State-of-the-Science: Thin Layer Placement Construction

Thin Layer Placement: Permitting and Regulation Meeting
Jacksonville, FL 11-12 April, 2017

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US Army Corps of Engineers®

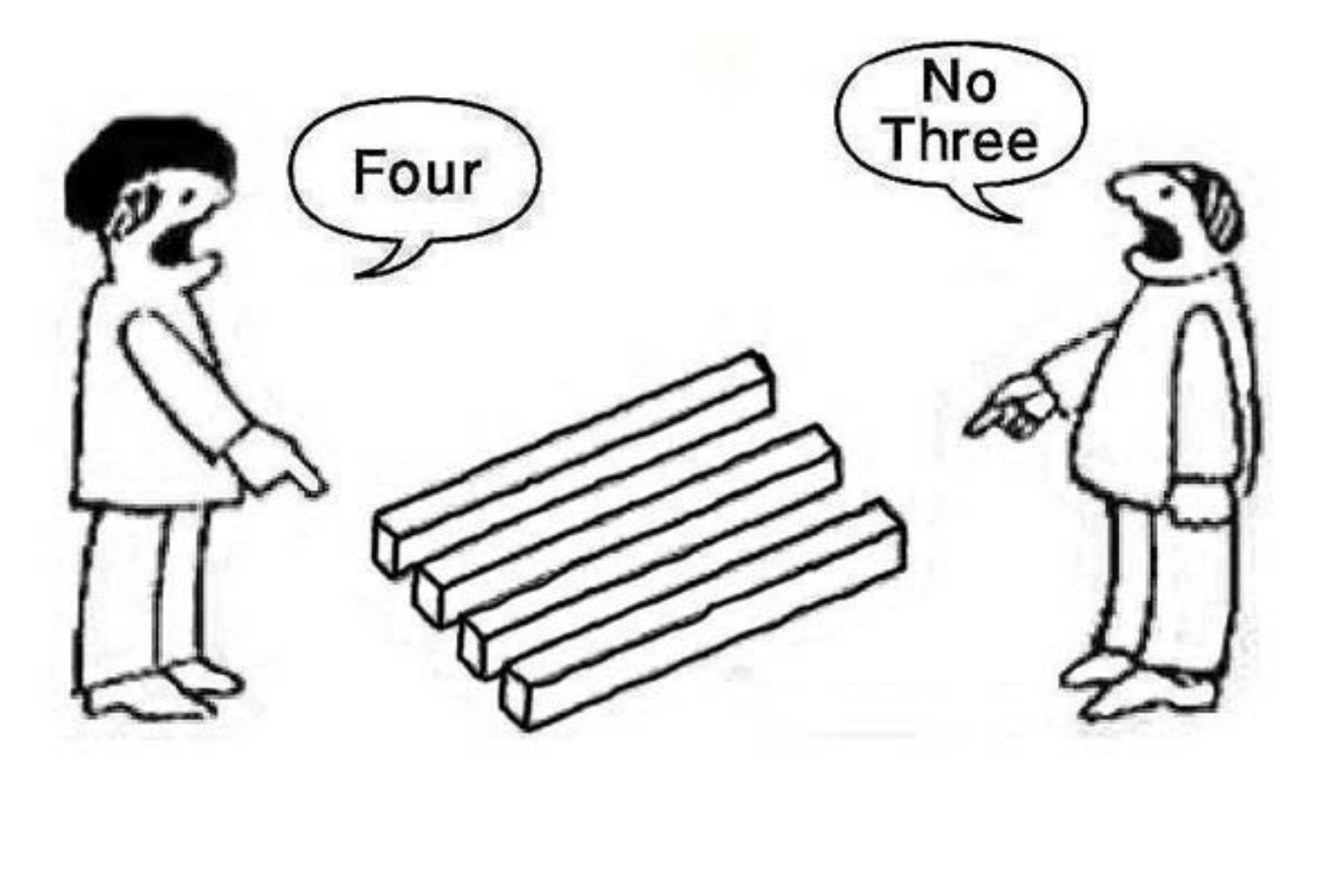
Outline

- Context – TLP on wetlands
- Perspective
- Engineering/Construction Considerations
- R&D

Dredging a Channel vs. Restoring a Wetland

Dredging People Versus Wetland People

Different Perspectives



Perspective

- From a Wetlands Perspective – Dredging Means Sediment
- From a Dredging Perspective – Wetlands mean a Placement Site

Both sides want to optimize from their own perspective.

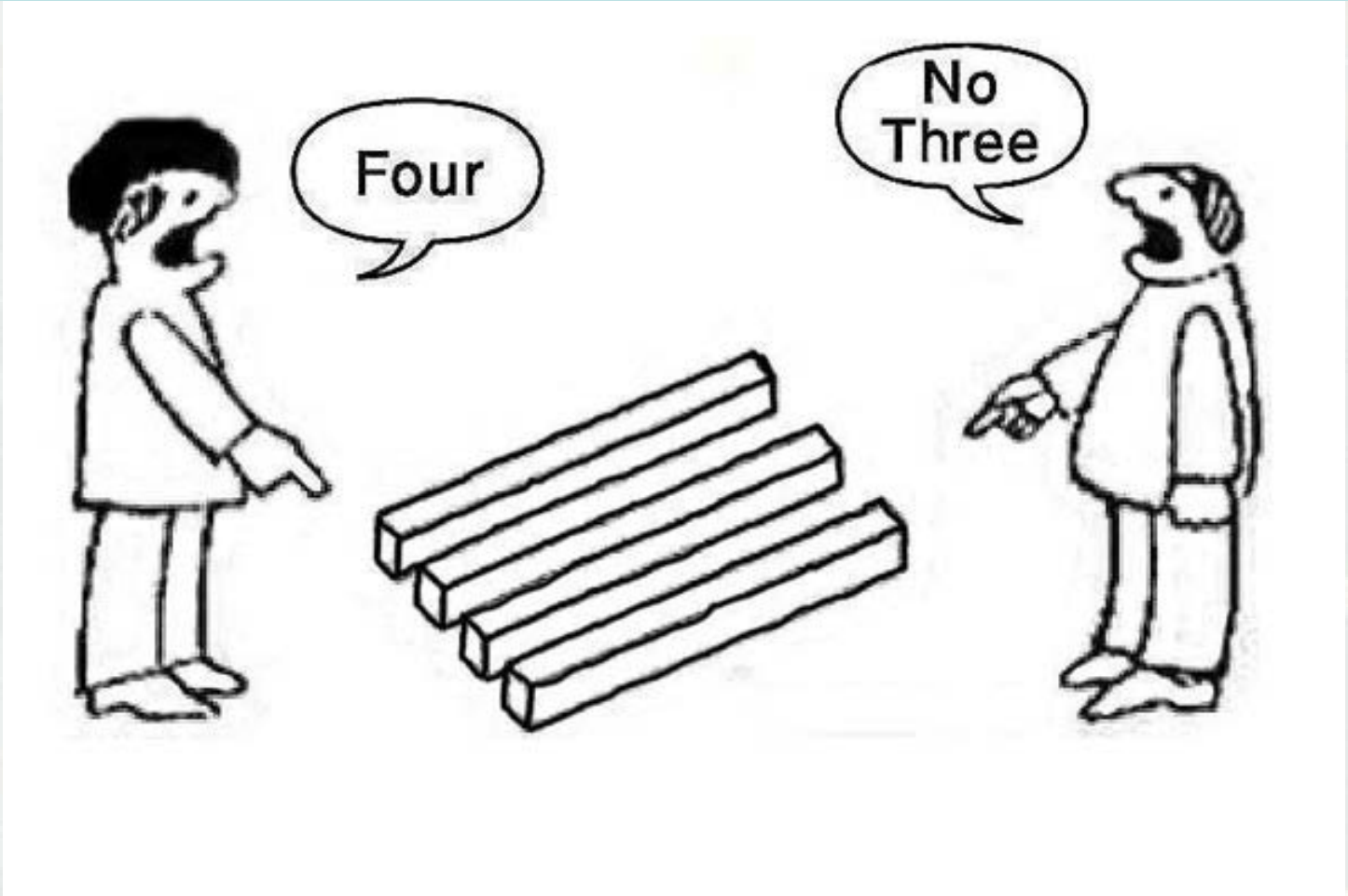
What is this?

Funding

Dredging a Channel AND Restoring a Wetland

Dredging People AND Wetland People

Merged Perspectives



Clearly define project objectives!

Candidate Wetland Site
Candidate Dredging Site

- Site conditions of wetlands
  - ecological, elevations, area, features, geotechnical, etc.
- Site conditions of dredge site (sediment)
- Distance and conditions between the two sites

Engineering Considerations
Elevation! Elevation! Elevation!

AVALON LIDAR Survey
Areas A,E,D,C, and F

Required 18 hours for
14 LIDAR Setups
22 Target Locations

- Elevation - grade control
  - Invasive specie management
  - Quality control
    - RTK
    - Land based Lidar
    - Aerial Lidar & Photogrammetry
    - Eyeballing against existing vegetation
    - Grade stakes

- RTK Global accuracy
- approx ±0.1 ft vertical
- ±0.07 ft horizontal
- LIDAR (local 5 mm @ 400m)
- Based on GPS
- ±0.06 ft

The smaller the tide range: the tighter you want your survey.

Absolute X, Y, Z accuracy of down to 3 cm (1.2 in) (0.1 ft)

Smaller Cutterhead Dredges

8 inch to 18 inch discharge pipelines

Single Point via Dredge-mounted Nozzle

Spraying distance 50 - 200 ft
No “pipeline”
Directionality

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Single Point via Shore Nozzle

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Single Point via Barge Nozzle

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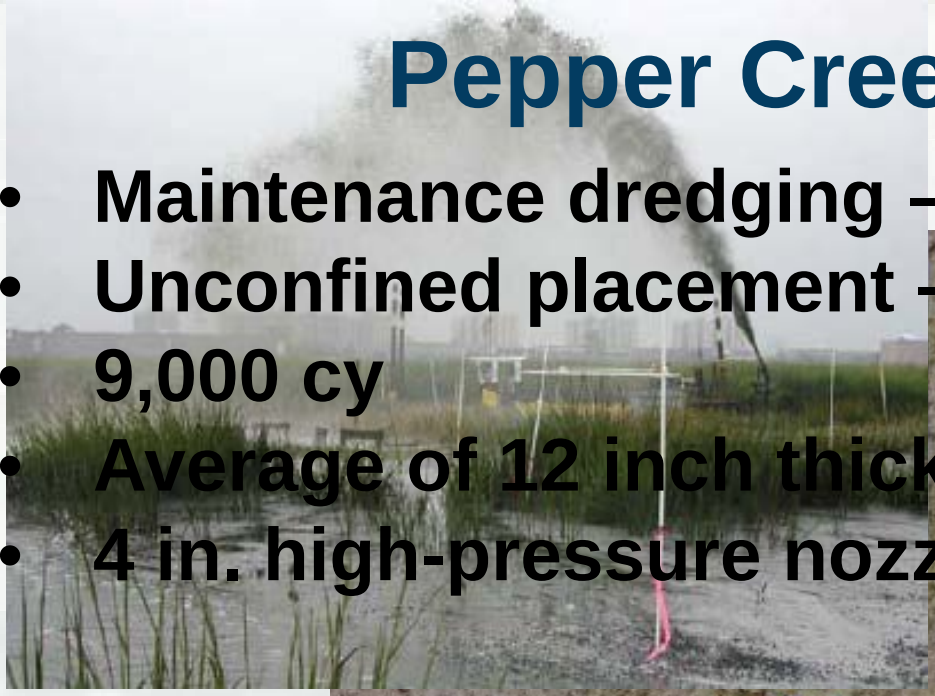
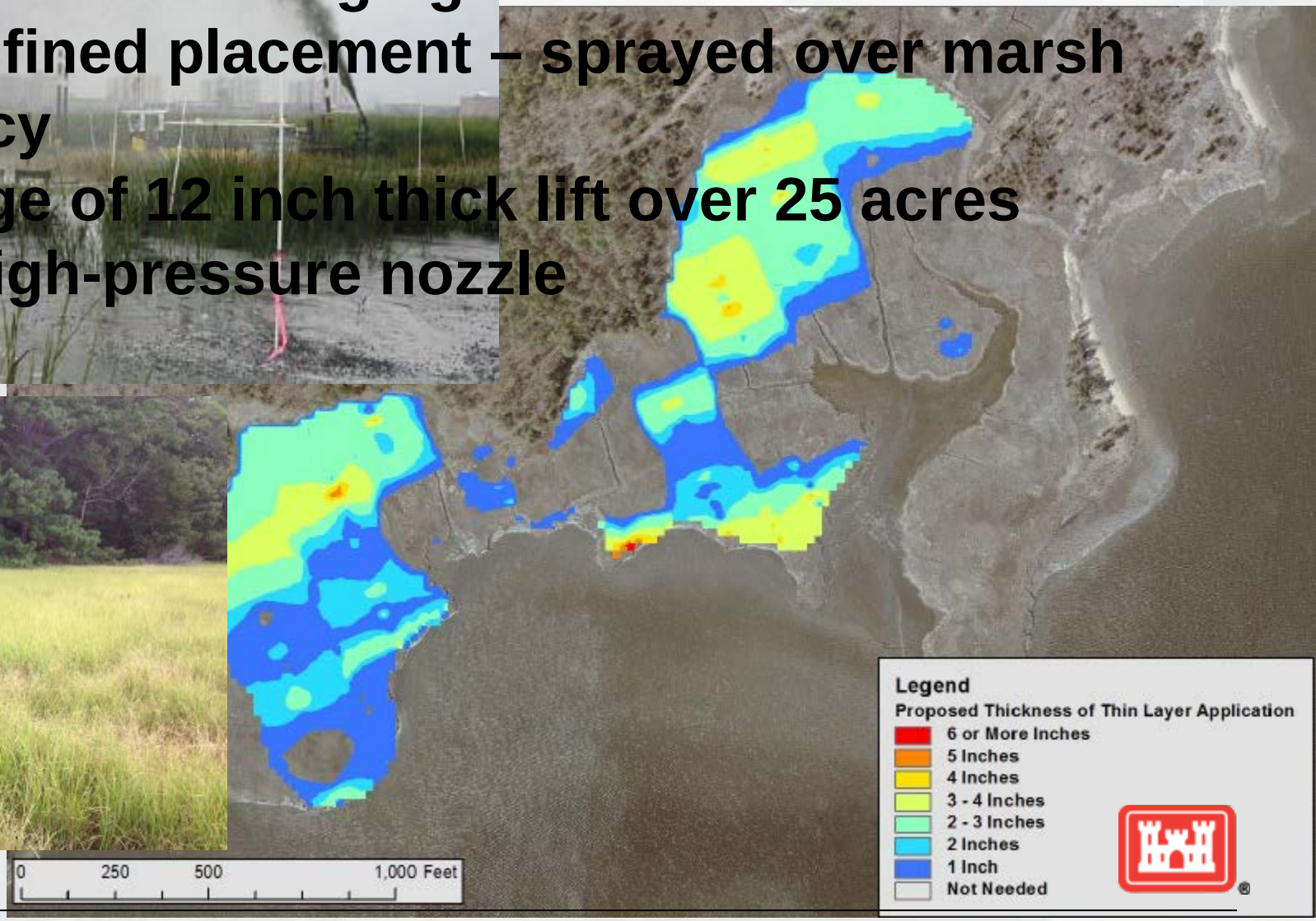
Pepper Creek – Delaware

- Maintenance dredging – Marsh Restoration
- Unconfined placement – sprayed over marsh
- 9,000 cy
- Average of 12 inch thick lift over 25 acres
- 4 in. high-pressure nozzle





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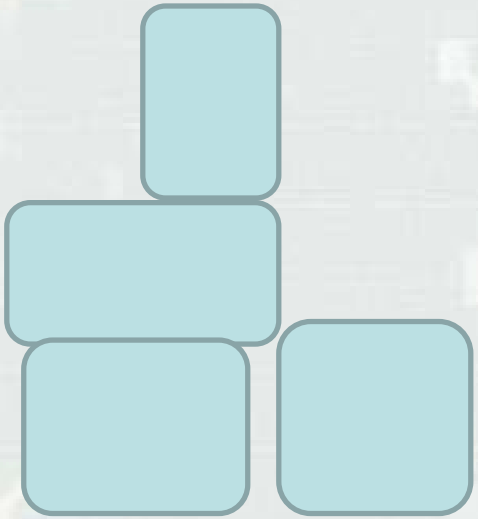
BUILDING STRONG®

Delaware Center for the Inland Bays, Batholomew Wilson, P.G.

Single Point Low Pressure on Shore

Single Point VS Multiple Point Discharge Configuration

Use of wye valves etc.



Engineering Considerations
End of Pipe Placement

A primary distinction - the deposition pattern……

Characteristics to be considered:

- Dimensions of placement area
- Where you want sediment and where you don't
- Dredge production
- Economics
- Type of sediment

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Type of Sediment
Match Sediment to Purpose

- Know where what sediment is where in channel
- Hydraulic sorting (coarse grained falls out faster)
- Sand consolidates less but is heavier

Bulking and consolidation of DM in marsh environments

PDT Lead: Tim L. Welp

Team: Susan Bailey, Paul Schroeder, and Zachary Tyler

- If material is hydraulically placed, elevation changes over time.
- Elevation change can be modeled.
  - Maximum volume: at end of placement
  - Elevation subsides during primary settling and drainage of ponded water (SETTLE)
  - Long term: consolidation of dredged material and underlying foundation (PSDDF).

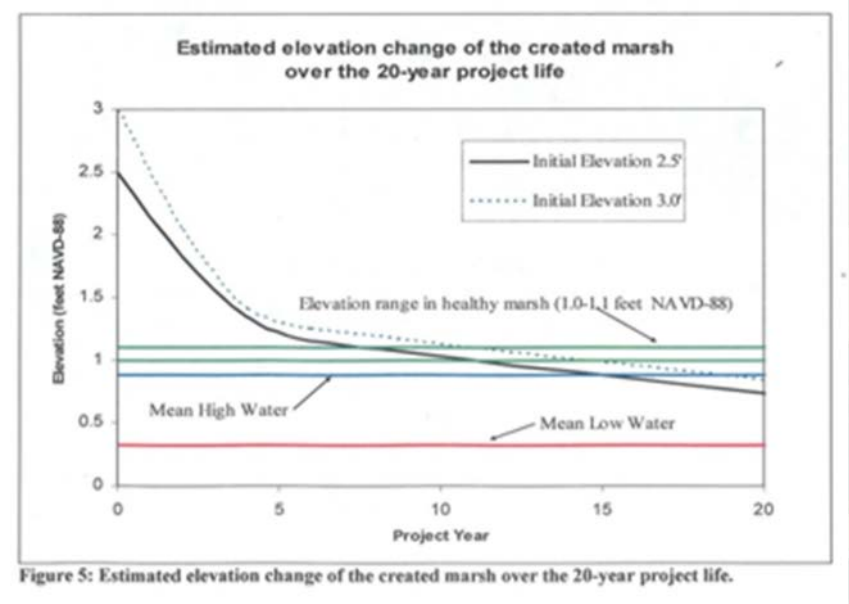

Figure 5: Estimated elevation change of the created marsh over the 20-year project life.

Sediment Containment Structures

- Hay bales
- Coir (coconut) logs
- Biodegradable filter socks
- Silt curtains
- Sediment

Engineering Considerations
Shore Equipment

- Construction and maintenance activities associated with installing/moving pipelines, building berms, etc. will inevitably result in damage to the marsh surface.
- Airboats have few and generally short-lived impacts.
- Low ground pressure vehicles - “marsh buggies” less than 2 psi

* Even with low pressure vehicles, repeated passes over the same area can cause cumulative impacts

All examples are approximate, and will vary based on conditions
Hovercraft: 0.7 kPa (0.1 psi)
Human on Snowshoes: 3.5 kPa (0.5 psi)
Rubber-tracked ATV: 5.165 kPa (0.75 psi)
Diedrich D-50 - T2 Drilling rig: 26.2 kPa (3.8 psi)
Human male (1.8 meter tall, medium build): 55 kPa (8 psi)
M1 Abrams tank: 103 kPa (15 psi)
1993 Toyota 4Runner / Hilux Surf: 170 kPa (25 psi)
Adult horse (550 kg, 1250 lb): 170 kPa (25 psi)
Bagger 288 Excavation machine: 170 kPa (25 psi)
Passenger car: 205 kPa (30 psi)
Wheeled ATV: 13.8 kPa (2 psi)
Adult elephant: 240 kPa (35 psi)
Mountain bicycle: 245 kPa (40 psi)
Road racing bicycle: 620 kPa (90 psi)
Stiletto heel: 3,250 kPa (471 psi)

Construction Lessons Learned

- Use experienced design and/or construction crew to avoid costly delays and get job done.
- Incorporate adaptive management considerations.
- Allow the natural processes to facilitate continued development of the wetland. Do not over-engineer.

Mohan et al. 2016

Developing operational guidelines for thin layer sediment placement

- PDT leads: Tim L. Welp and Candice D. Piercy
- Topics: tools and methods to aid in site selection, design considerations, equipment, construction methodologies, planning tools, and linking design elements to ecological outcomes

Questions?

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