Institute for Catastrophic Loss Reduction

Safety Assessment of flood defences in the Netherlands

An ongoing concern

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Rijkswaterstaat

Outline

Dutch water management

- Some facts
- History
- Present approach to flood control (Flood Defense Act)

Assessment of primary flood defences

- How does assessment work?
- Results 2nd national report, 2006
- Evaluation
- Towards the 3rd report, 2011

Some facts about the Netherlands

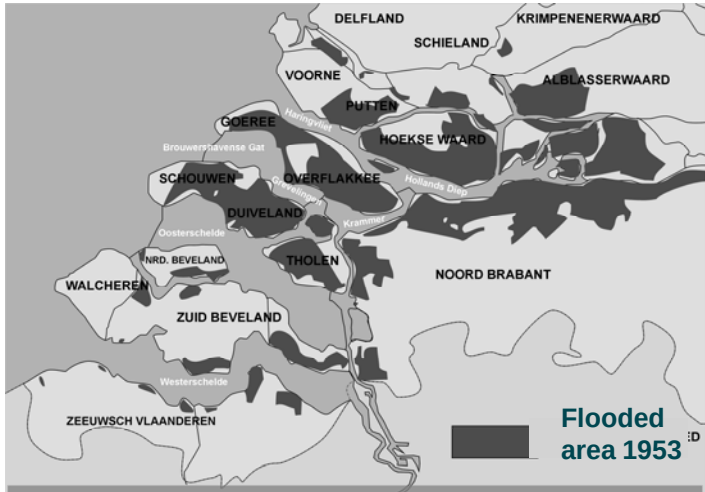
Area below MSL, ór threatened by rivers

- 41.528 km²
- 26% below **mean** sea level (NAP)
- 66% of the area is flood prone
- 9 million people live in these low areas
- 70% of GNP is earned in flood-vulnerable area

Examples of floodings in The Netherlands, the coast

The Northsea

- 1570, nov. 1st All-Saints-Flood.
  > 20.000 died. Lots of towns drowned.
- 1916, jan. 13/14th. Flooding around Zuiderzee, now Lake IJssel.
  Start of Zuiderzee Works, e.g. Afsluitdijk
- 1953, disaster in Southwest Holland.
  > 1800 people died.
  Start of Deltaworks



February 1st 1953, Southwest Holland

Zuiderzee works: Afsluitdijk (1932)

Deltaworks: Storm Surge Barrier Eastern Scheldt (1986)

Deltaworks: Storm Surge Barrier Maeslant (1997)

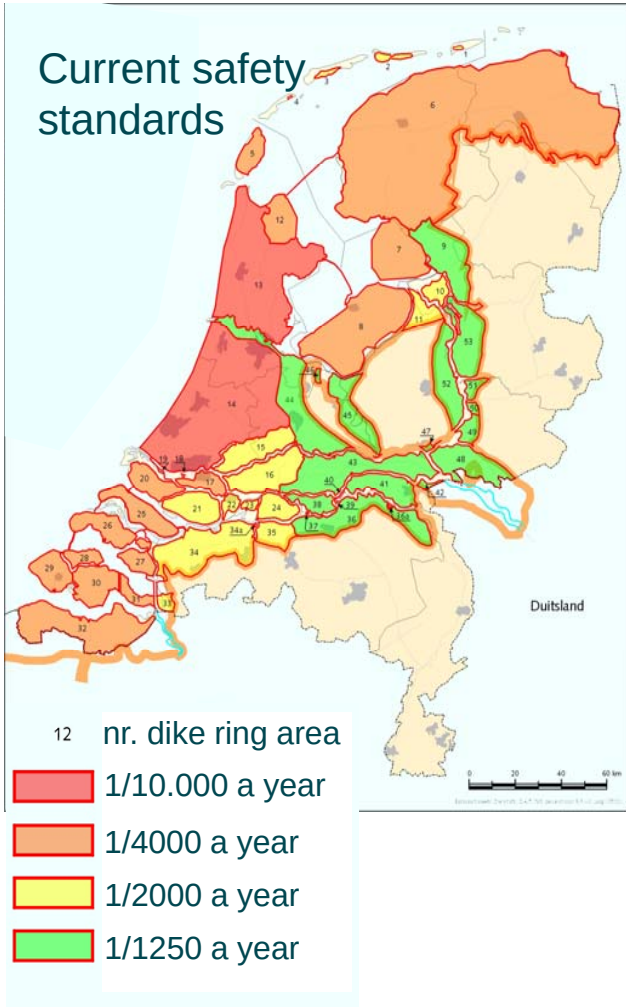
Present approach to Flood Protection

1960 advise Delta Committee

- Close estuaries, shorten the coastline 700 km.
- A safety standard (norm) based on a CBA was proposed

1996 Flood Defences Act

- Objective: durably maintain the achieved safety level
- Based on approach Delta Committee
- 53 ‘dike ring areas’ with safety standard probability of exceedence
- 5 yearly assessment



Roles Ministry in Flood Protection

Roles Directorate General Water, policymaking

- Prepare legislation, safety standards
- Responsible for guidelines (VTV) and hydraulic boundary conditions (HR) for safety assessment
- Financing the reinforcement of water defences, the Flood Protection Programme

Roles Directorate General Rijkswaterstaat, implementation

- Implement guidelines and boundary conditions for safety-assessment
- Manager and maintenance of coastline, rivers and 10% of the defences (mainly dams)

Role Transport and Water Management Inspectorate, Inspection

- Evaluate safety assessment and management

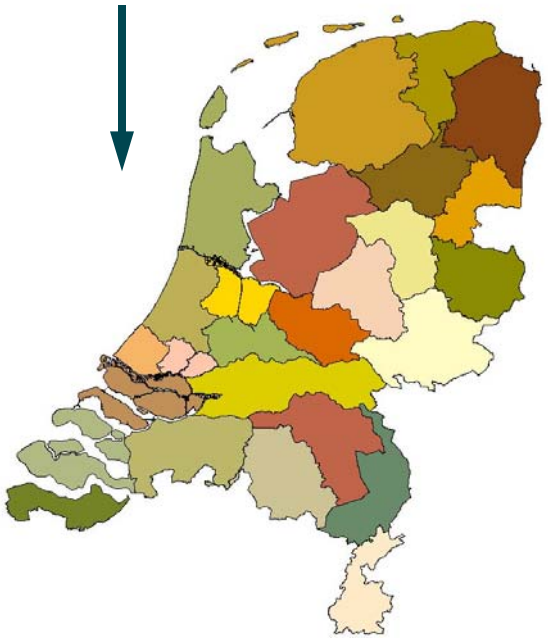
Other organisations in Flood Protection

26 Water Boards (manage 90% of defences)

- Daily management and maintenance
- Carry out safety assessment and reinforcement works

11 Provinces

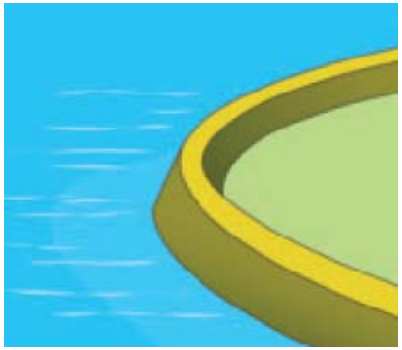
- Regional supervision



Assessment of primary flood defences

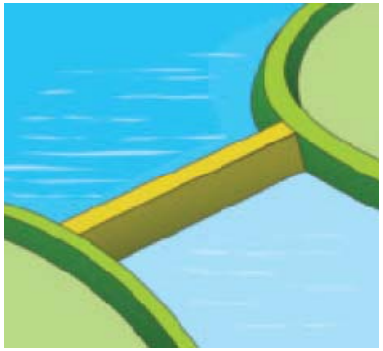
Those managing the *primary flood defences* test every five years whether the dikes, dunes and hydraulic structures (e.g. sluices, orifices) meet the statutory safety requirements.

Primary defences:
- *53 + 42 'dike rings'*
- *27 connecting defences (b)*
- *3,500 km dikes, dams and dunes*
- *Appr. 800 structures*



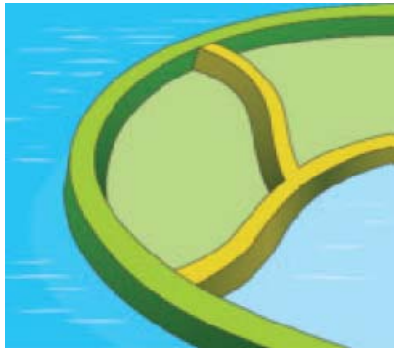
Category a

Direct protection (sea, river, lake)



Category b

Connecting dams



Category c

Indirect protection

Statutory safety requirements, the rules

Article 9 of the FDA states that assessment has to be carried out based on:

- Legal safety standard per dike ring (e.g. 1/10.000)
- Pre-determined Hydraulic conditions (water levels & wave parameters per km)
- Asset management system (‘legger’)
- Procedures and rules in Directive Safety Assessment Regulations

Guidelines (calculation rules)

Defence types & Failure mechanisms

Dikes & dams

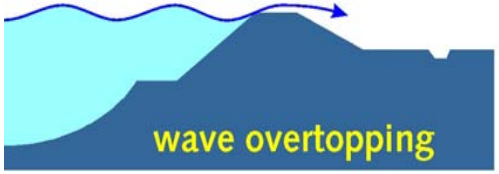
- Overflowing/topping (height)
- Stability
- Revetments
- ‘strange’ objects (cables/pipes)

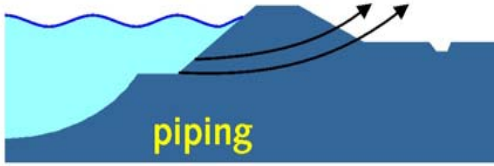
Dunes

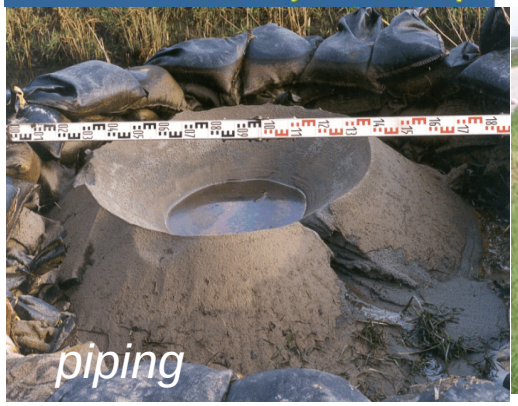
- Erosion of sand profile
- ‘strange’ objects

Structures

- Overtopping
- Strength / Stability
- Operational failure

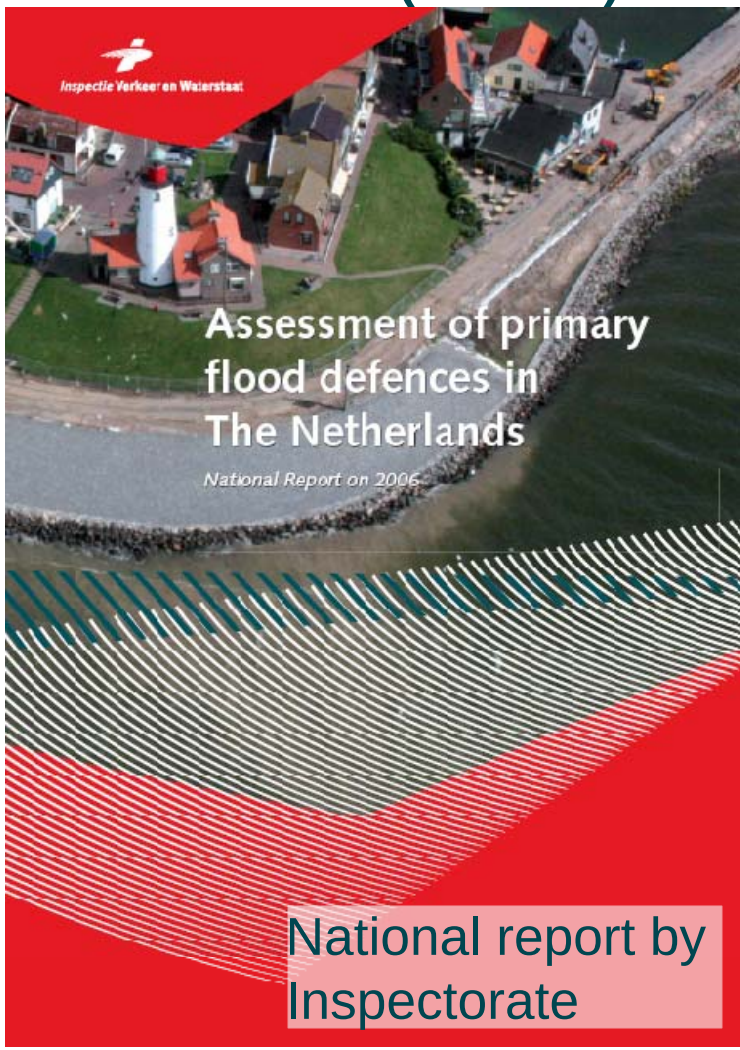






2nd assessment of primary flood defences (2006)

- During the assessment the managing authorities check whether the **strength** of the flood defences meets the statutory **requirements (e.g. loads)**
- They report to the provinces. The provincial assessments are submitted to the minister.
- The Inspectorate assesses nationwide. Eventually the minister reports the national overview to the parliament.



National report by Inspectorate

Results 2nd safety assessment

2875 kilometres dams, dikes and dunes of category a or b

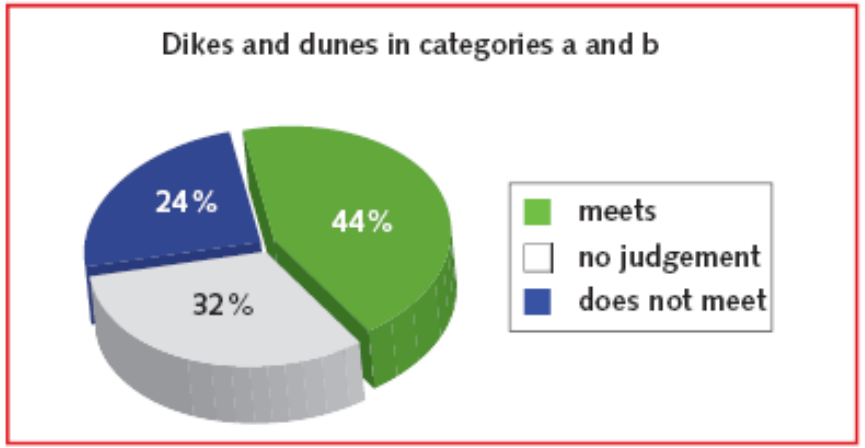


Figure 1. Assessment of primary water defences 2006 – categories a and b (total 2875 km).

Comparison 1st and 2nd assessment

Category a & b defences

- 1264 km, or **44% meets** the standard.
  1st assessment in 2001: **40%.**

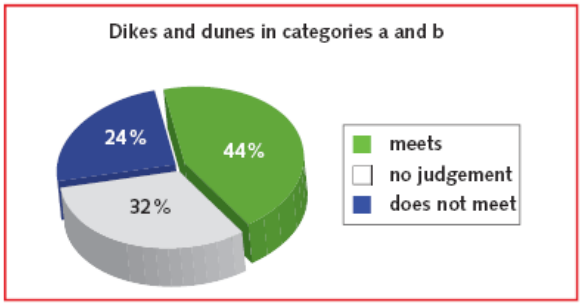


Figure 1. Assessment of primary water defences 2006 – categories a and b (total 2875 km).

- 680 km, or **24% does not meet** the standard.
  1st assessment in 2001: **19%.**
  -stresses the urgence of already initiated works (revetments Zeeland, Lake IJssel)
  -more failure modes investigated, not only height

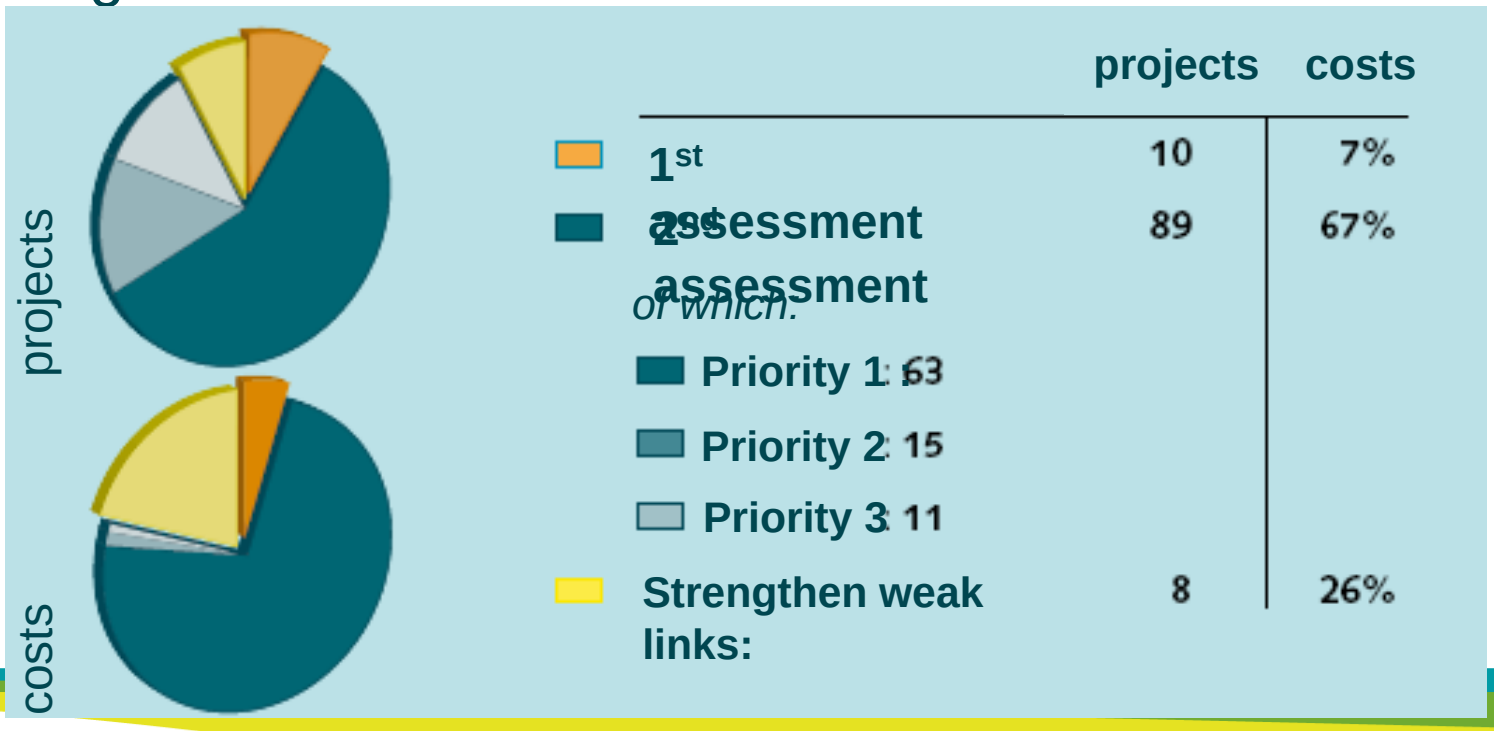
- 931 km, or **32%** was labelled **'no judgement'.**
  1st assessment in 2001: **41%.**
  - the inability to gather sufficient data
  - insufficiency of the set of instruments available. (HC, Guidelines)

Special Situations

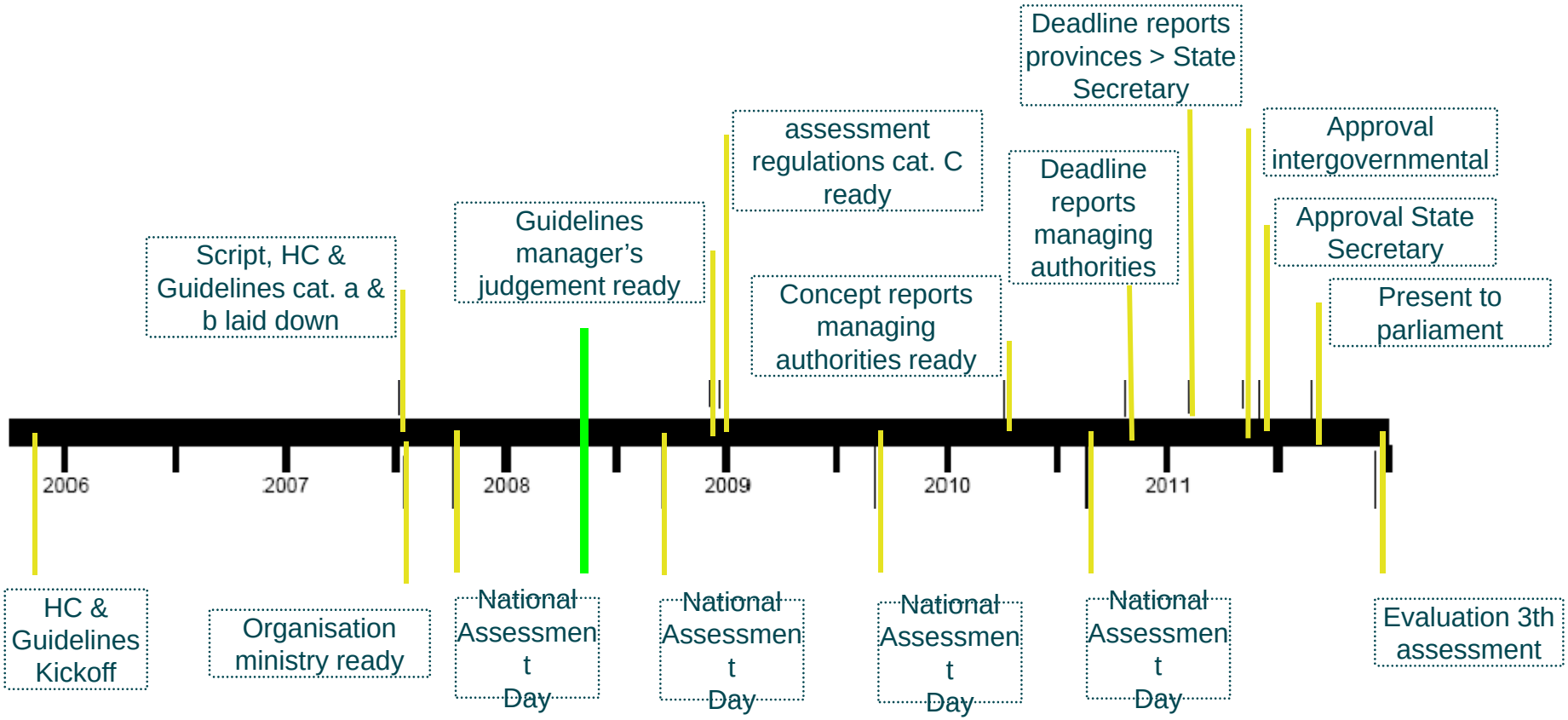
- **Coastal Weak Links**
  Wave loads appeared higher in 2003. The programme CWL was started.
- **Category C defences**
  No Hydraulic Boundary Conditions were available.
- **The Maeslant storm surge barrier**
  Design criterium '*probability of failure per closure <1:1000* not met. Hinterlandstudy carried out in 2007. Conclusion: barrier does not meet the standard.
- **Afsluitdijk (enclosure dam)**
  Not high enough, cannot withstand erosion. Hinterland study. Conclusion: dam does not meet the standard

Consequences of 2nd assessment

- Defences that don't meet the standards, need to be improved/strengthened
- Projects are classed under the "Flood Protection Programme". Finished in **2015** at cost of **2.3 billion Euro**



Towards 3rd assessment, 2011



Conclusions & recommendations

- Big achievement for the involved parties, mainly the water boards.
- 2nd assessment more complete than the 1st
- Essential information for the assessment has to be provided on time *(Hydr. Bound. Cond. & Guidelines)*
- Roles of the involved parties must be very clear, therefore a script for the assessment-proces is needed
- Gaps in the assessment regulations need to be filled *(category C, Waveloads in Waddensea and at the coast)*

Questions