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Enhancing Society Together

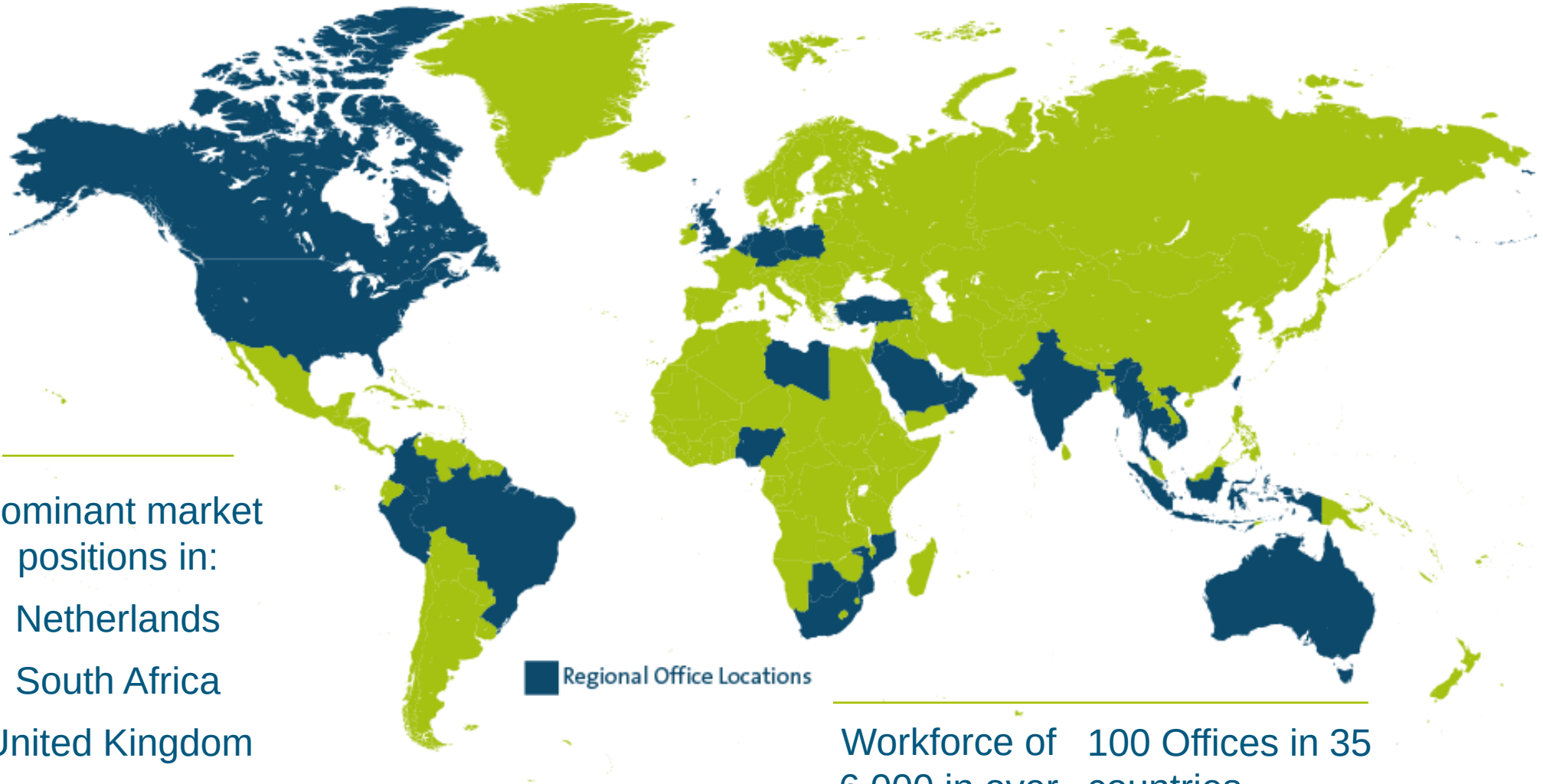
Flood risk adaptation through digital service

Global Flood Risk Tool

PCNC Strategies for storms, flooding & sea level defense
December 4rd 2019
Matthijs Bos MSc.

Where we are in the world

Engineering, Environmental & Project Management Consultancy Services



Dominant market positions in:

Netherlands

South Africa

United Kingdom

Indonesia

Workforce of 6,000 in over 150 countries

100 Offices in 35 countries

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Royal HaskoningDHV

Consultancy | Engineering | Project Management

Headquarters in the Netherlands with offices worldwide, **including in USA**

Forefront of **innovative approaches** and **technologies**

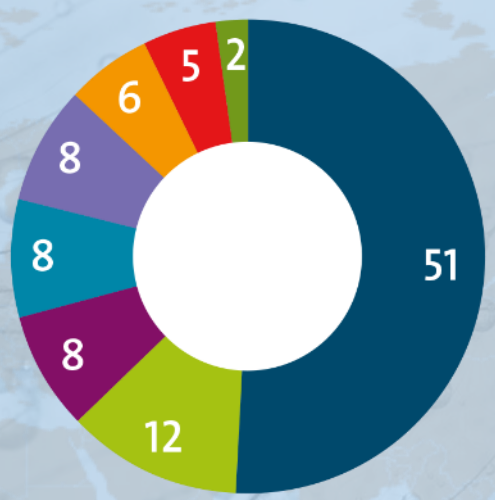
Flood Risk Management experience

One of the **top independently owned** engineering companies

- Net turnover 600 million Euro;
- EBITA 26 million Euro

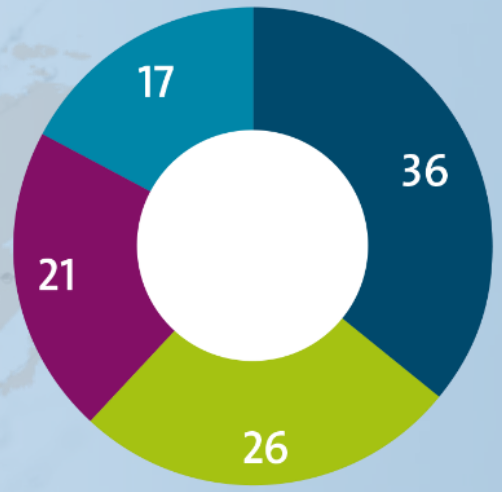
100+	6000+	150	1000
Years of Flood Risk Management experience	Workforce	countries	Water experts

TURNOVER BY REGION %



- Netherlands
- Africa, Middle East and India (excl. SA)
- Asia Pacific (excl. ID)
- South Africa
- United Kingdom
- Americas
- Continental Europe (excl. NL)
- Indonesia

TURNOVER BY CLIENT GROUP %



- Government & Society
- Industry & Business
- Infrastructure & Utilities
- Intermediates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Resilience in cities
Key principles
Combined effort of business & government
Transparent governance with strong policies, regulation & institutions
Mix of different resilience enhancing measures aligned with local needs
Social inclusiveness & empowering people by local stakeholder engagement & community involvement
Design for storm & norm anticipating uncertain future
Integrated System approach fitting local context
Resilience for Smart Places

With Digital ‘Resilience’ Services

3 Product Lines:

1. **What COULD happen: Exposure, risk & impact mapping**
2. What IS happening: Monitoring
3. What IS ABOUT to happen: Forecasting & Alerting

For weather and climate change hazards

1. Floods (rain, river, sea)
2. Heat & drought stress
3. Snowfall & severe cold
4. Storm

Up to 5th order cascading effects (supply chain, business disruption)

Global by design:

- For any location & object worldwide
- As automated as possible
- At ever increasing resolution and frequency

Enabling our clients:

- assess their vulnerability to,
- alert them for,
- and analyze the business impact of these events

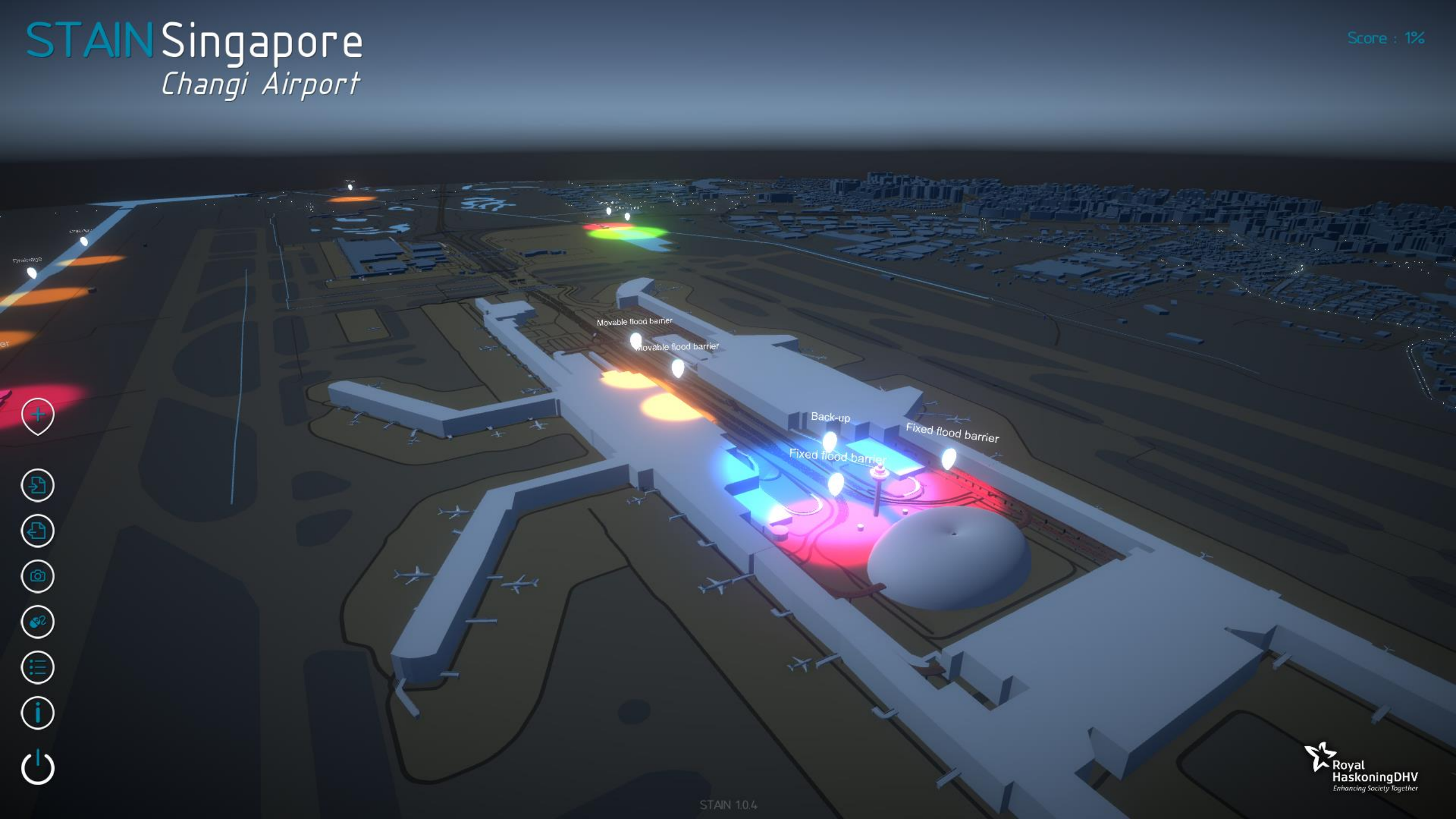
Thereby:

- reducing their business disruptions and economic damages,
- continuously (re)assess the risk profile of insured and invested portfolios
- and benefiting from weather related opportunities.

Changi Airport - Preparing world's best airport for climate change

STAIN Singapore
Changi Airport

Score : 1%



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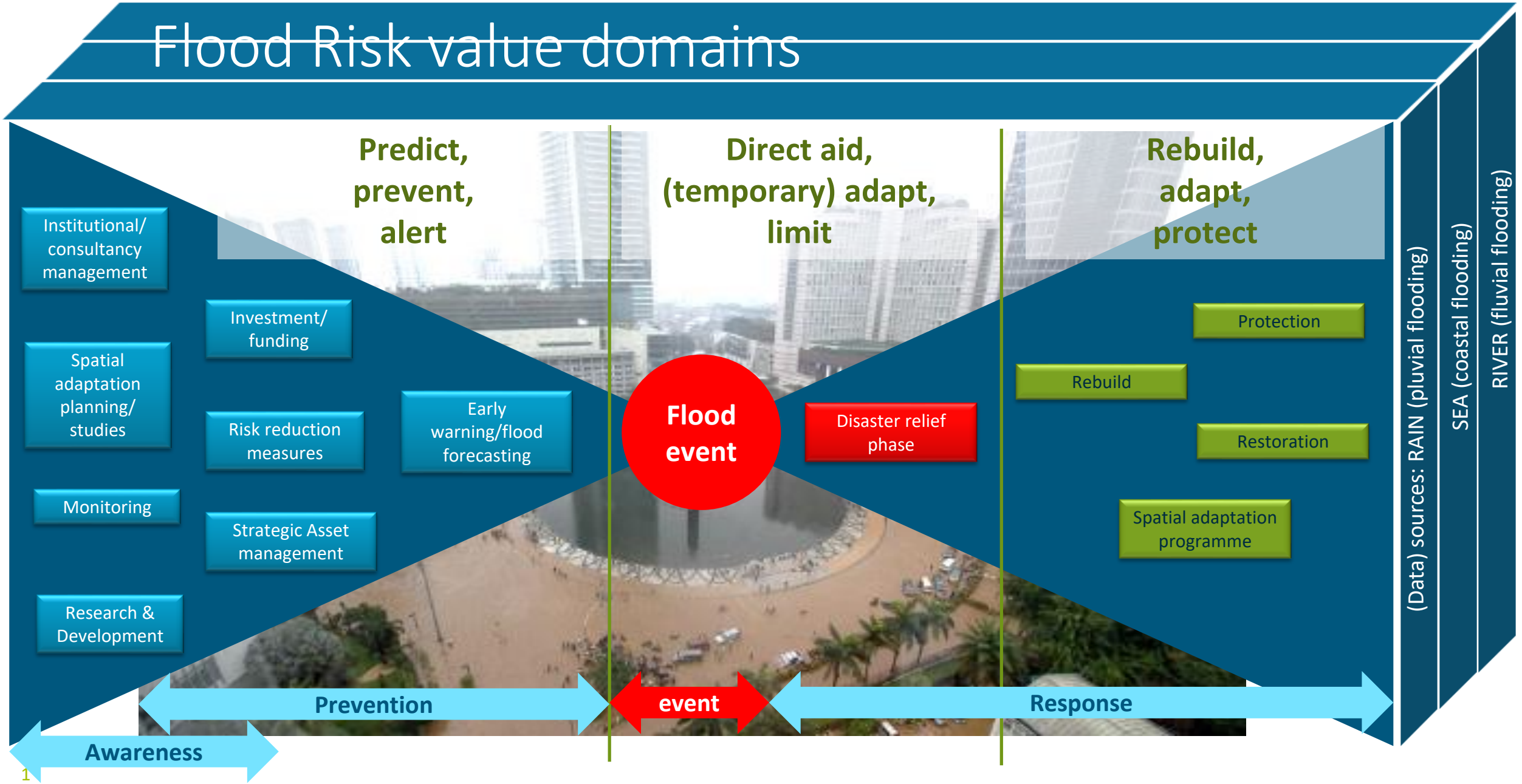
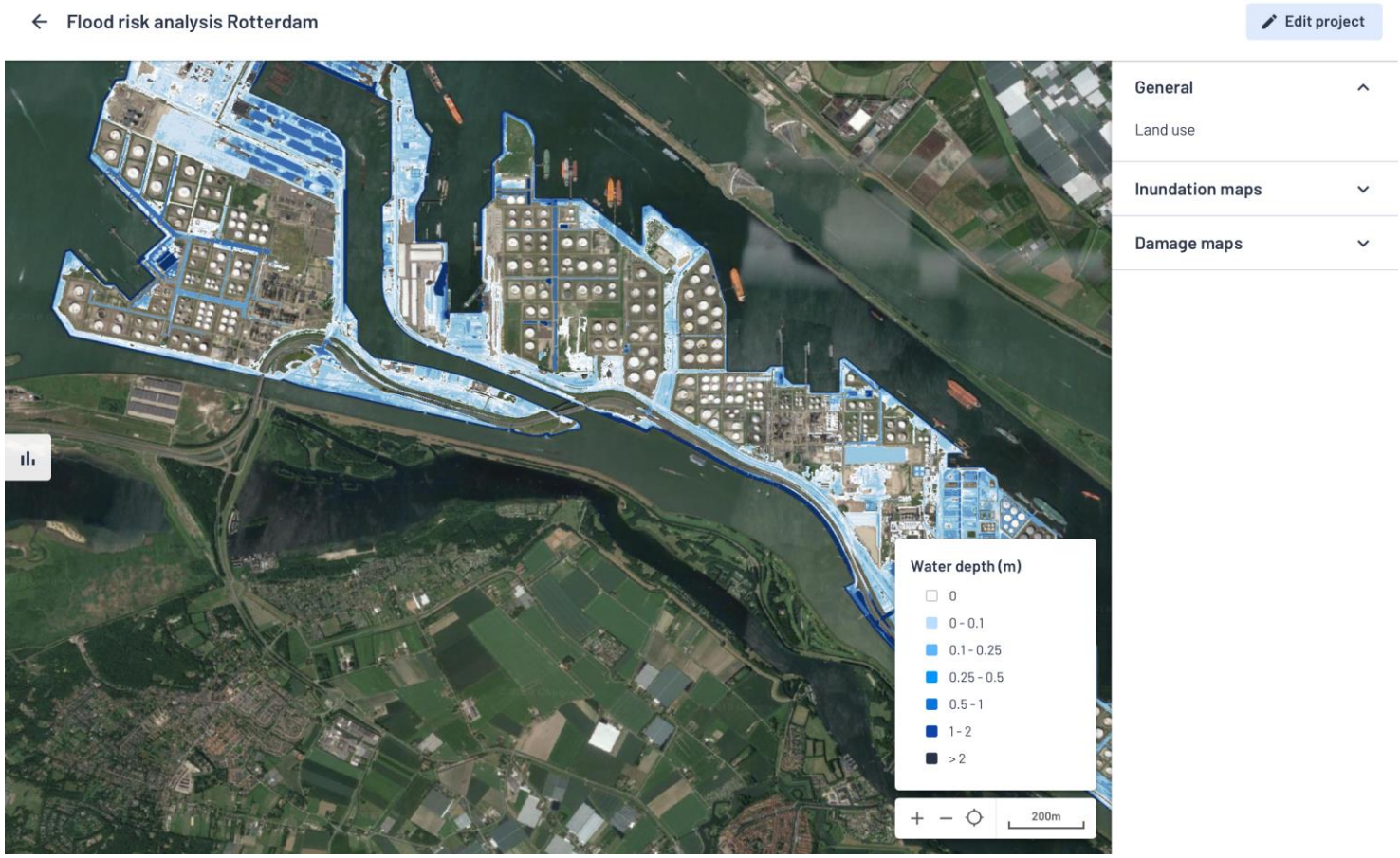
STAIN 1.0.4

Flood Risk value domains



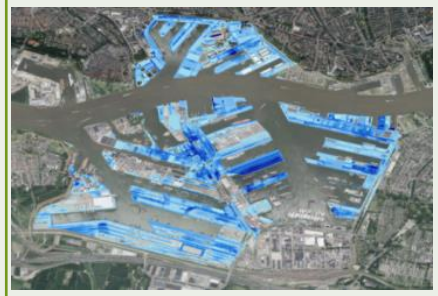
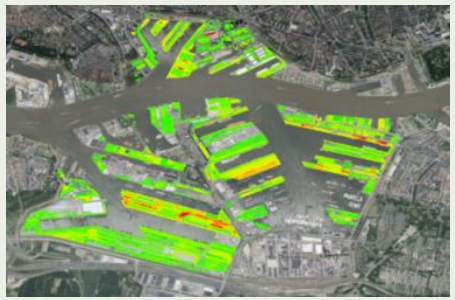
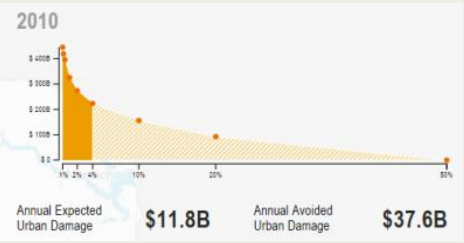
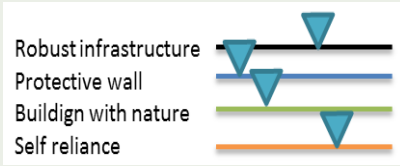
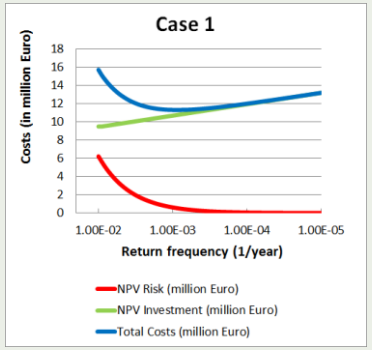
Digital ‘Resilience’ service - Global Flood Risk Tool

- Calculated Flood Risk through cloud-based computing platform based on 5-steps approach
- User interface is interactive, visually attractive and understandable for non-experts to stimulate stakeholder dialogue.
- Tool is fast: Multiple climate scenario’s can be run within a minute instead of hours.



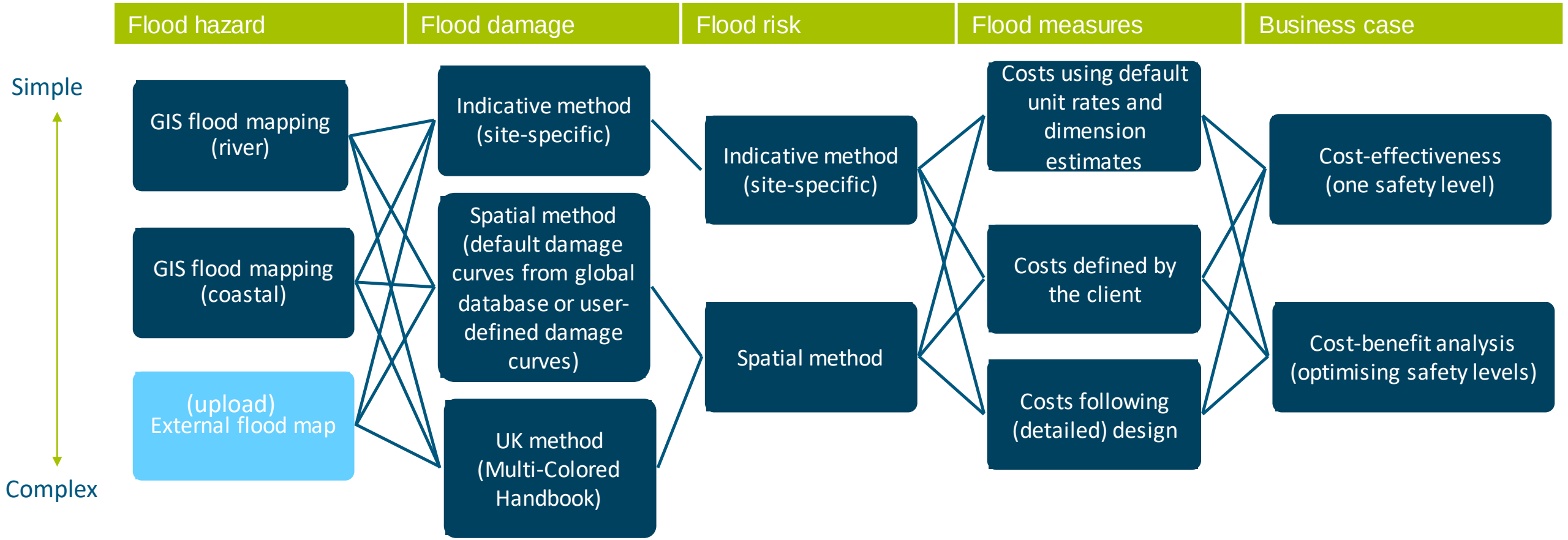
Methodology

Flood Hazard → Flood Damage → Flood Risk → Flood Measures → Business Case

Input	**Water levels for multiple return periods or Flood maps**	**Flood maps Damage curves Maximum damage/m2**	**Direct damage maps for ≥ 3 return periods**	**Dimensions of simple measures (length, width, height)**	**- Investment costs for multiple return periods - Economic risk for multiple safety levels**
Output	Flood maps for multiple return periods	Direct damage maps per return period	- Flood risk map - Damage-probability curve	Investment costs	Optimum safety level
Example					

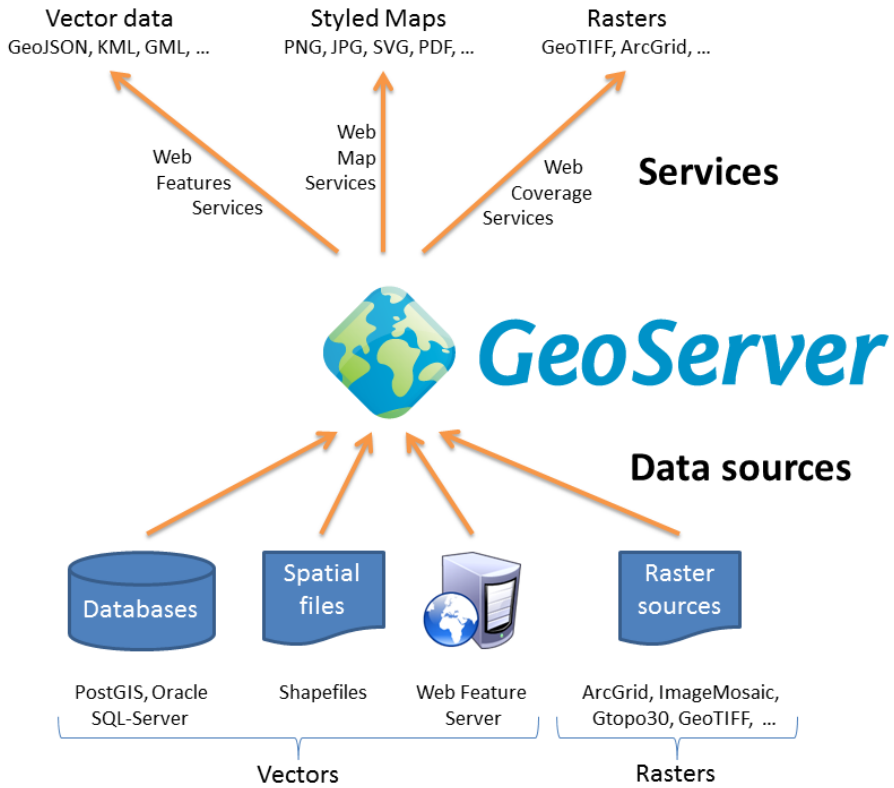
Underlying magic - Levels of detail

Flood maps can be created online



Underlaying magic – Cloud based tool

- Online platform, to maximize computation power and increase speed: Performance from 5hours to **1 minute**!
- 100% open-source, written in GDAL and Python code, calculations on Amazon web service (AWS), codes stored in Github. API to enable connection with other tools and models



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Projects overview

Search a project ...

+ Create project

Project title
Vancouver, CANADA
It is probably the dream of any amateur astronomer to be able to be the boss of one of the great multi million dollar telescopes even if it was just for one.
Uesugi Suzuki — 2 hours ago

Title of project
Rotterdam, THE NETHERLANDS
It is probably the dream of any amateur astronomer to be able to be the boss of one of the great multi million dollar telescopes even if it was just for one.
Henrietta Todd — 2 hours ago

Flood risk project
Madrid, SPAIN
Edit
Delete
It is probably the dream of any amateur astronomer to be able to be the boss of one of the great multi million dollar telescopes even if it was just for one.
Philip Hernandez — 2 hours ago

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Rotterdam, THE NETHERLANDS
It is probably the dream of any amateur astronomer to be able to be the boss of one

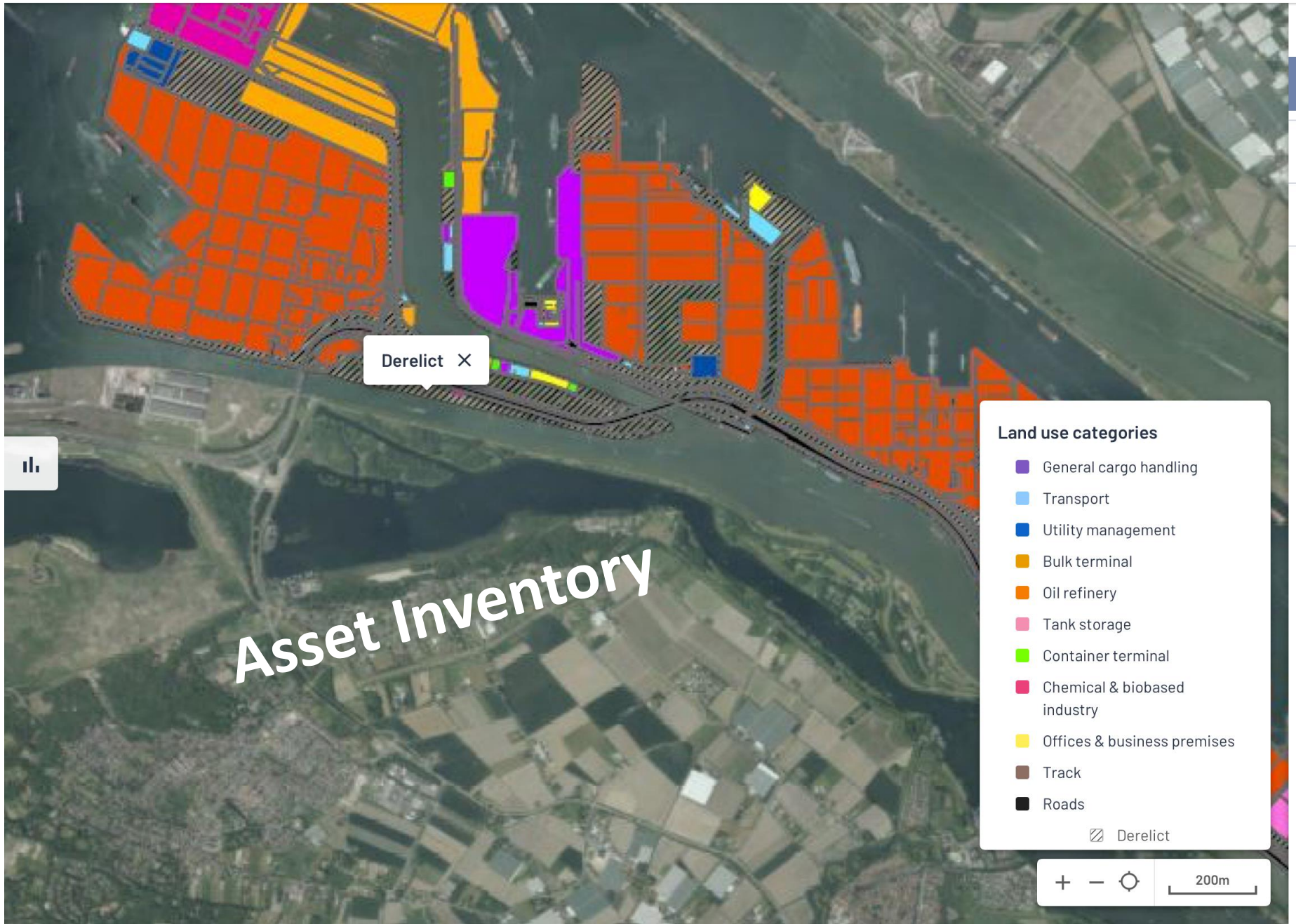
3 missing files

Upload the remaining files to generate damage maps.

Project boundary	Uploa
Land use	Uploa
Damage functions	Uploa

Inundation maps

Time horizon ↓	Return period	
2018	10	
2018	100	
2018	300	
2018	1000	
2018	3000	
2018	10000	
2050	10	
2050	100	
2050	300	



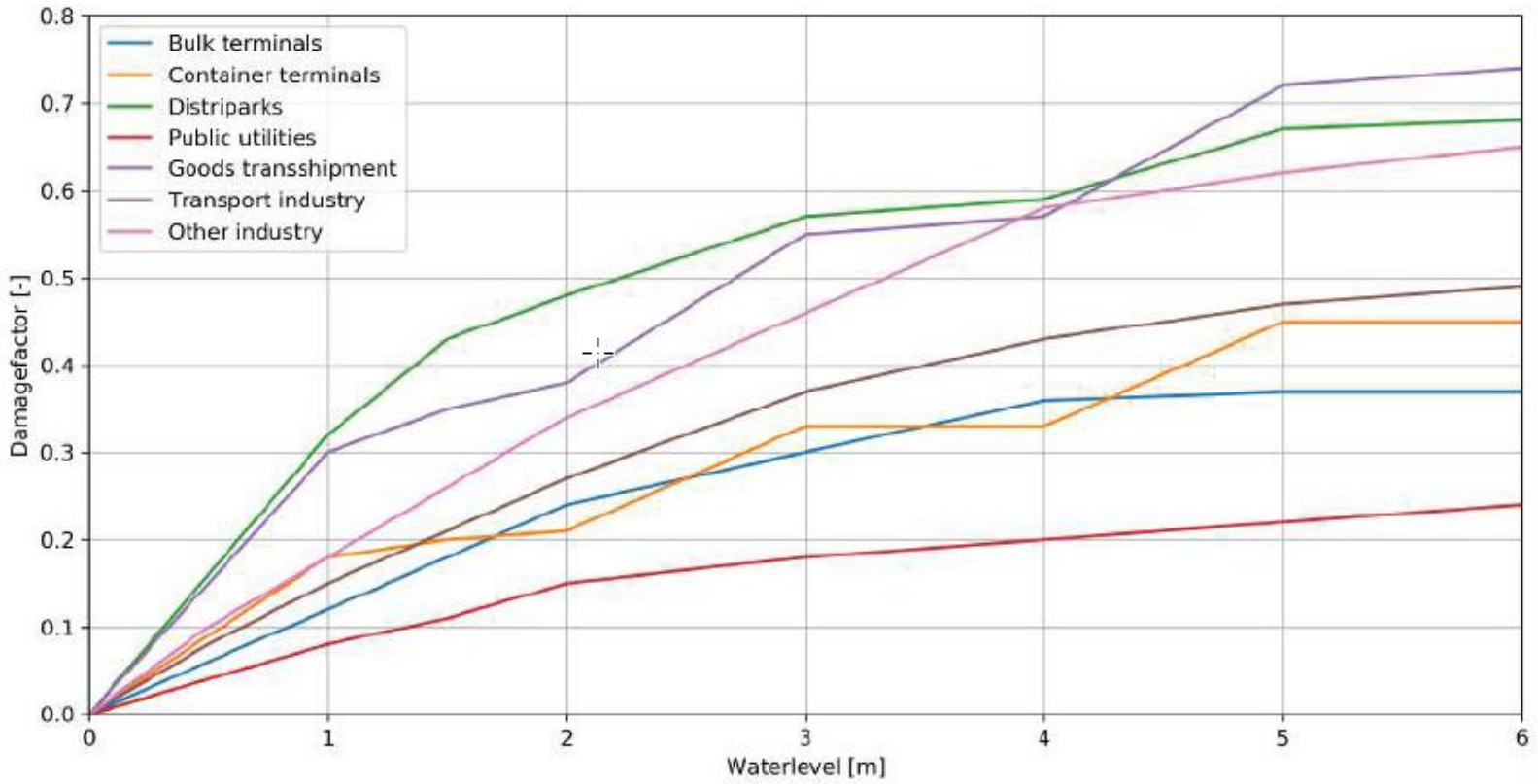
General

Land use

Inundation maps

Damage maps

Economic input parameters



Sector	Value
Bulk terminals	€ 443
Container terminals	€ 696
Distriparks	€ 886
Public utilities	€ 1583
Goods transshipment	€ 886
Transport industry	€ 633
Other industry	€ 633

Sources:
* JCR, 2017. Global flood depth-damage functions: Methodology and the database with guidelines, Huizinga, De Moel and Wojciech: https://publications.jrc.ec.europa.eu/repository/handle/JRC105688
* Tebodin, 1998. Schade bij inundatie. By Rijkswaterstaat

Flood risk analysis Rotterdam

Edit project

Generating 2 damage maps

General

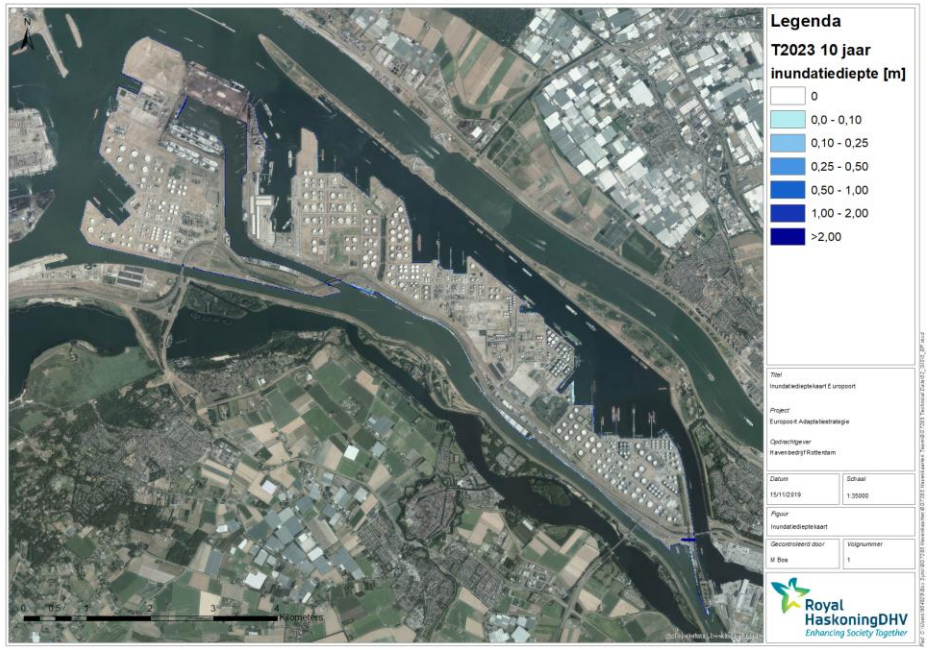
Inundation maps

Time horizon	Return period	
2018	10	
2018	100	
2018	300	
2018	1000	
2018	3000	
2018	10000	
2050	10	
2050	100	
2050	300	
2050	1000	

Damage maps

Time horizon	Return period	
2018	10	
2018	100	

2023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inundatiediepte [m]
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0,10 - 0,25
0,25 - 0,50
0,50 - 1,00
1,00 - 2,00
>2,00
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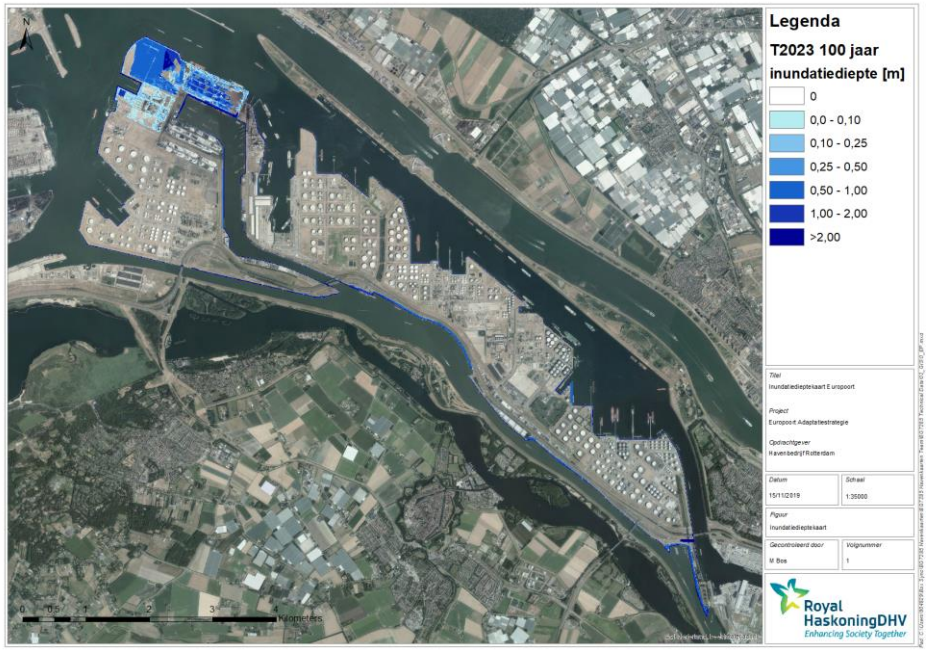
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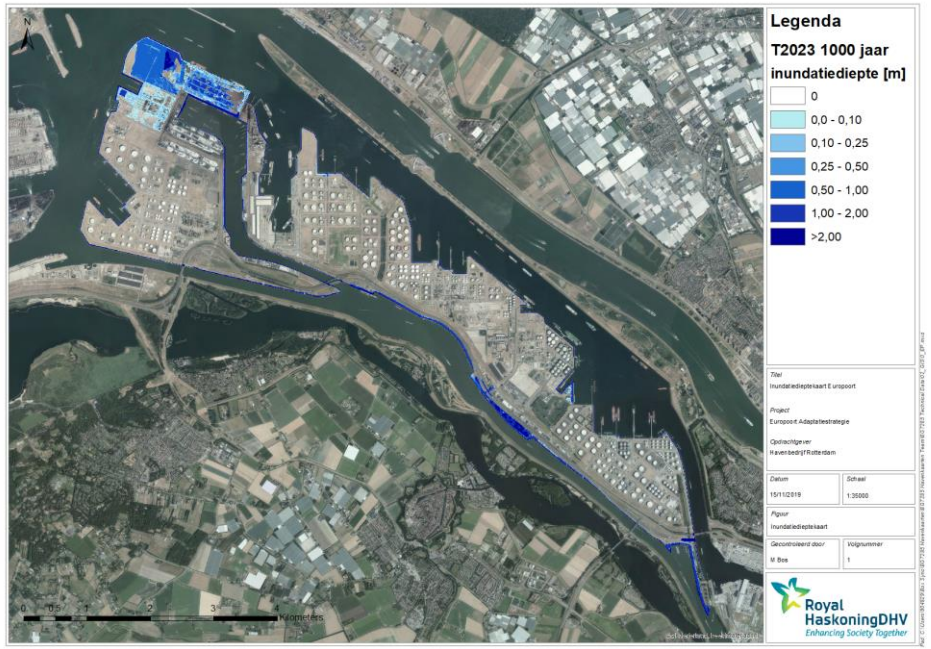
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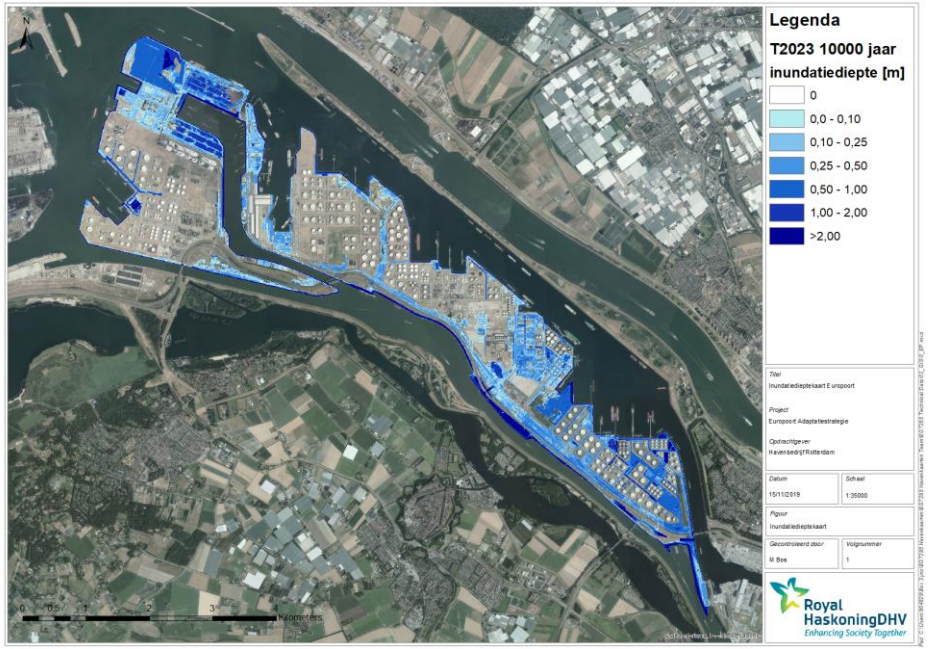
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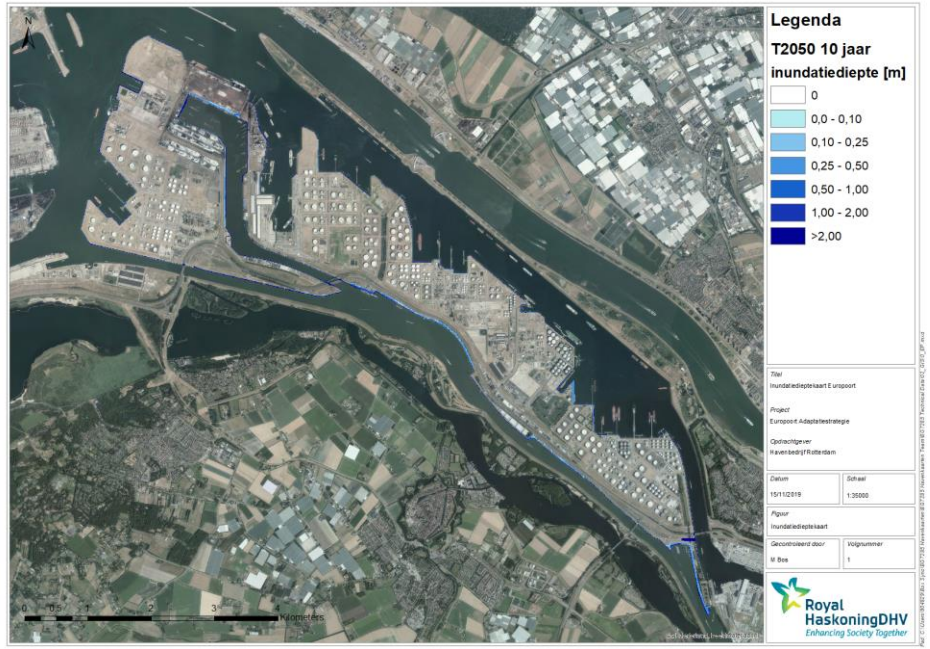
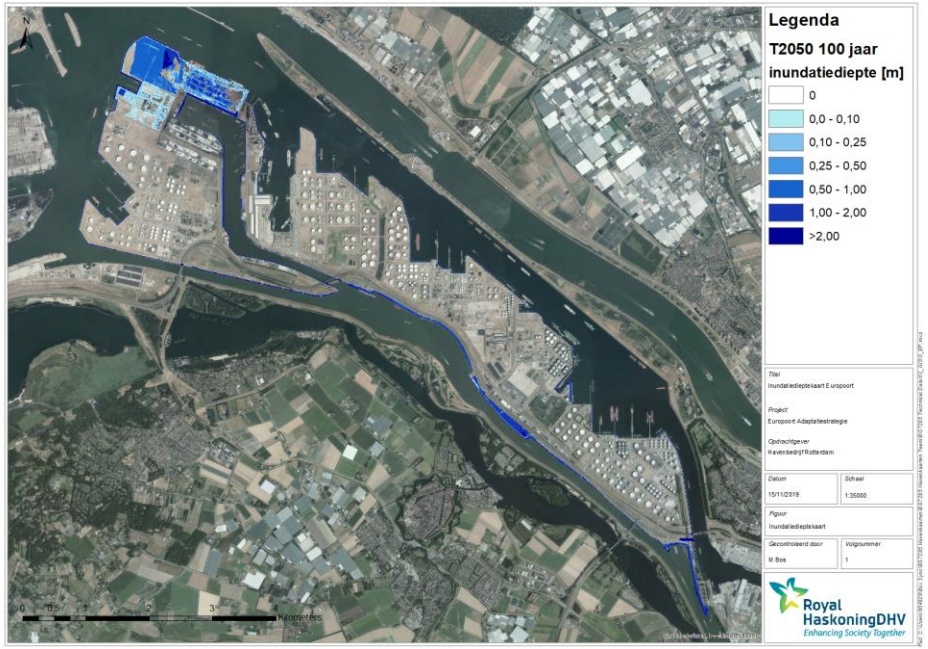
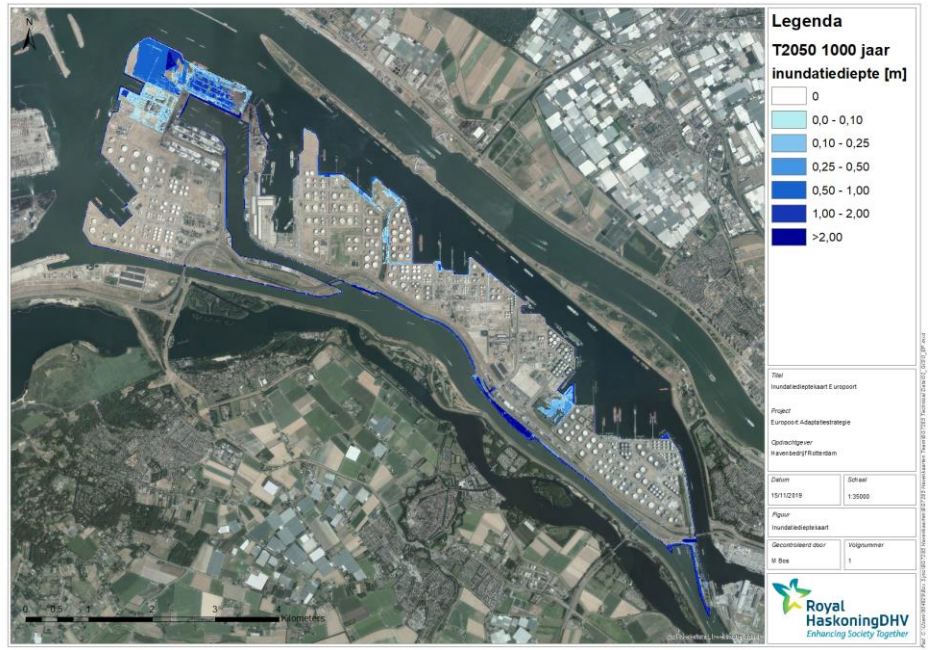
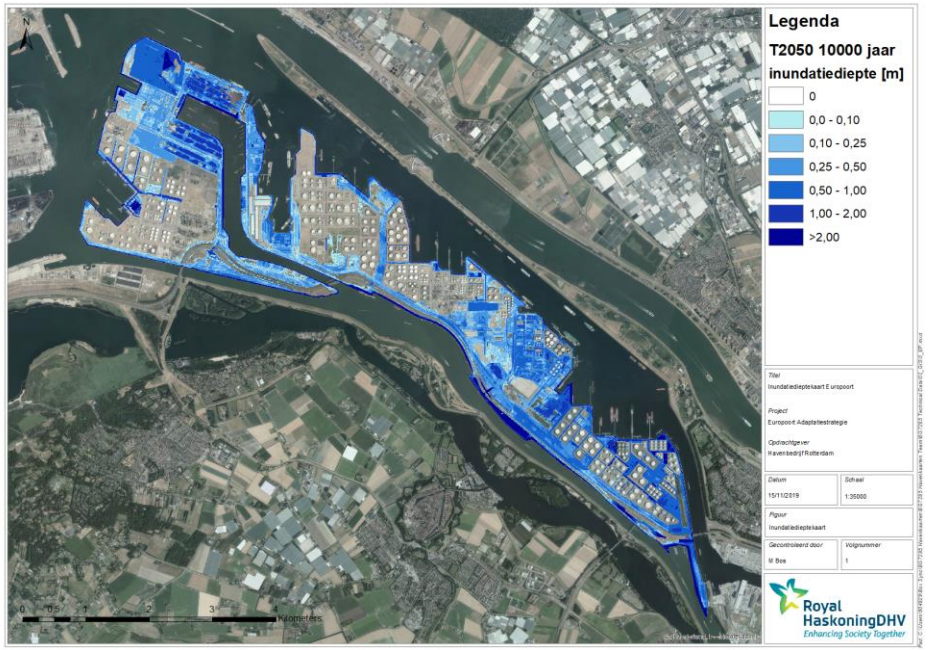
2050
+35cm SLR

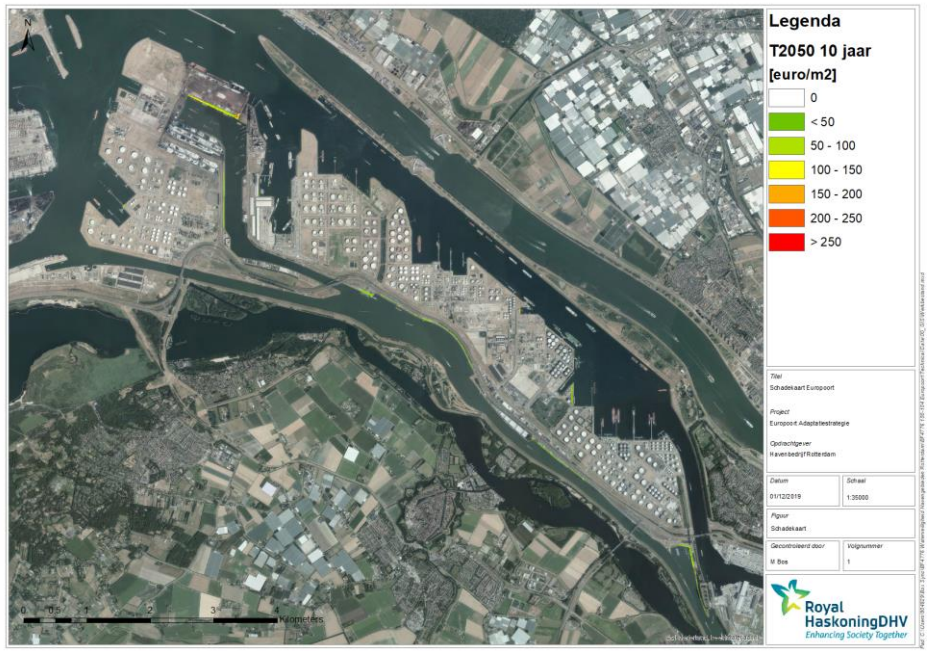


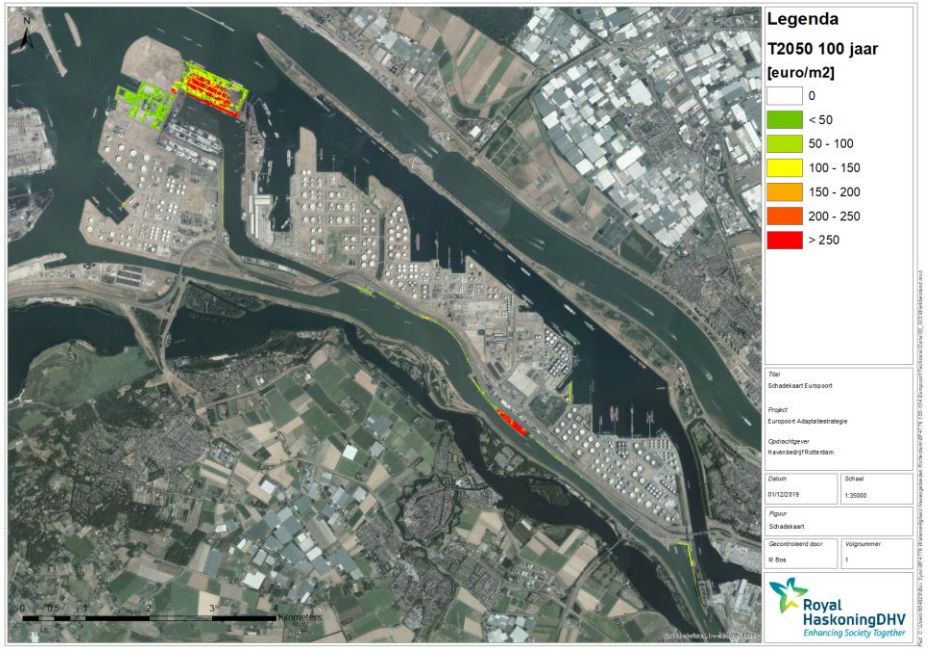


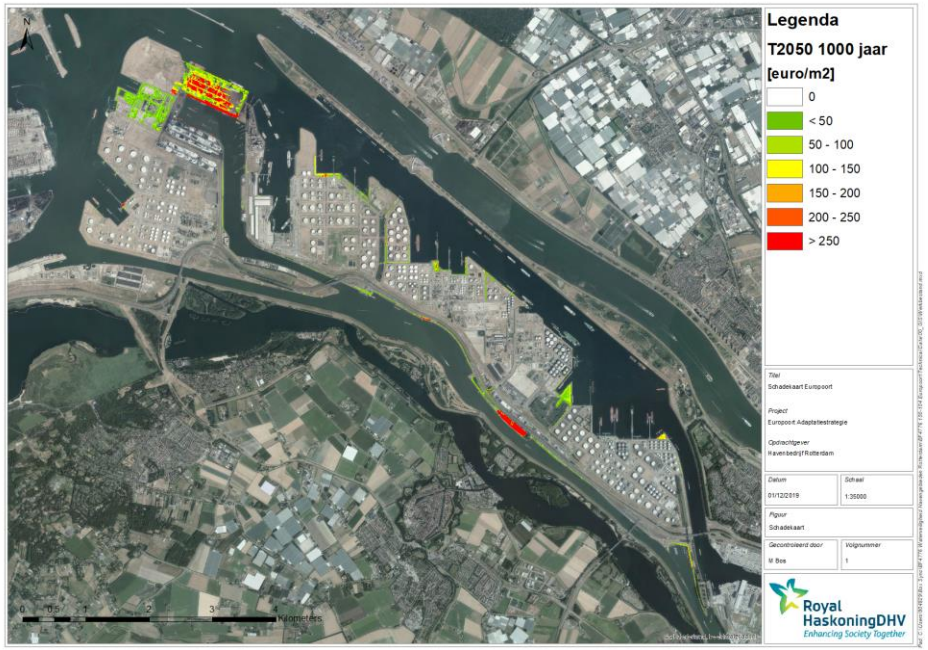


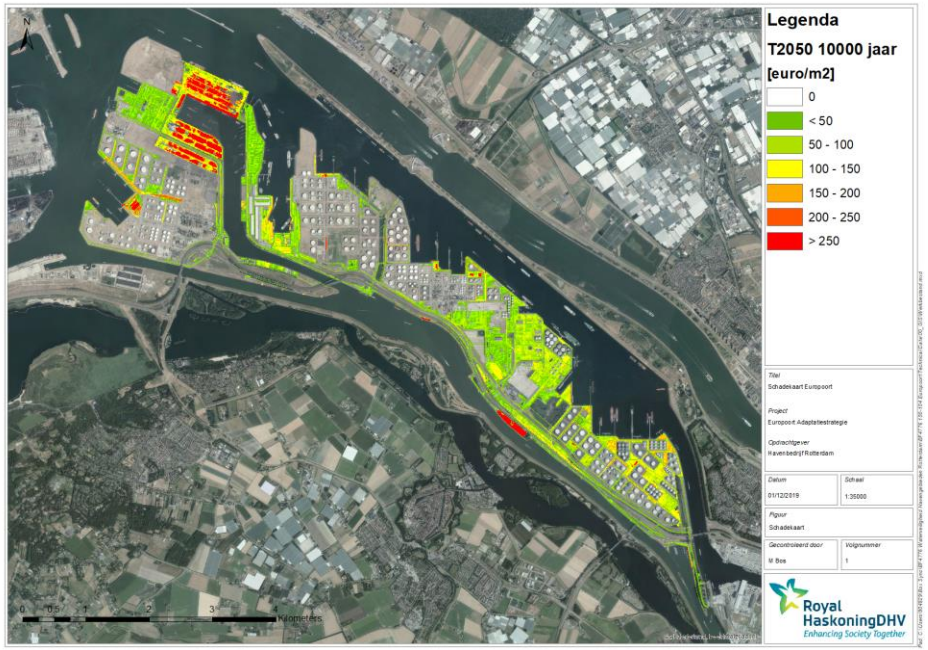


2050
+35cm SLR









Flood risk analysis Rotterdam

Edit project

Flood damage results

Return period (years)	Damage (million €) 2018	2050	2100
10	10	20	30
100	20	40	60
300	30	60	80
1000	50	100	120
3000	200	350	450
10000	1000	1200	1500

Damage graphs | Risk graphs

Download results

General

Inundation maps

Damage maps

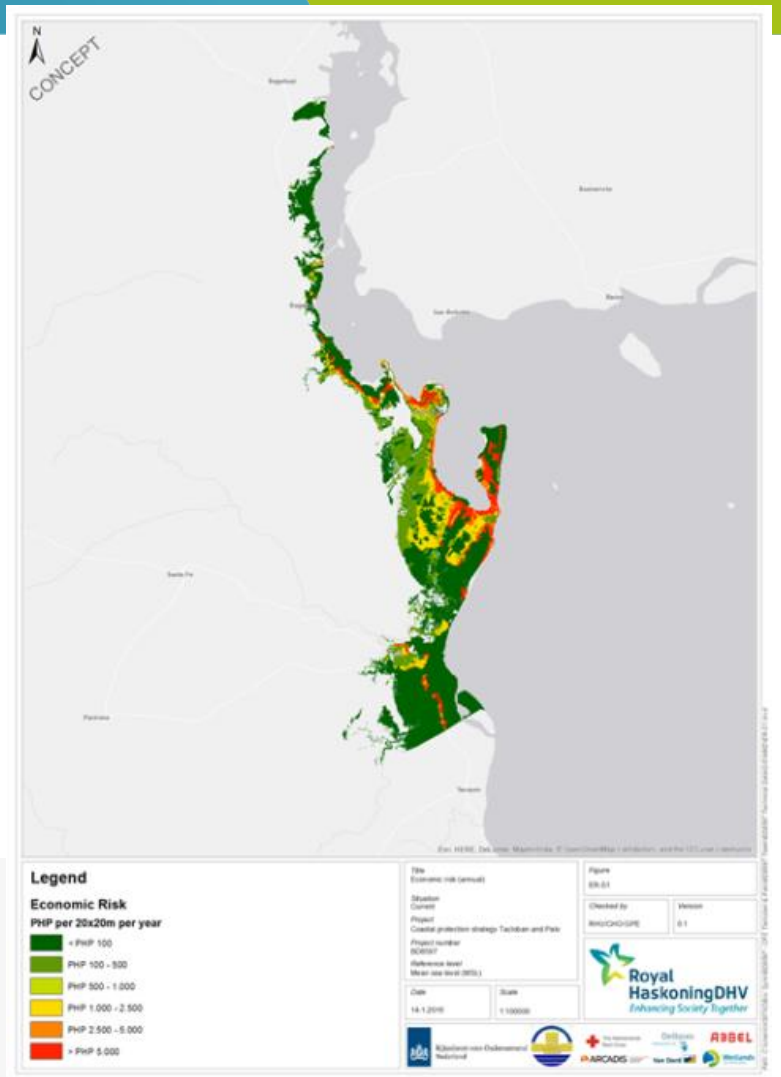
Time horizon	Return period	
2018	10	
2018	100	
2018	300	
2018	1000	
2018	3000	
2018	10000	
2050	10	
2050	100	
2050	300	
2050	1000	

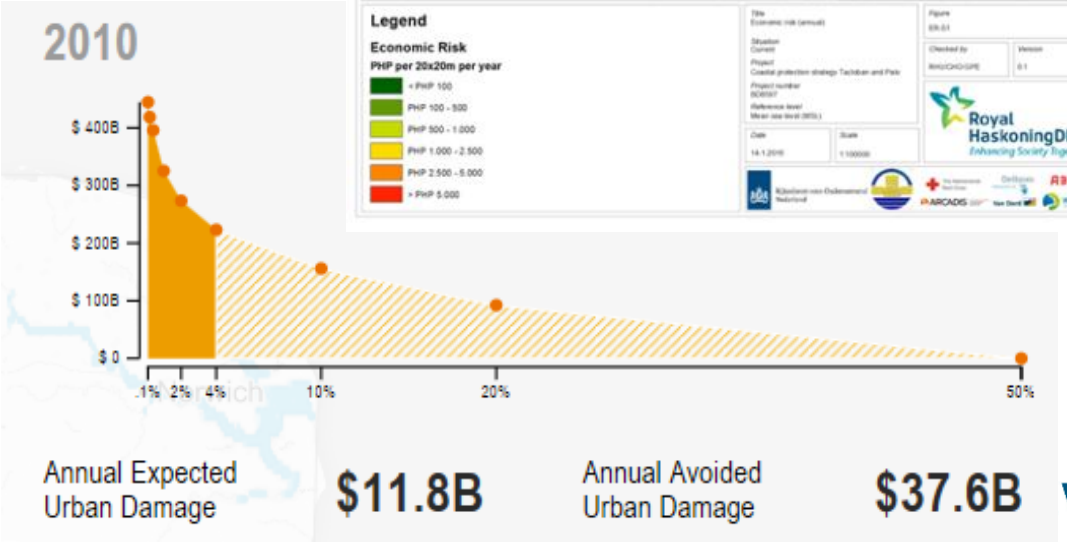
Damage and Risk calculation

- **Risk based decision making**
- **Damage tabels and graphs + to include indirect damages**

Total Economic damage [million euro]			
	Time horizon		
Return period	**2015**	**2050**	**2100**
10	3	4	19
100	12	22	66
300	22	43	85
1000	47	62	91
3000	62	82	221
10000	88	153	451
Annual Expected Damage [€/year]	**1.2**	**2.1**	**6.8**
Present Value of the risk	**41**	**71**	**235**

Discount rate is 5.5% - 2.6 for economic growth = 2.9%





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Resilience in cities

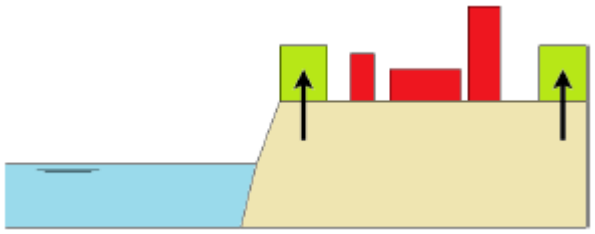
Resilience for Smart Places

Measures

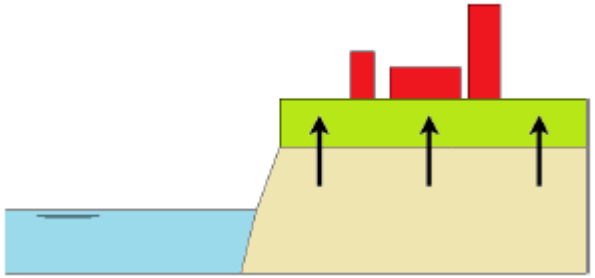
The multi-level safety approach is based on:

- Level 1: Preventive/ structural measures (both conventional and nature based)
- Level 2: Adaptive/ spatial planning (retreat)/non-structural measures
- Level 3: Emergency response and crisis management

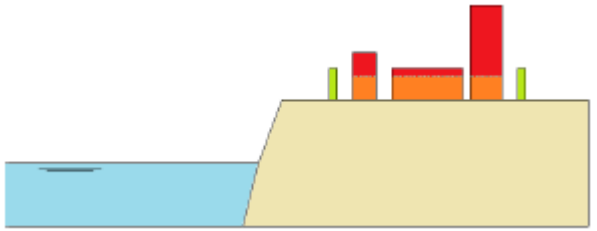
Figure 25 Conceptual levels of safety. Source: Ministry of Infrastructure and Water Management, The Netherlands (2009)



Flood defense



Terrain elevation

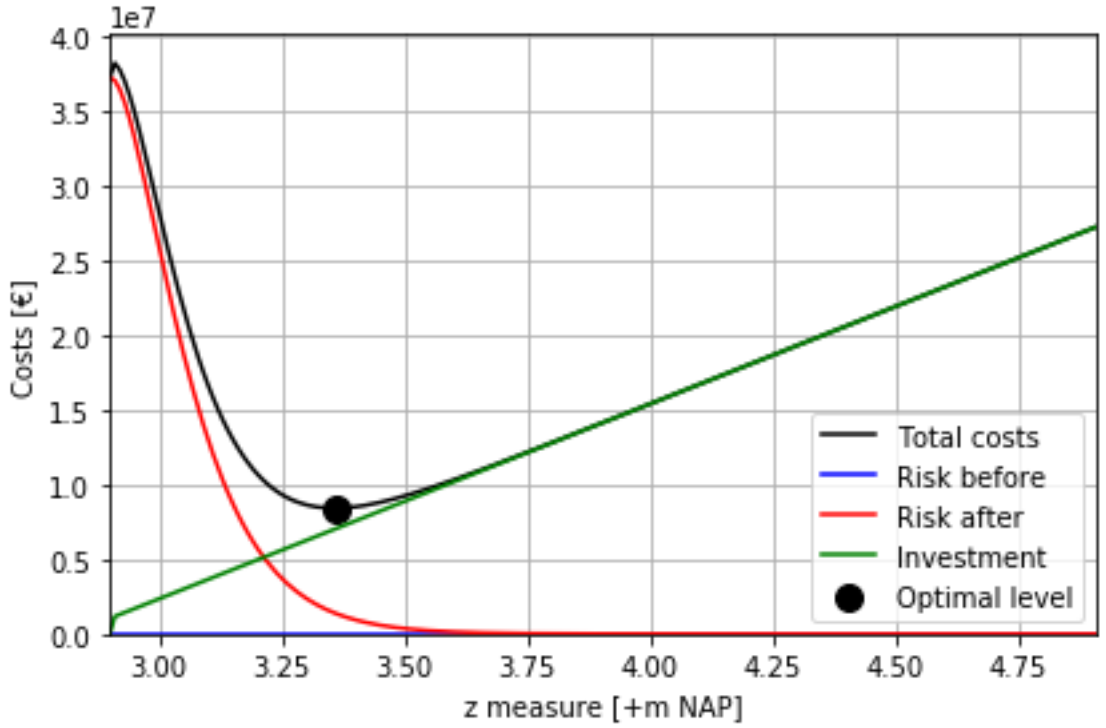


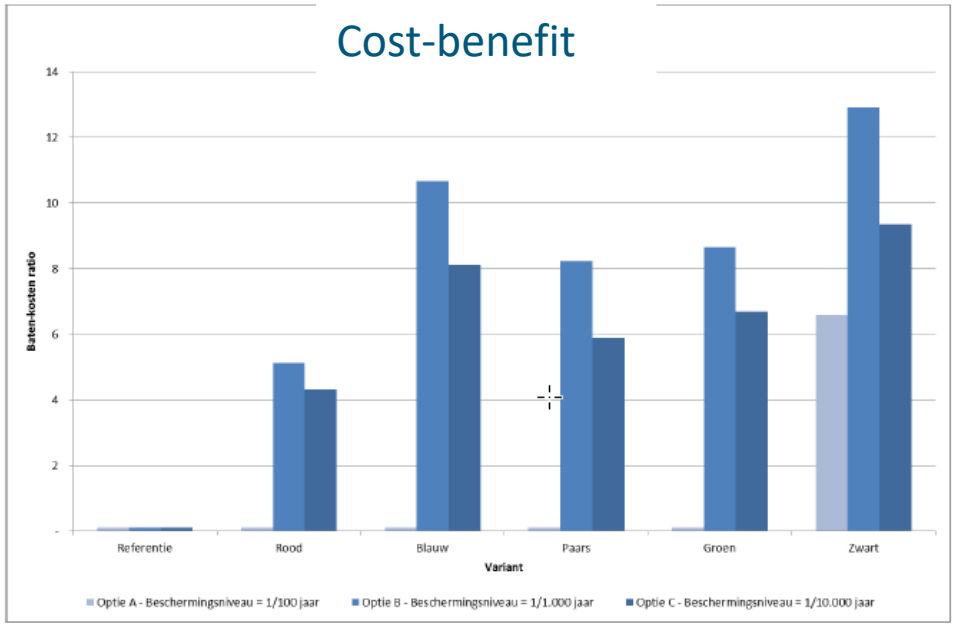
Flood proofing

Optimal investment:

- min costs and max. cost-benefit

- Use results assessment for prioritization



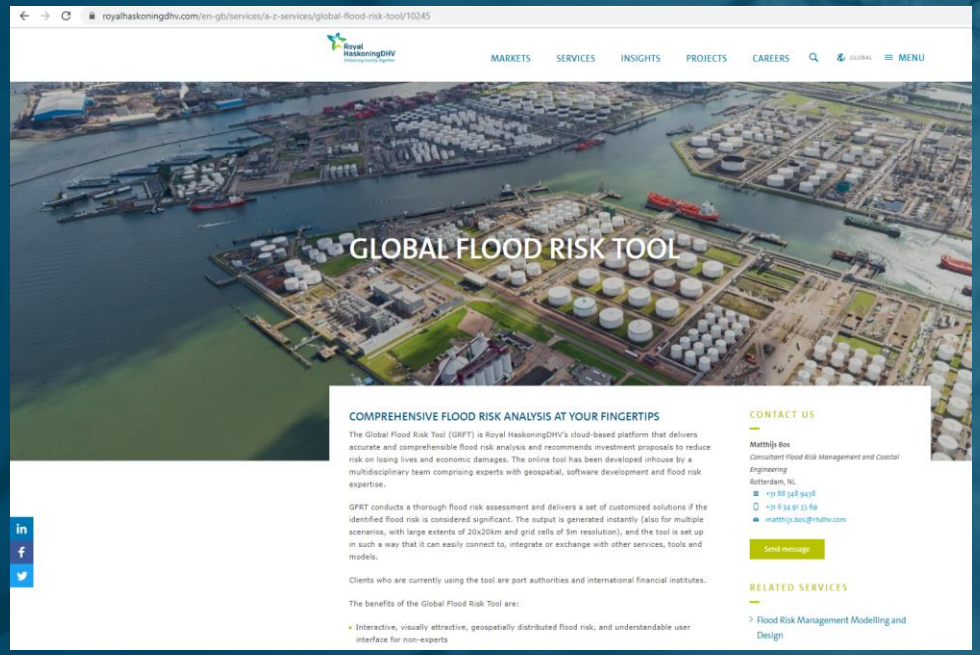


Figuur 7. Baten-kostenratio per variant voor drie dijkopties / beschermingsniveaus.

Thank you!

More information on:

https://www.royalhaskoningdhv.com/en-gb/services/a-z-services/global-flood-risk-tool/10245



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