
Great
Lakes
Lake
Michigan
Commission
ecosystem
Superior
water
environmental
management
resources
communities
health
integrity
development
citizens
natural
protect
provide
economic
actions
healthy
policy
consensus
education
benefit
basin
Erie
innovative
sustain
lives
protection
preventive
dedicated
provides
largest
fulfill
programs
Basin
States
biodiversity
connecting
coastal
advocacy
system
national
society
human
conserving
communication
focus
public
personal
contaminants
government
participants
consumer
ensures
native
policies
pelagic
building
environmentally
supports
use
organizations
managed
biological
believe
scope
protected
noted
including
among
dialogue
affecting
safe
eat
created
vision
shorelines
tributaries
information
region
moving
free
preventable
physical
fish
advocates
River
lake
life
responsibility
cooperation
bi
anywhere
Ontario
products
may
economically
chemical
environment
Land
materials
project
integrated
future
voice
Heart
provinces
regional
work
restore
Compact
Sea
states
leadership
ensure
facilitation
foundation
integration
committed
procedures
conservation
collectively
Office
reporting
speak
collaborative
processes
quality
clean
Grant
sustainable
people
Vision
coordination
maintained
land
issues
landscapes
generations
Huron
Member
habitats
toxic
unified
resource
extent

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Ecosystem Services – An Introduction

Michigan SWCS 9 Mar 2011 Dr. Patrick Doran

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Aldo Leopold

A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

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Aldo Leopold

Examine each question in terms of what is ethically and aesthetically right, as well as what is economically expedient.

A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.

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Ecosystem Services

The benefits people derive from the environment

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Provisioning Services

Products obtained from ecosystems

- Food
- Fresh water
- Fuelwood
- Fiber
- Biochemicals
- Genetic resources

Regulating Services

Benefits obtained from regulation of ecosystem processes

- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- Pollination

Cultural Services

Nonmaterial benefits obtained from ecosystems

- Spiritual and religious
- Recreation and ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage

Supporting Services

Services necessary for the production of all other ecosystem services

- Soil formation
- Nutrient cycling
- Primary production

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A Useful Categorization…

- Final ecosystem services
  - Tangible benefits to people
  - E.g., clean water for drinking
  - More direct link to human well-being
  - More often valued
- Intermediate ecosystem services
  - Other ecosystem processes that are needed to produce a final ecosystem service
  - E.g., proper nutrient cycling in a watershed
  - Less direct link to human well-being
  - Less frequently valued

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Cropland Agriculture

- Total global value of crops greater than $1 trillion annually
- Food production has increased by 168% over last 4 decades.
- Crop production per se not very compatible with biodiversity
- Most conservation projects seek to make agriculture more

ViaMoi

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Forage for Livestock

- Total value more than $600 billion
- Extensive production often compatible with some biodiversity in grassland systems
- Movement toward more intensive production
- Many “working lands” projects at TNC

NDSU Ag Comm

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Relevant Services: Timber

- Global value of timber harvest is $400 billion
- Harvests have increased by 40% over recent decades
- Harvesting can be sustainable or not
- Very common ES project for TNC (IP, Great Bear)

teejaybee

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Carbon

- Current market $140 billion
- Right now less than $20/ton, may rise with climate agreement
- Projects to increase sequestration may be compatible with biodiversity
- REDD projects usually

MizzD

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Erosion Control

- Affects more than 1.1 billion ha per year, moves 75 billion tons of soil
- Reduces farm productivity by 0.1%/yr in the US, off-site damages $2-8 billion/yr
- Most TNC projects aim at stopping erosion to protect freshwater

cyberdees

Biodiversity

- 3 big "final" ES:
  - Existence value
  - Option value
  - Bequest value
- Very difficult to quantify, but clearly significant (e.g., much TNC fundraising!).
- Biodiversity motivates a large part of what TNC does, but usually for its intrinsic value

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Water Purification (Irrigation, Residential, Industrial)

- More than 1 billion lack access to safe drinking water
- Water-borne diseases kill 1.7 million lives/yr
- Treatment facilities are expensive- $10's millions
- Natural ecosystems can serve that role. Wetlands are worth $288/ha for water treatment on average.
- Key ES for TNC: Water funds, floodplain restoration…

USFWS Pacific

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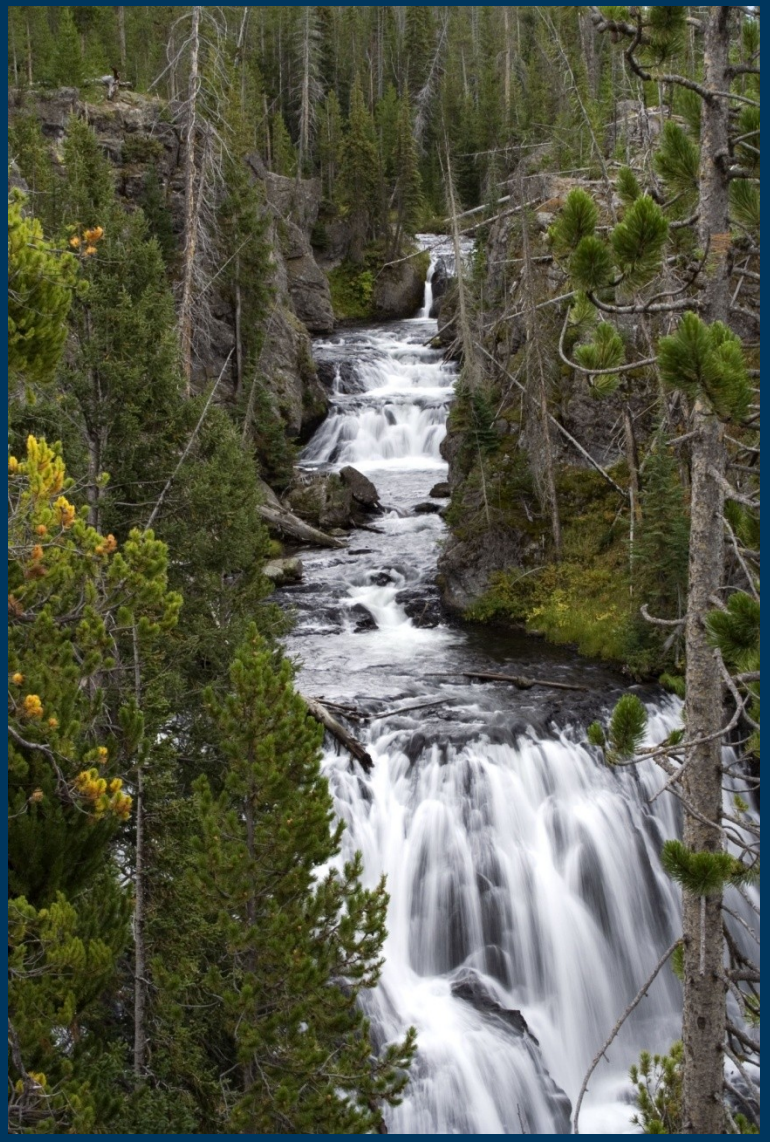
Water Quantity (Irrigation, Residential, Industrial, Hydropower)

- Land-use changes affect quantity of water available
- Maintaining or restoring natural habitat *may* increase water quantity.
- South African example with invasive trees being removed
- Less frequent as a conservation ES project



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Recreation and Tourism

- At least $500 billion annually on just tourism
- Only some tourism and recreation dependent on nature
- TNC helps promote "open space" and preserves for hunting, fishing, etc.
- Ecotourism

GuideGunnar

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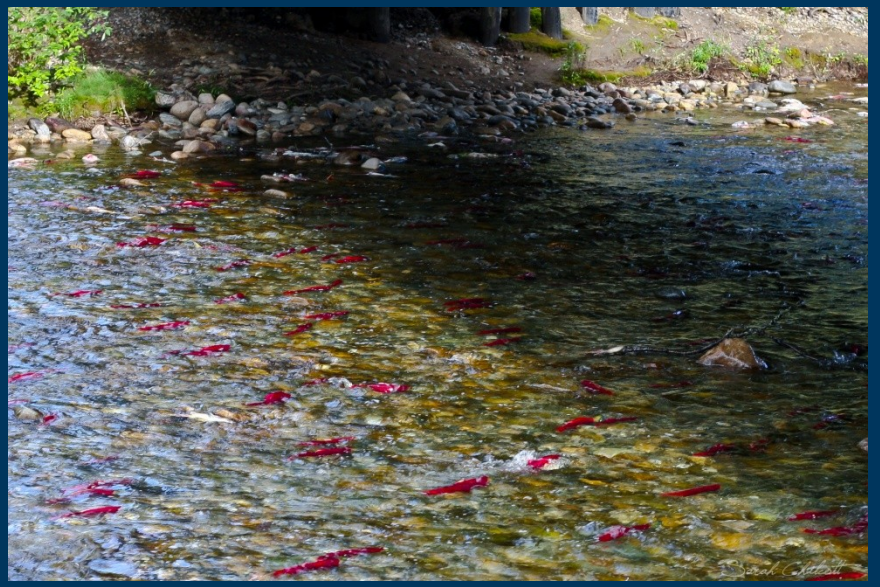
Fish Production

- Large volume harvested, although often from non-native species
- Can be subsistence, or recreation
- In the US, $30 billion a year industry



SBC9

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Water Timing (Flood Regulation)

- Natural habitat tend to:
  - reduce peak flows
  - increase groundwater infiltration
- Maintaining or restoring natural habitat can thus mitigate flooding

Revo_1599

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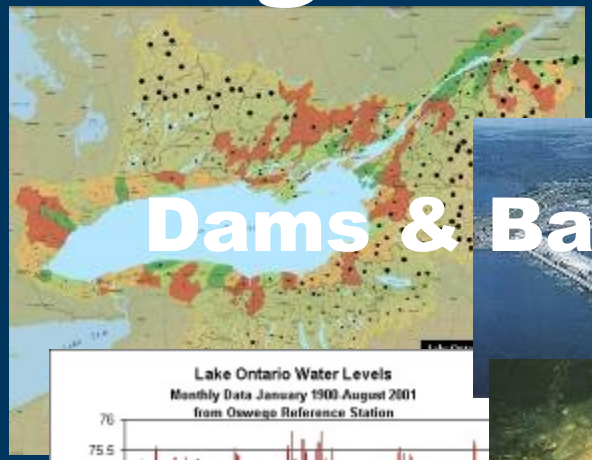
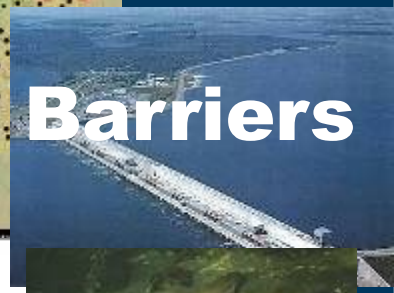
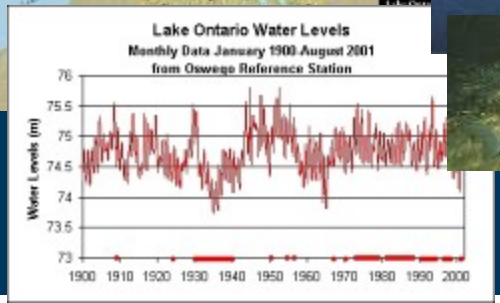
Ecosystem of Opportunity…


en water benthic & pelagic systems
©Shedd Aquarium
islands
tributaries
nearshore
migratory fish
coastal terrestrial
coastal wetlands
aerial migrants

Climate Change

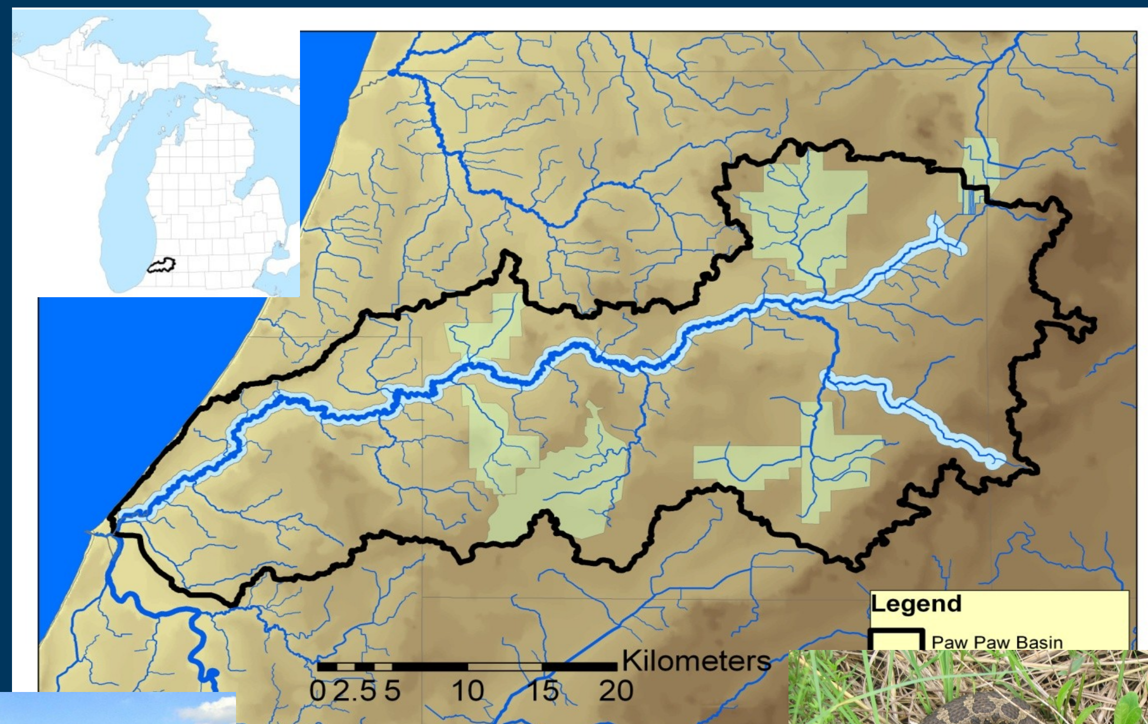


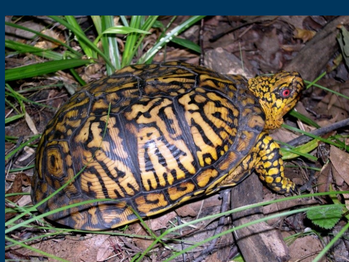


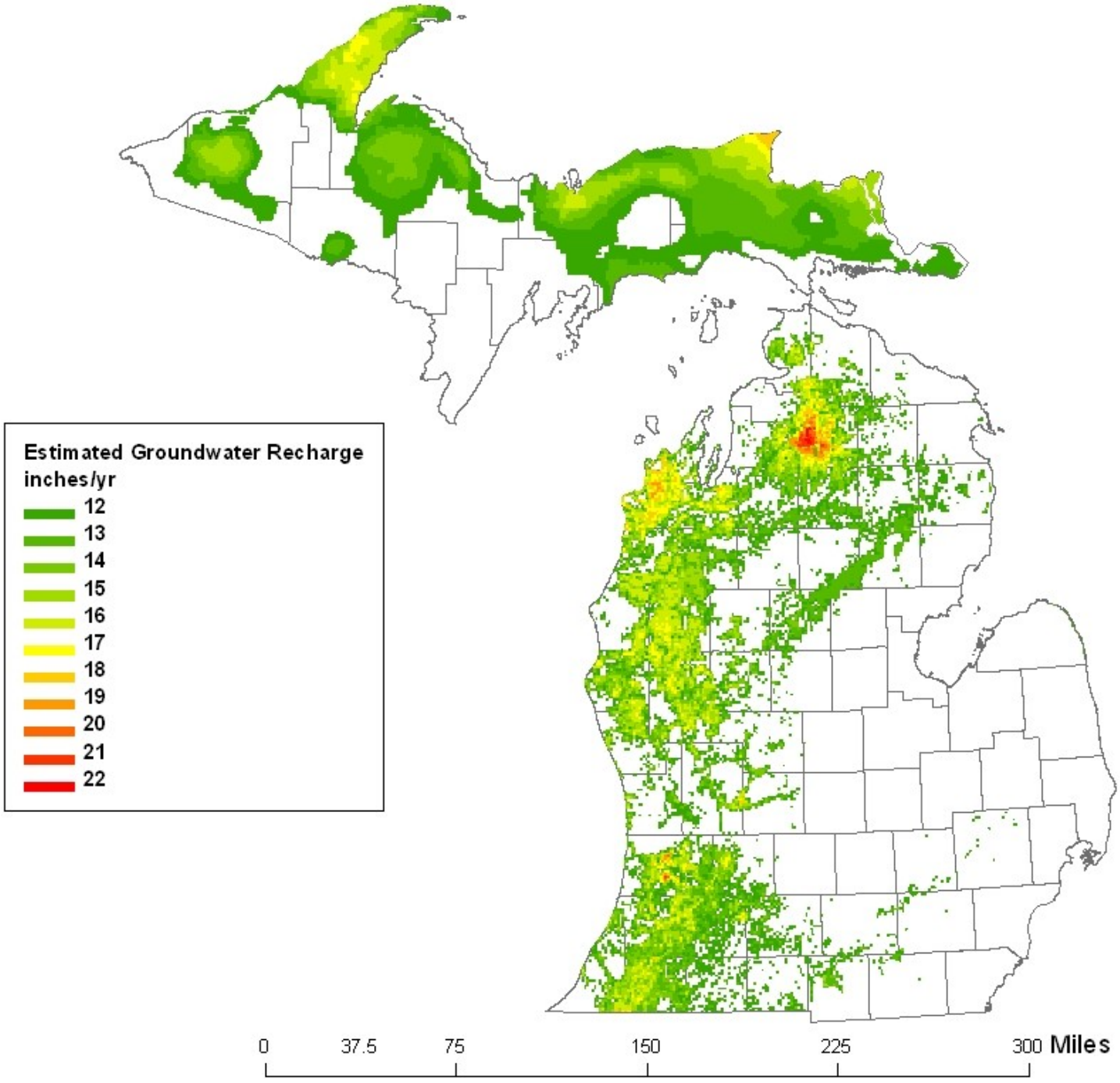


Paw Paw Watershed

- Freshwater Targets: Paw Paw Mainstem & East Branch
  - Significant stresses: sedimentation and altered hydrology
  - Strategy: application of agricultur
    rvat
    ces






Estimated Groundwater Recharge
inches/yr
12
13
14
15
16
17
18
19
20
21
22
0
37.5
75
150
225
300
Miles

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Agricultural Conservation Practices (BMPs)

Ecosystem Services Approach…

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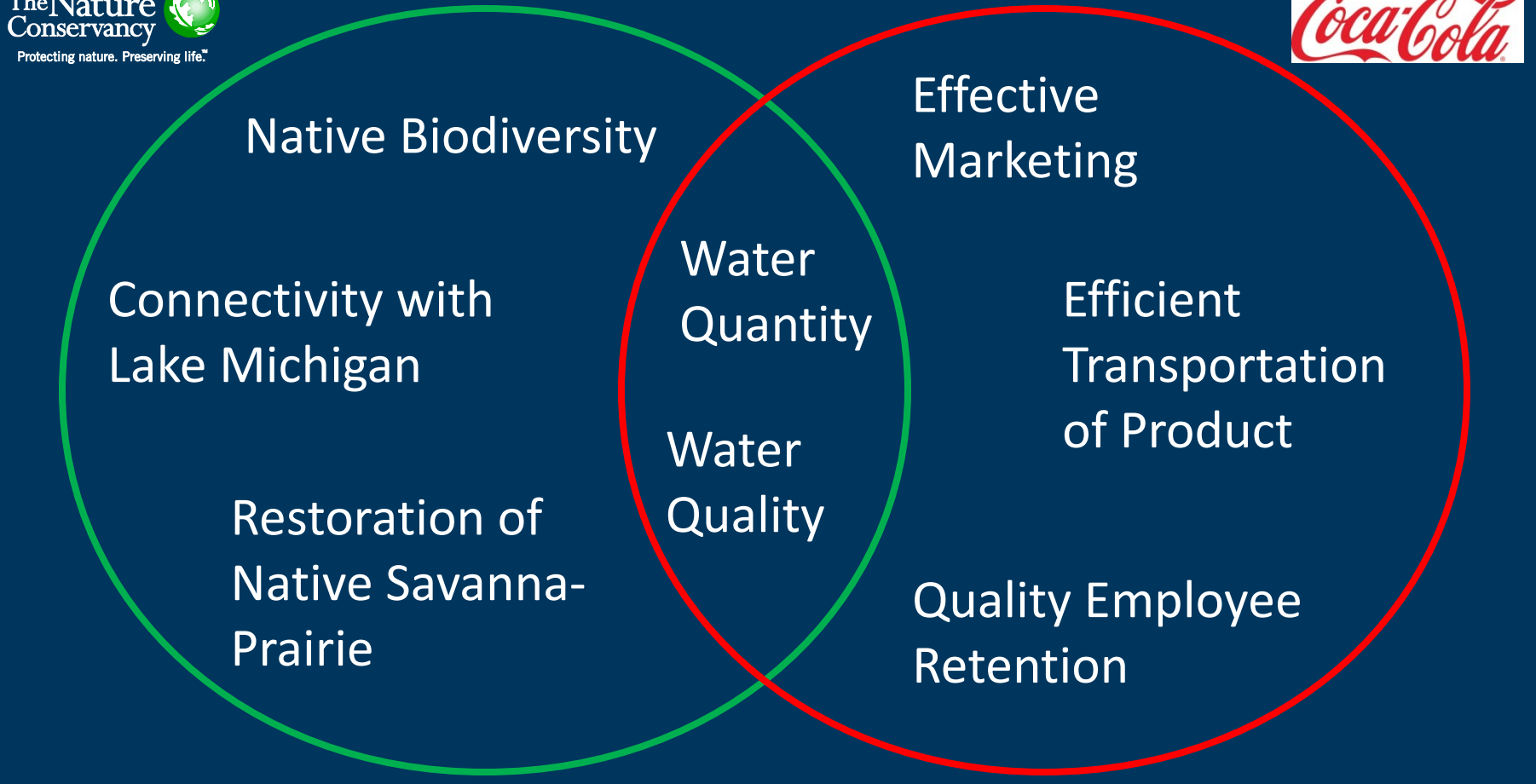
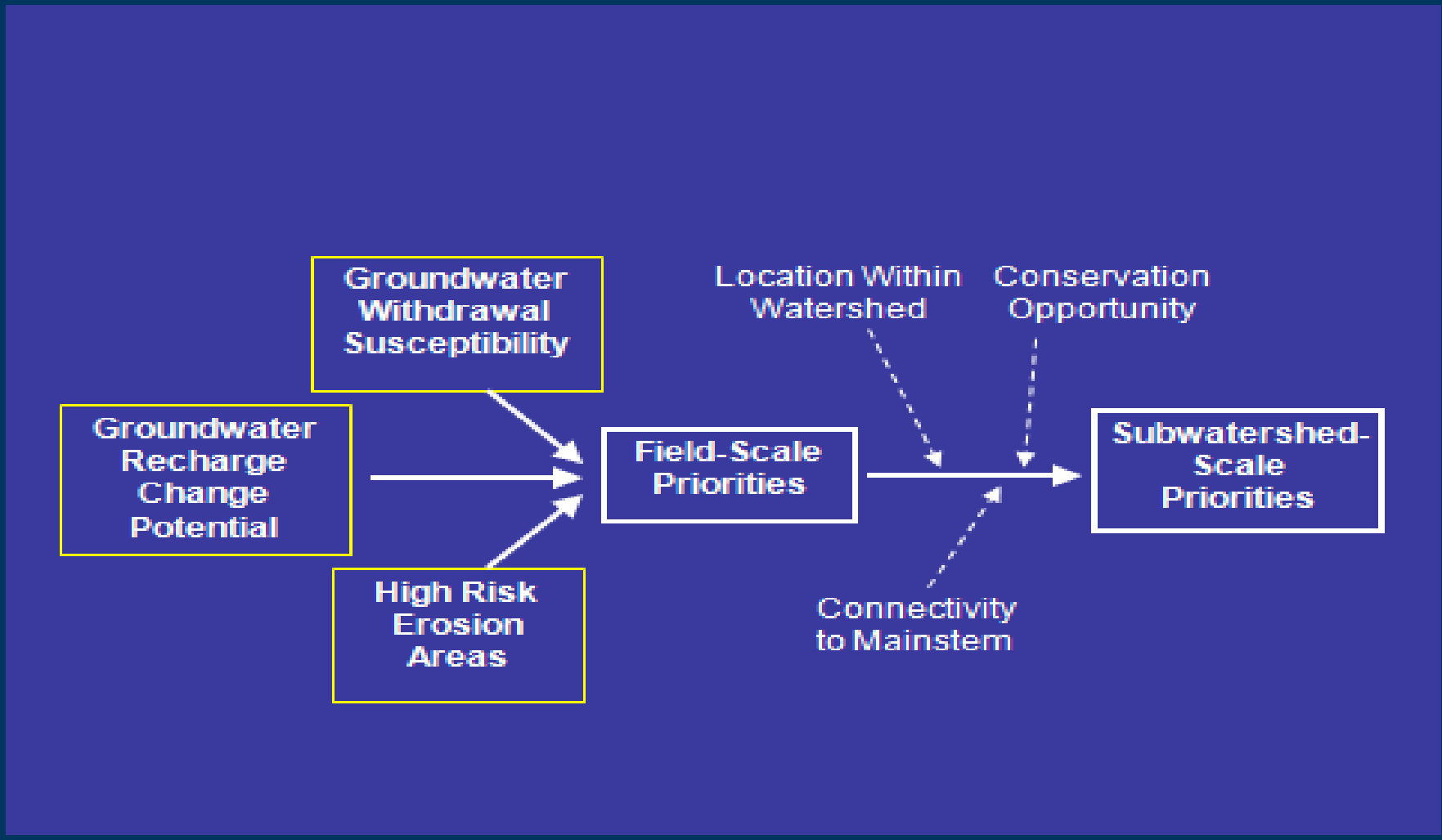
Paw Paw River Conservation

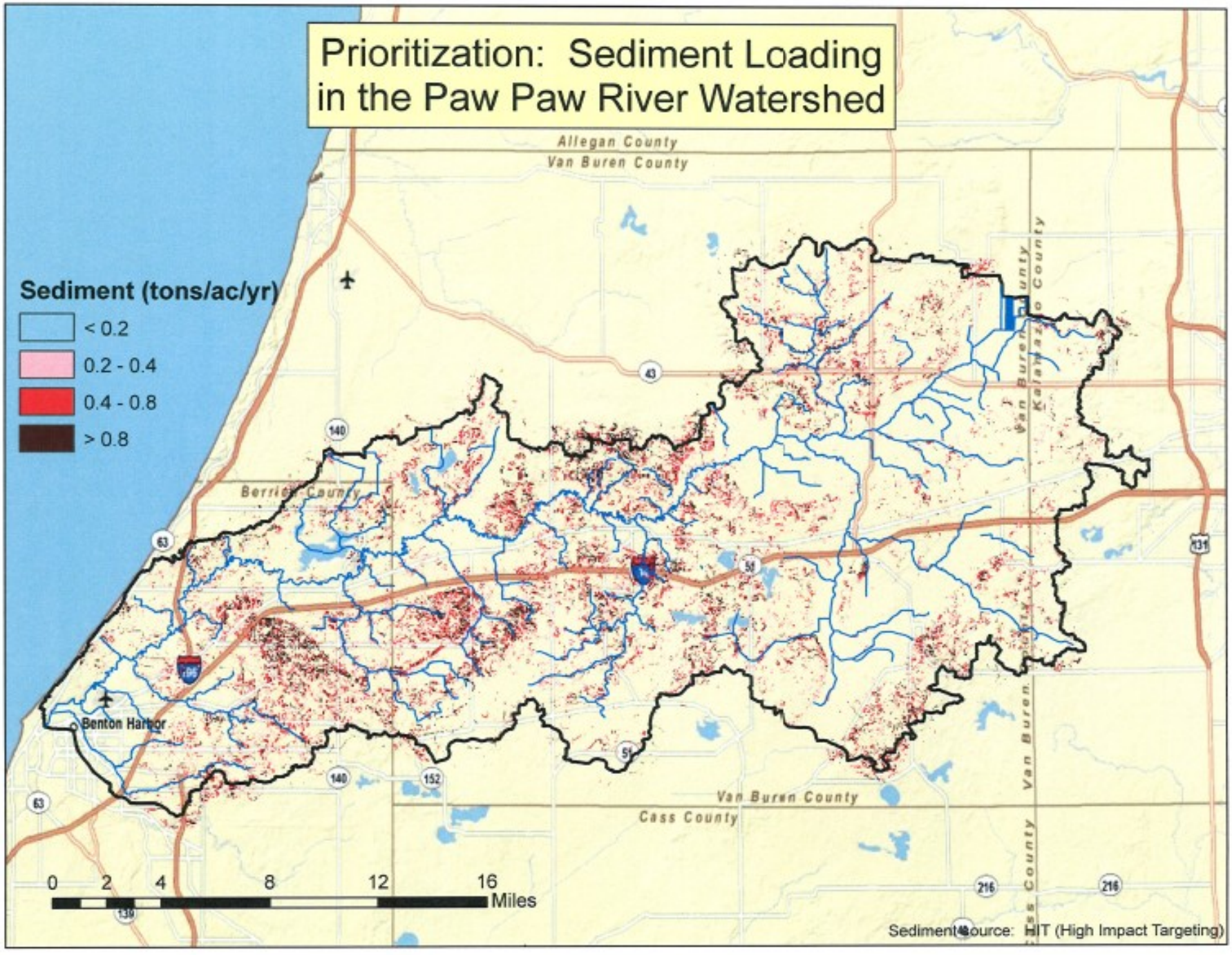
Coca Cola

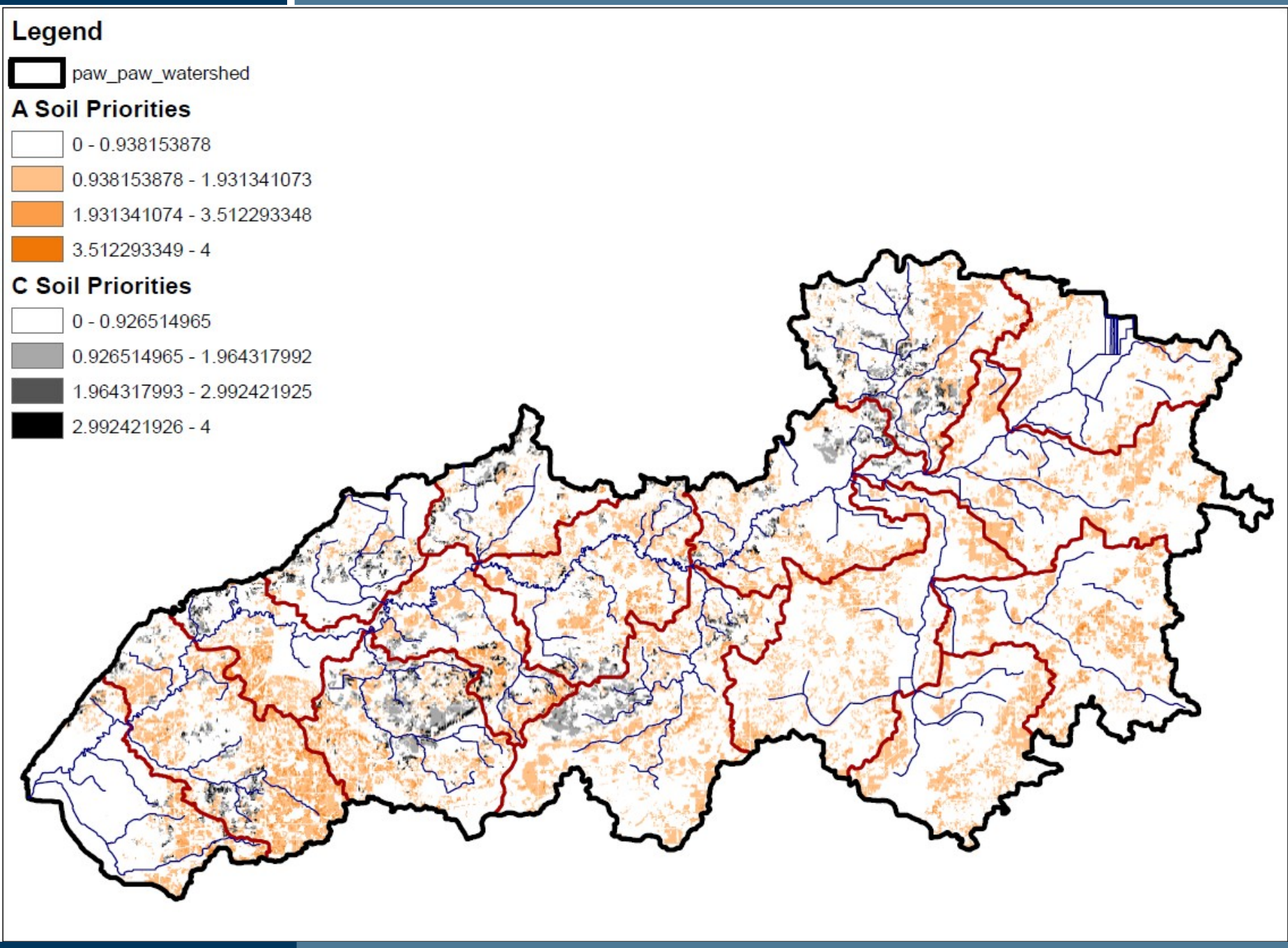
Bottling Plant Profitability



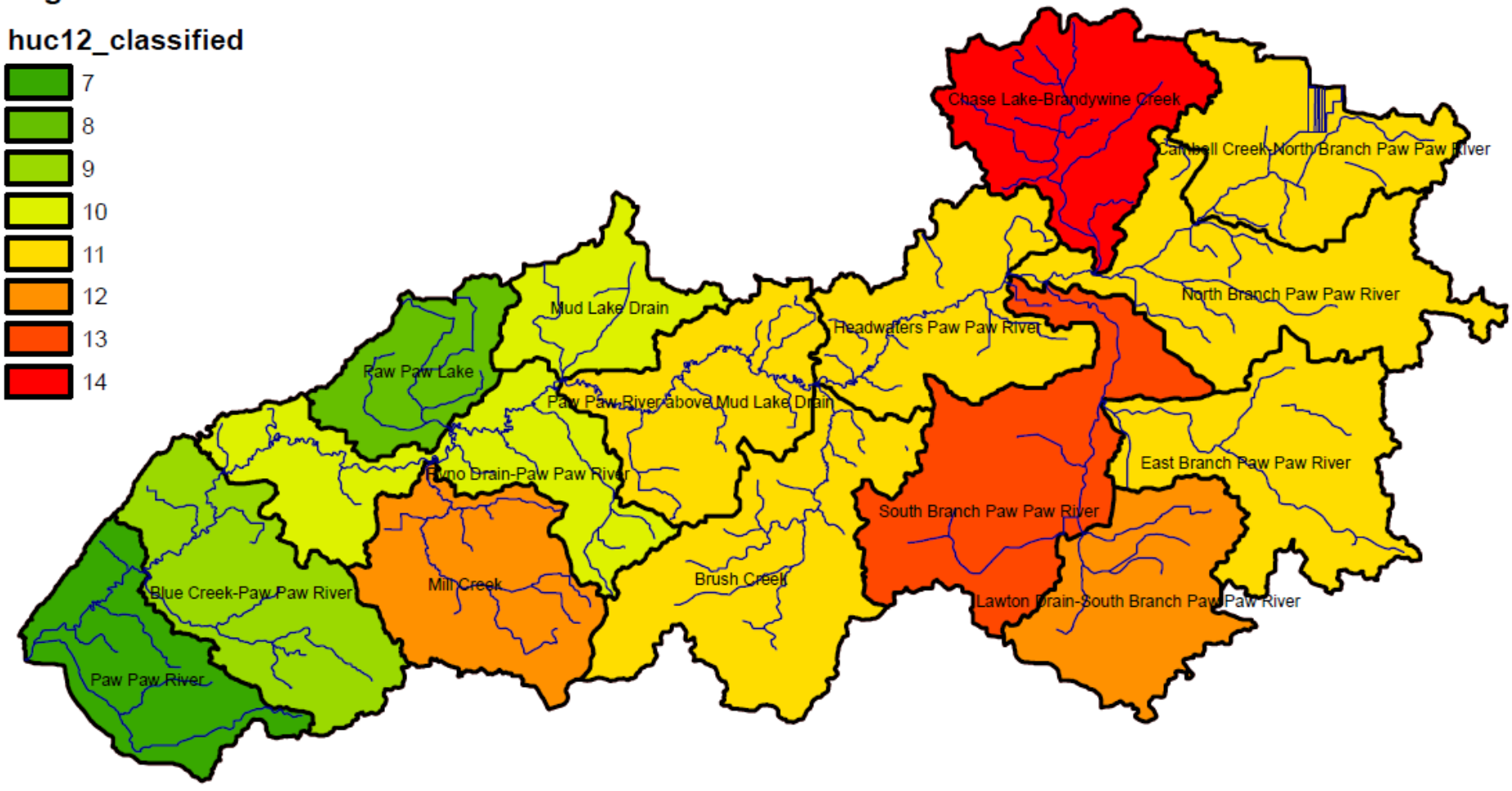
BMP Prioritization Diagram

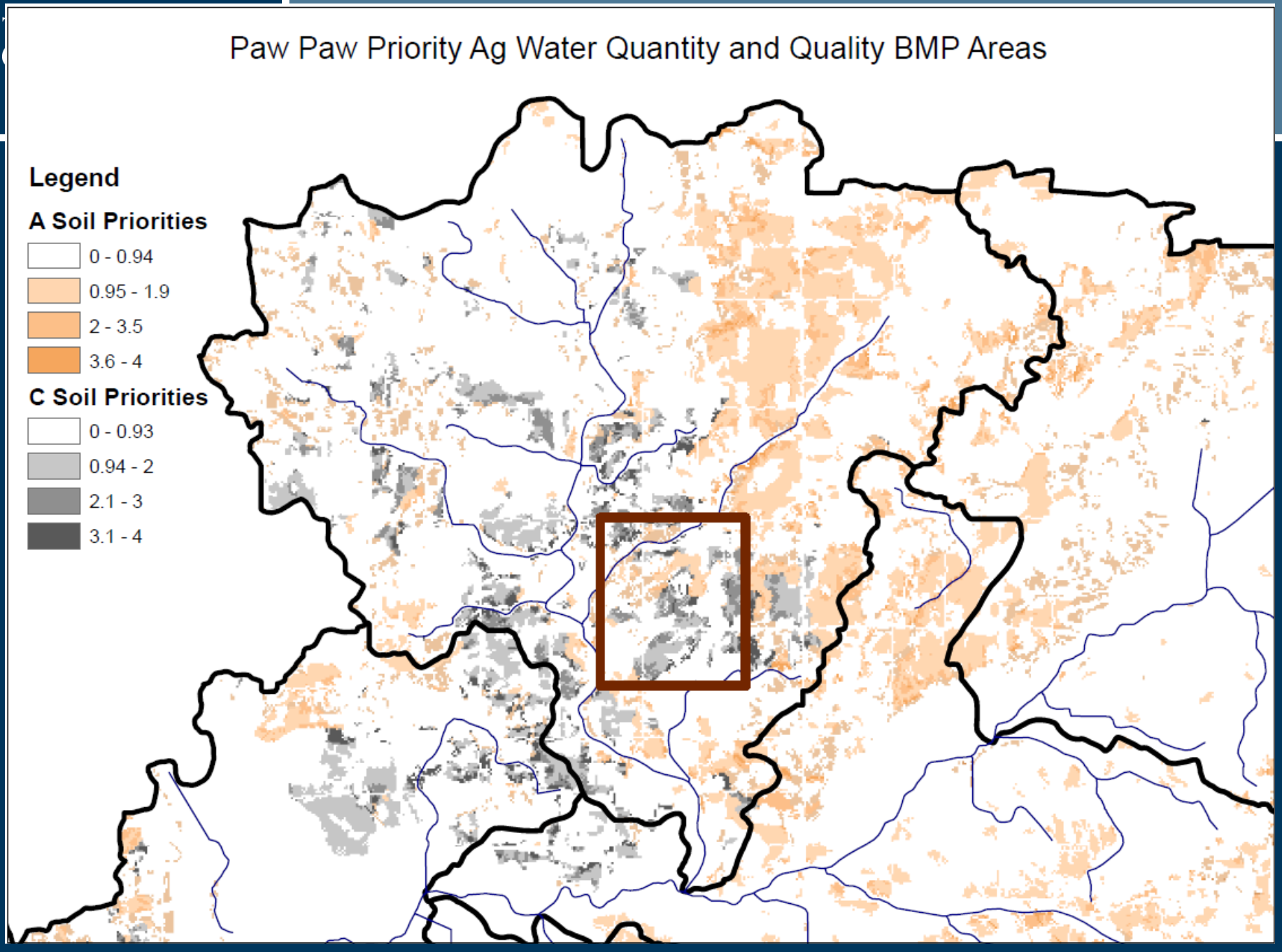



Prioritization: Sediment Loading in the Paw Paw River Watershed
Sediment (tons/ac/yr)
< 0.2
0.2 - 0.4
0.4 - 0.8
> 0.8
Allegan County
Van Buren County
Berrien County
Benton Harbor
Van Buren County
Cass County
Kalamazoo County
0 2 4 8 12 16
Miles
Sediment Source: HIT (High Impact Targeting)

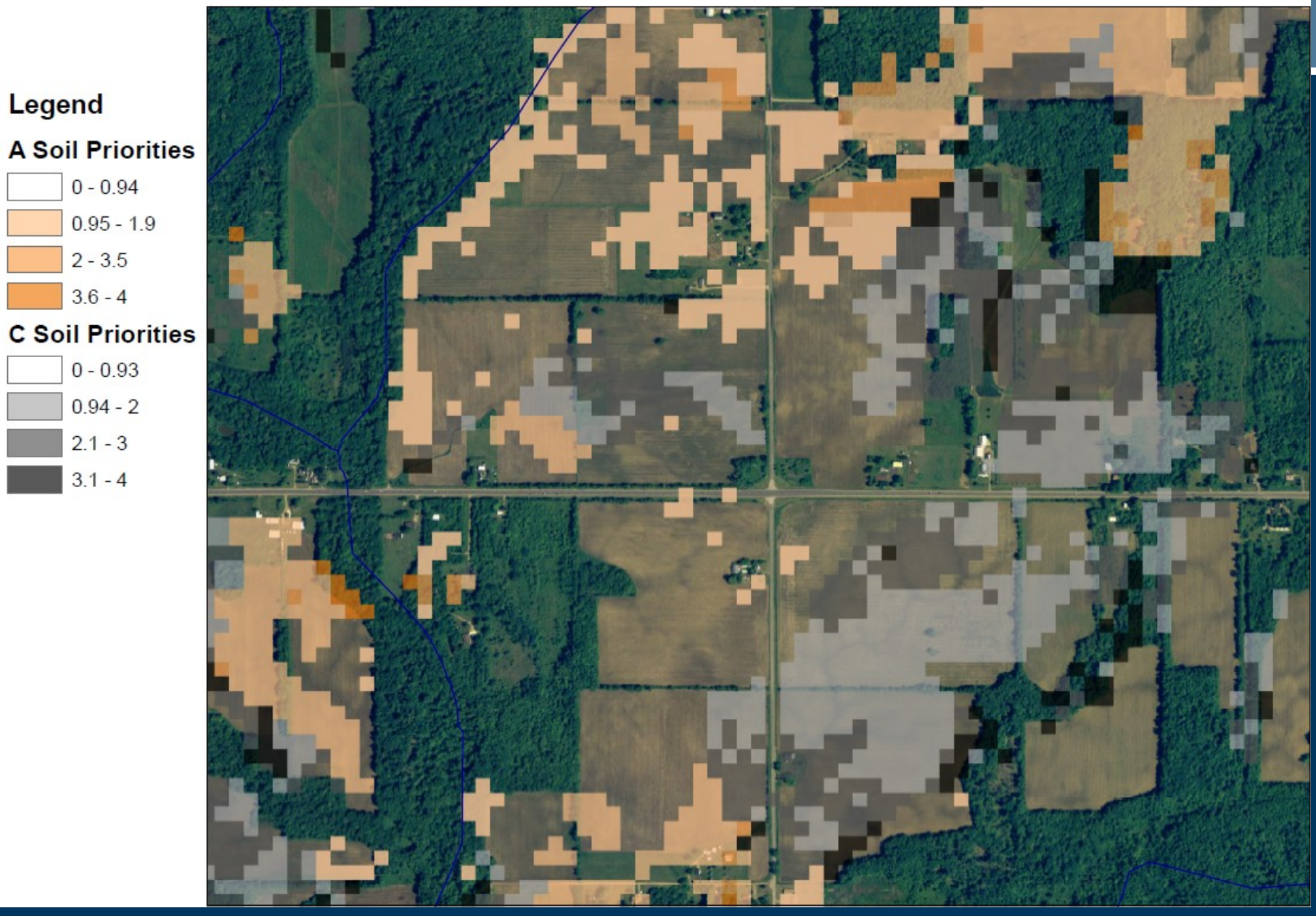

Legend
paw_paw_watershed
A Soil Priorities
0 - 0.938153878
0.938153878 - 1.931341073
1.931341074 - 3.512293348
3.512293349 - 4
C Soil Priorities
0 - 0.926514965
0.926514965 - 1.964317992
1.964317993 - 2.992421925
2.992421926 - 4

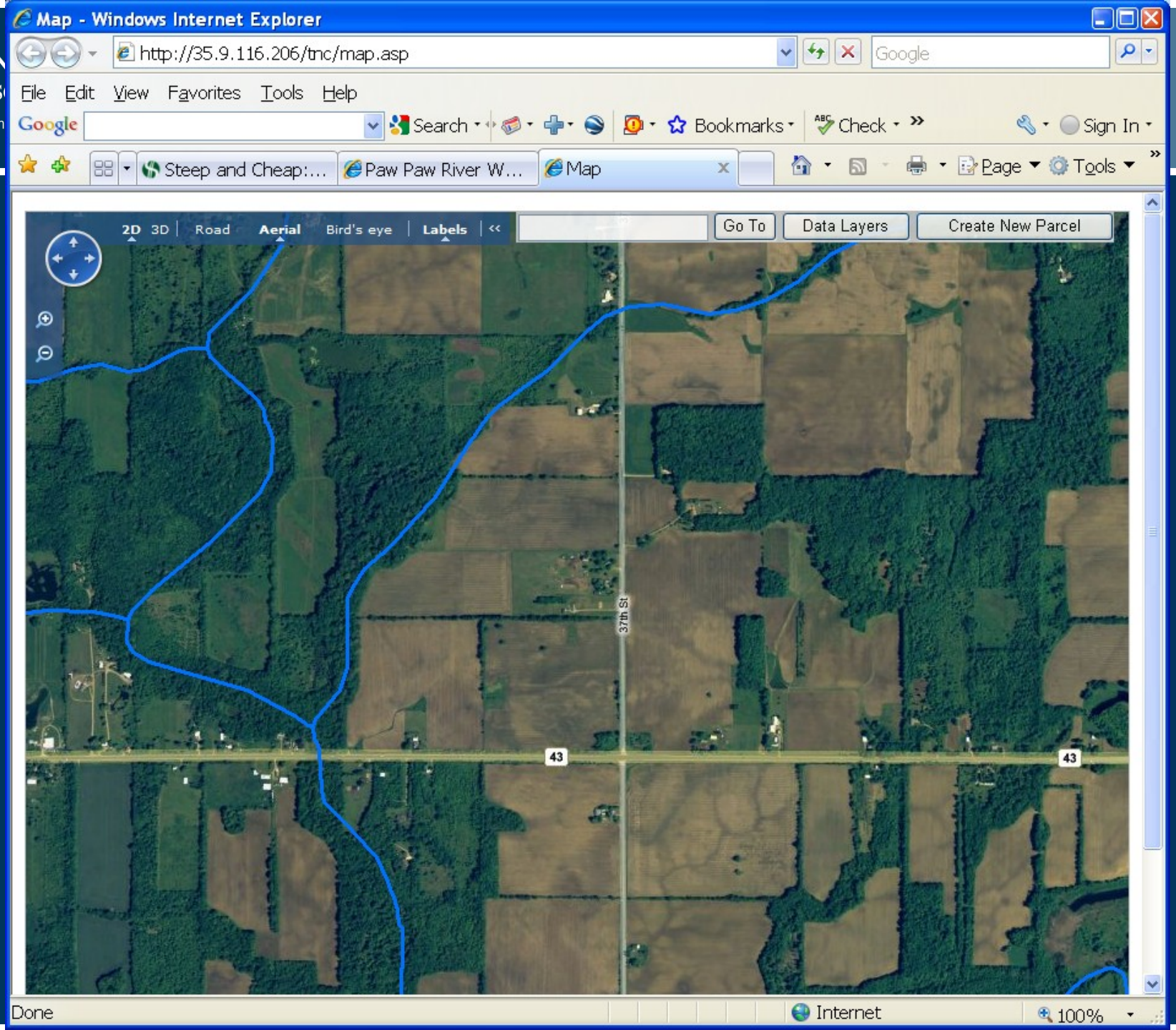
Paw Paw Priority Ag BMP Subwatersheds
With consideration of potential water quantity & quality benefits, watershed position, connectivity, and opportunity




Paw Paw Priority Ag Water Quantity and Quality BMP Areas
Legend
A Soil Priorities
0 - 0.94
0.95 - 1.9
2 - 3.5
3.6 - 4
C Soil Priorities
0 - 0.93
0.94 - 2
2.1 - 3
3.1 - 4

Paw Paw Priority Ag Water Quantity and Quality BMP Areas




Map - Windows Internet Explorer
http://35.9.116.206/tnc/map.asp
Google
File Edit View Favorites Tools Help
Search Bookmarks Check Sign In
Steep and Cheap:...
Paw Paw River W...
Map
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2D 3D Road Aerial Bird's eye Labels
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Data Layers
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43
43
Done
Internet
100%

The N
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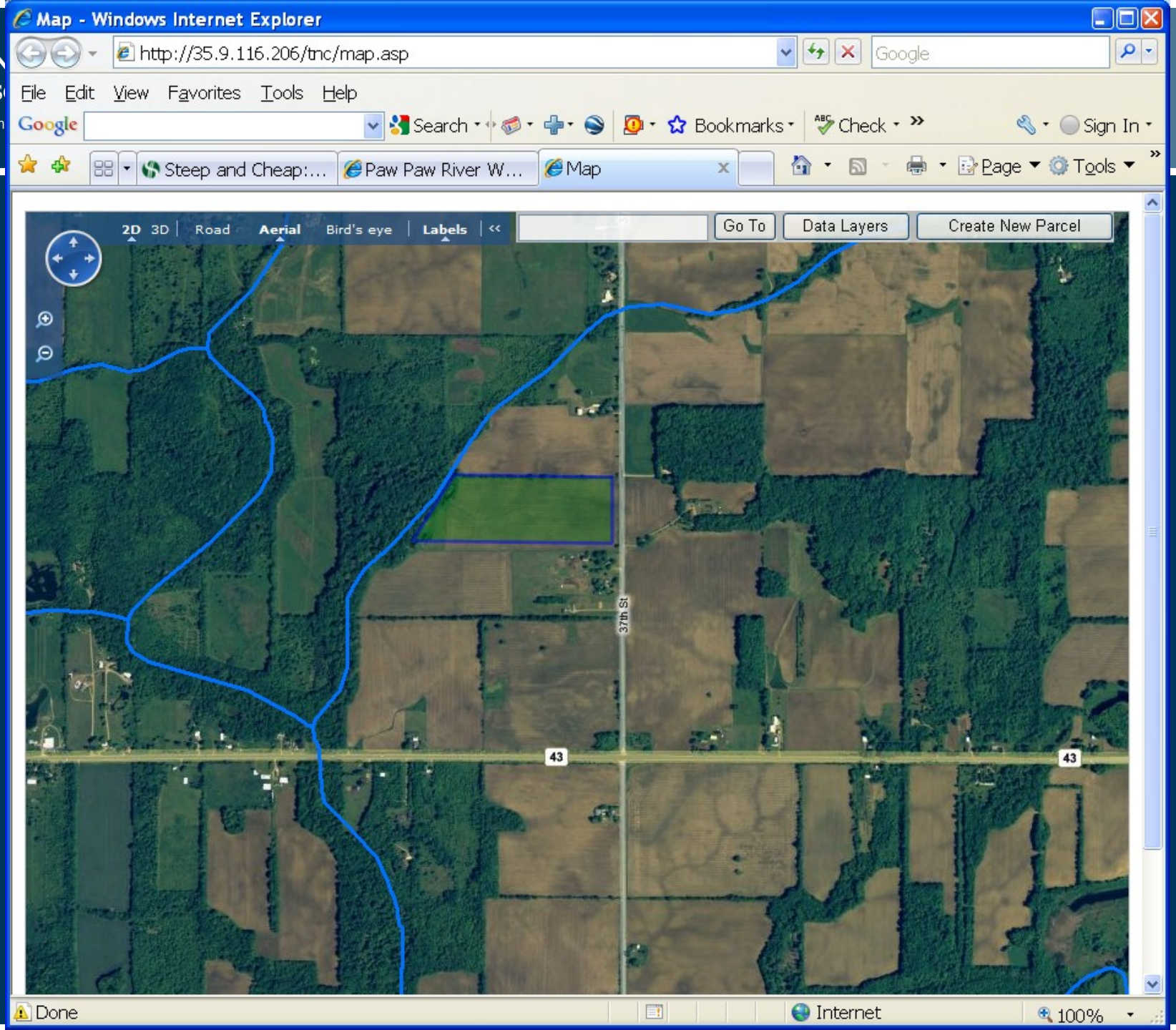
Protectin



Map - Windows Internet Explorer

http://35.9.116.206/tnc/ma

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Google

Steep and Cheap:...

Done

Paw Paw River Watershed Recharge Calculator - Windows Internet Explorer

http://35.9.116.206/tnc/recharge.asp?area=45&soilgrp=C&st=1

Google

File Edit View Favorites Tools Help

Google Search Bookmarks Check Sign In

Paw Paw River Watershed Recharge C...

Page Tools

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Paw Paw River Watershed Recharge Calculator

The following recharge calculator estimates recharge values for different land cover types for the Paw Paw river watershed. The results are generated from the SWAT model and require four inputs to run.

Size of Parcel:	45 acres
Current Land Use/Cover:	Conventional Row Crop
Proposed Land Use/Cover:	
Soil Type: (The parcel overlaps 1 soil polygons)	
in Recharge	
Offset Equivalent Pumping	

- Alfafa
- Meadow Grass
- Switch Grass
- Forest Deciduous
- Forest Mixed
- Shrug/Scrub Rangey Brush
- Urban High-density
- Urban Medium-density
- Urban Low-density
- Wetland Forested
- Wetland Non-forested
- Reduced Tillage
- Conventional Row Crop
- No Till
- Conventional Row Crop w/ Cover Crop
- Reduced Tillage w/ Cover Crop
- No Till w/ Cover Crop

Water Recharge (in/yr)

0 0 0 0 0 0 0 0 0 0

Narrative Results

Done

Internet

100%

Map - Windows Internet Explorer

http://35.9.116.206/tnc/ma

File Edit View Favorites Tools Help

Google

Steep and Cheap:...

Done

Paw Paw River Watershed Recharge Calculator - Windows Internet Explorer

http://35.9.116.206/tnc/recharge.asp?locid=undefined&curid=13&proid=14&sizeic

Google

File Edit View Favorites Tools Help

Google Search Bookmarks Check Sign In

Paw Paw River Watershed Recharge C...

Page Tools

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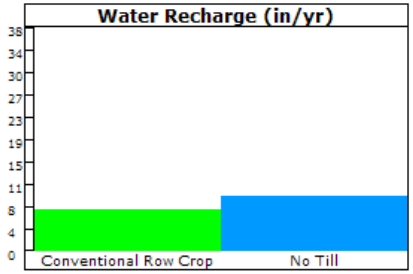
Paw Paw River Watershed Recharge Calculator

The following recharge calculator estimates recharge values for different land cover types for the Paw Paw river watershed. The results are generated from the SWAT model and require four inputs to run.

Size of Parcel:	45 acres
Current Land Use/Cover:	Conventional Row Crop
Proposed Land Use/Cover:	No Till
Soil Type:	B
Increase in Recharge	**4.09 in/yr**
Offset Equivalent Pumping	**9.52 gal/min (continuous)**

Calculate



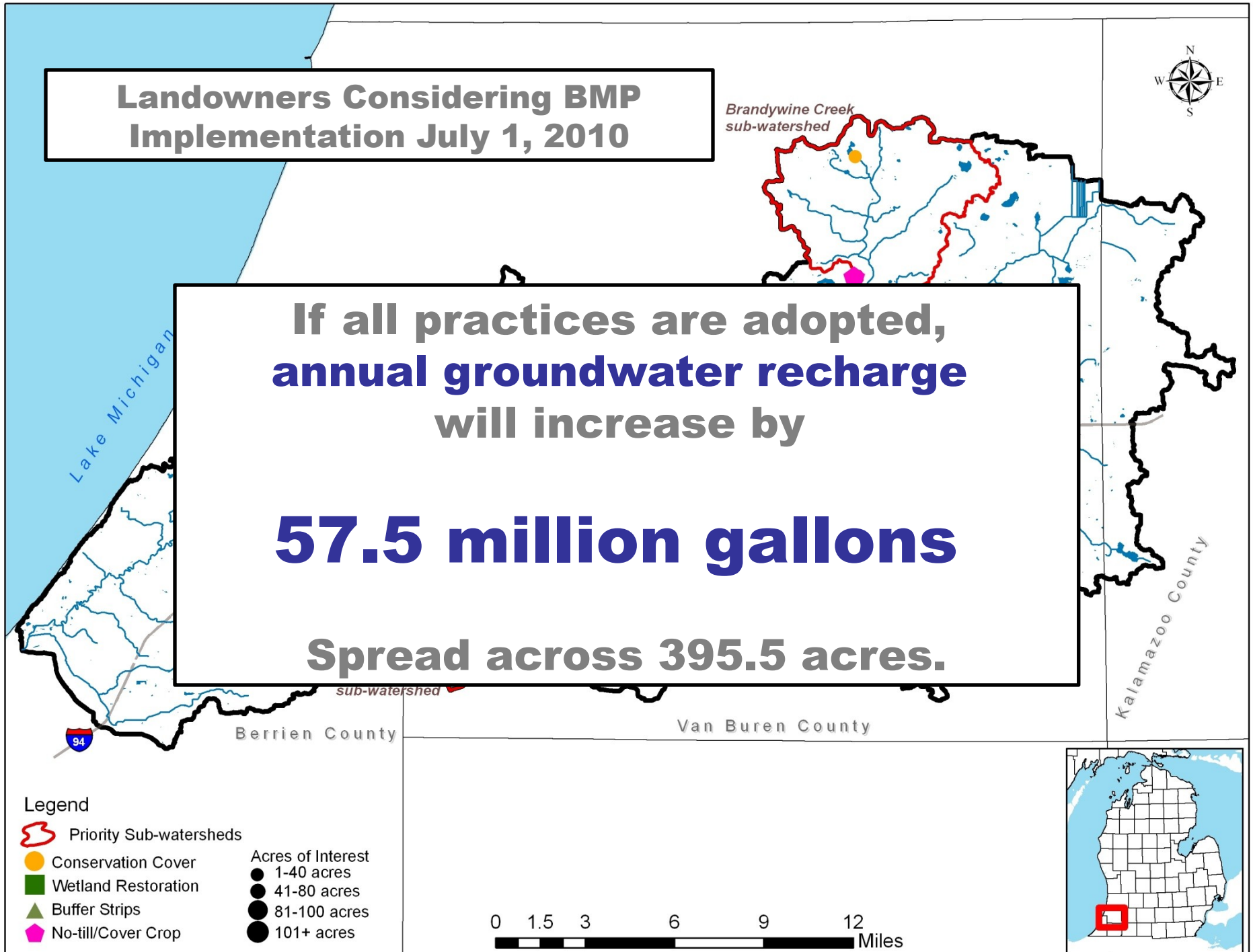
Narrative Results

You have selected to converted 45 acres of Conventional Row Crop to No Till. This conversion results in a Increase of 4.09 in/yr. That is equivalent to pumping 9.52 gal/min (continuous) from a high capacity well.

Done

Internet

100%


Landowners Considering BMP Implementation July 1, 2010
Brandywine Creek sub-watershed
If all practices are adopted,
annual groundwater recharge
will increase by
57.5 million gallons
Spread across 395.5 acres.
Lake Michigan
Berrien County
Van Buren County
Kalamazoo County
94
N
W
E
S
Legend
Priority Sub-watersheds
Conservation Cover
Wetland Restoration
Buffer Strips
No-till/Cover Crop
Acres of Interest
1-40 acres
41-80 acres
81-100 acres
101+ acres
0 1.5 3 6 9 12
Miles

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Getting Back to Biodiversity

Current analyses underway to do the following:

1. Use SWAT analyses to map historic flow conditions.
2. Use fish community data and data on historic agricultural conservation practices to relate fish data to practices.
3. Identify the amount of agricultural conservation practices needed in the Paw Paw, and where they should be placed, to attain desired response in fish community (representative of all biodiversity).