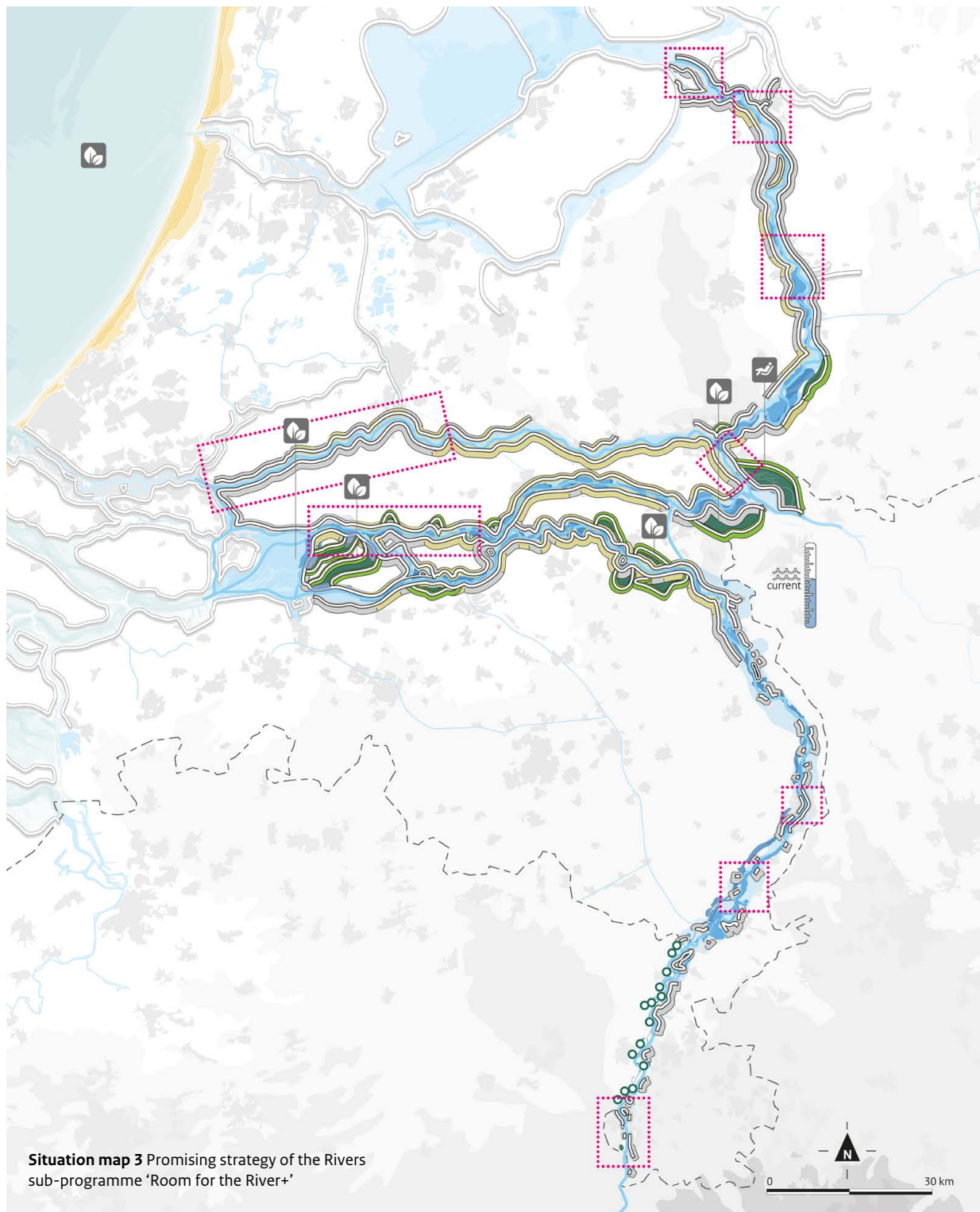
This strategy comprises measures that will give the river more room. It includes measures for areas outside the dykes, such as summer bed lowering in a number of regions, and measures for areas inside the dykes such as dyke relocation and peak storage. Water levels will not rise as a result of this strategy; they will not change or will fall. The majority of tasking for flood risk management can be resolved by Room for the River+. The Rijnstrangen peak storage area is expected to be required at all times.





Some of the tasking will not be (fully) resolved by the Room for the River+ strategy, meaning that dyke improvements will also be required. This is definitely the case in places where there is piping and in places where the effects of the sea dominate: along the Meuse to the west of Geertruidenberg, in the Waal downstream of Hardinxveld-Giessendam, and in the Lek to the west of Vianen. This strategy will also not fully resolve tasking in places where there is a lack of space: at three locations along the Meuse (e.g. Bovenmaas, transition between Plassenmaas-Peelhorstmaas and around Maastricht and Venlo), along the




upstream part of the Pannerdensch Kanaal and downstream of Zaltbommel along the Waal (depending on the solution for the Merwedes). Along the Nederrijn-Lek, river widening is only possible in (the upstream part of) the Nederrijn.

This strategy presents opportunities for linkage with other developments in the area around the major rivers. One example concerns a number of the so-called 'hotspots' for nature development, e.g. the Rivierklimaatpark IJsselpoort plan. These make implementation dependent on other developments. River widening takes a long time to implement and is relatively expensive. Where dyke sections fail inspection, it may be possible to combine interventions. Social considerations, e.g. on the quality and characteristics of the landscape, nature and cultural history, also set strict limits on the actual implementation of the measures. These considerations also play a role in such measures as introducing peak storage areas and bypasses (e.g. in Deventer, Zutphen, Land van Heusden en Altena and Rijnstrangen), which are included in this phase of the promising strategies to explore every aspect of the playing field. Administratively speaking, there still appears to be very little support for major interventions. This will require careful consideration when determining the preferential strategy. Moreover, the regional processes have shown that there is still no support for a number of concrete measures in this strategy (especially for green rivers and peak storage areas). This is an administrative fact to consider when determining the preferential strategy.

The two strategies have been compared with each other and with a reference strategy (continuation of current prudent policy). The reports from the region show that both strategies could, from a technical perspective, achieve the flood risk management tasking resulting from climate change. One exception is the Nederrijn-Lek, for which Room for the River+ does not provide enough options. Under Room for the River+ water levels will not rise or may even fall. As a result, flood water levels in the case of any flooding will not be as high and will be less consequential. The investment costs of spatial measures will be higher than those associated with traditional dyke improvements. The benefits will be mapped out in the next phase. The cost of new concepts such as the Delta Dykes or water-retaining landscapes has not been included. Less initial investment is required for the dyke strategy, which is a familiar measure and presents opportunities to link up with dyke improvements scheduled in the new HWBP. The Room for the River+



-  create room for the river through measures for areas inside the dykes in combination with dyke relocation and retention
-  create room for the river through measures for areas outside the dykes
-  not possible to create room for the river or major tasking
-  areas of attention for piping; dyke improvement

-  river water levels, same water levels in areas outside the dykes (as current water levels) in the case of high discharges
-  dykes
-  Flemish measures

Linkage opportunities
(indicative and not exhaustive)

-  nature
-  recreation

strategy builds on the policy change that was rolled out in 2000 and provides a robust solution. There are more linkage opportunities with this strategy than there are with Getting More out of Dykes. However, development time is required to utilise these opportunities.

The benefits and co-financing options need to be worked out in further detail. The benefits will primarily result from a sustainable organisation of the river system, an increase in spatial quality, an improved ecology, options for area development and linking uses. The task in hand is to find an economically responsible optimum strategy. In the case of linkage with what the area wants and aspires to achieve, the preferential strategy should also address who is going to bear the costs and when to invest. The option of tying in with other major infrastructural investments and the new HWBP will co-determine the programming of the measures. Both strategies may encounter social resistance if spatial quality is affected too much. Both strategies are subject to physical limitations: sometimes improving flood defence systems is difficult (e.g. because of spatial restrictions or 'soft' subsoil) and sometimes there is not enough space on the river bed for the river to be widened. There is relatively limited space in the current water system and this may require use of the current area inside the dykes.

The regions do not consider either solution to be the right solution. Social considerations of such things as spatial quality, the characteristics of the landscape, nature, cultural history and costs restrict measures which are technically feasible. A combination of both strategies for each tributary is probably the best solution.

New safety levels and multi-layer flood risk management

The Rivers sub-programme has analysed whether in the area around the major rivers there is a need for an increased safety level, given the new basic principles for standards (▢ sub-section 3.2). A higher safety level would be preferred for practically all the area around the major rivers, based on the tolerable individual risk (local individual risk, LIR) and on the major economic damage and the risk that large groups of people will die in the case of a flood (MKBA analysis WV21). These insights also provided the rationale for making the area around the major rivers an area of attention for updating the safety levels.

When deciding the tolerable individual risk based on a proposal standard for the flood defence systems in the area around the major rivers, it was assumed that 75% of the people could be evacuated in good time (evacuation fraction of 75%). This is in line with the basic principles of the WV21 studies. For the dyke rings in the transitional area between the upstream and downstream rivers (i.e. dyke rings 15, 16, 24 and 35), the WV21 studies assumed an evacuation fraction of 15%. Because the Rivers sub-programme examined the risks of flooding by the rivers, a higher evacuation fraction of 75% was assumed for the calculations.

The basic principle in any case is that the basic level of safety will be achieved (LIR of 10^{-5}). This can then be fine-tuned based on the economic damage or the risk of there being large groups of casualties (group risk). What is noticeable is that an economically optimal protection level (MKBA) for many of the dyke rings in the area around the major rivers will lead to significantly more stringent standards than the basic level of safety. Given this major difference, an administrative decision has been made to bring the minimum safety for relevant dyke ring sections temporarily a little closer to the economically desired level of safety. The Delta Rhine and the Delta Meuse steering groups have used the above rationale to determine potential provisional upper and lower limits for the new standards (▢ table 13). The sub-programme's final recommendation on new standards will comprise customisation for each dyke ring. This recommendation will be coordinated with neighbouring sub-programmes and may deviate from the upper and lower limits included here.

Table 13 Provisional recommendation from the Delta Rhine and the Delta Meuse steering groups on the upper and lower limits for possible new standards, expressed in annual probabilities of a flood (not rounded off to flood classes).

Area and dyke ring (sections)			Minimum standard level (/year)	Maximum standard level (/year)
Waal	16*	Alblasserwaard/Vijfheerenlanden	a	a
	38-1	Bommelerwaard	5,800	5,800
	40-1	Heerewaarden	1,250	5,500
	41-1	Land van Maas en Waal	1,250	5,500
	42	Ooij and Millingen	2,100	2,100
	43	Betuwe, Tieler- and Culemborgerwaarden	1,250	2,700
	48-1	Rhine and IJssel	5,600	5,600
Nederrijn and Lek	43	Betuwe, Tieler- and Culemborgerwaarden	1,250	2,700
	44	Kromme Rijn (river side)	1,250	41,800
	45	Gelderse Vallei (river side)	1,250	159,600
	15*	Lopiker- and Krimpenerwaard	a	a
	16*	Alblasserwaard/Vijfheerenlanden	a	a
IJssel	47	Arnhemse- and Velperbroek	1,250	7,000
	48-2	Rhine and IJssel	1,250	9,000
	49	IJsselland	1,250	1,250
	50	Zutphen	1,250	8,700
	51	Gorssel	1,250	1,250
	52	Oost-Veluwe	5,500	5,500
	53	Salland	1,250	2,900
	10	Mastenbroek	2,000	2,000
	11	IJssel delta	2,000	2,000
Bedijkte Maas	36	Land van Heusden-De Maaskant	1,250	4,100
	36a	Keent	1,250	1,250
	37	Nederhemert	1,800	1,800
	38-2	Bommelerwaard	1,250	4,600
	39	Alem	2,200	2,200
	40-2	Heerewaarden	500	500
	41-2	Land van Maas en Waal	1,250	3,000
	24*	Land van Altena	2,900 ^a	2,900 ^a
	35*	Donge	2,000 ^a	2,300 ^a

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* Based on the Proeve Plangebied report, which used casualty risk analysis WV21 (Appendix B, in Dutch) the MKBA WV21 and regional administrative decisions. Administratively speaking, a provisional lower limit has been chosen for a substantial number of dyke rings that is higher than would be required based on the basic level of safety (10^{-5}).

^a For these dyke rings, it was assumed that they flood from the rivers, which is why a higher evacuation fraction (75%) was assumed than in the WV21 studies (15%); the upper and lower limits for possible new standards for dyke rings 15 and 16 are in the table under Rhine Estuary-Drechtsteden. The provisional bandwidth that the Rivers sub-programme has determined is within the bandwidth calculated by the Rhine Estuary-Drechtsteden sub-programme. In the next phase, the two sub-programmes together will work out the bandwidth for these dyke rings in more detail.

Table 13 Provisional recommendation from the Delta Rhine and Delta Meuse steering groups (continued)

Area and dyke ring (sections)		Minimum standard level (/year)	Maximum standard level (/year)
Limburgse Maas	54 Mook-Middelaar-Milsbeek-Ottersum	250	1,300
	55 Gennepe-Heijen	250	1,300
	56 Afferden	250	600
	57 Heukelom-Nieuw Bergen	250	300
	58 Luinbeek-Groeningen	250	250
	59 Bergen-Aijen	300	300
	60 Well	300	300
	61/62 Geijsteren Wanssum / Wanssum-Oost	250	600
	63 Bitterswijk-Ooijen	250	400
	64 Broekhuizen-vorst	250	600
	65 Arcen	250	800
	66 Lottum	300	300
	67 Grubbenvorst	250	500
	68 Venlo-Velden	250	600
	69 Blerick	250	8,800
	70 Baarlo	400	700
	71 Belfeld	250	250
	72 Kessel	300	^b
	73 Beesel	250	250
	74 Neer	300	300
	75 Buggenum	500	1,100
	76 Alexanderhaven	300	600
	76a Hammerveld-West	250	500
	77 Roer-Merum-Herten-Ool	400	700
	78 Heel	250	500
	79 Wessem-Thorn	250	400
	80 Brachterbeek	250	250
	81 Ohé-Stevensweert	250	300
	82 Aasterberg	250	250
	83/84 Visserweert-Nattenhoven-Grevenbicht-Roosteren	300	700
	85 Urmond	400	700
	86 Meers	300	300
	87 Maasband	300	2,000
	88 Geule aan de Maas	300	250
	89 Voulwammes	300	250

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^b There is insufficient information available for these dyke ring sections to be able to evaluate them.

Table 13 Provisional recommendation from the Delta Rhine and Delta Meuse steering groups (continued)

Area and dyke ring (sections)			Minimum standard level (/year)	Maximum standard level (/year)
Limburgse Maas	90	Geule-Maastricht-Oostoever	250	4,500
	91	Itteren	300	700
	92	Borgharen	250	900
	93	Maastricht-Westoever	300	1,300
	94	St. Pieter	250	250
	95	Eijsden	^b	^b

^b There is insufficient information available for these dyke ring sections to be able to evaluate them.

The review rejected a number of category-c dykes in the area around the major rivers. The Rivers sub-programme is examining the cost-effective alternatives for improving and standardising these flood defence systems. An initial inventory for the category-c dykes in Central Holland has been completed. This inventory has shown that a higher standard for the dykes along the northern side of the Lek is more cost-effective than extensive investment in the category-c dykes of Central Holland (with the exception of the tidal part of the Hollandsche IJssel). The defence system managers and the HWBP programme office have started a general exploration into this subject in collaboration with the Rivers and Rhine Estuary-Drechtsteden sub-programmes. The exploration will address the measures to increase the strength of the dykes along the Lek (risk-based approach) and reduce the load as an alternative to the extensive improvements of the category-c dykes along the canalised Hollandsche IJssel that failed inspection. The exploration will also address the future status of the category-c dykes.

The promising strategies for the area around the major rivers will be combined with measures in the second and third layers of multi-layer flood risk management. Layer 2 primarily provides a perspective on the areas outside the dykes and along rivers with no dykes, e.g. stretches of the Limburgse Maas and along the IJssel. In the areas inside the dykes, revised forms of physical planning are the most promising if the safety level of the dykes is too low, flood water does not rise too much or dyke improvements encounter objections. The use of multi-layer flood risk management has been specifically explored for two town expansions in Zwolle (Kraanbolwerk and Stadshagen) and on Kampereiland. The probability of a flood in Stadshagen, which borders the Zwarte Water, can be reduced by converting a noise barrier into a compartmentalisation dyke. In the case of Kampereiland, measures in the second and third layers could contribute to the new tolerable risk level. Various regions in the area around the major rivers see prospects for compartmentalisation. Measures in layer 3 are always of major importance in the area around the major rivers because when setting the necessary basic level of safety in large sections, it was assumed that 75% of the people could be evacuated in good time (↗ sub-section 3.2).

The IJssel-Vecht delta: options in the second and third layers

The IJssel-Vecht delta is a key economic area in a vulnerable water system. The water threat could be from high water in the IJssel, a storm on the IJsselmeer lake and high water in the regional system (Vecht and Sallandse Weteringen). The high water situation in the spring of 2012 once again demonstrated the need for flood risk management tasking, which is becoming more urgent with climate change. High water discharges are on the increase and this comprises an area of attention for the flood risk management standard. In the IJssel-Vecht delta, this climate tasking is being viewed as an opportunity for a unique area development by creating smart links to spatial-economic developments. Regional parties recently summarised their ambition in the *'handelingsperspectief IJssel-Vechtdelta Deltaproof'* report on possible approaches towards Delta-proofing the IJssel-Vecht delta. The main ambition is: a long-term safe and climate-proof environment in which to live, work and recreate in the IJssel-Vecht delta. This approach will be laid out in more concrete terms in an implementation programme of projects focusing on the risk-based approach and use of multi-layer flood risk management. A few examples:

Zwolle town centre/Kraanbolwerk



Zwolle town centre is an area outside the dykes. The water in the canals is directly connected to the water level in the IJsselmeer lake. The hinterland may also pose a high-water threat: the Sallandse watercourses drain into Zwolle.

When designing the Kraanbolwerk (some 150 flats/apartments), the design water levels took climate tasking into account from the outset. When detailing the project, utilities, building entrances and the car park were located on high enough ground. Different living levels were also incorporated to cover fluctuations in water levels. By doing so, water has been given amenity value and makes a key contribution to the spatial quality of the project. Construction will start in late 2013. The lessons learned will be used for the further delta-proof development of Zwolle town centre.

Kampereiland

For the Kampereiland area, a study involving residents was carried out that looked into the options of a flood risk management strategy based on multi-layer flood risk management. Strictly speaking, the area is outside the dykes, but it is protected by a number of regional defence systems. Furthermore, it has been designated as a flood storage area. The provisional strategy will improve the safety of the flood defence systems (1/500 probability of a flood), with a preference for defence systems that can be flooded and/or grazed. Over time, the area will be organised so that it is water-proof, e.g. using mounds. The evacuation plan will be improved and a disaster drill will be carried out in 2014. Once decision-making is over, construction will start in 2014.

Stadshagen

Stadshagen is located in the Mastenbroek polder. If flooded, 2 to 5 m of water would end up in this polder. The new residential area comprises some 8,000 homes and is being extended even more. The project focuses on moving a provincial road, the majority of which has been planned to run around Stadshagen. Investigations are ongoing to see whether the noise barrier along the provincial road could also serve as a defence system that could minimise consequences. In that case, the number of casualties and the damage caused by a flood could be limited to a considerable extent. A decision on actual construction will be taken in 2013.

Adaptive delta management rivers

The Room for the River PKB and the Meuse Integrated Exploration address a number of spatial reservations of the area inside the dykes for river-widening measures that have been laid down in the Barro (*Besluit algemene regels ruimtelijke ordening* in Dutch), a government decree on spatial reservations for additional flood discharge or storage. Various regions set great store by using river-widening measures. Ongoing programmes such as WaalWeelde and Ooijen-Wanssum will use regional co-financing for the combination of integral area development and river widening. There are also discussions concerning a major and urgent tasking that will lead to an extensive dyke improvement programme as a result of the Third Assessment, piping and updating of the standards. Completion of this dyke improvement may take decades. In the case of spatial reservations that remain valid for a long period of time, but for which no implementation is scheduled, it is important to limit the hindrances for the area as much as possible. Options such as 'provisional alternative designation' are to be considered in this case. One of the

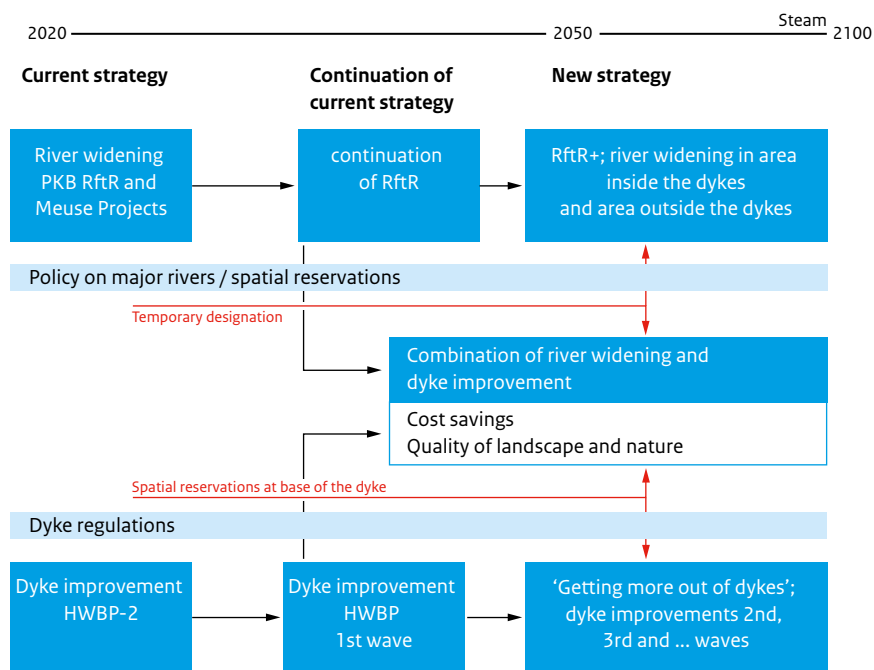
aspects of adaptive delta management is considering the options for switching between strategies. To develop the preferential strategy, a study is being performed to establish the best way to combine the two promising strategies Room for the River+ and Getting More out of Dykes.

Towards the preferential strategy

Next year, the Rivers sub-programme will draw up a preferential strategy for the area around the major rivers by selecting an optimal combination of measures from the two promising strategies for each section (in addition to the decision on discharge distribution). The sub-programme will assume the following mottos in this case:

- Meuse and IJssel: river widening where possible, dyke improvement where necessary;
- Waal: river widening and dyke improvement – a powerful combination;
- Nederrijn-Lek: dyke improvement, with local opportunities for river widening.

Figure 18 Adaptation path for Rivers



The six regions will shortly be exploring the consequences of new standards for the necessary measures and support, assuming the upper limit of the provisional new standards. Based on a more detailed analysis, a final recommendation on the standards will be made. This may deviate from the bandwidth outlined in [table 13](#). Next year, the sub-programme will finalise the analysis of the usefulness and need for category-c dykes and will carry out a study into protection and the transmission effects in the Meuse area. Finally, the measures for flood risk management and the spatial ambitions will be identified, divided into three periods (2015-2030, 2030-2050 and 2050-2100), to make the most of the linkage opportunities.

This will also include linking up with the major tasking in the area around the major rivers to bring the flood defence systems up to scratch. A large number of the flood defence systems need to be improved. The linkage opportunities that this tasking provides, e.g. creating more work from work, will also be highlighted when developing the preferential strategy.

The past year has shown that the strategy of 'system interventions' is not promising in general. The strategy comprised major interventions in the area around the major rivers with a supraregional effect, such as building new links between tributaries. The strategy generally scores very poorly in terms of liveability (cutting through areas and connections between villages) and agriculture (loss of area). A revised discharge distribution across the Rhine tributaries, which would see an additional discharge in excess of 16,000 m³/s flowing entirely via the IJssel, will not be elaborated any further. A further study for the Nederrijn-Lek is required, however. There are two steps to this follow-up study. Joint fact-finding will be carried out first to collate all available information related to discharge distribution. After that, the usefulness and need for a further study into additional relief of the Nederrijn-Lek will be evaluated, and the findings communicated to administrative bodies. The conclusions will be included in DP2015 as part of the section on the Delta Decision on the Rhine-Meuse delta.

As regards the areas where the Rhine Estuary-Drechtsteden and Rivers sub-programmes overlap, a joint process of information gathering and discussion will be organised. These areas are Alblasserwaard and Vijfheerenlanden, Land van Heusden en Altena, and the Drechtsteden. The sub-programmes will map out the desired measures along the

Merwede and the Waal together to be able to properly weigh up the interests of the entire river Waal, the Merwede and the Rhine Estuary-Drechtsteden.

The promising strategies for the area around the major rivers also clearly address the river-widening measures as a solution for the safety tasking, in accordance with current policy and implementation of Room for the River. The preferential strategy is expected to be a customised set of measures concerning dyke improvement and river widening. Given the major tasking and limited resources, the most economical version may be given the greatest focus. Considering the importance of spatial solutions alongside classic dyke improvements when realising the desired level of protection and the importance of community support, the Delta Programme Commissioner recommends setting aside space for this where it is an efficient solution for flood risk management. Although this solution may be more expensive, it is of (added) value in terms of the social benefits it brings. This will have to be considered for each measure. This requires a transparent decision-making process as part of the annual Delta Programme.

To ensure that the Netherlands remains sufficiently safe, liveable and attractive, the Cabinet has already opted to give rivers more space where possible. As a result, the river system will be made more flexible to be able to process flood water, and links with natural processes will be sought where possible. This also allows linkage with other ambitions and boosts spatial quality. At present a government decree on spatial reservations for additional flood discharge or storage (Barro) indicates for which areas wide-scale capital-intensive developments may not be included in zoning plans if they could hinder river-widening measures in the future. When adopting the Delta Decisions and area-based strategies in 2015, a decision will also be taken as to whether the Barro will be modified.

The Cabinet shares the Delta Programme Commissioner's recommendation that transparent decision-making on the financing of the river-widening measures is required. The safety yield of the measure, the social costs and benefits, the options for linkage and co-financing, and the budget available in the Delta Fund all play a role in this.

Promising strategies for Rhine Estuary-Drechtsteden

The Rhine Estuary-Drechtsteden sub-programme elaborates strategies for flood risk management in this region (solutions for freshwater in this area are covered in the [\[\] Freshwater sub-programme](#)). The risk of floods in this particular transitional area arises because of the interplay between the sea and the rivers. It is a vulnerable location in the Dutch delta. Rhine Estuary-Drechtsteden is home to a vast number of residents and is of considerable economic value.

As such, this region has a major tasking for flood risk management through 2100. The first tasking is to raise the protection level of the dykes, with a large part of the area requiring a higher safety level than is currently the case. The current design of the main water system, which includes a storm surge barrier in the Nieuwe Waterweg, also appears to be robust in the long term. The tasking can be resolved with local customisation and specific investment in the locations at greatest risk. That will also present the largest number of opportunities to link up with the region's wishes and ambitions. Research should reveal whether a change in the discharge distribution across Rhine tributaries and flood storage in the Grevelingen are promising additions. Current knowledge does not provide enough grounds to change the discharge distribution across the Rhine tributaries because of flood water. Further research is required for the Nederrijn-Lek (in the case of discharges up to 16,000 m³/s) and the discharge distribution across Rhine tributaries for volumes exceeding 16,000 m³/s ([\[\] strategic decision for the Rhine-Meuse delta](#)).

Promising strategies

The past year has shown that the tasking in the western part of Rhine Estuary-Drechtsteden can be covered in the long term by optimising the current strategy: dyke improvements and a closable-open storm surge barrier in the Nieuwe Waterweg. With dyke rings such as Alblasserwaard and Krimpenerwaard, tasking in the eastern part is more complex and the solution not as clear.

The opportunities and bottlenecks presented by local measures have been explored for each region. These have been mapped out using two strategies: Prevention above all and Customisation according to risk. These strategies were examined, using the probabilities of a flood (according to

the second reference of WV21⁴⁰) and how the main water system is currently organised as points of reference. The following insights have been garnered from this as a result:

• Prevention above all

In this strategy, protection against floods (layer 1) is paramount. Preventive measures include dyke improvements or river widening, with the observation that river widening is not effective where the influence of the sea dominates. Where the river has greater influence, there is often more choice between dykes and room for the river ([\[\] Rivers sub-programme](#)).

For each dyke ring section, a calculation has been made of the costs and effects of enforcing the current probability of a flood (second reference WV21), of applying the tolerable individual risk of 10⁻⁵ and of applying the economically optimal standard (based on the MKBA of WV21). The costs of dyke investment in the reference clearly show the costs related to a changing climate under the current standard (including settling of the dykes). The total cost⁴¹ for the entire area through 2100 amounts to approximately € 5-6 billion, if the excess height is not factored in. It appears that the additional costs for higher safety levels are relatively limited: approximately € 1 billion, of which more than 55% is for Alblasserwaard and Krimpenerwaard. It may end up costing less because some of the water defence systems have excess height. However, these water defence systems must be strong enough, which is the case in approximately a third of the area. In the western part of the Rhine Estuary-Drechtsteden, the desired level of safety can probably be achieved at no additional cost because of the excess height and strength there (however, tackling the piping issue may lead to additional costs).

A higher standard for the Alblasserwaard, along with settling and climate change, will lead to more extensive tasking, as part of which the dykes will have to be 1-2 m higher – and therefore also wider – in places where there is very little space. The Krimpenerwaard will also face serious tasking because of this, even for dyke sections that were

⁴⁰ The second reference situation provides an estimate of the expected flood risks once the current improvement projects and programmes have been completed (in 2015/2020). This will consider new insights when determining the flood risks (the contribution of piping and the influence of length effects).

⁴¹ Total nominal dyke improvement costs (billion € plus VAT, 2009 price level, bandwidth -25% to +40%). Source: The Delta Programme's Centre of Expertise for Costs and Benefits (*Expertisecentrum Kosten en Baten* in Dutch)..

only recently improved. Spatial impact and support will be major factors to consider in the final decision for these areas. River widening is an alternative for some of the dyke improvements along the Merwede, from Hardinxveld-Giessendam upstream past Gorinchem.

- **Customisation according to risk**

This strategy is based on customisation for parts of the dyke ring with an optimum combination of all the layers of multi-layer flood risk management. This means that the approach for each dyke ring differs. The standards for each dyke ring (section) also differ, depending on the risks. Customisation allows the use of local excess height, excess strength and forelands for safety purposes. This strategy can achieve the desired safety for less cost than Prevention above all. The customisation strategy that has been elaborated for Eiland van Dordrecht will ensure a higher level of safety (a lower risk) at the same cost as the economically optimal standard for the entire dyke ring (approx. € 400 million through 2050⁴²). In the case of Hollandsche IJssel, just factoring in the forelands would see costs drop to approx. € 150 million, according to estimates from the Schieland and Krimpenerwaard water board. Additional measures, such as reducing the failure probability of the storm surge barrier in the Hollandsche IJssel, seem to be cost-effective alternatives to reduce the cost of dyke improvements even further. What is notable is that the measures in this strategy also primarily stem from layer 1 (prevention), but are more attuned to the local risk (differentiation). As such, the strategy ties in with the new safety approach (▢ sub-section 3.2). Measures to limit the consequences through spatial organisation add only limited value because in the case of a flood the water in the dyke rings will be very high in no time at all. Not enough is known yet about the options presented by layer 3 for protecting the vital and vulnerable uses.

If the above-mentioned strategies do not provide any solutions, integrating flood risk management and spatial development may be an option. That means that, in the long term, the uses in an area must be properly aligned with the probabilities of a flood. This approach fits in with the line of thought of the Delta Decision on Spatial Adaptation, in which focused decisions concerning spatial development can limit tasking in the future.

Although customisation may seem more economical in the end, the effects of both approaches are very similar. Therefore, support and feasibility will have to be considered when deciding which strategy to go for. Fundamental issues also have to be addressed: what is preferred: dyke improvement, river widening, a small number of major interventions or numerous small ones? How great is the desire to prevent the consequences of floods from increasing in the future? When opting for customisation, various government authorities together must detail the tasking and take responsibility for it.

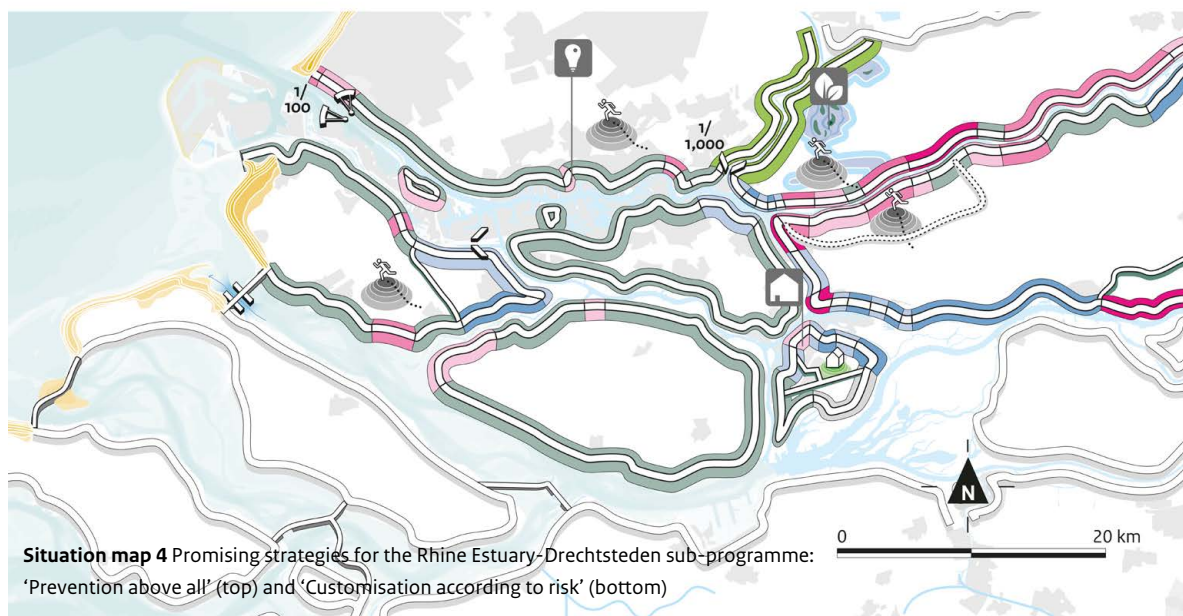
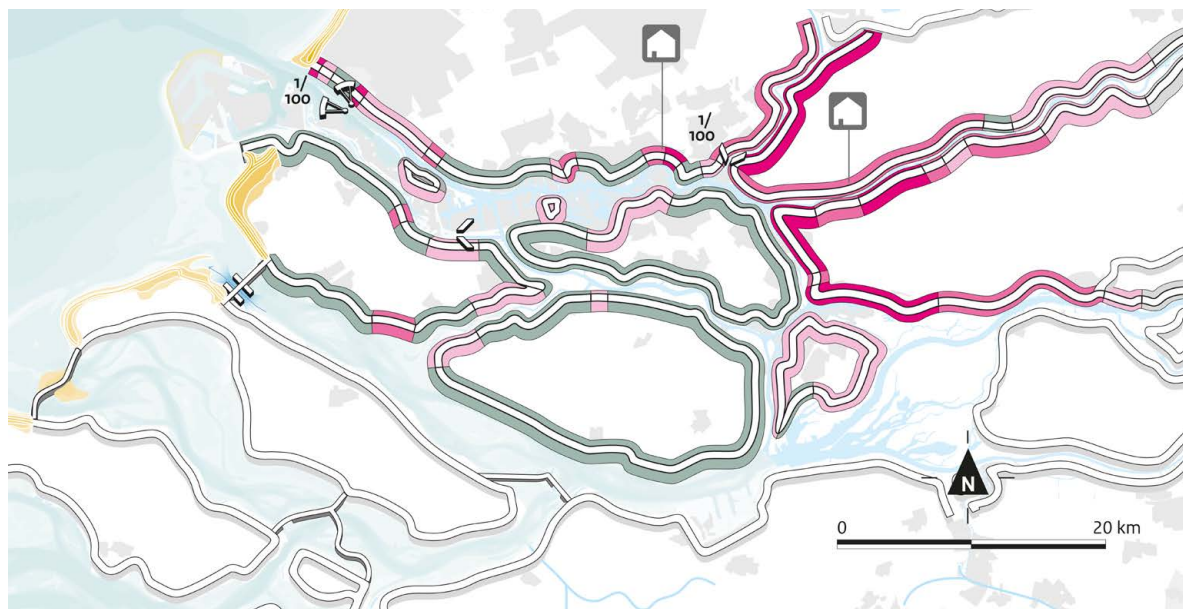
New safety levels and multi-layer flood risk management

The Rhine Estuary-Drechtsteden sub-programme has incorporated the options for new safety levels into the building blocks for promising strategies. Analyses have shown that nearly every dyke ring requires a higher standard to be able to provide a tolerable individual risk of 10^{-5} , assuming that tasking can be resolved with dykes alone. Moreover, the desired level of safety needs to be increased almost across the board to limit the risk of large groups of casualties or substantial economic losses. The standards in ▢ table 14 are the results of a mathematical exploration.⁴³ They provide an impression of the bandwidth for the updated standard. In one dyke ring, the objective of acquiring a basic level of safety leads to the highest standard, while in another dyke ring the economically optimal standard (according to the MKBA) could end up being dominant. For some areas, the reference (current standard) is given as the lower limit; this could be lower once a final decision has been reached on tolerable individual risk.

Administrative deliberations on a final recommendation have yet to take place for DP2015. These will also address the opportunities related to multi-layer flood risk management, standard differentiation and the impact of dyke improvements. The desired level of protection of the areas outside the dykes will also be covered in the preferential strategy for Rhine Estuary-Drechtsteden. The sub-programme and the Rivers sub-programme will draw up the recommendation on the standards for dyke rings 15 and 16.

⁴² Nominal costs (€ million) through 2050 for dykes without excess height.

⁴³ Slootjes, N., Jeuken, A., 2013, Costs and consequences of promising measures and strategies Deltares report 1207828-004.



Situation map 4 Promising strategies for the Rhine Estuary-Drechtsteden sub-programme: 'Prevention above all' (top) and 'Customisation according to risk' (bottom)

Layer 1: prevention

- dyke improvement (possibly between 0 and 50 cm)
- dyke improvement (possibly between 50 and 125 cm)
- dyke improvement (possibly more than 125 cm)
- construction of Delta Dyke / reduce probability of breach 1:100,000
- no dyke tasking on account of possible excess height of dyke
- Delta Dyke (probably) present
- no tasking on account of existing forelands
- reduce failure probability of storm surge barrier
- dykes

Layer 2: spatial organisation (possible local solutions)

- realise storage in area inside the dykes
- existing compartmentalisation
- remove existing compartmentalisation
- shelter
- ensure vertical refuge options

Linkage opportunities (indicative and not exhaustive)

- innovation
- nature
- living

Table 14 Illustration of the bandwidth for possible new standards, expressed in annual probability of a flood*

		Minimum standard level (/year)	Maximum standard level (/year)
14-1	Zuid-Holland Kust	3,800	9,300
14-2	Zuid-Holland Nieuwe Waterweg-West	200	1,700
14-3	Zuid-Holland Nieuwe Waterweg-Oost	13,700	22,000
15-1	Lopiker- and Krimpenerwaard	1,940	8,910
16-1	Alblasserwaard and the Vijfheerenlanden	5,240	26,000
17-1	IJsselmonde	4,200	9,600
18-1	Pernis	12,300	72,000
19-1	Rozenburg	500	3,800
20-1	Voorne-Putten-West	3,500	5,360
20-2	Voorne-Putten-Midden	704	3,000
20-3	Voorne-Putten-Oost	4,400	9,300
21-1	Hoeksche Waard	600	820
22-1	Eiland van Dordrecht	2,500	2,800

* Based on: Casualty risk analysis of 21st-century flood risk management (▢ Appendix B, in Dutch) and Social cost-benefit analysis (MKBA) of 21st-century flood risk management.

Through customisation, multi-layer flood risk management can contribute to the water safety level, although prevention will always remain the top priority. A Delta Dyke across a part of the dyke ring can make Eiland van Dordrecht just as safe, at a lower cost, as standard dyke improvements across a longer section. The sub-programme is looking for creative solutions for a sustainable spatial organisation and disaster management for Alblasserwaard and Vijfheerenlanden, e.g. Delta Dykes, compartmentalisation and shelters (▢ sub-section 3.2). In general, proper detailing of multi-layer flood risk management requires more insight into the possible evacuation strategies because it has been assumed that the required basic level of safety in large sections arises in part because only 15% of the people can be evacuated in good time.⁴⁴ It appears promising to make more use of vertical evacuation in this region (evacuate to higher buildings in the area). More insight into the vital and vulnerable uses with a supraregional interest is also required. Whether these uses deserve additional protection has to be decided as well. These include

marshalling yards such as Kijfhoek on IJsselmonde and the gas distribution station in Alblasserwaard.

Towards the preferential strategy

The Rhine Estuary-Drechtsteden sub-programme will elaborate the above results next year into a preferential strategy for flood risk management, in which customisation will play an important role. There is already an outline of the preferential strategy for a number of areas:

- In the western areas, dyke improvement will remain the key cornerstone. In the case of a higher level of safety, customisation for each dyke ring section is the preferred option. A higher level of protection already exists in a number of places as a result of excess height, but only if there is excess strength too. Existing forelands can also contribute to a higher level of safety.
- Customisation in layers 1, 2 and 3 also presents a cost-effective option for creating a higher level of safety for Eiland van Dordrecht. This area will be home to one of the pilot projects for multi-layer flood risk management (▢ sub-section 3.2 and ▢ box on page 83).

⁴⁴ Compared to the upper river area, the number of residents to be evacuated in the area around the tidal rivers is quite large given the available time and the circumstances are not favourable: high river water levels along with a serious storm. As a result, the percentage of residents that can actually leave the area is less than in the area around the upper rivers.

- Dyke improvement tasking along the Hollandsche IJssel can be reduced considerably by factoring in existing forelands for the safety of the flood defence systems and probably also by improving the failure probability and the closure regime of the storm surge barrier Hollandsche IJssel. A spillway to a nature area in the Krimpenerwaard may contribute too.
- The preferential strategy for the Lopiker- and Krimpenerwaard (dyke ring 15) and the Alblasserwaard and Vijfheerenlanden (dyke ring 16) requires further

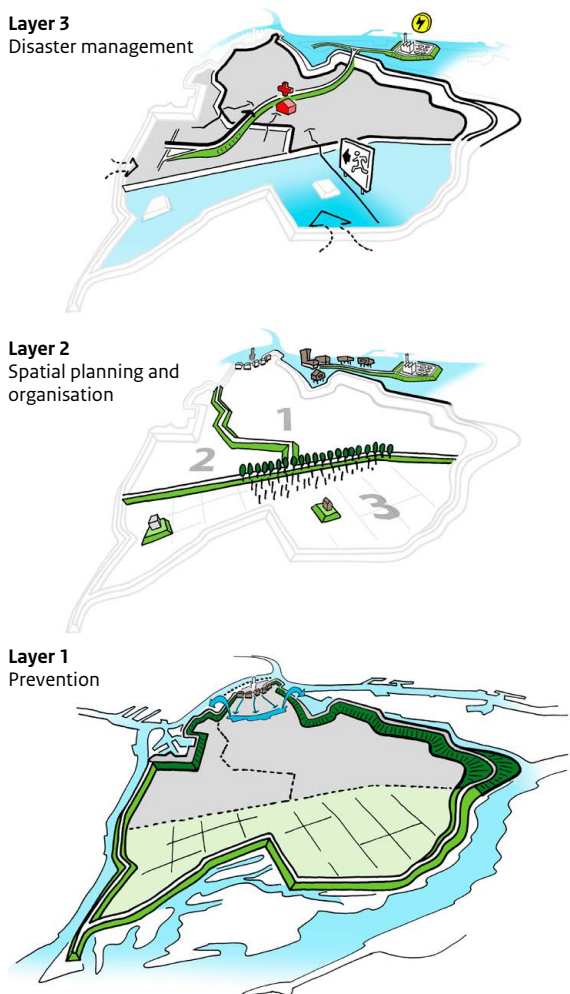
research into the options for resolving the complex tasking with measures in the main water system and opportunities for multi-layer flood risk management. Customisation is also required in the areas outside the dykes so that each area can anticipate the local flood characteristics, uses and dynamics.

Adaptive delta management will play an important role in the final preferential strategy. The timing of the measures and the possible development paths for the long term will also be elaborated.

Multi-layer flood risk management – Eiland van Dordrecht

Dordrecht wants to be a ‘self-sufficient island’ because in the case of very high water there will be very few options to get off the island and the surrounding areas will also be threatened. Self-sufficiency means that the residents have a concrete action strategy to be able to survive on the island for approximately one month in the case of a flood. This ambition is focused on how to deal with the consequences of extreme situations. In the current system, the consequences cannot be managed because water levels in the built-up area will be too high everywhere (and often rise quickly as well). However, the consequences can be made more manageable by using the promising strategy ‘Customisation according to risk’.

This strategy focuses on limiting consequences through spatial planning and organisation (layer 2) and disaster management (layer 3), supplemented with preventive measures (layer 1). Constructing a Delta Dyke on the north-eastern side of Dordrecht will have a targeted effect. This measure is enough to achieve the standard based on the MKBA or the LIR and it can be supplemented with measures in layers 2 and 3 to increase self-sufficiency. As part of layer 2, the regional flood defence systems can be used to create a safe haven for local evacuation inside the dyke ring. As part of layer 3, essential preconditions for self-sufficiency can be set by linking up with public and private investments in a smart way constructing ‘smart shelters’ for those who are not self-sufficient, protecting vital infrastructure and improved risk and crisis communication.



The past year has shown that a number of measures in the main water system are not promising: constructing a ring of river flood gates; pumping at the Haringvliet sluices; a dam with navigation locks in the Nieuwe Waterweg; and damming off the Hollandsche IJssel. These measures are no longer being considered. Flood storage in the Grevelingen still remains an option, however (Promising strategies for the Southwest Delta). Current knowledge does not provide enough grounds to take a decision on changing the discharge distribution across the Rhine tributaries for flood water. However, further research is required for the Nederrijn-Lek, bearing in mind climate change and future standard changes ([↗ Strategic decisions for the Rhine-Meuse delta](#)).

Promising strategies for the Southwest Delta

The Southwest Delta sub-programme is elaborating strategies for tasking for flood risk management and freshwater supplies in this region. The large (former) inlets are typical of this region, with their widely varying features in terms of flood risk management, ecology and economy.

Dyke improvements can be used to resolve tasking in the Southwest Delta, also in the long term. Optimising this strategy presents opportunities to create integrated solutions for safety, ecology and economy. This is in line with the ambition of this area: a climate-proof, safe, ecologically resilient and economically vital delta.

Promising strategies

The Draft Delta Decisions include strategic decisions for the main water system which are leading for flood risk management in the Southwest Delta ([↗ sub-section 3.2](#)). As part of these decisions, the Southwest Delta sub-programme has explored promising strategies for flood risk management in the northern and southern parts of the delta. The sub-programme has evaluated the effects of these strategies against the criteria in line with the ambition and the Delta Programme evaluation system (*Vergelijkings-systeematiek* or VGS in Dutch) ([↗ sub-section 4.1](#)). The following insights have been garnered from this as a result:

• Northern part

This part of the Southwest Delta includes Haringvliet, Hollandsch Diep, the Grevelingen and the Volkerak-Zoommeer. Two promising strategies have been elaborated for this region:

- *Continue current strategy*
This strategy provides for increasing the height and strength of the dykes combined with storing river flood water in the Volkerak-Zoommeer as already agreed (Room for the River). Using this strategy, flood risk management tasking through 2100 can be resolved across the board. The strategy does not make any positive contribution to ecology, economy or freshwater supplies. The strategy can be optimised by supplementing traditional dyke improvements with innovative dyke concepts. Examples include using sand in a smart way on top of, against or in front of the dyke; using biobuilders, such as salt marsh planting or reefs of oyster shells; and more robust designs, such as a climate dyke or a dual dyke.
- *Flood storage in the Grevelingen*
In this strategy, the Grevelingen serves as an additional flood storage area for river water so that the water level in Haringvliet and Hollandsch Diep does not rise as much in extreme situations. As a result, dyke improvements along these waterways are less extensive and only required at a later stage. This strategy, too, can resolve flood risk management tasking.

As both strategies are suitable for dealing with the tasking, the decision can be taken based on cost-effectiveness and the contribution to other objectives for the Southwest Delta. The study will be conducted next year as part of the government framework vision on the Grevelingen and Volkerak-Zoommeer lakes. The results will provide input for the Delta Decision on the Rhine-Meuse delta.

• Southern part

The southern part of the Southwest Delta comprises the Oosterschelde and the Westerschelde. Two promising strategies have been elaborated for these waterways too:

- *Continue current strategy*
This strategy comprises increasing dyke height and strength in combination with the current management of the Oosterscheldekering storm surge barrier. Exhaustive dyke improvements are only required after 2050 when the Zeeweringen project has been finalised.

- *Optimise current strategy*

In the Oosterschelde, the current strategy can be optimised by adjusting the management and closure regime of the Oosterscheldekering and introducing sand replenishments. An optimal combination of dykes, a flood defence system and shoals will contribute to safety and to fighting the erosion of the intertidal area ('sand demand'). In the Westerschelde, optimisation can be achieved by also using the deposits from the dredging and deposit work in the fairway to maintain the shoals and the shorefaces. That will benefit safety and ecology. Furthermore, multi-functional dyke concepts can be used in both waterways.

Oesterdam and Sophiastrand safety buffer

In 2013 and 2014, two improvements to the sea wall in the Oosterschelde, which have been developed together with regional parties, will be carried out. These improvements will help restore the environmental value and are good for recreation. In both projects, the Ecoshape consortium is building up knowledge for the future use of 'building with nature'.

In the case of the Oesterdam safety buffer, sand replenishment will raise the height of the foreland, which plays an important role for nature and safety, but is being eroded. This will extend the lifespan of the dyke slope – which was improved last year – by several dozens of years and restore the environmental and recreation value of the area. The plans have been developed with and co-financed by Natuurmonumenten and the province of Zeeland. Besides the replenishments, there will be close collaboration with the oyster industry to see whether there are any options for innovations that can provide the sector with knowledge for future developments.

For the Sophiastrand project, improvement of the dyke slope has changed to sand replenishment for the dunes and beach. Not only does this increase safety, it also increases the environmental value of the shoreface and the recreation value of the beach. This change came about in collaboration with the Scheldestormen water board, the province of Zeeland, the Ecoshape consortium (for building with nature), the municipal council of Noord-Beveland and Roompot Recreatie.

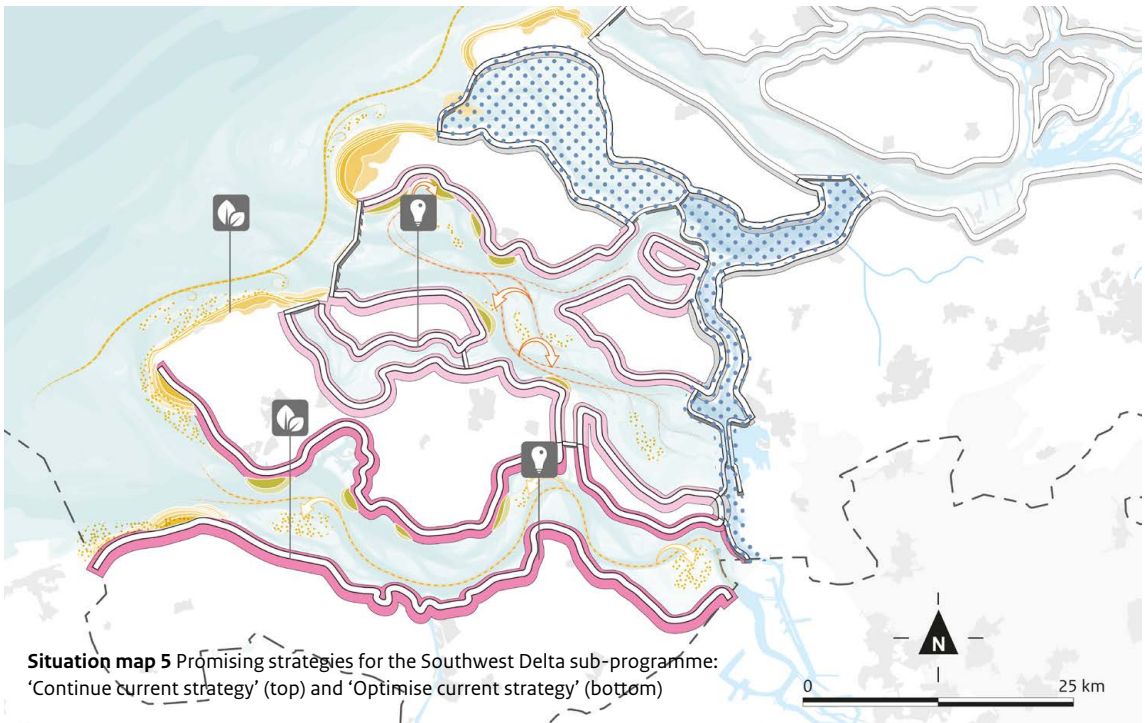
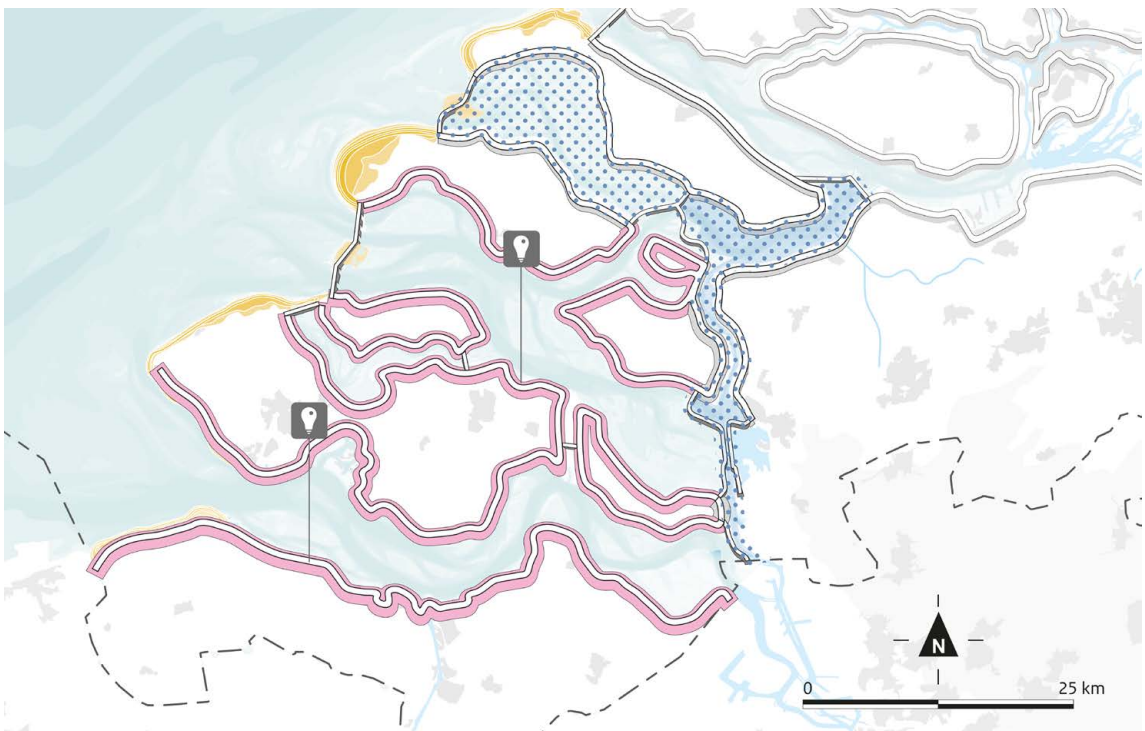
Both strategies present promising solutions to resolve tasking. The decision depends on the costs and the effects, focusing particularly on ecology and economy. Optimising the current strategy is more beneficial to ecology. One thing to consider is that some aspects of this strategy, e.g. the sand replenishments and adjusting the dredging and depositing strategy, will have to start very shortly to have any effect in a few decades' time.

In the Southwest Delta, three promising strategies have been elaborated for the freshwater supplies. They differ in their approach to freshwater supply levels, expressed in water quality, water quantity and delivery reliability, and the role of (private) freshwater users. In the first strategy, the supply level increases because of measures in the main water system and adjustments to the regional water system. In the second strategy, the supply level adapts to developments in the climate and the economy. For this, both the main and the regional water systems will be optimised. The third strategy actually encourages self-sufficiency through innovations that call for a more economical and efficient use of freshwater. The initiative here lies primarily with the users.





The likelihood of the elaborated strategies succeeding varies from region to region. To decide on preferential strategies, measures from the three strategies will be combined and a selection made on the basis of a more detailed analysis of costs and effects. Based on this, an investment programme will be proposed for the short, medium and long term. For those areas with an external supply of freshwater, it is essential that Haringvliet, Hollandsch Diep and Biesbosch be retained as strategic freshwater buffers and supply routes. For those areas without an external supply, the focus will be on innovative measures in the regional system and among users (self-sufficiency and subsoil storage).






New safety levels and multi-layer flood risk management

The Southwest Delta sub-programme has analysed what the proposed new safety approach means for this region (☞ sub-section 3.2). This analysis shows that virtually the entire area already meets the tolerable individual risk of 10^{-5} . Exceptions are Zierikzee, Hansweert and Geertruidenberg. In the case of Zierikzee and Hansweert, basic safety can be achieved with local customisation, without having to increase the standard for the entire dyke ring. A higher safety level could be considered for Geertruidenberg because major economic damage could be caused in the



Situation map 5 Promising strategies for the Southwest Delta sub-programme: 'Continue current strategy' (top) and 'Optimise current strategy' (bottom)

-  dyke improvement (in the case of optimisation: depending on the Oosterscheldekering regime)
-  Westerschelde dyke improvement, where necessary
-  shoreface deposit
-  dykes

-  coastal sand replenishment
-  channel margin replenishment
-  maintain depth of channel using smart dredging
-  Oosterschelde: replenishment within system to retain sand banks
-  work area of the government framework vision on the Grevelingen and Volkerak-Zoommeer lakes

Linkage opportunities
(indicative and not exhaustive)

-  innovation
-  nature

case of a flood. Compartmentalisation offers no prospects for this dyke ring. The dykes around Volkerak-Zoommeer are now classified as category-c dykes, but will be classified as category-a dykes because of their flood storage function. The sub-programme has taken a broad look at what consequences this would have for standards; this requires further analysis.

Prevention remains the basis for flood risk management policy. A water-robust design and disaster management could be attractive additions to this. When determining the required basic safety, it was assumed that 30-35% of people could be evacuated in good time in large parts of the area.

Towards the preferential strategy

Over the next year, the Southwest Delta sub-programme will be developing a preferential strategy for flood risk management and freshwater supplies in the northern and southern parts of this region. As part of this, the sub-programmes will use new information on the cost of the promising strategies for the southern part, the open questions on the cost-effectiveness of flood storage in the Grevelingen (government framework vision on the Grevelingen and Volkerak-Zoommeer lakes) and the possible combination with solutions for freshwater supplies. The elaboration of strategies for the sandy coastal system will also contribute to the preferential strategy for the Southwest Delta.

Two options for flood risk management in the northern part do not appear promising: flood storage in the Oosterschelde and pumps in the Haringvliet sluices. The effect of storing on the Oosterschelde is very limited, while pumps in the Haringvliet sluices are very expensive. As such, these options will not be elaborated any further.

Promising strategies for the Coast

The Coast sub-programme is exploring strategies for a safe, attractive and economically robust coast. The rise in sea levels and sand movement along the coast determine tasking in this case. The intermingling of flood risk management with ecology, economy and landscape is typical of the coast.

Sand replenishments, dunes and dykes are and will be the pivot on which flood risk management along the coast turns. The promising strategies present opportunities for spatial developments along the coast; collaboration along the entire coastal area is crucial in this regard.

The Southwest Delta steering group on the government framework vision on the Grevelingen and Volkerak-Zoommeer lakes

From the integrated perspective, the Southwest Delta steering group once again seeks to – in due course – restore the tides in the Grevelingen, reintroduce salt water into the Volkerak-Zoommeer and create an open link to the Grevelingen. The decision on this will be made in the government framework vision (in line with preparations for the Delta Decisions).

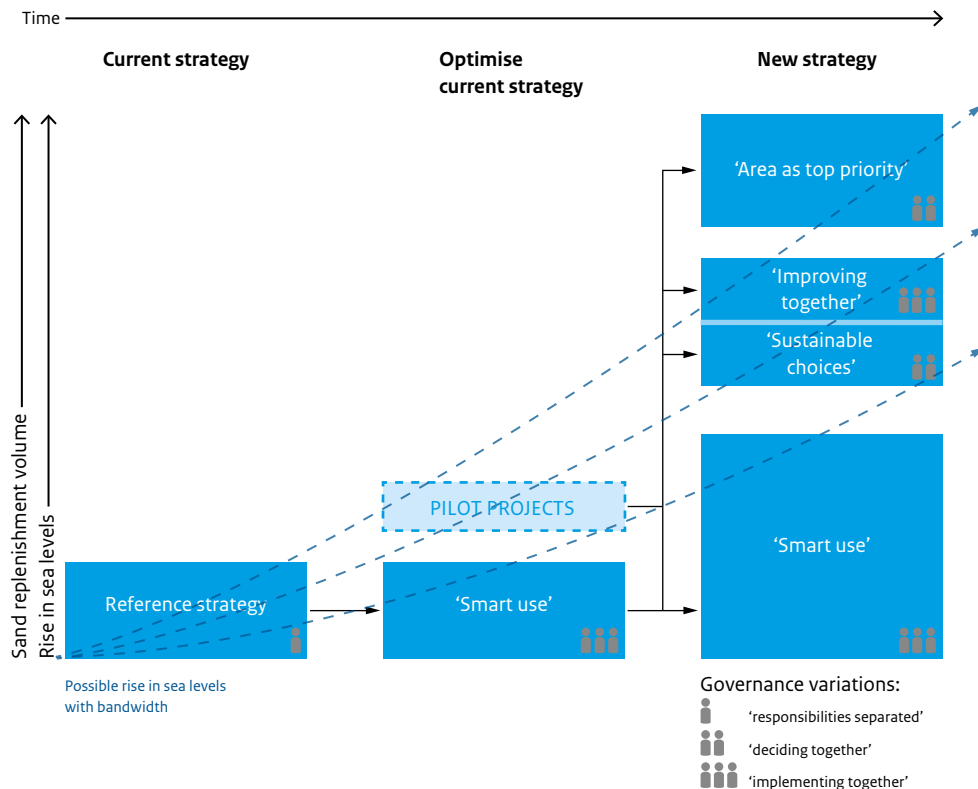
A link between both lakes is possible in combination with flood storage in the Grevelingen. The step towards reintroducing salt water into the Volkerak-Zoommeer is subject to the freshwater supply for the areas in question being organised and the controllability of any remaining salt leakage (via the Volkerak locks to the Hollandsch Diep). The latter point is prompted by the fact that Haringvliet-Hollandsch Diep is the most strategic freshwater supply.

Promising strategies

Last year, the Coast sub-programme explored physical measures for each type of coast (e.g. wide dunes, narrow dunes, dykes, channels, ports and seaside resorts) to deal with the tasking. This year, the sub-programme has elaborated promising strategies for the entire coast. These include administrative and financial measures to be able to fully meet the three objectives.

The strategies came about by combining two lines of thought: ‘coastal safety and surface area at the required level’ and ‘spatial development’. The first line of thought is about allowing the coastal foundation zone (i.e. the area between the NAP -20m isobath and the inside edge of the dune) to more or less adapt to the rise in sea level via three versions of sand replenishments: monitoring, balancing the coastal foundation zone or creating an additional sand buffer. The second line of thought presents different perspectives for organising and collaborating to set conditions for spatial development using sand replenishment: keeping responsibilities separate, deciding

Figure 19 Adaptation path for Coast



together or implementing together. The lines of thought are being elaborated into a National Coastal Vision and have produced four promising strategies for the Coast sub-programme:

- **Strategy 1: Smart use**

This strategy assumes that the coastline stays where it is for at least 50 years, so that the land surface area remains the same. The coastal foundation zone rises partially in tandem with the rising sea levels. Flood defence systems will only be maintained if this is essential to be able to invest in safety as efficiently as possible. The strategy will not actively contribute to the desired spatial developments along the coast; this is the responsibility of market parties and regional or local government authorities, with the aid of a good collaborative venture.

- **Strategy 2: Sustainable choices**

The key difference with the first strategy is that the coastal foundation zone rises entirely in tandem with rising sea levels. To this end, sand replenishments will gradually be increased. The strategy presents more opportunities for

utilising spatial development than strategy 1. Agreement on the development plan for the coast is an essential part of this.

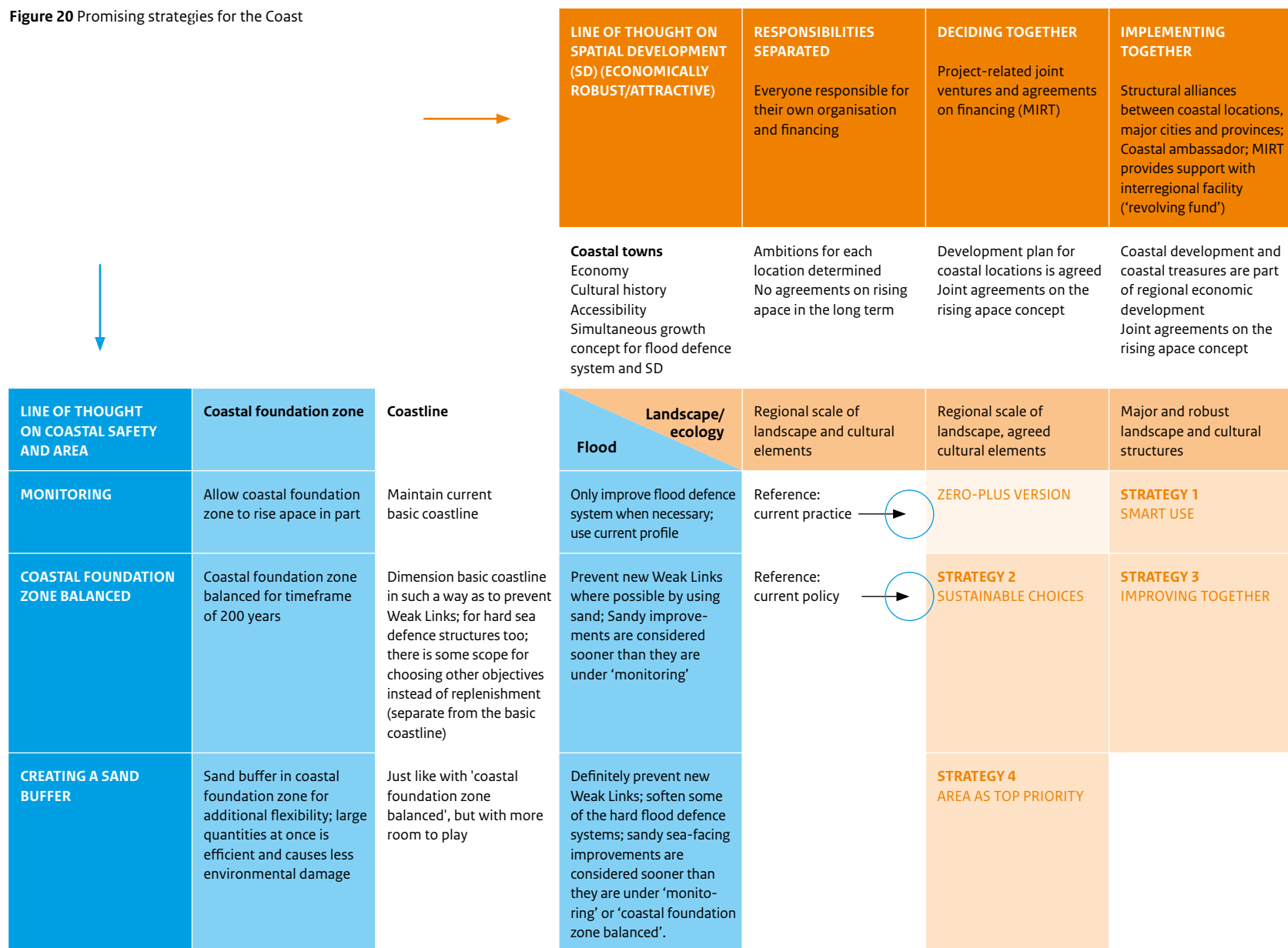
- **Strategy 3: Improving together**

This strategy is an extension of the Sustainable choices strategy: there is even more interconnectivity with spatial development. Combined solutions are the aim here and spatial development helps determine sand distribution along the coast. Stakeholders in this strategy jointly take decisions for development sites along the coast (the 'coastal treasures').

- **Strategy 4: Area as top priority**

The quantity of sand means that there is enough space to serve uses other than safety. Space will be created for development because the Dutch territory may be slightly extended seawards in some places (where desired). Collaboration has been set up in such a way that the greatest social benefit can be derived from the sand buffer.

Figure 20 Promising strategies for the Coast



Using the evaluation system VGS, which has been specially developed for the Delta Programme, the promising strategies were compared and their effects mapped out. All the strategies satisfied the safety standards. The differences relate to additional safety or factors that could influence safety. The effects of closer collaboration are considered to be very positive.

The comparison indicates the following for each strategy:

- ‘Smart use’ will lead to the lowest investment costs (investments are only made where necessary), but presents limited opportunities to link up with recreation, space, nature and the economy.
- ‘Sustainable choices’ will lead to costs and effects that are comparable to the reference strategy (the current policy).
- ‘Improving together’ scores better in terms of linking up with recreation, nature, landscape and the economy. Numerous beneficial effects are expected from closer collaboration at a level that includes the entire coastal zone.
- ‘Area as top priority’ scores highly in terms of linkage opportunities because of the increased sand volume, but does entail the highest investment costs and risk.

New safety levels and multi-layer flood risk management

The Coast sub-programme has analysed what the new approach to flood risk management ([\[2\]](#) sub-section 3.2) will mean for the coast. If a flood were to occur, there would be huge numbers of casualties and massive economic consequences along sections of the coast, according to the MKBA and the casualty risk analyses WV21⁴⁵. However, the current safety level of the dykes appears to be sufficient, bearing in mind the climate changes expected over the next century. The current safety level will ensure that the tolerable individual risk of 10^{-5} is achieved everywhere.

It has been set down in legislation that the coastline will be maintained dynamically with sand replenishments. The sandy coastal foundation zone forms the vital basis for the long-term protection of all the coast. Safety along the coast will be at the required level once the programme ‘Weak Links on the Coast’ has been finalised, with a robust system of dunes, dykes and dams. In combination with keeping the sandy coastal foundation zone at the required level, this will ensure the long-term protection of the entire coast. Flood

defence system measures will be taken if necessary because of developments in sea level and climate. In that way, the safety level of the coast will be maintained. Measures in layer 2 are related to a water-robust physical planning – especially in the area outside the dykes – to reduce consequential damage where possible. In terms of evacuation options, measures in layer 3 have already been considered in the desired level of safety. As part of this, an evacuation percentage of 15% has been assumed for the coastal areas.

By continuously managing and maintaining the sandy system, areas outside the dykes will be maintained and will be high enough. The Ministry of Infrastructure and the Environment has therefore decided that no additional policy is required for the area outside the dykes of thirteen coastal locations. The probability of a flood in these areas will be monitored as an elaboration of the European Directive on the assessment and management of flood risks (*Europese Richtlijn overstromingsrisico's (ROR)* in Dutch).

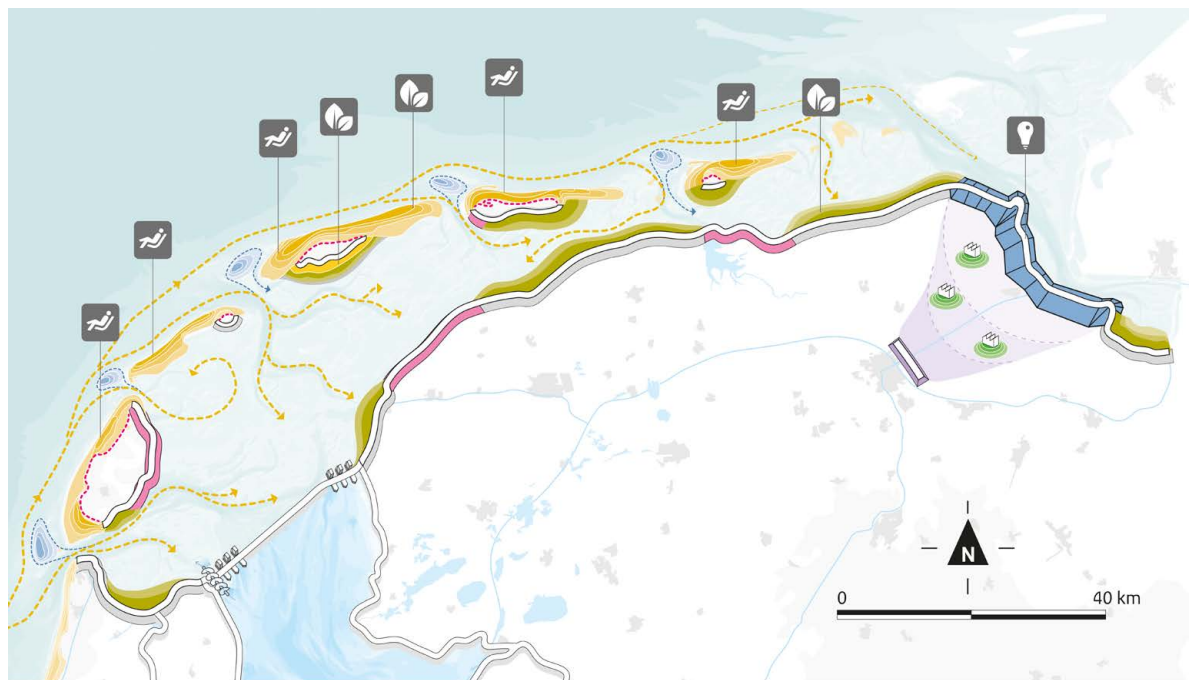
Towards the preferential strategy

The preferential strategy for the coast is closely tied in with the Adaptation Agenda for Sand ([\[2\]](#) sub-section 3.2). The adaptation agenda will be detailed further in DP2015. The measures arising from this adaptation agenda will be included in the Delta Plan on Safety. Adaptive delta management will be specified in the National Coastal Vision in so-called integrated adaptation concepts. Stakeholders can use these concepts to make plans and investments and build on that. This reduces the risks of disinvestment.



Promising strategies for the Wadden Region

The Wadden Region sub-programme is elaborating strategies for flood risk management in the Wadden Region. In 2009, the Wadden Sea was added to the list of UNESCO World Heritage sites, as it is one of the largest estuarine areas in the world and has very unique natural values. Shoals, islands, mud flats and shorefaces (salt marshes) all protect the coast of the northern part of the Netherlands. One crucial issue for flood risk management is whether enough sediment is available to allow both the Wadden Sea and the sandy coast to adapt to rising sea levels. Moreover, rising sea levels and soil settlement mean that maintaining the strength of dunes and dykes also needs to be addressed.

⁴⁵ MKBA WV21, appendix to Parliamentary document 31710, no. 22.





Sandy coast and Wadden Sea

-  sand replenishment
-  pilot project of sand replenishment of outer delta



Primary flood defence systems

-  improve dykes
-  innovative dykes
-  green dyke, lush dyke and eco-dyke
-  soft flood defence system
-  dykes

Layer 2: spatial organisation

-  water-robust organisation and protection of vital infrastructure
-  secondary flood defence system

Linkage opportunities (indicative and not exhaustive)

-  innovation
-  nature
-  recreation

In the large, shallow Wadden Sea, various natural forces distribute the sand, but this does not always happen in a predictable manner. Pilot projects and monitoring are therefore central to the strategy for the sandy coast in the Wadden Region sub-programme. If sand replenishments are insufficient to guarantee the safety of the Wadden islands and the coast of the northern part of the Netherlands, measures using hard materials are a fallback option. Innovative dyke concepts using natural forelands are also promising ([\[\]](#) sub-section 4.4, box on Prins Hendrikdijk). First and foremost, the Wadden Region must remain safe. The aim is for measures on flood risk management to go hand in hand with those for improving nature, sense of space and the economy.

Promising strategies

Last year, the Wadden Region sub-programme elaborated four possible strategies for flood risk management. The conclusion was that the current strategy, with sand replenishments along the sandy coast, and the management and maintenance of the flood defence system, can be utilised for a long time to come to keep flood risk management at the required level. The sub-programme worked out the strategies in further detail for the sandy coast and the Wadden Sea and for the primary flood defence systems (dunes, dykes and structures). The strategies present numerous opportunities for natural flood risk management measures that also contribute to amenity value and tourism (building with nature).

- **Sandy coast and the Wadden Sea**

Sand is replenished regularly along the coast of the North Sea and the Wadden islands to keep the coastal foundation zone at the required level and thus guarantee the desired level of safety. Sand replenishments will have to become more extensive if sea levels rise even more quickly. The aim is to have the sand volume in the coastal foundation zone remain in balance in the long term to retain the intertidal area along the islands and in the Wadden Sea. The long-term maintenance of the outer deltas is in the interests of the safety of the primary flood defence systems at the northern ends of the Wadden islands because the outer delta breaks the waves from the North Sea. Accordingly, not only does the region maintain a sustainable buffer against the wave attacks from the North Sea, it also provides valuable areas for nature and recreation. It is difficult to forecast how much sand that requires. A multi-year knowledge and monitoring programme and pilot projects should provide insight into that. The pilot projects also seek to provide insight into the options for other types of replenishments and their advantages and disadvantages (e.g. depositing larger volumes of sand in one go, other deposit sites or replenishment using other basic material). In the Adaptation Agenda for Sand, the Southwest Delta, Coast and Wadden Region sub-programmes jointly make decisions on the distribution of the amount of sand along the coast based on new insights from the multi-year knowledge and monitoring programme and the pilot projects.

Current sand replenishment along the islands can be optimised so that nature and recreation can benefit more. The replenishments can help ensure that the dunes and low-lying parts of the islands adapt to the rise in sea level. There is support on the islands to explore these optimisations together. To increase insight, pilot projects and monitoring are required for this too.

- **Primary flood defence systems**

Innovative dyke concepts in the Wadden Region may be a solution for safety tasking and can be linked to ambitions for nature, recreation and ongoing area developments. Five dyke concepts appear promising: lush dykes, eco-dykes, standard dykes with innovative elements, green dykes and standard dykes with a salt marsh wall. There is widespread support for a dyke along the Dollard covered in grass that fades into a salt marsh by way of a slight incline. The salt marsh naturally adapts to the rise in sea level, ensuring the long-term safety of the dyke (building with nature). Green dykes also add value to nature and the landscape. An exploration has shown that developing the forelands can contribute to flood risk management and biodiversity.

New safety levels and multi-layer flood risk management

The Wadden Region sub-programme has taken a general look into the consequences of the new safety approach for this region ([\[2\]](#) sub-section 3.2). Based on the latest insights, it is expected that the basic safety standards will be met almost everywhere. This will be elaborated further next year together with the Safety sub-programme. The Ems delta requires closer attention because the gas production, storage and transport facilities in this area could result in social disruption if gas supplies failed. This risk may be minimised by using multi-layer flood risk management. A further study will provide insight into any consequential damage. A study into the influence that earthquakes resulting from gas extraction in the north-eastern part of Groningen may have on the stability of the dykes will be carried out, the results of which will be known in late 2013.

Gas infrastructure

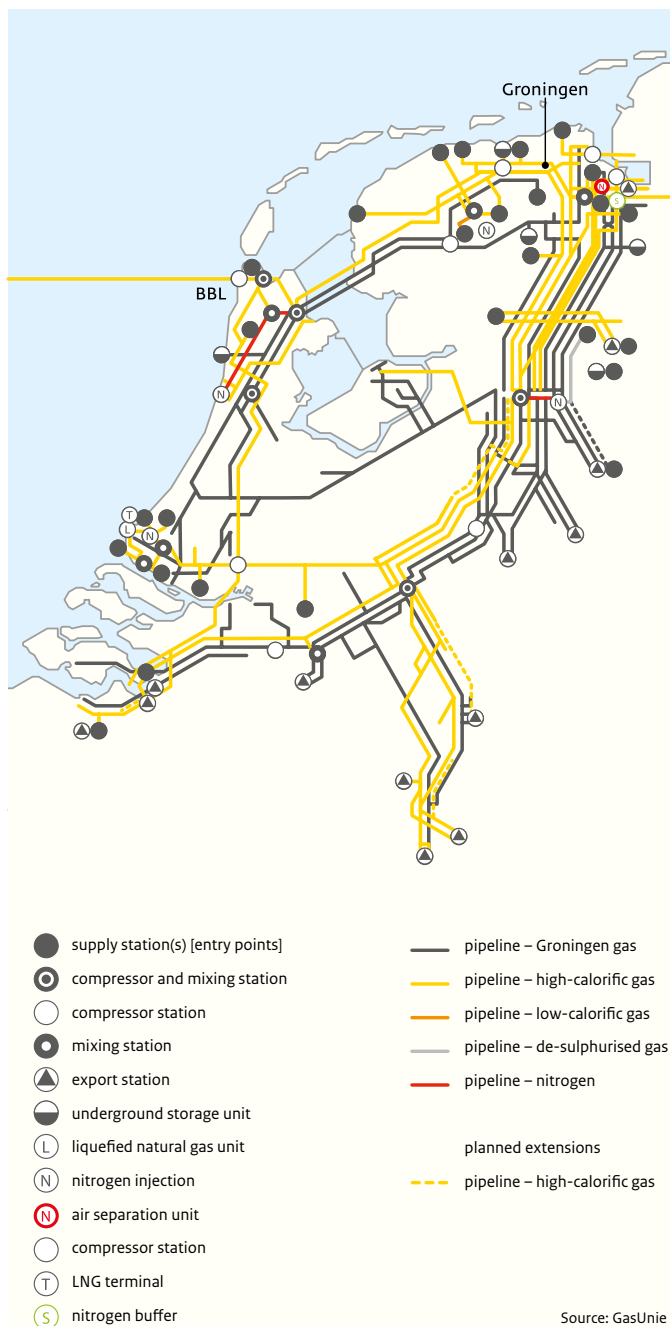
The organisations *Nederlandse Aardolie Maatschappij* (NAM) and *Gasunie* are responsible for gas extraction and transport. The Dutch state earns approximately € 10 billion every year from these activities and the sale of gas. This figure does not factor in turnover and employment opportunities.

Estimate of the consequences

A flood from the sea will, by and large, always affect multiple transport and extraction locations. It is estimated that if more than three of the larger locations fail, gas transport will also partially fail. The system is protected in such a way that there would be no additional safety risks. The larger locations would take an estimated two years to recover. The direct cost of this would amount to approx. € 75 million for each production location and for gas transport installations. There are about 30 locations in the Ems delta. The indirect damage would be much greater. If the system were to fail, a considerable part of the turnover and profit of the gas infrastructure would be lost for a longer period of time. A failure of the gas transport would also have an impact on gas supplies in a part of (Western) Europe. It is difficult to express this loss in figures, but it is estimated to run into the billions of euros. As such, sufficient protection of the Ems delta is a social tasking of international importance

A few figures

Book value of Gasunie: approx. € 9 billion; replacement cost of the NAM clusters in Groningen: € 1.5 billion (€ 75 million for each cluster); value of Gasunie + NAM in Groningen: pipelines: approx. € 1.5 billion (excluding NAM), stations: approx. € 50-100 million, installations: approx. € 3.5 billion.



3.4

Towards proposals for Delta Decisions and preferential strategies

The general leading principle in the Wadden Region is ensuring safety via the first layer. Explorations into multi-layer flood risk management indicate that the most cost-effective approach to flood risk management for most of the Wadden Region is by using primary flood defence systems. This does not apply to the islands, where customisation via the second and third layer is required. The Ems delta multi-layer flood risk management pilot project has shown that measures in layer 2 could be cost-effective in this region too. A dyke breach between Eemshaven and Delfzijl at this point in time would see a large and low-lying area being submerged, right up to the city of Groningen, with water levels possibly exceeding 2 m. The consequences of a flood can be minimised in this case by constructing a secondary defence system near the city of Groningen and embankments around the gas power plants. Constructing embankments around the gas power plants is only useful, however, if the other parts of the gas infrastructure are sufficiently protected against flooding as well.

Towards the preferential strategy

Next year, the sub-programme will be working towards a preferential strategy for the Wadden Region, for which a number of studies will provide additional information. As such, the sub-programme continues to work on a better understanding of the sand system and the role that sand replenishment plays in it. The sub-programme is also elaborating options for the financing of a multi-year knowledge and monitoring programme and the implementation of pilot projects with sand replenishments. The sub-programme is working on this together with the Southwest Delta and Coast sub-programmes in the context of the Adaptation Agenda for Sand.

In 2013, the study should show whether using the new dyke concepts is cost-effective to be able to meet the standards in 2050. An exploration will also be carried out into the concepts with the greatest added value. The elaboration of multi-layer flood risk management for the Ems delta has been included in the pilot projects for multi-layer flood risk management ([\[2\]](#) sub-section 3.2).

Next year, the Delta Programme will be working towards a proposal for Delta Decisions and preferential strategies that will bring flood risk management and freshwater supplies to the required level. The Delta Decisions structure the approach toward tasking and set the direction for the preferential strategies; they are main decisions for flood risk management and freshwater supplies for the short and long term. These Delta Decisions and preferential strategies will form the basis for the set of measures proposed in DP2015.

The preferential strategies will be more clearly and precisely focused on achieving the objectives for flood risk management and freshwater supplies. With the 'promising strategies', "the objectives for flood risk management and freshwater supplies are achieved in a cost-effective manner with maximum benefits: at limited cost, with minimal negative side effects and seizing all opportunities to link up with other developments and ambitions" ([\[2\]](#) DP2013, page 80). This approach will be developed and outlined in further detail in the features of the preferential strategies presented below.

Features of the preferential strategies

A preferential strategy is a strategy with which the objectives for flood risk management and freshwater supplies can be attained in a cost-effective manner and with maximum benefits. The features of a preferential strategy are as follows:

- **Robust:** the objectives of all Delta Scenarios (i.e. scenarios for climate change and socio-economic developments) can be achieved with the preferential strategy;
- **Flexible:** implementation of the strategy can be sped up or slowed down easily and changing to a different strategy in due course is possible;
- **Feasible:** the strategies are feasible in practice, which means that they take into account the legal, technical, procedural and process-related risks, as well as the opportunities to link up with other developments and the options for revising the strategy in the interim;
- **Efficient:** the proposed measures ensure that the objectives for flood risk management and freshwater supplies can be realised in an efficient manner, financially speaking, bearing in mind the complete lifecycle of the measures (construction, management and maintenance) and the social added value of linking up with regional and local ambitions;
- **Holistic:** when deciding on the measures, the unintended side effects and contributions (linkage opportunities) to

regional and local ambitions and developments in other policy areas (such as shipping, agriculture, nature and recreation) are considered;

- In line with the long-term path: the strategy elaborates on the basic values of 'solidarity' (bearing in mind subsequent generations and other regions), 'flexibility' (scope to respond to new developments and innovations) and 'sustainability' (people, planet and profit in balance);
- Logical whole: the strategy is an effective and logical fit in the entire set of preferential strategies and Delta Decisions.

The sub-programmes use the evaluation system to assess whether the preferential strategies have these features (☑ sub-section 4.1). The 'robust', 'flexible' and 'feasible' features relate specifically to the strategy itself aimed at the entire sub-region or the entire subject matter. In terms of measures, 'technical feasibility' means that construction, management and maintenance as well as operational use are feasible, also under extreme conditions. 'Efficient' and 'holistic' apply to local or regional measures. The contribution toward the long-term path and the logical whole are primarily relevant for national interconnectivity and the Delta Decisions. The Delta Programme Commissioner oversees this part and will make a proposal for DP2015.

The social added value of the proposed investment in the preferential strategies is of major importance. The Delta Programme will provide insight into this with 'hard' and 'soft' values. Hard values, such as a direct economic return for business sectors, are relatively easy to express in monetary terms. This is not as easy where soft values such as the quality of nature and the landscape are concerned.

Short and long term

The preferential strategies will deliver a set of measures for the short term that can be planned with a fair degree of certainty. It is essential that this set of measures be linked with other planned measures, regional ambitions and ambitions for other policy areas to ensure cost-effective combinations and sufficient support. As such, the Delta Programme maps out how the preferential strategy relates to:

- the MIRT area agendas and relevant MIRT projects;
- the VONK Replacement Tasking for Hydraulic Structures (☑ section 2 and ☑ Appendix C, in Dutch);
- regional spatio-economic developments and any implementation programmes;

- ambitions for other policy areas and other implementation programmes.

When deciding on the short-term measures, it is important to keep options open for the long term, so that it is possible to switch to another strategy if future socio-economic developments or climate change should give rise to that. Under direction of the Delta Programme Commissioner, the Delta Programme is therefore elaborating different development paths for each preferential strategy and laying down the conditions under which changing strategy is reasonable. This may reveal that additional short-term measures are needed to be able to change strategies at a later stage if required. In addition, it may be necessary to embed the options to change strategies in law, institutional practice and proceedings. DP2015 will address this.

When developing the promising strategies, various solution strategies and long-term measures were scrapped:

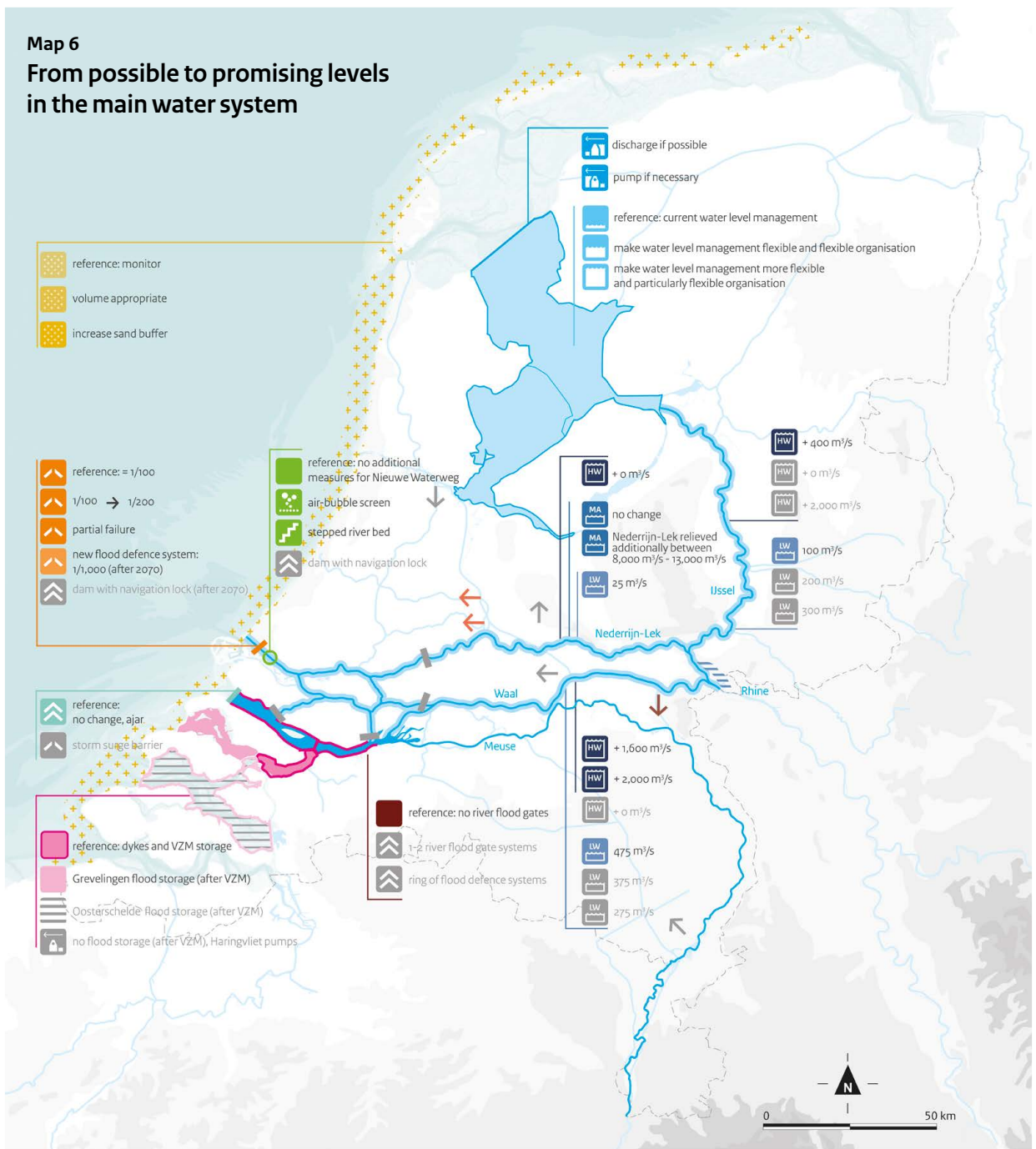
- allowing the water level in the IJsselmeer lake to adapt to the rise in sea level to a significant extent;
- extending the supply area of the IJsselmeer lake with (water for) the west of the Netherlands (there are better solutions available for that);
- discharging all of the Rhine discharge in excess of 16,000 m³/s via the IJssel;
- major interventions in the area around the major rivers with a supraregional effect, such as constructing new rivers;
- a dam with navigation lock in the Nieuwe Waterweg;
- a ring of flood gates in the rivers around the region of Rotterdam;
- pumps in the Haringvliet sluices;
- flood storage in the Oosterschelde.

These measures will no longer be included when developing the preferential strategies. For other measures, the options will be kept open, and these may become part of the preferential strategies:

- allowing the water level in the IJsselmeer lake to adapt to the rise in sea level to a limited extent after 2050;
- other discharge distribution across Rhine tributaries in the case of low water after 2050;
- current knowledge does not provide enough grounds to change the discharge distribution across the Rhine tributaries for flood water. Further research is required for the Nederrijn-Lek (in the case of discharges up to 16,000 m³/s) and the discharge distribution across Rhine tributaries for volumes exceeding 16,000 m³/s;

Map 6

From possible to promising levels in the main water system



Options for distribution of Rhine discharge

- flood water (16,000-18,000 m³/s in the case of peak discharges)
 - FW ref.: + 1,600 m³/s (Waal), + 400 m³/s (IJssel), + 0 m³/s (Nederrijn-Lek)
 - FW Waal: + 2,000 m³/s (Waal)
 - FW IJssel: + 2,000 m³/s (IJssel)
- intermediate discharges
 - ID 1: no change
 - ID 2: Lek relieved additionally between 8,000 m³/s - 13,000 m³/s
- low water (600 m³/s in the case of extremely low discharges)
 - LW ref.: 475 m³/s (Waal), 100 m³/s (IJssel), 25 m³/s (Nederrijn-Lek)
 - LW 1: 375 m³/s (Waal), 200 m³/s (IJssel), 25 m³/s (Nederrijn-Lek)
 - LW 2: 275 m³/s (Waal), 300 m³/s (IJssel), 25 m³/s (Nederrijn-Lek)
- peak storage of Rijnstrangen area (maximum 500 m³/s)

Options for the IJsselmeer Region

- discharge to the Wadden Sea
- water level management
- limit salt intrusion
- extend alternative supply
- Mid-western part of the Netherland
- Waal-Meuse link

Options for protecting against the sea and screening the Rhine Estuary-Drechtsteden from the influence of the river

- protecting the Nieuwe Waterweg against the sea: reduce failure probability of the Maeslantkering
- protecting the Rhine Estuary-Drechtsteden using (closeable) river flood gates
- extent of the storage capacity (Haringvliet, Hollandsch Diep)
- management of Haringvliet sluices

Options for a sand system

- sand replenishment (variations with increasing volumes)
- option put on hold
- options put on hold: alternative supply from the IJsselmeer Region; construct new rivers

- additional design requirements for the Maeslantkering, e.g. to combat salt water intrusion;
- flood storage in the Grevelingen.

Towards the preferential strategies – process

Next year, the sub-programmes will continue collaboration with regional parties. This collaboration is important to utilise all knowledge, gain insight into the support for measures and to forge connections with regional and local ambitions. Each of the sub-programmes will approach the collaboration in whatever way suits them best. For instance, the Rivers sub-programmes will be working with regional processes and the Rhine Estuary-Drechtsteden sub-programme is organising subject tables.

The final proposal for preferential strategies will be written step by step. The Delta Programme steering group (under the leadership of the Delta Programme Commissioner) and the National Water Consultation Committee (NBO, chaired by the Minister for Infrastructure and the Environment) play an important role in this. The Delta Programme has updated the administrative schedule. The schedule indicates when different agenda items for DP2015 are scheduled in both the national and regional steering groups. The schedule also indicates when the responsible portfolio holders, States, councils and administrative boards could discuss the preferential strategies. This administrative schedule has been included in [\[7\]](#) Appendix F (in Dutch).

4 Approach

(photo) Winter 2012, flood water. More discharge capacity via the IJssel and Nederrijn thanks to Hondsbroeksche Pleij 'control system'.



Customisation, natural measures, linkage opportunities: these are the features of the solution strategies for the water tasking that has been established in collaboration with the business community, knowledge institutes, social parties and across all layers of government. The foundation is thorough knowledge, developed or made accessible for the Delta Programme. A unique approach, which also attracts international interest.

4.1

Consistent, reproducible and transparent

The Delta Programme decisions should be based on sound content. The approach opted for ensures that all the sub-programmes use the same up-to-date knowledge and employ the same methods, basic principles and models for their analyses. A set of Delta tools was developed with this in mind. In the past year, important building blocks of this set of tools were delivered, including the Delta model.

Delta Scenarios

Since late 2012, the sub-programmes have been able to use revised Delta Scenarios. Delta Scenarios are possible future scenarios, focusing on the years 2050 and 2100, in which climate change and socio-economic developments vary. The revised Delta Scenarios have been supplemented with recent insights in climate change, such as those that will be outlined in the March 2014 report from the IPCC (Intergovernmental Panel on Climate Change). Furthermore, the revised Delta Scenarios also include new insights that are primarily of regional importance: increasing intensity and quantity of precipitation in the coastal region in the summer; the likelihood that a period

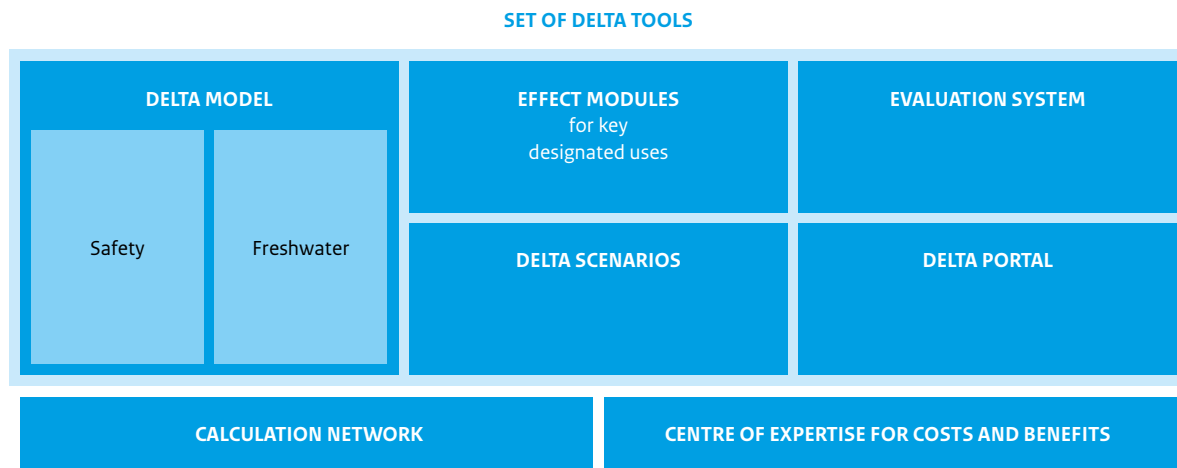
of excessive rainfall may coincide with a persistent stormy period. This affects the probability of a flood and hampers discharging excessive water, resulting in pluvial flooding. The knowledge in the Delta Scenarios comes from key knowledge institutes in the Netherlands: Deltares, the Royal Netherlands Meteorological Institute (*Koninklijk Nederlands Meteorologisch Instituut*, KNMI), the Netherlands Environmental Assessment Agency (*Planbureau voor de Leefomgeving*, PBL), the Netherlands Bureau for Economic Policy Analysis (*Centraal Planbureau*, CPB) and the Agricultural Economics Research Institute (*Landbouw-Economisch Instituut*, LEI).

The new IPCC insights are based on climate scenarios and socio-economic developments that have been linked together via so-called Representative Concentration Pathways (RCPs). This new IPCC approach reconfirms the previously forecast trends and bandwidths in temperature increases (2-4 °C in 2100) and precipitation in the climate scenarios of the KNMI, now providing a new generation of climate models and analyses. The bandwidth of the forecast rise in sea levels in 2100 (i.e. 35-85 cm) is still plausible, although a greater rise is not out of the question. More information is available on www.ipcc.ch. The KNMI next scenarios translate what the new insights mean for the Netherlands.

Environmental Impact Assessment

The Delta Decisions and preferential strategies of the Delta Programme are embedded in the follow-up to the National Water Plan (2015). The Environmental Impact Assessment (*Milieu-effectrapportage* (m.e.r.) in Dutch) required for the follow-up to the National Water Plan will, therefore, have to map out the effects of the Delta Decisions and the preferential strategies. However, the process of turning promising strategies into preferential strategies has already produced options for the Delta Decisions and the area-based strategies for which information on the environmental, natural and cultural-historical effects from the Plan-MER (i.e. the Strategic Environmental Impact Statement) is important and has to be mapped out. For that reason, the Environmental Impact Assessment process for the Delta Decisions and area-based strategies starts in September 2013, so that the results of this process will be ready in 2014. The results will be used when deciding the preferential strategies. The results will also be the building blocks for the Plan-MER for the follow-up to the National Water Plan and for Environmental Impact Assessments for regional policy plans, insofar as parts of the decisions on the Delta Programme are embedded in them.

Figure 21 Elements of the set of Delta tools



Set of Delta tools: explained in short

An essential part of the set of Delta tools, version 1.0 of the Delta model, was delivered in December 2012. This model is at the heart of all water management analyses that the Delta Programme conducts. The sub-programmes use this model for the freshwater parts of the main water system and the regional water system, so that the results are mutually consistent and reproducible. For saltwater systems, the sub-programmes use assumptions and basic principles that are consistent with the Delta model. The Delta model is a combination of various existing models that have proved their feasibility and reliability in practice. An international review committee oversaw the development of the Delta model with recommendations on safeguarding the quality.

Another part of the set of Delta tools is the VGS evaluation framework, which provides managers with objective information on strategies for flood risk management and freshwater. The VGS is a method for clearly outlining and comparing the strategies. This is done using five main criteria:

1. policy objective for flood risk management;
2. policy objective for freshwater;
3. side effects and opportunities;
4. feasibility;
5. financing.

When exploring the possible strategies, the emphasis was on the first two main criteria (version 1.0). In that phase, primarily qualitative estimates were made based on expert judgement. Version 2.0 was used this past year to roughly outline the (side) effects and, where possible, the costs for the promising strategies (main criteria 3 and 5). In the next phase, when the preferential strategies are being developed, the Delta Programme will apply version 3.0 of the VGS. This will also include a review of the feasibility (main criteria 4).

The effects of the promising strategies have in part been determined using the Delta model's effect modules. The Delta Programme has outlined in effect protocols how the effects of strategies will be mapped out. An effect protocol is a guideline determining effects qualitatively using a panel of experts with or without a method for quantitative calculations (an effect module). The protocols have been drawn up for the effects of strategies on agriculture, nature, shipping, industrial water and water for energy and cooling. Together with the Ministry of Economic Affairs, the Ministry of Infrastructure and the Environment and the Dutch Foundation for Applied Water Research (*Stichting Toegepast Onderzoek Waterbeheer (STOWA)* in Dutch), the Freshwater sub-programme is improving the effect decisions on water management interventions on agriculture and nature. This allows the Delta Programme to increase the transparency and reproducibility of the effect analyses. The results of the effect analyses have been incorporated into the description of the promising strategies ([section 3](#) and [Appendices A1 to A8](#) (in Dutch)).

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>> (continued)

The Expertisecentrum Kosten en Baten (centre of expertise on the costs and benefits of Delta Programme measures and strategies) ensures that the information on costs and benefits is collated in a uniform fashion. This centre also indicates which indicators and methods form the basic principles for calculations. Experts from Rijkswaterstaat, the water boards, Deltares, the Government Service for Land and Water Management (*Dienst Landelijk Gebied* (DLG) in Dutch), LEI, CPB and PBL collaborate on this.

All the results from the Delta model, the VGS and the effect modules are published on the so-called [Delta portal](#). Depending on the status of the results, they will be available for internal use (within the Delta Programme) or as external information.

[DP2013](#) (pp. 86-88) provides a more detailed explanation of the various parts of the set of Delta tools.

The crux of adaptive delta management is dealing with uncertainties in a sensible manner. The Delta Programme implements this by looking into the distant future of long-term tasking and using that knowledge to take the right steps at the right time. As part of this, working with multiple strategies (adaptation paths) and appreciating the flexibility of solution strategies is combined. The ambition is for the water system to meet requirements at all times, for solutions to be able to adapt to new insights and circumstances, and for sufficient options to remain open in the future to take the required measures.

When developing promising strategies, the sub-programmes elaborated the four essential aspects of adaptive delta management:

- linking short-term decisions with long-term tasking around flood risk management and freshwater;
- incorporating flexibility into the possible solution strategies themselves and by keeping options for adjustment open in the future;
- working with multiple strategies that can be alternated between (i.e. adaptation paths);
- linking different investment agendas.

Interconnectivity between long and short term

The Delta Programme wants to agree on measures for the short and medium term with tasking for the long term in the following way:

- Tackling tasking for the short term with customisation. Where possible and effective, links with other interests and ongoing or planned spatial developments should be established. This is elaborated in [section 3](#).
- Until 2050, gradually adapting the present water management to changes in precipitation patterns, river discharges and rises in sea levels. This requires gradual changes in water management (flexibility), in the management, maintenance and replacement of structures and flood defence systems, and in the spatial organisation. Various sectors, such as agriculture and shipping, will have to gradually adjust their operations to the changing climate. Nature objectives may also have to be revised.
- After 2050, more large-scale interventions in the main water system may be required. This will depend on the socio-economic and climate situation. A final decision on

the actual implementation of large-scale interventions is not necessary yet, but preparations will have to be made if these interventions are required after all. It is important that the long-term situation is already anticipated:

- Programmes for the short term (e.g. the new HWBP) explicitly consider large-scale interventions that may be required after 2050. Examples from the promising strategies are changing the discharge distribution across the Rhine tributaries, using the Rijnstrangen as a peak storage area and a (limited) rise in the water level of the IJsselmeer lake. If a study next year shows that these interventions may not be required after 2050, they will be incorporated into the preferential strategies as a preferential plan or as an option to be kept open. This will affect the decision, dimensioning and programming of projects for the short term.
- Innovations in water management and other sectors specifically encourage cost-effective alternatives for large-scale changes to the main water system and facilitate transitions in agriculture, for instance. This is elaborated in [\[2\]](#) section 3.
- Decisions and investments in spatial planning that are made in the short term but determine the physical organisation of the Netherlands in the longer term should consider the insights from the Delta Programme.

Robustness and flexibility

The strategies that are developed in the Delta Programme should be robust and flexible. Robust means that the strategies are future-proof and provide enough of a solution for the tasking arising from all four of the Delta Scenarios for climate change and socio-economic development ([\[2\]](#) sub-section 4.1). Flexibility is one of the core values of the Delta Programme, along with solidarity and sustainability. A strategy can be deemed to be flexible if it is relatively easy to accelerate or delay and facilitates switching between strategies. Such flexibility may be incorporated into the preferential plan of a strategy (e.g. using sand replenishments along the coast in a flexible manner) and can be achieved by keeping options open (e.g. by considering any future flood storage in the Grevelingen).

Adaptive delta management and flexibility in promising strategies

Flexible water level management is the option for the IJsselmeer Region until 2050. This will allow increasing the amount of water that is available. It is expected that this will allow the increasing demand for water from the region to be met until 2050 at least. To be able to increase the quantity of available water after 2050 even further, should this prove necessary, the options to make water level management even more flexible or to have more water flow via the IJssel in the case of low Rhine discharges (in the case of a very large demand for water) will remain open.

In the promising strategy for the IJsselmeer Region, the option of 'adapting to the sea level rise to a limited extent' will also remain open. This will create maximum scope for optimising the ratio of pumping and discharging to expel water towards the Wadden Sea.

To be able to address any increase in the water dynamics of Zwolle town centre in good time without any damage being caused, the Kraanbolwerk construction project (150 flats/apartments) has anticipated higher water levels. This will create a flexible and more robust organisation of the area around the IJsselmeer lake.

Adaptive delta management in the coastal areas will be realised by opting for the flexible strategy of sand replenishment, by viewing the issues at a system level and by opting for a 'learning as we go' approach through such things as pilot projects.

For the area around the major rivers, various spatial reservations for using the area inside the dykes for river-widening measures in due course as based on the Room for the River PKB and the Meuse Integrated Exploration are now (2013) laid down in the Barro. Various regions set great store by using river-widening measures.

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4.3 Knowledge

>>(continued)

Ongoing programmes such as WaalWeelde and Ooijen-Wanssum will combine integral area development with river widening using regional co-financing. Clearly, a major and urgent tasking lies ahead that will lead to an extensive dyke improvement programme (Third Assessment, piping, updating the standards). Completion of this dyke improvement may take decades.

Creating momentum to have river-widening measures implemented in the period up to approx. 2030 based on the regional spatial ambitions is a challenge. In those instances where there are linkage opportunities, spatial measures can be selected in the short term; for all other instances, a strategy focused on dykes can be chosen. In the case of spatial reservations that remain in place for a long period of time, but whose implementation is not yet provided for, it is important to limit the hindrances for the area as much as possible and to consider options such as 'provisionally designate otherwise'.

Knowledge in the Delta Programme forms the basis for decisions, sometimes with far-reaching consequences, for instance for the safety, economy or living conditions of people. That's why the Delta Programme has paid a lot of attention to quality assurance and developing and unlocking knowledge.

Quality assurance

The quality of the preferential strategies and the proposals for the Delta Decisions, which will be included in DP2015 next year, must be sufficiently guaranteed. During the phase of promising strategies, experience was gained with quality assurance by having independent experts perform a review. The experts assessed whether the provisional decisions for the Delta Decisions and the decisions in the promising strategies are demonstrably well substantiated and traceable, whether the right knowledge was properly applied and whether uncertainties were dealt with in a responsible manner. This review was coordinated on behalf of the Delta Programme Commissioner and implemented by the 'Knowledge for Climate' programme.

The review shows that, in general, the substantiation is properly outlined, but that it could sometimes stand improvement. It is important to outline the (scientific) substantiation in a sufficiently clear and complete manner. Since the Delta Committee's 2008 recommendations, a whole range of arguments and considerations have led to today's decisions and promising strategies. Their traceability could also be improved. When substantiating preferential plans, natural dynamics and opportunities in areas deserve more attention alongside arguments concerning safety and the cost of spatial quality. The Delta Programme will take the lessons from this review and use them to review the proposals for the Delta Decisions in DP2015.

Quality assurance also means that information, maps, knowledge and reports that form the foundation for the strategies and Delta Decisions are accessible and recorded for the long term. To achieve this, the Delta Programme uses the Delta portal, Deltaweb and the structures that have been developed for the Delta model. This ensures that the future implementation organisation of the Delta Programme can continue working with high-quality underlying information, applications and models and can continue to build on the analyses carried out for the Delta Decisions.

Economic analysis

A sound economic substantiation is of great importance to the proposal for the Delta Decisions and the area-based preferential strategies. Accordingly, the Delta Programme has invested a lot of time and energy in conducting a sound economic analysis of the issues and the strategies. Although not mandatory in the MIRT Study phase, the Delta Programme sub-programmes have introduced a number of different economic evaluation tools. Their primary reason for doing this is to provide a reliable substantiation of the cost associated with possible measures. The *Expertisecentrum Kosten en Baten* was set up for this within the Delta Programme. Then, partly based on these cost substantiations, cost-effectiveness analyses (KEAs) and, where possible, cost-benefit analyses (KBAs) are carried out. From an economic perspective, these analyses provide essential information for decision-making on the Delta Decisions and preferential strategies.

Discount rate

The social cost-benefit analysis (MKBA) is a frequently used tool to support decision-making. However, it also provokes discussion because of the way in which it incorporates long-term effects. Generally speaking, Dutch practice is to use a discount rate of 5.5% a year (in exceptional cases 4%, when there are negative external effects that a project addresses or causes and where the external effects are irreversible). As such, costs and benefits that arise after a few decades hardly count, while in the Delta Programme it is the long-term effects that play a major role. The Delta Programme Commissioner therefore asked the CPB to study whether the long-term effects could be weighted in a better way and/or differently in the KEAs and the MKBAs.

The discussion on the right discount rate is not merely a technical and theoretical one. Given that the discount rate establishes a relationship between the current and future value of the costs and benefits of an investment, ethical and hence political considerations also need to be taken into account. After all, this does concern evaluating future generations in relation to a decision that has to be made now. From a purely technical point of view, it is not easy to decide whether the current Dutch fixed discount rate of 5.5% or 4% is the best or whether it is better to use a discount rate that decreases over time, as used in the United Kingdom and France and advocated by the Organisation for Economic Co-operation and Development (OECD).

In 2003, the United Kingdom switched from a discount rate that was fixed over time to one that decreases over time, in accordance with table 15 below.

France has also been using a decreasing discount rate for a few years. A 4% discount rate is used for a 30-year time horizon, after which it gradually decreases. After one hundred years, this rate will be approximately 3% and it will ultimately drop to 2%.

Clearly one of the key questions is whether the discount rate should be constant or whether it should vary over time. What is also clear is that a decreasing discount rate can be substantiated theoretically. However, it is difficult to say whether this substantiation holds up, empirically speaking. Next year, DP2015 will go into this in more detail, based on the results of the CBP study.

Table 15

Decreasing discount rate in the United Kingdom

Period in years	0-30	31-75	76-125	126-200	201-300	301+
Discount rate	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%

Joint fact-finding with the Deltaweb

The Deltaweb plays a key role in sharing and unlocking knowledge. The number of people using the digital platform continues to rise. The conclusion is that the Deltaweb contributes to creating an online Delta community. There are currently more than 1,100 users. Professionals from knowledge institutes, universities and research programmes can make their knowledge available on Deltaweb, whilst also learning about other colleagues' findings. This accelerates knowledge exchange and contributes to quality.

Knowledge conference

In 2013, the Delta Programme held the third annual knowledge conference, this time together with the 'Knowledge for Climate' programme and Wageningen University. More than 250 delegates shared and discussed the current knowledge issues in the Delta Programme and the knowledge offering from universities, knowledge institutes, research programmes and market parties. Separate attention was devoted to 'Deltaproof', the STOWA research programme. On this occasion, the emphasis was on the 'green aspects' of the Delta Programme: how the tasking and the solutions for flood risk management and freshwater supplies relate to agriculture, nature and the type of measures in which natural processes are used (building with nature). Issues concerning the further elaboration within the Delta Programme and the Delta Decisions after 2015 were addressed, such as making water management more flexible, regional customisation, linking up with other developments and the requisite governance. The objective of the knowledge conferences is to encourage innovation and creativity by bringing those who want knowledge and those who can supply it together and embedding that knowledge. In 2014, the Delta Programme will be organising the knowledge conference in collaboration with Deltares and NLingenieurs.

Developing knowledge

The Delta Programme is and will remain a knowledge-intensive programme that utilises ongoing knowledge development programmes such as Deltaproof and Knowledge for Climate as much as possible. Knowledge issues will arise after 2015 as well when detailing and implementing the strategies. Follow-up studies for this will primarily require application-oriented knowledge. Implementing (technical) innovations will require more implementation-oriented knowledge. Other issues will

require fundamental research. Furthermore, the sand replenishments require a multi-year programme of knowledge development and monitoring. The strategic knowledge agenda of the Delta Programme ([DP2013, Appendix D, in Dutch]) is in line with the water agendas of the Ministry of Infrastructure and the Environment and Rijkswaterstaat.

The Delta Programme has a knowledge agenda that is relevant to being able to make the Delta Decisions in a responsible manner. The results from research programmes such as Knowledge for Climate and Climate for Space (that are coming to a close) could be used effectively here. Knowledge issues will still need to be addressed for the follow-up to the Delta Programme after the Delta Decisions have been made. It is essential for this that fundamental and applied knowledge across a wide field of subjects covered by the integrated Delta Programme be developed in conjunction. The knowledge issues for this are for the most important part already known. The Delta Programme Commissioner recommends starting a similar knowledge programme after 2015, the aim for this programme's scope being to cover about 1% of the annual scope of the Delta Fund. This should in part be co-financed. Collaborating with STOWA, the Top Sector Water and the European Commission has already been suggested.

The Cabinet supports the need to be able to answer relevant knowledge issues within the Delta Programme. Using fundamental and applied knowledge, an answer can be given to the issues concerning flood risk management and freshwater supplies and links can be forged with other relevant social topics, such as innovation, economic development, nature, space and sustainability. This requires money without a doubt, but the content and scope of such a broad knowledge programme need to be worked out in more detail. Only then can it be ascertained whether financing could be covered by the Delta Fund from 2015 or whether (part of) the funds can be raised elsewhere.

Knowledge of morphological processes

The Delta Programme Commissioner has advised Rijkswaterstaat to study whether knowledge development in the field of morphological processes is sufficient to reduce the uncertainties and is in line with the required measures in the Delta Programme.

The study showed that while there is a lot of morphological information, the uncertainties are sometimes quite significant. Knowledge is particularly limited when it comes to the influence of soil dynamics on the strength of the flood defence systems and ecology. The same can be said about knowledge on system behaviour in the long term: the influence of rising sea levels on the coastal foundation zone and the development of channels, and the influence of the sub-soil on the stability of river courses. In the short run, it is important to identify the best way to deal with uncertainties to manage the risks as effectively as possible. Minimising the uncertainties in the future will require more knowledge development. Monitoring plays a very important role here to gain more insight into the autonomous morphological developments and the effects of interventions such as the Sand Engine. These results will be included in the above-mentioned shared knowledge agenda of the Ministry of Infrastructure and the Environment, Rijkswaterstaat and the Delta Programme.

Delta-atelier (Delta workshop)

The Delta-atelier is the workplace for research by design in the Delta Programme. Research by design is a tool that contributes to linking the tasking for water and space. The Delta-atelier uses it to support the development and visualisation of regional strategies and the Delta Decisions. The closer the decision-making gets, the more important it will be to link the strategies for the water system to the regional spatial ambitions. The workshops that the Delta-atelier has organised have provided keener insight into linkage opportunities and the potential tension between regional promising strategies, national interests from the framework vision on Infrastructure and Space, and the MIRT area agendas.

Research by design has also played a crucial role in the dialogue that the sub-programmes are having with the regions. Visualising strategies has clarified how measures in the water system may affect spatial organisation. Using those insights, a joint search for linkage opportunities was instigated.

Earthquakes

In January 2013, the north-eastern part of Groningen was hit by a number of unusually strong earthquakes that are probably associated with the gas extraction in this region. The Ministry of Economic Affairs, the Ministry of Infrastructure and the Environment and the water boards concerned are having a study conducted by Deltares. The objective is to map out whether this type of earthquake can damage the regional and primary flood defence systems. Results are expected in late 2013.

4.4

Market and innovation:

Top Sector Water

The Delta Programme wants to approach the tasking for flood risk management and freshwater supplies in a more efficient, less expensive and more attractive way using innovative solutions. The Delta Programme Commissioner's recommendation on this is included in DP2013. The Cabinet endorses this approach. As such, the Delta Programme has proactively sought out collaboration with the business community and knowledge institutes in the Top Sector Water to contribute to achieving the top sector's ambition: 'from knowledge and expertise to cash'.

Early input from the business community

The business community has collaborated proactively on the development of promising strategies. Using subject tables, the Rhine Estuary-Drechtsteden sub-programme has outlined the opportunities to link the business community's regional spatial-economic plans and desires to the long-term solutions of the Delta Programme. The opportunities for each of the subject tables and their added value will be finalised and available by late 2013. The New Urban Development and Restructuring sub-programme has set up coalitions of government authorities and market parties. These coalitions provide concrete proposals to remove obstacles for working in a climate-proof manner, such as making agreements, developing tools and legislation and regulations ([link](#) sub-section 3.2). The Coast sub-programme has involved the business community in the so-called 'vanguard processes'. A 'market explorer' has also been posted to this sub-programme on behalf of the *Vereniging van Waterbouwers* (the Dutch Association of Contractors in Dredging and Shore and Bank Protection), who will provide knowledge from the business community on matters such as the sandy coastal system. The IJsselmeer Region sub-programme has involved the market in an online competition for innovative pumping ideas called *IJsselmeerafvoer 2050* (IJsselmeer lake discharge 2050). This sub-programme will try out the results from this competition in pilot projects over the next few years. This will show if the results can be used for the flexible organisation of the water system.

Using innovations

The Cabinet continues to focus fully on its policy on the top sectors. With the Delta Programme, the Top Sector Water has an important home market, especially for the delta technology and water technology clusters. The innovations that these clusters develop are not only of value to the Delta Programme but also to the sector's international

competition position. Collaboration boosts all parties involved. For the Delta Programme, two types of initiatives are of particular importance: technical innovations and process- and policy-related innovations.

To be able to implement the Delta Programme, it is essential that promising technical innovations be introduced into projects and developed further in the short term. To this end, the office of the new HWBP has developed an innovation strategy together with HWBP-2, Rijkswaterstaat and the Delta Technology Taskforce, in which technological innovations are tested and validated. The business community and knowledge institutes can introduce their product innovations at an early stage. Implementation of HWBP-2 also already provides space for pilot projects with innovations in the short term, e.g. the use of geotextiles, which could be a promising and cost-effective measure for dealing with piping. This will be tested in a Room for the River project in collaboration with the Rivierenland water board. Sensor technology may prove promising for managing dykes. The IJkdijk foundation has carried out practical tests with sensor technology and is now working on a wider use in the management area of the De Stichtse Rijnlanden water board.

Natural safety measures are being developed at a number of different locations, such as the Oeverdijk along the Markermeer lake and the Prins Hendrikdijk on Texel. These soft solution strategies could also be used elsewhere. Using Delta Dykes for various locations as part of regional safety strategies is viewed as promising. In the Rhine Estuary-Drechtsteden area, this is the case for the north-eastern side of the Eiland van Dordrecht and the northern side of the Nieuwe Waterweg. There are indications that Delta Dykes could be promising in parts of Alblasserwaard, Voorne-Putten and IJsselmonde as well. The Rivers sub-programme has shown that there are prospects for Delta dykes along the Nederrijn-Lek (Wageningen: Grebbedijk), close to the bifurcation points (dyke ring 48) and along the southern banks of the Waal (Heerewaarden). The Delta Programme's approach, in which all government authorities are involved and water and space are interlinked administratively speaking, presents numerous opportunities for such initiatives.

Prins Hendrikdijk

A fine example of linking objectives and ambitions by a careful consultation between different administrative layers and stakeholders is the intended improvement of the Prins Hendrikdijk on Texel. A traditional improvement in the area inside the dykes would negatively impact agriculture and buildings, while a traditional improvement outside the dykes would negatively impact nature. The alternative sandy solution opted for does not have this negative impact and meets regional spatial ambitions and nature objectives. In addition to the central government's contribution to the budget for HWBP-2, which is based on a simple and effective improvement, the water board, the municipal council, the province and the Wadden Fund all contribute to the chosen alternative. By linking agendas and budgets, an integrated project is established that can count on broad support.

Process- and policy-related innovations are also important in the Delta Programme. The application of innovations requires innovative contracts with proper agreements on the division of risks. The Delta Programme Commissioner made a recommendation on this last year, following which Rijkswaterstaat is now studying the concrete use of innovative contracts when implementing the new HWBP. Rijkswaterstaat has contracted out a large portion of coastal management (sand replenishments) under a multi-year contract. This contract has proved successful and has even delivered significant cost savings. Within the new HWBP, Rijkswaterstaat and the water boards are looking into other options to combine projects, e.g. by looking beyond the borders of a water board. The water boards have gained experience with EMVI (*economisch meest voordelig inkopen*, i.e. purchasing the economically most advantageous option), which is an innovative way of contracting. Purchasing with focus on innovation is also one of the spearheads of the water boards' purchasing policy. Programming of the new HWBP will be updated every year as part of the Delta Programme. As it does for the Delta Programme as a whole, this presents the opportunity to anticipate new developments, such as technical innovations, financial constructions and new insights in the regions.

Developing innovations for the short term as a prospect for the long term

The sub-programmes seek out innovative solutions for tasking in a proactive and timely manner.

Together with Rijkswaterstaat, the **Coast sub-programme** is exploring the option of a sand extraction mill to be able to extract sand and/or replenish sand in places that are difficult for ships to reach. This option is being developed gradually to test practical feasibility. An initial pilot is expected to start in 2014. There is also the innovative contract of the Hondsbossche and Pettemer sea wall. The parties receive a functional specification instead of detailed specifications, and they have to meet a list of requirements concerning incorporation as well as management and maintenance.

The **Wadden Region sub-programme** seeks to develop knowledge on replenishment methods via pilot projects in outer deltas and channels together with the business community. Deltares and Imares are currently exploring the options. New safety concepts are being tested along the mainland coast of the Wadden Region as part of the new HWBP. The 'innovative green dyke' concept could be used in the Ems-Dollard and possibly elsewhere in the Wadden Region.

Climate buffers help to integrate climate tasking into spatial developments. They form a basis for collaboration between nature and environmental organisations, government authorities and the business community. For example: nature organisations Natuurmonumenten and Staatsbosbeheer, along with the province, municipal councils, water managers and the **Rivers sub-programme**, devised the development framework Rivierklimaatpark IJsselpoort. This may allow water levels to be reduced by 20-40 cm, as a result of which the flood risk management tasking at the IJsselkop can be easily combined with other ambitions related to nature and business.

The **Freshwater sub-programme** is working on an investment programme for the short term, which will focus on making the system more flexible and less susceptible to extremes (see sub-section 3.2). Innovations can contribute to this; these will be combined in an innovation strategy. Examples include the framework visions on climate-proof water management for the east of the Netherlands (the 'Landbouw op peil' project) and Limburg (by the Peel en

4.5 Collaboration

Maasvallei water board). Another example is the project ‘Salty Agriculture Texel – Living with Sea Water’, in which a study is being conducted into the cultivation and processing of crops on salty agricultural land. The basic principle here is not to combat salinisation, but rather to look for opportunities for agriculture to use salinisation. This generates knowledge which contributes to the competitive position of the Netherlands. The Southwest Delta also presents opportunities for this. The **Southwest Delta sub-programme** includes an innovative approach in many of the projects that are ongoing, together with the business community. Initiatives related to water and energy also arise, which can trickle down to other sectors.

Sand Engine

In the autumn of 2011, the finishing touches were put to the Sand Engine, an innovative form of sand replenishment for the Ter Heijde coast. In total, 21.5 million m³ of sand was used. Besides creating space for nature and recreation, this project seeks to primarily ensure the required coastal safety for the long term by using natural sand transport (i.e. wind and water) for a 20-year period instead of making periodic shoreface or beach replenishments every 3-5 years. Not only is that more cost-effective, it is also less invasive for the benthos along the coast. It was expected that approximately 1 million m³ of sand would deposit to the north and to the south of the replenishment of the coastal foundation zone. The first results became known this spring, and it appeared that the Sand Engine is doing what it was expected to do. In the first 18 months, 1.5 million m³ of sand moved around the Sand Engine, of which at least 1 million m³ deposited immediately to the north and the south of the Sand Engine along the coast. Whether model calculations verify this is being investigated. Rijkswaterstaat will pursue this experiment over the next few years, in collaboration with the province of Zuid-Holland, Ecoshape, Delft University of Technology and various knowledge institutes to gain an insight into the way in which this innovation can continue to contribute to long-term safety. Using the knowledge and expertise related to the Sand Engine internationally strengthens the position of the Dutch water sector.

The Netherlands will have to continue investing in flood risk management and freshwater supplies, which requires the support and commitment of a large number of parties. The Delta Programme proactively seeks out these parties, also beyond the world of water. The objective is to create a substantively sound, innovative and cost-effective programme that can count on the broad support of society.

Collaborating

Over the past year, regional collaboration was paramount. Parties in the region worked together to seek out solutions for national objectives that tie in with the features of the region in question and that present opportunities for an integrated approach. Government authorities, market parties and stakeholder organisations mapped out these solutions and opportunities (see section 3). This collaboration has, for example, led to customisation in the strategies and the commitment of several parties.

As the work progresses and the step towards preferential solutions and proposals for Delta Decisions is getting closer, the involvement of the democratically elected constituencies becomes increasingly important. In that context, at the request of managers, the Delta Programme Commissioner consulted with the Delta Programme Steering Group to make more time for updating and consulting these constituencies. When preparing DP2014, two periods were set aside for involving the constituencies. Time will also be earmarked for this when preparing DP2015. In Q1 2013, the regional steering groups and the Freshwater Administrative Platform organised an administrative information and consultation meeting about current thinking on provisional plans for promising strategies and Delta Decisions. This consultation showed that there was wide support for the provisional plans for Delta Decisions and promising strategies. Specific points of attention were raised for further elaboration. Moreover, responses showed that this information and consultation meeting was essential to understanding the sense of urgency related to the tasking of the Delta Programme and to pointing out the opportunities (and risks) that the Delta Programme presents to the portfolio holders of the local administration and to encourage them to continue participating in the following period. These results underline the importance of the proper involvement of the democratically elected constituencies to guarantee broadly supported proposals.

This year, links were also forged with parties working in crisis management. This is important because disaster management is a part of the new approach to flood risk management that the Delta Programme is proposing (the third layer of multi-layer flood risk management). On the initiative of the Delta Programme Commissioner, a meeting was held between the Ministry of Infrastructure and the Environment, the Ministry of Security and Justice and a representative of the Veiligheidsberaad (chairmen of security regions). This led to some good agreements. The three parties have complementary responsibilities for disaster management in the case of floods:

- The **Ministry of Security and Justice** is responsible for the systems for disaster and crisis management and provides frameworks and basic premises for decision-making on large-scale evacuations.
- The **Ministry of Infrastructure and the Environment** is responsible for directing the crisis organisations within the water column, employing the main infrastructure and countering environmental consequences; the director-general of Rijkswaterstaat chairs the Flood Management Steering Group.
- The **security regions** prepare themselves for all relevant risks, including floods, and take responsibility for operational crisis management within their region.

☑ Section 3 discusses the actual results of this collaboration.

The sub-programmes have also been in touch with the security regions, with which the Rhine Estuary-Drechtsteden sub-programme, for example, is exploring opportunities to improve the evacuation options in the area and mapping out the vulnerable and vital facilities in the area.

A special IPCC report, 'Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation', stresses the importance of linking disaster management and climate adaptation. To that end, an approach is advocated that ties in well with the methods of the Delta Programme.

Social parties

Numerous social organisations proactively contribute to the development of the Delta Programme, for instance, by making their wishes and ideas known at an early stage. This happens at both a regional and a national level. A few organisations have contributed framework visions and recommendations, such as:

- the 'Water to the sea' framework vision from the WWF in collaboration with the Natural Climate Buffers Coalition;
- the interim report 'Knowledge and opportunities' from the Natural Climate Buffers Coalition;
- a position paper from Koninklijke Schuttevaer;
- the paper from VEMW, the Association for Energy, the Environment and Water, called 'Sustainable industrial water consumption, joint tasking for government and industry';
- the Delta Plan on Agricultural Water Management from the National Horticultural Organisation;
- and a joint letter from VNO-NCW, LTO, Vewin and VEMW on freshwater policy.

At a regional level, the various advisory groups play an important role in the preparations and considerations that are made in the regional steering groups. Each sub-programme has organised the input from social parties in their own way, depending on the environment and the job in hand. Feedback from the administrative considerations on the input and recommendations from the social organisations is given through the (regional) steering groups of the Delta Programme.

The input from social organisations is incorporated into the proposals for the promising strategies for the various sub-programmes. For instance:

- The Regional Consultative Body for the IJsselmeer Region has contributed the framework vision 'Thinking about the IJsselmeer lake of the future'. Two points have been taken from this which will benefit nature: a higher water level in the early spring and allowing the water level in the autumn to gradually fall below the summer water level in certain places at an earlier stage.
- The Social advisory group of the Rhine Estuary-Drechtsteden sub-programme, which comprises members from the business community and social organisations, asks that the interconnectivity of flood risk management and spatial development in the region be carefully addressed. The advisory group refers to the

economic and urban importance of the areas outside the dykes for the Rhine Estuary-Drechtsteden. The advisory group also points out that many economic activities in this region depend on good freshwater supplies. The recommendation has been incorporated into the steering group's final report on promising strategies.

- During the consultation on the promising strategies in the Southwest Delta, the social parties primarily focused on the link with issues relating to ecology and the economy in the short term. Many parties called for the Volkerak-Zoommeer lake to be turned into a saltwater lake, to reintroduce the tide in the Grevelingen lake and to realise an open connection between these waterways. Flood storage in the Grevelingen has been included as a promising strategy.
- In the Wadden Region, social organisations stressed the importance of monitoring to substantiate decisions and explain the effects of interventions. The need to gain proper insight in the Wadden system has been recognised.

At a national level, social parties make recommendations on the Delta Programme in the Consultative Body on Infrastructure and the Environment (*Overlegorgaan Infrastructuur en Milieu* (OIM) in Dutch). This consultation committee has issued a recommendation on establishing the promising strategies and DP2014. In this recommendation, the OIM supports the proposed further elaboration in the run-up to DP2014. The OIM asks that extra attention be paid to the economic value of freshwater. The consultation committee feels that the supply level should concern all designated uses and views a central direction of freshwater supplies as a key basic principle. The OIM feels that a Water Test is required before spatial decisions are made to be able to come up with the desired water-robust design. The OIM stresses the importance of an integrated approach and spatial quality in the Delta Programme and opportunities for linkage with the economy and ecology. The OIM also feels that criteria such as sustainability and linkage opportunities are important for the decision on promising strategies. The consultation committee supports the adaptive delta management approach and notes the importance of reasoning from the perspective of a long term strategy. The Delta Programme Commissioner responded to the recommendation on behalf of the Delta Programme Steering Group. The full recommendation and the response are in Appendix [G1](#) and [G2](#).

Public communication and participation

Citizens can stay abreast of developments in the Delta Programme via the annual Delta Programme and the website. Framework visions and ideas have already been included in the elaborations in the sub-programmes. Input from citizens is by and large linked to the input from social organisations. As such, it is expected that the majority of the knowledge, experiences and points of view will be presented in good time and in sufficient detail. In a recommendation, the Participation Directorate of the Ministry of Infrastructure and the Environment concludes that the current approach for citizens to provide input is in line with the basic principles of the Delta Programme. The approach is recognisable, efficient and effective and contains sufficient guarantees. All of the Delta Programme's annual reports are public. As part of the preparation procedures for the follow-up to the National Water Plan, citizens can officially participate in formal consultations.

The Delta Viewer shows in words and in pictures how the Netherlands can wrestle with water or adapt to it. This game is on display in several museums and visitor centres, and has been used in various exhibitions. An [English version](#) is also available now. The Delta Viewer was called the 'Best Serious Game from the Government 2012'.

Delta Programme after 2014

2014 is the year in which the Delta Decisions and the preferential strategies will be proposed. After that, the Delta Programme enters a new phase, which will present new requirements for the organisation. A number of aspects will remain the same: in accordance with the Water Act as amended by the Delta Act, the Delta Programme Commissioner will submit an annual proposal for the Delta Programme, which will primarily include measures and provisions related to flood risk management and freshwater supplies. The area-based approach should be viewed as an interconnected national whole and the projects and programmes in the Delta Programme will have to be subjected to the MIRT framework. The administrative link between MIRT and the Delta Programme will also remain important. It is important that the added value of the area-based collaboration, in which several government authorities have agreed to the national objectives and are elaborating those objectives regionally, be kept for the future. With some adjustments, an area-based approach would also be useful for the next phase.

Organisation of the Delta Programme

Central government, provinces, municipal councils and water boards work together on the Delta Programme, involving social organisations and the business community.

The *Delta Programme* stands for a safe and attractive Netherlands, now and tomorrow, where flood risk management and freshwater supplies are organised effectively. That is a key condition for the Netherlands' continued existence and a strong economy. Ongoing projects and programmes and decisions on future measures are all part of the Delta Programme.

The *Delta Programme Commissioner* directs the Delta Programme.⁴⁶ They monitor national interconnectivity in the solutions and steer the process towards decision-making. They also encourage input from *market parties* and the use of innovations in water management. Every year, the Delta Programme Commissioner submits to the Cabinet a proposal for specifying the Delta Programme. Just like previous reports from the Delta Programme, DP2014 incorporates the proposal and response from the Cabinet and presents these as an integral part of the report to the Dutch House of Representatives.

The *Delta Fund* comprises resources for financing the measures and facilities of national importance that are needed for a safe delta and sufficient freshwater supplies.

The Delta Programme, the Delta Programme Commissioner and the Delta Fund are embedded in the *Water Act as amended by the Delta Act*. The *Minister for Infrastructure and the Environment* coordinates the Delta Programme.

The government authorities prepare the decisions in the Delta Programme together. The responsibilities agreed in the Administrative Agreement on Water are leading. The National Water Consultation Committee (NBO) provides the administrative agreement on the entire Delta Programme and the interconnectivity of the measures within the programme that are to be programmed. With national interconnectivity as a precondition, the Delta Programme also uses the MIRT Consultation Committee, in those cases where the interconnectivity in an area and the integrated nature of the Delta Programme projects are concerned.⁴⁷ For instance, this is what happened with the WaalWeelde programme and the Ooijen-Wanssum project.

⁴⁶ Section 3.6 b Delta Act: "The Delta Programme Commissioner promotes the formation and the implementation of the Delta Programme".

⁴⁷ See also [\[7\]](#) DP2013, page 96-97 for a further explanation of the interconnectivity between MIRT and the Delta Programme.

4.6 International

The focus of the Delta Programme will change: it will now be aimed at elaborating the Delta Decisions and preferential strategies. The Delta Programme needs an implementation organisation in which the water managers are key and which builds on the experiences of ongoing implementation programmes. In DP2013, the water managers indicated that they wanted to take responsibility for the implementation as part of a far-reaching collaboration with regional parties. The programme office of the new HWBP is the first implementation organisation. Its set-up and approach can be considered the axis around which the implementation of the Delta Programme can continue to be built. What has also changed is that there no longer are any FES programmes (Economic Structure Improvement Fund, *Fonds Economische Structuurversterking* (FES) in Dutch) for knowledge development, even though knowledge development is an essential element for the Delta Programme and its integrated approach to be able to implement tasking in a way that delivers as much social added value and is as cost-efficient as possible ([\[↗\]](#) sub-section 4.3).

DP2015 will include an outline of the programme direction (mapping out the link between the short and long term) and the governance of the Delta Programme after 2014. External advice will be sought on this. Both the requisite continuity and a proper transition are of importance. The time available will be used to outline an organisation that will be supported by all partners.

There is enormous international interest in the Delta Programme, primarily in the way it is organised and its methods: how is the process best organised so that various types of tasking can be combined and how is effective collaboration between government authorities best organised? Dealing with uncertainties and financing issues are also of interest, as is the long term orientation.

International collaboration

Following hurricane Sandy, the Netherlands is in close contact with the United States. This contact has contributed to a Memorandum of Agreement being signed between the U.S. Department of Housing and Urban Development and the Dutch Ministry of Infrastructure and the Environment. The experience gained here may also be of interest to the Delta Programme.

The Delta Programme has also highlighted the Dutch approach at the UN. In December 2012, the Delta Programme Commissioner presented the institutional and adaptive aspects of the Delta Programme to the advisory board of the international UN programme that is aimed at Disaster Risk Reduction (UN-ISDR). Incidentally, considering the tsunami in Japan (2011) and the flooding in Bangkok (2012), this UN programme highlights that the effect of flooding on global production chains can be huge. The role that the Netherlands plays in European and global transport chains is an additional argument for proper flood protection.

Collaboration with the Ministry of Foreign Affairs has intensified. As such, the Delta Programme remains a good tool for showcasing the Netherlands' knowledge and expertise of water. The Top Sector Water and the Ministry of Economic Affairs, the Ministry of Foreign Affairs and the Ministry of Infrastructure and the Environment spread the word about the Dutch Delta Approach in any international contact they have, e.g. when working together with partner countries in WaterMondiaal and Partners for Water and in relation to the UN.

International commissions

The Netherlands coordinates the management of international rivers in international river commissions. In the International Commission for the Protection of the Rhine (ICBR), the countries are detailing a joint climate adaptation strategy to counter the effects of climate change on high water levels. The effects during low water are addressed for the first time and the countries discuss water distribution in the case of low discharges. This climate adaptation strategy is on the agenda of the sixth Rhine Ministers Conference, which is being held in Basel on 28 October 2013. Research into low water measures will also be addressed there. In the International Meuse Commission (IMC), the countries along the banks of the river study the effects of climate change on low and high water situations. The Interreg project Amice has delivered the first building blocks for a joint climate adaptation strategy. The Delta Programme will provide knowledge and expertise for the joint strategy.

The Delta Programme also has a clear relationship with the European Directive on the assessment and management of flood risks (ROR). All member states of the European Community are drawing up flood risk management plans for this directive, in which they will lay down objectives and measures to manage flood risks. The options for protection, prevention (spatial planning) and preparation should also be covered in these plans. The Delta Programme is currently elaborating area-based measures for the spatial measures and for preparing for floods. In the first version of the plans, the Netherlands will include the policy established for flood risks: a significant part of the Delta Programme's implementation programmes ([\[2\]](#) section 2) and established measures from the provinces, water boards and security regions. The Delta Decisions will also be included, as a preview of future objectives and measures.

The Netherlands and the German federal state of North Rhine-Westphalia are working on flood risk management along the Rhine in the border area between the Netherlands and Germany by way of an existing collaborative venture. The two dyke rings that cross the border are of major importance in this. The intention is to intensify collaboration over the coming years. Similar bilateral consultations between Flanders and the Netherlands along the Grensmaas are also being held. This is particularly important because practically all of the left bank of the Grensmaas is on Belgian soil.

The Flemish-Dutch Scheldt Commission (*Vlaams-Nederlandse Scheldecmissie* (VNSC) in Dutch) is working together with the Flemish Region on developing a sustainable and vital Scheldt estuary. The challenge is finding an optimum balance between the interests of a safe, accessible and natural estuary. These elements feature prominently in the Agenda for the Future of the Scheldt Estuary, which the VNSC has set up in agreement with the Delta Programme.

European Union

The European Commission presented its EU climate adaptation strategy in April 2013. On 23 April, the Commission explained this strategy for the Delta Programme during the Knowledge conference. The key action points from the strategy are: to promote and facilitate actions by member states; to use knowledge for decision-making; to make climate adaptation mainstream in sectoral EU policy (such as policy for agriculture, countryside development, biodiversity, water, infrastructure, transport and energy). The overall aim is to create a climate-proof Europe.

Part of the first action point is that EU member states are expected to have formulated a national climate adaptation strategy by 2017 at the latest. The countries have to map out the key risks and inventoried risks should be consistent with the response. The Netherlands already meets most of the water-related requirements with its Delta Programme. The Commission helps member states to draw up such a strategy and projects by providing a number of tools, which were launched at the same time as the strategy. For instance, there are guidelines for preparing adaptation strategies to promote a common understanding of the important parts of an adaptation process. Furthermore, the EU budget for 2014-2020 includes a number of funds for climate activities, including adaptation, in particular, LIFE, which addresses such things as coastal management in primarily densely populated deltas and coastal towns and cities. Climate-ADAPT, the online information source on climate adaptation, is one of the tools that the Commission is explicitly positioning to promote the proactive exchange of knowledge issues, knowledge and experience. Knowledge from the Delta Programme is also posted there.

From 2014, the Commission will be publishing a scoreboard with updates on progress in the member states. The indicators for that are still being developed. In 2017, the Commission will evaluate the current status of the adaptation strategies, also with a view to possible statutory obligations. Over the past few years, there has been regular contact with the Commission to exchange insights and ideas. The strategy ties in with the Delta Programme's approach ([↗](#) more information on EU strategy and the associated guidelines).

In the 2014-2020 period, 20% of expenditure from the EU budget must be related to climate, including adaptation to climate change. This money will be available from various existing funds, such as LIFE+, the Cohesion Policy and Common Agricultural Policy, and via the Horizon 2020 research programme. Parts of the Delta Programme have to meet various criteria to be eligible for this funding. The Ministry of Infrastructure and the Environment is exploring how these options can be used.

In DP2011, the Delta Programme Commissioner recommended that climate dynamics be taken into account when revising the objectives of European directives, specifically also for Natura 2000 regulations. The Cabinet has indicated that it will work on this and also that a revision of Natura 2000 cannot be expected before 2015. With the promising strategies mapped out and the outlines of the preferential strategies in sight, it has become increasingly clear that considerations need to be made on how (within the Natura 2000 regulations) to retain existing and create new nature as effectively as possible. This is in line with the recommendation from the Council for the Living Environment and Infrastructure (*Raad voor de leefomgeving en infrastructuur (Rli)* in Dutch), '*Onbeperkt houdbaar*', which advocates improving synergy between nature and initiatives and developments in other fields based on the social significance of nature for water management and flood risk management. The Delta Programme Commissioner has therefore recommended for the short term that Natura 2000 objectives be used as dynamically as possible, and for the medium term that a more dynamic European nature policy and European legislation be encouraged that are more in line with a changing climate, also in wider international contexts, such as the catchment basin commissions.

The Cabinet is bearing in mind that on closer inspection some of the current nature objectives do not appear to be feasible in the long term because of climate change and other factors. This requires further analysis and decisions on the desired perception of nature, the requisite flexibility and the desired associated dynamic. This is what the announced evaluation of Natura 2000 in 2015/2016 should set out to achieve. Nature objectives will be thoroughly examined then and modified, where necessary. The Natura 2000 management plan processes should reveal where the bottlenecks are. It is essential that a long-term ambition, which is in line with issues of climate change and flood risk management, be drawn up for the larger waterways.

OECD

The Delta Programme provides expertise for OECD research and studies, including a study into the sustainability of the Netherlands' current water management and capacity to anticipate future tasking. The Delta Programme will incorporate the recommendations from this study in due course when implementing and shaping the Delta Programme further.

The Delta Programme also contributes to the OECD Water Governance Initiative, a global network in which all stakeholders in the field of water exchange information on innovations, learning experiences and examples.

5

The Delta Fund: the financial basis of the Delta Programme

(photo) March 2013, Lelystad water management centre. International catchment areas mapped out.



A robust and safe delta requires continual investment. The Delta Fund is the essential financial basis for these investments, a basis which is sound, despite the cuts which have also had an impact on this fund. According to the Delta Programme Commissioner, however, it is clear that additional financial resources will be required in due course to be able to continue properly protecting the Netherlands against flooding over the next few decades and to keep freshwater supplies at the required level.

5.1

Introduction: analysis by the Delta Programme Commissioner and economic importance

DP2014 is an appendix to the 2014 Delta Fund budget. This section outlines the connection between the Delta Fund and the Delta Programme by comparing the available resources with the expected (financial scope of the) tasking of the Delta Programme. This provides insight into the financial safeguarding of the Delta Programme for the third year in a row. As such, this section is a logical follow-up to DP2012, DP2013, the 2013 Spring Memorandum and the 'April letter' from the Minister for Infrastructure and the Environment on the course of water policy, which includes information on the details and consequences of cuts in the Delta Fund.⁴⁸

At the request of the Dutch House of Representatives, DP2012 included an extensive analysis and recommendation from the Delta Programme Commissioner on 'safeguarding the financing of the Delta Programme in the long term'. This was done by mapping out the financial resources available in the Delta Fund at that time and comparing them with the expected tasking for flood risk management and freshwater. The conclusion was that the ongoing implementation programmes were already covered financially and that there were sufficient financial resources for flood risk management until 2015⁴⁹. The Delta Programme Commissioner did not, however, exclude an additional financial tasking for the state budget in the somewhat longer term because there will still be extensive flood risk management tasking once the current implementation programmes come to an end (which for the most part will be in 2017) and also beyond the current Delta Fund horizon of 2028. That analysis still applied in last year's DP2013 and it remains in full force. In fact, compared to DP2013, the tension between the budget that will be available through 2028 and the resources needed for future projects has only increased. This increased tension is due to the cuts in the 2013 Delta Fund budget that were detailed last year and on which the Minister advised the House in the aforementioned 'April letter'.

Next year, the Delta Programme Commissioner will once again publish a financial analysis and recommendation in DP2015. These will be comparable to the analysis and recommendation in DP2012, except that they will be more concrete and precise because more will be known about the financial effect of the proposals. The Delta Programme Commissioner will do this in conjunction with the proposals for the Delta Decisions, the area-based preferential strategies and the programming of measures in the Delta Plan on Flood Risk Management and the Delta Plan on Freshwater Supplies.

Economic importance of the Delta Programme

Sufficient financial resources are a condition for a dynamic implementation of the Delta Programme. A dynamic implementation of the Delta Programme is not only important to provide people with the requisite protection; it also has an important economic impact. Some economic considerations play a role when implementing the Delta

⁴⁸ Parliamentary document 33400 J, no. 19.

⁴⁹ The expected final year of the then cabinet periods.

5.2

The current status of the Delta Fund

Programme. A safe country with a sufficient supply of freshwater, for instance, is a major factor for companies deciding to set up businesses here. Moreover, additional investments in flood risk management are – as the MKBA WV21 has shown – cost-effective and beneficial to our national economy, especially in the area around the major rivers and parts of Rhine Estuary-Drechtsteden. Investments in the Delta Programme are investments that primarily end up in Dutch companies and, as such, they rarely filter down to other countries. Furthermore, these investments also end up with a substantial number of companies in the construction sector (civil engineering) which is weathering hard times and, therefore, they contribute directly to reducing unemployment and maintaining employment opportunities. Last but not least, investments in the Delta Programme also give the leading Dutch water sector an additional boost to demonstrate its innovative strengths to the world and to conquer that world and earn money from a robust domestic market.

The Delta Fund includes financial resources for financing measures of national importance for flood risk management and freshwater supplies, the water quality measures that are directly connected to these and the management and maintenance related to this ([↗](#) section 2 provides an overview of all Delta Programme measures, including the related budgets).

The Delta Fund budget is split across five budget articles:

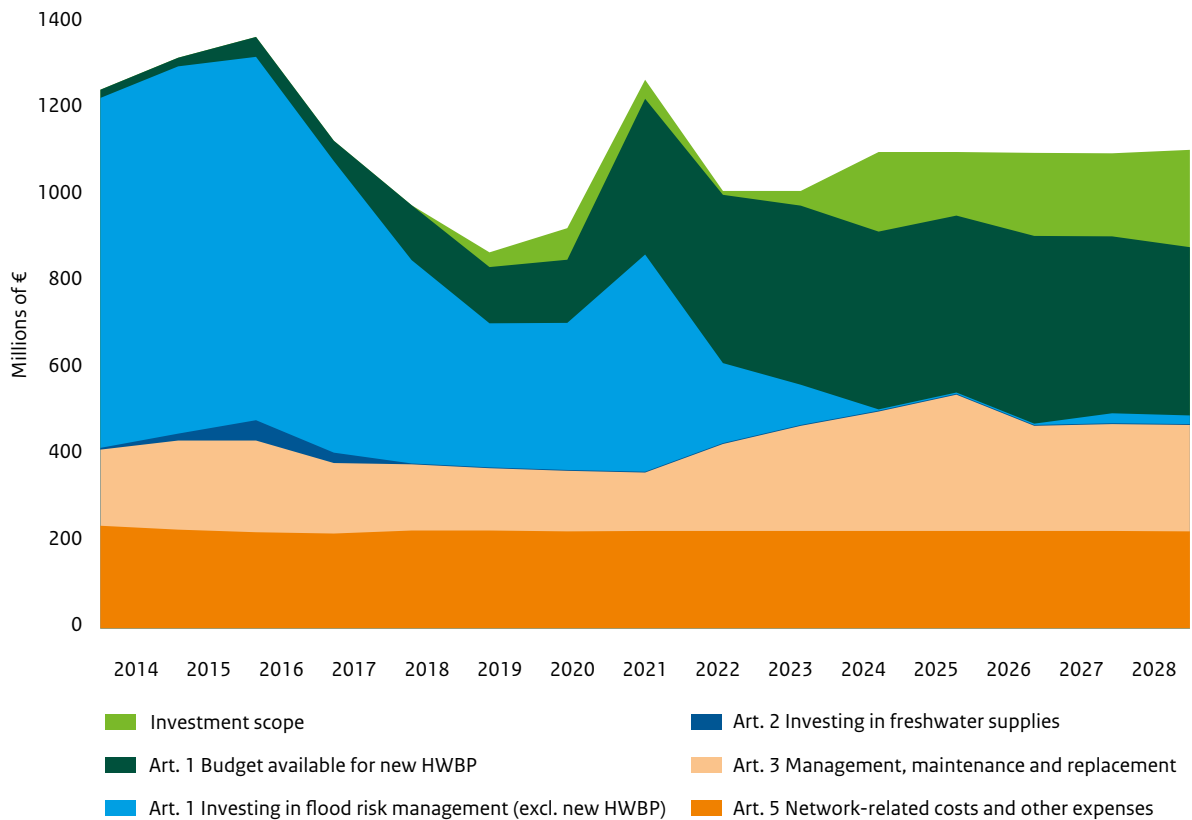
- article 1: investing in flood risk management;
- article 2: investing in freshwater supplies;
- article 3: management, maintenance and replacement;
- article 4: experimenting in accordance with section III of the Delta Act (the integrality article of the Delta Fund);
- article 5: network-related costs and other expenses.

Just like the Infrastructure Fund, the Delta Fund has a financial lifecycle that runs through 2028. For the entire 2014-2028 period, approximately € 16.6 billion is available, which means that the annual budget averages approx. € 1 billion (table 16). The table shows that at present there is a little under € 1.1 billion remaining in investment scope through 2028. [↗](#) Figure 22 presents the budgets of the Delta Fund article by article for the years 2014-2018.

Table 16 Delta Fund budgets in 2014 and in total (based on the 2014 draft budget, in millions of €)

	2014	Total (2014-2028)
Art. 1: budget earmarked for the new HWBP	18.6	3,751.1
Art. 1: investing in flood risk management (other)	809.3	5,146.8
Art. 1: investing in flood risk management (total)	827.9	8,897.9
Art. 2: investing in freshwater supplies	3.9	114.3
Art. 3: management, maintenance and replacement	176.3	3,100.0
Art. 4: experimenting	0	0
Art. 5: network-related costs and other expenses	237.3	3,381.2
Investment scope	-14.5	1,078.5
Total	1,231	16,572

Figure 22 Delta Fund budgets 2014-2050 (based on the 2014 draft budget)



At the end of the Rutte I cabinet, prior to the cuts that were included in the 2013 Delta Fund budget, the Delta Fund comprised an open investment scope of approx. € 1.6 billion for the period through 2028. This scope would gradually become available from 2021. The previous cabinet made cuts in the Delta Fund budget totalling € 605 million. € 17 million of this was incorporated into 2013 and the investment scope was reduced by € 203 million. As a result, the status of the investment scope a year ago was approx. € 1.4 billion, as also stated in DP2013. The Spring Memorandum has since cut the remaining € 385 million from the investment scope in the years 2014-2023. On the other hand, incorporating the 2012 price adjustments and other contract plus points has seen the scope increase. As such, the investment scope now totals a little under € 1.1 billion. In accordance with the coalition agreement, € 0.8 billion of that is programme scope for this Cabinet and € 0.3 policy scope for the next Cabinet. As Figure 22 shows, the first millions in the € 1.1 billion investment scope will become available in 2019. This means that there

is no investment scope in the years until then, with all resources from the Delta Fund being fully allocated. The largest portion of the current investment scope will become available in the years 2024-2028.

The cash outlay of the investment scope and the years to which the cuts relate do not tally. As such, cash has been moved around. As a result, some of the cash flows are now more in line with the actual programming of projects, e.g. money for improving the Markermeer dykes (a HWBP-2 project) is actually required later than originally included in the budget. The situation concerning the improvement of the IJsselmeer Closure Dam and the phased introduction of pumps in the existing Den Oever sluice complexes is clearer: this integrated project will be realised from 2017 onwards. This has also created some room to move cash around. However, delays could not always be avoided: the resources to increase sand replenishments along the coast from 12 million m³ to 20 million m³ a year will no longer be available in 2021-2023, but in 2023-2025 instead because of the cash moves.

The scope to primarily invest in flood risk management through 2028 is, incidentally, not limited to the remaining investment scope of € 1.1 billion.

Most of the budget set aside for the new HWBP, approximately € 3.75 billion through 2028, still has to be programmed (this amount is still exclusive of the 10% project-related part contributed by the water boards; this project-related part is separate from the Delta Fund). Including the project-related share, a total of € 4.1 billion is available for the new HWBP until 2028. This budget is shown in [Figure 22](#) under the header ‘art. 1: budget available for HWBP programming’. Section 2 of the Delta Programme includes the first programming of this new implementation programme for the 2014-2019 period ([Figure 23](#) sub-section 2.3).

Any additional cuts could delay ongoing projects. In any case, investment scope will continue to decrease as a result and become available later. As stated in the ‘April letter’, this will delay implementation of the measures arising from the Delta Decisions and the preferential strategies. In concrete terms, one specific additional cut in the 2014 Delta Fund budget will be made: not paying out the price adjustments. In his letter ‘Response to CPB figures’⁵⁰ of 1 March 2013, the Minister for Finance wrote that the indexation according to 2013 price levels would not be paid out. This will save the central government budget a total of € 0.7 billion in 2014 and this cutback will have an ongoing effect. As such, this measure will not only impact the Delta Fund in 2014, it will continue to have an impact amounting to an estimated € 270 million for the entire plan period through 2028.

Pursuant to the Water Act, it is up to the central government and the water boards to pay for improving the primary flood defence systems. The central government does this via the Delta Fund as outlined in [Figure 23](#) sub-section 5.2. In the period 2013-2016, the water boards expect to invest an average of € 1.4 billion every year, of which 37% will go to flood risk management (approx. € 0.5 billion).⁵¹ A substantial part of this is made up of the so-called water boards contribution to the flood risk management measures for improving the primary flood defence systems, as agreed in the Administrative Agreement on Water. This contribution amounts to € 131 million in 2014 and € 181 million a year from 2015 onwards.

The Delta Programme works on effective, integrated solutions for the flood risk management and freshwater tasking of national importance. As regards integrated solutions, it is not just the central government and the water boards that are accountable; all administrative partners of the Delta Programme bear (financial) responsibility. The experimental article of the Delta Fund may play a role in finding future integrated solutions. This budget article is intended for the integrated approach of the Delta Programme.

The Delta Programme already includes a number of good examples of integrated projects to which various government authorities make a financial contribution, each based on their own task and responsibility. For instance, area developments such as Ooijen-Wanssum, IJsseldelta-Zuid and WaalWeelde ([Figure 23](#) section 2) receive substantial financial support from the provinces of Limburg, Overijssel and Gelderland, respectively. To date, provinces and municipal councils have not contributed very much to the actual flood risk management measures. Next year, however, this issue will be up for discussion in relation to the decisions on the preferential strategies, e.g. when a strategy with integrated river-widening measures is preferred, which besides bringing additional benefits, will also incur significantly higher costs. The sandy improvement of the Prins Hendrikdijk on Texel, for instance, is a fine example of an integrated project in which several parties have contributed to the desired flood risk management solution. Instead of less expensive traditional

⁵¹ This information comes from the publication ‘The water board taxes in 2013. Why do the water boards charge tax and what do they do with it?’, a publication of the Unie van Waterschappen.

⁵⁰ Parliamentary document 33566, no. 1.

5.4 The financial tasking of the Delta Programme

dyke improvement covered by the budget for HWBP-2 with a negative impact on either agriculture and buildings or nature that has to be compensated for, a sandy improvement of the Prins Hendrikdijk will be implemented, with a positive impact on nature and no negative effects on agriculture and buildings. This improvement is possible thanks to contributions to the construction, management and maintenance costs from the Hollands Noorderkwartier water board, the province of Noord-Holland, the municipal council of Texel and the Wadden Fund ([\[2\]](#) sub-section 4.4).

As regards freshwater supplies, the modification to the Roode Vaart is an example of a successful joint financial effort by the central government (€ 9.5 million) and the region (€ 30 million). The project is currently being prepared ([\[2\]](#) sub-section 3.2).

Social organisations can also contribute financially to measures they want. For instance, Natuurmonumenten has helped pay for the improvement of the Oesterdam in Zeeland, together with the central government and the province of Zeeland. The dam was reinforced with sand last year, which also helps fight sand demand in this part of the Oosterschelde. Promoting safety and nature go hand in hand here. The contribution from Natuurmonumenten is funded by the Natural Climate Buffers programme.

Flood risk management

The Delta Programme is preparing a system change for flood risk management ([\[2\]](#) section 3.2). The proper protection of the Netherlands against floods will require several billion euros in investment over the next few decades. Dealing with the varied flood risk management tasking in conjunction with and based on the flood risk approach can, however, ensure that more efficient and effective work is done than is presently the case. This is explained in more detail below.

The second Delta Committee recommended increasing current flood risk management standards for all of the Netherlands by a factor of 10. Following that, Deltares carried out two studies on behalf of the Ministry of Infrastructure and the Environment: The social cost-benefit analysis of 21st-century flood risk management⁵² (MKBA WV21) and the casualty risk analysis of 21st century flood risk management (SLA WV21). Based on the MKBA, it has been concluded that a general revision by a factor of 10 is not required. By fine-tuning the standards in the area around the major rivers, parts of Rhine Estuary-Drechtsteden and the area around Almere, flood risk management policy will be more effective and billions can be saved in comparison with the proposals put forward by the Veerman Commission. Following on from the MKBA, three areas of attention have been highlighted where fine-tuning would be of use in terms of costs and benefits.

Apart from regular maintenance, flood risk management tasking for the next few decades (until 2050) comprises the following: improving the primary flood defence systems that failed the (extended) Third Assessment (via the new HWBP), the approach to the piping issue, the new standards (as expressed in improving the primary flood defence systems that fail a subsequent assessment because of these new standards) and dealing with the consequences of climate change and soil subsidence. Combining all these flood risk management measures may increase synergy. This will certainly be the case in the area around the major rivers,

⁵² The developers of the arithmetic method used in MKBA WV21 won the prestigious Franz Edelman Award in 2013. The following organisations were involved in developing this arithmetic method and received the award: the Cultureel Planbureau (CPB), Tilburg University, Delft University of Technology, Deltares, HKV Consultants, the Ministry of Infrastructure and the Environment, and the Delta Programme Commissioner. The Franz Edelman Award is awarded annually by the Institute for Operations Research and Management Sciences (INFORMS®), an international scientific association which has a number of Nobel Prize winners among its members.

where all the aspects of flood risk management tasking mentioned play a major role. A key reason for this increased synergy is the fact that a substantial part of the dyke improvement costs consist of fixed costs. If these have to be incurred only once, then this is of course much more efficient. Moreover, it will be more efficient and less expensive to switch to a risk-based approach now (with a flood probability for each dyke section as standard). This step will make dealing with dyke improvements more cost-effective. As part of this, the dyke sections that contribute the most to the flood probability of a dyke ring/dyke ring section are addressed first and are probably already sufficient to realise the desired flood probability, i.e. the desired protection level.

In accordance with the approach of the Delta Programme and the preferences of the Dutch House of Representatives, flood risk management tasking is therefore tackled together. Resources from the Delta Fund are available for national tasking. Some of these resources come from funds from the water boards and the central government in the series earmarked for dyke improvements. The Administrative Agreement on Water has left the issue of financing for the changes to standards (i.e. who pays for what) open. To promote a dynamic and therefore efficient approach of the flood risk management tasking, the Delta Programme Commissioner recommends that, in accordance with the Administrative Agreement on Water, further agreements on financing the changes to standards be reached between the central government and the water boards before DP2015. It is essential that a proper cost estimate be available for this as soon as possible.

The Cabinet feels it is important that proper agreements be made with the water boards on the costs arising from changes to a standard that are not currently covered by the 50-50 agreement. The outcome of this agreement on financing should be part of the Delta Decision on Flood Risk Management which the Cabinet is going to take in 2015. An idea of where standards need to be changed and what the additional costs of this will be is expected by late 2013. The basic principle is that tasking be combined as much as possible and innovations used to limit additional costs where possible. The (additional) costs will be financed using the available budget from the Delta Fund.

The proposals for structuring Delta Decisions, area-based preferential strategies and an umbrella implementation programme (Delta Plan on Flood Risk Management and Delta Plan on Freshwater) will be available next year. After that, it will be easier to estimate the financial tasking of the Delta Programme than it is now. At present, the main aspects from the Delta Programme Commissioner's analysis in DP2012 on safeguarding the funding for the Delta Programme are still in full force. In line with DP2012, the total cost of flood risk management tasking up to 2050 is expected to amount to a (roughly estimated) figure of tens of billions. This rough estimate should not be deemed to be final in any way. First and foremost, the estimate is based on a model and not yet on local customisation. Furthermore, up to now, the estimate has only considered dyke improvements and not a spatial approach. An approach according to Room for the River is significantly more expensive, but will also provide more benefits. Thirdly, the area-based preferential strategies provide a solution for more than just flood risk management tasking, while the estimate from the MKBA WV21 only covers flood risk management via dyke improvements. The strategies, therefore, cover much more and are, accordingly, more integrated.

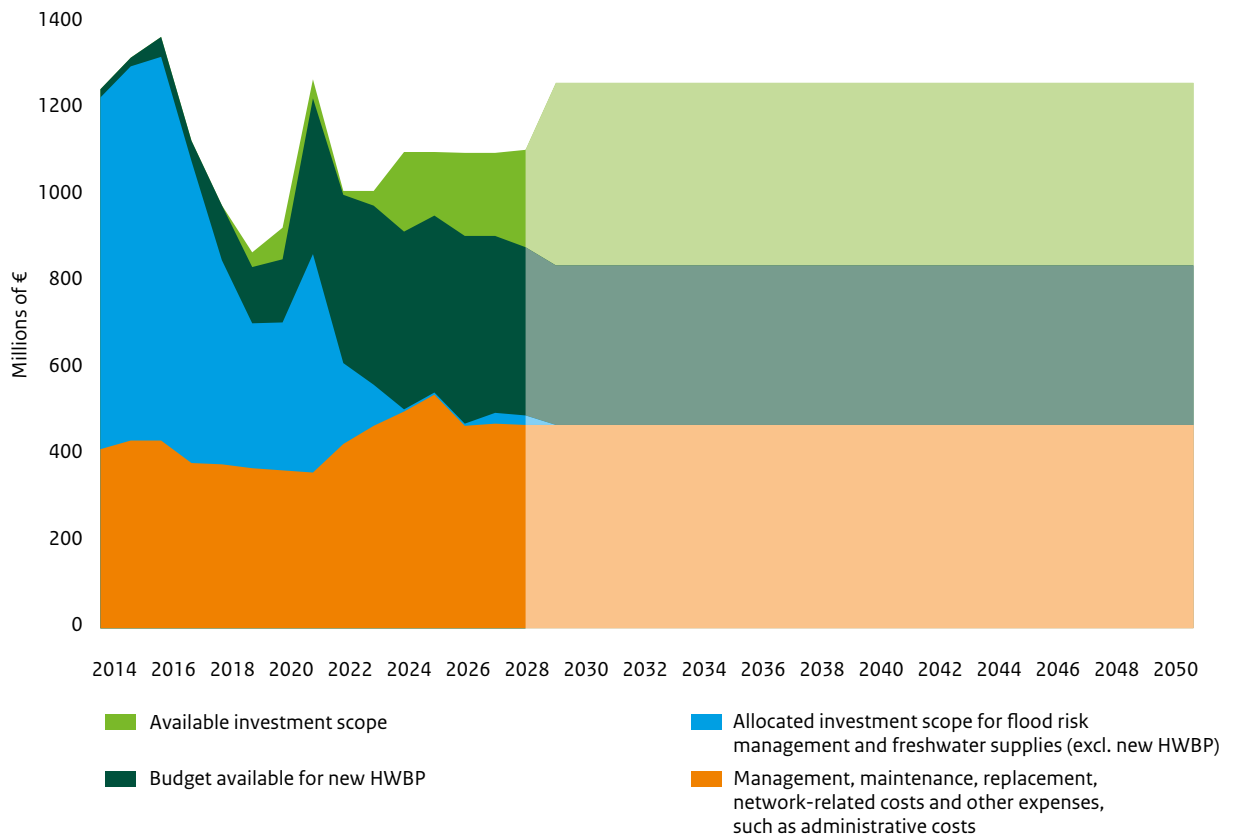
Freshwater supplies

As far as can currently be seen, freshwater tasking is considerably smaller than flood risk management tasking. Where flood risk management involves billions of euros, freshwater supplies, according to the latest insights, entail a much smaller amount. However, for economic development, investment in freshwater supplies is of much greater importance. Until 2050, freshwater supplies can be made more robust by investing in a number of targeted measures ([\[7\]](#) sub-section 3.2). According to estimates from the Delta Programme Commissioner, these measures require an investment of hundreds of millions of euros. These insights will form the beginning of a decision-making procedure in accordance with the MIRT framework.

Tasking and ambitions versus resources

At present, there is € 1.1 billion available from the Delta Fund for new investments in the Delta Programme through 2028. Furthermore, through 2028, there is € 3.75 billion in investment budget set aside for the new HWBP (including the resources for the 2014-2019 HWBP projects programmed in this DP2014). There are no resources available from the Delta Fund for the period after 2028, but it is clear that with

Figure 23 Delta Fund budgets 2014-2050



the resources currently available, the tasking outlined above will not have been implemented by then. That is actually not essential: the objective in the National Water Plan is that all primary flood defence systems meet the new flood risk management standards by 2050.

Given this objective, the Delta Programme Commissioner included a graph of the Delta Fund in DP2012, in which the budgets were extrapolated until 2050 on their own authority. The Delta Programme Commissioner updated this graph based on the 2014 draft budget.

The extrapolation was based on the year 2028. In the extrapolation, the Delta Programme Commissioner also took into account the € 1.2 billion cash shift from the 2021-2028 period to the 2014-2020 period effected in 2011 as part of the Administrative Agreement on Water. It was also assumed that the earmarked series for the new flood risk management measures is to be continued after 2028 (the dark green area in the graph). The extrapolation shows that

of the approx. € 1.25 billion annual sum in the Delta Fund for the 2029-2050 period, some € 0.5 billion is needed every year for management, maintenance and replacement (art. 3) and network-related and other expenses (art. 5) and that in terms of investment budget (art. 1 and 2, including the monies available and set aside for new flood risk management measures at the water boards) over € 0.75 billion a year is available in the 2029-2050 period. This means that the investment budget that will become available in the 2029-2050 period would amount to over € 17 billion. When the remaining investment scope and the budget earmarked for the new HWBP until 2028 is added to that, a total of some € 22 billion would become available in the Delta Fund for the flood risk management and freshwater supplies tasking of national importance in the period until 2050. Therefore, the conclusion that the Delta Programme Commissioner drew in DP2012 still stands, namely that it will be a challenge to get the flood risk management and freshwater tasking implemented before 2050. Furthermore, the investments in flood risk management have been

shown to be profitable and, hence, conducive to prosperity. Postponing or not implementing these will, therefore, lead to a loss in prosperity.

Co-financing measures

The full story of the Delta Programme has not yet been told. In accordance with the Water Act as amended by the Delta Act, the central government's resources in the Delta Fund are intended for flood risk management and freshwater tasking of national importance (including the legally required incorporation costs) and the associated management and maintenance. Financially speaking, the Delta Programme is broader than just the Delta Fund. As outlined in [\[7\]](#) sub-section 5.2, it is generally several partners of the Delta Programme who contribute financially to the integrated projects, which cover more than flood risk management and freshwater supplies alone. Even when flood risk management and freshwater solutions are chosen that generate additional costs but also additional benefits, a contribution from financial sources other than the Delta Fund is expected.



Photo page 128.

Winter 2012, flood water. Hollandsche IJsselkering closed to protect low-lying and densely populated area around Rotterdam.

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A high-resolution version of the maps in this publication is available [online](#).

Documents in Dutch

You will find the documents below [↗](#) online as well as on the usb card attached to the printed version of DP2014.

Delta Programme 2014 – Working on the delta

- [↗](#) **PDF of the report** *(in Dutch)*
- [↗](#) **Appendices** *(in Dutch)*

Appendix A Promising strategies for sub-programmes

- [↗](#) A1 Delta Programme New Urban Development and Reconstruction
- [↗](#) A2 Delta Programme Freshwater
- [↗](#) A3 Delta Programme IJsselmeer Region
- [↗](#) A4 Delta Programme Rivers - Part I
- [↗](#) A4 Delta Programme Rivers - Part II
- [↗](#) A5 Delta Programme Rhine Estuary-Drechtsteden - Part I
- [↗](#) A5 Delta Programme Rhine Estuary-Drechtsteden - Part II
- [↗](#) A6 Delta Programme Southwest Delta
- [↗](#) A7 Delta Programme Coast
- [↗](#) A8 Delta Programme Wadden Region

[↗](#) Appendix B Further explanation of the new Flood Protection Programme

[↗](#) Appendix C Replacement of Rijkswaterstaat's Hydraulic Structures

[↗](#) Appendix D Administrative choices in National Coastal Vision

[↗](#) Appendix E Positioning of the Delta Dykes

[↗](#) Appendix F Administrative schedule

[↗](#) Appendix G1 Recommendation of the Consultative Body on Infrastructure and the Environment on DP2014

[↗](#) Appendix G2 Response from the Delta Programme Commissioner to the recommendation of the Consultative Body on Infrastructure and the Environment

[↗](#) Appendix H Current status of the Delta Programme Commissioner's recommendations

The Delta Programme

The Delta Programme is a national programme, in which the central government, provinces, municipal councils and water boards work together, involving social organisations and the business community. The objective is to protect the Netherlands from flooding and to secure a sufficient supply of fresh-water for the generations ahead.

The Delta Programme Commissioner promotes the formation and the implementation of the Delta Programme. He submits an annual proposal for the Delta Programme to the Minister for Infrastructure and the Environment and the Minister for Economic Affairs. This proposal comprises measures and provisions to minimise flooding and water shortages. The Delta Programme is presented to the Dutch States General on the annual budget day.

The Delta Programme has nine sub-programmes:

- Safety
- Freshwater
- New Urban Development and Restructuring
- Rhine Estuary-Drechtsteden
- Southwest Delta
- IJsselmeer Region
- Rivers
- Coast
- Wadden Region

www.rijksoverheid.nl/deltaprogramma
www.deltacommissaris.nl

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