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PRESENTS:

Evaluating Impacts of In Situ Solidification/Stabilization of Sediments

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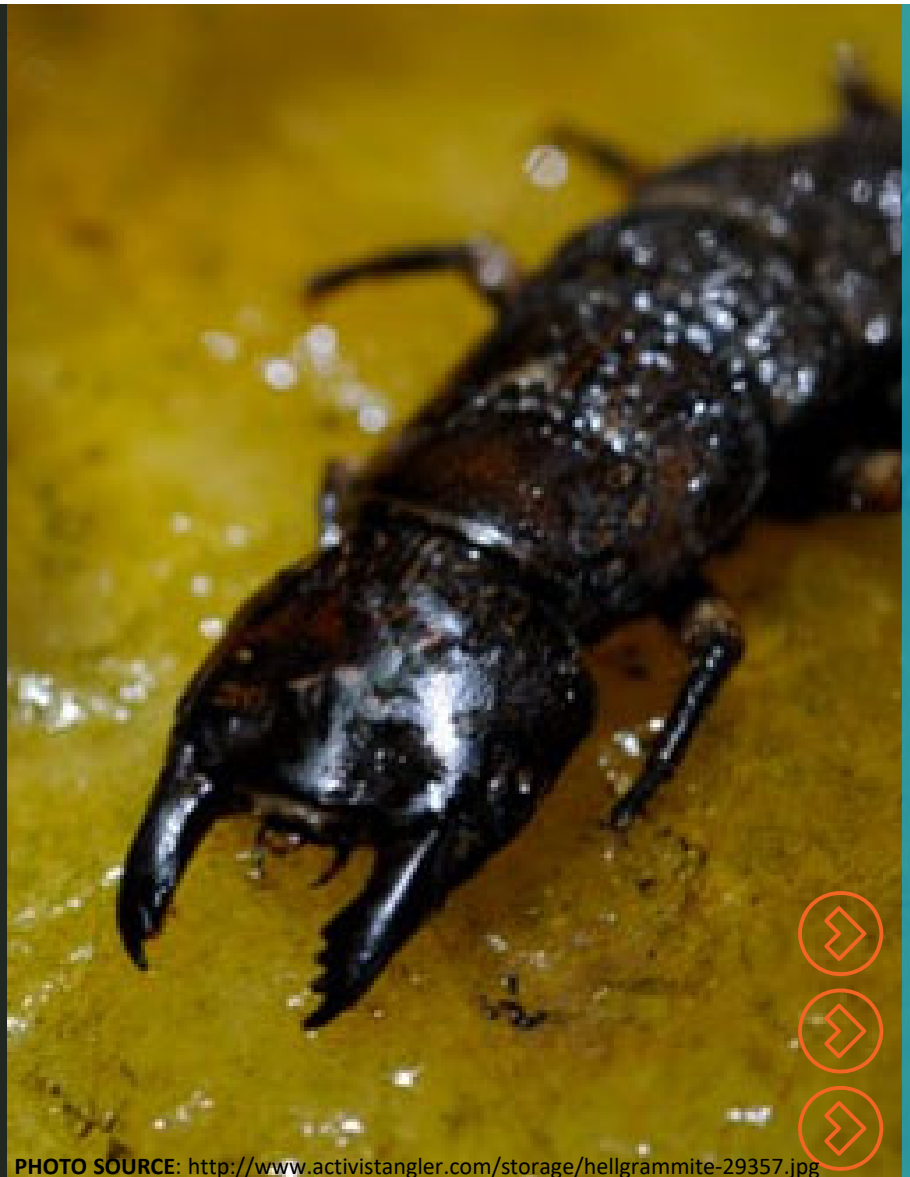


PHOTO SOURCE: http://www.activistangler.com/storage/hellgrammite-29357.jpg

Support

Internal innovation project

Funded by OBG, Part of Ramboll and WEC

Teamed with MSU

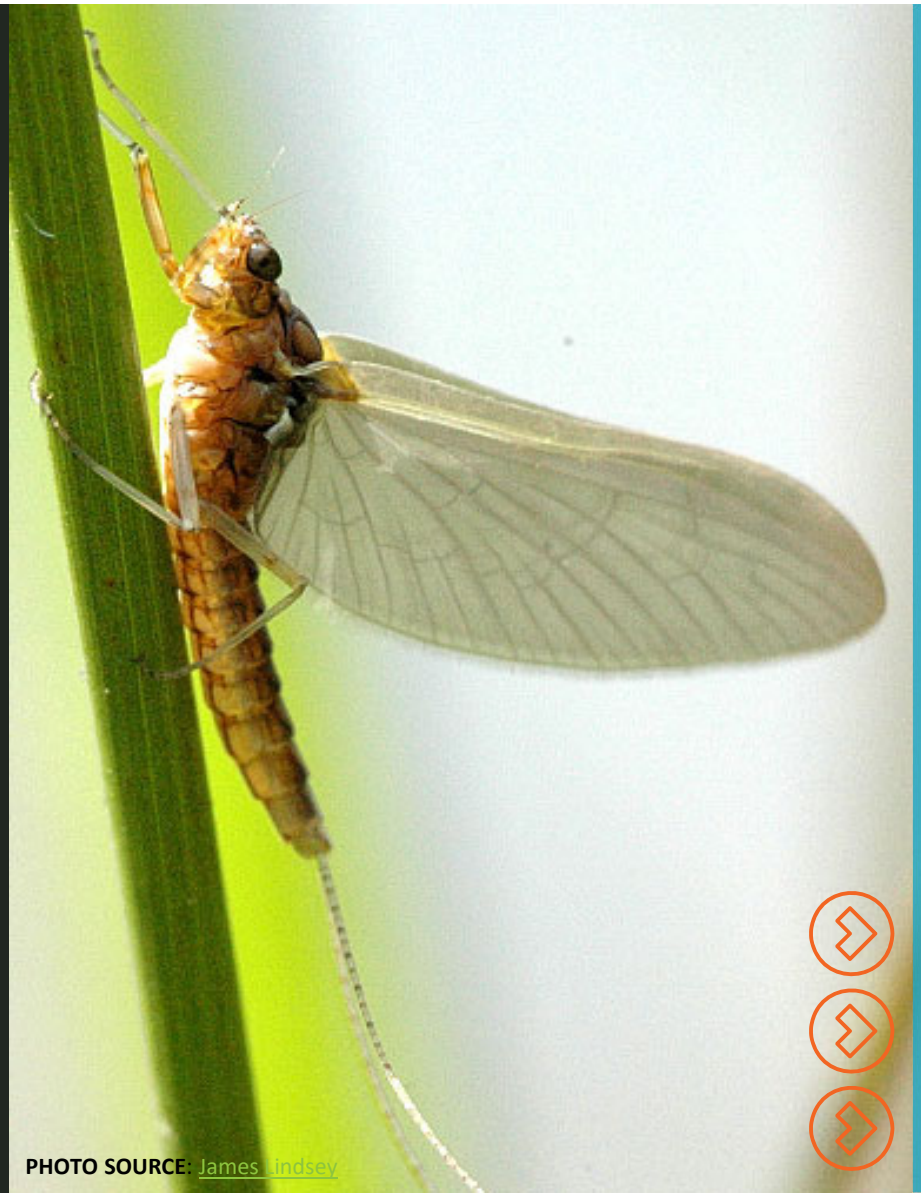


PHOTO SOURCE: James Lindsey

OVERVIEW

Site background

ISS as a remedy

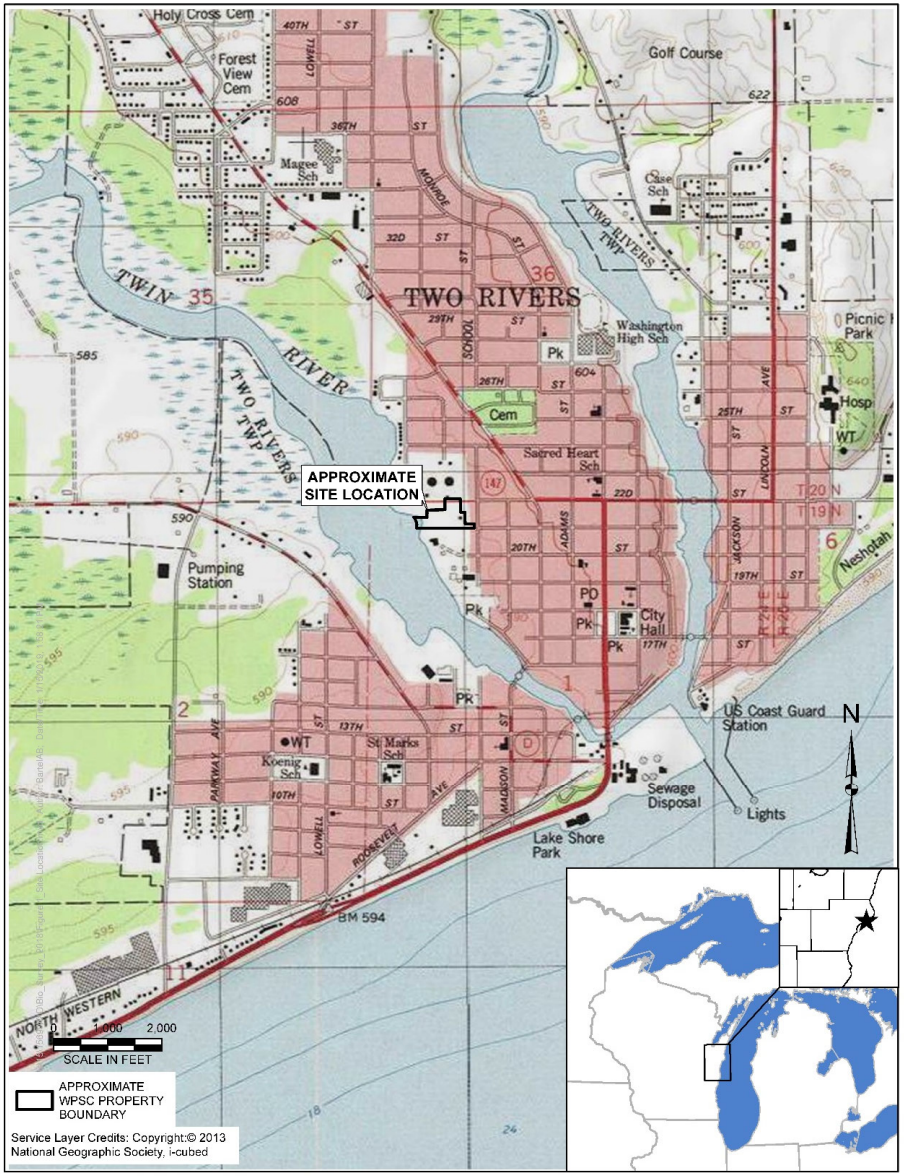
Post-ISS ecosystem health

Benthic community monitoring

Surface sediment monitoring

Conclusions

Site Background



Former Two Rivers Manufactured Gas Plant

Operated from 1925-1946

Post-1946 used for propane storage and distribution

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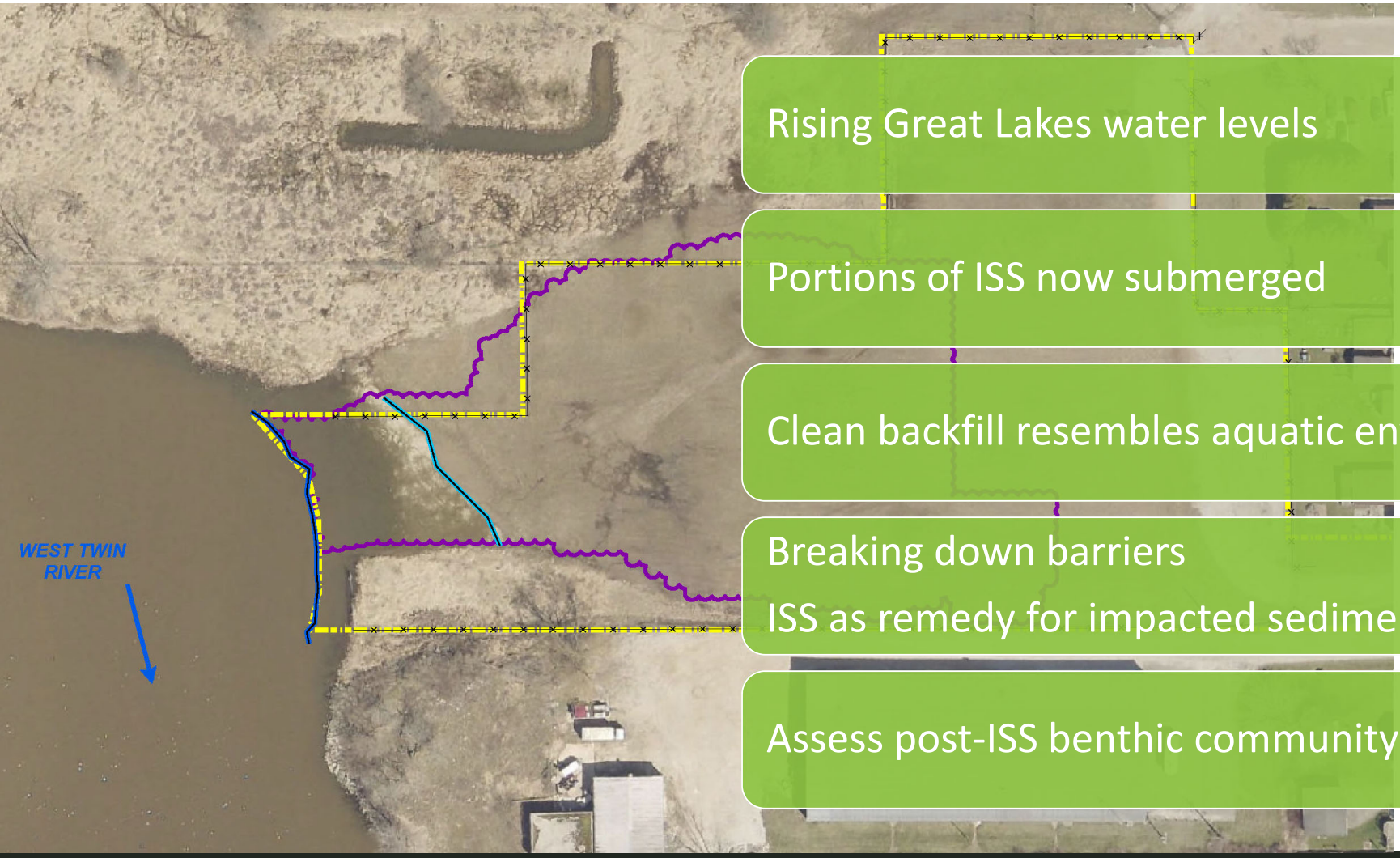
- MGP source material impacted soils
- U.S. EPA Time-Critical Removal Action
- ~4 acre ISS effort; ~2 acre designated wetland
- Approximately 80,000 CY impacted soil
- Two feet of clean backfill



- Rising Great Lakes water levels
- Portions of ISS now submerged
- Clean backfill resembles aquatic environment
- Breaking down barriers
  ISS as remedy for impacted sediment sites
- Assess post-ISS benthic community recovery

Benthic Community Monitoring

MICHIGAN STATE UNIVERSITY

Partnered with MSU's Department of Entomology

- ✓ Followed methods described by Hilsenhoff 1982
- ✓ Used D-frame aquatic net to disturb substrate
- ✓ Allowed dislodged invertebrates to wash into net
- ✓ Collected at least 100 individuals per station*
- ✓ Or 30 minutes per station

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Benthic Community Monitoring

- ✓ Invertebrates were transferred to sorting pans
- ✓ Invertebrates were sorted from debris
- ✓ Sorted individuals retained for identification in lab
- ✓ Taxa data recorded to family or genus
- ✓ Data supported biotic index calculations

D-frame nets used to sample at substrate

Invertebrates transferred to sorting pans

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Hilsenhoff Biotic Index (HBI)

- Estimates tolerance of community
- Weight by relative abundance of each taxon
- Organisms assigned tolerance value
- Ranging from 0 (most sensitive) to 10 (most tolerant)
- Multiply number of individuals by tolerance value
- Sum products and divide by total number of arthropods

EXAMPLE

$$\text{HBI} = \frac{n_i \, x \, ai}{N}$$

n = number of individuals in taxon *i*
a = tolerance value of taxon *i*
N = total number of individuals in sample

Group (*i*)	Tolerance Value (*a*)	Specimens (*n*)	Product (*n* x *a*)
Perlodidae	2	5	10
Baetidae	4	3	12
Uenoidae	3	7	21
	Total	**15**	**43**

HBI = 43 ÷ 15 = 2.87

PHOTO SOURCE: James Lindsey

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Evaluation of water quality using biotic index values

HBI	Water quality
0.00 – 3.75	Excellent
3.76 – 4.25	Very good
4.26 – 5.00	Good
5.01 – 5.75	Fair
5.76 – 6.50	Fairly poor
6.51 – 7.25	Poor
7.26 – 10.00	Very poor

Low HBI scores reflect higher abundance of sensitive taxa

Thus, lower HBI scores represent higher levels of water quality

The HBI score in the example (2.87) indicative of excellent water quality

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Table 1. Collection Results

Station name	Number of Families	Number of Individuals
Reference – upstream	7	184
Reference – midstream	6	146
Reference – downstream	6	113
Reference – all	8	443
ISS – upstream	4	26
ISS – midstream	7	122
ISS – downstream	6	67
ISS – all	10	215

http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=407741

http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=770829

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Table 2. Collection Results

Family name	ISS Area	Reference Area
Asellidae	•	•
Baetidae	•	•
Caenidae	•	•
Ceratopogonidae	•	•
Chironomidae	•	•
Coenagrionidae	•	
Corixidae	•	
Hydrophilidae	•	•
Hydroptilidae		•
Leptoceridae	•	•
Libellulidae	•	

✓ ISS area dominated by:

- 45% individuals Chironomidae (gathering & filtering collectors, predators, shredders, scrapers)
- 44% individuals Caenidae (gathering collectors)
- 5% individuals Ceratopogonidae (predators)

✓ Reference area dominated by:

- 49% individuals Caenidae (gathering collectors)
- 30% individuals Ceratopogonidae (predators)
- 14% individuals Chironomidae (gathering & filtering collectors, predators, shredders, scrapers)

✓ Community composition indicative of succession following disturbance at ISS site (Mackay 1992)

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Table 3. Family level Hilsenhoff Biotic Index

Station name	Biotic Index	Water Quality
Reference – upstream	6.80	Poor
Reference – midstream	6.61	Poor
Reference – downstream	6.64	Poor
Reference – all	6.72	Poor
ISS – upstream	7.00	Poor
ISS – midstream	6.93	Poor
ISS – downstream	7.01	Poor
ISS – all	7.04	Poor

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Table 4. Family-Genus Hybrid Hilsenhoff Biotic Index

Station name	Biotic Index	Water Quality
Reference – upstream	6.80	Poor
Reference – midstream	6.66	Poor
Reference – downstream	6.74	Poor
Reference – all	6.77	Poor
ISS – upstream	7.00	Poor
ISS – midstream	6.93	Poor
ISS – downstream	7.09	Poor
ISS – all	7.04	Poor

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Table 5. Ephemeroptera, Plecoptera, and Trichoptera

Station name	Percent of EPT individuals
Reference – upstream	60%
Reference – midstream	46%
Reference – downstream	46%
Reference – all	52%
ISS – upstream	15%
ISS – midstream	37%
ISS – downstream	69%
ISS – all	44%

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Previous Site Investigations

- Based on site-specific sediment toxicity testing, using a sensitive aquatic ecological receptor (i.e., a benthic invertebrate species) and exposure modeling conducted, tPAH (13) was found to be a sediment COC
- There were no surface water concentrations of analytes detected above their respective ecological SLs proximal to ISS area
- Insect larvae (midge species) and oligochaetes were the primary benthic invertebrates identified in surface sediments proximal to ISS area
- Within the sediment samples, no isopods or amphipods were observed

Surface Sediment Methods

- Three sediment samples collected each from the ISS area and a reference area (Woodland Dunes State Natural Area) upstream of the ISS area
- Sediment samples were analyzed for concentrations of BTEX, VOCs, PAHs, and total metals

Surface Sediment Results

BTEX and VOCs results were non-detects for reference and ISS area sediments

PAHs results were non-detects for reference area sediments; PAHs results included detected concentrations in ISS area sediments:

- geometric mean concentrations of PAHs were less than CBSQGs; however, there was a single exception in which the geometric mean concentration for acenaphthylene exceeded the most conservative CBSQG value (TEC)
- tPAH (13) results did not exceed minimum risk threshold value of 60 mg/kg

Total metals concentrations were detected in both the ISS and reference areas and in all instances, total metals concentrations were less than CBSQGs

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Conclusions

- Concentrations of sediment samples collected from ISS area not expected to present risk to benthic invertebrates
- Benthic invertebrate community HBI scores similar between ISS and reference areas
- Benthic community at ISS area indicative of earlier succession stage relative to reference area
- Benthic community metrics at ISS area supportive of remedial technology in aquatic environments

Future Consideration

Goal is to develop further bench top studies

Additional monitoring to determine community equilibrium

Baseline monitoring for ISS in sediments projects

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Thank you!