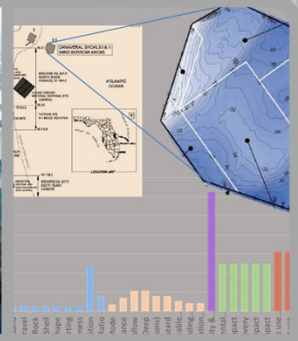
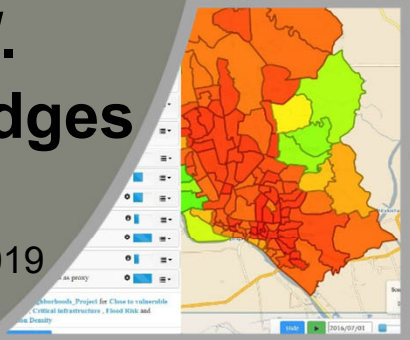
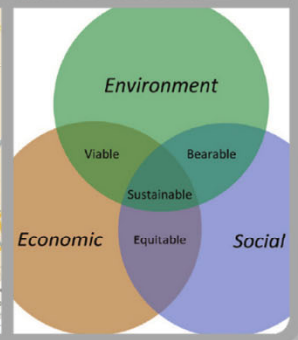
Assessing Sustainability and Ecosystem Support in Dredging and Navigation Projects







Matthew E. Bates, Stephanie Galaitsi, Cate Fox-Lent, David W. Moore*, Igor Linkov, Todd S. Bridges

**Presenter*

Battelle Sediments Conference, New Orleans, February 2019

ERDC
Engineer Research and Development Center

Innovative solutions for a safer, better world

US Army Corps of Engineers®

U.S.ARMY®

US Army Corps of Engineers Dredging Mission

- Maintain national waterway networks
- Specific depths for each water channel
- Federal government supports 100% costs for
  - Existing projects (unless deeper than 45 ft)
  - Operating/maintaining disposal facilities for dredged material
- Federal standard of least-cost environmentally acceptable alternative

Sustainability

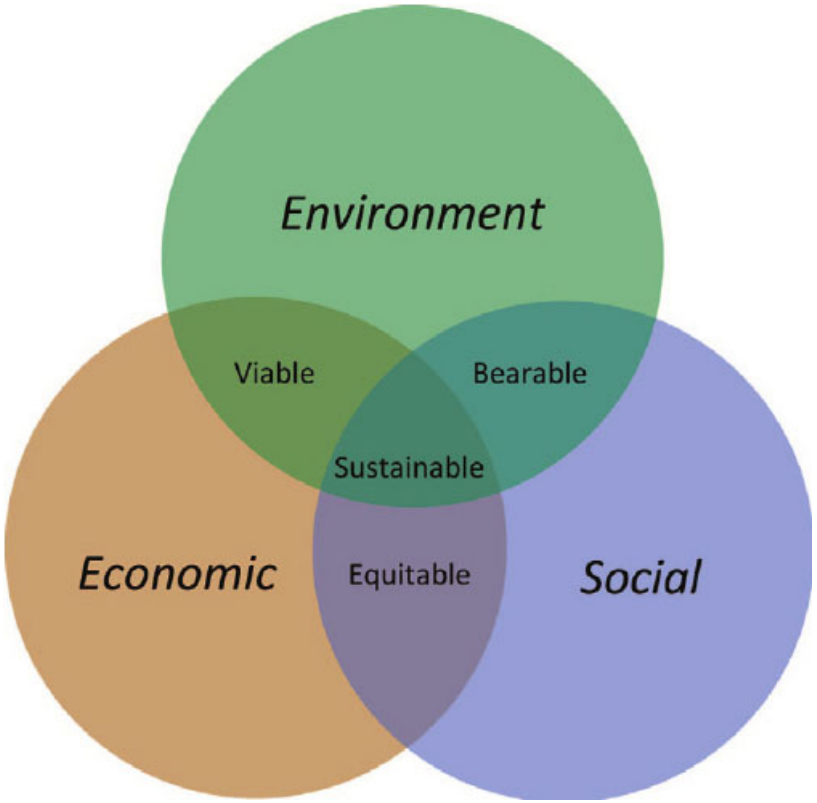
- Brundtland Commission 1987

  Meeting the needs of the present without compromising the ability of future generations to meet their needs

- Three pillars
  - Environmental
  - Economic
  - Social

- For Cleveland, exploring:

  Which disposal practices are sustainable over time?

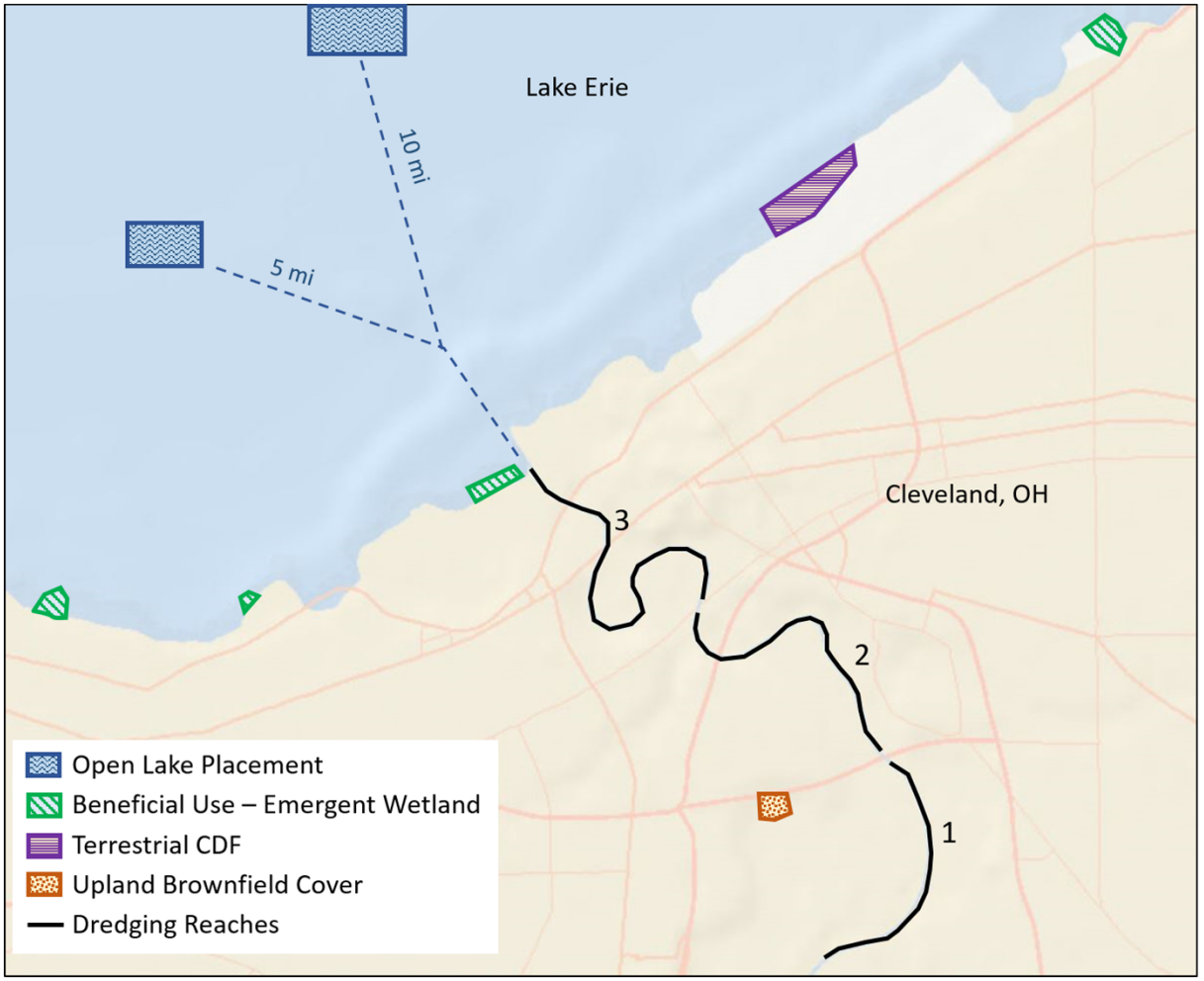


Port of Cleveland

- Cuyahoga River
- 225,000-330,000 cubic yards must be dredged annually
- Environmental
  - Long term placement capacity
  - Environmental impacts
- Economic
  - Costs of operation
  - Regional economic effects
- Social
  - Community compatibility
  - Regulatory

Analysis of Alternatives for Dredged Material Placement, Cleveland

Considering Alternatives for Cleveland



Alternative 1: Continued Placement in Confined Disposal Facility (CDF) 12

Long Term Sediment Capacity	**0-47 years**
Environmental Effects	**Neutral**
Costs of Operation to USACE	**Dredging + waterborne transport + offloading + tipping fee**
Regional Economic Effects	**Port able to sell sediment for beneficial purposes**
Regulatory Issues	**No hurdles**
Community Compatibility	**Community approves**

Alternative 2: Open Lake Placement to Cap Hotspots

Long Term Sediment Capacity	**Dependent on number of hotspots approved; CLA-1 = 180,000 cy**
Environmental Effects	**CONTESTED: Existing harmful PCB contamination could be capped with cleaner dredged material**
Costs of Operation to USACE	**Dredging + waterborne transport**
Regional Economic Effects	**Tied to (contested) environmental benefits/impacts**
Regulatory Issues	**Regulatory approval required**
Community Compatibility	**Community strongly opposes**

Alternative 3: Beneficial Use through Wetland Restoration

Long Term Sediment Capacity	**3.5 years based on current estimates**
Environmental Effects	**Contribute to parks and habitat**
Costs of Operation to USACE	**Dredging + waterborne transport + offloading + habitat formation (cost share partner needed)**
Regional Economic Effects	**Improved city access to environment**
Regulatory Issues	**Regulatory approve required (beneficial use category)**
Community Compatibility	**Community Supports**

Alternative 4: Open Lake Placement to Support Fish Habitat

Long Term Sediment Capacity	**Depends on placement areas selected**
Environmental Effects	**Improved fish habitat**
Costs of Operation to USACE	**Dredging + waterborne transport**
Regional Economic Effects	**Improved fisheries**
Regulatory Issues	**Regulatory approval required (beneficial use category)**
Community Compatibility	**Community strongly opposes**

Alternative 5: Direct Upland Placement for Construction or Agriculture

Long Term Sediment Capacity	**Depends on sediment uses found; Unclear if possible, studies currently being conducted**
Environmental Effects	**Neutral - positive**
Costs of Operation	**Dredging + waterborne transport + offloading + upland transport – potential revenue**
Regional Economic Effects	**Unclear, but likely positive**
Regulatory Issues	**Regulatory approval required**
Community Compatibility	**Likely positive (but may vary by use/site)**

Alternative 6: No Action (Dredging Halted)

Long Term Sediment Capacity	**N/A**
Environmental Effects	**Vegetation not disturbed, but shallow depth may affect water quality**
Costs of Operation	**N/A**
Regional Economic Effects	**Cleveland harbor no longer navigable – industry cannot export/import**
Regulatory Issues	**USACE unable to fulfill its navigation mission**
Community Compatibility	**Broader effects on Cleveland as a prosperous city**

Comparing Alternatives

	Continued CDF placement	Open lake, cap hotspots	Wetland restoration	Open lake, fish habitat	Direct upland placement	Dredging Halted
Long Term Sediment Capacity						
Environmental Effects						
Costs of Operation to USACE						
Regional Economic Effects						
Regulatory Issues						
Community Compatibility						

Comparing Alternatives

Cleveland's perspective & preference

	Continued CDF placement	Open lake, cap hotspots	Wetland restoration	Open lake, fish habitat	Direct upland placement	Dredging Halted
Long Term Sediment Capacity						
Environmental Effects						
Costs of Operation to USACE						
Regional Economic Effects						
Regulatory Issues						
Community Compatibility						

Comparing Alternatives

USACE's perspective & preference

	Continued CDF placement	Open lake, cap hotspots	Wetland restoration	Open lake, fish habitat	Direct upland placement	Dredging Halted
Long Term Sediment Capacity						
Environmental Effects						
Costs of Operation to USACE						
Regional Economic Effects						
Regulatory Issues						
Community Compatibility						

Multi-Criteria Decision Analysis (MCDA): *A way to aggregate different scores*

Process	MCDA identifies the "best" alternative from a pool of options, according to stated preferences and explicit performance data
including	
People	Preferences – Determined with stakeholder engagement, to specify criteria importance. Needed to develop a consistent evaluation framework.
&	
Tools	Performance data – Quantifying, modeling, and analyzing various alternatives through the lens of each sustainability consideration.

Benefits of Multi-Criteria Decision Analysis

1. Transparent – each item's score is clear and is consistent with established preferences and demonstrated performance data.
2. Replicable – Evaluations can be rerun to receive the same answer.
3. Tractable – Able to break large problems down to manageable components.
4. Scalable – Framework is applicable to broad types of decisions.
5. Promotes identification/consideration of a broader set of objectives.
6. Allows exploration of trade-offs between these objectives.
7. Separates subjective data [weights] from objective data [scores] .
8. Can integrate values across a group with diverse views.
9. Enables scenario exploration and sensitivity analysis to examine the results' stability under different models or alternative assumptions.

General Multi-Criteria Decision Analysis

(1) Identify objectives

Sustainable placement area for dredged material.

(2a) Identify criteria

Capacity
Env. Effects
Cost
Econ. Effects
etc.

(2b) Generate alternatives

CDF
Hot spot
Wetlands
Fish Habitat
etc.

(3a) Elicit weights

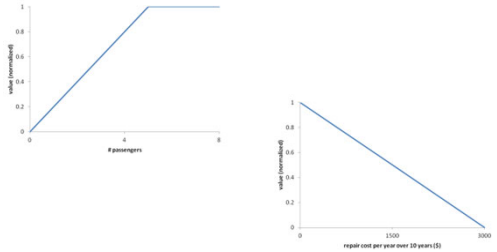
Capacity (a%)
Env. Effects (b%)
Cost to USACE (c%)
Econ. Effects (x%)
Regulatory (y%)
Comm. (z%)

$$\sum_{m=1}^{M} w_m = 1$$

(3b) Identify metrics

Capacity:	Cubic yards
Env. Effects:	Low/med/high
Cost	Dollars
Econ. Effects:	Low/med/high
Regulatory:	Time, cost, hassle
Comm:	Low/med/high

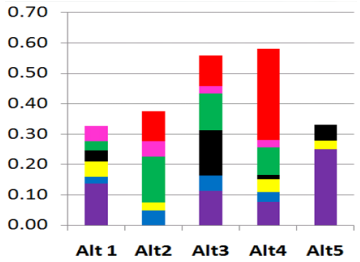
(4) Develop value f(x)



(5) Score alternatives

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Capacity	0.136	0	0.144	0.076	0.025
Env. Effects	0.023	0.048	0.05	0.033	0
Cost	0.05	0.028	0	0.042	0.028
Econ. Effects	0.038	0	0.15	0.015	0.053
Regulatory	0	0.1	0.15	0.3	0

(6) Calculate MCDA



(7) Analyze sensitivity

Vary scores/weights within a plausible range (e.g., +/- 10%)

Evaluate driving criteria most influential on results

Path forward—need to identify:

- Data agreement
  - Environmental effects of hot spot capping?
  - Capacity (no options are unlimited)?
  - Difficulty of regulatory approval?
  - Other options? Bed load interceptors?
- Weights for the sustainability criteria?
- Multi-criteria decision analysis for data & preference aggregation?

Questions?

POC: Matthew.E.Bates@usace.army.mil