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Enabling Delta Life

Flood hazard mapping

on the purposeful combination of individual flood characteristics in behalf of hazard zoning

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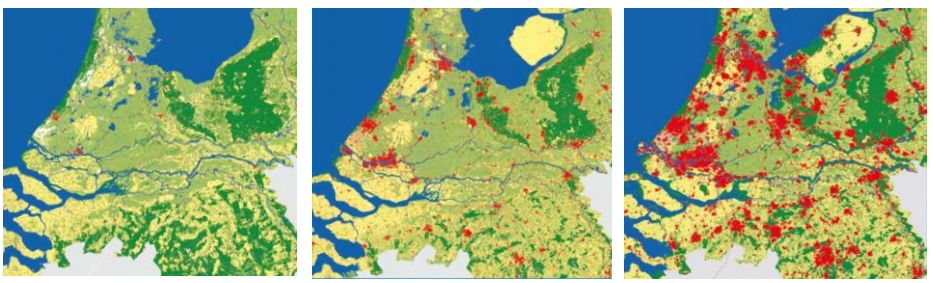
Spatial development causes increase of vulnerability

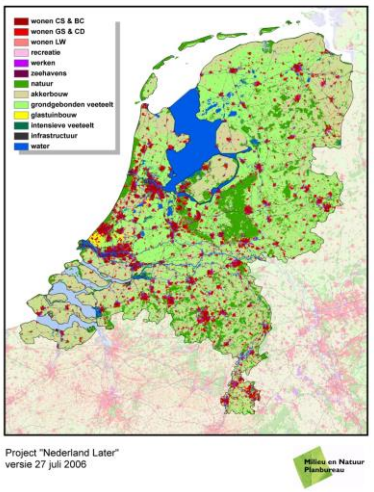
1900 1960 2010



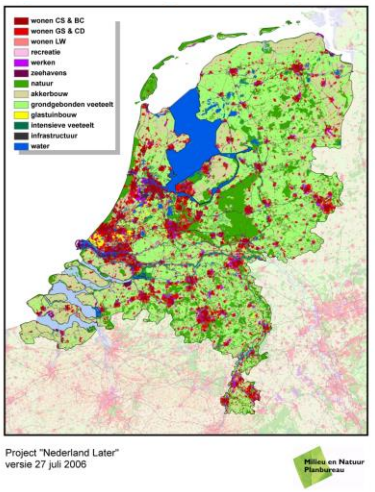
- Main cause of increasing flood risk world-wide: population and economic growth
- Up to now in Netherlands: no regulation of development planning (except river floodplains)

Further increase of vulnerability (scenarios)

Land use 2000



Land use 2040 ?



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Policy background

EU Directive requires: Flood Risk Maps and Flood Risk Management Plans

Netherlands: Delta Programme 21st century (Flood Security and Spatial Development)

Netherland's minister of Infrastructure & Environment:

"I find it very important that flood risk and flood-proof development are fully taken into account in spatial planning"

Required: policy framework for location policy (*elsewhere*?) and building codes (*otherwise*?)

Applies to new developments and re-development (brownfields, etc.)

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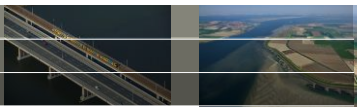
Terminology: risk or hazard?



FLOODsite (‘*Language of Risk*’, 2006; www.floodsite.net)

- Risk = probability * consequence
- Risk = hazard ∩ vulnerability

Hazard: “the *potential* to cause harm”
Risk: “the probability that *actual* harm occurs” (“without people no risk”)

Elaborated in EXCIMAP (‘*European Exchange Circle on Flood Mapping*’; Handbook on good practice on flood mapping in Europe, 2007)

Adopted by EU Flood Directive

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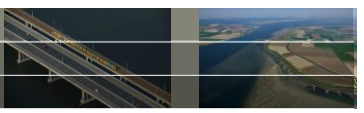
Supportive tools



Flood hazard zones
Classification of land use types (developments) after ‘vulnerability’
Guidance (policy framework) for communities etc.

Objective of hazard zoning:
to provide a clear, unambiguous and ‘stable’ map of hazard zones for which specific policy guidance can be defined

Character:
“*aid for deciding whether further investigations are necessary* (signalling)

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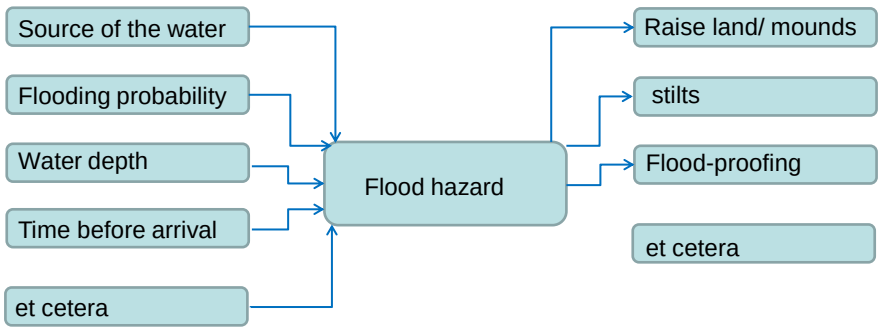
Position of hazard zoning map relative to background in maps and derivatives

Background maps
(EU Floods Directive)

Derived maps:
'suitability for …'

signalling map



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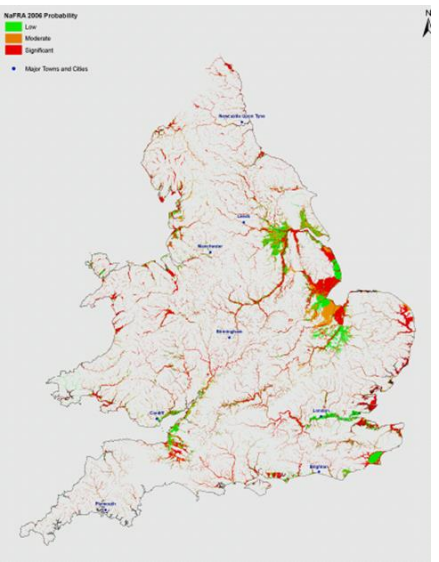
Examples from abroad (e.g the UK)?

PPS25 (policy statement)

Environment Agency
'Flood Map'



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Needed: hazard maps/ hazard zonering

Many maps made available in context of EU Directive (www.risicokaart.nl), but …
which one to choose? (1 hazard zoning map)

Hazard for people (fatality) ≠ hazard for property (damage)

- Probability
- Maximum depth
- Flow velocity
- Rising speed flood water
- Arrival of first flood water
- Final depth
- Flood duration

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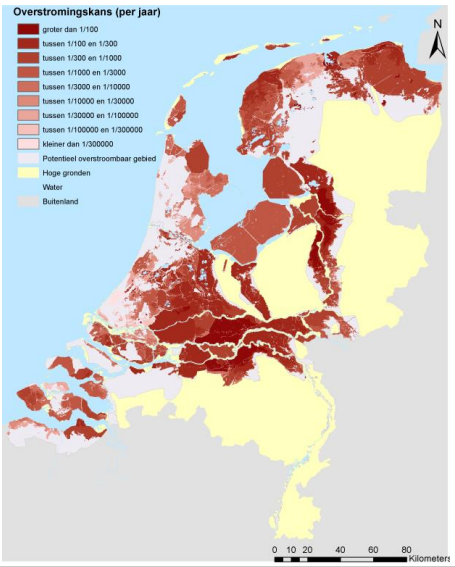
Flooding probability (present/ reference DP-V)
(failing embankments only



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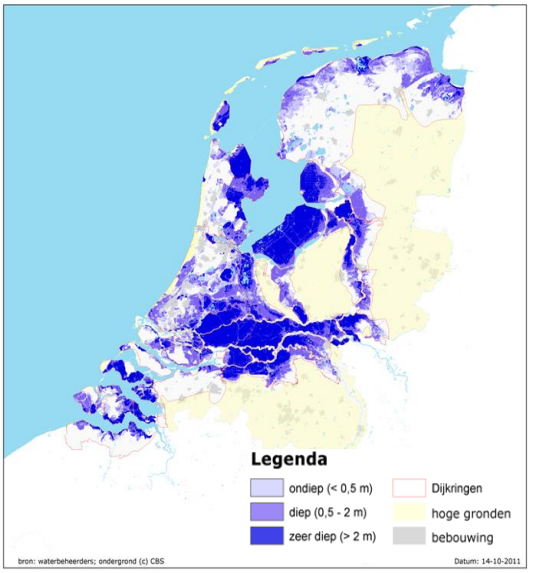
Maximum water depth (failing embankment)



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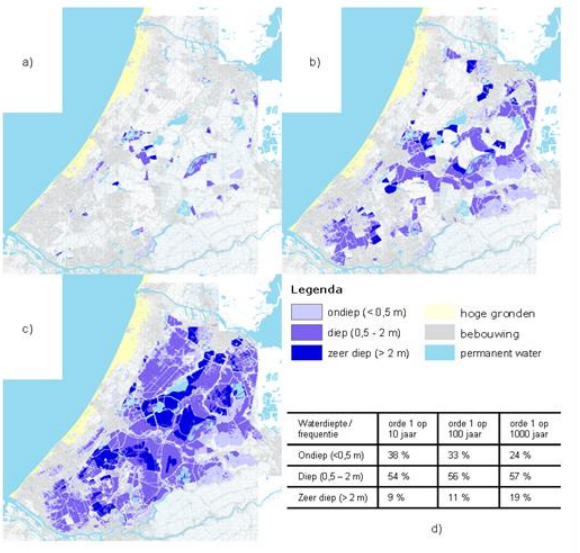
But relationship depth – probability is not unambiguous



Waterdiepte / frequentie	orde 1 op 10 jaar	orde 1 op 100 jaar	orde 1 op 1000 jaar
Ondiep (<0,5 m)	38 %	33 %	24 %
Diep (0,5 – 2 m)	54 %	56 %	57 %
Zeer diep (> 2 m)	9 %	11 %	19 %

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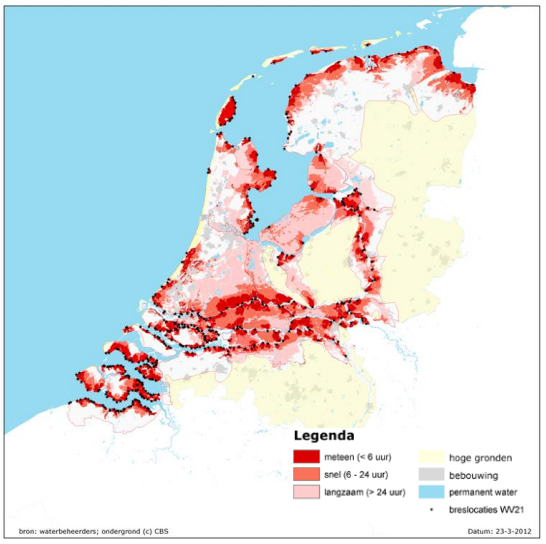
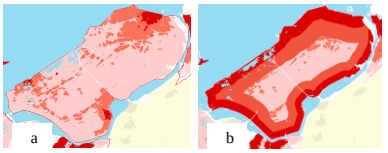
For fatalities time to arrival of first flood water relevant





Arrival time depends on available simulations
a) from scenarios versus b) generalised

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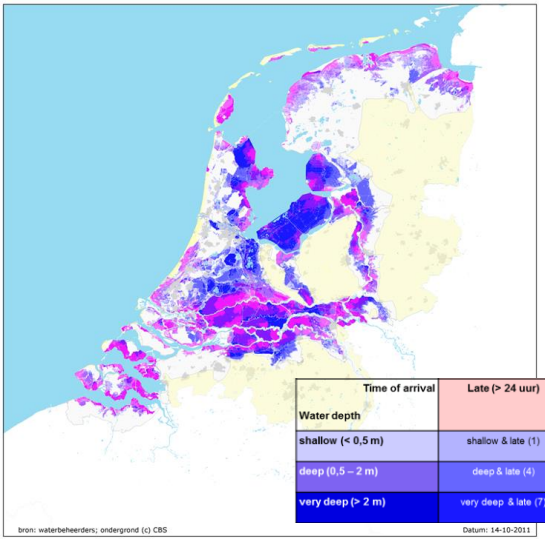
Common approach: combination by overlay (see EXCIMAP)



Time of arrival / Water depth	Late (> 24 uur)	Early (6 – 24 uur)	Immediate (< 6 uur)
shallow (< 0,5 m)	shallow & late (1)	shallow & early (2)	shallow & immediate (3)
deep (0,5 – 2 m)	deep & late (4)	deep & early (5)	deep & immediate (6)
very deep (> 2 m)	very deep & late (7)	very deep & early (8)	very deep & immediate (9)

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Alternative: new concepts/ modelling approach

(Local) Flood Fatality Hazard: FFH (often called LIR)
(Local) Flood Damage Hazard: FDH

result of modelling 'hypothetical people', resp. 'hypothetical land use'

allows combining all relevant factors/ variables

Allows *adding up* hazard from all sources/ various probabilities
(pluvial, groundwater, insufficient discharge, river floods (overflow), breaching embankments)

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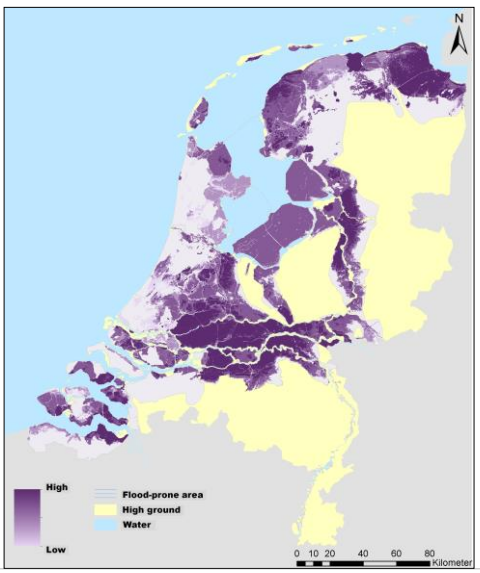
(Local) Flood Fatality Hazard (FFH) ('unclassified'/ breaches only)



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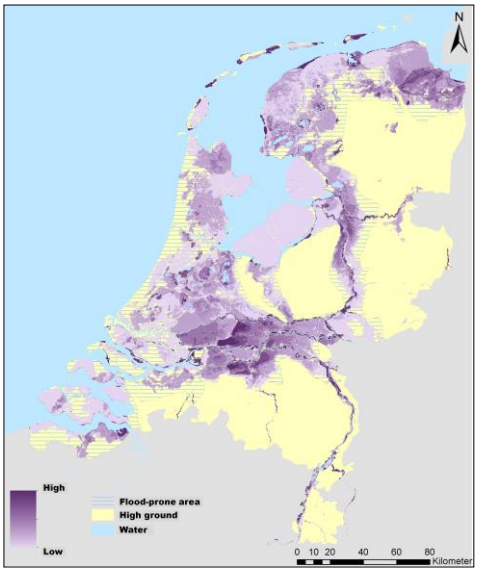
(Local) Flood Damage Hazard (FDH) ('unclassified'/ all floods)



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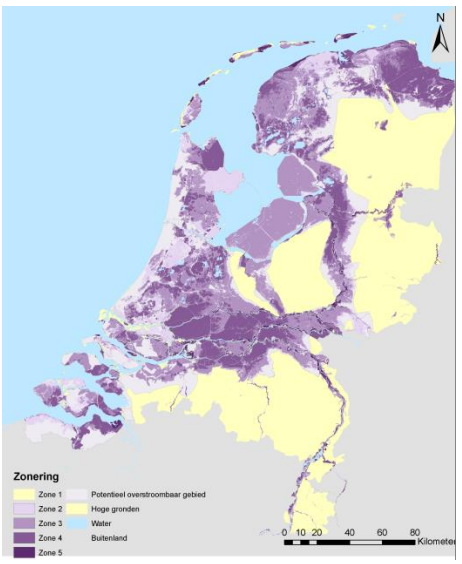
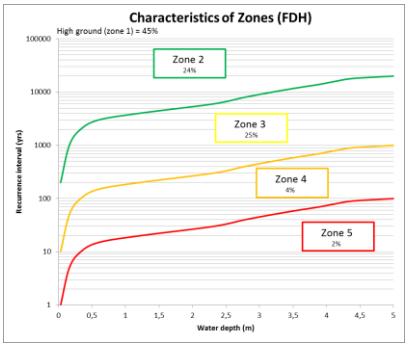
Hazard Zones (classified): based on FDH (+ FFH)





Advantages: summation possible, all floods, both damage and fatalities

Subjective elements in setting borders:

- active floodplain = zone 5
- FFH $> 10^{-5}$: zone 3 becomes 4

Remarks: not as intuitive as flooding depth or probability alone

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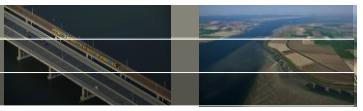
Conclusions



Flood hazard zoning should be based on all relevant characteristics

This is difficult for different flood sources, especially for protected area (flood defences/ failure probabilities), because depth and probability are not correlated (and the rest!)

The new concepts of Flood Damage Hazard and Flood Fatality Hazard allow combining *all relevant information* in a scientifically sound way *(publication in prep.: De Bruijn et al.)*

Their classification and combination of the 2 requires a certain degree of interpretation/ expert judgement (a subjective element)

The approach yields a 'simple' and 'sound' map of hazard zones, which may serve for signalling: *"closer investigations into flood hazard needed before urban (re-)development"*