Interreg
North-West Europe

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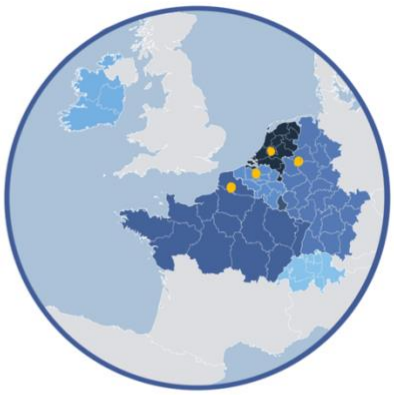
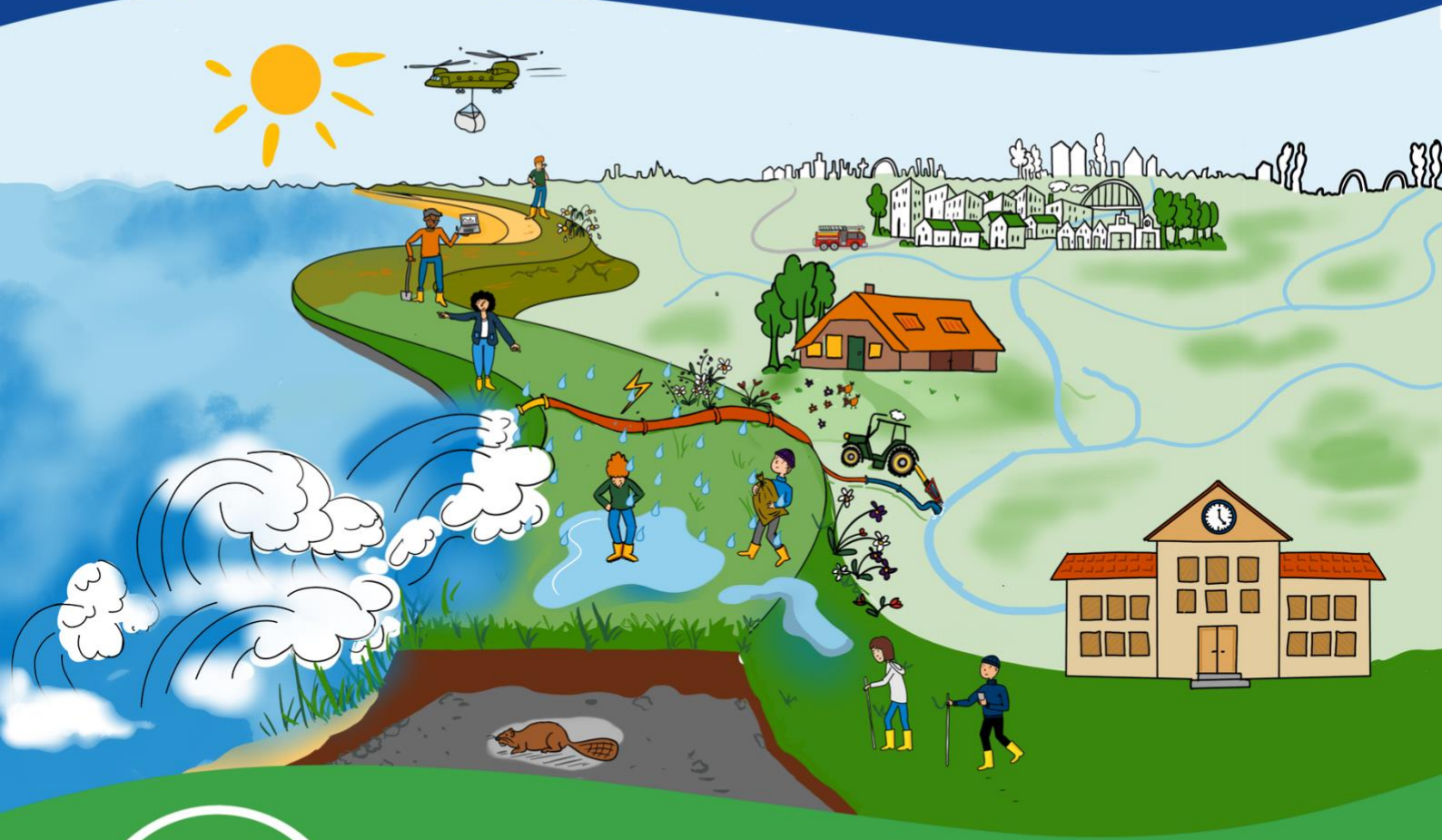


D.2.1.4 Jointly developed test plan on disaster management



Climate and environment

Interreg North-West Europe

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D.2.1.4 Jointly developed test plan on disaster management

Version:

Final

Authors:

STOWA, RWS, HZ, MinDef, Cerema, DMOW, DVW, HHNK, USiegen

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INTERREG NWE BONSAI project

Climate change

Climate change is accelerating, leading to increased rainfall, drought, storms, flooding, and sea level rise, particularly impacting the NWE region with its extensive estuarine systems. How can we better prepare these areas for climate change for the long term?

BONSAI objective

The overall objective of BONSAI is to make flood defence systems in tidal estuaries of NWE more short and long term resilient against climate change by learning from sites in different climate zones over Europe and developing and sharing pro-active and responsive measures. Organisations responsible for flood resilience and societal partners in tidal estuaries in NWE are empowered through capacity building to strengthen their resilience and better act in case of flood threats caused by extreme weather events.

Main results

The main results are (1) a transnational strategy for national authorities and 3 action plans for regional and local authorities, (2) 5 solutions on increasing robustness and resilience and enhancing disaster management and (3) multiple training schemes and courses on flood disaster management and flood resilience and 1 joint transnational flood academy.

BONSAI aims

BONSAI aims to apply a holistic approach that is focusing on (short and long term) flood defence system resilience and the improved disaster management. Different NWE countries tackle these challenges from their own perspective. Transnational cooperation between the NWE regions and beyond is essential because estuarine systems and climate change transcend borders, offering opportunities for mutual learning and resilience building.

Unique approach

The BONSAI approach is unique, 1. bridging the three layers of the multi-layer water safety approach: prevention, disaster management, and spatial planning 2. simulating shifting climate zones based on the application of insights from more southern regions to northern regions and 3. focusing on increased cooperation between countries to learn from each other, north learning from south as well as south learning from north.

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Test plans embedded in BONSAI

Within the BONSAI project in the second project period, Activity 2.1: Jointly Develop Test Plans for Pilots were planned. In this introduction, these test plans are put into context of the whole BONSAI project. The test plans are part of Work Package 2, pilots leading to solutions.

Following the NWE programme priority specific objective and the BONSAI project overall objective, three Project Specific Objectives (PSO) were formulated. For WP2 the project specific objective is the following:

1. Jointly develop and validate transnationally:
    a. 2 short term flood defence robustness solutions
    b. 2 long term increased resilience of flood defence systems solutions
    c. And 1 solution for enhancing disaster management for flood risk related disasters
2. Towards the end of the project, the solutions will be fully implemented by our 6 flood risk management project partners and available for other authorities responsible for flood risk management.

For project period 2 (P2), Activity 2.1 of the project work plan focuses on jointly formulating Test Plans for pilot actions yielding the following three deliverables:

- D.2.1.2: Jointly develop a test plan on short term robustness
- D.2.1.3: Jointly develop a test plan on long term resilience
- D.2.1.4: Jointly develop a test plan on disaster management

From the project organisational point of view, test plans are the foundation for achieving the PSO of WP2 and therefore the activities following A2.1 from P3 and further, being:

- Activity 2.2: Jointly implement pilot action for short term flood defence robustness – erosion
- Activity 2.3: Jointly implement pilot action for short term robustness – animal activity
- Activity 2.4: Jointly implement pilot action for long term resilience – biodiversity/vegetation
- Activity 2.5: Jointly implement pilot action for long term resilience – nature based solutions
- Activity 2.6: Jointly implement pilot actions for disaster management

These activities and their deliverables are envisioned to yield the following Outputs, namely 5 Solutions, applicable by other organisations in similar contexts:

1. Method for predicting erosion progression under various circumstances and climate zones;
2. Risk profiling approach for evaluation of the sensitivity of levees to animal effects;
3. Protocol for seed mixtures and maintenance strategy on vegetation-covered flood barriers;
4. Digital twin to demonstrate added value of nature-based solutions on long term resilience;
5. Location based AI supported model for disaster management.

Underneath a summarising figure is enclosed.

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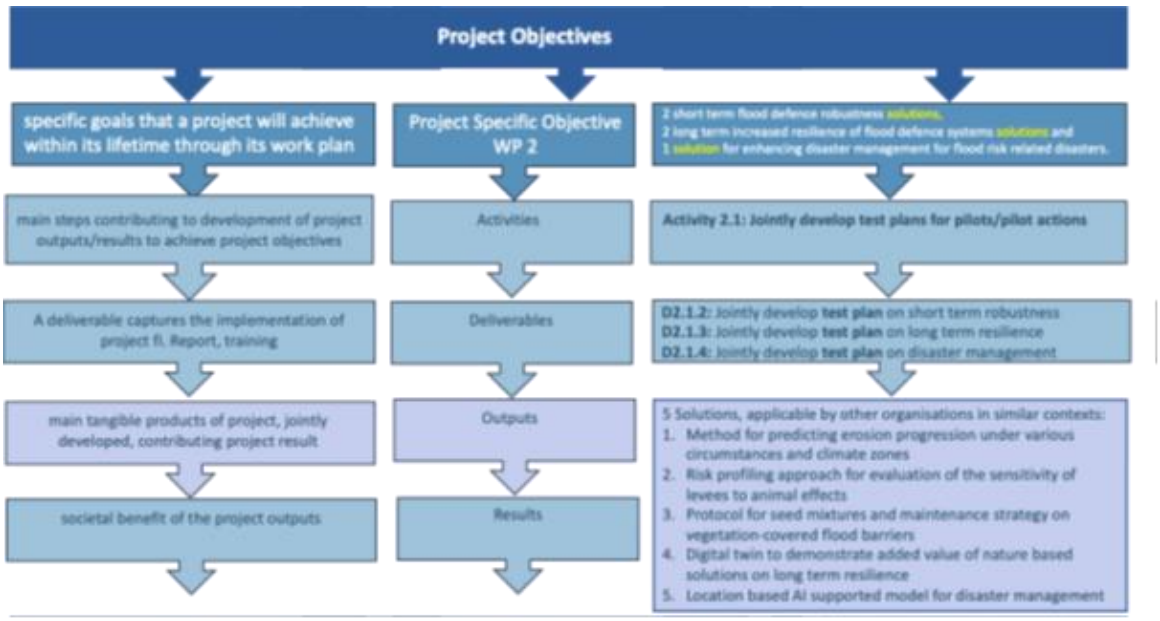

This test plan, on disaster management, incorporates relevant pilot actions of follow up activity A2.6.

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1 Introduction

1.1 Purpose

Besides an increase in mean sea level rise, climate change creates the potential for more high energy storms and extreme weather events, thereby increasing the probability of extreme loading conditions for levees. BONSAI aims to help areas in North-West Europe prepare for climate change in the long term. The BONSAI approach thereby applies a multi-layer defence approach covering different topics.

This specific **test plan focusses on the topic of disaster management** and describes experimental set-up, parameters and test protocol for the pilot action on disaster management (A.2.6). It includes aspects such as mobile barriers and innovative inspection techniques. Not all activities will take place on a real life/ physical test site. But a lot of work will be done by desktop study.

1.2 Scope and goals

The pilot action on disaster management includes 6 parts that were discribed in the project propasal under activity A.2.6:

- Impact of overtopping waves or overflow on people, objects and infrastructure (D.2.6.1);
- Emergency response measures for failures caused by f.i. erosion and animal burrows, repairs as well as mobile barriers and creating controlled breach (D.2.6.2);
- Testing smart innovative inspection techniques for disaster management (D.2.6.3);
- Development and testing of a (location based) datamanegement portal for crises, including preventive and response measures knowledge center/library (D.2.6.4);
- Exchange crisis communication ways from different countries and partners and prepare/teach citizens about failing communications during flood (D.2.6.5);
- Development of a decision support system for disaster management (D.2.6.6).

1.3 Background

Disaster management is a very important and essential step in keeping the North-Western region of Europe save from flood risk. Due to climate change, we will increasingly rely on the commitment and expertise of dike managers and related organizations to protect us from flooding. Higher dikes alone will no longer suffice. We will also need to find other solutions. Bonsai's multi-layer approach does exactly that. Bonsai's disaster management program addresses many related issues, seeking solutions before, during, and after problems arise.

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2 Test Objectives

2.1 Perform pilot action on multiple test sites and reference sites

The tests of Bonsai are performed on multiple test sites inside the NWE and reference sites outside the NWE. The locations of tests sites and reference sites are relevant to simulate the shifting climate zones. The test sites are described in D.2.1.1, Test and reference site characterisation. Tests are also conducted in the office on the computer when working with numerical modelling or AI based evacuation models al lot of work is done not in the field, but at a desk testing and evaluating scrips and models.

2.2 Develop a solution for enhancing disaster management

The ultimate goal for the pilot action on disaster management is to jointly develop and validate transnationally a solution for enhancing disaster management for flood risk related disasters in estuarine areas. The outcome of each of the different tests within the pilot will contribute to this ultimate solution. The solution (output2.2) is described as 'location-based AI supported model for disaster management'

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3 Experimental Set-up

Each part of the pilot action on disaster management is described in more detail. Including which test- and reference sites are used, who is in the lead, the set-up of the tests, the planning etc.

3.1 Impact of overtopping waves or overflow on people, objects and infrastructure

The test in this part covers the impact of overtopping waves onto overflow on people, objects and infrastructure. Four major points will be addressed:
1. Identify resilient routes for emergency in road network;
2. Planning for evacuation;
3. Location of temporary barriers for protecting critical facilities; and
4. Working safely on a rope.

3.1.1 Objective

The test plans of points 1 and 3 will be calculated based on established algorithms and models, while the test plan of point 4 will be mainly done in the field. The aim of points 1 and 3 is to investigate the impact of flooding and inundation following a dike breach. Assuming as a case study a hypothetical breach in Nordendeich, a series of maps will be produced showing the availability of roads for evacuation (1) and highlighting the threatened infrastructure (3) including e.g. buildings, hospitals, and energy supply.

Point 2 of this section is largely based on work carried out in the Interreg FIER project, we are assessing how to apply this model with data from the region CAEN (France). The model developed there is used as a starting point. We want to understand this model better and make it available for all stakeholders.

Because disasters are becoming more common, we must prepare ourselves and our organisations on how to work safely. Prior to Bonsai written instructions were developed on how to work safely in water, on a rope. These instructions will be tested and evaluated, with special attention regarding safely working on the waterline and surging 'under water' especially for the inspection for Beaver Holes and for repairing them during a water crisis.
These instructions will be transformed into instruction cards with special attention for the visualization of the working process. These instructions can be taken into the field.
They will be made available for all organisations involved in Bonsai so work can be done in a save way.
There will be training possibilities for working safely on a rope during the exercises and tests at Marnewaard.

3.1.2 Location(s)

The tests on impact of overtopping waves or overflow on people, objects and infrastructure are planned to take place at the following test/reference sites:

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Points 1 and 3 will be investigated in the Nordendeich, Norden (Lower Saxony) in cooperation with our German associate Partner (Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz, Betriebsstelle Norden). These are not physical tests, but rather numerical modelling tests done by the University of Siegen.

At the Marnewaard test site the instructions for working on a rope (point 4) will be tested. During the project other opportunities for testing could be recognized and used for further enhancement of the instruction cards.

The Marnewaard test site is described in D.2.1.1.

3.1.3 Test protocol

For Points 1 and 3 the following steps will be conducted:

- Raw data will be collected from the test site in Germany.
- Rawa data will be processed to be used by the Numerical Models
- Numerical simulations will be done on different dike breach scenarios for different return periods.
- Impact to the road network (availability of roads) and to critical infrastructure will be quantified based on the different scenarios.
- After that risk will be quantified and maps will be produced.
- Barriers experiment in Vlassenbroek and the Marnewaard.

For Point 2 the following steps will be conducted:

- Contact with FIER project will be established
- Exchange of the Evacuation-planning model developed by FIER
- Prepare a short report on the model
- Make it available to all partner and stakeholders in the BONSAI network

For Point 4 the following steps will be conducted:

- Studie the existing instructions
- Develop a protocol for the testing of the instructions
- Testing of instructions in the field
- Evaluating the instructions
- Making instruction cards
- Making instruction cards available for all stakeholders and partners in the Bonsai network

3.1.4 Roles and responsibilities

Lead: USiegen will lead points 1 and 3

Stowa will lead point 2 and 4

- Close support by RWS (Barriers experiment in Vlassenbroek and the Marnewaard), UniLille (interface/tool), DVW and Min def

Supported by all partners.

Point 2 (may delegate at a later stage to another partner)

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3.1.5 Planning

Point/Period	P2	P3	P4	P5	P6	P7
Point 1						
Point 2						
Point 3						
Point 4						

3.1.6 Expected outcome/ deliverable

The outcome of this test is a report on the impact of overtopping waves or overflow on people, objects and infrastructure (**Deliverable 2.6.1**). The report includes

1. Identify resilient routes for emergency in road network (displayed by Maps)
2. Planning for evacuation (short report on the Evacuation-planning model)
3. Location of temporary barriers for protecting critical facilities (displayed by Maps) A desktop study will be conducted, D.2.6.2 live testing of mobile barriers is foreseen at the locations Vlassenbroek and Marnewaard.
4. instructions for working safely (in water) on a rope. (instruction cards)

Yearly status updates of the report will be delivered.

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3.2 Emergency response measures for failures

3.2.1 Objective

The focus of this part of the Bonsai project is on different aspects of emergency repose measures for failures. These specifically were identified and will be tested in this part of the project:

1. Mobile barriers
2. Repairs
3. Controlled breach
4. Piping plug

1. Mobile barriers

Within the framework of emergency response measures for flood-related failures, mobile barriers are considered as a potential measure to limit the consequences of acute flooding situations. Mobile barriers may offer a flexible and rapidly deployable solution to temporarily protect vulnerable locations, provided that they can be deployed in a timely and operationally feasible manner.

In this context, we will explore the use of mobile barriers as part of our crisis management approach. The Dutch partners will further test existing mobile barriers that were previously tested to specify which ones are most useful in which situation. The De Vlaamse Waterweg (DVW, Flemish Waterways) will specifically focus on tidal river systems in Flanders. Their objective of this test is to assess whether mobile barriers can be operationally deployed as an emergency response measure within the DVW crisis management context, particularly in tidal river systems.

All tests aim to evaluate the practical usefulness, limitations and risks associated with the deployment of mobile barriers during flood-related emergency situations.

More specifically, the test seeks to answer the following questions:

- whether mobile barriers (and which ones) can be deployed in a timely manner within a crisis scenario;
- under which conditions and constraints such deployment is feasible;
- if possible an overview of possible mobile barriers will be made;
- which risks and limitations need to be taken into account during decision-making;
- and whether mobile barriers could potentially complement the existing toolbox for emergency flood response within DVW.

The test is exploratory, validating and training-oriented in nature, and builds on existing experience and knowledge from the Netherlands, which will be applied and assessed in a Belgian context.

2. Repairs

Repairing a breach or preparing a problem in a levee to prevent a breach is one of the more logical parts of emergency response when we think about flood protection. We always hope to prevent just this, but we have to be prepared. Because animal burrows are becoming a

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bigger and bigger problem we have to keep improving our methods for repairing the holes especially beavers can make.
There are some (proven) methods, but we will try and focus on innovative solutions. Therefor a challenge regarding repairing/closing Animal burrows (BEAVER BURROWS) during an emergency will be performed. With the solutions developed during the challenge we will aim to develop factsheets for repairing animal burrows to be used during crisis situations.

Also the existing instructions on Sandbag Science will be evaluated and if appropriate improved resulting in a renewed factsheet.

3. Controlled breach
The focus will on the early detection of breaches, the assessment of breach development, numerical modelling of breaches and the exploration of innovative breach-closing techniques. We will use this knowledge to get a better understanding to control breaches and how to imply them. Especially the modelling at the Norder Deich In Germany could deliver these answers

4. Piping plug
A Piping Plug is a device that is developed to make it easy for levee managers to stop piping/ sand boils. Sand boils are a major problem in levee failure and thus for levee managers to detect and solve. When the water levels rise these sand boils will occur and the higher the water the more dangerous and frequent they are.
The Piping Plug is an emergency response measure that can be rapidly deployed, to prevent further piping under the levee, functioning as a relieve valve, also to create time for preparing more impactful solutions. The Piping Plug still needs testing and possibly adjustments. Tests will be done in the Bonsai project to evaluate the model that was developed.

3.2.2 Location(s)

The tests on emergency response measures for failures are planned to take place at two different test/reference sites:

The test of mobile barriers executed by DVW will be conducted at a test site that is currently under selection, with Vlassenbroek identified as the most likely candidate location. The final selection of the test site will depend on the requirements and relevance of the developed crisis scenario. If another location proves more suitable to realistically simulate the selected failure mechanisms, emergency response context, or stakeholder involvement, the test site may be adjusted accordingly.
The tests in the Netherlands will be done at the Marnewaard test location. There a series of tests will be done to make an in-depth report possible. Experiments regarding the use and position of a mobile barrier will be conducted. This will include placement of the mobile barriers on a levee, behind a levee and on ground level to divert the water local away from critical infrastructure.

Min Def, STOWA, DVW and Rijkswaterstaat:

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Every year in the spring (starting in April 2026) at the location Marnewaard Min Def, STOWA, DVW and Rijkswaterstaat will conduct experiments. Other partners and Stakeholders will be invited to participate.

These locations are further described in D.2.1.1.

3.2.3 Test protocol

On the Vlassenbroek location mobile barriers will tested. These tests are planned for November 2026 (D.3.1.1 and D.3.1.2). The test will focus on conceptual and operational testing in a simulated emergency.

The test protocol includes the following steps:

1. Preparation
    - Review of existing experiences and test results with mobile barriers, to avoid unnecessary duplication of testing efforts. Also will be looked on which kind of surface they will be placed (wet, muddy or asphalt)
        - Selection of one or more relevant mobile barrier concepts, depending on available knowledge and budget.
        - Development of a crisis scenario (D.3.1.1), in which the deployment of a mobile barrier forms a potential emergency response measure.
    - Identification of practical requirements for simulating the emergency (e.g. creation of a basin). Also will be taken into account the results of other experiments outside BONSAI, for example at HDSR in November 2025.
2. Execution
    - Simulation of an emergency within the crisis exercise.
    - Deployment and set-up of the mobile barrier by the contractor, in close cooperation with the local DVW district.
    - Observation of the deployment process, with particular attention to timing, logistics and coordination.
3. Evaluation

- Qualitative evaluation by DVW, focusing on usability, deployment speed, operational constraints and observed risks.
- Collection of lessons learned regarding decision-making, timing and practical feasibility.

At Marnerwaard location a challenge regarding repairing/ closing Animal Activities (BEAVER BURROWS) during an emergency will be performed. A test protocol for this challenge will be developed.

Also at the Marnerward the existing instructions on Sandbag Science will be evaluated and if appropriate improved resulting in a renewed factsheet.

3.2.4 Roles and responsibilities

Lead: DMOW

Support: MinDef, HZ, RWS, UCL, DVW, Cerema, STOWA

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DMOW will be in the lead to for the synthesis of the above mentioned experiments in a comprehensive report.
DVW will focus on the Vlassenbroek experiments and participate in the Marnewaard tests
STOWA will focus on the optimal positioning of mobile barriers in the field and a working safely on a rope instruction.
Min. Def will in cooperation with Rijkswaterstaat and STOWA organize the yearly Marnewaard experiments.

3.2.5 Planning

Point/Period	P2	P3	P4	P5	P6	P7
Point 1						
Point 2						
Point 3						
Point 4						

Vlassenbroek

- Preparation phase: first half of 2026
  Scenario development, knowledge exchange with Dutch partners and preparatory planning.
- Test execution: November 2026
  Deployment of the mobile barrier during a DVW crisis exercise.
- Evaluation phase: end of 2026 – 2027
  Documentation of lessons learned and formulation of recommendations.

Marnewaard
Every year in the spring (starting in April 2026) at the location Marnewaard Min Def, STOWA, DVW and Rijkswaterstaat will conduct experiments. Also other partners and Stakeholders will be invited to participate.

3.2.6 Expected outcome/ deliverable

The outcome of this test is a report on emergency response measures for failures (**Deliverable 2.6.2**).
We will aim to develop factsheets to be used during crisis situations.

The report and factsheets will include the emergency response measures tested:
1. Mobile barriers

The expected outcomes of this activity will be:

- a qualitative assessment of the operational applicability of mobile barriers as an emergency response measure within the DVW crisis management framework.
- an improvement of the STOWA manual on mobile barriers including a practical assessment regarding the placement of the mobile barriers on a levee, behind a levee or on ground level to divert the water local away from critical infrastructure.

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2. Repairs

The expected outcomes of this activity will be:

- The development of factsheets to be used during crisis situations regarding the results of the challenges of repairing/ closing of Animal Activities (BEAVER BURROWS) during an emergency.
- The existing instructions on Sandbag Science will be evaluated and if appropriate improved resulting in a renewed factsheet.

3. Controlled breach

The expected outcomes of this activity will be a report on the possibilities for early detection of breaches, the assessment of breach development, numerical modelling of breaches and the exploration of innovative breach-closing techniques.

4. Piping plug

The expected outcomes of this activity will be a better tested and adjusted piping plug and to evaluate the developed model. If possible a factsheet how to rapidly deploy and use the piping plug during highwater will be generated.

Yearly status updates of the report will be delivered.

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3.3 Innovative inspection techniques for disaster management

3.3.1 Objective

Key in disaster management is early detection prior and during crises events. We will jointly develop a citizen science instruction for animal burrow awareness and test the potential of IR drones.

Examine the effectiveness of infrared (IR) imagery for detecting surge and seepage locations during high water. This helps water managers assess the risk of flood defenses and improve management strategies due to the failure mechanism of piping.

Drone images and field observations will be collected. The IR images should be analysed for temperature differences indicative of seepage or surge. A distinction will be made between seepage locations with diffuse temperature increases and potential well locations, such as point sources with clear signs of flow.

The citizen science instructions will be a focus point of the Fieldweeks that will be organized by HZ. We aim for assignments for students on developing a citizen science instruction for animal burrow awareness.

3.3.2 Location(s)

The tests on innovative inspection techniques for disaster management are planned to take place at the following test/reference sites:
At locations of the fieldweek(s) to be decided later. The citizen science is probably a not physical site but more a methodology like desk study.
These locations are further described in D.2.1.1.

3.3.3 Test protocol

A test protocol for these experiments will be developed before the actual experiments.

Some elements for the IR Drones observations and the interpretation of these images are:

- Temperature: A large difference between groundwater and seepage water temperature increases the chance of detection.
- Sun and precipitation: Sunlight and rain complicate the interpretation of IR images.
- Season: Winter is most suitable due to favourable temperature contrasts.

Students will be asked to develop a test protocol for the citizen science instruction.

3.3.4 Roles and responsibilities

Lead: DMOW will be in the lead to for the synthesis of these experiments in a comprehensive report.
Support: RWS, Cerema will contribute with the IR imaging and processing.
HZ: in support by Stowa will focus on the citizen citizen science instructions

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3.3.5 Planning

These experiments are follow the field experiments on the pilot locations. So the exact moment of execution have not yet been planned, but it seems logical to have them the end of 2027 or the beginning of 2028, so period P6 and P7.

3.3.6 Expected outcome/ deliverable

The outcome of this test is a report on innovative inspection techniques for disaster management (**Deliverable 2.6.3**).

The report includes:

- Early detection prior and during crises events
- Develop citizen science instruction for animal burrow awareness
- Test the potential of IR drones

Yearly status updates of the report will be delivered.

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3.4 Location based datamanagement portal for crises

3.4.1 Objective

The objective of this test is to assess the usability, added value and applicability of a location-based data management portal to support crisis management during flood-related events. The test focuses on how such a portal can improve situational awareness, information sharing, prioritisation and decision-making within a crisis room setting.

Within BONSAI, De Vlaamse Waterweg (DVW) develops and tests a proof of concept (POC). The test aims to evaluate whether a location-based data portal:

- effectively supports operational decision-making during a crisis,
- integrates relevant spatial and non-spatial information in a user-friendly way,
- adds value compared to current crisis management practices, and
- has the potential to be further developed or transferred to other organisations and regions.

3.4.2 Location(s)

The test will be conducted in a scenario-based crisis management context, rather than at a fixed physical test site. The primary test moment is embedded in a BONSAI crisis exercise planned for November 2026, during which the location-based data management portal will be used by the DVW crisis team.

The crisis scenario is expected to focus on a flood-related emergency, most likely situated in the area of Vlassenbroek, although the final location may be adjusted depending on the requirements of the developed scenario. This flexible, scenario-driven approach ensures that the test remains operationally relevant and aligned with the objectives of the crisis exercise.

These locations are further described in D.2.1.1.
[please include any relevant site characteristics that were not yet included in the site characterisation D.2.1.1 or that still need to be determined]

3.4.3 Test protocol

The test consists of the configuration, use and evaluation of a location-based data management portal during crisis exercises. These components are configured and adapted to the DVW GIS environment and crisis management workflows.

The test protocol includes the following steps:

1. Preparation and configuration
    - Configuration of a basic portal and applications within the DVW GIS environment.
    - Selection and preparation of relevant spatial layers and background information to support crisis management.
    - Preparation of a crisis scenario and associated workflows.

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2. Use during crisis exercise
    - Deployment of the portal during the crisis exercise.
    - Registration of field observations and incidents.
    - Visualisation of information through dashboards and maps to support situational awareness.
    - Use of the portal to support prioritisation and follow-up of emergency measures.

3. Evaluation and feedback
    - Collection of feedback from users involved in the crisis exercise.
    - Evaluation of usability, clarity of information, and added value for decision-making.
    - Identification of strengths, limitations and improvement opportunities.

The test is iterative in nature, with insights from the first use feeding into refinements and further testing in subsequent exercises.

3.4.4 Roles and responsibilities

Lead: DVW is responsible for the overall coordination of the test, configuration of the portal within the DVW environment, integration into the crisis exercise, and evaluation of its usability and added value.

Support: MinDef, HZ, USiegen

These BONSAI partners contribute by providing input, feedback and reflections at different stages of the test. Their involvement supports transnational learning by sharing experiences from other contexts and helping to assess the broader applicability and relevance of the solution beyond the DVW context.

3.4.5 Planning

Q1 2026

Initial configuration of the portal and definition of core functionalities within the DVW GIS environment. This phase includes the selection of relevant information layers and the preparation of a first operational set-up.

Q2–Q3 2026

Further development and optimisation of the portal based on feedback from the preparatory exercise. Preparation of the BONSAI crisis scenario and alignment of the portal with the requirements of the planned crisis exercise.

November 2026

Deployment and testing of the portal during a BONSAI crisis exercise, serving as the main validation moment for Deliverable 2.6.4.

Q1-Q4 2027

Consolidation of results, documentation of lessons learned and formulation of recommendations for further development and potential transferability.

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	2026				2027			
Activity	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Portal configuration & initial set-up								
Preparatory internal exercise								
Refinement based on feedback								
Preparation of BONSAI crisis scenario								
BONSAI crisis exercise (main test moment)								
Evaluation, lessons learned & recommendations								

3.4.6 Expected outcome/ deliverable

The outcome of this test is Deliverable 2.6.4: a location-based data management portal for crises, developed and tested as a proof of concept within the DVW crisis management context. The deliverable includes:

- a validated proof of concept of a location-based data portal supporting crisis management;
- an evaluation of its usability and added value during crisis exercises;
- a set of lessons learned and recommendations for further development and implementation;
- an assessment of the potential transferability of the concept to other BONSAI partners and regions, if the solution proves effective.

Yearly status updates of the deliverable will be provided.

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3.5 Effective crisis communication

3.5.1 Objective

During an emergency situation it is essential that the communication is clear, gives perspectives and leads to the right actions. The target group can be distinguished into citizens, professionals and decision-makers.

Experience shows that there can be a lot of interference between the sender and the receiver of communication messages. The expert thinks that his advice is clear, the citizens cannot believe that it is really that serious and the decision-maker cannot deal with all kinds of uncertainties or scenarios. The goal is to create a guide to effective flood risk crisis communication with which organizations can train their own staff

3.5.2 Location(s)

As this sub-deliverable is not suitable to test in field exercises, it is better to test it in already existing emergency boards, selected target groups of civilians and by expert communication officers. We can use one of the field exercises to build the narrative, that can be used to test the developed guidelines for effective flood risk crisis communication. We will ask the partners to make s short list of above-mentioned target groups. For example, the Netherlands:

- Citizens: we will ask HZ (BONSAI partner) to create this target group, as they did for Polder2C Interreg project
- Experts: we will ask the National Coordination Centre Flood Risk Management (LCO) to test the guidelines during one of their annual exercises
- Decision makers: we will ask the SMWO (Water and Flood Management Steering Group) to use this guideline during one of the big national exercises that is developed in 2026.

3.5.3 Test protocol

Still to be worked out. But roughly we will first develop a flood crisis communication strategy based on international best practices.

- One of the BONSAI stakeholders (USACE) has information on effective flood crisis management based on experiences during New Orleans flooding (Dr. Charles Yoe presentation “Risk Communication for LSO’s”, Galveston 2014).
- The International Handbook for Emergency Management of Flood Defences is also one of the sources to consult.
- Environment Agency has developed effective communication strategies they are happy to share
- HZ has done a lot of research on effective crisis communication
- Etc.

After writing the concept guideline we want to test is based on already planned integral flood crisis exercises. Integral means: all stakeholders involved.

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3.5.4 Roles and responsibilities

Lead: RWS, will be in the lead to for the synthesis of these experiments in a comprehensive report.
Support: ISL, Cerema, HZ, Stakeholders like USACE and EA
HZ: in support by Stowa will focus on the citizen citizen science instructions
USACE and EA will contribute to the flood crisis communication strategy by sharing their best practices

3.5.5 Planning

Point/Period	P2	P3 (2026)	P4 (2026)	P5 (2027)	P6 (2027)	P7 (2027)	P8 ((2027	P9 ((2027
flood crisis communication strategy								
Test based on already planned integral flood crisis exercises								
Citizens								
Experts								
Decision makers								

3.5.6 Expected outcome/ deliverable

The outcome of this test is a report (guideline) on effective crisis communication (**Deliverable 2.6.5**). Exchange crisis communication ways from different countries and partners. Prepare/ teach citizens, communication experts and decision makers about failing communications during flood.
Yearly status updates of the report will be delivered.

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3.6 Decision support system for disaster management

The test plan in this part covers the development of a decision support system for assisting disaster management. The system will decide the optimal intervention plan given the flood inundation simulation, the spatial distribution of the critical infrastructure and its relative importance, subject to road and barriers availability, assemble time of the barriers, and time before flood arrival. The intervention plan will be given as a timeline of scheduled actions describing the where (the location of barriers) and when. The AI tool will be investigated (and integrated) for optimising evacuation planning.

3.6.1 Objective

This test is computer based. The aim is to develop a DSS-tool that will assist on deciding the optimal placing of temporary barriers for flood protection, and the AI for optimising evacuation will be integrated in the DSS-tool.

3.6.2 Location(s)

The tests on decision support system for disaster management are planned to take place at the following test/reference sites:
This test will be investigated in the Nordendeich, Norden (Lower Saxony) in cooperation with our German associate Partner (Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz, Betriebsstelle Norden). The tests related to planning-evacuation will be conducted in Caen France. These are not physical tests, but rather numerical modelling tests done at the University of Siegen.

3.6.3 Test protocol

The following steps or developing the tool will be conducted:

- Raw data on critical infrastructure, and temporary barriers will be collected from the test site in Germany.
- Raw data will be processed to be used by the numerical models.
- Numerical simulations will be done on different dike breach scenarios for different return periods, with different locations of temporary barriers.
- Impact to the critical infrastructure will be quantified based on the different scenarios.
- A tool that will assist on deciding the optimal placing of temporary barriers for flood protection will be developed.
- The tool will deliver for various scenarios the optimal placing of the barriers.

The AI tool will be investigated (if successful) integrated in the FIER Evacuation-planning model.

- Add a layer of AI to the Evacuation-planning model to find optimal solution. The tool will be investigated and tested in Caen in France.

3.6.4 Roles and responsibilities

Lead: USiegen will lead the task of developing the decision support tool. University of Lille leads the investigation of the planning evacuation tool supported by CEREMA.

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Support: MinDef, RWS, HZ, UCL, DVW, DMOW, ISL, Cerema will support in collecting information about temporary barriers, and on dike breach scenarios that can be investigated. The development and integration of the AI tool will be lead (University of Lille).

3.6.5 Planning

Point/Period	P2	P3	P4	P5	P6	P7
Development of the tool						
Integration of the AI tool for planning-evacuation.						

3.6.6 Expected outcome/ deliverable

The outcome of this test is a decision support system for disaster management (**Deliverable 2.6.6**). A Decision support system to support crisis management organisations during a calamity. An AI tool will be integrated.

Yearly status updates of the report will be delivered.

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