Evaluating Wetland Restorations for Power Plant Water Cooling

DE – NT0006644

"Wetland Water Cooling Partnership: The Use of Restored Wetlands to Enhance Thermoelectric Power Plant cooling and Mitigate the Demand of Surface Water Use"

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Phase 1. Evaluate Potential Value of Wetlands as a Cooling water Source for Power Producers

- **Develop empirical hydrologic, water quality and physical assessment tools to evaluate the potential for restored wetlands to be used for water cooling.**
  - Quantify potential benefits to water cooling, cooling efficiency, make-up water availability, operational costs.
  - Quantify potential benefits to reduce local potable water demands for cooling.
  - Evaluate regulatory links and conservation partnership values.
- **Use modeling to project the potential benefits of restoring "water cooling wetlands" for also reducing existing watershed and riverine impairments at watershed and subwatershed scales.**
  - Quantify potential restoration opportunities and outcomes for "scenario" projects.
  - Establish links between hydrologic parameters and measures of habitat, biodiversity, and ecological function
  - Develop monitoring plans that measure hydrologic and ecologic benefits of restoration projects – identify key parameters
- **Draft a set of evaluation tools and testable scenarios that can be applied to demonstration project(s) to measure the value of "water cooling wetlands" for the power production systems and to contribute to improved hydrology, water quality and ecosystem conditions and functions in the watersheds.**

Phase 2. Design, Implement Demonstration Project(s) to test Wetlands Water Cooling for Power Producers

- **Test and Affirm the empirical hydrologic, water quality and physical assessment tools to evaluate the potential for restored wetlands to be used for water cooling.**
  - Measure water cooling, cooling efficiency, make-up water availability, operational costs.
  - Measure reductions to local potable water demands for cooling.
  - Document real regulatory project links and permitting needs.
  - Establish conservation-power producer "conservation partnership" around wetland restoration investments for cooling waters.
- **Test and Affirm the potential benefits of restoring "water cooling wetlands" for also reducing existing watershed and riverine impairments at watershed and subwatershed scales.**
  - Establish Quantify potential restoration opportunities and outcomes for "scenario" projects.
  - Establish links between hydrologic parameters and measures of habitat, biodiversity, and ecological function
  - Develop monitoring plans that measure hydrologic and ecologic benefits of restoration projects – identify key parameters
- **Refine the evaluation tools and testable scenarios that can be applied to demonstration project(s) to measure the value of "water cooling wetlands" for the power production systems and to contribute to improved hydrology, water quality and ecosystem conditions and functions in the watersheds.**

Why Consider Restoring Wetlands For Water Cooling

Benefits:

- Habitat
- Water Quality
- Flood Damage Reduction
- GHG management
- Make up water capacity
- Biofuels for co-firing
- Evaluate Economics
- Avoid unit derating

Wide Applicability:

Many types of wetlands:

- Perennial - Seasonal
- Riverine- Depressional- Seeps

Many water sources

- Freshwater-Brackish-Estuarine
- Sewage water re-use
- Mine/quarry sourced

Why Consider Restoring Wetlands For Water Cooling

- Use the same water for multiple outcomes
- Link power generation Investments with Conservation Investments on the land.
- Reduce PR, Financial and regulatory impediments to new power projects and existing operations.

% Reduction in Wetlands Correlates with Impairment to US Waterways

- Imperviousness
- Dam Storage
- Canals/Ditches
- Minor Road Intersect
- Major Road Intersect
- Potential Restorable Wetlands
- 8-digit HUC watersheds

Role of Wetlands on the Landscape

Historic Functions:

- Flood water retention and management
- Ground water infiltration
- Micro-site climate cooling
- Habitat values and benefits
- Modulation seasonal in-stream flows.
- Soil carbon sequestration and biomass production

NOW

- Nationally→80 % reduction in wetland acres due to agriculture and land development
- Reduced flooding and improved in-stream flows and water quality in watersheds with > wetland acreages.
- Higher biodiversity in watersheds often with highest % wetlands remaining.

Increased Flood Risk

Impaired Ecology and Water Quality

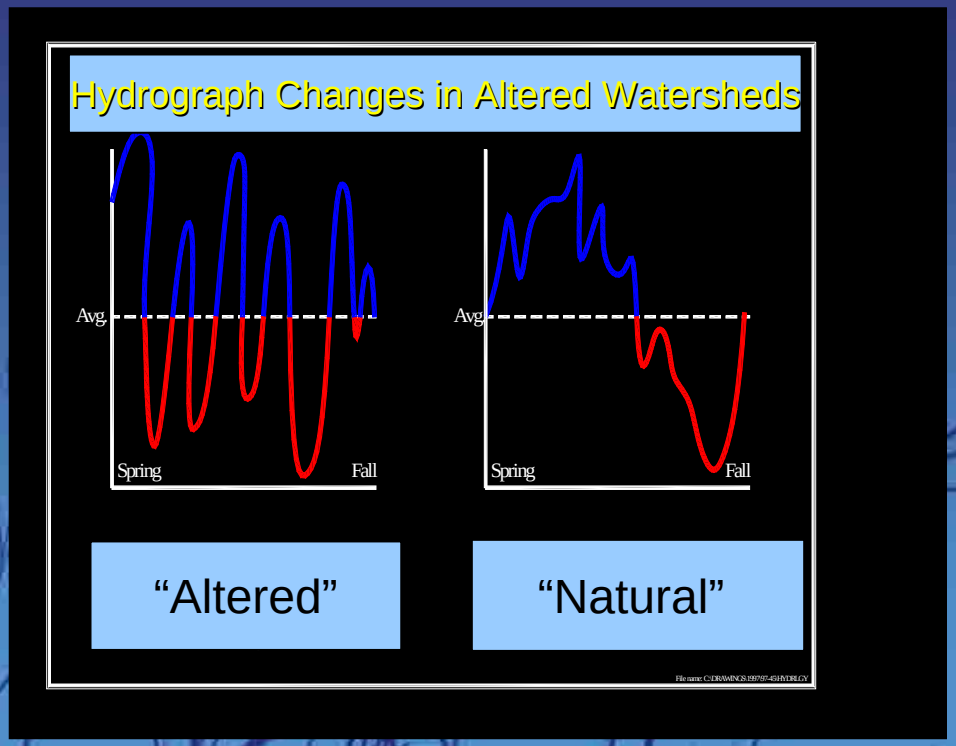
Degradation of Remaining Wetlands

Ecotoxicological Impacts in the Ecosystem

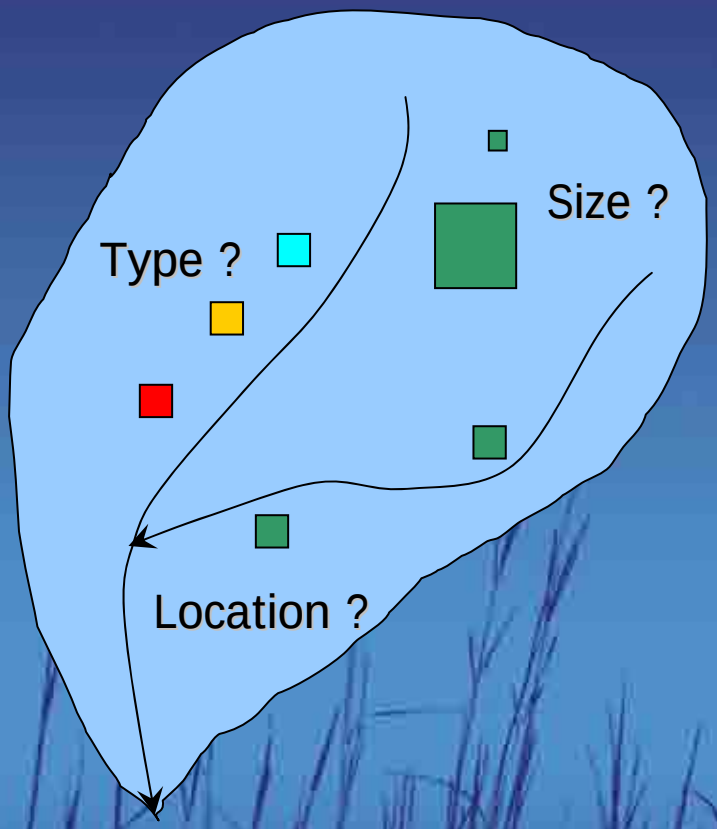
Restoring historic wetlands for water cooling

Restore:

- Altered in-stream/lake/estuarine hydrology regimes
  - Frequency
  - Magnitude
  - Timing
  - Duration
  - Rate of Change
  - Base-flows
  - Thermal regimes
  - Water quality
- Ecological Conditions, habitats



Wetlands for Water Cooling



- How much water is retained and stored by restored wetlands?
- What are important factors that control wetland water cooling?
- Assess different water cooling scenarios based on:
  - Wetland type
  - Wetland size
  - Location
  - Thermal relations
  - Seasonality
  - Wetland design
  - Regulatory drivers
  - Conservation partner drivers

STELLA

Model Tool for Assessing Wetland Function and Performance

Analysis Tasks

Evaluate:

- Water Availability from Sources
- Water Availability vs. Water Usage and Heat Transfer for a Sustained Time Period
- Wetland water quality treatment functions.

Model Requirements

- easy to use and change
- accurate
- able to apply input data
- able to output results in usable format

STELLA Assets

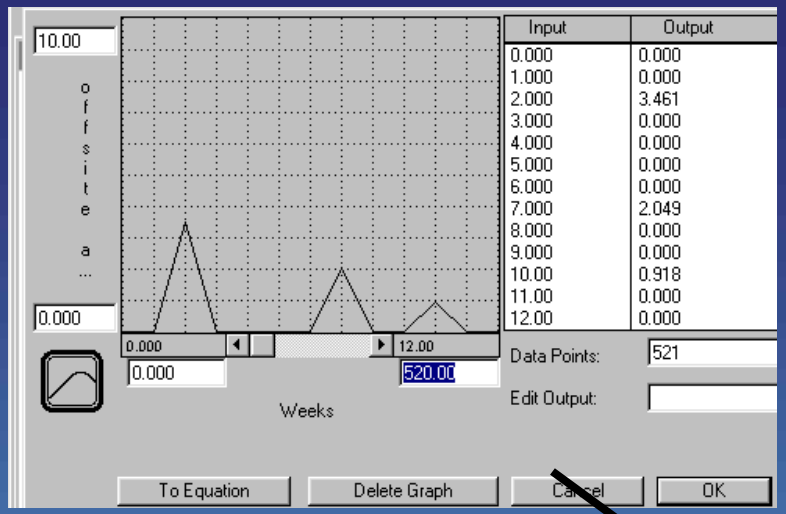
- model platform accepts data for continuous time periods and simulates user specified processes with user specified inputs

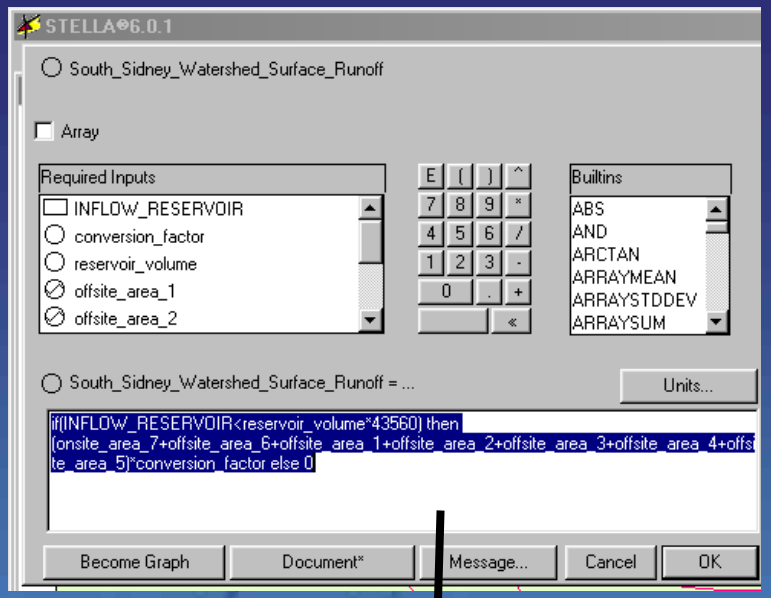
- includes run-time version so model users can perform additional analysis and change the input parameters

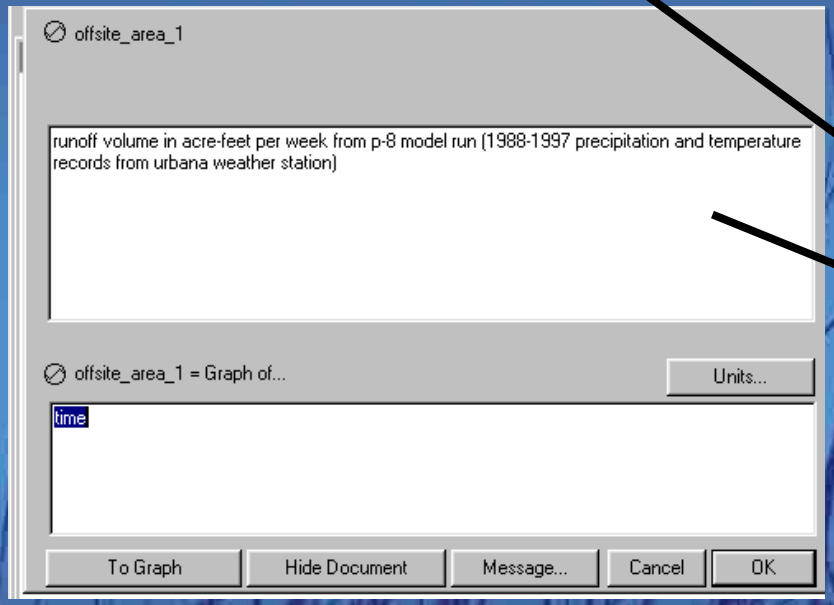
STELLA

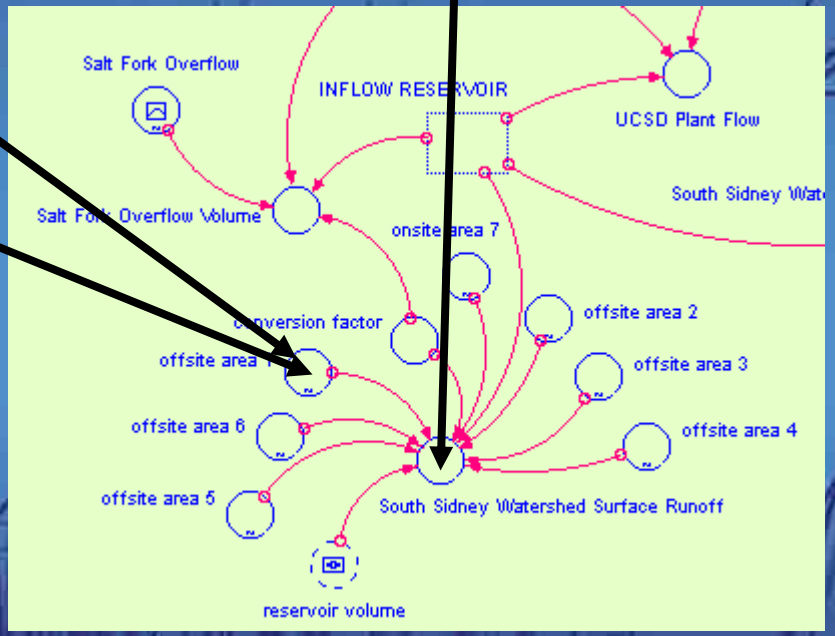
Application Examples

Defining Source Water Inflows





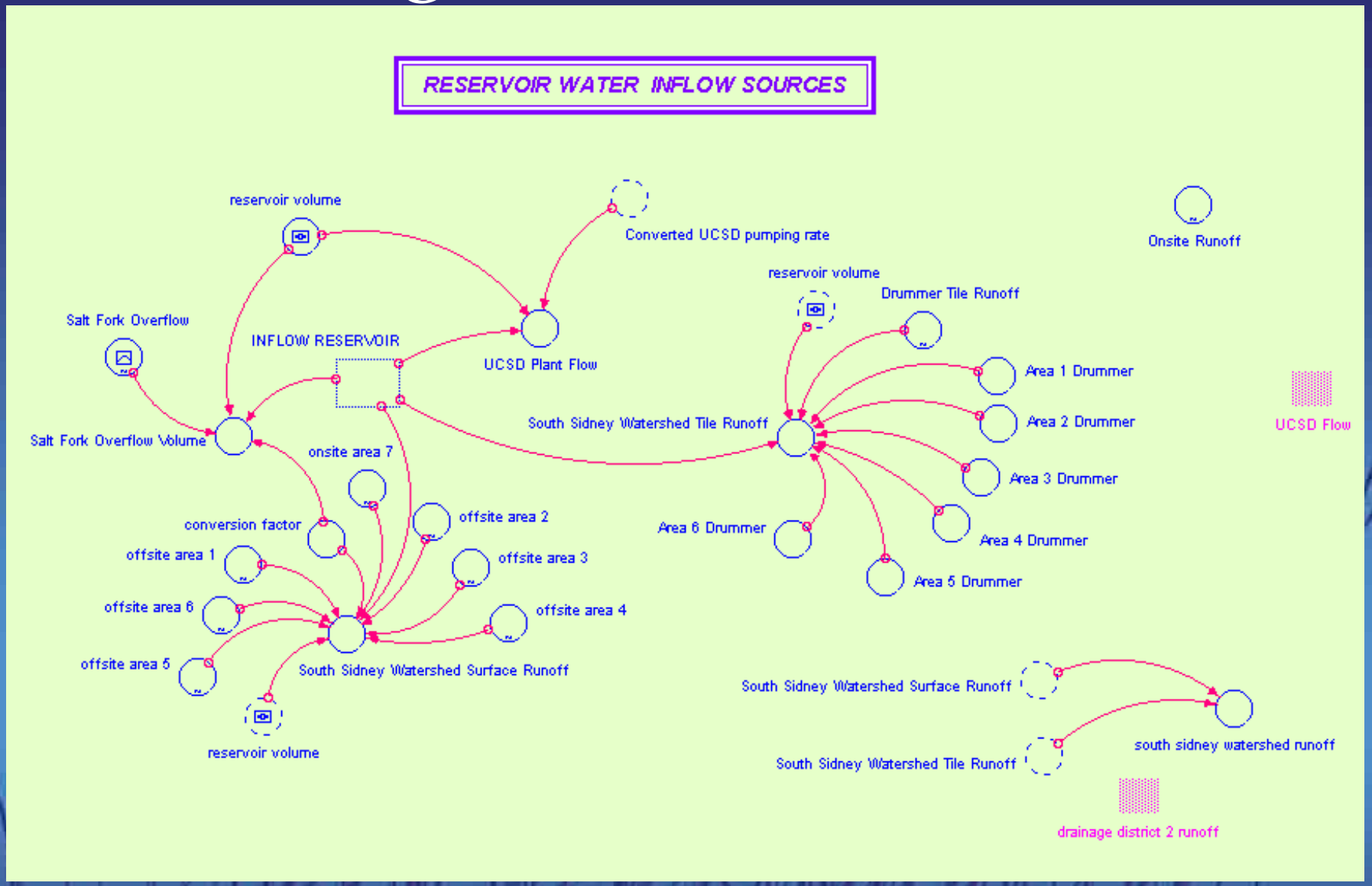




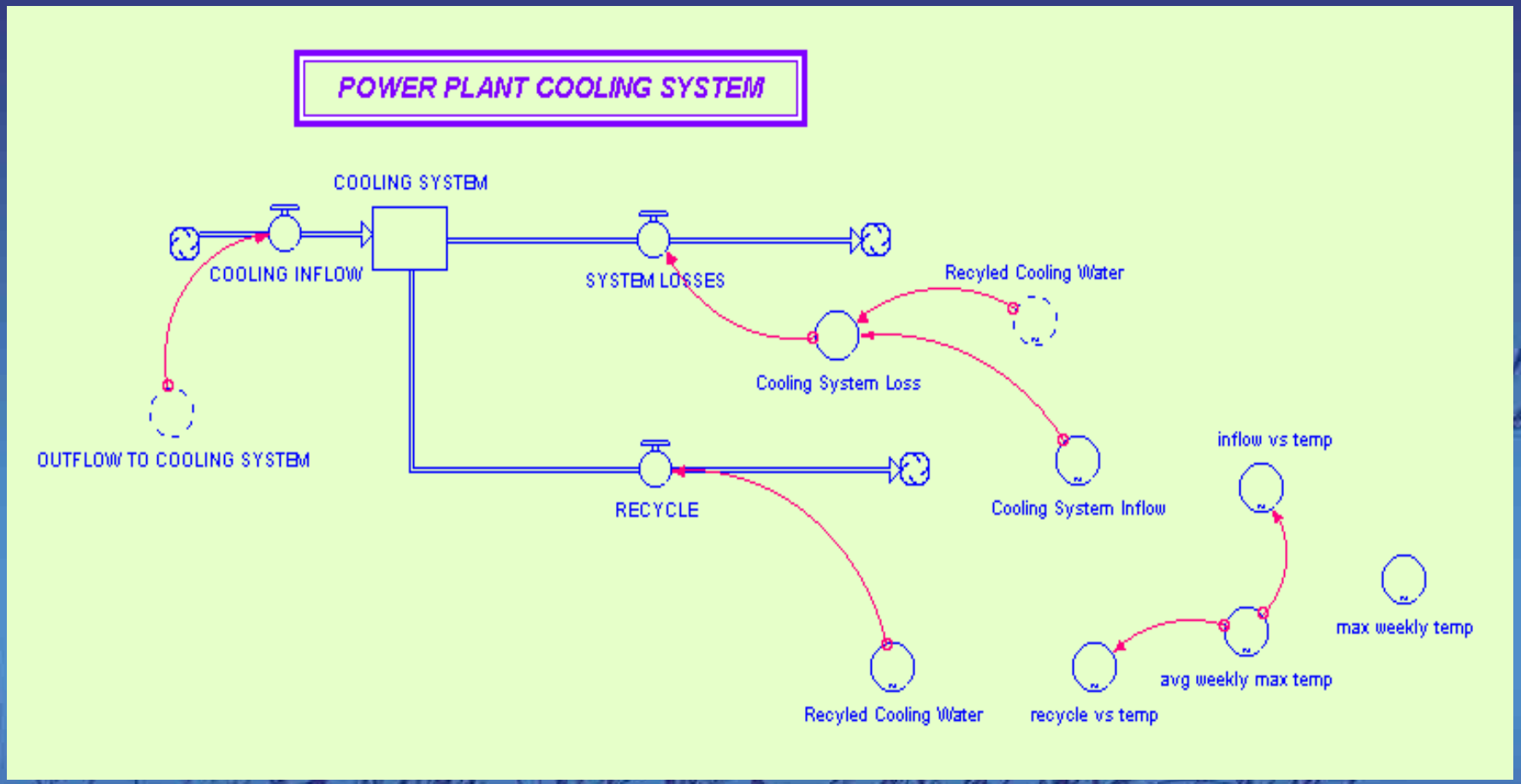
Anticipated Water Sources

- Surface Waters
  - tiled discharge
  - overland runoff
- Sanitary Treatment Plant Discharges
  - piped from treatment plant
  - taken from receiving water body
- Stream Flood Overflows
- Recycled Plant Cooling Water

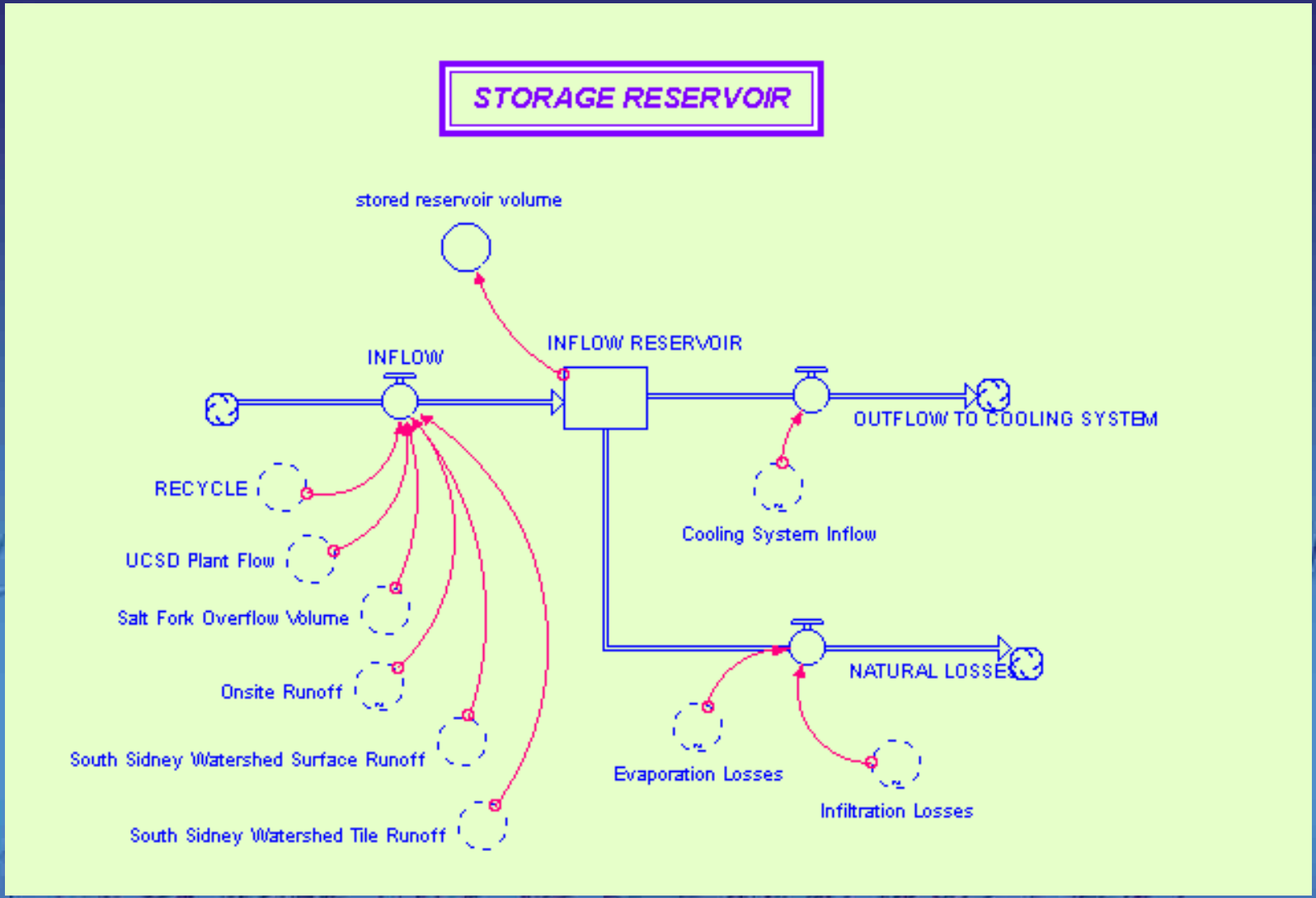
Combining Wetland Water Sources



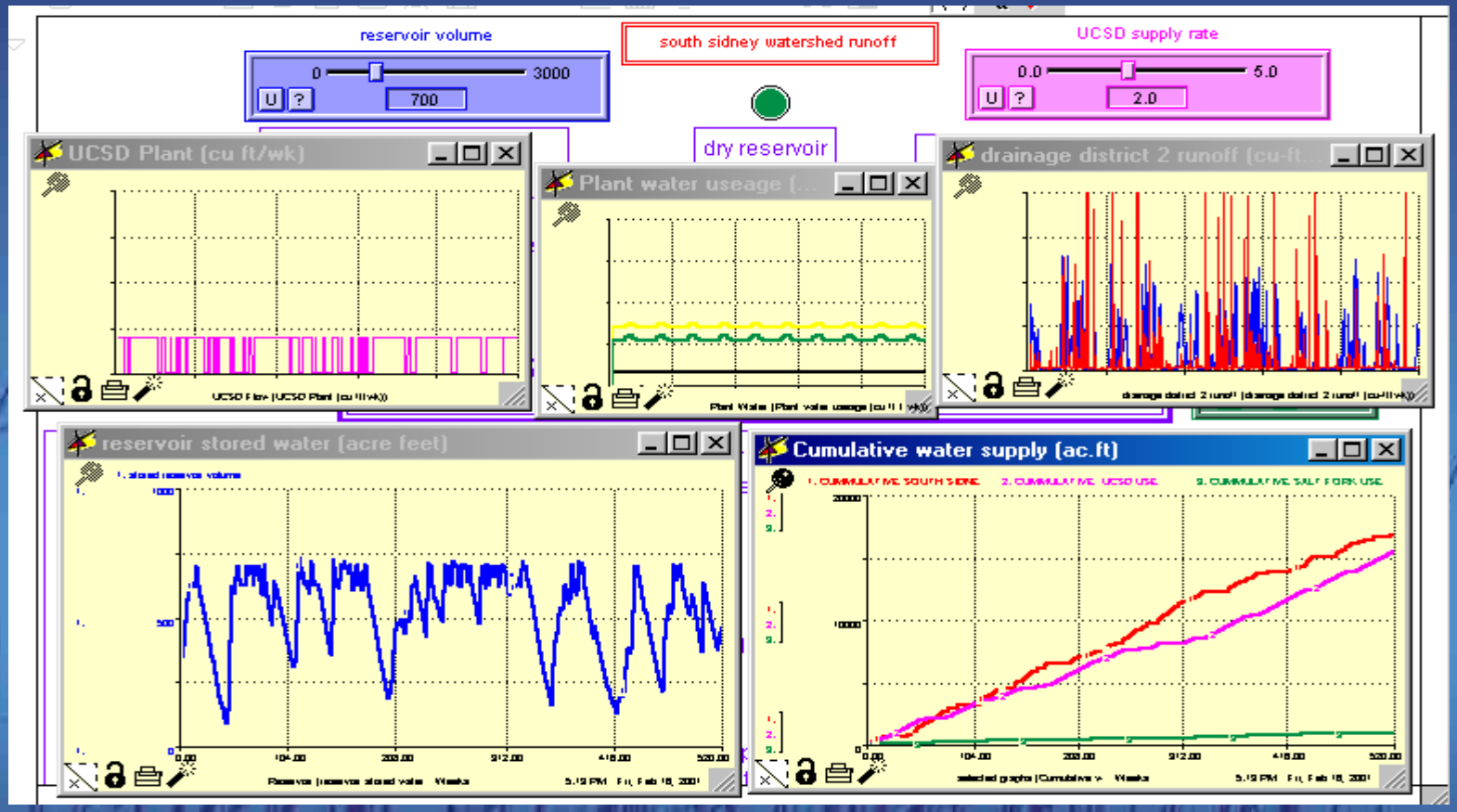
Quantifying Power Plant Water Usage



Defining Wetland Variables



Balancing Wetland Requirements to Water Supply and Usage



Example Wetland Restoration Projects

Otter Creek Wetland Park

St. Charles, Illinois

56-acre restoration

Otter Creek Wetland Bank – First Private U.S. Wetland Bank – Goals:

1. Restore 56 acres of tile and ditch drained historic wetlands, and degraded agricultural lands.

2. Restore these lands to native grasslands, various wetlands, riparian forest.

3. Generate and sell 47 acres of wetland mitigation credit.

4. Generate wetland credit revenue to finance restoration, expansion and protection of a greenway for St Charles, Illinois and investments in a community park now serving 85,000 school children every year as an outdoor laboratory.

5. Use wetland credit revenue to do other wetland banks. We have over 33 banks that were successfully started or are underway currently using the model from Otter Creek.

6. Establish Otter Creek Bank as a National model for establishing US banking policy.

Otter Creek Wetland Park

St. Charles, Illinois

56-acre restoration

Economics

Costs

Land ……....$60,000

Design/Engineering …….... $50,000

Construction, Management …….$790,000

Credit Sales

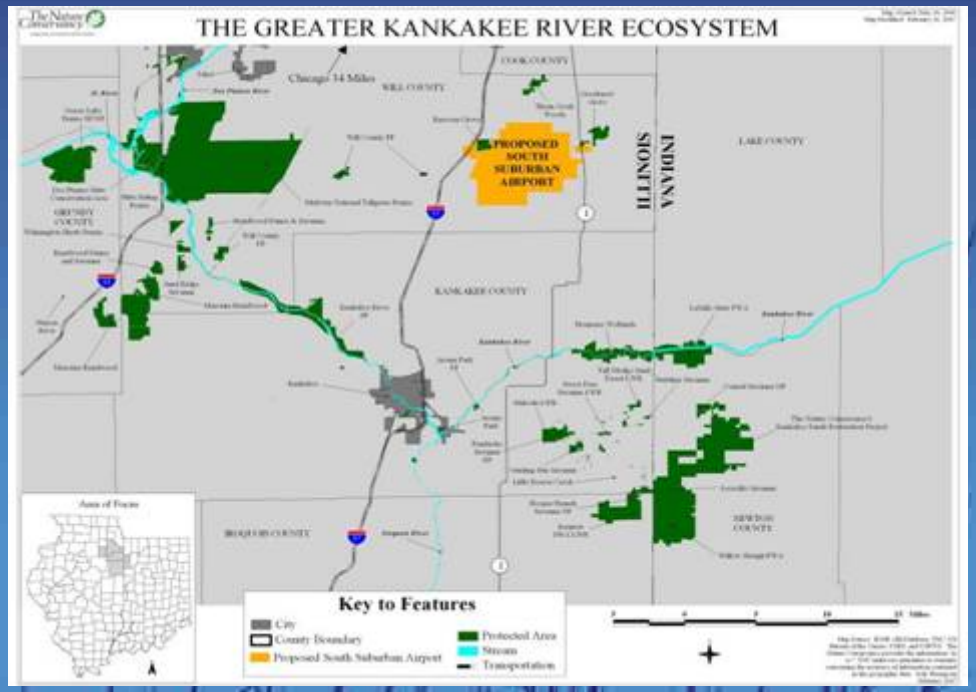
47 credits at $45,000 per acre ……..$2.1 Million

Net Economics …….. $1.2 Million in 6 years

Kankakee Sands

Enos, Indiana

7,300 acre restoration



Kankakee Sands Goals

Enos, Indiana

7,300 acre restoration

1. Restore 7300 acres of agricultural land to 5200 acre of wetland, 2000 acres of prairie and 100 acres of savanna.

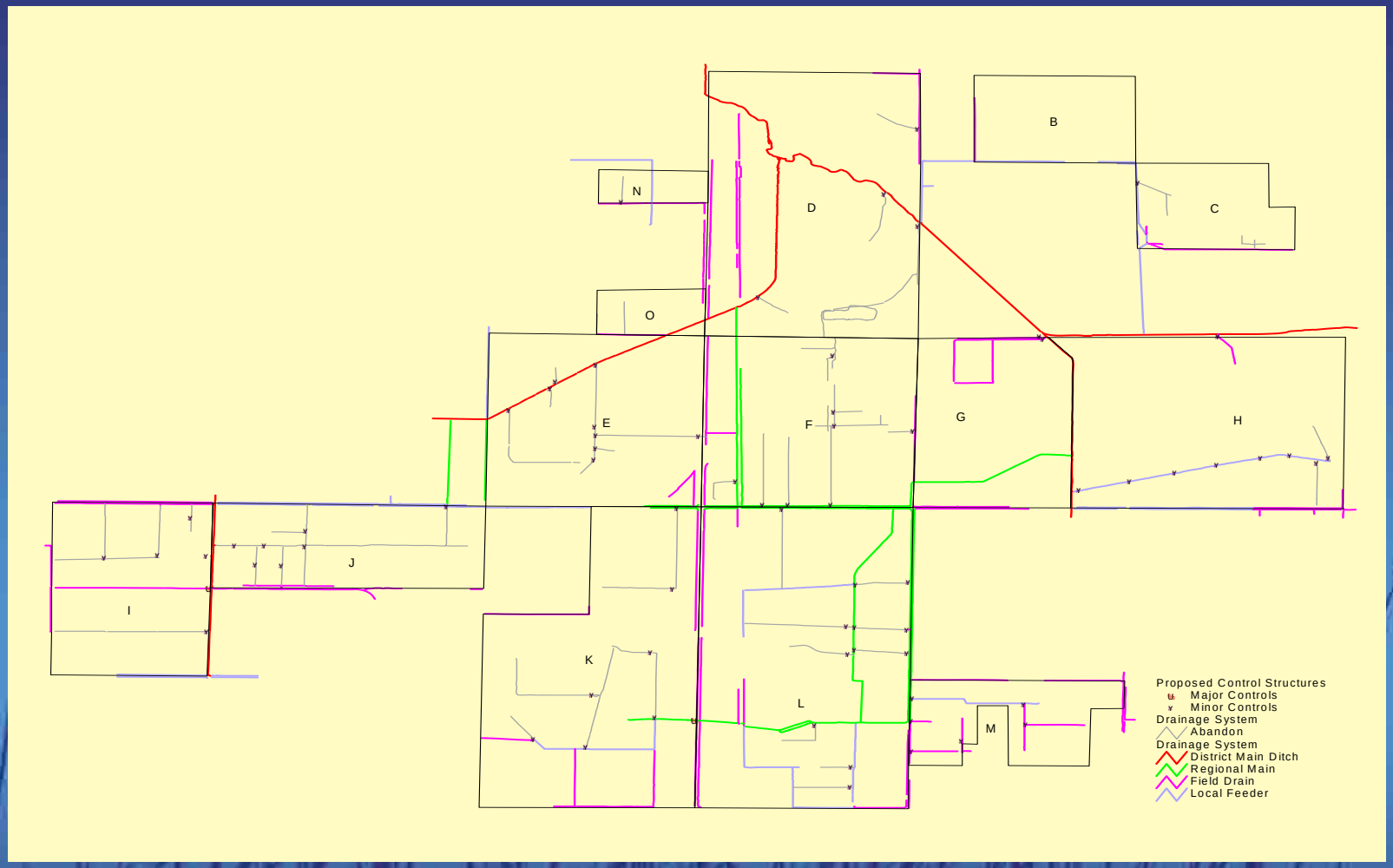
2. Restore soil carbon from current depleted levels to an equilibrium over a period of 30 years to achieve 5 million tons of total C02 accrual.

4 Generate revenue to finance restoration, expansion-protection and restoration of other conservation lands and outreach, education and community investments.

5. Demonstrate multiple revenue sources from marketing environmental services.

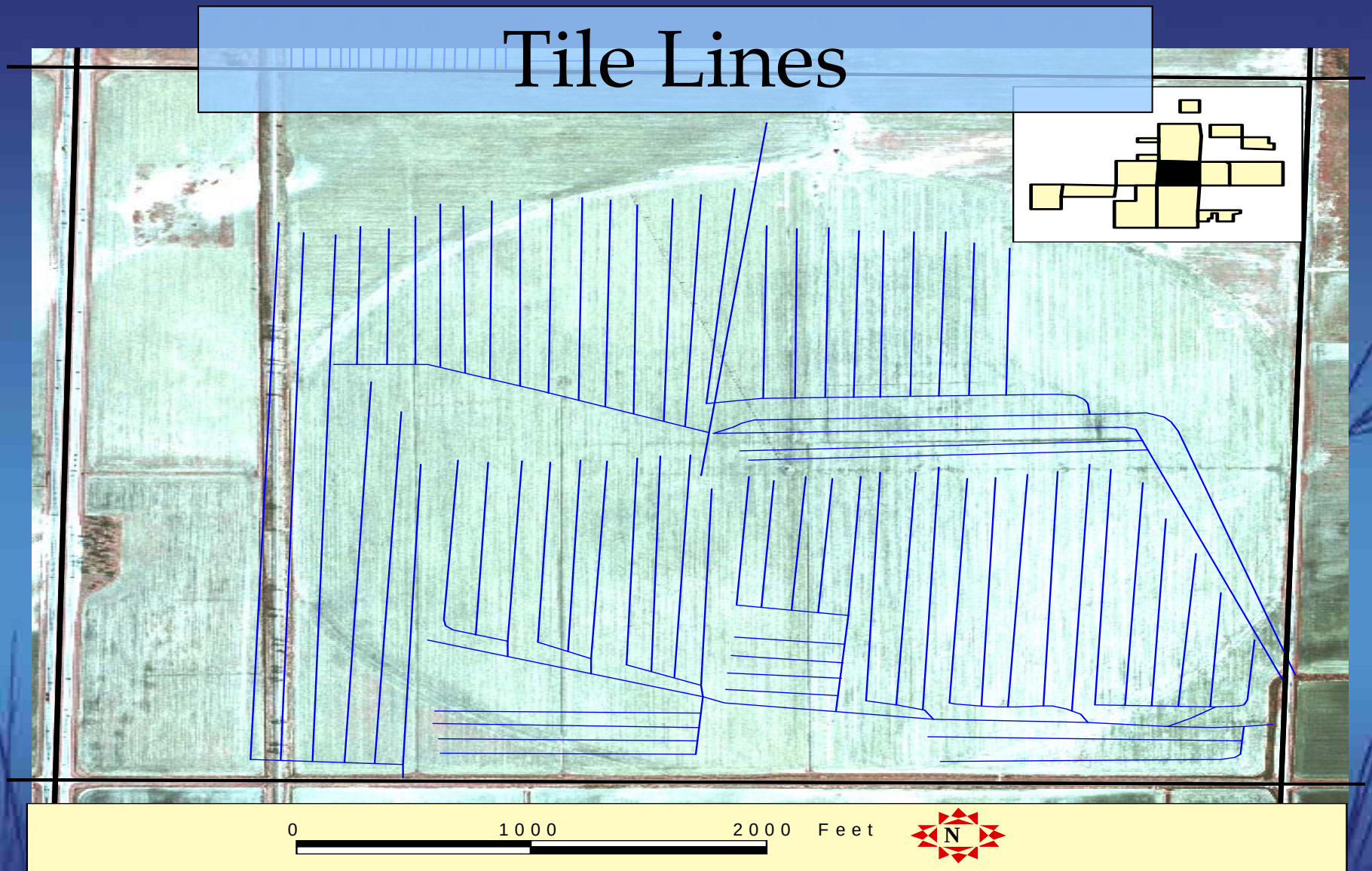
Kankakee Sands

Ditch Hierarchy and Restoration



Fair Oaks Farm

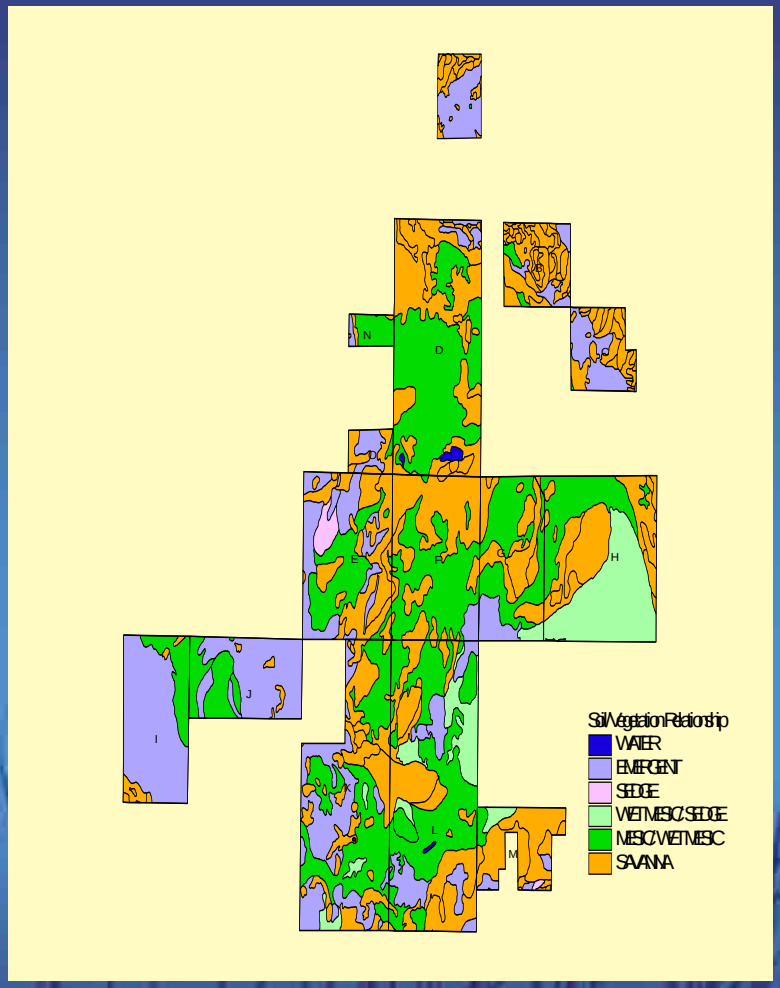
1997 Digital Aerial Photography & Drain Tiles



Kankakee Sands

Enos, Indiana

7,300-acre restoration



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