Pre-Disaster Mitigation and Watershed Resiliency within Wisconsin's Lake Superior Basin

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Air Fox Photography, LLC (John Buvala)

Wisconsin's Lake Superior Basin

- Young geology – glacial lake Duluth shoreline and sediments
- Rising topography with steep drops flowing towards the Lake
- Pre-settlement forest cover
- Forest clear-cutting for wood products
- Agricultural land clearing
- Imposed drainage for dewatering fields
- Streams prone to sedimentation and erosion
- Increased storm intensity and precipitation

Community of Practice

- Flood Attenuation
- Natural Habitat Degradation
- Infrastructure Damage
- Economic Impacts
- Federal, State, Local Gov’t
- Landowners
- Stakeholders
- Body of Science Knowledge

Slow-the-Flow Initiative

- Changes in Land use and land cover altered hydrology and sediment delivery
- Loss of traditional cover increased flood magnitude and intensity
- Decline in storage (vegetation and wetlands) increased runoff
- Increase in bluff erosion, stream incisions, steep valley walls and downcutting
- Sediment plumes at river mouths and in Lake Superior

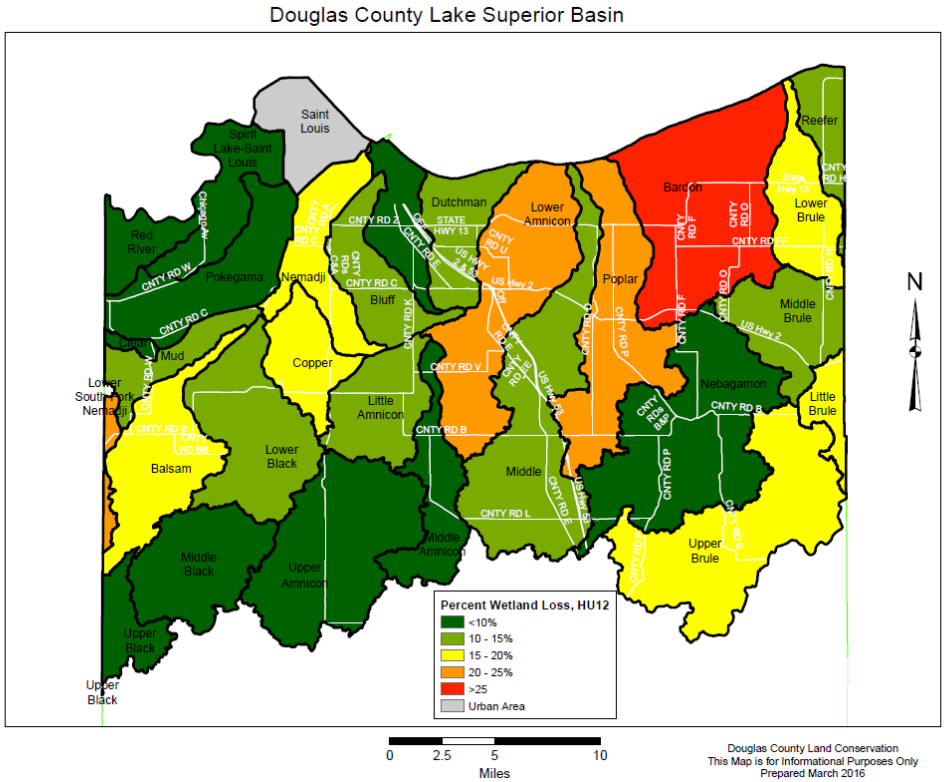
Landscape Level Assessments

Focus on landscape level approaches to reduce peak flows

- Wetland Inventory
- Functional Assessment
- Increase in-channel roughness
- Increase upland roughness
- Increase upland storage and infiltration

Potentially Restorable Wetlands

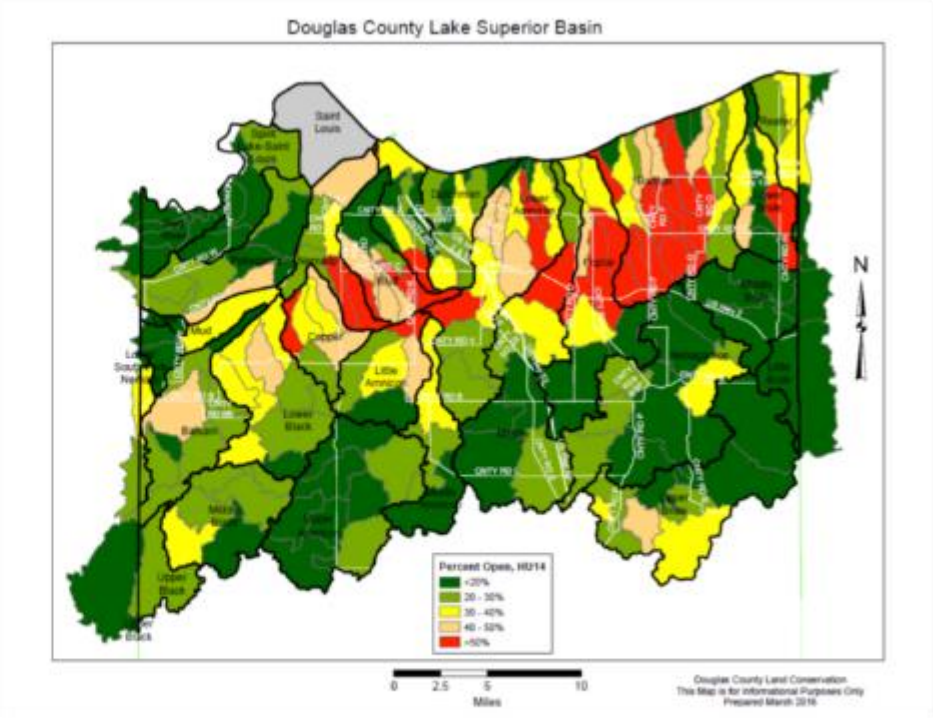
Watersheds with the *highest amount of wetland loss*



Watersheds with Open Lands

Watersheds that are more than *40% open* land cover

Open land cover includes agriculture, forest stands less that 16 yrs. old and urban areas



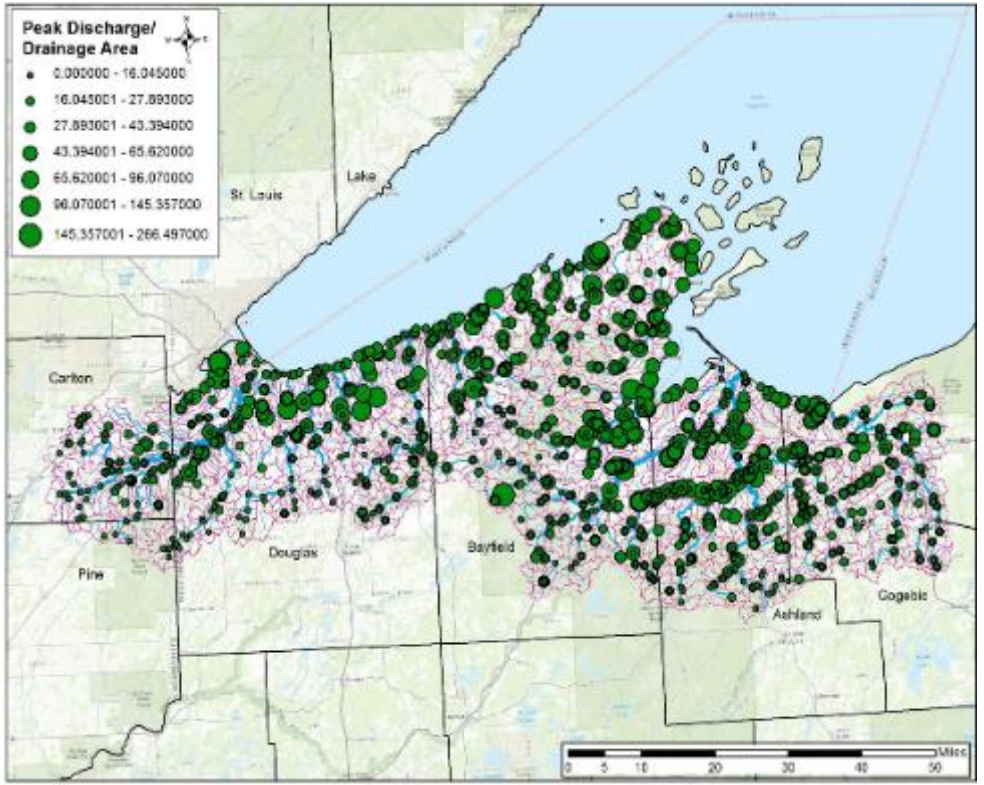
Wetland/Open Lands Combined

Priority locations for future wetland restoration projects

Watershed	Wetland Loss (%)	Number sub watersheds > 40% open land
Bardon Creek	**26.5**	**15**
Poplar River	**21.1**	**4**
Lower Amnicon River	**20.8**	**6**
Copper Creek	18.5	3
Upper Brule River	18.4	1
Lower Nemadji River	16.7	3
Balsam Creek	15.4	1
Lower Brule River	15.4	2

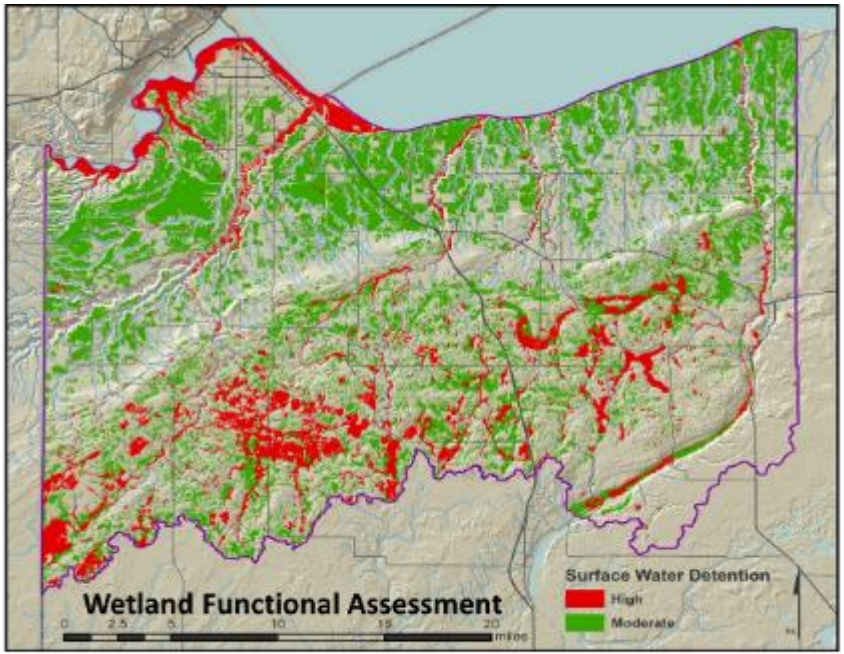
Calculating Peak Discharge

- Increased large storms
- Increased in-channel and bluff erosion
- Calculated 2-year peak discharge to drainage area ratio
- Prioritize management actions: wetland restoration, ag. BMP's, in-channel restoration, upland roughness



Increase Water Storage

- Increase flow duration
- Moderate peak flows
- Wetland restoration in both forested and ag. settings
- De-synchronize flow events



Above: Distribution of PRWs that can provide flood attenuation functions in Douglas Co. Analysis and image provided by St. Mary's Geospatial Services .

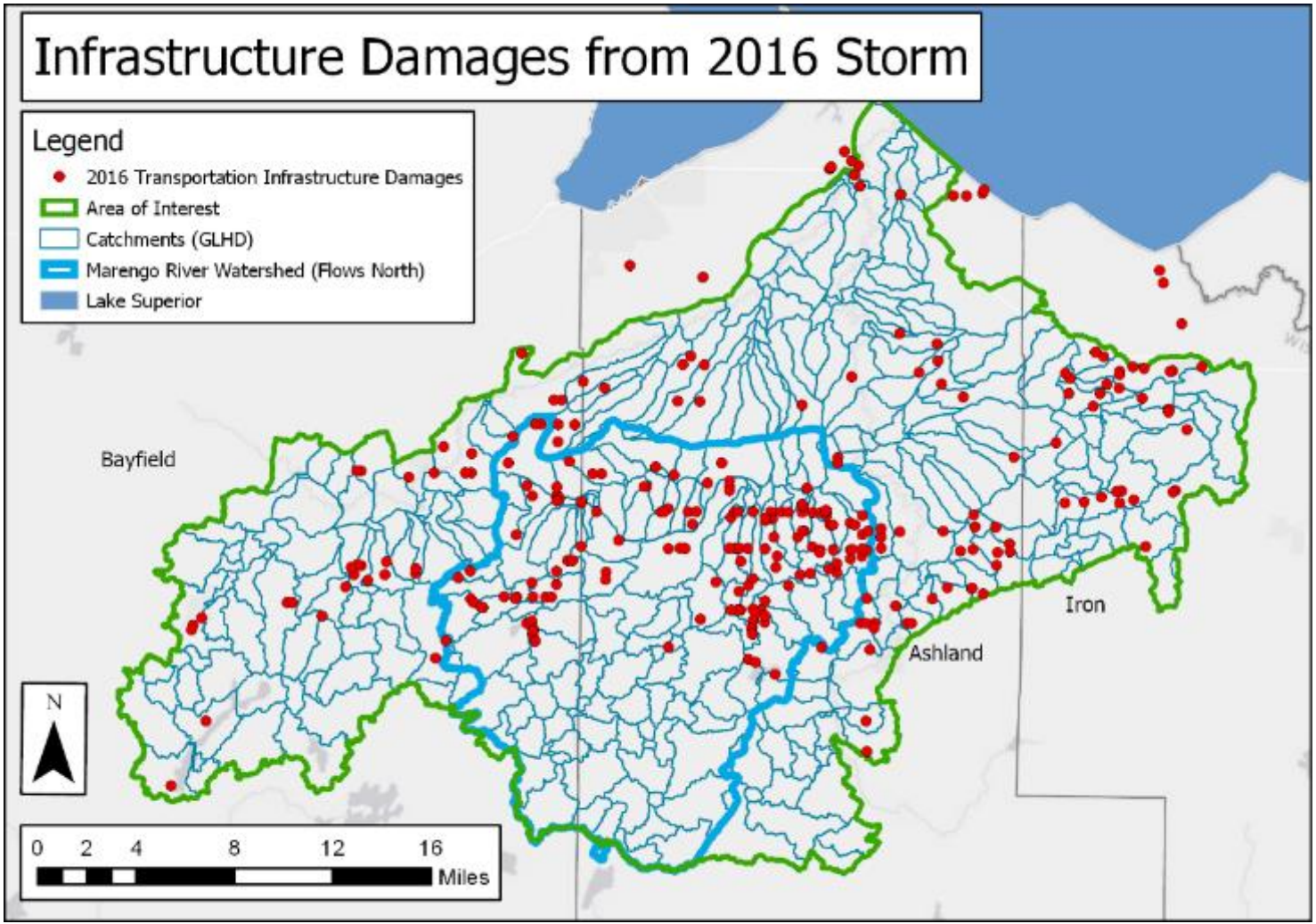

Infrastructure Damages from 2016 Storm
Legend
2016 Transportation Infrastructure Damages
Area of Interest
Catchments (GLHD)
Marengo River Watershed (Flows North)
Lake Superior
Bayfield
Iron
Ashland
N
0 2 4 8 12 16
Miles

Photo: USFS CNNF

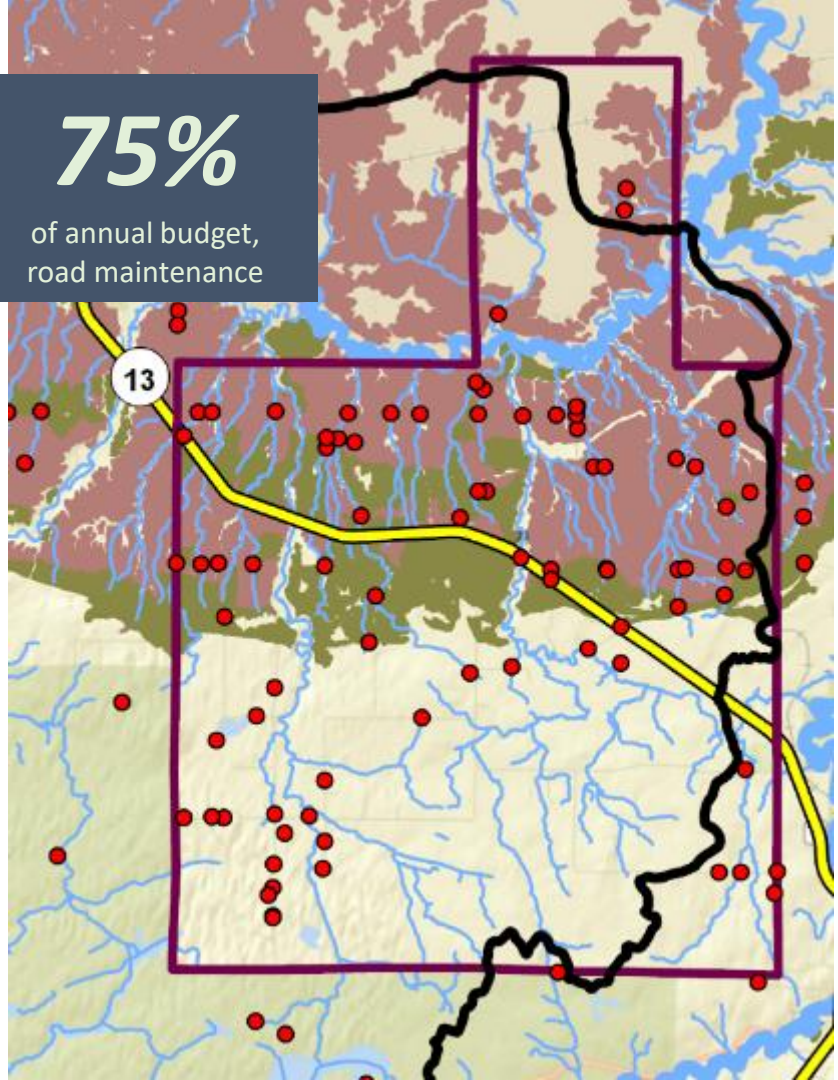
Town of Ashland

—*Almost every culvert washed out*

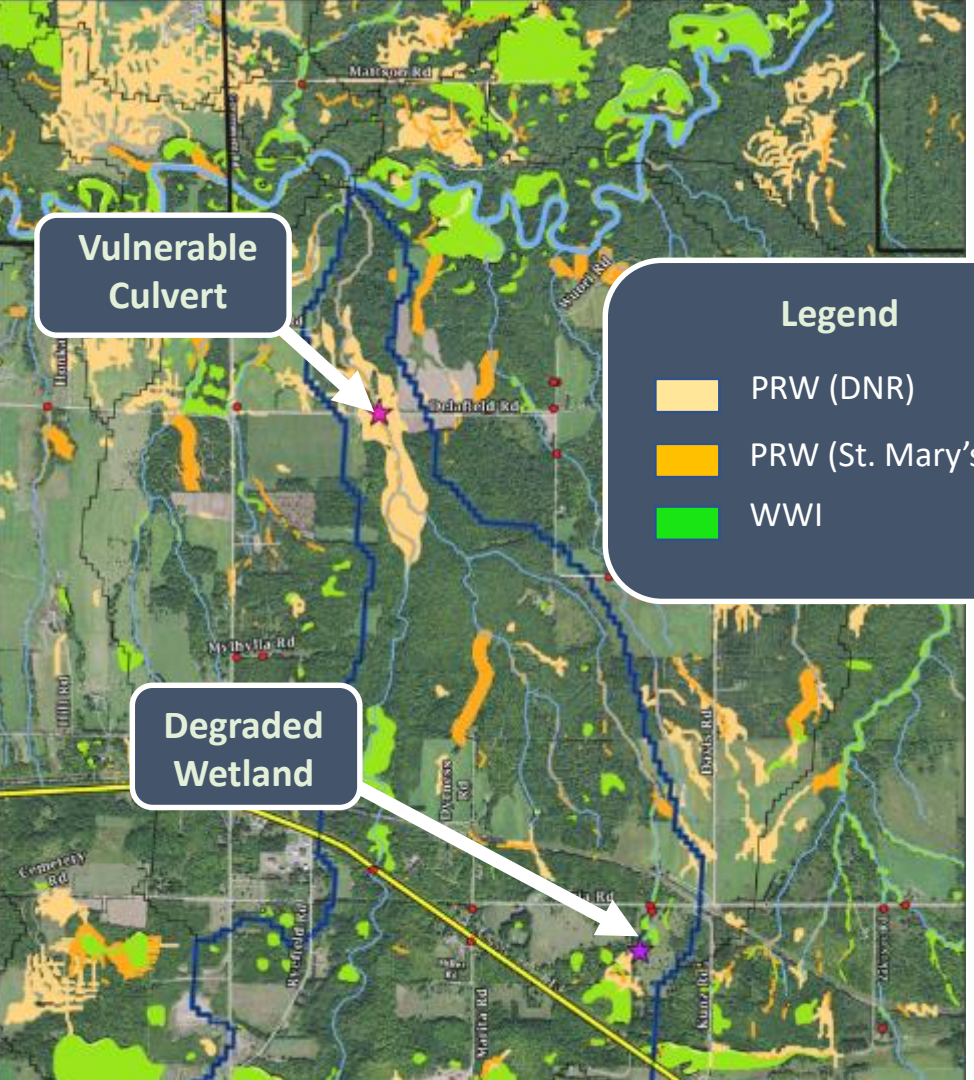
—*Lean budget, dependent on loans*

75%

of annual budget,
road maintenance



Incomplete Story



Erosion-Induced Drainage

+ headcuts
+ gullying
+ ravine erosion

= loss of watershed storage

= disconnected floodplains

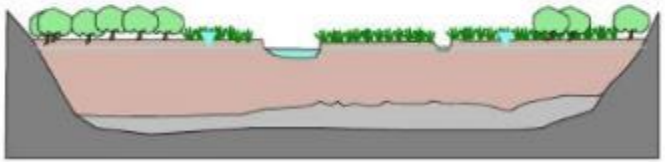
Channel Incision

Frame the problem, urgency, and solutions

Drivers of Stream Power

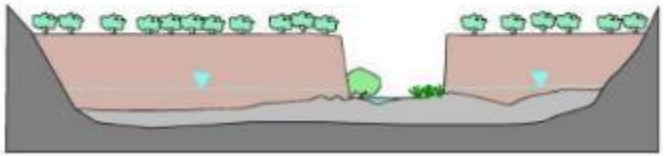
Connected floodplain system:

- sedge meadows
- deep accumulation of sediments
- elevated water table

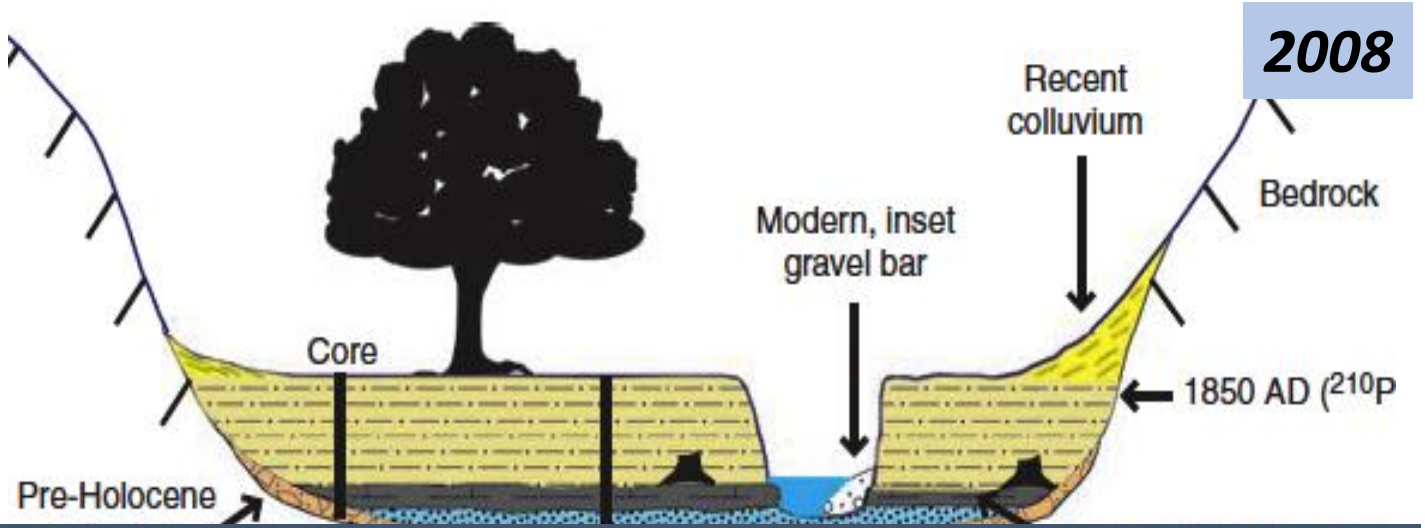


Disconnected floodplain system:

- conversion to sagebrush
- lowered water table
- intermittent streamflow



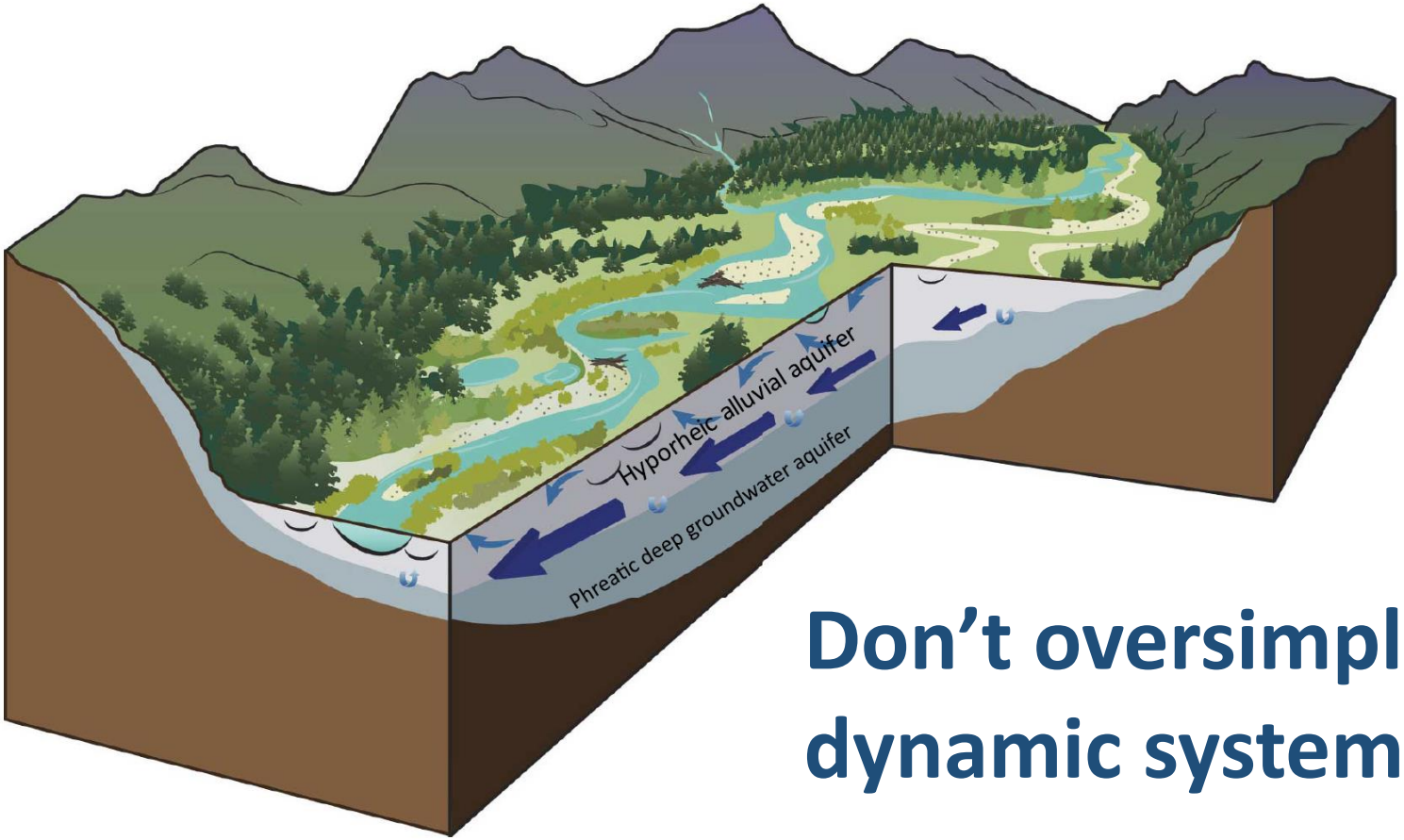
Slide Credit: Colin Thorne



"…before European settlement, the streams were small, anabranching channels within extensive, vegetated wetlands"

Slide Credit: Colin Thorne

Walter, R.C. and Merritts, D.J., 2008. Natural streams and the legacy of water-powered mills. *Science*, *319*(5861), pp.299-304.



Don’t oversimplify dynamic systems

Figure from: Hauser et al. 2016 Science Advances

FEMA PDM Project – Ashland Co.

—Culvert Community of Practice
(NOAA Project of Special Merit)

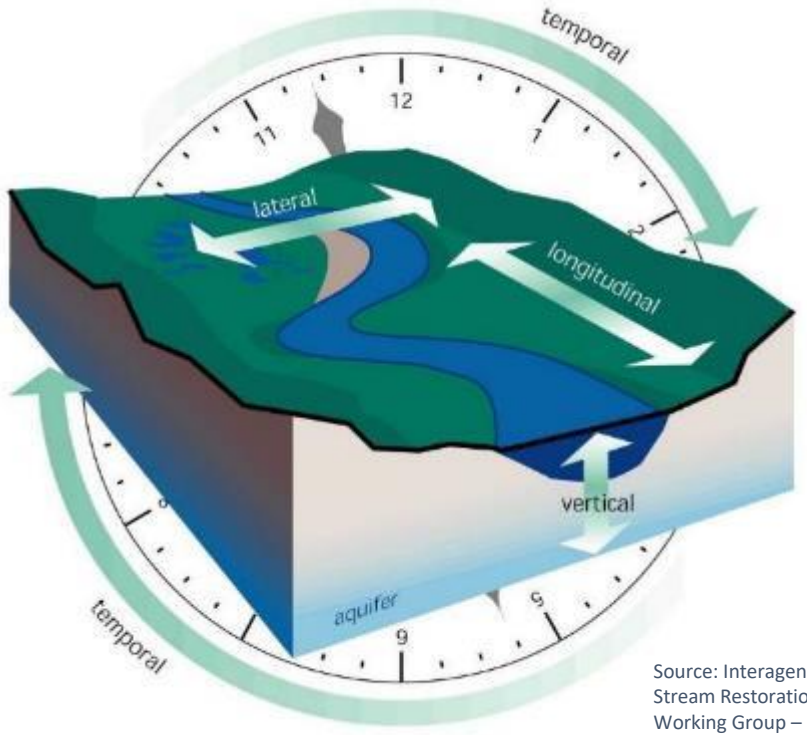
—Pilot fluvial erosion hazards methods with consideration of wetlands

—Prioritize restoration potential

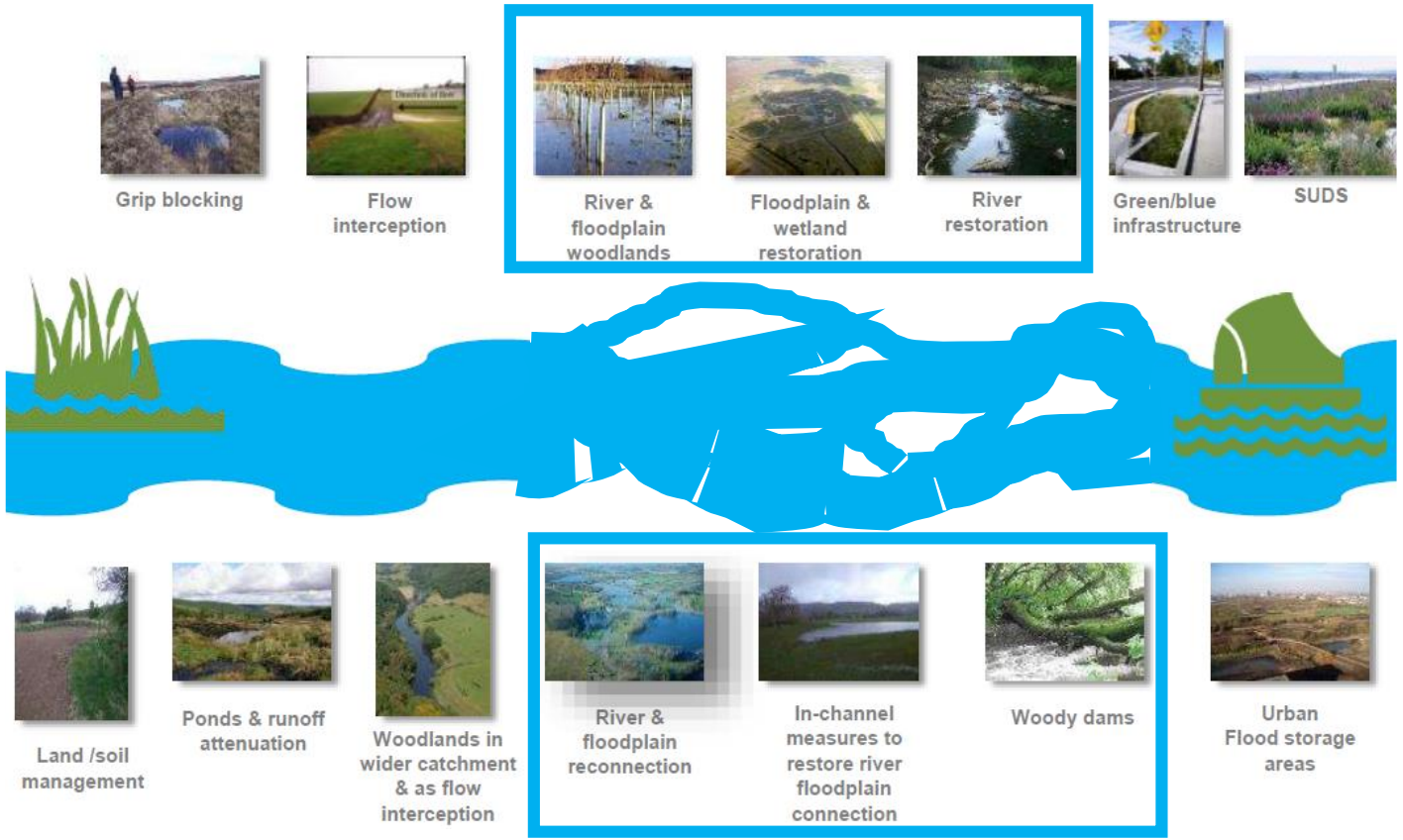
—Diversify stakeholder engagement

Natural Flood Management

Assess 4 types of connectivity



Source: Interagency Stream Restoration Working Group – '98

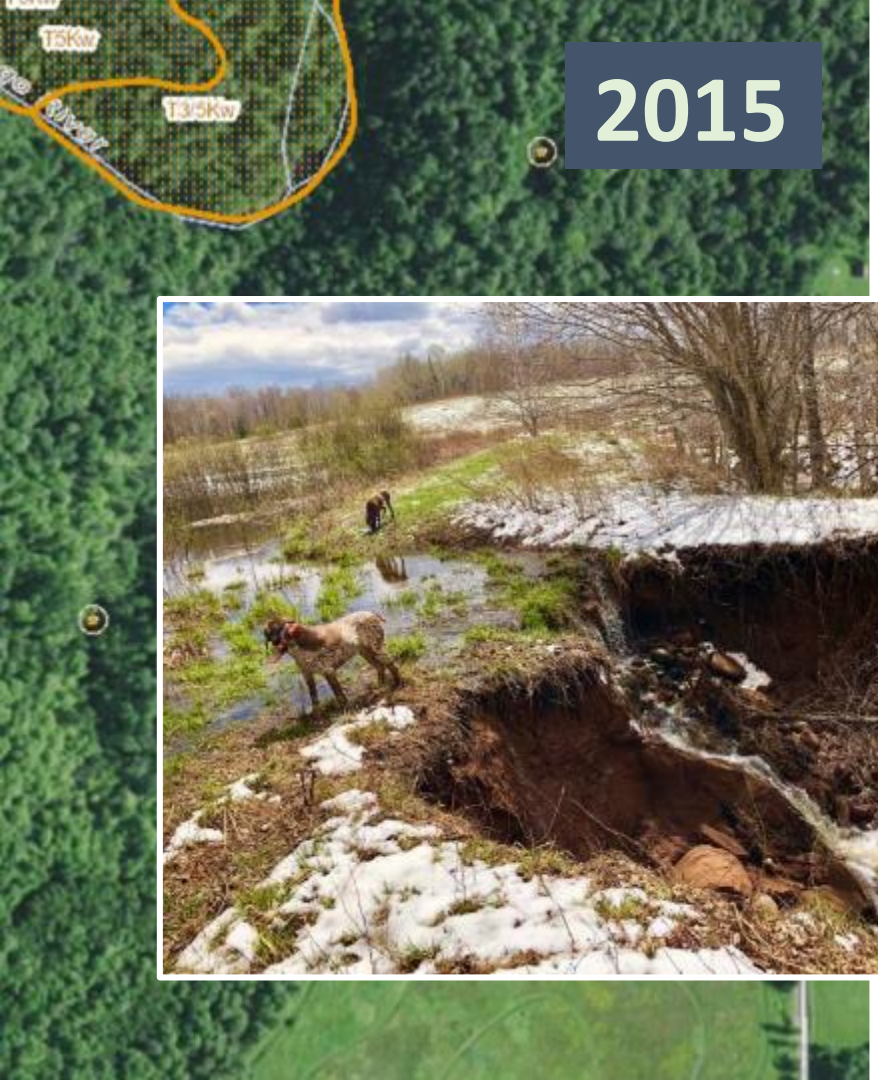


Natural Flood Management

Clare Dinnis FCRM Strategy

Slide Credit: Colin Thorne

Uplands/steep slopes	Floodplain	In-channel	Urban

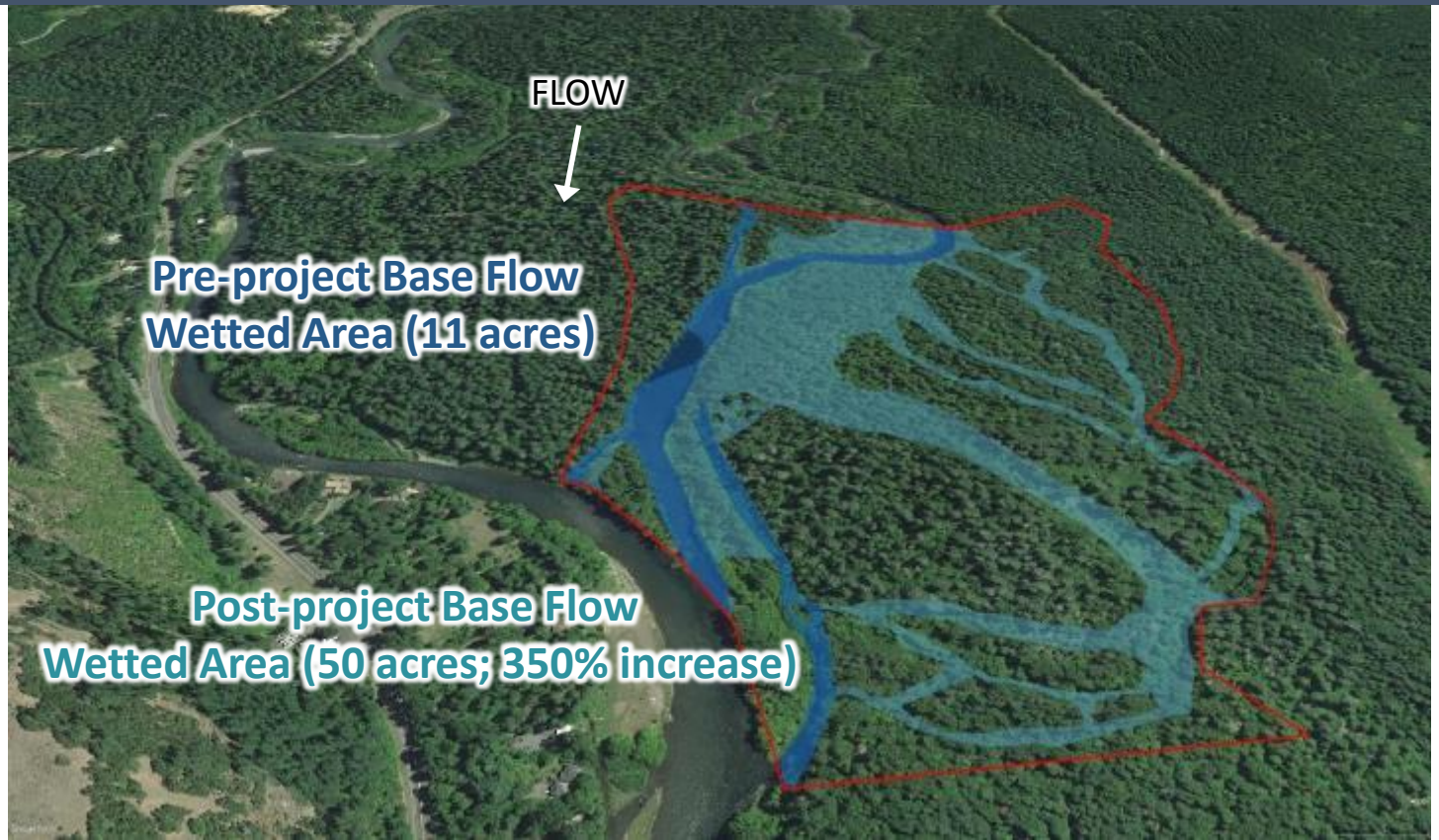

T5Kw
T3/5Kw
2015


2019

Understand Pre-Disturbed Conditions

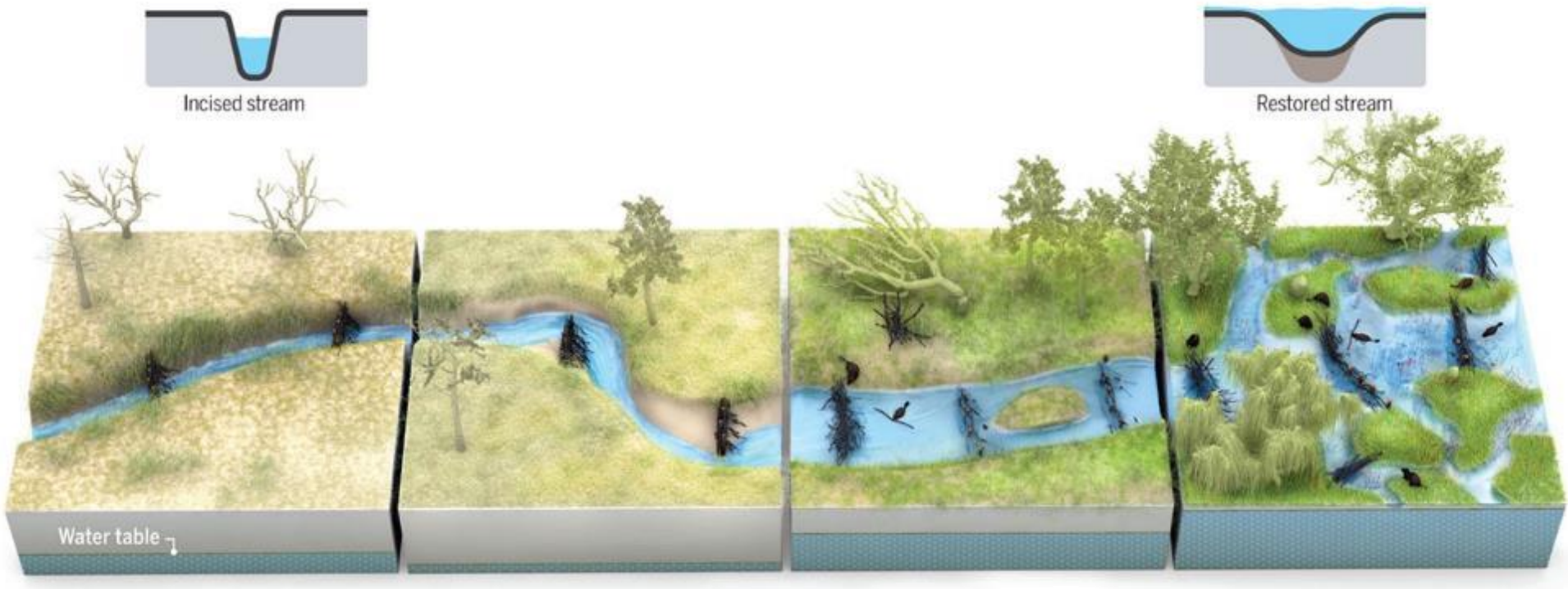
Slide Credit: Colin Thorne

Visualize Historic Features



Slide Credit: Colin Thorne

Dynamic Flow Modeling

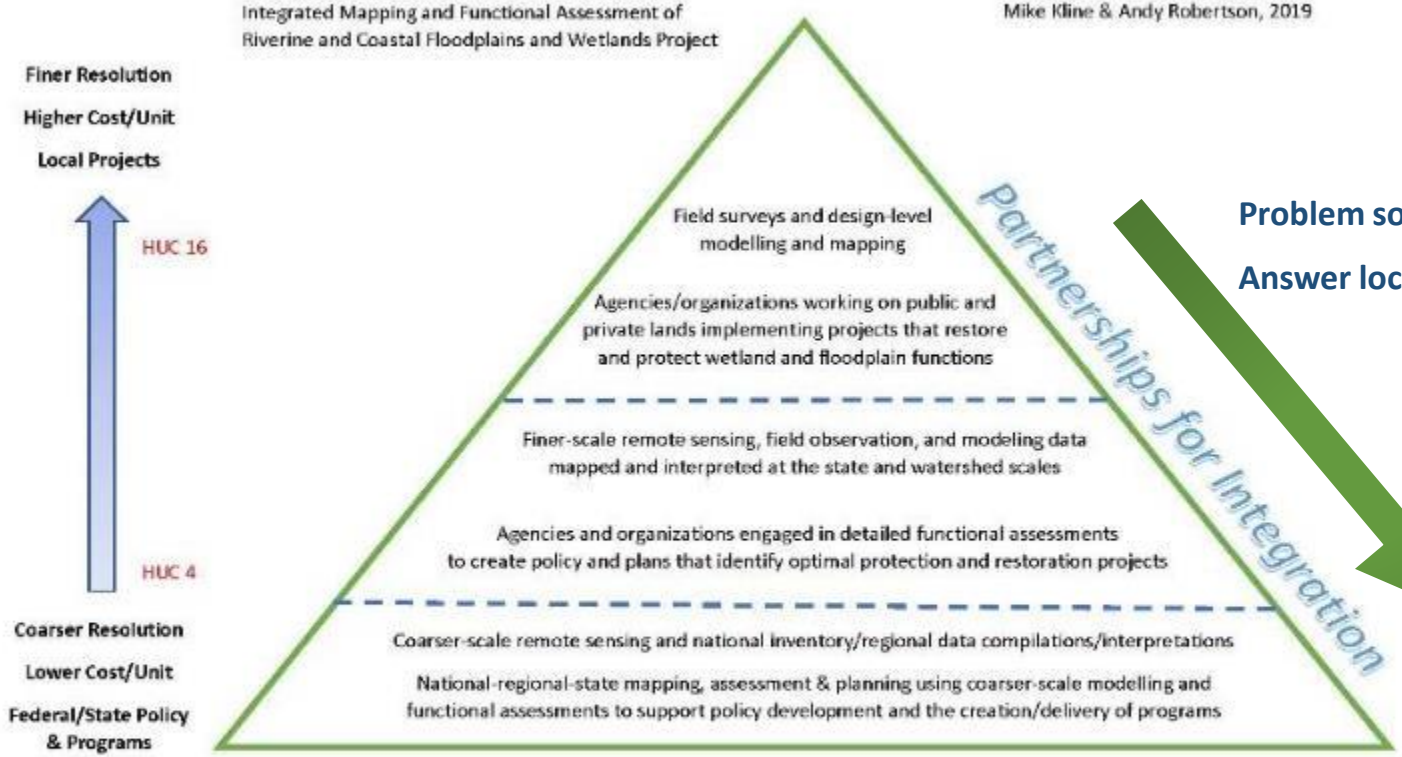


GRAPHIC: V. ALTOUNIAN/*SCIENCE* 'A stream comes back to life' *SCIENCE* 360: 1058 (2018)
DOI: 10.1126/science.360.6393.1058

Scale and Applicability of Floodplain Maps & Functional Assessments

Integrated Mapping and Functional Assessment of Riverine and Coastal Floodplains and Wetlands Project

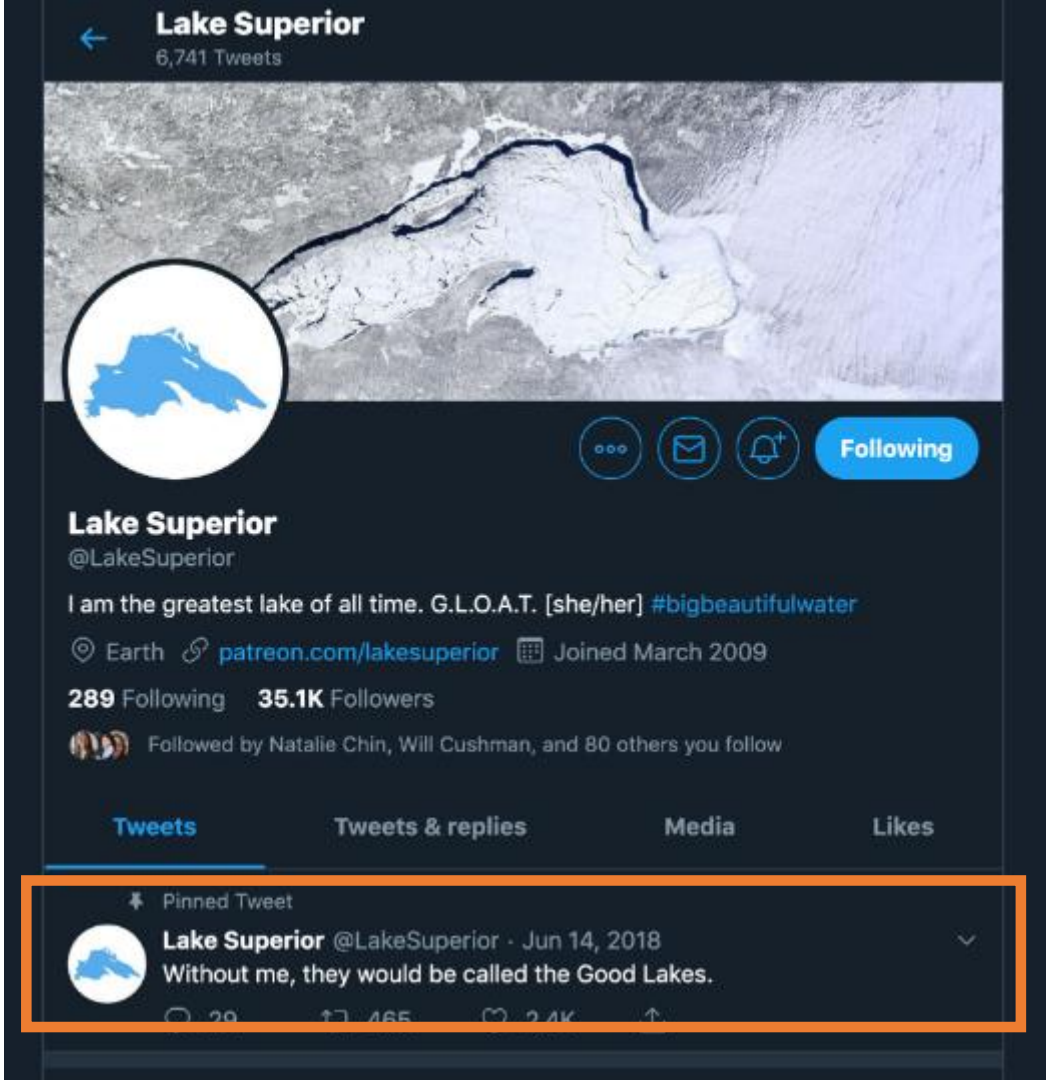
Mike Kline & Andy Robertson, 2019



Programs = regulatory, technical, outreach, and funding assistance provided by government agencies and/or NGOs

Projects = restoration of wetland/floodplain functions and/or conservation / land use regulation that protects wetland/floodplain functions

Partnerships = agencies and organizations working together across organizational and geographic scales to co-develop data, functional assessments, science needs, technology, funding and continuity for watercourses that cross jurisdictional boundaries



- #SciComm

- Invest in coordination, cross-cultural communication
- Tread lightly with decision support tools
- Empower local action, with ***right*** expertise
- Sideline biases
- Design Charrette

Acknowledgments

- St. Mary's of U of MN Geospatial Services (Andy Robertson, Kevin Stark, Kevin Benck)
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- Ben Goldfarb (author, *Eager: The Suprising, Secret Life of Beavers and Why They Matter*)
- Colin Thorne (University of Nottingham)


Questions?