

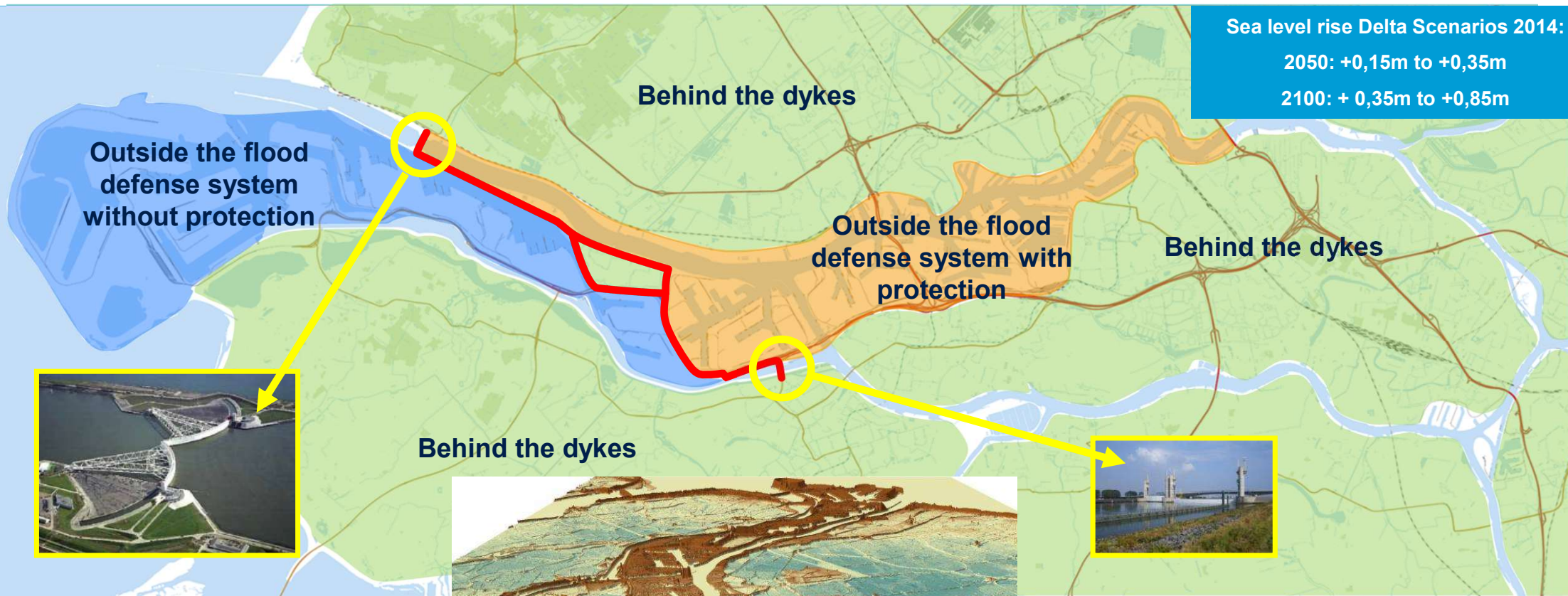
# FLOOD RISK MANAGEMENT IN PARTNERSHIP



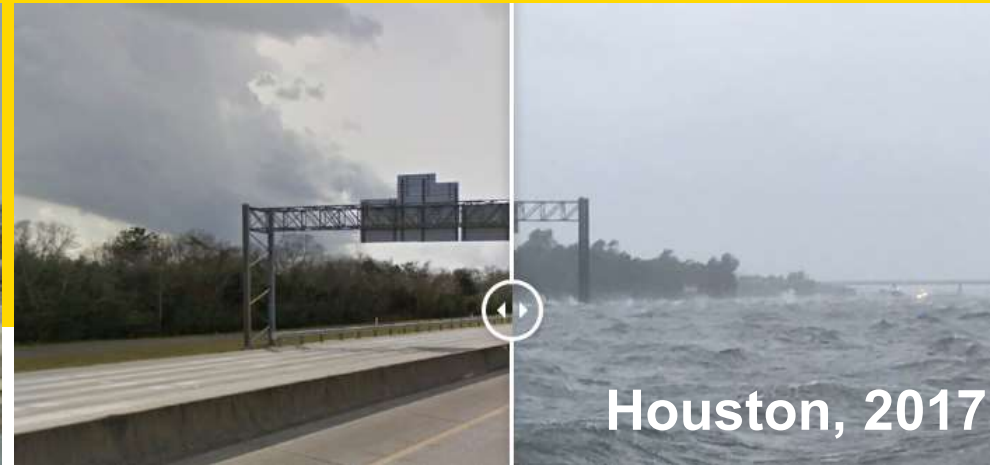
Marc Eisma, Weatherwise Cities, 3 November 2020

# Port of Rotterdam at present climate proof

## Port located outside the flood defense system, but heightened



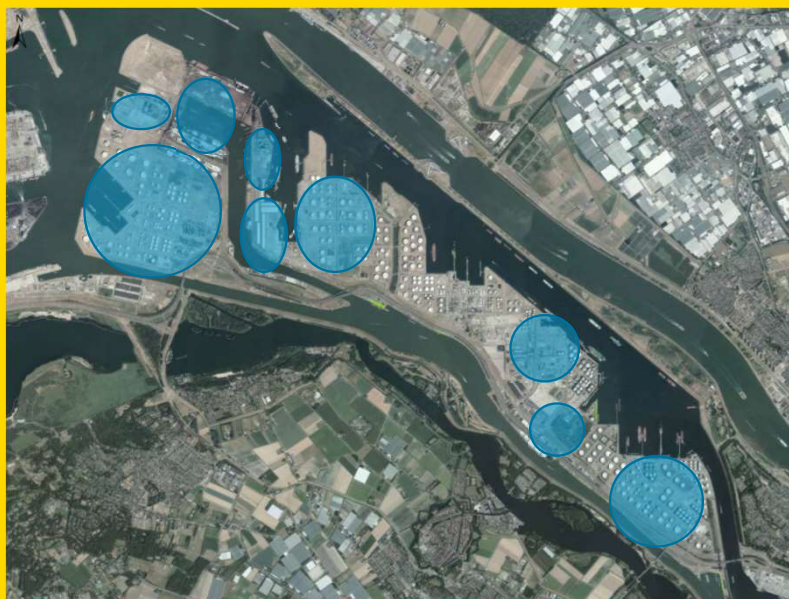
# Impact of flooding in industrial areas



# Stakeholder involvement right from the start

- Companies

- Chemical industry
- Refineries
- Tank terminals
- Distribution centres
- Dry bulk terminals
- Break bulk terminals
- Power plants
- etc.



- Public organisations:

- Municipality of Rotterdam
- Rotterdam-Rijnmond Safety Region
- Environmental Protection Agency
- Ministry of Water Management
- Rail and road authorities

- Utility owners

- Electricity
- Gas
- Water

# Approach and steps

- in partnership with companies and public organisations -

## Approach:

- Creating awareness
- Information sharing + visualisation
- Joint Fact Finding
- Create common language and commitment!

## Steps:

- Flood risk analysis
- Impact assessment (*workshop with stakeholders*) + applying flood risk assessment framework
- Jointly building a flood risk adaptation strategy (*workshop with stakeholders*)

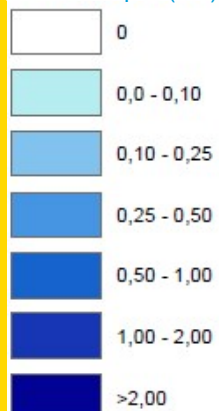


# Waal-Eemhaven flood risk analysis

Water depth 2015 ( 1/1.000 year storm)\*

## Legend

Water depth (cm)

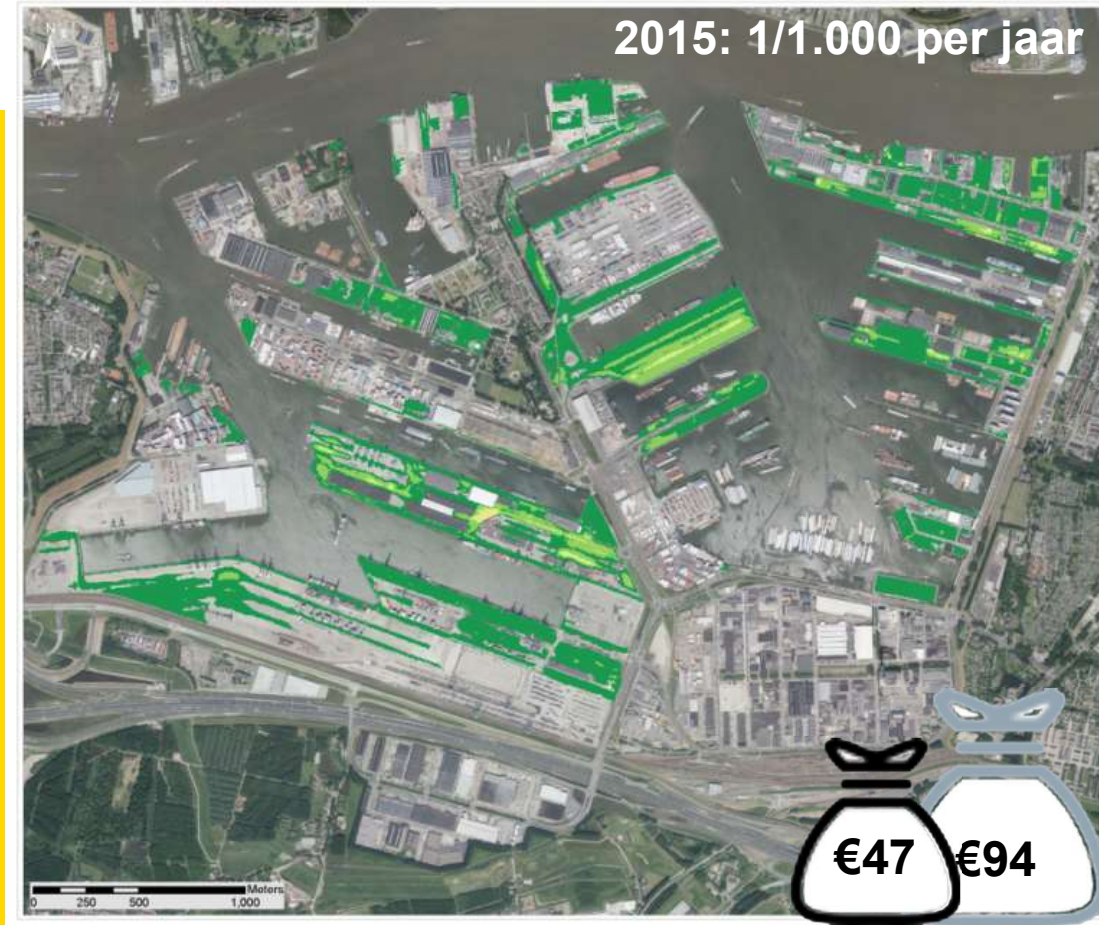


\* Dutch Flood event 1953: 1/300 year storm



# Impact assessment

- Assessment of impact on:
  - (Deadly) casualties
  - Economy (direct and indirect)
  - Environment (air, water, soil)
 Social disruption
- Quantitative approach (modelling of direct and indirect economical impact)
- Qualitative approach (workshops and interviews with stakeholders)



 Direct effect [mln €]
  Total effect [mln €]



# Interpretation of the results

- Outside the flood defence system: no legislation or standards
- Different approaches possible, compare the results with e.g.:
  - Inside flood defence systems (“behind the dykes”)
  - Other international seaports (Houston, Singapore, Hamburg, etc.)
  - Safety standards for external safety of companies
  - Company risk management schemes

| KANS         | VEILIGHEID                             | BETROUWBAARHEID                    | DOELMATIGHEID  | JURIDISCH   | MILIEU                                 | IMAGO                          | Vrijwel   | Overeenkomstig | Mogelijk | V/sarschijnlijk | 10 Jaarlijk | Jaarlijk    | Maandelijkse | Wekelijkse  | Dagelijkse | Permanet |
|--------------|--|------------------------------------|----------------|---|--|--------------------------------|-----------|----------------|----------|-----------------|-------------|-------------|--------------|-------------|------------|----------|
|              |  |                                    |                |   |  |                                | Omgegeven | Wol een van    | Meerdere | Wol een         | meerdere    | omkeken per | son per week | son per dag | meerdere   |          |
| EFECT        |  |                                    |                |   |  |                                | <0,0000%  | >0,0000%       | >0,0000% | >0,01           | >0,1%       | >1%         | >10%         | >50%        | >3000%     | >10000%  |
| Catastrofaal | Eerstig blijvend letsel dodelijk       | > >100% boven landelijk gemiddelde | > 100.000 Euro | Strafbare feiten<br>Aansprakelijkheid: 100.000 Euro<br>Internationale concessie   | Onkerstelbaar/omvangrijke milieuschade | Langdurige nationale sandscht  |           |                |          |                 |             |             |              |             |            |          |
| Eerstig      | Eerstig letsel arb. ongeschiktheid     | 100 % boven landelijk gemiddelde   | > 50.000 Euro  | Vernietigbaar handels<br>Aansprakelijkheid: 50.000 Euro<br>Strafkorting EK        | Eerstige milieuschade                  | Kortdurende nationale sandscht |           |                |          |                 |             |             |              |             |            |          |
| Behoorlijk   | Licht letsel meer dan 10 dagen verzuim | 50 % boven landelijk gemiddelde    | > 10.000 Euro  | Aansprakelijkheid: 10.000 Euro<br>Aansprakelijkheid: 50.000 Euro<br>Onderzoek OoV | Overstrijden van milieunormen          | Langdurende regionale sandscht |           |                |          |                 |             |             |              |             |            |          |
| Matig        | Licht letsel 6-10 dagen verzuim        | 20 % boven landelijk gemiddelde    | > 5.000 Euro   | Aansprakelijkheid: 5.000 Euro<br>Kritische brief EK                               | Emissie met meldingsplicht             | Kortdurende regionale sandscht |           |                |          |                 |             |             |              |             |            |          |
| Klein        | Licht letsel 1-5 dag verzuim           | Op landelijk gemiddelde            | > 1.000 Euro   | Aansprakelijkheid: 1.000 Euro   | Emissie op grensoverk meldingsplicht   | Kleinischalig (Straat)         |           |                |          |                 |             |             |              |             |            |          |
|              | Invalidee minder                       | Minder landelijk                   |                | Aansprakelijkheid   | Geringe emissie                        |                                |           |                |          |                 |             |             |              |             |            |          |

|            |            |                        | Impact              |                                   |  |                           |
|------------|------------|------------------------|---------------------|-----------------------------------|--|---------------------------|
|            |            |                        | 0                   | 1                                 | 2  | 3                         |
|            |            |                        | Acceptable          | Tolerable                         | Unacceptable                                   | Intolerable               |
|            |            |                        | Little or No Effect | Effects are Felt but Not Critical | Serious Impact to Course of Action and Outcome | Could Result in Disasters |
| Likelihood | Improbable | Risk Unlikely to Occur |                     |                                   |  |                           |
|            | Possible   | Risk Will Likely Occur |                     |                                   |  |                           |
|            | Probable   | Risk Will Occur        |                     |                                   |  |                           |



# Flood risk assessment framework

## 1. Definition of Limit State for a specific object

Difference between 2 Limit States:  
Functionality (Service Limit State - SLS):

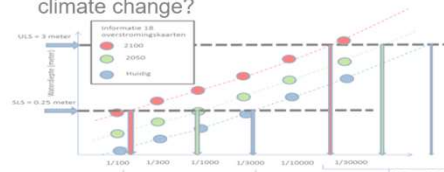


Failure (Ultimate Limit State - ULS):



## 2a. Determine SLS / ULS

What is the chance that a SLS or ULS takes place in the present time and how does it change in time as a result of climate change?



## 3. Assessment if the object meets the SLS / ULS during its life span

Based on public assessment frameworks  
(inside the flood defence system, “behind the dykes”)

**Example ULS:** Oil tank is damaged and causes environmental contamination of the surrounding area due to leakage of oil out of a tank. Repair will cost a lot of money and months of work.



What are the consequences of exceeding the SLS / ULS?  
How acceptable is this?

| Acceptable kans (1 jaar) | Totaal aantal dodelijke slachtoffers | Totale economische schade (in miljard Euro) | Maximale ruimtelijke schaal met overstroming (rucht, water, bodem) |
|--------------------------|--------------------------------------|---|--|
| 1/100                    | 1                                    | 0.1   | < 100m   |
| 1/1.000                  | 10                                   | 1   | < 1 km   |
| 1/10.000                 | 100                                  | 10  | < 10 km  |
| 1/100.000                | 1000                                 | 100   | < 100 km   |

**Result: acceptable SLS / ULS of an object**

2015      2050      2100

Result: insight if an object meets the acceptable SLS / ULS and if not, when does it become unacceptable in time (e.g. in 2060 in example above).

# Application of the assessment framework

- comparison of the impact with the acceptable level of risk -

| Pieren               | 2015   | 2050   | 2100   |
|----------------------|--------|--------|--------|
| Sluisjesdijk         | Green  | Yellow | Red    |
| Pier 1               | Green  | Yellow | Red    |
| Pier 2               | Green  | Yellow | Red    |
| Pier 4               | Green  | Yellow | Red    |
| Pier 6               | Green  | Green  | Yellow |
| Pier 7               | Red    | Red    | Red    |
| Pier 8               | Green  | Green  | Red    |
| RDM                  | Green  | Green  | Red    |
| Eemhavenweg          | Green  | Green  | Yellow |
| Bunschotenweg        | Green  | Green  | Green  |
| Den Hamweg           | Yellow | Red    | Red    |
| Eemnesweg            | Green  | Green  | Yellow |
| Noord Vondelingenweg | Green  | Green  | Yellow |
| Streefwaalseweg      | Green  | Green  | Green  |

## TRAFFIC LIGHT



impact = still acceptable

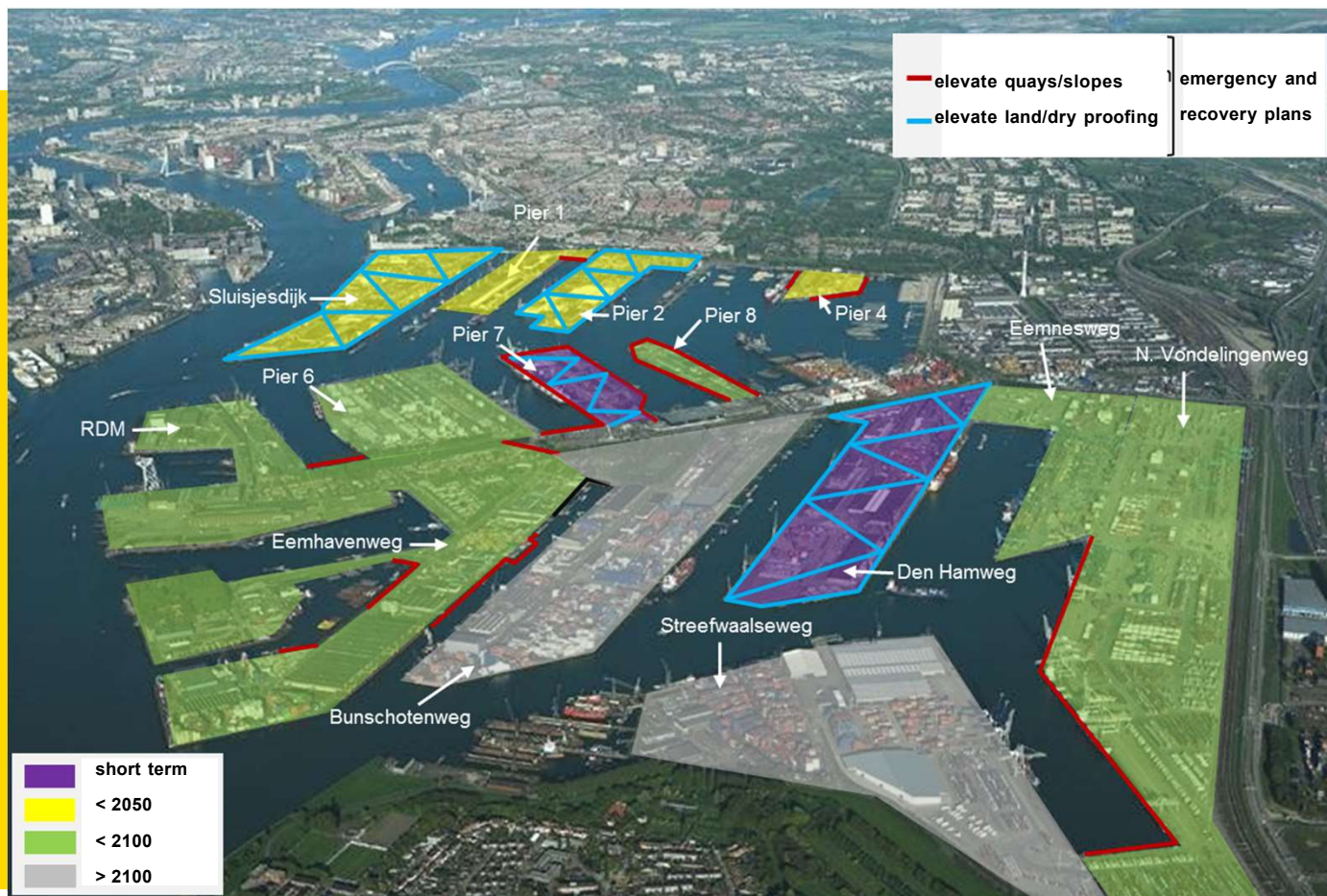


impact = close to unacceptable



impact = unacceptable

# Waal-Eemhaven flood risk adaptation strategy



## “Risk dialogue”

- Combining preventive measures with spatial adaptation and emergency response.
- Gives insight in necessity of collaborative approach.
- Commitment and first steps to jointly follow up on the strategy.

**A safe port, now and in the future!**

