Fixing Failures or Re-thinking Futures?: From Resilient Remedies to Resilient Land- and Water-scapes

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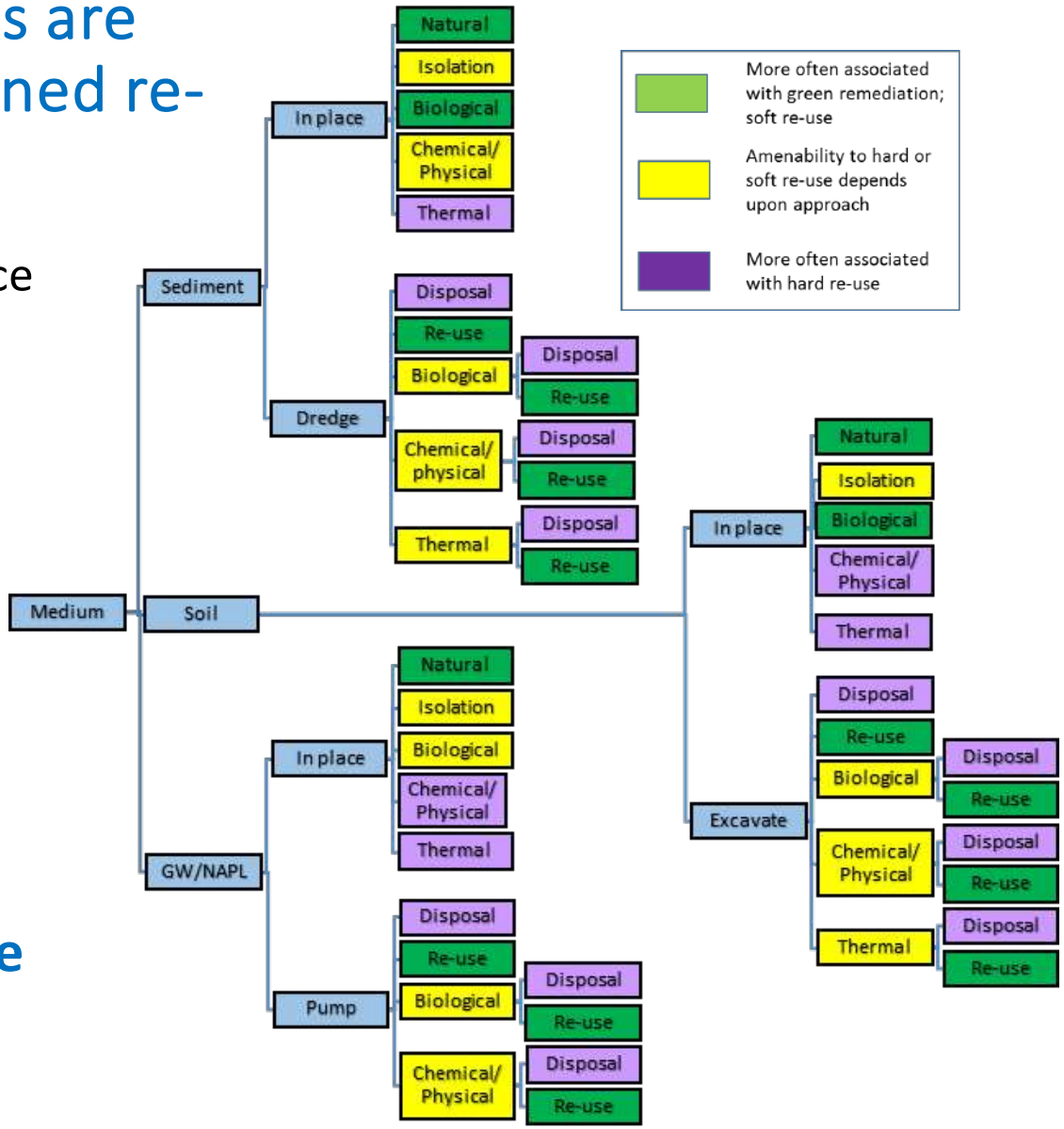
…transform information into action

13th International SedNet Conference
Faculty of Sciences of the University of Lisbon, Lisbon, Portugal

Remedial and disposal alternatives are linked to site conditions, and planned re-use

- Remediation approach may limit re-use
  - Re-use may affect remediation resilience
- Alternatives are a blend of media, contamination levels and, thus, remedial approaches
- Technologies are more similar for soils and sediments
  - Technological indicators may be similar
- Sediments and groundwaters/NAPL have strong similarities (and indicators)
  - Accessibility, feasibility and resilience
  - Long-term re-recontamination

Any assessment approaches must be designed with these issues in mind



Remediation is not a sustainable practice

- We remediate sediment, soil, water and groundwater to address past, unsustainable practices
- ***All*** active management results in (desirable and undesirable) **environmental**, **economic** & **social** impacts
- Given uncertainty, we are addressing how to balance ***certain harm*** against ***uncertain benefit***
- The challenge is optimization – how does one achieve the maximum **environmental benefit** with the minimum **undesirable impact**?
- **But, are we missing opportunities to use these massive projects to enhance regional resilience, when we separate clean-up from restoration and planning?**

Image from http://www.eoht.info/page/Pandora%E2%80%99s+box

There are a variety of assessment tools

- These can be evaluated using a range of criteria

Criterion	Low Score	Medium Score	High Score
Boundary-orientedness	No reference	Reference values based on status quo or scenarios	Science/Policy - based thresholds
Comprehensive-ness	1 pillar	2 pillars	3 or more pillars
Integratedness	Monodiscipilinary	Multi or interdisciplinary	Transdisciplinary
Stakeholders' involvement	Communication	Resonance	Interaction
Scalability	Local Scale/ limited time frame	Only temporal or spatial scale	Multi temporal and spatial scale
Strategicness	Accounting	Sustainability principle-oriented	Change-oriented
Transparency	Closed model	Partially Open Model	Open model/ transparent values
Quantitation	only quantitative or quantitative data	Semi-quantitative	Integrates qualitative and quantitative

Adapted from Sala et al (2015) A systemic framework for sustainability assessment. Ecological Economics, 119, 314-325.

Tools and approaches can be complementary; may address differing issues or tiers in an overall framework

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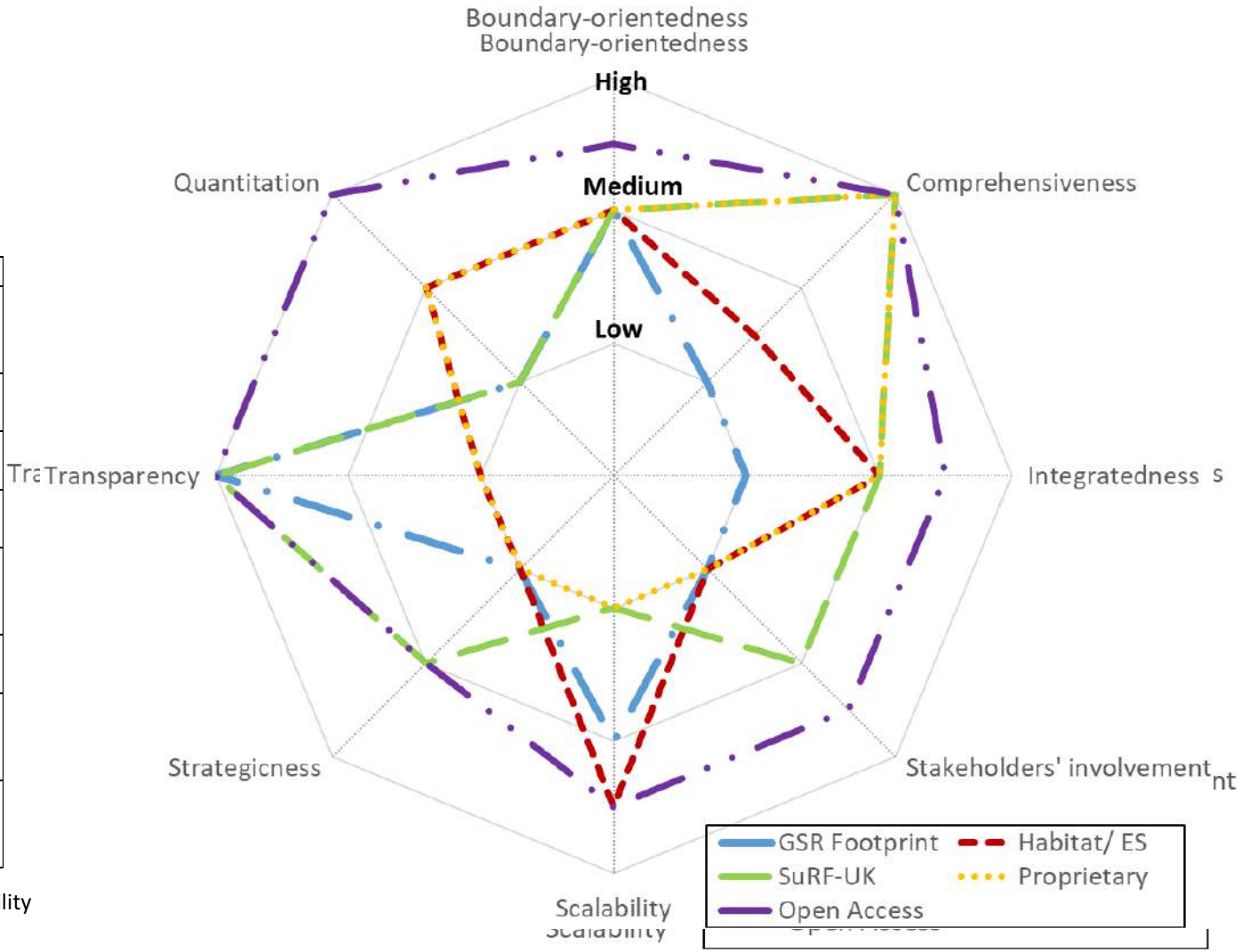
Habitats and/or Ecosystem Services Sustainability's



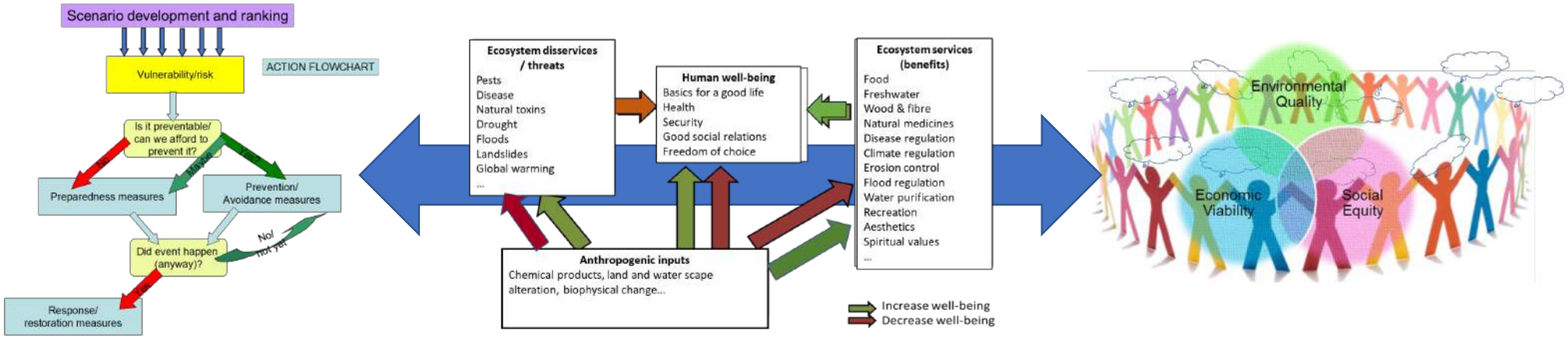
Framing perspectives: different sides of the same coin

Environmental risk questions

- What are the risk and vulnerabilities?
- Are we protecting against everything?
- At what spatial and temporal scale?
- What is controllable, what is not?
- Are we developing preventions, tracking changes, selecting responses?

Sustainability questions

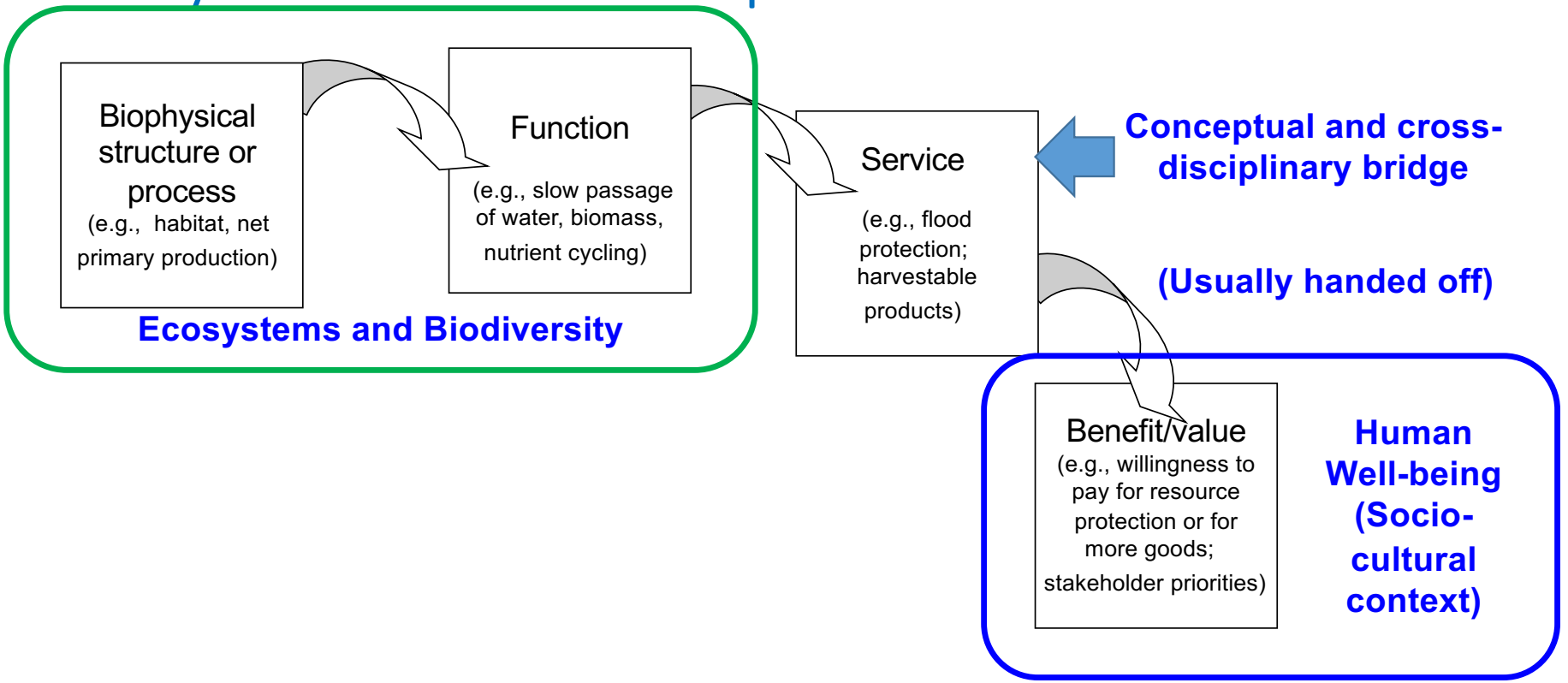
- What is it you want to sustain?
- Who benefits?
- For what period of time will benefits be conveyed?
- At what cost (to whom)?
- Who decides?



What is the vision of site re-use?

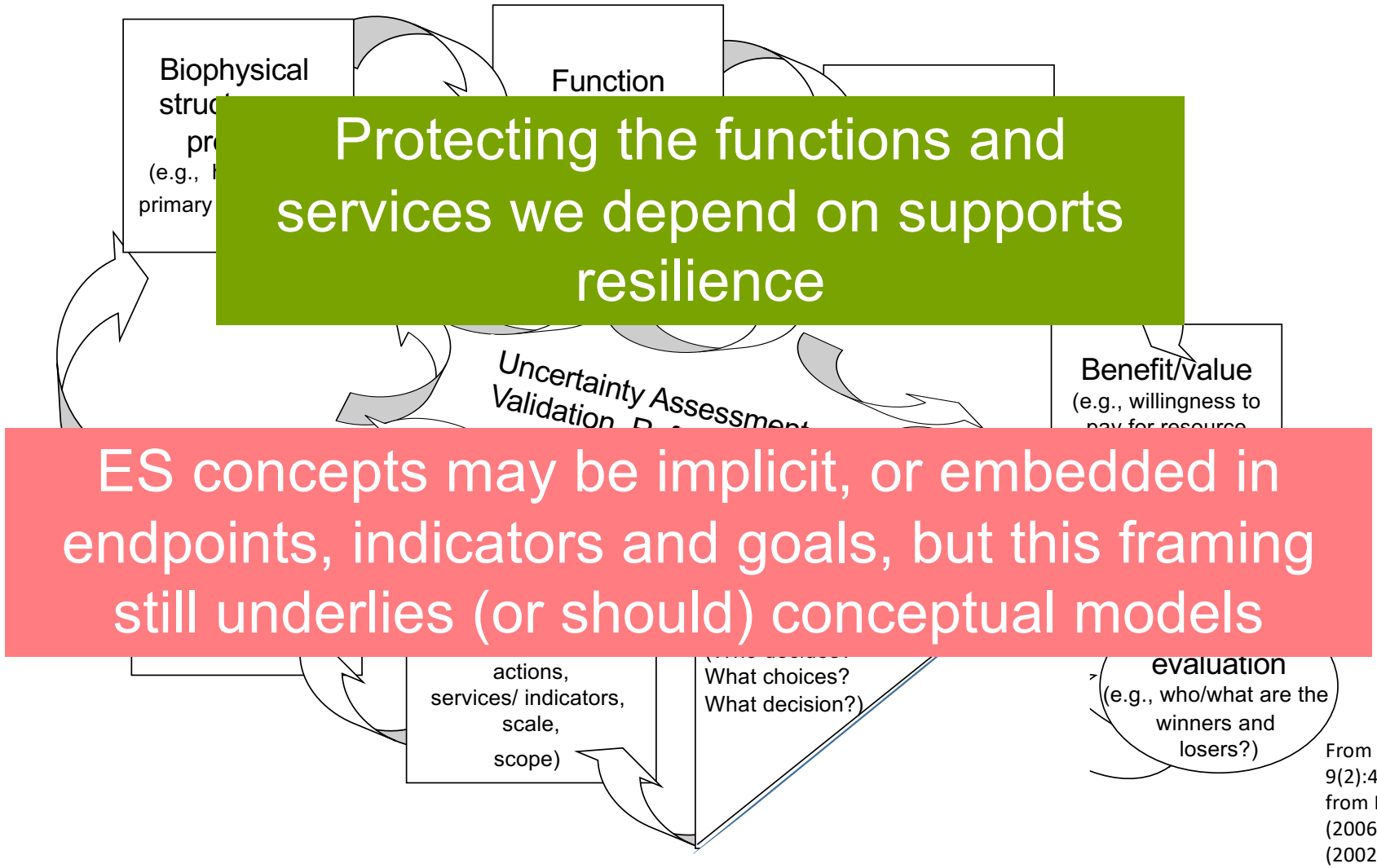
Risks, opportunities and trade-offs of alternatives differ, depending upon regional objectives

Ecosystem Services Conceptual Flow: Scientific



From Apitz (2013) Ecosystem services and environmental decision making: Seeking order in complexity, IEAM 9(2):414-430

Ecosystem Services Conceptual Flow: Scenario-Driven



Protecting the functions and services we depend on supports resilience

ES concepts may be implicit, or embedded in endpoints, indicators and goals, but this framing still underlies (or should) conceptual models

From Apitz (2013) IEAM 9(2):414-430. adapted from Haines-Young et al. (2006) and De Groot et al. (2002)

Projects both impact and are dependent upon ecosystems and their services

Resilient projects avoid vulnerabilities

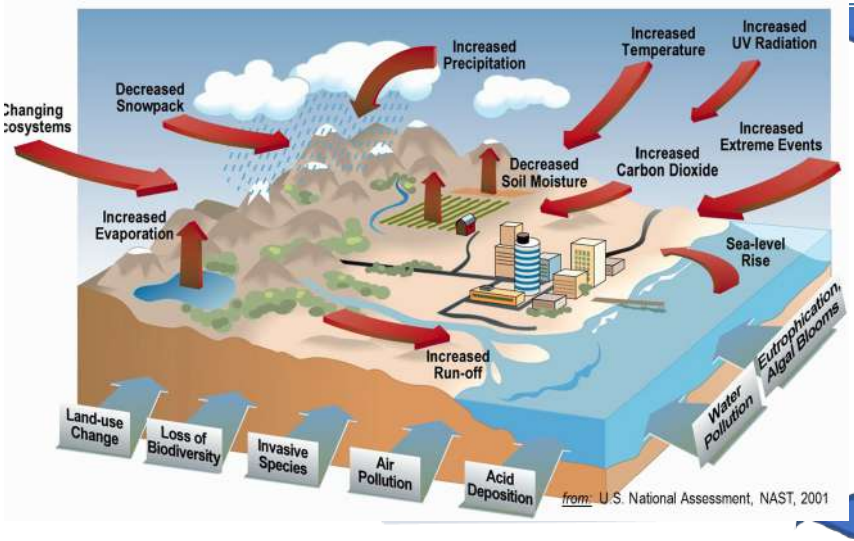
Scenario or project impact on ES

Type I ES

Could the project affect the provision of this ES?

YES or

-climate and Natech* vulnerabilities



priority ES

Scenario or project dependence on ES

Type II ES

Could this ES change in ways that could affect operational performance?

NO

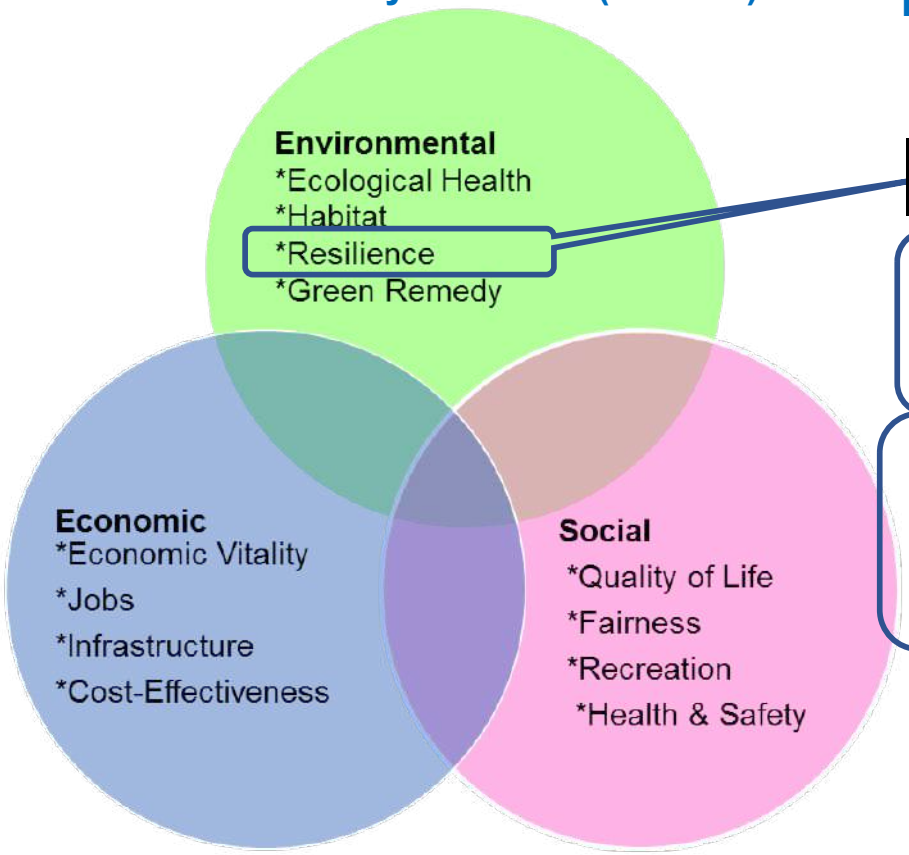
YES or UNKNOWN

Priority ES

*Natural Hazards Triggering Technological Disasters; the interaction between natural disasters and industrial accidents

Alternatives (here, sediment remediation options) can be scored in terms resilience and vulnerability

What issues that stakeholders value are affected by decision (criteria)?



How are they affected (indicators)?

Resilience

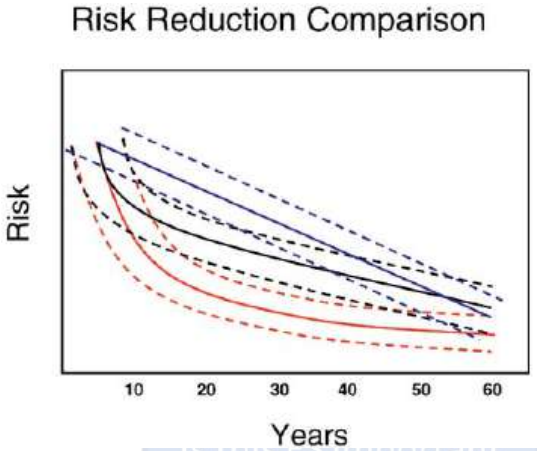
Re-contamination, natural attenuation

Vulnerability to extreme events, disturbance

How can this be quantified (metrics)?

- Upstream inputs vs cleanup goals, source control
- Volumes/levels in-place
- Flood and storm models
- Design criteria
- Environmental security

Resilient projects optimise opportunities



-climate and Natech* vulnerabilities

-working with nature (benefitting from natural processes, e.g., natural attenuation)

Scenario or project dependence on ES

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*Natural Hazards Triggering Technological Disasters; the interaction between natural disasters and industrial accidents

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Could the project affect the provision of this ES?

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Is this ES important to stakeholders' livelihoods, health, safety or culture?

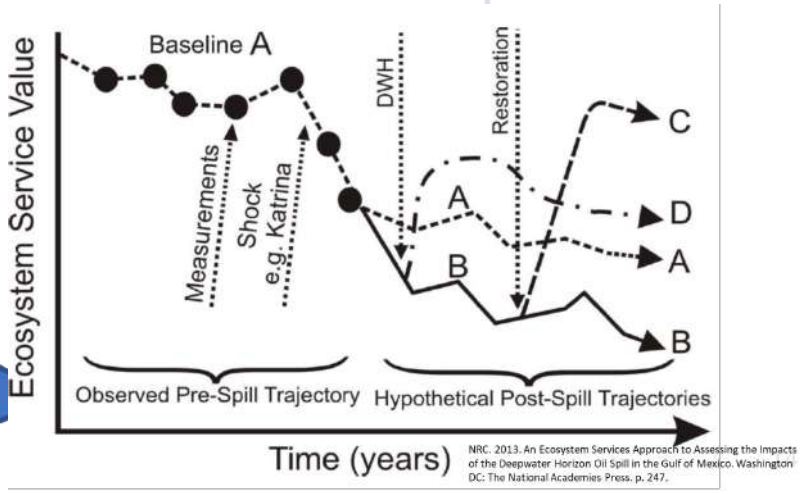
NO

YES or UNKNOWN

Priority ES

Sustainable projects also seek to avoid impacting regional resilience

-undesirable impacts (minimize); reduce risk



NRC. 2013. An Ecosystem Services Approach to Assessing the Impacts of the Deepwater Horizon Oil Spill in the Gulf of Mexico. Washington DC: The National Academies Press. p. 247.

Scenario or project impact on ES

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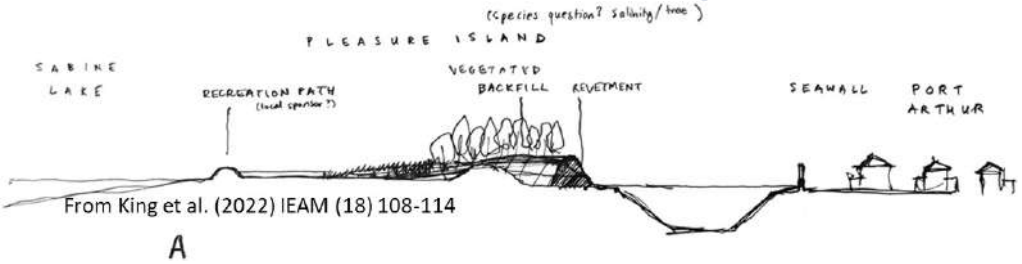
Can projects also enhance regional resilience?

-undesirable impacts (minimize); reduce risk

-low-hanging fruit (win-win opportunities)

→stakeholder outreach

→regional integration



From King et al. (2022) IEAM (18) 108-114

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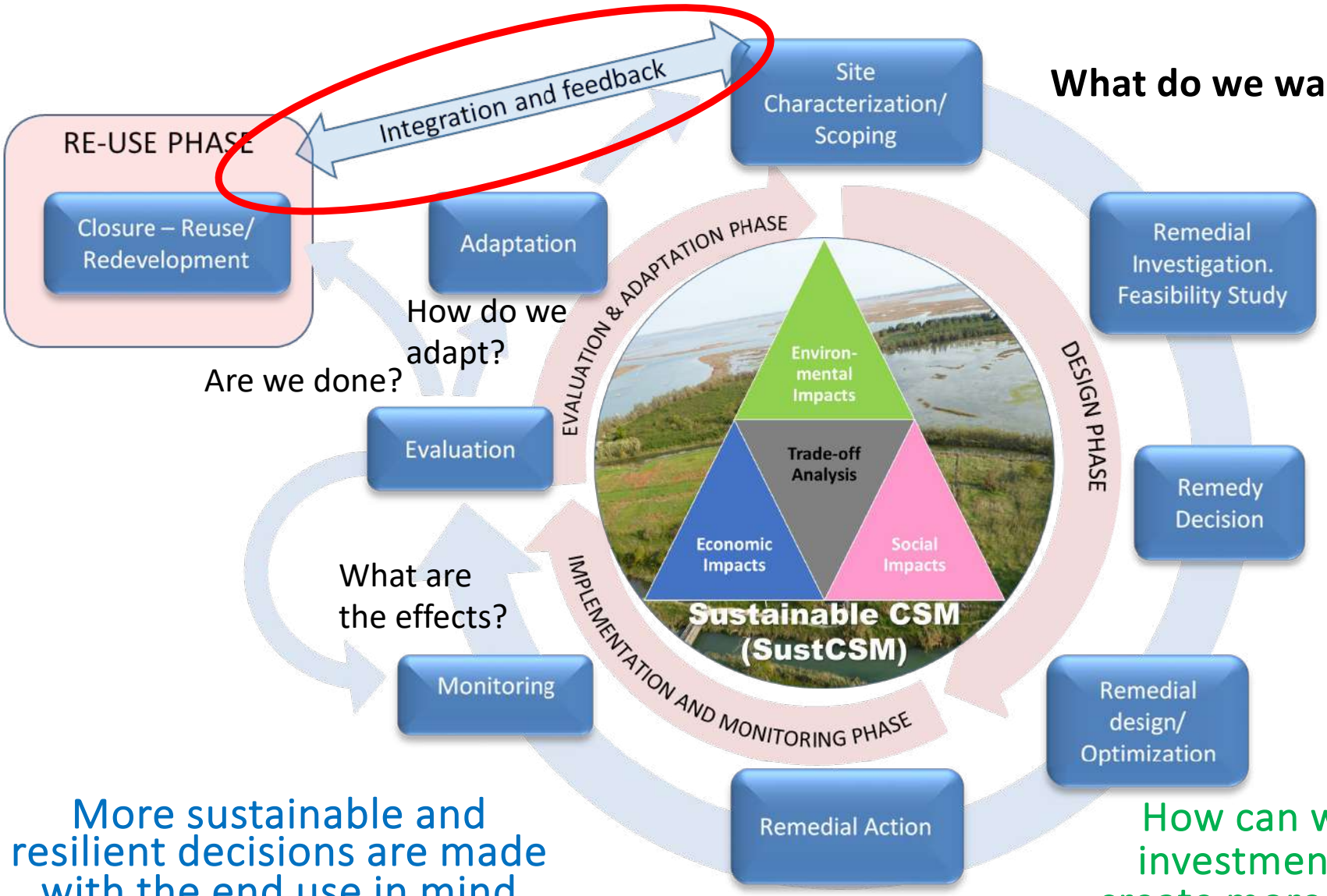


What do we want to achieve?

How do we adapt?

Are we done?

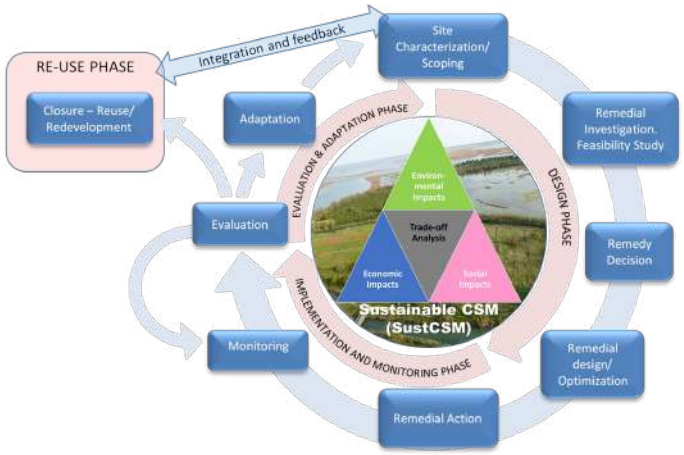
What are the effects?

How do implement and optimise?

More sustainable and resilient decisions are made with the end use in mind

How can we leverage our investment in clean-up to create more resilient futures?

A sustainable conceptual site model provides a bridge between stakeholder expectations and sustainability assessment, throughout the project cycle

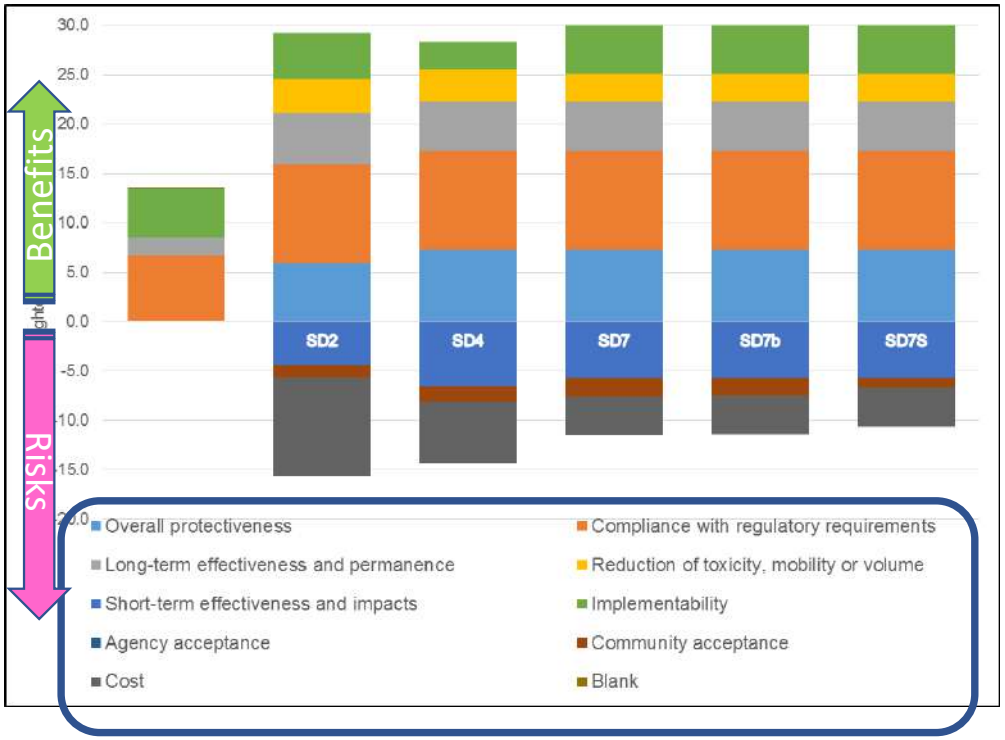


Phase	Sustainability Role	Stakeholder
Site characterization/ scoping	Sustainable Conceptual Site Model (SustCSM) Development	Identify ; link
	Preferred end or future use linked remedial evaluation	
Remedial Investigation/ Feasibility Study	Footprinting; C	SM links stakeholder concerns to assessment; communicates outputs; stakeholder weighting and evaluation
Remedy D	Balancing/ negotiation/ communication	
R	BMPs; Optimization	Adapt to stakeholder concerns; conflict resolution
R	SustCSM guides monitoring	Communicate progress; address concerns
M toring		
Evaluation	SustCSM informs and communicates	
Adaptation	SustCSM guides adaptation selection	SustCSM provides platform for communication and negotiation
Closure/ Reuse Redevelopment	SustCSM bridges between closure and re-use	

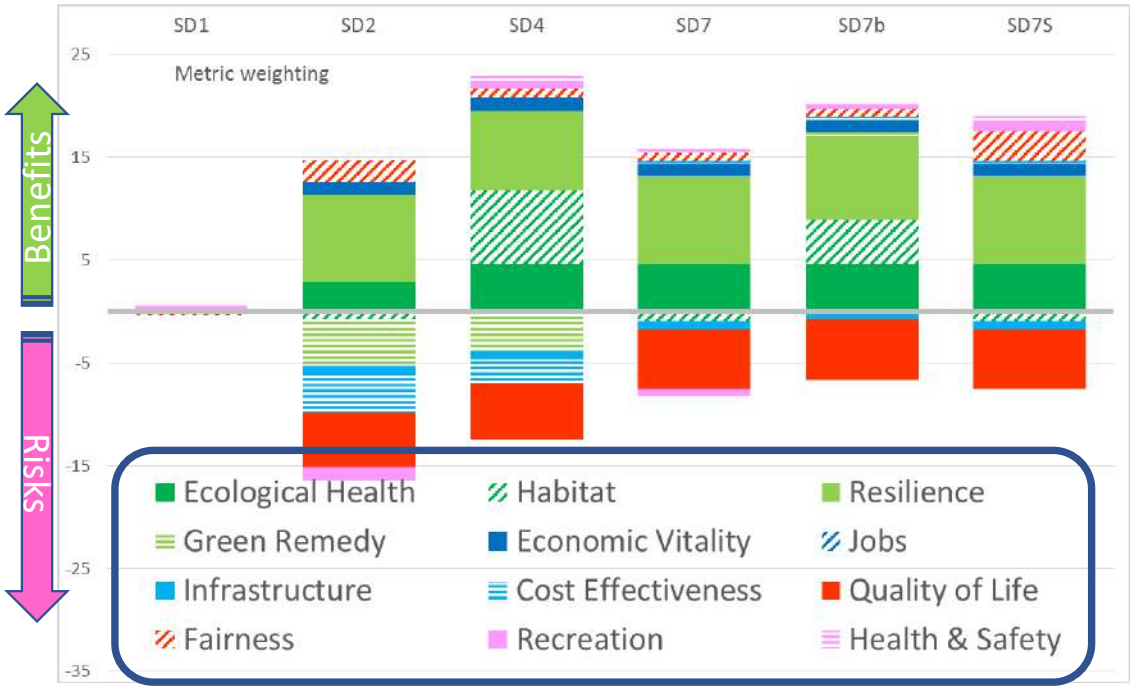
Assessments can be translated in terms of both project and stakeholder/regional goals

Same alternatives, same data, different viewpoints and aggregation – perspective affects how one prioritizes alternatives

Scored in terms of regulatory criteria



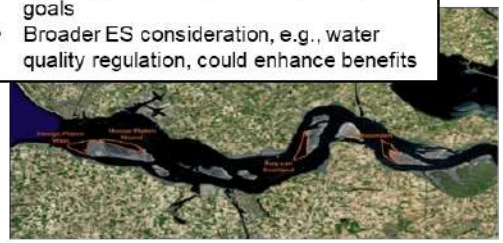
Scored in terms of community impact



How can projects be integrated within regional vision, enhancing resilience?

Case 2: Western Scheldt

- **Full-cycle (baseline, prospective, monitoring, evaluation, adaptation) selective, non-explicit ESA** to design beneficial, synergistic dredged material disposal and management
- WwN to enhance habitats and optimize hydrologic function, balancing multiple goals
- Broader ES consideration, e.g., water quality regulation, could enhance benefits



Case 4: Sigmaplan

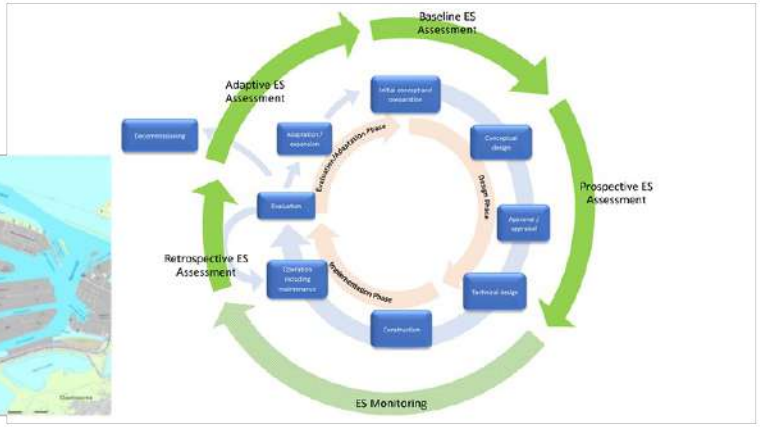
- **Baseline ESA** identified multiple objectives; **prospective ESA** informed conceptual design phase
- Monetary societal cost-benefit analysis sought highest net benefits, considering flood safety, navigation, agricultural, regulation and cultural services
- Alternative chosen differed from choice based upon flood control alone, demonstrating benefits of early ES consideration

Case 6: Ems estuary

- GIS-based **retrospective, baseline and prospective ESA** (1930, present, and 2050) evaluating provisioning and regulating ES, and a restoration masterplan
- Early, explicit consideration of ES facilitates communication and future planning
- A broader range of ES could increase impact

Case 1: Maasvlakte II

- **Prospective ESA** of design solution trade-offs
- Legislation-driven inclusion of natural and social values identified opportunities to mitigate or compensate for impacts
- Early consideration would save time and money; facilitating approval



Case 5: Nicaragua Canal

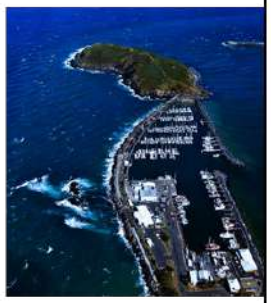
- **Baseline ESA**, then **prospective ESA** examining impacts of selected design to identify mitigation measures
- Qualitative assessment, as part of ESIA
- Earlier and explicit consideration of ES in design phase may reduce impacts and the need for mitigation

Case 3: Atchafalaya

- **Retrospective ESA** identified multiple, serendipitous ES benefits from a mid-channel disposal strategy
- Channel stabilization reduced dredging requirement, while providing beneficial habitat for critical species
- Earlier consideration of ES may identify more such opportunities for future projects

Case 8: Blue Carbon

- Small-scale pilot **baseline and prospective ESA**; **monitoring plan** focusing on carbon sequestration (climate regulation) and water quality improvement via blue habitat creation
- Small-scale research focuses on one ES (carbon sequestration), which can be directly into an economic benefit
- Future work, considering broader range of ES, may support port enhancement and mitigation plans



Case 7: Coffs Harbour

- Prospective, non-explicit ESA informed multi-criteria assessment to balance "use values" (safety, recreation and economics) of shoreline protection plans
- Values were gathered through early, multi-disciplinary stakeholder engagement
- More explicit consideration of potential ES may have broadened criteria

From PIANC EnviCom WG195.
https://www.pianc.org/publications/envicom/wg195

How is the (business) case made for regional enhancement?

Monetization of natural capital showed the value of enhanced protection

Monetary societal cost-benefit analysis identified the highest net benefit design

Historical ecosystem service surveys engaged stakeholders in new strategies

If stakeholders are engaged early; more equitable approaches are possible. This can also speed project approval. Can added benefits be reflected in ESGs?

Legislation-driven inclusion of natural and social values optimised compensation and mitigation

Ecosystem services assessment identified design impacts for mitigation

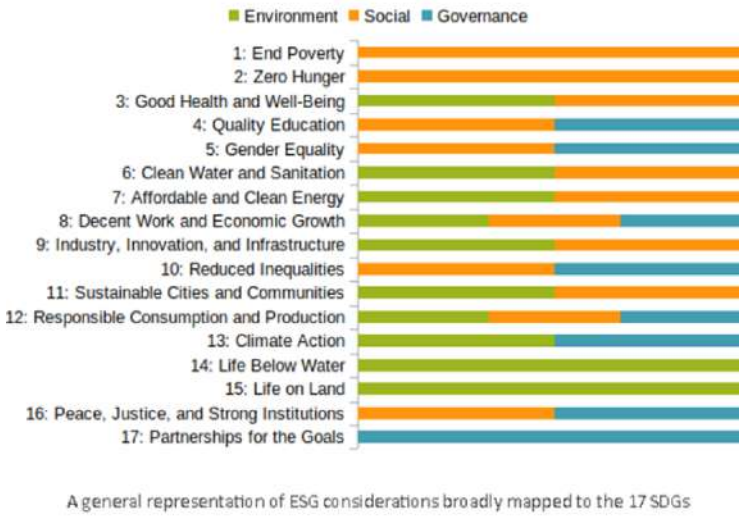
Post-hoc benefit monetization informs and supports future design

Studies of Blue Carbon benefits seek to optimize climate benefits

Multi-criteria assessment of use values optimised stakeholder values and expectations

From PIANC EnviCom WG195.
https://www.pianc.org/publications/envicom/wg195

From Corporate/Finance (ESGs) to Sustainable Development Goals: Question-Specific, Transparent Translation of Metrics



A general representation of ESG considerations broadly mapped to the 17 SDGs

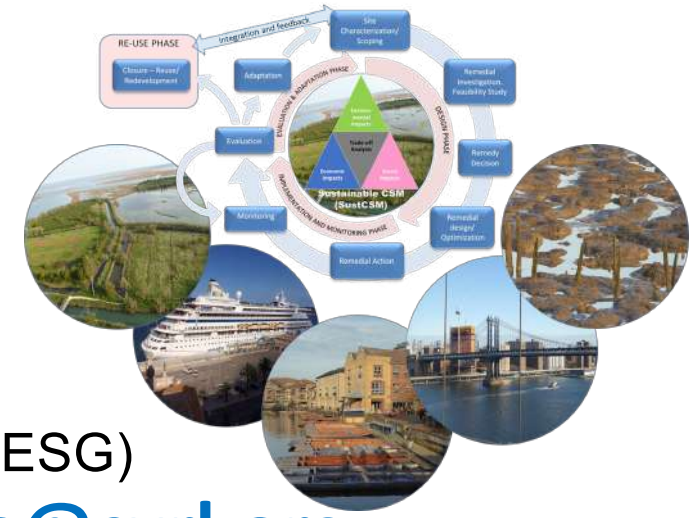
Connections between ESG and UN SDGs

EVOLVE Analysis for UN SDGs

From Paige Molzahn, Jacobs, AEHS West 2023

In conclusion…

- **Conceptualizing a project within wider regional goals and resilience**
  - Transparent basis for communication to diverse stakeholders – enhancing community support
  - Framed to support **equity** and **environmental justice**
  - Monitoring for adaptive and resilient decision making
  - Bridges sustainability, working with nature and climate change framings
- **Broader resilience thinking builds a business case by identifying and amplifying benefits; avoiding vulnerabilities**
  - Non-traditional values and costs
  - Emerging sustainability approaches
    - UN Sustainable Development Goals (SDGs)
    - Sustainable Blue (and Green) Economy
    - Principles of Responsible Investment (PRI); and
    - Environmental, Social and corporate Governance (ESG)



Thank you for your time. Questions? **drsea@cvrl.org**