



Practical challenges in delivering Hydro-morphological Improvements in Rivers

Hendrik Havinga

Dutch Ministry of Transport,
Public Works and Water Management
Rijkswaterstaat  Oost Nederland

Technical University Delft 



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- WFD and river management practice
- Ecological values
- Ecological effects of inland navigation
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River training: large changes in Hydro-morphology



Levees and dikes
 Bend cut-offs
 Closing side channels
 Embankments
 Groynes
 Weirs

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River training: for the benefit of user functions (however, severely reduction of ecological values)



Flood protection
 Navigation
 Agriculture
 Water supply

River Restoration measures:

Removal of bank defenses
 Side channels
 Lowering dikes + flood plains

MAY

have adverse affect on river related functions

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Present ecological status is not good (but improving...)



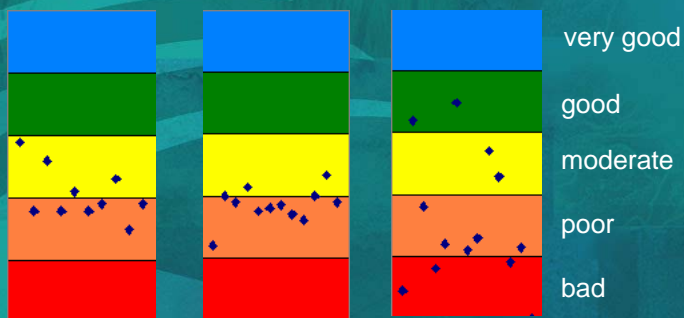
fish



macrofauna



macrophytes



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How to obtain references

“Heavily modified water bodies”

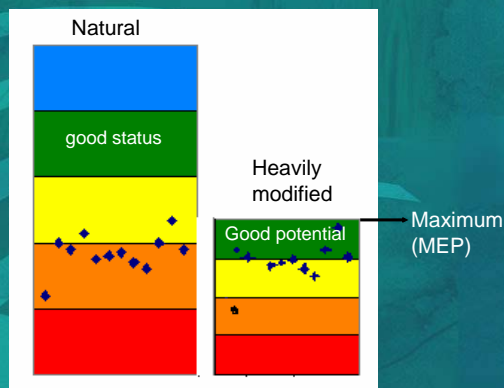
- ⇒ Define Maximum Ecological Potential (MEP)
- ⇒ Define Good Ecological Potential (GEP)



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Scale for heavily modified water bodies

Example benthic invertebrate fauna
slow flowing rivers (R7)



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Ecological effects of inland navigation

- Direct effects related to the ships:
 - emissions,
 - **hydro-morphological effects**,
 - mechanical effects
- Indirect effects related to the environment and facilities: navigation channel, sluices, dams, riverbanks, groynes, longitudinal dams, harbours
- Navigation channel cannot be a WFD target:
 - Turbulence
 - Turbidity
 - Dynamic sedimentation/erosion
 - Anchoring
 hamper ecological developments.
- The river bank is a very sensitive area, with ecological potentials (using nature friendly bank defenses, innovative groyne concepts, longitudinal dams, etc.)

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Inventarisation of ecological improvement measures



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More measures



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WFD: not necessarily negative for Navigation¹¹

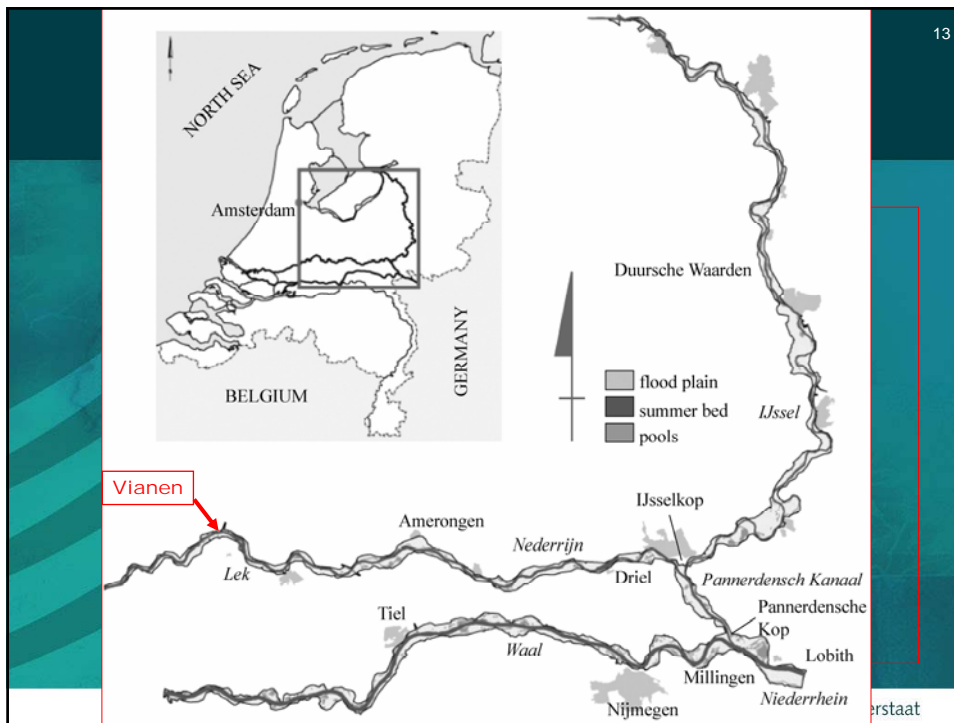
(Remarks, conditions)

- Navigation is an accepted and favourite mode of transport (NL)
- The WFD attention should be focused on flood plains and bank area (groyne fields), NOT THE LOW WATER BED
- Ecological changes must be accepted (erosion, sedimentation, cyclic rejuvenation)
- Dutch experience shows that rehabilitation and restoration schemes can be successful
- Conditions for success: money, research, adequate river management, tailor made approaches
- WFD may structure and integrate the many different initiatives

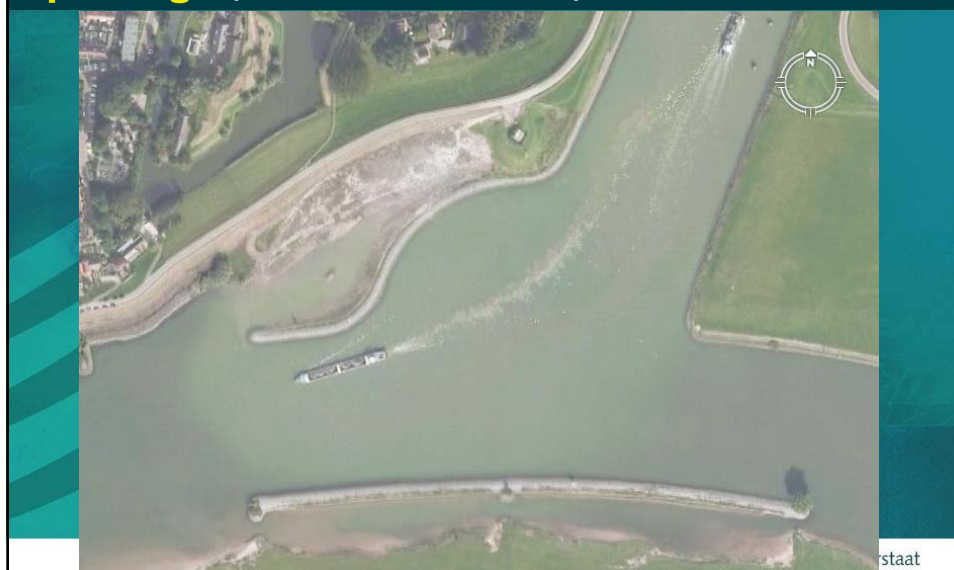
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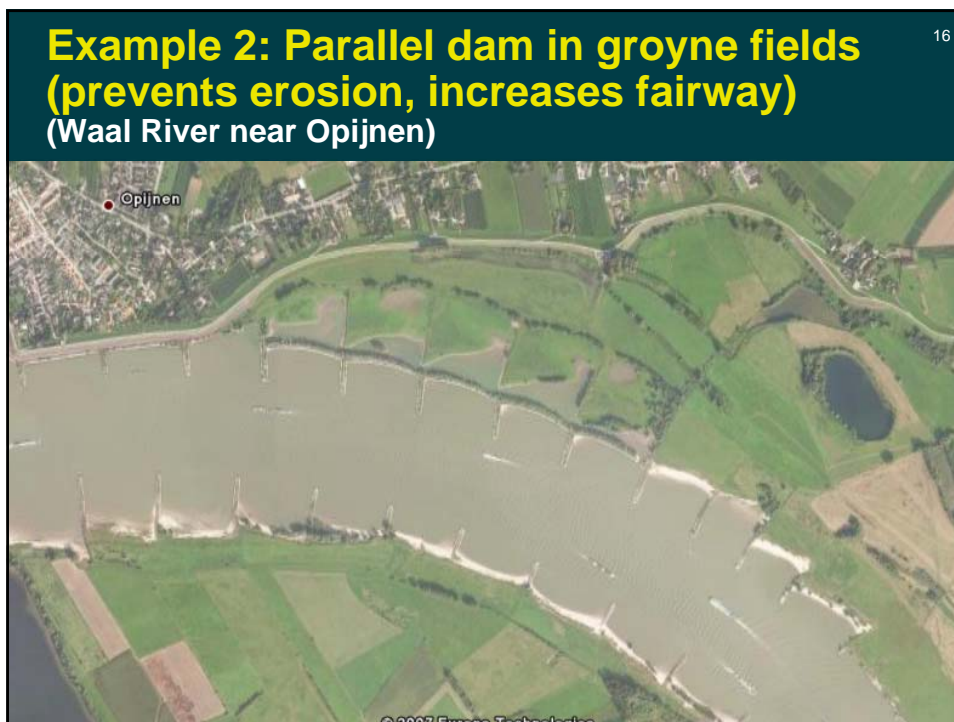
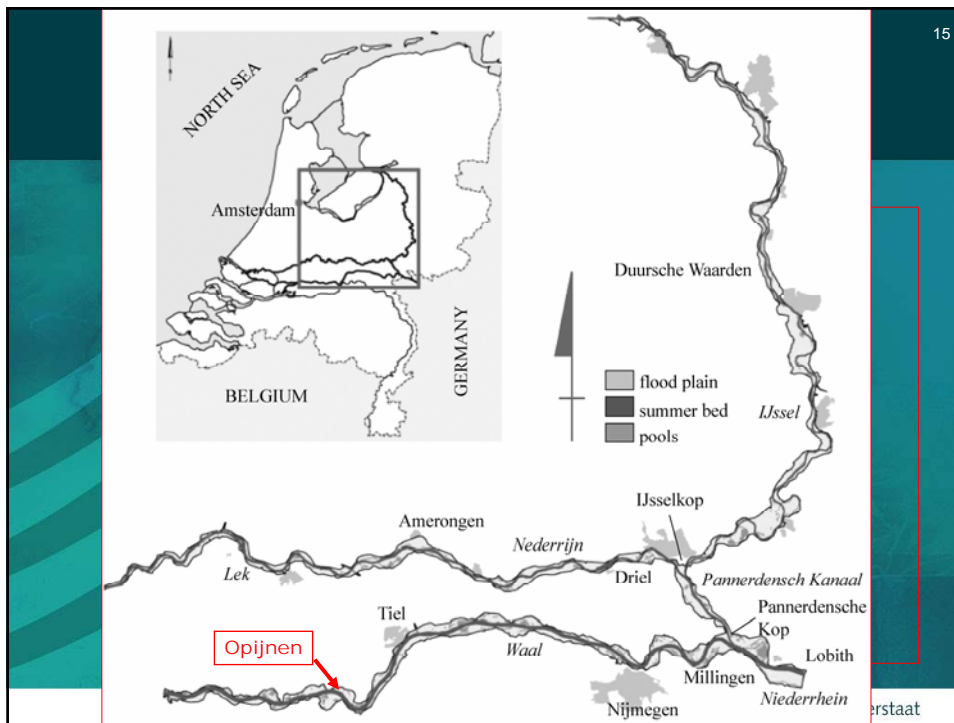
Examples of Hydro-morphological improvement measures¹²

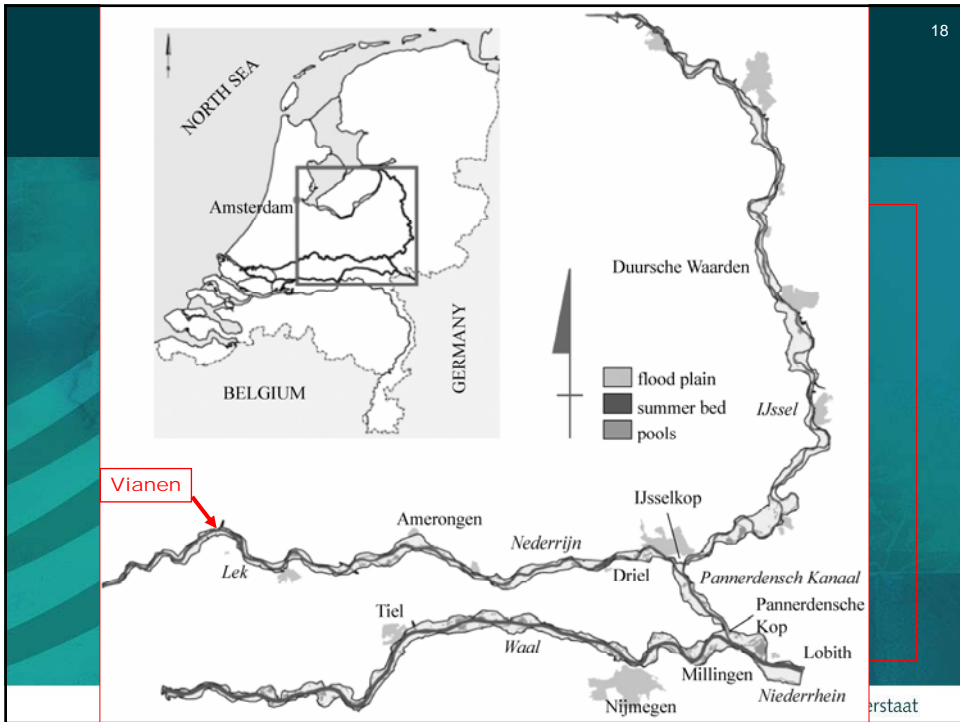
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Example 1: Parallel dam opposite wide canal (to increase fairway). Side channel = fish passage (Lek River near Vianen)







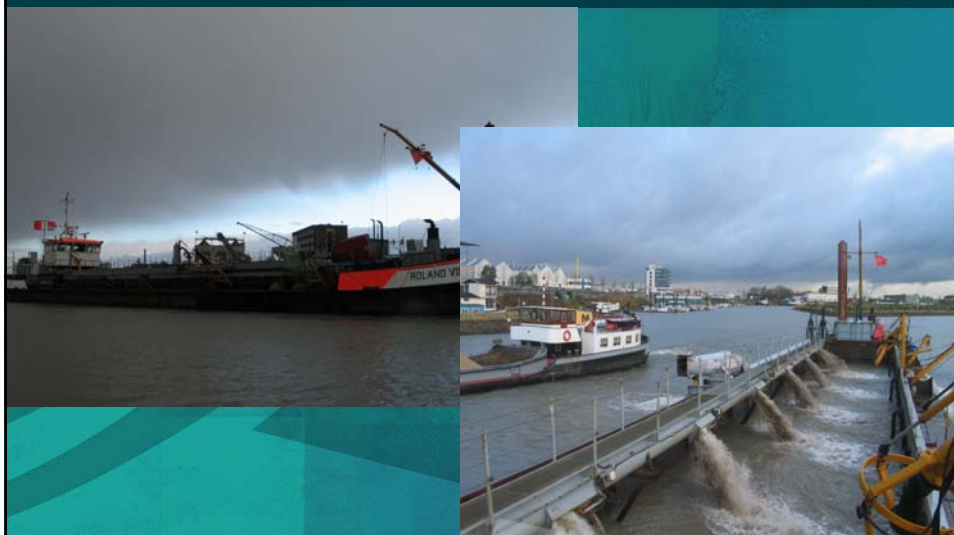
Example 3: Shoals cause nautical bottle-neck (Lek River near Vianen)



Green and red buoys in fairway



Common solution: Dredging + ..



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.. and dumping in deep reaches



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Alternative approach: Suppletion of dredged sediment on eroded bank (e.g. after defense removal).



Problem: Erosion approaches levee

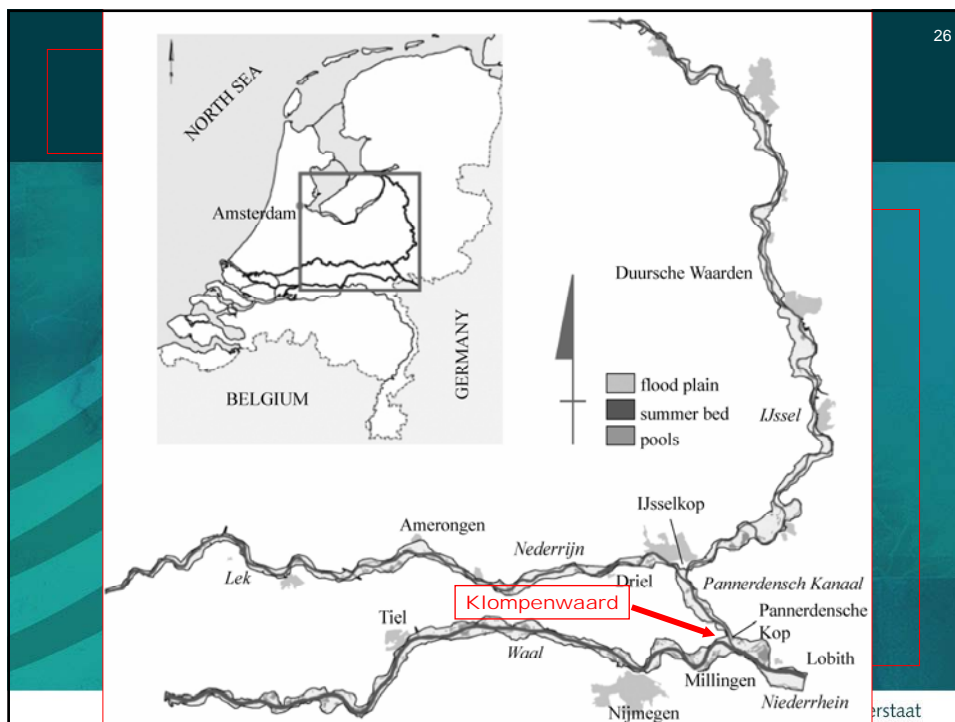
Question: Is this form of cyclic rejuvenation acceptable for WFD ?



Result: After suppletion functions are (temporarily) recovered



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Example 4: Side channel (Waal River, Klompenwaard)



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Side channel in outer bend Here no problems with sailing depth



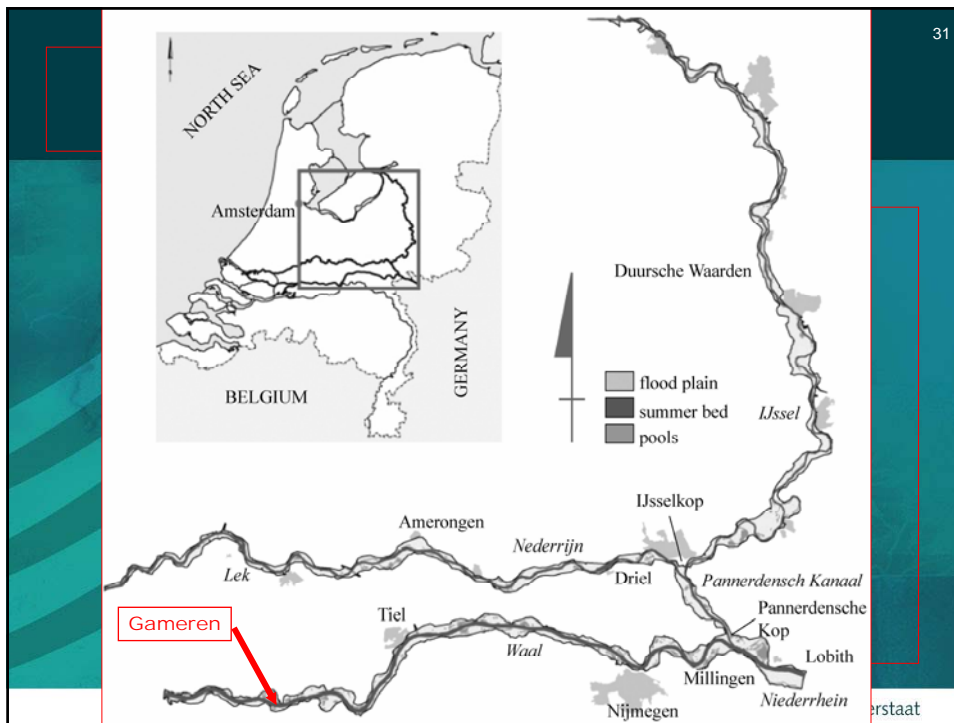
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Re-introduction of side channels presents potential problems

- “Green politics”, since 1980’s
- WWF: Living Rivers concept (**FIRST PHASE**)
- After 1993 and 1995 floods: call for more resilience and sustainable concepts/designs
- Since 1997: Construction of side channels (**SECOND PHASE**)
- Since 2000: Room for the river concept: more spatial quality
- 2007: side channels become important feature in WFD schemes

Problems -> Intensive discussions

- Re-introduction of the ice danger ?
- How to cope with free banks, vegetation
- Who pays the bill for mitigating measures:
 - Dredging
 - Local normalisations
- Different administrations for flood plain management and fairway management



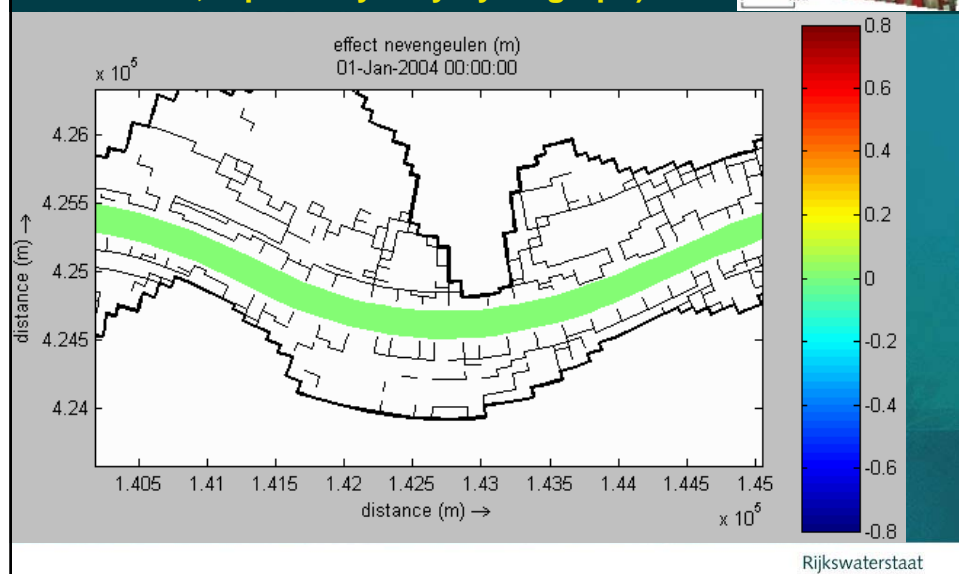
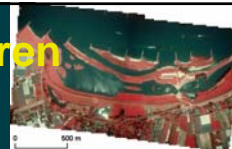
Aggradation main channel as planned (2 dm).

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Local erosion at groyne roots and transfer zones undefended/defended banks



Computed bed level respons Gameraen (2 dimensional morphological model Delft3DMOR, repeated yearly hydrograph)



Erosion at intakes



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Erosion of groyne root



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Third phase in dealing with side channels: limiting uncertainties

- Applying a Dynamic River Management System:
 - Quick-scan monitoring systems
 - Adequate Data storage and presentation (GIS)
 - Impact assesment/design of measures using 2-D hydraulic and morphological models
 - Quick implementation of correcting measures
- Change in river administration methods
- Introduction of the WFD will underline the use of such a system

Conclusions w.r.t. the WFD and Navigation

- Dealing with the WFD objectives are not new (NL)
- The position of Inland Water Transport is no issue (NL)
- WFD objectives cannot be met in navigation channels
- If ecological changes (e.g. cyclic rejuvenation) are accepted, the WFD may lead to more optimal solutions favouring navigation as well
- Conditions for succes: money, research, adequate river management, tailor made approaches



Thank you for your attention