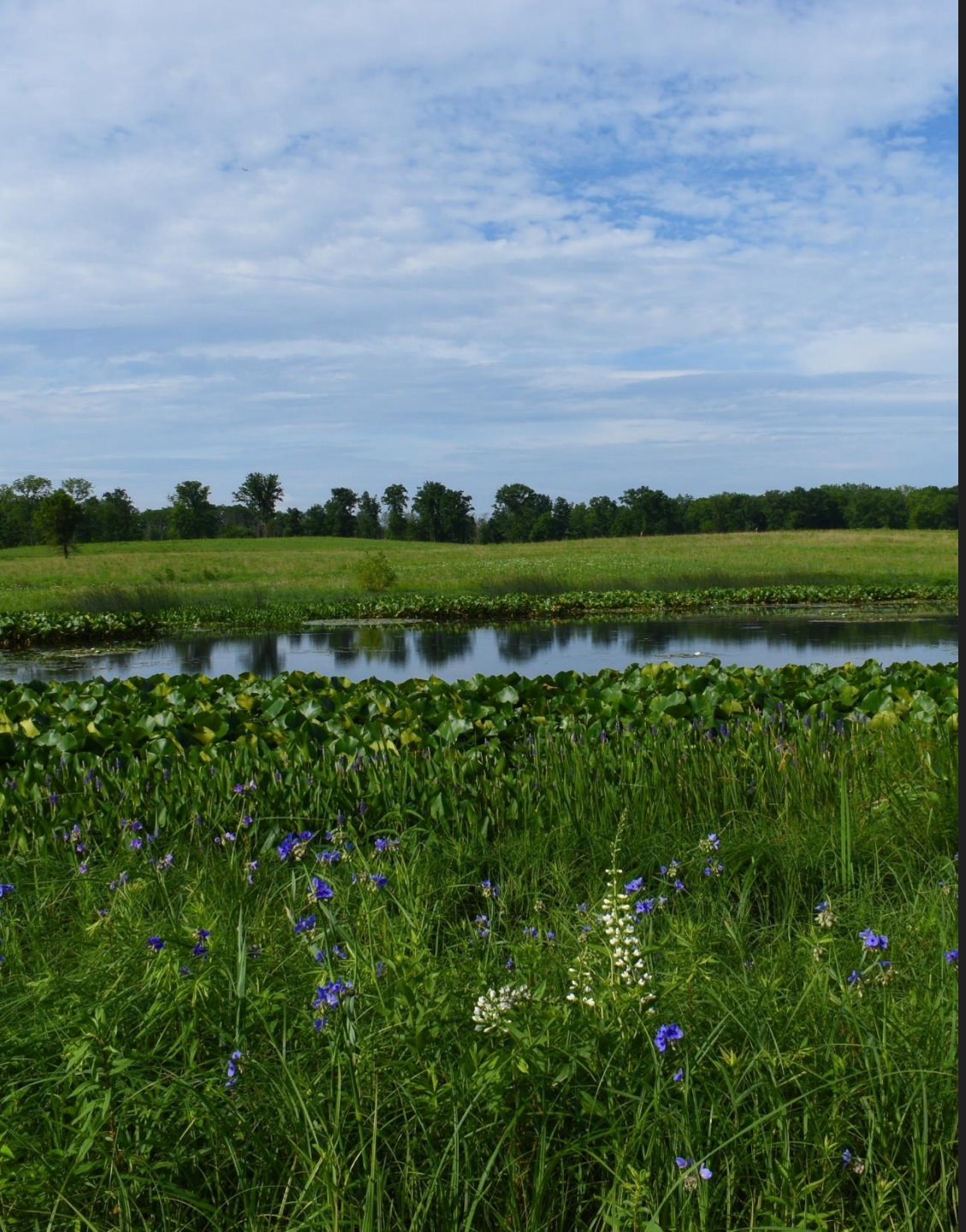
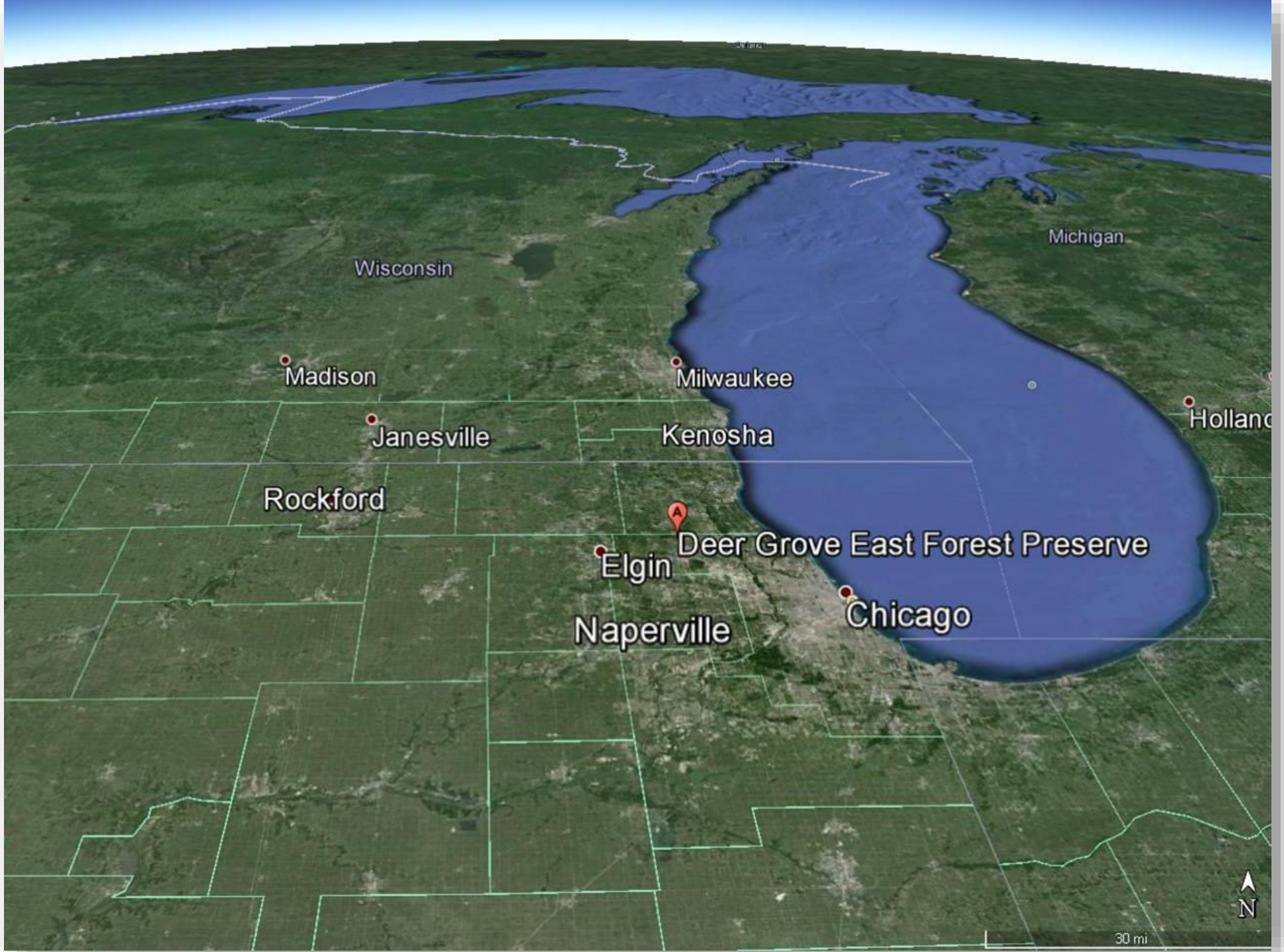


IAFSM 2024 Conference

Stormwater and Economic Benefits Case Studies for a Wetland and Natural Area Restoration in an Urban Landscape

Aaron Feggestad PWS, MS
Senior Ecologist

Stantec


Wisconsin
Michigan
Madison
Milwaukee
Janesville
Kenosha
Rockford
Deer Grove East Forest Preserve
Elgin
Chicago
Naperville
N
30 mi

Project Background

Project purpose

- O'Hare Modernization Mitigation Account (OMMA)
  - Mitigation agreement (*in lieu* fee) between **Openlands, Chicago Department of Aviation, and USACE**

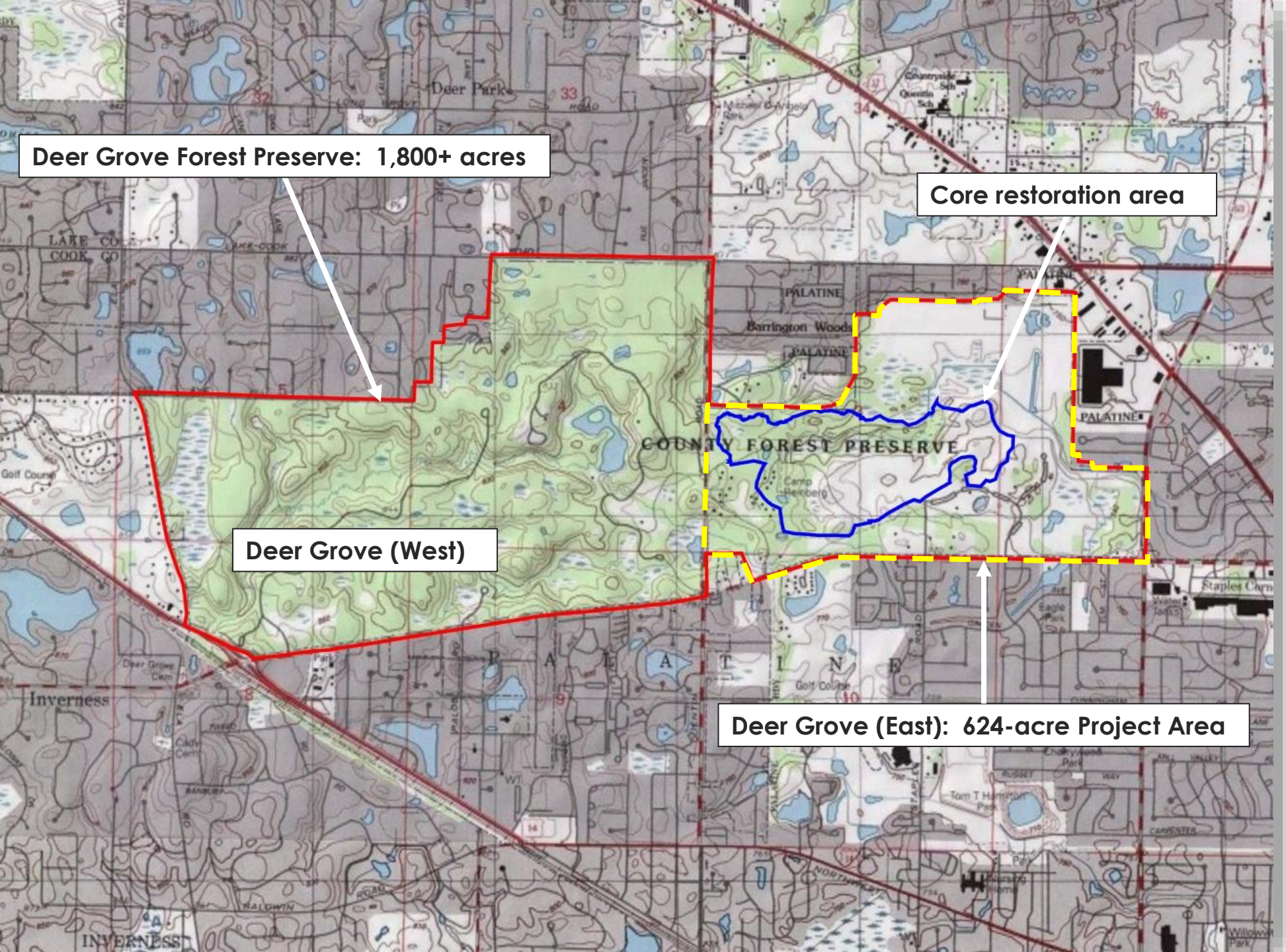
- A long-term project
  - Planning and permitting (2008-2009)
  - Construction (2009-2010)
  - Management and monitoring (2011-2015)
  - Long-term management plan and project expansion (2016-present)

openlands
conserving nature for life

US Army Corps of Engineers®

Project goals

- Mitigation credits
- Watershed approach
- Ecological integrity
- Community involvement
- Ecosystem services benefits

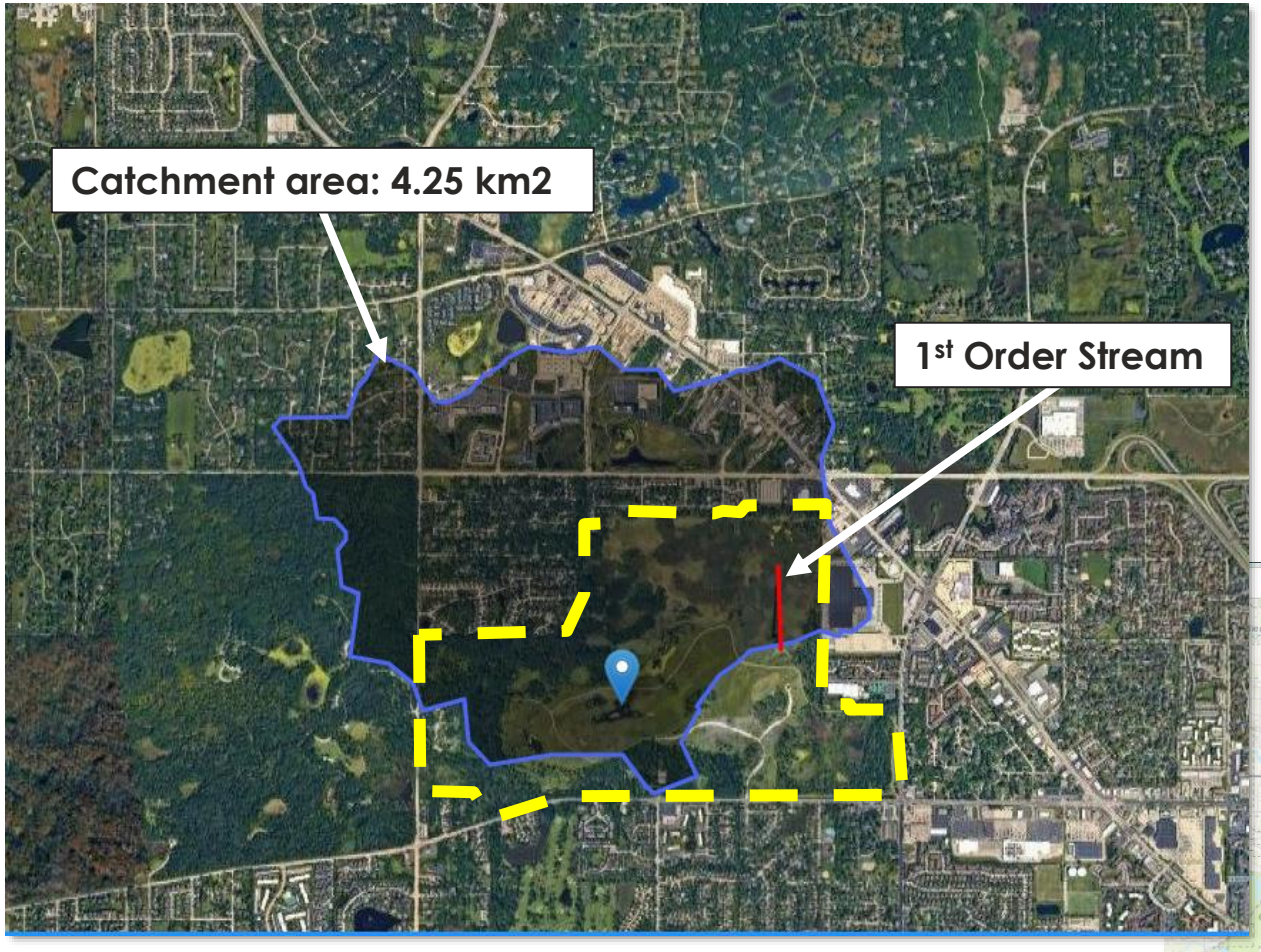


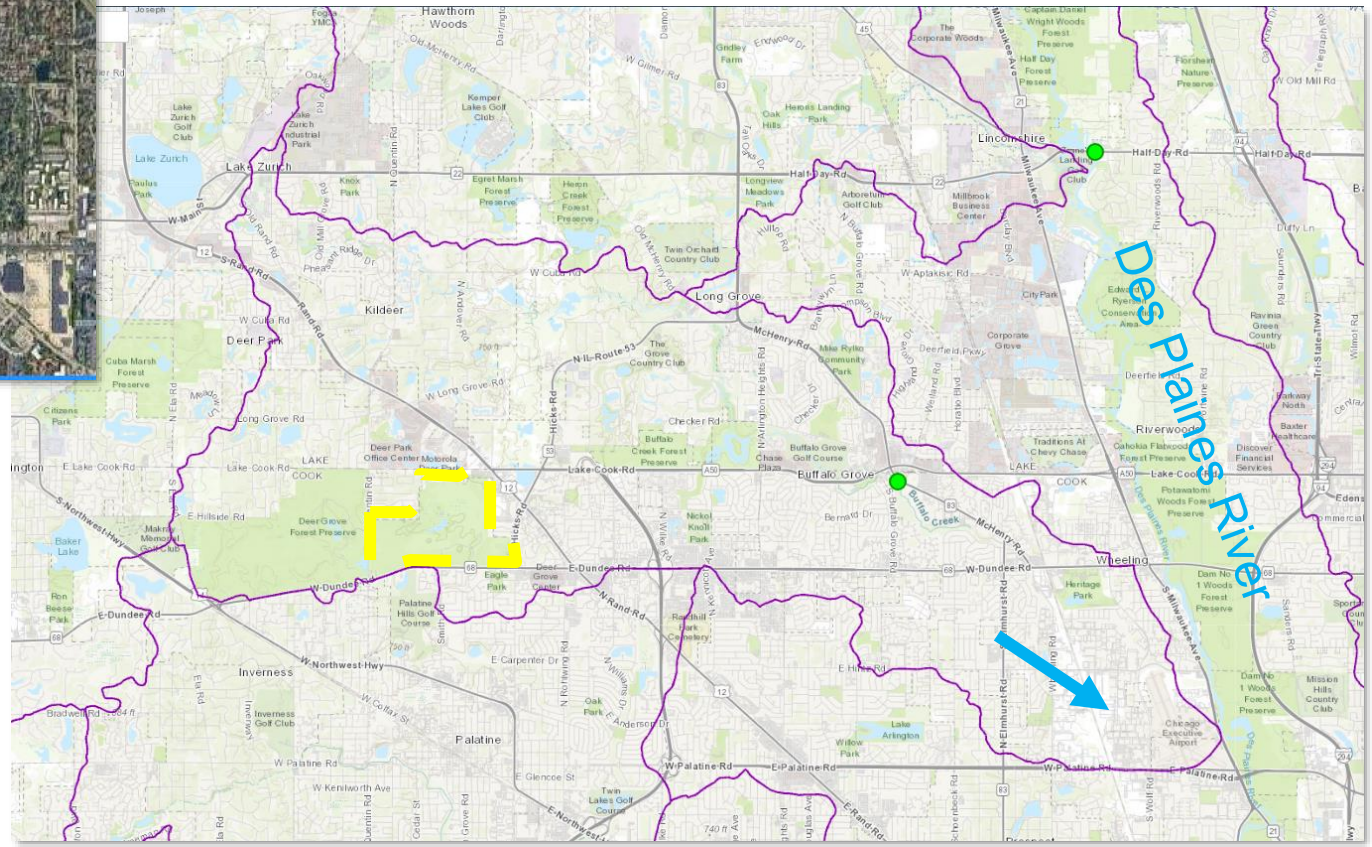
An oasis for nature

1916: Deer Grove (West) becomes the first forest preserve in the U.S.

1939: Deer Grove (East) addition to the Forest Preserves of Cook County system

Heavily urbanized watershed





Sources:
US EPA StreamCat Web Tool
USGS National Water Dashboard

Project Background

Original land cover of the area

Wetland

10% of the original wetlands remain in IL

Oak savanna/woodland

Most are now gone (critically imperiled globally)

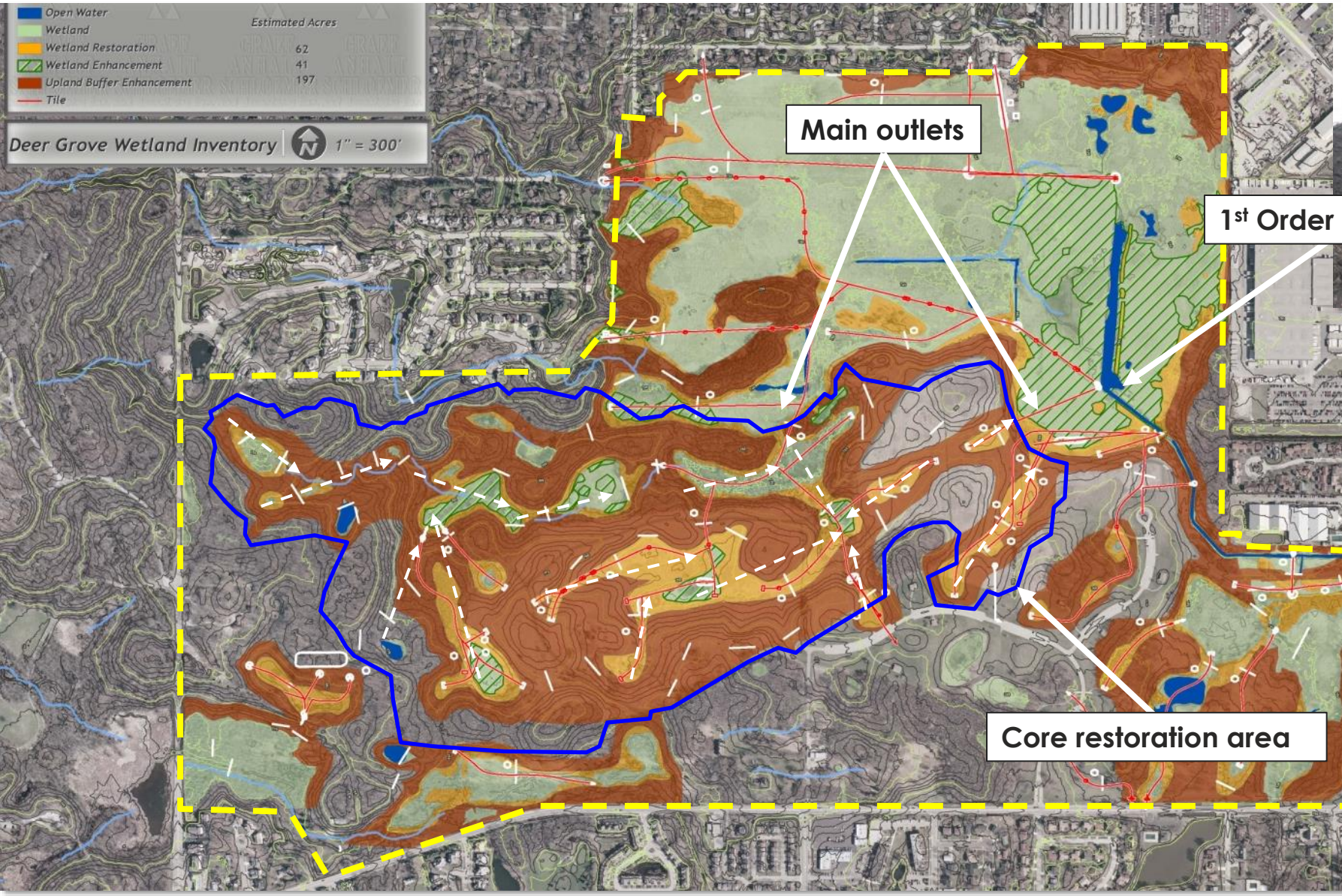
Prairie

0.01% of original (21 million acres) prairies remain in IL

Historic (1938) aerial photograph

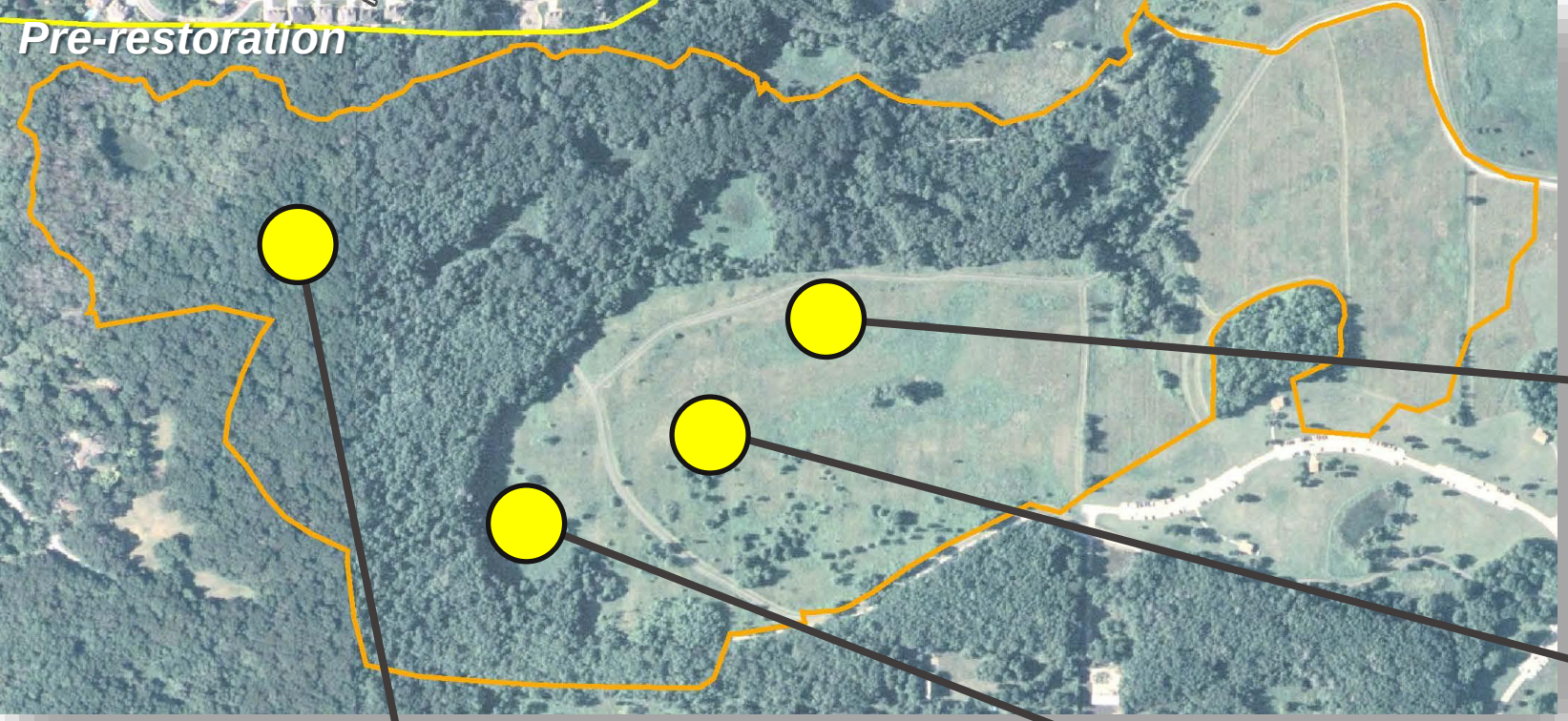
Source:
Illinois State Geological Survey
Clearinghouse

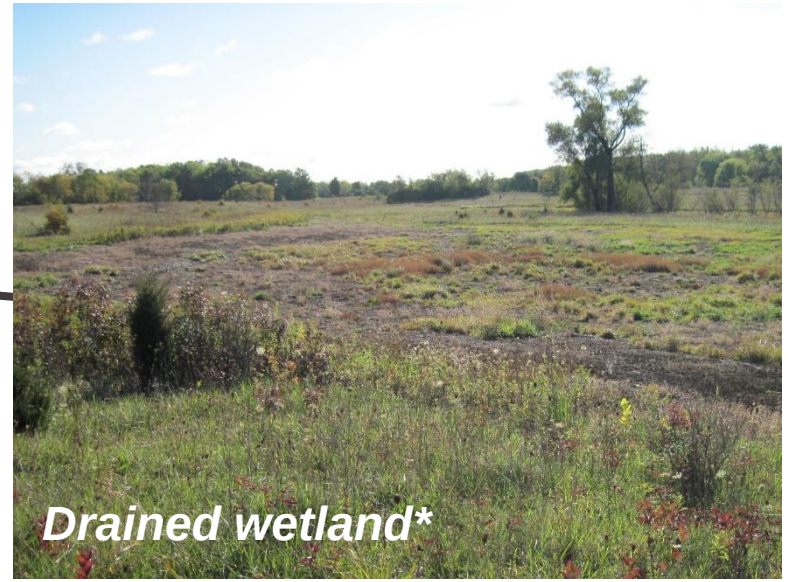
Wetland delineation and drain tile mapping



Final project area narrowed down to a sub-catchment

- Eliminate off-site and limit on-site impacts





* Photo taken after 1-year drain tile test break and invasives control

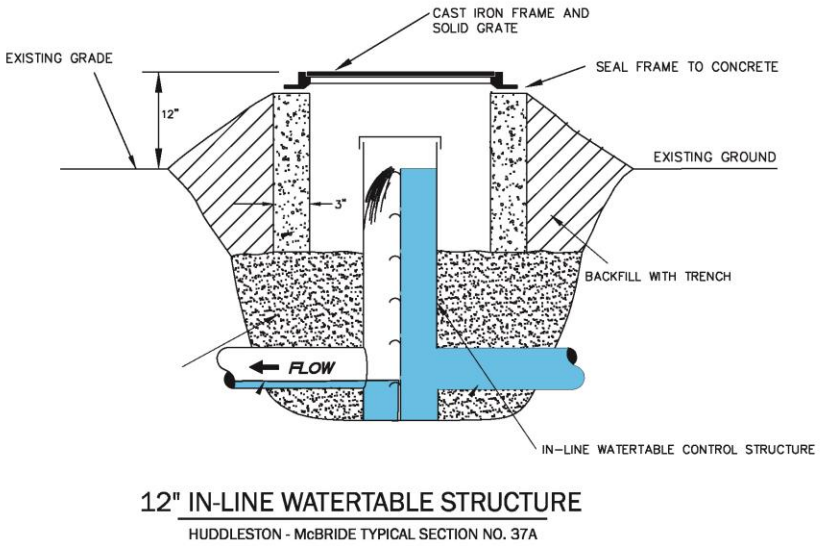
Drain tile removal

Shrub and selective tree removals

Native seeding and planting

Implementation / Construction

Drain tile valving



Before-after aerials

Eurasian meadow to prairie conversion

Oak ecosystem enhancement

Wetland restoration

* Photo taken after 1-year drain tile test break and invasives control

Project Background

Project outcomes

- All wetland mitigation credits received
- Achieved high ecological integrity
  - **Site dedicated as the Jens Jensen Grasslands and Woods Land & Water Reserve by the Illinois Nature Preserves Commission**
- Viewed as "***a model for smart restoration***"

What are some of the project benefits beyond generation of wetland mitigation credits?

Sandhill cranes with colt

Restored prairie in bloom

Study objectives

Study 1: Select a tool and develop a methodology to determine if there is a quantifiable storm water benefit of the restoration

- Applied for this project and future restoration projects:
  - How do wetland hydrology restoration **and** plant community changes (and other changes) affect site hydrology?
  - Quantity and rate of release

Restored dry-mesic prairie

Tool selection

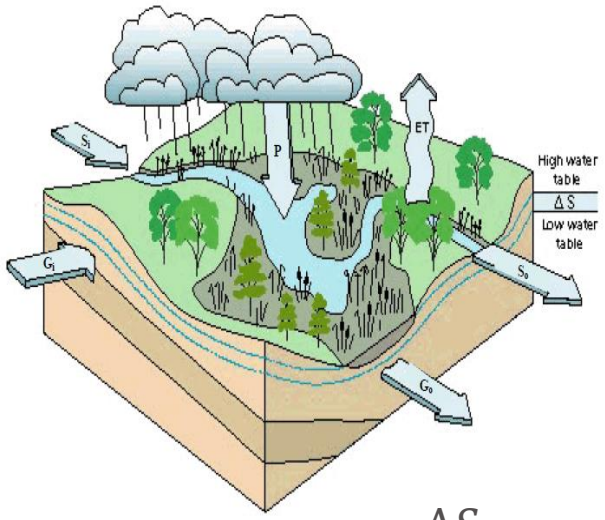
- Data driven
- Repeatable and practical (applied at multiple OMMA sites)
- Academic literature review
- Peer outreach

Storm Water Management Model (SWMM)

- Can simulate drain tile hydraulics
- Watershed-based
- Robust hydrologic and hydraulic simulation routines (long-term)
- Provides for volume and flow change quantification
- Functional with types of data typically associated with wetland restoration
- Widely accepted and recommended during peer outreach

Step 1: Conceptual water budget

Mass balance water budget



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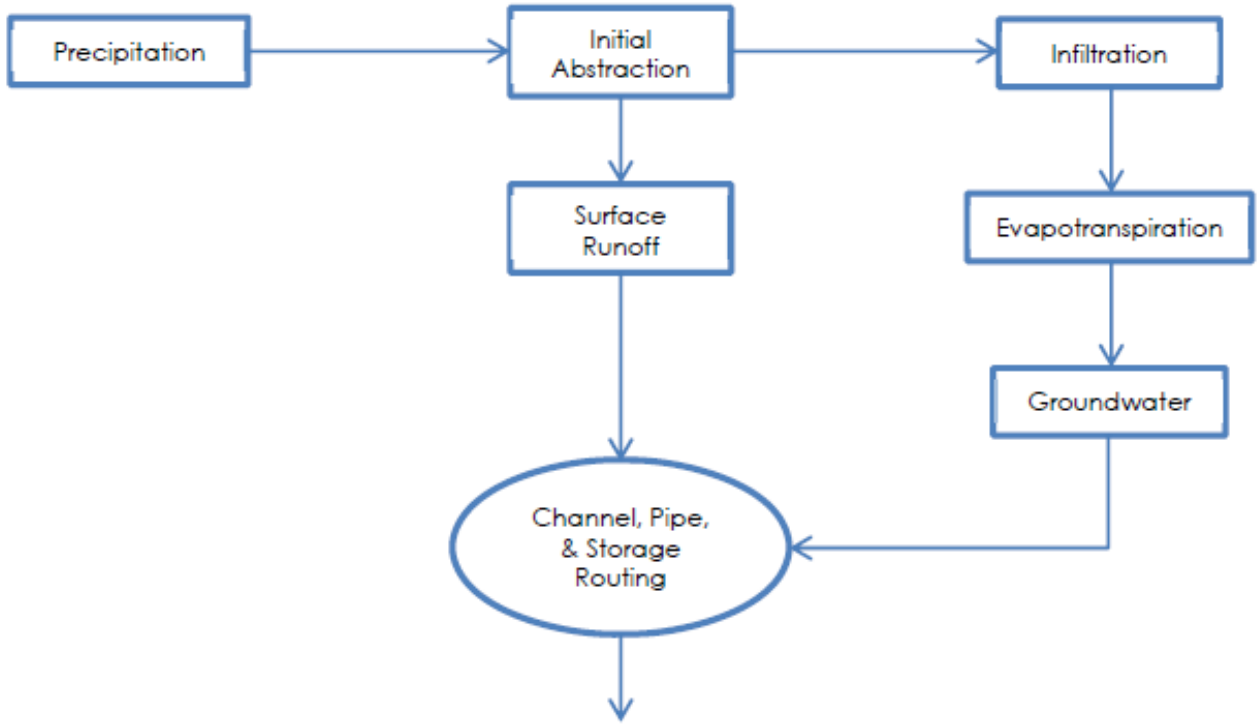
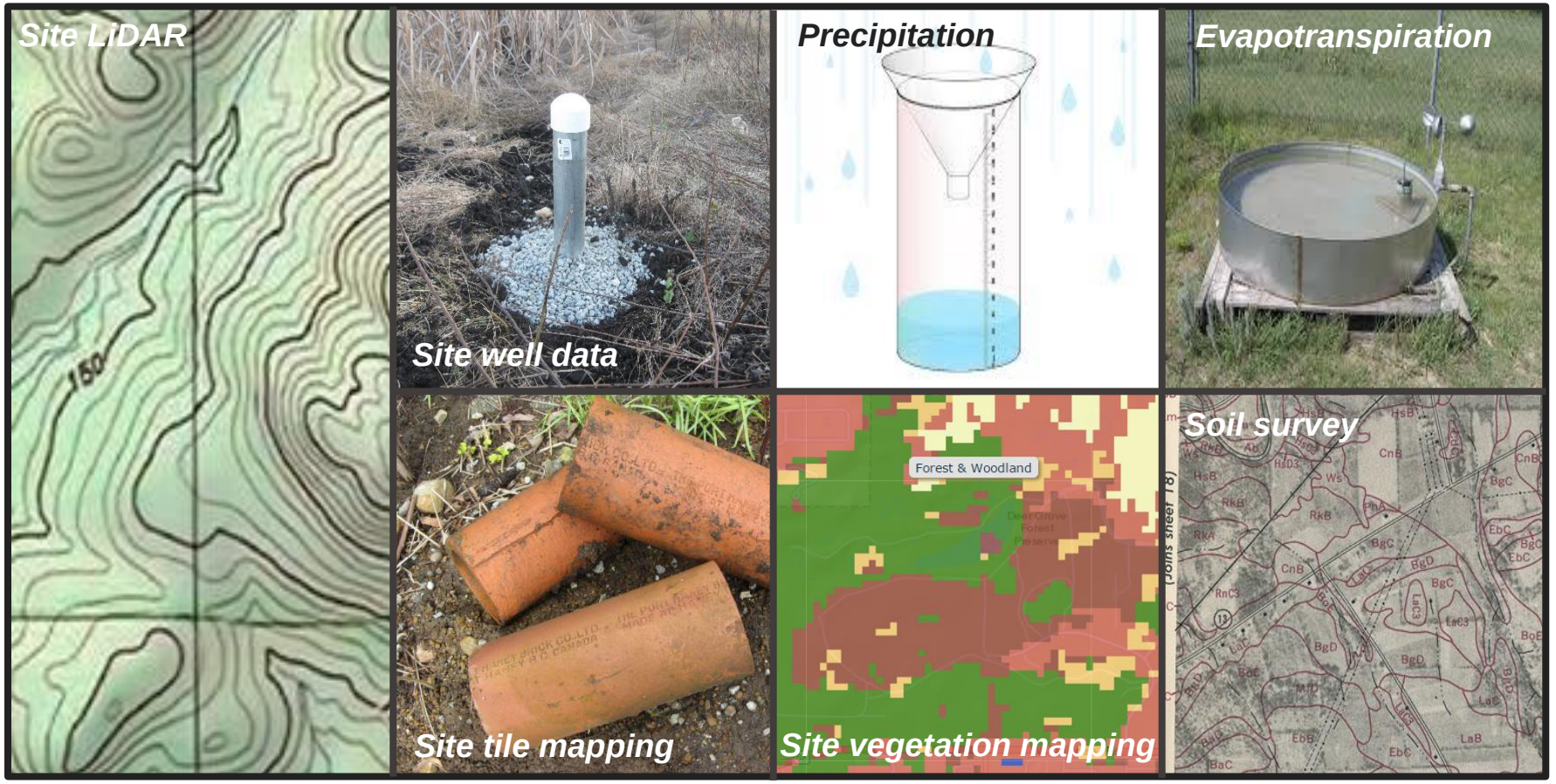


Processes modeled by SWMM

Hydrologic Changes Study Methods

Step 2: Data acquisition and review

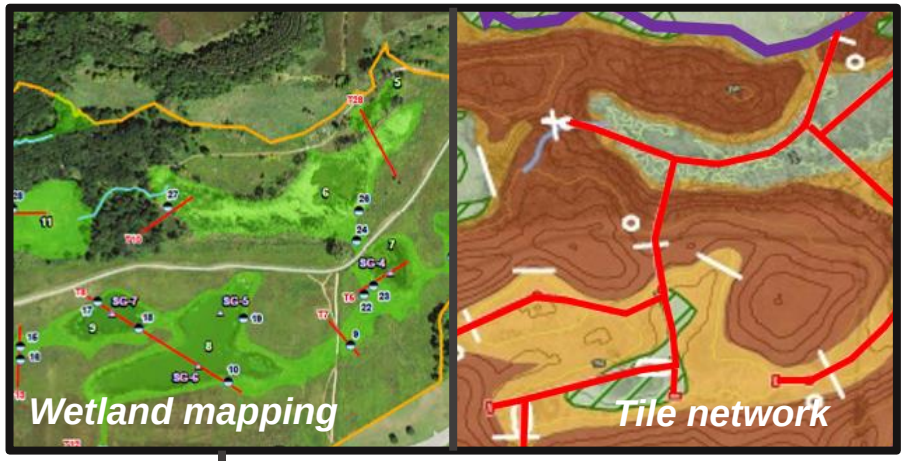


Hydrologic Changes Study Methods

Step 3: Model construction and parameterization

Hydrologic and hydraulic network

33 interconnected sub-catchments

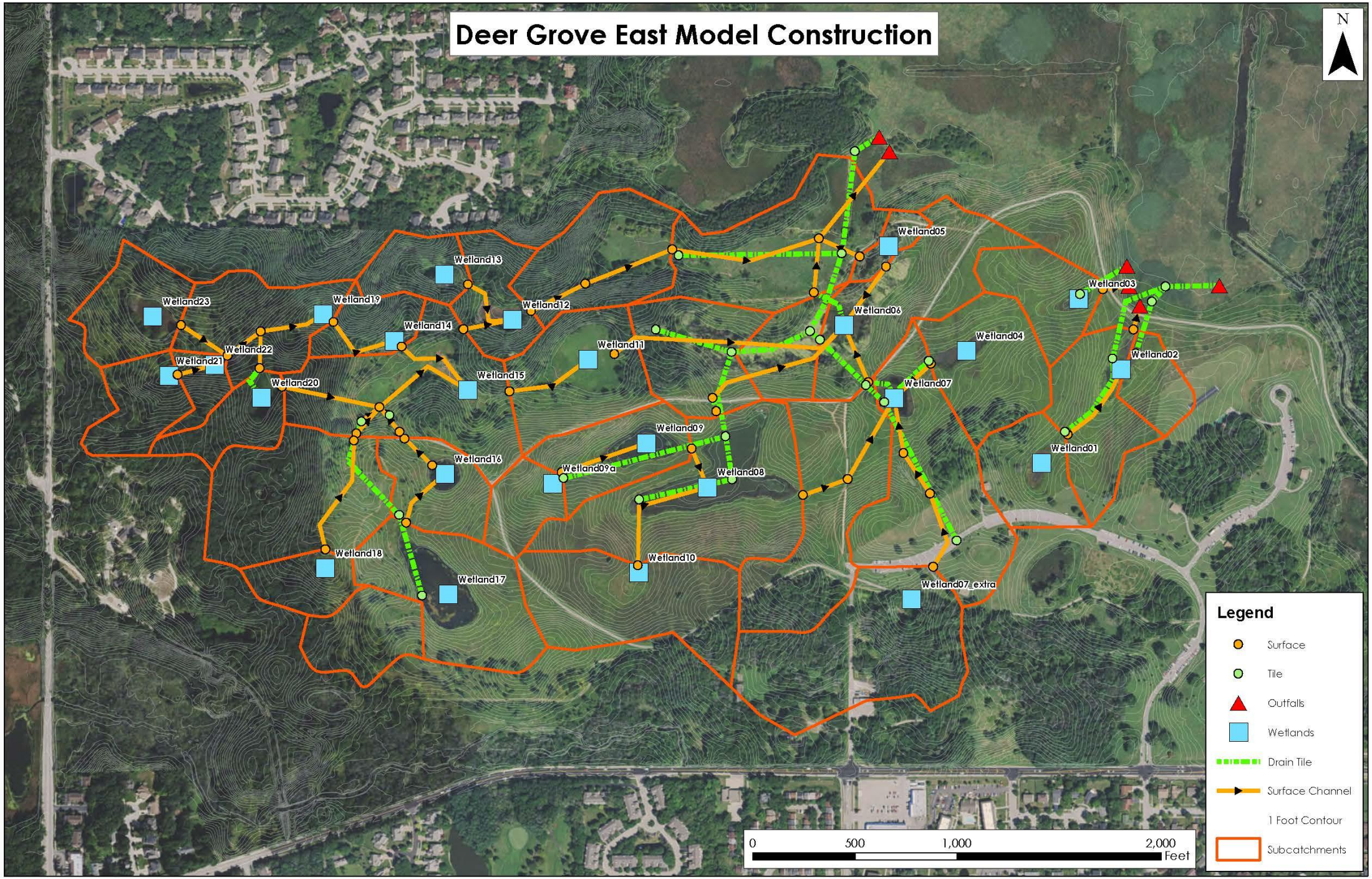


Storage nodes

Model runs

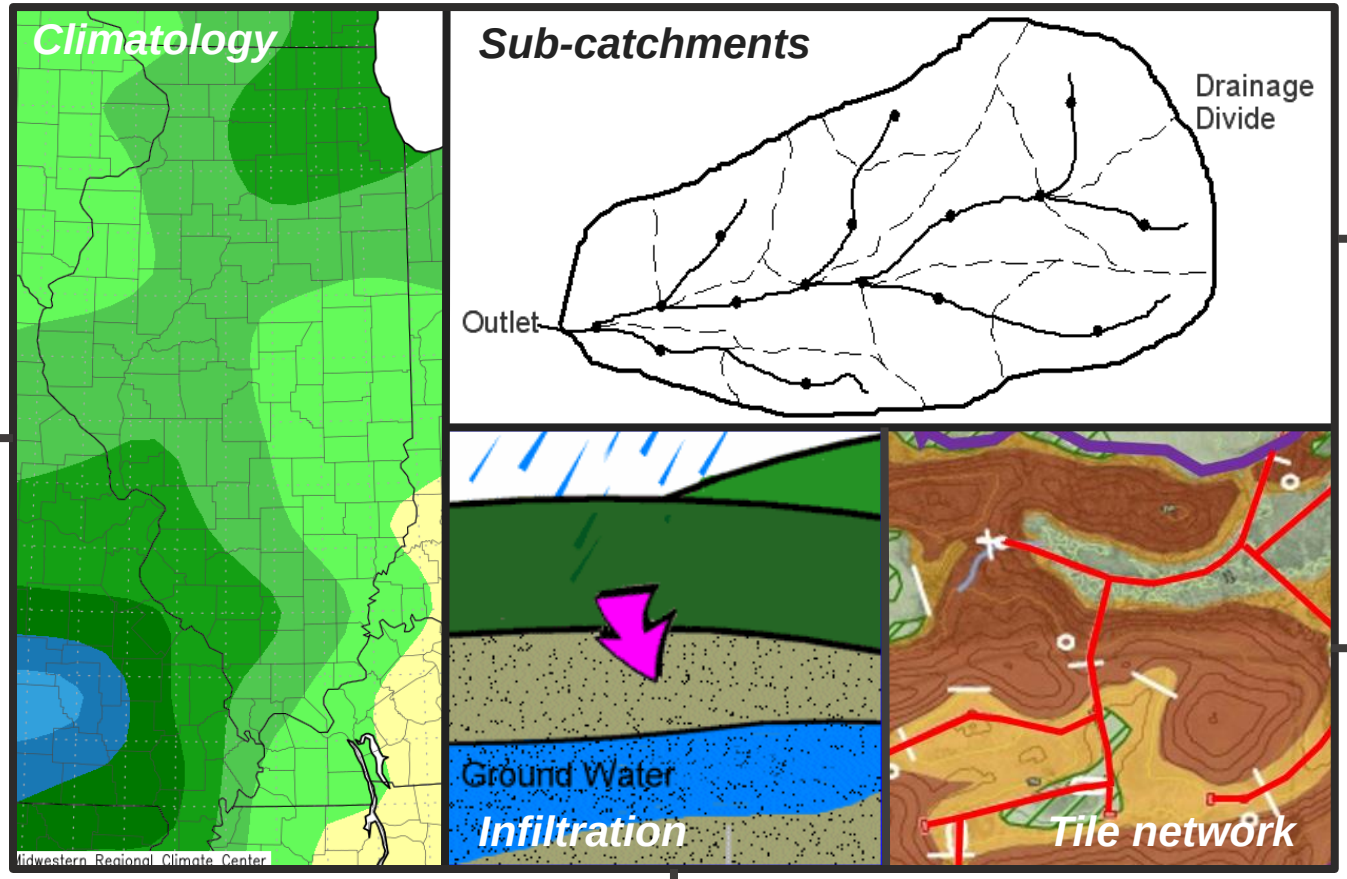
2 pre- and post-restoration simulation years

- Compare modeled volume leaving the site under pre- and post-restoration conditions
- Continuous simulation model run March 15 – November 1
- Initial 2-week abstraction
- “Normal” monthly patterns of precipitation in both model years


Deer Grove East Model Construction
N
Wetland23
Wetland19
Wetland13
Wetland12
Wetland14
Wetland22
Wetland21
Wetland20
Wetland11
Wetland15
Wetland05
Wetland06
Wetland03
Wetland04
Wetland02
Wetland07
Wetland09
Wetland01
Wetland16
Wetland09a
Wetland08
Wetland18
Wetland10
Wetland17
Wetland07_extra
Legend
Surface
Tile
Outfalls
Wetlands
Drain Tile
Surface Channel
1 Foot Contour
Subcatchments
0
500
1,000
2,000
Feet

Inputs for model parameters

- ET data
- Crop coefficients



- Rainfall data
- Catchment delineations, flow paths, and slopes
- Assign outlets
- Impervious surfaces
- Surface roughness
- Depression storage

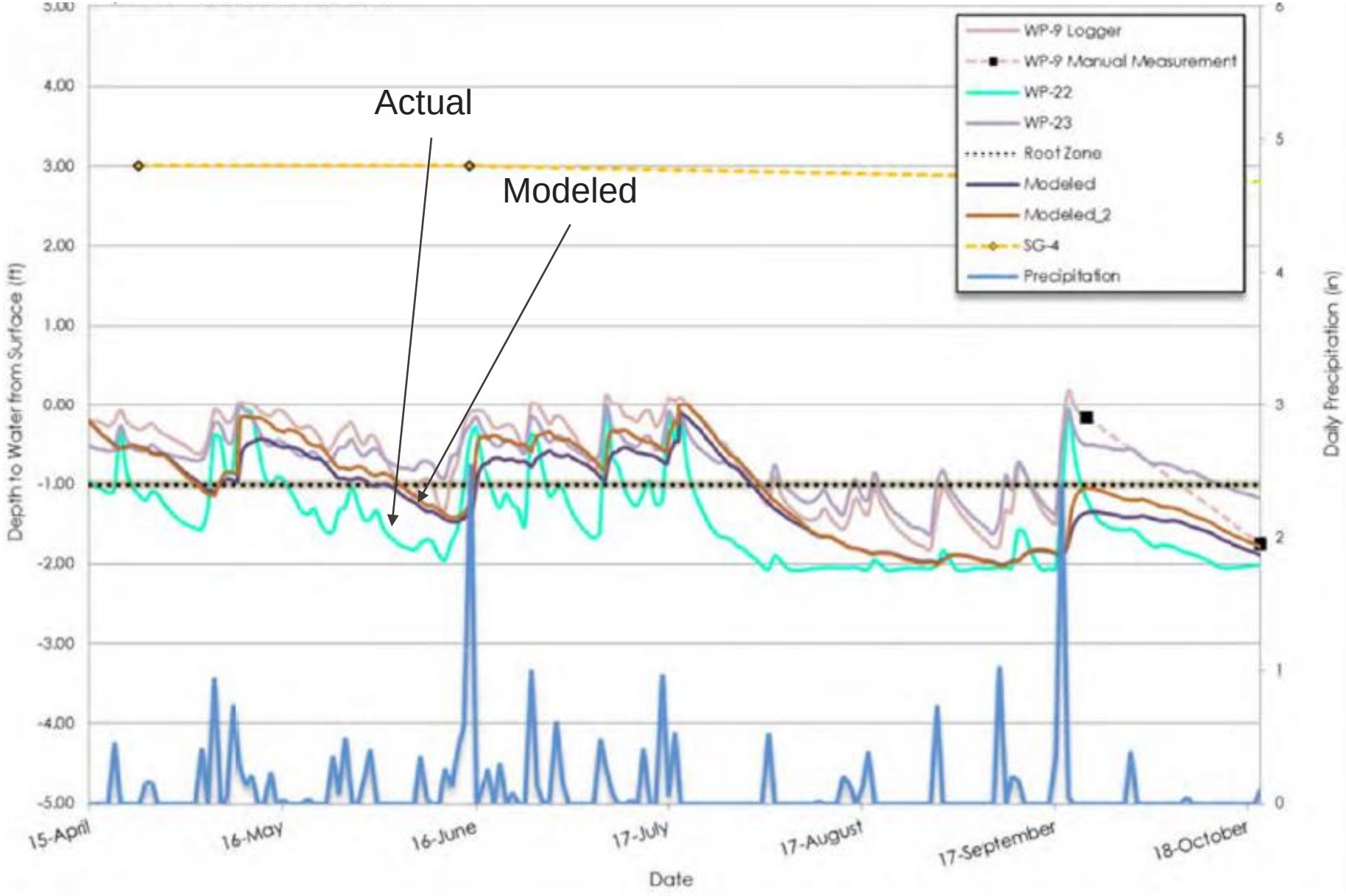
- Coefficients to simulate the effect of tile drainage on aquifers

- Soil types
- Porosity, field capacity, wilting point
- Rooting depth*

Step 4: Model calibration and verification

- Shallow (48-inch depth) water level observation wells
  - Data from 45 wells from 2010 – 2015
  - Equipped with pressure transducers that collected readings at 2-hour increments throughout the growing season
- Required adjustment of modeled aquifer parameters

Example calibration hydrograph



Calibrated hydrographs reasonably predicted observed data

Hydrologic Changes Study Results

Step 5: Compare pre- to post-restoration changes (water budget results)

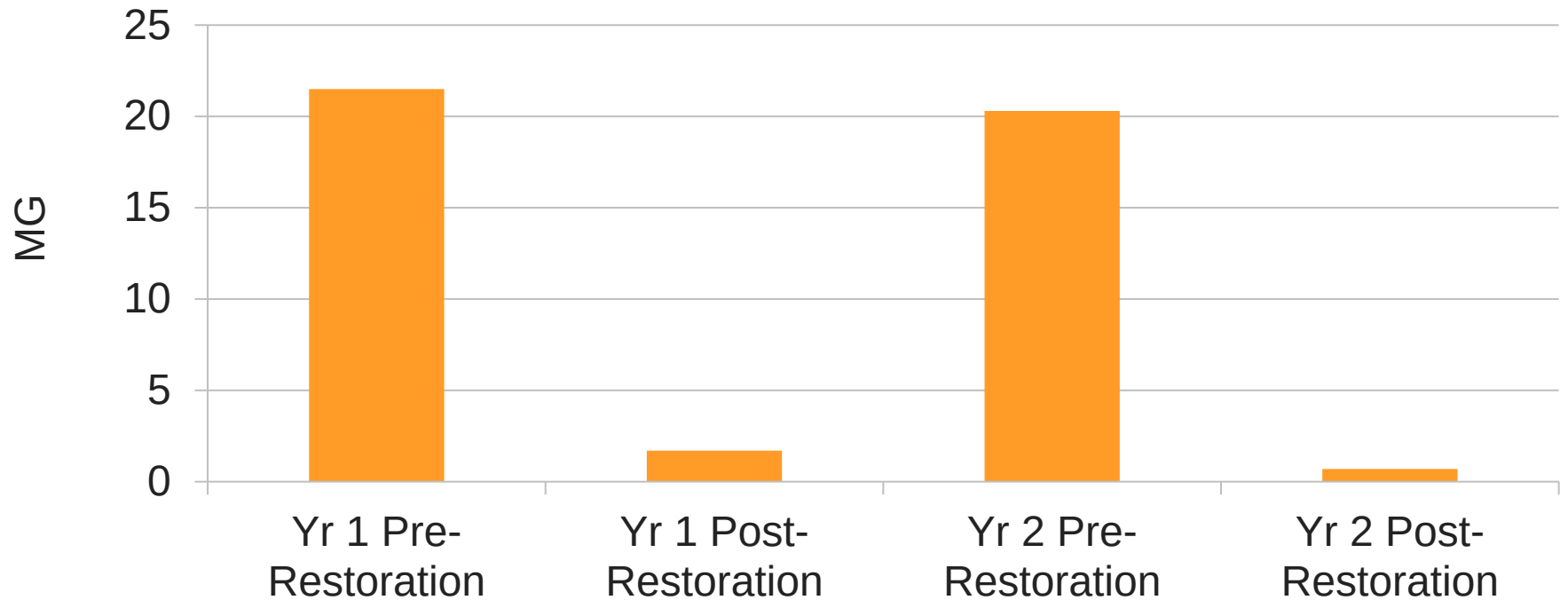
	Year 1			Year 2		
	Pre-Restoration	Post-Project	Percent Change	Pre-Restoration	Post-Project	Percent Change
	Sub-catchment Results (Inches)					
Precipitation	27.0	27.0	0%	28.7	28.7	0%
Surface Evaporation	1.9	1.2	-36%	2.2	1.0	-56%
Infiltration (to Groundwater)	20.0	21.7	9%	22.7	24.7	9%
Surface Runoff	5.3	4.2	-20%	3.9	3.2	-19%
	Groundwater Results (Inches)					
Total Infiltration	19.5	21.4	10%	22.2	24.4	10%
Upper Zone ET	1.6	1.9	19%	1.7	2.2	24%
Lower Zone ET	12.6	20.9	67%	13.2	22.8	72%
Groundwater Loss	2.5	2.5	-1%	2.5	2.4	-4%
Tile Drainage	6.7	0.1	-99%	7.0	0.0	-99%

Site-specific balance of drain tile removal and vegetation changes

- Drain tile hydraulics
  - Reduced outflow
- Vegetation changes
  - Increased roughness
  - Increased evapotranspiration (from rooting depth)

Hydrologic Changes Study Results

Example output: site discharge volumes (MG)



Discharge volumes of water leaving the site was reduced by ~40 million gallons for the 2 model runs combined

Study objectives

Study 1: Quantify the stormwater benefits of the restoration

- How do wetland restoration **and** plant community changes affect site hydrology?
- Model pre- and post-restoration conditions

Study 2: Quantify the economic benefits of the restoration

- How did the expenditures associated with the project impact the local economy in the short-term?
- What is the long-term monetary value of the ecosystem services provided by the restoration?

Volunteer native seeding event

GUIDANCE FOR ASSESSING CHANGES IN ENVIRONMENTAL AND ECOSYSTEM SERVICES IN BENEFIT-COST ANALYSIS

Office of Information and Regulatory Affairs

Office of Management and Budget

Published: February 28, 2024

NATIONAL STRATEGY TO DEVELOP STATISTICS FOR ENVIRONMENTAL-ECONOMIC DECISIONS

A U.S. SYSTEM OF NATURAL CAPITAL ACCOUNTING AND ASSOCIATED ENVIRONMENTAL-ECONOMIC STATISTICS

OFFICE OF SCIENCE AND TECHNOLOGY POLICY
OFFICE OF MANAGEMENT AND BUDGET
DEPARTMENT OF COMMERCE

JANUARY 2023

THE WHITE HOUSE
WASHINGTON

Ecosystem Services Benefits Methods

2-part analysis

Quantify costs and benefits of ecosystem restoration in the Chicago Region

Part 1: Short-term

Temporary regional economic effect generated from expenditures to plan, implement, maintain, and monitor the project ($5M over the project lifespan)

Part 2: Long-term

Monetary valuation of the ecosystem services provided by the restoration

Provisioning services *such as food and water;* ***regulating services*** *such as flood and disease control;* ***cultural services*** *such as spiritual, recreational, and cultural benefits; and* ***supporting services****, such as habitat quality, that maintain the conditions for life on Earth.*

United Nations Millennium Ecosystem Assessment

Ecosystem Services Benefits Methods

Ecosystem services valuation

Cultural services

- Recreation

Regulating and supporting services

- Water Flow/Regulation
- Water Quality (contaminant reduction)
- Groundwater Recharge
- Climate Regulation
    i. Pollution removal services
    ii. Carbon sequestration
    iii. Carbon storage

Supporting services

- Habitat

Restored oak ecosystem with walking path

Ecosystem Services Benefits Methods

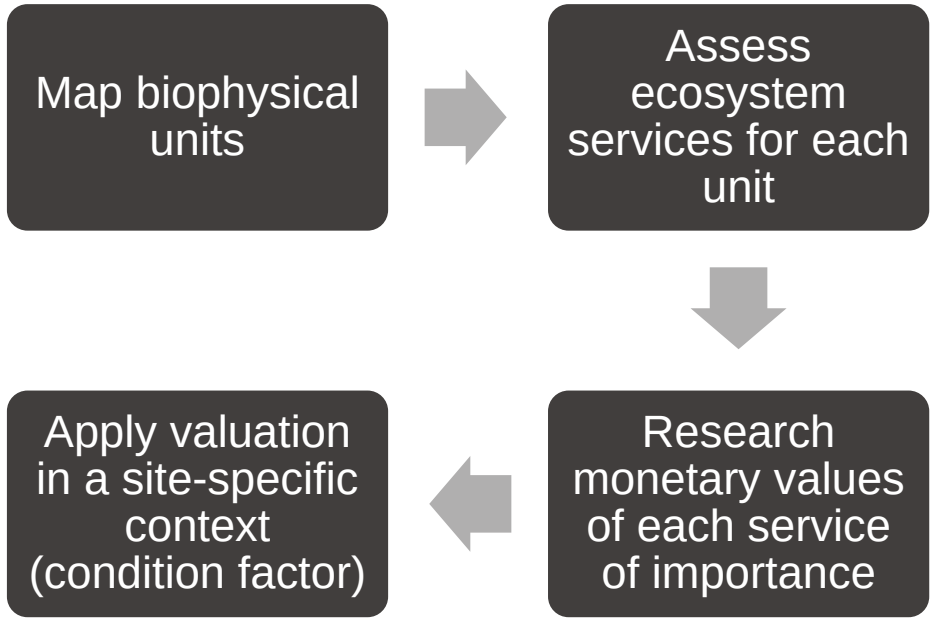
Methods and tools

Part 1: Economic model

- Input-output model and database for estimating regional economic impacts
- IMPLAN Pro https://implan.com/
- “Economic multiplier” effects: models the way a dollar expended within one sector of the economy is spent and re-spent in other sectors
- Accepted and used by federal agencies

Part 2: Benefits transfer

- Estimates economic values by transferring available information from studies completed in another location
- 20-year projection



Ecosystem Services Benefits Results

Economic valuation Results

Part 1: Short-term

- Total temporary regional economic effect generated from the project expenditures was approximately **$10,585,816***
- 2:1 benefit over the expenditure period

Part 2: Long-term (20 years)

- Cultural service improvements
  - **$20,048,636*** over 20 years
  - Increased willingness to pay for access to a restored landscape
- Regulating, support, and habitat service improvements
  - **$13,478,555*** over 20 years
  - Mostly from ecosystem services derived from **wetlands**
- Long-term returns of 6:1 over a 20-year period

* Not discounted

Project partners

openlands
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CITY OF CHICAGO
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FOREST PRESERVES of Cook County

O'Hare Modernization Program

WBK

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Questions?

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