

This is not an ADB material. The views expressed in this document are the views of the author/s and/or their organizations and do not necessarily reflect the views or policies of the Asian Development Bank, or its Board of Governors, or the governments they represent. ADB does not guarantee the accuracy and/or completeness of the material's contents, and accepts no responsibility for any direct or indirect consequence of their use or reliance, whether wholly or partially. Please feel free to contact the authors directly should you have queries.



Deltares

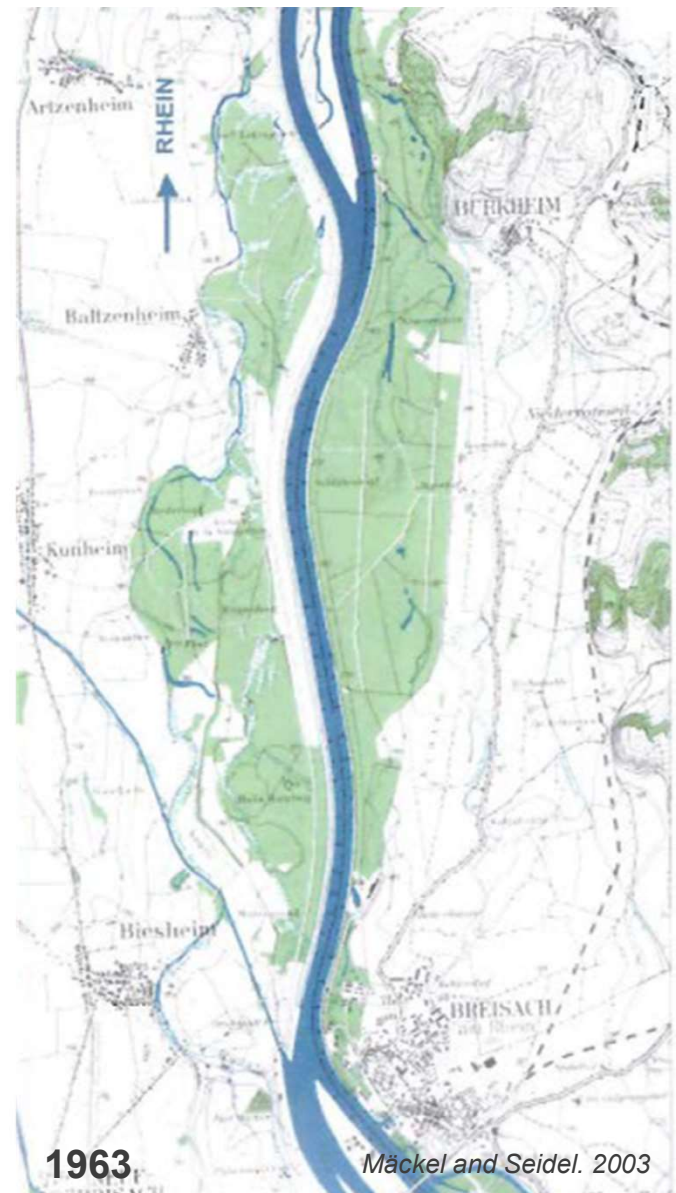
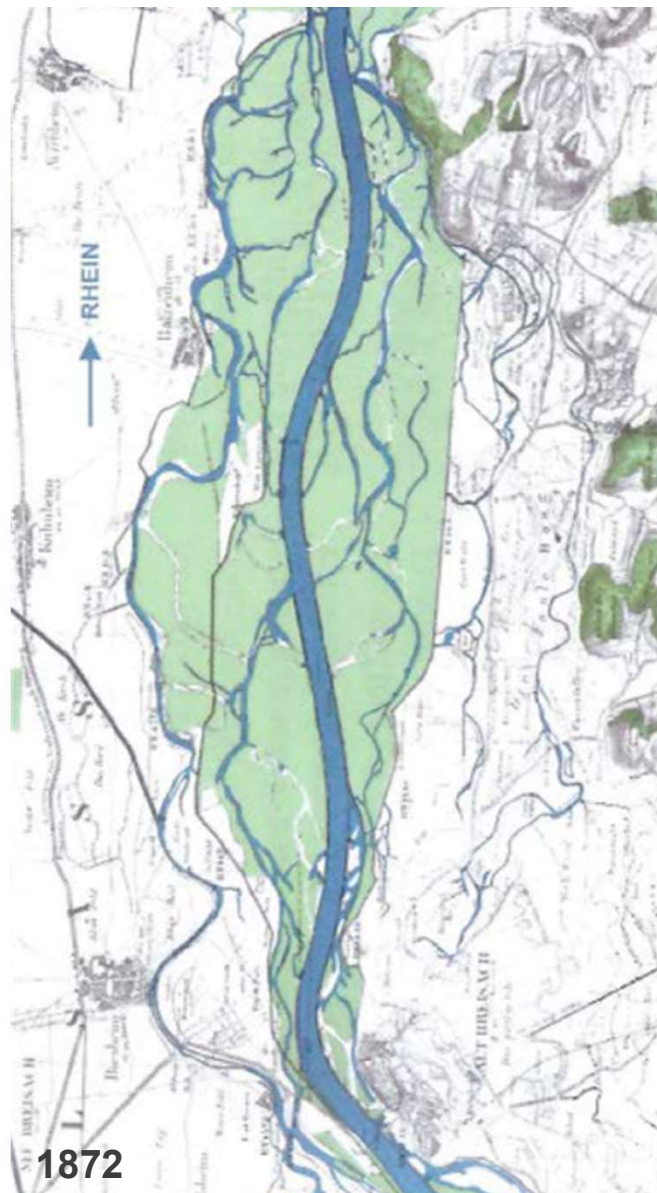
Nature-based Solutions and Natural River Management

Dr. Ellis Penning

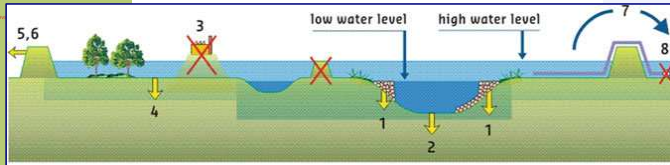
Program lead for Nature-based Solutions

Ellis.penning@deltares.nl

 ellispenning



Room for the river



- 1 - lowering of groynes
- 2 - deepening low flow channel
- 3 - removing hydraulic obstacles
- 4 - lowering flood plains
- 5 - locally setting back dikes
- 6 - setting back dikes on a large scale
- 7 - retention reservoir
- 8 - reduction lateral inflow

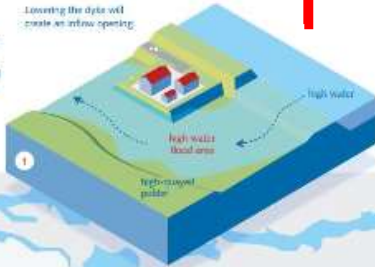
Source Silva, W., Klijn, F. and Dijkman, J.P.M. Room for the Rhine branches in the Netherlands, what the research has taught us **3**

Room for the River

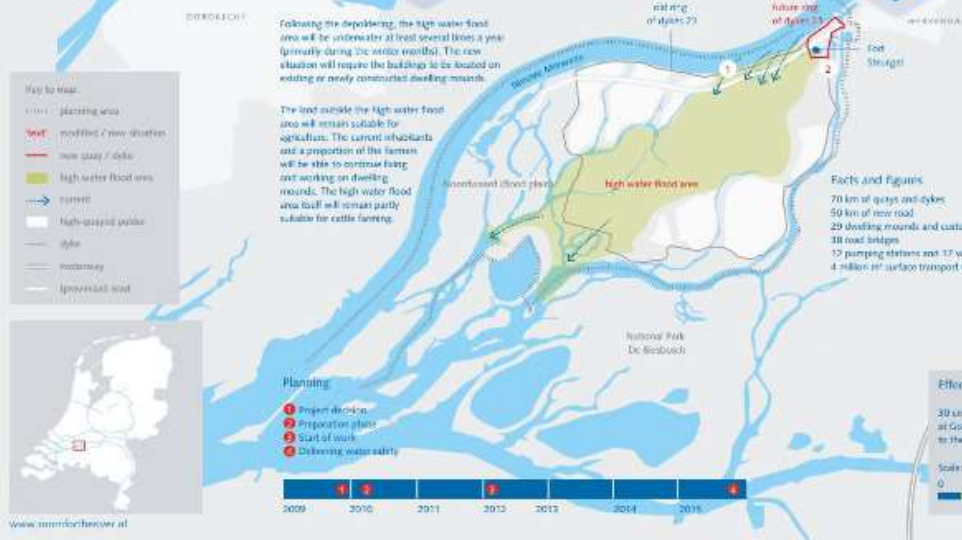
Depoldering Noordwaard (flood plain)

The Noordwaard (flood plain) is being depoldered by partially digging up the dykes on the river side and reducing the size of the ring of dykes. This will allow the river Nieuwe Merwede to flow through the Noordwaard (flood plain) to the sea more easily at high water. Furthermore, the water safety will increase in Goirtheem.

Lowering the dyke will create an intake opening.



An innovative dyke is being built at foot straight. Crossing an oak thicket will reduce the wave load on the dyke, allowing it to be constructed lower.



https://issuu.com/ruimtevoorderivier/docs/depoldering_noordwaard_flood_plain

Deltares

Photos – Robbert de Koning

Natural River Management (NRM)

Natural river management

Definition

Low interference management of rivers aiming to optimize river use and to reduce river related risks, while respecting natural dynamics and flow of fresh water, sediment and nutrients, and peoples' dependence on these at a basin scale.

Aims

Facilitate sustainable social and economic development by advocating a short- as well as long-term perspective on effects on the natural river system.

Define optimal management strategies and interventions for long-term sustainable river management.

Give guidance on optimizing the engineering process to arrive at a coherent set of interventions that constitutes the best investment option in the whole basin for achieving the desired objectives.

NRM approach

NRM APPROACH

Step 1: Definition of goals and objectives

Step 2: System analysis

Step 3: Selection of hotspot areas

Step 4: Selection of NbS

Step 5: Impact and economic analysis

Step 6: Prioritization of interventions

Step 7: Implementation

Step 8: Maintenance and monitoring

Deltares

River function	Objective
Nature	<ul style="list-style-type: none">• Ensure flows of freshwater and sediment to sustain downstream livelihoods, ecosystem services and biodiversity
Flood safety	<ul style="list-style-type: none">• Decrease vulnerability of people to flooding through targeted, sustainable and long-term strategies per river section
Other functions	<ul style="list-style-type: none">• Accommodate other functions but minimize interference with natural river behavior as much as possible

NRM approach

NRM APPROACH

Step 1: Definition of goals and objectives

Step 2: System analysis

Step 3: Selection of hotspot areas

Step 4: Selection of NbS

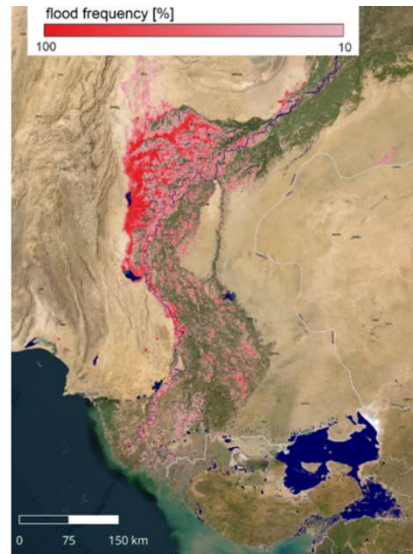
Step 5: Impact and economic analysis

Step 6: Prioritization of interventions

Step 7: Implementation

Step 8: Maintenance and monitoring

Deltares



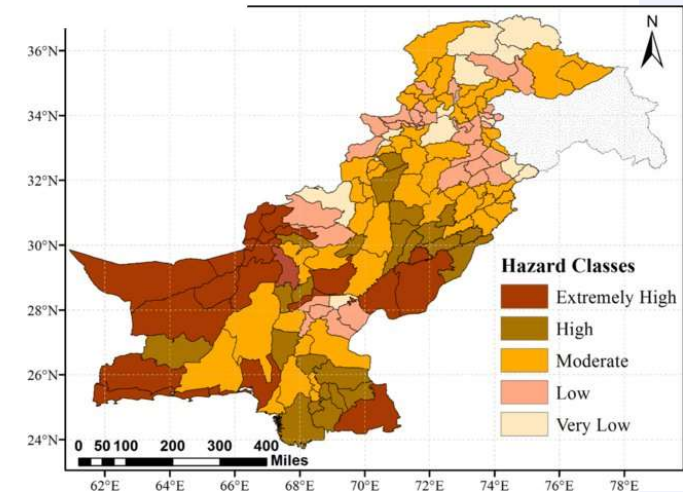
Flood frequency | Pakistan / Indus Valley.
Frequency of flood detection in period 18 August - 23 September 2022.

Source: <https://www.eumetsat.int/features/towards-better-flood-and-drought-monitoring>



Remaining flood area.
Flood area remaining in period 1 December - 15 December 2022.

Dynamics in space and time



Drought hazard map showing the vulnerability index for each district of Pakistan
Source Adnan&Ullah, 2020 <https://link.springer.com/article/10.1007/s11069-020-04116-3>



NRM approach

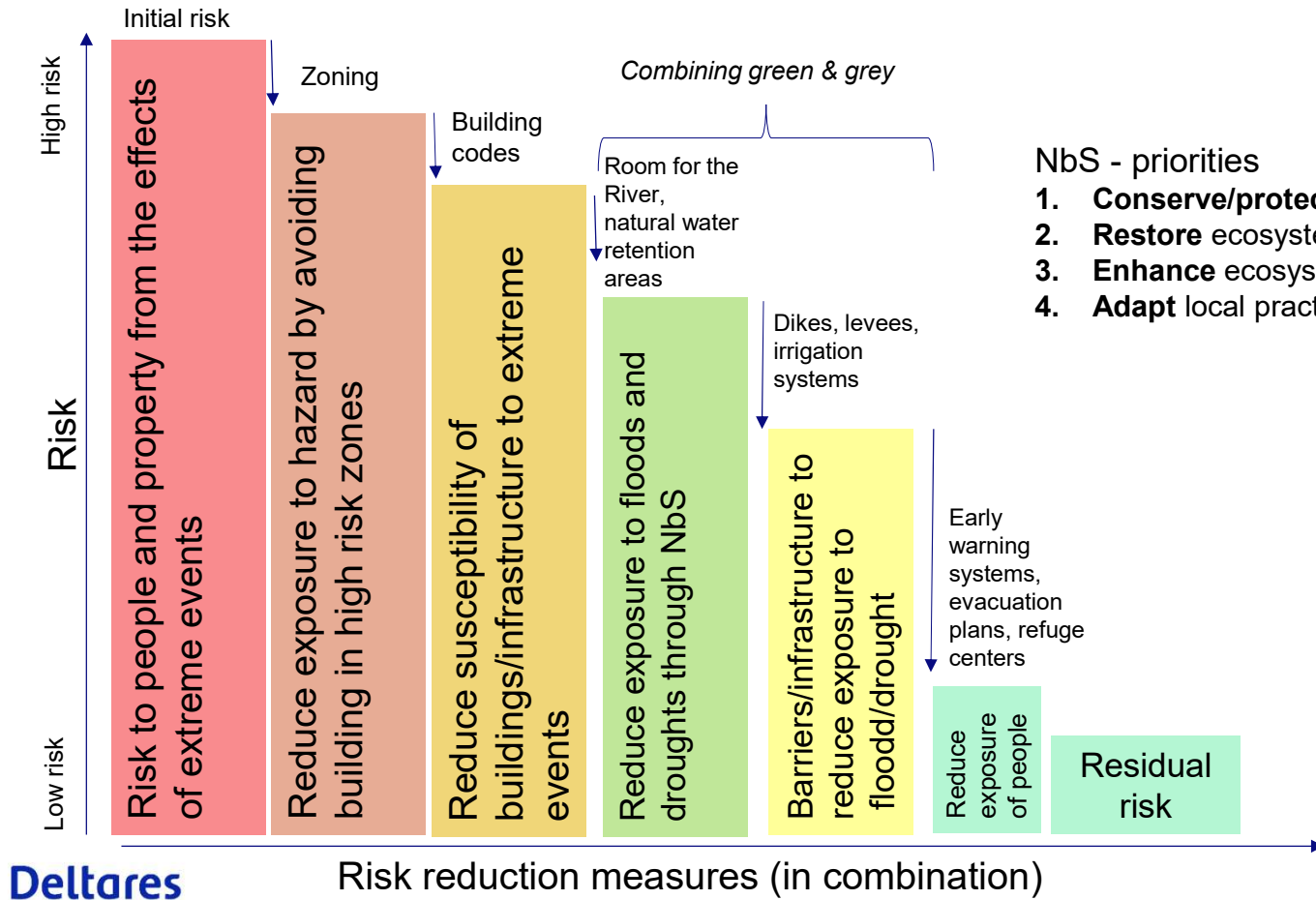
NRM APPROACH

- Step 1: Definition of goals and objectives
- Step 2: System analysis
- Step 3: Selection of hotspot areas**
- Step 4: Selection of NbS
- Step 5: Impact and economic analysis
- Step 6: Prioritization of interventions
- Step 7: Implementation
- Step 8: Maintenance and monitoring

Deltares



Where do Nature-based Solutions fit in?



NbS - priorities

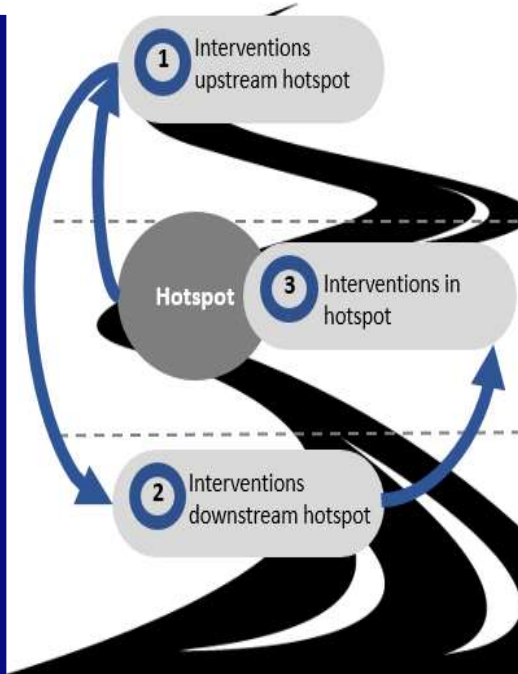
1. **Conserve/protect** ecosystem functioning and services
2. **Restore** ecosystem functioning and services
3. **Enhance** ecosystem functioning and services
4. **Adapt** local practises/use of ecosystem services

NRM approach

NRM APPROACH

- Step 1: Definition of goals and objectives
- Step 2: System analysis
- Step 3: Selection of hotspot areas
- Step 4: Selection of NbS
- Step 5: Impact and economic analysis
- Step 6: Prioritization of interventions
- Step 7: Implementation
- Step 8: Maintenance and monitoring

Selection of interventions



Nature-based & non-structural

- Restoration of natural landscapes
- Land use mngmt. & agricultural reform
- Floodplain & wetland restoration
- Re-meandering & side channels
- Widening of river channel & Bank retreat
- Retention areas

Grey

- Dams/Reservoirs
- Groynes

- Relocation, lifting up or embanking (small) communities
- Zoning (no building zones)
- Early warning & evacuation
- By-pass
- Obstacles removal
- Embankments/dikes/levees



Take home messages

- Define an overarching water management strategy for floods AND droughts
- Ensure good system understanding
- Respect and harness flows of fresh water, nutrients, sediment and species to increase resilience of natural systems and maintain their services
- Give space to the river and create buffer zones
- Apply NbS in combination with other types of solutions



Contact

 www.deltares.nl

 [@deltares](https://twitter.com/deltares)

 [linkedin.com/company/deltares](https://www.linkedin.com/company/deltares)

 info@deltares.nl

 [@deltares](https://www.instagram.com/deltares)

 [facebook.com/deltaresNL](https://www.facebook.com/deltaresNL)

