GREEN INFRASTRUCTURE VISION

VERSION 2.3 ECOSYSTEM SERVICE VALUATION

Chicago Wilderness

THE CONSERVATION FUND

Northwest Indiana Regional Planning Commission

Ecosystem Services in the NIRPC Region

No Adverse Impact Approach Workshop

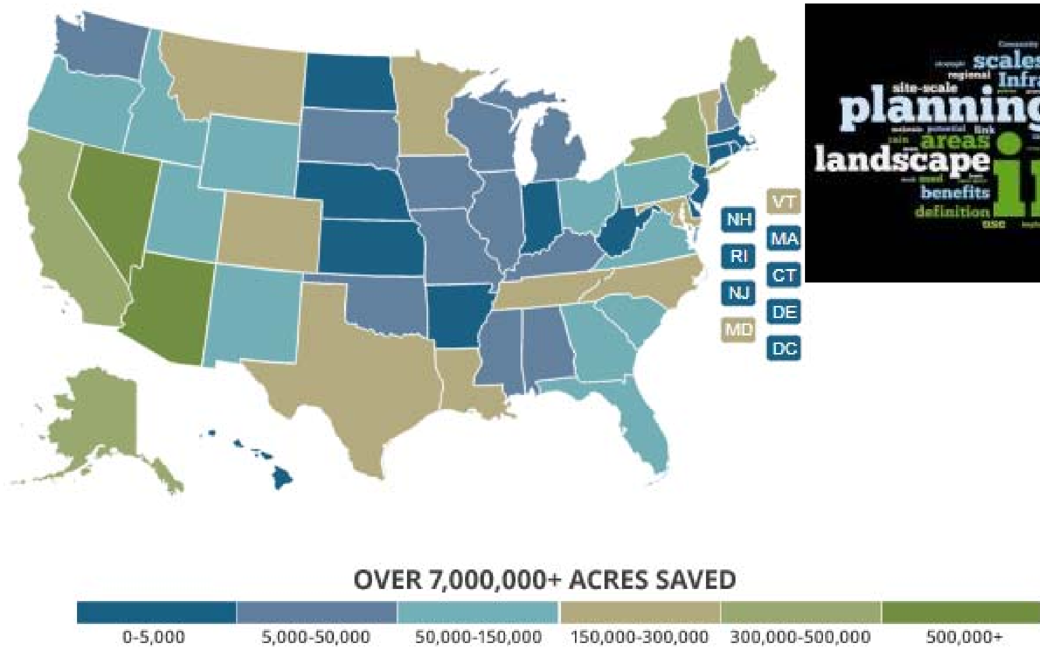
Jazmin Varela

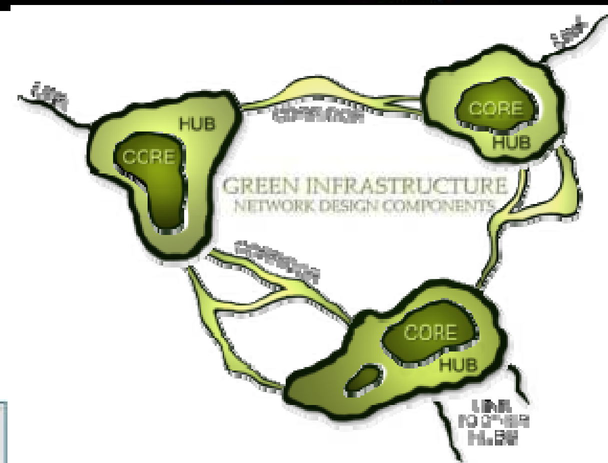
The Conservation Fund

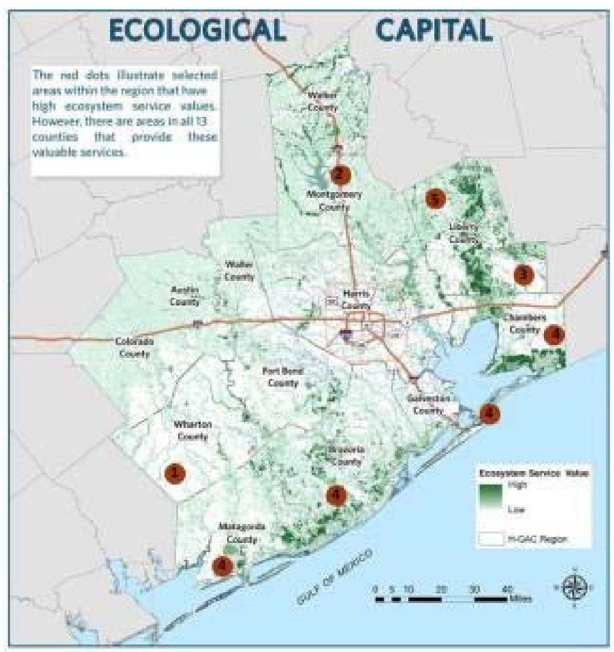
Hammond Marina, IN

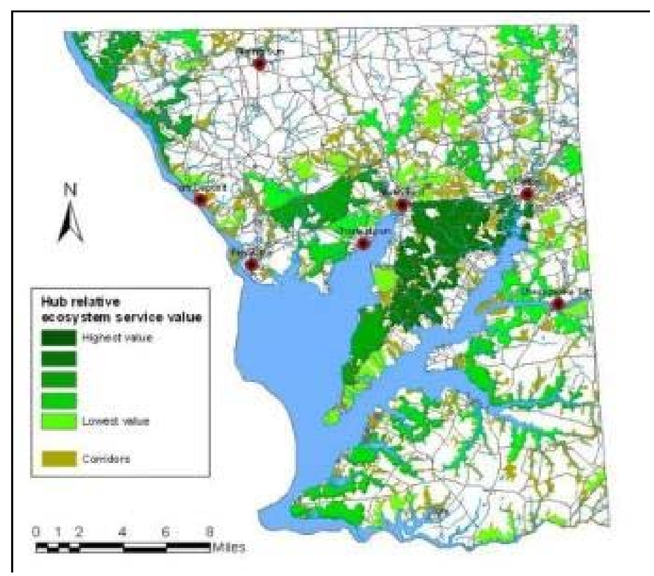
June 25th, 2015

THE CONSERVATION FUND









Other work in Indiana

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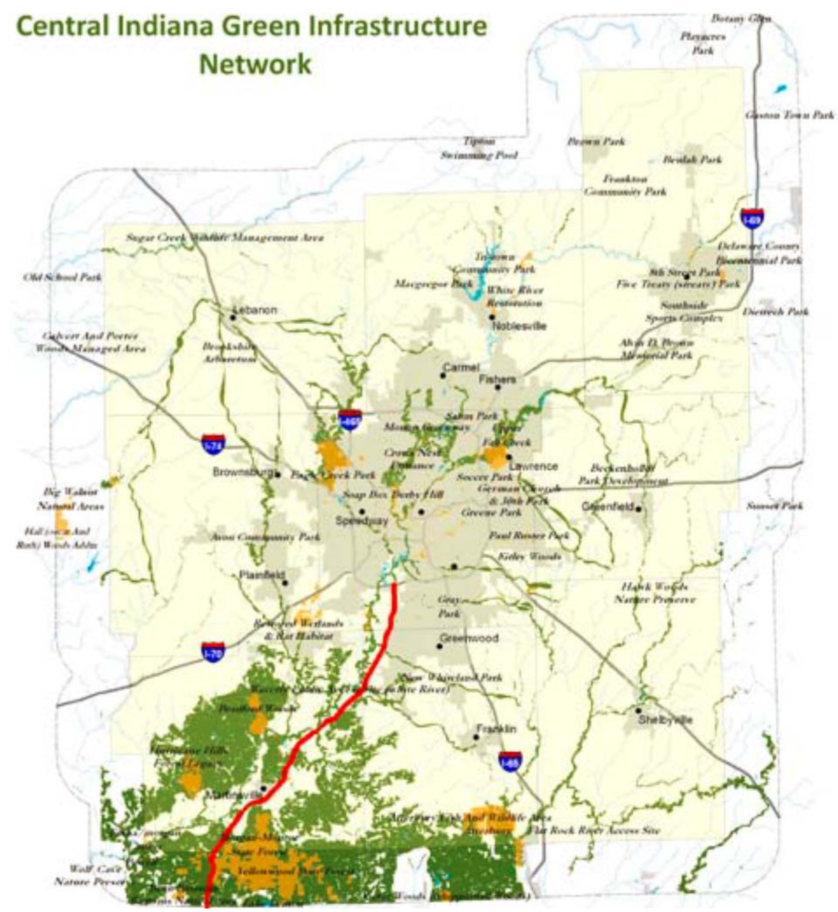
Sustainable Fish Success In Indiana

Species Mitigation



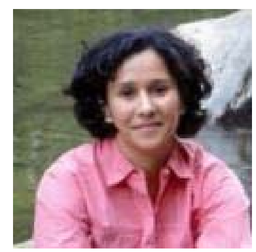
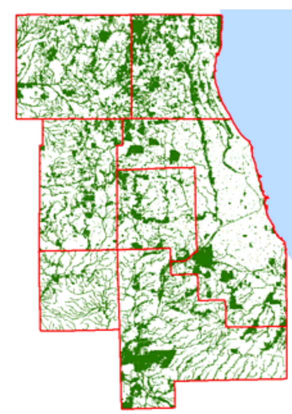
Greening The Crossroads: Central Indiana Green Infrastructure Plan

Project Team

THE CONSERVATION FUND

- **Will Allen**, Director of Strategic Conservation Planning
- **Ted Weber**, Strategic Conservation Science Manager
- **Jazmin Varela**, Strategic Conservation Information Manager
- **Dr. Kent Messer**, Resource Economist, University of Delaware




Chicago Wilderness Biodiversity Recovery Plan

Chapter 1

Executive Summary

Chicago Wilderness and Its Biodiversity Recovery Plan

1.1 Introduction

1.1.1 Chicago Wilderness: who we are, what we are accomplishing.

"Chicago Wilderness" refers to nature and to the people and institutions that protect it. Chicago Wilderness is 200,000 acres of protected conservation land—some of the largest and best surviving woodlands, wetlands, and prairies in the Midwest. It is also the much larger matrix of public and private lands of many kinds that support nature in the region along with the people who protect and live compatibly with it.

Many of the surviving natural communities of the Chicago region are of national and global significance for conservation. The region is blessed with both richness and opportunity for its conservation. Yet research indicates that we are experiencing a steady decline in both native species and communities. For example:

- In a review for this plan, the Chicago Wilderness Science and Land Management Teams found that more than half of the major community types of the region were at the highest level of conservation concern due either to the small amount remaining or to the poor ecological health of the remaining examples.
- A 1995 survey of DuPage County forest preserves revealed that 80% of its natural areas had declined to poor health (Applied Ecological Services 1995).

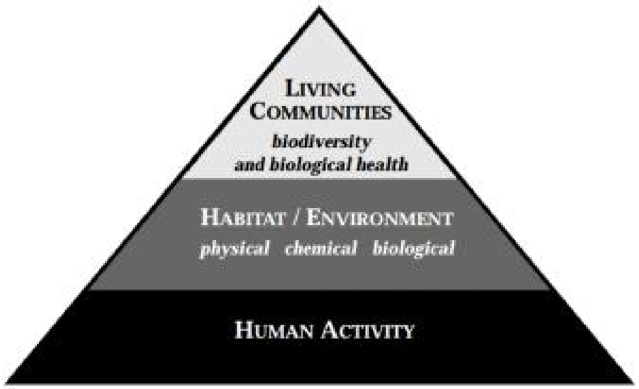


Figure 3.1 Ecosystem health and human activity

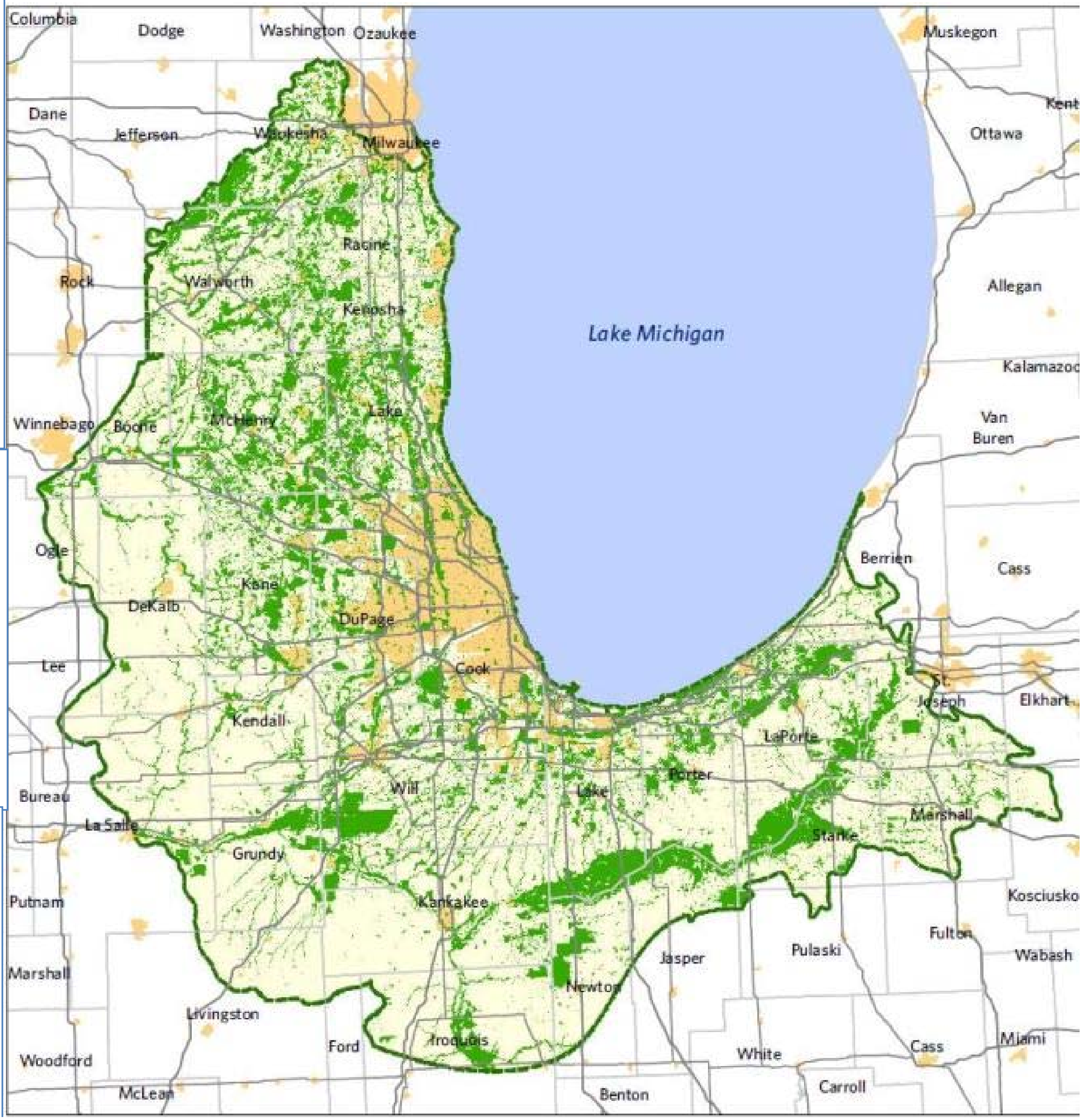
Chapter 8

Preserving Land and Water Resources for Biodiversity

8.1 Introduction

The previous chapters reviewed the types of natural communities found in the Chicago Wilderness area and the goals and actions needed to sustain them. As noted in Chapter 3, the natural areas of the region can be seen as

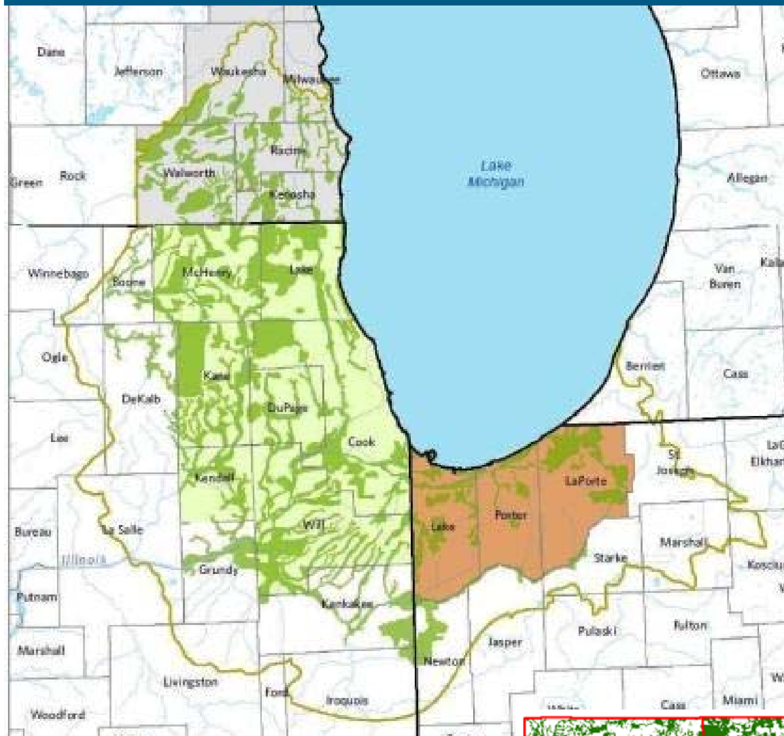
Ownership of natural areas in the Chicago Wilderness region is a mix of public and private. The core of Chicago Wilderness consists of public land permanently dedicated to the conservation of nature. However, as human use of the land intensifies, the choices made by private landowners become increasingly important. Land management by private owners can strongly affect the course of events in nearby public natural areas. Fortunately,



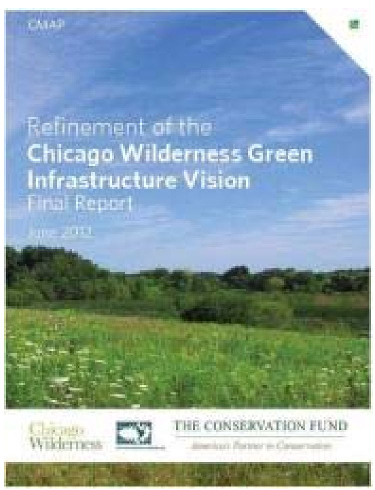
CW GIV: A Brief History

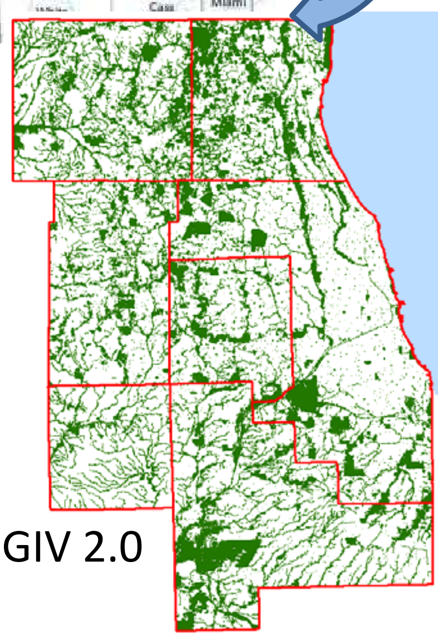
HISTORY

1. 2004 – GIV 1.0
2. June 2012 – GIV 2.0
3. November 2012 – GIV 2.1
4. 2013 – GIV 2.2
5. 2014 – GIV 2.3 ESV



GIV 1.0





GIV 2.0

GIV 2.2

GIV Layers and Models for ESV

GIV 2.3	GIV Layer	Model Reference
GIV landscape features		
	Core woodland/forest designated areas	**Woodland/Forest Layers 3a & 3b**
	Core woodland/forest	**Woodland/Forest Layer 4**
	Core prairies	**PGS Layer 1**
	Core savannas	**PGS Layer 2**
	Core wetland designated areas	**Wetland Layers 4a & 4b**
	Core wetlands	**Wetland Layer 5**
	Core lakes and streams	**Steams/Lakes Layer 3**
Functional connections		
	Woodland/forest corridors	**Woodland/Forest Layer 7**
	Wetland corridors	**Wetland Layer 8**
	Undeveloped NHD+ stream buffer	**Steams/Lakes Layer 2**
	Undeveloped freshwater systems	**Steams/Lakes Layer 5**
Restoration building blocks		
	Forest Sites	**Woodland/Forest Layer 5**
	Pre-settlement woodland/forest	**Woodland/Forest Layer 6**
	Grassland blocks	**PGS Layer 3**
	Pre-settlement prairie/grassland	**PGS Layer 4**
	Pre-settlement savanna complexes	**PGS Layer 5**
	Prairie/grassland corridors	**PGS Layer 7**
	Wetland sites	**Wetland Layer 6**
	Wetland complexes	**Wetland Layer 7**
	NHD+ raster buffer	**Steams/Lakes Layer 1**
	Freshwater Systems	**Steams/Lakes Layer 4**
Composite layers		
	GIV ecological network	**Hub Layer 1**
	Protected lands raster	**Hub Layer 2**
	GIV network + protected lands	**Hub Layer 3**

Woodlands/Forest Landscape

Core Woodlands / Forest

F4

Woodland/Forest Sites

F5

Presettlement Woodland/Forest Complexes

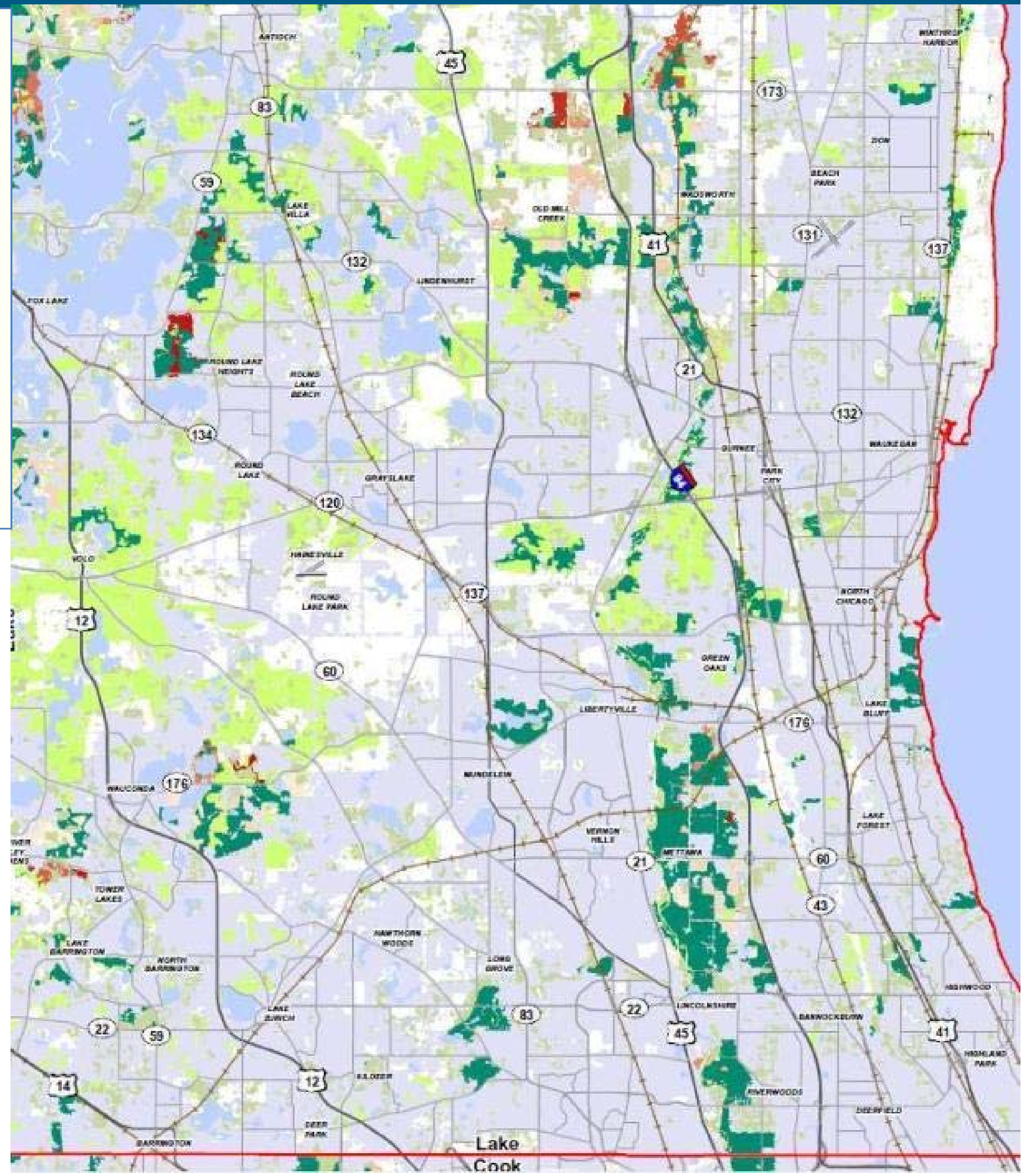
F6

Woodland/Forest Corridors (F7)

Functional Connectivity

Higher

Lower



Prairie / Grassland / Savanna Landscape

Core Prairie

PGS1

Core Savanna

PGS2

Potential Grassland Blocks

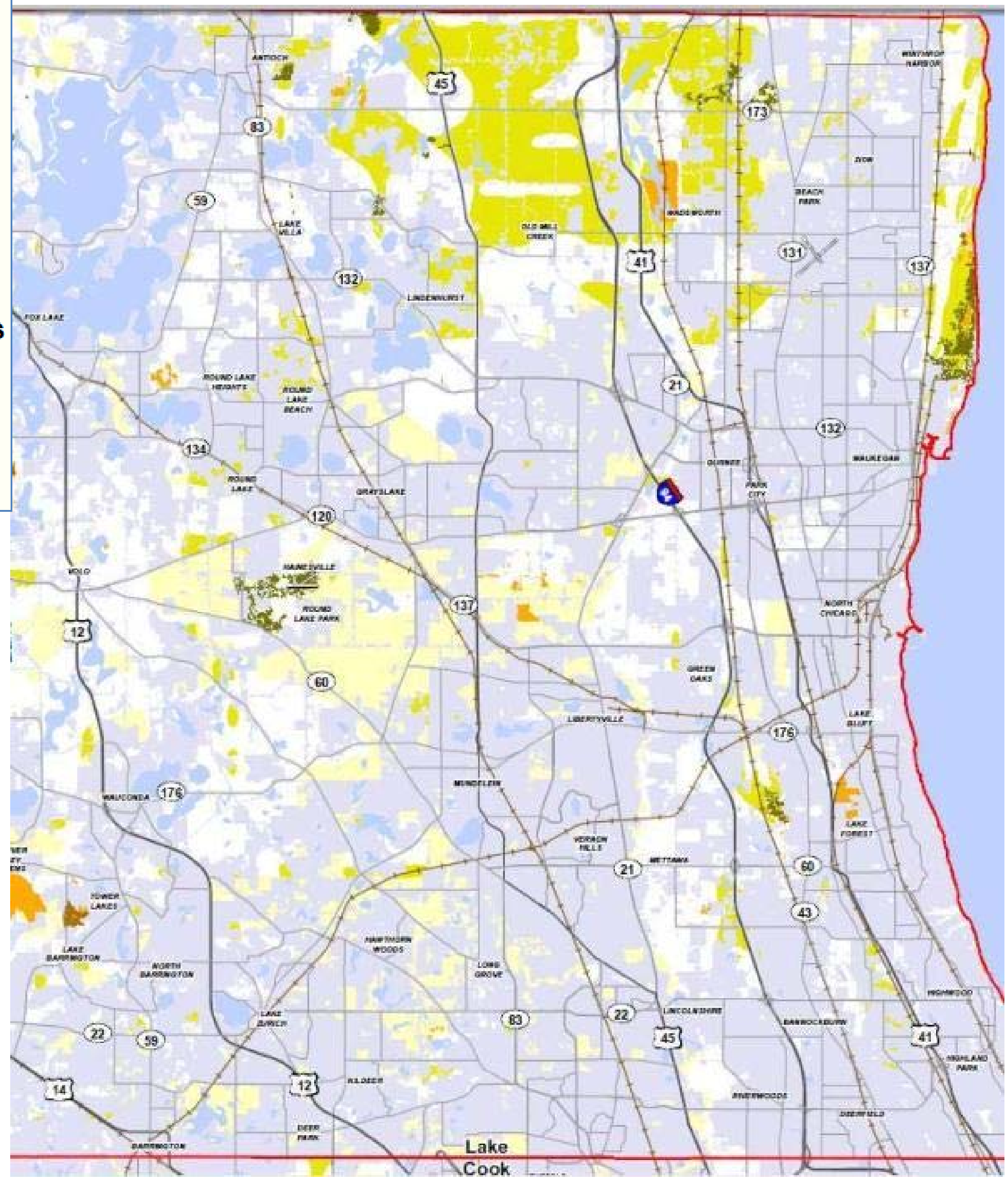
PGS3

Pre-Settlement Prairie/Grassland Complexes

PGS4

Pre-Settlement Savanna Complexes

PGS5



Wetlands Landscape

Core Wetlands

W5

Wetland Sites

W6

Wetland Complexes

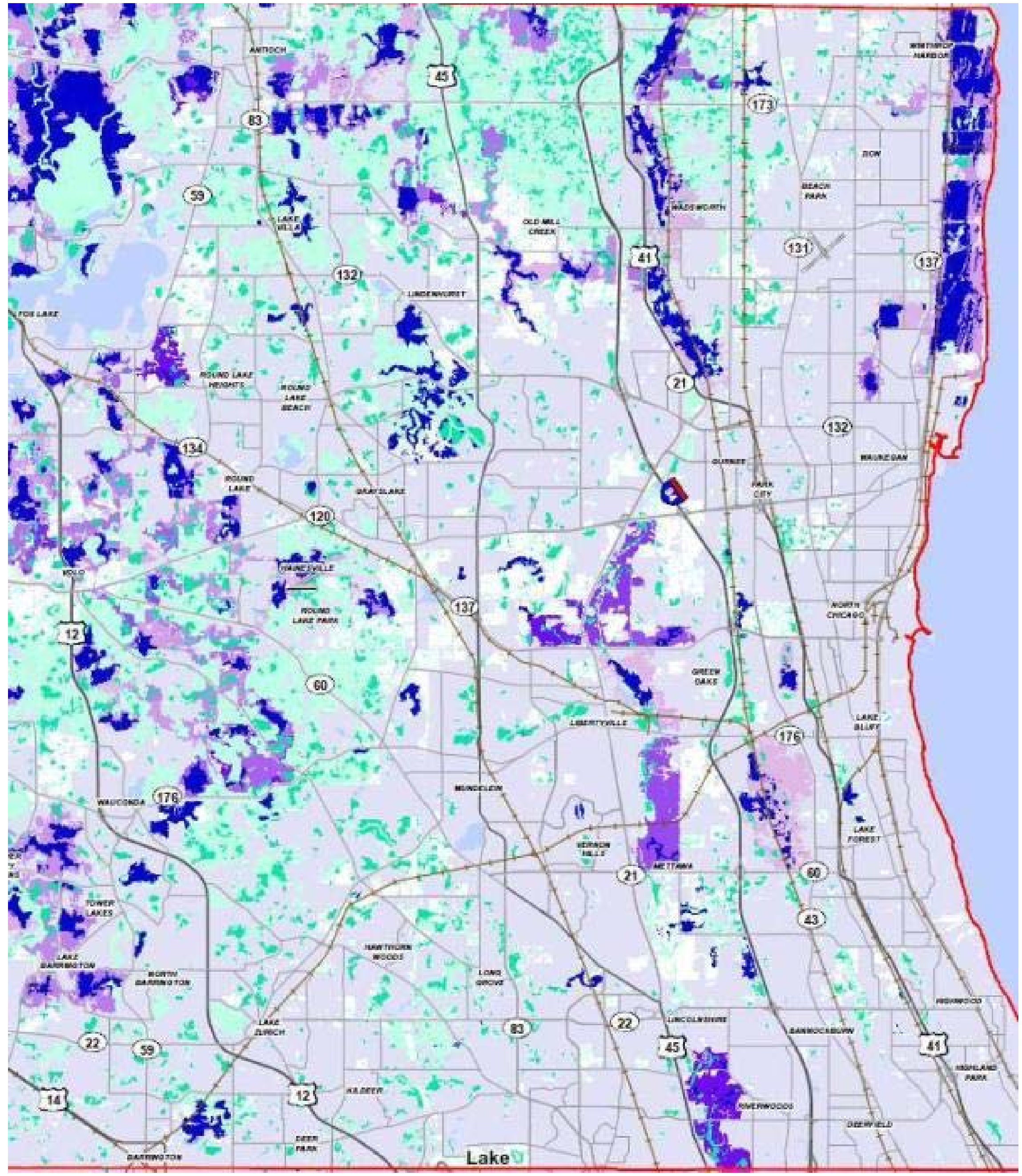
W7

Wetland Corridors (W8)

Functional Connectivity

Higher

Lower



Streams and Lakes Landscape

Core Streams and Lakes

SL3

Undeveloped Stream Buffer

SL2

Undeveloped Freshwater Systems

SL5

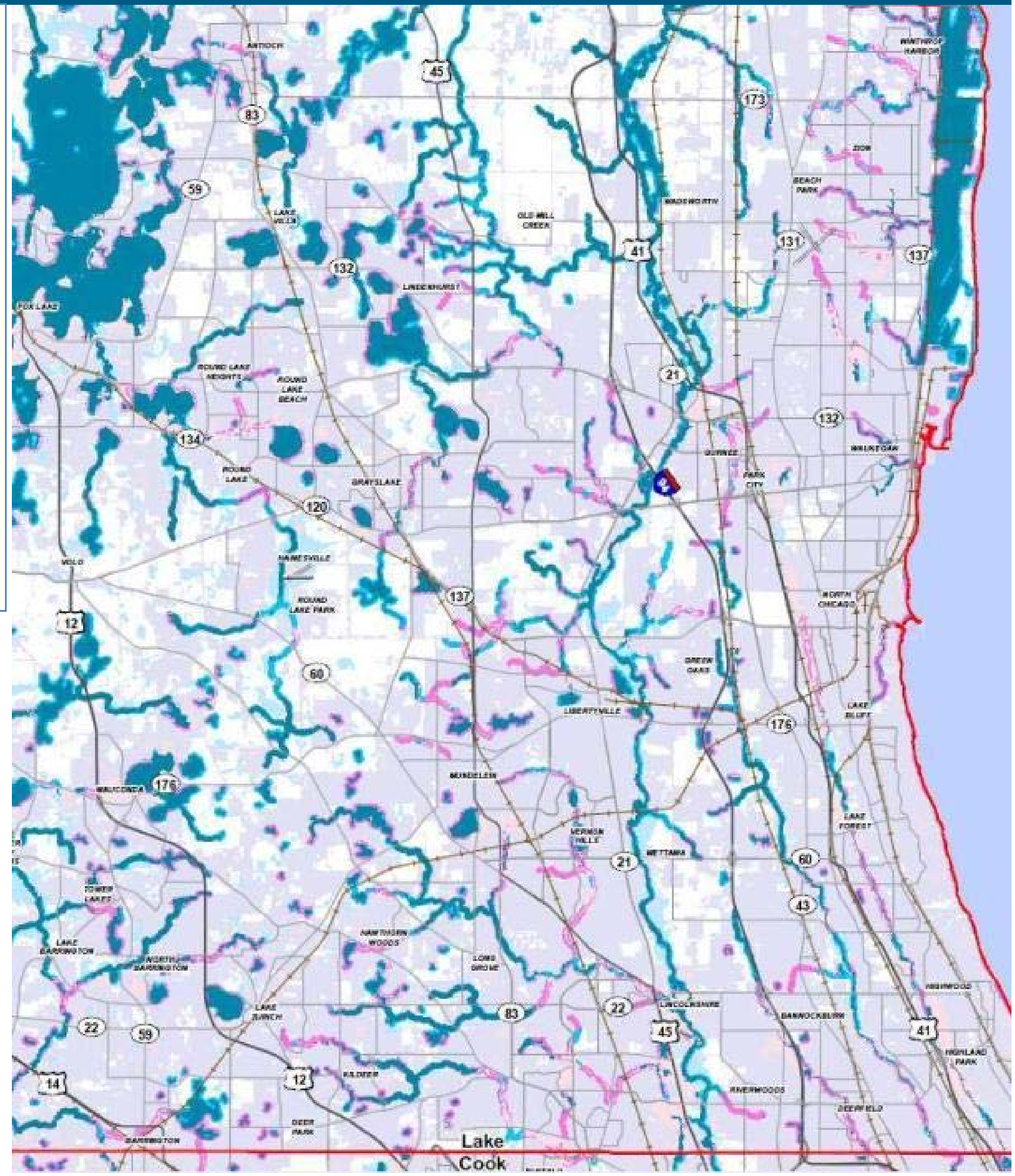
Freshwater Systems - Restoration Potential

SL4

Developed Stream Buffer

SL1 NHD+ Buffer

Other Open Water



Recreation and Ecotourism Landscape

CMAP Regional Trails

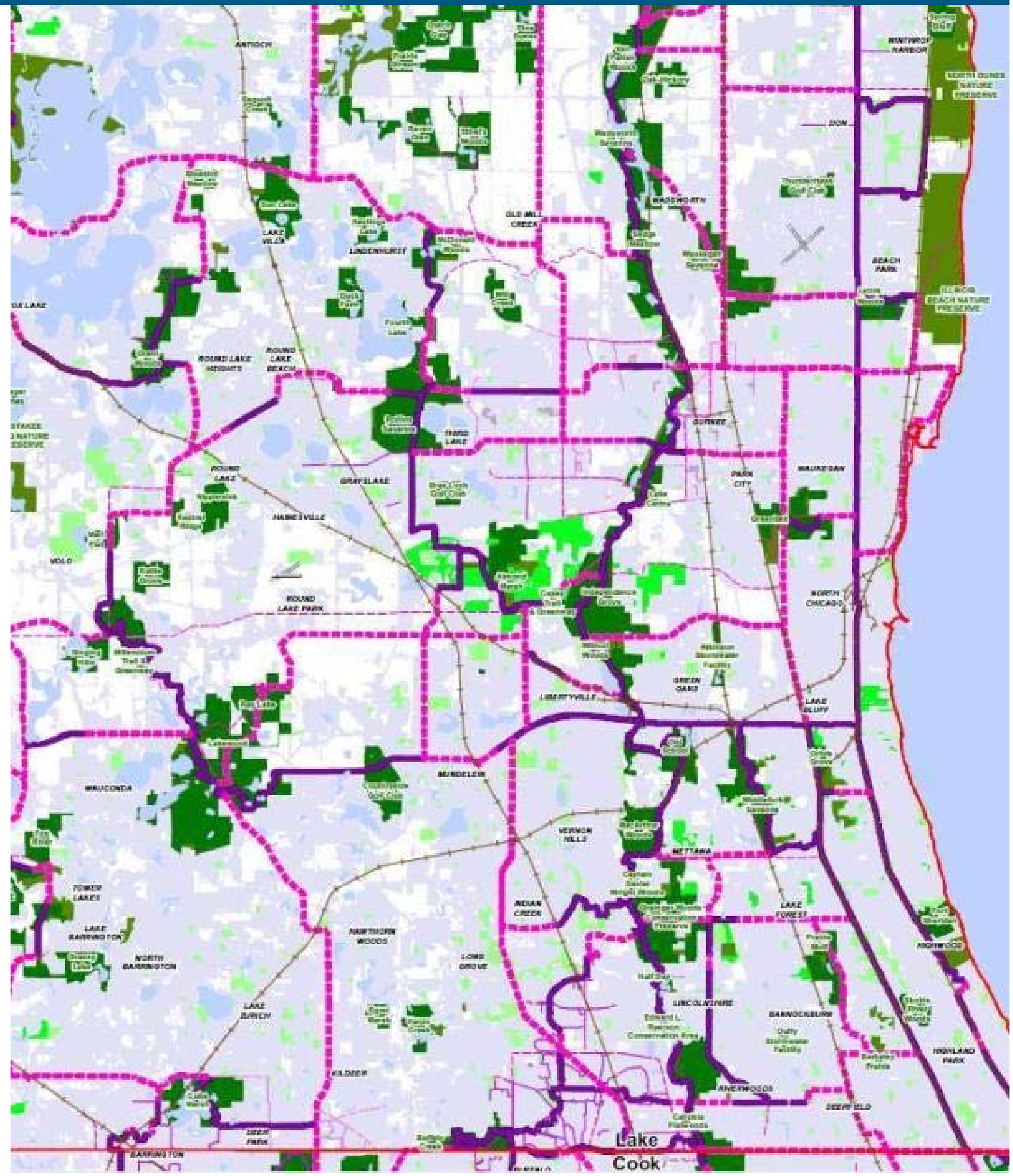
- Existing & Programmed
- Planned & Future

County and FPD Paths and Bike Lanes

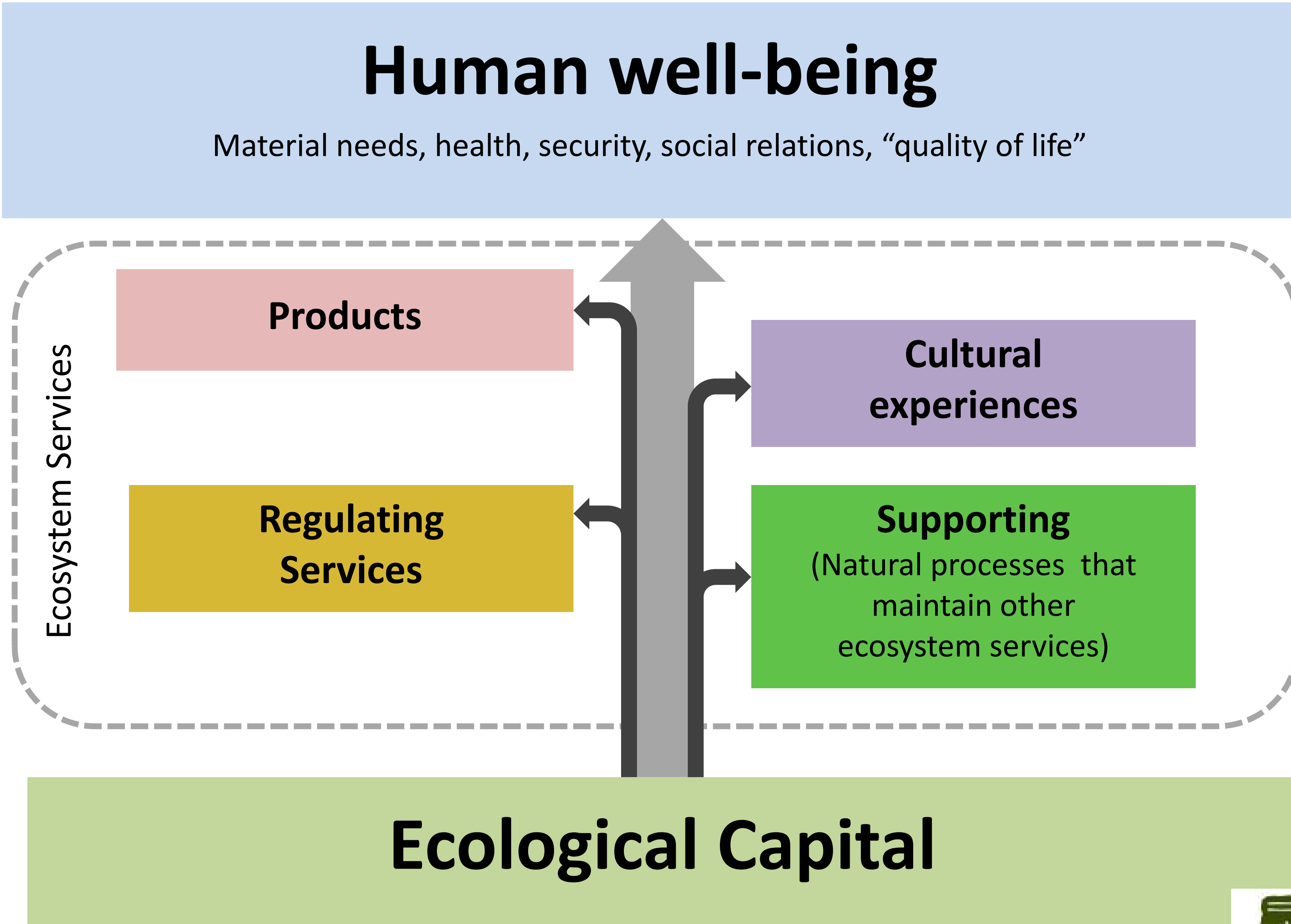
- Existing
- Future

Municipal Paths and Bike Lanes

- Existing
- Future



What are Ecosystem Services?



Adapted from 2010 Ecological Footprint Atlas

HOUSTON WILDERNESS

What are Ecosystem Services?

Classic Public Goods

Non-rivalrous

Non-excludable

Ecosystem Services are neither prized by markets not explicitly protected by law

Source: Salzman. Jim. 2005. The Promise and Perils of Payments for Ecosystem Services.

Ecosystem Services Markets

1. Mitigation

2. B2B

3. Government Payment Schemes

Source: Salzman. Jim. 2005. The Promise and Perils of Payments for Ecosystem Services.

GREEN INFRASTRUCTURE VISION

VERSION 2.3 ECOSYSTEM SERVICE VALUATION

✓Given existing peer reviewed science, GIV Version 2.2 can help estimate the monetized social benefit of conservation in comparison with the investments required to protect land.

✓ Balmford et al. (2002) found that if the values of ecological services are considered, the benefits from conserving natural land gives a return on investment of at least 100 to 1.

✓ A framework to better inform all levels of land use, conservation, development, and infrastructure planning and decision making.

2. Selecting ecosystem services to map

Ecosystem Service	Description
REGULATING & SUPPORTING	
Hazard Amelioration	
Water Flow Regulation / Flood Control	Maintain water flow stability and protect areas against flooding (e.g., from storms).
Water Purification	Maintain water quality sufficient for human consumption, recreational uses like swimming and fishing, and aquatic life.
Erosion Control and Sediment Retention	Maintain soil and slope stability, and retain soil and sediment on site.
Groundwater Recharge	Maintain natural rates of groundwater recharge and aquifer replenishment
Air Purification	Remove particulates and other pollutants from the air
Climate	
Microclimate Moderation	Lower ambient and surface air temperature through shading
Regulation of Water Temperature	Moderate water temperature in streams
Carbon Storage	Sequester carbon in vegetation and soils, thereby reducing atmospheric CO_2 and global climate change
Biological	
Support Native Flora and Fauna	Maintain species diversity and biomass
Pollination	Provide pollinators for crops and other vegetation important to humans
Pest and Disease Control	Provide biota which consume pests and control diseases
Provisioning	
Food Production	Production of plant or fungal-based food for human consumption
Game and Fish Production	Production of wild game and fish for human consumption
Fiber Production	Production of wood and other natural fibers for human use
Soil Formation	Long-term production of soil and peat for support of vegetation and other uses
Biochemical Production	Provision of biochemicals, natural medicines, pharmaceuticals, etc.
Genetic Information	Genetic resources for medical and other uses, including those not yet realized

2. Selecting ecosystem services to map

Ecosystem Service	Description
Cultural	
Recreation and Ecotourism	Outdoor, nature-based experiences like hiking, birding, hunting, camping, etc.
Savings in Community Services	Savings in community services from not converting natural land to houses
Increase in Property Values	Provide attractive location for homes and businesses
Science and Education	Existence of natural systems and areas for school excursions, advancement of scientific knowledge, etc.
Spiritual and Aesthetic	Aesthetic enjoyment or spiritual or religious fulfillment
Bequest value	The value placed on knowing that future generations will have the option to utilize the resource.
Existence value	The non-use value of simply knowing that particular resources exist, even if they are not used.

Total list 24 → Researched 9 → **To be mapped 6**

GREEN INFRASTRUCTURE VISION

VERSION 2.3 ECOSYSTEM SERVICE VALUATION

- ✓6 services mapped within the NIRPC-region:
  - ✓Water flow regulation/flood control
  - ✓Water purification
  - ✓Groundwater recharge
  - ✓Carbon storage
  - ✓Recreation and ecotourism
  - ✓Air purification

- ✓3 services researched but insufficient information to map:
  - ✓Microclimate moderation
  - ✓Increases in property values
  - ✓Flora and Fauna

Valuation Methods

Avoided cost: Services allow society to avoid costs that would have been incurred in the absence of those services (e.g., natural flood control preventing property damages or natural waste treatment preventing health costs)

Replacement cost: Services could be replaced with man-made systems (e.g., natural waste treatment having to be replaced by costly engineered systems)

Factor income: Services provide for the enhancement of incomes (e.g., water quality increasing commercial fisheries catches and fishermen incomes)

Travel cost: Service demand may require travel, whose costs can reflect the implied value of the service (e.g., value of ecotourism or recreation is at least what a visitor is willing to pay to get there)

Hedonic pricing: Service demand may be reflected in the prices people will pay for associated goods (e.g., increase in housing prices due to water views or access to parks)

Contingent valuation: Service demand may be elicited by posing hypothetical scenarios that involve some valuation of alternatives (e.g., how much people are willing to pay for increased availability of fish or wildlife).

Key NIRPC Region Ecosystem Services

Ecosystem Service	Metrics	Types of economic analyses
Water Flow Regulation / Flood Control	- Reduction of flood damage - Reduction of stormwater flows - Reduction of peak discharges - Reduction of combined sewer system costs - Reduction of soil erosion	- Avoided cost of constructing and operating stormwater management infrastructure - Replacement cost of damaged infrastructure
Water Purification	- Reduction of N, P, Cl-, sediment, bacteria, and other pollutants for drinking water, swimming, fishing, aquatic life, and other uses.	- Avoided cost of tertiary water treatment - Replacement cost of water treatment infrastructure
Groundwater Recharge	- Supply of water to groundwater rather than surface runoff	- Avoided cost of water constructing and operating supply infrastructure - Replacement cost of deeper wells - Price of public water supply
Carbon Storage	- Reduction of atmospheric CO2 and associated climate effects (increased storm intensity, droughts, and heat waves)	- Avoided cost of damage to trees from extreme weather events - Market price of carbon

Key NIRPC Region Ecosystem Services

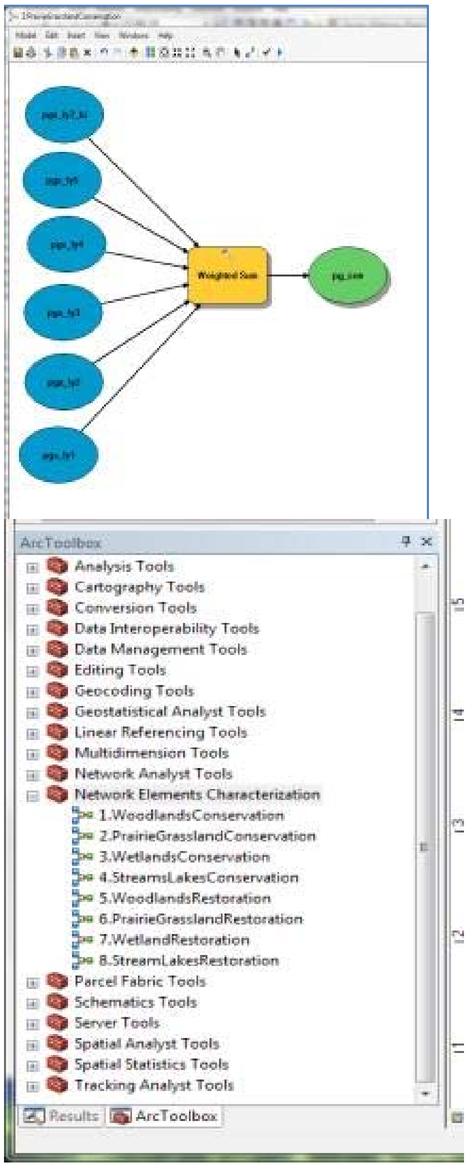
Ecosystem Service	Metrics	Types of economic analyses
Native Flora and Fauna	- Protection of wildlife habitat, Maintenance of ecosystem functions and resilience	- Surveys of willingness to pay for protection and maintenance
Recreation and Ecotourism	- Money spent on nature-based recreation (hunting, fishing, birding, hiking, etc.)	- Surveys of money expended on nature-based recreation
Air Purification	- Removal of SOx, NOx, O3, CO, and PM10 from the air (pollutants with public health impacts)	- Avoided cost of air quality improvement systems - Replacement cost of infrastructure due to poor air quality
Microclimate Moderation	- Energy savings - Reduction of CO2 emissions	- Avoided cost of energy production and utility bills
Increase in Property Values	- Increase of property prices	- Hedonic analysis of components of real estate value

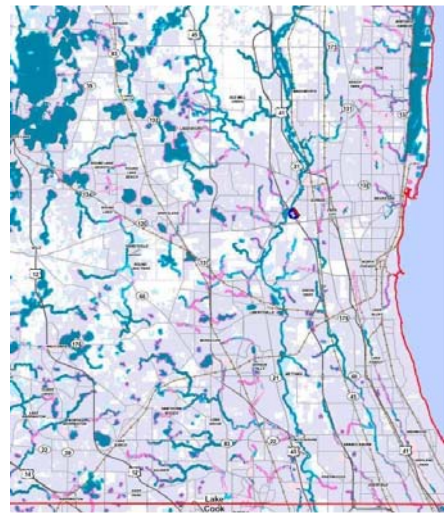
Assigning Values to Landscape Types

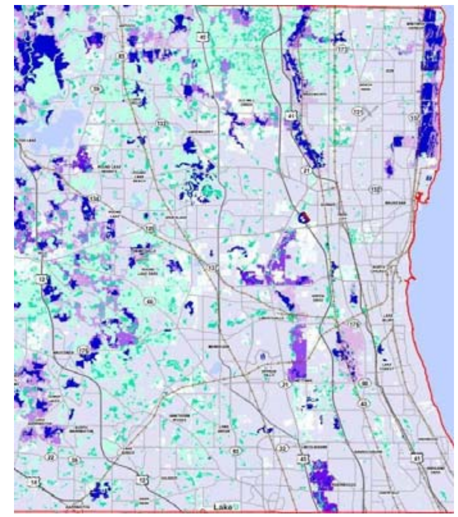
		LANDSCAPE TYPE				
ECOSYSTEM SERVICE		Woodlands / Forest	Prairie / Grassland / Savanna	Wetlands	Natural Floodplains	Lakes
Water Flow Regulation/ Flood control	Selected	$1,603	$16,000	$22,000	$6,500	$37,000
	Median	$1,415	$16,000	$4,900	$3,700	$43,000
Water Purification	Selected	$1,300	$57	$4,350		$0
	Median	$1,060	$57	$3,429		$0
Groundwater Recharge	Selected	$269	$269	$660	$4,806	$566
	Median	$269	$269	$2,479	$4,806	$566
Carbon Storage	Selected	USE SPATIALLY EXPLICIT DATA FROM NBCD + gSSURGO				
	Median	$133	$82	$136		$0
Air Purification	Selected	$390	No data	No data	No data	No data
	Median	$390				
Recreation and Ecotourism	Selected	$48	$48	$1,434	$2,229	$335
	Median	$48	$1	$1,434	$2,229	$335

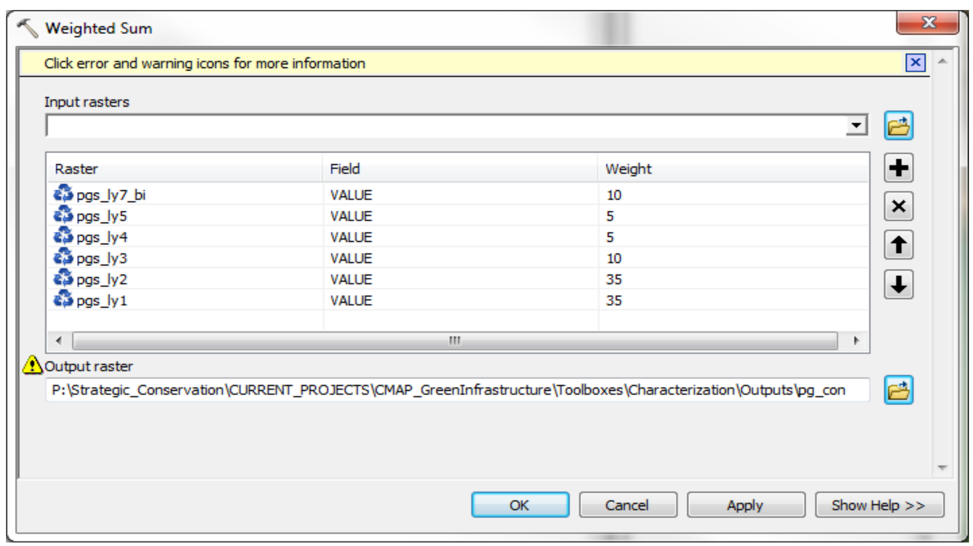
Technical Approach

Apply the ecosystem service values spatially on the GIV version 2 map layers









Water Flow Regulation / Flood Control

- A large tree can reduce 5,400 gallons of stormwater runoff per year in the Midwest. A forest stand can intercept over 200,000 gallons per acre per year.

- An acre of forest provides an avoided stormwater treatment cost of $21 per acre per year and over $9,000 per acre per year in avoided gray infrastructure investment costs.

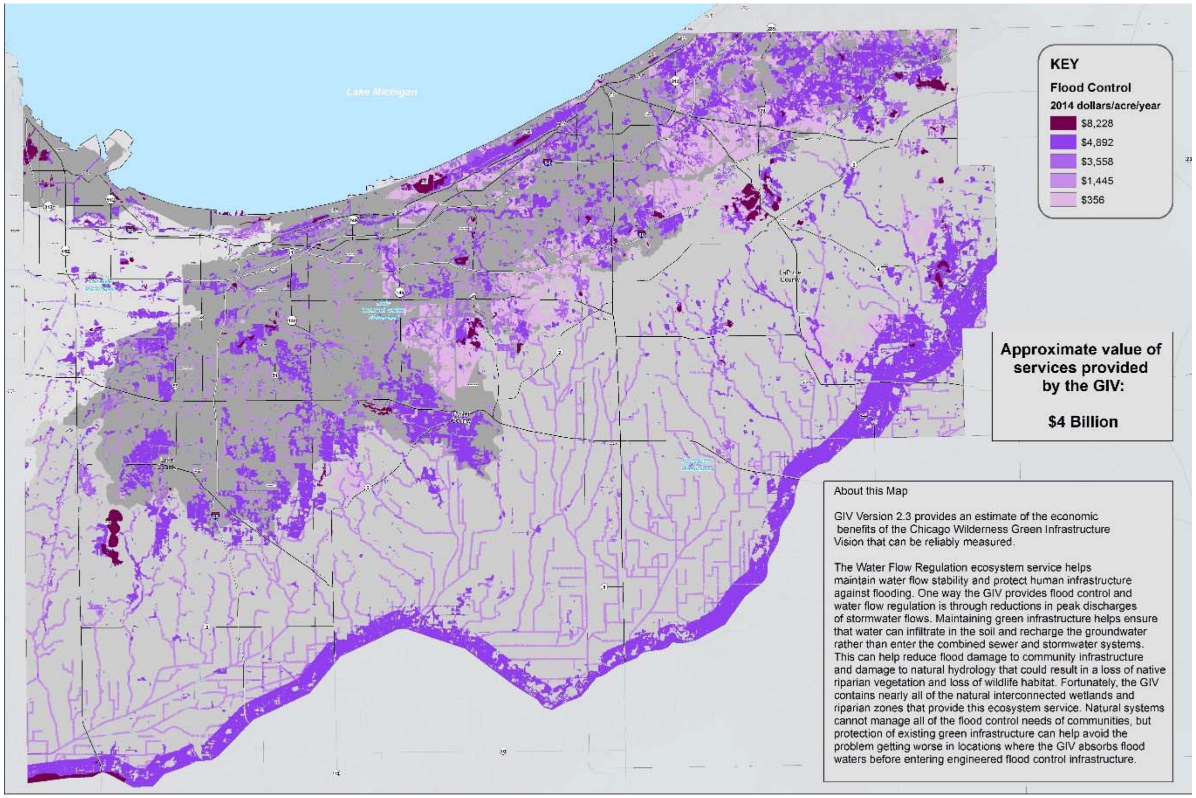
- An acre of wetlands can typically store 1-1.5 million gallons of floodwater.

- In Wisconsin, watersheds with 30% wetland or lake area had flood peaks 60-80% lower than watersheds with no wetland or lake area.

- Not building in floodplains in the Chicago metropolitan area could save an average $900 per acre per year in flood damages.

Water Flow Regulation / Flood control

	Median ($2014/ ac)	Selected ($2014/ ac)
Woodlands / Forest	$1,415	$1,603
Prairie / Grassland / Savanna	$16,000	$16,000
Wetlands	$4,900	$22,000
Natural Floodplains	$3,700	$6,500
Lakes	$43,000	$37,000



Water Purification

- Forested buffers can remove up to 21 pounds of nitrogen and 4 pounds of phosphorus per acre per year from upland runoff. Forest buffers can reduce up to 98% of nitrogen, phosphorus, sediments, pesticides, pathogens, and other pollutants in surface and groundwater.

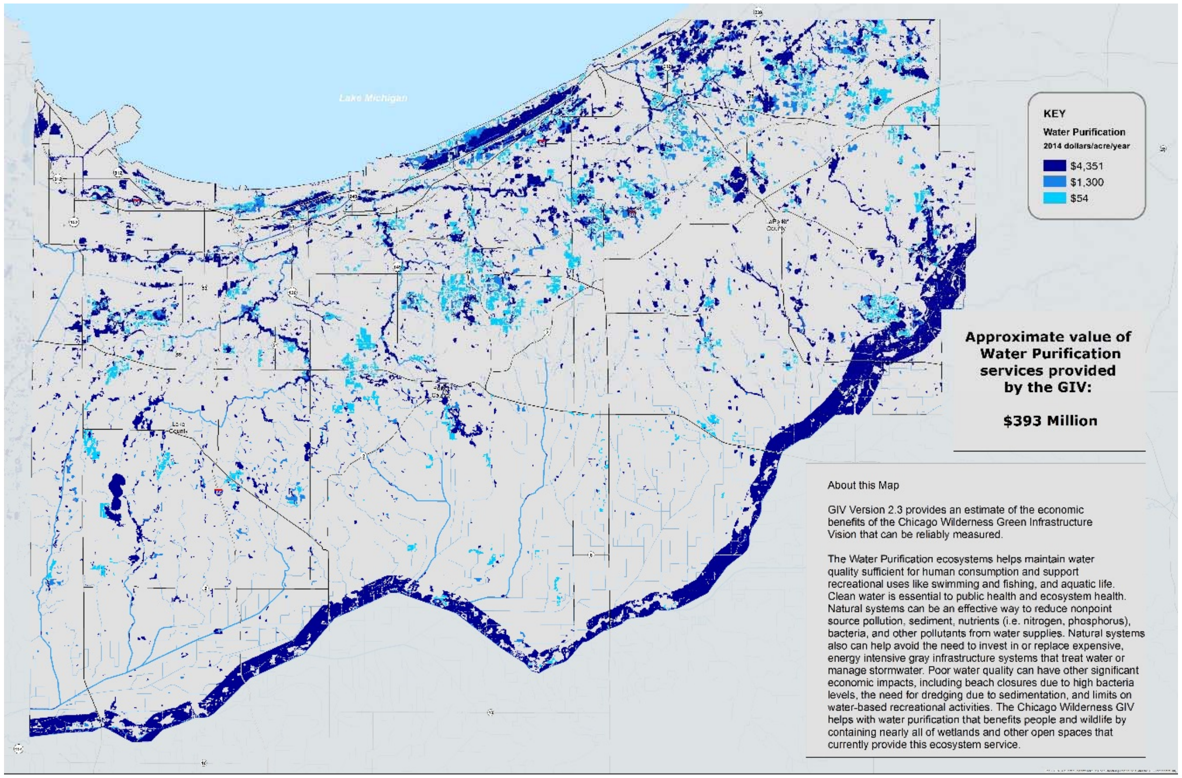
- In a comparison of 11 types of BMPs for treating stormwater runoff, constructed wetlands were the most effective. The wetland removed 100% of suspended solids, 99% of nitrate, 100% of zinc, and 100% of petroleum byproducts, and reduced peak flows by 85%. This greatly exceeded the performance of standard retention ponds, as well as expensive manufactured devices.

- The average wastewater treatment costs using conventional methods are $4.36 per 1,000 gallons, but through wetlands construction, the cost is only $0.63/1,000 gallons ($2014).

- The cost of restoring and operating wetlands to remove nitrogen and phosphorus can be 50-70% less than the cost of constructing and operating engineered wastewater treatment systems.

Water Purification

	Median ($2014/ ac)	Selected ($2014/ ac)
Woodlands / Forest	$1,060	$1,300
Prairie / Grassland / Savanna	$57	$57
Wetlands	$3,429	$4,350



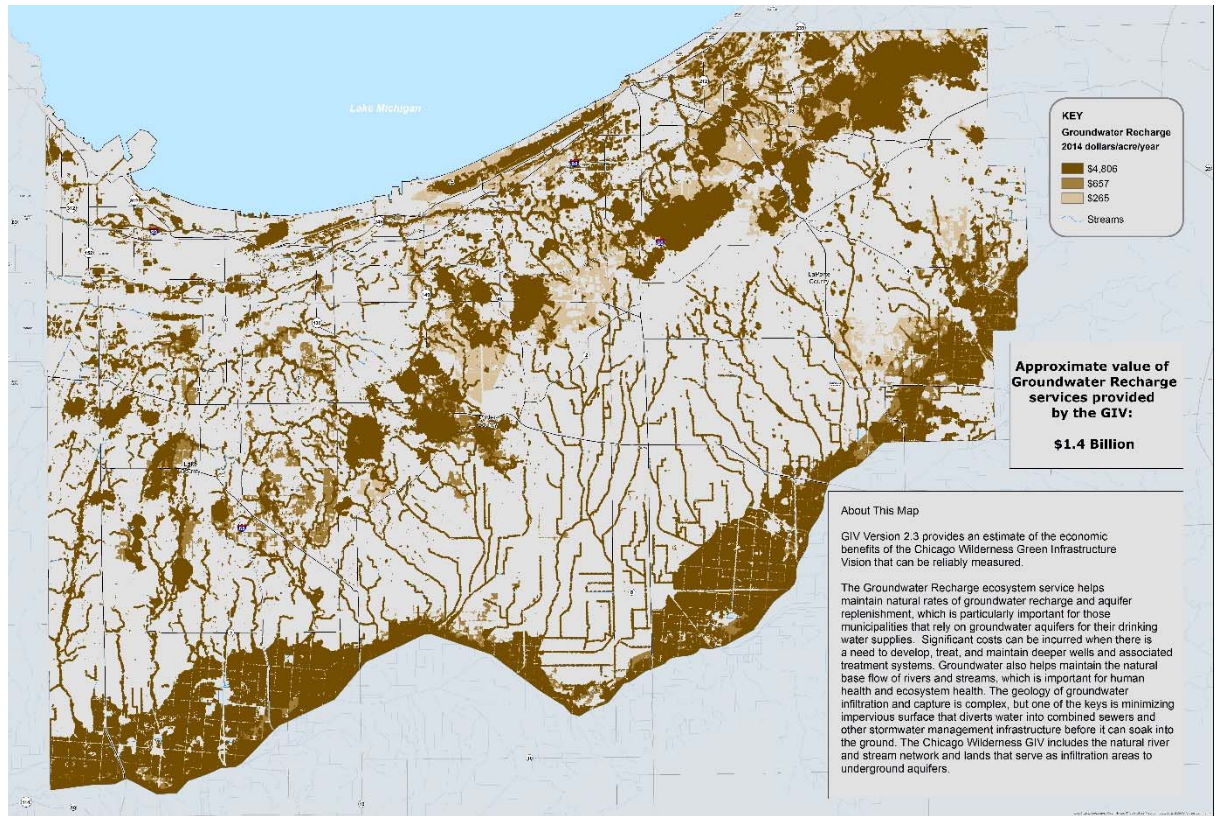
Groundwater Recharge

- Forest soils can store 50% more water than urban land and allow 34% more groundwater recharge.

- Forested wetlands overlying permeable soil can release up to 100,000 gallons per acre per day of groundwater.

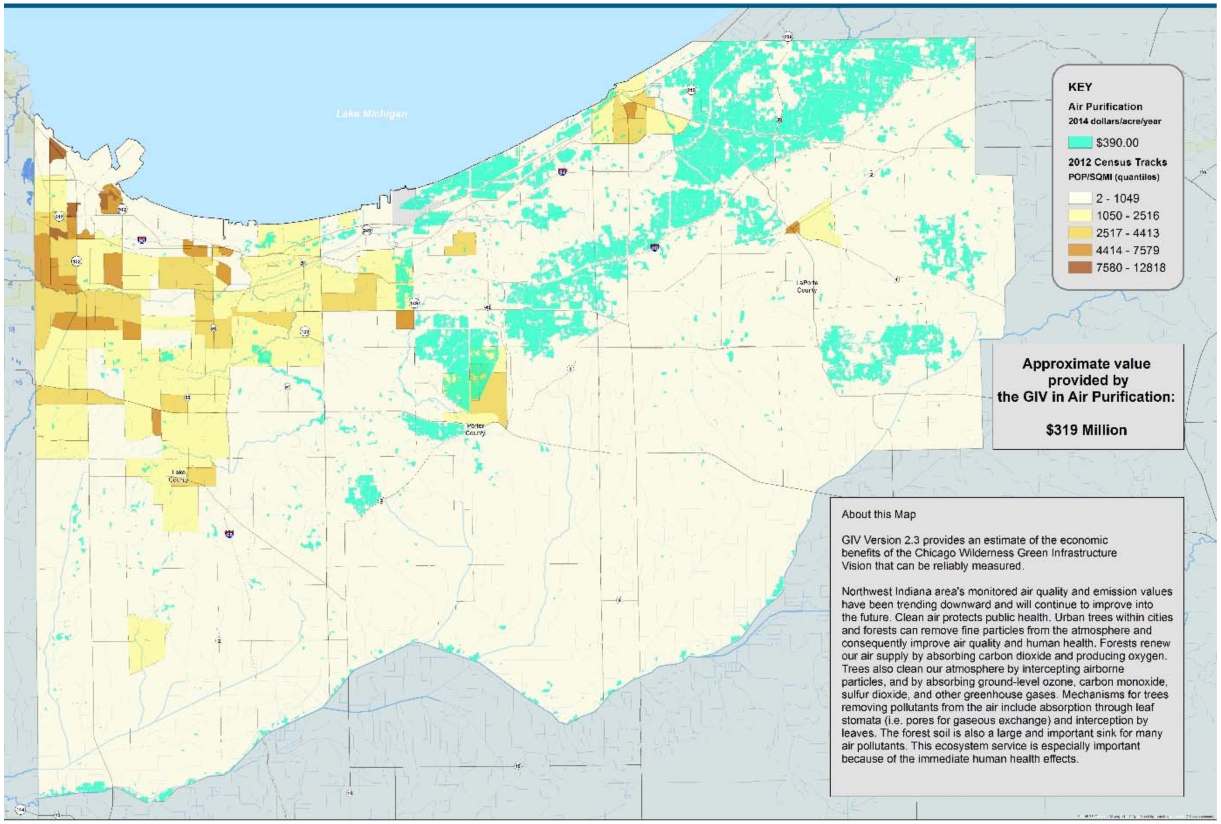
Groundwater Recharge

	Median ($2014/ac)	Selected ($2014/ac)
Woodland / Forest	$269	$269
Prairie / Grassland / Savanna	$269	$269
Wetlands	$2,479	$660
Natural Floodplain	$4,806	$4,806
Lakes	$566	$566



Air Purification

	Median ($2014/ ac)	Selected ($2014/ ac)
Woodland / Forest	$390	$390
Prairie / Grassland / Savanna	No Data	No Data
Wetlands	No Data	No Data
Natural Floodplain	No Data	No Data
Lakes	No Data	No Data



Carbon Storage

- Forests help remove large amounts of CO_2 from the air. During photosynthesis, trees convert CO_2 into oxygen; carbon is also stored in the body of the tree, in the soil surrounding its roots, and in debris that falls to the ground. Larger and healthier trees sequester carbon at greater rates.

- A large tree can remove over 1,000 pounds per year of CO_2 from the atmosphere.

- A mature oak-hickory forest can contain over 130 tons of carbon per acre.

- Restoring prairie vegetation rebuilds organic matter in the surface soil and sequesters carbon, taking centuries to reach maximum storage potential.

- Remnant prairie at Fermi National Accelerator Laboratory contained around 0.76 kg of carbon per square meter above ground and 13.5 kg per square meter below ground.

Carbon Storage

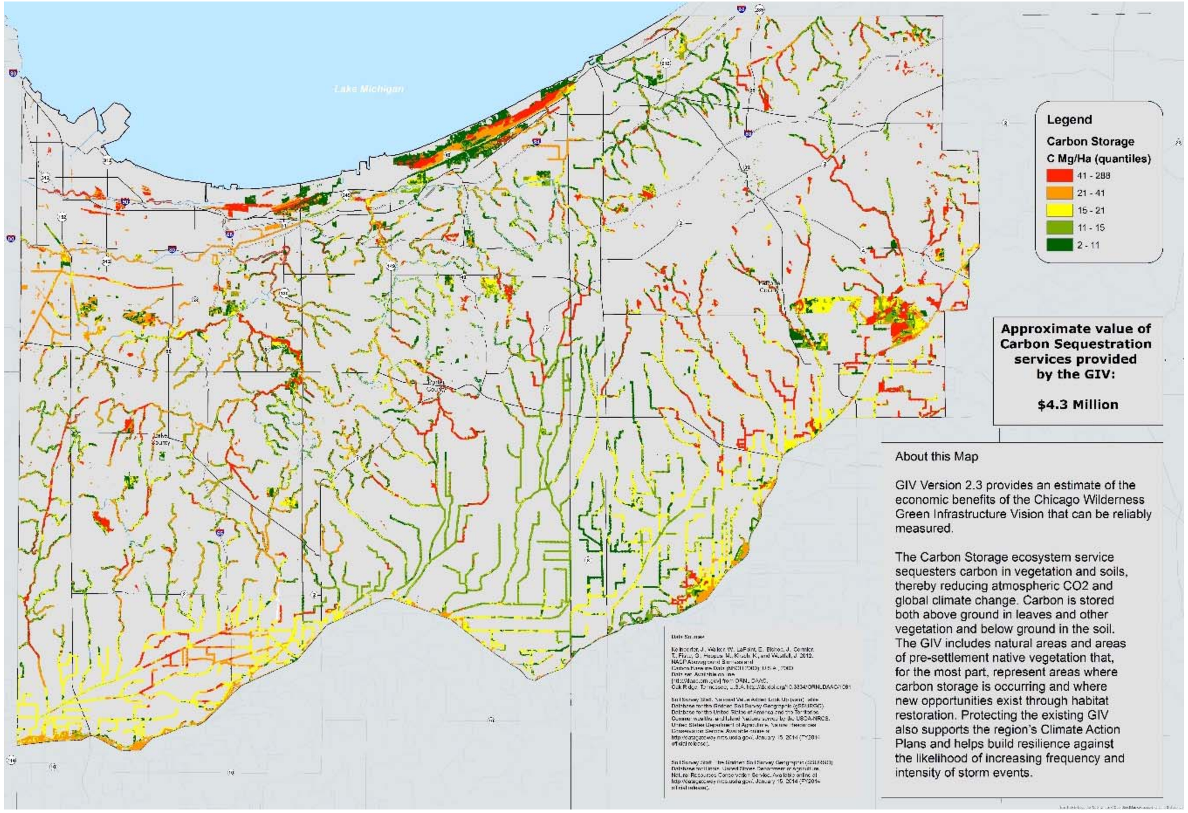
The carbon storage value per grid cell
= (**C**above + **C**below) * $2/tonne/year

Cabove = Aboveground carbon storage (dry weight biomass * 0.5) from NBCD

Cbelow = Belowground carbon storage from gSSURGO

$2/tonne/year was estimated avoided future damage from the carbon being sequestered in vegetation and soil instead of in the atmosphere.

This is a snapshot in time. In the absence of disturbance, carbon storage will increase over time as forests and prairie reach maturity. Disturbances, especially fire, will release some of this carbon (primarily from the aboveground stock) into the atmosphere.

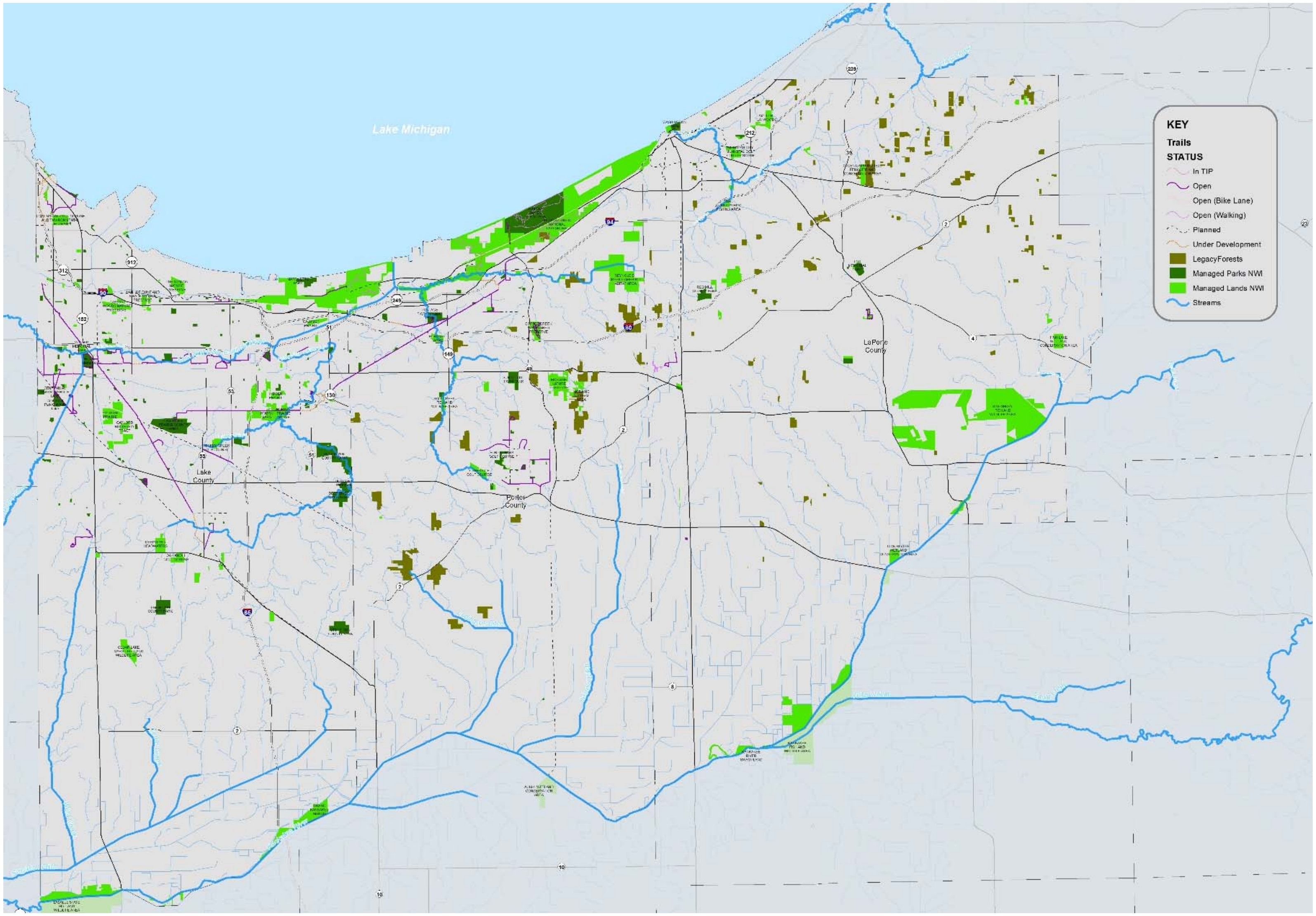


Recreation and Ecotourism

$121 million/year for Indiana Dunes State Park

$168 million/year for Indiana Dunes National Lakeshore

Total = $289 million/year



Implementation: Case Study

Greenseams® - a Regional Green Infrastructure Plan in partnership with the Milwaukee Metropolitan Sewerage District

- Non-structural approach to flood management
- Land acquisition (easement or fee simple)
- Preserving undeveloped lands, connecting corridors
  - 65,000 gallons retained per acre
  - $9+ Million leverage

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ENBRIDGE LINE 6B

FUNDING OPPORTUNITY IN NORTHWEST INDIANA

- Acquisition or Restoration of forest habitat for migratory birds
- $500,000 available
- Can be used as matching funds for federal programs/ Indiana BNT program
- Lake, Porter, La Porte and St. Joseph Counties

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Lauri Lindquist
269-426-8825

llindquist@conservationfund.org

ENBRIDGE LINE 6B: Completed Projects

- Addition to Deep River County Park – Lake County Parks

- Robert C. Frame and Ruth J. Frame Little Calumet Conservation Area – Porter County Chapter Izaak Walton League

Questions