Delta Programme 2017

Knowledge Agenda: Progress

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Delta Programme 2015 comprises the knowledge and innovation issues that are relevant to the further elaboration and implementation of the Delta Decisions and preferential strategies (Knowledge Agenda of the Delta Programme, background document A to Delta Programme 2015).

These knowledge and innovation issues have meanwhile been incorporated into the knowledge programmes of the Ministry of Infrastructure and the Environment, Rijkswaterstaat, STOWA Foundation for Applied Water Research, KNMI Royal Netherlands Meteorological Institute, Deltares, Alterra, the Netherlands Organisation for Applied Scientific Research TNO, and universities. In addition, they have been directive for a number of new calls from the Netherlands Organisation for Scientific Research NWO, the knowledge and innovation contracts of the Top Sector Water (Top Consortium for Knowledge and Innovation (TKI) Delta technology), and the structure and substantiation of the National Water and Climate Knowledge and Innovation Programme (NKWK).

This Background Document E presents the status of components of the Delta Programme Knowledge Agenda. The majority of the components have been rolled out or are in progress. Some of the issues have meanwhile been resolved, superseded, refined, or updated.

DP2015 knowledge issues (September 2014)	Status as per July 2016
Flood risk management	
Statutory assessment tools, including securement of forelands	The new standards come with an adjusted scheme allowing the district water boards and Rijkswaterstaat to assess the safety of the primary flood defences ("Statutory Assessment Tools"). The central government has developed this scheme in consultation with flood defence managers and experts. In 2016, the district water boards were officially heard with respect to the preparations for the scheme. In the fourth quarter of 2016, a final rehearsal will be conducted to field-test the software of the tools. Any improvements found necessary can then be carried out. The Dutch Human Environment and Transport Inspectorate (ILT) has conducted an enforceability test. The scheme is expected to enter into effect concurrently with the amendment to the Water Act. This will enable the managing authorities to adopt the new standards as the basis for their assessment of the primary flood defence systems in 2017. The scheme will also indicate the approach to be pursued with respect to assessing forelands. From 2017 to 2023, all the flood defence system managers will set to work on the new assessment. A first national picture of the safety of the primary flood defence systems based on the new standards will be available by 2023. The statutory assessment tools will be further developed for the second assessment round, in order to be able to fine-tune the safety picture during the next assessment rounds.
	A new Flood Risk Management knowledge agenda is expected in 2016. Rijkswaterstaat and the Directorate-General for Spatial Development and Water Affairs (DGRW) will address long-term knowledge development in the NKWK[1] focus area "flood defence systems".
Spatial adaptation	
NH1[2]**:** general	• The Delta Programme on Spatial Adaptation is responsible for the NKWK focus area "climate-proof cities". This is aimed at identifying and generating new knowledge issues pertaining to climate-proofing urban areas. Area-based building regulations for vulnerable areas may be addressed in the interim evaluation to be conducted in 2017. • Climate adaptation in regional agendas will be addressed in the MIRT[3] programme on sustainability. • Smart targets for the Climate Adaptation 2020 programme will be formulated at the local level.

[1] NKWK: National Water and Climate Knowledge and Innovation Programme

[2] NH: New urban development and restructuring

[3] MIRT: Multi-Year Programme for Infrastructure, Spatial Planning and Transport

DP2015 knowledge issues (September 2014)	Status as per July 2016
NH2: urban ground water level management	• A study into the potential of measures aimed at preventing phreatic decline is underway. It is focused on cost, benefit, and funding options for separating rainwater drainage from sewers. • A study into the potential of active groundwater level management is underway; if need be, follow-up pilots may be conducted. • The study into lessons from active groundwater level management in urban areas has been completed with the publication of the report entitled *Grondwateraanvulling voor funderingsbehoud* [Groundwater recharge for the preservation of foundations] (KCAF, November 2014).
NH3: urban water systems	Cancelled as a separate knowledge issue.
NH4: Multi-layer flood risk management, implementation of second layer, connecting MIRT and Flood Protection Programme	• In 2015, the learning evaluation of pilots resulted in the report entitled *Die het water deert die het water keert, Overstromingsrisico als maatschappelijke gebiedsopgave* [Whoever is harmed by water shall stem the water, Flood risk as a societal regional tasking]. Results and lessons from the multi-layer flood risk management pilots will be followed up in 2016 by translating concrete multi-layer flood risk management experiences into generic lessons. Regional collaboration and the division of roles will also be taken into consideration. • Cultural differences between water and the spatial domain will be addressed in the evaluation of impact projects. • Within the framework of the Innovation MIRT, connections will be established between the Flood Protection Programme and the MIRT programme. A pilot may be conducted under the Dordrecht City Deal (2016-2017).
NH5: vital and vulnerable	• The study into chain dependencies within and among vital functions has been completed in the form of the HZ University of Applied Sciences thesis (http://www.ruimtelijkeadaptatie.nl/l/nl/library/download/urn:uuid:1db7e473-8725-4133-b440-34741116640d/ra+venk+dependency+chains+between+three+vital+and+vulnerable+functions+-+final+report+hz+%281%29+%281%29.pdf). • The interconnectivity between "vital and vulnerable" and climate-proof cities will be substantiated further in 2016. • National and international expertise on and experience with water-resilient vital and vulnerable functions have been set down in the 2015 report http://www.ruimtelijkeadaptatie.nl/l/nl/library/download/urn:uuid:e6d8acc7-2d9f-48aa-bdd1-5196c1becff4/towards+water+robust+critical+infrastructure_final+report+%281%29.pdf. • Rijkswaterstaat is working on accessible information on flood risks for the benefit of relevant Ministries and grid managers. Commercial companies are also marketing this information in an accessible manner. • A follow-up issue regarding the status of the international study into chain dependencies within and among vital functions may be addressed by Wageningen University and Research Centre.
NH6: research by design / Delta Design Platform	• In 2015, the Delta Design Platform supported various initiatives related to research by design and the options for land use in climate extremes. It continued its support in 2016. • The design team is already expending concrete efforts in Nijmegen. The municipality of Nijmegen and the Rivierenland district water board have requested assistance on how to consolidate the implementation of the new flood protection standards for the dyke near Lent with the need for building houses and a shopping complex immediately behind the dyke in the near future. • The Delta Design Platform has collaborated on the development of a dyke and water opportunities map, as a building block for the National Environmental Vision. • The Delta Design Platform has joined forces with the Ministry of Education, Culture and Science, and the Cultural Heritage Agency to complete a (historical) dyke map of the Netherlands. • The Delta Design Platform will participate in the Flood Protection Programme proposal to develop a Vision on Environmental Quality for each dyke section, and in the two-day inspirational session to be organised for that purpose. • The regions may request the Delta Design Platform to assist in the performance or commissioning of research by design. The Delta Design Platform has been asked to provide design input for the IJsselmeer Regional Agenda 2050.

DP2015 knowledge issues (September 2014)	Status as per July 2016
NH7: Spatial Adaptation incentive programme	The Spatial Adaptation incentive programme intends to give impetus to the transition in thought and action which will boost the integration of climate-proof and water-resilient planning into area processes and the associated tools at the local and regional levels, at various scale levels. The demand among stakeholders will direct the substantiation of the programme. The programme supports impact projects and living labs, and encourages the mutual sharing of knowledge and experience in various ways, such as a knowledge portal (www.ruimtelijkeadaptatie.nl/en). Meetings on, inter alia, the stress test light, the funding of spatial adaptation, and impact projects will be held in 2016.
Freshwater supply	
ZWV1[4]**:** water system measures	• Rhine-Meuse estuary system analysis: Rijkswaterstaat, the district water boards and consumers are conducting a study, to be completed in 2017, into underlying salinisation processes in the Rhine-Meuse estuary and adjacent areas, the relation to water distribution and the impact of interventions, and how this will affect water availability. A point of attention is the further underpinning of second-phase measures for the freshwater supply to the western Netherlands. • Integrated study into flood risk management and water level management in the IJsselmeer region (see IJM9).
ZWV2: measures at the local and company levels	• In 2015, Alterra research institute initiated a study into the salt tolerance of agricultural crops, together with Rijkswaterstaat, STOWA Foundation for Applied Water Research, the Ministry of Economic Affairs, and the Ministry of Infrastructure and the Environment. The study uses various sources, including practical data from companies and the Ministry of Economic Affairs. • In 2015, STOWA commissioned Deltares research institute to study options for enhancing self-sufficiency (Self-supporting freshwater supply: identifying possibilities; small-scale solutions for a more resilient regional freshwater supply).
ZWV3: smart water management	• Within the framework of the National Water and Climate Knowledge and Innovation Programme (NKWK), Rijkswaterstaat is conducting a study, together with district water boards, STOWA, private parties, and knowledge institutes, into interconnected measures for preventing / reducing water shortages and pluvial flooding by optimising the use of the available capacities of the (regional and main) water systems. The study will run from 2016 to 2021. • Failure risk analysis for the Amsterdam-Rijn canal and the North Sea canal for situations involving water shortage and pluvial flooding (to be completed in 2017).
ZWV4: elaboration of supply level	• Supply level is currently referred to as “water availability”; the elaboration is carried out in an administrative context rather than primarily as a knowledge development activity. It involves the development of a method for generating administrative information for decision-making processes. In addition, within the (Rijkswaterstaat) Main Water System Water Availability project, the demand of and supply to the main water system are determined on the basis of frequencies. The first results are expected by the end of 2017. • In 2015, a project was launched to develop a policy supporting instrument for administrative choices with respect to the preparations for or prevention of water shortages, and the scheduling of measures.

[4] ZWV = Freshwater supply

DP2015 knowledge issues (September 2014)	Status as per July 2016
ZWV5: economic aspects, cost-benefit method	• Deltares research institute, Stratelligence consultancy, and LEI research institute further developed the set of economic tools in 2015 with a method to optimise the quantification and monetisation of drought measures. In 2016, an Action Plan will be drawn up to translate this method into policy-relevant results. In addition, the method will be implemented in the Rijnland case study. • Various water managers, provinces, drinking water companies, agricultural organisations, and knowledge institutes are working on an Agricultural Water Guide which will provide a simple tool to determine damage caused by drought, rising water levels, or salinisation under various meteorological conditions and climate scenarios. The water guide can also be used to determine the effectiveness of water management measures. Dairy cattle will be the focus in 2015-2016, agriculture in 2016-2017. • In 2016, LEI research institute will draw up an action plan for the development of a practical method to determine the cost and benefit of measures aimed at combating loss of agricultural crop yield. • In 2016, Deltares and HKV Consultants will commence their participation in the EU project IMPREX. This project focuses, inter alia, on the development and implementation of a risk-based approach to drought and water shortages.
ZWV6: good governance	In 2016, the Delta Programme on Freshwater Supply, together with stakeholders such as consumers, water managers, and civic society organisations, will map out the knowledge issues relating to freshwater supply governance in more concrete terms, including planning and budget.
ZWV7: sharing knowledge, climate adaptation pilots	• The innovative climate adaptation pilots are intended to gain experience with enhancing regional self-sufficiency by optimising the use of available sources, better storage and retention methods, more efficient use, and smarter management of the water system. The innovative climate adaptation pilots are: IJsselmeer testing ground, Freshwater Supply testing ground for areas without supply (Southwest Delta), efficient use of water by elevated sandy soils, Groote Lucht freshwater plant (western Netherlands), and sustainable use of shallow groundwater (Rivierenland). The pilots have been rolled out (with the exception of the shallow groundwater) and they are proceeding according to schedule across the board. • Trends in internal salinisation: GO-FRESH Innovative self-sufficiency pilots: in the Zeeland Freshwater Supply testing ground, the parties are elaborating opportunities for enhancing the coping capacity of individuals by expanding the availability of freshwater and reducing the freshwater dependency of saline areas. To this end, tests are conducted involving expansion of freshwater storage in the soil and expansion of the rainwater lens. This will significantly enlarge the subsoil freshwater volume. FRESHEM: the freshwater-saltwater mapping, reflecting the subsoil saltwater distribution for the entire province of Zeeland, will be completed by the end of 2016. • In 2016, Rijkswaterstaat launched a three-year programme to monitor the effectiveness of the recently constructed longitudinal dams in the Waal and the replenishment of sand and gravel on the river bed in order to reduce river bed scouring and phreatic decline.
ZWV8: adaptive management	• Deltares developed a “signposts and triggers” theoretical framework in 2015 in order to enable timely anticipation in adaptation tracks. The framework has been implemented in two pilot areas in elevated and low-lying parts of the Netherlands. A follow-up study in 2016 will focus on instruments that may aid timely assessment of whether or not freshwater supply strategies need adjusting. • In 2015, a start was made on setting down a “spatial planning agenda” process design enabling the agendising and funding of freshwater supply at an early stage of the spatial planning processes. The first results are expected in 2016.
IJsselmeer Lake	
IJM1[5]**:** preparations for flexibilisation of water level management	The directive criteria and assessment rules for flexible water level management have been roughly elaborated. In 2016, they will be elaborated in detail, followed by administrative field-testing through “serious gaming”.
IJM2: amendment of Decision Support System	See IJM1. A separate information provision working group has been created to the Operationalisation of Flexible Water Level Management project (+ smart water management).

[5] IJM = IJsselmeer lake

DP2015 knowledge issues (September 2014)	Status as per July 2016
IJM3: detailed exploration of freshwater supply measures in regional systems	Has been completed as a knowledge project and will be followed up under the *Administrative Agreement on IJsselmeer Region Freshwater Supply Measures 2016-2021.*
IJM4: elaboration of supply level	Has been completed as a knowledge project and will be followed up under the *Administrative Agreement on IJsselmeer Region Freshwater Supply Measures 2016-2021.*
IJM5: regional systems pilots	Has been completed as a knowledge project and will be followed up under the *Administrative Agreement on IJsselmeer Region Freshwater Supply Measures 2016-2021.*
IJM6: water-resilient design of Westpoort	The flood risks have been mapped out and an initial design for the spatial planning aimed at enhancing water resilience has been submitted.
IJM7: flexible building outside the dykes pilot	A risk assessment tool for the Flevoland areas outside the dykes has been developed, reflecting the flood risk for each location, design and use, and how a flexible design of the lake shores could reduce the risks. The Flood Risk Management expertise network considers this a valuable tool for risk communication. In 2016, the tool will be implemented into the new flood risk management policy for the areas outside the dykes, pursued by the province of Flevoland.
IJM8: monitoring and evaluation	The implementation of the preferential strategy impacts the IJsselmeer region. In order to properly set down the consequences and learn from the steps taken, measuring data and practical experiences of the (water) managing authorities are amassed once a year, analysed in an interconnected manner, and gauged against the latest insights into climate change. This is coordinated with the Monitoring, Analysing, Acting system implemented throughout the Delta Programme.
IJM9: integrated study into flood risk management and water level management (ISWP)	The report on the first phase was completed in the autumn of 2015. It deals with the functioning of the water system and the initial effects of the various types of measures. Phase 2 explores how the water level impacts the hydraulic load (and the cost). A pilot will be conducted in 2016.
Nieuw IJM10: study into robust natural shores	The Ministry of Infrastructure and the Environment has investigated where dyke improvements may be combined with robust natural shores along the borders of the IJsselmeer and Markermeer lakes. The Natura2000 targets were taken as a point of departure. The study has identified the nature targets which could be negatively impacted by a potential second step in the flexibilisation of the water level (beyond 2050). According to the study, from a legal perspective it will be difficult to set down that constructing robust natural shores *now* – linked to dyke improvement projects – will serve to offset the effects resulting from future measures scheduled in the second step in the flexibilisation of the water level management. Creating a surplus of nature by means of smart links between flood risk management and nature holds more promise.
Rhine-Meuse delta	
RMD1[6]**:** Central Holland general exploration	The Central Holland general exploration comprises two phases. The first phase was completed at the end of 2015, with a further substantiation of ideas, focusing attention on the societal optimum for category C dykes and Lek dykes. The second phase has yet to commence; it entails the selection of essential projects.
RMD2: Rhine distributaries discharge distribution	The "benefit and necessity of changing the Rhine discharge distribution after 2050" study aims to determine the advisability and feasibility of keeping open the option of changing the discharge distribution between the Rhine distributaries after 2050. The study commenced in 2015 and has generated, among other results, a line of arguments with preliminary conclusions. In early 2017, the study report will be used as input for the decision on whether or not to keep open the option of changing the discharge distribution in the long run.

[6] RMD = Rhine-Meuse delta

DP2015 knowledge issues (September 2014)	Status as per July 2016
RMD3: reduction of Maeslant storm surge barrier failure risk / partial closure	The sub-study into the question of whether partial closure is physically feasible has almost been completed. The sub-study that is mapping out the options for reducing the failure risk will also be completed in the course of 2016. The study will thus be rounded off at the end of 2016.
RMD4: development of Haringvliet salinisation as a result of the decision to open the sluices	Research will be conducted in conjunction with a monitoring programme, before 2028.
RMD5: behaviour of bifurcation points under design conditions	See R2.
New RMD6: Geurts motion 2014 / Nieuwe Waterweg sea locks	In response to the Geurts motion (2014), Rijkswaterstaat has investigated the pros and cons of a variant involving sea locks to close off the Nieuwe Waterweg navigation channel. On the basis of this research, the Minister of Infrastructure and the Environment has decided against constructing such locks in the near future, but rather taking this option into consideration as a fully-fledged alternative in the future study into the replacement of the Maeslant storm surge barrier (this study is expected to commence around 2040). Until that time, the region is energetically continuing on the preferential alternative, implementing the work as no-regret measures. The Delta Programme is keeping track of new insights into climate change, flood risk management, and freshwater supply, in order to be able to launch the study at an earlier date if need be. This decision is in line with the recommendations of the Rhine Estuary-Drechtsteden Steering Group and the Delta Programme Commissioner.
Coast	
Sand1: coastal genesis 2.0 (including monitoring)	Coastal Genesis II is a long-term research programme, implemented under the National Water and Climate Knowledge and Innovation Programme (NKWK), and focused on sand transport along the Dutch coast. The programme addresses knowledge issues such as: how much sand is needed for our coastal system in the long run, and where and when will we replenish that sand along our coast? The studies are conducted on a "learning by working" basis. In 2016, Rijkswaterstaat set down an action plan, which gives priority to the demand for knowledge regarding the coastal foundation and the exchange with tidal inlet/outlet systems, as a basis for long-term area preservation and coastal safety. Several small-scale replenishment pilots have been launched (Vlieland, Ameland), aimed at gaining insight into sand transport movements between the coastal foundation, tidal inlet/outlet systems, and basins. International collaboration is taking place within the Interreg programme Building with Nature. A number of sub-studies have already been marketed; the remainder will follow suit in the course of 2016. Consultations are underway with the Ministry of Economic Affairs, provinces, district water boards, universities and private parties regarding the outsourcing of knowledge issues pertaining to the topics of "sand extraction", "ecology", "spatial planning and the economy". The parties represented on the National Consultation Committee on the Coast (LOK) will also be involved in this. The ecological impact of sand extraction and replenishment will be mapped out within the Rijkswaterstaat regular coastline maintenance programme, in collaboration with the Coastal Genesis 2.0 research programme. This will serve as the basis for assessing whether, and if so, how replenishment policy needs to be adjusted. The Ministry of Economic Affairs is involved in the components of this survey that focus on monitoring sea bed life.
Sand2: pilots, channel margin replenishments	The sand replenishment programme for 2012 – 2015 comprises six replenishments that have also been designated as a pilot within the framework of the Delta Programme. One of these replenishments is in progress (Brouwersdam). The remaining replenishments are expected to be carried out in the next 1.5 years.

DP2015 knowledge issues (September 2014)	Status as per July 2016
Wadden Region	
W1: innovative dyke concepts	The first phase of the Wadden Sea dykes general exploration has been completed. During this phase, promising solution strategies have been elaborated by a joint project organisation comprising the three northern district water boards and various stakeholders. The second phase, that will run up to 2018, will involve the testing and examination of twelve solution strategies. These concern new dyke concepts, the use of materials, and hydraulic preconditions. The studies will be linked to dyke improvements scheduled for dyke ring 6 (Wadden coast). The end product will be solution strategies for the Wadden Sea dykes that are widely supported at the administrative level and that may possibly also be applicable elsewhere.
W2: mud flat management as a component of flood defence systems	Factoring in mud flats in flood risk management is addressed in three studies within the context of the Wadden Sea Dykes general exploration: the study into the Hydraulic Preconditions for Forelands, the Dyke with Foreland study, and the Wide Green Dyke pilot. The first two studies are conducted by Wetterskip Fryslân, the latter by Hunze en Aa's district water board.
W3: integrated flood risk management strategy for the islands	The study into multi-layer flood risk management was completed in the spring of 2016, as a spatial adaptation impact project. The study shows how island residents jointly cope with the initial impact of floods and flood risks. Together with the scenario study completed in 2015, this will provide the basis for an integrated strategy for each island, to be set down in 2016. This will seek solutions for longer response times in the event of a flood (emergency shelters on the islands), connections with the mainland (accessibility of ferry causeways), and sustainable management of a dynamic coastal zone (dune management, wash-overs).
W4: Friesland/Groningen parallel flood defence systems	In line with the draft Environmental Vision, the province of Groningen is further elaborating the Wadden Coast tasking in concert with the regional partners. The dyke improvement tasking along the Eems-Dollard (the entire section, from Eemshaven to Germany) is geared to the improvement of the estuary wherever possible. The focus is on the trapping of sediment and its subsequent utilisation in future dyke improvements. To this end, two projects have been launched that have a direct bearing on coastal defence: • The Green Dollard Dyke pilot involves the use of three different sediment flows from the system to improve the dyke (levelling off the outside bank); • In the Kleirijperij pilot, various sediment flows are subjected to individual treatments in order to examine whether they can be processed into suitable dyke clay.
W5: evaluation tools for innovative dykes	Will be tackled by Wetterskip Fryslân at the end of 2016.
New W6: study into a sand engine for the Wadden region (SEAWAD)	If we allow Nature to run its course in the Wadden Region, the coast off the Wadden islands will eventually erode and the sand will be deposited in the Wadden Sea. For that reason, the Wadden islands are regularly subjected to sand replenishment. In September 2015, researchers from three universities embarked on SEAWAD: a four-year research project focused on exploring whether a huge sand replenishment at the islands' seaward side will produce the same result. With SEAWAD, the research institutes are addressing a key question from the preferential strategy for the Wadden Region.
Southwest Delta	
ZWD1, 2[7]**:** future design and management of Grevelingen, Volkerak Zoommeer lake.	The process involving the conclusion of administrative agreements on the future design of Grevelingen (featuring limited tidal movement) and a saline Volkerak-Zoommeer lake (VZM) based on the draft Grevelingen-VZM National Framework Vision is expected to see its completion in 2016. In the risk dossier, various substantive issues have been explored in detail. In addition to the morphology and sediment deposits in the Grevelingen lake, these issues also pertained to the potential optimisation of salinity reduction in West Brabant and the development of the Quagga mussel in the VZM lake. Potential new knowledge issues will be re-formulated in 2016 based on the decisions made regarding these basins.

[7] ZWD = Southwest Delta

DP2015 knowledge issues (September 2014)	Status as per July 2016
ZWD3: MIRT Study into Oosterschelde flood risk management, Roggenplaat pilots	The Oosterschelde Integrated Safety MIRT study commenced in 2015. The study maps out the most appropriate measures for ensuring long-term safety. Such measures may concern the Oosterschelde storm surge barrier, the dykes along the Oosterschelde, and sand replenishment on the foreshores and shoals. Opportunities for nature and the economy are factored in. The study will be completed by the end of 2016. The Oosterschelde Sand Demand MIRT exploration was completed at the end of 2014. In line with the preferential strategy, the impact of sand demand can be counteracted by sand replenishment in intertidal areas. Sand replenishment at the Roggenplaat shoal will commence in 2017-2018. Funding has been provided by the central government, the province, municipalities, civic society partners, and residents (through crowdfunding). The regional contributions include a pending EU subsidy. The other areas are covered by the Oosterschelde Integrated Safety MIRT Study.
ZWD4: future design and management of Westerschelde	In 2013, the Flemish-Dutch Scheldt Commission set down the Agenda for the Future, a research programme for the Scheldt estuary. Its aim is to reinforce the balance between safety, accessibility, and natural development in the estuary. An interim review will be the conducted in 2016.
ZWD5: future design and management in relation to freshwater supply	• The specific freshwater supply measures in the Southwest Delta are in various stages of progress. The measures concern the regional water system, national waters, the Roode Vaart transfer in West Brabant and Zeeland, other measures related to a saline VZM lake, and the Freshwater Supply testing ground climate adaptation pilot. • The regional measures are aimed at improving the resilience of the water system and also involve measures linked to the potential salinisation of the VZM lake. These projects are still in an administrative preparatory phase and/or are dependent on the decisions made within the context of the Grevelingen/VZM National Framework Vision. • Winter flushing of the Volkerak-Zoommeer lake features in the VZM water agreement that was signed in early 2016. In consultation with the water managers involved, it will be substantiated further in 2016, in inter-relationship with the Rhine-Meuse Estuary Smart Water Management project. • The plan elaboration of the innovative freshwater-saltwater separation scheme at the Krammer locks is scheduled for 2016. To this end, the preferential variant for the push-towing locks has been optimised and geared to the requirements of the main stakeholders. • Once the Haringvliet locks are re-opened (2018), the effects will be monitored. • Innovative self-sufficiency pilots / Southwest Delta testing ground: the parties involved in the Zeeland Freshwater Supply testing ground are elaborating opportunities for improving self-sufficiency by expanding the availability of freshwater and reducing the freshwater dependency of saline areas. To this end, tests are conducted involving expansion of freshwater storage in the soil and expansion of the rainwater lens. This will significantly enlarge the subsoil freshwater volume. The freshwater-saltwater mapping, reflecting the subsoil saltwater distribution for the entire province of Zeeland, will be completed at the end of 2016. In the Rietkreek pilot, the Brabantse Delta district water board has joined forces with farmers to explore options for water preservation and the joint optimisation of the regional water system. Based on the study, the parties will set down agreements on responsibilities for water availability in the area by no later than 2018. Zeeuws Vlaanderen Robust Water Management involves a comprehensive regional exploration of potential optimisations and the re-use of freshwater among the various consumers. The exploration will be continued in 2016.
Rhine Estuary-Drechtsteden	
RD1: interventions in main water system	• The study into partial closure of the Maeslant storm surge barrier will be completed in 2016. • Morphological effects of spatial interventions: see R1.
RD2: Alblasserwaard and Hollandse IJssel MIRT Studies, Krimpenerwaard pilot, Botlek	• These MIRT Studies have been rolled out as administrative issues and will be removed from the list of knowledge issues. • The Krimpenerwaard / Spatial Dyke Improvement Tools study has been completed; the results were presented in February 2016. The conclusion is that the spatial reservation tools are up to standard. The tools are particularly effective if implemented by the parties on the basis of a joint vision for the region. This calls for administrative willingness and collaboration between government authorities, residents, and companies in the area.

DP2015 knowledge issues (September 2014)	Status as per July 2016
RD3: small-scale water supply	• The exploratory phase of the study into the capacity expansion of the small-scale water supply will be completed in 2016. The exploration is intended to develop a preferential alternative for step 1 in the expansion of the small-scale water supply capacity to approx. 15 m^3/s. • The exploration for the Irene Locks Bypass project also commenced in 2016. It is aimed at securing a sufficient freshwater supply in the Amsterdam-Rijn canal. In addition, a joint fact finding process has been initiated regarding further expansion of the water supply to the western Netherlands and potential alternatives, including a permanent eastern supply route.
RD4: elaboration of business cases	Various elaborations have been rolled out as administrative issues and will be removed from the list of knowledge issues.
RD5: in-depth insight into main water systems (morphology, salt intrusion, soil erosion)	• Study into river morphology in flood risk management tasking, morphological effects of interventions: see R1. • Salt intrusion following implementation of decision on opening Haringvliet locks: study is scheduled in conjunction with a monitoring programme, before 2028. • Structural approach to soil erosion of Oude Maas, Spui, Kil and Noord: morphology study will be completed in 2016.
RD6: damage rates for areas outside the dykes	The development of a strategic agenda for areas outside the dykes commenced in the second half of 2015; the agenda will be completed by the end of 2016.
RD7: dyke strength and height (actual strength, innovative measures, forelands)	These issues will be tackled in various general explorations (GEs) within the framework of the Flood Protection Programme: Piping GE, Macro-stability GE, and Forelands GE. In 2017, the district water boards will start their dyke assessments. The Rhine Estuary-Drechtsteden Delta Programme uses the latest insights into dyke strengths, innovative technologies, et cetera.
RD8: Hollandse IJssel probabilistic approach	The knowledge issue has been resolved by a Rijkswaterstaat memorandum on the significance of the new probabilistic model approach in relation to adapting the failure risk of the storm surge barrier near Krimpen a.d. IJssel.
RD9: transmission effects in central Holland	See RMD1.
RD10: impact reduction of floods (disruption of society, vertical evacuations, vital infrastructure)	• The quantifiability of Societal Disruption will (in part) be addressed within the national Water and Evacuation project. • The Water and Evacuation project will provide tools for drawing up an evacuation strategy and guidelines for determining real evacuation fractions. Results will be presented in the third quarter of 2016. • Together with the district water boards, Rijkswaterstaat, and the municipality, the Rotterdam-Rhine Estuary security region is carrying out a case study into flood disaster management by making available and developing know-how. The study will provide guidelines for more efficient disaster management in various stages of a crisis, from the development of a threat up to and including the reconstruction of a flooded area. One of the taskings is to flesh out “vertical evacuation”. • The promising multi-layer flood risk management combination for the Eiland van Dordrecht is elaborated further in the MIRT Study “Operationalisation of the strategy to enhance the coping capacity of the Eiland van Dordrecht”. • The resilience of vital functions and grids will be addressed at the national level within the Delta Programme on Spatial Adaptation / vulnerable and vital.
RD11: governance	Involving the security regions in the disaster control policy agenda, the improvement of the approach to vital and vulnerable functions, and evacuation: this has (in part) been addressed within the national Water and Evacuation project.
RD12: damage impact of Maeslant storm surge barrier closure on shipping and port	Study has been requested by Rijkswaterstaat. Not addressed within the Delta Programme for Rhine Estuary-Drechtsteden.

DP2015 knowledge issues (September 2014)	Status as per July 2016
Rivers	
R1: morphological behaviour of river systems	**Monitoring of morphological effects of Room for the River measures:** • As reported in its publication entitled "*Morfologische Pakketsom Waal*" [Overall morphology of the Waal river], Deltares research institute estimates that Room for the River measures on the Waal will lead to sedimentation in the Midden-Waal, resulting in increased maintenance dredging and a slight reduction of autonomous river bed erosion. In the Boven-Waal, Beneden-Waal, and Merwedes this process will cause additional erosion in the long run. • Within the STW perspective programme RiverCare, morphological research is conducted into the effects of secondary channels and longitudinal erosion control dams, with the aim of minimising management and maintenance requirements. In addition, the effects of replenishments are studied. This research programme runs up to December 2019. A mid-term review is scheduled for November 2016. • The longitudinal erosion control dams constructed on the Waal within the Room for the River framework were transferred to the manager (RWS Eastern Netherlands) on 23 March 2016. Before and during the construction, the contractor has conducted measurements (benchmarks). In the period ahead, an 8-weekly monitoring programme will be conducted in the main channel and the bank channels. • In the context of the National Water and Climate Knowledge and Innovation Programme, a Rivers focus area will be initiated. A key component will be the morphological development at the system level (including the bifurcation points and the effect of (uncertainty regarding) the river bed level on the discharge distribution). Long-term response (equilibrium level and response to measures) is also on the agenda. • Delft University of Technology recently launched the *Long-term bed degradation in rivers: causes and mitigation* project. This project spans a period of four years (NOW-Water 2015). **Morphology & Shipping** • In its report "*Optimalisatie Baggerstrategie Waal na 2015*" [Optimisation of Waal dredging strategy beyond 2015], Arcadis recommends the use of existing technologies to accommodate the expected increase in dredging requirements, by deploying additional appropriate equipment. • In 2015, the Directorate-General for Spatial Development and Water Affairs and the Directorate-General for Mobility and Transport commissioned the "Rhine tributaries sustainable navigable depth 2" study. This showed that the continuing river bed erosion in the Bovenrijn and downstream of the bifurcation points will lead to bottlenecks for shipping traffic. The most urgent one is the resistant layer near Nijmegen. The study has indicated several potential solutions to be explored in more detail: longitudinal erosion control dams, replenishment, and groyne adjustments. On the other hand, Room for the River will also result in additional sedimentation and thus disruptions to shipping traffic. In addition to monitoring, a follow-up study is recommended to further explore the sets of measures. • In its report on the sustainable navigable depth of the Rhine tributaries, Deltares also estimated the impact of Water Framework Directive projects and the preferential strategy for the rivers on bed levels and navigation channel maintenance. The simulations indicate that minor river-bed lowering requires substantial maintenance, that preferential strategy measures in the IJssel may have a considerable impact on navigation channel dimensions and navigation channel maintenance, and that the impact of the preferential strategy measures for the floodplains may be kept within limits, provided the measures are optimised.

DP2015 knowledge issues (September 2014)	Status as per July 2016
R2: bifurcation points	The study into the Rhine tributaries bifurcation points area commenced in 2015, elaborating the preferential strategy for the Rivers pertaining to this specific area. • Hydraulic study: five combinations of measures have been calculated from a river management point of view, with respect to water levels and impact on the discharge distribution. In general terms, with a discharge of 17,000m3/s, all the variants accommodate preservation of the discharge distribution as set down in policy. However, lower discharge levels may have a considerable impact. The study shows how the impact of river widening in the bifurcation points area extends to a considerable distance downstream along all the river tributaries. • Study into regional and local taskings: the report on river widening measures and regional/local taskings in the bifurcation points area was presented in 2016. The province of Gelderland has mapped out how the measures taken at the bifurcation points area will impact the surrounding area, and identified connections with other policy taskings. • As already stated under R1, morphological behaviour, a cluster of studies has been proposed within the framework of the Rivers focus area of the National Water and Climate Knowledge and Innovation Programme, which will address the long-term response of the rivers to changing preconditions and also look into models for the morphological development of bifurcation points and the impact of (uncertainty regarding) river bed levels on the discharge distribution.
R3: cross-border discharge	• At the end of 2015, the governments of the Netherlands and North Rhine-Westphalia signed a collaborative agreement on the joint exploration of flood risk in the border area. The study focuses on the application of the Dutch risk-based approach – as developed within the Delta Programme – for the cross-border dyke rings in the border area between the Netherlands and North Rhine-Westphalia. The study maps out the differences in the approaches pursued and how they impact the safety of residents on both sides of the border, in order to be able to properly coordinate future flood risk management measures. The results will be available in 2017. • GRADE/Rhine: the results achieved with the GRADE tools and potential emergency measures show that the maximum discharge of 18,000 m^3/s will be a likely upper limit in 2100, based on the insights into the increase in discharge, the impact of floods in Germany, and the effect of German measures (both preventative measures and contingency measures). For that reason, the Delta Programme will continue to use the upper limit above as its point of departure for the Rhine discharge. The upper limit is not all conclusive. Depending on the applicable standard and the failure mechanism, a range of discharges will be taken into consideration in the calculations. • The recommendations provided by the Flood Risk Management Expertise Network (ENW) with respect to GRADE will be implemented in the years ahead. The schedule for next year features, inter alia, an improvement of the GRADE modelling of the floods in Germany in the last stretch up to the border. The improved GRADE will be available in time for the next version of the design tools in 2018. In this context, a decision will also be made on how to incorporate the new KNMI[8] 2014 climate scenarios in the design of flood defence systems, and how this will impact maximum discharges. • GRADE/Meuse: the standards in force along the Meuse differ widely. This means that we have to reckon with discharges with highly different probabilities of occurrence. The Meuse discharge statistics have been re-calculated using the GRADE method. The results will be discussed with the stakeholders in the Meuse area, as will further choices to be made regarding the scenarios and flows to be observed in order to set down the 2018 design tools.
R4: area-specific studies – Rhine	The Ministry of Infrastructure and the Environment is examining the cost-effectiveness of river widening along the Waal, IJssel, and dyked river Meuse. A first analysis shows that in the event of an overall flood level reduction, river-widening measures along the Waal appear to yield higher savings in the cost of dyke improvements compared to such measures along the IJssel. The study will be followed up in 2016 by determining the impact of river widening measures for each dyke section (cf. R6).

[8] KNMI: Royal Netherlands Meteorological Institute

DP2015 knowledge issues (September 2014)	Status as per July 2016
R5: area-specific studies – Meuse	The adoption of the new standards has terminated the requirement that the flood defence systems in the Meuse valley must be able to overtop, subject to the precondition of compensating measures being taken. Without compensation, water levels in the Meuse valley and the dyked river Meuse will rise. Further research shows that this unwanted effect can be compensated by dyke relocations and retention areas along the Meuse valley. These aggregate measures are designated as "improvement of Meuse transmission effects". More information is provided in the paragraphs on this area. A first analysis by the Ministry of Infrastructure and the Environment shows that in the event of an overall flood level reduction, river-widening measures along the Meuse appear to yield higher savings in the cost of dyke improvements compared to such measures along the Waal. In the Meuse valley, river widening will generate additional savings on the additional dyke extensions needed for the dykes to continue to link up with the elevated soils, even at higher water levels.
R6: flood risks in relation to retention, river widening, and river management	See R4. In 2015, the Ministry of Infrastructure and the Environment presented a report on river widening in resilient areas around the major rivers. This study provides insight into how river widening contributes to the resilience of river systems, among other ways by enhanced risk reduction, limiting the formation of breaches, and removing hydraulic bottlenecks. The lower water levels ensuing from river widening lead to a further reduction of economic damage and casualties in areas within and outside the dykes. A combination of river widening and dykes yields more of a risk reduction than dyke improvement alone. The exact proportion varies from one area to the next. The cash value of such reductions (in euros) cannot (yet) be indicated. In 2016, a follow-up study commenced, focused on the further quantification of the contribution to the resilience of the system.
R7: impact of spatial reservations	The province of Gelderland has explored, in concert with the other authorities, how the spatial development of the Rijnstrangen area can be continued despite the spatial reservation for retention purposes. Developments that comply with the zoning plan are permitted in any case: new nature and infrastructure, expansion of farms, renovation or construction of new houses, and a holiday park. Initiators of new developments are advised to enter into a dialogue with the municipal authorities at an early stage. Since the reservation in 2005, any development envisaged has been possible. In part, this can be explained by the fact that until 1960 Rijnstrangen used to serve as a peak water storage area. For that reason, the results cannot be applied just like that to other reservation areas, though the approach and line of thought can. A reservation does not lock this or other areas; developments within the zoning plan can continue, and an early dialogue with the municipal authorities is vital with respect to new developments.
R8: Multi-level governance	Removed from the list as a separate knowledge issue.
Elevated Sandy Soils	
HZ1[9]**:** Potential of new solutions and tools	• In line with the national knowledge agenda, the eastern and southern regions are drawing up regional knowledge agendas, focusing on studies into the effect of the aggregate measures: on the overall water system, water availability, cost and benefits, and the contribution to other regional goals. In their agendas, the regions are factoring in pluvial flooding, and tying in with the taskings and measures related to water quality. • In 2016, the Lumbricus programme was rolled out in the eastern and southern regions, as a sub-programme of the national Soil and Subsoil Knowledge and Innovation Programme (KIBO). In this context, knowledge regarding the interconnectivity between soil, freshwater, and subsoil is being developed and applied in testing grounds. Testing grounds in the southern region are the sub-areas of Agger, Raam, and Groote Molenbeek; in the eastern region, the Vecht between Junne and Hardenberg serves as a testing ground. Responsibility for the testing grounds lies with the relevant district water boards.

[9] HZ = Elevated Sandy Soils

DP2015 knowledge issues (September 2014)	Status as per July 2016
Delta Programme – generic topics	
DP1: adaptation of Delta Model	The Directorate-General for Spatial Development and Water Affairs (DGRW) and Rijkswaterstaat have commissioned Deltares and Alterra to develop the Delta Model into a National Water Model (NWM). The NWM provides insight into the consequences of climate change for the Netherlands, by making so-called basic water dynamics forecasts (for 2050 and 2085) for the purpose of flood risk management, water availability, and water quality. The NWM can also be used to calculate the effects of intended measures. A component of the model is the National Hydrology Model ensuing from the Dutch Hydrology Tools. By now, the water availability component of the NWM is operational.
DP2: monitoring, analysing, acting (MAA)	In 2015 and 2016, the outlines of the MAA system were developed and roughly elaborated under the direction of the MAA Core Team (the Directorate-General for Spatial Development and Water Affairs, Rijkswaterstaat/Water, Traffic and Environment unit, the Netherlands Environmental Assessment Agency, and the staff of the Delta Programme Commissioner). The results were discussed in the Steering Group Delta Programme in September 2015, April 2016, and June 2016 (in the latter case, through a written round). Sub-programmes, umbrella organisations of the regional authorities, and executive organisations have participated in the MAA consultative group. A research team of the Netherlands Environmental Assessment Agency, the University of Amsterdam, and Delft University of Technology has provided substantive support during the process. The final report will be presented in the summer of 2016.
DP3: implementation of Adaptive Delta Management	Some of the governance issues have been addressed under DP2. In addition, the Netherlands Bureau for Economic Policy Analysis has conducted a study into the valuation of flexibility. The ambition of a periodic resilience test has been addressed under DP2. Mapping out the adaptiveness of strategies and determining their added value will be tackled in the autumn of 2016.

Deltaprogramma

The Delta Programme is a national programme involving an innovative collaboration between the central government, the provinces, municipalities and district water boards, with input from civic society organisations, knowledge institutes, citizens, and the business community. The aim is to protect the current and future generations of the Netherlands against flooding, to ensure a sufficient supply of freshwater and to climate-proof our country in order to prevent major damage.

The Delta Programme Commissioner submits an annual proposal for the Delta Programme to the Minister of Infrastructure and the Environment, fosters the implementation of the Delta Programme, and monitors progress. The proposal comprises all the measures scheduled and provisions made to reduce floods, pluvial flooding and water shortages. The Delta Programme is presented to the States General every year on *Prinsjesdag*, the state opening of Parliament.

Eight areas are working on the further elaboration and implementation of the strategies outlined in the Delta Programme. These areas cover the entire country. They are:

- Rhine Estuary-Drechtsteden
- Southwest Delta
- IJsselmeer Region
- Rhine
- Meuse
- Coast
- Wadden Region
- Elevated sandy soils

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

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