



# Engineering With Nature on Great Lakes Infrastructure

**Burton Suedel**

Research Biologist

ERDC Environmental Laboratory

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US Army Corps  
of Engineers®

**ERDC**

Engineer Research and  
Development Center



# Applying EWN to Corps Great Lakes Infrastructure

- Evaluate alternatives for enhancing aquatic ecosystem benefits at existing breakwaters and navigation structures
- During routine repairs and maintenance, as part of modifications, or during comprehensive structural repairs and replacements
- Project Team:
  - USACE District
  - ERDC EL &CHL
  - Academic partner
  - Stakeholders
- Funding leveraged via O&M, EWN, in-kind support from stakeholders



# Milwaukee Harbor Project Approach

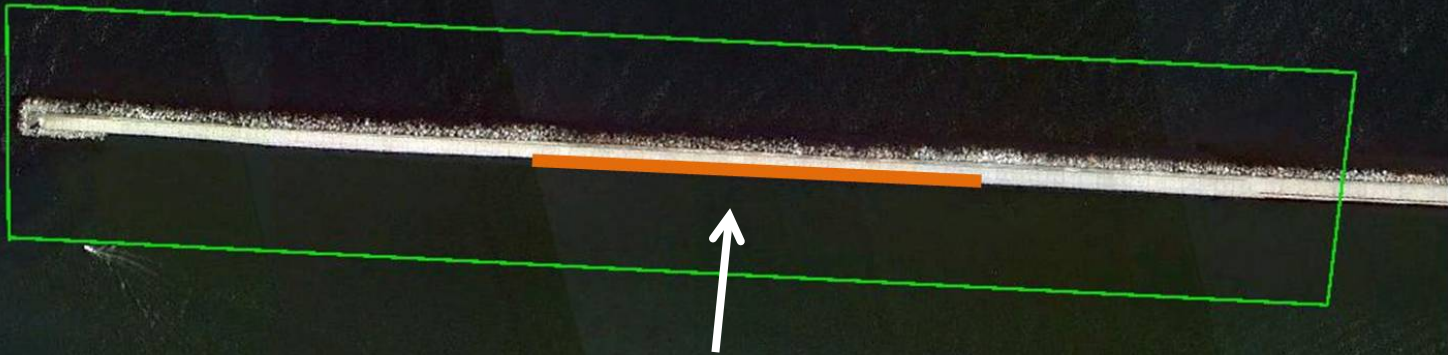
- **Extend beyond indirect and unplanned habitat creation**
- **Modify design of rubble mound breakwater during maintenance**
- **Provide features creating habitat opportunities for GL fish and other aquatic life**
- **Examine creation of habitat surfaces using rubble mound**
  - **Stone size**
  - **Gentler sloping shelf**
- **Create spawning bed for fish such as walleye and yellow perch**





# Fish Spawning Bed Location

500' demonstration section  
Spring 2014 construction



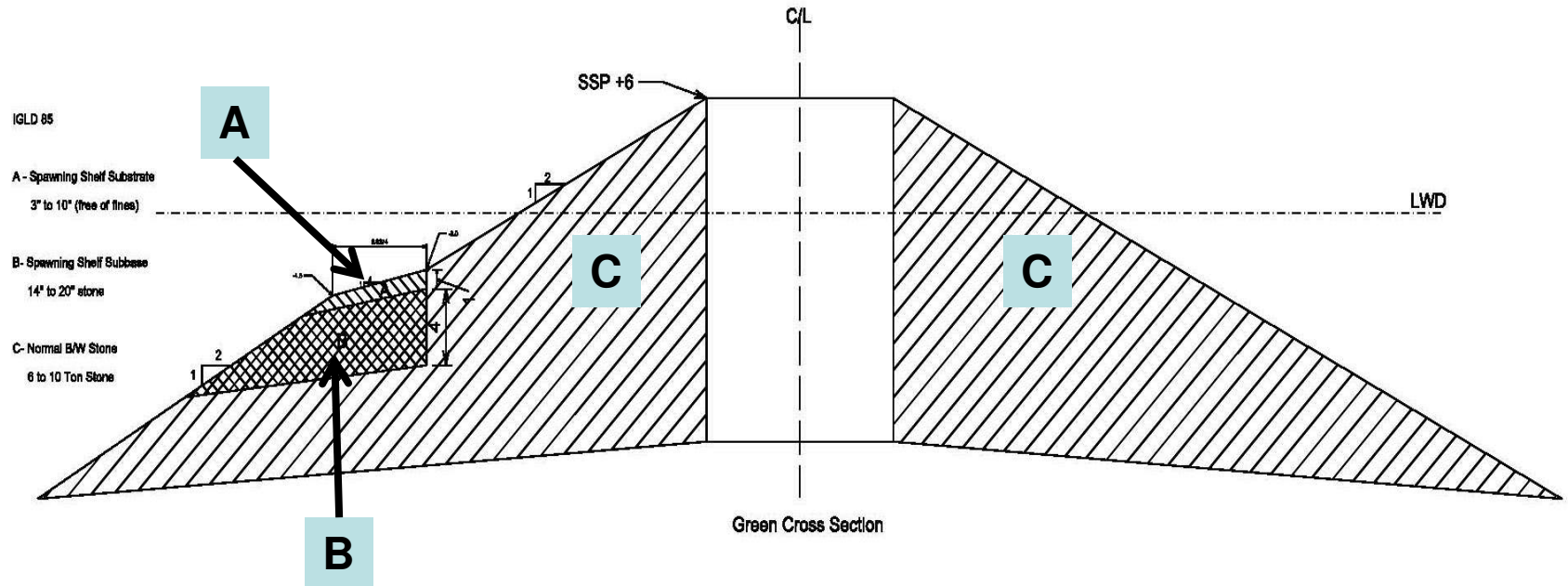
- Length of Spawning Bed: 500 ft
- Width of Spawning Bed: 6 ft
- Discontinuous Bed



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# Modified Rubble Mound Breakwater Fish Habitat Shelf



- A - Spawning Shelf Substrate: 4-8" stone free of fines**
- B - Spawning Shelf Sub-base: 8-18" stone**
- C - Normal B/W Stone: 6-10 ton stone**



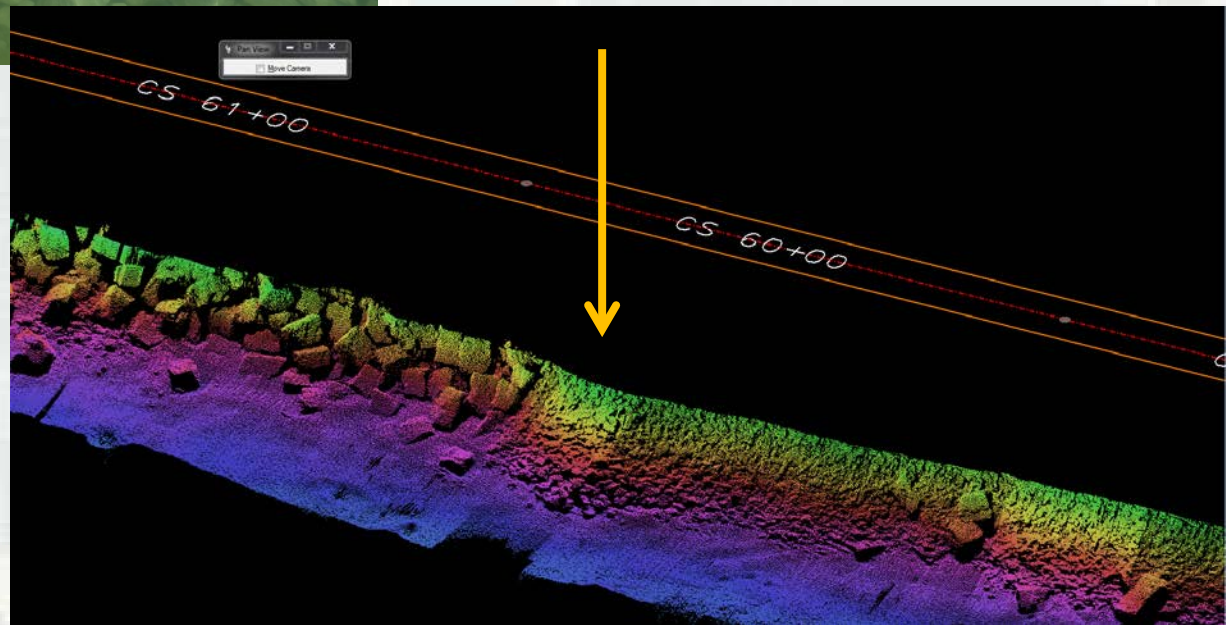


# Post Construction Monitoring



Visual  
Confirmation

Side-scan  
Sonar



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# Soo Compensating Works

## Description of problem

- St. Marys Rapids has historically been a world class fishery
- Flow out of Lake Superior is controlled by man-made water retention structures that form a dam across head of the St. Marys River
- Anthropogenic impacts on flow rates have reduced quality of fishery
- Flow rates and native substrate make Rapids ideal for habitat restoration
- Flow of water through this dam is controlled by Compensating Works gates
- Gate position adjustments are made using manual cranks resulting in quick gate position adjustments causing flow rates and water levels in Rapids to change abruptly
- Abrupt flow rate changes negatively impact fish spawning in Rapids by stranding fish when gates are raised and flushing out eggs and fry when gates are lowered





# Soo Compensating Works Gate Automation for Fish Spawning Habitat Restoration





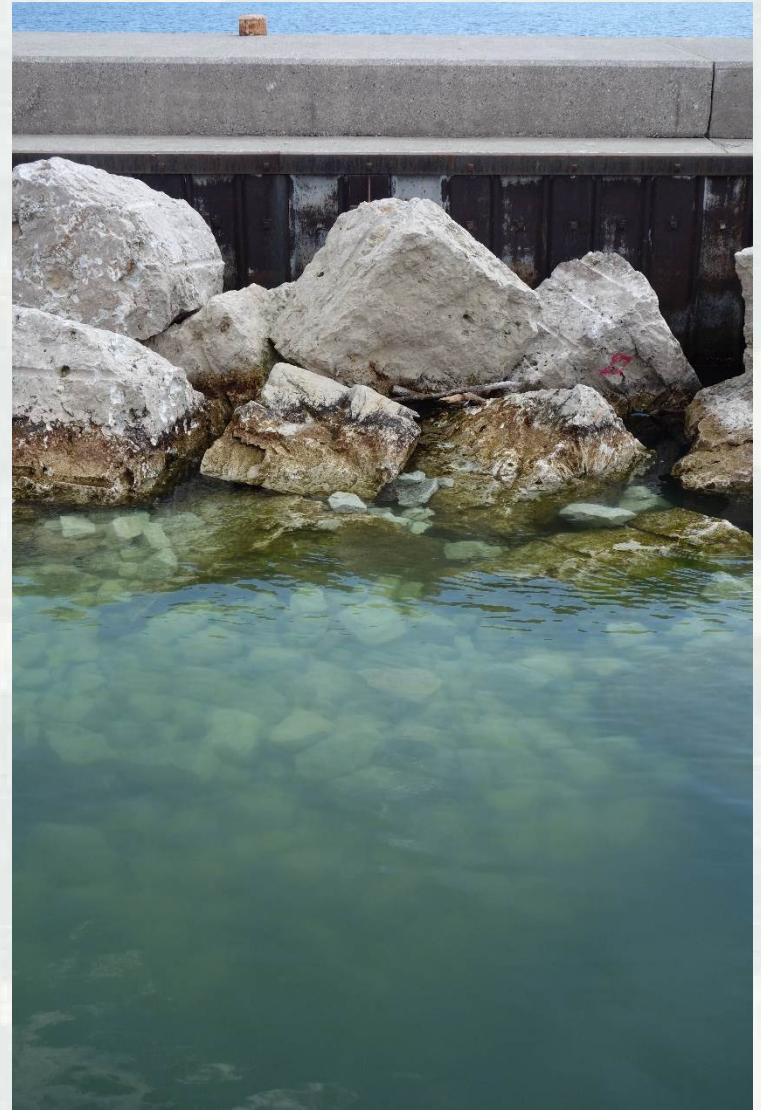
# Soo Compensating Works Benefits

- Rapids offer a rare combination:
  - Ideal spawning flow rates (averaging 3 fps)
  - Optimal spawning substrate of cobble and gravel, fractured bedrock, and bedrock
- Gate automation will result in measured fluctuations in flow rates and water level elevations, thus preventing:
  - Fish from being stranded when gates are raised
  - Protecting flushing of eggs and fry when gates are lowered
- Gate automation will provide improved spawning habitat for sturgeon, walleye, steelhead, Atlantic salmon, coho salmon, king salmon
- Unique outreach opportunity at the Visitors Center



# Lessons Learned

- Demonstrations largely successful
- EWN approach can be broadly applied
- Adaptively manage based on demonstration results
- Assess and report on benefits and realized ecosystem services
- Seek opportunities to conduct demonstrations or full scale projects





# Big Questions

## Challenges

- Costs and cost-sharing
- Widespread application of the concept on rubble mound structures
- Attractive nuisance (non-native species & future repairs)

## Needs

- Designs for other species and habitats
- Stakeholder communications
- Continued monitoring

