



Benefit Cost Analysis & Engineering With Nature

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Sciences, Engineering and Medicine
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US Army Corps
of Engineers

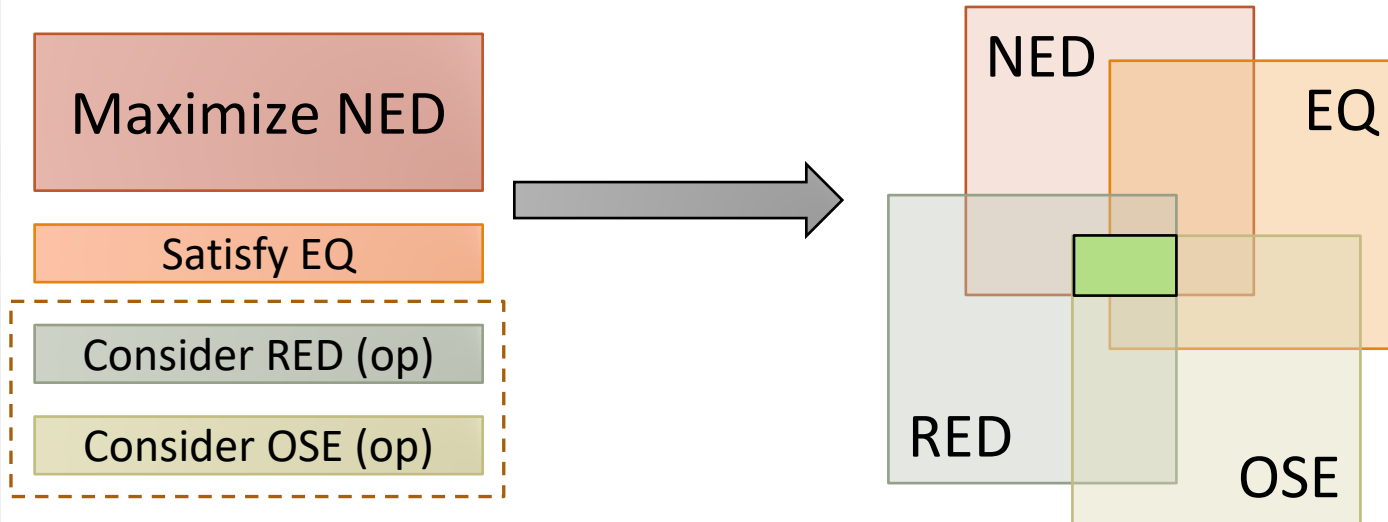


Evolving Economic Analysis for Federal Water Projects

Principles and Guidelines

1983

2024 (pending)

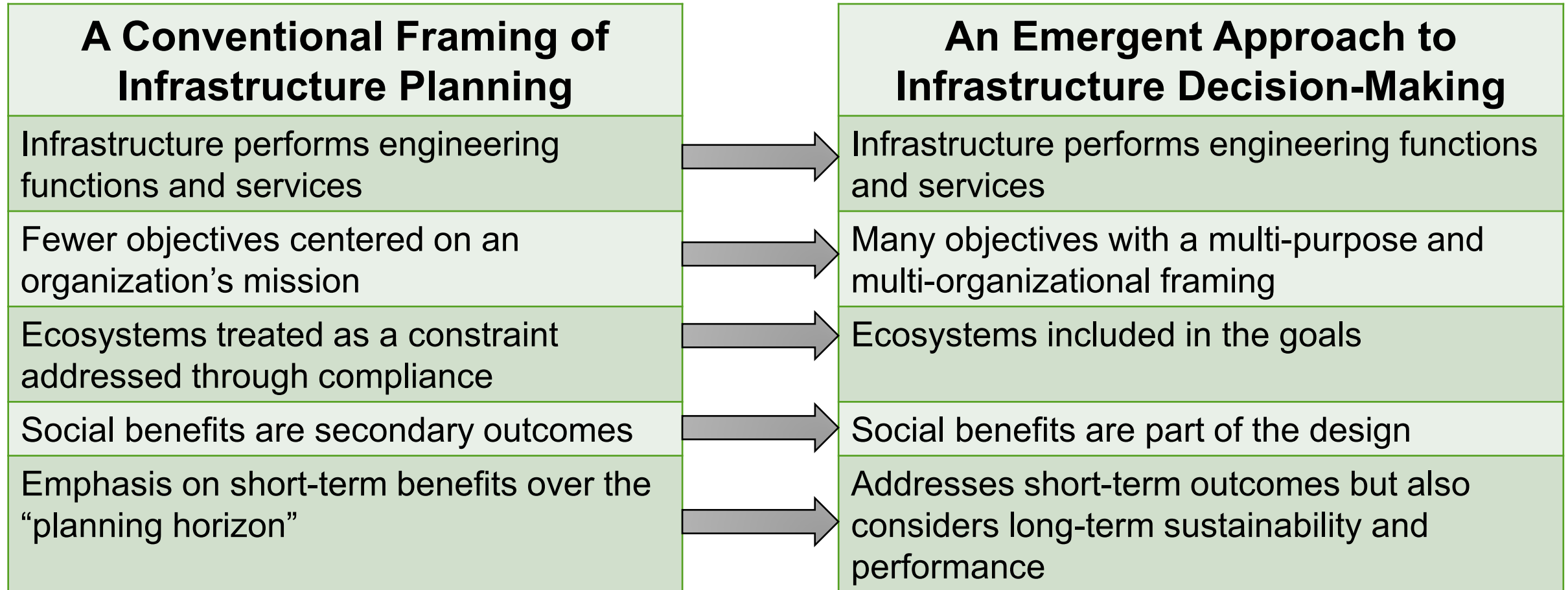


NED = National Economic Development
EQ = Environmental Quality
RED = Regional Economic Development
OSE = Other Social Effects

Guiding principles:

- Healthy and resilient ecosystems,
- Sustainable economic development,
- Floodplains,
- Public safety,
- Environmental justice, and a
- Watershed approach.

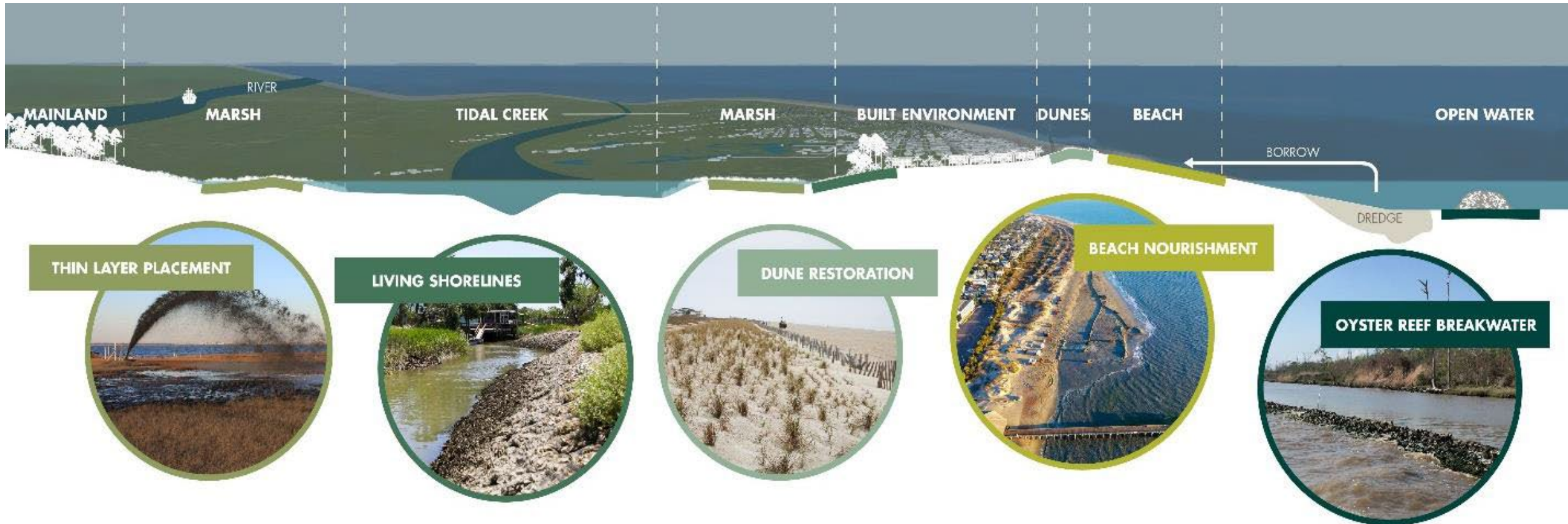
A Shifting Narrative about Infrastructure Benefits and Co-Benefits



Figures: Adapted from Suedel et al. (2022, *STOTEN*)



...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaboration.



Graphic developed by Rhett Jackson and Kelsey Broich, Network for Engineering with Nature, University of Georgia. Thin layer placement image by Tim Welp, USACE. Living shoreline and dune restoration images by UGA Marine Extension and Georgia Sea Grant. Beach nourishment image by Alan Robertson, City of Tybee. Oyster Reef Breakwater, Bon Secour National Wildlife Refuge in Alabama photo used with permission and provided to the University of Georgia by USACE, Engineering With Nature.

Broadening Benefits

- Hazard Loss Reduction
- Habitat
- Recreation & Tourism
- Climate Regulation
- Carbon Storage
- Human Health and Well-Being
- Water Quality
- Food Provision
- Lifecycle cost avoidance

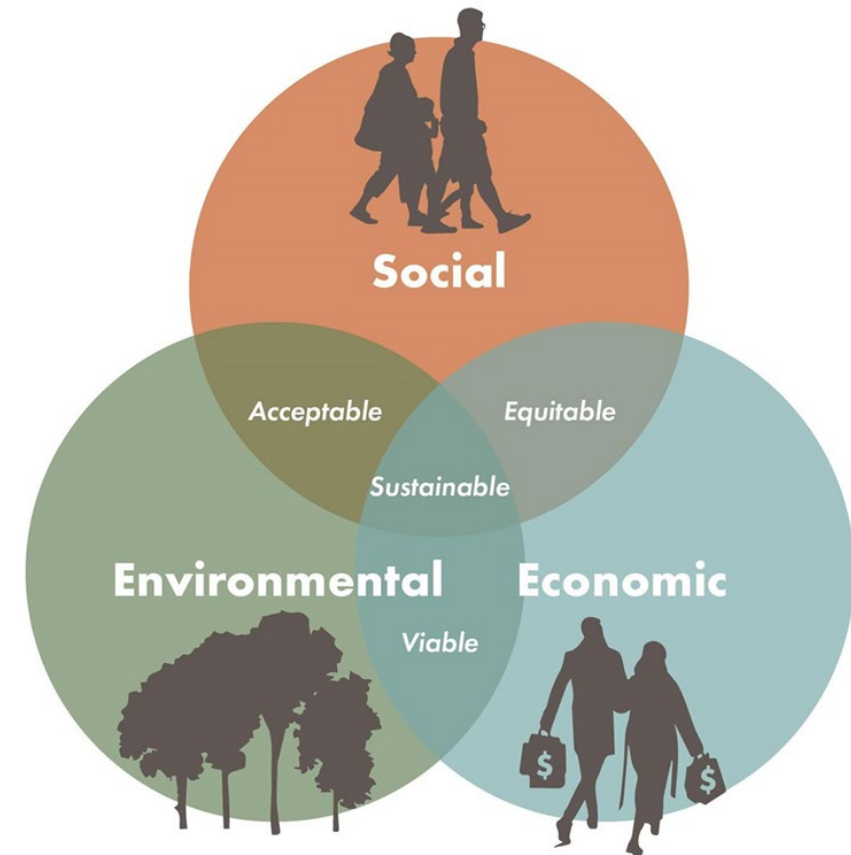


Figure 4. Triple-Win Outcomes Achieved through EWN (Large Text) and Associated Additional Benefits (Small Text)
From (USACE, 2018).



The USACE Navigation Mission Provides the “Currency” of EWN Climate Resilience - Sediment

Sediment “Recharge” via
Dredging



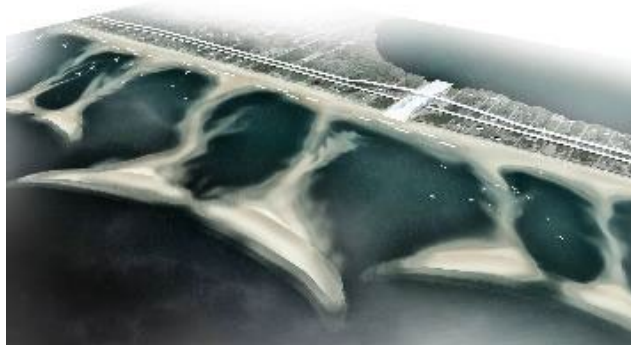
Direct Wetland
“Nourishment”



Wetland Creation



Island Enhancement or
Restoration



Strategic Placement



Thin-Layer Placement for
Bottom Contouring

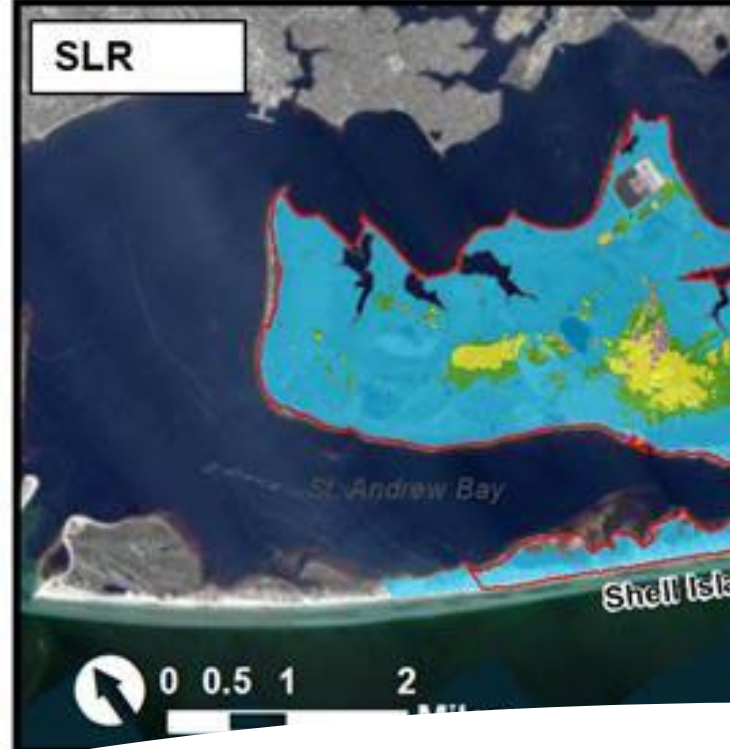


Beach and Dune
Construction



New Island
Construction

SLR

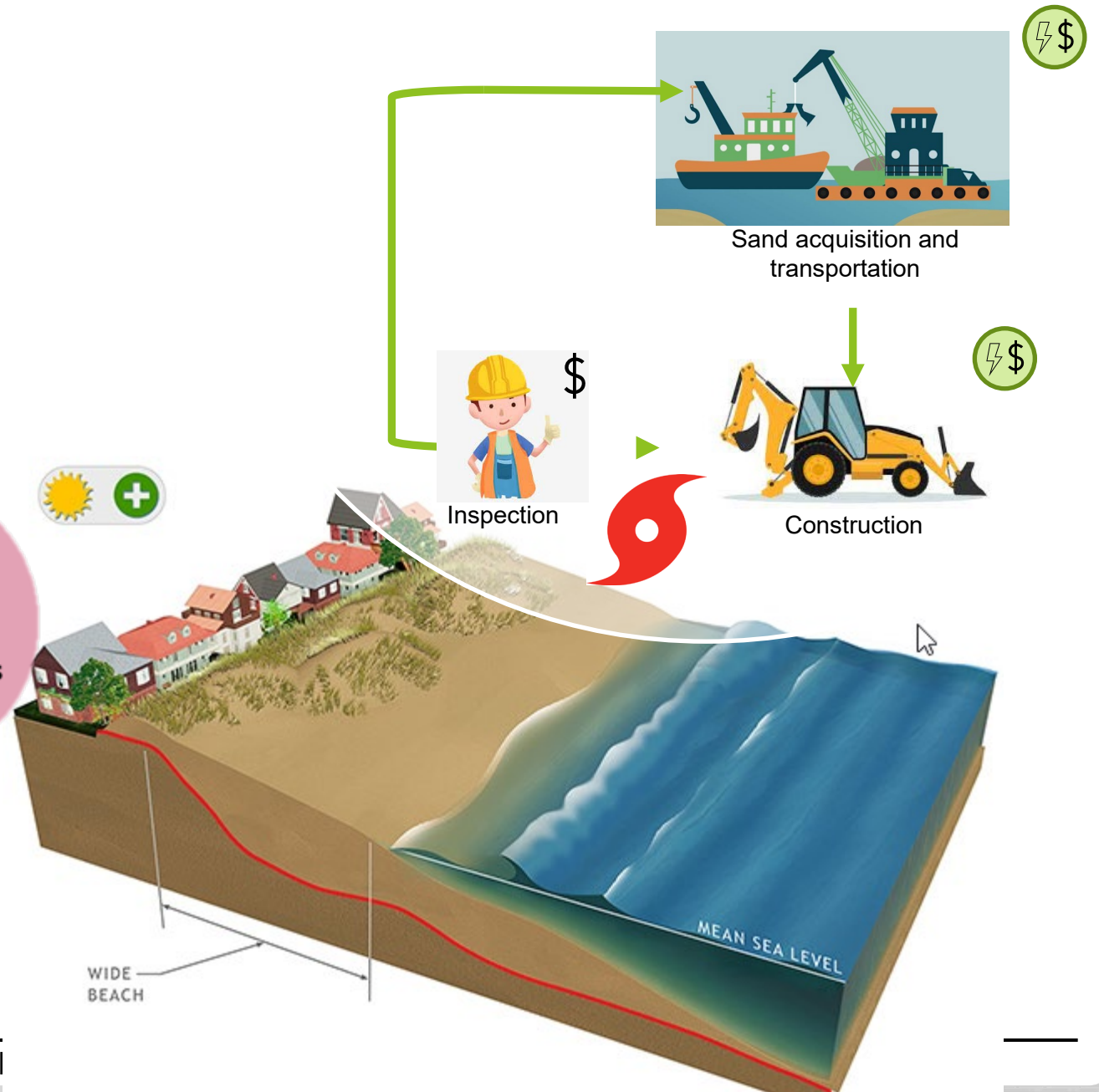
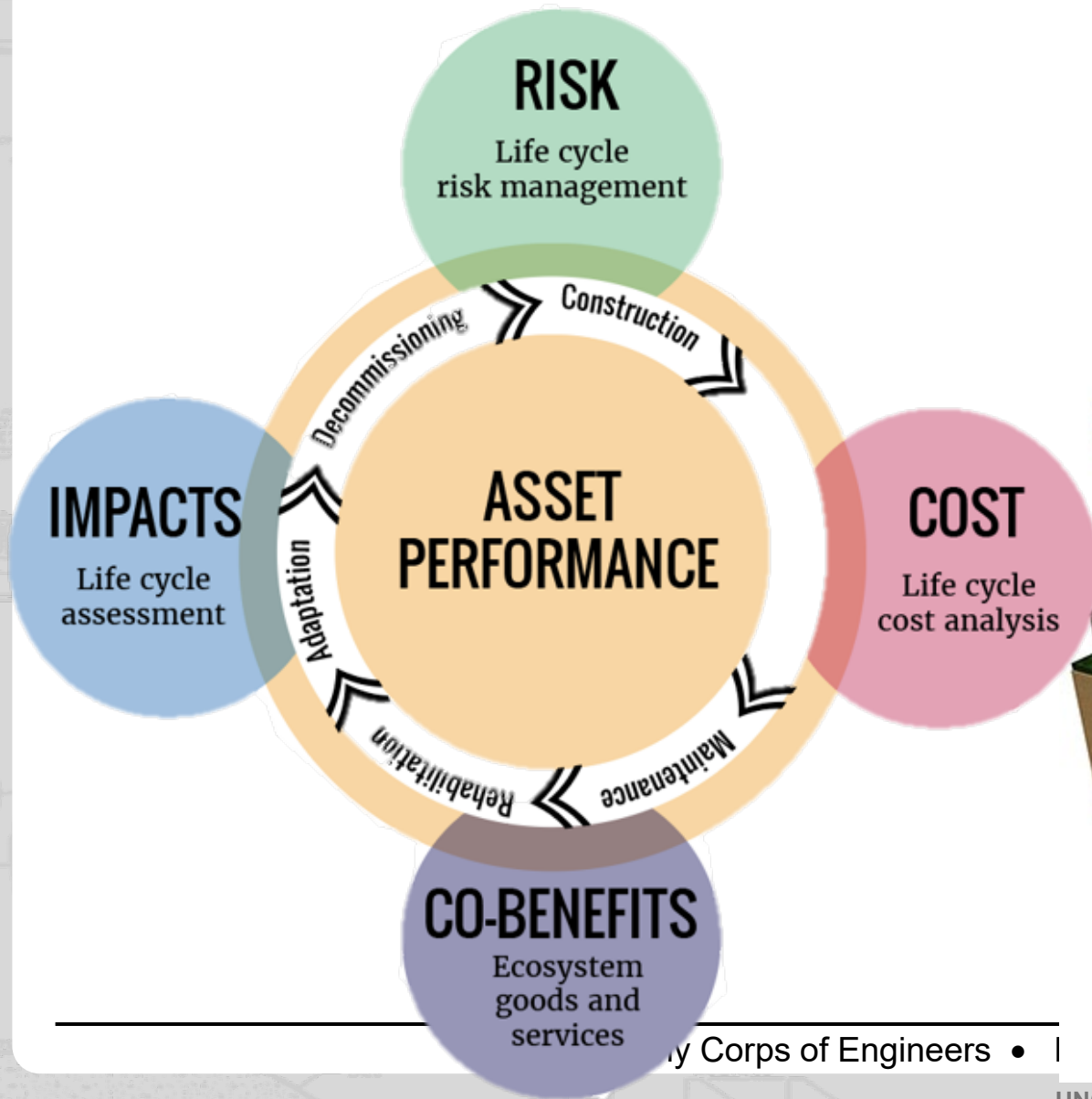


- BU is not generally the least cost way to meet a project's objective
- Benefits accounting is not set up to include many of the strengths of EWN projects
- Local demand for EWN projects is uneven
- Adaptive management can be viewed as a weakness of project design

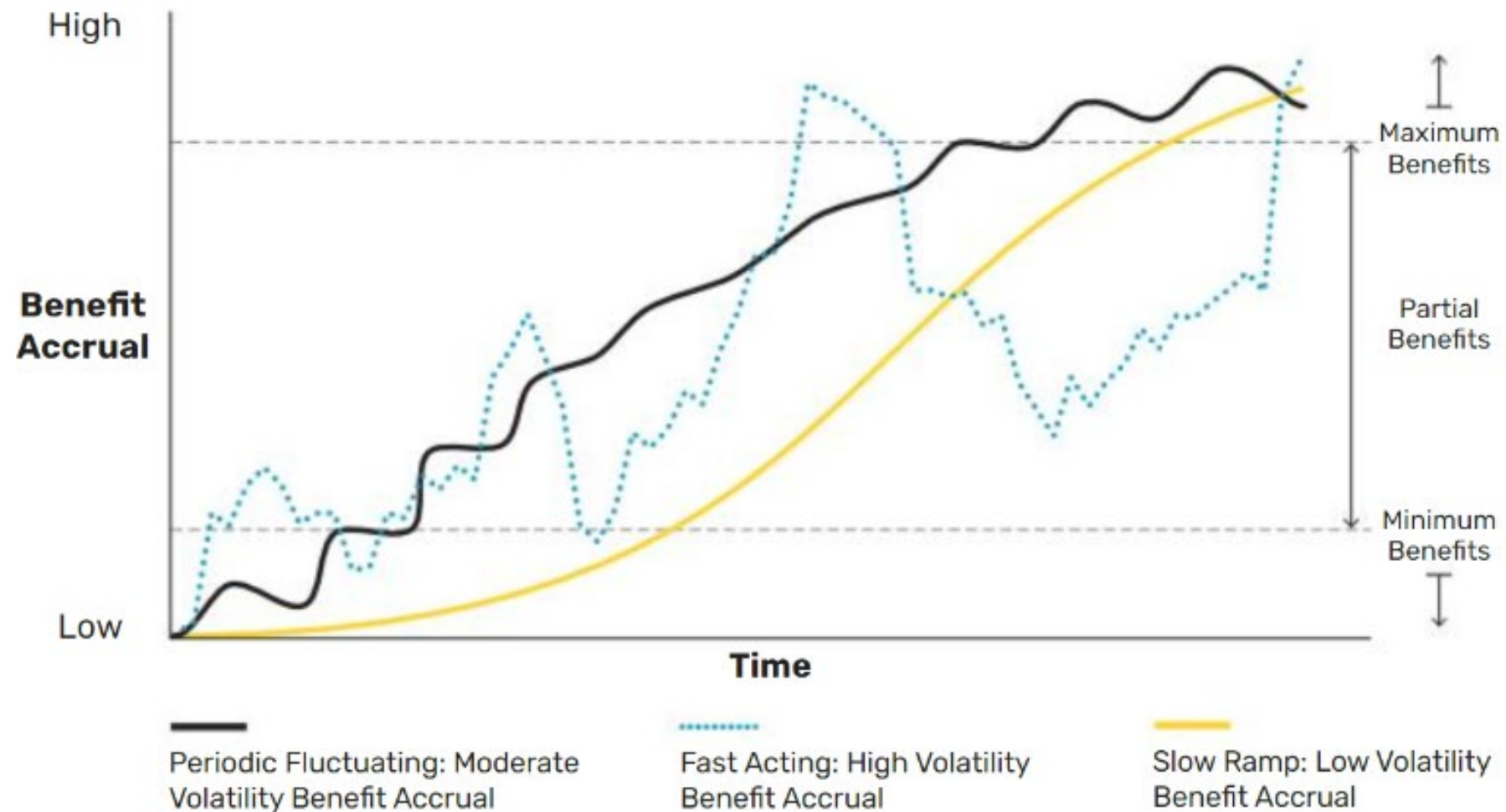
- Regulations that prevent BU, vary by state
- Technology not optimized for BU
- Missions and authorities are siloed, which make operational efficiencies and systems thinking difficult
- Institutional culture is risk-averse

Agency Context: Constraints on Beneficial Use (BU)

Life Cycle Perspective



Dynamic Benefit Streams



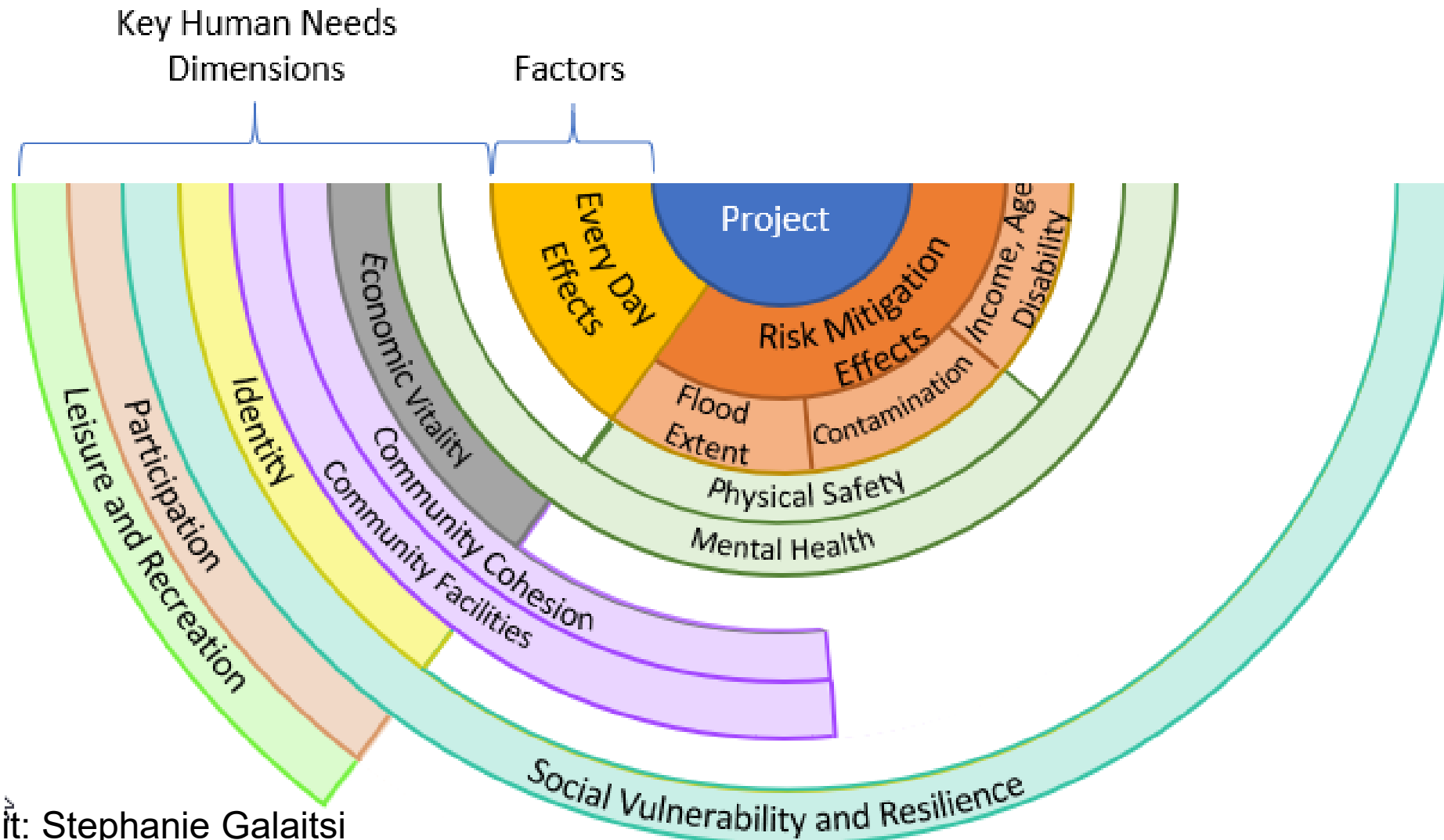
From International Guidelines on NNBF for FRM Ch. 6

Resilience Benefits of Natural Infrastructure



Plan/Prepare	Shoreline and/or sediment stabilization
	Enhance shoreline accretion
	Decrease shoreline erosion/mitigate shoreline retreat
Absorb	Wave attenuation and/or dissipation
	Protect and reduce erosion from storms and rising tides
	Wind speed reductions due to windbreaks or shelter belts
Recover	Promotes self-recovery after hazard event
	Able to recover with minimal intervention
Adapt	Adaptability to changing community needs
	Enhance likelihood of landform evolution naturally

Consider “Everyday Effects”



Graphic Credit: Stephanie Galaitsi



THE WATER
INSTITUTE

Enhancing benefits evaluation
for water resources projects:

Towards a more
comprehensive approach for
nature-based solutions

Case Study Results

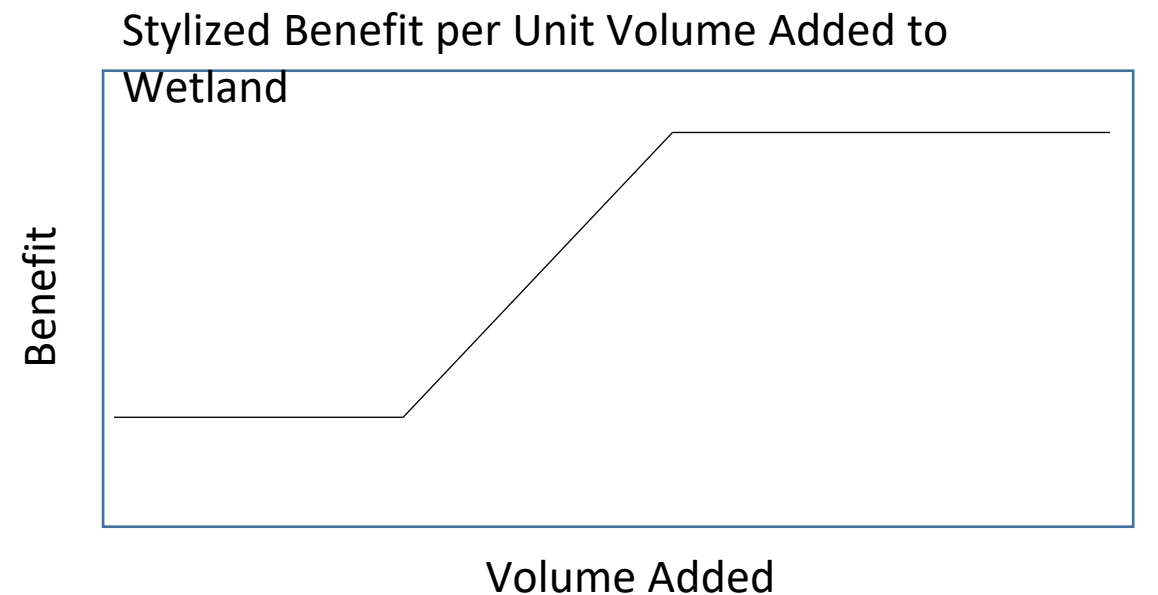
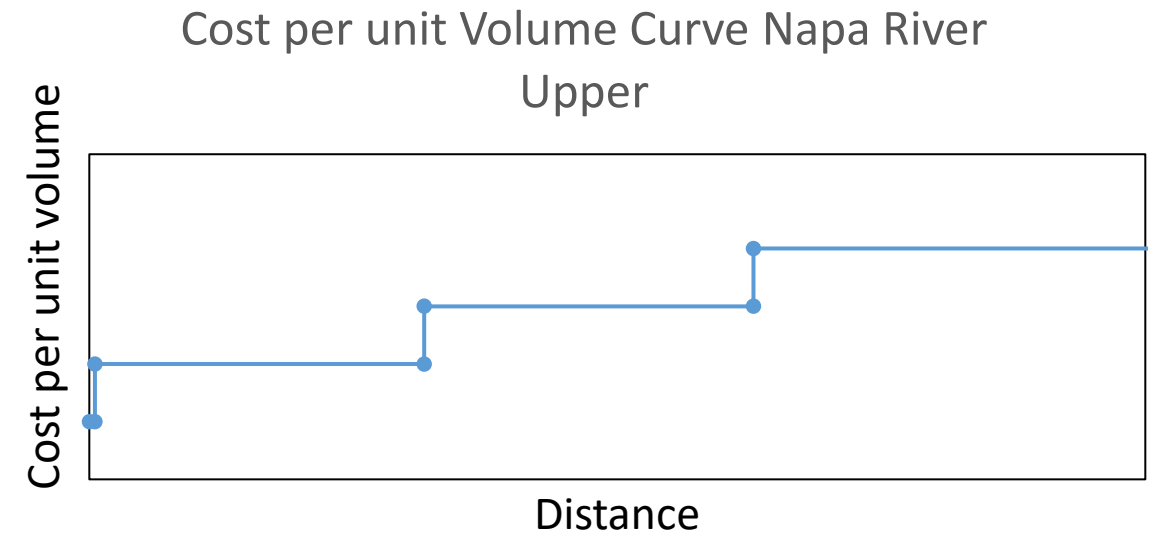
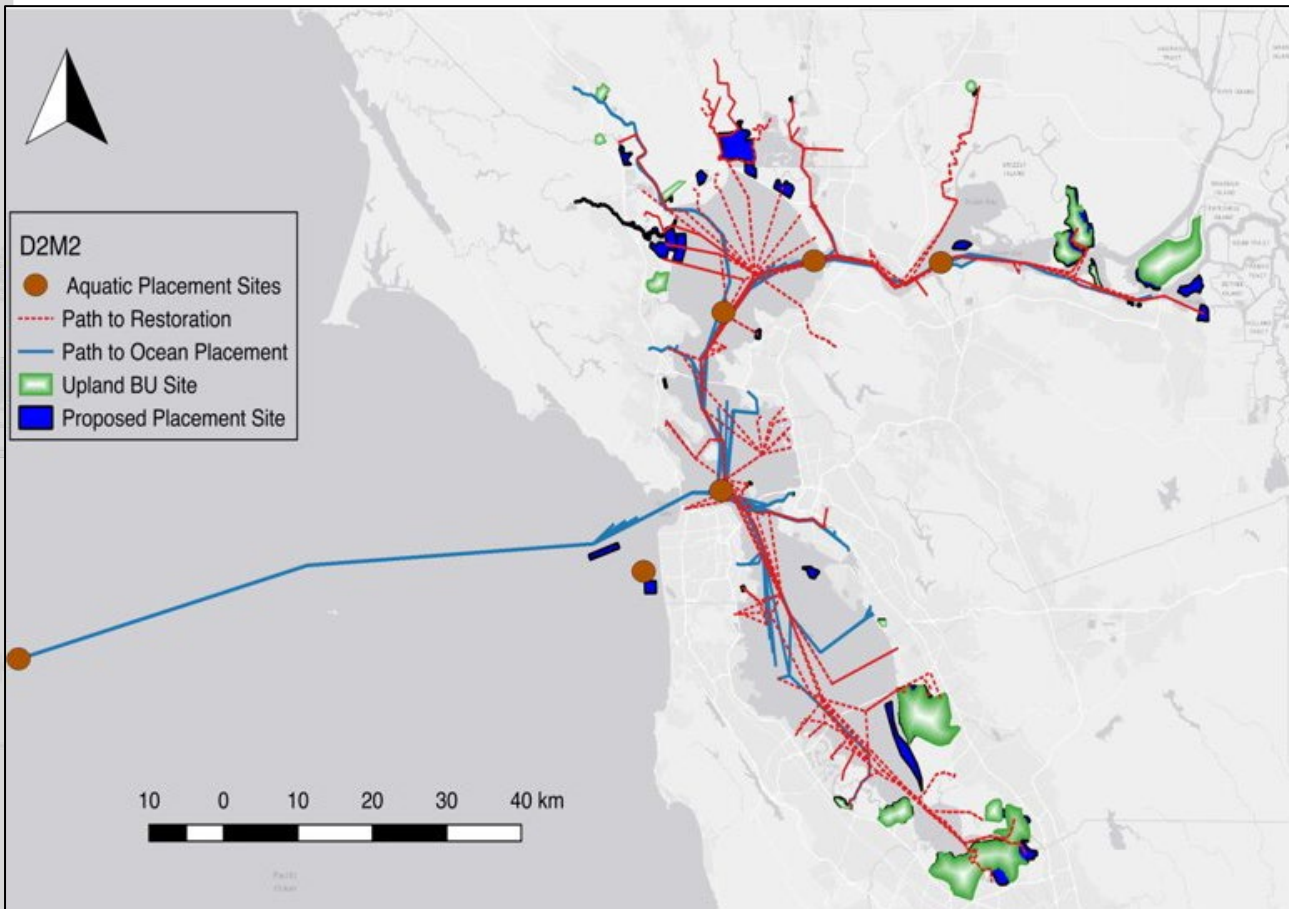
Table ES 1. Summary of key findings and opportunities, organized by planning stage.

Planning stage	Key finding	Opportunity
Study Scope	Scoping within separate mission areas limits NBS opportunities.	Use an integrated, multi-objective approach to scope planning studies.
Alternative Formulation	NBS options are often excluded during alternative formulation.	Formulate integrated alternatives designed to provide benefits or co-benefits across all PR&G guiding principles and to different communities of interest.
Evaluation of Non-Monetized Outcomes	Existing tools can support non-monetary benefit estimation.	Evaluate alternatives using metrics for all PR&G guiding principles and communities of interest.
Ecosystem Service Valuation	A range of existing methods may be applied to enable more comprehensive valuation.	Develop USACE guidance, resources, and tools for monetizing a broader range of benefits.
Prioritization and Alternative Selection	Monetizing ecosystem service benefits improved BCA analysis but was generally insufficient to change alternative rankings due to decisions made during scoping, screening, and alternative formulation. Multi-objective analysis is necessary to capture all benefits.	Apply transparent multi-criteria decision analysis as the primary approach for alternative ranking and selection.

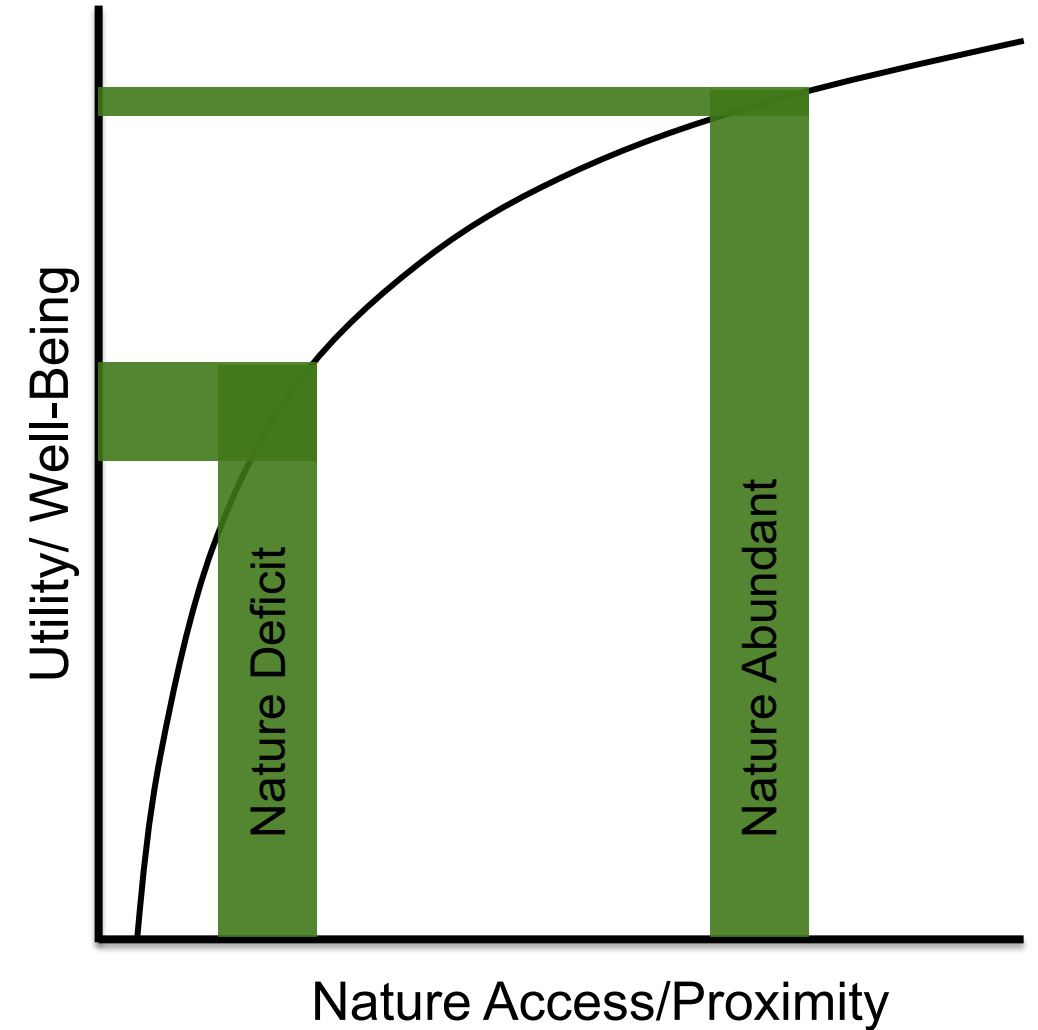
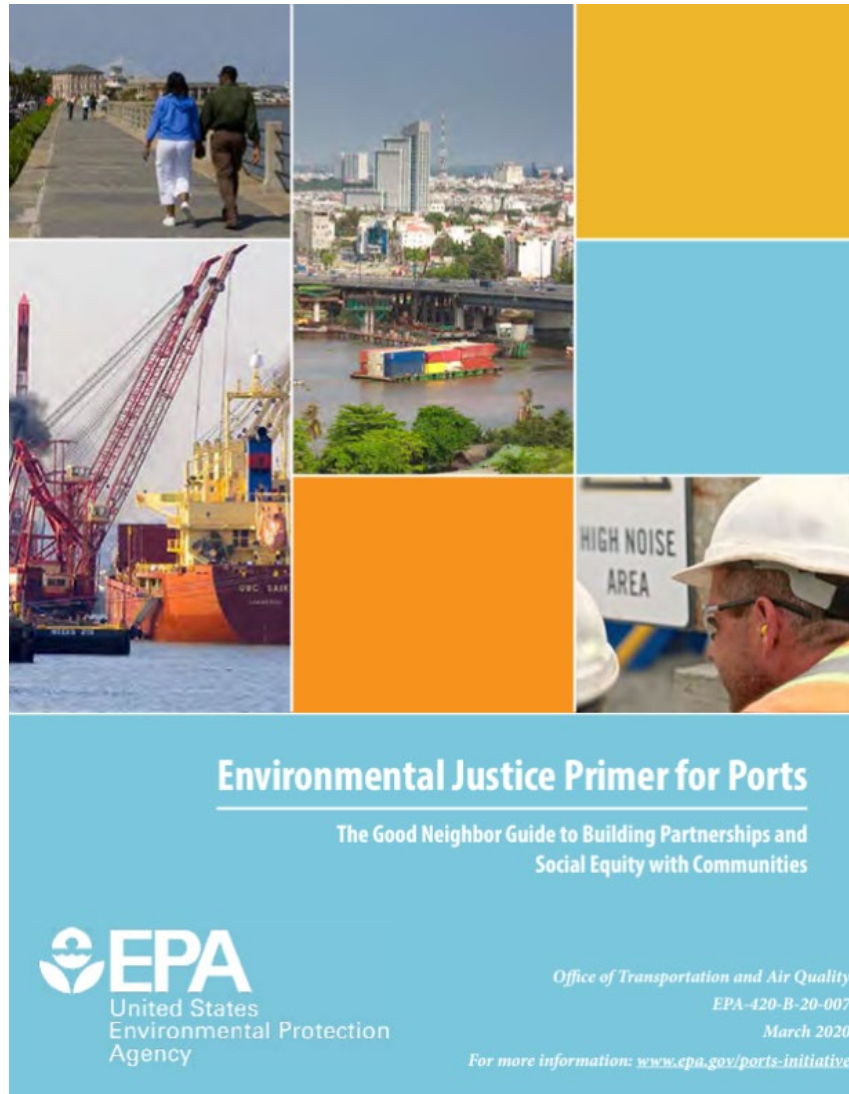
- Engineer Research and Development Center

System-Wide Planning

Optimize placement to minimize cost, maximize benefit



Distributional Costs and Benefits

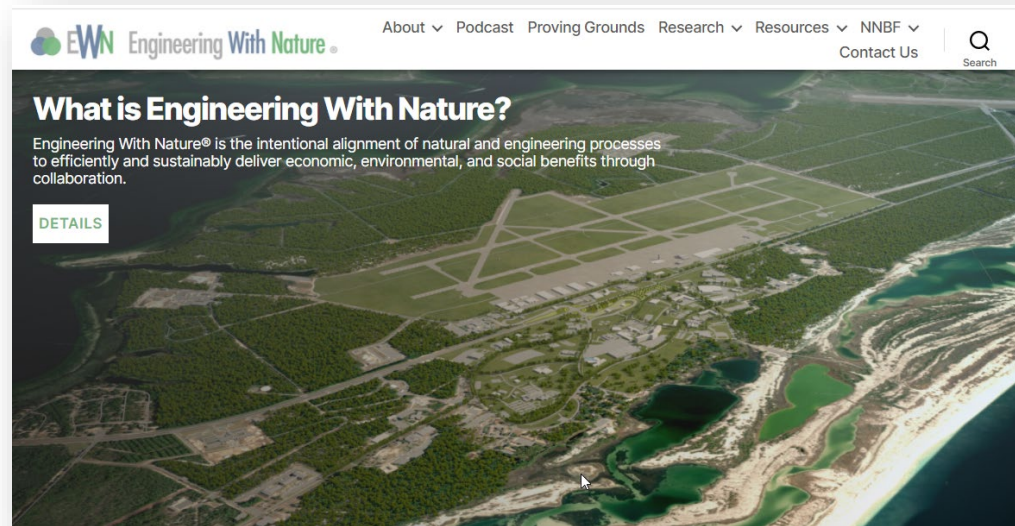


BU Decision Support Matrix – Demo

Under Development. POCs Chuck Theiling, Burton Suedel, Ben Emery, Justin Wilkins

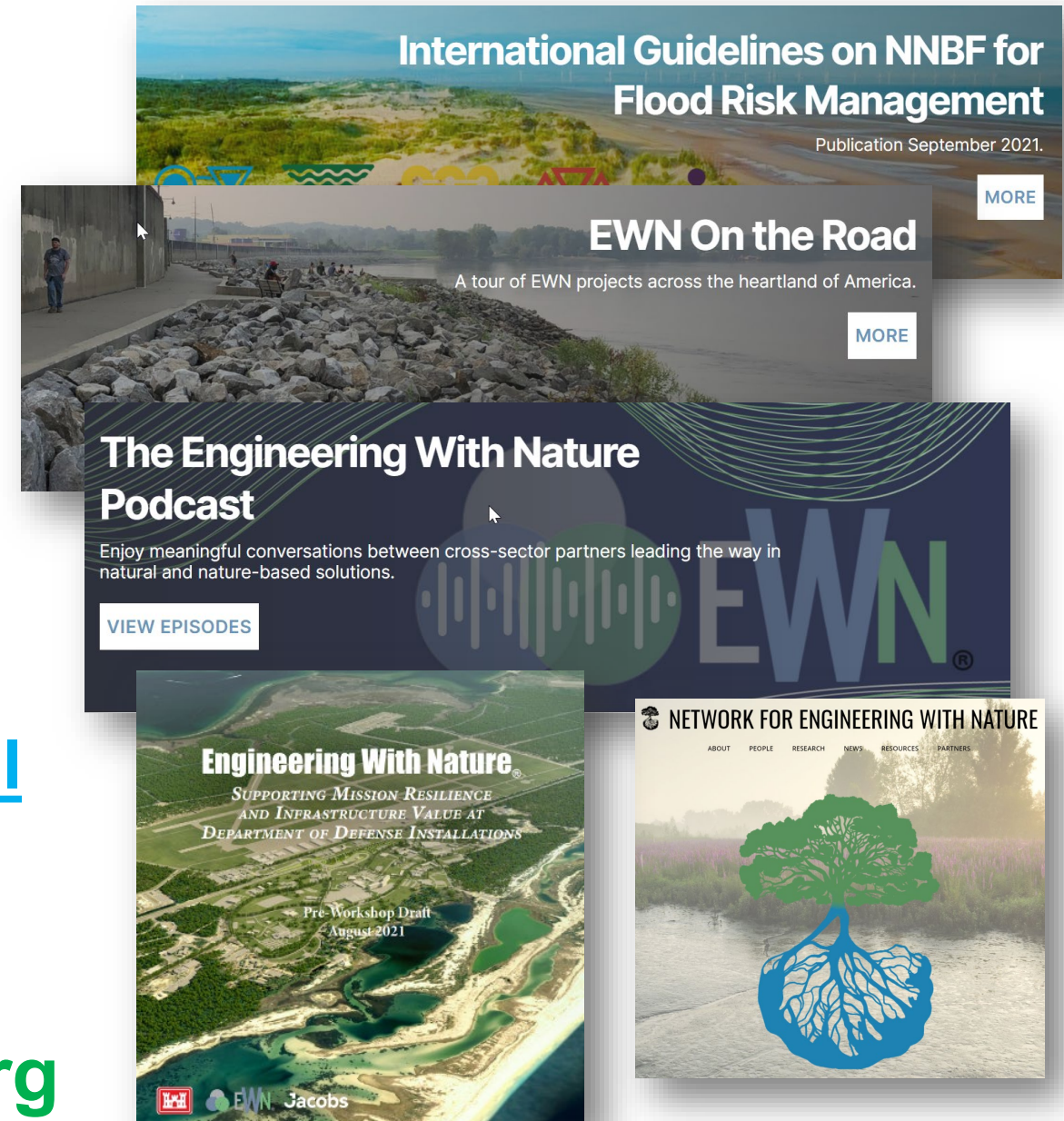
	A	B	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Beneficial Use Placement Site Alternatives					1			2			3			4						
2	Decision guidance matrix					Beach Nourishment (littoral, nearshore, or shallow water), Nimitz Beach Park			Beach Nourishment (littoral, nearshore, or shallow water), Agat Mayors Office			Open-Water Placement, G-DODS			Construction and Industrial/Commercial Uses, Dredge Harbor and Stockpile						
3						Capacity: 8,000		Capacity: 8,000		Capacity: 8,000		Capacity: 8,000									
4						Unit Cost: \$ 263.03	Unit Cost: \$ 266.20		Unit Cost: \$ 148.03		Unit Cost: \$ 174.34										
5						Total Cost: \$ 2,104,204	Total Cost: \$ 2,129,633		Total Cost: \$ 1,184,245		Total Cost: \$ 1,394,719										
6						Duration: 240 d	Duration: 240 d		Duration: 30 d		Duration: 60 d										
7	Criteria					Benefit			Benefit			Benefit			Benefit						
8	Ecosystems Goods and Services (EGS)					Urgency			Urgency			Urgency			Urgency						
9	Weight					Priority			Priority			Priority			Priority						
10	1	Aesthetics	5%	High	High	5%	High	Medium	4%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
11	2	Climate regulation/Carbon sequestration	5%	None	None	0%	None	None	0%	Low	Low	1%	None	None	0%	None	None	0%	None	None	0%
12	3	Cultural, spiritual, educational	10%	High	Medium	8%	High	Medium	8%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
13	4	Ecosystem sustainability	10%	High	High	10%	High	High	10%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
14	5	Food provisioning	10%	Low	Medium	3%	Low	Medium	3%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
15	6	Hazard mitigation	20%	Medium	Medium	10%	Medium	High	15%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
16	7	Human health support	10%	High	Low	5%	High	Low	3%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
17	8	Navigation maintenance	20%	High	High	20%	High	High	20%	High	High	20%	High	High	20%	High	High	20%	High	High	20%
18	9	Raw goods & materials provisioning	5%	None	None	0%	None	None	0%	None	None	0%	None	None	0%	Medium	Low	1%	None	None	0%
19	10	Recreation Supply	5%	High	Medium	4%	High	Medium	4%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
20	11	Water Purification & Waste Treatment	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
21	12	Water Supply & Regulation	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
22	13	(Other): enter here	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%	None	None	0%
23	*notes					max			Score			Score			Score			Score			
24						100%			64%			65%			21%			21%			
		About	Table 1. Placement Sites	Table 2. EGS	Table 1. Summary	Table 2. Summary	BU scoring	BU Scoring chart	BU EGS Scoring Charts	EGS_ ...											

Thank you

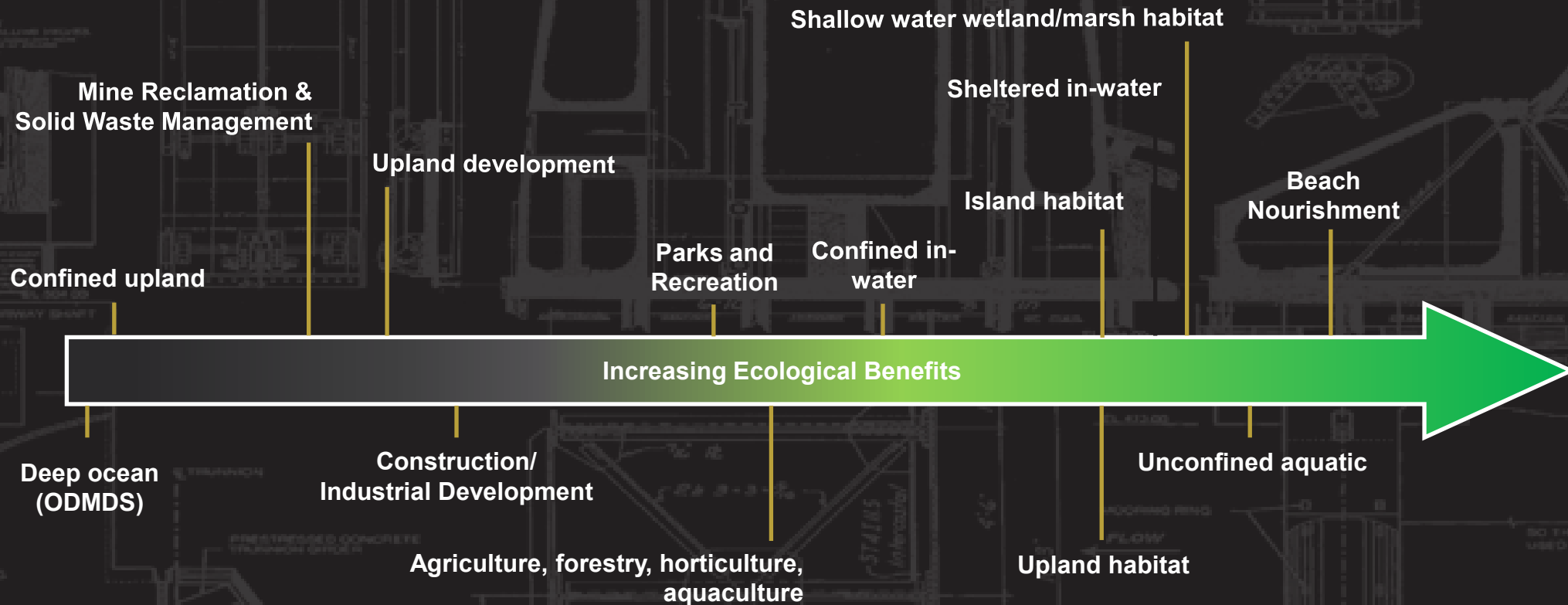


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Sediment Beneficial Use Placement as an Economic–Social–Ecological Continuum



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