Healthy Port Futures

Great Lakes Protection Fund

Ohio Environmental Protection Agency

ST. ANTHONY FALLS LABORATORY
College of Science & Engineering
University of Minnesota

MICHIGAN AEROSPACE

USGS science for a changing world

B/a+p

DREDGE RESEARCH COLLABORATIVE

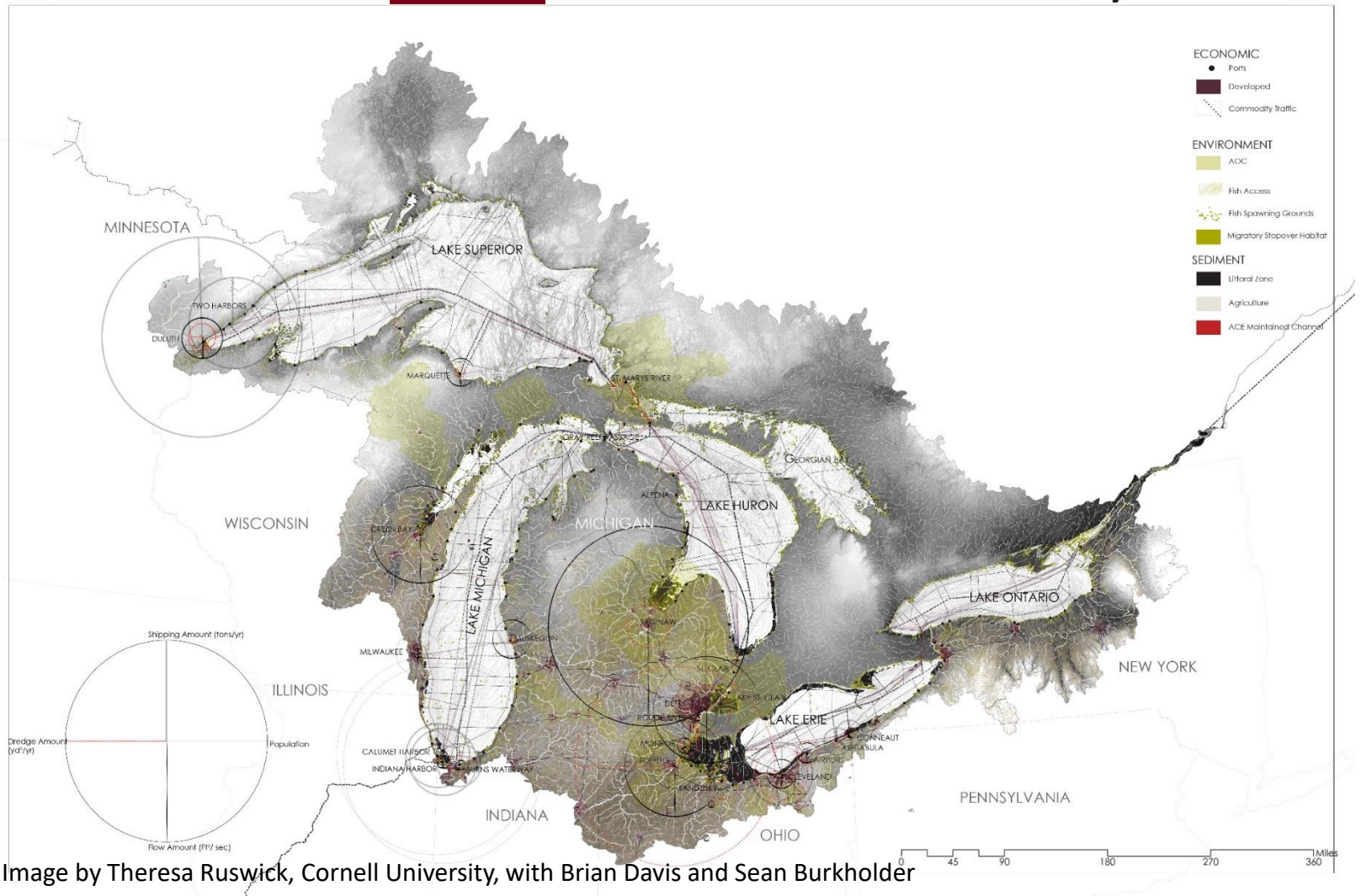
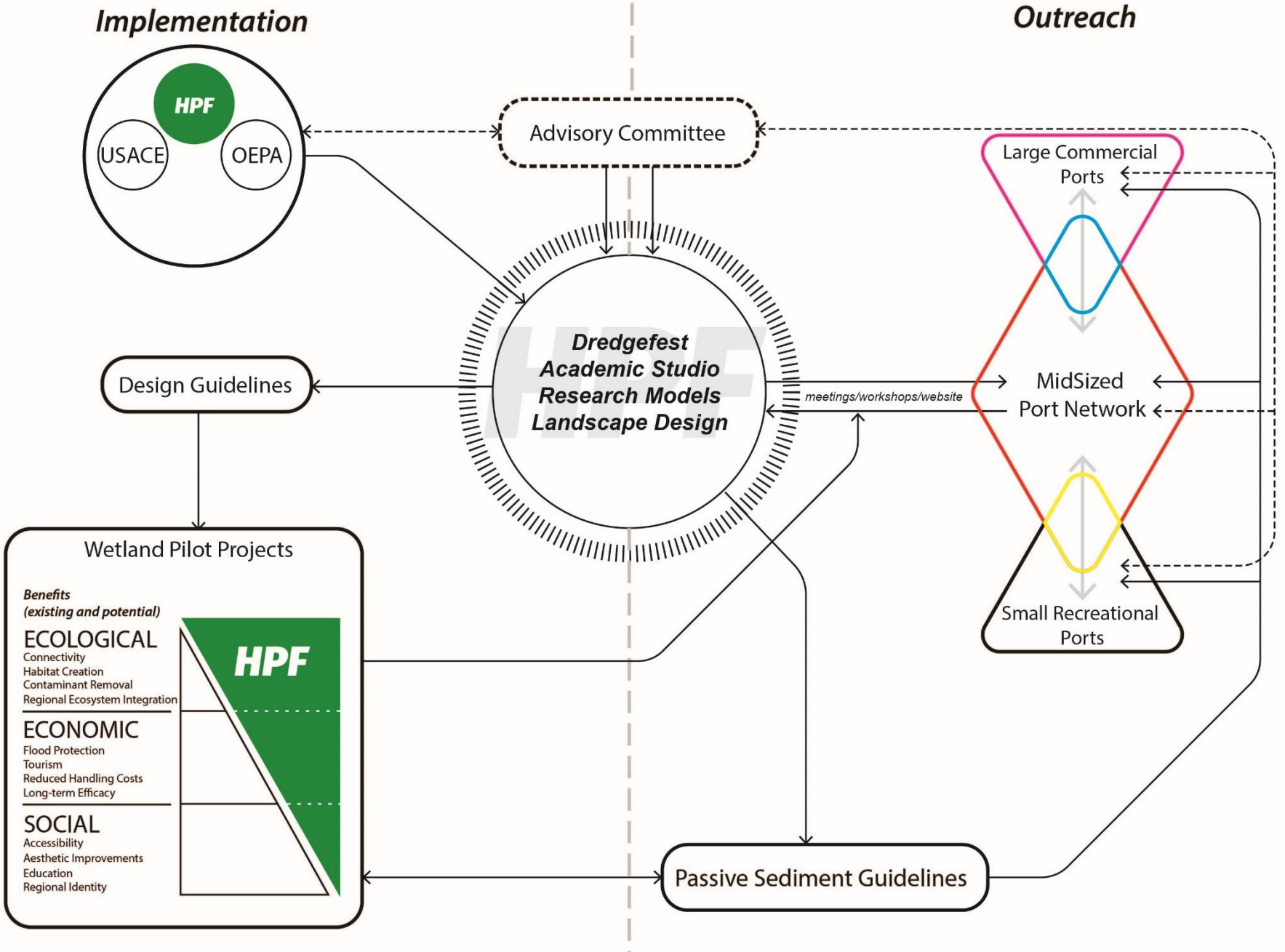


Image by Theresa Ruswick, Cornell University, with Brian Davis and Sean Burkholder

Healthy Port Futures - Project Organization Chart



The Opportunity

New strategies are necessary to complement or augment the traditional practices of dredging in order increase its long term effectiveness, and to capture the larger value-creation opportunities associated with sediment management.

Image by Theresa Ruswick, Cornell University, with Brian Davis and Sean Burkholder

All Sediment is not Equal (context matters)

These new strategies should work with natural processes whenever possible, meaning they should be calibrated to existing conditions in order to maximize local efficacy – all sediment is not equal.

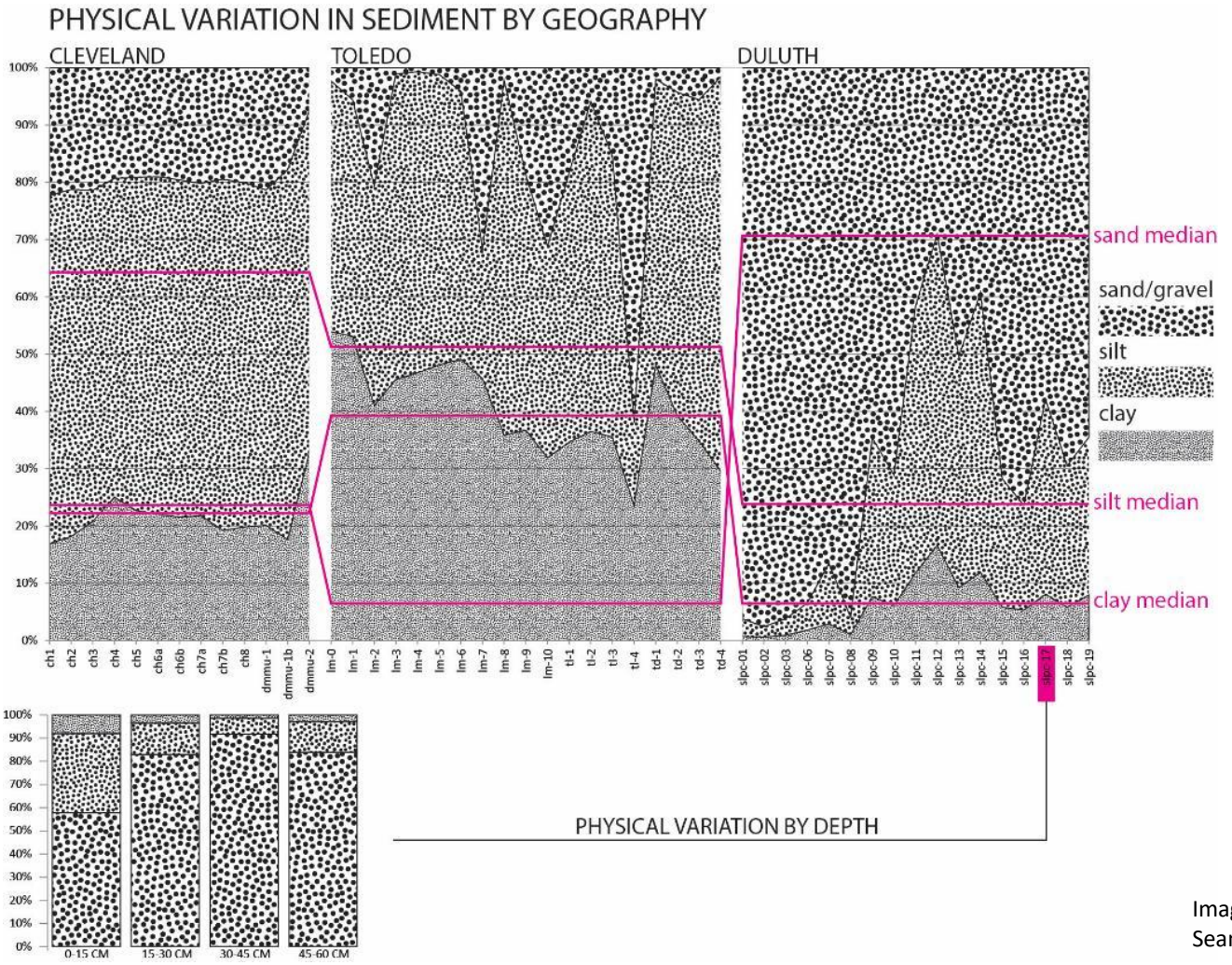
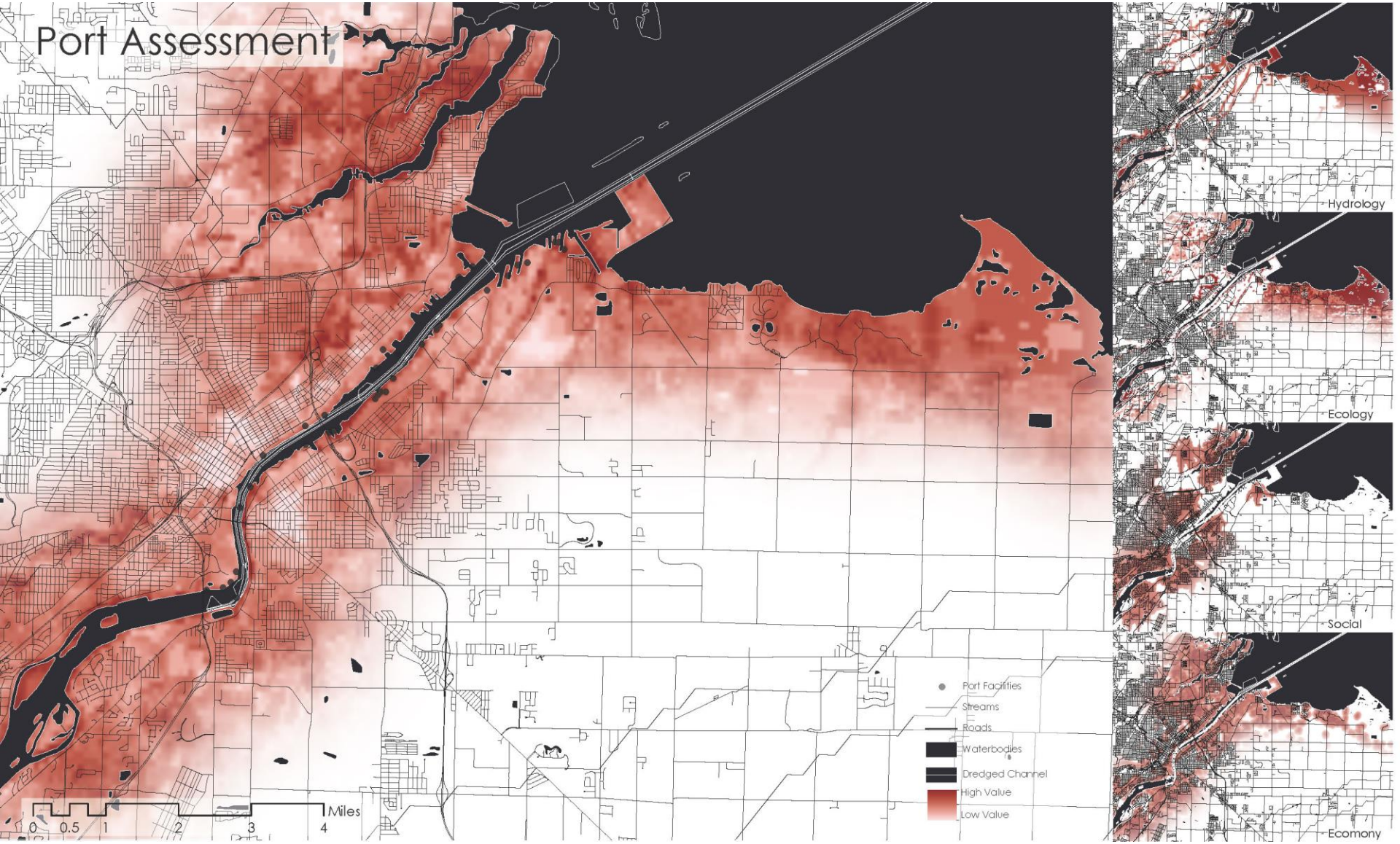
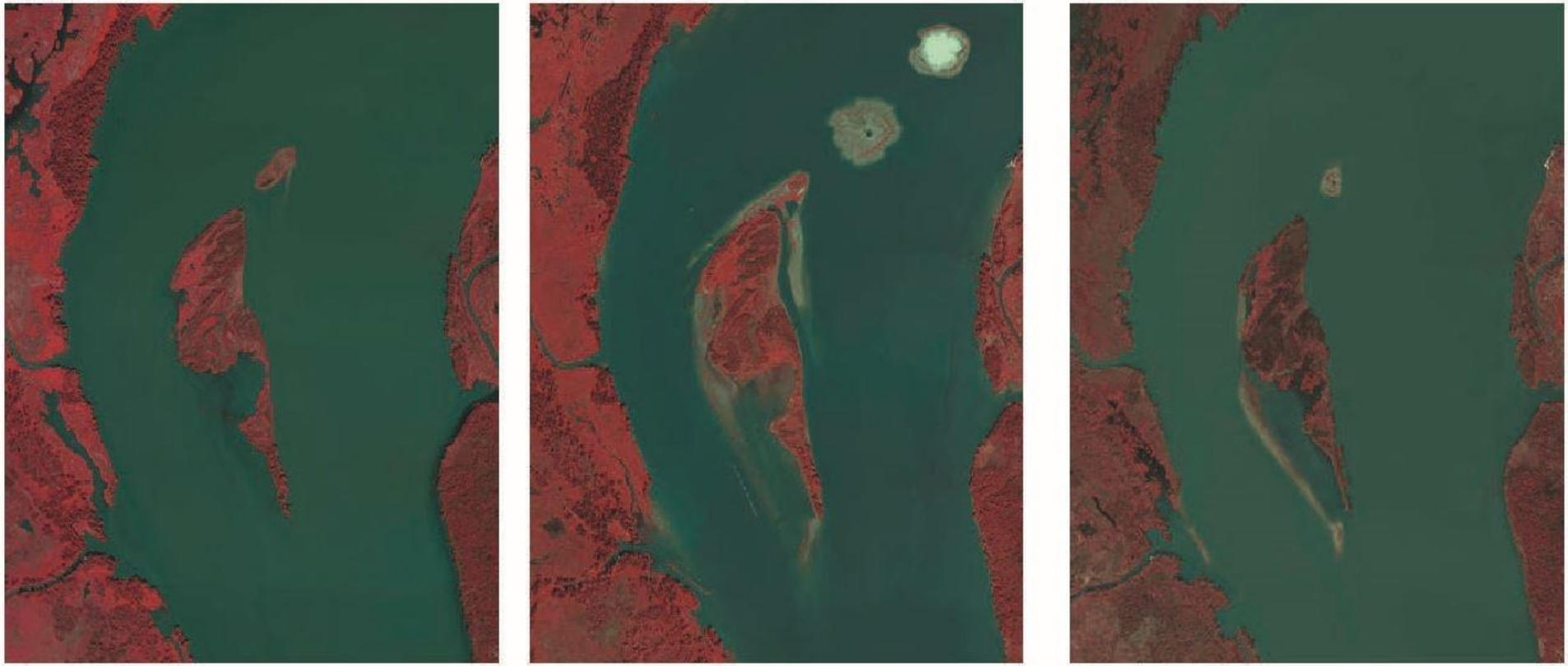


Image:
Sean Burkholder


Port Assessment
Hydrology
Ecology
Social
Ecomony
Port Facilities
Streams
Roads
Waterbodies
Dredged Channel
High Value
Low Value
0 0.5 1 2 3 4
Miles

Working with natural processes to undertake aspects of sediment management – are underway worldwide, yet see very little application within the Great Lakes Region.



Horseshoe Bend Island Creation

Image by USACE MVN

Cross Valley Structure | Toutle River, WA

Image by USACE

Mississippi River Training Structures

Image by USACE


Sand Engine | The Netherlands

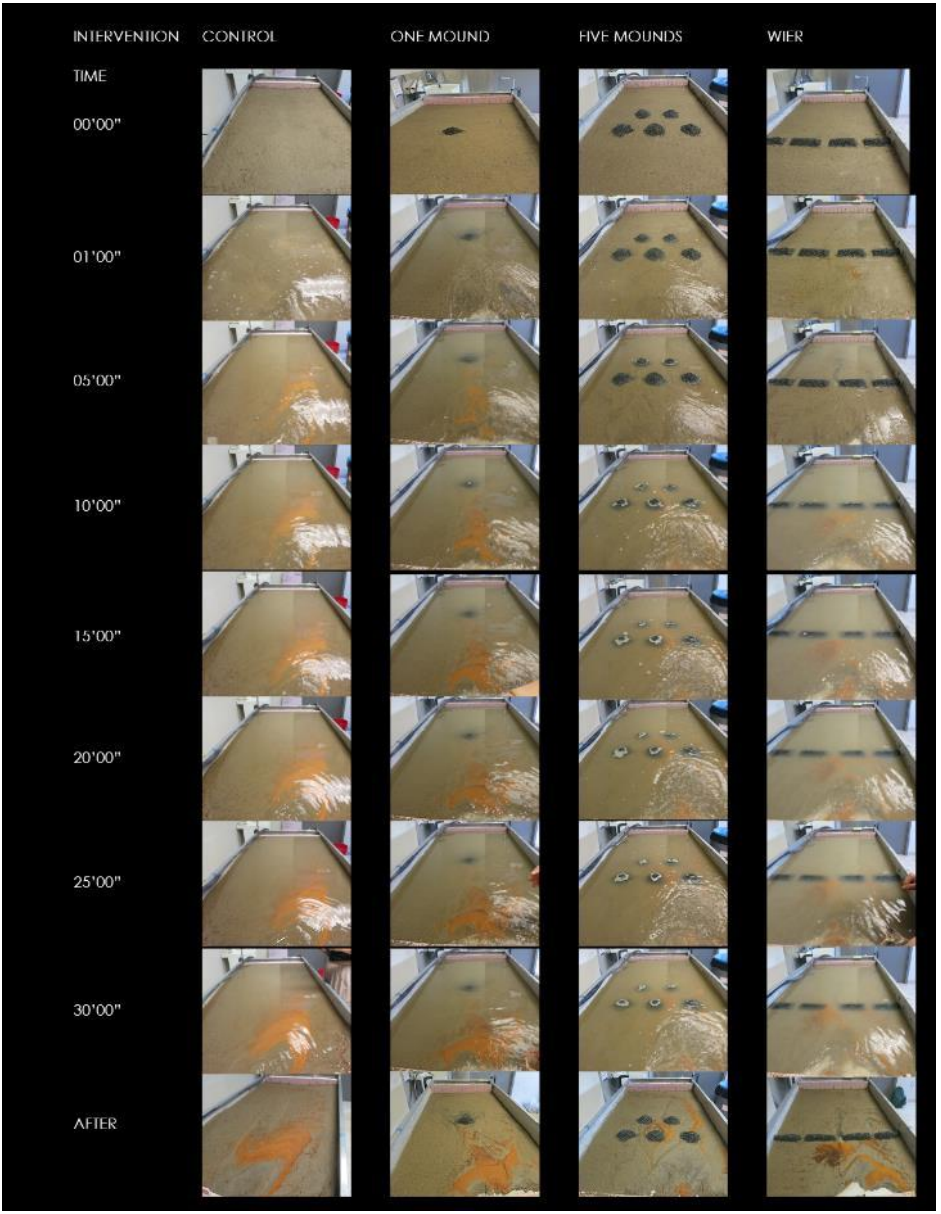

Sand Engine | The Netherlands

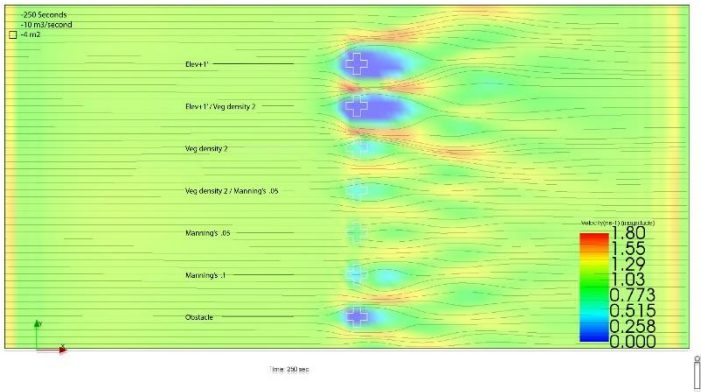
Multiple Benefits

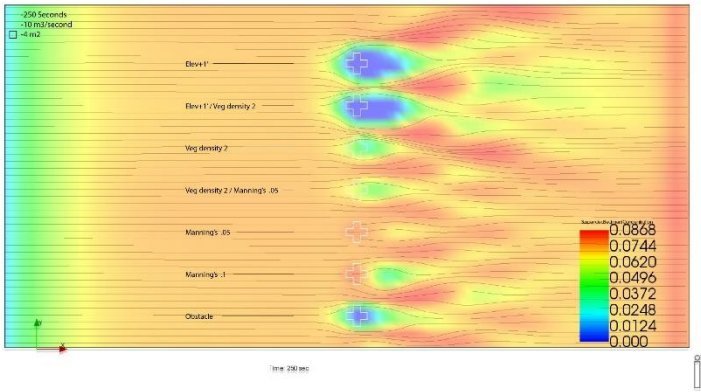
Adaptive and Contextual approached to sediment management:

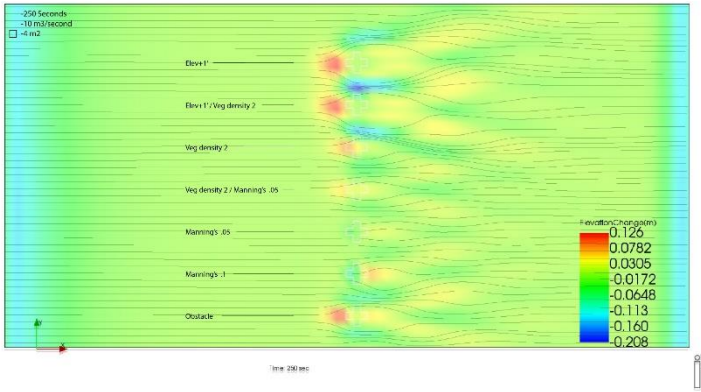
1. Minimizing capital costs associated with the handling and placement of sediment
2. Stretch the dredging cycle
3. Promote natural accretion which generate wetlands naturally. This process is less labor intensive, costly and destructive.
4. Keep sediment in areas where it is desirable
5. Promote a landscape approach which can generate stronger community buy-in.
6. Help bridge the gap between federal and local concerns

A Design/Experiment Process



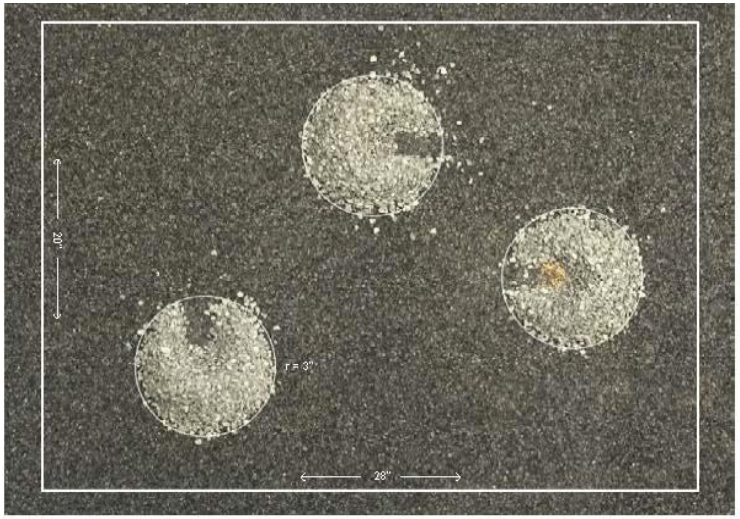






Images by Brian Davis and Sean Burkholder

Hybrid modeling to predict performance of a new sediment trap prototype



Point cloud from Python import: *before particle input*

Grasshopper Mesh Evaluation: focus area of 0.00" to 0.25" analyzed.

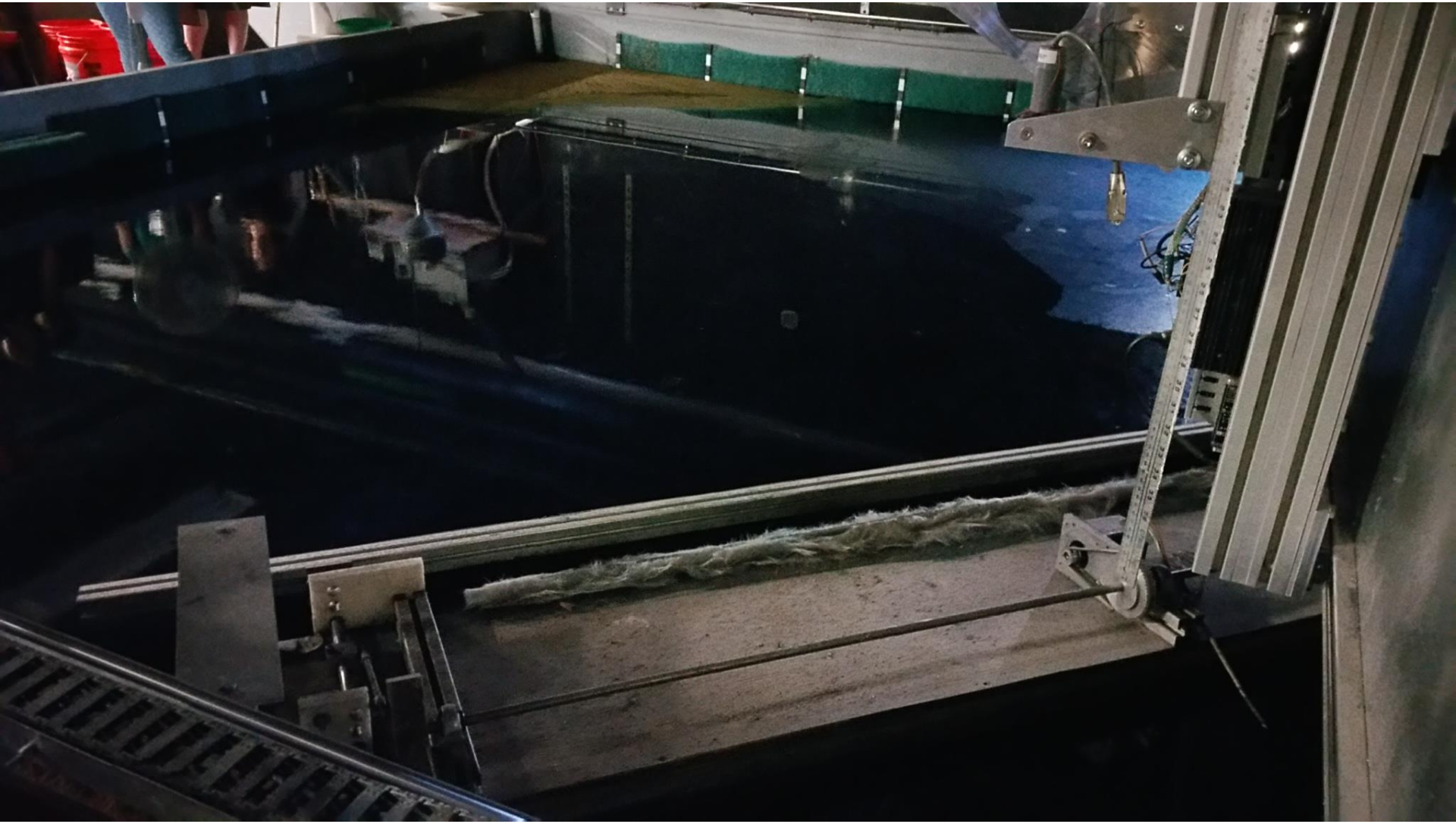
note: total height of scalloped shapes is about 1.25"

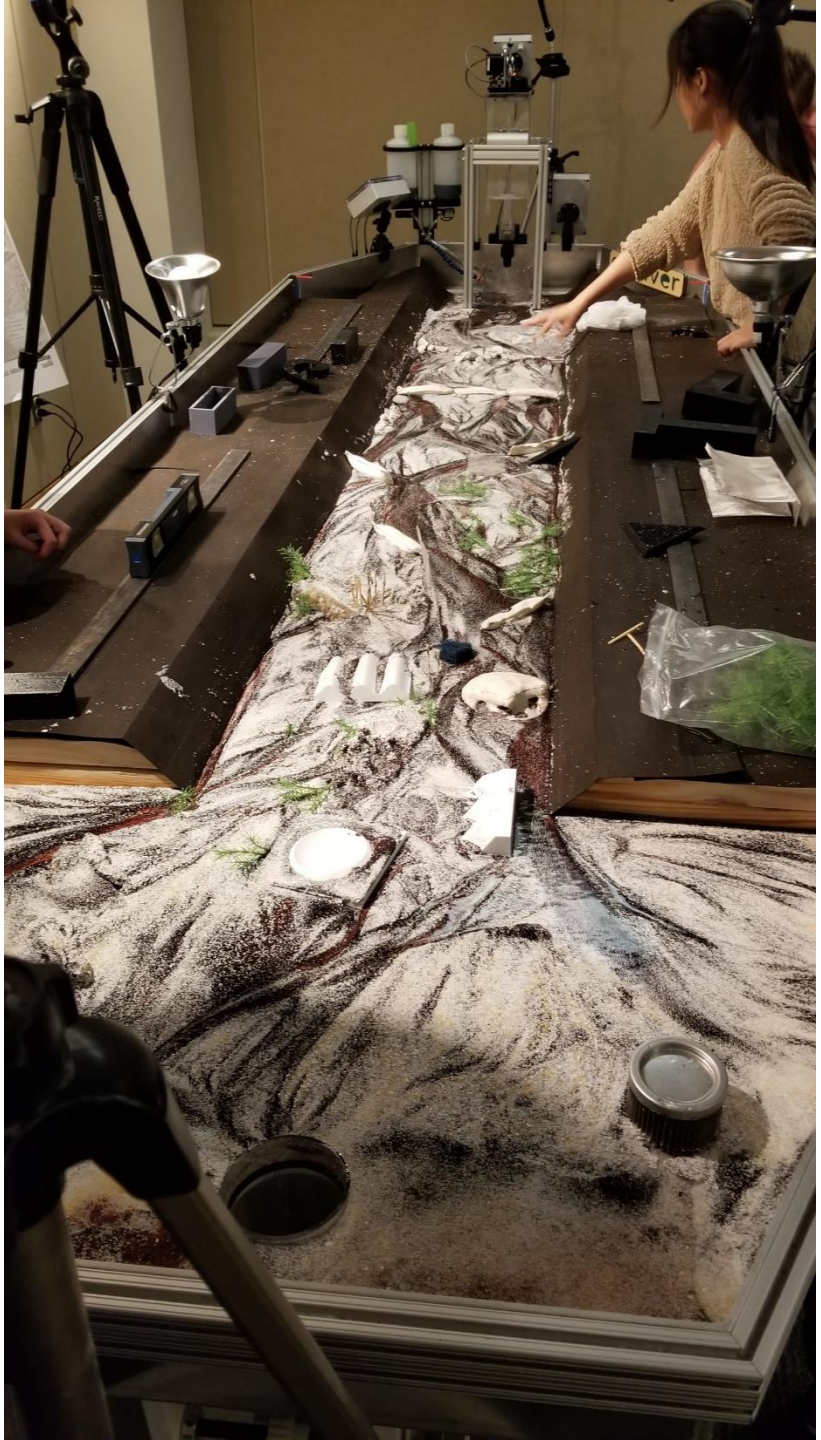
Point cloud from Python import: *after particle input*

Grasshopper Mesh Evaluation: focus area of 0.00" to 0.25" analyzed.

Image by Matthew Moffitt with Brian Davis and Sean Burkholder


DELTA
BASIN
SUPPLIES
HOMER
PAINT
BUCKET





Predictive models can also be physical and educational, such is the case at Saint Anthony Falls Laboratory in Minneapolis, where outdoor models directly suggest real-world implications.

Remote sensing using drone technology allows for rapid, precise, cheap environmental monitoring, to quickly understand performance in terms of sediment movement or vegetation growth.

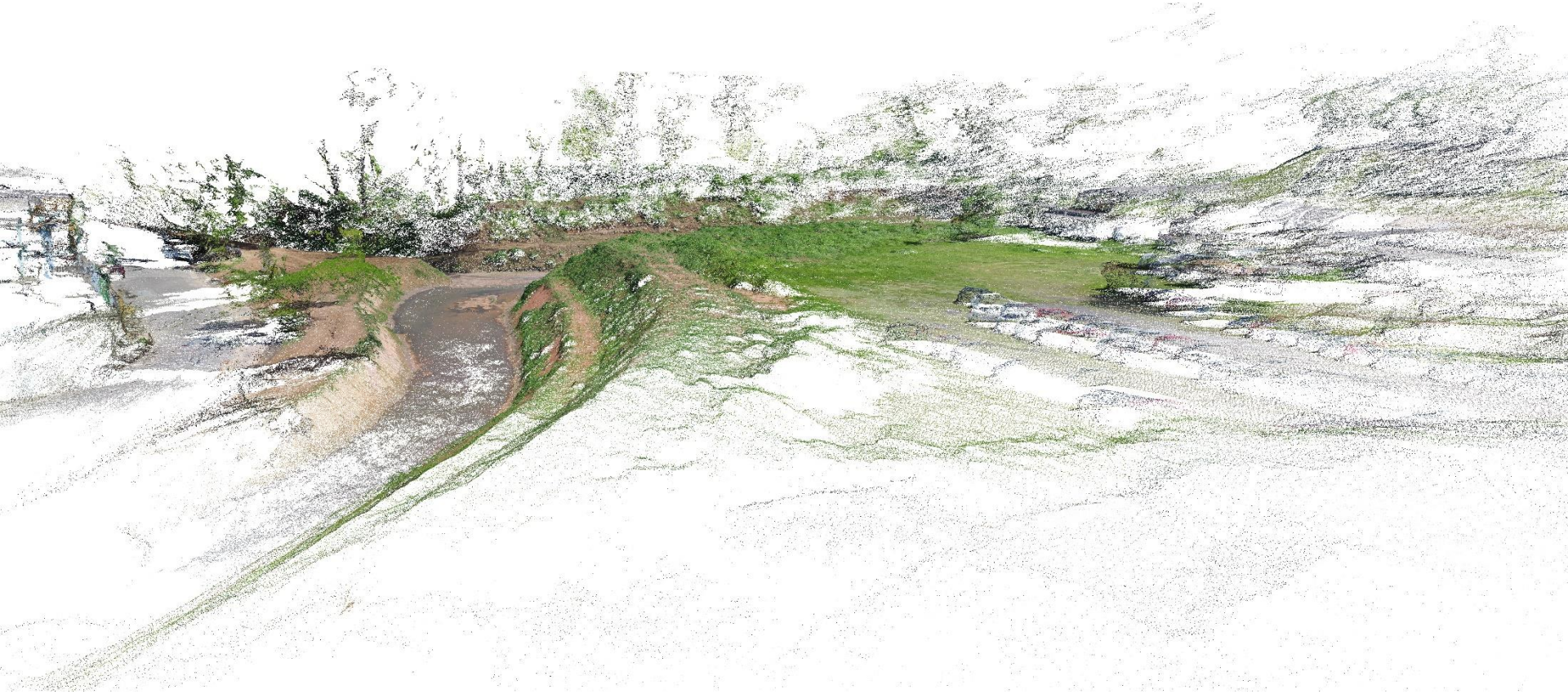


Image by Brian Davis, Cornell University

Figure 4: Single frame from drone video collection. This frame contains both phragmites and glossy buckthorn. MAC's automated algorithms can identify the regions of the image that contain invasive species.

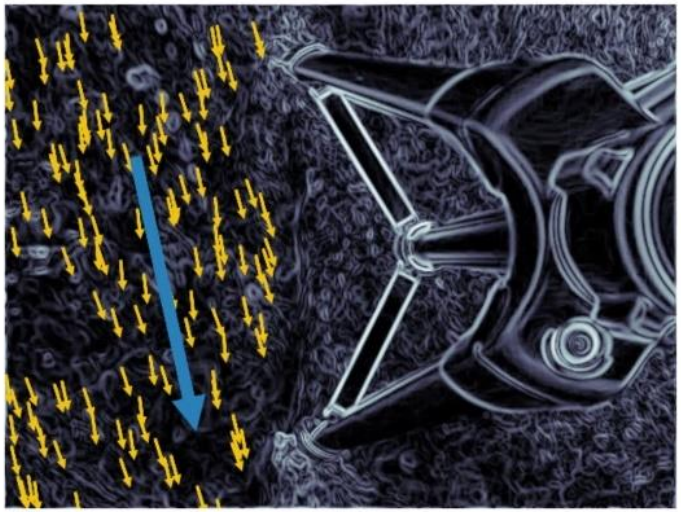


Figure 8: A camera mounted on a tripod was placed in a river; optic flow algorithms are able to reconstruct the water velocity field using the video feed. Yellow arrows indicate individual velocity estimates; blue is their mean.

Figure 5: Probability of phragmites (green) and glossy buckthorn (red) in the image. If a tile has a higher probability of containing phragmites, it is overlaid in green with an intensity proportional to that probability; if a tile has a higher probability of containing glossy buckthorn, it is overlaid with red with an intensity proportional to that probability. Using this method, large scale probability "heat maps" may be generated, showing the location of various invasive species.

Images by Matthew Lewis, Michigan Aerospace

The Power of Proposition

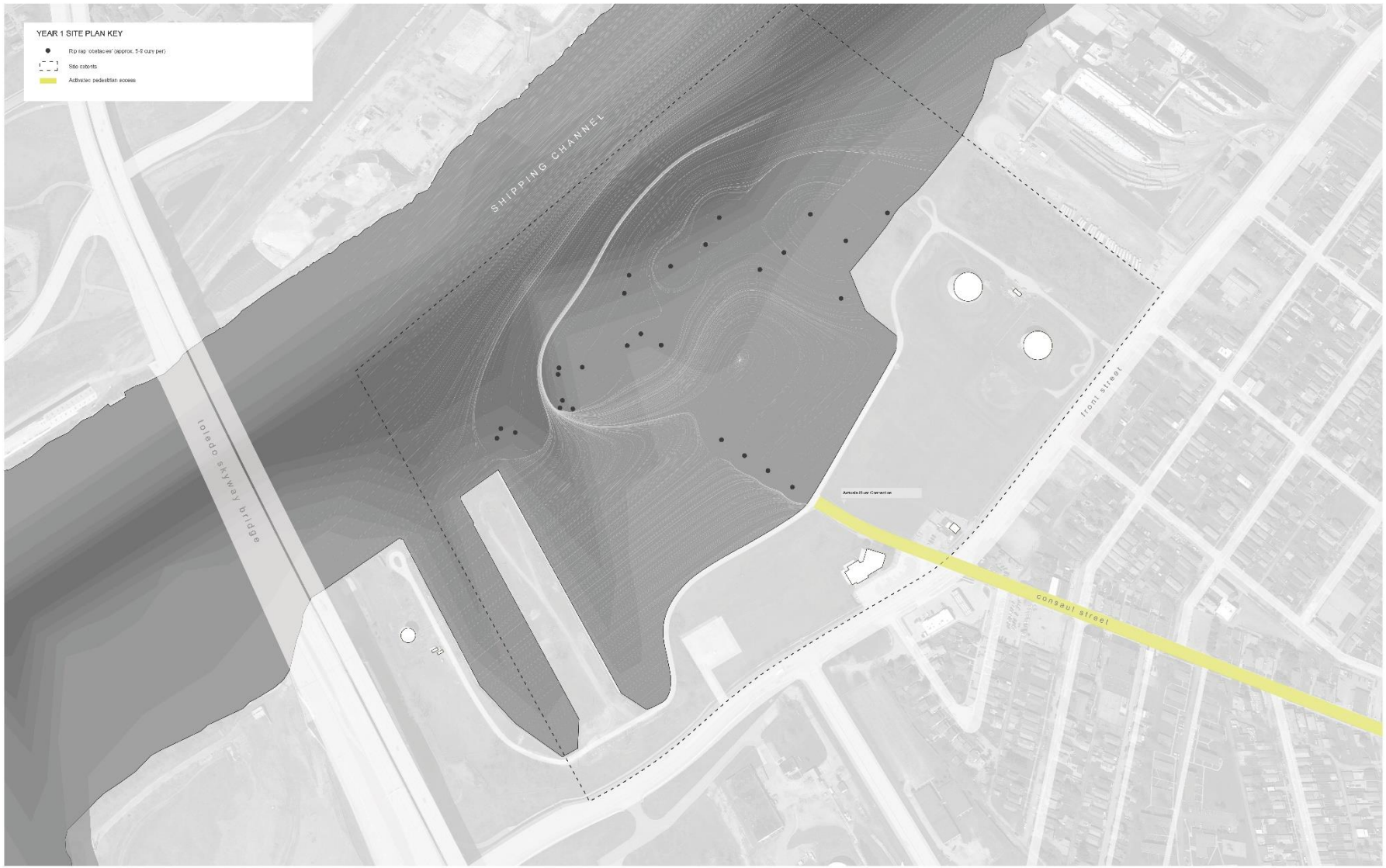
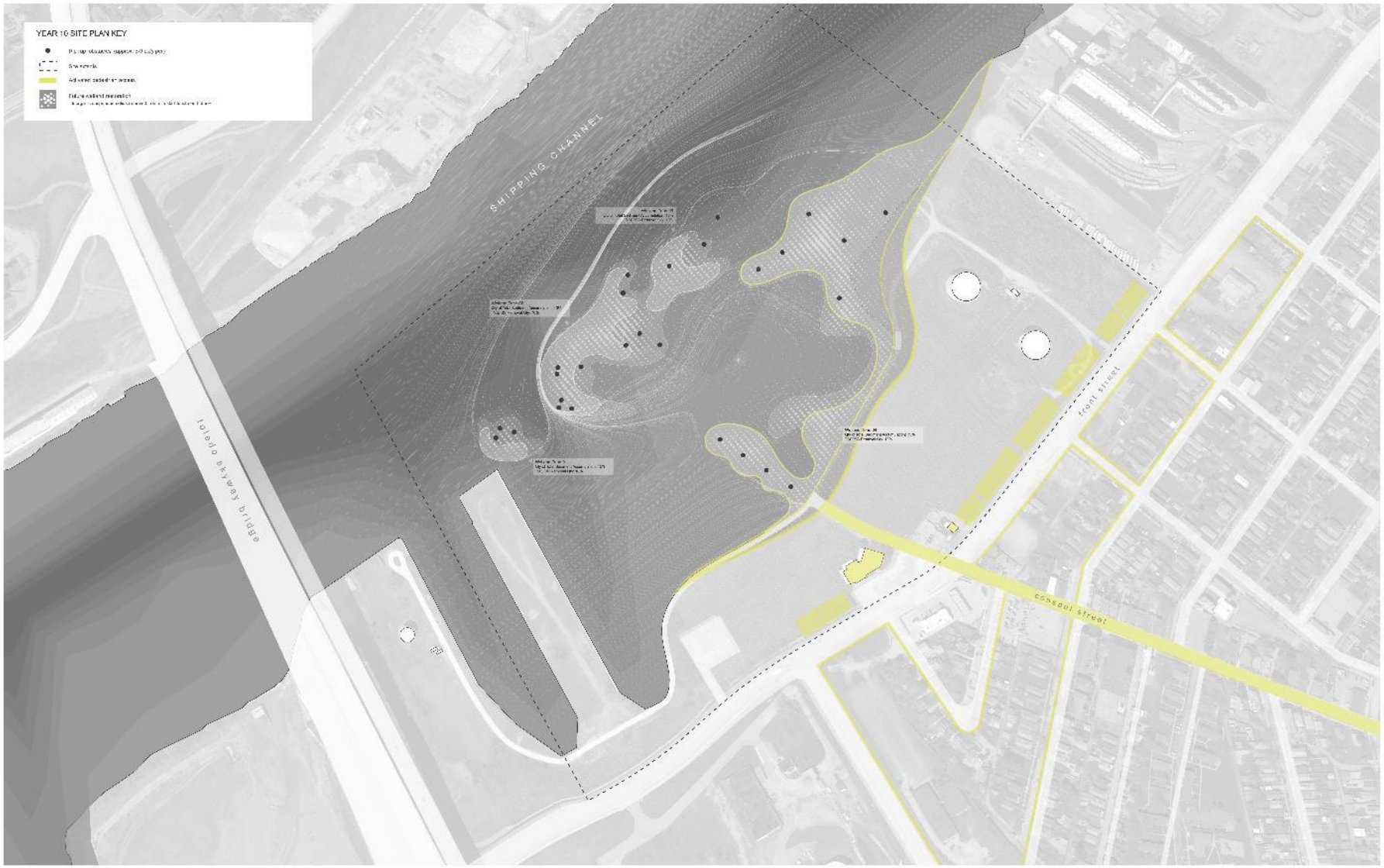


Image by Matthew Moffitt with Sean Burkholder and Brian Davis



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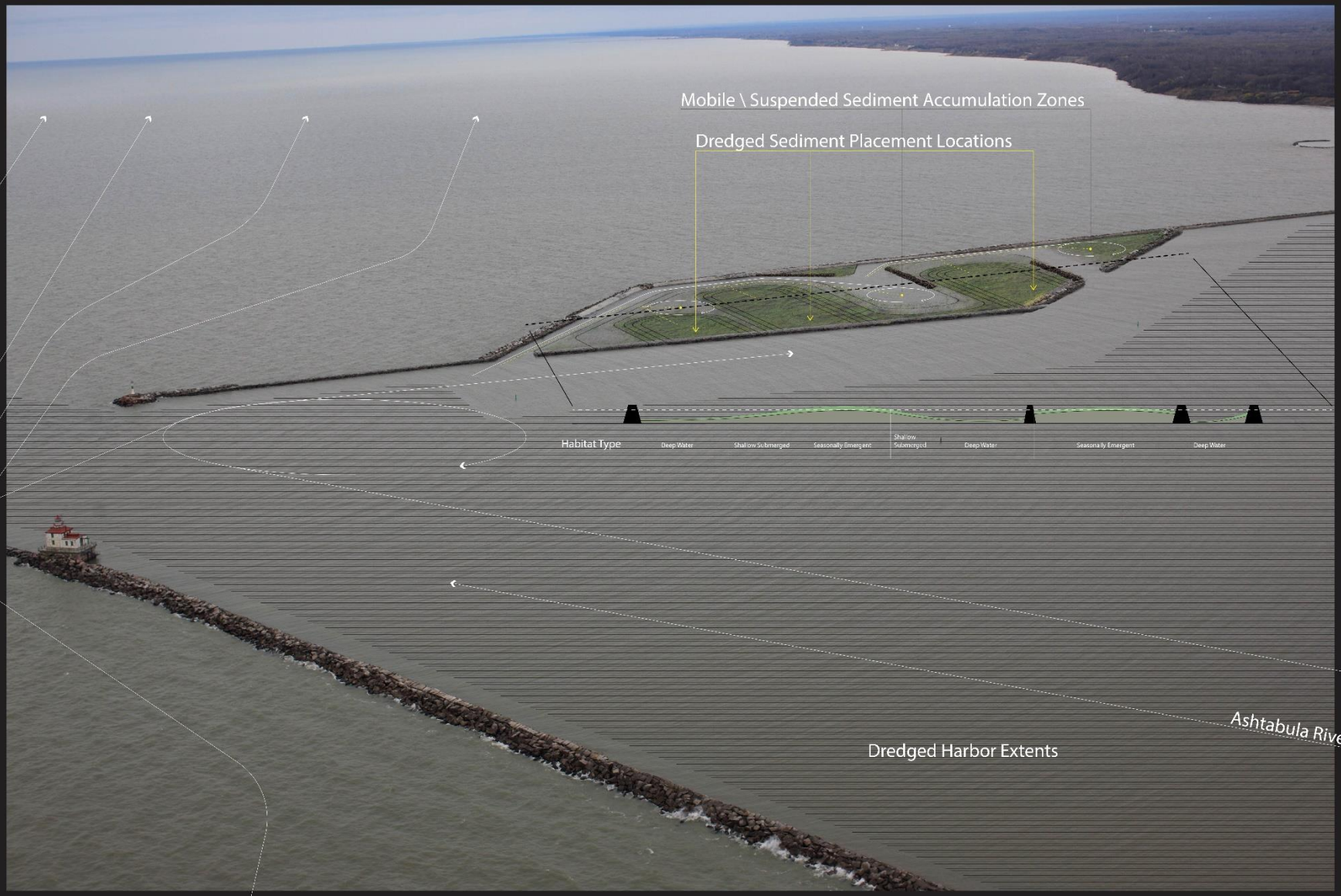
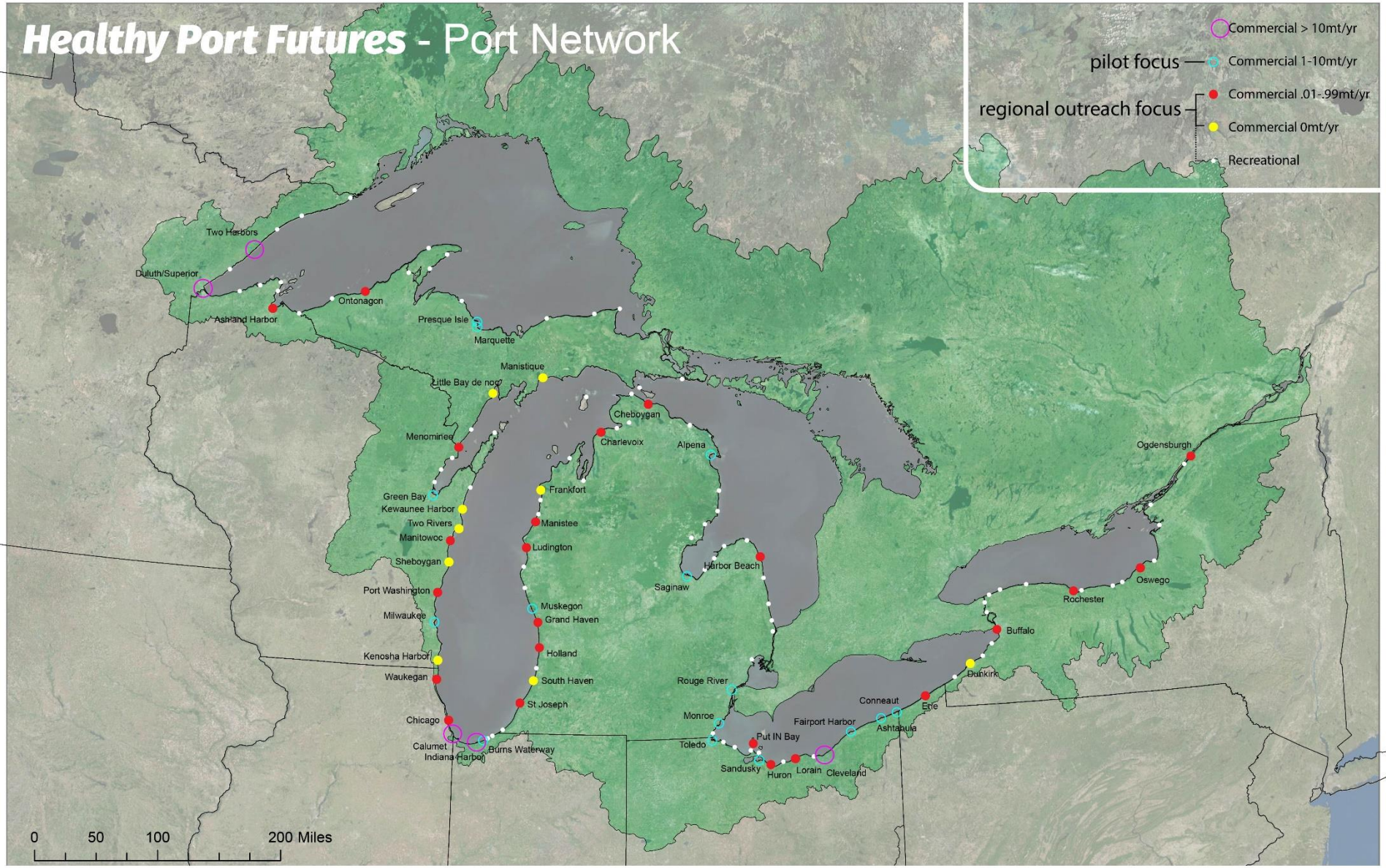
HEALTHY PORT FUTURES | ASHTABULA - Dynamic Sediment Management Habitat Wetland Concept | 18 Acres | ≈ 400k cy





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