

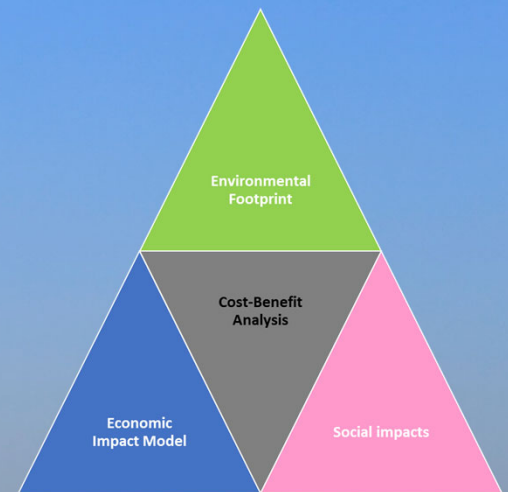
# Social, Environmental, and Economic Impact and Benefit Sustainability Analysis

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engineers • scientists • innovators

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Economic Consulting

**BATTELLE**

Tenth International Conference on the Remediation and Management of Contaminated Sediments

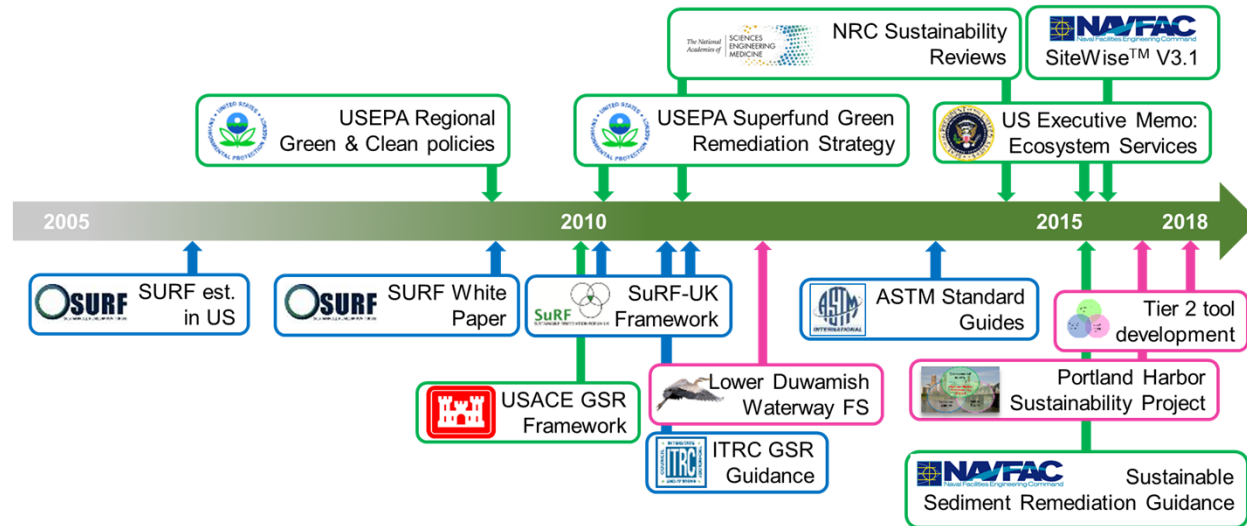


# Sustainability concepts in remediation have been evolving

**Sustainability:** “to create and maintain conditions, under which **humans** and **nature** can exist in productive harmony, that permit fulfilling the **social**, **economic**, and other requirements of present and future generations.” Executive Order No. 13514, 2009

## Sustainable remediation:

the practice of demonstrating, in terms of **environmental**, **economic** and **social** indicators, that the benefit of undertaking remediation is greater than its impact, and that the optimum remediation solution is selected through the use of a balanced decision-making process (Sustainable Remediation Forum-United Kingdom)

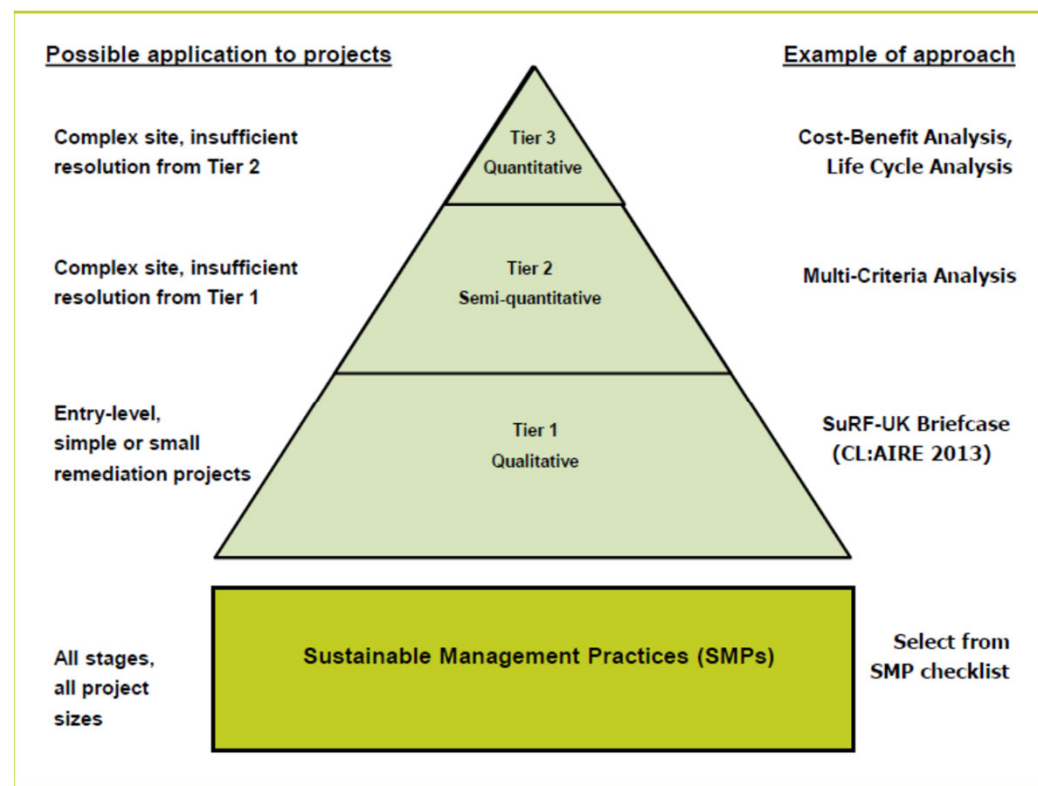


## Why is sustainability evaluation important? Why now?

- ❖ National Research Council (NRC) has advised EPA to enhance role of stakeholder-focused sustainability in decision making (2014)
  - Consideration of impacts of remediation
  - Stakeholder communications
- ❖ Executive Orders (2003-15), Executive Memo on Ecosystem Services (2015) have provided basis to advance sustainability in the context of stakeholder impacts
- ❖ Superfund Task Force (2017) is focusing on redevelopment & community revitalization and engaging stakeholders
- ❖ Alternative land re-uses and remedial approaches will impact stakeholder groups differently
  - Sustainability assessment provides a framework for assessing, communicating and negotiating these trade-offs in a rigorous but accessible manner
  - Regulatory, environmental, economic and social tools assess alternative impacts from complimentary viewpoints

# Sustainability assessment should only be as complex as needed

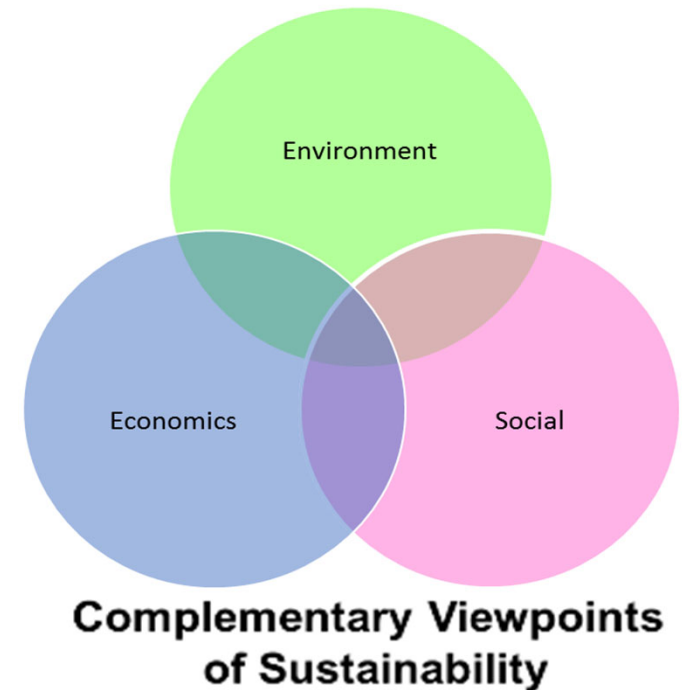
- ❖ Sustainable remediation forum (SuRF) and others recommend a tiered approach
- ❖ Sustainable management practices (SMPs) should underlie all stages



Source: SuRF-UK, S., 2014. Sustainable Management Practices for Management of Land Contamination; [www.claire.co.uk/surfuk](http://www.claire.co.uk/surfuk)

## Portland Harbor Sustainability Analysis was a detailed, Tier 3 Assessment at a complex site

- ❖ Portland Harbor Sustainability Project (PHSP)
  - ❖ Conducted sustainability analysis (**environmental**, **economic** and **social**) of 5 EPA FS remedial options
  - ❖ Alternatives included dredging up to 9 million cubic yards of sediment, 17+ years of construction, and up to \$4 billion in costs
- ❖ High-level, custom tool developed
  - ❖ Methods in journal special series\*
- ❖ **Not all sites are this large, data-rich or resourced**



\*<https://setac.onlinelibrary.wiley.com/toc/15513793/14/1>

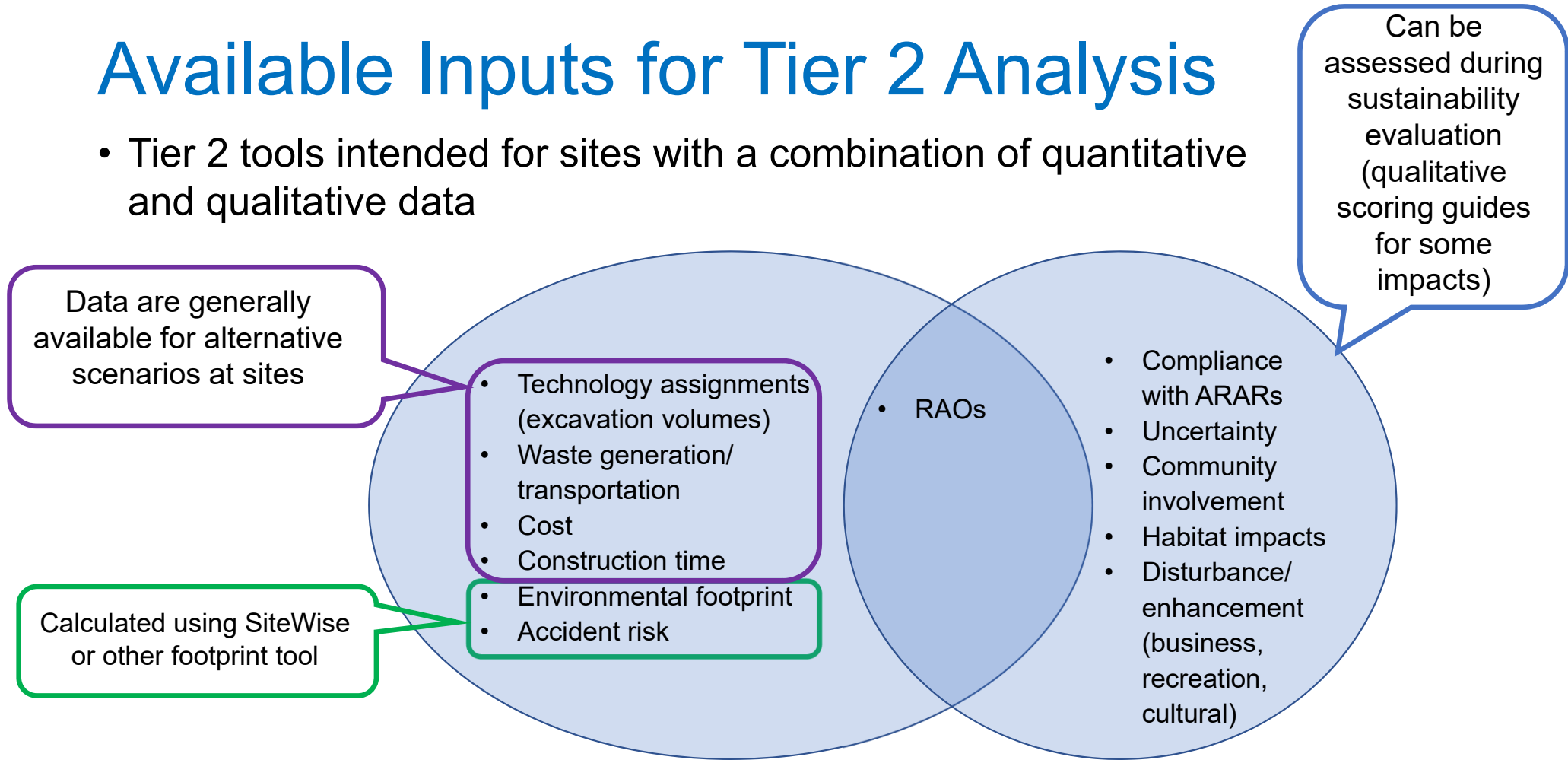
# PHSP tool adapted for smaller, less data-rich sites

- ❖ Consolidated input sheet for quantitative and qualitative alternative characteristics
  - ❖ Standard alternative characteristics (most available in site documents) populate input table
- ❖ Automated regulatory and social calculations linked to input table
  - ❖ Transparent calculations and scoring
- ❖ Tool can be adapted for project-specific issues and run with inputs from site technical documents
- ❖ Living tool, can evolve with alternatives and data

| <b>SEEI+BeST</b>   |  |  |
|--|--|--|
| Social, Environmental, & Economic Impact + Benefit Sustainability Tool   |  |  |
| <i>A quantitative tool to evaluate the sustainability of remedial alternatives at Tier 2 contaminated sediment sites</i> |  |  |
| User Entered Data  | <a href="#">1. Site Info</a>                       | Enter general site information that provides context for the evaluation of remedial alternatives                           |
|  | <a href="#">2. Inputs</a>                          | Enter data for each remedial alternative from cost estimates, feasibility study, footprint analysis, or other data sources |
| Regulatory Criteria (RegCrit)  | <a href="#">3. RegCrit - Criteria</a>              | Identify regulatory cleanup criteria (if different from CERCLA) and assign a weight to each criterion                      |
|  | <a href="#">4. RegCrit - Calculations</a>          | Metrics mapped to regulatory criteria are calculated and scored. <i>No data entry on this tab.</i>                         |
|  | <a href="#">5. RegCrit - Summary</a>               | Numerical summary of regulatory criteria results   |
|  | <a href="#">6. RegCrit - Graphics</a>              | Graphical summary of regulatory criteria results (weighted benefit, cost-benefit, cost-effectiveness)                      |
| Value Criteria (ValCrit)   | <a href="#">7. ValCrit - Weights</a>               | Assign weights to each value and metric  |
|  | <a href="#">8. ValCrit - Calculations</a>          | Metrics mapped to value criteria are calculated and scored. <i>No data entry on this tab.</i>                              |
|  | <a href="#">9. ValCrit - Summary</a>               | Numerical summary of value criteria results  |
|  | <a href="#">10. ValCrit - Summary Graphics</a>     | Graphical summary of regulatory criteria results (weighted benefit - stacked bar and radar)                                |
|  | <a href="#">11. ValCrit - Value Graphs</a>         | Graphical results for each value (by metric)   |
|  | <a href="#">12. ValCrit - Value Graphs Stacked</a> | Graphical results for each value (by alternative)  |

# Available Inputs for Tier 2 Analysis

- Tier 2 tools intended for sites with a combination of quantitative and qualitative data

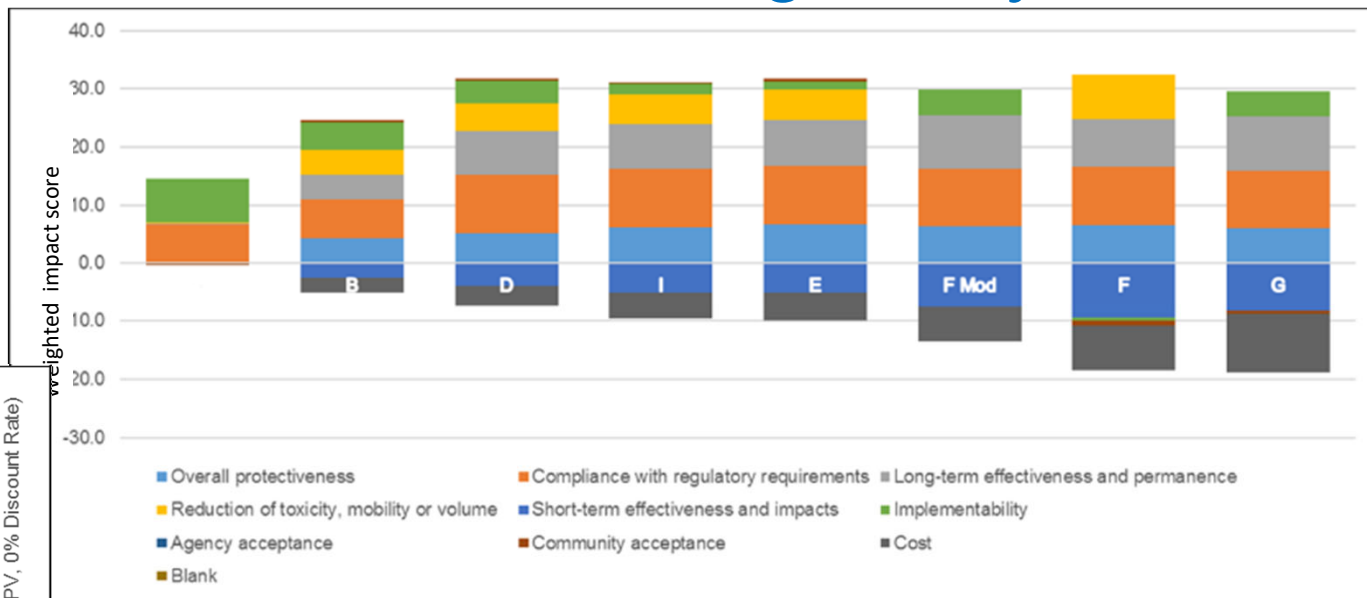
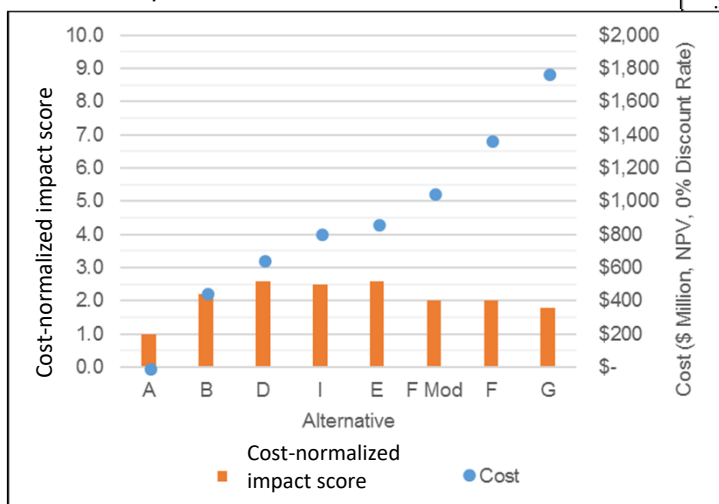




# Regulatory Impacts: Metrics generate cost and benefit information on alternatives based on regulatory criteria

Criteria can be aggregated for an overall score

Example results shown for a Tier 2 adapted Portland Harbor dataset

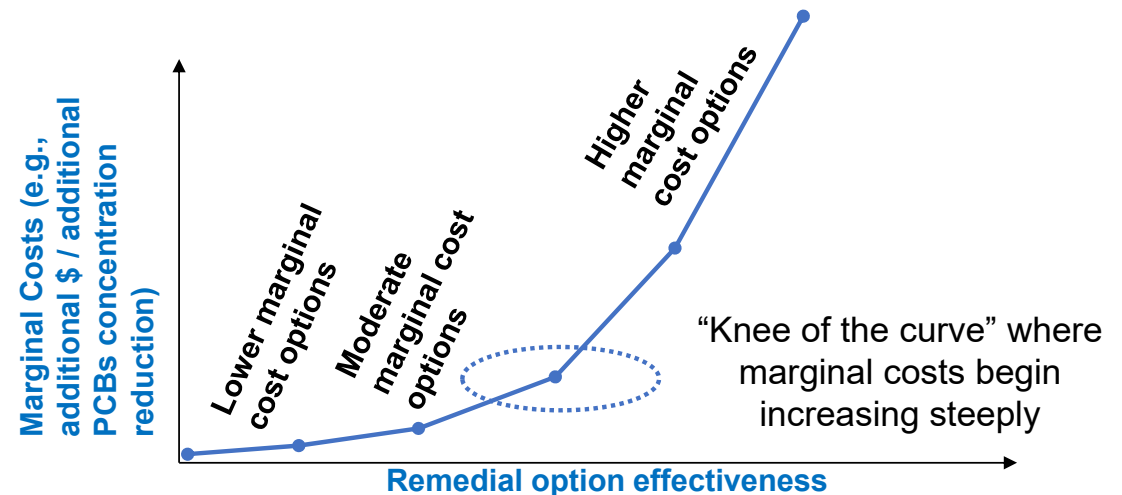


Remedial alternatives are scored in terms of impacts on regulatory criteria



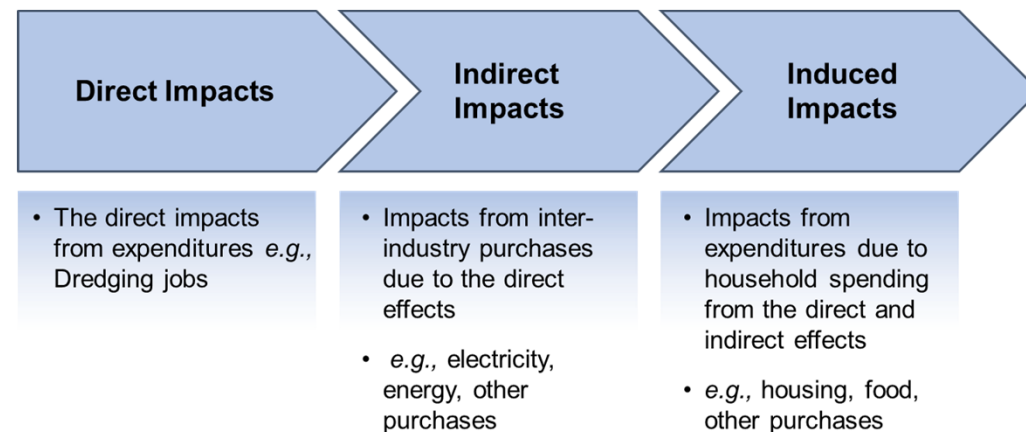
# Economic impacts: Incremental Cost-Effectiveness Analysis

- ❖ Cost-effectiveness analysis uses costs and non-monetary benefits
- ❖ Uses *incremental* cost-effectiveness to evaluate the “knee of the curve” (“additional bang for additional bucks”) for clean up activities



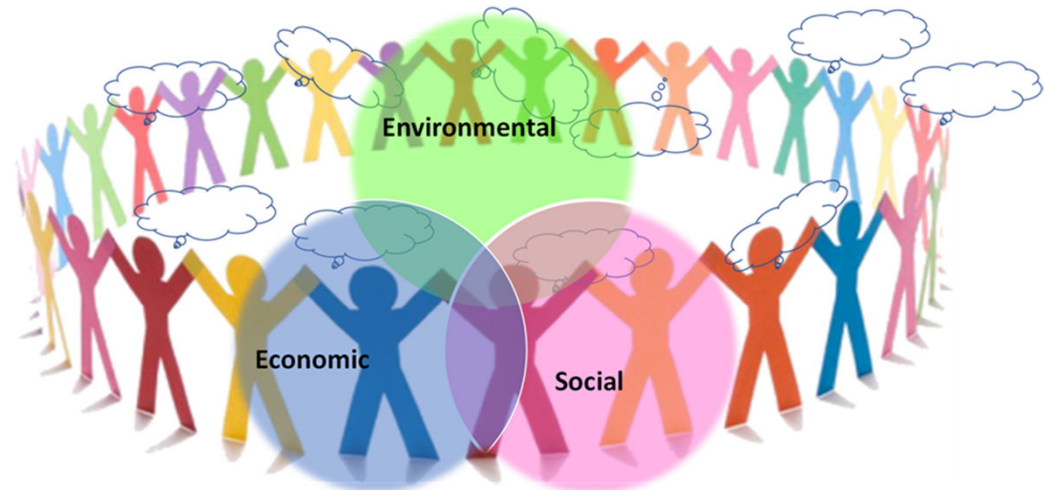
# Economic Impact Analysis

- ❖ Evaluates impacts of alternatives on the site and surrounding economy
- ❖ Input-output model evaluates “Full” Economic Impacts
  - *Positive* impacts of expenditures in region
  - *Negative* impacts of locals paying for some expenditures (and thus foregoing other spending)
- ❖ Metrics for economic impacts
  - Employment (Jobs)
  - Gross regional product (GRP)



Separate analysis, but feeds into SeeltBeST tool

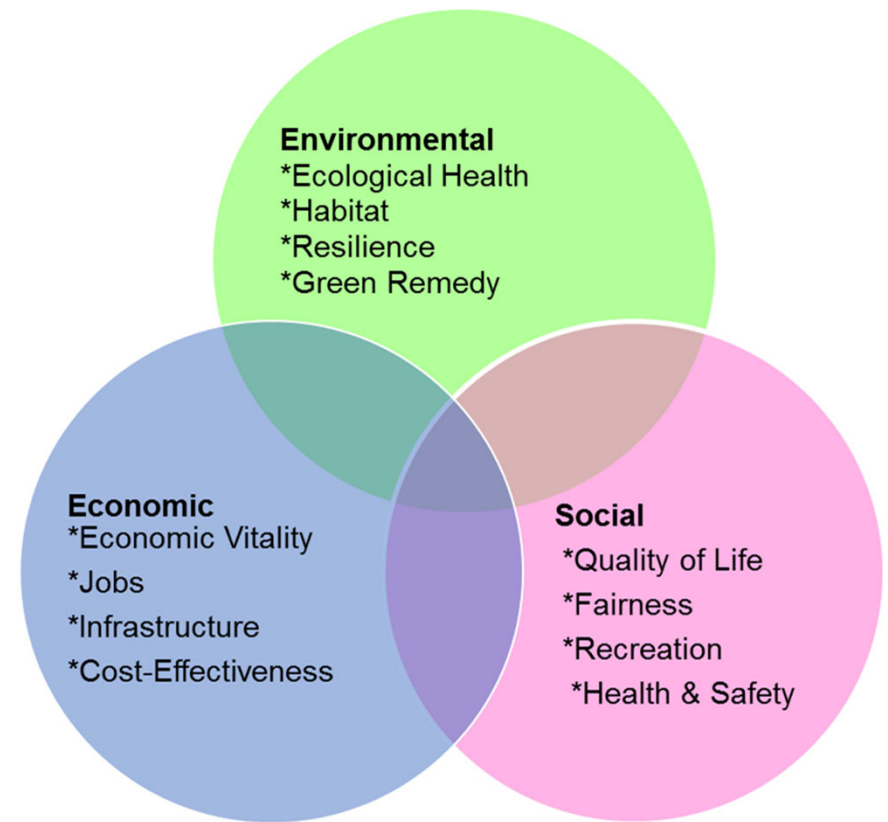
Arguments based upon single criteria can lead to polarization



Broader discussion supports completeness and balance

# Engaging stakeholders to solve their shared problems

- ❖ It's all **social** - stakeholders must decide on the values they wish to sustain
- ❖ Social sustainability tool bridges indicators of impact to community values and priorities
- ❖ Data-driven decision making
  - To identify trade-offs and points of contention
  - To **sustain** societal values
- ❖ Provides systematic, transparent community engagement
- ❖ Consistent with stakeholder-focused Consensus-based Environmental Decision-making – CBED (ASTM E2348 – 17, 2017)

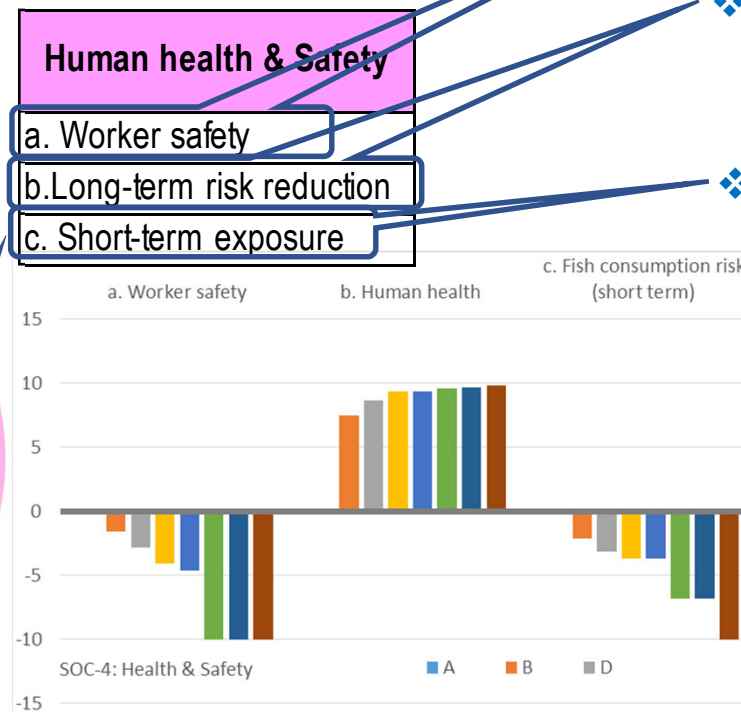
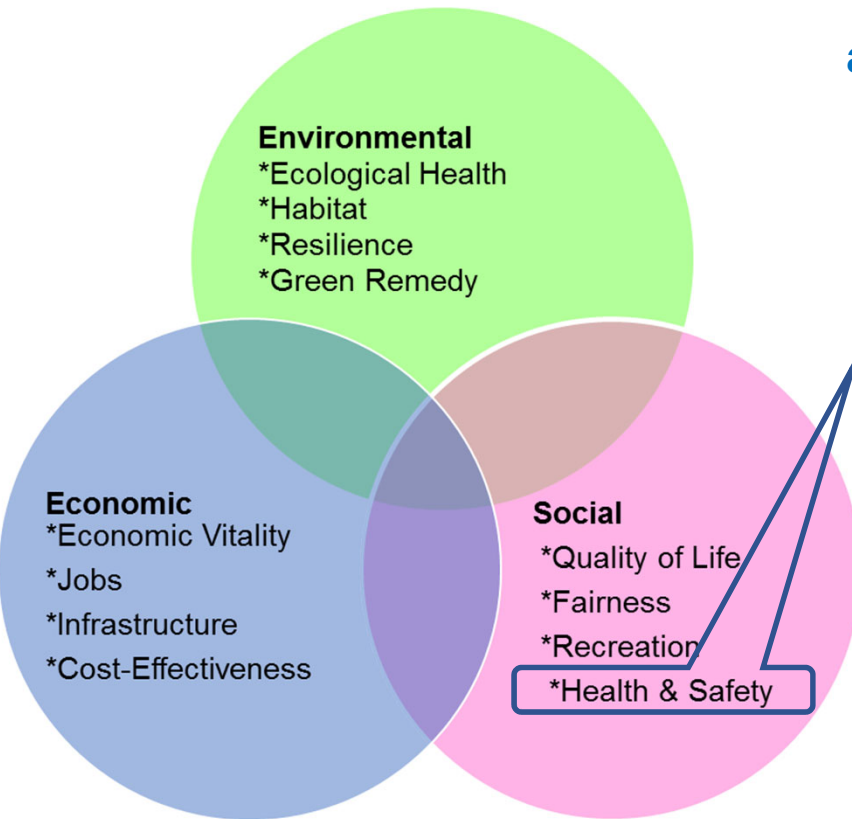


## What issues that stakeholders value are affected by remediation (criteria)?

## How is this quantified (metrics)?

## How are they affected (indicators)?

- ❖ SiteWise or similar
- ❖ Risk calculations in FS
- ❖ FS, years of construction, number of pathways in conceptual models (data dependent)



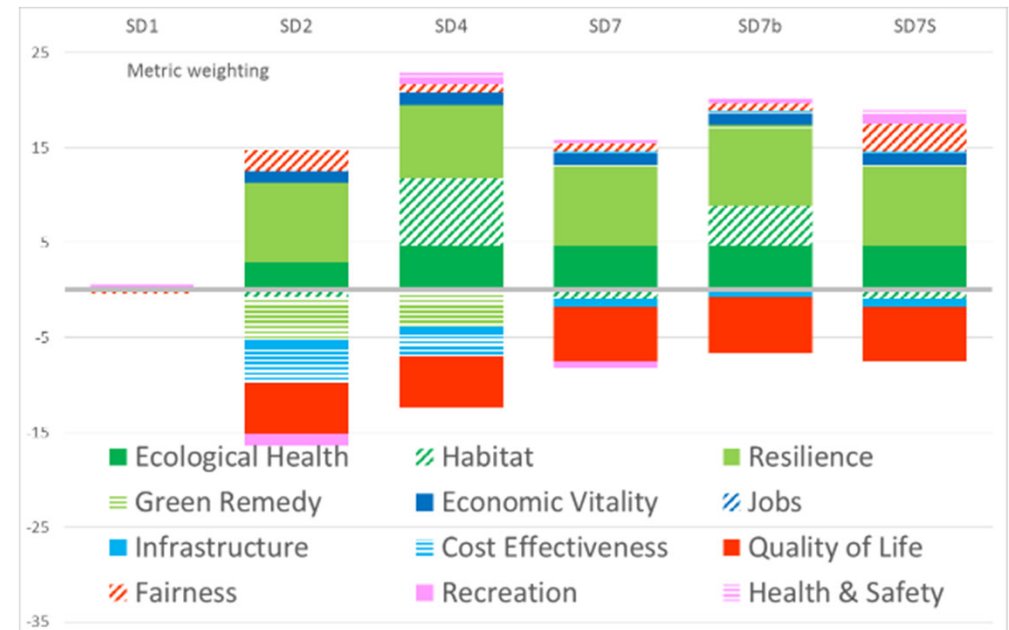
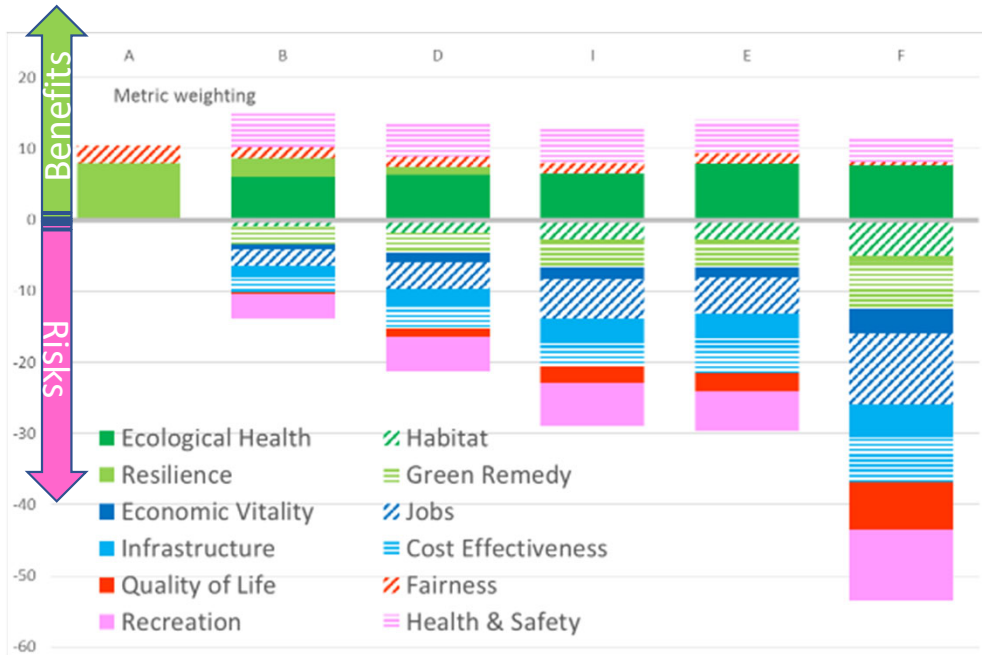
Value and metric scores can be weighted based on stakeholder priorities. This can be done in real time or based on wider surveys or engagement

| Value (names link to calculation sheet) | Metric (names link to calculation sheet) | Value weighting (links to calculation sheet) | When considering impacts of remediation, how important is this value to you? | Metric weighting (links to calculation sheet) | When considering impacts of remediation, how important is this aspect of the value to you? |
|---|--|--|--|---|--|
| <b>Ecological Health</b>                |  | 5.00   | Critically important   |   |  |
| ENV-1a                                  | a. Residual risk, T=0                    |  |  | 1.00  | Marginally important   |
| ENV-1b                                  | b. Downstream risk                       |  |  | 2.00  | Unimportant, or not relevant   |
| ENV-1e                                  | c. Residual Risk, long term              |  |  | 4.00  | Marginally important   |
| <b>Habitat</b>                          |  | 1.00   | Very important   |   | Somewhat important   |
| ENV-2a                                  | a. Terrestrial                           |  |  | 1.00  | Critically important   |
| ENV-2b                                  | b. Freshwater                            |  |  |   |  |
| <b>Resilience</b>                       |  |  |  |   |  |
| ENV-3a                                  | a. Resilience                            |  |  | 4.00  | Very important   |
| ENV-3b                                  | b. Resilience                            |  |  | 5.00  | Critically important   |
| <b>Green Remedy</b>                     |  |  |  |   |  |
| ENV-4a                                  | a. Green Remedy                          |  |  | 3.00  | Important  |
| ENV-4b                                  | b. Green Remedy                          |  |  | 3.00  | Important  |
| ENV-4c                                  | c. Green Remedy                          |  |  | 2.00  | Somewhat important   |
| ENV-4d                                  | d. Green Remedy                          |  |  | 2.00  | Somewhat important   |
| ENV-4e                                  | e. Green Remedy                          |  |  | 2.00  | Somewhat important   |
| ENV-4f                                  | f. Green Remedy                          |  |  | 2.00  | Somewhat important   |
| <b>Economic Vitality</b>                |  |  |  |   |  |
| ECON-1a                                 | a. Economic Vitality                     |  | Very important   | 5.00  | Critically important   |
| ECON-1b                                 | b. Economic Vitality                     |  |  | 1.00  | Marginally important   |
| ECON-1c                                 | c. Economic Vitality                     |  |  | 1.00  | Marginally important   |
| ECON-1d                                 | d. Economic Vitality                     |  |  | 1.00  | Marginally important   |
| <b>Jobs</b>                             |  |  |  |   |  |
| ECON-2a                                 | a. Employment                            |  | Very important   | 3.00  | Important  |
| ECON-2b                                 | b. Local employment                      |  |  | 4.00  | Very important   |

User can select 1 of 6 qualitative ranks for inferred or measured values:

- Not relevant
- Marginally important
- Somewhat important
- Important
- Very important
- Critically important

# Example aggregated social scores – two case studies



Scenario in which different removal volumes compared

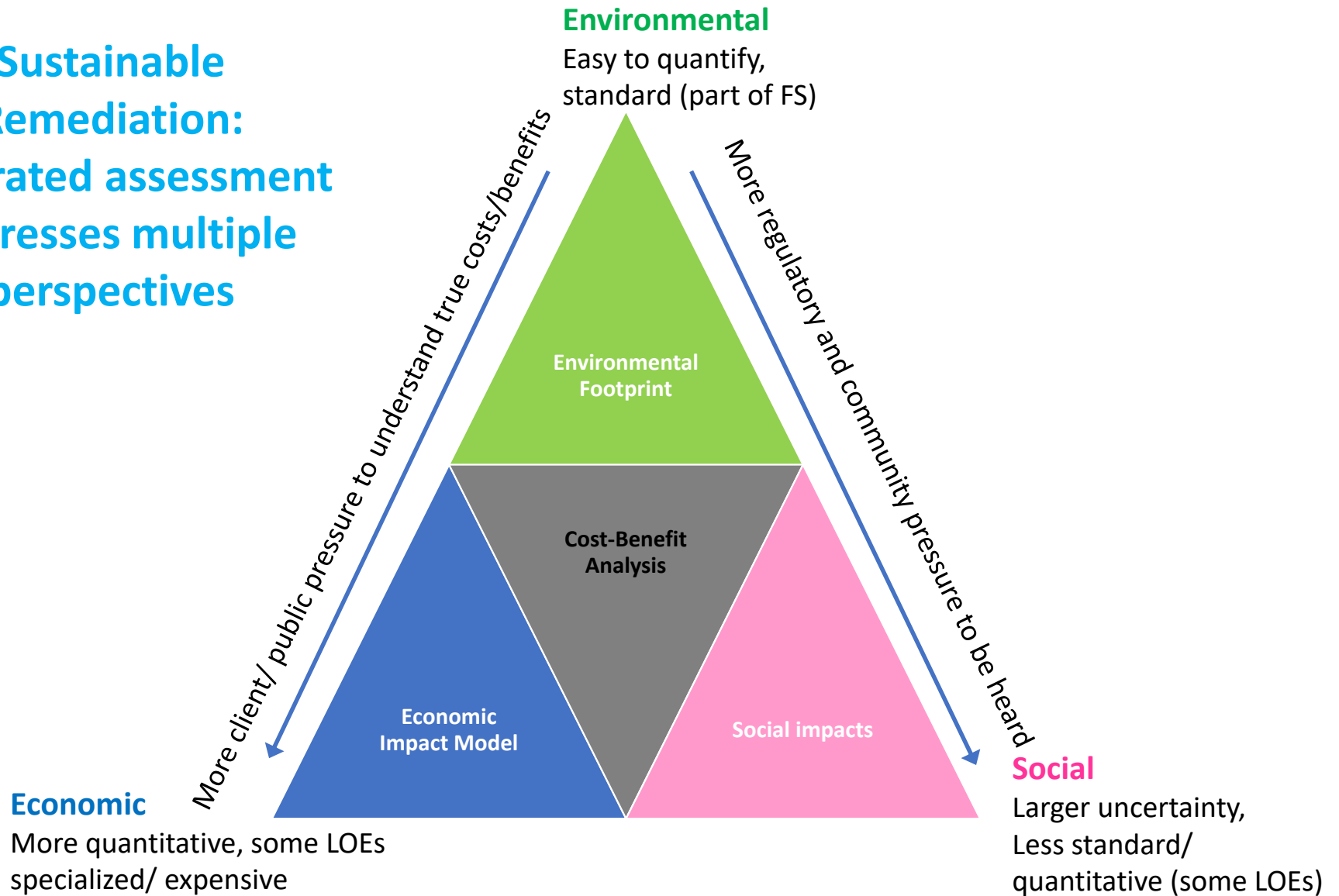
Hotspot removed in all active alternatives; more removal results in greater negative effects without significant benefits

Scenario with same removal, different disposal

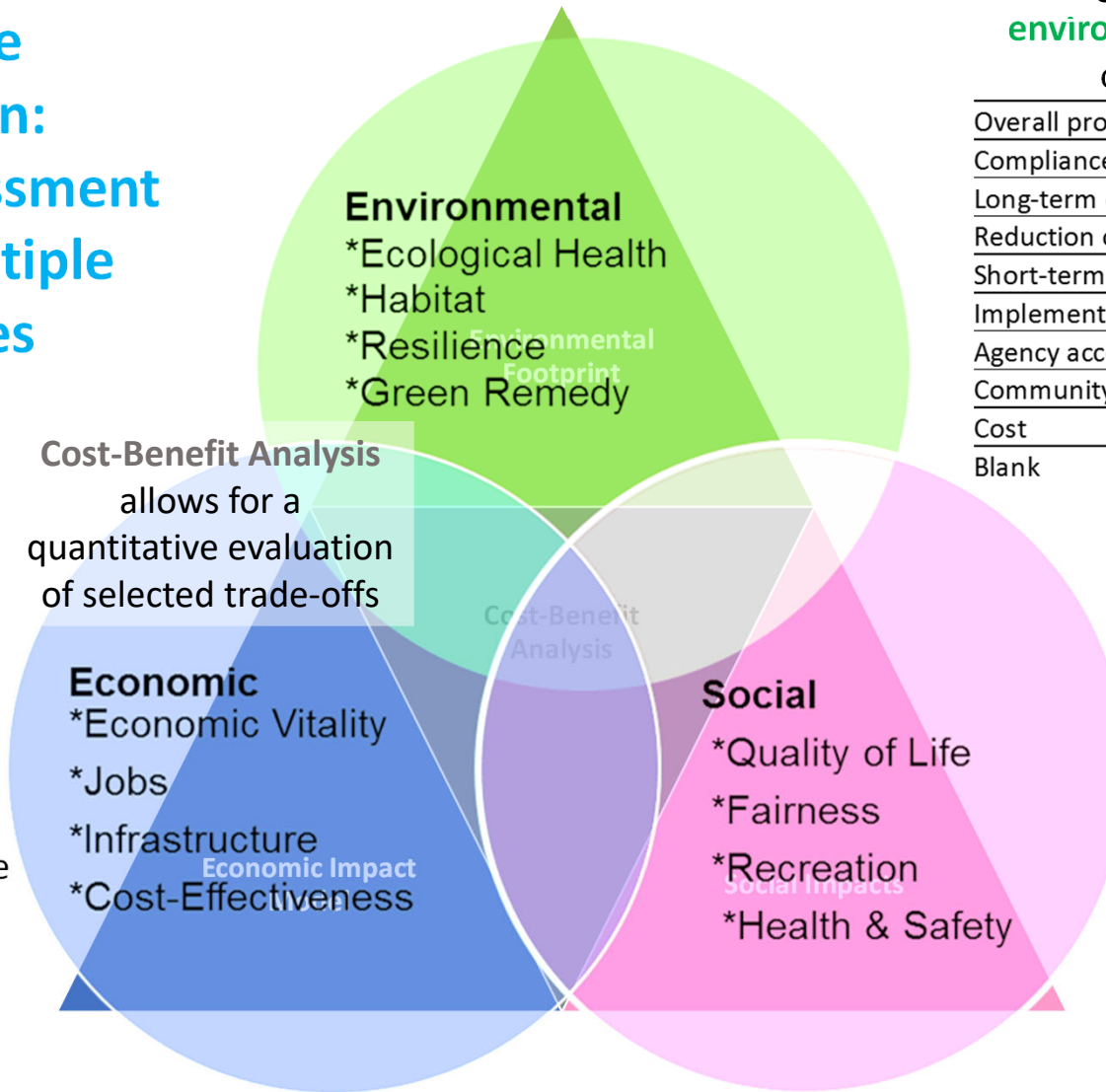
Habitat enhancement in SD4 and SD7B; “social uplift” in SD7S



**Sustainable  
Remediation:  
Integrated assessment  
addresses multiple  
perspectives**



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Regulatory module scores  
**environmental** impacts in terms  
of regulatory criteria

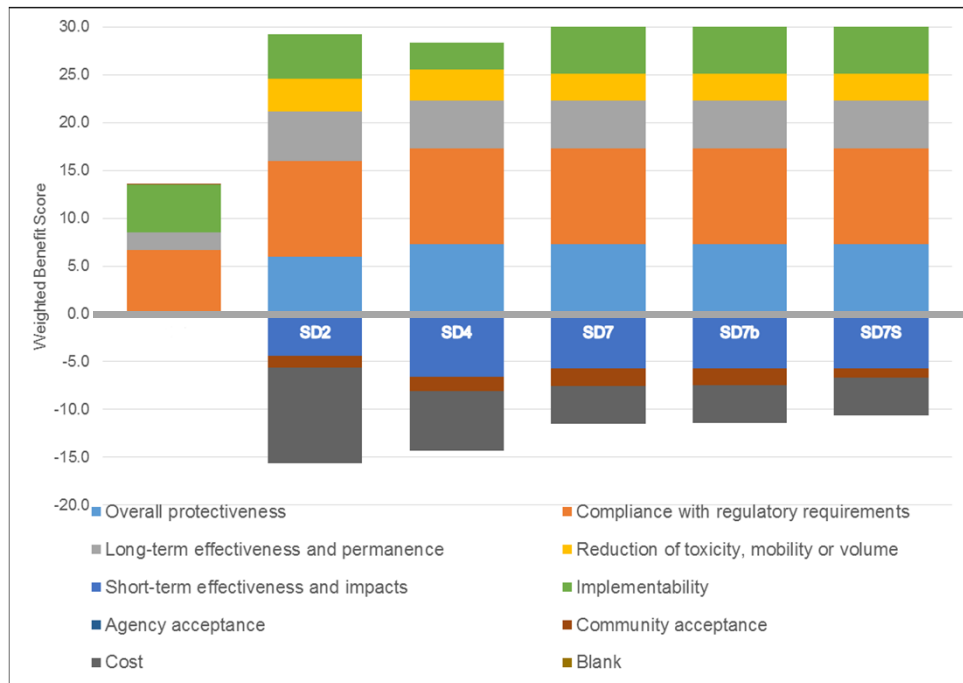
|   |
|---|
| Overall protectiveness                    |
| Compliance with regulatory requirements   |
| Long-term effectiveness and permanence    |
| Reduction of toxicity, mobility or volume |
| Short-term effectiveness and impacts      |
| Implementability                          |
| Agency acceptance                         |
| Community acceptance                      |
| Cost                                      |
| Blank                                     |

**Social** module  
evaluates social  
impacts and aggregates  
tri-pillar impacts in  
terms of stakeholder  
values

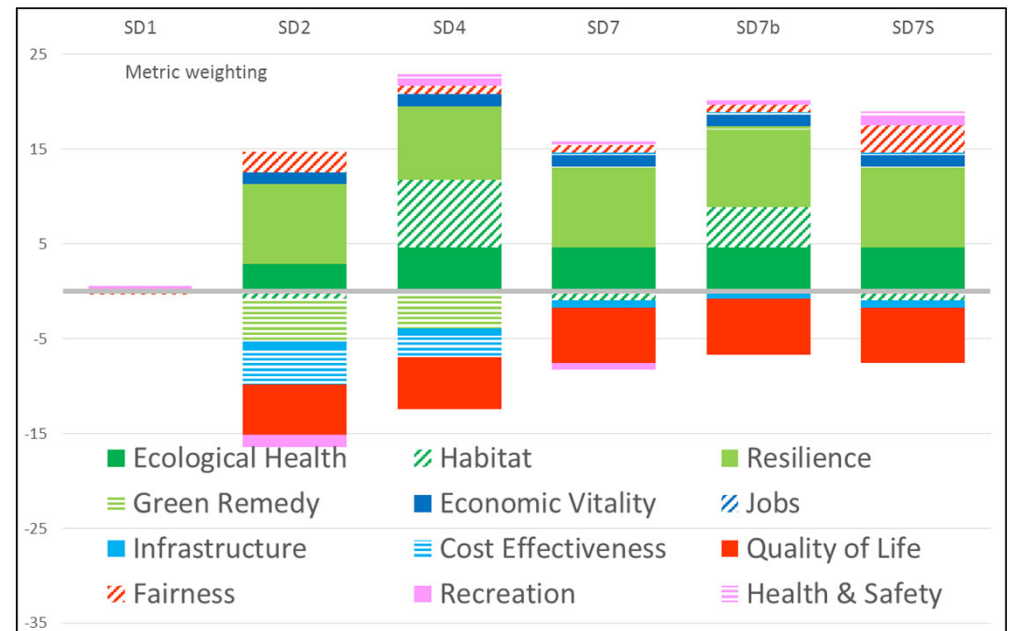
**Economic** Impact  
model determines  
the regional job and  
GRP impact of  
remedial expenditure  
and investment

Same alternatives, different viewpoints – considering broader community impacts reveals differences that regulatory criteria alone do not address

### Scored in terms of regulatory criteria



### Scored in terms of community impact



# Summary

- ❖ Site-specific information can be used to evaluate sustainability
  - Environmental/regulatory, economic and social impacts
  - Informed by stakeholder (including regulator) values
  - Consistent with emerging policy and guidance
- ❖ Sustainability tool supports users in community-linked remedial decision making
  - **Scores** indicators of impact based on alternative characteristics
    - Narrative scoring tables for less quantitative indicators (fairness, uncertainty, infrastructure...)
  - Guides **weighting** of regulatory and social indicators based on priorities
  - Clarifies “what is at stake”, including important trade-offs ***from a range of perspectives***
- ❖ Relatively cost-effective and efficient way of advancing a sustainability analysis into the stakeholder realm, using much of the same data