HORICON MARSH PLANNING ASSISTANCE TO STATES CONCEPTUAL MODELING WORKSHOP – PHASE 2

And a little about Beardstown, Illinois River

BEAVER DAM, WISCONSIN
JUNE 4 – 6, 2014

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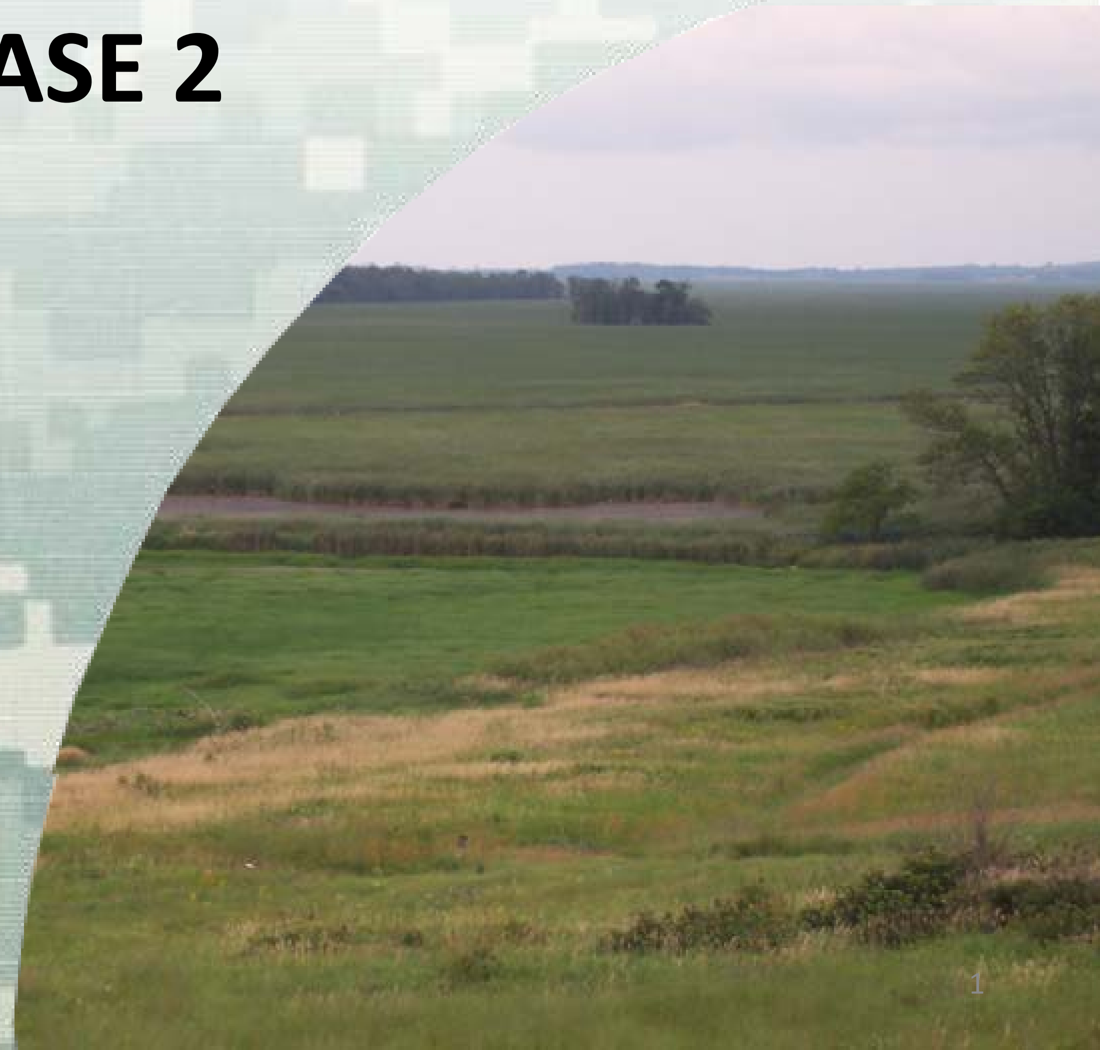

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Rock Island District
St. Paul District

Project History

- Rock River Comprehensive Plan (S. Russel)
- Projects within plan:
  - Horicon Marsh
  - Lake Koshkonong
  - Lake Sinnissippi
- Horicon Focus
  - Everglades Comp Plan WOTS
  - Coastal Hydraulics Lab – Dredging WOTS
  - PAS Conceptual Model

Everglades experts recommended:

- A conceptual model as an important next step.
- Enable the Horicon Marsh Management Team to better identify and articulate:
  - Problems,
  - Needs,
  - Opportunities, and
  - Constraints

as part of the master planning process.

Purpose for Conceptual Models

- Determining important ecosystem components,
- Choosing indicator species or communities
- ID relationships of interest between these parts,
- Specifying the mechanisms by which ecosystem components interact,
- Identifying missing information, and
- Exploring the connections between proposed future actions and desired responses.

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1999

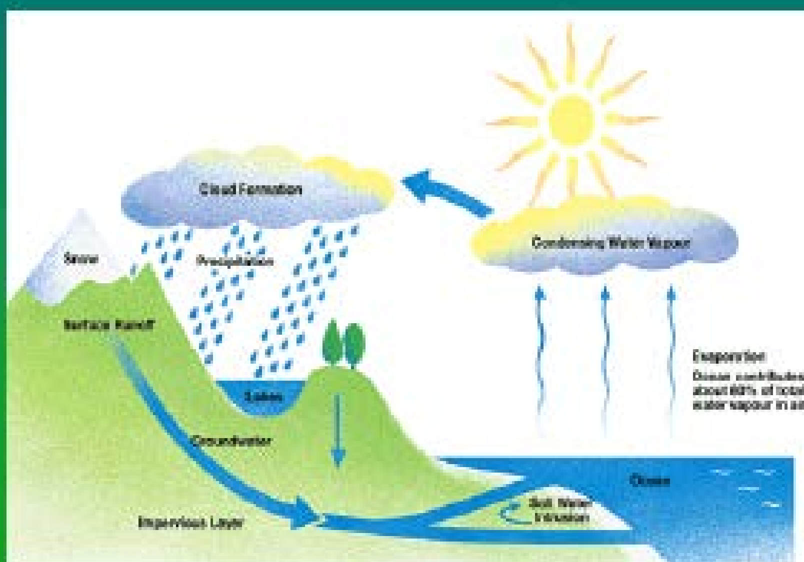
A Framework for an Ecosystem Integrity Report Card

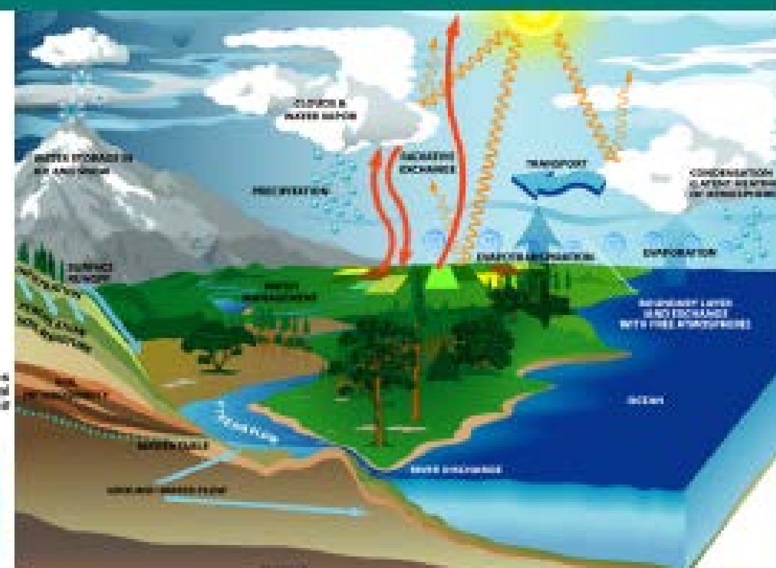
Examples from South Florida show how an ecosystem report card links societal values and scientific information

Mark A. Harwell, Victoria Myers, Terry Young, Ann Bartuska, Nancy Gassman, John H. Gentile, Christine C. Harwell, Stuart Appelbaum, John Barko, Billy Causey, Christine Johnson, Agnes McLean, Ron Smola, Paul Templet, and Stephen Tosini

What Are Conceptual Models?

A conceptual model is a tentative description of a system or sub-system that serves as a basis for intellectual organization.





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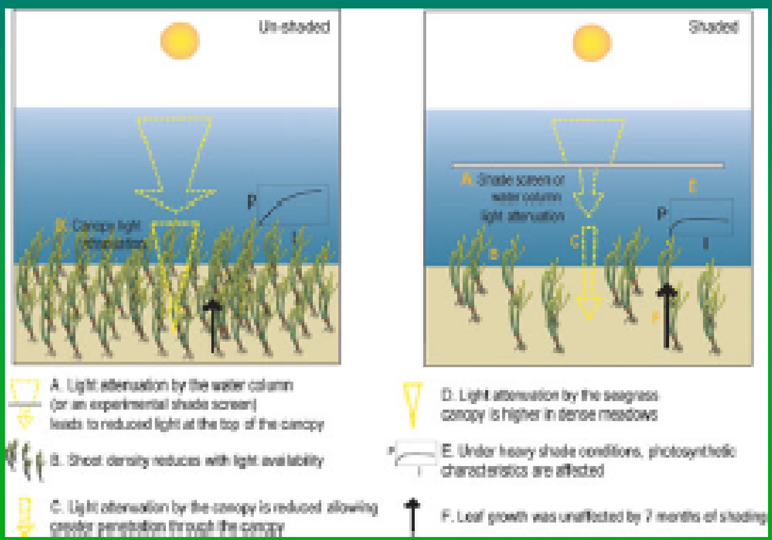
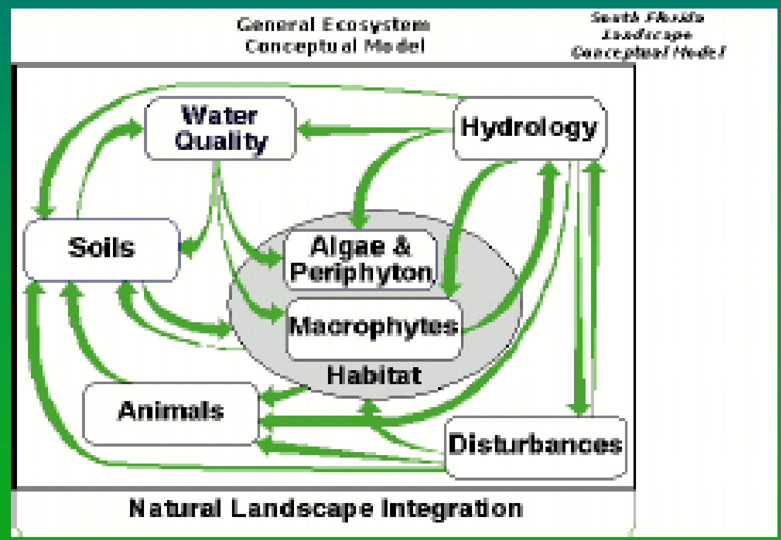
What CM's Do

Conceptual models describe general functional relationships among essential ecosystem components. They tell the story of "how the system works."





Conceptual Models are NOT:

- *The truth* – they are simplified depictions of reality
- *Comprehensive* – they focus only upon those parts of an ecosystem deemed relevant while ignoring other important (but not immediately germane) elements
- *Final* – they provide a flexible framework that evolves as understanding of the ecosystem increases

Process for CM

Fischenich (2008)

1. State the model objectives (see slides 3 &4)
2. Bound the system of interest
3. Identify critical model components within the system of interest
4. Articulate the relationships among the components of interest
5. Represent the conceptual model
6. Describe the expected pattern of model behavior
7. Test, review, and revise as needed

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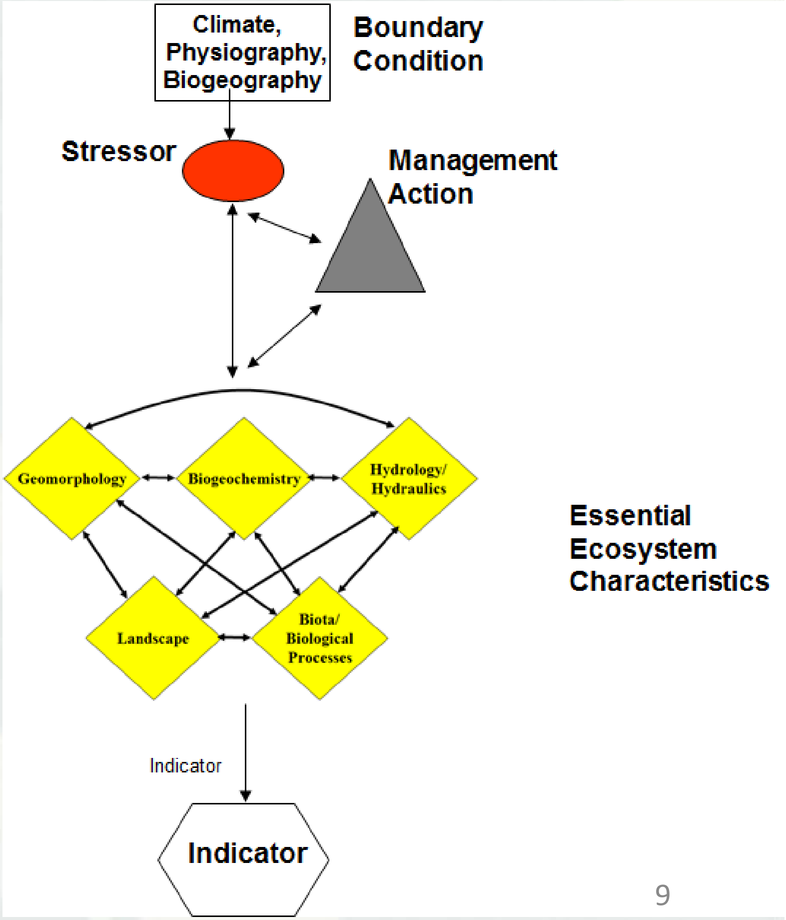
Driver-Stressor-Indicator Framework.

- Shows the major forces that influence a system,
- Causes of change, and
- Affected outcomes.

Resource managers can implement management actions intended to influence the drivers and stressors



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Rapid Prototype Process for CM

Using a rapid prototype modeling approach allows adaptation to team dynamics (Starfield 1997).

The facilitation team anticipated using box and arrow, driver-stressor-indicator conceptual model structure, but also introduced other methods and was prepared to adapt.

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Facilitator Note: Have extra tools in your toolbox; Go to NCTC SDM training

1. State the Model Objectives

Help Direct FWS Water Management
Identify Methods To Manage Sediment
Guide Future Infrastructure Design
Make a Conceptual Model for Decision Making
Something That Can Facilitate Communication With Public and Leaders
Help Define Management Strategies To Improve Water Quality and Fisheries
Help Prioritize Actions and Direct Management Timelines
Something To Engage Public and Help Them Understand Objectives
Identify Data Gaps

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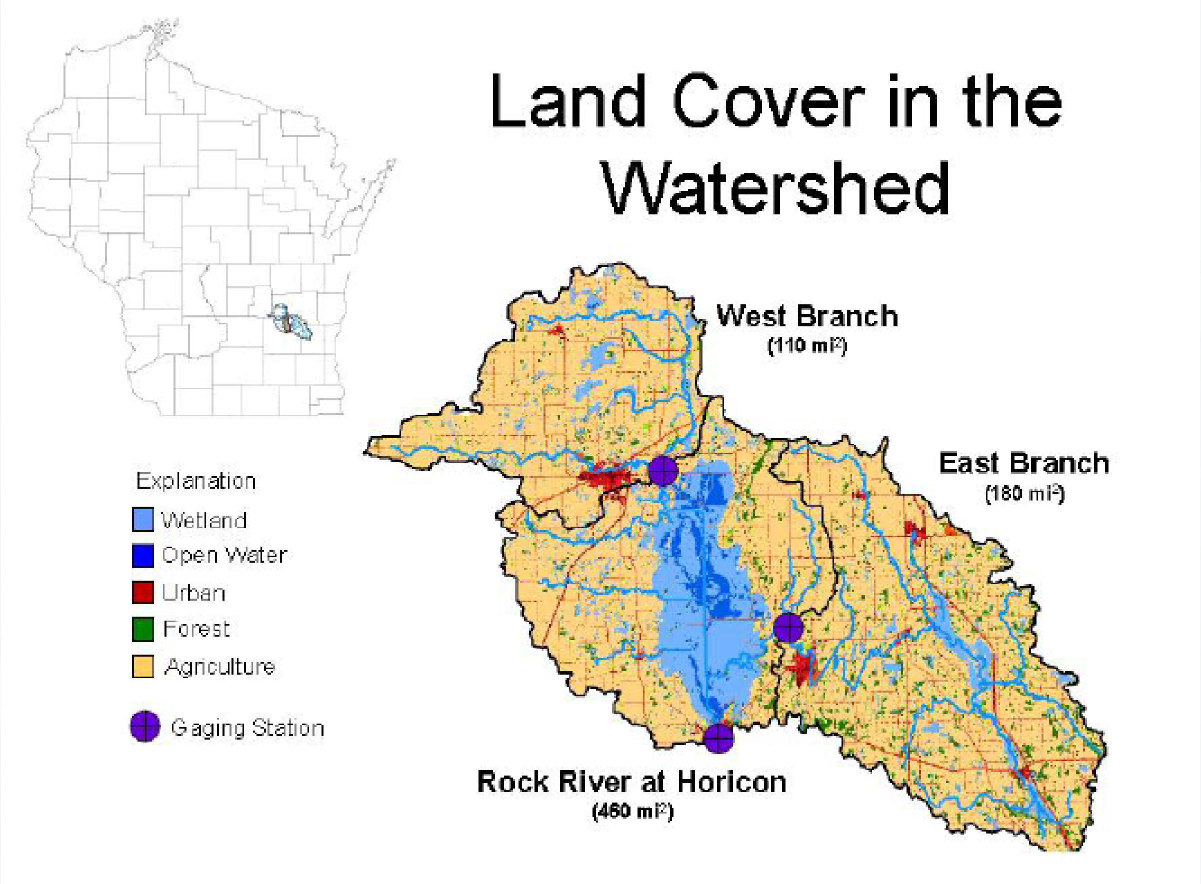
2. Bound the System of Interest

- Famous site with TONS of history and unique qualities **(Facilitator Note: ID Unique Qualities)**
  - largest freshwater cattail marsh in the United States
  - home to more than 305 kinds of birds
  - "Wetland of International Importance" and a "Globally Important Bird Area."
  - 32,000 acres in size; mostly open water and cattail marsh.
  - Federal Area (Upstream) = 21,000 acres; State Area = 11,000 acres
- The existing ecosystem condition is an artifact of long-term Holocene evolution, punctuated by human use disturbances in the 19th and 20th centuries.
- Many temporary alternate stable states along the way
- "The scars of the past have healed themselves, and as the Team gaze out over the marsh the Team get a feeling for the Algonquin word from which this marsh takes its name—Horicon, the land of clean, pure water." (Horicon CCP)

2. Bound the System of Interest



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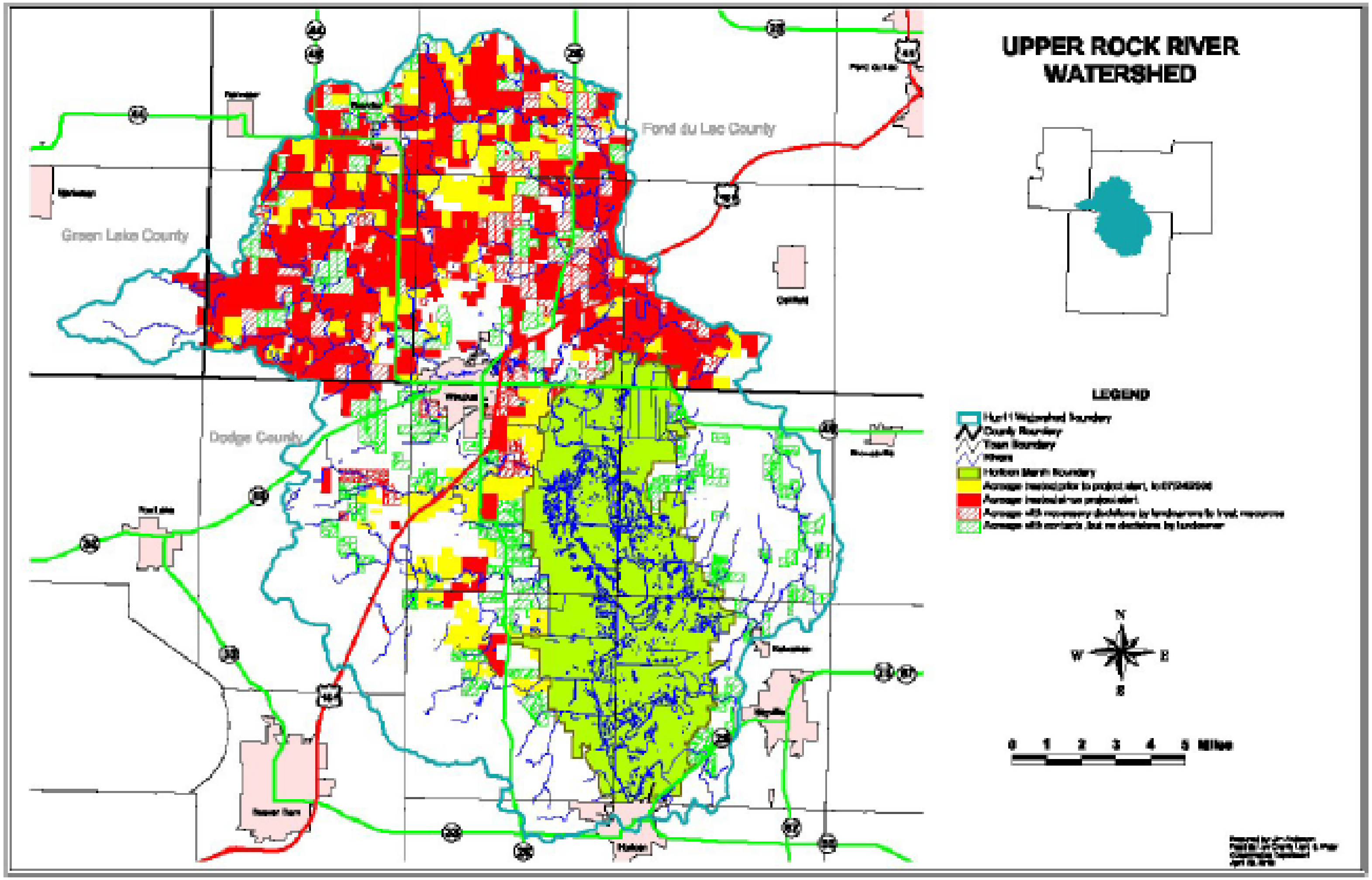
2. Bound the System of Interest

The "Erv" Effect Continued….move into other counties and use monitoring to prove successes.



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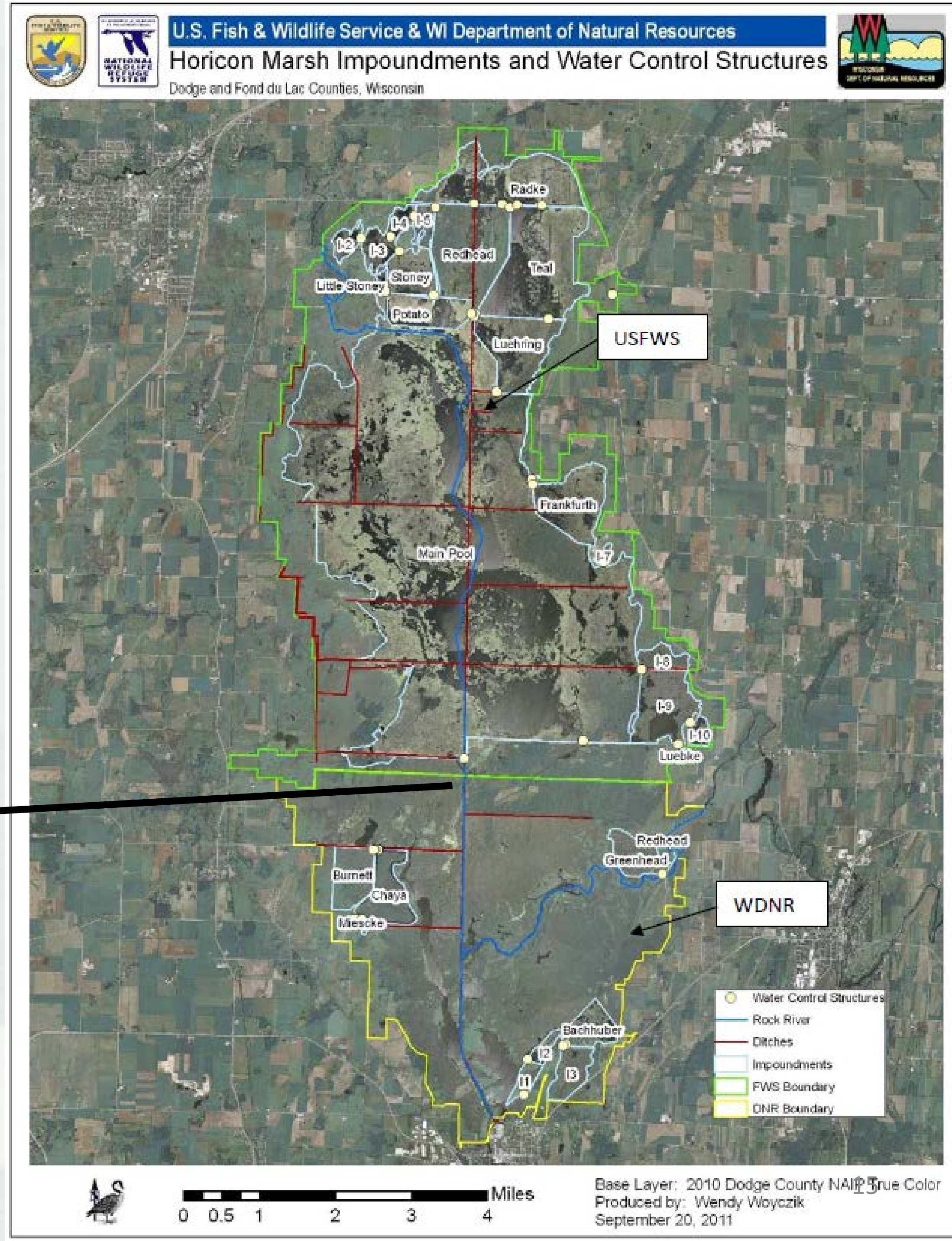

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3. Identify Critical Model Components Within the System of Interest

Indicators

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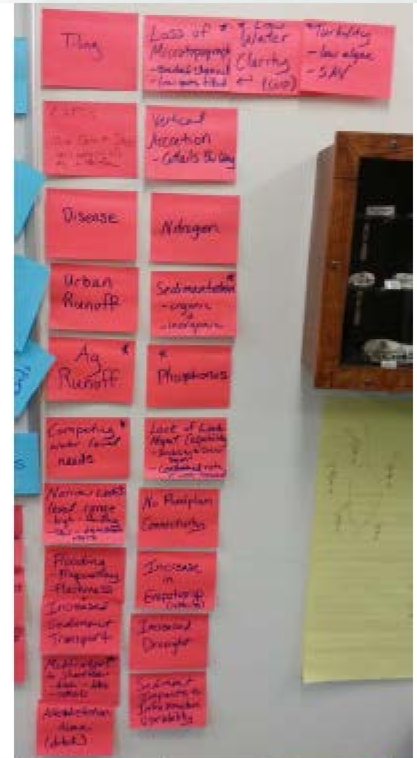
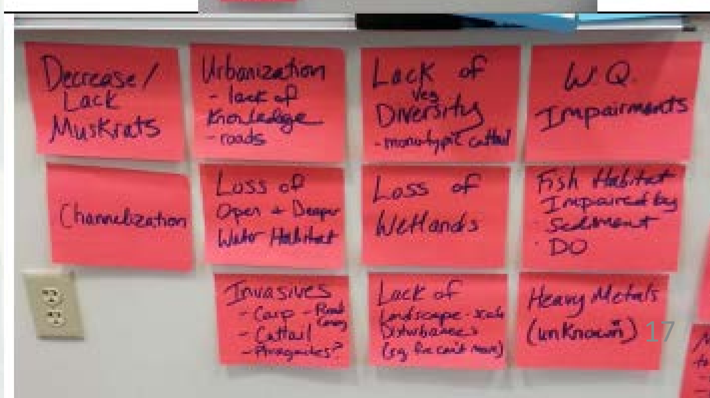
3. Identify Critical Model Components Within the System of Interest

Drivers

Stressors





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Most Important Drivers, Stressors, and Indicators Selected for the Phase 2, Conceptual Model

Drivers	Stressors	Indicators
• Water Levels (natural & manipulated) (8) • Agriculture (farming Intensifying) (7) • Carp (6) • Water Management Infrastructure (6) • Nutrient Cycle	• Competing Water Level Needs (lack of water management, narrow water level range) (9) • Agricultural Runoff (8) • Invasive Species (5) • Modifications to Sheetflow (dam, dike, ditch, cattails) (5) • Sedimentation (3) • Loss of Microtopography (1) • Water Quality (1) • Loss of Wetlands (1)	• Marsh Hydrology • Marsh Water Quality o Dissolved Oxygen o Water Clarity o Nutrients o Temperature • Marsh Habitat Quality • Marsh Biota o Diverse, patchy aquatic plants o Invasive plants – cattail, reed canary grass o Carp o Waterbirds o Gamefish o Muskrats

Facilitator Note: Sticky dot ranking exercise

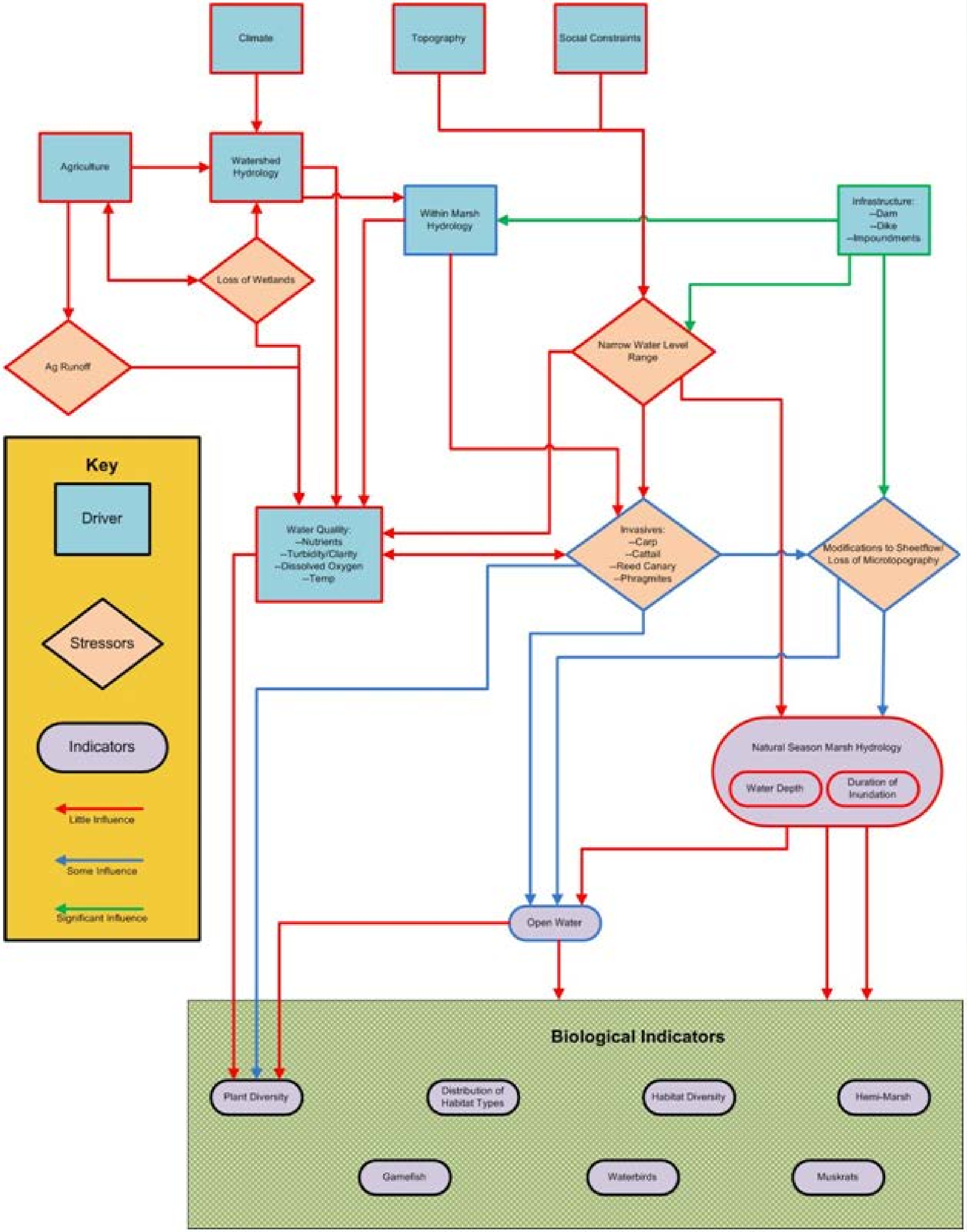
4. Articulate the Relationships Among the Components of Interest

Adding Weights

1. How much does the Team know? and
2. How much can the Team influence with our management?

Indicators:

- Water quality,
- Sheetflow disturbance,
- Sedimentation, and
- Invasive species



5. Represent the Conceptual Model

(After the Workshop CM Clean-Up)

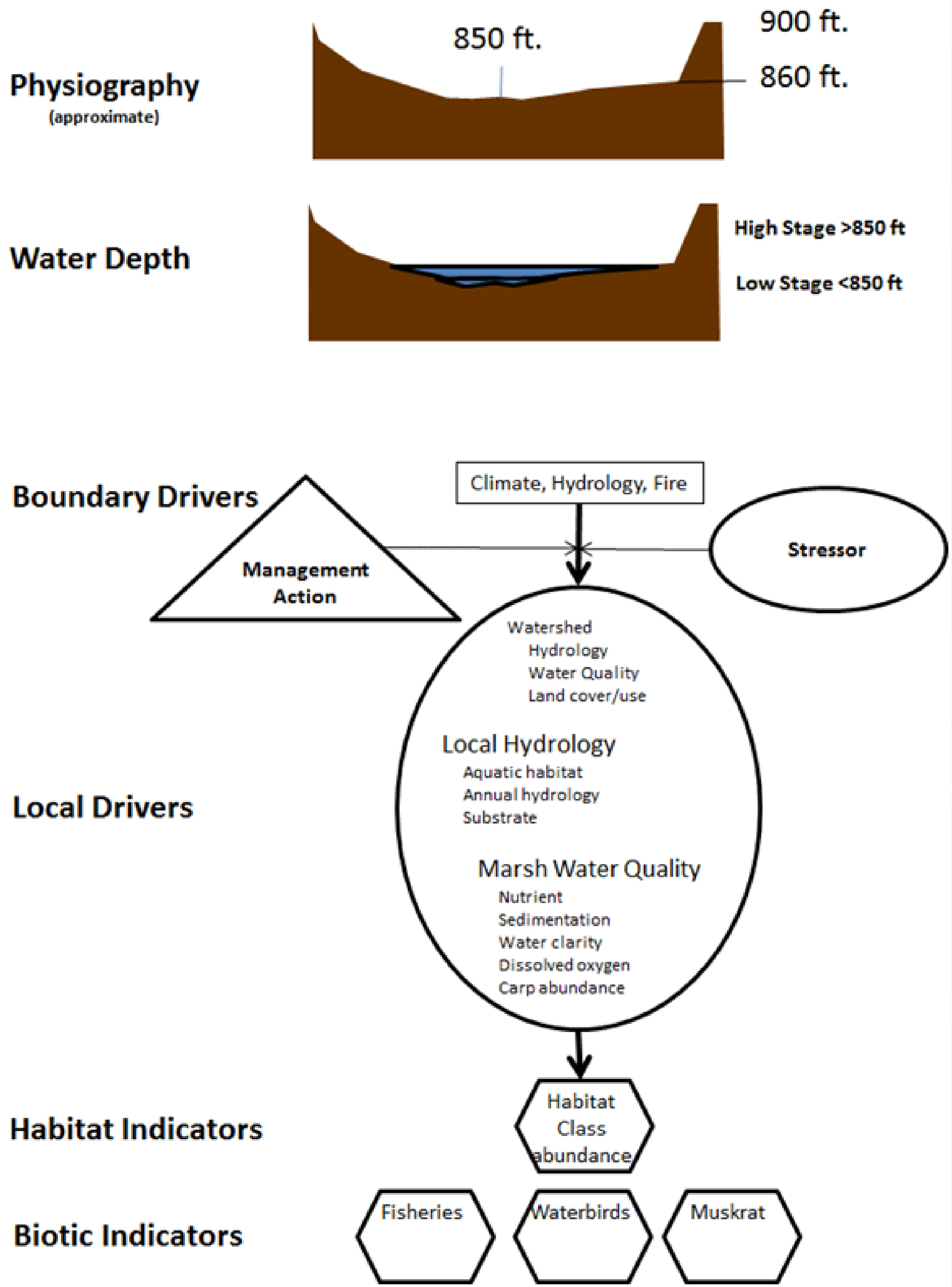
6. Describe the expected pattern of model behavior

- Simulate Natural Seasonal Hydrology [1]
  1) Capacity to Drain in XX days/weeks
  2) Cooperation from Sinnissippi
  3) Complete drawdown
  4) Ditch system helps
  5) Restore original channel
- Water Control Structure at Cross Dike
  (faster drainage for USFWS and natural flow to State)
- Increase Water Level Management Range (Social)
- Dredge for Deeper Water
- Islands – spread material over cattail
- Explosives
- Fire – fresh growth – muskrats control
- Sediment Traps
- Dredge Mill Ponds
- Super pump
- Bypass
- Move Dam – higher water
- Ditch Fill – Sheet Flow
- Remove Main Dike Road
- More Impoundments
- Kill Carp
- Spray Cattails
- Trade Nutrients
- Remove all dams

Prototype 2

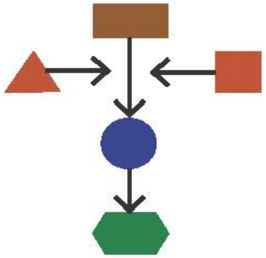
- Box and arrow not helpful for public audience
- Interesting historical stable states punctuated by human use disturbances in the 19th and 20th centuries.
- Many attributes and influences to organize

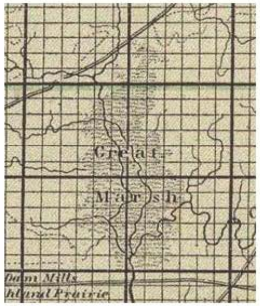
Graphic Simplification for Master Planning

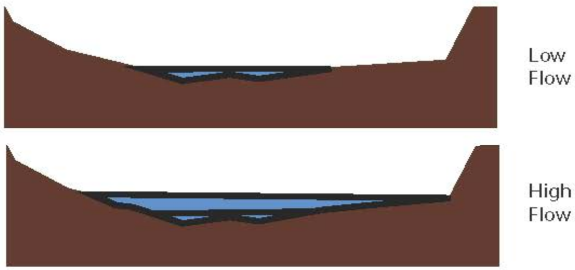


Reference Condition CMs

HORICON Marsh - Pre-Settlement Riverine Marsh







BOUNDARY CONDITIONS

Climate: 1800-1850

Hydrology: Pre-disturbance

Fire: Savanna

LOCAL DRIVERS

WATERSHED
- Hydrology: Seasonal
- Water Quality: Good
- Land cover/use: Savanna

LOCAL HYDROLOGY
- Aquatic Habitat: River Marsh
- Annual Hydrology: Seasonal Flood
- Substate: Peat

MARSH WATER QUALITY
- Nutrient: Low
- Sedimentation: Low
- Water Clarity: High
- Dissolved Oxygen: High
- Carp Abundance: Absent

STRESSOR -

Natural/Anthropogeric Fire, Seasonal Climate & Hydrology, Muskrats

MANAGEMENT ACTION

Native American Fire

HABITAT INDICATORS

HABITAT CLASS
- Wet Meadow,
- Wild Rice

BIOTIC INDICATORS

FISHERIES
- Pike
- Panfish

WATERBIRDS
- Very Abundant

MUSKRAT
- Very Abundant

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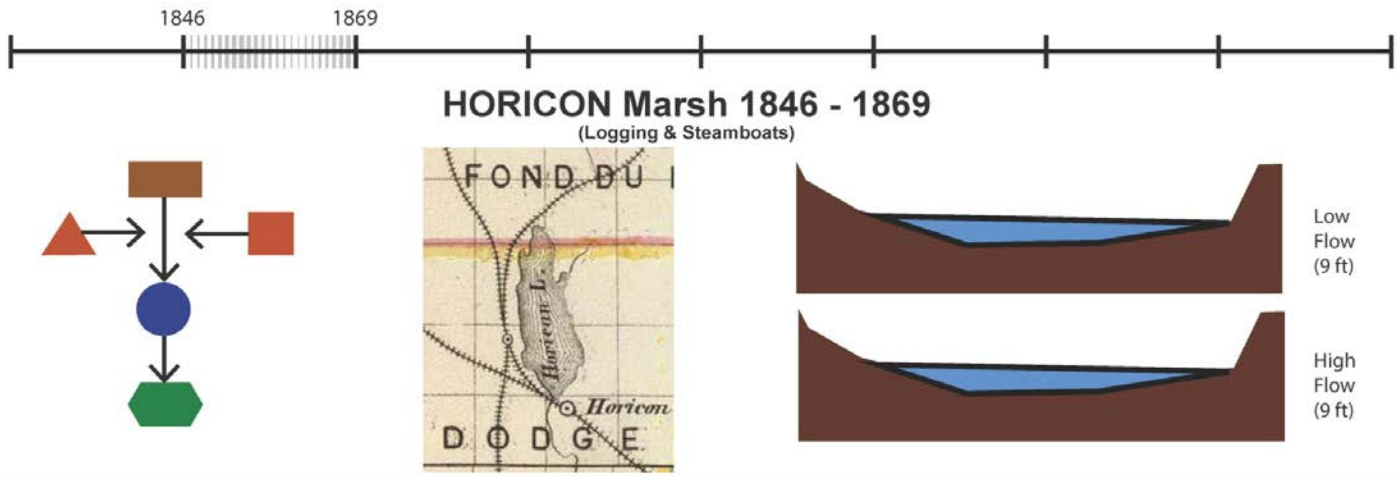
Reference Condition CMs



BOUNDARY CONDITIONS

Climate: 1850-1900

Hydrology: Pre-disturbance

Fire: Suppressed

LOCAL DRIVERS

WATERSHED
- Hydrology: Seasonal
- Water Quality: Good
- Land cover/use: Savanna; Deforestation; Early Agriculture

LOCAL HYDROLOGY
- Aquatic Habitat: Lake
- Annual Hydrology: Impounded
- Substate: Peat

MARSH WATER QUALITY
- Nutrient: Low
- Sedimentation: Low
- Water Clarity: High
- Dissolved Oxygen: High
- Carp Abundance: Absent

STRESSOR -

Impounded Lake
Logging
Steamboats

MANAGEMENT ACTION

Sinissippi Dam;
Sawmill Dam

HABITAT INDICATORS

HABITAT CLASS
- Meso-Trophic Lake

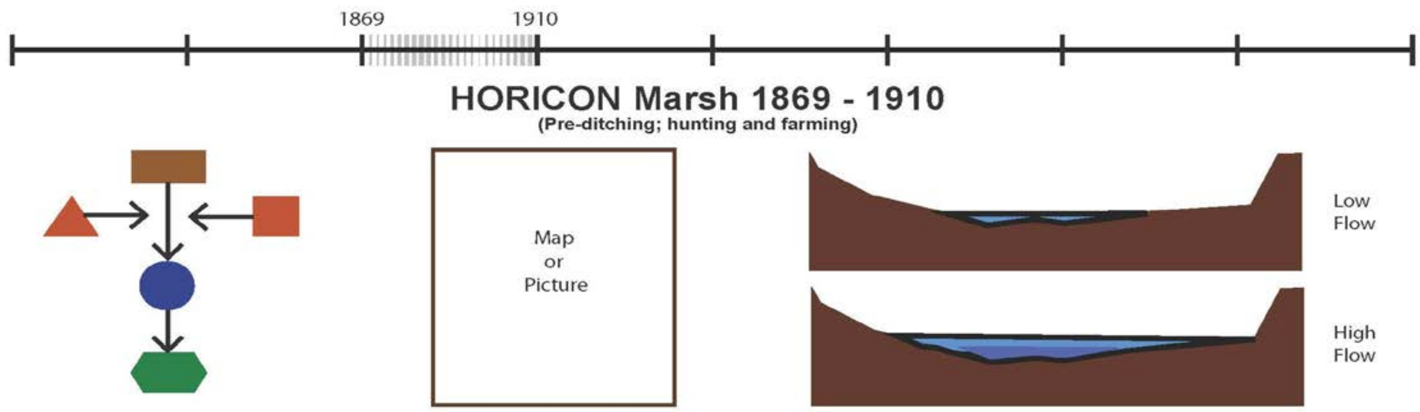
BIOTIC INDICATORS

FISHERIES
- Lentic

WATERBIRDS
- Low Abundance

MUSKRAT
- Low Abundance

Reference Condition CMs



BOUNDARY CONDITIONS
- Climate: 1900
- Hydrology: Early Channelization
- Fire: Suppressed

LOCAL DRIVERS

WATERSHED
- Hydrology: Early Agriculture
- Water Quality: Good
- Land cover/use: Early Agriculture

LOCAL HYDROLOGY
- Aquatic Habitat: River Marsh
- Annual Hydrology: Low Flow Impounded
- Substate: Peat

MARSH WATER QUALITY
- Nutrient: Low
- Sedimentation: Increasing
- Water Clarity: High
- Dissolved Oxygen: High
- Carp Abundance: Low

STRESSOR
- Wetland hydrology
- Low Flow Impounded
- Carp Introduced
- Market hunting
- Good muskrats

MANAGEMENT ACTION
- Sinissippi Dam;
- Horicon Dam Removal

HABITAT INDICATORS

HABITAT CLASS
- Rice
- Sedge
- Wet Meadow

BIOTIC INDICATORS

FISHERIES
- Carp

WATERBIRDS
- Low Abundance

MUSKRAT
- High Abundance

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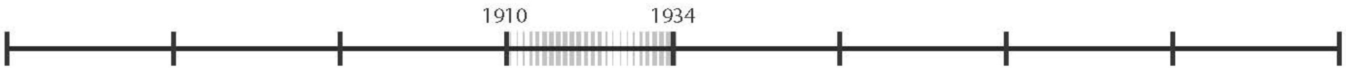
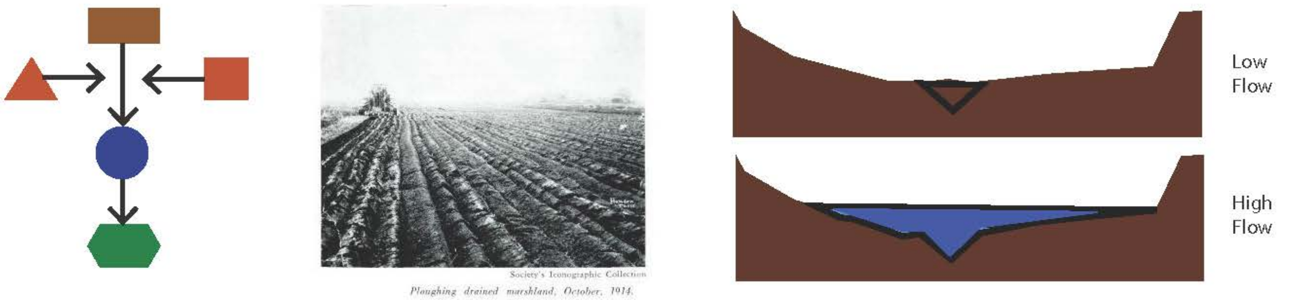
Reference Condition CMs



HORICON Farms 1910 - 1934
(Marsh Agriculture)



BOUNDARY CONDITIONS

Climate: Wet Period

Hydrology: Channelization & tile

Fire: Suppressed

LOCAL DRIVERS

WATERSHED

- **Hydrology:** Increasing Agriculture
- **Water Quality:** High Sediment
  - Nutrient: Enrichment;
  - Point Source BOD;
- **Land cover/use:** Increasing Agriculture

LOCAL HYDROLOGY

- **Aquatic Habitat:** Drained
- **Annual Hydrology:** Dry
- **Substate:** Burned Peat

MARSH WATER QUALITY

- **Nutrient:** Substrate Nutrients Disturbed
- **Sedimentation:** High, Filling Channels, Bioturbation
- **Water Clarity:** Low
- **Dissolved Oxygen:** Low
- **Carp Abundance:** High

STRESSOR -

Ditched & Drained
Low Flow Impounded
Peat Fires
Point Source Pollution

MANAGEMENT ACTION

Sinissippi Dam;
Mainline Ditch

HABITAT INDICATORS

HABITAT CLASS
Crops
Livestock

BIOTIC INDICATORS

FISHERIES
Carp in Ditches

WATERBIRDS
Low Abundance

MUSKRAT
Low Abundance

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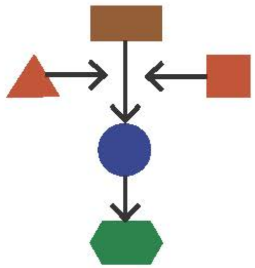
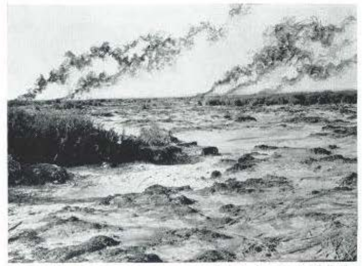
Reference Condition CMs

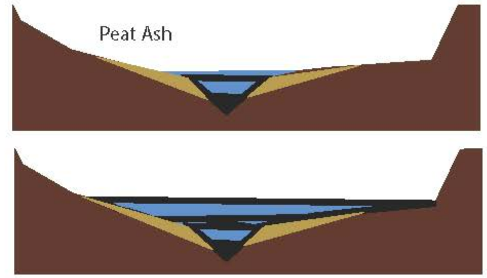
HORICON MA/Refuge 1934 - 1948
(Horicon Dam; Early Conservation/Refuge)





Society's Iconographic Collection

Fire destroying the Horicon Marsh Wildlife Refuge, August, 1931.



BOUNDARY CONDITIONS
- Climate: Drought Period
- Hydrology: Channelization & Tile
- Fire: Suppressed

LOCAL DRIVERS

WATERSHED
- **Hydrology:** Channelized; Tiled; Drained;
- **Water Quality:** High Sediment; Nutrient Enrichment: Point Source BOD; Increasing Animal/agriculture phosphorus
- **Land conver/use:** Increasing Agriculture

LOCAL HYDROLOGY
- **Aquatic Habitat:** Marsh
- **Annual Hydrology:** Ditched & Impounded;
- **Substate:** Peat Ash

MARSH WATER QUALITY
- **Nutrient:** Increased Nutrients
- **Sedimentation:** High, Filling Channels, Bioturbation (carp)
- **Water Clarity:** Poor Due to Carp
- **Dissolved Oxygen:** Decreasing from Organic Loading
- **Carp Abundance:** High/Nuisance

STRESSOR -
- Sheet Flow Hydrology
- Low Flow Impounded
- Peat Fires
- Point Source Pollution
- Carp
- Wind Fetch

MANAGEMENT ACTION
- Sinissippi Dam
- Mainline Ditch
- Horicon Dam
- Early SCS
- Rough Fish Management

HABITAT INDICATORS

HABITAT CLASS ABUNDANCE
- Marsh

BIOTIC INDICATORS

FISHERIES
- Carp Poor Response to Kill

WATERBIRDS
- National Trend

MUSKRAT
- Low

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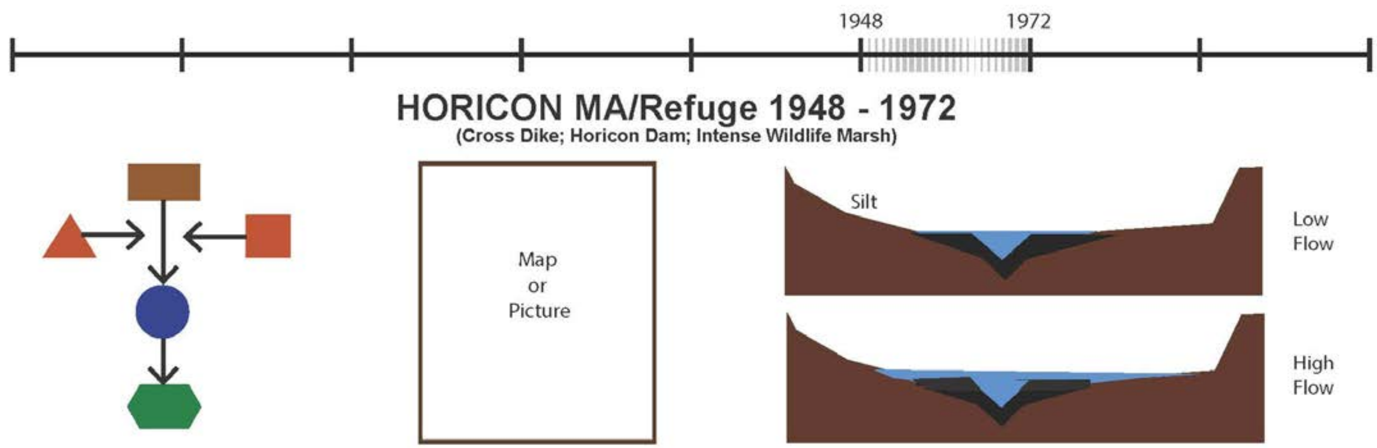
Reference Condition CMs



BOUNDARY CONDITIONS

Climate: Normal Period
Hydrology: Channelization, tile, row crop
Fire: Suppressed

LOCAL DRIVERS

WATERSHED
- Hydrology: Channelized; Tiled; Drained;
- Water Quality: High Sediment
  - Nutrient: Point Source BOD; Increasing Animal phosphorus
- Land cover/use: Increasing Agricultural Mechanization/Row Crop; Human Encroachment

LOCAL HYDROLOGY
- Aquatic Habitat: Impounded Marsh
- Annual Hydrology: Ditched and Impounded; Altered Sheet Flow
- Substate: Silt; Muck

MARSH WATER QUALITY
- Nutrient: Nutrient Enriched
- Sedimentation: High, Filling Channels, Bioturbation (carp)
- Water Clarity: Poor Due to Carp
- Dissolved Oxygen: Fair
- Carp Abundance: High/Nuisance

STRESSOR -

Altered Sheet Flow;
Low Flow
Impounded;
Sedimentation;
Sediment Resuspension;
Point Source Pollution
Carp; Cattails;
Geese; Post WWII Chemicals/Mechanization;
Row Crops;
Human Encroachment

MANAGEMENT ACTION

Sinissippi Dam;
Mainline Ditch;
Horicon Dam;
Cross Dike;
Carp Kill Drawdown
Intense Resource Management

HABITAT INDICATORS

HABITAT CLASS
- Cattail Marsh;
- Open Water
- Hemi -Marsh

BIOTIC INDICATORS

FISHERIES
- Carp Poor Response to Kill

WATERBIRDS
- National Trend

MUSKRAT
- Peak on Drawdown

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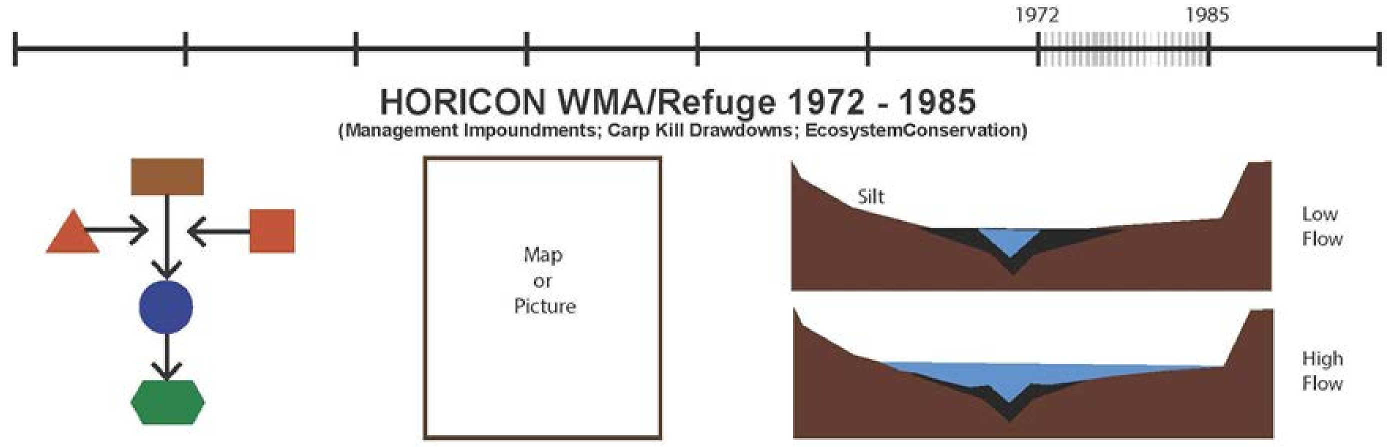
Reference Condition CMs



BOUNDARY CONDITIONS

- Climate: Normal Period
- Hydrology: Channelization, Tile, Row Crop
- Fire: Suppressed

LOCAL DRIVERS

WATERSHED
- Hydrology: Channelized; Tiled; Wetland Loss;
- Water Quality: High Sediment
  - Nutrient: Decreased Point Source BOD; Phosphorous Loading
- Land conver/use: Increasing Agricultural Mechanization/Row Crop; Human Encroachment

LOCAL HYDROLOGY
- Aquatic Habitat: Impounded Marsh
- Annual Hydrology: Ditched Impounded Sub-Impounded; Altered Sheet Flow
- Substate: Silt; Muck

MARSH WATER QUALITY
- Nutrient: Nutrient Enriched
- Sedimentation: High, Filling Channels, Bioturbation (carp)
- Water Clarity: Poor Due to Carp
- Dissolved Oxygen: Fair
- Carp Abundance: High/Nuisance

STRESSOR

Altered Sheet Flow;
Low Flow
Impounded;
Sedimentation;
Sediment Resuspension;
Point Source Pollution:
Carp; Cattail Hybrids;
Geese;
Post WWII Chemicals/Mechani-zation;
Row Crops;
Human Encroachment;

MANAGEMENT ACTION

Sinissippi Dam;
Mainline Ditch;
Horicon Dam;
Cross Dike;
Carp Kill Drawdown;
Sub-Impoundments;
N-S Unit Differentiation;
Farm Bill

HABITAT INDICATORS

HABITAT CLASS
- Cattail Marsh
- Hemi-Marsh
- Open Water

BIOTIC INDICATORS

FISHERIES
- Carp Poor Response to Kill

WATERBIRDS
- National Trend

MUSKRAT
- Peak on Drawdown

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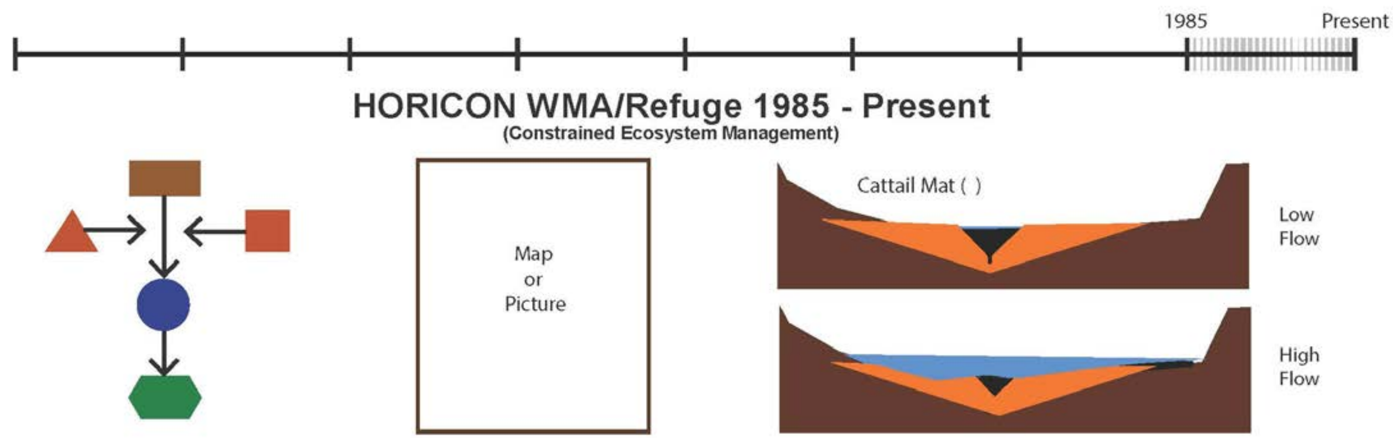
Reference Condition CMs



BOUNDARY CONDITIONS

Climate: Climate Change
Hydrology: Channelization, tile, row crop
Fire: Prescribed

LOCAL DRIVERS

WATERSHED
- Hydrology: Channelized; Tiled; Weak Wetland Recovery
- Water Quality: High Sediment
  - Nutrient: Decreased Point Source BOD; Phosphorous Loading
- Land conver/use: Row Crop; Human Encroachment

LOCAL HYDROLOGY
- Aquatic Habitat: Impounded Marsh
- Annual Hydrology: Ditched, Impounded; Sub-Impounded; Altered Sheet Flow
- Substate: Silt; Cattail Mat

MARSH WATER QUALITY
- Nutrient: Nutrient Enriched
- Sedimentation: High, Filling Channels, Bioturbation (carp)
- Water Clarity: Poor Due to Carp
- Dissolved Oxygen: Fair
- Carp Abundance: High/Nusiance

STRESSOR -

Altered Sheet Flow;
Low Flow
Impounded;
Sedimentation;
Sediment Resuspension;
Point Source Pollution:
Carp; Cattail Hybrids; Geese;
Post WWII Chemicals/Mechanization; Row Crops; Human Encroachment; Major Flood & Drought; Tornado

MANAGEMENT ACTION

Sinissippi Dam;
Mainline Ditch;
Horicon Dam;
Cross Dike;
Carp Kill Drawdown;
Sub-Impoundments;
N-S Unit Differentiation;
Burning: Chemical use (cattail & carp); Increased BMP;
Clean Water Act;
Ecosystem Restoration;
Spoil Pile Erosion

HABITAT INDICATORS

HABITAT CLASS
- Cattail Marsh;
- Open Water

BIOTIC INDICATORS

FISHERIES
- Carp Poor Response to Kill

WATERBIRDS
- National Trend

MUSKRAT
- Peak on Drawdown

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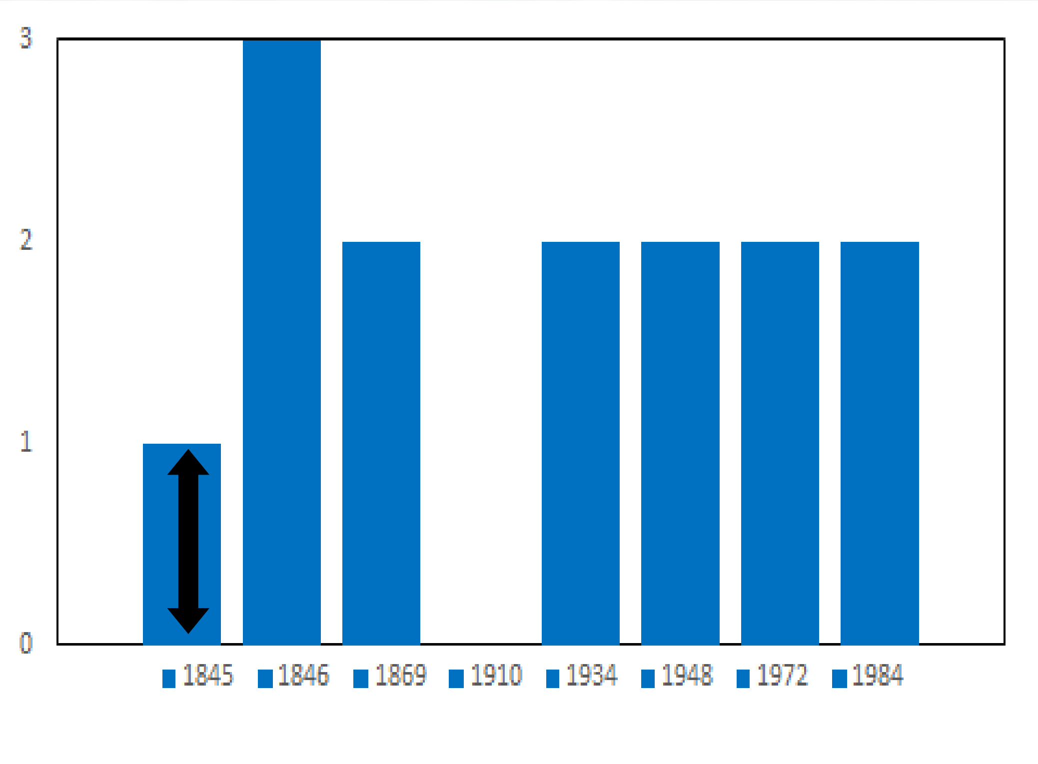
Quantifying the Model

Reference Period	Relative Water Level
1845	1
1846	3
1869	1
1910	0
1934	2
1948	2
1972	2
1984	2



Relative water level:

1. Unimpounded and variable
2. Deep impoundment – lake
3. Shallow impoundment - stable

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Conclusions

Realistic desired Future changes to infrastructure/management options

- Increase high water management by moving dam upstream – long ago study, but not well known.
- Can work in watershed with nutrient credit trading
- Ditch filling should increase sheetflow
- Kill cattails to increase sheetflow – minor influence
- Kill carp for positive effect on WQ and plants
- Remove main dike
- Change social pressure on water management (allow low water levels)
- More interior impoundments (least worst option)
- Superpump around dam
- By-pass diversion around marsh
- To restore seasonal hydrology- fill ditch, remove dams, cooperate with Sinnissippi, complete drawdown, restore flow path to increase retention time.
- Know more about water budget and nutrient budget, know more about water transit times
- What about groundwater?
- Install gates in main dike road at former meander
- Create channel to spillway in Federal area to increase
- Dredge for more open water
- Crushing and mowing cattails
- Explosives
- Make cattail "fresh" and water deep for muskrats
- Upland sediment traps, mainstem sediment trap, dredge out existing sediment traps

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Conclusions

- The model helps demonstrate that the marsh must function within heavy constraints. Unless radical changes occur on the landscape, the marsh must continue to contend with increased runoff, sediment and nutrient inputs, and other stressors.
- Conversely, the model also highlights the areas where managers have the most influence and areas where influence may be increased. This helps focus managers' efforts to areas where they have some influence and away from areas that are beyond their control.
- The conceptual model also points to connections where managers could increase their influence, and thus improve the system.
- The conceptual model can be used to communicate with both technical audiences and the public.

Conceptual Modeling Sedimentation Impacts and Opportunities at the Sangamon and Illinois Rivers Tributary Delta Complex

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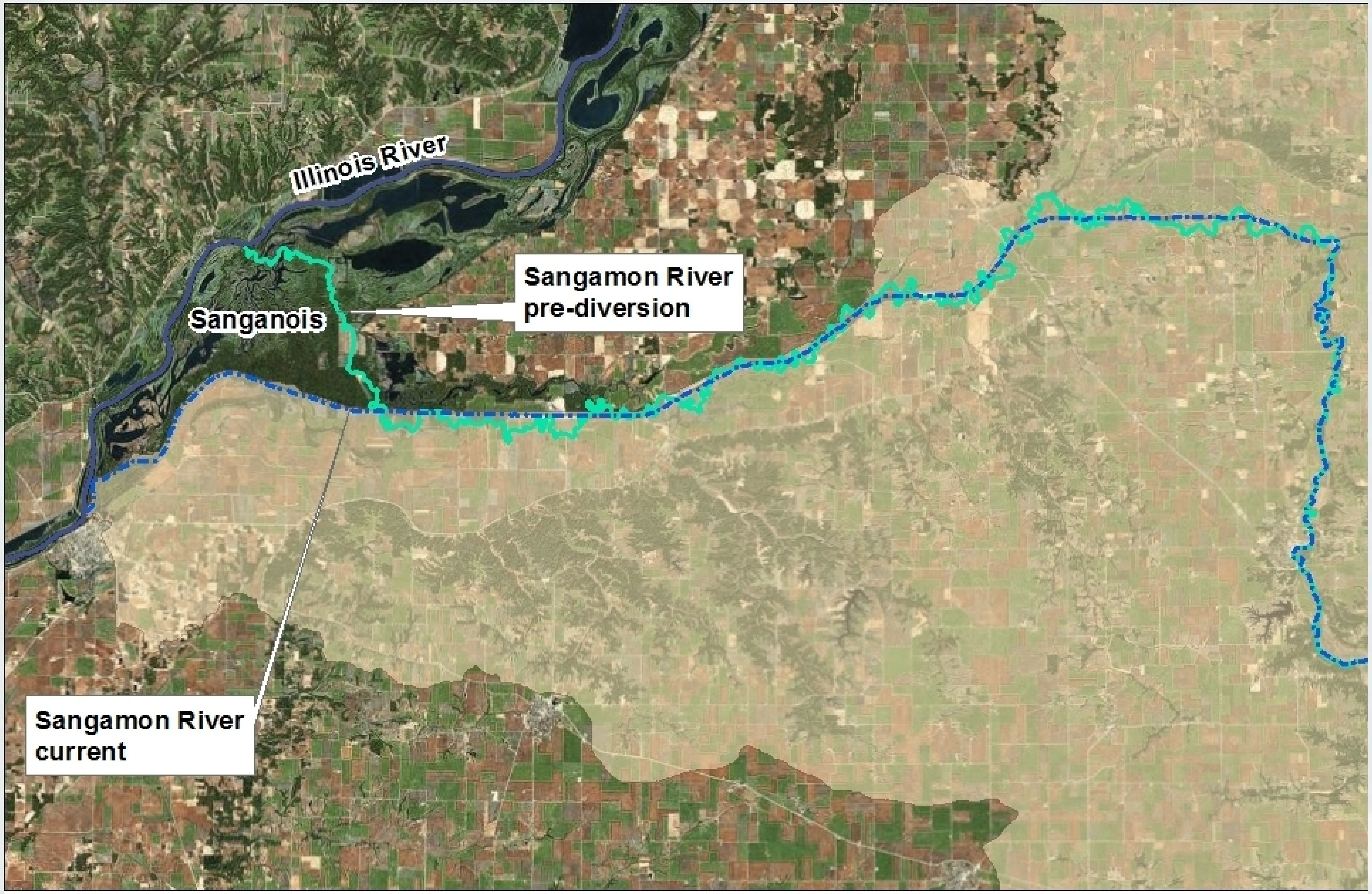
US Army Corps of Engineers
BUILDING STRONG®

Conceptual Modeling

Will use maps, photos, and data to identify and illustrate natural resource management and economic development **problems and opportunities** in the Sangamon River Tributary Delta Functional Process Zone.

Facilitator Note: Know where you are at on a project

Sangamon River Diversion (1949)



Historical Length = 63 miles
Historical Slope = 0.5'/mile

Current Length = 36 miles
Current Slope = 1'/mile

Goals of the Workshop

- ID Problems
- ID Opportunities including Unconventional Ideas
- Report of all ideas (after the meeting)
- ID what fits within RSM, other Corps programs, non-Corps programs
- Follow-up at Public Meeting

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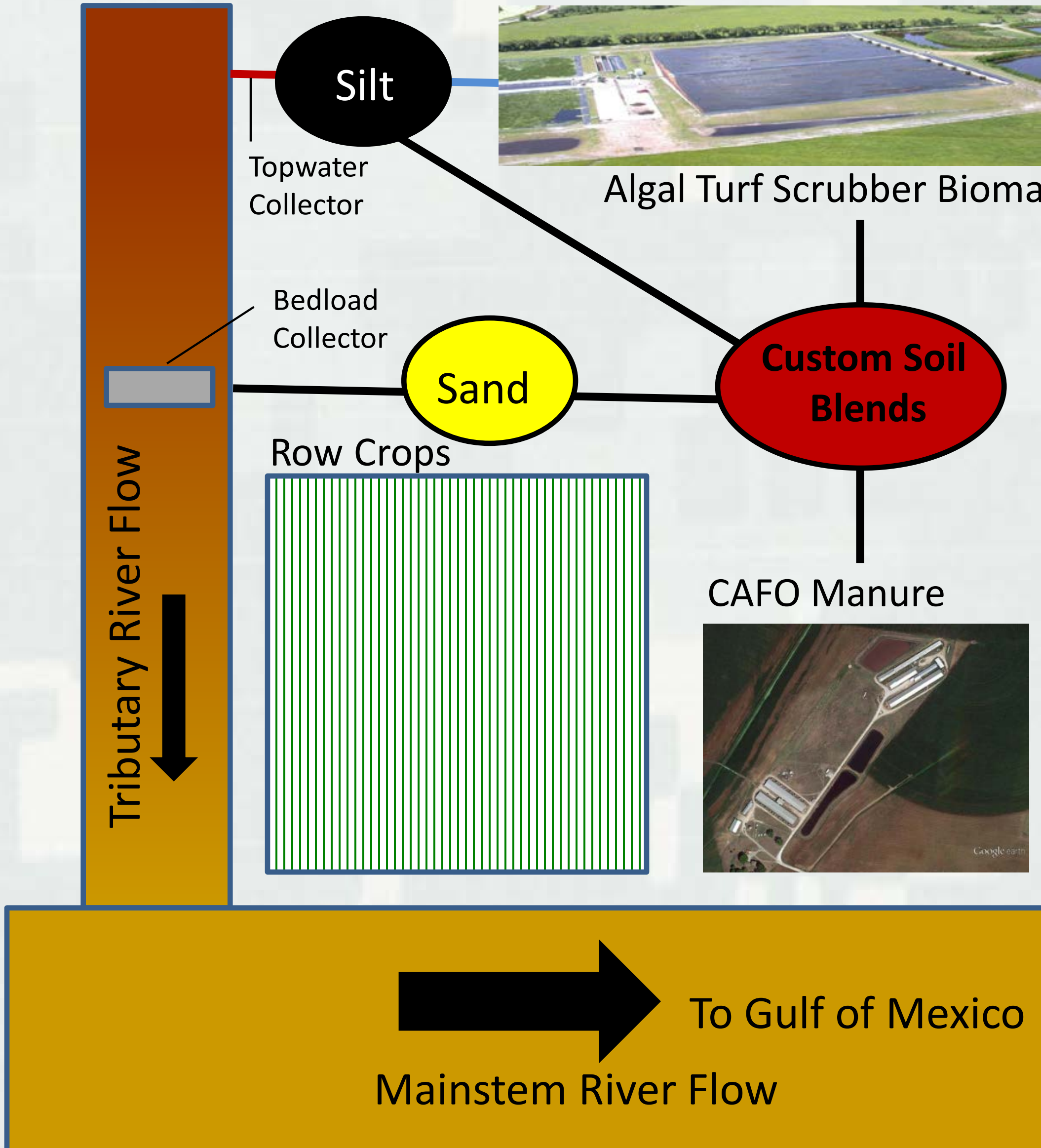
Dredging Practices are the Drivers of Opportunity

- Mechanical
- Hydraulic
- Unconventional (Bedload collector)
- Placement Alternatives

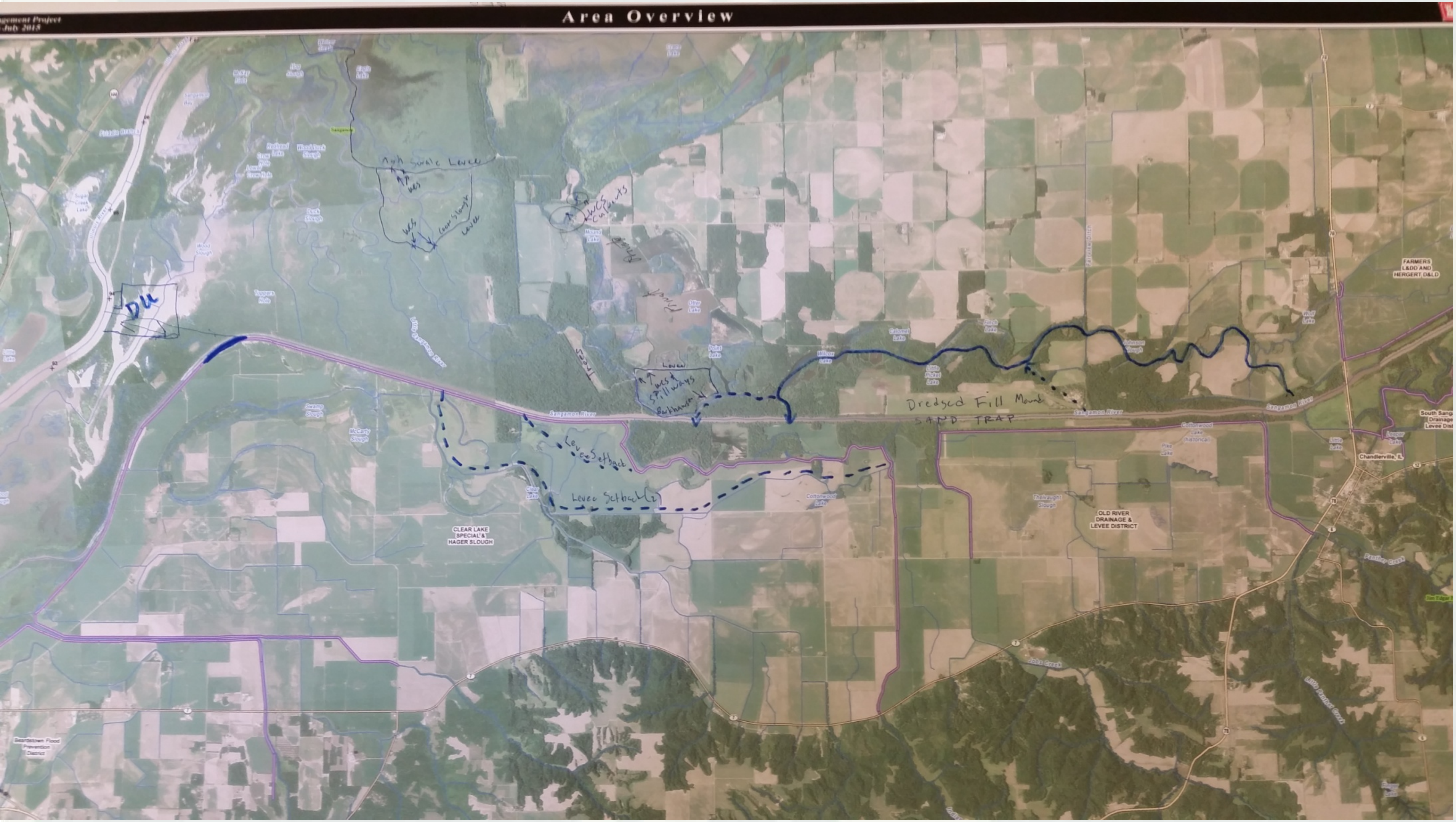
Unconventional Ideas and Integrated Thinking

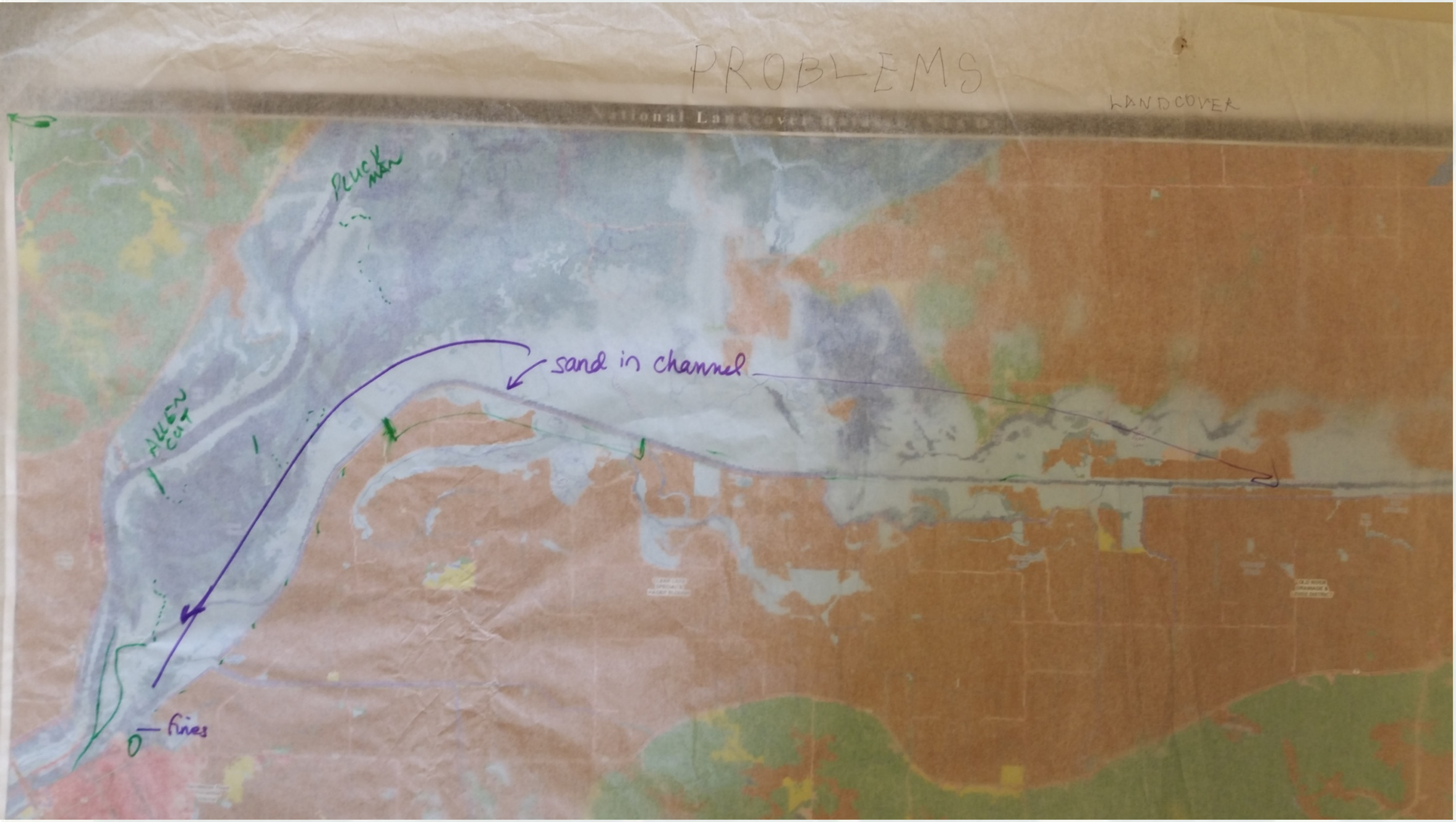
- **Ecosystem sustainability** – Habitat set-asides
- Water supply and regulation
- **Hazard mitigation** – staged floodway
- **Navigation maintenance**
- Recreation
- Cultural, spiritual, educational
- Aesthetics
- **Food Provisioning** – crops, hydroponics
- **Raw goods and materials provisioning –** crops, alternative crops/markets, hydroponics
- **Water purification and waste treatment** – Alternative approach/markets, phytoremediation
- **Climate regulation, carbon sequestration -** Alternative approach/markets, phytoremediation
- Human health support

Floodplain Soil Manufacturing and Water Treatment



Breakout Summary





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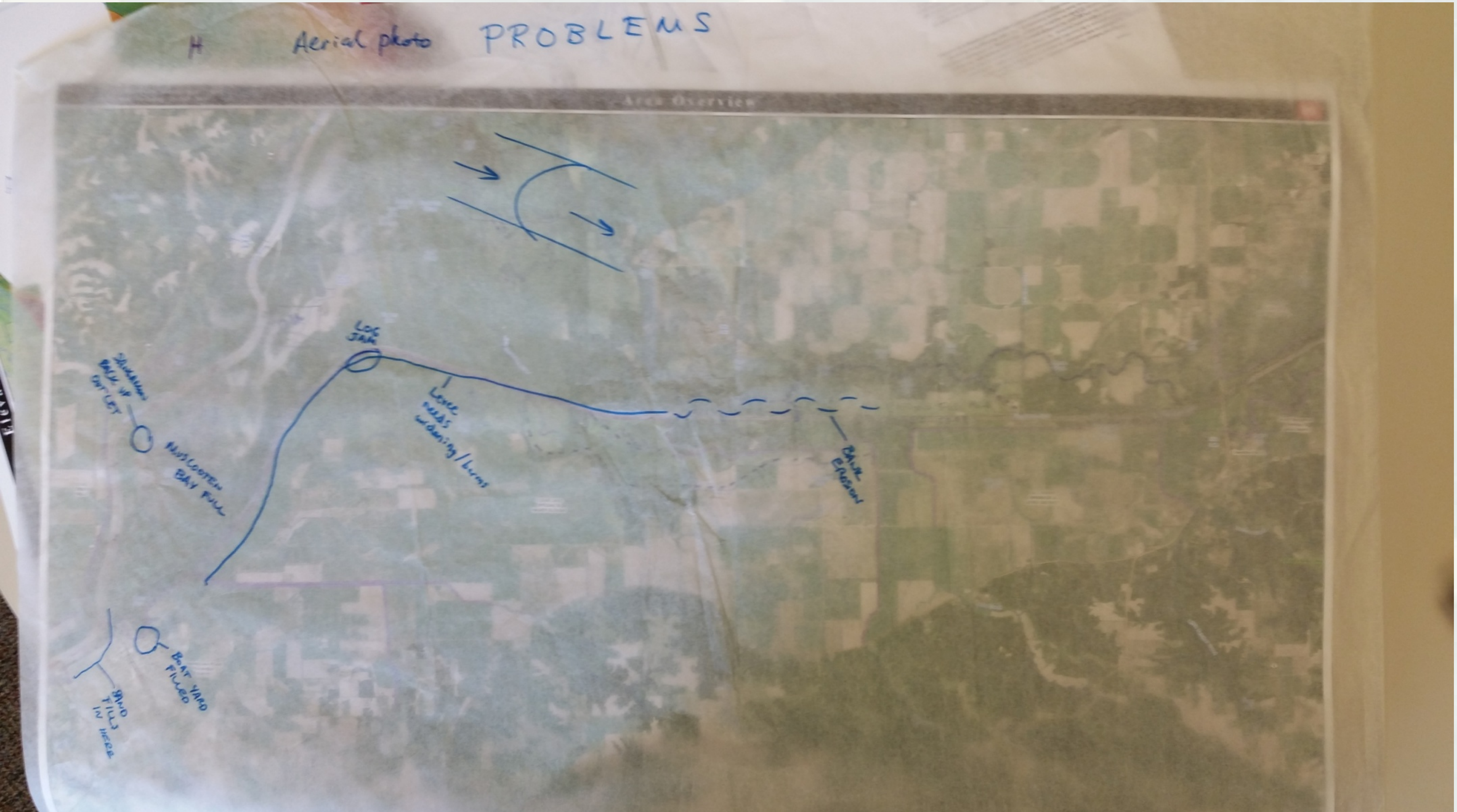

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Public Meeting Summary

The breakout groups compiled **58 problems** with only three items repeated in all groups:

- sand supply,
- log jams, and
- backwater filling.

There were two items identified by three groups:

- Sangamon River channelization and
- sedimentation into the Sanganois Conservation Area.

Comments documented in two groups included:

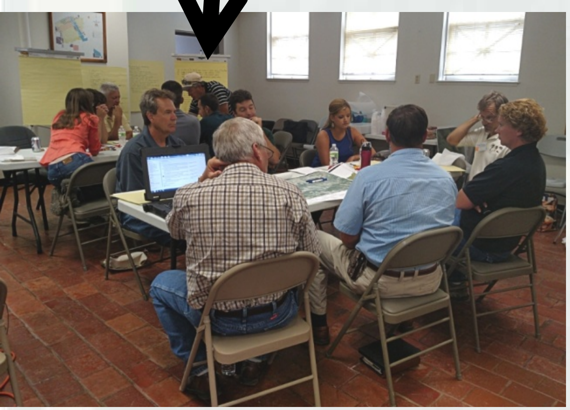
- a specific pinch point in the channelized reach,
- dead trees,
- slow flow/backwater effect,
- lack of funding,
- land ownership,
- regulatory issues,
- altered hydrology,
- breaks in natural levees, and
- working in watersheds.

Each breakout groups identified 3 common objectives, 2 groups shared 13 common objectives, and there were 47 individual opportunities not repeated in another group. The opportunities identified most often were:

- watershed tax
- remeander Sangamon
- enhance topographic diversity using dredged material
- strengthen levees with dredged material.
- The longer list of opportunities identified in two groups includes:
- tax levee districts for Sangamon River maintenance
- divert Sangamon to main channel
- sediment collector
- beneficial use on roads
- beneficial use
- watershed buffers
- watershed plan
- reservoir plan
- detention basins/WASCOBs
- build lakes/reservoirs
- stabilize grade/weirs
- stop head cuts
- pump/move silt uphill with thin later placement.

Ending Thoughts

"Best Corps meeting I've ever been to!"



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There is a problem, what can we do?
This problem is larger than this area
Let's work together
Thanks for sharing
Good communication and thinking outside the box
Breakout groups with different disciplines was good
Solution doesn't mean reversing past
Different ideas are good
Unconventional ideas were interesting
More in-depth information
Getting to know local folks
Glad there is a greater awareness
Glad to get the log jam on people's radar
Some people like and others don't like taxation
Good to get private perspective
Dredging can be proactive instead of reactive
Getting to know local concerns
Short term combined with long term
Corps can work together with other agencies
Complex issues with different interests
Problems didn't happen overnight, they won't be solved overnight
Need to understand longterm issues
Open

We're Here to Help!

Megan and Chuck love doing this and are available to help with your project planning needs. Listen to the EAB:

Environmental Advisory Board recommended that:

"The Corps should encourage the explicit use of conceptual models to guide ecosystem restoration planning and implementation. Conceptual models should be required as a first step in the planning process, as they provide a key link between early planning (e.g., an effective statement of problem, need, opportunity, and constraint) and later evaluation and implementation."

(EAB 2006)

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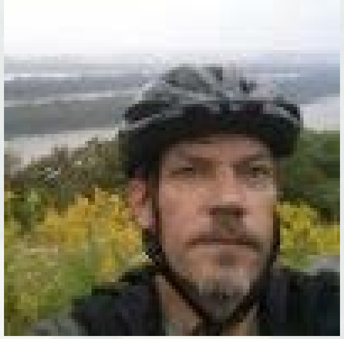

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