DEME

Dredging, Environmental
& Marine Engineering

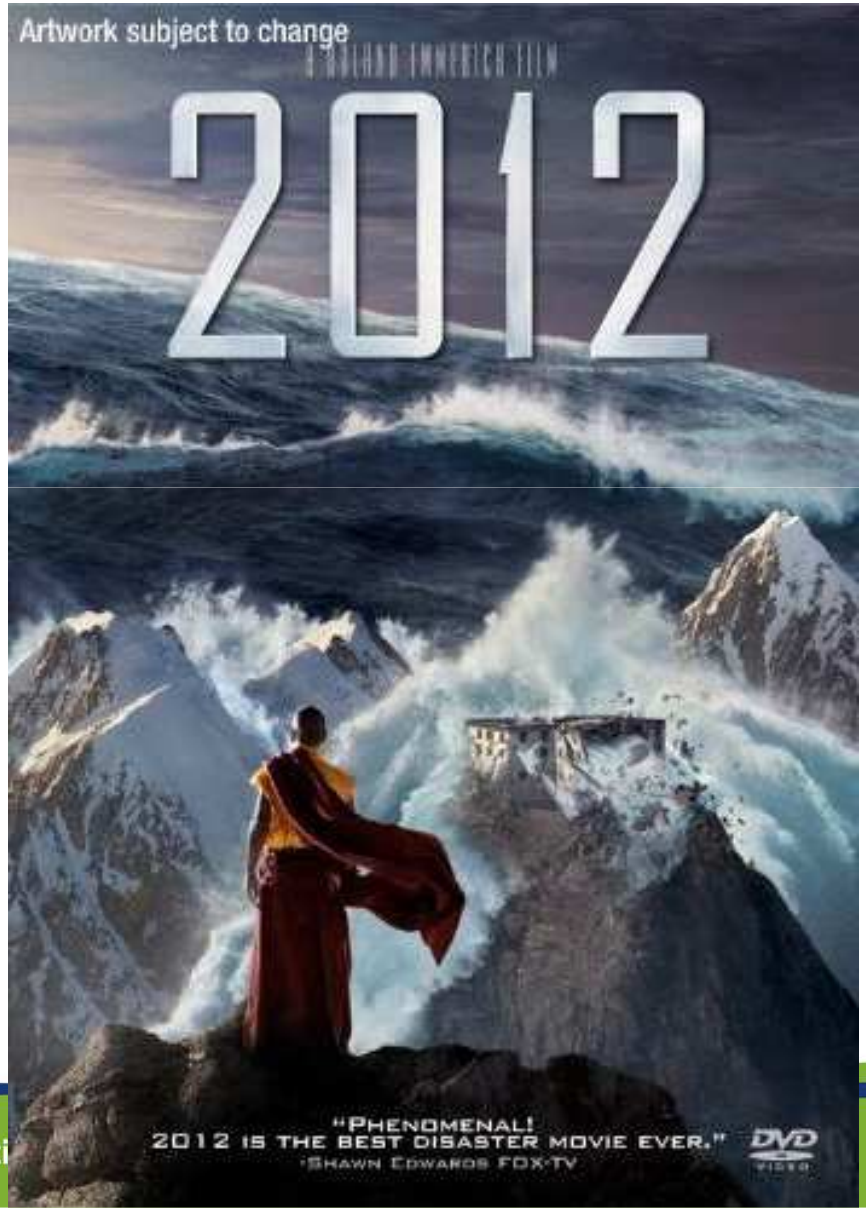
Natural Disasters – A Dredger's View

16 November 2011, Sheraton Brussels Airport Hotel

Dr. Erik Van Wellen – DEME Chief Technology Officer

Creating land for the future

How timely are we?



- if we follow the Mayan calendar:
  - 401 days to go…

A quick word on definitions

- Natural phenomenon -- natural hazard -- natural disaster

  Natural phenomenon:
  physical processes such as earthquakes, storms, floods, …

  Natural hazard = natural phenomenon in populated area

  Natural disaster = is effect of natural hazard leading to financial, environmental or human losses

- Remarks:
  - "Natural": man induced floods, storms due to global warming, …
  - disasters occur when hazards meet vulnerability: the resulting loss depends on the vulnerability of the affected population to resist the hazard.

- http://www.oas.org/DSD/publications/Unit/oea54e/ch05.htm
- http://en.wikipedia.org/wiki/Natural_disaster

A quick word on chances:

- Consequence of occurrence:
  - Represents the impact of the event occurring

- Likelihood:
  - Probability of occurrence:
    - The chance of a singular event compared to the population of events
  - Frequency of occurrence:
    - The expected number of occurrences in a given time frame

Likelihood is…

- Let's first start with taking a look at the issue of likelihood

- They load one chamber
- Spin the cylinder
- Pull the trigger
- Spin the cylinder again (if one is still around) and it all continues…

Likelihood is…

If “lucky” = getting killed. … then:

- The likelihood of Robert De Niro getting “lucky” on the first spin is 1/6 or 16.7%
- The likelihood of him getting “lucky” on the 10th individual spin is also 1/6 or 16.7% on that individual event

- The likelihood of getting “lucky” in a row of 6 on any of the attempts is: 1-(1-1/6)^6 = 66.5%
- The likelihood of getting “lucky” in a row of 25 on any of the attempts is: 1-(1-1/6)^25 = 99%

What does this teach us on coastal disasters?

- The 1/100 year storm or tide event could happen tomorrow… or the day after, or…
- If we spin the cylinder faster we tend to get “lucky” faster…
  - Or putting it differently: placing something with a 35 year design life in the path of 1/100 year return period event gives you a 30% chance of getting “lucky”

What does this teach us on coastal disasters?

- The 1/100 year storm or tide event could happen tomorrow… or the day after, or…
- If we spin the cylinder slower we tend to get "lucky" slower…
  - Or putting it differently: placing something with a 35 year design life in the path of 1/100 year return period event gives you a 30% chance of getting "lucky"
  - Or putting it differently: placing something with a 35 year design life in the path of 1/1000 year return period event gives you a 3.5% chance of getting "lucky"
    - But accepting a mere 3.5 year design life gets you just as lucky (3.5%) for the 1/100 year return period

⇨ reduction of getting "lucky" = increase of initial investment

Is the Irish Sea getting stormier?

- Hedges, T.S. (1993), Rising Sea Level: Some Implications for Beaches and Coastal Structures, in **Rising Sea Level and Coastal Protection**, Seminar Report, Belfast 22nd April 1993, Oceanography Laboratories, University of Liverpool: 24-34.

⇨ The Irish Sea appeared to be getting stormier

(was Robert De Niro spinning the cylinder faster?)

Or the likelihood of the natural hazard increases

What risks are we looking at here?

- Risk of storm induced damage
- Risk of increases tidal reach
- Joined risk thereof

Something on the increasing risk of Disasters

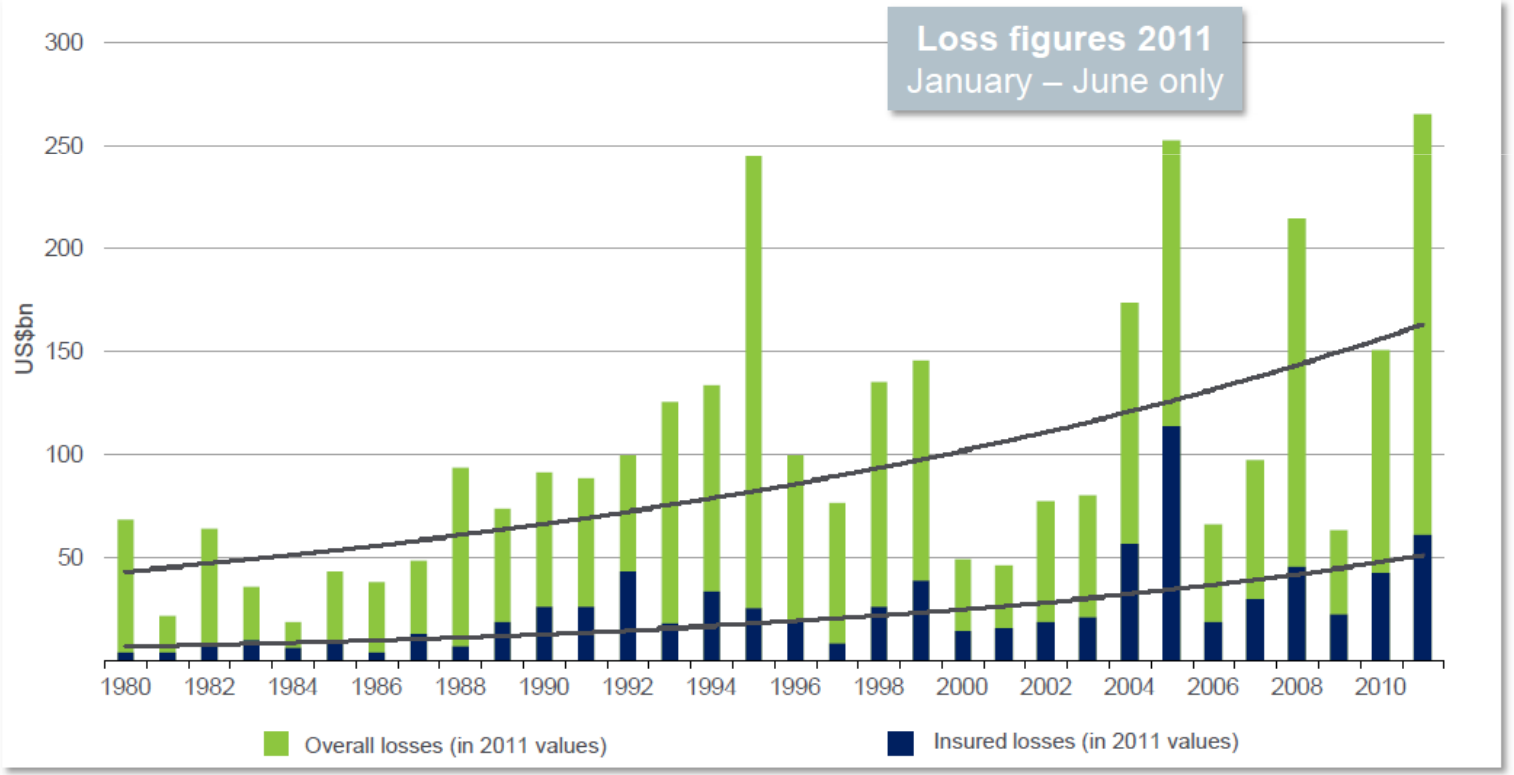
Global Natural Catastrophe Update

Worldwide Natural Disasters 1980 – 2011

Overall and Insured Losses

Munich RE

Losses in 2011: Overall = US$ 265bn ; Insured = US$ 60bn



Source: MR NatCat*SERVICE*

Something on the increasing risk of Disasters

Global Natural Catastrophe Update

Natural Catastrophes, 2011

Overview and comparison with previous years

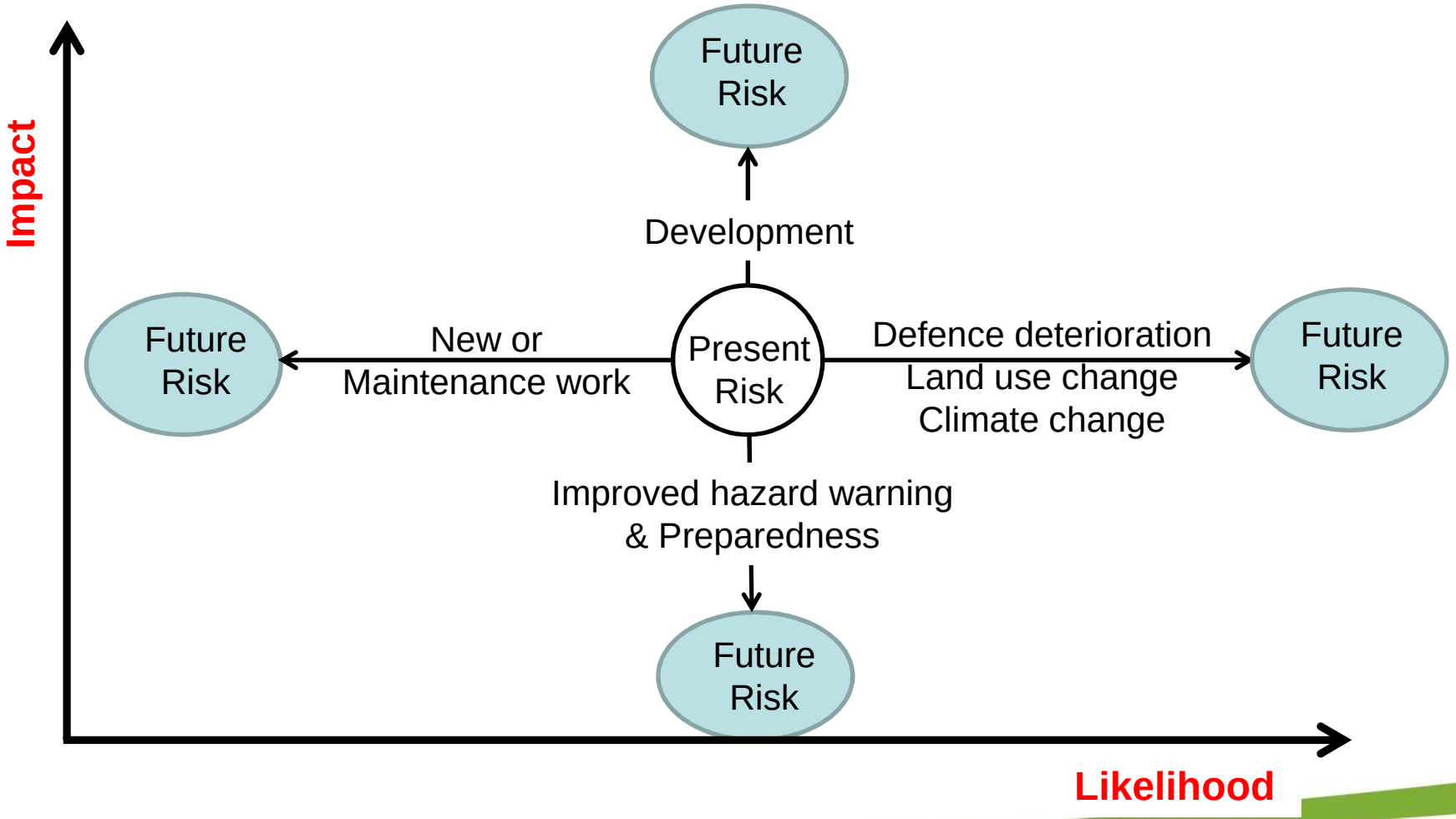
Munich RE

	2011 (Jan – June)	2010 (Jan – June)	Average of the last 10 years 2001-2010 (Jan – June)	Average of the last 30 years 1981-2010 (Jan – June)	Top Year 1981 -2010 (Jan – June)
Number of events	355	480	390	310	2007
Overall losses in US$m (original values)	265,000	97,200	47,400	36,400	1995 (EQ Kobe)
Insured losses in US$m (original values)	60,000	26,900	12,100	8,200	1994 (EQ, US Northridge)
Fatalities	19,380	230,300	52,900	42,700	2010 (EQ Haiti)

Source: MR NatCat*SERVICE*

30

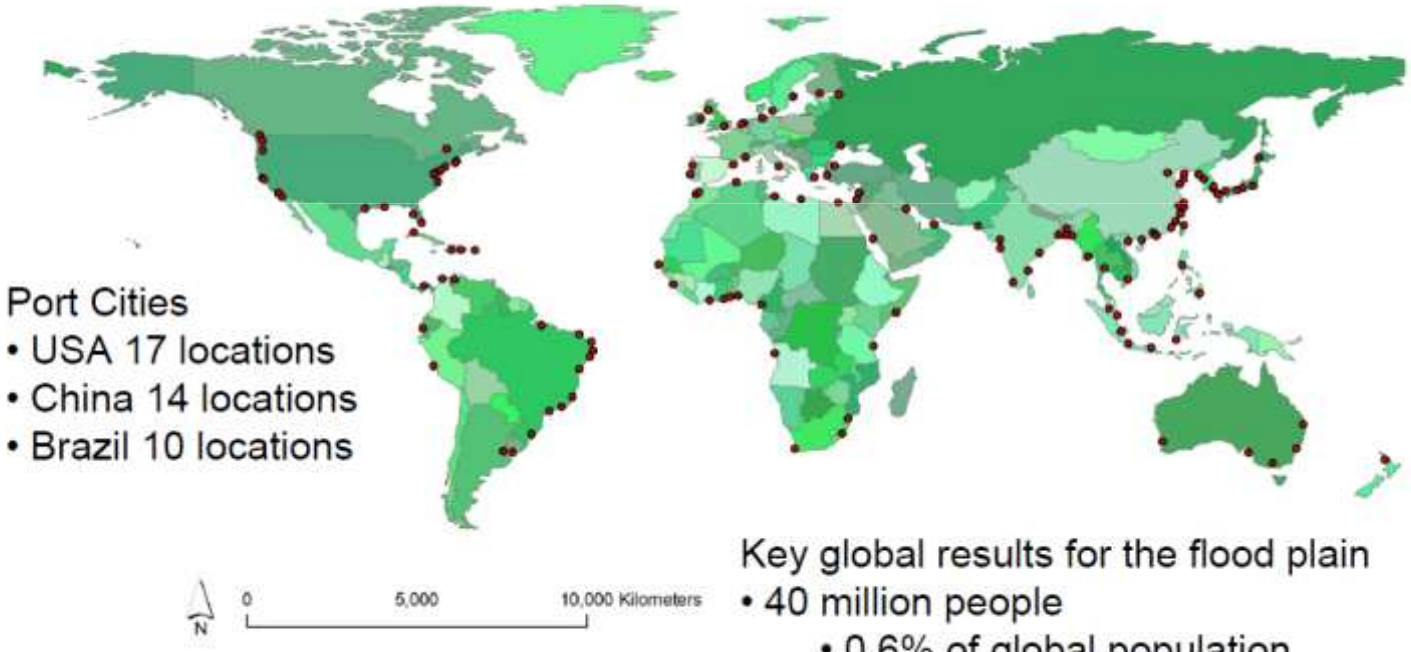
What factors may influence these future risks?



Where are assets going?

Port City Locations

≥1 million population in 2005
136 locations

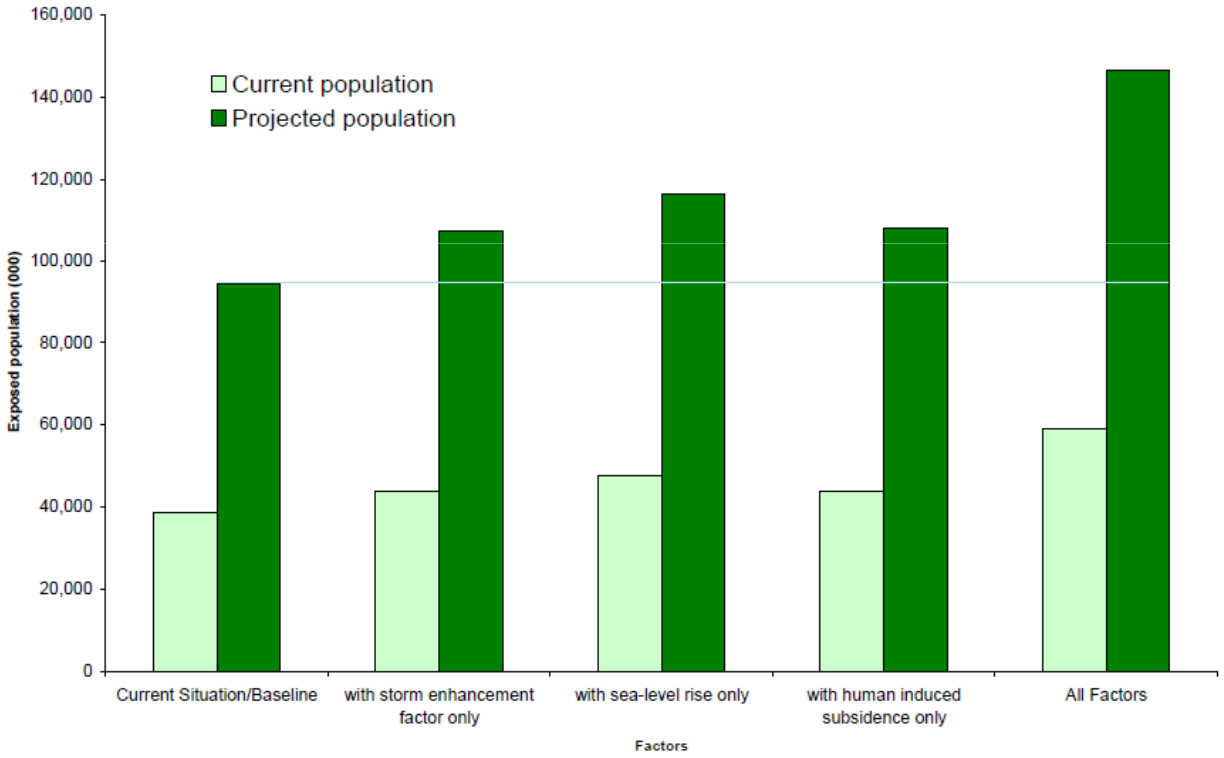


Key global results for the flood plain
- 40 million people
  - 0.6% of global population
  - (10% of port city population)
- US $3000 billion of assets
  - 5% of global GDP

Prof Robert J. Nicholls, University of Southampton

Global Population Exposure

Influence of different change factors: 2005 to 2070s



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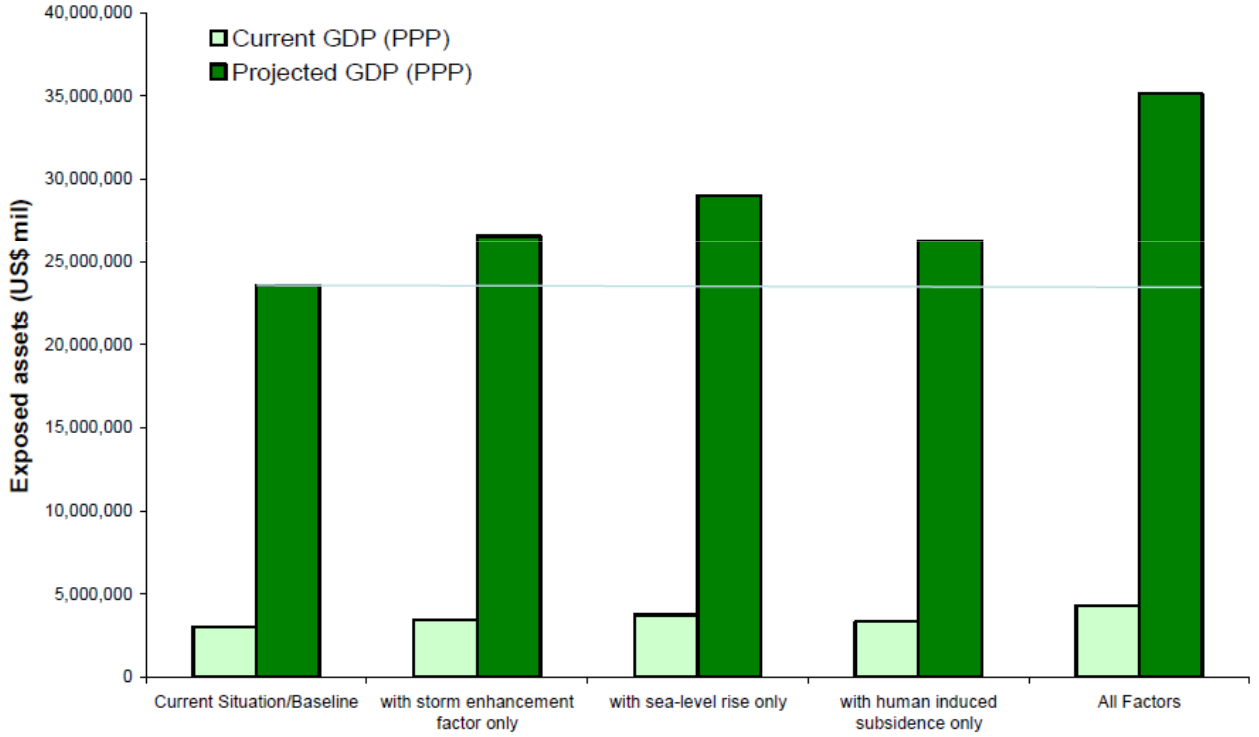
Global Asset Exposure

Influence of different change factors: 2005 to 2070s



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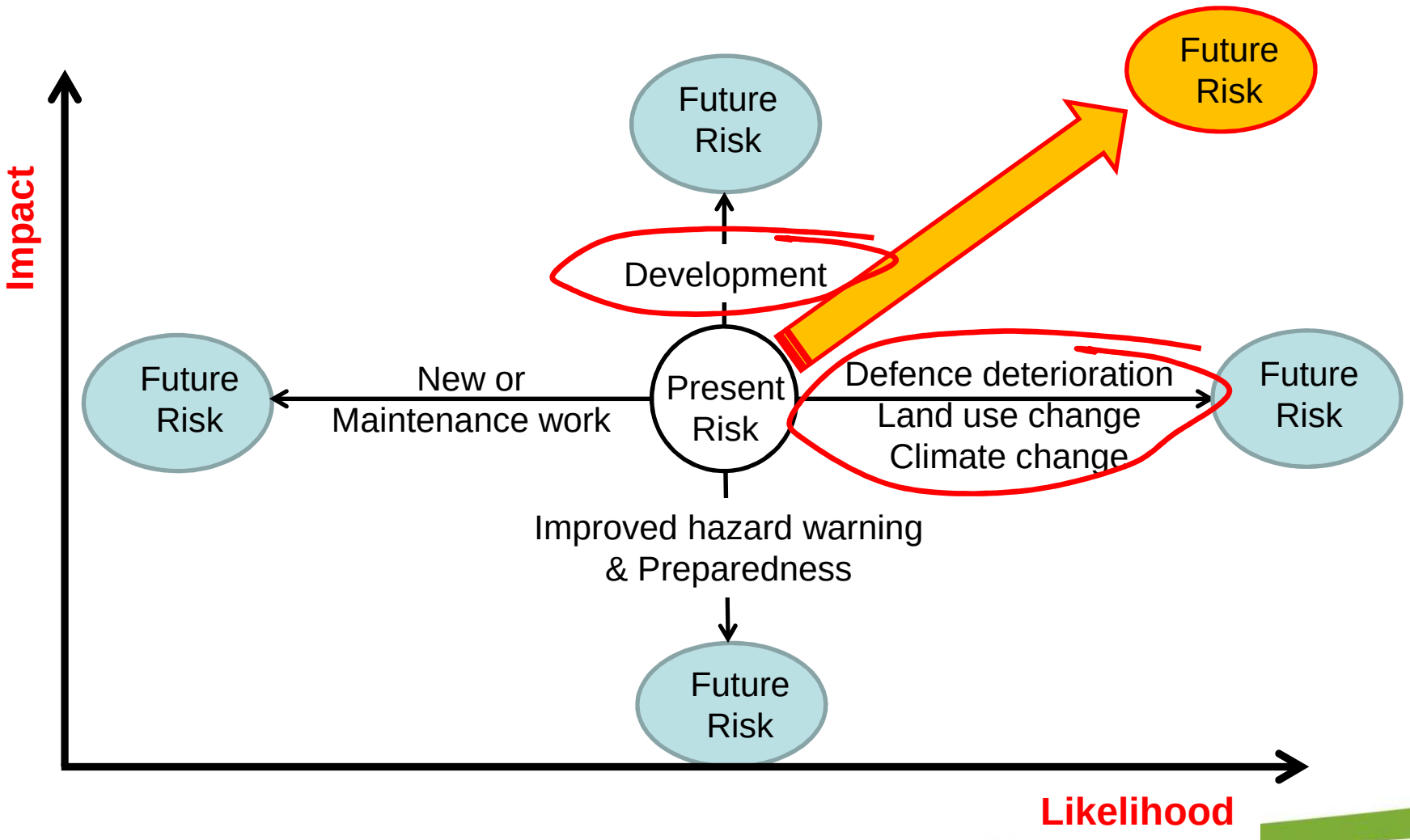
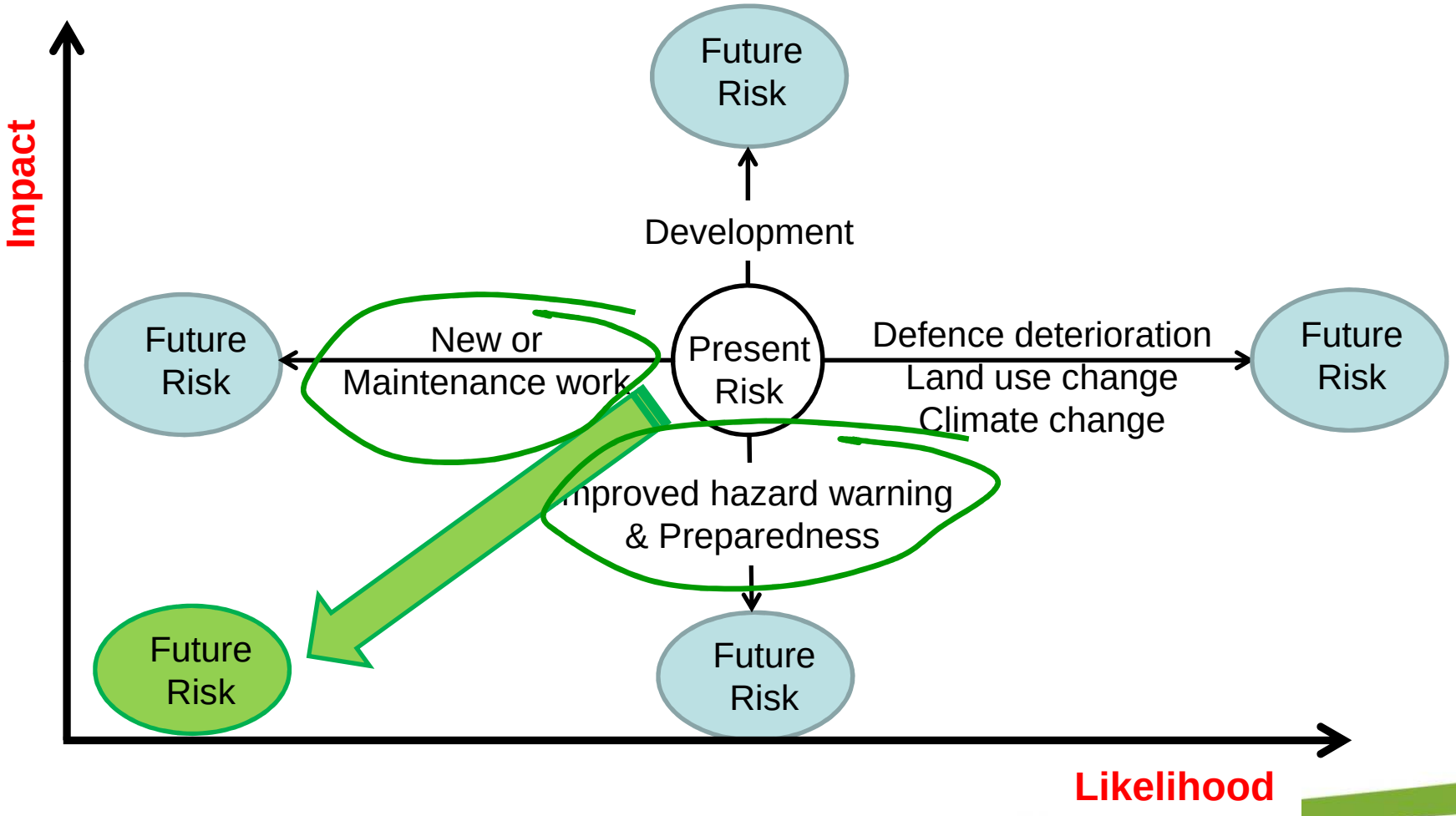
Resulting effect on the risk?



Where can dredging fit in?



A dredger's view on this:

- New or Maintenance work
  - Increase height of river & sea defences
    - Hard/soft
  - Increase bed roughness
  - Offshore breaker/feeder berms & other submerged structure
- Improved hazard warning Preparedness
  - Increase holding potential of rivers & flood planes
  - Increase & maintain water evacuation potential of waterways
  - Increase detection capability

Increase height of river & sea defences

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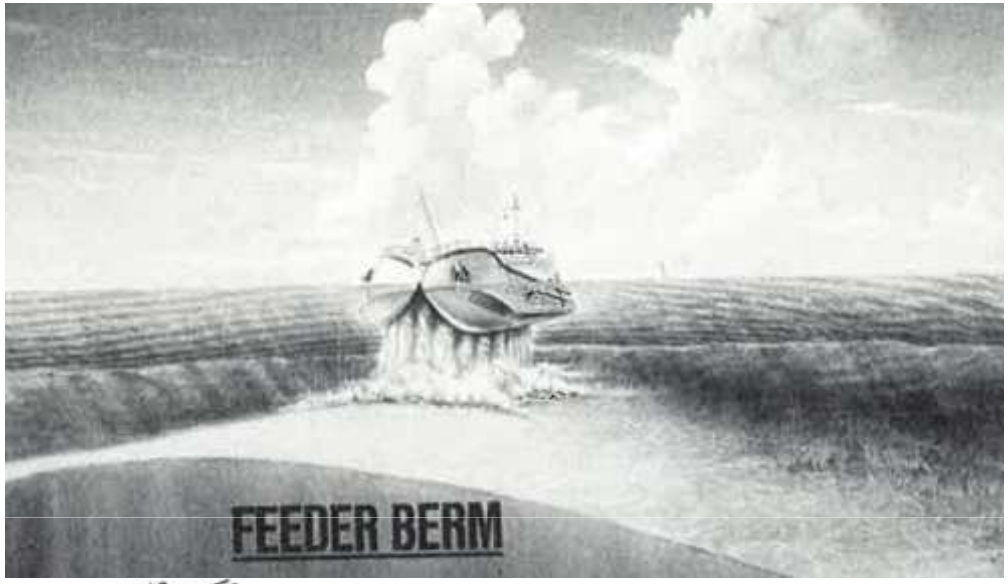
Increased bed roughness

Offshore breaker/feeder berms & other submerged structures



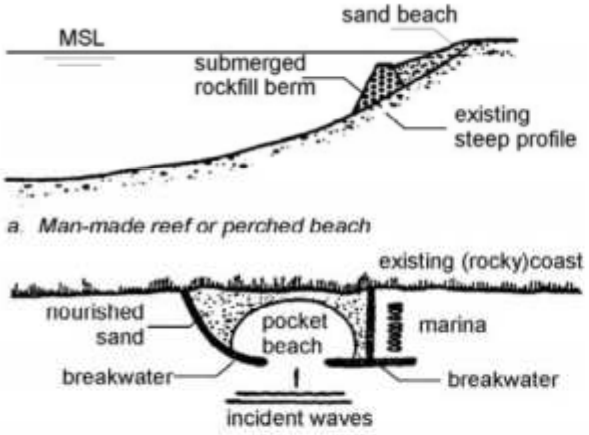


Fig. 1 Examples of low-crested structures

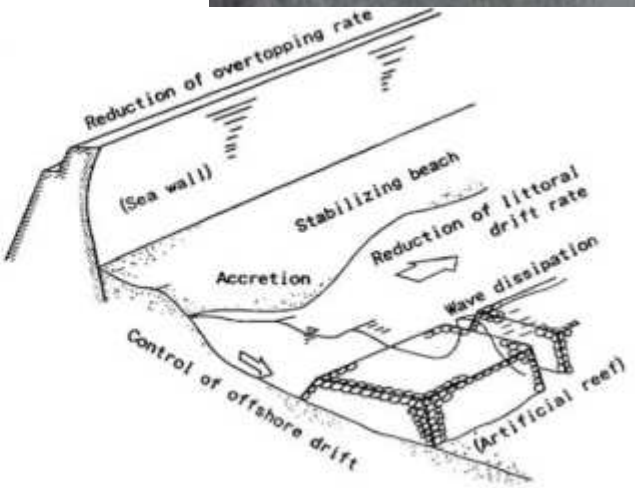
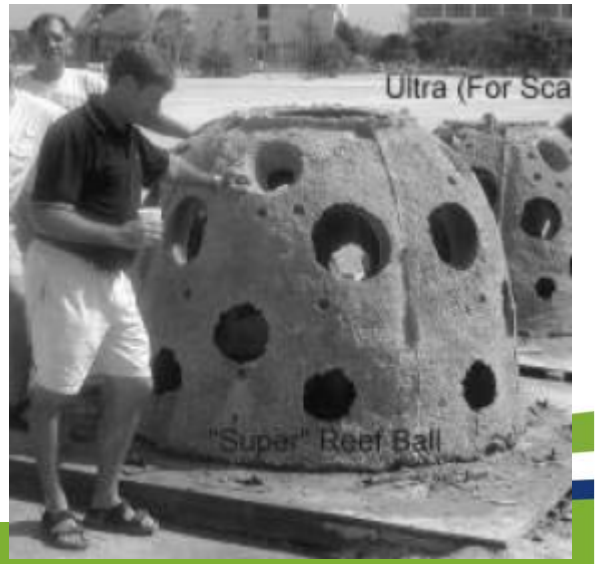


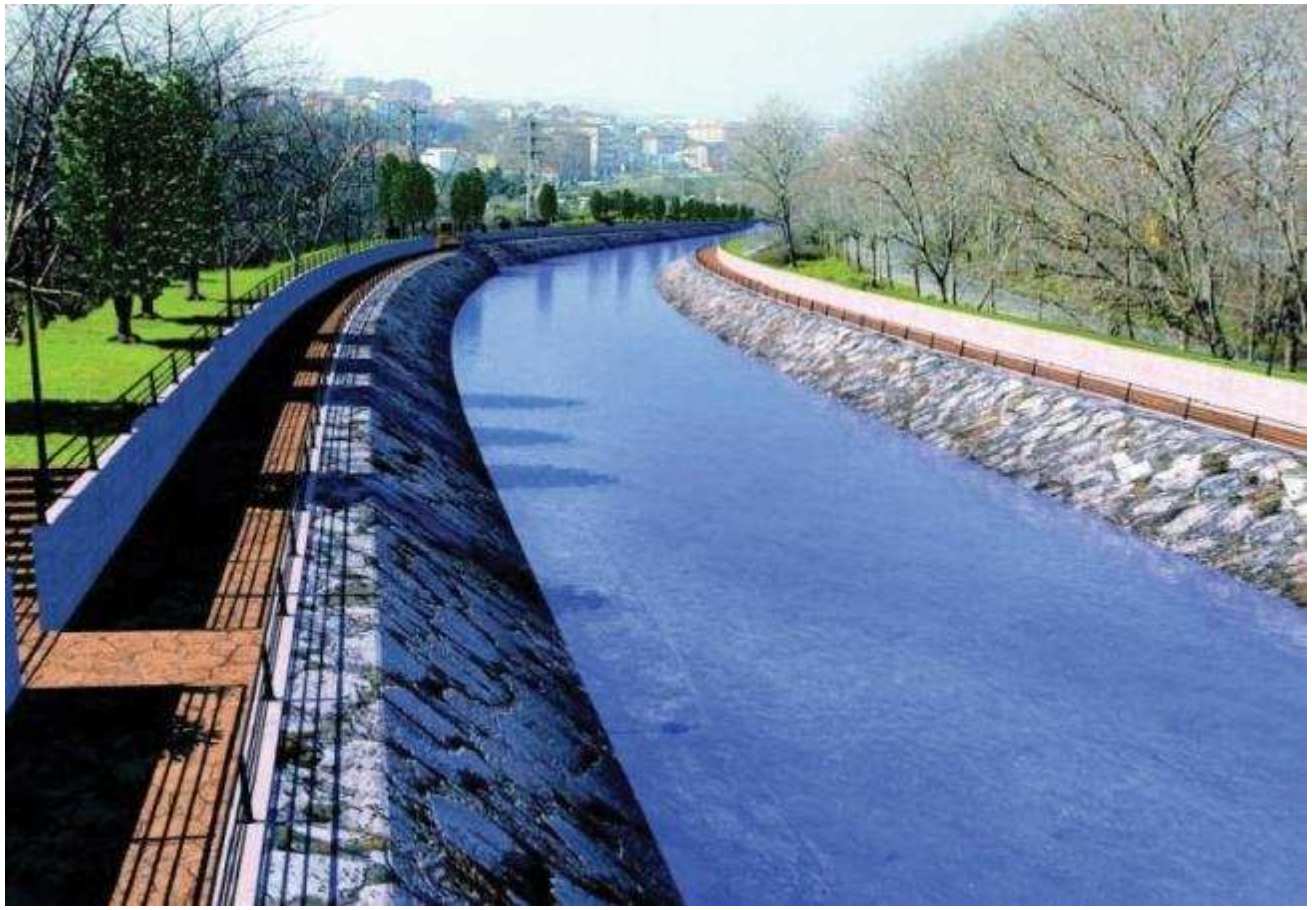
Fig. 2 Objectives of artificial reefs



Increase holding potential of rivers & flood planes

Increase & maintain water evacuation potential of waterways

Increase & maintain water evacuation potential of waterways



Increase & maintain water evacuation potential of waterways

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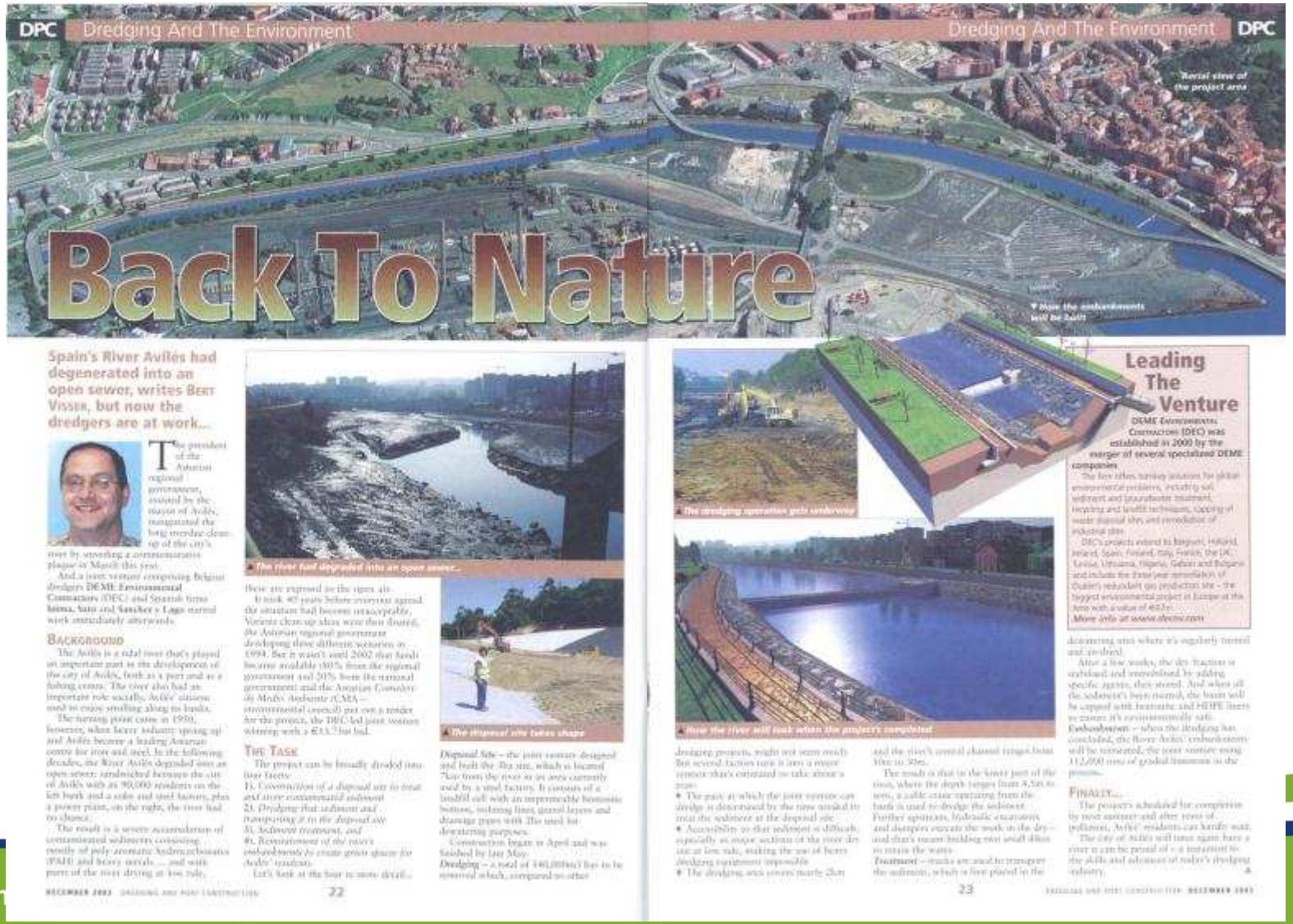


DPC Dredging And The Environment

Back To Nature

Spain's River Avilés had degenerated into an open sewer, writes Bert Visser, but now the dredgers are at work...

The president of the Asturian regional government, assisted by the mayor of Avilés, inaugurated the big overdue clean-up of the city's river by unveiling a commemorative plaque in March this year.

And a joint venture comprising Belgian dredgers DEME Environmental Contractors (DEC) and Spanish firms Isolux, Sato and Sánchez y Lago started work immediately afterwards.

Background

The Avilés is a tidal river that's played an important part in the development of the city of Avilés, both as a port and as a fishing centre. The river also had an important role socially. Avilés' citizens used to enjoy strolling along its banks.

The turning point came in 1950, however, when heavy industry sprang up and Avilés became a leading American centre for iron and steel. In the following decades, the River Avilés degraded into an open sewer, sandwiched between the city of Avilés with its 90,000 residents on the left bank and a coke and steel factory, plus a power plant, on the right, the river had no chance.

The result is a severe accumulation of contaminated sediments consisting mostly of poly aromatic hydrocarbons (PAH) and heavy metals ... and with most of the river drying at low tide, these are exposed to the open air.

It took 40 years before everyone agreed the situation had become unacceptable. Various clean-up ideas were then floated, the Asturian regional government developing three different scenarios in 1994. But it wasn't until 2002 that funds became available (80% from the regional government and 20% from the national government and the Asturian Consejería de Medio Ambiente (CMA – environmental council) put out a tender for the project, the DEC-led joint venture winning with a €13.7m bid.

▲ The river had degraded into an open sewer...

▲ The disposal site takes shape

The Task

The project can be broadly divided into four facets:

1). *Construction of a disposal site to treat and store contaminated sediment*

2). *Dredging that sediment and transporting it to the disposal site*

3). *Sediment treatment, and*

4). *Reinstatement of the river's embankments to create green spaces for Avilés' residents.*

Let's look at the four in more detail...

Disposal Site – the joint venture designed and built the 3ha site, which is located 7km from the river as an area currently used by a steel factory. It consists of a landfill cell with an impermeable bentonite bottom, sealing liner, gravel layers and drainage pipes with 2m steel bar dewatering purposes.

Construction began in April and was finished by late May.

Dredging – a total of 440,000m³ has to be removed which, compared to other dredging projects, might not seem much. But several factors turn it into a more complex task's estimated to take about a year:

- The pace at which the joint venture can dredge is determined by the time needed to treat the sediment at the disposal site.
- Accessibility to that sediment is difficult, especially as major sections of the river dry out at low tide, making the use of heavy dredging equipment impossible.
- The dredging area covers nearly 2km and the river's central channel ranges from 30m to 50m.

The result is that in the lower part of the river, where the depth ranges from 4.5m to 10m, a cable crane operating from the bank is used to dredge the sediment. Further upstream, hydraulic excavators and dumpers execute the work in the dry – and that's meant building two small dikes to retain the water.

Treatment – trucks are used to transport the sediment, which is first placed in the dewatering area where it's regularly turned and aerated.

After a few weeks, the dry fraction is stabilised and remediated by adding specific agents, then stored. And when all the sediment's been treated, the basin will be capped with bentonite and HDPE liners to ensure it's environmentally safe.

Embankments – when the dredging has concluded, the River Avilés' embankments will be recreated, the joint venture using 112,000 tons of graded limestone in the process.

Finally...

The project's scheduled for completion by next summer and after tons of pollutant, Avilés' residents can hardly wait.

The city of Avilés will once again have a river it can be proud of – a testament to the skills and advances of today's dredging industry.

▲ The dredging operation gets underway

▲ How the river will look when the project's completed

Leading The Venture

DEME Environmental Contractors (DEC) was established in 2000 by the merger of several specialised DEME companies.

The firm offers turnkey solutions for global environmental problems, including soil, sediment and groundwater treatment, recycling and landfill techniques, capping of waste disposal sites and remediation of industrial sites.

DEC's projects extend to Belgium, Holland, Ireland, Spain, Finland, Italy, France, the UK, Latvia, Lithuania, Nigeria, Gabon and Bulgaria and include the three-year remediation of Dublin's redundant gas production site – the biggest environmental project in Europe at the time with a value of €42m.

More info at www.deme.com

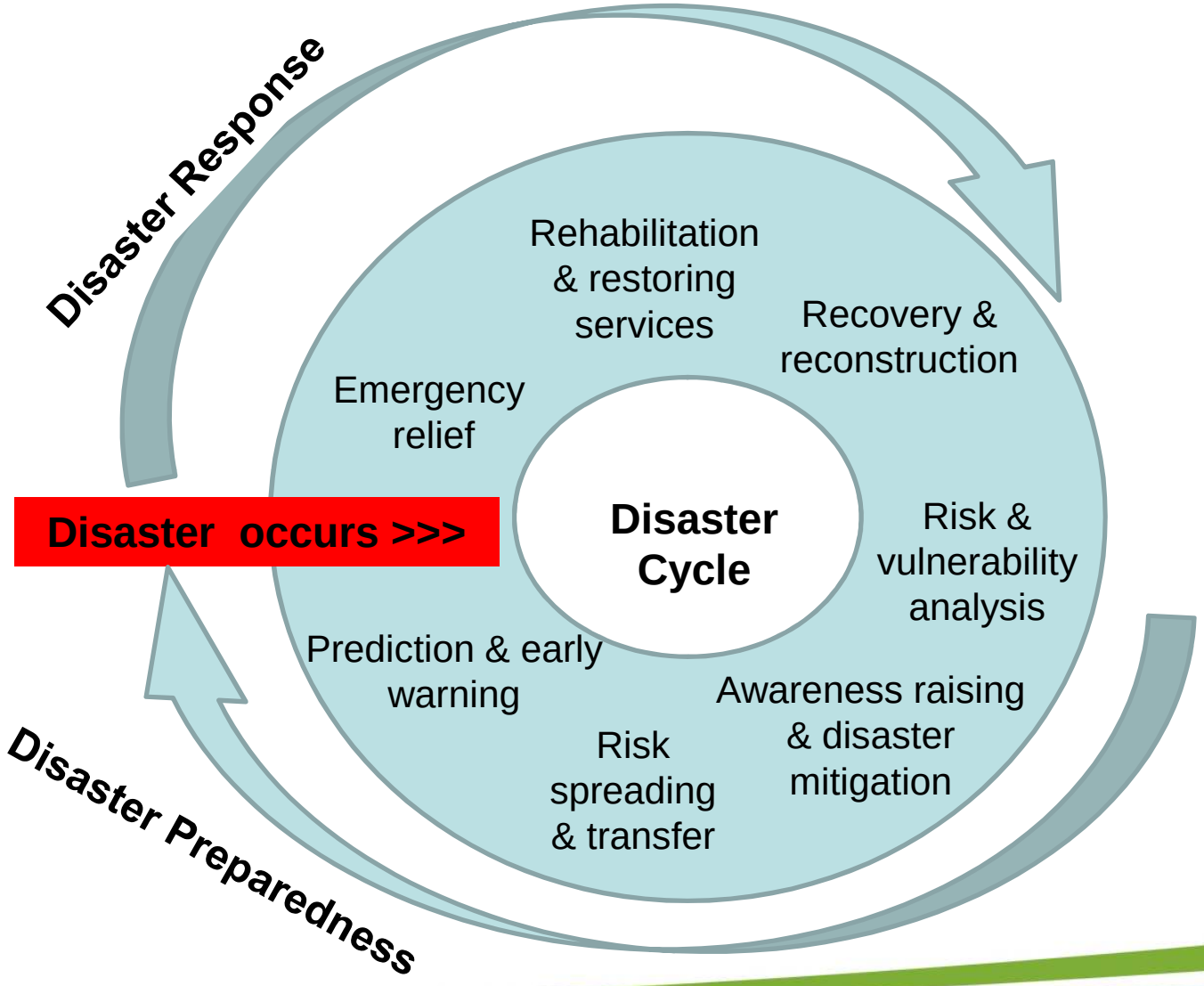
Increase detection capability

- Met ocean data gathering stations combined with the renewable energy parks would cover significant parts of the seas towards often densely populated area

Cfr tsunami warning system

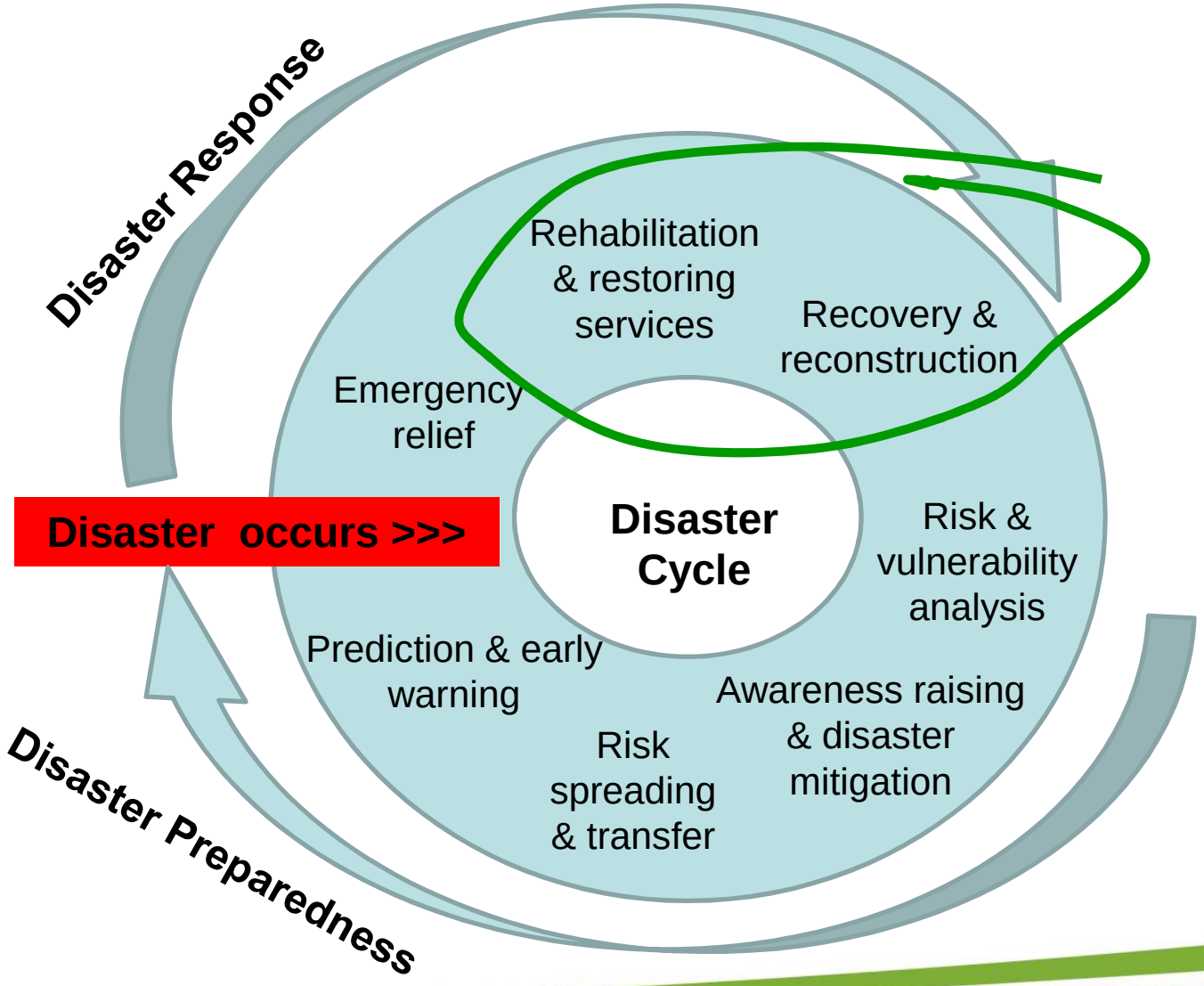
Who (likes to) pay(s) for insurance? …. And when?

What if it does all go wrong?



The disaster cycle of disaster management continuum (after Warner K 2002 The role of Governments in the Disaster Cycle and Disaster Finance)

What if it does all go wrong?

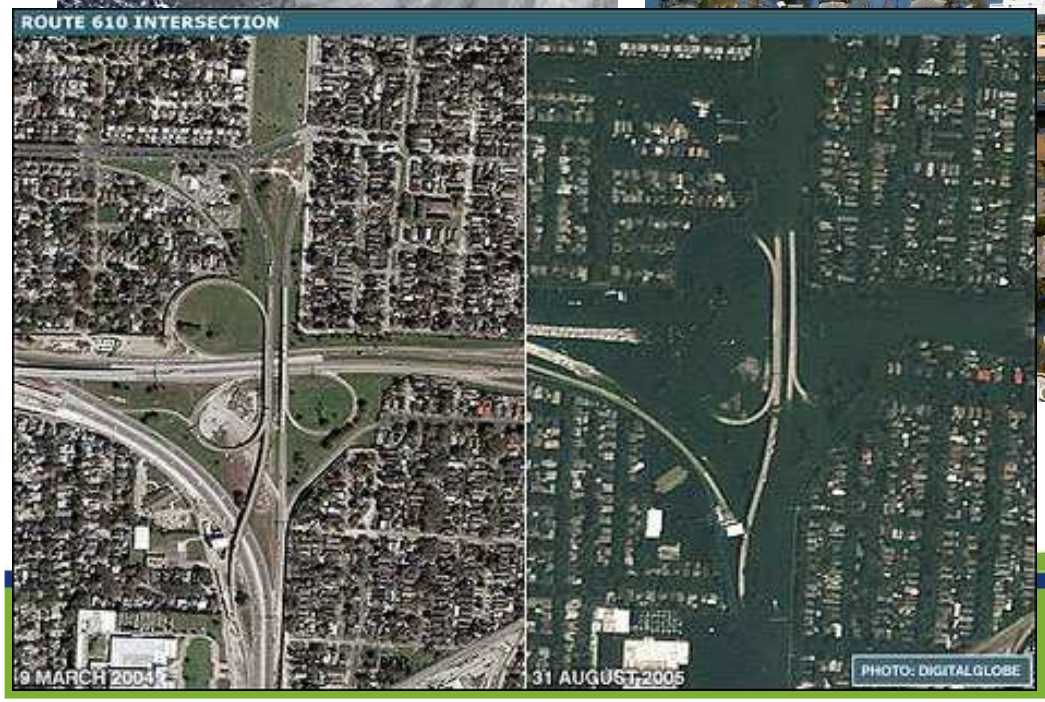


The disaster cycle of disaster management continuum (after Warner K 2002 The role of Governments in the Disaster Cycle and Disaster Finance)

Japan March 2011

Japan March 2011

USA – New Orleans - Aug 2005



Hurricane Katrina

What if it does all go wrong?

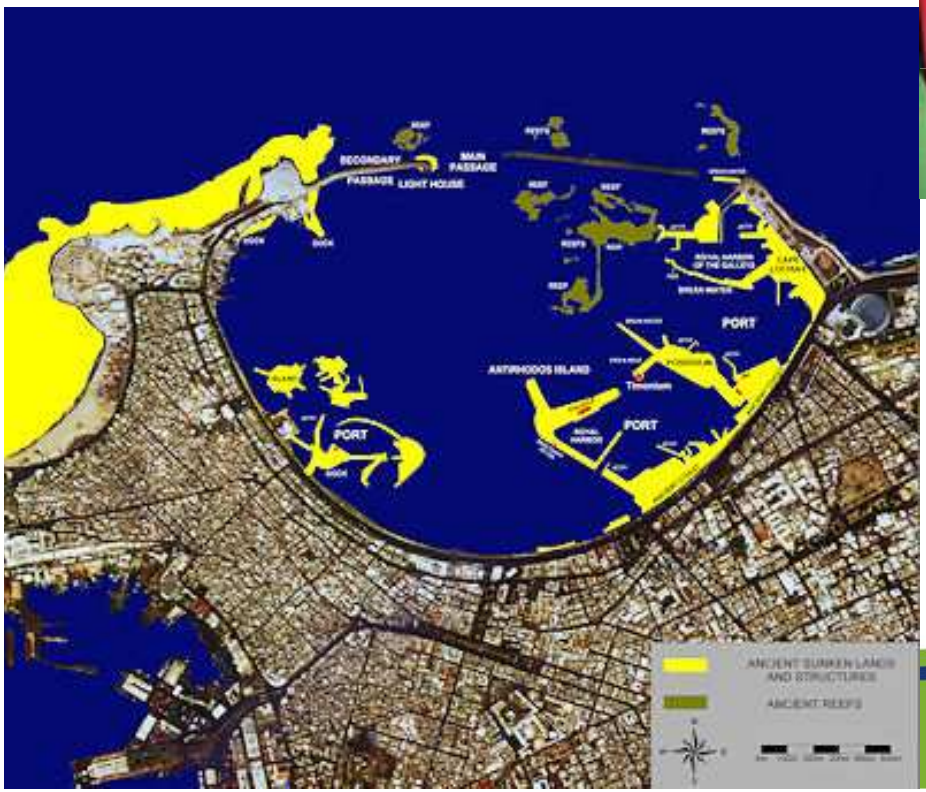
Concluding thought

- if the extreme event happens tomorrow…we may all be in trouble

but

- adequate preparation time
  + the application of suitable skills & resources
  = delivery of the options to prevent “occurrences”
  from becoming disasters

- Investing in adequate coastal defences today may proof to be the best insurance available on the market today/tomorrow and even in the next hundred/thousand years



Thank you for your attention