SPEED UP, CONNECT AND RECONSTRUCT

NATIONAL DELTA PROGRAMME 2023

2023 Delta Programme

Speed up, connect and reconstruct

You will see underlined words and phrases from time to time in the text. In the online version of the 2023 Delta Programme, these are hyperlinks. You can find the online version on https://english.deltaprogramma.nl.

Cover photo: Gorinchem-Waardenburg dike reinforcement, Dalem (Zuid-Holland), July 2022

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Our reference
IENW/BSK-2022/145778

Annexes
2

Date 20 September 2022
Subject Cabinet response to 2023 Delta Programme

Dear Madam Chairperson,

It is my pleasure to present to you the 2023 Delta Programme (DP2022). The Delta Programme is the annual proposal from the Delta Commissioner concerning the fields of flood risk management, freshwater supplies and spatial adaptation which is presented to you in accordance with Article 4.10(1) of the Water Act. DP2023 reports on the progress and changes in the Delta Programme and on the measures for the years ahead. The DP2023 was written in close collaboration between the national government, municipal and provincial authorities, water authorities, stakeholder organisations and the business community, and it enjoys broad support from all stakeholders.

The Delta Commissioner presented DP2023 to the Cabinet with a pressing sense of urgency. He refers to the obvious signs that climate change is not a matter for the distant future, and that, in recent years in the Netherlands, we have already clearly been experiencing the effects of more frequent and more extreme rainfall, floods, heat waves and drought. The KNMI's Climaat Signal '21 also draws attention to this. In addition, the latest insights regarding sea level rise are fuelling the sense of urgency. The government is taking the signals from the Delta Commissioner very seriously and has already stated in the coalition agreement that concrete actions are needed.

In his cover letter accompanying DP2023, the Delta Commissioner sets out three recommendations and the related proposals:

1. Work on mitigating consequences now by raising awareness and crisis management based on multi-layer safety (layers 2 and 3). This recommendation is elaborated as three proposals:
    a. Include clear performance requirements in the 'national yardstick for climate-adaptive building' announced by the government, allow the water and soil system to be the leading factors in this respect, and stipulate this clearly.
    b. Address this theme more effectively in the next round of stress tests, risk dialogues, implementation agendas and frameworks for spatial plans, including assessment.

   c. Work with the safety regions and platforms that bring together local and provincial government authorities to decide which party should take the lead in mitigating the consequences of flooding.
2. Give transitions in the rural areas a flying start and make use of the approach of the Delta Programme. The proposals in this area are:
   a. use the measures and organisation of the Delta Programme as an instrument and tool for the implementation of the transition in rural areas.
   b. use existing financing arrangements, such as those already in place with the Delta Fund, pending the definitive adoption of new financing arrangements for the transition fund.
   c. Link agendas in rural areas for nature restoration and sustainable agriculture to the objectives of the Delta Programme wherever possible.
3. The time for freedom of action is over, you really must get to work!

Response of Cabinet to DP2023
In this letter, the Cabinet wishes to inform the House of Representatives about which steps are being taken to be better prepared for the consequences of climate change, and how the Delta Commissioner's recommendations are included in that process:

1. *Work on mitigating consequences now by means of spatial measures and crisis management, and raise awareness of the risks of casualties and damage.*

a. Include clear performance requirements in the 'national yardstick for climate-adaptive building' announced by the government, allow the water and soil system to be the leading factors in this respect, and stipulate this clearly.

The Cabinet agrees with the Delta Commissioner that, given the effects on the climate, not all activities are possible straightforwardly at every location. The Cabinet is therefore working on a guiding framework in which water and soil will lead Spatial Planning with the aim of mitigating or, if possible, preventing the damage and social disruption caused by the impacts of extreme weather conditions. Clear performance requirements for mitigating measures in climate-adaptive construction, and how they will be reflected in concrete regulations for new construction, renovation, and management and maintenance, are already part of the policy programme of the Ministry of Infrastructure and Water Management (Parliamentary Paper 35925 XII, no. D) and the national approach of the Ministry of the Interior and Kingdom Relations to Climate Adaptation in the Built Environment.

In the past year, the fact that sea levels are rising, which has already been established globally, was also clearly demonstrated along our coastline. The further acceleration of sea level rise in the future is being taken into consideration in the implementation of upgrade projects. However, spatial developments in an area must, where possible, already take into account future, higher water levels due to sea level rise and higher river discharges. On the one hand by earmarking additional space for future upgrades around flood defences in addition to the space that has already been put aside. Administrative arrangements are being made with the water authorities for this purpose. In addition, climate change also requires more space for water storage and the discharge of water through the

rivers. An evaluation of the Policy Line for the Large Rivers has therefore been initiated, the results of which will be available in 2023.

b. Address the theme of consequence mitigation, awareness and crisis management with multi-layer safety – collectively – in the next round of stress tests, risk dialogues, implementation agendas and frameworks for spatial plans, including review.
c. Work with the safety regions and platforms that bring together local and provincial government authorities to decide which party should take the lead in mitigating the consequences of flooding.

In the autumn of 2021, the Flooding Policy Platform was established with the aim of learning from the situation that occurred in Limburg so that the Netherlands will be better prepared, now and in the future, for the consequences of a period of extreme precipitation. This policy platform consists of administrative representatives of parties with a role and responsibility for water systems and spatial planning at the national or regional levels. The policy platform advised looking at the mitigation of consequences for flooding as well, conducting supra-regional stress tests in this respect and also examining the theme of mitigating the consequences of flooding at both the local and regional levels. The Cabinet supports this recommendation. The policy platform will publish its final advisory report later this year. Here again, there is a strong focus on mitigating consequences and on strengthening the current approach to climate adaptation that makes use of stress tests, risk dialogues, implementation agendas and translating these activities into spatial planning. The monitoring and review of proposed measures and plans should also receive full attention here. The Cabinet is adopting this recommendation from the Delta Commissioner and it will work with the safety regions and others to determine the best way of implementing coordination. It is important to work together to ensure that the consequences and damage resulting from climate change are reduced and that social disruption is limited in the event of a disaster. The Delta Commissioner and the approach of the Delta Programme can make a significant contribution in this respect.

2. *Give transitions in rural areas a flying start.*
   In that context, the Delta Commissioner advises the Cabinet to:
   a) *deploy the measures and organisation of the Delta Programme as an instrument and tool to speed up the implementation of the transition in rural areas;*
   b) *pending the definitive adoption of new financing arrangements for the transition fund, make use of existing financing arrangements, such as those already in place with the Delta Fund, in order to make it possible to start implementing measures quickly;*
   c) *link agendas in rural areas for nature restoration and sustainable agriculture to the objectives of the Delta Programme wherever possible.*

The national government wants to initiate the transition in the rural area through joint (i.e. national and regional) area-specific approaches in the National Programme for Rural Areas (NPLG). The Delta Programme can make an important contribution here by monitoring the coordination of the multitude of agendas and providing incentives to tackle the agendas in conjunction, in part in those area-specific approaches. This can be done, for example, during the development of a new perspective for the agricultural sector that can achieve the goals for nature

(including nitrogen), water (quality, freshwater supply and water buffering) and climate (greenhouse gases).

In this regard, the water partners should be involved (automatically) in the area-specific approaches of the NPLG. The NPLG initial memorandum advises using making use here of the governance arrangements, which are working well, for the area-specific programmes such as the Delta Programme and the WFD Regional Administrative Consultation Platforms. In addition, the Delta Programmes for Freshwater (DPZW) and Spatial Adaptation (DPRA) have been included in the NPLG initial memorandum in the list of 'Examples of programmes with strong substantive coherence and with which intensive collaboration is needed, nationally and at the area level'. Where possible, existing financing instruments will be used in order to make it possible to implement measures quickly.

3. The time for freedom of action is over, you really must get to work!

There is full support for this call from the Delta Commissioner. The limits have been reached as far as water and soil management is concerned: water managers are already facing major challenges and the impact of climate change will be felt more and more in the future. In addition, it was agreed in the coalition agreement that 'water and soil will become leading factors in spatial planning'. With the increasingly insistent insights about climate change and experience with its impacts, we can say that this is a very essential and urgent principle that will have to lead to changes in areas such as spatial and climate policies.
Because of the increasing use of the subsurface, it is becoming ever more important to make informed spatial choices at the national, regional and local levels. The Ministry of Infrastructure and Water Management is supporting regional and local government authorities in this respect with guidance and knowledge exchange, and is assuming the task of coordinating spatial planning in the subsurface in order to safeguard the sustainable use of that subsurface. These outlines will produce dilemmas and require choices. In the months to come, the Ministry of Infrastructure and Water Management will therefore be working them out in greater detail with the ministries and other government authorities involved. The House of Representatives will be informed in greater detail about how this process will be implemented and how it will be positioned in relation to other programmes such as the NPLG.

During the Water Committee debate on 7 June, in response to a question from House Member Grinwis, a commitment was made to provide information about how updated Delta Decisions will be arrived at. In 2022, preparations will begin for the second six-year periodical evaluation of the Delta Decisions and regional preferred strategies for 2015 and 2021. That process will be shaped in close dialogue with all other ongoing processes, with coordinated planning and concrete deadlines. The diagram in Figure 3 *Preparations for the second periodical evaluation of Delta Decisions and related processes* shows that there are several related, image-defining policy processes, each with an individual focus and completion dates. Those processes feed into and influence each other along the road to the second periodical evaluation of the Delta Decisions.

In conclusion
The government fully recognises the urgency of the issue of climate change and its potential consequences. KNMI's Climate Signal '21 states that, in the future, we will have more extreme summer rain events, prolonged drought or heat. It is crucial for the Netherlands to be better prepared for this so that we can limit

inconvenience, reduce damage and prevent disruption. The Dutch water system is vulnerable to climate change because of its location. Action is needed now for our water system to be prepared in time for a future with higher river discharges in winter and lower discharges in summer, sea level rise and water shortages. The impact of climate change, which is already becoming increasingly apparent and will be felt more directly and intensely during the course of this century. The soil and water system is already so close to the limit, or past it, that it does not have the capacity to absorb that impact without interventions.
The changes in the climate will also have consequences for the planning of the Netherlands. Climate adaptation is a necessity; water and soil must become leading factors in spatial planning. I will send your House a letter this autumn about the further details of Water and Soil as Leading Factors.
At the same time, we are in the process of taking the necessary steps with the aim of ensuring that the challenge of adaptation does not become even greater.

Yours sincerely,

THE MINISTER OF INFRASTRUCTURE AND WATER MANAGEMENT,

Mark Harbers

Ministry of Infrastructure and Water Management

Our reference
IENW/BSK-2022/145778

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Our reference
DC-2022/494

Annexes
2

Date 29 June 2022
Subject Presentation of 2023 Delta Programme

Your Excellency,

It is with a pressing sense of urgency that I present you with the 2023 Delta Programme.

The goal of the Delta Programme is a safe and liveable delta, now, in 2050 and far beyond. The climate is changing faster than we thought, and so climate scientists are telling us that there is less and less time to secure a liveable and sustainable future for all. This makes climate change *the* challenge for this generation and the next, as is also stated in the coalition agreement. Climate change is – unfortunately – manifesting itself more and more clearly in rainstorms, floods, heat waves, droughts and sea level rise. Wet is getting wetter, dry is getting drier, hot is getting hotter. Weather extremes are becoming more frequent and we need to tackle that now. In several places, the Netherlands is running up against the inflexible limits of the system (natural and otherwise).
In addition, we in the Netherlands are faced with major transitions in agriculture, housing and energy supplies, and also the challenge of restoring nature. The coalition agreement rightly noted that the water and soil system must lead spatial planning more.

My conclusion is that we need to move ahead faster with the Delta Programme and the implementation of concrete measures, in conjunction with the major transition agendas referred to here. Given this urgency and the progress you can read about in this Delta Programme, I wish to submit three additional recommendations:

1. Work on mitigating consequences now by means of spatial measures and crisis management, and raise awareness of the risks of casualties and damage.
2. Give transitions in the rural areas a flying start and make use of the approach of the Delta Programme.
3. The time for freedom of action is over, you really must get to work!

Delta Commissioner

Date
29 June 2022

Our reference
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1. Work on mitigating consequences now by means of spatial measures and crisis management (layers 2 and 3 of multi-layer safety) and raise the awareness of the risks of casualties and damage.

The challenges resulting from climate change are an integral part of the overall spatial challenges at the national, regional and local levels. Given my experience with the implementation of the Delta Programme, I am increasingly convinced that measures aimed solely at preventing flooding, drought or problems with excess water are inadequate to keep the Netherlands safe, resilient and liveable in the longer term.

The Pluvial and River Flooding Policy Platform (hereinafter: the Flooding Policy Platform) has shown that a 'water bomb' like the one seen in 2021 in Limburg can fall at any time and anywhere. We are not yet sufficiently prepared for this eventuality and the average inhabitant of the country is not sufficiently aware that it could happen. With such extreme, but realistic, precipitation events, not all physical disruption or even threats to physical safety can be prevented. In my opinion, however, more efforts are required to minimise social disruption, damage and the disturbance of vital functions as a result of problems with excess water or flooding. This requires mitigating consequences by making adaptations in spatial planning, by improving crisis management *and* by raising awareness.
This will involve looking at the main water system in conjunction with the regional water system. The Policy Platform has, in this context, drawn attention to the limited level of coordination at present between problems in the main water system and problems in the regional and local water systems. Multi-layer safety – the prevention and mitigation of consequences – should be addressed in a coordinated way at all scales. The European Flood Risk Directive also requires member states to take a coordinated approach to measures for prevention, mitigating consequences and crisis management in order to reduce flood risks. Despite earlier calls for more attention to be paid to mitigating the consequences of floods and problems with excess water through spatial planning and crisis management (layers 2 and 3) in addition to safe flood defences (layer 1 of multi-layer safety), I wish to note here that this area is still receiving too little attention and that application is still coming up short. In order to be well prepared for a crisis during flooding or extreme problems with excess water, it is important for this to be, or become, a priority in the programming and actions of all safety regions.

A range of instruments are available to support government authorities and other parties with the implementation of the concrete measures required. They should be used much more. That begins with the next round of stress tests: here also, the theme of 'mitigating the consequences of problems with excess water and flooding' must play a proper role. In that respect, I believe that it is important for 'mitigating the consequences of floods' to be studied at both the local and regional levels. I call on the provincial and municipal authorities, and the water authorities, to work together, and in coordination with the safety regions, to determine which organisations should assume the primary responsibility in this area. At present, this is an area that often falls between two stools.
In addition, measures to mitigate the consequences of flooding – such as increasing the possibility of a discharge through the abutments of bridges and viaducts to reduce the backing up of water at vulnerable locations – should also be included in the administrative consultations between the national government and the region about the MIRT. I also advocate placing a stronger structural focus on

the conditions for effective and prompt recovery after an event. Examples here include the selection of the crops to grow and materials used.
A broader awareness of the fact that not everything can be done everywhere any longer requires strong and persistent action from the joint authorities. This certainly applies in the area of active and transparent information for the general public and the availability of relevant risk information (online or otherwise) for local residents. After all, flooding can never be entirely prevented, now or in the future.

1a) I recommend the inclusion of clear performance requirements for measures to mitigate consequences in the 'national yardstick for climate-adaptive building' that has been announced for the future. Make the water and soil system the leading factor in this respect and set out how this will be reflected in concrete regulations for new construction, reconstruction and management, and maintenance (real estate, mobility infrastructure and urban spatial integration).

1b) I also ask all parties to address this theme better in the next round of stress tests and to formulate it in risk dialogues, implementation agendas and frameworks for spatial plans and the assessment of those plans (including in the Water Test).

1c) I ask the government to work with the safety regions and umbrella organisations of local government authorities to determine which party should take the lead in mitigating the consequences of flooding. Here, in addition to the national government, municipal authorities and safety regions always play a role during large-scale disasters. It is vital to ensure that people do not pass the buck.

2. Give the transitions in rural areas a flying start

The challenge for rural areas is to establish sustainable land use that fits in with the area-specific water and soil system while at the same time restoring nature on a large scale. Nitrogen deposition has to be reduced rapidly and conditions for nature conservation and restoration must be improved. Combinations with the water agenda offer many opportunities. The Ministers of Agriculture, Nature and Food Quality (LNV), of Housing and Spatial Planning (VRO) and of Infrastructure and Water Management (IenW) are working with the local government authorities on the National Programme for Rural Areas (NPLG). This requires adequate collaboration between the relevant authorities in order to arrive at concrete implementation in the different areas on the basis of national direction for the agendas. Given my experience with the Delta Programme, I know how much time and care such a process requires, even in the preparatory stages. Starting to implement the measures before 2024 is therefore a huge challenge.

However, I see a lot of overlap in terms of content – and therefore synergy opportunities – between the NPLG and the agendas of the Delta Programme. For example, the restoration of brooks will be an important component of the supplementary measures for water quality and aquatic ecology (Water Framework Directive) and higher groundwater levels are needed for nature restoration in areas with sandy soils and to reduce land subsidence in peat/peatland areas.
The Delta Programme has implementation organisations in the regions that are working well. More specifically, the Freshwater Delta Programme is already executing measures such as brook restoration and the raising of groundwater

levels. The freshwater regions are willing to explore options for incorporating some of the supplementary NPLG measures in their programmes. Local processes and the implementation of measures can then be speeded up and coordination with climate agendas can be assured.

Water offers opportunities and it is an important boundary condition for preserving and strengthening nature in our country. Improving nature/biodiversity is a major challenge. The combination of existing pressures on nature with the possible effects of climate change and sea level rise is still difficult to assess[1]. What is clear is that nature requires more space and better water conditions but that it can also contribute to the robust buffers for climate agendas. As part of the National Adaptation Strategy (NAS), the Ministry of LNV is looking at what actions are needed to make nature in the Netherlands climate-adaptive. I advise government authorities to establish links between measures in the Delta Programme as far as possible with the agendas for nature and biodiversity, preferably opting for nature-based solutions. Sustainable land use that is appropriate for the natural soil and water system, and improving biodiversity, go hand in hand, for example when restoring healthy soils or brook valleys. An integrated approach ensures that synergy opportunities are taken.

2a) I advise the Cabinet to deploy the measures and organisation of the Delta Programme as an instrument and tool to accelerate the implementation of the transition in rural areas.
2b) In order to make it possible to start implementing measures quickly, I advise the Cabinet to use existing financing arrangements, such as those already in place with the Delta Fund, pending the definitive adoption of new financing arrangements for the transition fund.
2c) I advise linking agendas for nature restoration and sustainable agriculture in rural areas to the objectives of the Delta Programme wherever possible.

3. The time for freedom of action is over, you really must get to work!

The realisation that the water and soil system must be leading factors has been a component of national policy frameworks, alongside the layer approach, for decades. However, the transformation of that realisation into concrete policy instruments at both the national and – in particular – regional levels is lagging behind. For example, it has emerged that the principles in the National Environment Planning Vision are still being integrated in the regional regulations to a only very limited extent. Making real work of that integration process requires transformation. This is also true of the water sector: in addition to its traditional accommodating stance, it must also be prepared to set boundary conditions and limits for areas such as housing and agriculture. The time for freedom of action is over.

[1] Source: Rijkswaterstaat (December 2021), Verkenning effecten klimaatdrukfactoren op de natuur van de Grote Wateren. Literatuurscan, vraagarticulatie regio's en synthese, in het kader van het Kennisprogramma Zeespiegelstijging.

Delta Commissioner

Date
29 June 2022

Our reference
DC-2022/494

My recommendations about working on the housing agendas in climate-adaptive ways[2], in conjunction with my unsolicited advisory letter to the Ministers of Infrastructure and Water Management, Agriculture, Nature and Food Quality, and Housing and Spatial Planning 'Work on climate adaptation now'[3] provide many pointers for climate-resilient action. For example, we are already very good at climate-robust building, and we also know enough about how to manage peat/peatland areas in sustainable ways and protect nature areas better. I found the cabinet response[4] to my recommendations about housing and climate adaptation to be extremely supportive and I was gratified to read about the concrete actions it describes.

I will be explicitly including the need to put climate-resilient approaches into practice on the agenda of the partners in the Delta Programme in the year ahead. In doing so, I call on all parties involved to take genuine action from now on: to make water and soil the leading factors for spatial planning, to be more frugal with our fresh water, to broaden stress tests, to work on mitigating consequences and crisis management, and to protect our nature and biodiversity. In doing so, I am well aware of the pressures that there already are on the operational capacity of government authorities and the uncertain times in which the work must be done. This is precisely why sound mutual collaboration between government authorities is more important than ever. National government, provincial and municipal authorities, water authorities and safety regions must work as a single government to make joint preparations for 'wetter, drier, hotter, and more often'. This does not alter the fact that the unabated commitment of government to reducing carbon emissions and meeting carbon reduction targets continues to be essential if we are to keep adaptation challenges manageable.

This is the first Delta Programme to be presented to you as the Minister of Infrastructure and Water Management. A new Cabinet took office on 10 January 2022 and the municipal elections were in March 2022. The strength of the collaboration of the partners in the Delta Programme, led by a Delta Commissioner, and the continuity it offers have again proved their worth in the past year. It is in part thanks to this organisation and this institute that I am able to present this 2023 Delta Programme to you.
In addition to the complete 2023 Delta Programme, I am also sending you the brochure 'Delta Programme Outlines'. This brochure provides a concise overview of progress for the relevant authorities in The Hague and in the regions. As a basis for a healthy discussion.

P.C.G. Glas
Government Commissioner for the Delta Programme

[2] Advisory letter from the Delta Commissioner on Housing Construction and Climate Adaptation, 1 September 2021 and Advisory letter from the Delta Commissioner on Housing Construction and Climate Adaptation (Track 2), 3 December 2021
[3] Advisory letter from the Delta Commissioner, 6 April 2022
[4] Letter from the government Response to advisory letter from the Delta Commissioner on climate adaptation and housing, 24 May 2022, id-2022Z10281

CHAPTER 1

Governance issues

Westergouwe climate-adaptive residential area, Gouda, April 2022

Since the publication of the previous Delta Programme, the urgency of climate adaptation has only continued to increase. The Intergovernmental Panel On Climate Change (IPCC) didn't beat about the bush: if greenhouse gas emissions continue at the current rate, the scope of our options to adapt adequately will be reduced.

United Nations Secretary-General António Guterres responded to the latest report with a powerful appeal: "Stop burning this planet!" Climate scientists are telling us that there is less and less time to secure a liveable and sustainable future for all. The latest scientific insights and the floods in Limburg, Germany and Belgium demonstrate that climate change is - unfortunately - also becoming increasingly manifest in our part of the world in the form of extreme rainfall, floods, heat waves, periods of drought and sea level rise. They also demonstrate that change is accelerating, and that the consequences are more far-reaching than we assumed until recently. So we need to move quickly to adapt if we want future generations to continue to live and work here safely and well. The future is now!

The National Delta Programme was established by statute to ensure that our country is protected against floods, shortages of fresh water and extreme weather. With the right measures and from a long term perspective: in concrete terms through to 2050 and looking ahead to beyond 2100. The coalition agreement 'Looking out for each other, looking ahead to the future' endorses the need for this approach and states clearly:

> *We are investing more in the Delta Fund to eliminate backlogs and accelerate the implementation of the national Delta Programme. We are continuing to invest in our dikes, dunes and dams. Financing will also be made available to provide better protection for the brook valleys in Limburg and elsewhere. We are working towards recalibrated Delta Decisions for a water-secure country with adequate supplies of fresh water and a future-resilient structure. Water and soil will be leading factors in spatial planning.*

Necessary pre-condition

The coalition agreement also addresses the major transitions for housing, nature restoration, agriculture and energy. In all these transitions, the water and soil system has to serve as the basis. Climate adaptation is a *sine qua non* in all interventions in the physical environment. The future-resilient implementation of the construction agenda requires selecting and designing locations in ways that explicitly include and consider climate adaptation. The goals for the reduction of carbon emissions in the peatland area can be achieved only if freshwater supplies are in order. Nature restoration in the areas of the country with sandy soils requires both the reduction of nitrogen deposition and the restoration of groundwater levels. These transitions must be tackled at the same time as the agendas in the Delta Programme, and the Delta Programme's own focus - in conjunction with the operational capacity of the government authorities - must not come under pressure.

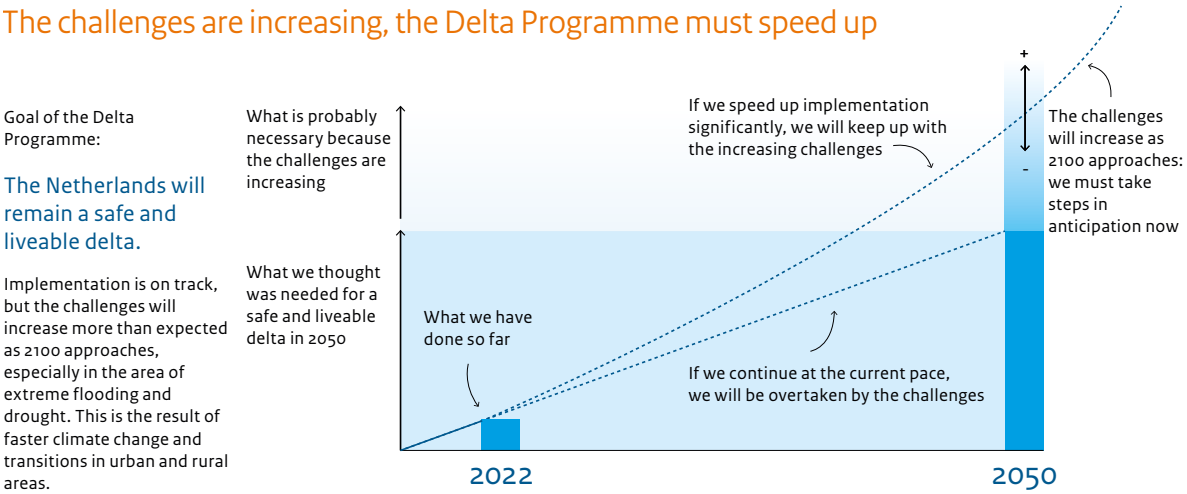


Figure 1 *The challenges are growing, the Delta Programme must accelerate*

The people of the Netherlands expect their country to be safe and liveable. However, no guarantees can be given - especially in the context of a climate that is changing faster and more erratically. The floods in the summer of 2021 demonstrated this once again. That two days of rain in the heart of Western Europe could cause more than two hundred deaths, with tens of billions in damage and enormous social disruption, is something we could not imagine until recently. But it did happen! Everybody could see, and feel, the prolonged periods of drought in recent years for themselves. Nevertheless, the people of the Netherlands must be able to count on their national government, the provincial and municipal authorities, the water authorities and all the other organisations who underpin the national Delta Programme continuing to do everything in their power to keep the delta safe and liveable. This requires clear and resolute choices. A more concrete implementation is needed of the principle that water and soil are at the heart of these choices. The Ministry of Infrastructure and Water Management (IenW) will present a framework on how to make water and soil leading factors in decisions in the physical domain. This framework will be developed with involvement from other government authorities and the Delta Programme[1]. The leading role for water requires the different areas of the Delta Programme to include in decision-making, starting now, the limits and boundary conditions associated with their area-specific circumstances.

Limits in sight

The links between short- and long-term agendas need to be stronger. This begins with making choices in the spatial domain. Not everything can be done everywhere, nor can everything be done the way we do it now. The limits for the water and soil system are in sight, and they have even been reached in some respects in terms of both drought and coping with extreme floods. That is why the Delta Commissioner sent an unsolicited advisory letter[2] to the relevant ministries with the message: "work on climate adaption now!".

In the years ahead, the regions will also have to work on major agendas such as housing construction and the energy transition. Water and soil are leading factors here, as explained in the Spatial Planning Policy Letter (Ministry of the Interior and Kingdom Relations, 17 May 2022):
In order to turn the tide and have a sustainable, healthy and appealing living environment in the long term, we must again 'listen' to what soil and water 'have to say to us'. Bringing spatial planning decisions about housing, the energy transition, nature, agriculture, infrastructure and the economy into line with the condition and quality of the subsurface and the natural dynamics of water will result in a logical and future-proof spatial structure - which will be beautiful, meaningful and liveable in itself. (p.7)

Spatial planning decisions based on water and soil, among other factors, can provide the right frameworks andboundary conditions for what needs to be done locally in specific areas.
The Ministry of Infrastructure and Water Management's Water and Soil as Leading Factors programme formulates the boundary conditions and structuring decisions needed to spatially secure the bearing capacity of water and soil systems in a structural way. (p. 19)

The increasing pressure on the regions represents a risk. Bottlenecks may arise in terms of capacity, knowledge and expertise, space and time, making it difficult for water authorities, municipal authorities and provincial

[1] Infrastructure and Water Management Policy Programme. Parliamentary Paper 35925-X11 no. 106

[2] Advisory letter from the Delta Commissioner, Make work of climate adaptation, 7 April 2022 (in Dutch).

authorities to work together. Limited operational capacity, both in the regions and at the national level, means difficult decisions have to be made at the regional level: what comes first, what can be done smarter, what comes later, who does what? Operational capacity is also threatened by the rapidly rising prices and the decline in the supply security of basic materials which have been affecting construction and hydraulic engineering since the outbreak of the COVID pandemic and the war in Ukraine. Inflation is currently very high and, as a result, the budgets of all the government authorities that make investments are under pressure[3].

The periodical evaluation of the Delta Decisions in the 2027 Delta Programme will generate new choices relating to the scope and cost estimates for the Delta Programme. Given the current scope of the Delta Programme and the inflation data now available, there are budgetary pressures as a result of high inflation, but these would appear to be manageable for the time being (given the long-term nature of the programme). A more detailed analysis of the impact of inflation on the budgets accounted for in the Delta Fund budget can be found in Chapter 7.

[3] The government authorities and sector associations in the Construction Consultation Platform want to take a joint approach to the challenges posed by price increases and supply insecurities, and they are committed to furthering continuity in the sector so that construction work can continue as much as possible. With this goal, they signed the Declaration of Intent *Continuing to Build Together in Uncertain Times* on 31 May 2022.

1.1 Towards a second periodical evaluation of the Delta Decisions

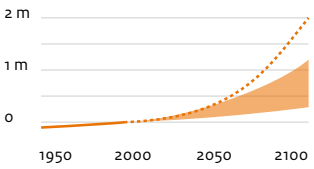
The substantive links between the water agendas, spatial planning for our country and other social agendas will demand all our attention and efforts in the time ahead. How can we be as prepared as possible so that we change course in time and keep options open as long as possible? We want to preserve the room to adapt that will be needed in the future and prevent casualties and damage, social disruption and high recovery costs. The ambition for the Delta Programme continues to be that of establishing an intergenerational programme that avoids passing on problems as much as possible; and that at a time when the limits of solidarity - between sectors, regions and generations - are being called into question.

The climate is changing faster than expected; the challenges facing the Delta Programme are increasing

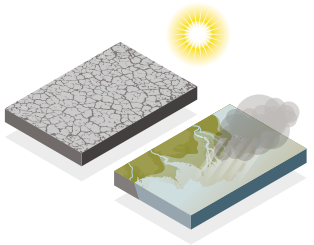
Which factors are in play?

The planet is warming up faster. Expected effects in NL:

Depending on carbon emissions, sea level rise could increase up to 1.2 m by 2100 and up to 2 m if the land ice breaks up.



More frequent extreme weather: heat, drought and rainstorms will be more frequent and more intense.

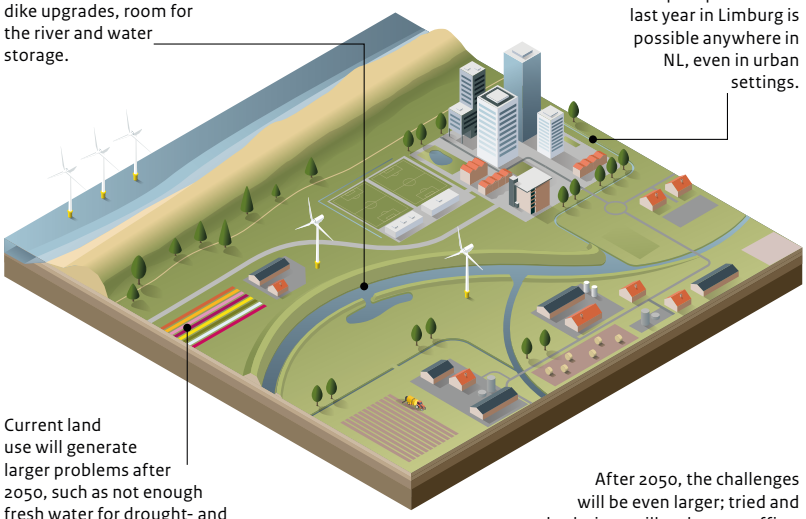


What are the consequences?

The challenges facing flood risk management, fresh water and spatial adaptation are increasing. Drastic measures may be needed sooner, even before 2050.

More space is needed for dike upgrades, room for the river and water storage.

Extreme precipitation like last year in Limburg is possible anywhere in NL, even in urban settings.



Current land use will generate larger problems after 2050, such as not enough fresh water for drought- and salt-sensitive crops.

After 2050, the challenges will be even larger; tried and tested solutions will no longer suffice.

Figure 2 *The climate is changing faster than expected; the challenges facing the Delta Programme are growing*

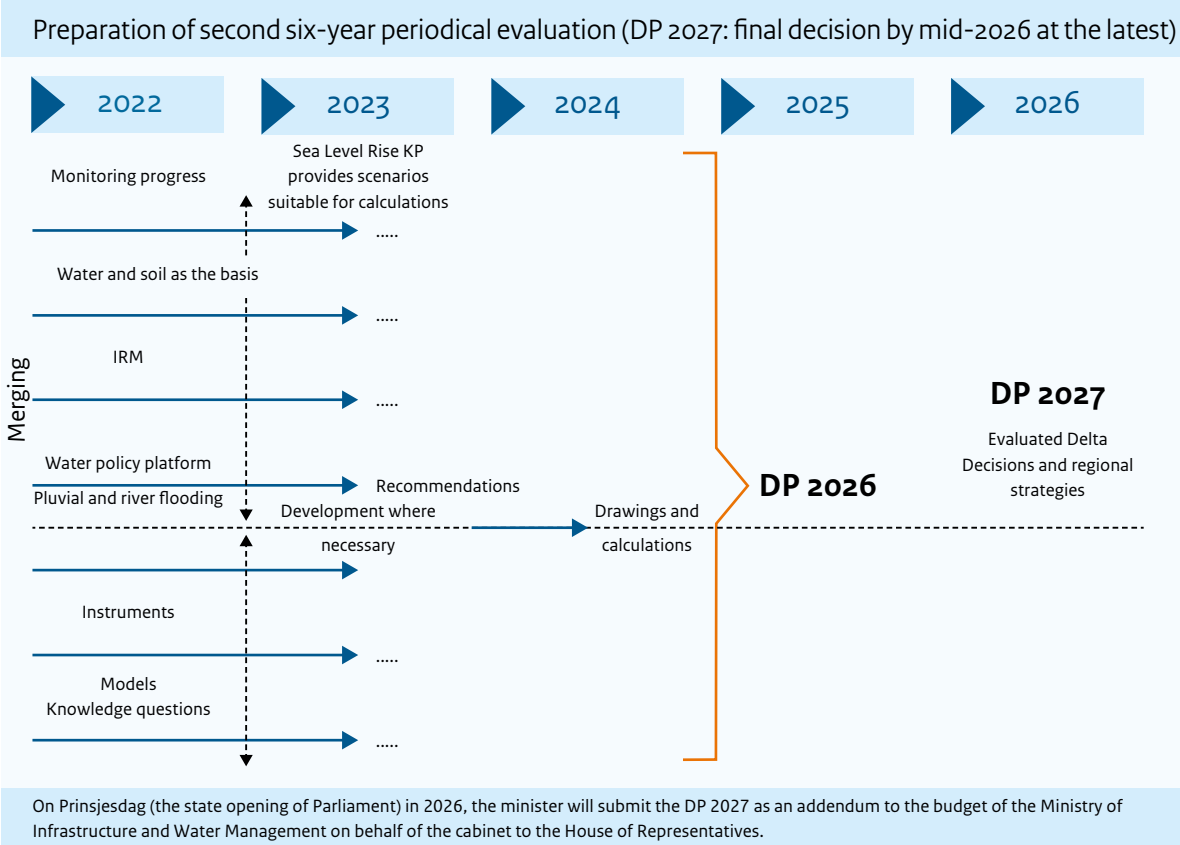


Figure 3 *Preparation for second periodical evaluation of Delta Decisions and related processes*

To make the right decisions, we need to accelerate our efforts to establish a picture of the options available - in the light of climate change - for an alternative approach to planning the Netherlands of the future and to describe the possible consequences in the years ahead. This already requires extra attention, in collaboration with those parties who are responsible for implementation. The consequences (financial, legal and spatial) must guide the knowledge and investment agendas of the years to come.

In 2022, preparations will begin for the second six-year periodical evaluation of the Delta Decisions and regional preferred strategies. Potentially far -reaching decisions for the structure of our country will be made in the 2027 Delta Programme. That process will be shaped in close dialogue with all other ongoing processes, with coordinated planning and concrete deadlines. The diagram in Figure 3 shows that there are several related, image-defining policy projects, each with an individual focus and completion dates. The second six-year periodical evaluation in the context of the Delta Programme is therefore one of these processes and it will undoubtedly have a significant impact on all other policy processes in the physical domain through the Delta Decisions and operational strategies.

Sea Level Rise Knowledge Programme

The Sea Level Rise Knowledge Programme is considering possible solutions for future sea level rise. The knowledge programme focuses on the long term and identifies the concrete issues that require decisions in the medium, or even short, term. This involves collecting input, particularly from the coastal regions and also from a large number of external planners who put forward - sometimes far-reaching - ideas and alternatives for protecting and structuring the Netherlands. In part on that basis, the Sea Level Rise Knowledge Programme will generate alternative scenarios in 2023. These scenarios will be elaborated in area-specific design workshops, with the various spatial agendas and their interdependencies being given a central role. They will be translated in maps for each area. The next step will be to establish the substantive, technological and financial consequences of these scenarios. Examples include the required height of flood defences, in addition to the land required for that purpose, replenishment volumes, the space required for water storage areas and pumping capacity, supra-regional coordination, the associated costs for construction and maintenance, and the side-effects for sectors such as shipping, agriculture, housing and nature/ biodiversity.

The results of the ongoing research on the rivers will also be used in the second periodical evaluation. The programme covered by the Integrated River Management Environment Act (POW IRM) studies situations with both high and low discharges. It will draw on the Water System inventory (*Watersysteemverkenning*), insights from the Pluvial and River Flooding Policy Platform (hereinafter; the Flooding Policy Platform) and the inventory looking at climate-resilient freshwater supplies in the main water system.

The first assessment round of the primary flood defences is a major milestone, and also a relevant source of knowledge. In 2023, this round will produce a picture of national flood protection. All primary defences will then have been assessed for the first time on the basis of the statutory flood risk management standards set out in the Water Act in 2017. There will then be a clearer picture of the overall dike upgrade agenda on which the Flood Protection Programme (HWBP) is working. New knowledge developed in the context of the Delta Programme on Fresh Water and spatial adaptation will also feed into the process leading to the second periodical evaluation, such as the results of the Groundwater Study Group, the evaluation of the National Climate Adaptation Strategy (NAS) and the Flooding Policy Platform.

1.2 Speed up, connect, reconstruct

The goals of the Delta Programme can only be achieved if the guiding principle of 'water and soil as leading factors' genuinely constitutes the basis for all the major challenges facing our country. The Netherlands is on the eve of a major renovation. That means *every new development climate-proof*. But that is not a straightforward process. We must accelerate and connect.

Speed up

As residents of the Meuse Valley were beginning to clear up the havoc wreaked by the floods of the summer of 2021, the Flooding Policy Platform started on the work needed to learn from these floods. In March of 2022, the first results of the policy platform became available and, shortly after the publication of this 2023 Delta Programme, the policy platform will publish its final report. The first report[4] was as clear as it was uncomfortable: these weather conditions were extreme but they may occur more often and elsewhere in the Netherlands. And this will result in major problems and damage amounting to billions everywhere. Serious difficulties cannot be prevented in circumstances like this but it may be possible to prevent social disruption due to casualties and extremely high levels of damage. But that means getting to work: on mitigating the consequences, making spatial planning water-robust, raising awareness, better weather forecasts, and improving the coordination of operational crisis management. The Policy Platform is elaborating the recommendations from the first advisory report in the final report, which will be published in October 2022. The recommendation to include extreme weather situations such as the one in Limburg in stress tests will be elaborated in the Working Regions of the Delta Programme for Spatial Adaptation. The € 300 million earmarked for brook valleys in Limburg and elsewhere has not yet been requested from the Ministry of Finance pending the activities of the Flooding Policy Platform.

[4] Parliamentary Paper 32698 no. 64 (in Dutch)

See also Section 2.3 and Chapter 7.
The Flood Protection Programme has not yet achieved the intended speed of implementation. At present, approximately 70 of the most urgent dike upgrade projects are in the preparatory stages or being implemented (covering a total of 600 kilometres of the total estimated requirement of 1500 kilometres between now and 2050). However, it is unfortunately still the case that many projects are delayed. Since 2019, an average of 45% of the intended milestones have been delayed. The reasons vary. The delays may be due to the local consultation process, the focus on synergy opportunities, the search for an appropriate technical design, or the impact of corona or nitrogen measures.
Programmes can be affected by project delays in the operational phase in particular and this can have substantial financial consequences. For example, it can result in the under-utilisation of the budget and lead to financial tensions in subsequent years. Project delays can mean that other projects have to wait longer. The Flood Protection Programme alliance of water authorities and Rijkswaterstaat has acknowledged the problem and has taken steps to address it. The goal of ensuring that all dikes meet the flood risk management standard by 2050 is not questioned by any of those involved.

In order to explore new options for speeding up the process of climate adaptation from the private sector, the Delta Commissioner will further intensify the discussions that have already begun with the financial sector. In its first advisory report, the Flooding Policy Platform advised the Minister of Infrastructure and Water Management to initiate a strategic inventory of whether climate risks can be insured.

Connect

The Netherlands is on the eve of major transitions and the coalition agreement is announcing meaningful steps

for nitrogen/nature restoration, housing and the energy transition. All these transitions are linked to the goals of the Delta Programme. For example, nature restoration in areas with sandy soils requires the reduction of nitrogen emissions but also the restoration of groundwater levels and water quality. Reducing carbon emissions requires raising water levels in peat/peatland areas and it leads to increasing demand for water. The stress test for the IJsselmeer area (in Dutch) has shown that the freshwater buffer will be under pressure in the future due to the additional need for water for the purposes of slowing down land subsidence. This can, in turn, lead to larger fluctuations in the level of the lake and therefore have effects on, in particular, spatial developments and natural habitats outside the dikes. The different agendas therefore need to be addressed in conjunction. Furthermore, measures are required in a range of areas to enhance adaptive capacity, and changes in land use must also be considered.

The regional authorities have an important role to play in terms of establishing coordination and links between the various transitions and the goals of the Delta Programme: the freshwater regions, the working regions of the Delta Programme for Spatial Adaptation and the areas in the national Delta Programme. The regional implementation of national programmes such as the Housing Agenda and the National Rural Area Programme (NPLG) need to be described in conjunction in order to clarify the system boundaries (and the differences in those boundaries), the diverse and related goals, and the opportunities for synergy. The Delta Programme repeatedly focuses on long-term goals here at both the national and regional levels. We do not wish to limit the potential solutions any further and want to be as clear as possible about where potential and actual agendas in other policy areas conflict with the Delta Programme. Friction is undoubtedly inevitable!

At the request of the Ministry of the Interior and Kingdom Relations, and the Ministry of Infrastructure and Water Management, the Delta Commissioner has submitted recommendations about linking housing construction to climate adaptation in two advisory letters[5]. The main message is that action on housing and the redevelopment of existing areas must take the effects of climate change, now and in the long term, into account in a more structural way. To start with, water and soil must become leading factors in spatial planning. This involves the approach to construction, how areas are planned and *where* we build. It is not happening enough at present. The cabinet's response to the recommendations[6] indicates that the actions resulting from this report will be included in the National Approach to Climate Adaptation in the Built Environment, which will be sent to the House of Representatives after the summer. An important action is the development of a national yardstick for climate-resilient and water-robust building. This yardstick is being developed by the Ministries of Housing and Spatial Planning, Infrastructure and Water Management, and Agriculture, Nature and Food Quality, and involves consultations with other government authorities and stakeholders. The development of the yardstick ties in as much as possible with past development in recent years in a number of regions in collaboration with private parties.

The power of design

The regional implementation of a range of activities in conjunction requires a high level of creativity from all those involved. A design-oriented approach can serve as a tool and provide opportunities to arrive at new and appealing solutions, for example through regional design sessions. This approach supports links between long-term agendas and short-term interventions, imagining the possible future and elaborating different scenarios. In the area of water management, the Netherlands has a tradition in this approach that we can build on, as in the case of the Room for the River quality team and the work of the Board of Government Advisors. See background document A for an overview of examples of the deployment of a design-oriented approach that use water and soil as leading factors, visualise coordination and connections between agendas, work with future scenarios and encourage discussion between parties. The examples link the challenges in the Delta Programme (flood risk management, freshwater availability and spatial adaptation) to the agendas in the areas of agriculture, nature and housing.

Reconstruct

Moving forward with the preparation and implementation of measures in the Delta Programme requires additional efforts and impulses. If the Netherlands is to remain the best protected delta in the world, we must earmark physical space now for measures to manage flood risks in the future. This will be additional space alongside the dikes and other flood defences that - in view of future upgrades, and safe discharge and water storage in the riverbed - must be secured to prevent the irreversible use of the land for other purposes. This space[7] must be secured properly and in a uniform way in municipal and provincial regulations and, for example, by using temporary permits so that the space will continue to be available, even after 2050.

[5] Advisory letter from the Delta Commissioner on Housing Construction and Climate Adaptation 1 September 2021 (in Dutch) and Advisory letter from the Delta Commissioner on Housing Construction and Climate Adaptation (Track 2) (in Dutch) 3 December 2021.

[6] Parliamentary Paper 32813, no. 1079 (in Dutch)

[7] Earmarked physical space.

It will also be necessary, during the course of spatial developments, to take the possible need for extra water storage and level fluctuations in large bodies of water into consideration even more, for example in the IJsselmeer and along the North Sea Canal.

The traditional approach in water management - making the desired land use possible through engineering measures - has run into difficulty in several areas, as in the peat/peatland areas and in areas with sandy soils. The management measures focused on drainage for the purposes of land use were intended as a solution for housing and agricultural production, among other things, but they have become part of the problem. They contribute to land subsidence in the peatland areas and lead to the aridification of nature and the depletion of groundwater resources in areas with sandy soils. As argued earlier, a transformation is needed in which land is used in ways that are more in line with the condition of the soil and the water system - rather than the other way round. A transition in the use of land based on this connection will generate major opportunities for synergy with the nitrogen agenda, the agricultural transition, the restoration of biodiversity and nature, the protection of strategic drinking water buffers, and landscape management.
Sound steps have already been made in the area of spatial adaptation. However, at the same time, there is still a lot to do, for example the planning of essential and vulnerable functions. The climate adaptation agenda must be linked properly to the other spatial agendas so that every new development is climate-adaptive. This requires more capacity, focus and concrete goals that both the government authorities and business community on the ground can work with in practice. Municipal, provincial and water authorities, as well as the Dutch national government, are working on stress tests, risk dialogues, ambition statements and implementation programmes. These activities are repeated in a six-year cyclical process. The lack of adequate capacity - particularly at municipal authorities - means that there is a risk of momentum being lost. Municipal authorities have to cope with an accumulation of challenges in both the social and physical domains. Given the importance of climate-adaptive spatial development, the Delta Commissioner is again calling for adequate capacity to be made available for this purpose, and to look at how additional support can be given to municipal authorities in particular. Sharing scarce and often specialised expertise between government authorities can also be very effective in this regard. The renovation of our country to make it a climate-resilient delta is inevitable. The establishment and efficient deployment use of the required capacity must therefore be a top priority.

1.3 Monitoring progress, monitoring the local context

Transitions are inevitably accompanied by tensions between interests and by resistance from society at large. Until now, the Delta Programme has been working on the basis of an adaptive approach: growing with climate change through incremental adaptation and change. However, the speed of climate change will require a switch to a transformative approach for some themes and areas - as in the case of the peat/peatland areas and the areas with sandy soils. Abrupt changes may be needed at the level of the water system as a whole. As in the case of the Delta Works last century.

Successful technical management measures - focusing on robustness and adaptation - are reaching their limits and have even become part of the problem. For example, excessive drainage in the areas with sandy soils leads to the aridification of nature in various locations, periodical damage to agricultural yields and the depletion of groundwater buffers. Transitions often require a different form of governance, with more national control based on the agendas on the one hand and the securing of the space required to deliver solutions in the areas on the other.
In the Delta Programme, experience and awareness have been built up indicating that national control requires continuous coordination between the establishment of frameworks and implementation in order to strike a balance between ambitions and effectiveness in implementation. However, the transitions that await our country mean that we need to set more concrete and more binding goals in order to take into account the long-term sustainability of possible solutions, and that we must not further limit the possible ways to achieve those goals.
The IPCC and KNMI have stated that the climate is changing faster than previously anticipated and that implementing an energetic adaptation programme has become more urgent. The Delta Programme is therefore working on an approach that fits in with the transformative approach, in which the feasibility of the proposed adaptation pathways and long-term future scenarios will be tested systematically.

In the past year, work has been done to strengthen the cycle 'analysis - planning - decision-making - execution - evaluation'. See Figure 4. Methods have been developed for, among other things, broadening the monitoring role of the Delta Programme and for the more targeted deployment of governance instruments (direction, regulation, encouragement, connection; see background document B). These methods will be applied in practice in the coming year and refined further. The final results will be presented in the 2024 Delta Programme.

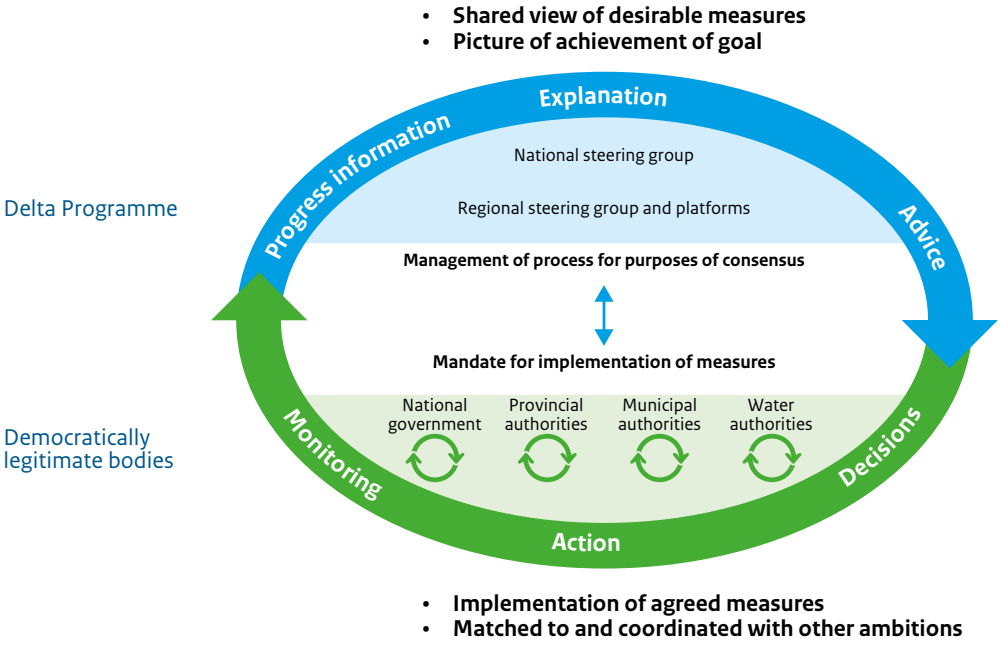


Figure 4 *Cycle of analysis - planning - decision-making - execution - evaluation*

The National Delta Programme

In the National Delta Programme, the Netherlands focuses on three interrelated agendas to make the Netherlands climate-resilient:

- flood risk management: proper protection against floods;
- fresh water: adequate fresh water in the right place and drought resilience;
- spatial adaptation: robust planning for mitigating consequences during floods, excess water, drought and high temperatures.

The Netherlands must be climate-resilient and water-robust by 2050. Meanwhile, the Delta Programme is also looking beyond that, to 2100. Because the climate is changing faster.

Since 2010, the Netherlands has been working on these agendas in a unique way in the Delta Programme. We are working on common goals, not waiting until a new disaster due to flooding or extreme weather overcomes us, but planning to prevent disasters, major damage and social disruption. We are doing this using adaptive delta management: looking ahead to the challenges in the future, deciding on measures together and constantly checking whether we are working at the right pace and in the right direction. We are keeping options open and making adjustments to the strategy in time if necessary.

National and regional parties have been working intensively together in the Delta Programme since the outset: national government, provincial authorities, water authorities and municipal authorities. All of these parties have committed to the joint national goals and the implementation of the Delta Programme on the basis of their own responsibilities. Overall control is the responsibility of the Delta Commissioner – who answers politically to the Minister of Infrastructure and Water Management. The business sector, safety regions, knowledge institutes and stakeholder organisations are involved. The combination of strong regional involvement and national control has produced a successful organisational form that allows us to establish supported preferred strategies, energetic implementation and joint financing. This is also demonstrated by the various evaluations conducted since the start of the programme.

To ensure that all parties have the same course in mind, Delta Decisions and Regional Preferred Strategies were proposed in 2014. They include goals and ambitions for 2050, looking ahead to 2100. The Delta Decisions provide

the national frameworks; the regional preferred strategies provide direction for the measures in each area. The Delta Programme keeps its finger on the pulse and conducts a periodical evaluation every six years to determine whether a change of course is needed. In 2020, the Delta Decisions and Preferred Strategies were evaluated on the basis of new insights. The possible acceleration of sea level rise is a potential threat to our delta. In order to be able to make informed proposals in 2026 about whether or not to adapt Delta Decisions and Preferred Strategies, the Sea Level Rise Knowledge Programme was launched in 2019.

Important concrete results have been achieved since then. For example, in 2017, the new flood risk management standards for the primary flood defences were established by law; the first dike upgrades based on these standards are in progress. The primary flood defences must comply with these standards by 2050. In 2018, a new water level decision was adopted for the IJsselmeer area that makes flexible water level management possible. This measure already proved its worth during the three dry years of 2018, 2019 and 2020. And in the dry spring of 2022, it was decided to let in additional water as well. The investments made by the national and regional government authorities since 2014 in freshwater influx routes, the retention of water and innovations have also proven effective. The priority sequence for regional water management – developed in the Freshwater Delta Programme – was included in the National Environment Planning Vision (NOVI) and the National Water Programme for 2022-2027 (NWP) in 2021. The priority sequence is based on the premise that land use should be adapted in line with water availability. In 2021, the Delta Commissioner submitted a second advisory letter on housing and climate adaptation[8] to the Ministries of the Interior, and Infrastructure and Water Management. In 2022, he sent an unsolicited recommendation to the government to take immediate and substantial measures in the area of climate adaptation[9].

Since 2017, the Delta Plan for Spatial Adaptation has been part of the Delta Programme, complementing the Delta Plan for Flood Risk Management and the Delta Plan for Freshwater Supplies. Since 2021, co-financing has been possible from the Delta Fund via the *Stimulus Scheme* for measures to prevent pluvial flooding and drought, and to reduce the effects of flooding. In this way, the government authorities are taking concrete steps towards climate-resilient planning and the Netherlands will be better prepared to deal with excess water, drought, heat and the consequences of floods.

[8] Advisory letter from the Delta Commissioner on Housing Construction and Climate Adaptation 1 September 2021 and Advisory letter from the Delta Commissioner on Housing Construction and Climate Adaptation (Track 2) 3 December 2021.

[9] Advisory letter from the Delta Commissioner, Make work of climate adaptation, 7 April 2022.

CHAPTER 2

Ongoing development of the Delta Programme

Flooding during storm Corrie, Vlaardingen, January 2022

The Delta Programme uses an adaptive approach. The knowledge base and the approaches are constantly developing and and these insights are being included in planning and implementation for the areas and themes. In recent times as well, new insights and inventory studies have become available that are relevant for the ongoing processes and keeping the preferred strategies up to date. A key consideration here is that climate change is faster and more unpredictable than previously thought and that the effects are already noticeable, and require action. An integrated approach and connections with other developments in the spatial domain continue to be crucial.

2.1 Sea Level Rise Knowledge Programme

Global sea level rise has now increased from 2 mm to 4 mm a year. Regional differences in the rate of rise - in part as a result of wind influences - make it difficult to see this acceleration along the Dutch coast but the KNMI says that the first signs are already visible. These insights provide a better fit between the observations and the new climate scenarios that the KNMI will publish in 2023.

The impacts of sea level rise on the water system and existing strategies relating to flood risk management, freshwater supplies and coastal maintenance are currently being modelled. This is all being done in consultation with the partners of the Delta Programme. The initial results will be available in the latter half of 2022. Meetings for each area are also exploring alternative options for the long term and their possible interaction with current and future investment agendas for renewable energy, housing, infrastructure, agriculture and nature. The meetings show that the parties involved need practical tools and examples that show how investment agendas can take future water agendas into account. The interim results have been incorporated in the Delta Commissioner's housing recommendations (see Figure 5).

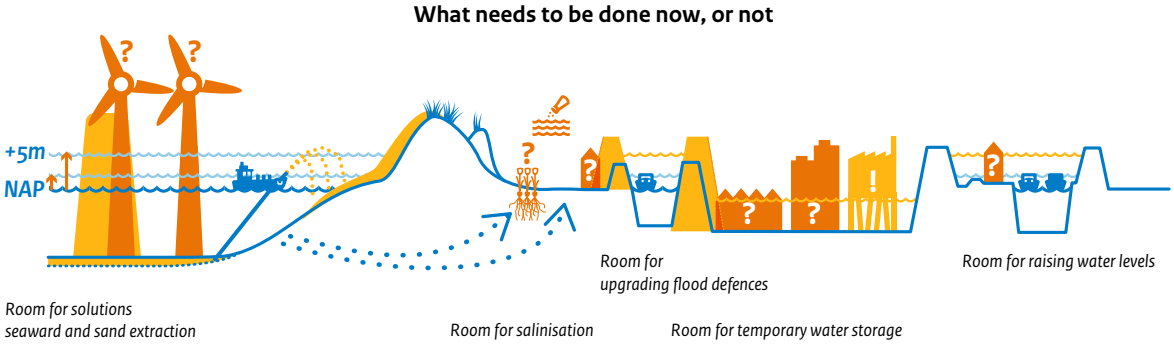


Figure 5 *Potential spatial consequences of sea level rise for new investments*

In parallel with these area meetings, fourteen planners have presented their ideas about future solutions to experts and participants in the Delta Programme. Relevant building blocks - physical, legal or financial measures - that result from this process will help in the area-specific implementation of the long-term solutions in 2022. More information about the results of the area meetings can be found in Chapter 6.
The Knowledge Programme also focuses on implementation issues (Track V). That includes communications. A key internal communications activity was the third national day of the Sea Level Rise Knowledge Programme on 5 April 2022, where 200 participants from government authorities, knowledge institutes and the water community were informed about progress. Another crucial component of the Knowledge Programme is participation by NGOs and government authorities. The participation plan was completed in late 2021. It sets out the form that collaboration with stakeholder organisations will take. As part of the implementation strategy, governance and transition issues involved in anticipating sea level rise in good time are also being explored. For the short term, an important question is how local governments take uncertain sea level rise into account in spatial-planning decisions. Information about the progress of the Knowledge Programme can be found on the website of the national Delta Programme. The plans that have been submitted can also be found there.

The Knowledge Programme organises annual consultations with representatives of the Flemish Department of Mobility and Public Works (MOW) and the Maritime Services and Coast Agency. The aim of the consultations, which focus on research into accelerated sea level rise and possible measures, is to further coordination and collaboration.

An interim assessment of the Knowledge Programme will be published in the autumn of 2023, stating insights into the effects of sea level rise on the water system, an initial description of long-term solutions, and the follow-up research required. At that time, the new sea level rise scenarios will also have been published as part of the KNMI'23 scenarios. The second phase - from 2023 onwards - answers questions relating to the possibility of extending the scope of existing strategies and side-effects on other functions. The results of these analyses will also be transformed into adaptation pathways and the transition and governance developments required for this purpose. This second phase will provide the necessary input in 2025 for the periodical evaluation of the Delta Programme in 2026.

Background to the Sea Level Rise Knowledge Programme

Sea level rise in 2100 may exceed the upper limit of one metre currently adopted by the Delta Programme. That is stated in the IPCC Working Group 1 report of August 2021 and the KNMI Climate Signal of October 2021 based on that report. In 2019, the Minister of Infrastructure and Water Management and the Delta Commissioner initiated the Sea Level Rise Knowledge Programme. Government authorities, knowledge institutes, companies, planners and stakeholder organisations are working together on new knowledge about sea level rise and the possible consequences for flood risk management and freshwater availability.

The programme serves several purposes and the work has been broken down into five tracks:

- Improving knowledge about sea level rise (Track I) and observing the acceleration of sea level rise in a timely and reliable manner (Track III).
- Mapping out the sustainability and possibility of extending the scope of the current Delta Decisions and strategies - in a context of extreme sea level rise scenarios and the associated salinisation, and in combination with high river discharges (Track II).
- Exploring possible action perspectives for the long term. The Knowledge Programme also includes the exploration of options for securing space that may be needed to keep options open for the long term (Track IV).
- Ensuring that communications and participation are satisfactory and preparing in good time for future transition and governance issues (Track V).

The annual Delta Programme describes the progress of the Knowledge Programme. The Knowledge Programme provides the important decision information for the next periodical evaluation of the Delta Programme in 2026. The Knowledge Programme has its own web page with background information about the various tracks, reports and minutes of meetings.

2.2 Recommendation from the Delta Programme Signal Group

The Delta Programme Signal Group monitors changes in the climate, sea level, hydrology and land use using indicators that relate to the past and the future. The Signal Group consists of substantive experts from authoritative knowledge institutes that are relevant for the Delta Programme. Currently, these are: KNMI, Netherlands Environmental Assessment Agency, Deltares, Wageningen University & Research, Rijkswaterstaat and Statistics Netherlands. In December 2021, as in previous years, the Delta Programme Signal Group submitted recommendations to the Delta Commissioner (see background document C).
The recommendations address the acceleration of climate change noted by the IPCC and KNMI and the unpredictability of extremes such as the torrential downpours in the summer of 2021. The Signal Group called for a systematic check on the assumptions underlying the current strategies, and a critical analysis of the risk and planning concepts used. It also called for attention to be paid to the adaptive capacity of urban communities and the importance of coordination with other spatially relevant transitions. The Delta Commissioner intends to adopt the recommendations. He also subscribes to the need to develop a method that can visualise the usefulness of, and necessity for, transformative interventions. In addition, he has commissioned a public-friendly summary of the recommendations. This summary supports the discussion at the governance level and further implementation in the regions, and makes the recommendations accessible for a wider public.

2.3 Flooding Policy Platform

In July 2021, there was extreme rainfall in an area half the size of the Netherlands. The result was severe flooding and problems with water in Limburg, Germany, Belgium and Luxembourg. The floods, particularly in the tributaries of the Meuse and Rhine rivers, resulted in over 200 deaths in other countries, and caused suffering and damage (€ 40 billion) for residents, business and organisations in the affected area. The problems with the excess water were so extensive that the government decided to declare the situation a national disaster and to implement the provisions of the Disaster Compensation Act (Wts).

Extreme precipitation of this kind can fall anywhere in the Netherlands. As a result of climate change, climate extremes are on the increase and, according to the KNMI, there is a genuine possibility that events like this will become more frequent. The Minister of Infrastructure and Water Management therefore established the Flooding Policy Platform in July 2021. The purpose of this temporary policy platform is to learn from the situation in Limburg in order to deal better with the consequences of extreme precipitation throughout the Netherlands. The policy platform includes a range of parties, such as the national government, the Limburg authorities, the Union of Water Authorities (UvW), the Association of Provincial Authorities (IPO), the Association of Netherlands Municipalities (VNG) and the Delta Commissioner. The policy platform will publish two advisory documents within a year: the first appeared in the spring; the second will appear in the autumn of 2022.

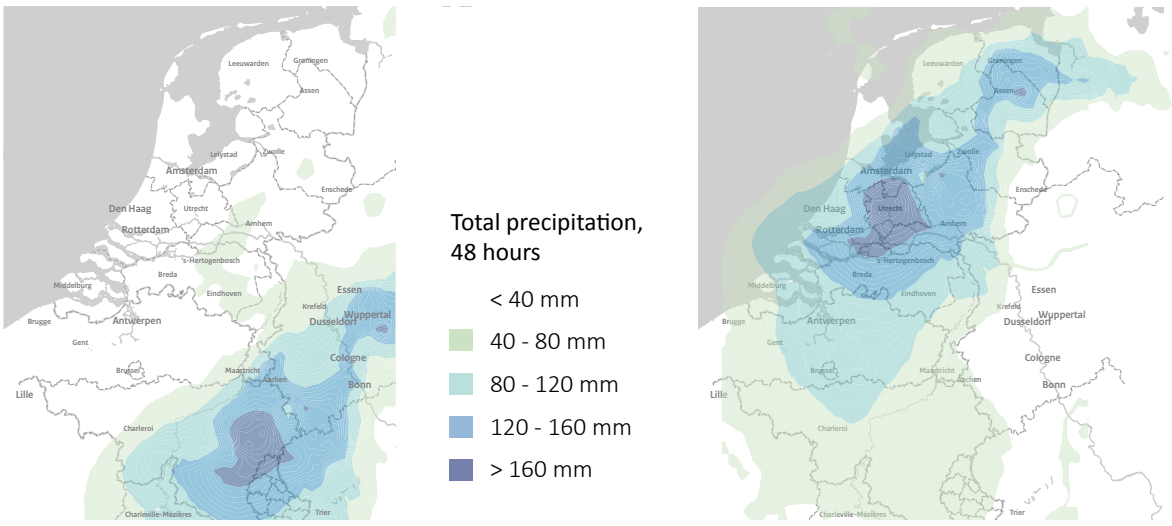


Figure 6 *48-hour rainfall in July 2021, actual situation (left) and an example of a relocated situation (right). Source: Deltares*

The first advisory document states that our water systems, spatial planning and crisis management cannot prevent problems with water during such extreme precipitation events. However, it is possible to limit the damage, social disruption and dislocation. That will require preventive measures, as well as more efforts to mitigate the consequences, through spatial planning, raising awareness and crisis management. The second advisory document will add more depth and scope to the first.
The Delta Commissioner is represented on the policy platform; the recommendations are being elaborated in ongoing programmes and existing organisations, including the Delta Programme for Spatial Adaptation. That process of elaboration will focus in particular on:

- The establishment of norms for regional problems with excess water, determining which developments in the norms system are needed to take supra-normative events into account and how to ensure that the water and soil system will act more as a leading factor.
- The development and implementation of supra-regional stress tests for extremes in very large areas, such as the one in July 2021. These stress tests will provide a picture of the consequences and the action perspective for all stakeholders in water management, spatial planning, vital networks and functions, and crisis management.
- The further development of stress tests as they began with the Delta Plan for Spatial Adaptation in 2018, including agreements about further norms and knock-on effects.
- Smart area development in which water and soil act more as leading factors, so that damage is limited during weather extremes.
- Incorporating the lessons in policy, including the Delta Programmes for Flood Risk Management and Spatial Adaptation, and Integrated River Management (IRM), specifically for the Meuse River.
- Concrete options to raise water awareness.
- Analysis of the impact of extreme precipitation on other locations in the Netherlands, including an action perspective for better preparations in these areas.
- System Analysis for Limburg and the resulting recommendations.

2.4 Groundwater Study Group

The dry years of 2018 and 2019 have demonstrated the vulnerability of the groundwater system - particularly in the areas with sandy soils. Nature areas were affected by subsiding groundwater levels, drinking water extraction came under pressure, and water extraction for sprinkler irrigation increased dramatically. For years, parts of the high-lying areas of the Netherlands in particular have seen a trend of structural damage in groundwater-dependent nature areas, the depletion of deep groundwater buffers, and falling seepage pressure. In the low-lying areas of the Netherlands, falling groundwater levels lead to land subsidence and damage in the built environment, both in public spaces and to property. This prompted the Water Steering Group (now the Water Administrative Consultation Platform) to set up a temporary 'groundwater study group'. This study group is analysing the barriers and opportunities relating to the sustainable management of groundwater resources and - where this is meaningful - it will issue recommendations relating to both substantive matters and for eliminating impasses in governance. The study group is focusing on aridification in the high-lying areas of the Netherlands; the built environment and salinisation in low-lying areas of Netherlands; groundwater quality; the societal value of groundwater; and the energy transition. A report with recommendations and action perspectives will be published in late 2022.

The study group includes government representatives: the Ministries of Infrastructure and Water Management (IenW), Economic Affairs and Climate (EZK) and Agriculture, Nature and Food Quality (LNV); the umbrella organisations UvW, IPO and VNG; and the Delta Commissioner's Staff in order to maintain the connection with the Delta Programmes on Spatial Adaptation and Freshwater. The study group reports to the Water Steering Group.

2.5 Knowledge Agenda for Cross-Border River Discharges and Discharge Distribution

The effects of climate change are already affecting the river area: there are higher peak discharges, longer periods of low discharge and longer periods of high discharge. It is the question whether the knowledge that is currently available will be adequate for an assessment of the need to adapt the Delta Decisions. In 2021, the Delta Commissioner therefore recommended the establishment of a Knowledge Programme on Cross-Border River Discharge and Discharge Distribution. An ongoing review shows that a lot is already being done with respect to knowledge development for the distant future of rivers, both within the Netherlands and across borders. Through research programmes, national policies, pilot studies and international partnerships, work is taking place on the establishment of a future-resilient river area. However, the experts interviewed believe that a broader view is required. In particular, it is necessary to

look ahead further in time (beyond 2085) and further in terms of space; at the system as a whole; and across country and management boundaries using the most integrated approach possible. This requires the development of a range of scenarios and the exploration of different possible solutions. The current planning arrangements and requirements are the starting point here, but the necessary transitions such as those for energy and sustainability, autonomous developments and a possible (radically) different design of the Dutch delta must also be taken into account[10].

The results of the inventory will be included in the Rivers Knowledge Agenda – which is currently being established by Rijkswaterstaat and the Directorate-General for Water and Soil – in conjunction with the Integrated River Management (IRM) programme. This programme is working on policy decisions for future-resilient and climate-robust spatial planning for the rivers. On the basis of the Rivers Knowledge Agenda, there will be a discussion of which topics need to be investigated further and how best to organise this.

[10] Kennisontwikkeling voor het Nederlandse rivierengebied, Inventarisatie lopend onderzoek, Author(s) Anna Kosters, Nathalie Asselman. Deltares 2022

2.6 Innovations

'We need more innovation'. That is the position of the countries working together in the Adaptation Action Coalition (a United Nations initiative). For the Delta Programme, too, the development of new methods and techniques is a prerequisite if the goals for 2050 are to be achieved. Over the past decade, all kinds of programmes have invested in innovations to make the Netherlands climate-resilient and water-robust. Examples are the national Knowledge and Innovation Programme on Water and Climate (NKWK) and the living labs and testing grounds set up in all parts of the country.

An example of an initiative of this kind is the alliance between Delft University of Technology and public and private partners under the name VPdelta. VPdelta has drawn up an overview for the Delta Programme of the lessons learnt from ten years of experience with its own programme practice, and described them on the basis of inspiring examples[11]. One of the lessons is that other funding mechanisms and more room for innovative solutions in tender methods are needed for the structural deployment of innovations from the pilot projects for a climate-resilient delta.

[11] See background document D

2.7 Participation

Participation is an important pillar of the Delta Programme. The agendas require the active involvement of, and ideas from, government authorities, business, the general public and interest groups. Participation takes place at various scales, ranging from streets or neighbourhoods to the national level. The sub-programmes shape participation in area processes and workshops (IRM), risk dialogues and discussions about water availability (Spatial Adaptation and Fresh Water) and in regional sessions (Sea Level Rise Knowledge Programme).
At the national level, the Physical Environment Consultative Body (OFL) formally advised on the 2023 Delta Programme. See background document E. In its report, the OFL expresses its appreciation for the concise and clear format of the 2023 Delta Programme Outlines, which implemented an earlier OFL recommendation. The OFL recognises that the agendas facing the Delta Programme are increasing and that this requires an acceleration of the approach and coordination with the major transitions. The OFL expects the Delta Programme and the Delta Commissioner to play a leading and driving role. In addition, the report refers to the necessary balance between national control and regional implementation. An illustration is provided by the agendas in the IJsselmeer area, which must be considered in conjunction with the regional and the national contexts. Finally, the OFL supports the 'water and soil as leading factors' approach, but asks for more concrete formulation, including the utilisation of nature and natural solutions. In the autumn of 2021, the OFL had already recommended in an unsolicited advisory document that the soil and water system should play a more leading role. In that report, the OFL advised that the Delta Programme could play a driving role and seek to establish links with other transitions and agendas in the regions - including housing and biodiversity.

Involvement of the younger generation

The goal of the Delta Programme is to keep the Netherlands safe and liveable for future generations. That is why importance is attached to the input and involvement of the younger generation. Like last year, the Delta Commissioner spoke to a number of students about the administrative introduction to the DP2023. These were students of water management or climate at colleges or universities. Among other things, the students recommended giving water shortages a more prominent position in the Delta Programme, since this is an ongoing challenge. At the same time, consideration of the floods in Limburg in 2021 is important because they made people aware that floods caused by extreme rainfall are possible everywhere. The students called on the Delta Commissioner to give the text a greater sense of urgency: we have to start *now*. The Delta Programme is asking students to write their own administrative introduction to the Delta Programme 2024 with the aim of incorporating their ideas even better. The Delta Commissioner also had discussions with young engineers in a College Tour setting at the Maeslant barrier this year. The young people discussed the advisory document about housing that the Delta Commissioner sent to the Minister of the Interior and Kingdom Relations. Among other things, they asked about the Delta Commissioner's view of the role of the engineering industry in the transitions currently facing the Netherlands.

2.8 International context of the Delta Programme

The United Nations Sustainable Development Goals (SDGs) are the international framework for the Delta Programme. The Delta Programme contributes to the national implementation of SDG 6 'Sustainable management of water and sanitation for all', SDG 11 'Make cities and human settlements inclusive, safe, resilient and sustainable' and SDG 13 'Urgent action to combat climate change and its impacts'. Around the world, countries are unfortunately still not making adequate progress towards meeting these goals.

Meanwhile, the risk of flooding, drought, problems with excess water, salinisation and water pollution is increasing worldwide, partly due to the effects of climate change and more extreme weather. In addition to the global action required to achieve effective and timely climate mitigation, climate adaptation is one of the largest challenges we face for the coming decades. In March 2023, the Netherlands and Tajikistan will host the UN Water Conference in New York. This will be the first UN water conference since 1977.

Gathering and disseminating knowledge

Every year, the Delta Programme receives numerous requests from abroad to learn about the lessons of the Delta Programme. In many cases, these lessons are shared through webinars that are tailored to, and appropriate for, the particular culture, institutions and policies of the country in question.
Under the banner of the Netherlands International Water Ambition (NIWA), the Netherlands helps other countries to address the complex and urgent issues at hand. Improving water security is a question of perseverance. It is important here to gather and disseminate knowledge. In that context, long-term partnerships have been established with delta countries such as Bangladesh (Bangladesh Delta Plan), Vietnam (Mekong Delta Plan) and the Philippines (Manila Bay Master Plan), and there is intensive knowledge-sharing with Singapore - including knowledge about urban climate adaptation.
The Dutch government (including the Ministries of Infrastructure and Water Management, and Foreign Affairs, and the Delta Commissioner's Staff) advises stakeholders in these countries upon request, particularly in the area of the governance of water management in delta areas.

European strategy for climate adaptation

In March 2021, the European Commission presented – as part of the Green Deal – the European Climate Adaptation Strategy. This strategy is also important for the Delta Programme. The strategy aims to deliver smarter, faster and more systematic climate adaptation and to generate more international attention for the adaptive capacity of countries and regions. The focus is on the development of measures and their implementation (and encouraging that development), in part by providing more access to the knowledge and finances required.
The European Commission will promote regional and cross-border cooperation and support the development and implementation of adaptation strategies and plans at all administrative levels.

2.9 Redesigning Deltas

Redesigning Deltas (RDD) is a trans- and multi-disciplinary knowledge programme that investigates the role of design and design research in the development of a long-term vision and strategy for the sustainable and safe planning of the Netherlands. The international programme was established in 2021 by Delft University of Technology in collaboration with Deltares, the Erasmus University Rotterdam and Convergence[12], Wageningen University & Research and the Netherlands Environmental Assessment Agency. Redesigning Deltas focuses primarily on strengthening the scientific basis underlying possible future scenarios and identifying development pathways towards them. The Delta Programme contributes to RDD - financially and through the exchange of insights and information. The results of the RDD knowledge programme can play a role in the periodical evaluation of the Delta Decisions in 2026. RDD and the Sea Level Rise Knowledge Programme work together closely.
Key questions covered by RDD include:

- Which intervention and adaptation strategies are available for the different impacts of climate change and at which system and scale levels are they applicable? How do technical, spatial and ecological strategies relate to each other? Which strategies are proven and effective? Which factors determine willingness to invest for the different strategies (time, cost, damage)?
- Which constraints on economic and other functions follow from the various intervention and adaptation strategies for vulnerable or dynamic delta areas? How can this be handled and how can these constraints be transformed into opportunities? How can design research help to identify opportunities?
- To what extent can other developments and transitions in the areas of energy, mobility, circularity and biodiversity contribute to the creation of additional opportunities?
- Which futures, scenarios, design principles and innovations do the various intervention and adaptation strategies deliver for vulnerable or vital delta areas, and which adaptations or new approaches could this deliver for policy, practice, education, and research?

Five design teams have started work; they include fifteen Dutch firms from the professional field (landscape architecture, urban planning and engineering firms). The initial results are expected in late 2022. On 16 and 17 June 2022, representatives from eight different deltas met at the International Delta Conference in Rotterdam. The questions above were looked at here from an international perspective with the aim of providing further direction for the multi-year knowledge programme.

[12] Background information (in Dutch)

CHAPTER 3

Flood risk management

Start of Heel-Beesel dike upgrade, Heel, March 2022

The high water in Limburg in July 2021 made it clear once again that an unremitting focus is crucial for flood risk management in our country. In order to meet the targets for flood risk management by 2050, the Netherlands must maintain the pace of work on the upgrading of the primary flood defences and widening the rivers. The work is clearly picking up steam. Inventory studies, detailed planning and actual dike upgrades are continuing unabated. Some 22 kilometres of dike upgrades will be completed in 2022. In addition, the assessment of all the primary flood defences will be completed this year. The national flood risk management agenda is coming more and more into focus and operational projects are beginning. The number of completed kilometres of upgrades in the Flood Protection Programme (HWBP) will increase in the coming years. And that is needed to achieve the annual average of 50 kilometres required if all flood defences are to meet the statutory requirement by 2050.

3.1 Objective for 2050: perspective

Everyone in the Netherlands who lives behind a primary flood defence will have at least a basic protection level of 1 in 100,000 annually by 2050 at the latest. That means that the probability of an individual dying as a result of a flood must not exceed 0.001% per year.
As a basis for achieving this goal, new flood protection standards for the primary flood defences have been in place since 1 January 2017. These flood defences must comply with the legal standards by 2050. Primary flood defences that do not meet the standard are being upgraded in the Flood Protection Programme (HWBP). On the basis of current understanding, some 1,500 kilometres of dike will require upgrading between now and 2050.

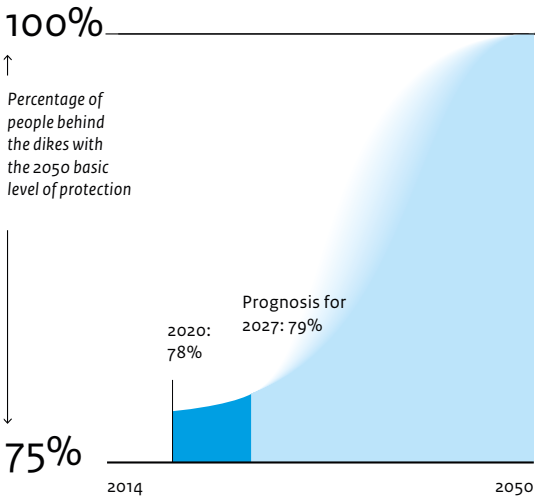
The current HWBP Programme began in 2014. An HWBP project lasts an average of seven years and consists of an inventory, planning and operational phase. The programme puts a priority on returns. In other words, defences that fall further short of the standards are tackled first. As a result, more complex projects are currently in the operational phase. These larger projects generally have longer lead times. The upgrades are therefore proceeding at a slower pace at present. From 2027 onwards, the annual number of kilometres of completed upgrades will increase markedly.

Of the approximately 9 million people living behind a primary flood defence in our country, about 78% already had the basic level of protection in 2020 that is required by 2050. The upgrades will lead to an increase in this percentage over the years. By 2050, everyone – in other words 100% of the people living behind a primary defence – must have the basic level of protection. In 2027, this percentage will have increased to approximately 79%. From 2027 onwards, when the rate of upgrade completion under the HWBP accelerates, this percentage will increase more rapidly by comparison with earlier years.

By 2050, everyone in the Netherlands will have the basic level of protection

What is the goal and what is our current position?

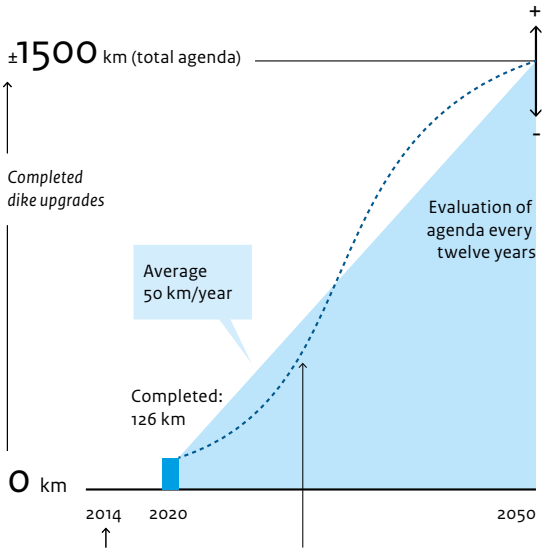
National Water Programme: in 2050, the basic level of protection* will apply to everyone behind the dikes



*The probability of mortality due to flooding shall not exceed an average of once in 100,000 years

How are the measures progressing?

Dike upgrades are the most important measure in the Delta Plan for Flood Risk Management.



Initial years for preparation, then leap in rate of completion

Figure 7 *Flood risk management - By 2050, everyone in the Netherlands will have the basic level of protection*

3.2 Progress

Evaluation of Water Act

The Water Act stipulates that, before 1 January 2025, the Minister of Infrastructure and Water Management (IenW) will report to both houses of parliament about the effectiveness and the effects of five components of the Water Act relating to flood risk management (Articles 2.2, 2.3, 2.12, 3.9, and 7.23-7.26). In early 2021, the Ministry of IenW, with the relevant stakeholders, started on the elaboration of the scope and key questions for the evaluation. Important stakeholders are the Union of Water Authorities (UvW), the water authorities with primary flood defences, Rijkswaterstaat, the Flood Protection Programme, the Association of Provincial Authorities (IPO), the Association of Netherlands Municipalities (VNG) and the Human Environment and Transport Inspectorate (ILT). In December 2021, the Water Steering Group established the scope, primary research questions and demarcation of the retrospective evaluation of the five components of the Water Act relating to flood risk management. The evaluation is being conducted in 2022 and 2023. The administrative completion of the evaluation will begin in early 2024.

National assessment round

The first national assessment round for primary defences based on the new standards began in 2017. The end of this round is approaching because all assessments must be submitted to the ILT by 2022. In the meantime, the managers have built up considerable experience and knowledge relating to the new system and instruments. It is expected that, by mid-2022, almost all sections of dike will have been assessed and the assessments submitted to the ILT. Coordination with the ILT is going well, knowledge exchange has intensified and management authorities are working together with the aim of fulfilling their deadlines. In addition, the Ministry of Infrastructure and Water Management, Rijkswaterstaat and the Union of Water Authorities are still providing sound support.

The first National Flood Risk Assessment will be available in 2023. The results will provide important information for the management and maintenance of the primary flood defences and for the necessary upgrade projects. A better picture will emerge of the effort required to ensure that all primary flood defences will comply with the required standards by 2050. This will help to establish a clearer picture of the overall agenda up to and including 2050.

Afsluitdijk Barrier Dam

The operational phase of the project for the Reinforcement and Renewal of the Afsluitdijk barrier dam is currently in full swing. The project includes, among other things, reinforcing the dike over a distance of more than thirty kilometres, building two pumping stations and two floodgates, and the construction of an opening in the dike for a fish migration channel. These elements are scheduled to be completed no later than 2023. Two other parts of the project have been delayed: the construction of new discharge sluices and the renovation of the existing discharge sluices. The design of the new discharge sluices was based on incomplete information about combinations of wave heights and water levels on the IJsselmeer side of the dike and had to be revised. Because the new discharge sluices will be completed later, it will take longer before additional capacity is available for water discharge purposes. That has implications for the renovation of the two discharge sluices in place: this work is now being done in phases so that there is always enough capacity for water discharge. The new timetable takes the requirement of keeping the road open during the work into account, as well as working restrictions during the nesting and storm seasons. As a result, the renovation of the existing discharge sluices will take longer. The work is expected to be completed by 2025, with the exception of the renovation of the existing discharge sluices, for which the final completion date has yet to be determined.
The final solution will implement the original objectives for flood risk management and discharge while preserving the aesthetics of the original design.
The flood protection afforded by the Afsluitdijk will be safeguarded for at least fifty years after completion of the work. On 20 May 2022, the Minister of Infrastructure and Water Management informed the Dutch House of Representatives about progress and developments with respect to the strengthening and renovation of the Afsluitdijk and the associated financial consequences[13].

Steering Group for the Management of Water Crises and Floods (SMWO)

Crisis management and crisis measures

The Steering Group for the Management of Water Crises and Floods (SMWO) is working on a vision for water crisis management that includes looking ahead to 2030. By conducting surveys and interviews with all the crisis organisations involved with the SMWO, visionary storylines for the year 2030 are being elaborated for five different crises - including drought and flooding. These visionary storylines will be compared with the current development agendas of the crisis organisations involved, and this will include identifying gaps. The goal is to arrive at a joint vision and strategy for the period up to 2030. The vision document is expected to be completed in late 2022.

WAVE2020

The 2020 Safety Region Approach for Floods (WAVE) was a programme directed by the Steering Group for the Management of Water Crises and Floods (SMWO). The aim was to embed the management of water crises in the crisis plans of the safety regions. In this context, the safety regions have continued to work recently on impact analyses in order to improve evacuation plans and collaboration between the parties concerned. They will continue to elaborate these analyses in conjunction with the SMWO, and this process will also draw on input from their evaluations relating to the 2021 floods in Limburg.
The WAVE2020 programme has now been completed and it has submitted a number of recommendations to the SMWO. See final report. The lessons learned from the 2021 floods in Limburg will also be included in follow-up actions.
Safety regions participate in the SMWO and remain responsible for crisis response.
The implementation of the recommendations will take place in close consultation with the Delta Programme, which is represented on the SMWO.

Dike ring 48 (outcomes)

In January 2021, the Ministry of Infrastructure and Water Management, Directorate-General for Water and Soil (DGWB) began an inventory of the flood risk in the cross-border dike ring 48 in the SMWO (see Figure 8). Flooding from Germany may mean that the basic level for flood protection cannot be met everywhere within this dike ring by 2050.

This study was conducted in collaboration with the Rijn en IJssel and Rivierenland water authorities and the Gelderland-Midden and Noord- en Oost-Gelderland safety regions. The aim was to investigate how the basic level of protection can be achieved everywhere in 2050 – when the dikes in the Netherlands are required to meet the standard – inside dike ring 48, taking into account the role of the risk of flooding from Germany. In addition, several courses of action were described in order to improve evacuation options. This may help not only to achieve the basic level of protection but also to reduce numbers of casualties in the current situation.

The level of the failure probability for the German defences is a major determinant of the extent to which the basic level of protection can be achieved by 2050 everywhere in dike ring 48. Given a failure probability of about 1/3,000 per year (or less) for the German defences in 2050, it is expected that the basic level of protection can be met everywhere in the area[14].

[13] Parliamentary Paper 35925-A no. 73

[14] 'Pilot evacuatie dijkring 48. In het kader van de evaluatie van de normering van waterkeringen en verbetering van de voorbereiding op evacuatie' HKV, September 2021.

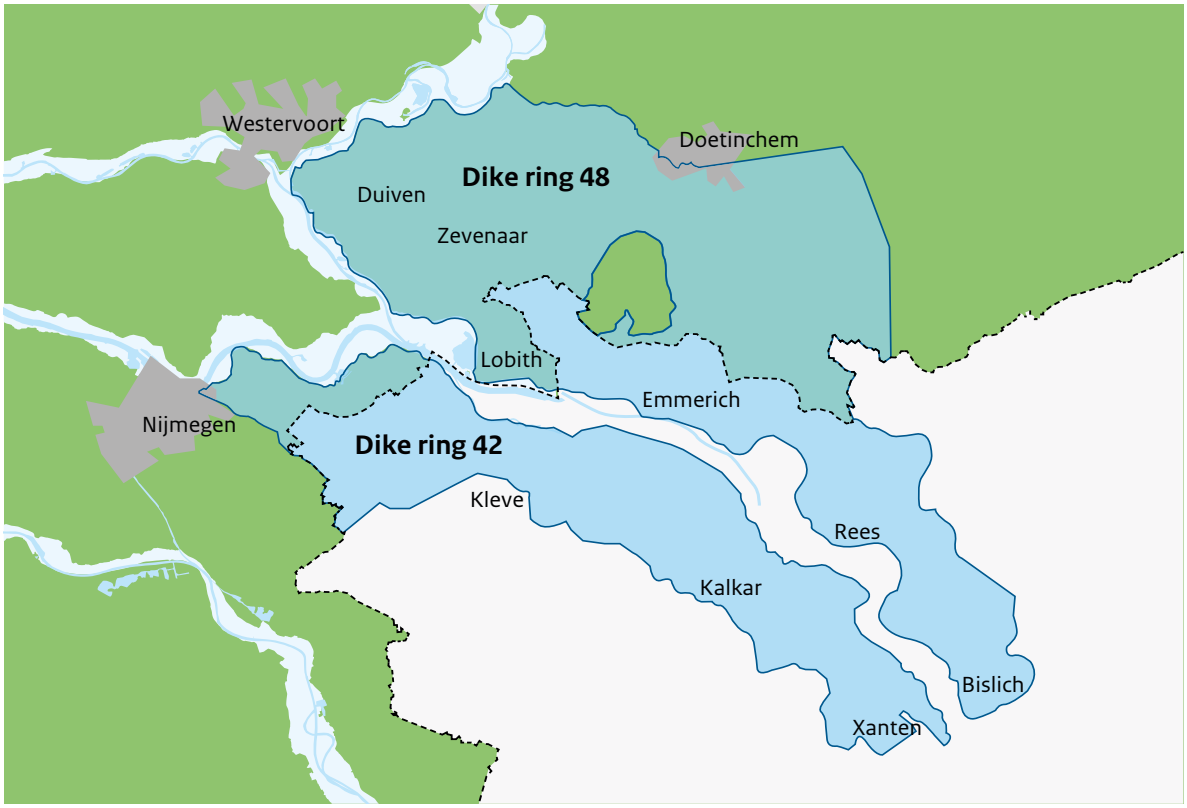


Figure 8 *The location of dike ring 48*

It is therefore essential to establish a picture of the probable failure probability of the defences in Germany in 2050. To this end, steps will be taken on the basis of the assessment of the cross-border dike rings. This assessment is a part of the national assessment round and it focuses how dike breaches in other countries can affect the risk of flooding in the Netherlands. The results will be published in the summer of 2022. It may follow that, in the cross-border dike rings along the Rhine, measures are needed that focus on flood risk and collaboration with the German partners.

3.3 Developments

Flood Risk Management Expertise Network (ENW) recommendation about discharge distribution

The Rhine water that enters the country at Lobith is split near the village of Pannerden into the Waal river branches and the Pannerdensch Kanaal and near Arnhem into the IJssel and the Lower Rhine. At high discharge, discharge distribution is also regulated by two installations at these locations. In 2006, a policy principle was established about the distribution of the then-prevailing normative discharge to the Rhine distributaries. This principle is known as 'sparing the Lek' and it was confirmed in the 2016-2021 National Water Plan (NWP): "As a precaution, the government is taking into account an increase in the current maximum river discharges in the decades ahead. Here, the government will maintain the current policy-based discharge distribution to the Rhine distributaries until at least 2050."

The introduction of the new approach to flood risk that underpinned the current statutory flood protection standards (2017) raised the question for the Ministry of Infrastructure and Water Management of how to reinterpret the 'sparing the Lek' policy. In addition, the question also arose as to whether the principles and considerations underlying the 'sparing the Lek' policy are still valid. The Flood Risk Management Expertise Network (ENW) issued an advisory document on the future of this policy in 2021[15].

In accordance with this document, the current policy regarding discharge distribution and 'sparing the Lek' will stay in place. The years 2050 and 2100 are used indicatively as points in time for switching to the distribution 17,000

[15] Advisory document "Toekomst van het beleid 'Lek ontzien'", Expertisenetwerk Waterveiligheid, 27 July 2021.

m^3/s and 18,000 m^3/s, respectively, sparing the Lower Rhine-Lek. This policy will be included in the Statutory Assessment Instruments.
After the new KNMI climate scenarios become available in 2023, a wide-ranging study of the long-term discharge distribution will be initiated in accordance with the advisory document.

Knowledge Agenda

Statutory Assessment Instruments

In recent years, the Knowledge for Flood Defences programme has generated a great deal of knowledge for the ongoing development of instruments for assessing and designing primary flood defences. The present statutory assessment instruments are adequate for the proper implementation of the assessment currently being made. In the period up to and including 2022, the instruments have been, and are being, further developed in collaboration with the partners in the flood risk management sector. From 2023 onwards, the managers of flood defences will be able to use that improved set of instruments to conduct the assessment of the primary flood defences in the second round of assessments, which will continue until 2035.

In the period prior to 2035, the continued development of instruments is expected and they will be supplied to the management authorities at regular intervals when important new insights emerge. The managers of flood defences have now acquired six years of experience with the new flood and risk approach, and the assessment and design instruments. This experience will support ongoing development during the period 2023-2035. With the improved instruments and the experience acquired, a more detailed picture of flood risks will emerge during this period.

Flood risk management requires space

In the advisory letter, Make work of climate adaptation, the Delta Commissioner called for space to be earmarked now for flood risk management measures in the future. This means additional room alongside the dikes that must be set aside and ringfenced in the light of future upgrades, and more space for safe discharge and water storage in the river bed. The Delta Commissioner also recommends that spatial planning should take into consideration, to an even greater extent, the possible need for additional water storage and level fluctuations in large bodies of water, for example in the IJsselmeer and along the North Sea Canal.

3.4 Delta Plan for Flood Risk Management

The Delta Plan for Flood Risk Management includes all the studies, measures and provisions of the Delta Programme relating to flood risk management.

3.4.1 Flood Protection Programme

The programming of the Flood Protection Programme (HWBP) for the period 2023-2028 can be found in Tables 1 to 7 inclusive.

Progress and programming

In 2023, there will be preparations and dike upgrades for about 650 kilometres of primary flood defences. Inventories have been completed for more than half of the defences and the subsequent phases have begun. By 2023, nearly 50 kilometres of dike will have been upgraded on time. The total length of the required dike upgrades between now and 2050 is estimated at approximately 1,500 kilometres. Inventory studies, detailed planning and operational projects have now been programmed for 780 kilometres.

Signals and new insights

The first assessment of primary defences will continue until 2023. New upgrade projects will be programmed for sections of dike that are rejected during the assessment. A clearer picture will therefore be established in the years ahead of the scope of the programme as a whole between now and 2050.

year	completed with operational phase	completed without operational phase	total completed
2014	0.2 km	0.2 km	0.4 km
2015	0.9 km	11.6 km	12.5 km
2016	0.9 km	0.3 km	1.2 km
2017	11.0 km	15.8 km	26.8 km
2018	6.0 km	27.3 km	33.2 km
2019	1.9 km	12.2 km	14.1 km
2020	13.9 km	24.4 km	38.3 km
2021	1.6 km	28.4 km	30.0 km
Total	**36.4 km**	**120.2 km**	**156.5 km**

	forecast
2022	12.8 km
2023	4.0 km
2024	10.9 km
2025	7.8 km
2026	107.2 km
Total	**142.7 km**

28.5 km Annual average between 2022 and 2026

Basis

- Programming
- Modification request process
- Programme 2022 - 2027/33

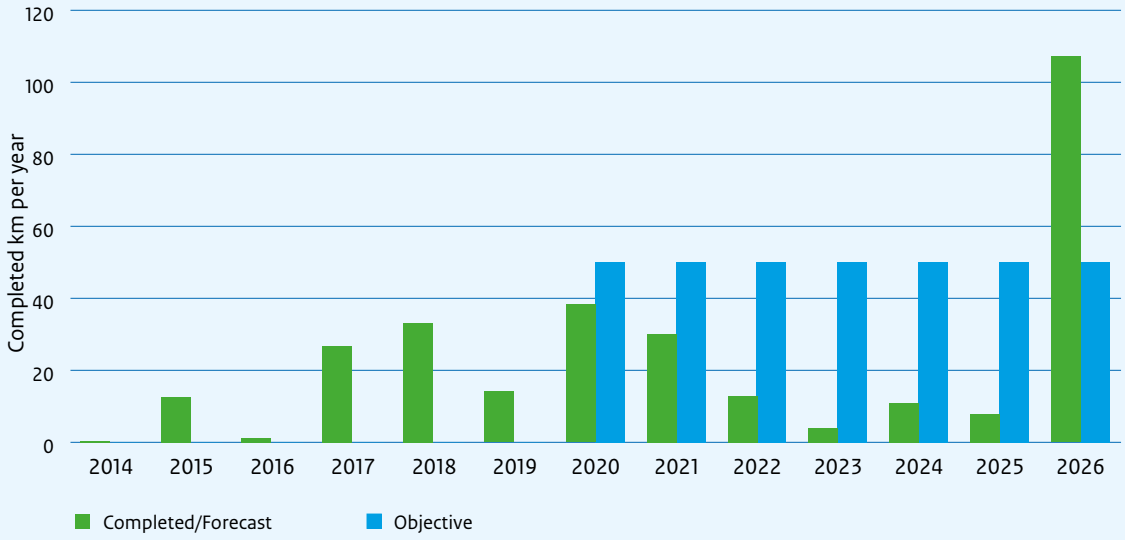


Figure 9 *Implementation of the Flood Protection Programme. Source: 2021 Annual Report from HWBP*

The ambition of the HWBP alliance (Rijkswaterstaat and the water authorities) is to bring an average of 50 kilometres of primary flood defences up to the standard every year, in part with physical measures such as dike upgrades and, in isolated cases, dike relocation.

Figure 9 shows a projection of the completed HWBP projects stated as the expected increase in the length of upgraded flood defences. In 2026, the expectation is that 107 kilometres will be completed, and that is in line with the goal of 50 kilometres annually. In the start-up phase of the programme, progress failed to match the objectives. It will be necessary to catch up with the backlog from the years 2021 through to 2025 in later years. The HWBP Alliance has devoted considerable attention to the stability of the programme in recent years. Measures to enhance the stability and predictability of the HWBP have been identified and they will be implemented over the next two years.

On the basis of the current estimate of the total upgrading required in the Netherlands between now and 2050, the Delta Fund is expected to have sufficient funding available for the entire agenda of the Flood Protection Programme. A condition here is that the agreements made in the Administrative Agreement on Water Management about input to the Delta Fund should be extended to include the period up to and including 2050. The costs of dike upgrades are rising steadily. The next periodical evaluation will have to re-examine whether the available budget of the Delta Fund will be adequate. This will also depend on further price developments for raw materials and fuels, about which there is considerable uncertainty at present. In addition, developments related to the legal framework for nitrogen may affect the costs of dike upgrades. Chapter 7 discusses the financing of the Delta Programme as a whole.

Knowledge development and innovations

It has emerged that furthering knowledge and innovation in over 60% of the upgrade projects ultimately results in the reduction of the scope of the work that needs to be done and better integration in the surrounding area. It also results in emission reductions, better teamwork and the exploitation of synergy opportunities. Savings to date have been estimated to be at least € 370 million. This emerged from the response to the 2021 Knowledge and Innovation Monitor[16].

Examples

In 2021, the construction of the Coarse Sand Barrier in the Waal dike in Gameren meant that we had another solution for the washing away of sand under the dike (*backward erosion piping*). The piping trial in the Hedwige polder has shown that less drastic dike upgrades are needed on the coast and in the delta. The overtopping trials on grass dikes on the Vecht and IJssel, and the Delta Flume test with sediment for the Broad Green Dike, have shown that some of the dikes are more resistant to erosion than previously assumed. These results help to incorporate dikes better in the surroundings and to make savings in the future. See also De Innovatieversneller wiki.

Linking spatial agendas

The aim of the Flood Protection Programme is to link the dike upgrade projects where possible to agendas not covered by flood risk management. A good example of this is the Flood Defence Landscape Scenario that joint authorities and stakeholders drew up for Schiermonnikoog. Initiatives of this kind are encouraged by funding broad inventory studies and integrated approaches to determining the scope of activities. The identification of promising synergy opportunities or options for integrated area development are regularly included in the inventory studies conducted under the auspices of the HWBP. Dike upgrades can act as drivers for other agendas here.

Other examples

In the Tiel-Waardenburg project, a combination was made with the agenda for the Water Framework Directive (WFD) in the floodplains adjoining this section. This will also compensate for the strengthening of the dike on the river side and ensure that this does not restrict the space the river needs to drain water. As part of the Programmatic Approach for the Main Water System (PAGW), agendas in the areas of nature and water quality are being integrated in a range of projects, such as Lauwersmeer-Vierhuizergat, Koehool-Lauwersmeer and Meandering Meuse. As part of the Zwolle-Olst project, the Paddenpol dike relocation was combined with the PAGW, WFD and Integrated River Management (IRM, see Section 6.4.3) programmes. In the Gorinchem-Waardenburg project, funds were released in 2022 under the Heritage Deal to use the heritage of the Old and Holland Waterline for climate adaptation solutions and to use them to open up the Waterline Landscape for leisure purposes. In almost all dike upgrade operations, municipal or provincial authorities also contribute to larger or smaller opportunities for leisure, nature development or road safety.

Linking sustainability agendas

In 2021, the HWBP Alliance took further steps in the Programmatic Approach for Sustainability and Spatial Quality to support the transition to sustainable, climate-neutral and circular dike upgrades with spatial quality. The goal is to safeguard sustainability and spatial quality in structural ways in all HWBP projects by 2023.

[16] Annex 3 2021 Annual Report.

Earthmoving accounts for most of the carbon footprint of dike upgrades by far. By optimising the design and using local soil as much as possible, a substantial reduction in carbon emissions can be achieved. This approach could also contribute to achieving objectives in the field of circularity and nature development, thanks in part to the excavation outside the dikes of the soil needed for the dike upgrade. The Meandering Meuse project developed a clear approach for this purpose that could be improved on the basis of the input of knowledge about the area from the disciplines of cultural history and archaeology. As part of the Knowledge and Innovation Agenda, the Rivierenland, Drents Overijsselse Delta and Vallei en Veluwe water authorities initiated five sustainability projects to promote and actually implement innovations in this area.

In 2021, in order to implement the considerable agenda set out in the Climate Agreement, options for reducing emissions at the construction site and the associated costs were examined for four projects. In 2022, this will be seen in the operational projects Rijnkade Arnhem, Sterke Lekdijk-Salmsteke and Hansweert, and the working method for these projects will be evaluated.

Table 1 Knowledge and innovation agenda[17]

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
	Reservation for innovation												
33T	POS Kunstwerken												
33H	POV Kabels en Leidingen												
	Knowledge and Innovation Programme (KIA)												
	Embankment Suite/GEOLIB												
13D	Ravenstein - Lith innovatie												
13K	Cuijk - Ravenstein innovation												
33M	JLD Dike stabilizer (POV Macrostability) Nastel and monitoring phase												
33Q	Onderzoek Gras op Zand												
33X	Dijken en Natuur - een symbiose												
33Z	Praktijkonderzoek opbarsten bij dijken (POD)												
28F en 28G	Pipingproef Vijfhuisterdijk (Lontkade)												
33N	Onderzoek Asfaltbekleding (POV-W)												
33N	Continuering monitoring degeneratie asfalt												
33S	Proef Piping Hedwigepolder												
17D	Pilot Kerkhovenpolder - Duitsland (Brede groene dijk)												
33I	Monitoring Gras- en Kleibekleding fase D POV-W												
T2i	Tranche 2 innovatie Steyl Maashoek												
T1i	Tranche 1 Planuitwerking innovatief												
33L	POV-Dijkversterking Gebiedseigen Grond												
18A innovatie	Eemshaven - Delfzijl - MJVM												
18A innovatie	Eemshaven - Delfzijl - Dubbele Dijk												
33D	POV Piping												
22E	Gameren innovatie GZB												
33E	POV Macrostabiliteit												
33U	Duurzamere en vergunbare HWBP dijkversterkingen												
22L	Dijkversterkingen Wolferen - Sprok												

[17] See also https://www.hwbp.nl/documenten/jaarplannen/2021/12/09/definitief-programmavoorstel-2023-2034

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
33V	De innovatieversneller												
33Y	Future dikes												
33AA	Pilot Soilmix Heaveschermen - voorbereidingsfase												
24AG	Zuid-Beveland West, Westerschelde Hansweert - innovatie												
25P	Grebbedijk innovatie PU												
33R	POS HEEL												

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034

Legend: Innovation

Table 2 Programming of measures for Flood Protection Programme 2023-2028/2034

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
02C	Versterking voormalige C-kering HDSR (GHIJ)												
02B	Waaiersluis te Gouda												
02F	Culemborgse Veer - Beatrix Sluis (CUB)												
02E	Salmsteke												
02D	Wijk bij Duurstede Amerongen (WAM)												
02I	Irenesluis - Culemborgse Veer												
02H	Jaarsveld - Vreeswijk												
02G	Salmsteke Schoonhoven (SAS)												
03I	Noordzeekanaal (D31 t/m D37)												
03O	Den Oever - Den Helder DODH, incl. tussen- en aansluitstukken												
03E	Wieringermeer C-kering												
03V	Aanpak Kunstwerken												
03Y	Koppelstuk Durgerdam												
03S	Koppelstuk Markermeerdijk												
05C	Verbetering IJsseldijk Gouda Stadsfront Voorlanden spoor 3												
05E	IJsseldijk Gouda (VIJG) spoor 2												
05F	Kunstwerken Spaarndammerdijk												
05G	IJsseldijk Gouda (VIJG) spoor 4 (GHIJ)												
06K	Krachtige IJsseldijken Krimpenerwaard (KIJK)												
06D	Capelle - Zuidplas*												
13D	Ravenstein - Lith												
13K	Cuijk - Ravenstein												
13H	Boxmeer - Cuijk (deel)												
13	Dijkkruising Oeffelt												
13Y	Lith - Bokhoven												
14E	Moerdijk												
14F	Standhazense Dijk												
15E	Stadsdijken Zwolle (15E)												
15Q	Zwolle - Olst												
34AK	Vecht - Stenendijk Hasselt												
34AQ	Vecht Dalfsen Zwolle												

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
34L	Genemuiden - Hasselt												
34O	Mastenbroek IJssel												
34P	Mastenbroek Zwarte Meer												
34R	Keersluis Zwolle												
34Q	Mastenbroek Zwarte Water												
34AR +34AS	Vecht-Oost												
34AM	Vecht Zwartewaterland												
28F	Koehool - Lauwersmeer												
28O	Lauwersmeerdijk												
28A	Dijk- en Duinversterking Schiermonnikoog												
28E	Zurich - Koehool												
16E	Zettingsvloeiing V3T												
16M	Geervliet - Hekelingen 20-3												
16P	17-3 Oostmolendijk Ringdijk*												
17D	Kerkhovenpolder - Duitsland LRT3												
23AB	Alexanderhaven AB												
60AJ	Roermond deeltraject Zuid												
60AF	Venlo 't Bat*												
18D	Lauwersmeer/Vierhuizergat												
21AT	Westervoort - Pannerdense Waard												
21AU	Tolkamer - Pannerdense Waard												
21AV	Tolkamer - Spijk												
21AX	Deelproject 1B Bronsbergen Zutphen												
21AW	Deelproject 1B Zutphen Den Elterweg												
22BV	Wolferen - Sprok - De Stelt												
22X	Gorinchem - Waardenburg (GoWa)												
22Y	Tiel - Waardenburg (TiWa)												
22D	Neder-Betuwe												
22BY	Vianen Hazelaarplein												
22W	Vianen												
22AW+BW	Sprok - Sterreschans - Heteren												
22BX	Sprok - Sterreschans - Heteren Kruising A15												
22AR	Streefkerk Ameide Fort Everdingen (SAFE)												
22BM	Stad Tiel Fluvia												
22K	Stad Tiel excl. Fluvia												
22L	Wolferen - Sprok incl. DTO												
24AG	Zuid-Beveland West, Westerschelde Hansweert												
24AU	Zuid-Beveland West, Westerschelde S2												
24AO	Zuid-Beveland West, Westerschelde S3												
24AE	Zuid-Beveland Oost, Oosterschelde												
24R	Zuid-Beveland Oost, Westerschelde												
24AB	Emanuelpolder												
25L	Noordelijke Randmeerdijk (incl WDOD)												

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
25K	Apeldoorns kanaal												
25P	Grebbedijk												
25I	Eemdijk - Spakenburg, deel Westdijk												
27D	Zuidermeerdijk - MSNF												
27E	IJsselmeerdijk												
27C	Kunstwerken Noordoostpolder												
27G	Oostvaardersdijk												

Legend: Inventory/pre-inventory Planning Implementation Fast lane Payment of pre-financing for the inventory/ pre-inventory *Subject to approval of financing

Table 3 Measures in Meuse Administrative Agreement

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
60AI	Willem Alexanderhaven C (23C)												
60B	Steyl - Maashoek (19D)												
60D	Thorn (19H)												
60E	Heel (19I)												
60F	Arcen (19J)												
60G	Well (19K)												
60H	Venlo Velden (19L)												
60I	Baarlo (19M)												
60J	Nieuw-Bergen (19N)												
60K	Buggenum (19O)												
60L	Beesel (19P)												
60M	Belfeld (19Q)												
60N	Kessel (19R)												
60O	Blerick - Groot Boller (19S)												
60A	Blerick de Oude Gieterij (19C)												

Legend: Inventory/pre-inventory Planning Implementation

Table 4 Pre-financing

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
03AA	Katwoude												
03AB	Volendam (Zuideinde)												
03AD	Monnickendam Zeedijk												
03AC	Monnickendam Binnenstedelijk												
03AE	Schellingwoude												
14A	Geertruidenberg en Amertak												
14D	Willemstad - Noordschans												
60AE	Lob van Gennep												
21A	Rijnkade Arnhem												
21E	Industrieterrein Grutbroek												
21I	IJsselpaviljoen Zutphen												
24AK	Sint Annaland												
24AX	Kop van Ossenisse												

Legend: Inventory/pre-inventory Planning Implementation

Table 5 Funding transfer, room for the river-dike upgrades

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
06K	Faalkansreductie Hollandse IJsselkering uit project KIJK												
13K	Meanderende Maas bijdrage uit project Ravenstein - Lith												
13H	Meanderende Maas bijdrage uit project Boxmeer - Cuijk												
13H	Oeffelt bijdrage uit Boxmeer - Cuijk												
13K	Meanderende Maas bijdrage uit project Cuijk - Ravenstein												
60G	Oeffelt bijdrage uit Dijkversterking Tranche 3												
60G	Meanderende Maas bijdrage uit (Dijkversterking Tranche 3/Well)												
60AE	Uitwisselingsbijdrage Lob van Gennep												
21AI	IJsselpoort fase 1, uitwisseling dijktraject 48-1												

Legend: Implementation

Table 6 Multi-Year Programme for Infrastructure, Space and Transport (MIRT)

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
60D	MIRT Thorn (19H)												
60F	MIRT Arcen (19J)*												
60G	MIRT Well (19K)*												
60H	MIRT Venlo Velden (19L)												
60I	MIRT Baarlo (19M)*												

Legend: Inventory/pre-inventory Planning Implementation

*The HWBP contributions to the MIRT for the Arcen, Well and Baarlo projects consist of the prevented costs for the dike upgrade and from defences that are not built, in accordance with the BO MIRT agreements from 2019.

Table 7 Rijkswaterstaat

Code	Project name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
80F	IJmuiden Dijk												
	IJmuiden kunstwerken												
	Keerschuif Prs. Marijkesluis												
80L	Marken												
80K	SVK Hollandse IJsselkering (schuif)												
80G	Vlieland												
	Voorhavendijken Noordelijke Lekdijk (bestuursovereenkomst HDSR)												
	Overbruggingsmaatregelen Oostsluis Weurt												

Legend: Implementation

3.4.2 HWBP-2

The Second Flood Protection Programme (HWBP-2) consists primarily of projects resulting from the first review (2001) and the second review (2007) of the primary flood defences. The last two projects in this programme are currently being implemented:

- the Eem dike upgrade and the Zuidelijke Randmeren dike upgrade (completion in 2022);
- dike upgrade, Markermeer dike Hoorn-Edam-Amsterdam (completion in 2027).

The expectation is that 22 kilometres will have been completed in 2022. More information can be found in the 21st progress report for HWBP-2[18].

[18] Parliamentary Paper 32698, no. 66

3.4.3 National defences programme

The first overall safety report on the regional flood defences will be completed and presented to the House of Representatives in 2021. The report states that approximately 67% of these dike sections meet the standards for 2050, that parts of sections were rejected in 31% of the cases on the basis that they did not comply with one or more of the failure mechanisms and that no opinion could be expressed on approximately 2% because data were missing[19]. Of the engineering structures serving as flood defences, approximately 63% meet the standards and approximately 12% do not; in the case of other sections, no opinion could be stated yet because data were missing. It should be pointed out that the fact that flood defences or parts of them do not comply with the standard does not mean that there is an acute problem. However, follow-up action will be required between now and 2050. Additional assessments will be conducted between now and the end of 2022.

Rijkswaterstaat is working on an initial implementation programme for the period up to and including 2032. A more detailed safety analysis is still being conducted for a small proportion of national defences. That is expected to result in a number of projects, including upgrades (particularly of stability) of the dikes on the Amsterdam-Rhine Canal and upgrades (stability and height) of the defences along canals in Limburg and Brabant. One frontrunner project has reached the planning phase and it will start in 2022: the upgrade of the regional defence (stability and revetment) of the Betuwe section of the Amsterdam-Rhine Canal.

The timetable is that the assessments of the primary national defences will be completed and submitted to the ILT by mid-2022. The safety assessments constitute the basis for the implementation programme for primary flood defences, which will be drawn up in 2023/2024. In anticipation, a number of frontrunner projects have begun: the dike upgrades on/near Marken, Vlieland and IJmuiden, the IJmuiden lock complex and the flood barrier in the Princess Marijke locks. The replacement and improvement operation on the drive mechanism in the downstream barrier in the Hollandsche IJssel Storm Surge Barrier is in the final phase and it will be completed in 2023.

3.4.4 Afsluitdijk Barrier Dam

The operational phase of the project for the Reinforcement and Renewal of the Afsluitdijk barrier dam is currently in full swing. Most of the work will be completed in 2022 and 2023. The construction of new discharge sluices and the renovation of the existing discharge sluices have been delayed. Work on the new discharge sluices is expected to be completed in 2025 (see Section 3.2). A new final date for the renovation of the existing discharge sluices has yet to be determined.

3.4.5 Foreshore deposits

Rijkswaterstaat and the Scheldestromen water authority have been implementing the Foreshore Deposits programme since late 2019. The aim of the deposition of rock at 27 locations along the Eastern and Western Scheldt estuaries in Zeeland is to reinforce the foreshores and in that way to counter the process known as liquefaction[20]. Rijkswaterstaat is conducting sixteen of these upgrade operations, fifteen of which have now been completed. The Scheldestromen water authority will be working on the other eleven sites between now and 2026. The project began in 2021.

3.4.6 Room for the river

Work on flood risk management by providing room for the rivers is continuing unabated. Detailed information about these projects can be found in the MIRT Overview.

IJssel Delta phase 2 and Groyne Lowering in Pannerdensch Kanaal

Two projects are in progress to reduce water levels along the branches of the Rhine: IJssel Delta Phase 2 and Groyne and Bank Lowering in the Pannerdensch Kanaal. The final two sub-projects included in IJssel Delta phase 2 will be completed in 2023. The Groyne and Bank Lowering in the Pannerdensch Kanaal project will also be completed in 2023.

Room for the river in conjunction with dike upgrades

Meuse

Seven projects are being conducted on the banks of the Meuse to reduce water levels, often in combination with integrated area development and dike upgrades: Thorn-Wessem, Baarlo-Hout-Blerick, Arcen, Well, Oeffelt, Lob van Gennep and Meandering Meuse. The Vierwaarden project (north of Venlo) is in the preparatory stages.

Rhine

The planning phase for the IJsselpoort River Climate Park began in 2021 (see Section 6.4.2).

[19] Parliamentary Paper 27625 no. 540

[20] Liquefaction or bank failure is a form of instability that occurs in moderately steep underwater slopes consisting of fine sand on dynamic estuaries, rivers, and coasts, in which large amounts of soil flow down the bank to deeper areas in a relatively short period of time.

CHAPTER 4

Fresh water

Construction of new bridge to increase freshwater influx KWA+, Bodegraven, March 2022

The overarching goal of the Freshwater Delta Programme is to ensure that the Netherlands will be resilient to water shortages by 2050. The agenda is to maintain and further a healthy and balanced water/groundwater system (with the land being used in ways that are appropriate to safeguard water availability), to maintain crucial user functions and to use the available freshwater effectively and economically. The measures taken by the national government (Rijkswaterstaat and the Ministry of Infrastructure and Water Management) and freshwater regions (provincial authorities, water authorities, drinking water companies, location managers and others) have been set out in detail in the Freshwater Delta Plan for the second phase: 2022-2027. 2021 was the final year of the first phase of the Freshwater Delta Plan (2015-2021). That phase consisted of working on the implementation and completion of measures, and on decision-making with respect to, and preparation for, the second phase.

4.1 Objective for 2050: perspective

There has been intensive work recently on measures to increase resilience to water shortages, such as the expansion of the capacity of the Climate-Resilient Water Channel (KWA). In the second phase, work will continue on resilience, focusing on the priority sequence for freshwater management from the National Water Programme and the National Environment Planning Vision (see Section 4.2). The underlying principle is economical water use and land use that takes the availability of fresh water into consideration.

The limits of the water system are coming into view, and water and soil have to play a more leading role in spatial planning. Thanks to that transition, the Netherlands will remain liveable and climate-robust in the future. Traditionally, the Netherlands has been good at allocating water in intelligent ways. In recent years, measures have been taken to improve the retention of fresh water, particularly in the High-Lying Areas with Sandy Soils. Major savings can still be achieved by using water more sparingly. These savings can be achieved by, for example, more efficient flushing for the purposes of combating salinisation in the coastal areas. This does require land use being adapted more in the light of freshwater availability. Major advances can still be made here.

Integrated area-specific approach

An integrated area-specific approach seems more desirable than ever. Given the current challenges facing the Netherlands, it will be necessary to address a range of ambitions (water, nitrogen deposition and the reduction of carbon emissions) in a coordinated way. This will require sustainable groundwater management for water use (agriculture, drinking water) and for large-scale nature restoration. The Groundwater Study Group was established to identify the administrative obstacles to achieving sustainable groundwater management, as well as the possible courses of action. The development of possible solutions for these obstacles will be coordinated with the Delta Programme.

The current measures in the Freshwater Delta Programme currently focus primarily on making water supplies more robust. In water management and spatial planning, a transformation is needed - in addition to adaptive measures - to focus on changes in land use where relevant. This requires measures that are consistent with the agricultural transition and with nature restoration. This transformation will not be achieved within six years and it continues to be 'work in progress'. In preparation for the third phase of the Freshwater Delta Programme, the freshwater objectives will be further concretised. The aim of this process is to provide answers to the question of the extent to which the measures contribute to achieving the goals and guide input for other transitions. It is important to continue investing in freshwater availability after 2027.

The Netherlands will be resilient to water shortages by 2050

What are our goals and what is our current position?

Priority sequence for freshwater management from the NOVI

1. Water and soil lead spatial planning

Progress: hardly begun

2. Economical use of water

Too little: more savings, for example on tackling salinisation

3. Better water retention

Progress mainly in high-lying areas with sandy soils

4. Smart allocation of water

We are traditionally good at this but an even more intelligent approach is possible

5. Acceptance of damage/residual damage

Acceptance of economic/ecological damage/residual damage not yet an explicit choice

100% (expert judgement)

How are the measures progressing?

Focus is on water retention and influx

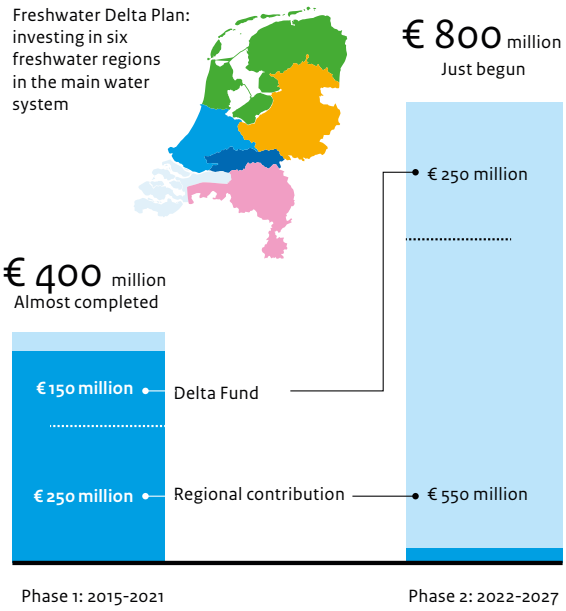


Figure 10 *Fresh water - The Netherlands resilient to water shortages by 2050*

4.2 Progress

Completion of first phase of Delta Plan (2015-2021)

Between 2015 and 2021, 37 measures were implemented as part of the first phase of the Freshwater Delta Plan. In 2021, the measures from the Higher Ground in the Northern Netherlands programme and the IJsselmeer Area Testing Ground were completed and the regional priority sequencing for the Northern Netherlands was established. The six provinces with sandy areas also completed their studies of drought in 2018 and 2019. On 10 March 2022, the research results were presented at a conference. In the Western Netherlands, a start was made on optimising the Brielse Meer water distribution and work continued on the Climate-Resilient Water Channel (KWA) in the provinces of Utrecht and Zuid-Holland. The River Area region completed the climate pilot project for the sustainable use of groundwater. In the Southwest Delta, work continued on improving the freshwater supplies for West-Brabant. After the port in Zevenbergen went into operation in late 2020, the robust inlet facility at the Roode Vaart lock was completed. The inlet facility has now been tested and it was operational for the 2022 growing season.

Work is still continuing on 24 measures, half of which will be completed by late 2022. See Table 8. Approximately 58% of the Delta Fund budget for the first phase of the Freshwater Delta Plan (2015-2021) was actually spent during this period. The remaining 42% of the budget will be spent in the period 2022-2025. The implementation of a number of more complex implementation measures in the Freshwater Delta Plan will take more time than anticipated. These include the widening of the Noordervaart, the implementation of the new water level decree for the IJsselmeer area, the KWA and the measures for the Frisian IJsselmeer coast. The delays are attributable in part to the effects of the corona pandemic, nitrogen deposition issues and delayed land purchases. In some projects, the delay was also linked to staff shortages. There is a great deal of pressure on project implementation and the available capacity for implementation is already fully utilised in many organisations.

On 18 March 2021, the Administrative Platform for Fresh Water (BPZ) agreed to delay the completion of some measures until 2024 at the latest. The total planned expenditure by all parties for the freshwater measures in the Freshwater Delta Plan in the period 2015 to 2025 is over € 443.5 million, € 177.3 million of which is financed from the Delta Fund. There is still a risk reserve of over € 1.2 million in resources from the Delta Fund.

Table 8 Programming of measures in Freshwater Delta Plan 2021-2024

	2022	2023	2024
IJsselmeergebied			
HWS: maatregelen Friese IJsselmeerkust	■	■	■
HWS: robuuste natuurlijke oevers IJsselmeergebied 1e fase	■	■	■
HWS: Implementatie peilbesluit IJsselmeer	■	■	■
Projectprogramma Hogere Gronden Regio Noord met:			
Natuurlijke inrichting Dwarsdiepgebied	■		
Hoge Zandgronden			
Uitvoeringsprogramma Deltaplan Hoge Zandgronden, Regio Zuid	■	■	
Uitvoeringsprogramma Zoetwatervoorziening Hoge Zandgronden, Regio Oost	■	■	
West-Nederland			
Klimaatbestendige Water Aanvoer West-Nederland (KWA)	■	■	■
Optimalisatie watervoorziening Brielse Meer, stap 1	■		
Zuidwestelijke Delta			
Roode Vaart doorvoer West-Brabant en Zeeland	■		
Klimaatpilot Proeftuin Zoetwater Zeeland met:			
E7 - Meer fruit met minder water	■		
E11(2) - Uitbreiding Waterhouderij Walcheren	■		
E13 - Ondergronds beregenen	■		
E15 - Wolphaartswater	■		
Rivierengebied			
HWS: onderzoek langsdammen	■		
Start maatregelen Rivierengebied-Zuid	■		
Hoofdwatersysteem (zie ook onder de regio's)			
Slim Watermanagement (SWM)	■		
Noordervaart	■	■	■
Extra maatregelen Beleidstafel Droogte			
HWS: Zoutmonitoring en modelontwikkeling Amsterdam-Rijnkanaal/Noordzeekanaal	■		
HWS: Zoutmonitoring en model ontwikkeling in het IJsselmeer	■		
HWS: Sturen op zout WNZ extra meetpunten RMM	■	■	■
HWS: Debietmeters Nederrijn-Lek t.b.v. zoetwaterbuffers west NL	■		
Zoutkartering 1e fase	■		
Freshem NL	■		

Legend: ■ Implementation ■ Study ■ Climate pilot projects

Start implementation of Delta Plan, second phase (2022-2027)

The second phase of the Delta Plan was adopted by the Minister of Infrastructure and Water Management last year. For the new Freshwater Delta Plan, the national government and the freshwater regions have developed a € 800 million package of measures. Of this, € 250 million comes from the Delta Fund and € 550 million from the regional government authorities. See Table 9. Financial agreements have been reached about a 'specific allowance' (SPUK scheme) and regional administrative agreements have been concluded in several regions. Each freshwater region has a strategy defined by government with the associated measures.

More than half of the investments are planned for the High-Lying Areas with Sandy Soils with the aim of making the switch to better water retention. The other measures focus on the more effective and efficient distribution of the available water, the use of alternative sources (such as effluent and brackish seepage), the more robust/climate-robust structuring and management of the water system, and innovations in, among other things, agriculture.

In the second phase, Smart Water Management – in which water managers jointly 'direct' water to where it causes the least inconvenience or where it is actually most needed – will also be used for the further development of the Climate-Resilient Freshwater Facility for the Main Water System (KZH) strategy. This strategy is based on the assumption of freshwater buffers and zones in the main water system. Fresh water is directed to the regional water systems depending on the situation determined on the basis of a national overview.

In preparation for the Main Water System (KZH), a programme was established in 2021 to work on an inventory of the strategy in the years ahead. By studying the effects, we learn from implementation and make adjustments where they are needed. In addition, a new programme plan has been established for Smart Water Management. Some freshwater regions are also taking steps in anticipation of the second phase. For example, in the Western Netherlands, the Coastal Dunes pilot project began with the aim of expanding the freshwater buffer below the dunes.

Table 9 Overview of investments in the second phase

By region and including the details of the € 14.6 million still to be distributed from Table 13, 2022 Delta Programme

Freshwater Regions and Main Water System	Investment (x € million)	Delta Fund contribution (mln €)
High-Lying Areas with Sandy Soils, South	200.0	50.0
High-Lying Areas with Sandy Soils, East	200.0	50.0
Low-Lying Northern Netherlands	65.6	18.0
High-Lying Northern Netherlands	60.0	15.2
Western Netherlands	62.7	22.3
Southwest Delta	96.0	23.7
River area	7.0	1.8
Main water system	58.4	58.4
Risk reserve		11.1
Total investments adopted	**749.7**	**250.5**

Table 10 Additional measures, second phase

€ 14.6 million still to be distributed from Table 13, 2022 Delta Programme

Freshwater Region	Measure	Delta Fund contribution (mln €)
West	Temmen brakke kwel[21]	2.00
West	COASTAR pilot project, Westland	0.75
West	COASTAR pilot project, brackish water extraction in polders	1.05
West	Harnasch polder (Delfland), reuse as irrigation water	3.25
Total West		**7.05**
North	Fresh on Saline Lauwersmeer	0.60
North	Agricultural projects testing ground: Salfar	0.63
Total North		**1.23**
Southwest Delta	Water from the Brabantse Wal	2.50
Rijkswaterstaat	Other RWS measures[22]	3.60
Total RWS		**3.60**
Total		**14.4**

[21] This measure has been split up. Some of the costs will be transferred to phase 3 of the Delta Plan for Fresh Water.

[22] This means that two measures will be added to the list of Measures for the Main Water System (Table 14 in 2022 Delta Programme) and the total amount will be raised by € 3.6 million.

Priority sequence

The Netherlands is facing droughts and periods of low water in the rivers more frequently. The National Environment Planning Vision and the National Water Programme therefore include a priority sequence for water management to safeguard the availability of water, to prevent flooding and to serve as a basis for balancing interests in spatial planning. The underlying principle is to match freshwater demand with water availability. This is done by taking water availability into account when allocating functions that require water and by focusing on the economical use of water by those functions. The priority sequence to prevent water shortages is:

- improved retention and storage;
- distributing water more intelligently;
- accepting damage/residual damage and preparing for it because not all damage caused by natural phenomena can ever be prevented.

Working continuously on water availability

Working continuously on water availability is an important component of the Freshwater Delta Programme and therefore the Freshwater Delta Plan. In regional processes, government authorities and users of fresh water work together to establish a picture of the availability of fresh water and the demand for water in normal and dry conditions, now and in the future. They also arrive at agreements about what everyone can do to maintain the availability of water and to reduce the risk of water shortages. The focus here is on the availability of groundwater and surface water. As a result, the major consumers of fresh water know what to expect from the government and where their own responsibilities lie. That insight helps when making investment decisions and therefore provides an action perspective. An understanding of water availability helps to make water and soil leading factors in spatial planning.

Recommendations for the Drought Policy Platform

During the implementation of the first phase of the Freshwater Delta Plan, there were prolonged periods of drought in 2018, 2019 and 2020. This has made working on freshwater supplies even more urgent and boosted collaboration between and within freshwater regions. Because the drought in these years was tangible and visible to everyone, the challenge was brought to the attention of a much larger public. The Drought Policy Platform was established in response to the 2018 drought. That resulted in concrete recommendations and a clearer course for the Freshwater Delta Programme. Work also took place in 2021 to implement a number of recommendations:

- Freshwater regions and users of fresh water are working together on how to apply the national priority sequence at the regional level when there are freshwater shortages. It was agreed that each freshwater region would work up the priority sequence for their own regions by the spring of 2022; a number of regions will be continuing to work on this process in 2022.

- To provide an impetus for targeted knowledge development and to strengthen the connection between science and practice, the Freshwater and Drought Expertise Network was launched. An updated Freshwater Knowledge Agenda will follow in 2022.
- In 2021, a pilot project was conducted for the establishment of a water profile for industry. Using a profile of this kind makes the water interests of industry clear, resulting in better decision-making when there are impending or actual water shortages. At present, the freshwater regions are working on a plan of action for the drafting of water profiles for various industrial clusters in the Netherlands.
- The subject of fresh water has been more clearly linked to the Delta Programme for Spatial Adaptation by including water availability as a leading principle in spatial planning.

Insights from the Delta Programme Signal Group

The independent scientific Delta Programme Signal Group has issued an advisory document that is also relevant to the freshwater agenda. The recommendations are to:

- Anticipate faster and less predictable climate change, which is sometimes not covered by standard calculation methods, while also looking at events with small probabilities but high impact. This is in line with the recommendations of the Drought Policy Platform and is a recommendation that will be included in the process leading up to the third phase of the Delta Plan and the concretisation of goals.
- Consider the urban environment: the focus of the freshwater programme is on the rural areas but the link to the built environment will also receive attention. To this end, we are working with the Delta Programme for Spatial Adaptation at the national and regional levels.
- Acknowledge that, in addition to working on adaptation, there may be reasons to engage in spatial transformation. In the process of deriving the objectives for the third phase of the Delta Plan, the switch to transformation (where applicable) is an important underlying principle. This will include exploring the links with other transitions, particularly in the rural area.

4.3 Developments

Water and soil as the basis

As explained in Chapter 4.1, in line with the priority sequence for fresh water in the National Environment Planning Vision, there is an increasing emphasis on the principle of taking the boundary of the surface and water system more into consideration in land use, including a focus on the availability of fresh water and the risk of flooding. The prolonged drought in 2018 and the high water and floods in Limburg in 2021 have shown that there are limits to our capacity to cope with future periods of extreme drought, or precipitation or flooding, by means of technical interventions in the water system. In areas such as those with sandy soils and peatlands, changes in land use will also be needed. This requires a switch from the current approach - in which adaptation measures (technical and otherwise) are used to make the desired land use possible - to setting out limits and boundary conditions.

The Water System Inventory Study (*Watersysteemverkenning*) in the National Water Programme describes future choices for the water system. This makes it clear which knowledge is required for good decision-making. The Water System Inventory Study draws on studies from the Delta Programme and the Sea Level Rise Knowledge Programme for this purpose. In combination, this is intended to contribute to a coordinated and integrated approach to all water agendas and the spatial impact. To this end, the 2022-2027 Freshwater Delta Plan includes a roadmap that indicates which decisions - of relevance to fresh water - will be taken when, which knowledge will be developed, and how programmes interact.

Water test and National Programme for Rural Areas

The coalition agreement 'Looking out for each other, looking ahead to the future' announces that water and soil will become leading factors for spatial planning, including the major transitions for housing, energy and nature restoration. In addition, water management authorities must be involved at an earlier stage in the drafting of spatial plans and, according to the new Dutch cabinet, the water test must become more coercive in nature, for example via an update of the National Environment Planning Vision.

The new cabinet is investing in the approach to nature restoration and the nitrogen problem with the National Programme for Rural Areas. Up to and including 2035, € 25 billion has been made available for this purpose on a cumulative basis through a fund that focuses on the transition in the agricultural sector and the restoration of nature. Over € 800 million is available for measures covered by the Water Framework Directive. This is a particular issue in brook valleys, where there are synergy opportunities for freshwater agendas.

Joint approach

The area-specific approach focuses on reducing nitrogen emissions, the hydrological restoration of nature areas, improving water quality, soil and climate agendas, and providing a future-resilient perspective for agriculture. The joint approach to drought problems, nature restoration and nitrogen issues opens up major opportunities for measures to enhance resilience to freshwater shortages.

Without hydrological restoration, there can be no robust nature, and the soil and water system constitutes the basis for both these agendas.

In addition, the Nitrogen Reduction and Nature Improvement Act has been passed to address the issue of nitrogen deposition. It states that all provincial authorities must develop provincial area plans to address that issue. The area plans must have been completed by mid-2023. The approach to the various agendas must be synchronised in the regions; the joint organisation of operational capacity at all levels of government is an important prerequisite for success.

Stress tests generate new insights

The ambition for the main water system is for it to be in a position to cope with a drought that occurs once every twenty years. A stress test for the IJsselmeer area and the main water system has shown that the sustainability of this freshwater ambition will come under pressure as a result of climate change, increased water consumption and new water users. The second phase of the Freshwater Delta Programme will therefore look at which additional measures are required to achieve the ambition for the main water system. Decision-making about water distribution (during periods with low discharges in particular) is therefore linked not only to the Climate-Resilient Freshwater Facility in the Main Water System (KZH) but to all kinds of other factors – including fish migration in the Haringvliet and bed, bed erosion in the Waal (IRM) – and it affects archaeology and leads to spatial restrictions due to level fluctuations. This requires the broad consideration of different interests at the national level, a process for which preparations will be made in the time ahead.

In the IJsselmeer area, the stress test has shown that, even in a huge water buffer like the IJsselmeer, water shortages can occur up to once every five years in the 2050 Steam scenario. 'Steam' is one of the Delta Scenarios; it involves rapid climate change and strong economic growth. New policy choices will be required to reduce the probability of water shortages in the IJsselmeer area in the coming decades. This relates to both policies that focus on enhancing freshwater supplies and policies to prevent further increases in freshwater demand.
For example, spatial planning will have to take into consideration larger level fluctuations in the IJsselmeer and a possible second route for water influx through the Amsterdam-Rhine Canal. Salinisation via the sluices in the Afsluitdijk will have to be reduced so that much less water will be needed to flush the IJsselmeer. In addition, all water users will need to take steps to use water more economically: agriculture, industry *and* consumers.

Peatland strategies

On the basis of the climate agreement, efforts are being made to reduce carbon emissions and, at the same time, to limit land subsidence and peat oxidation. In the six provinces with large areas of peatland, regional peatland visions are being drawn up (including former peatlands in which there is arable farming), with the raising of water levels as the principal element of the strategy to slow land subsidence. This strategy implies additional water demand, which will then have to be met using the water available. The stress test in the IJsselmeer area has shown that this additional demand for water cannot always be met in the Northern Netherlands and other areas in the lower-lying areas of the country and that a broad consideration is required of the different interests, which are also related to water level management and water influx. The Freshwater Delta Plan and the IJsselmeer Area Delta Programme are working closely together on this process. The Delta Programme organised a sensitivity analysis to visualise the water requirements for various measures and, in this way, to help the regions to devise regional strategies. Those strategies should be consistent with water availability and national water allocation. Ultimately, the peatland strategies must be included in the integrated area plans that the regions are working on for the National Programme for Rural Areas and that are scheduled for 2023.

Making objectives SMART

A range of policy evaluations have concluded that the 2050 resilience goal of the Freshwater Delta Programme is still relatively abstract. The Freshwater Administrative Platform has therefore decided to explore the further concretisation of freshwater objectives, which will play an important role in the preparation of the third phase of the Delta Plan. That exploration should provide answers to the question of the extent to which the measures contribute to the achievement of the goal. The ambition for the concretisation of the freshwater objectives is to make them as SMART as possible at both the national and regional levels. SMART stands for: Specific, Measurable, Acceptable, Realistic, Time-bound. Goals must be set at the national and regional levels. This will involve regional differentiation so that the goals match the specific differences in the freshwater regions.
In response to the resilience goal, a report from Bureau Drift further clarified the concept of 'resilience'. The conclusion was that current freshwater measures focus primarily on increasing robustness and adaptive capacity but still contribute too little to the unavoidable transformations in land use that will be required, such as those in the country's high-lying areas with sandy soils and in peatlands. This process has become more urgent because of the need for concrete targets for programmes such as the National Programme for Rural Areas, the provincial area plans under the Nitrogen Reduction and Nature Enhancement Act, and spatial planning (including the principle that water and soil should be leading factors).

4.4 Collaboration

Spatial Adaptation

In the efforts to make the Netherlands climate-adaptive, collaboration between the Freshwater Delta Programme and the Delta Programme for Spatial Adaptation has become increasingly important. The two programmes organise joint knowledge days, provide access to press releases and new insights through the joint Climate Adaptation Knowledge Portal and encourage the combination of risk dialogues for spatial adaptation and area processes in order to enhance freshwater availability and resilience during freshwater shortages. The collaboration contributes to the knock-on effect of the freshwater and drought agenda at municipal authorities and in spatial planning.

Pluvial and river flooding

There are close links with other agendas. Following the example of the Drought Policy Platform, a Flooding Policy Platform has been established which is expected to produce recommendations in 2022 in response to the extreme precipitation in July 2021 in Limburg (see Section 2.3). The recommendations of this policy platform are also expected to be relevant to the freshwater agenda. In many areas, water shortages and floods are two sides of the same coin. The construction of buffers should help retain water for as long as possible in anticipation of dry periods, while buffers can also help to prevent problems with excess water. The July 2021 precipitation event covered an area the size of half the Netherlands. This underlines the importance of supra-regional assessments of interests and stress tests, for which the Smart Water Management alliance provides a basis.

Groundwater

The study 'Drought in sandy areas of the southern, central and eastern Netherlands', which was published in late 2021, shows the effect of the three dry years in 2018, 2019 and 2020 on the sandy areas. The study provides an understanding of the effectiveness of measures and makes recommendations. For example, it advises the combination of major changes in water management with other major agendas, such as changes in the use of fertilisers in agriculture. Even in the low-lying areas of the country, drought and falling groundwater levels can lead to damage ranging from land subsidence to damage to foundations, archaeological heritage, and to nature and urban green spaces.

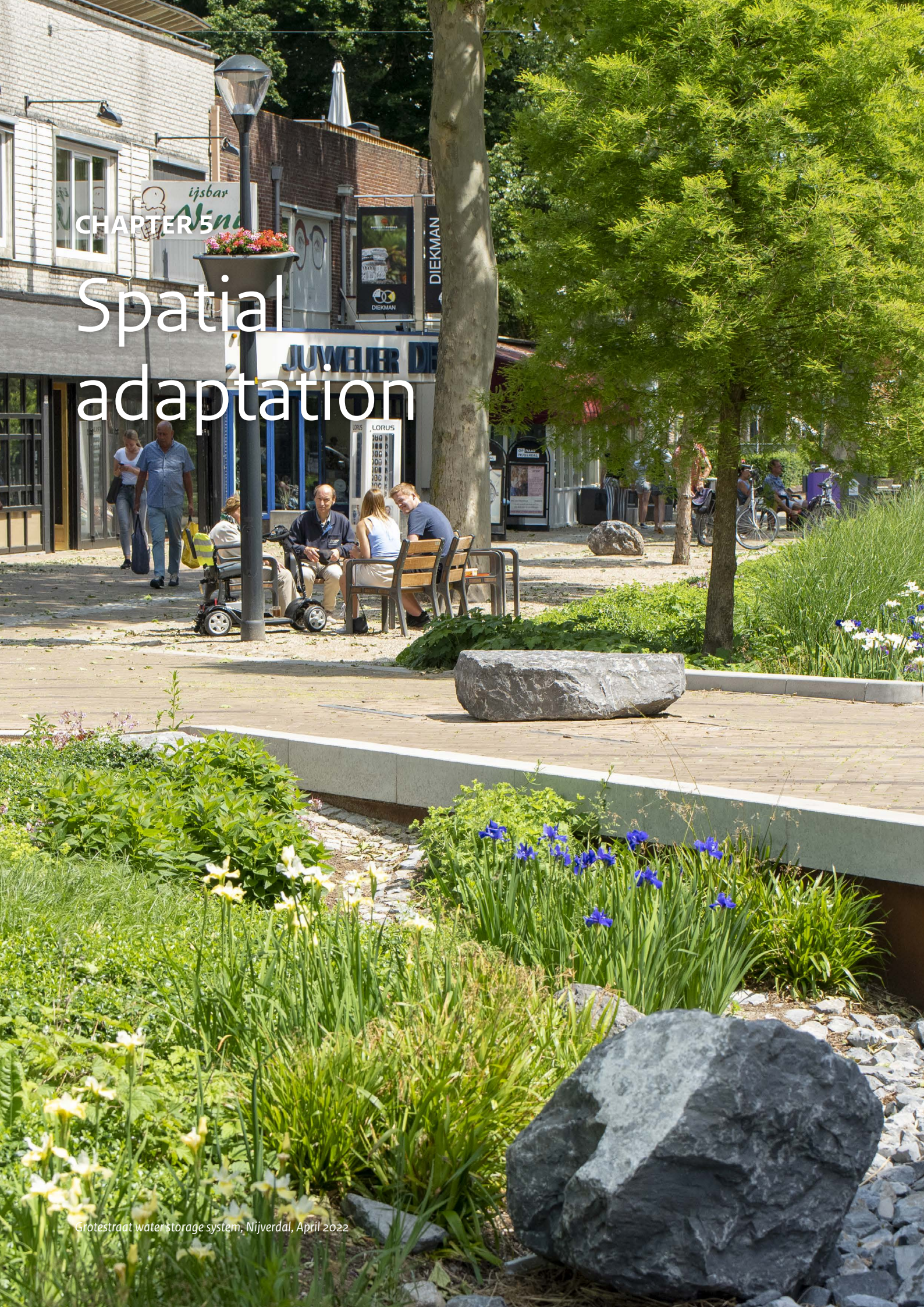
A more careful approach to water/groundwater is important because the Dutch climate is changing[23]. The probability of water shortages in the spring and summer is rising. National agendas require adequate amounts of clean water/groundwater, as in the case of drinking water supplies, which are rising in line with the need for more housing. A number of processes have been initiated for this purpose, including the designation of Supplementary Strategic Reserves (ASV) and National Groundwater Reserves (NGR). This involves considering which groundwater stocks should be designated and protected for the – possibly distant – future. Nature restoration and the Water Framework Directive involve international obligations relating to groundwater.

The Groundwater Study Group (see Section 2.4) identifies administrative obstacles in the area of groundwater and possible action perspectives. The development of possible solutions for these obstacles will be coordinated with the Delta Programme.

[23] cf. KNMI Klimaatsignaal '21 - Hoe het klimaat in Nederland snel verandert (in Dutch)

CHAPTER 5

Spatial adaptation



Grotestraat water storage system, Nijverdal, April 2022

The Delta Plan for Spatial Adaptation sets out how municipal authorities, water authorities, provincial authorities and the national government intend to accelerate and intensify the process of spatial adaptation. 2021 was a year in which the events in Limburg, and the extreme heat and forest fires in large parts of Europe, brought the subject of spatial adaptation more to the forefront. A lot of hard work is being done but the road to making the Netherlands climate-resilient is still a long one. Moreover, it runs concurrently with other transitions that will create spatial opportunities but also dilemmas. The coalition agreement emphasises the importance of climate adaptation, for example by stating that water and soil will become leading factors in spatial planning and by also explicitly mentioning heat stress as a threat.

5.1 Objective for 2050: perspective

The goal of the Delta Plan for Spatial Adaptation (DPRA) is for the Netherlands to be climate-resilient and water-robust by 2050. This goal involves a huge social transition: consistently thinking and acting with the aim of minimising the damage caused by climate change. For example, making new buildings climate-resilient from the outset will ensure that we do not end up tackling the symptoms without tackling the cause. The final goal set for 2050 requires persistence and a realisation that there is still a long way to go. The intermediate goal of always acting in climate-proof ways has been achieved to only a – very – limited extent. Most provincial and municipal authorities (70% according to a sample of the working regions) are now working actively on including climate adaptation in their environmental visions. Another hopeful sign is that climate adaptation is now receiving extensive attention thanks to the work done in recent years in the 45 working regions of the DPRA. Awareness among the general public and stakeholders is increasing and this is an important button that can be pressed in relation to managing the impacts of climate change.

It is still difficult to establish a clear overview of the extent to which making vital and vulnerable functions has progressed. The efforts made by 344 municipal authorities, together with provincial and water authorities, to go through the DPRA process is a cause for satisfaction. Those efforts involve the cyclical process of stress tests, risk dialogues, implementation agendas, synergy in integrated development, knowledge accretion, regulation and embedding, and a focus on how to tackle disasters. Municipal authorities are achieving good results but, at the same time, struggling with the large numbers of spatial claims and a lack of capacity in implementation. An important step was taken in 2021 with the completion of the first Implementation Agenda for Climate-Resilient Networks. This implementation agenda describes the steps the Ministry of Infrastructure and Water Management will take in the coming years to make the main waterway network, the main water system, and the main road network more climate-resilient. However, actually implementing that agenda will take many years yet.

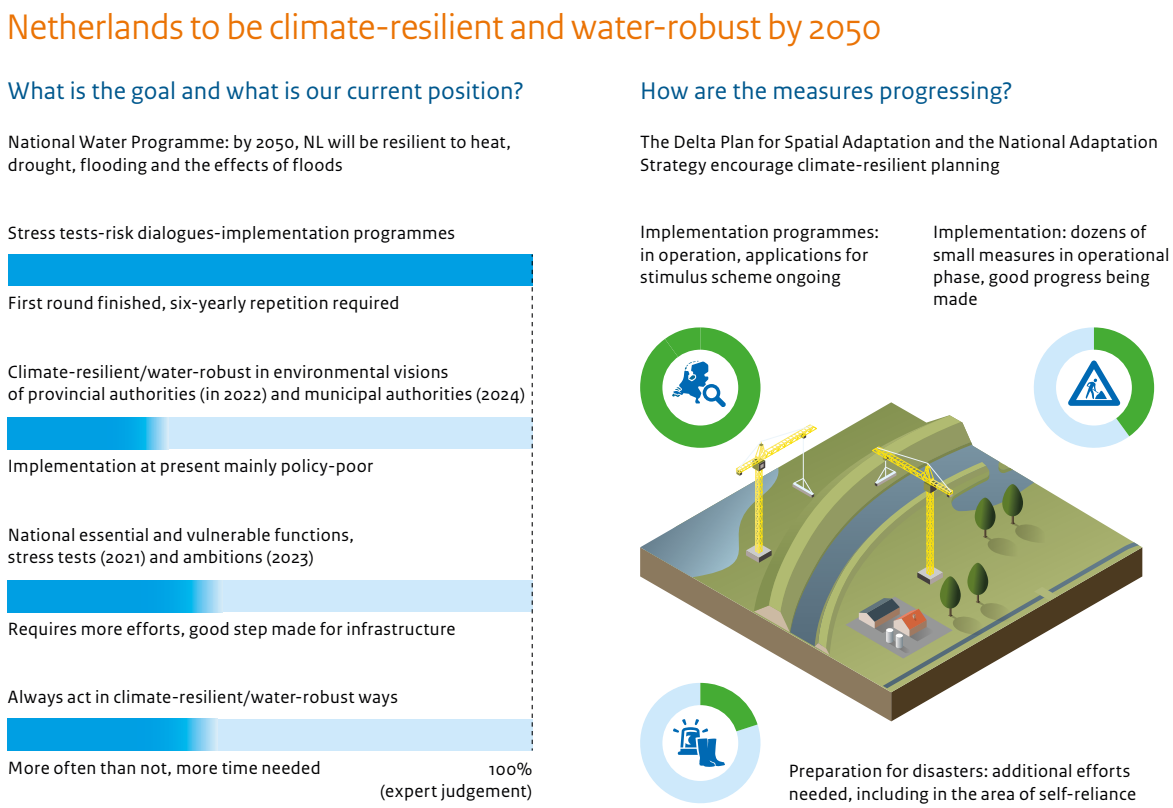


Figure 11 *Spatial Adaptation - Netherlands to be climate-resilient and water-robust by 2050*

5.2 Progress

The Climate Adaptation Stimulus Scheme has been in effect since 1 January 2021. In 2021, more than half of the 45 working regions submitted their first official application. Fifteen applications were processed in 2021, involving a total of € 48.95 million in state funding. Including the contributions from the working regions themselves, which accounted for two-thirds of the funding, the package of measures in the 2021 applications amounts to nearly € 150 million.
The risk dialogues were completed last year on time; implementation agendas have also been drawn up in a large number of working regions.

Green City Challenge

Greening is an important measure in climate-resilient planning. The Green City Challenge was organised for the first time this year, and 103 municipal authorities participated. The municipalities of Delft and Rijswijk were elected the Greenest Cities of the Netherlands.

National Paving-Stone Removal Championships

In 2021, 81 municipalities participated over a period of six months in the first edition of the National Championships for removing paving stones. The aim of this competition was to replace as many paving stones as possible with green alternatives and in that way to encourage water awareness among the public in their own surroundings. The municipality of Rucphen won The Golden Paving Stone with a score of 989 paving stones removed per one thousand inhabitants. Measured in absolute numbers, the City of The Hague came out on top. A total of 1.5 million paving stones were removed. The competition will be organised again in 2022.

Delta Commissioner's recommendations on housing and climate adaptation

At the request of the Ministries of the Interior and Kingdom Relations (BZK) and Infrastructure and Water Management (IenW), the Delta Commissioner submitted recommendations in two stages about linking the housing agenda to climate adaptation: an advisory letter on 1 September 2021 and an advisory letter on 7 December 2021[24]. The recommendations focused on an approach for the short and long terms and also took the effects of sea level rise into consideration. The main message is that

[24] Advisory letter from the Delta Commissioner on Housing Construction and Climate Adaptation 1 September 2021 (in Dutch) and Advisory letter from the Delta Commissioner on Housing Construction and Climate Adaptation (Track 2) 3 December 2021 (in Dutch).

meeting the demand for housing and the redevelopment of existing areas must take the effects of climate change into consideration on a more structural basis, now and in the long term. In addition, water and soil must become leading factors in spatial planning. This involves the approach to construction, how areas are planned and where we build. This is not happening enough at present.

The Ministers of Housing and Spatial Planning (VRO) and of Infrastructure and Water Management sent a response to the Delta Commissioner's recommendations to the House of Representatives on 24 May 2022[25]. The actions linked to the recommendations and the response will be included in the National Approach to Climate Adaptation in the Built Environment, which will be sent to the House of Representatives after the summer. An important component is a national yardstick that BZK and IenW are developing this year with the Ministry of Agriculture, Nature and Food Quality (LNV) in which other governments and stakeholders will be involved. This yardstick states what is meant by climate-resilient and water-robust building. As far as possible, this will tie in with what has already been developed jointly with market parties in a number of regions in recent years. In the project 'Water and soil as the basis', the Ministry of Infrastructure and Water Management, with the relevant departments and other government authorities, is elaborating goals and boundary conditions in the run-up to 1 October 2022 that may have consequences for housing construction, among other things.

National Approach to Climate Adaptation in the Built Environment

The Ministry of the Interior and Kingdom Relations, the Ministry of Infrastructure and Water Management, the Ministry of Agriculture, Nature and Food Quality and the Ministry of Health, Welfare and Sport are working together on a 'National approach to climate adaptation in the built environment 2022-2025, towards green, climate-adaptive towns and villages'. In this approach, the national government provides a picture of what the ambitions are on the road towards green, climate-adaptive towns and villages, which steps are being taken to achieve those ambitions, and how the national government intends to work with other government authorities and many other stakeholders. The approach is the elaboration of the 'built environment' spearhead of the National Climate Adaptation Strategy (NAS), in line with the Action Programme on Climate Adaptation in Agriculture and the Action Lines on Climate Adaptation in that have been published previously. Since 2016, the NAS has focused on developing climate-adaptive policies for sectors to complement the Delta Programme. The approach will be sent to the House of Representatives after the summer of 2022.

[25] Parliamentary Paper 32813 no. 1079

5.3 Connection

Climate adaptation should not be elaborated as an agenda in isolation. Particularly in the spatial domain, upon which much of the work of climate adaptation should focus, there are already numerous sector- and agenda-specific area approaches. That is true of, for example, the energy transition, tackling nitrogen emissions, making agriculture and the economy more sustainable, the housing agenda and restoring biodiversity. In built-up areas, where there are not always synergy opportunities when implementing provisional solutions to difficulties, climate adaptation is complex. This requires additional capacity and structural resources, as well as interdepartmental coordination, for urban areas.

Many government authorities lack the capacity and the resources to implement measures in the area of climate adaptation on spatial lines. The subject of climate adaptation should be more normative and mandatory so that the agenda in the spatial domain is clear and the discussion can focus on how climate adaptation can be implemented. For now, there are numerous opportunities to make climate adaptation part of an integrated area approach. This can be done, for example, via the approach to the peatland problem, as part of regional energy strategies, through the National Programme for Rural Areas or via urbanisation strategies such as the National Environment Planning Vision. Climate adaptation is an important driving factor here in the elaboration of the principle of 'water and soil as leading factors' and for the development of the yardstick for climate-resilient and water-robust building.

Proper appreciation of the role played by provincial authorities in spatial planning

Since the publication of the first Delta Plan for Spatial Adaptation, many provinces have invested heavily in linking climate adaptation to other spatial agendas: from the housing agenda and the energy transitions to agendas

in the areas of agriculture, economy and nature. In the various policy domains, this has led to new insights, new tools, the formation of public/private networks and action perspectives to work with our growth ambitions in the Netherlands in a climate-resilient way. Provincial authorities are assuming their roles in spatial planning by including climate adaptation in their environment visions and regulations. In this role, they are an important partner in the dialogue with the national government organised to ensure that climate adaptation is incorporated into national developments such as the yardstick mentioned above, the development of water and soil management, and the integrated area approach in a large number of national programmes.

Land subsidence

In the working regions where land subsidence is an issue, this topic is also considered in the context of climate adaptation. The national approach to land subsidence in peatland areas is being shaped by the national peat plan and the provincial peat programmes. The Ministry of the Interior and Kingdom Relations is working with the Ministries of Infrastructure and the Environment and the Ministry of Agriculture, Nature and Food Quality on a supporting national programme to address foundation problems. This approach focuses on a wider area than land subsidence alone. The Regional Deal for Land Subsidence in the Green Heart and the Living On Soft Soils programme (a part of the National Science Agenda) are generating knowledge for adaptive measures. As a result, the national Knowledge Centre for Land Subsidence and Foundations is being established to supply residents and professionals with knowledge and information about how to tackle land subsidence.

5.4 Developments

In addition to the annual survey, interviews were held with representatives of the working regions, with area coordinators (usually from the provincial or water authority) generally being involved. This monitoring round was conducted on behalf of the Delta Programme for Spatial Adaptation by employees of the Samen Klimaatbestendig (*Climate-Resilient Together*) platform. On the basis of the results, it can be concluded that the principal agendas in the field of spatial adaptation relate to capacity and the implementation of concrete projects. Another problem is that the financial resources for the additional costs of building and managing climate-adaptive measures are often lacking. The resources available through the stimulus scheme have often proved inadequate, too small in scale, or too focused on water-related measures alone.

New report by IPCC and Climate Signal'21

Climate change has led to global, and in part irreversible, consequences for people and nature, particularly as a result of more frequent extreme weather conditions. This trend will continue for the time being, and the limit of 1.5 degrees of temperature rise will be reached in about ten years if we continue down the same road globally. These conclusions were published by the United Nations climate panel in the latest IPCC reports. In October 2021, KNMI published the Climate Signal'21, which focuses on the impact of climate change in the Netherlands. Both the IPCC reports and the Climate Signal indicated that climate change is happening faster than originally expected and that the impacts and risks must be expected to be more severe and higher, respectively, than stated in the previous IPCC report from 2014. It has also been made clear for the first time beyond doubt that current global warming must be ascribed to human activity.

Floods in Limburg and policy platform

As a result of climate change, climate extremes are on the increase and there is a genuine probability that events such as the floods and excess water seen in July 2021 in Limburg, Belgium, Germany and Luxembourg will become more frequent. This is the view of the Royal Netherlands Meteorological Institute (KNMI) as stated in the Climate Signal'21. The first advisory document of the Flooding Policy Platform stated that the water systems, spatial planning and crisis management were not adequately prepared for a situation of this magnitude. The advisory body was established to produce recommendations for strengthening the approach to climate adaptation. The first phase was completed in early 2022 and a report was sent to the House of Representatives. That report contains a number of points relevant to the Delta Plan for Spatial Adaptation. For example, there is a recommendation to standardise the underlying principles for stress tests, determining which climate factors should be included and which weather extremes. The report also advises conducting system-level risk analyses for extreme events that link the different scales of stress tests better. Moreover, more attention should be paid to working together, both nationally and internationally, in the event of calamities. The process of arriving at more standardised principles for the stress tests has now begun and it is expected to continue until early 2024. Then new climate scenarios from the KNMI will also be available at that time. It is therefore recommended to postpone any new round of stress tests until an updated guidance document is available.

National Climate Adaptation Strategy and further actions

During 2022, the evaluation of the National Climate Adaptation Strategy (NAS) will be published and consideration will be given to follow-up action. The European LIFE IP project will be in place from 2022 onwards and the aim is to implement the NAS with a focus on regional collaboration in the field of climate adaptation. The Delta Programme for Spatial Adaptation sees opportunities for the stronger implementation of the NAS through its network of working regions and the possibility of broadening dialogues there.

A number of ministries working together asked the Netherlands Environmental Assessment Agency (PBL) to produce an overview of new insights into all climate risks. Furthermore, climate adaptation is being implemented in urbanisation strategies and in strategies for rural areas through the spatial-planning portfolios of the Ministry of the Interior and Kingdom Relations. The Ministry of Infrastructure and Water Management is a partner in this area and it is developing frameworks to make goals for climate adaptation and governance in spatial planning processes more concrete. This involves both the implementation of the National Environment Planning Vision and the housing agenda. As far as the latter is concerned, consideration must also be given to how nationally available data, and local and regional knowledge, about climate impacts can be made accessible with the aim of being in a position to map out the agendas properly.

The consequences of climate change for health

Climate change can have consequences for health. In addition to the effects of heat, these include risks in the area of infectious diseases and allergies. Adaptation measures for water availability and to manage flooding can, in addition to producing health benefits, have undesirable side effects. For example, water collection or storage can improve or create habitats for mosquitoes. Green measures can have an impact on the spread of ticks. As part of the NAS, the Ministry of Health, Welfare and Sport is working on the theme of health and climate adaptation. The Ministry of Health, Welfare and Sport and the Delta Programme are exploring how the Delta Programme can prevent or limit the negative side effects of adaptation measures on health.

5.5 Delta Plan for Spatial Adaptation

The Delta Plan for Spatial Adaptation includes seven ambitions that are intended to result in a climate-resilient and water-robust Netherlands by 2050. See also Monitor 2022, background document G.

5.5.1 Progress on stress tests, risk dialogues and implementation agendas

Progress

Since the first round of stress tests, which was completed in 2020, additional analyses have been completed where deemed necessary. They were then used in theme-specific risk dialogues with stakeholders, residents and others, including the Municipal Health Services (in discussions about heat stress), land management organisations, drinking water companies and safety regions. It is striking is that most risk dialogues focus specifically on one or two themes such as flooding, disruption, heat or drought. Most working regions are now working on the implementation agenda and submitting an application for the Climate Adaptation Stimulus Scheme based on the agenda. There has been a clear rise in interest in the topic of climate adaptation, in part as a result of climate subsidy schemes and risk dialogues with residents. This is particularly true of the working regions that include extensive urban areas. Except for the area that was directly affected, the recent weather extremes in South Limburg have not prompted a re-evaluation of the ambitions already in place. A number of weather extremes that received less national attention did have an impact on the ambitions in the working regions where they occurred.

Collaboration in the working regions

Collaboration takes various forms in the 45 working regions. In large cities, a lot of work is being done on climate adaptation, with the work of getting all the different units of the organisation on board requiring a lot of effort. Large municipalities have more capacity but the processes are also more complex to organise. Smaller municipalities have begun to work together more with each other in working regions. In rural areas, collaboration mainly follows existing structures, with municipal and water authorities doing a lot together. The provincial authority is also often involved. Organisations such as the Municipal Health Services, Safety Regions, the Forestry Commission, Rijkswaterstaat and drinking water companies are sometimes invited to work together on a specific theme.

In general, they work together well. With regard to the issue of responsibility, questions are being raised in some working regions about responsibilities in the area of coordination, about the transition area between rural and urban areas, and about how to work with landowners. Concerns about operational capacity are widely shared.

Not a great deal is being done as yet in the area of public-private partnerships. Housing corporations are involved in a number of places, as are entirely private companies in one

working region, mainly in larger municipalities. In the Delta Plan for Spatial Adaptation, the working regions can only devote limited time to monitoring; when it happens, it is process-oriented. The working regions believe that capacity and resources are inadequate to monitor the development of climate resilience. The need for monitoring is on the increase, particularly with respect to governance. The focus here is on keeping track of the scale of the agenda and progress with the transition to climate-proof spatial planning.

Connecting role of the provincial authorities

Many provinces play a connecting role with respect to collaboration in the working regions. Some provinces are also actively taking on the role of area coordinators in the Delta Programme for Spatial Adaptation, with a number of working regions from inside the provincial authority or from a water authority actively collaborating and sharing knowledge. The provincial authorities generally provide active support for the establishment of regional implementation agendas and the applications for the Climate Adaptation Stimulus Scheme. In addition, provincial authorities are often able to connect theme-specific stakeholders at the supra-regional level with regional and local climate adaptation issues. Those stakeholders include housing corporations, the private construction sector and investors, the safety regions, the water authorities, and the municipal health authorities.

5.5.2. Exploiting synergy opportunities

Exploiting synergy opportunities (ambition 5 of the Delta Plan for Spatial Adaptation) has proven to be a difficult step, with few openings being available as yet. Municipalities are being increasingly successful in linking climate adaptation to regular management work such as the replacement of sewers (in Leiden), sheet piling (in the municipality of Nissewaard) or major maintenance by housing corporations (in Vlaardingen). In addition to keeping the costs of climate-adaptive planning manageable, more information and knowledge are becoming available about the additional costs for municipalities in both the construction and management phases.
A clear understanding is also emerging about what the logical moments are to intervene in order to encourage action by private home-owners (as in Nissewaard). As a result, municipal authorities are acquiring more tools for the effective management of their subsidy instruments and communications.

Being able to make the most of synergy opportunities requires a shared language and focus for different areas of expertise. This is, for example, the case with the opportunities afforded by synergy with the energy transition. Differences in policy goals and focus, and a lack of familiarity with each other's working processes, get in the way of an effective joint approach. In Zuid-Holland, a 'swiper' was developed for this purpose. This is a digital presentation that offers concrete action perspectives for how to establish links with both climate adaptation and the energy transition. The presentation resulted in a range of concrete follow-up actions: a guide to combining solar panels with water and vegetation on roofs, and a follow-up study on sustainable sources for cooling the built environment. With regard to the latter, an assessment was made of how the results of that research could be given a place in the Regional Energy Strategies.

5.5.3 Stimulate and facilitate

Applications for Stimulus Scheme

In 2021, over half of the 45 working regions submitted their first official application for the Climate Adaptation Stimulus Scheme (see 5.1). Measures are being designed at the working region level thanks to the scheme. However, these measures are implemented on a municipality-by-municipality basis. The stimulus scheme is often used to establish synergy between the climate adaptation agenda and other projects. The working regions have said that they are having difficulties with fact that the approach to heat stress, and sometimes the green measures as well, cannot be financed from the stimulus scheme, and nor can resources for the societal objectives and the process costs for climate adaptation. Here, a comparison is made with schemes for the energy transition, which provide more openings in this respect. The importance of maintaining the cohesion between the implementation of the Delta Plan for Spatial Adaptation and the Delta Plan for Freshwater is also mentioned.

5.5.4 Regulating and securing

Developments in terms of regulating and securing measures are in progress in many locations. Rainwater regulations for new buildings are becoming more standard, and a building covenant has been signed in several regions that includes the topic of climate adaptation. Many municipal authorities and private bodies are increasingly beginning to feel that the non-committal nature of this approach is an obstacle to progress and are arguing for a more mandatory framework for climate adaptation at the national level. This can be done, for example, using the yardstick for climate-adaptive building referred to above. Several provincial authorities have focused on making climate adaptation mandatory for new area developments at the regulatory level. The provincial authority of Zuid-Holland, for example, has embedded climate adaptation as one of the relevant aspects in its own sustainable procurement policy.

Climate Adaptation Standards Consultation Platform

The importance of standardisation and quality standards has been emphasised by provincial authorities and the Climate Adaptation Standards Consultation Platform (OSKA). In the OSKA platform, national government is working with the business community, fellow government authorities and 'standardisation organisations' to ensure that climate adaptation is included in certain standards. These may include practical guidelines or technical standards for the design of buildings, installations and facilities in public spaces. This amounts to a total of approximately 250 standards for the built environment alone.
An example of how climate adaptation is being included in standards is the OSKA Statement of Intent 'cooling buildings', which ensures that homes remain liveable and cool, even during heat waves and without the use of air conditioners. A second example consists of agreements about the construction and performance of systems for the infiltration of rainwater, such as wadis or infiltration paving.

It is important to keep the basic data that are required for standardisation up to date. Essential datasets are missing or there are no safeguards in place for periodical updating for a number of subjects. This could pose a problem in the context of cyclical stress tests and the solution again requires national coordination.

5.5.5 Emergency response

There are no developments in this respect that require discussion in this report. The subject has the full attention of the Flooding Policy Platform. See Section 2.3.

5.5.6 Vital and vulnerable functions and the IenW networks

Vital and vulnerable processes

The Netherlands has a multitude of vital and vulnerable processes that must be climate-resilient and water-robust by 2050. These processes constitute the vital infrastructure of the Netherlands. Failure or damage to these processes due to flooding, excess water, drought or heat can lead to serious consequences for people, the environment or the economy. These can be processes in the energy system, but also drinking water system, main infrastructure and hospitals. There may be direct damage but there may also be extensive knock-on damage that goes beyond local and regional borders. This damage can occur because vital and vulnerable processes are interdependent.
The national government has a responsibility - in collaboration with local government authorities and suppliers - to ensure that vital and vulnerable processes, and infrastructure, are in a better position to cope with the effects of climate change. In late 2023, the national government will adopt a realistic ambition in terms of policy and supervision with regard to vital and vulnerable processes.

Progress on climate adaptation for vital and vulnerable processes

In terms of vital and vulnerable processes, the overall picture is now largely similar to what was reported in the 2021 Delta Programme. It is - because of the size and complexity - not easy for the national government, regions and providers of the vital processes to establish a clear picture of the resilience of vital and vulnerable processes, the associated infrastructure and the interdependencies. Partly for this reason, it is difficult at present to present a reliable overall picture annually which includes more information than is already available. In 2021, therefore, a start was made on improving the coordination of, and approach to, vital and vulnerable processes at both the national and regional levels. This initiative will continue in the time ahead in order to further clarify roles, responsibilities and expectations.

However, there is a lot happening around the *vital and vulnerable* theme. For example, as part of the 2022 WAVE (Safety Region Approach for Floods) programme, a supra-regional Impact Analysis for Floods was conducted looking at the consequences outside a flooded area. This included looking at the role of critical infrastructure. The analysis provides a sounds basis for better understanding the relationship between various indirect impacts and for arriving at sound agreements about their coordination. The consequence is that the collaborative partners in the SMWO (Steering Committee on Management of Water Crises and Floods) will be working on broadening action perspectives and further describing the consequences of flooding in five significant breach scenarios.

Climate adaptation progress in IenW networks

To establish climate-resilient networks, Rijkswaterstaat (RWS) and ProRail completed their stress tests and risk dialogues in 2021. The results have been included in the Rijkswaterstaat Climate Impact Atlas. The first version of the Rijkswaterstaat Implementation Agenda for Climate-Resilient Networks describes how Rijkswaterstaat is working on climate adaptation. The implementation agenda and information about ProRail's climate impact atlas were sent to the House of Representatives on 29 March 2022. Furthermore, a framework is being developed to anchor the implementation of climate adaptation for the networks.

CHAPTER 6

Progress by area

Low water levels in the Rhine, Spijk, June 2022

In seven separate areas, the partners in the Delta Programme are working to implement the preferred strategy for the three agendas of the Delta Programme: flood risk management, freshwater availability and spatial adaptation. This chapter describes the progress that has been made.

6.1 Introduction

Accelerating climate change is making the agendas facing the different areas more daunting. In order to achieve the targets that have been set for 2050, it will be necessary to pull out all the stops. The following sections describe how the various government authorities are working on this challenge, and the resulting insights.
Figure 12 provides a bird's eye view of the key insights for the individual areas.

Anticipate the major water challenges after 2050 now

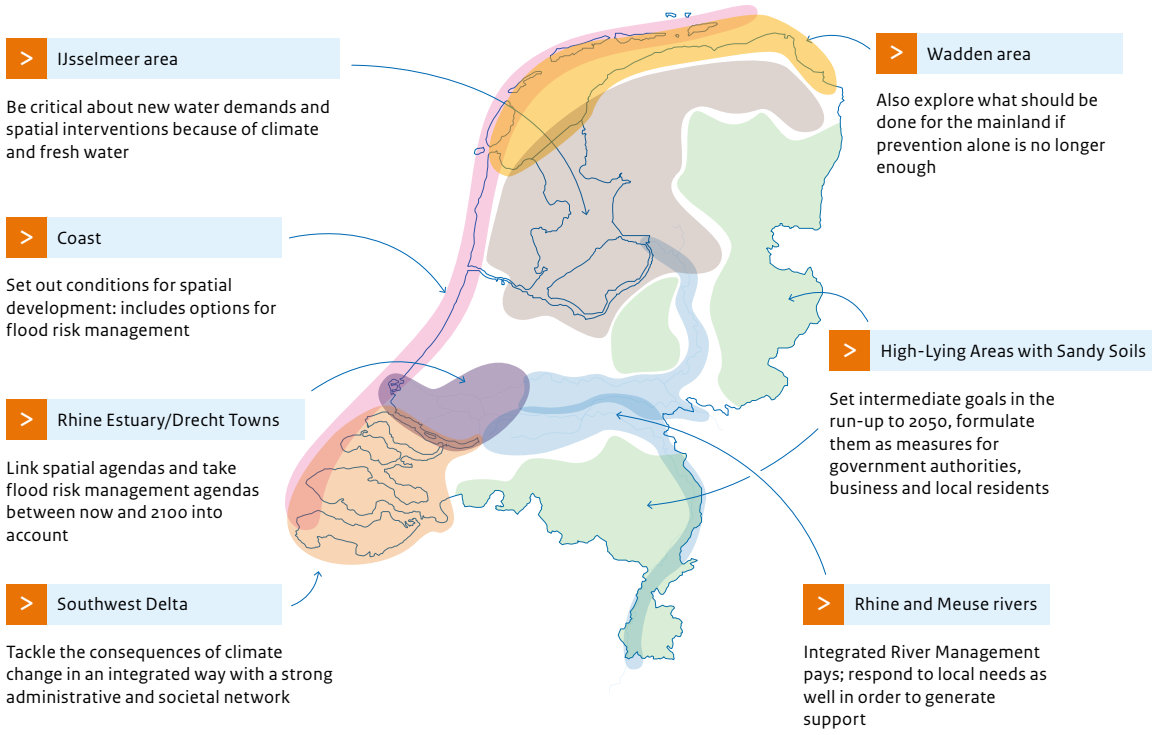


Figure 12 *Bird's eye view of the key agendas in the Delta Programme areas*

Although the Amsterdam-Rhine Canal/North Sea Canal area, which is also referred to as Central Holland, is not an area that is covered by the Delta Programme in a formal sense, the connection between this vulnerable but important region and the Delta Programme is of major importance and that is why it will also be discussed here. In this area all three DP challenges - flood risk management, freshwater availability and spatial adaptation - apply.

Amsterdam-Rhine Canal/North Sea Canal area
The Amsterdam-Rhine Canal/North Sea Canal (ARK/NZK) area is an important economic region in the Netherlands. The North Sea Canal and the Amsterdam-Rhine Canal together make up the discharge system for a large part of Noord-Holland, Utrecht, and parts of Zuid-Holland and Flevoland. They are crucial for water management and many functions in the region (such as nature, agriculture, drinking water, shipping and industry). The proper functioning of the water system in the ARK/NZK area, and any shortcomings in that respect, can have major societal and economic consequences. Examples include possible floods in rural and urban areas if the excess water cannot be drained properly, the social disruption that may occur if vital functions fail due to floods, and the consequences for nature and agriculture if there is not enough fresh water during dry periods.

Objective for 2100: perspective

The ARK/NZK water system is reaching the limits of its capacity to accommodate all the claims that are being placed upon it. The various spatial developments in the ARK/NZK area - such as the construction of hundreds of thousands of homes, the mitigation of land subsidence, the energy and agriculture transitions - have a major impact, now and in the future, on water management, and vice-versa: from the possible acceleration of precipitation run-off to higher demand for fresh water. These developments cannot be viewed separately from developments in the climate and water system: it is important to have a clear picture of the agendas and boundary conditions from the perspective of the water system.
In this area also, it is important to take an integrated approach to agendas from the Delta Programme in conjunction with spatial developments. This requires clear organisation at both the administrative and governance levels. An organisational model will be elaborated in the near future for this purpose so that this area can become a fully-fledged component of the next periodical evaluation round in the Delta Programme.

A range of initiatives are focusing on the challenges in the ARK/NZK water system in both the short and long term. There are several NOVEX areas in the ARK/NZK area. These are areas where national agendas in the physical domain accumulate in such a way that an area-specific classification and prioritisation of different national agendas is required. These areas will be reclassified and/or substantially restructured in response to national spatial agendas and decisions. The TB regional programme (the Future-Resilient Water System in the Amsterdam-Rhine Canal/North Sea Canal Area) will work
on achieving future resilience by 2100 on the basis of the link between the water system and the spatial domain.

Progress

In collaboration with track IV of the Sea Level Rise Knowledge Programme (see Chapter 2), action perspectives for the distant future are being explored in area sessions on the basis of *a design-oriented approach*. This involves looking at the shape of possible solutions for the long term, and the opportunities and dilemmas in the area in terms of transitions and agendas.
It has emerged from various TB studies in 2022 that additional measures are needed in the water infrastructure and/or spatial developments in the relatively short term to prevent flooding and maintain adequate supplies of fresh water, now and in the future. The 'Water and Climate Adaptation' expert group, an alliance of water management authorities associated with the National Environment Planning Vision (NOVI), has established an overall picture of the water agendas in conjunction with other agendas. The Metropolitan Region of Amsterdam's Urbanisation Strategy is one of the underlying principles here.
The TB further notes that space will have to be ringfenced in order to ensure there is enough room for water system measures in the longer term. The water system is reaching its limits. To engage in dialogue with parties in the spatial domain, the TB drew up a *TB dialogue chart* in 2022 that identifies possible areas that will be ringfenced. This information was also supplied to the two design studies conducted as part of the Creative Industry Stimulus Fund: shaping the adaptation strategy 'Moving with the flow' for Central Holland and flood risk management in the large-scale Port City housing project.
Options include the temporary raising of the emergency level around the ARK/NZK and/or large-scale peak storage sites. To this end, it is important for spatial developments to anticipate this development now.

Connection

The TB programme works adaptively and in an area-specific way with a range of other initiatives on the basis of a network structure. These include the various sub-programmes of the Delta Programme, the Smart Water Management (SWM) project, the Sea Level Rise Knowledge Programme, the Urbanisation Strategy for the Amsterdam Metropolitan Region, the North Sea Canal Area NOVI, the Rijkswaterstaat Climate-Resilient Networks (KBN - see inset) programmes and the Replacement and Renovation programme for the IJmuiden pumping station and discharge complex. In addition, the TB has provided input for the environmental visions of municipal and provincial authorities. The programme continues to work on establishing connections by bringing the water agendas and the leading role of water to the attention of consultation platforms, new and old. The aim is to provide the right information, at the right moment, in the right platform.

Climate-Resilient Networks

To shape the implementation of the Administrative Agreement on Climate Adaptation (2018), Rijkswaterstaat is working on the water-robust and climate-resilient structuring of the networks it manages.
The aim of the Climate-Resilient Networks (KBN) is to reduce vulnerability to climate change and take advantage of opportunities provided by a changing climate. In doing so, Rijkswaterstaat is following the pattern defined in the Delta Plan for Spatial Adaptation. There is now a national implementation agenda. In addition, additional stress tests are taking place and two follow-up studies may be launched: an interface analysis and a study of the effect of future developments on the fresh-salt water balance at the opening to the Amsterdam-Rhine Canal

Developments

The discharge of water in the ARK/NZK area is highly dependent on the main discharge location: the IJmuiden discharge and pumping complex. In the future, the maximum discharge capacity will be required more often during more extreme precipitation events and it will be inadequate more often. This is because more water is flowing in from the area, while the discharge capacity is falling as a result of sea level rise. Rijkswaterstaat conducted stress tests showing that the IJmuiden discharge and pumping complex is the most vulnerable to climate threats of all Rijkswaterstaat facilities in the Netherlands.

In the case of extreme sea level rise, gravity discharge through the IJmuiden discharge complex will be almost impossible after 2050.
It is therefore vital to create additional discharge capacity. The possibilities for a study under the auspices of the Multi-Year Programme for Infrastructure, Space and Transport (MIRT) are therefore being explored; large amounts of information are already available from the TB and work is taking place on generating additional knowledge.

Freshwater shortages and salinisation

In the time ahead, the TB will also examine freshwater shortages and salinisation in the region. In collaboration with the Freshwater Delta Programme, an assessment is being made to see which short- and long-term measures are necessary. The first results will be available in mid-2023 but the study is ultimately working towards the periodical evaluation of the national water allocation in 2026. The TB roadmap will eventually provide a clearer picture of the required options.

Spatial developments

In order to allow water to serve as a leading factor for spatial planning, the TB is working on clear boundary conditions with which spatial developments must comply. In addition to the retention and/or storage of water, all spatial developments must capture the water discharge and the increase in precipitation in their 'own area' (climate-adaptive building). So discussions about these matters between water management authorities, provincial authorities and parties involved in the spatial planning process must be organised in the initial stages of development.

6.2 IJsselmeer area

The Delta Programme helps to preserve the area functions of the IJsselmeer area for the future and, if possible, to strengthen them. Collaboration is the key: parties recently signed an governance agreement in which the IJsselmeer area has, as the first region in the Netherlands, updated the regional priority sequence for freshwater supplies in line with a recommendation from the Drought Policy Platform. Freshwater supplies, dike upgrades, anti-salinisation activities and raising discharge capacity go hand in hand with knowledge development. Further knowledge development is required given the complexity of the agendas.

6.2.1 Objective for 2050: perspective

Water discharge to the Wadden Sea is all about 'gravity discharge when possible, pumping when necessary'. In a few years, pumps and additional discharge sluices will be available in the Afsluitdijk barrier dam. This discharge capacity will be adequate to continue discharging water into the Wadden Sea until 2050, safeguarding proper flood risk management.
By 2050, the Afsluitdijk's discharge complexes will have reached the end of their technical lifespan and they will have to be replaced. Recent new developments in our understanding of sea level rise underscore the need for a timely consideration of the extent and timing of that replacement.

Flexible management, adaptive planning

A step-by-step and coordinated approach is needed to preserve the balance between freshwater supply and demand. The New Water Level Decree for the IJsselmeer area (2018) increased the freshwater stocks in the main water system by 400 million cubic metres of water.

The surrounding freshwater regions are committed to flexible management and adaptive planning. The focus is also on the more efficient use of water by consumers. However, the Stress Test for Fresh Water in the IJsselmeer area has shown that, as 2050 approaches, the probability of water shortages will increase enormously. The supplies of fresh water will decline and demand will increase.

Looking to the distant future

The IJsselmeer area is facing developments in the areas of infrastructure, housing construction, the energy transition, climate adaptation, nature, cultural heritage, agriculture and fishing, and leisure and tourism. Until 2050, the investment agenda in the IJsselmeer area may amount to some € 140 billion[26]. This is where friction may arise: interventions in the IJsselmeer and Markermeer

[26] Source: Sweco, 'De investeringsopgave in Deltaprogramma regio's'.

reduce the buffer capacity of these lakes. The possibilities for increasing the size of the freshwater buffer by means of 'water-level adjustment' (in other words, retaining more water) may be hampered by developments outside the dikes in areas such as urbanisation, leisure, tourism and nature. There is not enough awareness that each individual spatial intervention has immediate effects and can have major short- and long-term consequences, locally and elsewhere. Interventions can also have consequences for areas outside the IJsselmeer area that depend on fresh water from the IJsselmeer area itself. Sustainable spatial planning for the entire area requires a shared vision looking to the distant future. Stronger-than-expected climate change has an effect on planning decisions, now and in the future: those involved must continue to keep possible water-level adjustments in mind. It is important to ensure that adaptation measures do not turn out to be ineffective and that costs do not rise in the longer term.

6.2.2 Progress

In early 2022, seventeen parties (provincial authorities, water authorities and Rijkswaterstaat) signed an administrative agreement as the outcome of the process of the Updating of Water Allocation in the IJsselmeer area. In this way, the region is implementing the recommendation of the Drought Policy Platform on the regional elaboration of the priority sequence and embedding it in governance arrangements. The process has resulted in a clearer picture, and better understanding between the parties involved. This means people are in a better position to look beyond their own area. As a result, the parties involved can make wider-ranging, joint assessments of water allocation in the event of water shortages.

Regional session

On 1 June 2021, the first regional session for the IJsselmeer area took place as a part of the Sea Level Rise Knowledge Programme. The participants jointly explored the relationships between accelerated sea level rise (and the possible solutions) and area-specific spatial-economic development agendas. The study provided a picture of important opportunities and dilemmas, and generated knowledge questions about the future planning of the area. A workshop will follow after the summer of 2022 consisting of four sessions during which possible long-term solutions and the associated opportunities and risks will be identified.

Water discharge and flood risk management

The Afsluitdijk project will provide additional discharge capacity as well as pumping capacity of 235 m^3/s. The strategy of 'gravity discharge when possible, pumping when necessary' requires further elaboration. Pumping affects lake level statistics. This is important for neighbouring regional water systems - as in the case of water discharge from the region. Dike upgrade projects are taking place on different sections in the IJsselmeer area (see also Section 3.4.1).

Combating salinisation

Rijkswaterstaat started exploring anti-salinisation measures at the Afsluitdijk in late 2021 on the basis of funding from the Freshwater Delta Plan. The measures focus on improved salinity control, while taking into account location-specific aspects associated with shipping and ecology. The drinking water company PWN in Noord-Holland is exploring a number of options to improve resilience to the salinisation of the IJsselmeer, including the possibility of developing a climate buffer in the IJsselmeer. This is the combination of a water buffer, which can be called upon if chloride concentrations increase, and nature development (PAGW). The buffer and nature also boost natural pre-treatment at PWN. This combined approach makes drinking water supplies more robust when there are water shortages. The results are important for future decisions about the allocation of fresh water from the IJsselmeer.

6.2.3 Connection

Policy framework for functions requiring fresh water

New developments requiring water have consequences for the freshwater buffer needed in the IJsselmeer area. Examples of these developments include: the drinking water supplies in relation to housing construction, the emergence of hydrogen plants for the energy transition, the construction of mega data centres and new water level management in the peatland areas. In the administrative agreement from the Updating of Water Allocation for the IJsselmeer area, it was agreed to update the current policy framework stating the approach in this respect. That policy framework focuses on both maintaining freshwater availability and facilitating a number of new developments that are required. The influx of water to the surrounding area is not unlimited and it therefore requires well substantiated decisions.

Spatial Inventory

The IJsselmeer Area Administrative Platform (BPIJ) has commissioned a Spatial Inventory as part of the 2050 IJsselmeer regional agenda with the aim of establishing a picture of the agendas and developments in the IJsselmeer area. That overview will result in suggestions for how to make joint decisions. The agendas may have a major spatial impact and therefore affect freshwater buffers and flood risk management.
The coordination of the water agendas, nature agendas, spatial planning for the IJsselmeer area and other societal agendas makes it crucial to take into account the long-term physical changes facing the area in the future. Those changes are: sea level rise, fluctuating river discharges, and larger and more frequent weather extremes. The new

government policy of making water and soil leading factors in spatial planning has been incorporated in the approach by applying the 'layer approach'. This is an analysis, design and assessment tool that is often used in area-specific projects.

6.2.4 Developments

The availability of fresh water is under pressure. The Sea Level Rise Knowledge Programme is also looking at new insights to emerge from the new climate scenarios and at salinisation in the long term. New insights into possible sea level rise off the Dutch coast may lead to a stricter interpretation of the need to raise winter levels in the IJsselmeer and Markermeer after 2050. As a result, in the years to come, consideration will have to be given to raising pumping capacity after 2050, to controlling lake level peaks, and to the effects on the regional water system.

Climate change

Climate change is becoming increasingly important for the spatial planning of the future of the IJsselmeer area. There is a possibility of more and longer periods without precipitation during which demand for water will increase. With higher temperatures, evaporation will increase and the acceleration in sea level rise will result in a higher salt load via sluice gates and shipping locks, with the subsequent need to use more fresh water to combat this salinisation. Other risks include: floods, impaired nature quality, and the degradation of the quality of the water system itself and of the habitat. The IJsselmeer Area Spatial Inventory will map out the tensions between 'making water and soil leading factors' and all the other agendas involved in spatial planning and spatial interventions.

Climate trends and weather extremes can also meet in the IJsselmeer area, with a major impact as a result of that combination. In this case, what would be the effect on the IJssel-Vecht delta, for example? That question leads to the need for a stronger focus on the interaction between the regional water system and the main water system.

Action perspective

The aim of the IJsselmeer Area Delta Decision is to maintain the balance between the available fresh water and the demand for fresh water from the IJsselmeer buffer. The Freshwater Stress Test for the IJsselmeer Area demonstrates the need to reduce possible water shortages in the future and to manage salt levels. This can be done by raising the water influx, by reducing water demand, or by blocking new sources of water demand. A policy framework for new water sources of water demand is therefore becoming important. In addition, water demand can be limited by the government authorities in question when they make spatial planning decisions. The peatland issue also arises, as well as a shift from drinking water extraction to surface water. This challenge will be addressed from 2022 onwards. It is not straightforward in practical terms to get the freshwater buffer to the right level at the right time. The buffer has to be replenished well before a drought becomes a possibility. This requires a better 'forecast horizon' for river discharges, and this in turn requires joint research. Other areas requiring joint investigation are management and use in upstream countries and international agreements.

Selected developments in the IJsselmeer area

There are a number of national developments that affect the IJsselmeer area. They are monitored closely and work is taking place on improving coordination. In order to increase the freshwater buffer in the IJsselmeer area, a study is being conducted as a part of the strategy with the Climate-Resilient Freshwater Facility for the Main Water System to see whether additional water can be supplied via the Amsterdam-Rhine Canal and what negative effects would have to be prevented if this were to be done. An example of a possible negative effect of this kind is the salinisation of the North Sea Canal. The erosion of the Upper Waal and the Pannerdensch Canal is also altering the discharge distribution between the Rhine distributaries at low discharge: less water will then flow into the IJssel. This can have consequences in time for the flow of water to the IJsselmeer. As part of the Integrated River Management Programme, a vision for the future is being developed that will also look at the low-water issue and discharge distribution.

New developments and insights are linked to the long-term perspective for the IJsselmeer area on the one hand and to the short-term implementation of initiatives in the area on the other. That requires a renewed awareness of the complexity of the agendas involved. Different time scales must also be considered for each agenda. This will contribute step by step to sound decision-making about the periodical evaluation of the Delta Decision for the IJsselmeer area, which will take place in a few years from now.

Operational strength and capacity

The multitude of agendas and the complexity of coordinating them in the IJsselmeer area necessitate an upgrade of the knowledge base of the parties involved in the Delta Programme. At the same time, those parties have said that a lack of human resources is already causing problems with coordination. This problem is expected to become more urgent in the years ahead.

6.3 Rhine-Meuse Delta

The Delta Decision for the Rhine-Meuse Delta looks at decisions in the main water system that affect the entire Rhine-Meuse Delta: the diked Meuse, the Meuse Valley, the Rhine distributaries, the Rhine-Meuse estuary area as far as the estuaries, and the northern basins of the Southwest Delta.

Discharge distribution in the Rhine distributaries

The developments relating to discharge distribution to the Rhine distributaries are described in Section 6.4.4.

6.4 Rhine and Meuse rivers

The first periodical evaluation of the preferred strategy for the Rhine and Meuse is being conducted in the Integrated River Management (IRM) programme. The aim is to address the agendas of flood risk management, nature and water quality, navigability, freshwater availability, and spatial and economic development in conjunction, while preserving and strengthening existing core qualities. IRM will be established in a programme under the Environment Act (POW-IRM). This programme is expected to be available for inspection in May 2023, after which final decisions can be made.

Integrated River Management programme

Since the IRM began in 2019, a great deal of knowledge has become available about how the river area works. Steps have also been taken in order to establish a programme under the Environment Act (POW).
In 2021, as an exercise, work began on the development of a vision of the future for two river sections. The evaluation of this exercise resulted in a periodical evaluation of the IRM in 2022 that distinguished between two steps: policy decisions and frameworks will be set out in the POW in 2023; after adoption and on the basis of the POW, integral elaboration will begin for the specific areas.
The POW sets out policy decisions at the levels of the system and the river tributaries: decisions about sediment management/bed location and decisions about discharge and storage capacity. Priority areas are also selected, in part on the basis of the urgency of specific agendas and overlapping agendas. Furthermore, the POW includes priority system measures.

The POW is binding on the national government; it is adopted on behalf of the national government by the Minister of Infrastructure and Water Management in consultation with, at least, the other ministries, provincial authorities and water authorities concerned. In administrative agreements between the national government and the provincial authorities and water authorities concerned, agreements are made about the regional effect and implementation of the POW. These agreements cover management, governance, collaboration, organisation, process conditions, funding and the harmonisation of financing frameworks. Agreements are also made about the monitoring, control and steering of the progress of IRM and about the six-yearly periodical evaluation of the POW as the preferred strategy for the Rhine and Meuse.
It has been decided to focus the POW on the principal choices for the river system and the selection of priority areas. The preferred alternative for the IRM Programme will be published on time in May 2023 for public consultation, after which final decisions can be made. It will then constitute the evaluated preferred strategy for the Rhine and Meuse.

IRM pilot projects

In order to acquire experience with integrated working and to establish a clear picture of the resulting lessons and dilemmas, nine IRM pilot projects were launched in 2020: three on the Rhine distributaries and six on the Meuse. Four new pilot projects for the Rhine distributaries followed in 2022: Self-realisation Middle Waal, Pre-inventory for the Gelderse Poort PAGW, Drought in the IJssel Valley and Flood Protection Programme-Safe Vecht. The learning questions arising from these pilot projects focus on integrating the goals, sources of financing, and timetables of the parties involved. Two active sediment management pilot projects were added in 2022: on the Middle Waal and the Border Meuse. Those pilot projects focus specifically on shaping the future approach to sediment management and riverbed location. The experiences from the pilot projects will be taken into consideration in the development of the IRM Programme. A more detailed explanation of the pilot projects can be found in Section 6.4.3.

6.4.1 Objective for 2050: perspective

The ultimate goal is a dynamic, navigable, safe and appealing river area. This will be achieved by developing a vision for the river area in the IRM Programme, identifying the interventions needed in the areas of flood risk management, navigability, freshwater availability, water quality, nature and an appealing living environment (economically and otherwise), while preserving and strengthening existing core qualities, and then implementing those interventions.

Because of the multitude of wishes and ambitions, choices have to be made and a commitment is needed to using space in multiple ways. This requires an integrated approach and measures that do not stand alone but are part of a logical and coordinated whole. In July 2021, there was a disaster in the Meuse region of national dimensions: extreme rainfall led to major and long-term social disruption in both the regional and main water systems. The urgency of working on flood protection in the river area continues undiminished and it requires action.

The first major agenda is climate change and its impact on high and low discharge levels and the ecology. It is necessary to increase the discharge capacity of rivers, retain water as long as possible, keep low discharge levels as high as possible and enhance river dynamics.
The climate agenda is complicated by the consequences of past interventions, such as the far-reaching fixing of the location of the river bed, leading to the deepening of the riverbed over time, with all kinds of consequences for freshwater supplies, water quality, nature and shipping. This is the second major agenda for the rivers. Both agendas play a role in the IRM Programme, in which policy decisions about discharge capacity and bed position are being prepared, including work on the details in priority areas where the urgent, systemic, agendas are located.

The goal for flood risk management is to achieve the new flood protection standard in 2050 and, specifically for the Meuse, to keep room in the river bed in the Limburg Meuse valley using twelve systemic measures. The expectation is that this goal will be achieved.
A major obstacle to the widening of rivers is that there is currently no investment programme on the lines of, for example, the Meuse Works or Room for the River. Financing has to be negotiated on a project-by-project basis.

A number of governance lessons can be identified for the Meuse River. Parties are working together closely to establish sound flood risk management: there is a strong emphasis on innovation (for example in the form of floating defences and glass walls) and support in the region. River widening is taking place only on a limited scale but, where it is being implemented, the result is positive. Research is continuing into objectives and possible measures focusing on robust freshwater availability from the Meuse.

6.4.2 Progress

Rhine

Dike upgrades (Flood Protection Programme)

Several projects are in progress on the Rhine. A few striking examples are:

Gorinchem-Waardenburg

In mid-2022, the Gorinchem-Waardenburg (23.5 km), Tiel-Waardenburg (19.5 km) and Wolferen-Sprok (13.1 km) dike upgrade projects are in progress. Several other projects are well advanced in terms of the elaboration of the plans. As part of the Flood Protection Programme, the Rivierenland water authority is sharing the knowledge generated by these projects. For example, in 2020, the water authority published an online report on lessons learnt for the Gorinchem-Waardenburg inventory and planning phase, and Wolferen-Sprok made a significant contribution as a specimen project for emission-free construction.

Table 11 Number of Flood Protection Programme projects (length of flood defence)

Water Authority	In preparation	Work in progress	Not yet launched
HH Stichtse Rijnlanden	5 (46 km)	1 (2 km)	
Rivierenland	4 (61 km)	7 (61 km)	13 (241 km)
Drents Overijsselse Delta	4 (77 km)		8 (91 km)
Rijn en IJssel	5 (18 km)		9 (115 km)
Vallei en Veluwe	1 (5 km)	1 (3 km)	4 (19 km)

Strong Lek Dike

In the Strong Lek Dike project, the De Stichtse Rijnlanden water authority will be upgrading almost the entire Lower Rhine and Lek dike between Amerongen and Schoonhoven (55 km). This project has been split up into six sub-projects. The Salmsteke sub-project will enter the operational phase in 2022. The other sub-projects are in the inventory or planning phases. The entire project has major ambitions in terms of innovation, spatial quality and sustainability, including zero-emission operations. The collaboration with the three innovation partners has been housed in a two-phase contract. Process innovation and sector collaboration are central to this innovation partnership.

Grebbe Dike

The upgrade of the Grebbe Dike is part of an area development in which the aim of the flood risk management is being implemented in combination with nature objectives and ambitions for leisure, cultural history, spatial quality and sustainability. In the summer of 2020, the partners adopted the preferred alternative for the area development. In the detailed planning phase, the municipal authorities of Wageningen and Rhenen, the provincial authorities of Gelderland and Utrecht, Rijkswaterstaat, the National Forestry Department (Staatsbosbeheer) and Het Utrechts Landschap are further elaborating the preferred alternative in collaboration with the Vallei and Veluwe water authority. Circularity is a particular focus with, for example, the establishment of a *materials passport* for the first time for a dike. The elaboration of the plans is expected to be completed in 2024. The operational phase will then begin.

Zwolle-Olst

To ensure that this dike section complies with the statutory flood protection standards again, an inventory was initiated in 2017. A range of alternatives were considered for this purpose with the parties concerned. They were studied in terms of environmental impact, cost and technology. The preferred alternative was adopted in September 2019. For most of the sub-sections, it was decided to upgrade the dike from the inside using a vertical solution to prevent backward erosion piping. A small number of sub-areas will be tackled by reinforcing the outer side of the dike. The project is currently in the planning phase. The operational phase will begin in 2023.

IJsselpoort River Climate Park

In the autumn of 2020, the five municipal authorities involved adopted the intermunicipal structural vision for the IJsselpoort River Climate Park and the Minister of Infrastructure and Water Management took the MIRT preferred decision. Planning is in progress at present. The plan consists of measures for river widening, shipping, water quality (WFD), nature development, encouraging nature-inclusive agriculture, the redevelopment of the brickworks site and leisure developments. This will also result in the improvement of the spatial quality of the unprotected area outside the dikes between Arnhem and Giesbeek. For the purposes of elaborating the plan, Rijkswaterstaat has taken over the lead role on behalf of the eight parties involved in the alliance from the provincial authority of Gelderland. The timetable for the planning phase will be worked out in detail in the spring of 2022.

Meuse

Flood risk management

Several small projects in the context of the Flood Protection Programme have been completed on the Meuse; some large ones will enter the operational phase in 2022 (Beesel and Heel) and many are in preparation. Six of the twelve system-restoration measures for creating additional room in the Limburg Meuse are under investigation or in preparation.

Twelve river widening projects are also in preparation, mostly in combination with dike upgrades. In many cases, these projects lead to integral area development. For all projects on the Meuse: see Section 3.4.1, Tables 2 to 6 inclusive.

Table 12 Number of Flood Protection Programme projects (length of flood defence in km)

Water Authority	In preparation	Work in progress	Completed	Remaining (<2050)
Limburg	14 (50.251 km)	2 (4.8 km)	2 (0.349 km)	70 km (The Limburg water authority is working on programming for 185 kilometres of dike between now and 2050.)
Aa en Maas	4 (71 km)			4 (44 km)
Brabantse Delta				
Rivierenland	0	0	0	A possible upgrade agenda for these Meuse dikes will follow only after the completion of the second national assessment round in 2023-2034.

Two projects on the Meuse highlighted:

Many agendas and qualities come together at Well, where an integrated approach has considerable added value. Measures for flood risk management are necessary and they will be used as a motor for the upgrading of the castle estate, which is a historical and natural asset, in ecological and leisure terms. For the purposes of flood risk management, a green river and new dike rings around Well and Elsteren are planned as the preferred variant; elsewhere, the dike will be relocated. The Molenbeek of Well flows from the Meuse Dunes into this area. This brook, some sections of which now flow underground, will be ecologically upgraded and acquire a new confluence with the Meuse. Excavating clay generates additional opportunities for seepage nature and the clay can be used for the dikes. After the preferred alternative and the environmental impact assessment were adopted in 2020, studies were conducted and designs were produced in consultation with the general public and businesses. On this basis, the parties involved are expected to sign an administrative agreement for the planning phase in 2022.

The Meandering Meuse project will strengthen the dike from Ravenstein to Lith, provide more room for the Meuse on both the Gelderland and Brabant sides and make the area more beautiful and economically stronger. Ten organisations are working with residents, entrepreneurs and stakeholders on the future of the characteristic area around the Meuse, while respecting the assets in place. In 2028, this will result in a stronger dike and a wonderful area that will be safe and attractive, with room for people, river and nature. In 2022, the Meandering Meuse project team will elaborate the measures for the dike upgrade, river widening and area development to produce a definitive design. This will result in better protection from flooding for approximately 270,000 residents, businesses and valuable infrastructure behind the dike and in Oss and Den Bosch.

Availability of freshwater
See background document F.

6.4.3 Connection

Rhine

Integrated River Management (IRM) Pilot Projects
The nine IRM pilot projects are synergy projects that are working on combining regional and national agendas. The new IRM Practice Network is helping the projects and IRM to progress together towards a robust river system. See also inset in Section 6.4.

Pilot projects in progress:
Werkendam
Business, government authorities and stakeholders are working together here on an integrated vision of the future. Elements include flood risk management, dike upgrades, river widening, nature quality and port expansion.
The phase relevant for the learning questions has been completed. An MIRT study has been completed for the Werkendam Port Development. It is currently not clear what the agendas based on IRM will be for this area and for dike upgrades. The assessment of the dikes was due to be completed in the spring of 2022 but it will take place later this year.

Havikerwaard, Fraterwaard and Olburgerwaard (HFO)
An MIRT study was conducted for this area in 2020. Follow-up research will take place in the autumn of 2022, focusing on aridification, space/land use and the influence of the river system. The basis for this will be a landscape-ecological system analysis (LESA) under the auspices of the PAGW pilot project Gelderse Poort. This follow-up study will generate scenarios for area development in relation to options for bed location and discharge capacity.

Paddenpol
The goals of this project include more room for the IJssel, a wider floodplain with opportunities for lower water levels, ecological water quality, exceptional river nature and leisure activities. The phase relevant for the learning questions has been completed. The relocation of the dike and the structuring of the unprotected area outside the dikes is part of the planning process for the Zwolle-Olst Flood Protection Programme project.

New pilot projects:
Self-realisation Middle Waal
Floodplain redevelopment with mineral extraction is planned for this area. There are opportunities here for collaboration between private bodies and the government. This constitutes the basis for the research questions of the pilot project.

Gelderse Poort
This pilot project will deliver knowledge about how to integrate the PAGW goals in IRM. A pre-inventory of an ecologically robust and future-resilient river system for the Gelderse Poort and its various sub-areas will be conducted in 2022. The first step will be an LESA, which is also being used for the HFO area. The result of the pre-inventory will be a set of possible solutions for creating nature in the short (N2000, NNN) and long terms (PAGW) in relation to the IRM system parameters of bed location and discharge capacity.

Drought in IJssel Valley
Research is taking place into the use of high discharge situations for periods with low discharge levels and drought in relation to land use (nature, agriculture, agricultural transition) and floodplain management. The project is now in the start-up phase.

Safe Vecht
This project focuses on safeguarding flood risk management for areas inside the dike along the Vecht river between Dalfsen and Zwolle, with an emphasis on possible other options in the Vecht catchment. These are, for example, systemic measures that contribute to flood risk management and resilience to climate change. The pilot project will be conducted as part of the inventory for the dike upgrade between 2020 and 2023.

Systemic measures Middle Waal
On behalf of Rijkswaterstaat, a study is currently being conducted into how replenishment can influence the river bed in such a way that the river functions can be housed in the Middle Waal in an integrated and sustainable way. In addition, an investigation is being conducted into ways in which integrated alliances can ensure that replenishment operations are efficient. This pilot project demonstrates the potential of river replenishment as a way of achieving the ultimate goal of IRM in practice. The research phase is expected to be completed in 2023. The operational phase will take approximately seven years.

Other projects:
Panorama of the rivers of Gelderland
The major rivers (Meuse, Waal, Lower Rhine-Lek and IJssel) are extremely important for the province of Gelderland. The rivers determine how we live, work and perceive the landscape. For decades, many partners have been working together to create future-resilient, natural and economically strong rivers. IRM and the Flood Protection Programme are increasingly overlapping with, for example, the energy transition, the sustainability of agriculture and urbanisation. These are complex agendas with numerous opportunities but they also constitute dilemmas in which working together is becoming increasingly important. The Panorama of the rivers of Gelderland is a provincial action perspective that can contribute to links between programmes initiated by different government authorities and initiatives from other partners. The panorama uses a system with four guiding principles that is comparable with the layer approach to spatial development. A number of complex area processes in Gelderland, including dike upgrades, will be further elaborated in consultation with the local partners on that basis.

Linge intersection
Major maintenance on five engineering structures will begin in 2026. One is the replacement of the culverts under the A325 that drain the water from the Linge to the east. The Rivierenland water authority will, where necessary, reinforce the sections at the Kop van de Betuwe - Sprok - Sterreschans-Heteren location to achieve a significant reduction in the risk of dike failure, and the resulting flooding.

However, the calculations do not take into account extreme rainfall of the kind seen in Limburg last year. Studies by Deltares and Sweco have shown that, if a similar rainstorm were to occur where the Linge passes below the A325 motorway, there could be flooding to a depth of up to 1 metre, with potentially major consequences.

The maintenance plan takes the replacement of the culverts into account. However, the culverts are not designed to handle flooding as a result of extreme rainfall. It will therefore be necessary to create room for the Linge, a lowland brook, by positioning piles below the A325 over a distance of 80 metres. The original width of the Linge can then be maintained as it flows under the road and the river will therefore no longer need to be narrowed to pass through the culvert. The room under the A325 will also be used for motor and bicycle traffic from east to west. A number of other engineering structures such as the Elster Bridge may be removed or downgraded as a result.

There are also other potential benefits. The ecological connection will increase significantly, water influx in times of drought will become more efficient and the gateway function of Park Lingezegen will also improve significantly. The connection from east and west under the A325 will improve access to villages, leisure facilities and biodiversity. In this study, the provincial authority of Gelderland, the water authority and the safety region are looking to work together with the national government and European funds for the purposes of financing.

Meuse
The intention is that the IRM programme will become a programme under the Environment Act. The goal is an integrated approach in which the agendas for the following functions will be combined as much as possible: flood risk management, freshwater availability, navigability, water quality and nature, and regional spatial and economic agendas such as the agricultural transition, energy transition, etc.

The following six IRM pilot projects have been launched on the Meuse:

- Lowering of the dam in the Lateral Canal;
- Banks of the Meuse in Maastricht;
- Vierwaarden;
- Alem and Fort Sint-Andries;
- Assessment of the creation of possible discharge through the abutment on the Gelderland side of the A2 motorway:
- Flood protection in 's-Hertogenbosch, Crèvecoeur.

A seventh pilot project was added in 2022 focusing on systemic measures for the Border Meuse. The goal of this sediment replenishment project in the Border Meuse is to learn how gravel replenishment operations can help to maintain the height and quality of the river bed at a target level both efficiently and sustainably. This should result in a bed that prevents damage to structures and banks as a result of scour and maintain the gravel river habitat at the same time.

The pilot projects have been classified in accordance with the learning phase:

Learning and implementation category

Lowering of the dam in the Lateral Canal:

- Investigation of the method for pre-financing by government authorities and a 'millimetre fund' for entrepreneurs and projects (a compensation scheme where entrepreneurs become partners and also pay for the measure in order to acquire room for their own initiative). These initiatives should eventually cover some of the costs of the lowering operation within a demarcated development area.

Learning and inventory category

Banks of the Meuse in Maastricht:

- Integral approach to nautical safety.
- Working with the different timing of the phases to address the various agendas.

Vierwaarden:

- By restoring inter-authority collaboration, identify synergy opportunities in this section of the river and generate benefits for the river and the surroundings. This will also bring an end to the uncertainty for local residents in the areas where the dike is being relocated.
- Collaboration with more parties than the government authorities alone (resident initiatives, public participation) and exploitation of opportunities for stimuli for villages (including the village economy) in the immediate vicinity of the river.

Pilot project for the self-realisation of integral area development in Alem and Fort Sint-Andries:

- The acquisition of experience with integral area development based on self-realisation.
- Several opportunities come together in the project: for lower water levels, nature with room for riparian woodland, mineral extraction, the quality of life on the island of Alem and strengthening spatial quality. This pilot project will establish connections with the development of initiatives to create an ecological stepping stone in the area where the Waal and the Meuse come close to each other and, until the 19th century, flowed over into one another at high discharge.

Assessment of the creation of possible discharge through the abutment on the Gelderland side of the A2 motorway:
The national government has investigated synergy opportunities associated with improving the potential for water to flow under the current A2 motorway bridge over the Meuse on the Gelderland side in conjunction with the nearby railroad bridge and Hedel bridge, including cost estimates. The conclusion was that the effects will be relatively limited and the costs relatively high. It was therefore decided not to include this synergy opportunity in the planning phase for the Deil - Vught section of the A2; the national government may reconsider this decision in the case of any replacement or renovation operation. The results of this study have been included in IRM to embed this approach in the entire water system agenda, and also to establish the approach as a consideration for intersecting infrastructure projects.

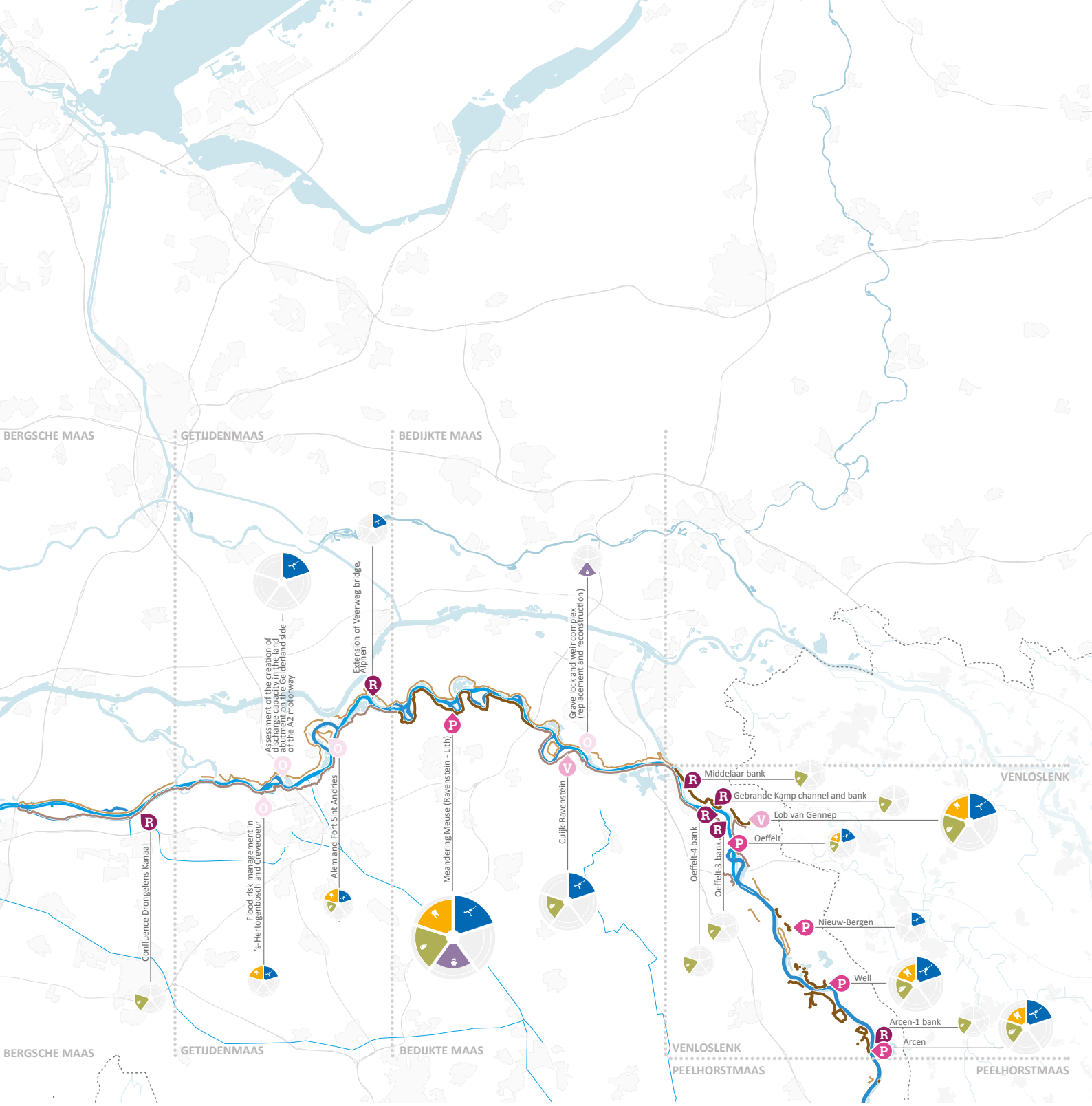
Learning and research category

Flood protection in 's-Hertogenbosch, Crèvecoeur:

- Linking Meuse agendas to agendas emerging from the Aa and Dommel regional water systems in conjunction with the development of nature and cultural heritage.

The pilot projects contribute to the IRM way of working and therefore strengthen integrated working approaches.

On the Meuse, this integrated approach has been visualised in a map showing the ongoing projects. Map 1 is a section showing the area around Gennep (see next page).



Agendas

- Flood risk management
- Freshwater availability
- Navigability
- Ecological water quality and nature
- Spatial and/or economic ambitions

Stage project has reached

- Research
- Inventory/pre-inventory
- Planning phase
- Operations (subject to change)

Dike upgrades in Flood Protection Programme: implementation completed

- Until 2025
- 2025-2035
- From 2035 onwards

Size/complexity of project

- Larger/complexer
- Smaller/less complex

Map 1 *Visualisation of integrated approach; section showing the area around Gennep*

The panoramas of the rivers in Gelderland show, among other things, how area development and the agendas can be visualised in the future. The Meuse Panorama (diked Meuse) is also on the website.

6.4.4 Developments

Rhine

Discharge distribution in the Rhine distributaries

In 2021, at the request of the Ministry of Infrastructure and Water Management, the Expertise Network for Flood Risk Management (ENW) published an advisory document on the policy regarding the distribution of discharges during extreme high water and specifically the component 'sparing the Lower Rhine-Lek'. ENW advises continuing to use the years 2050 and 2100 as indicative years for a possible adjustment of the relevant installations in line with an Upper Rhine discharge of 17,000 m^3/s and 18,000 m^3/s respectively in order to provide clarity for the designers of flood defences. ENW believes that the principles stated in the Key Planning Decision (PKB) Room for the River for the policy 'sparing the Lek' are still valid but that the context has changed and they are therefore not decisive. ENW recommends that, in the context of the IRM Programme, a broad follow-up study should be conducted looking at the most desirable discharge distribution for society in the long term. The start of the follow-up research is expected in the knowledge agenda of IRM after new climate scenarios become available (estimate 2023, run-out to 2024). This ensures that new knowledge will be included in the follow-up research.

Bed location and discharge capacity in the Rhine distributaries

The system review, one of the building blocks of the IRM programme, describes how the river systems currently function and how that functioning will develop in the foreseeable future. Four main choices and dilemmas emerged from the study: 1) the restoration of the discharge distribution at low discharge, 2) the raising of the river bed in the sections affected by scour, 3) a long-term perspective for the discharge distribution at high discharge, and 4) increasing the discharge capacity and widening the river bed. These dilemmas and choices have been included in the IRM programme. Specifically with regard to the location of the riverbed, trials and pilot projects are also taking place and work is proceeding on the development of a range of interventions and measures such as the construction of longitudinal groynes, bank and groyne modifications, and sediment replenishment.

Sea level rise

The effects of sea level rise will be perceptible on the Rhine, especially in the Merwede rivers, Waal and Lek. If the IJsselmeer level has to be adjusted in response to sea level rise, the consequences will also be felt in the IJssel-Vecht delta. This involves stacking risks since river discharges will also increase as a result of climate change and, in the longer term, discharge distribution to the Rhine distributaries will also play a role. Adaptation pathways are being developed for this issue as part of the Sea Level Rise Knowledge Programme in discussion with the Rhine region.

Flooding Policy Platform

The Rhine Administrative Platform has taken note of the first advisory document from the Flooding Policy Platform (see Section 2.3) and is willing to follow up on the recommendations that are relevant for the Rhine distributaries and the IJssel-Vecht Delta. The Administrative Platform did ask for the final advisory document to pay more specific attention to the application of the lessons to the Rhine tributaries and the IJssel-Vecht Delta.

International

The Netherlands and North Rhine-Westphalia signed a new joint declaration for cooperation on sustainable flood risk management in 2019. The parties established a new working programme for the period ahead in 2021. They are continuing to work together and looking for opportunities to strengthen this alliance. They are also continuing with work on further knowledge exchange in the areas of flood policy, the Flood Risk Directive, cross-border dike rings and crisis management. On 13 June 2022, the Rhine Symposium was organised with the theme 'Working together across borders on climate adaptation and water management'. Climate change is also having an increasing impact on water management in the border region. Germany and the Netherlands are facing the same problems. The provincial authority of Gelderland, the Rijn and IJssel water authority, the Rivierenland water authority and the German government authorities Bezirksregierung Münster and Bezirksregierung Düsseldorf want to anticipate the effects of the approach in both countries better by exchanging more knowledge and information and intensifying administrative cooperation.

Meuse

The first four of the developments below are a direct result of the July 2021 high water in the Meuse in Limburg.

The urgency of tackling flood risk management

Extreme precipitation in an area the size of half the Netherlands resulted in severe flooding and problems with excess water in Limburg in July 2021. The water led to suffering and damage for residents, businesses and organisations in the affected area. This situation highlighted the urgency of being well prepared for extreme rainfall. Rainfall of this kind is expected to become more frequent in the future as a result of climate change.

Links between the regional water system and main water system
In July 2021, the Geul, Gulp, Caumerbeek, Geleenbeek and Ruhr rivers had exceptionally high peak discharges. These were the result of days of heavy rainfall in the catchment areas of the Meuse and Ruhr, and in the Hills of South Limburg. The peak discharge in the Meuse also reached a record high. These peak discharges in conjunction with the bursting of the banks of the brooks led to a serious possibility that the Meuse would overflow the dikes in cities such as Maastricht, Venlo and Arcen. Until now, measures for flood risk management have not adequately taken into account the possibility of rainfall of this magnitude in the summer in conjunction with peak discharges in the Meuse and the brooks.

Multi-layer safety applicable to brooks
The first advisory document from the Flooding Policy Platform shows that our water systems, spatial planning and crisis management are not adequate to prevent pluvial floods entirely during such extreme precipitation events - nor can they reasonably be expected to be so in the future. It is therefore not always possible to prevent flooding as a result of extremes of this kind but the damage, social disruption and upheaval that follow can be limited as much as possible. This requires, in addition to prevention measures, a stronger focus on mitigation through spatial planning, awareness and crisis management. The present question facing the Policy Platform is how this multi-layer safety approach can be applied to the brooks in Limburg.

Water and soil as leading factors
Water and soil have to be leading factors in spatial planning. That agreement was included in the last coalition agreement but it has not been the case for a long time. On the basis of a belief in the possibility of engineering the country, and with assistance from technology, people have completely transformed the landscape and the subsurface during recent centuries. The consequences can no longer be denied: pluvial and river flooding, aridification and prolonged drought, soil and water pollution, and biodiversity loss - all compounded by climate change. In order to turn the tide and create a sustainable, healthy and appealing living environment in the river area in the long term, we need to 'listen' again to what soil and water 'have to say to us'. As the floods in South Limburg in 2021 made clear: there's no stopping water when it needs room. By making spatial choices in line with the condition and quality of the subsurface and the natural dynamics of water, we structure our country in climate-robust ways so that it is inherently safe, beautiful, meaningful and liveable.

Catchment approach requires international coordination
The rainfall and the subsequent floods in Limburg in 2021 have also made it clear that it is necessary to look at the entire Meuse catchment. Since much of that catchment is located in other countries, it is important to strengthen the international coordination of flood risk management.

Sea level rise
The effects of sea level rise will be acceptable on the Meuse as far as the area around 's Hertogenbosch. This involves a stacking of risks with the possible combination of a higher upstream discharge on the Meuse, peak discharges from the tributaries De Aa and De Dommel, and the effect of sea level rise. Adaptation pathways are currently being developed for this issue.

Soil erosion
The soil erosion problem in the rivers requires immediate attention and a targeted approach. Rijkswaterstaat is working on an approach that will also include the relationship with policy development in the IRM with regard to the riverbed location and sediment management.

In order to have more flexibility in the search for solutions in the river area, it is desirable to create more room and work more on the basis of the entire system rather than in a restricted area. Compensation for measures has to take place within the scope area, which is not always possible or desirable. Compensation in the system as a whole would significantly enhance the available options.

Working with local soil
The cross-project inventory Dike Upgrade with Local Soil (POV-DGG) has made it clear that there are major opportunities for improvements here to achieve a meaningful reduction in transport and emissions (CO_2 and nitrogen) during projects. Experience has now been acquired in this respect during the area-specific approach on the Meuse, for example by designing dike routes intelligently and 'making working with work'.

More integrated working approaches
The arrival of IRM is providing an extra stimulus for integrated working approaches on the Meuse. Six IRM pilot projects on the Meuse are opening up opportunities for strengthening integrated working approaches. The practical network launched by IRM can help to embed the experiences from the IRM pilot projects in the new way of working with respect to IRM.

6.5 Rhine Estuary-Drecht Towns/Western Netherlands Freshwater Region

After the periodical evaluation of the preferred strategy in 2020, the parties involved in the Rhine Estuary-Drecht Towns region were united in continuing with the regional implementation of the Delta Programme. In doing so, they are striving to make the approach to spatial agendas coincide with measures to make the region more water-secure and climate-resilient. Examples are river widening, dike upgrades and safeguarding freshwater supplies. In every investment these synergies are taken into consideration because area developments are for the long term, and efficient linkage to the agenda for flood risk management is not only safer but also potentially cost-effective. Furthermore, an integrated approach of this kind improves the quality of life in urban areas and beyond.

6.5.1 Objective for 2050: perspective

Flood risk management

Flood risk management in the Rhine Estuary-Drecht Towns will be assured until well after 2050 by the system of dikes and storm surge barriers. The 2050 goal as formulated for flood risk management is therefore achievable. The dikes and storm surge barriers are assessed every twelve years and the resulting findings are incorporated in management, maintenance and any dike upgrade projects. The urgent sections are being tackled first.
The findings show, also in combination with current expectations about the rate of sea level rise, that the strategy of a closable open water system can be maintained until at least 2070. In addition, work is taking place on layers 2 and 3 of multi-layer safety through spatial adaptation strategies for the dike zones and areas outside the dikes, and by developing plans for crisis management.

For the period after 2070, major decisions will have to be made about the strategy to be followed for flood risk management. To this end, parties are already making preparations now and taking future agendas into account in their investment processes: the short term is being linked to the long term. The tie-in with the Sea Level Rise Knowledge Programme helps to anticipate decisions in the future. The Rhine Estuary-Drecht Towns Delta Programme (DPRD), for example, is investigating the level of flexibility in the current system (with a particular focus on the storm surge barriers) and which possible solutions are conceivable for the long term with regard to strategies for flood risk management.

In practice, it is proving difficult to coordinate the planning of dike upgrades with other spatial developments. Scheduling dike upgrades earlier or later often proves to be infeasible. In addition, the financial constraints do not allow for the pre-financing of dike upgrades that have not yet been rejected or in locations where, for example, housing is currently being built, even though it is known that these dikes will fail any assessment in the future. Eliminating these difficulties would make it easier to establish links between other future agendas and the flood risk management agenda.

It is important for the various demands on space - both from the point of view of flood risk management, with measures to reinforce the dikes and widen the rivers, and from the point of view of other major social agendas, such as housing construction - to be well coordinated. In that way, all investments in the spatial domain will take the long-term agenda for flood risk management into consideration given that area developments are made for the long term and given that efficient coordination with the agenda for flood risk management is cost-effective. This ties in with the national aim of making soil and water leading factors for spatial development.

Fresh water

The Western Netherlands freshwater region wants to achieve resilience to freshwater shortages by 2050. Adequate supplies of water are crucial for maintaining the capacity of the regional flood defences. In its long-term strategy, the region is focusing on three pillars to enhance resilience to drought: optimising influx, the transition to alternative sources, and improving its own robustness (see Section 6.5.2). Depending on new insights into the effects of climate change or increasing water demand, the balance between the three pillars may shift to the increased use of alternative sources (such as brackish water or effluent), possibly in combination with transitions in, for example, spatial planning. The limits of the current influx system are in sight. Additional water demand cannot always be met in a straightforward way.
The meticulous development and implementation of the Climate-Resilient Freshwater Facility for the Main Water System is crucial for the long-term strategy, and it is important for the region that there should be no reduction in freshwater availability. The tie-in to the Sea Level Rise Knowledge Programme mentioned above is an important factor here.

Spatial Adaptation

The spatial agendas and ambitions for the future are considerable in this busy part of the Netherlands. In view of climate change and sea level rise, and 'water and soil as leading factors', the long-term sustainability of developments is an unremitting focus. The provincial authority of Zuid-Holland, in collaboration with the water

authorities in the province, is mapping out spatial strategies relating to the approach to investments in housing, energy, infrastructure and land use. The Covenant on Climate-Adaptive Building drawn up by the provincial authority of Zuid-Holland already serves as a guideline in this regard. In the Noord-Holland part of the Western Netherlands freshwater region, the regional ambitions for climate adaptation are included in the urbanisation strategy of the Amsterdam Metropolitan Region. The water authorities, provincial authorities, the vast majority of municipal authorities and private parties have jointly signed the declaration of intent on Climate-Adaptive New Building: a total package of regulations with which new buildings in the Amsterdam Metropolitan Region and the province of Noord-Holland must comply in order to be climate-resilient, mitigate damage caused by the changing climate and improve the living environment.

6.5.2 Progress

Flood risk management

Together with the partners in the Rhine Estuary-Drecht Towns Delta Programme (DPRD), the Hollandse Delta water authority developed an easy-to-use Excel tool: the 'No Regret' quick-scan tool. It provides a picture of the flood risks in unprotected areas outside the dikes as a result of sea level rise. In addition, the tool can help water management authorities and other parties to make the right decisions about climate-proof investments early on during plan development. The tool can therefore contribute to well thought-out area developments and location selection for investments.

The development of area-specific adaptation strategies for flood risk management for the entire Rotterdam port area has been completed. A analysis of flood risk management has been drawn up for the port of Dordrecht. The processing and application of these adaptation strategies will be central in 2023. The Port of Rotterdam Authority and the City of Rotterdam are engaging with stakeholders (businesses, utilities, infrastructure managers) in discussions about flood risk management in relation to their unprotected locations outside the dikes and how to make these locations climate-resilient by 2050.

Adaptation strategies for individual areas

A project team is developing adaptation strategies related to flood risk management for urban (inhabited) areas in Rotterdam. These projects involve housing associations and utilities. The aim is to develop a long-term adaptation strategy for each individual area in collaboration with the various stakeholders involved following on from the drafting of spatial development plans in and around areas outside the dikes. In 2022, the DPRD is working on adaptation strategies for the Kop van Feijenoord (southern bank) and an initial inventory has been completed of the combined agendas for spatial planning and flood risk management for the area around the Esch (northern bank) as a building block for an adaptation strategy for this unprotected area outside the dikes.

In addition to Rotterdam and Dordrecht, the DPRD is also working with the other river municipalities to develop flood risk management strategies for their unprotected areas outside the dikes. The experiences of Rotterdam (the City and the Port Authority) and Dordrecht are actively shared with other river municipalities and these municipalities receive support where possible.

Smart investments

A comprehensive approach to flood risk management for the Hollandsche IJssel is part of the DPRD's preferred strategy. Smart investments in the reliability of the storm surge barrier downstream of the other defences in the Hollandsche IJssel between Capelle and Krimpen can save several tens of millions of euros on the upgrade of the Strong IJssel Dikes in the Krimpenerwaard (KIJK) project and perhaps on future sections as well. As a result, there is also a significant reduction in the impact of the dike upgrade on the surrounding area. The reliability of the storm surge barrier can be increased to 1:1,500 - 1:2,000 by 2030. A decision about the final design for the dike upgrade will be made in late 2022.

Sound collaborative arrangements

In 2021, almost all the safety regions in the Rhine Estuary-Drecht Towns region produced impact analyses and evacuation strategies. The evacuation strategies of the various safety regions will be further elaborated at the supra-regional level in 2022. This is important because the effects of possible or actual floods do not stop at the borders of a safety region.

Another area conference for the Rhine Estuary-Drecht Towns Delta Programme is on the agenda for the summer of 2023. The 2021 area conference, which was organised as a hybrid event, was a success, with sharp and thought-provoking discussions, and over 150 participants.

The arrangements for collaboration in the DPRD are sound. The partners can establish contact with one another easily and projects are implemented by different sets of partners. The programme team brings everyone involved together and provides coordination, knowledge sharing and monitoring. In addition, the DPRD contributes actively to the Sea Level Rise Knowledge Programme. The emphasis here is on establishing a picture of the effects of sea level rise on the preferred strategy and on the timing of system decisions. There is also a particular emphasis on the effects of sea level rise on the functions in the area. Examples are unprotected

areas outside the dikes, housing construction there, the port of Rotterdam and nature. In the Rhine Estuary-Drecht Towns region, no major system decisions are needed for the time being. In the current preferred strategy, a supra-regional system analysis is planned in about 2040 with a specific focus on replacing the Maeslant barrier after 2070. However, the outcomes of the Sea Level Rise Knowledge Programme may still affect the timing of this analysis.

Fresh water

In 2021, the Western Netherlands freshwater region adopted a strategy and a package of measures for the second phase of the Freshwater Delta Plan, which will run from 2022 to 2027. The strategy is broader than the first phase (2015-2021) during which increasing the influx of freshwater was the main component. The new strategy is based on three pillars:

- The optimisation of water influx; a strategy that proved itself in the dry summer of 2018, and that also allows the region to contribute to the national strategy for climate-resilient water influx through the main water system.
- A transition to alternative sources focusing on the innovative use of the subsurface and the reuse of effluent.
- Enhancing the region's own robustness, reducing the regional water system's dependence on water influx and flushing. Examples here include better water retention, flexible water level management and the inclusion of water availability in spatial planning.
- One of the measures has already begun: a pilot project from the COASTAR programme in which the drinking water company Dunea is enlarging the freshwater lens below the dunes by extracting brackish water from beneath it. The extracted brackish water is converted into drinking water, with the enlargement of buffer capacity under the dunes as a result.

The Western Netherlands Freshwater Region contributed to the inventory and subsequent elaboration of the national strategy for climate-resilient water influx through the main water system. The strategy has benefits and drawbacks that are distributed unevenly in the region: without additional measures, freshwater availability in a part of the region will decrease because of the increasing salinisation of the Rhine-Meuse estuary. Without compensatory measures, this will cause damage (including economic damage) and impair the robustness of freshwater availability. The region is actively engaged in the learning-by-doing implementation of the strategy.

Alongside the preparation of the second phase, measures from the first phase are still being implemented. The automation of the inlet sluice at Spijkenisse was completed in 2021. Work is also in progress to expand the capacity of the Climate-Resilient Water Channel (KWA), which will be completed in 2024. The operational phases of the Polsbroek and Enkele Wiericke subprojects began in early 2022.

Own resources

In addition to the major projects from the Freshwater Delta Plan, the parties in the Western Netherlands freshwater region are also working with their own resources to increase resilience to water shortages. The water authorities are doing this, for example, by focusing on flexible water level management, smarter flushing and the automation of water level management. The water companies are exploring new sources for drinking water production.

Like all other freshwater regions, the Western Netherlands has elaborated the priority sequence for functions in times of water shortages in regional terms in accordance with the advice from the Drought Policy Platform. The result of that process will be available as an annex to the Regional Drought Consultation Platform protocol.

Spatial adaptation

In part as a result of the work of the provincial authority in the 'Weerkrachtig Zuid-Holland' (*Weather-Resilient Zuid-Holland*) programme, the sense of urgency with respect to climate change has increased over the past year, both in the organisation itself and among external partners. The efforts and initiatives of the provincial authority in this respect are appreciated. This is shown by, among other things, the nomination of the Climate-Adaptive Building Covenant as the Government Innovation of the Year. The products, studies, tools and instruments developed by the provincial authority are being cited and applied by parties in the province itself and around the country. Taking the effects of climate change into account in all policies and joint initiatives of public and private parties in Zuid-Holland is therefore 'the new normal' to an increasing extent.

Results from the region

Examples of impressive results from the working regions: the municipal authority of Leiden has studied the costs of linking climate adaptation to work on the sewage system. This is resulting in values that can be used by municipal authorities who wish to budget for projects of this kind. The municipality of Nissewaard has completed a study of effective intervention moments to encourage private home-owners to take climate adaptation measures. The municipal authority of Vlaardingen is organising 'synergy workshops' in which all the parties involved on the operational side (such as the municipal authority, the housing corporation or the drinking water company) are invited to discuss synergy opportunities for work at specific locations.

Several working regions have successfully submitted their first applications for the 2021 Climate Adaptation Stimulus Scheme. The other regions are set to submit their first applications in 2022.
In the Noord-Holland part of the Western Netherlands freshwater region, many results have been achieved under

the auspices of the area programme of the Amsterdam Metropolitan Region. Almost all of the working regions have also adopted implementation programmes and they are proceeding to the operational phase. In addition, climate adaptation is also being included in a range of area programmes that are linked to it, such as the Inner Dune Edge project, the Regional Peatlands Strategy, the designation of the North Sea Canal area as a NOVI area in the context of the National Environment Planning Vision, and the Low-Lying Holland project. Climate adaptation is also being addressed in a regional context: the Gooi and Vecht region, for example, is linking climate adaptation to a healthy living environment and climate adaptation is being included in the area-specific arrangements in the housing agreements. The theme of limiting the consequences of flooding has been worked up in more concrete terms in Amsterdam and it is part of a toolbox for area development as a result of the Thematic Study of Flood Risk Management for Amsterdam.

6.5.3 Connection

Flood risk management

On the basis of the idea of coordination and connection, it was decided in the spring of 2022 to establish more active connections with two themes from the Delta Programme: freshwater and spatial adaptation, and external developments such as housing construction, the energy transition, land subsidence and nature development. DPRD will therefore engage in official *and* administrative discussions with representatives of these themes about overlaps and synergy opportunities.
For the upgrading of dikes, the DPRD is actively looking for synergy opportunities with other spatial developments. An example can be seen in the opportunity chart drawn up for the Alblasserwaard-Vijfheerenlanden area, which the parties concerned update together on an annual basis.

During the design of riverbanks, nature development and leisure are primary objectives of area managers and stakeholder organisations. In this process, they in turn also take into consideration the possible contribution nature can make to flood risk management (for example as part of the River as a Tidal Park programme).

Fresh water

The Western Netherlands freshwater region explicitly takes into account other agendas and developments that affect water demand. Examples include the increase in demand for drinking water, measures to combat land subsidence, the raising of the water table in peatland areas, active groundwater level management in cities, the reduction of heat stress and opportunities for nature. Here again, the limits of the water influx system are in sight and increases in water demand cannot always be facilitated straightforwardly.
Naturally, it is also important to include freshwater factors in more integrated processes such as the development of environmental visions or area processes.
This process involves the relevant authorities themselves, including the input of knowledge from the freshwater region for the stress tests and area processes for spatial adaptation.

Spatial adaptation

In the context of freshwater availability, the following three themes are particularly important in Zuid-Holland: land subsidence in urban areas, raising the water level in peatlands, and salinisation, particularly in the western coastal areas. In all these areas, the reduction of vulnerabilities is closely related to freshwater availability on the one hand and storage capacity to prevent pluvial flooding on the other.
Flood risk management is a focus area with respect to the designation of new locations for housing. In Zuid-Holland, two new large housing locations are planned (Zuidplas and Valkenhorst near Katwijk) which will be designed to be as climate-adaptive as possible. New spatial strategies will be developed in 2022. An important component is the inclusion of flood risks and flood risk management, with the associated costs, during decision-making about any new future locations for housing or other investments.

Linking climate adaptation to other agendas

In the Noord-Holland part of the Western Netherlands freshwater region, climate adaptation is linked to other agendas at both the provincial and area levels. The urbanisation strategy of the Amsterdam Metropolitan Region is an example of this. This involves considering the complex regional agenda in conjunction, resulting in an integrated area approach. There is close collaboration with public and private parties. Tailored local solutions are needed, not least to see how other area characteristics and agendas can be included in the work on climate adaptation. The declaration of intent on Climate-Adaptive New Building from the Amsterdam Metropolitan Region is generic in nature but it will be implemented at the local level in an adapted form. In the Gooi and Vecht region, the climate adaptation agenda is linked to the policy for a healthy living environment. In more and more locations, the City of Amsterdam is combining planned redevelopment or major maintenance with innovations for climate-adaptive streets. An example is the construction of 10,000 m^2 of blue-green roofs, mainly on social housing. This was the Resilio project, which was supported by the European Union and completed in early 2022.

6.5.4 Developments

Flood risk management

The most important development for the Rhine Estuary-Drecht Towns region is the expected sea level rise. The KNMI will publish new climate scenarios in 2023. In addition to sea level rise, land subsidence also plays a role for some areas, as does the change in river discharges. There is a major housing shortage in the Rhine Estuary-Drecht Towns region. The challenge here is to respond in a climate-adaptive way. The Rhine Estuary-Drecht Towns area is actively committed to establishing the appropriate structures and boundary conditions for area developments. Important instruments here will be the municipal and provincial environment visions and the Water Test.

Fresh water

Sea level rise also has a significant impact on the availability of freshwater: it leads to an increase in saltwater seepage, which in turn pushes up demand for water in agriculture. In addition, seawater moves further up the river, as a result of which the salinisation of inlets becomes more frequent. In the long term, this situation will be exacerbated by possible changes in the discharge pattern of the major rivers.

Spatial adaptation

The most recent IPCC report has again shown that the rate of climate change and sea level rise is surprisingly fast. Its impact on Zuid-Holland's long-term economic growth and ambitions will be a focus of increasing attention. In the Noord-Holland part of the Western Netherlands region, several initiatives are anticipating this development. Here, the focus is not only on measures in the infrastructure but also on measures in spatial planning. The Future-Resilient Water System in the Amsterdam-Rhine Canal/North Sea Canal area (ARK/NZ) programme is playing an important role here: see also Section 6.1.

6.6 Southwest Delta

The Southwest Delta is faced with a number of complex agendas in the areas of flood risk management, fresh water and spatial planning. The partners are working on becoming the world's first climate-resilient region by 2050. Dike upgrades with sustainable and reusable materials are being prepared. The availability of fresh water (balance between supply and demand) will be further optimised, including in the area of Zeeland where there are no possibilities to bring in water from elsewhere. Scaling up from local pilot projects to the area level is important for the next five to ten years in order to meet the overall objective for the area.

6.6.1 Objective for 2050: perspective

The implementation of the current preferred strategy is proceeding as planned. Work with partners has been going on for several decades in order to achieve the integrated final objective of 'safe and climate-resilient, ecologically resilient and economically dynamic'. The governance ambition based on the Southwest Delta sub-programme for 2050 is to provide an extra stimulus for implementation. Over the next five to ten years, existing projects and programmes will contribute to the implementation of the objective.

The objective is realistic and feasible. There is ambition among the relevant authorities and experience has been acquired in the form of pilot projects and living labs in recent decades. There is a clear agenda in the short term for each sub-area. In addition, a network has been established that is geared towards collaboration. This network provides a firm basis for an integrated approach to the long-term agendas resulting from climate change.

Upscaling

Over the next five to ten years, activities will be scaled up throughout the Southwest Delta, taking into consideration all the experience acquired and developments in the area. The conceptual approaches in place are being implemented in practice at the local level in order to make it possible to determine the extent and speed of upscaling. An example is the Schouwen-Duiveland Living Lab, which is part of the Intergovernmental Programme for Dynamic Rural Areas. The network organisation Schouwen-Duiveland Living Lab is seeking new, innovative solutions for complex agendas in the areas of water, food, education and governance. That involves collaboration with educational institutions, business, government authorities, research institutes and local residents. Innovative solutions are being tested in practice on the road to a circular economy in Schouwen-Duiveland. By moving through iterative cycles between now and 2030, from current research into living labs at the local level (looking, for example, at the feasibility of freshwater storage in the subsurface) towards larger-scale application at the island level, it will eventually be possible to work on upscaling throughout the Southwest Delta in the period 2030-2050.

Conflicting interests

The goals to be achieved and the approach involve conflicting interests because of the diverse interests of the participating partners in the area. Trust, support and shared responsibility have proven to be important principles for

addressing conflicting interests. One focus is to ensure that initiatives do not get stuck in the research phase, and so fail to result in decisions about concrete application and implementation. A key success factor is that the relevant authorities should be willing, and have the courage, to look beyond their own interests and make decisions about those interests with the people they represent.

In addition to the above, a sound balance is needed between investments by the national government and regional investment. Another success factor is that opportunities should be sought for all interested parties and that the conflicting interests should be taken into consideration in the integrated approach. Tailored approaches for each sub-area and exchanges of interests can be key factors here. For example, five regional parties have joined forces in the Water between Wal and Scheldt project to look for opportunities to put the fresh water that currently flows into the Western Scheldt at Bath to good use. In doing so, the parties realise that what matters is not sharing the water between different parties but making the best use of the water to meet the shared goals of society in the region.

Water agenda and other challenges

The authorities involved have a great deal of influence on the decision-making process about the future of the Southwest Delta. It is good to realise that the water agenda is one among many of major agendas in the field of food production, climate, flood risk management, circular economy, biodiversity and energy. These challenges require a coherent, area-specific approach to agriculture, nature and the quality of the living environment. In this approach, different administrative levels work together, with each other and with other stakeholder organisations. The national government, provincial and municipal authorities, and the water authorities have joined forces in the form of the Intergovernmental Programme for Dynamic Rural Areas.

In the Southwest Delta, the rural area is being redesigned for agriculture, nature and tourism. This will require decisions to be made at the national and regional levels, for example in the area of spatial planning. A focus here is that adaptive delta management must not tip over into a cautious approach because not all the knowledge required is yet available. There will be more collaboration with independent advisory committees and communities to allow interdependent or collaborating parties to make the appropriate decisions. Participation by younger generations and also entrepreneurs is essential in order to respond properly to their future.

6.6.2 Progress

General

The Southwest Delta's ambition is to be the world's first climate-resilient region by 2050. The parties in the region are working on this together. In order to achieve the ambition, a memorandum of understanding has been signed guaranteeing the commitment and resources of the partners until 2027. A programme team with an independent programme manager has been established and an implementation programme for 2022 has been adopted. These steps will lead to the change from an organisation with a primary focus on processes and consultation to a more result-oriented organisation.

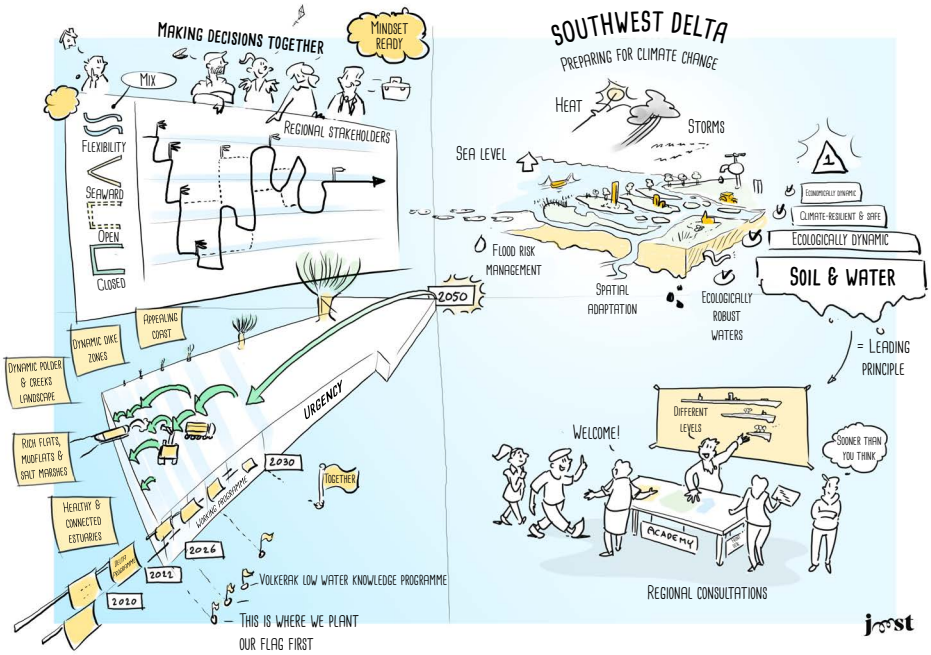


Figure 13 *Illustration 'Continuing to work ambitiously in our iconic region for tomorrow's climate-resilient Delta'*

Flood risk management

In the context of the implementation of the Flood Protection Programme, preparations are being made for a range of dike upgrades. In the province of Zeeland, those dike upgrades will be at Hansweert, Sint Annaland and in the dike section located between Hansweert and the Borssele nuclear power plant. The dike upgrade at Hansweert is complex because it is sandwiched in the village between the built-up area of Hansweert and a business located outside the dike. There is not a lot of space for the upgrade. The locality has been involved in the process at all times; residents were involved in discussions about a range of preferred variants and they contributed wishes and ideas during residents' evenings and dike excursions. They have been included in the relevant plans. These include changes to football fields, improving traffic safety, and designing part of the dike as a boulevard.

In the Noord-Brabant part of the Southwest Delta, the Willemstad-Noordschans and Moerdijk-Drimmelen sections, the Standhazen dike and the sections between Geertruidenberg and Oosterhout do not yet comply with the new statutory standard for 2050. The measures to make improvements in these sections are now being prepared. The upgrading of the section between Geertruidenberg and Oosterhout is particularly complex. Here, in a built-up environment, there are tens of kilometres of flood defences in need of improvement, including many engineering structures. The development of alternatives will therefore involve considering the potential for the construction of barriers in the Amertak and Donge rivers, which could circumvent the need for improvements to the flood defence in place.

Sustainable and reusable materials

For the upgrade at Hansweert and also for future dike upgrades, sustainable and reusable materials are used in part. In a trial at Hansweert, efforts are being made to produce blocks from dredged material for the stone revetment of the dike. The contractor is making a contribution to sustainable construction by not taking away materials released during the project, but reusing them. An additional benefit is that less transportation is required, which is important in terms of reducing the nitrogen load. In addition, the contractor is also trying to keep possible transportation routes as short as possible.

Assessment of dike sections

The water authorities and Rijkswaterstaat assessed a large proportion of the dike sections in 2021 and they will complete that assessment in 2022. On the basis of the initial results, it has been concluded that, given new standards and the application of the new statutory assessment instruments, a new, additional, agenda will be required in addition to the current dike upgrades. That agenda will have to be implemented before 2050. On the basis of the vision of the joint water authorities with respect to flood risk management, a picture will be established of the consequences for the Southwest Delta in 2022 and 2023.

Fresh water

2021 was the final year of a process for the planning period of the Delta Programme up to and including 2027 in which people worked on the establishment of a package of measures with regional contributions. This process was based on a government ambition drawn up previously.
In 2021 and 2022, plans were developed in the region to implement measures based on maintaining the role of the Volkerak-Zoommeer as a regional freshwater buffer and to further optimise freshwater availability in the region. This ties in with the government policy to implement the Stoffer motion[27].
Important components of the package of measures for the planning period to the end of 2021 were the establishment of freshwater influx through the Roode Vaart and the Freshwater Testing Ground in Zeeland. The Roode Vaart inlet facility was officially opened on 3 May 2022. This will allow West-Brabant to be supplied with extra fresh water from the Hollands Diep. The facility is robust enough to supply Tholen and Sint Philipsland with fresh water in the future if that is required. This does not alter the fact that work is also taking place to reduce water demand and store local water.

Freshwater Testing Ground in Zeeland

The Zeeland Freshwater Pilot Project is a programme that includes experiments with a range of measures with the objective of achieving a better balance between the supply and demand of fresh water in the area of Zeeland where it is not possible to bring in water from the outside. The emphasis recently has been on devising and testing approaches for the specific Zeeland situation. In the next planning period, the emphasis will shift to the possible upscaling of those approaches. For example, in the Walcheren Water Retention Project, farmers (water users) have been working closely with government authorities and external organisations (Aequator Groen & Ruimte, Deltares, ZLTO and Hogeschool Zeeland) since 2010 to become more self-sufficient in terms of water. They do this by not allowing fresh and salt flows in the area to mix and by storing the fresh water in the subsurface and in a basin. In addition, the soil has been made more resilient to drought by a targeted approach to enhancing biodiversity - and therefore water uptake capacity. In 2022, a new phase will begin in which two new underground freshwater lenses will be created. The additional retention of fresh surface water required for this purpose will be achieved by a nature-friendly widening of existing watercourses. As a result, water quality will also improve (in line with the Water Framework Directive) as a result of the reduction of the run-off and leaching of nutrients and pesticides into surface and groundwater. The measures require support in the local area. The new phase will therefore devote considerable attention to transparency about the impact of the measures by communicating monitoring results to the stakeholders in the area. As in earlier phases of the pilot project, knowledge about collaboration in the project will be disseminated after the completion of the project in order to launch the concept in other areas.

Water between Wal en Scheldt project

An important new project is the beneficial use of run-off water at the foot of the Brabantse Wal[28]. An inventory of the possibilities and opportunities was conducted for this project in 2021. Additional studies will be conducted in 2022 and 2023 to assess the feasibility of identified projects. On 3 May 2022, Minister Harbers and Delta Commissioner Glas were guests in the area for a working visit, during which they were informed about the opportunities and the importance of follow-up studies.

Spatial adaptation in Zeeland

The strategy to address the consequences of climate change for the Southwest Delta has been set out in the Climate Adaptation Strategy for Zeeland (KASZ). It was developed by the joint government authorities, with the municipal climate adaptation strategies and the climate adaptation strategy of the Scheldestromen water authority serving as building blocks. In conjunction, a joint implementation programme was developed and a six-year KASZ implementation covenant was signed. Progress for the western part of Noord-Brabant is reported through the Waterkring West working region as a part of the Spatial Adaptation Delta Programme.

6.6.3 Connection

Efforts are being made to link up with the action perspectives in the 2050 regional agenda in order to achieve the integrated final objective for the Southwest Delta, as referred to in Section 6.6.1, by 2050. The initiative referred to in Section 6.6.1 for the use of run-off water at the foot of the Brabantse Wal is an example of a possible approach. The 2050 regional agenda includes the link with the national agendas in the Southwest Environment Agenda, as well as the climate agendas detailed in the Knowledge Programme. These include nature agendas, the energy transition, the housing agenda and the agricultural transition. The design of the rural area must include room for leisure, spatial quality and the enjoyment of nature.

Building blocks

The above factors are the building blocks for the development of a climate-resilient, adaptive and flexible strategy for the short term that anticipates an uncertain long-term outlook for the future. The Sea Level Rise

[27] Parliamentary papers II 2020/21, 27 625, 521

[28] See background document F, Delta Freshwater Programme: progress in 2021 and review of first phase (2015-2021).

Knowledge Programme is examining the sustainability and flexibility of the current preferred strategy and the link will be established with the national and regional long-term agendas for the years after 2050. Other related programmes will also be included in the elaboration process, an example being the Intergovernmental Programme for Dynamic Rural areas. The experience acquired in this programme will be incorporated in the National Programme for Rural Areas, the Regional Energy Strategies of the provincial authorities, the Programmatic Approach for the Main Water System, the research programme of the Flemish-Dutch Scheldt Commission (VNSC) and the Flemish project, Coastal Vision.

Another example of an initiative to seek connections with programmes and networks in place is the link with the Waterpoort alliance. All parties around the Volkerak-Zoommeer are working together in this alliance on the themes of water, climate, nature and leisure. One of the strengths of this alliance is its approach to making the major agendas in the area concrete and feasible. There is also collaboration with the international Schelde Delta Geopark - Aspiring Unseco Global Geopark, particularly on raising awareness and furthering knowledge development relating to the theme of climate change and its effects on the area. In 2023, the aim is to arrive at concrete implementation proposals with both Waterpoort and the Scheldt Delta Geopark.

Goeree-Overflakkee

The municipal authority of Goeree-Overflakkee advises and supports residents in terms of sustainability with the Climate-Resilient Goeree-Overflakkee project. Several sustainability ambitions are involved here: both climate adaptation and the elaboration of regional energy strategies and the Heat Transition Vision (NL). Research is currently being conducted into how climate-proof construction can be integrated in municipal policy. At the Goeree-Overflakkee headland, a study is being carried out, in the context of the Intergovernmental Programme for Dynamic Rural Areas in collaboration with LTO Noord and others, into how adequate freshwater availability can be achieved in the summer. Here, the water authority is responsible for balancing the interests of the various parties in the area. By widening the scope to include other agendas in the area, and therefore not looking at freshwater availability alone, the individual agendas can often no longer be seen independently of each other. This calls for more coordinated research and programming at the area level.

6.6.4 Developments

To be in a position to make decisions for the future, specific and scientific knowledge is needed about the impact of sea level rise and climate change. For that reason and to provide support for the integrated issues facing the area, work is taking place in the Southwest Delta on an integrated knowledge and innovation agenda in the run-up to the periodical evaluation of Delta Programme in 2027. The regional agenda noted that this knowledge and innovation agenda must be well coordinated with national knowledge and research programmes such as the Sea Level Rise Knowledge Programme (particularly tracks II and IV), the Flood Protection Programme, and the Programmatic Approach for the Main Water System.

Knowledge in the knowledge and innovation agenda

A new approach was developed in collaboration with Deltares for the knowledge and innovation agenda. This will allow for the establishment in a structured way of an understanding of the complex integral issues facing the area in the short, medium and long terms. The next step in 2022 and 2023 will be to implement this new approach with partners in the working process for the acquisition of knowledge for the Southwest Delta. An investigation is still continuing to see whether the acquisition of knowledge for the Southwest Delta can be linked in substantive and organisational terms to the Delta Climate Centre (which is under development).

Specific components of the current strategy can be modified if necessary. In this way, progress can be made adaptively in stages on the road to possible major changes after 2050. The goal is that, with every new development, we will move towards a climate-resilient delta. An example is the measure in the context of the Programmatic Approach for the Main Water System in the Eastern Scheldt: sand nourishment operations on the Roggen and Galge tidal flats. Those operations tie in with the current preferred strategy but their frequency will have to change depending on the extent of sea level rise after 2050. To this end, Track II of the Sea Level Rise Knowledge Programme is investigating the sustainability of the strategy. In the period after 2050, this will involve the themes of flood risk management, ecology (strengthening robustness and resilience) and economic exploitation (including shellfish farming).

Innovation

On the innovation side of the knowledge and innovation agenda, the first step will be to build on pilot projects and living labs. One example consists of the 'iconic projects', which are a component of the Delta Issues Research Project that has already begun. For the iconic project Innovative Flood Defence Landscapes, the initiators are working together on projects that contribute to national and regional knowledge development. The focus is on:

- water landscapes in which social innovation is used to identify win-win situations for flood risk management, land use (including agriculture, nature and leisure) and hydraulic engineering that boost the quality of nature and climate resilience at the same time;

- Climate-Adaptive Flood Defence Landscapes for a liveable Eastern Scheldt and its communities;
- the project 'Learning together on the road to dynamic dike landscapes, a case study in the Western Scheldt'.

An icon group makes up a 'learning community' that exchanges experiences in order to arrive at innovative solutions together. For more information: https://www.waterlandschappen.nl.

6.7 Coast

The objective for 2050 is to have a safe, appealing and economically strong coast that can cope with sea level rise and its possible acceleration. This involves taking into consideration other water agendas, transitions (including the energy transition) and reducing carbon and nitrogen emissions. The Netherlands maintains the position of large sections of the coastline with sand nourishment operations. Those operations represent an important component of the preferred strategy for the coast: 'soft where possible, hard where needed'.

6.7.1 Objective for 2050: perspective

In view of the 2050 target, the margins of uncertainty for sea level rise and its possible acceleration were still too large in early 2022 to state boundary conditions and underlying principles for spatial developments. Steps will therefore be taken in the years ahead to reduce those margins in the context of the Sea Level Rise Knowledge Programme. If the Knowledge Programme can provide boundary conditions and underlying principles, it will be important to have them included in municipal environment visions. This will allow future options for flood risk management to be incorporated as a standard component of spatial planning. 'Regret measures' will be prevented and 'no-regret measures' can already be implemented.

For the time being, there seems to be enough time to make adjustments to measures on the coast where necessary. It is important to keep options open for future coastal reinforcement measures (taking sea level rise into account) for the long term and also to earmark space along the coast for this purpose.

6.7.2 Progress

Partly due to the success of the Coastline Maintenance programme and the duty of care for the flood defences, coastal flood risk management is as it should be. The primary flood defences and the sandy coast are currently being assessed in line with the new protection standards and they will comply with those standards by 2050. Linking other spatial ambitions with flood risk management in the future requires particular attention.

Sandy Coast project

In 2021, the Sandy Coast project, the successor to Coastal Genesis 2.0, will be transferred to the Sea Level Rise Knowledge Programme (Track II - System Inventories). The activities in the coming years will consist of building up knowledge to refine (if necessary) the Coastal Genesis 2.0 policy recommendations and acquiring knowledge for the periodical evaluation of the Coastal preferred strategy of the Delta Programme. The latter involves determining sediment demand at different values for sea level rise. The final evaluation of the Amelander Zeegat pilot nourishment project will also be conducted. The knowledge acquired will make it possible to anticipate future developments due to sea level rise that will affect the sandy system. Nourishment operations can also be deployed more effectively and cost-efficiently. We call this 'learning in practice'.

6.7.3 Connection

Linking other ambitions to flood risk management

A key objective of the preferred strategy for the Coast is to link the agendas for flood risk management with spatial ambitions. Initiators of spatial developments in the coastal zone do not always make the connection with future agendas in flood risk management. This is also difficult at present because we do not yet have the underlying principles and boundary conditions. They will emerge from the Sea Level Rise Knowledge Programme.

An example of a project that combines housing construction with flood risk management is the Den Helder Dike Zone project. This plan is unique for the Netherlands, responding to climate change with sea level rise *and* high demand in Den Helder for new housing. The existing dike will be widened in such a way that the probability of a breach in the next two hundred years will be very low. That operation will underpin a residential area with rented and privately owned housing.

6.7.4 Developments

Making coastal projects more sustainable

The Ministry of Infrastructure and Water Management wants to operate in a fully climate-neutral and circular way by 2030. The Dutch coast is maintained with dredging vessels and this causes carbon emissions. In 2019, the Ministry of Infrastructure and Water Management launched the Innovations in Coastline Maintenance (IKZ) programme: the Ministry is working in an innovation partnership with private parties to develop technical

solutions that will provide significantly more sustainable coastal maintenance.

Regional Session of the Sea Level Rise Knowledge Programme

A series of knowledge workshops for the Sea Level Rise Knowledge Programme will be organised in the second half of 2022, focusing specifically on the Coast. The aim of these workshops will be to reduce uncertainties in the Knowledge Programme.

6.8 Wadden area

In 2014, the Wadden Area Delta Programme adopted a preferred strategy that can be maintained until 2050 and that contributes to the goals of the Agenda for the Wadden Area. Progress is being made through innovative and integrated dike upgrades and sand nourishment operations, and an integrated strategy for flood risk management is being developed for each island. In the coming years, adequate capacity will need to be made available for a renewed approach to coordinating prevention, water-robust facilities and disaster management on the basis of the latest insights into the consequences of climate change.

6.8.1 Objective for 2050: perspective

Flood risk management in the Wadden Area is assured by maintaining the current buffering effect of the islands and the intertidal area as much as possible, as well as with innovative dike upgrades and sand nourishment operations. Specific integrated strategies for flood risk management will be established for each Wadden island. After a somewhat longer lead time, each island will be able to adopt and then implement a strategy for flood risk management in the years ahead. The underlying principle remains that, in the event of a failure of a flood defence on the islands themselves, there will be enough shelter for people because evacuation to the mainland will not be possible.

Since the adoption of the preferred strategy in 2015, several innovative dike upgrades have already been completed. Plans are now being prepared for other dike upgrades. All the required dike upgrades are expected to be completed before 2050. Integrated coastal management and sand nourishment can maintain the balance between the coastal foundation and sea level rise until 2050. The size and frequency of, and locations for, sand nourishment operations can be adapted periodically on the basis of the monitoring of the reference coastline and new insights.

In the years ahead, the partners in the Wadden area will have to organise sufficient organisational capacity to establish an integrated approach to flood risk management on the mainland in the longer term. The prevention of flooding from the sea *and* from regional waters, the water-robust design of the hinterland, and disaster management in the event of flooding can then be addressed integrally and in conjunction with other regional agendas.
In particular, a perspective for agriculture is important.

6.8.2 Progress

Sand nourishment will continue in the Wadden area on the North Sea side of the Wadden Islands. Those operations safeguard the protection afforded by dunes on the islands against flooding and protect other functions such as nature and leisure. Sand nourishment will take place in 2022-2023 for Texel, Vlieland and Ameland. Because the reference coastline can be exceeded on Schiermonnikoog without any risk for flood protection, it has been decided not to proceed with sand nourishment operations there for the time being.

An inventory has been initiated as part of the Sea Level Rise Knowledge Programme, looking at the extent to which the island dunes can grow naturally in line with the sea level and how much sand nourishment will be needed in the future. That will also include looking at how changes in the Wadden Sea will affect the flood defences on the mainland. The results of the study will be integrated in the following periodical valuation of the preferred strategy.

Flood risk management strategies for the Wadden Islands

The municipal authorities of the Wadden Islands and the safety regions of Fryslân and Noord-Holland Noord have completed the pilot project, Integral Flood Risk Management Strategy for the Wadden Islands, with other parties. If the evaluation of the pilot project is positive, that strategy will be rolled out to all islands in the autumn of 2022 and in 2023.

Two dike sections

The preferred variant has been developed for the Lauwersmeer-Vierhuizergat dike section. The decision about the project will be taken in the third quarter of 2022. The inventory has been completed for the Koehool-Lauwersmeer dike section, and the planning phase has begun. For both dike sections, measures are being

prepared integrally as HWBP-PAGW projects (Flood Protection Programme and Programmatic Approach for the Main Water System). These are measures for flood risk management, the expansion and improvement of habitat quality (salt marsh construction, 'Rich Dike' elements) and fresh-salt connections with the hinterland. An integrated approach is also being adopted for other dike sections, such as the Schiermonnikoog section, with respect to flood risk management and other area objectives.

Stronger collaboration and connections

The municipal authorities of the Wadden Islands and the safety regions of Fryslân and Noord-Holland Noord have strengthened their collaboration in order to arrive at integrated strategies for flood risk management for each island. This will result in an optimal array of preventive measures in the form of flood defences, spatially water-robust design and evacuation plans. An approach has been elaborated for ambitions that will be formulated in the future for strategies in the areas of flood risk management and possible policy goals. This project was taken up by the Wadden Islands, the Fryslân safety region in cooperation with Rijkswaterstaat, the Noord-Holland Noord safety region, the Fryslân water authority, the Hollands Noorderkwartier water authority and the provincial authorities of Fryslân and Noord-Holland.

The Wadden Area Delta Programme and the 2050 Agenda for the Wadden Area have sought to establish closer links with one another. The idea is to develop and strengthen those links in the time ahead. The Wadden Area Delta Programme will also seek to establish links with other programmes in the area.

6.8.3 Connection

The implementation of the preferred strategy fits in with the main objective of the 2050 Agenda for the Wadden Area: sustainable protection and development of the Wadden Sea as a protected nature area and the preservation of the unique open landscape (World Heritage since 2009). The 2050 Agenda for the Wadden Area focuses on a safe and resilient Wadden area that can cope with the consequences of climate change. The aim is also to have a dynamic Wadden area that is easily accessible and appealing as a place to live and work. Education and health care can be provided on the islands or along the coast. The integrated flood protection strategies for the Wadden Islands, the innovative dike concepts and both the Flood Protection Programme and the Programmatic Approach for the Main Water System contribute to these goals.
Links with transitions in the fields of energy, agriculture and housing, among others, are not being addressed, or at least not yet, by the Wadden Area Delta Programme.

6.8.4 Developments

Broad Green Dike

In the Broad Green Dike project, the knowledge consortium Ecoshape is building a 'broad green dike' on behalf of the Hunze and Aa's water authority. This work is taking place between April and October 2022 on the Dollard dike over a distance of 750 metres. This is a 'demonstration dike' with a gentle slope on the sea side. It will be made of local clay extracted from the Delfzijl seaport channel and the Breebaart natural polder. This clay has been dried for three years in clay ripening plants as part of a pilot project to make clay from sediment in a cost-effective way. For part of the dike, clay is being used from the excavation of an island for avocets on the salt marsh. If, after three years of monitoring (by Ecoshape), this demonstration dike turns out to be a success, the dike will be reinforced over the entire 12.5 kilometres in this way with clay that has been extracted and ripened locally.

Tidal culvert

For the Double Dike demonstration project, the provincial authority of Groningen will construct a tidal culvert in the outer element of the Double Dike in 2023. A tidal culvert is a tube that runs through the dike. Starting in 2024, this will allow seawater into the southern inner area with the tides. The sediment then settles in the inner area of the Double Dike. Some of the seawater will be used for saline agriculture in the northern inner area. The tidal culvert will be closed when extremely high water is forecast.

6.9 High-Lying Areas with Sandy Soils

The preferred strategy for the High-Lying Areas with Sandy Soils is required to safeguard the availability and quality of fresh water, and to make the areas more resilient to the effects of climate change. In terms of water management and land use, more attention is being paid to water retention and delayed drainage. The ambition is for 20% of the High-Lying Areas with Sandy Soils to fulfil the target for 2050 by 2027. In the sandy areas, the broadest and most integrated approach possible was selected from the outset. This is necessary because freshwater supplies in sandy areas cannot be viewed separately from agricultural and nature agendas, drinking water extraction, urban development and agendas in the rural area. Measures are therefore mostly implemented in projects with several other objectives alongside freshwater supplies.

6.9.1 Objective for 2050: perspective

Because of the links between the Freshwater Delta Plan and the Delta Plan for Spatial Adaptation, the partners in the North, East and South of the Netherlands have arrived at a joint agreement about an ambition and strategy for the High-Lying Areas with Sandy Soils. That joint ambition for the long term (2050) is: 'To make the High-Lying Areas with Sandy Soils in the North, East and South of the Netherlands climate-resilient and water-robust so that the regions can cope with extreme weather and water shortages. The transition will contribute to a beautiful, healthy and prosperous Netherlands.'

The following outlook for the period up to 2027 has been derived from this ambition: 'By 2027, climate-resilient and water-robust planning will be the usual practice. By 2027, 20% of the High-Lying Areas with Sandy Soils will comply with the ambition for 2050.'

Working in successive planning periods of six years allows for a timely response to the rate of climate change and developments in the spatial and societal context. Working with a programme of measures rather than with projects that are fixed in terms of location and size at the outset opens up the possibility of initiating projects earlier or later than planned during a planning period. This is done when it is warranted by the situation of specific areas or parties; operational flexibility is important. Addressing water availability in the High-Lying Areas with Sandy Soils is a matter of implementing a large number of measures at a range of spatial scales involving all regional government authorities and partners in society at large.

The selected approach of working programmatically with planning periods makes it necessary to look ahead in good time and to anticipate possible measures for the next phase of the programme. It is important here for the perspective for 2050 to remain the leading consideration when incorporating new long-term transitions based on other goals.

6.9.2 Progress

The East and South of the Netherlands

The East and South of the Netherlands established new working programmes for the second phase in 2021. The name of the working programme for the East is: 'Hold on well to your water! Working on a new balance'. The working programme for the South is called: 'Resilient to water shortages'. They are anchored in administrative agreements signed by all the participating parties.

The new working programmes build on the approach from the first phase, with measures in three main categories:
- adaptation of the water system;
- adaptation of water use;
- adaptation of land use.

In line with the recommendations of the 2019 Drought policy platform, it has been agreed that water management and land use should devote more attention to water retention and delayed drainage.

The focus in operations in 2021 and the early months of 2022 was on completing the ongoing projects from the first phase. By 1 January 2022, these will be 89% complete in the East and 93% complete in the South. This includes a range of projects in the areas of brook restoration, disconnecting urban water, reducing smaller-scale drainage, improving the sponge effect in soil and better water retention. In the East, some projects (11%) in agriculture and nature have been granted a postponement in order to allow completion in the period 2022-2023. In the South, several projects will continue in 2022. Two projects will continue in 2023.

Northern Netherlands region

In the second phase of the Delta Freshwater Programme, the Northern Netherlands Freshwater Region initiated a programme for the areas with sandy soils in Noord-Drenthe and the adjacent sandy areas in Groningen and Friesland. The underlying principles for the programme are the same as those in the East and South. They are founded on a programmatic approach for a climate-resilient area by 2050: a transition is needed for the current water system to achieve a better balance between water supply and demand.

The emphasis is on retaining water in the soil rather than draining it away. Measures to increase water availability are also needed in spatial planning.

For the second phase (2022-2027), a package of measures has been prepared in the North on the basis of an inventory in the same methodological way as in the East and South regions. The inventory resulted in a list of tailored measures. As in the East and South regions, a large number of partners are working together: provincial and municipal authorities, water authorities and the agricultural sector. Each partner is taking measures that are appropriate to its own role and responsibility.
The selected measures are:

- brook restoration and the re-profiling of registered watercourses;
- controlled drainage and underwater drainage;
- reduction of local drainage and water run-off;
- redevelopment of urban areas;
- improvement of the soil structure;
- targeted irrigation systems;
- company-specific incentive plans;
- adaptation of land use: changes in function to provide room for water;
- working together with all stakeholders in an area-specific way on freshwater retention and/or the economic use of water;
- 'winter water': the replenishment of groundwater during the winter (if enough water is available).

6.9.3 Connection

In the sandy areas, the broadest possible and most integrated approach was adopted right from the outset of the first phase. This approach is producing good results and it will continue in the period 2022-2027. This is because, in the sandy areas, freshwater supplies cannot be viewed in isolation from agricultural and nature agendas, drinking water extraction, urban development or agendas in the rural area. Measures are therefore mostly implemented in projects in which there are several other objectives in addition to freshwater supplies. With the start of the second phase, it was decided to give the integrated approach an extra boost by working with focus areas. In these areas, there are significant drought problems or freshwater availability issues. In addition, these areas provide good opportunities to establish synergy with other regional agendas such as the nature agenda, the Water Framework Directive or the agricultural transition.
By signing the administrative agreement, the regional partners committed themselves to the agendas for the North, East and South regions. On the basis of that commitment, they are currently elaborating the measures and implementing them as part of an area-specific approach over the course of the programme. Some partners have projects that are ready for the implementation phase.

6.9.4 Developments

Given the new coalition agreement, the elaboration and implementation of measures in the brook valleys in an integrated way are even more urgent. Here, there is a growing understanding that the current strategy of optimising the water system for one form of land use only is no longer adequate and that a radical transition is needed to make the High-Lying Areas with Sandy Soils future-resilient.

The announcement of a National Programme for Rural Areas, which focuses on the integration of agendas and solutions, is crucial. An approach of this kind requires long-term commitment, central management with room for regional tailored solutions, working together as a single government, and the realisation that this process will continue until 2050. Courage, tenacity, and thinking in terms of, and taking into consideration, the interests of individual residents and businesses will be needed here.

To support this process, a study of brook valleys is currently being conducted in the East Region; it should provide a better understanding of the use of brook valleys and natural lowlands throughout this freshwater transition. In inclined areas, the run-off route consists of the brooks and brook valleys, and the natural lowlands connected to the surface water system. They serve as the basis for the drainage of the surrounding area. The surface water system in those brook valleys and natural lowlands has a major impact on the functioning of the entire water system.
In response to the severe floods in the summer of 2021, research is being conducted in Limburg into ways of preventing this in the future. The resulting measures will have to be implemented in conjunction with the approach to fresh water.

CHAPTER 7

Delta Fund

'Crate field' to prevent flooding and aridification, Nijverdal, April 2022

This chapter describes the financial underpinning of the Delta Programme by comparing the available resources in the Delta Fund with the expected financial requirements of the agendas in the Delta Programme.

The Delta Programme includes measures that will be financed in whole or in part from the Delta Fund: the measures in the field of flood risk management and fresh water for which the national government has full or partial responsibility. In addition, the Delta Programme includes measures for which the national government has no responsibility, such as measures taken by provincial and municipal authorities, and water authorities, in the regional water system. These measures are not financed from the Delta Fund. The Delta Fund also finances expenditure that is not considered to be part of the Delta Programme, such as expenditure for management, maintenance, and replacement (Item 3) and the operating expenses of Rijkswaterstaat that come under the goals of the Delta Fund.

This chapter looks at the developments in the Delta Fund, the resources of the other partners in the Delta Programme, the financial agendas of the Delta Programme through to 2050 and the conclusions of the Delta Commissioner regarding the financial underpinning of the Delta Programme.

7.1 Delta Fund developments

Delta Fund budgets

In the period 2023-2036, the Delta Fund has approximately € 21 billion available, bringing the annual budget to an average of € 1.5 billion. This is evident from Table 13, which shows the Delta Fund budgets item by item and in total for the 2023 budget year and the period 2023-2036. Figure 14 shows the itemised budgets for the years up to and including 2035.

Table 13: Delta Fund budgets in 2023 and in total based on the 2023 draft budget (x € million)

		2023	total (2023-2036)
Item 1	Investment in flood risk management	653.1	6,855.3
Item 2	Investment in freshwater supplies	142.4	367.5
Item 3	Management, Maintenance and Replacement	371.6	3,427.3
Item 4	Experimentation	243.0	1,304.9
Item 5	Network-related costs and other expenditure	384.5	8,186.9
	of which scope for investment	*12.2*	*1,400.7*
	of which reservations	*12.5*	*2,163.4*
Item 6	Contribution from other national budgets	-	-
Item 7	Investments in water quality	113.8	950.4
Total Delta Fund expenditure		**1,908.4**	**21,092.3**

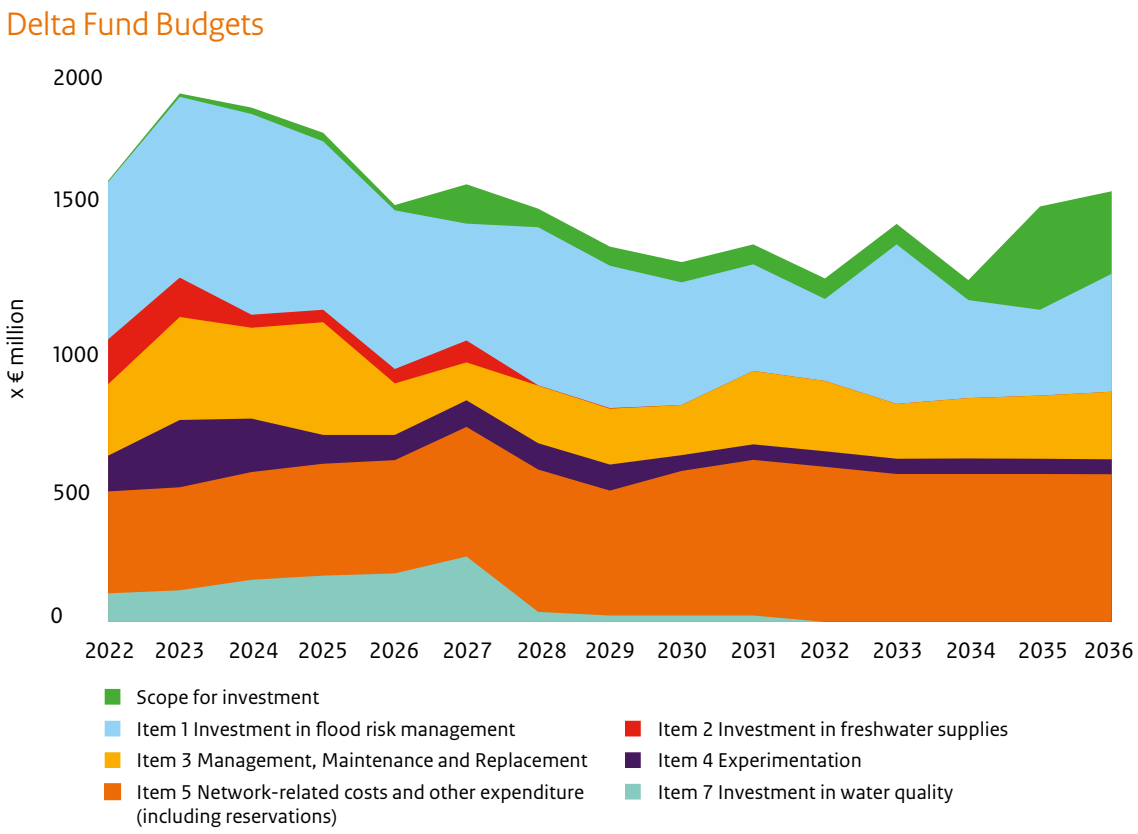


Figure 14 *Delta Fund budgets, itemised and total based on 2023 Draft Budget*

In this budget, in line with the agreed system, the Delta Fund is extended in increments of one year up to and including 2036. After deducting ongoing obligations (consisting mainly of management, maintenance and replacement, the network costs of Rijkswaterstaat and the national contribution to the Flood Protection Programme), this results in new scope for investment. A part of the scope for investment is added directly to ongoing reservations for policy purposes. In 2036, a balance of € 0.3 billion in scope for investment will be available for priority policy agendas relating to water. In the years ahead, these investment resources will be programmed in greater detail in an adaptive way on the basis of ongoing processes such as the assessment of primary flood defences, the Integrated River Management Programme, the Freshwater Delta Plan and the Delta Approach for Water Quality and Freshwater. The total scope for investment will be € 1.4 million in the period 2023-2036. Some of this amount is also subject to risk reservations (see draft budget for 2023 Delta Fund).

The coalition agreement 'Looking out for each other, looking ahead to the future' states that:

> *More will be invested in the Delta Fund to eliminate backlogs and accelerate the implementation of the National Delta Programme. We are continuing to invest in our dikes, dunes and dams. Financing will also be made available to provide better protection for the brook valleys in Limburg and elsewhere.*

Of the additional funds set aside in this regard in the Supplementary Item at the Ministry of Finance, only the first part of the reservation for Maintenance for the years 2022 through 2025 (€ 0.4 billion) has been transferred to the Delta Fund for the time being. These funds are not included in the budgets for investments under the auspices of the Delta Programme. Nevertheless, this has eliminated the threat identified in the 2022 Delta Programme that shortfalls in the management and maintenance of Rijkswaterstaat networks could squeeze the scope for investment for the goals of the Delta Programme. Furthermore, the intention is to use some of these budgets in the longer term for climate adaptation measures (acceleration of the Delta Programme). However, as long as this is not explicitly stated in the budget, it cannot be included in the calculations. The € 300 million earmarked for brook valleys in Limburg and elsewhere has not yet

been requested from the Ministry of Finance pending the activities of the Flooding Policy Platform.

Policy reservations

For foreseen future expenditure on programmes and projects for which a go decision has not yet been made, reservations are made under Item 5 of the Delta Fund, sometimes subject to the condition of co-financing from other parties. In the 2023 Draft Budget for the Delta Fund, reservations relevant to the Delta Programme have been made, the most important of which are:

Regional defences managed by the national government (€ 192 million). To have the regional flood defences managed by the central government meet the standards set out in the Water Decree.

Integrated River Management (IRM) (€ 703 million): This programme brings together the national river agendas – including flood risk management, navigation, water quality and quantity, riverbed location and vegetation management – to achieve synergy in programming and implementation. These agendas are also linked - where this leads to synergy - with urgent regional agendas.

Freshwater Delta Plan (€ 378 million): Some of the resources for the second Freshwater package have been reserved for the period 2022-2027. They are related to the continuation of the policy (follow-up to the first Freshwater package) to mitigate damage caused by drought and salinisation. The droughts of 2018, 2019, 2020 and 2022 have shown that we need to do more to prevent problems, such as those on the High-Lying Areas with Sandy Soils and in the IJsselmeer area. To this end, € 42 million has been reserved in the Delta Fund each year from 2028 onwards.

Programmatic Approach for the Main Water System (PAGW) (€ 601 million): This relates to the preservation and improvement of nature and water quality in order to make the main water system future resilient, with high-quality nature that fits in well with a strong economy. PAGW will continue through to the end of 2050.

7.2 The financial underpinning of the Delta Programme

The Delta Fund is one of the financial pillars underpinning the Delta Programme and it provides funds to protect our country from high water levels in the future and to safeguard adequate supplies of fresh water. Assuming the Delta Fund is extrapolated by € 1.6 billion annually, approximately € 22 billion will be available in the Delta Fund in the period 2037-2050. Some of these funds are available for projects considered to be part of the Delta Programme, but not all. The Delta Fund also covers national government expenditure outside the Delta Programme, such as the costs of managing and maintaining the main water system (Item 3), and network-related costs and other expenditure (a large proportion of Item 5).

The tentative extrapolation in Figure 15 is based on the year 2036. The Delta Commissioner has assumed here that the earmarked budgets for new flood protection measures at the water authorities will be continued after 2028 in accordance with the agreements between the national government and the water authorities as anchored in the Water Act. The extrapolation makes it clear that, of the approximately €1.56 billion available annually in the Delta Fund during the period 2037-2050, approximately € 0.8 billion a year has been set aside for management, maintenance and replacement (Item 3) and network-related and other expenditure (Item 5). In terms of investment budget, approximately € 0.7 billion a year is available in the period 2037-2050; this is the budget for the available or earmarked budgets for new flood risk management measures at the water authorities (Items 1 and 2) and the reservations relevant to the Delta Programme (Item 5). The Delta Commissioner assumes that the resources earmarked for the Delta Fund pursuant to the coalition agreement at the Ministry of Finance will also be transferred in their entirety to the Delta Fund. This has not yet been included in these figures and the resulting conclusion.

This means that a total of € 9.7 billion in investment budget will be available for the period 2037-2050. In the period 2015 through to 2036, on the basis of actual and budgeted budgets, approximately € 16.8 billion is available for the Delta Programme. This means that, calculated from the start of the Delta Programme in 2015, a total of approximately € 26.5 billion will be available through to the end of 2050 for the flood risk management and freshwater agendas of national importance. In addition, resources are expected to come from partners in the Delta Programme other than the national government and the water authorities, such as the provincial and municipal authorities.

The Delta Programme's agenda for the period 2015-2050 was subject to a periodical evaluation in the 2021 Delta Programme (DP2021), and estimated at € 25.9 billion (2020 price level). The budgets have been adjusted to the 2022 price level in line with wage and price adjustments. Accordingly, in order to make a proper comparison between the agenda and the budgets, the agenda must also be adjusted annually for inflation, as was also explained in DP2021.

Tentative extrapolation for Delta Fund

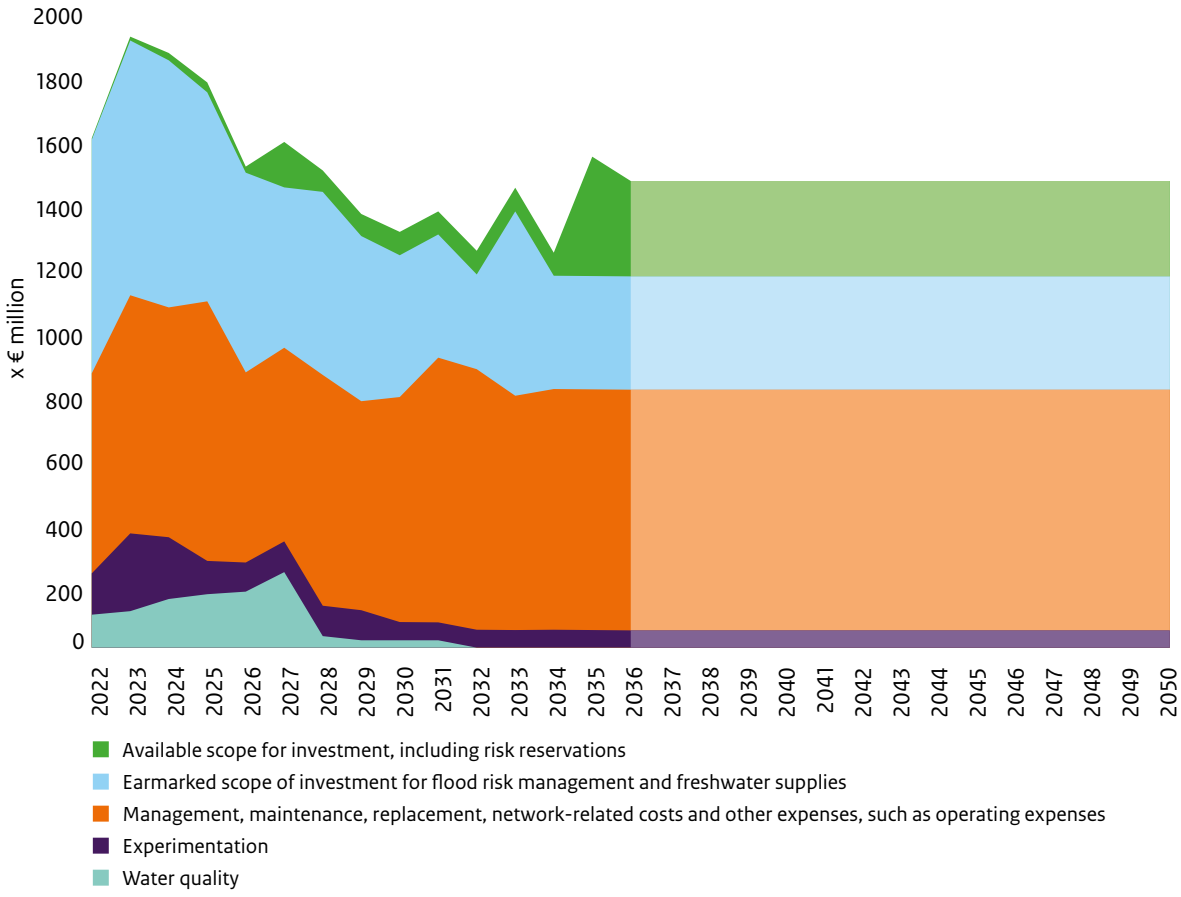


Figure 15 *Tentative extrapolation for Delta Fund*

The correction of the Delta Programme cost estimate for inflation uses the composite index followed by Rijkswaterstaat. In the 2022 Delta Programme, the correction for inflation for the period from 1 January 2020 to 1 January 2021 was still 0.2%. That seemed low even then but the explanation was that some components of the index, particularly fuel, gravel and tar for road construction, had fallen sharply during the COVID pandemic. The prices of these volatile building materials started to rise sharply from November 2020 onwards but this increase was not yet manifest in the index year 2020. The index year 2021 is, as was already expected and in line with what almost everyone is now feeling in their own pockets, an index year with very high inflation. According to the Rijkswaterstaat index, inflation in the civil engineering sector is 13.6% with respect to 1 January 2020, the base year for the cost estimate for the Delta Programme. In this index, labour costs have the heaviest weighting at 44%, but the increase in labour costs of more than 6% is still modest compared with the increase in the price of diesel (weighting 18%, increase 31%).

Corrected in line with the 2022 price level, the estimated costs of the Delta Programme tasks total € 29.4 billion. That is € 2.9 billion more than the assumed available budget of € 26.5 billion. This budgetary pressure will be mitigated if the funds reserved in the coalition agreement are transferred to the Delta Fund.

On the basis of the tentative extrapolation of the Delta Fund through to 2050 and the periodical evaluation of the estimate of the total costs of the Delta Programme, the Delta Commissioner has arrived at the provisional conclusion that, in the next few years, the operational capacity of the Delta Programme is under threat due to shortages in the labour market, prices and the availability of raw materials and building materials, and the expansion of the agenda. The periodical evaluation of the Delta Decisions in the 2027 Delta Programme may result in the need for new decisions that may affect the scope, the speed of implementation and cost estimates for the Delta Programme. For the time being, the pressure on the budgets needed to implement the Delta Programme is manageable given the scope that has been adopted, the earmarked budgets from the coalition agreement, the long duration of the programme and the margins of uncertainty that are common in cost estimates for such a long period.

7.3 Other resources from national government for the Delta Programme

The government funds available to achieve the goals of the Delta Programme come largely from the Delta Fund. However, other budgets in the national budget also serve to achieve the objectives of the Delta Programme. It is not possible here to present an exhaustive description of these budgets but the following larger items will serve to give an impression:

- The National Growth Fund is investing € 20 billion between 2021 and 2025 in large-scale investment projects and programmes with a minimum subsidy of € 30 million per proposal. Proposals must contribute to the sustainable earning capacity of the Netherlands. In the second round, a number of proposals were honoured (conditionally or in part) with a positive impact on the goals of the Delta Programme. They include the 'Water Technology Growth Plan' and the 'NL2120, the green earning capacity of the Netherlands' proposal. See www.nationaalgroeifonds.nl for more information.
- The Mobility Fund (formerly known as the Infrastructure Fund) sets out the estimated expenditure for land-based infrastructure projects that are prepared and implemented under the responsibility of the Minister of Infrastructure and Water Management. This also includes investments in the main waterways network. The IRM programme combines navigability goals with those for flood risk management, nature development and leisure, among others. The MIRT 2020 Administrative Consultation Platform agreed to reserve a contribution of € 100 million from the Mobility Fund to address riverbed-related bottlenecks for shipping on the major rivers. This budget will be invested in the IRM programme.
- The budget of the Ministry of Agriculture, Nature and Food Quality also includes expenditure in support of the objectives of the Delta Programme. Examples include investments in climate-adaptive nature and agriculture, the switch to circular agriculture, sustainable agricultural soil management, nature and biodiversity on land and in the main water system in the Wadden area, the Southwest Delta, the river area and the IJsselmeer area. Circular agriculture, agricultural soil management and climate-adaptive agriculture reduce freshwater demand for agriculture. Climate-adaptive nature contributes to the implementation of the freshwater agenda and supports adequate freshwater supplies for vulnerable functions. Through projects involving PAGW-HWBP collaboration, integrated flood risk management measures are also made possible and the agenda for flood risk management is limited (foreshores and forebanks stabilise dikes, limit backward erosion piping and reduce wave development, both in normal water situations and at high water levels). In addition, work is still continuing on the National Programme for Rural Areas (NPLG) and the associated transition fund.
- The Ministry of Education, Culture and Science (OCW) is also providing financing through matching for water projects in the Heritage Deal (budget from the 'Heritage Counts' policy). The same ministry is also contributing to the IJsselmeer Area Agenda.

7.4 Resources from other partners

Alongside the national government, the water authorities, and provincial and municipal authorities also invest in the agendas of the Delta Programme. Working with the national government, they rely on co-financing to implement measures from the Flood Risk Management, Spatial Adaptation and Freshwater Delta Plans.
The working regions for spatial adaptation, in which water authorities, provincial authorities and municipal authorities work together, contribute two-thirds of the co-financing for the packages of measures they submit in order to receive a contribution from the Climate Adaptation Stimulus Scheme (up to a maximum of the amount determined for each working region on the basis of the allocation formula).

Water authorities

Investments

The water authorities invest in measures in the regional water system and contribute half (approximately € 6 billion of the current estimate of approximately € 12 billion for 2015-2050) to the funding of the Flood Protection Programme.

Water authorities focus on establishing and maintaining the quality of flood defences and managing watercourses, and work to ensure that there is always enough good-quality water (not too much and not too little). They do this with pumping stations and with tens of thousands of smaller engineering structures and all kinds of design measures. In addition, water authorities treat waste water from businesses and households in waste water treatment plants.

The water authorities have to invest heavily in this infrastructure, in part because of climate change, sea level rise, land subsidence, urbanisation, salinisation, stricter environmental standards, the energy transition required and the closing of commodity cycles. The water authorities' investment agendas for the coming years show that they will together invest an average of € 2 billion a year in the period

2022-2025 (see Figure 16). Figure 17 shows how the total amount for these four years is allocated to the agendas for each water authority.

Flood Protection Programme (HWBP)

Investments in flood defences account for the largest share of total investments made by the water authorities (see Figure 17). These are mainly investments in the primary flood defences. The water authorities joined the Flood Protection Programme in 2011, since when the financing for the upgrading of the primary flood defences has been the joint responsibility of the water authorities and the national government. Since 2014, this financing has consisted of equal contributions from the water authorities and the national government which are booked as revenue for the Delta Fund. They have also been included in Figure 14. The amount has been indexed annually since 2016.

Estimated annual investment expenditure by water authorities, 2022-2025

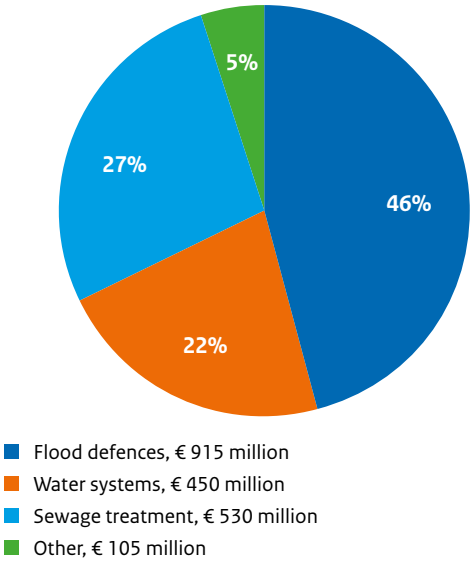


Figure 16 *The average annual investment expenditure of the water authorities in the period 2022-2025, broken down according to activity. Source: Dutch Association of Regional Water Authorities, June 2022*

Provincial authorities

The provincial authorities contribute to the Delta Programme in several ways: by providing staff for the various programme teams or their own organisations, financial contributions to sub-programmes, or contributions to research or measures. The provincial authorities work in particular on coordinating the various agendas in their areas in line with the agendas of the Delta Programme. Examples include coordinating agriculture, nature, and freshwater supply issues, or linking dike upgrades to improvements in the quality of the local area. The scope of their efforts - in terms of staffing and funding - differs from one region to the next and depends on the provincial agendas in the region concerned. Concrete examples are provided in Chapters 3 to 6 inclusive.

In flood risk management projects, the provincial authorities invest in synergy opportunities and area developments that further spatial development and spatial quality in the area concerned.

The provinces play a coordinating role in respect of water availability. That involves local processes in collaboration with water authorities and farmers (represented by LTO). Water availability and water quality are addressed in conjunction in groundwater protection areas and in the *regional drinking water dossiers* and the associated implementation programmes[29]. Through the National Programme for Rural Areas, provincial authorities will be making large-scale investments in the years ahead in local processes that combine the work that needs to be done on nitrogen, water quality (WFD), climate and other synergy opportunities. In addition, programmes with measures for brook restoration, water conservation in the areas with sandy soils, studies of the optimisation of water systems and making public drinking-water supplies future-resilient, such as the periodic evaluation of the flood protection policy. In the Drought Policy Platform, the provincial authorities have contributed to shaping the policy recommendations regarding groundwater and vulnerable nature; they are currently engaged in the implementation of the follow-up to these recommendations.

In terms of spatial adaptation, the provincial agenda consists mainly of linking climate adaptation to major spatial agendas such as housing, the energy transition, and regional spatial planning. In working regions and freshwater regions, the authorities are working with parties in the region to identify spatial adaptation agendas using stress tests and they are making agreements about the measures required through risk dialogues. The outcomes are set out in implementation programmes (see Chapter 5 for concrete examples). In the years ahead, the provincial authorities - working alongside municipal authorities, water authorities and the central government - will provide an additional impetus for work on climate adaptation and the implementation of measures, as stipulated by the Administrative Agreement on Climate Adaptation.

Municipal authorities

Municipal authorities fulfil a range of roles in terms of addressing climate change and urban water management. As policymakers and regulators, the authorities work on areas such as embedding climate adaptation in the municipal environmental vision documents, sector

[29] See, for example, the River dossier for water extraction in the Rhine Delta. River dossiers describe the Rhine and the Meuse as a source of drinking water supplies and the work required to secure this source.

Estimated total investment expenditure by water authorities, 2022-2025

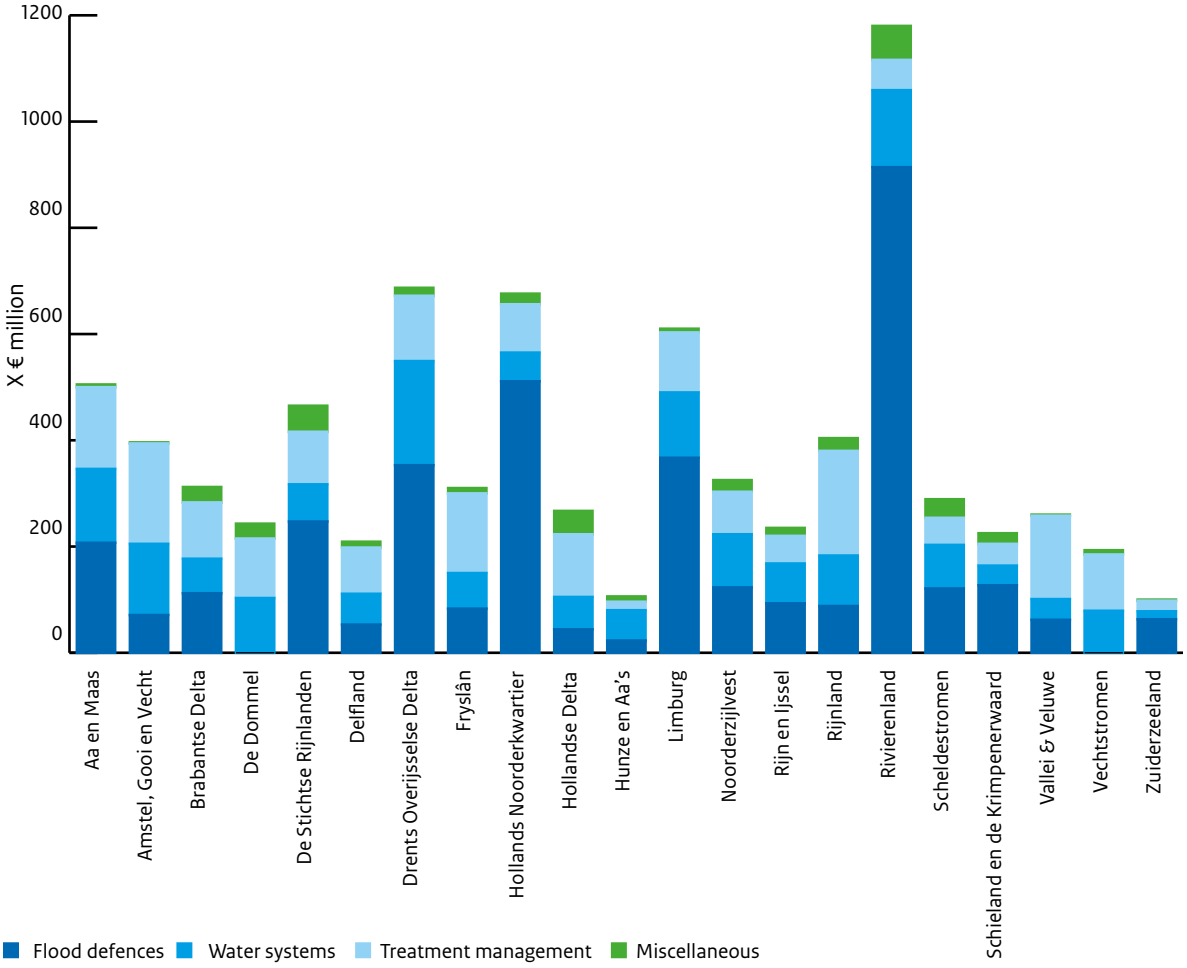


Figure 17 *Planned total capital expenditures per water authority in the period 2022-2025 broken down by activity*

programmes, and environmental plans. In addition, they determine the approach to rainwater and groundwater drainage in sewer plans. Rainwater is increasingly stored or drained above ground, for example using wadis, green strips, and roads designed for that purpose. As owners, many authorities are investing in making public properties (such as schools) and public areas climate-resilient, for example by introducing height differences or by creating more green areas and open water. Many municipalities are also acting as initiators by taking the lead in new initiatives involving multiple parties such as corporations and water authorities. Here, they can also act as co-financiers to get initiatives on the move and maintain momentum. At the working region level, municipal authorities and regional partners are mapping out spatial adaptation agendas on the basis of stress tests and drawing up agreements about the measures required through implementation agendas.

According to figures from Statistics Netherlands, the budgeted income from the sewerage rates will increase by 2.9% to € 1.8 billion in 2022. That is the largest increase since 2013. The average increase in the budgeted sewage rates over the past five years was 2.0%. The increase is related, among other things, to the increased costs of maintenance, management of the sewerage system and the expansion of the area covered. Municipal authorities can spend the revenue on municipal water activities only and they must not exceed the level needed to cover costs.

The national government, water authorities, municipal and provincial authorities, and drinking water companies all play a role in protecting our country from flooding and/or safeguarding adequate supplies of clean drinking water. Together, these organisations spent € 7.8 billion for this purpose in 2021. That is less than 1% of the country's gross domestic product (GDP). Water authorities account for 44% of this spending, municipal authorities for 22%, drinking water companies for 18%, the national government for 14% and the provincial authorities for 2%.[30]

[30] Source: Staat van Ons Water 2021 - Rapportage over de uitvoering van het waterbeleid in 2021. Annex to Parliamentary Paper 27625 no. 564

Overview of background documents

Trial for a Broad Green Dike, Dollard Dike, June 2022

Overview of the background documents

Background document A
Overview of examples of design-based approach to climate adaptation, soil and water are leading for land use

Background document B
Interim results of the Delta Programme Progress process - extending the monitoring function and instrument compass

Background document C
Response of Delta Commissioner to advisory document of the Delta Programme Signal Group dated December 2021 and summary of advisory document

Background document D
Adaptation through Innovation: experiences from regional practice

Background document E
Advisory document from the Physical Environment Consultation Platform and Delta Commissioner's response

Background document F
Freshwater Delta Programme: Progress in 2021 and review of first phase 2015-2021

Background document G
Spatial Adaptation Progress Report for 2021

Credits

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- Flooding during storm Corrie, Vlaardingen, January 2022: Tineke Dijkstra
- Start of Heel-Beesel dike upgrade, Heel, March 2022: Ger Peeters
- Construction of new bridge to increase freshwater influx KWA+, Bodegraven, March 2022: Stichtse Rijnlanden water authority
- Grotestraat water storage system, Nijverdal, April 2022: Thomas Klomp
- Low water levels in the Rhine, Spijk, June 2022: Tineke Dijkstra
- 'Crate field' to prevent flooding and falling groundwater level, Nijverdal, April 2022: Thomas Klomp
- Trial for a Broad Green Dike, Dollard Dike, June 2022: Edwin van Vliet, Ecoshape for Hunze en Aa's water authority

Figures and maps

Figures 1, 2, 7, 10, 11 and 12	Schwandt Infomation Design
Figure 5	Helder en Duidelijk
Figure 6	Deltares
Figure13	Joost Fluitsma
Figures 3, 4, 8, 9, 14, 15, 16 and 17	Delta3
Meuse Project Map	DEFACTO

The Netherlands is a low-lying country with an abundance of water. The national Delta Programme is in place to protect the Netherlands from flooding, to safeguard adequate supplies of fresh water, and to help render the Netherlands climate-resilient and water-robust. More information about the work on our delta can be found on the website of the national Delta Programme. The Programme involves concerted eff orts by the central government, the provincial and municipal authorities, and the water authorities, with active participation from research institutes, stakeholder organisations, residents, and businesses.

The national Delta Programme involves concerted efforts by the central government, the provinces, municipalities, and regional waterauthorities, with active participation from research institutes, NGOs, residents, and businesses.

WWW.DELTAPROGRAMMA.NL

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NATIONAL DELTA PROGRAMME

GIVING IT OUR ALL FOR A SAFE AND LIVEABLE DELTA