



# Wetlands by Design

## A Watershed Approach for Wisconsin

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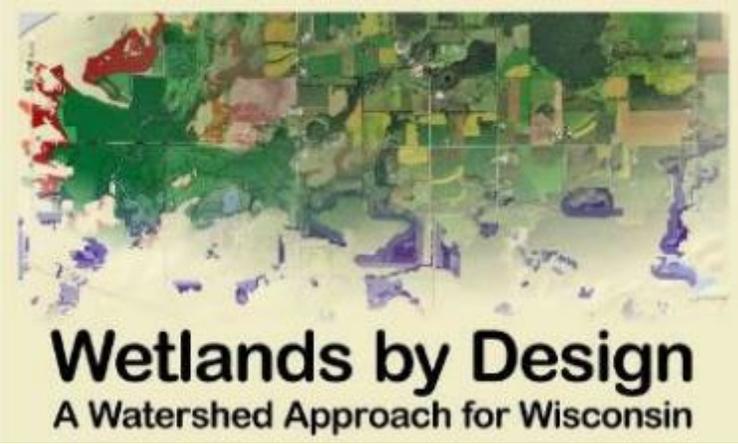


## Who is this for?

**Land Trusts**  
**Local governments**  
**Wetland Consultants**  
**Planners (Counties, RPC's)**  
**Nutrient Management Specialists**  
**Mitigation regulators & project sponsors**  
**Wildlife & Natural Resource Managers**  
**Universities & Extensions**  
**Watershed Planners**  
**Private Businesses**  
**Lake Associations**

## Potential Applications

Watershed plans  
Grant proposals  
Conservation planning  
Outreach & education  
Site selection, assessment, and design  
Local & regional Comprehensive Plans  
Nutrient trading & Adaptive Management  
Siting natural infrastructure (e.g., for flood control)  
Lake management plans (incl. shoreline protection)  
Nutrient management planning  
Wetland service valuation  
Habitat improvement  
Prioritizing projects  
Research



- **Overview**

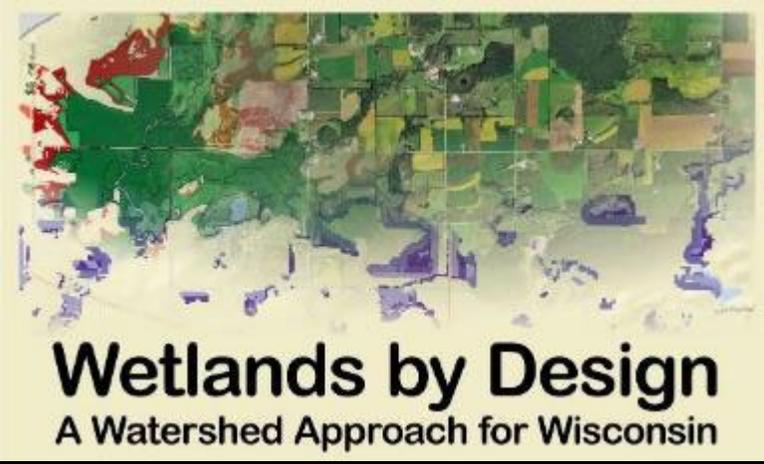
- **Examples: Decision Support Tool**

- **Methods**

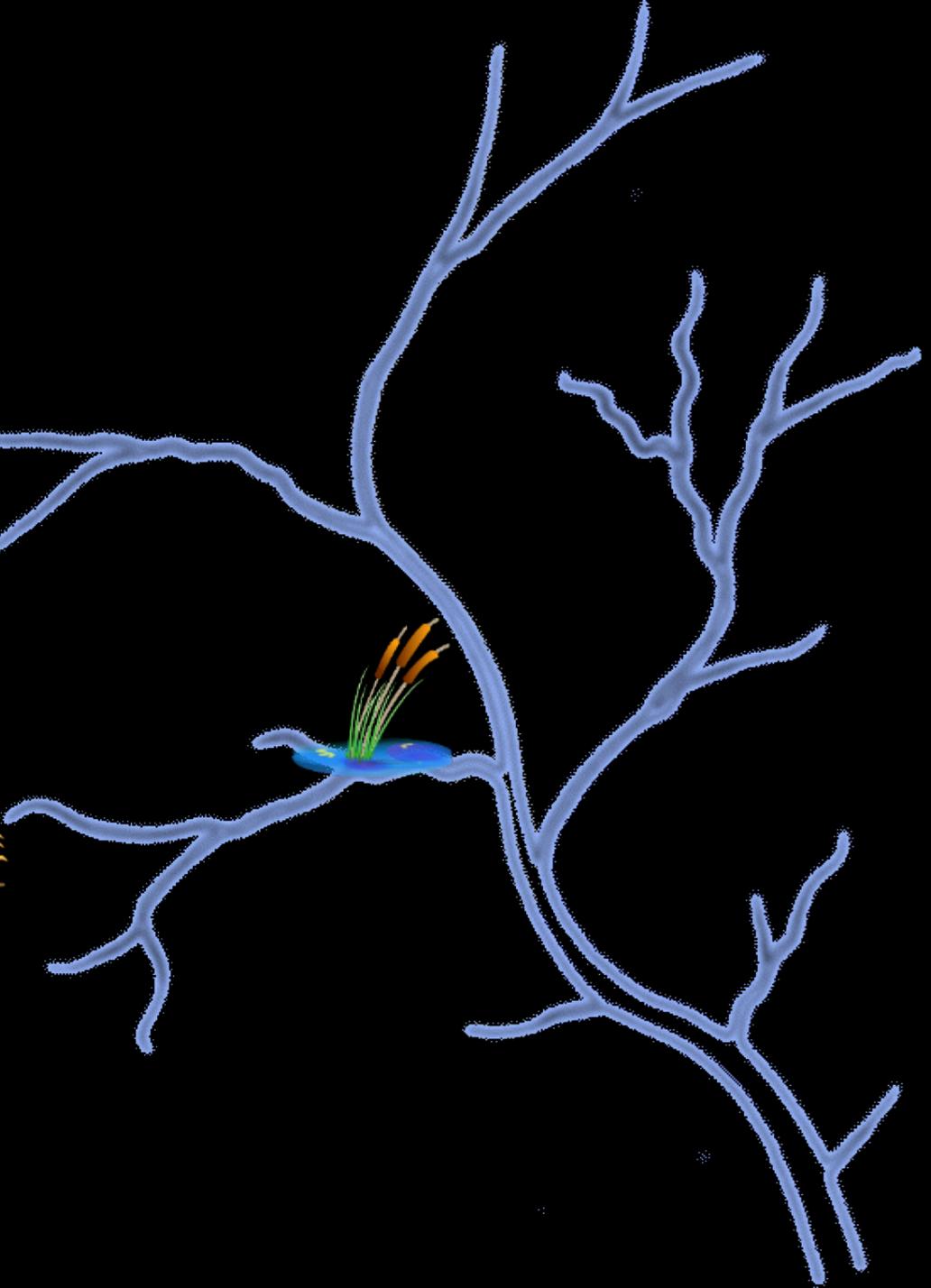
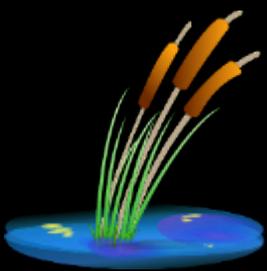
- **Watershed Assessment**

- **Site Assessment**

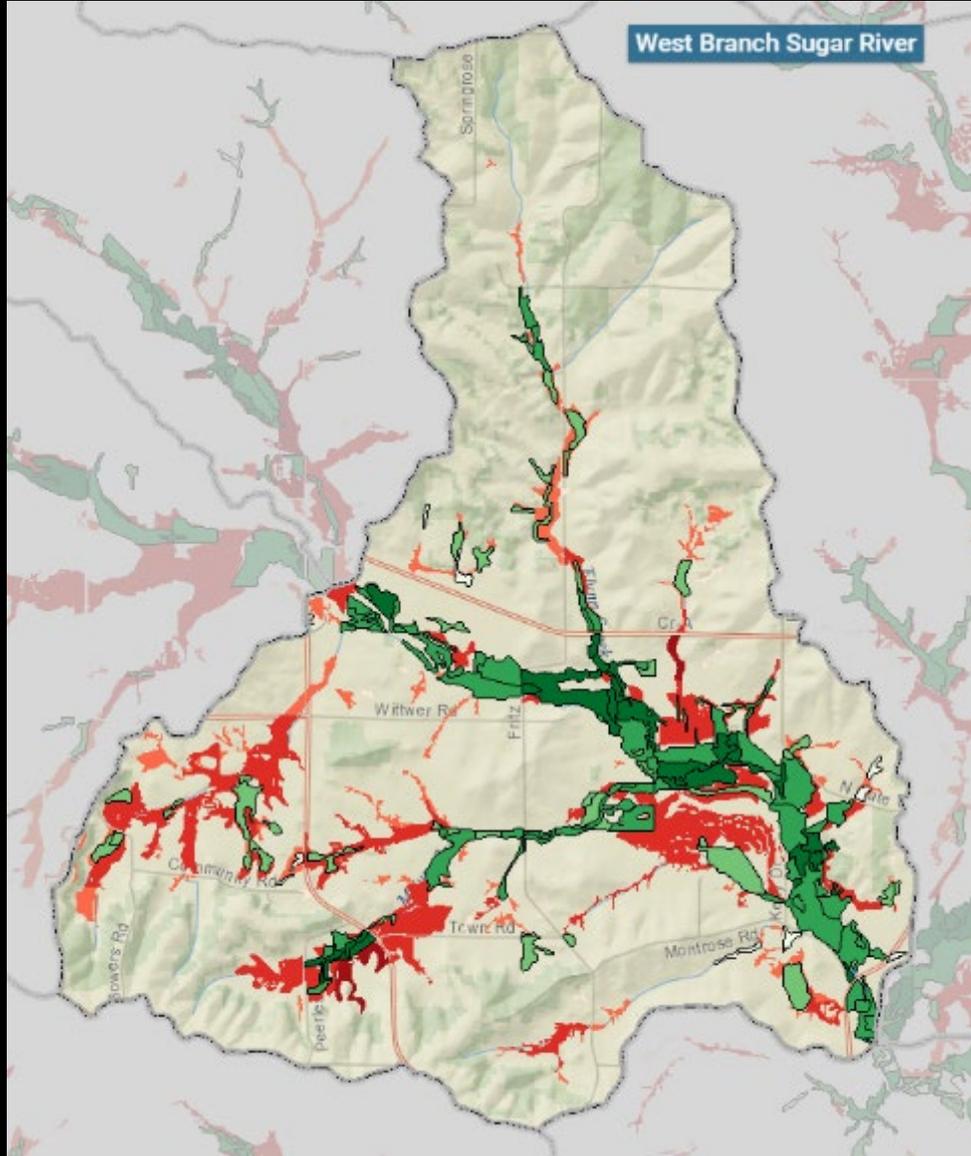
- **Wetland Wildlife Assessment**



## *Why a Watershed Approach?*



# WbD Approach Overview: Sites & Opportunities



## Protection Opportunities

- DNR Wisconsin Wetland Inventory

## Restoration Opportunities

- DNR Potentially Restorable Wetlands v3



# WbD Approach Overview: Watershed 'Needs'

## Step 1

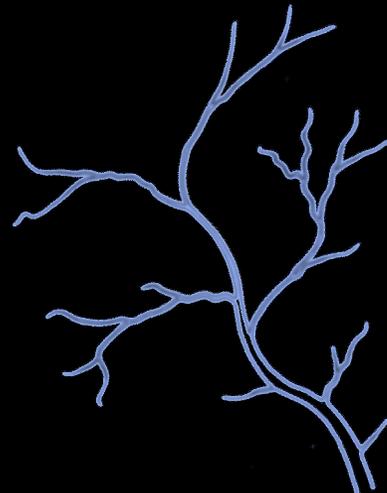
### Wetland Map Data

- Wetland location/extent
- Wetland types
- Water regime
- etc.



### Watershed Context Data

- Landscape Position
- Landform
- Waterbody type
- Waterflow path



### Ecosystem Services

Flood Abatement

Fish & Aquatic Habitat

Sediment Retention

Nutrient Transformation

Surface Water Supply

# WbD Approach Overview: Watershed 'Needs'

## Step 2

Historical  
Service Provision



Current  
Service Provision



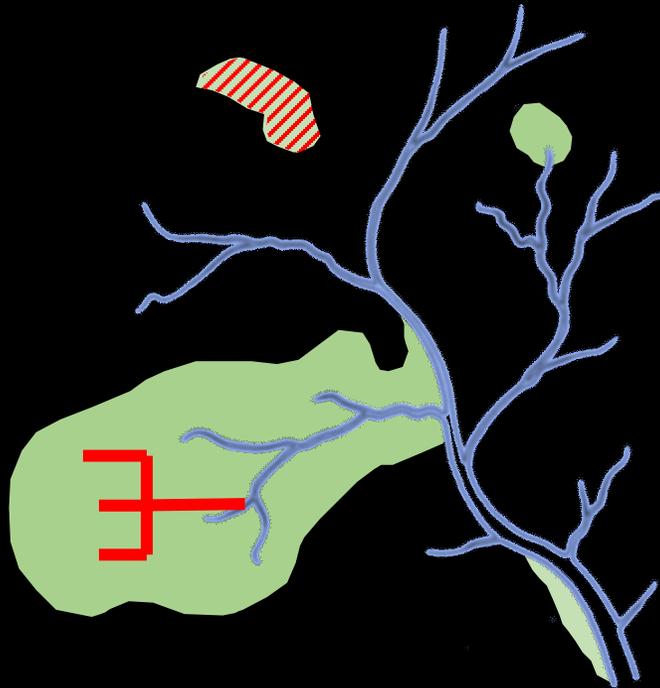
Watershed Service

*Loss*

*Need*

*Opportunity*

Historical Service Provision



# WbD Approach Overview: Site Ranks (Service Potential)

Example: Flood abatement



Water Quality

- Nitrogen Reduction
- Phosphorus reduction
- Sediment Reduction

Shoreline protection

Fish & aquatic habitat

Surface water supply

Carbon storage

Floristic Integrity

**Opportunity**

**Effectiveness**

**Social significance**

# WbD Overview: Wetland Wildlife Habitat

## Forest Interior Guild



## Shallow Marsh Guild

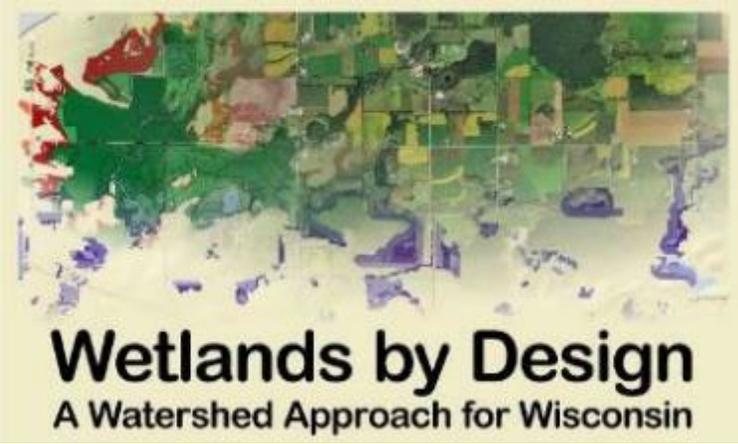


## Open Waters Guild



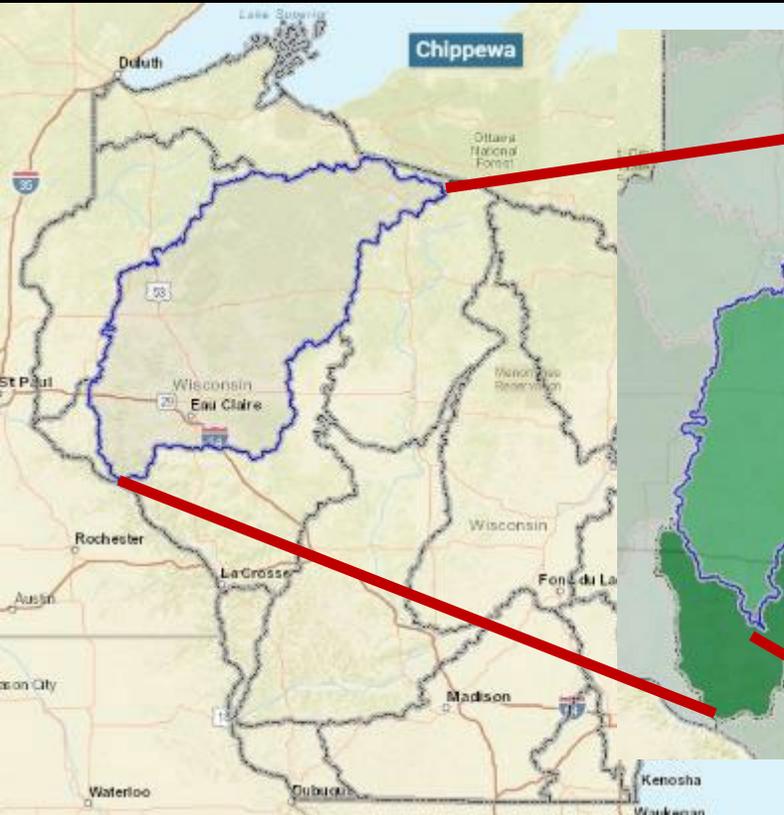
## Shrub Swamp Guild



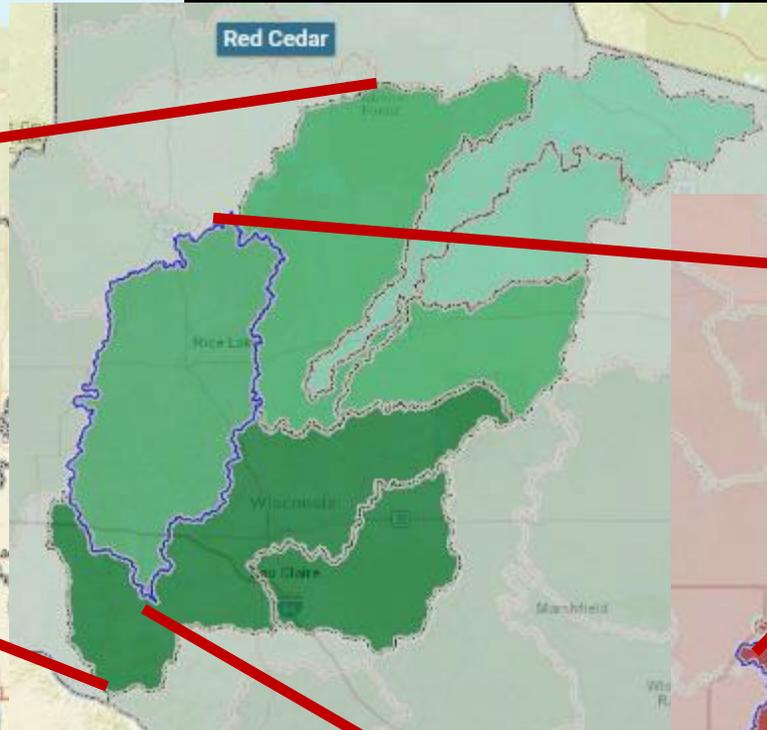


- Overview
- Examples: Decision Support Tool
- Methods
  - Watershed Assessment
  - Site Assessment
  - Wetland Wildlife Assessment

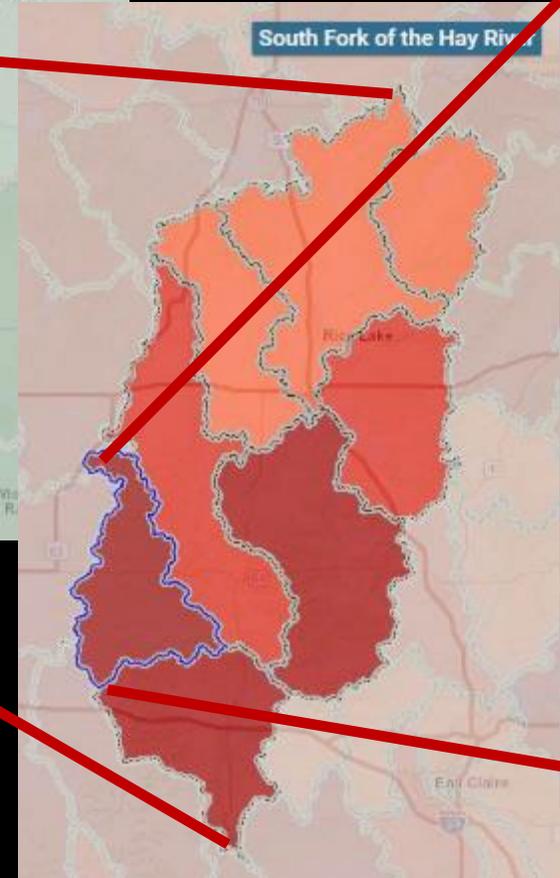
# Results: Watershed Service Losses



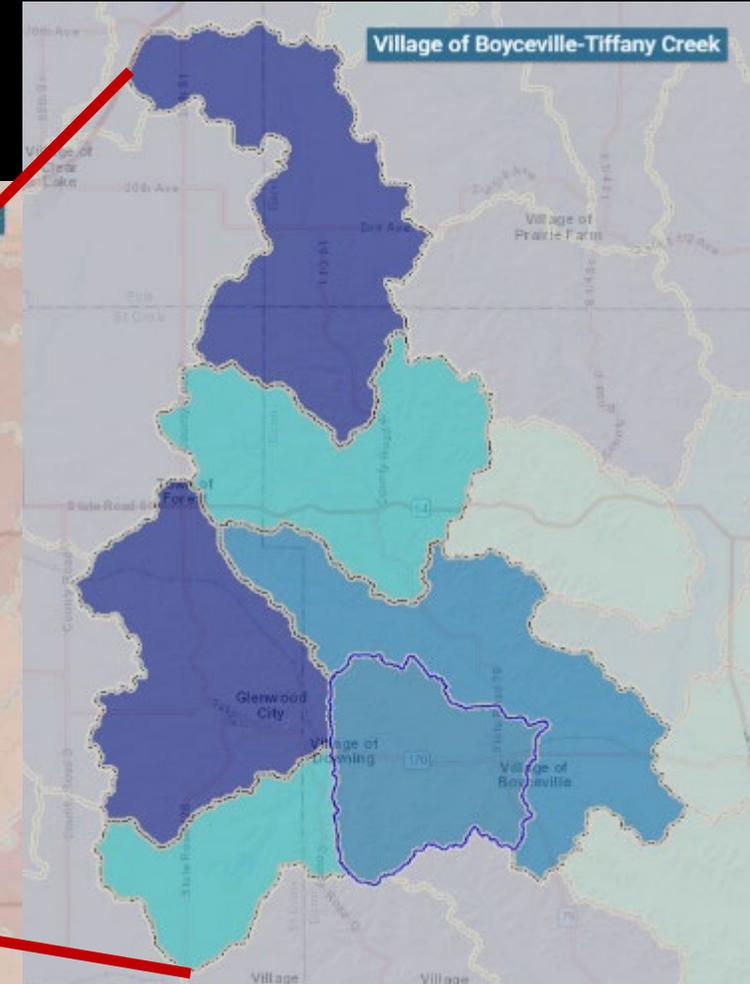
Chippewa River  
6-digit HUC



Red Cedar River  
8-digit HUC



South Fork Hay River  
10-digit HUC



Tiffany Creek  
12-digit HUC

# Which Major River Basin (6-digit Hydrologic Unit) do I want to work in?



## Wetlands & Watersheds Explorer

**Wetlands by Design: A Watershed Approach** Wisconsin's Waters, Wetlands and Watersheds

**Wetlands and Watersheds Explorer**

What would you like to do?

[Search for a new site](#) [Evaluate a known site](#)

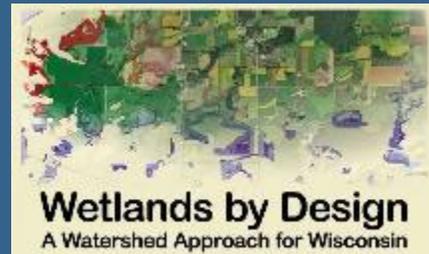
Single-click on a watershed to get started [View Report](#)

**Map Legend**

- HUC - Mask
- HUC - 6 - Boundary

Esri, HERE, Garmin, NGA, USGS, NPS

# The Upper Illinois has only two 8-digit Hydrologic Units The Upper Fox Basin has lost the most services



## Wetlands & Watersheds Explorer

Wetlands by Design: A Watershed Approach Wisconsin's Waters, Wetlands and Watersheds

Get Started  
Regional Planning  
Wetlands and Watersheds Explorer

Wetlands and Watersheds Explorer

What would you like to do?  
Search for a new site Evaluate a known site

Hide Explanations View Report

click on watersheds, at right, to navigate through these scales. To zoom back out, click on the desired watershed scale in the list below. Wetland restoration and preservation opportunities are visible at the "HUC 12" scale.

Full Extent - Hover over names to see HU code  
HUC 6 Watershed: Upper Illinois

Choose Service to Compare Watersheds:  
The map at right shows how subwatersheds compare for services lost, due to wetland loss. Loss of services can help with watershed planning—identifying where services may be needed and the relative amount of opportunity to restore and protect them. To choose a different service for comparison, click below.

Combined Services  Sediment Retention  
 Flood Abatement  Nutrient Transformation  
 Fish and Aquatic Habitat  Surface Water Supply

Opaque  Transparent

Range of Services: (Currently selected: Combined Services)

Combined Services: Most Loss
Flood Abatement: Most Loss
Fish and Aquatic Habitat: Most Loss
Sediment Retention: Most Loss
Nutrient Transformation: Most Loss
Surface Water Supply: Most Loss

Map Legend

- HUC - 8 - Boundary
- HUC6 - Combined Services
  - Least Loss
  - Moderate Loss
  - Most Loss

Upper Fox

Streets

Esri, HERE, Garmin, NGA, USGS, NPS

# Links to simple descriptions and more in-depth information

Wetlands by Design: A Watershed Approach Wisconsin's Waters, Wetlands and Watersheds

Wetlands and Watersheds Explorer

What would you like to do?

Search for a new site Evaluate a known site

Explain Each Section View Report

Selected Watersheds:  
Full Extent - Hover over states to see HQ code  
HUC 6 Watershed: Upper Illinois

Choose Service to Compare Watersheds:

Combined Services  Sediment Retention  
 Flood Abatement  Nutrient Transformation  
 Fish and Aquatic Habitat  Surface Water Supply

Opaque  Transparent

Hover over subwatersheds to compare range of services.

Map Legend

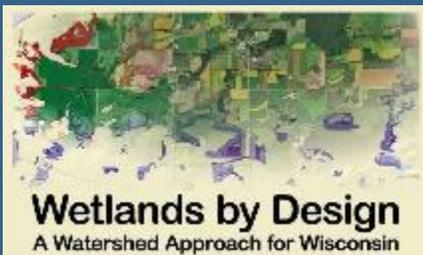
- HUC - 8 - Boundary
- HUC6 - Combined Services
  - Least Loss
  - Moderate Loss
  - Most Loss

Combined Services

Wetlands can provide multiple services. Each wetland's characteristics determine which services that wetland provides and to what extent. Some watersheds have lost more services than others, due to historical wetland loss and alteration.

View in report

## Details on Concepts and Methods in Report



## Wetlands & Watersheds Explorer

OW's current (OW, 2010) is a result of applying the CTR to areas with multiple wetland types. Wetlands identified in the Wisconsin Wetland Tracking Database that were not used after the date of the last wetland mapping are excluded from the FWI layer.

**C.R. Assess watershed needs and opportunities compare current and future wetland service potential across watersheds**

The basis of a watershed management plan is an assessment of watershed needs and opportunities. Our assessment of watershed needs and opportunities, in terms of wetland services, on a watershed basis at multiple scales.

The wetland service potential of the current landscape was compared with that of the landscape of the next 30 years when the original wetlands were intact. The difference between the present of current and historical wetland services indicates "functional deficits," or "wetland needs." Identified opportunities occur where wetlands can be re-attached to meet the need.

We compared current and historical wetland services of three watershed areas using the metrics developed for the (Wetland Services) Report. We show the R, the ratio of current to historical wetland services.

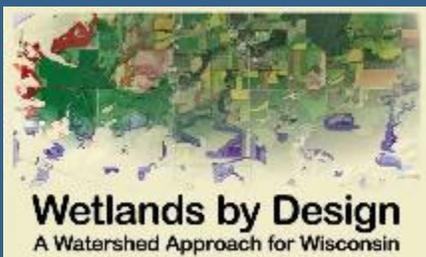
Wetland data includes the location and extent of a wetland, and design a new that includes its vegetation and hydrology regime. Wetland data, combined along with additional data about the surrounding landscape, are often sufficient for a functional assessment of an individual wetland, but they do not allow necessary wetland services across a watershed, or across large planning area.

Landscape-level analysis requires an expanded classification of individual wetlands. The basis that decides the position of the wetland is a 10 subtypes, its connectivity to subwatersheds and to other wetlands, and the directional flow of water. All three a wetland's ability to provide ecosystem services (Figure 2). The result of adding these three geographic attributes to the FWI is an overall FWI, or Wetland Functional Assessment (FWA).

FWA is based on the approach to the 10 subtypes (Wetland Inventory (WI)) to create the enhanced wetland dataset, Wet Plus, (Wet Plus) in WFWI, beyond those in WFWI. Details

- Landscape position or the relation of a wetland to a watershed
- Location on the physical shape of the

Within the Upper Fox Basin, which 10 digit Watersheds have the least/most loss of services?



## Wetlands & Watersheds Explorer

What would you like to do?

[Search for a new site](#) [Evaluate a known site](#)

[Explain Each Section](#) [View Report](#)

**Selected Watersheds:**  
Full Extent - *Hover over names to see HU code*  
HUC 6 Watershed: Upper Illinois  
HUC 8 Watershed: Upper Fox

**Choose Service to Compare Watersheds:**

Combined Services  Sediment Retention  
 Flood Abatement  Nutrient Transformation  
 Fish and Aquatic Habitat  Surface Water Supply

Opaque  Transparent

**View Wetland Wildlife Habitat:**

**Range of Services: (Currently selected: Combined Services)**

Combined Services: Least Loss
Flood Abatement: Least Loss
Fish and Aquatic Habitat: Least Loss
Sediment Retention: Least Loss
Nutrient Transformation: Least Loss
Surface Water Supply: Least Loss

**Map Legend**

- HUC - Mask
- HUC - 10 - Boundary
- HUC10 - Combined Services
  - Least Loss
  - Moderate Loss
  - Most Loss

Within the Mukwonago River Watershed which 12-digit Sub-watersheds have the least/most service loss?



## Wetlands & Watersheds Explorer

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**Wetlands and Watersheds Explorer**

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[Explain Each Section](#) [View Report](#)

**Selected Watersheds:**  
Full Extent - *Hover over names to see HU code*  
HUC 6 Watershed: Upper Illinois  
HUC 8 Watershed: Upper Fox  
HUC 10 Watershed: Mukwonago River

**Choose Service to Compare Watersheds:**

Combined Services  Sediment Retention  
 Flood Abatement  Nutrient Transformation  
 Fish and Aquatic Habitat  Surface Water Supply

Opaque  Transparent

**View Wetland Wildlife Habitat:**

**Range of Services: (Currently selected: Combined Services)**

Combined Services: <b>Most Loss</b>
Flood Abatement: <b>Most Loss</b>
Fish and Aquatic Habitat: <b>Most Loss</b>
Sediment Retention: <b>Most Loss</b>
Nutrient Transformation: <b>Most Loss</b>
Surface Water Supply: <b>Most Loss</b>

**Map Legend**

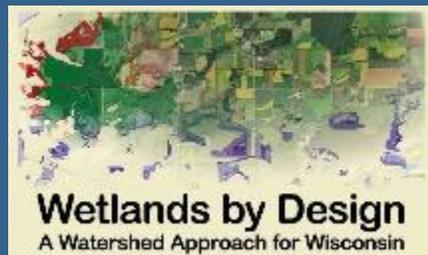
- HUC - 12 - Boundary
- HUC12 - Combined Services
  - Least Loss
  - Moderate Loss
  - Most Loss

3km  
2mi

County of Waukesha, Esri, HERE, Garmin, NGA, USGS, NPS

powered by **esri**

Mukwonago River 12-digit Sub-Watershed has the most loss, where are some large Potentially Restorable Wetlands areas to examine?



## Wetlands & Watersheds Explorer

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**Wetlands and Watersheds Explorer**

What would you like to do?

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[Explain Each Section](#) [View Report](#)

**Selected Watersheds:**  
Full Extent - *Hover over names to see HU code*  
HUC 6 Watershed: Upper Illinois  
HUC 8 Watershed: Upper Fox  
HUC 10 Watershed: Mukwonago River  
HUC 12 Watershed: Mukwonago River

**Choose Service to Compare Sites:**

<input checked="" type="radio"/> Count of Services $\geq$ High	<input type="radio"/> Nitrogen Reduction
<input type="radio"/> Flood Abatement	<input type="radio"/> Surface Water Supply
<input type="radio"/> Fish and Aquatic Habitat	<input type="radio"/> Shoreline Protection
<input type="radio"/> Phosphorus Retention	<input type="radio"/> Carbon Storage
<input type="radio"/> Sediment Retention	<input type="radio"/> Floristic Integrity

Opaque  Transparent

**View Wetland Wildlife Habitat:**

<input type="checkbox"/> All Guilds	<input type="checkbox"/> Shallow Marsh Guild
<input type="checkbox"/> Forest Interior Guild	<input type="checkbox"/> Open Waters Guild
<input type="checkbox"/> Shrub Swamp Guild	
<input type="checkbox"/> All-Guild Restoration Opportunities	

Opaque  Transparent

Click on individual wetland sites to see how they compare to others in this watershed.

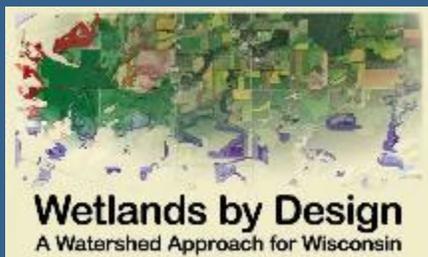
**Map Legend**

- HUC - 12 - Boundary
- Current Wetlands - Count of Services  $\geq$  High
  - 7-9
  - 4-6
  - 1-3
  - 0
- Potentially Restorable Wetlands - Count of Services  $\geq$  High
  - 7-8
  - 4-6
  - 1-3
  - 0

3km  
2mi

Esri, HERE, Garmin, NGA, USGS, NPS

Zoom in to look at several clusters, choose which to look at closer



## Wetlands & Watersheds Explorer

**Wetlands by Design: A Watershed Approach** Wisconsin's Waters, Wetlands and Watersheds

**Wetlands and Watersheds Explorer**

What would you like to do?

[Search for a new site](#) [Evaluate a known site](#)

[Explain Each Section](#) [View Report](#)

**Selected Watersheds:**  
Full Extent - *Hover over names to see HU code*  
HUC 6 Watershed: Upper Illinois  
HUC 8 Watershed: Upper Fox  
HUC 10 Watershed: Mukwonago River  
HUC 12 Watershed: Mukwonago River

**Choose Service to Compare Sites:**

<input checked="" type="radio"/> Count of Services $\geq$ High	<input type="radio"/> Nitrogen Reduction
<input type="radio"/> Flood Abatement	<input type="radio"/> Surface Water Supply
<input type="radio"/> Fish and Aquatic Habitat	<input type="radio"/> Shoreline Protection
<input type="radio"/> Phosphorus Retention	<input type="radio"/> Carbon Storage
<input type="radio"/> Sediment Retention	<input type="radio"/> Floristic Integrity

Opaque  Transparent

**View Wetland Wildlife Habitat:**

<input type="checkbox"/> All Guilds	<input type="checkbox"/> Shallow Marsh Guild
<input type="checkbox"/> Forest Interior Guild	<input type="checkbox"/> Open Waters Guild
<input type="checkbox"/> Shrub Swamp Guild	
<input type="checkbox"/> All-Guild Restoration Opportunities	

Opaque  Transparent

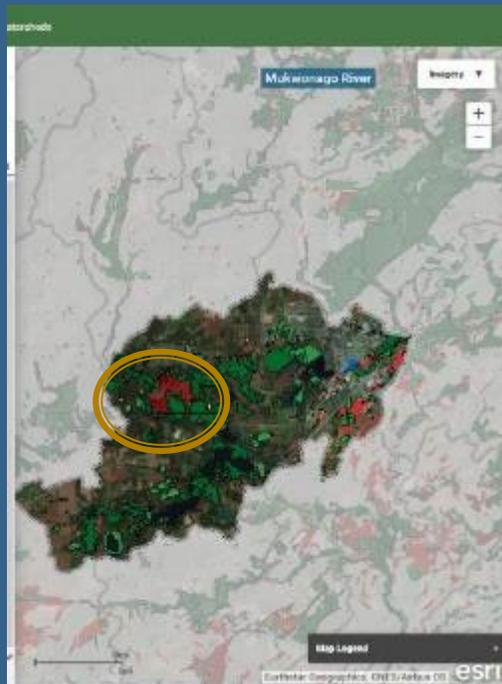
Click on individual wetland sites to see how they compare to others in this watershed.

Map Legend

County of Waukesha, Esri, HERE, Garmin, INCREMENT P, N...

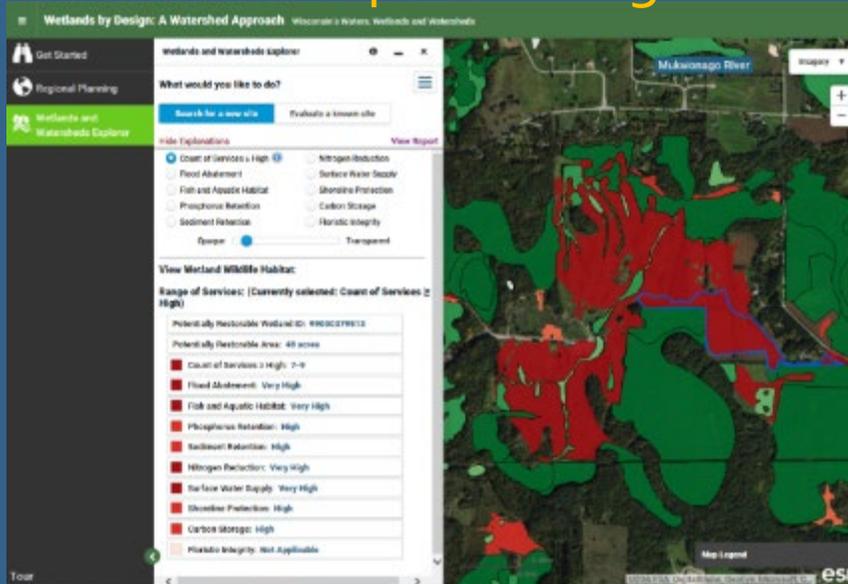
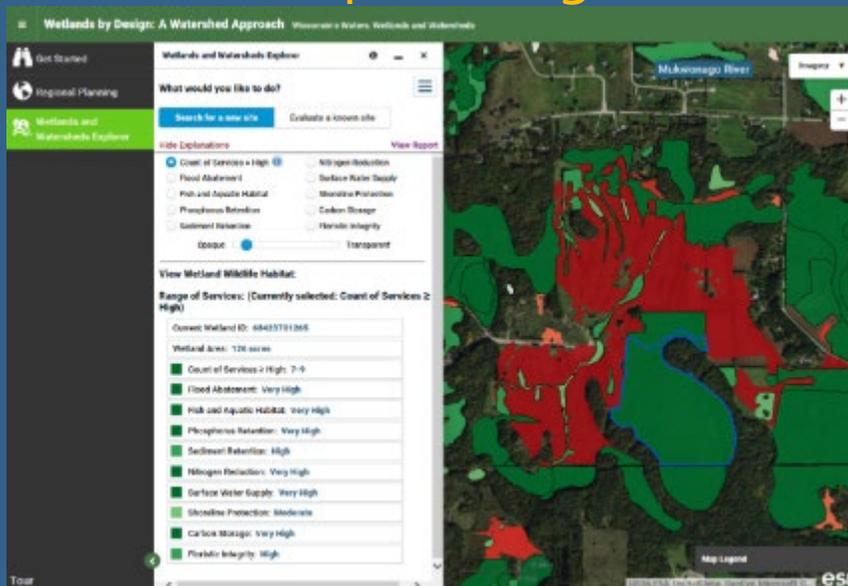
# Wetlands are providing services at the highest levels

Pick another promising area



Zoom in:

PRWs used to provide high service levels



# Watershed Services shown, but what about wildlife habitat?



## Wetlands & Watersheds Explorer

Regional Planning

Wetlands and Watersheds Explorer

What would you like to do?

Search for a new site Evaluate a known site

Hide Explanations View Report

Count of Services  $\geq$  High <sup>1</sup>  Nitrogen Reduction

Flood Abatement  Surface Water Supply

Fish and Aquatic Habitat  Shoreline Protection

Phosphorus Retention  Carbon Storage

Sediment Retention  Floristic Integrity

Opaque   Transparent

View Wetland Wildlife Habitat:

Range of Services: (Currently selected: Count of Services  $\geq$  High)

Potentially Restorable Wetland ID: 99000379513

Potentially Restorable Area: 48 acres

Count of Services  $\geq$  High: 7-9

Flood Abatement: Very High

Fish and Aquatic Habitat: Very High

Phosphorus Retention: High

Sediment Retention: High

Nitrogen Reduction: Very High

Surface Water Supply: Very High

Shoreline Protection: High

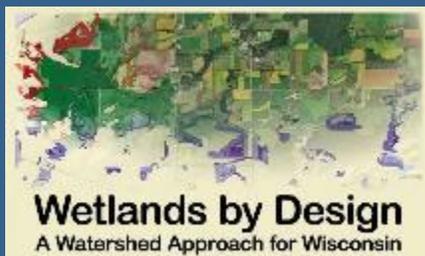
Carbon Storage: High

Floristic Integrity: Not Applicable

Mukwonago River

Map Legend

# Wetland Wildlife Habitat Assessment – All Guilds



## Wetlands & Watersheds Explorer

**What would you like to do?**

[Search for a new site](#) [Evaluate a known site](#)

[Explain Each Section](#) [View Report](#)

**Selected Watersheds:**  
Full Extent - *Hover over names to see HU code*  
HUC 6 Watershed: Upper Illinois  
HUC 8 Watershed: Upper Fox  
HUC 10 Watershed: Mukwonago River  
HUC 12 Watershed: Mukwonago River

**Choose Service to Compare Sites:**

Count of Services  $\geq$  High  Nitrogen Reduction  
 Flood Abatement  Surface Water Supply  
 Fish and Aquatic Habitat  Shoreline Protection  
 Phosphorus Retention  Carbon Storage  
 Sediment Retention  Floristic Integrity

Opaque  Transparent

**View Wetland Wildlife Habitat:**

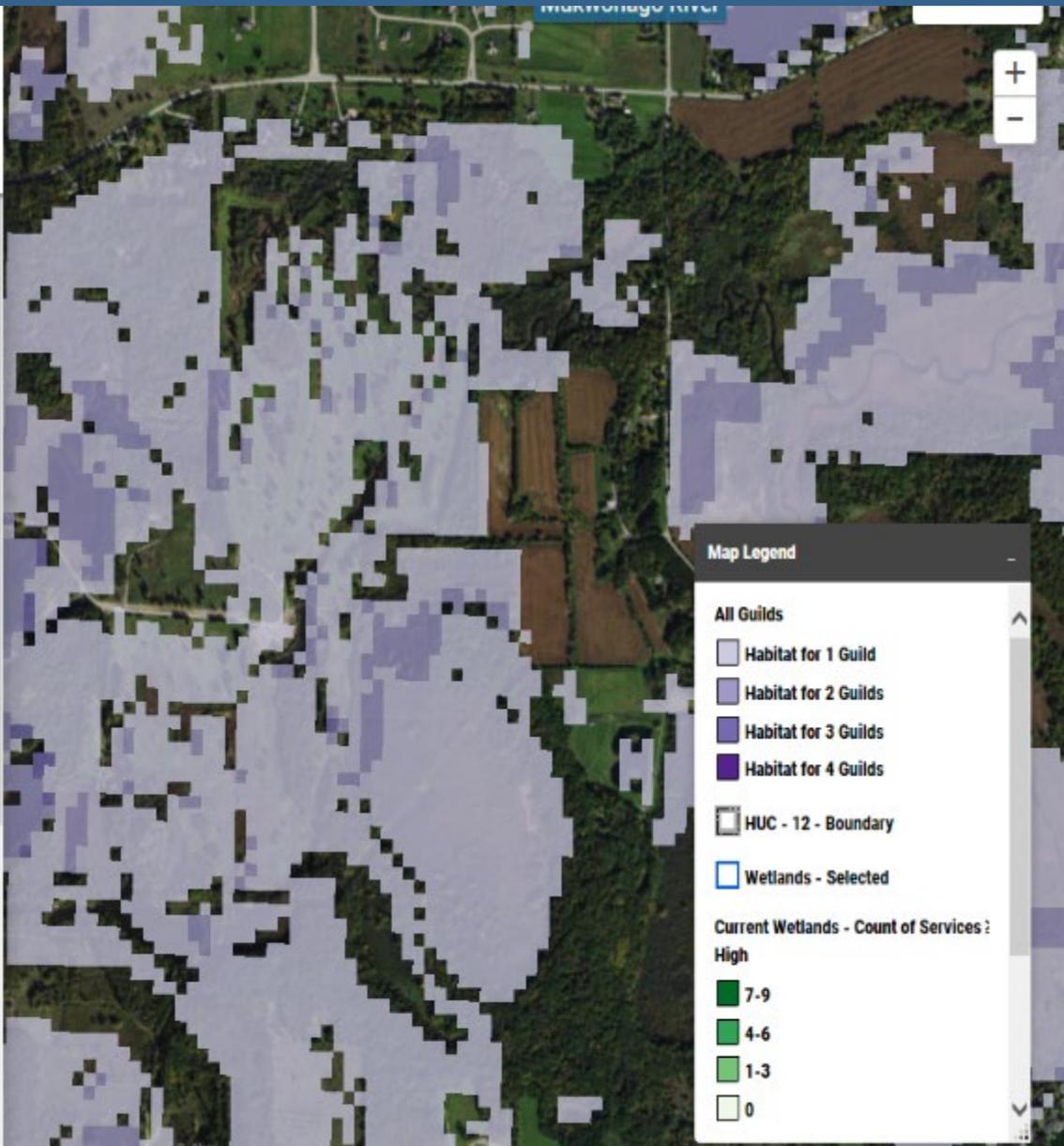
All Guilds  Shallow Marsh Guild  
 Forest Interior Guild  Open Waters Guild  
 Shrub Swamp Guild  
 All-Guild Restoration Opportunities

Opaque  Transparent

**Range of Services: (Currently selected: Combined Services)**

Potentially Restorable Wetland ID: **99000379647**

Potentially Restorable Area: **135 acres**



**Map Legend**

**All Guilds**

- Habitat for 1 Guild
- Habitat for 2 Guilds
- Habitat for 3 Guilds
- Habitat for 4 Guilds

HUC - 12 - Boundary

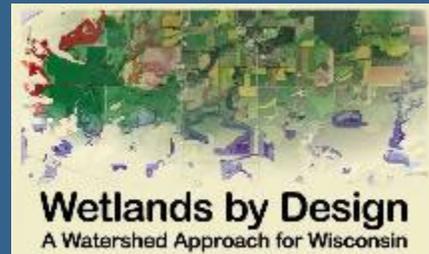
Wetlands - Selected

**Current Wetlands - Count of Services :**

**High**

- 7-9
- 4-6
- 1-3
- 0

# Shrub Swamp Guild



## Wetlands & Watersheds Explorer

**What would you like to do?**

[Search for a new site](#) [Evaluate a known site](#)

[Explain Each Section](#) [View Report](#)

**Selected Watersheds:**  
Full Extent - *Hover over names to see HU code*  
HUC 6 Watershed: Upper Illinois  
HUC 8 Watershed: Upper Fox  
HUC 10 Watershed: Mukwonago River  
HUC 12 Watershed: Mukwonago River

**Choose Service to Compare Sites:**

<input checked="" type="radio"/> Count of Services $\geq$ High	<input type="radio"/> Nitrogen Reduction
<input type="radio"/> Flood Abatement	<input type="radio"/> Surface Water Supply
<input type="radio"/> Fish and Aquatic Habitat	<input type="radio"/> Shoreline Protection
<input type="radio"/> Phosphorus Retention	<input type="radio"/> Carbon Storage
<input type="radio"/> Sediment Retention	<input type="radio"/> Floristic Integrity

Opaque  Transparent

**View Wetland Wildlife Habitat:** [Collapse](#)

<input type="checkbox"/> All Guilds	<input type="checkbox"/> Shallow Marsh Guild
<input type="checkbox"/> Forest Interior Guild	<input type="checkbox"/> Open Waters Guild
<input checked="" type="checkbox"/> Shrub Swamp Guild <a href="#">i</a>	
<input type="checkbox"/> All-Guild Restoration Opportunities	

Opaque  Transparent

**Range of Services: (Currently selected: Combined Services)**

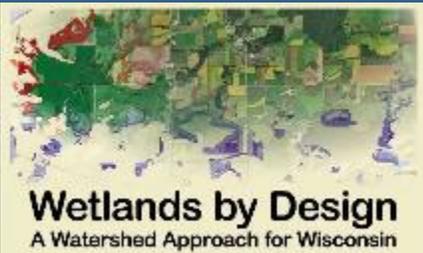
Potentially Restorable Wetland ID: **99000379647**

Potentially Restorable Area: **135 acres**

**Map Legend**

- Wet Shrub Birds Guild
  - Primary habitat
  - Secondary habitat
  - Tertiary habitat
- HUC - 12 - Boundary
- Wetlands - Selected
- Current Wetlands - Count of Services :  
High
  - 7-9
  - 4-6
  - 1-3
  - 0
- Potentially Restorable Wetlands -

# Another look at PRW Wildlife Habitat Benefits: how many guilds will restoration benefit?



## Wetlands & Watersheds Explorer

**What would you like to do?**

[Search for a new site](#) [Evaluate a known site](#)

[Explain Each Section](#) [View Report](#)

**Selected Watersheds:**

Full Extent - *Hover over names to see HU code*

- HUC 6 Watershed: Upper Illinois
- HUC 8 Watershed: Upper Fox
- HUC 10 Watershed: Mukwonago River
- HUC 12 Watershed: Mukwonago River

**Choose Service to Compare Sites:**

- Count of Services  $\geq$  High
- Flood Abatement
- Fish and Aquatic Habitat
- Phosphorus Retention
- Sediment Retention
- Nitrogen Reduction
- Surface Water Supply
- Shoreline Protection
- Carbon Storage
- Floristic Integrity

Opaque  Transparent

**View Wetland Wildlife Habitat:**

- All Guilds
- Forest Interior Guild
- Shrub Swamp Guild
- All-Guild Restoration Opportunities
- Shallow Marsh Guild
- Open Waters Guild

Opaque  Transparent

**Range of Services: (Currently selected: Combined Services)**

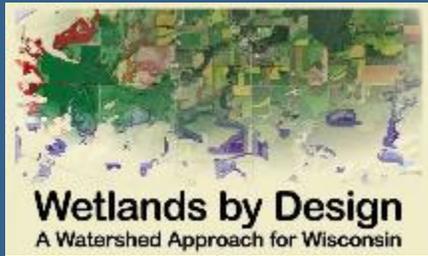
Current Wetland ID: 68423701265

Wetland Area: 126 acres

Count of Services  $\geq$  High: 7-9

**Map Legend**

- All-Guild Restoration Opportunities
  - Relevant to 1 guild
  - Relevant to 2 guilds
  - Relevant to 3 guilds
- HUC - 12 - Boundary
- Wetlands - Selected
- Current Wetlands - Count of Services  $\geq$  High
  - 7-9
  - 4-6
  - 1-3
  - 0
- Potentially Restorable Wetlands -



## Wetlands & Watersheds Explorer

Evaluate a known site

[View Report](#)

**Core Sites:**

**Habitat:**

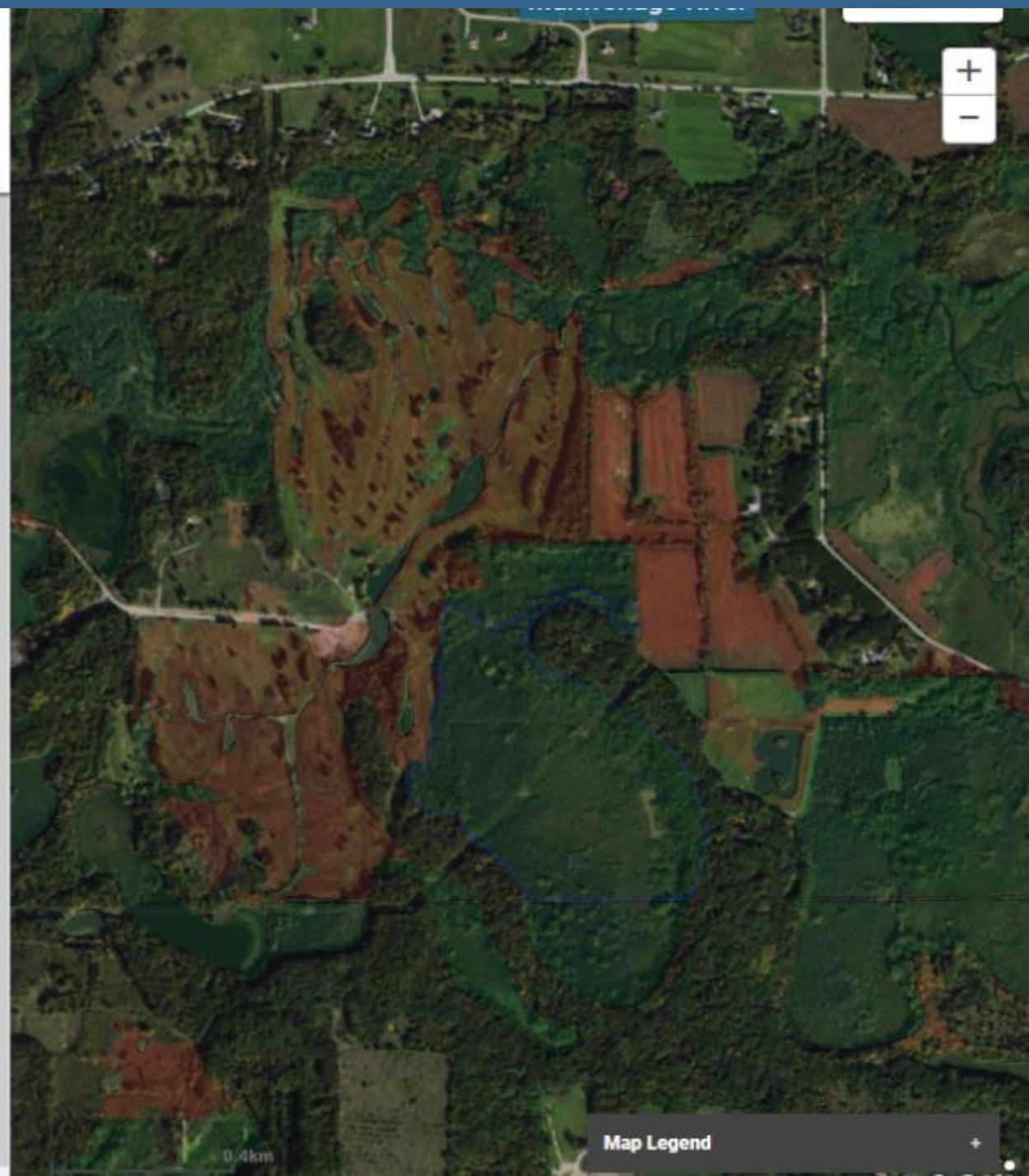
- Shallow Marsh Guild
- Open Waters Guild

**Opportunities** ⓘ

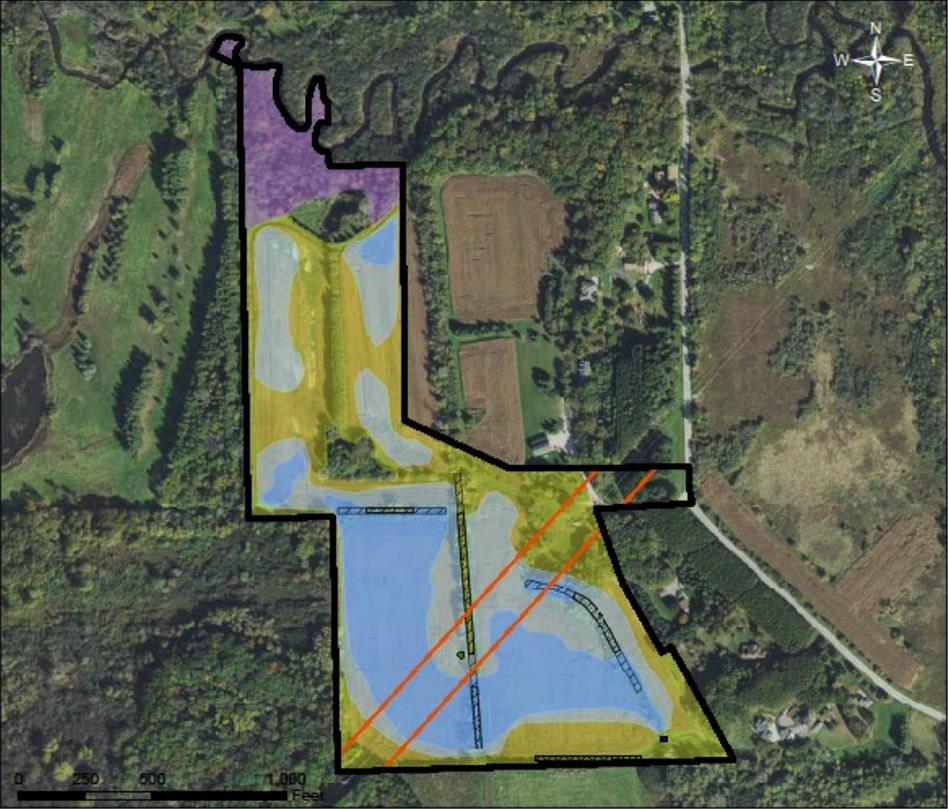
- Transparent

**Currently selected: Count of Services  $\geq$**

701265
High: 7-9
Very High
at: Very High
Very High
High
Very High
Very High
Moderate
High

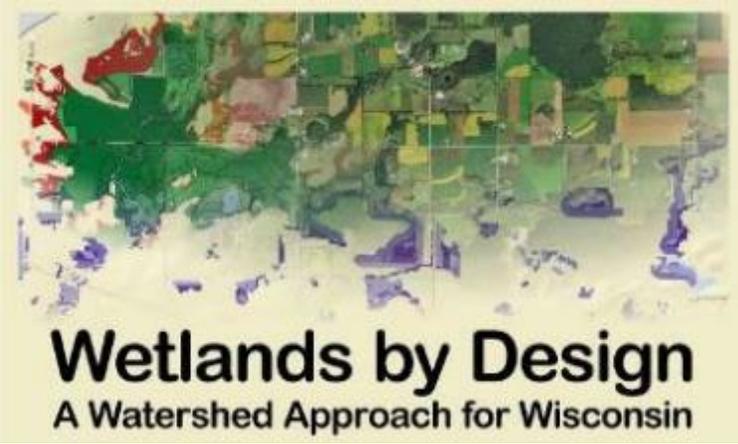


# Exhibit A: Proposed In-Lieu Fee Wetland Mitigation Site Concept Design



 Sedge Meadow	 ATC Easement	 ATC Tower
 Wet to Wet Mesic Prairie	 Constructed Ditch	 Rock Outlet
 Mesic Prairie - Buffer	 Ditch Plugs	
 Forest Floodplain Enhancement	 Existing Ditches	

Note: Re-establishment and enhancement areas are approximate. This design is for conceptual purposes only.

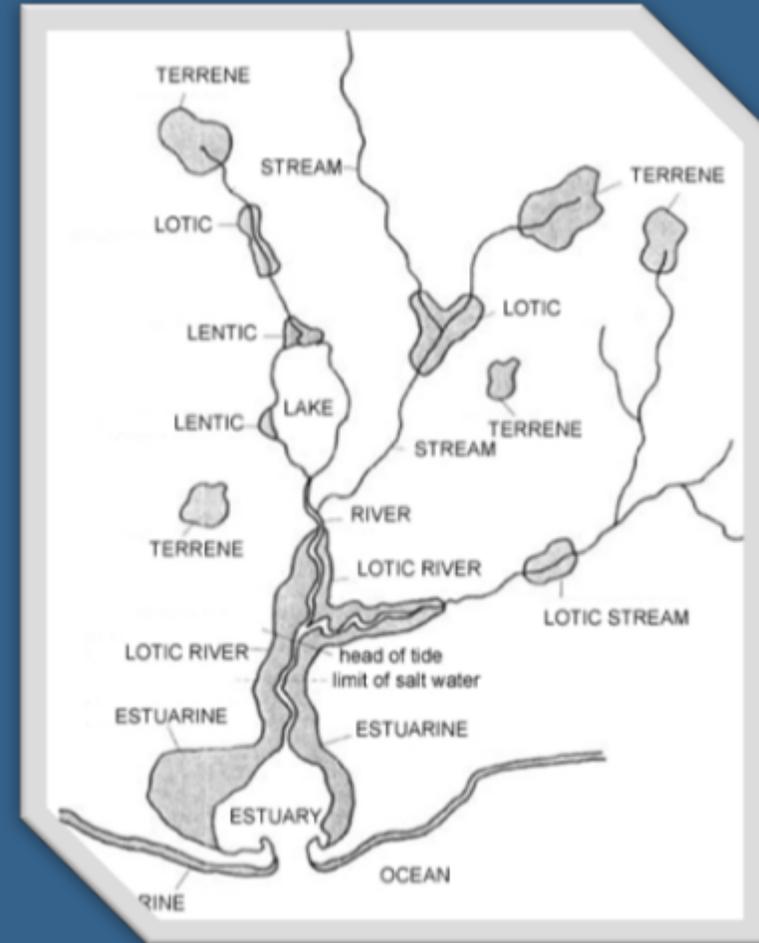


- Overview
- Examples: Decision Support Tool
- **Methods**
  - Watershed Assessment
  - Site Assessment
  - Wetland Wildlife Assessment

# Determining Watershed Needs Using LLWW Classification



- **Landscape Position:** Lentic, Lotic, Terrene
- **Landform:** Floodplain, Fringe, Basin, Flat, Slope
- **Waterflow Path:** Inflow, Outflow, Throughflow, Bi-directional; entrenched, artificial modifiers can be added
- **Waterbody:** River, Stream, Lake, Pond, NA,
- Scalable from HUC-12 to HUC-6
- **Functional Matrix**
  - Assign High and Moderate levels to functions based on LLWW type



Tiner, R.W. 2011.

Dichotomous Keys and Mapping Codes for Wetland LLWW.



# WWI to LLWW Classification via incredibly complicated GIS Models



## Ecosystem Service Correlations: Flood Abatement

Service Level	Wetland type Descriptions	LLWW or WWI Code Inclusions	LLWW or WWI Code Exclusions
High	Vegetated lentic and lotic wetlands Island wetlands Ponds, terrene basin and terrene flat wetlands that have inflow, throughflow, or intermittent throughflow	LE***, LR***, LS**** IL** **PDIN, **PDTH, **PDTI, TEBA*IN, TEBA*TH, TEBA*TI, TEFL*IN, TEFL*TH, TEFL*TI	*SL**, ***IS TEBA*BI TEFP*, TEFF*, TEFR* TEFL*OU, TEFL*OI, TEFL*CI WWI Class = F, unvegetated flats
Moderate	Wetlands with artificial throughflow Wetlands associated with an entrenched stream or river Terrene basin wetlands with connection intermittent Open water wetlands (except Ponds that are ranked "High")	***TA ***en  TEBA*CI, TEBA*OU, TEBA*OI WWI Class = W, open water wetlands	

### C.3.1.1 Flood Abatement

Storing floodwater reduces the extent of downstream flooding and lowers flood heights, both of which reduce damage from flooding events. All wetlands store some flood water. Here we identify those wetland types that perform a substantial level of flood abatement. These include wetlands along streams and rivers that can hold

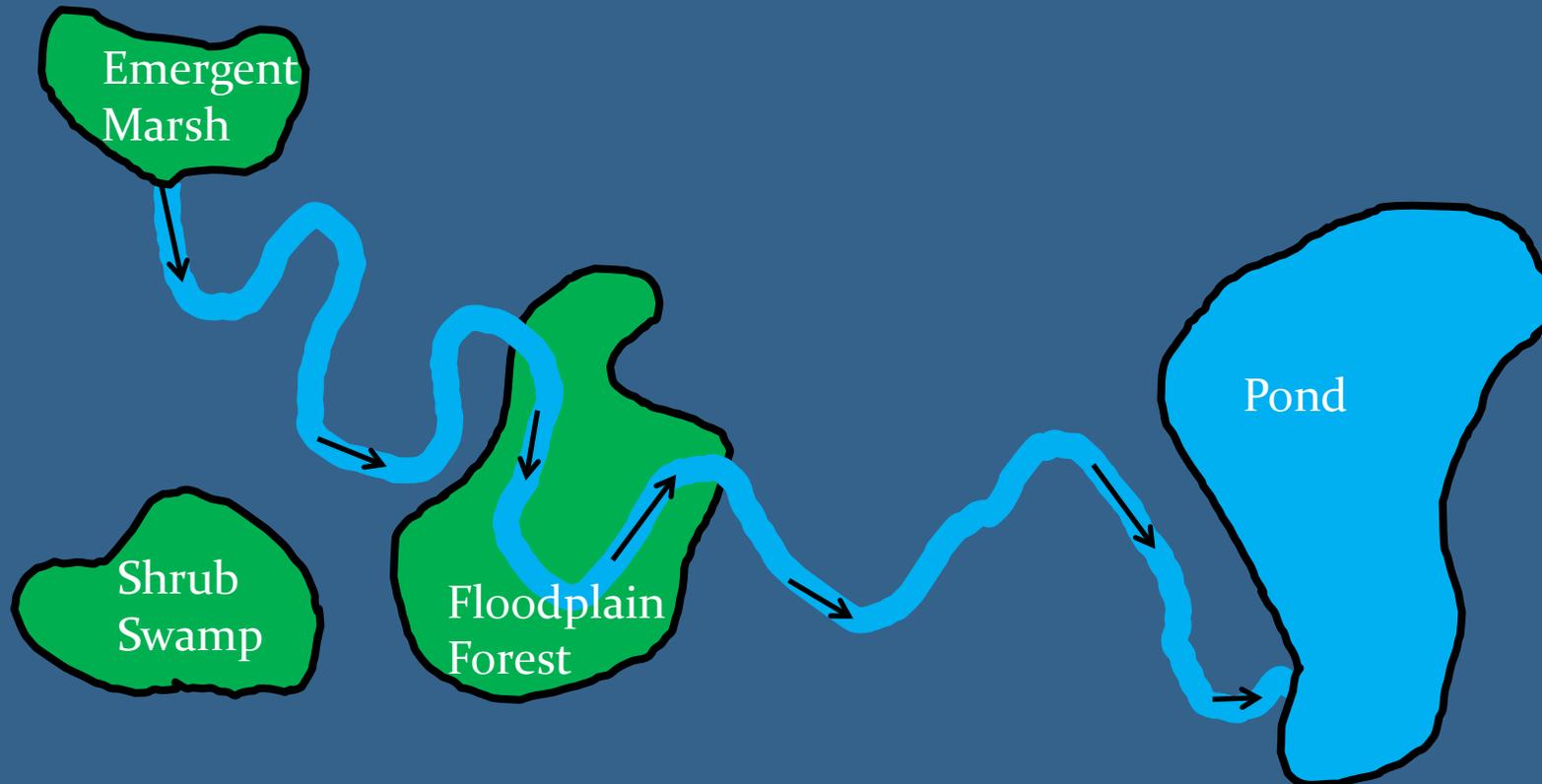
excess water until the stream or river can regain its capacity to move this excess water downstream. Wetlands with dense vegetation help to reduce water flow velocity. Ponds that are not artificially drained also provide this service. These depressions collect storm water runoff from adjacent lands, which prevents the water from flooding surrounding areas.

# How does LLWW work?



A 4 step GIS based process

- Step 1 - Start with Existing Information
  - Wetland mapping (WI Wetland Inventory and Potentially Restorable Wetlands)

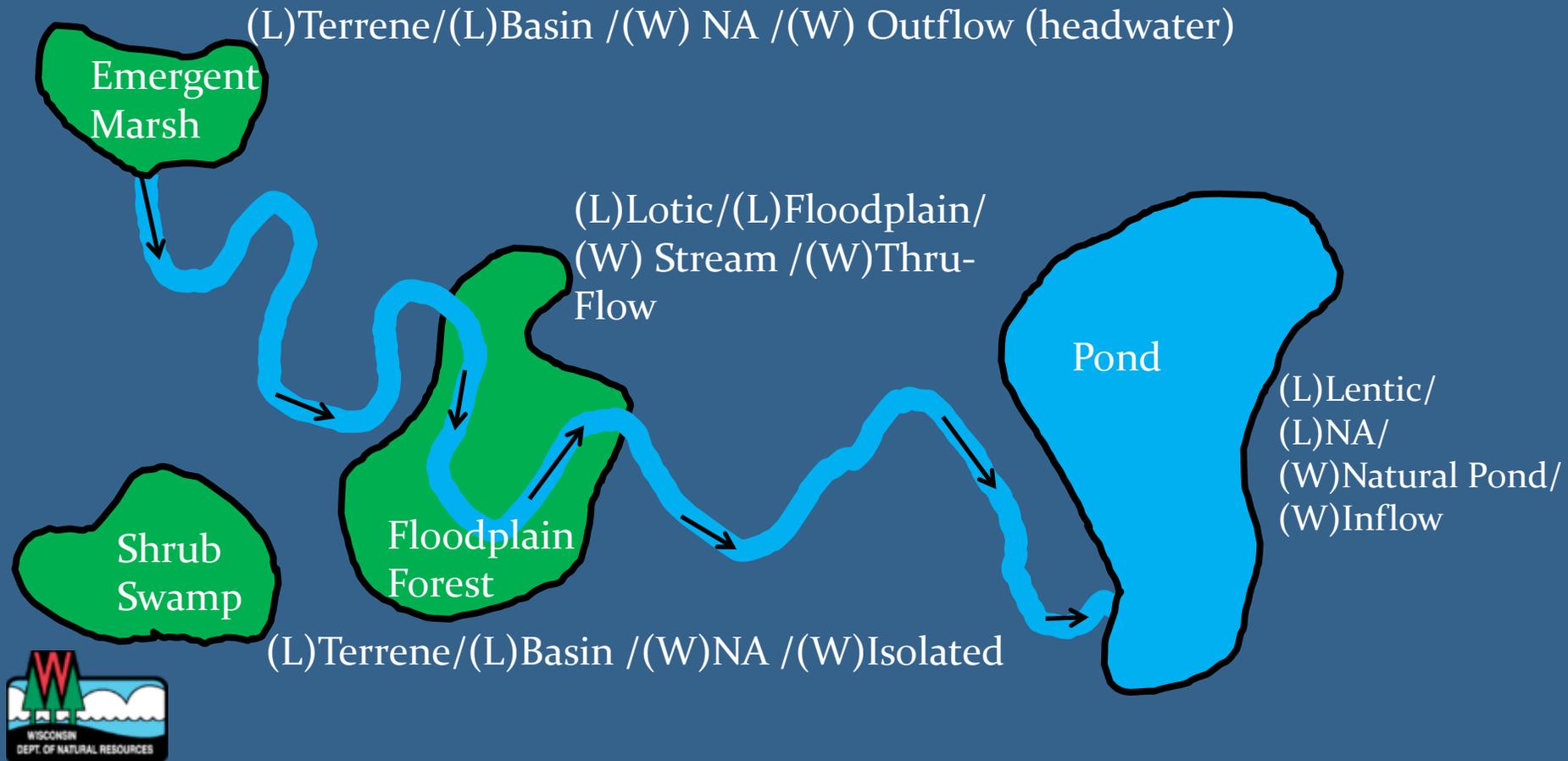


# How does LLWW work?



Step 2 – Add new information

- Landscape Position/Landform/Waterbody Type/Waterflow Path

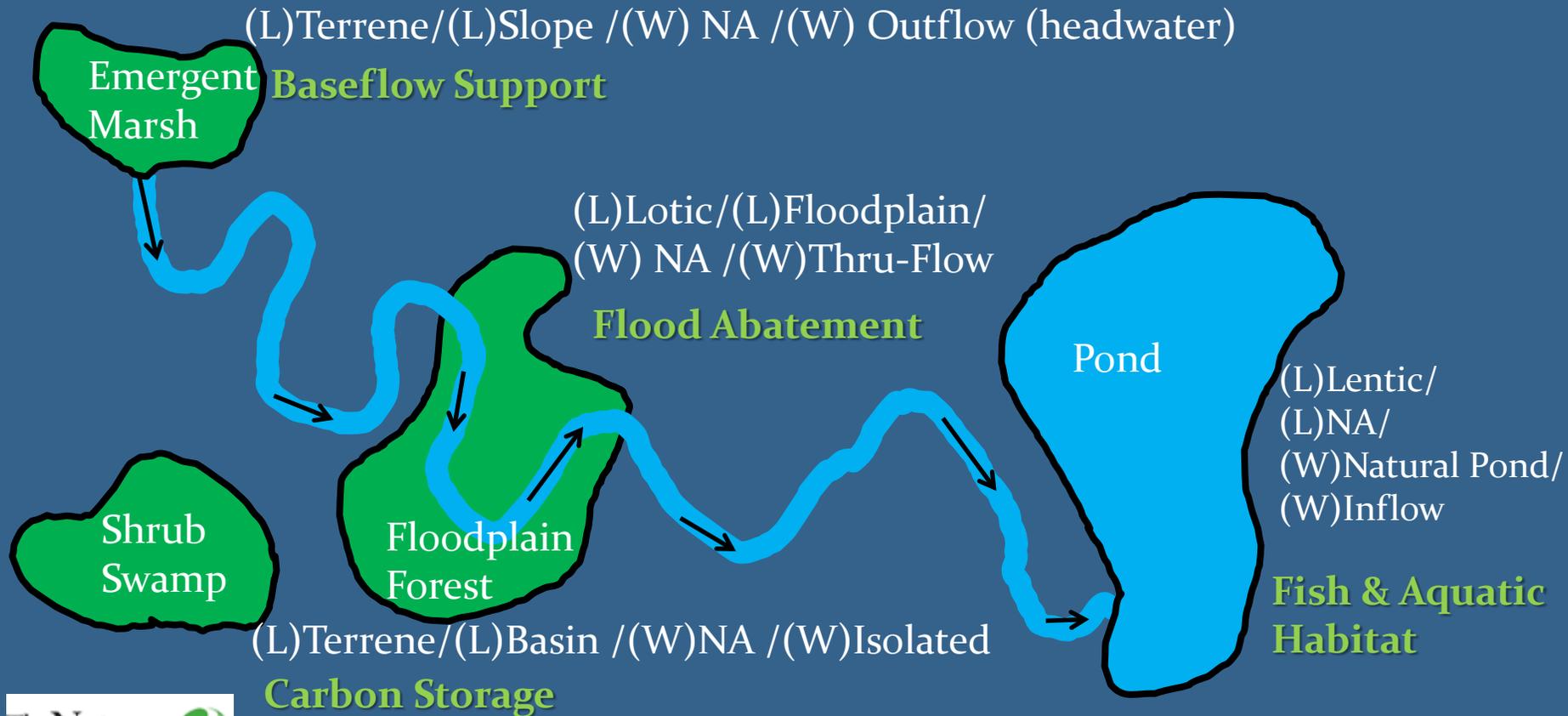


# How does LLWW work?



Step 3 – Correlate LLWW to functions

Existing Info + New Info = **Predicted Wetland Functions**



# How does LLWW work?



## Step 4 – Calculate watershed needs

- Reductions of wetland area for each function
- Historic (PRW) – Current = **Watershed Needs**



### Historic Wetland Extent

- No wetland impacts
- **Baseflow Support**
- **Fish & Aquatic Habitat**

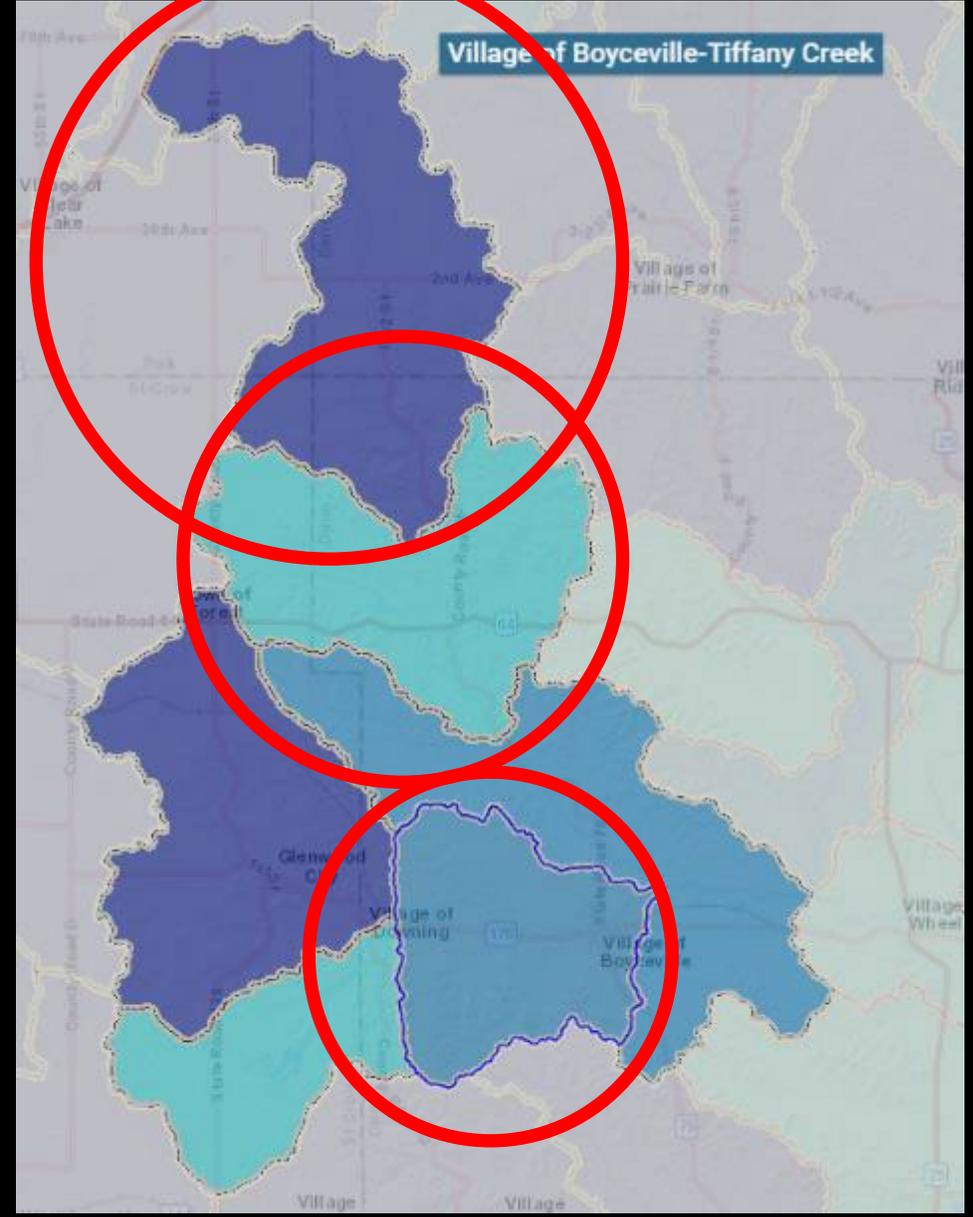
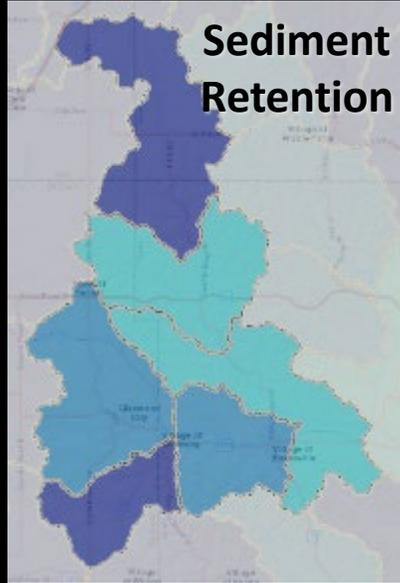
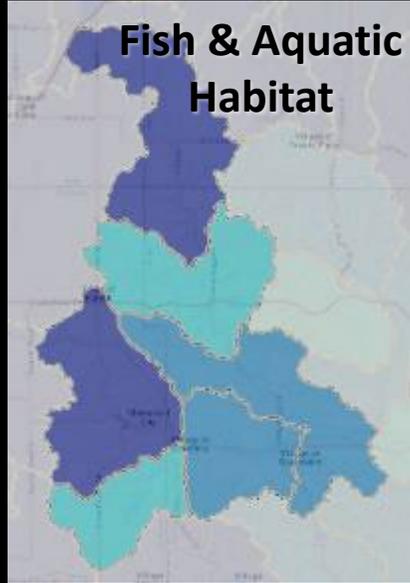
### Current Wetland Extent

- Carbon Storage:
- tiled / diked / drained
- Flood Abatement:
- filled for development

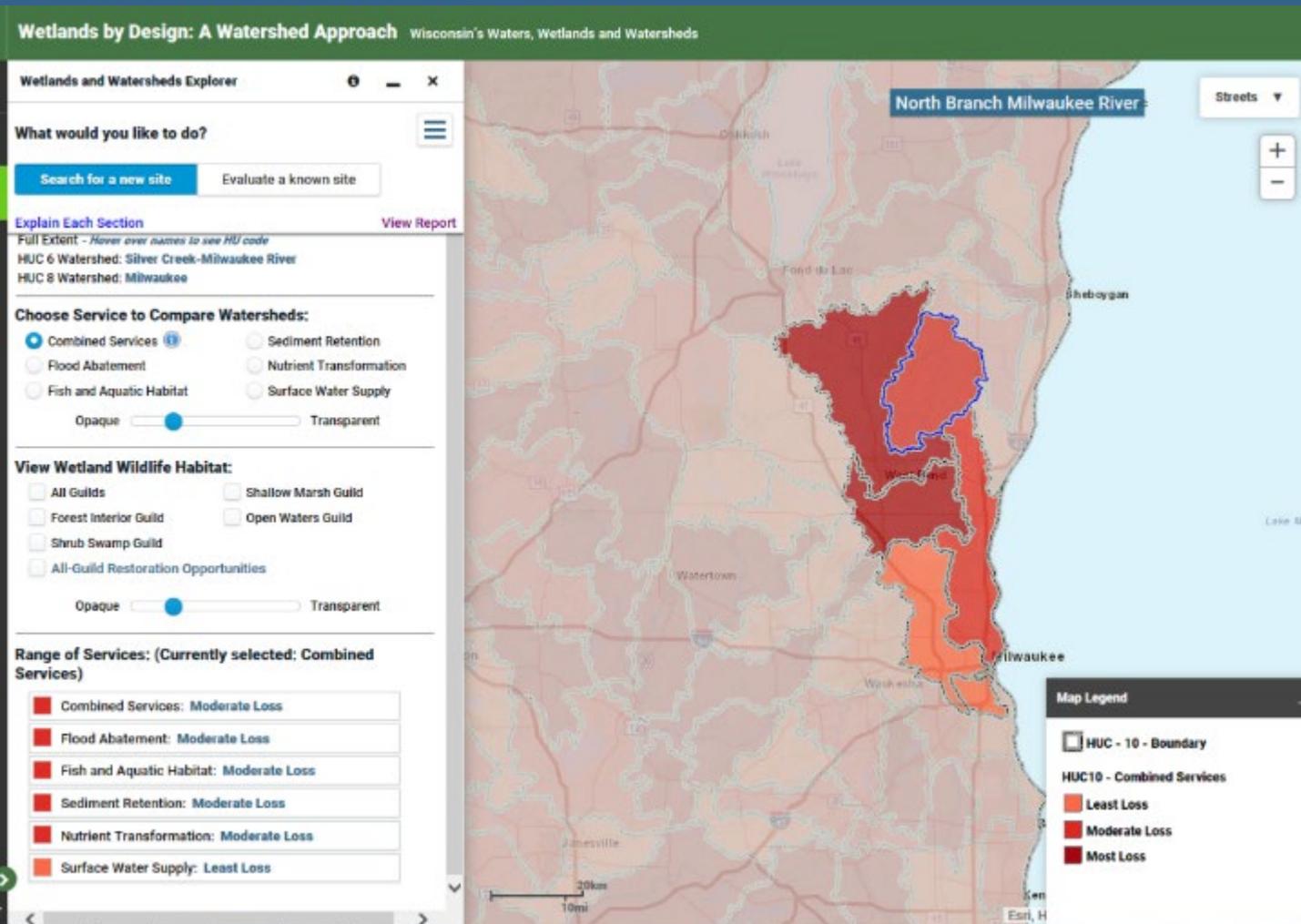
### Watershed Needs =

- **Highest Need**
  - **Carbon Storage**
- **Moderate Need**
  - **Flood Abatement**

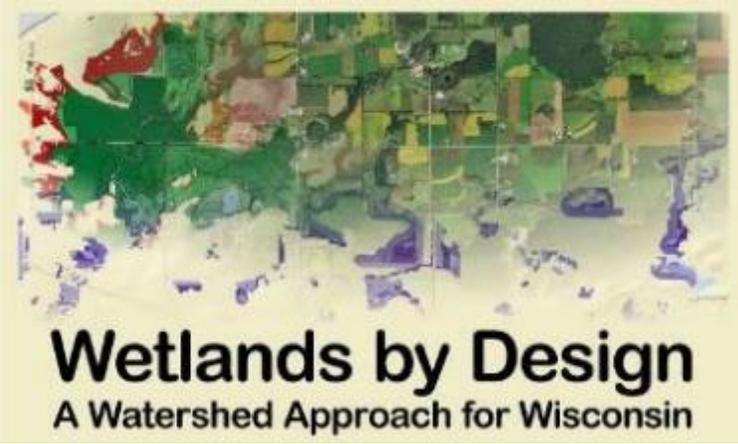
# Results: Watershed Service Losses



# Comparison of the relative need of the subwatersheds nested within a watershed



- HU 8s within HU 6; 10s within 8s, 12s within 10s
- Based on ES the watershed has lost



- Overview
- Examples: Decision Support Tool
- Methods
  - Watershed Assessment
  - Site Assessment
  - Wetland Wildlife Assessment

# GIS Rapid Assessment Method (GISRAM )

## Site Ranks (Service Potential)

Example: Flood abatement



### Water Quality

- Nitrogen Reduction
- Phosphorus reduction
- Sediment Reduction

Shoreline protection

Fish & aquatic habitat

Surface water supply

Carbon storage

Floristic Integrity

**Opportunity**

**Effectiveness**

**Social significance**

# LLWW – A key input for GIS RAM

## Appendix C. GIS Rapid Assessment Methodology (GISRAM)

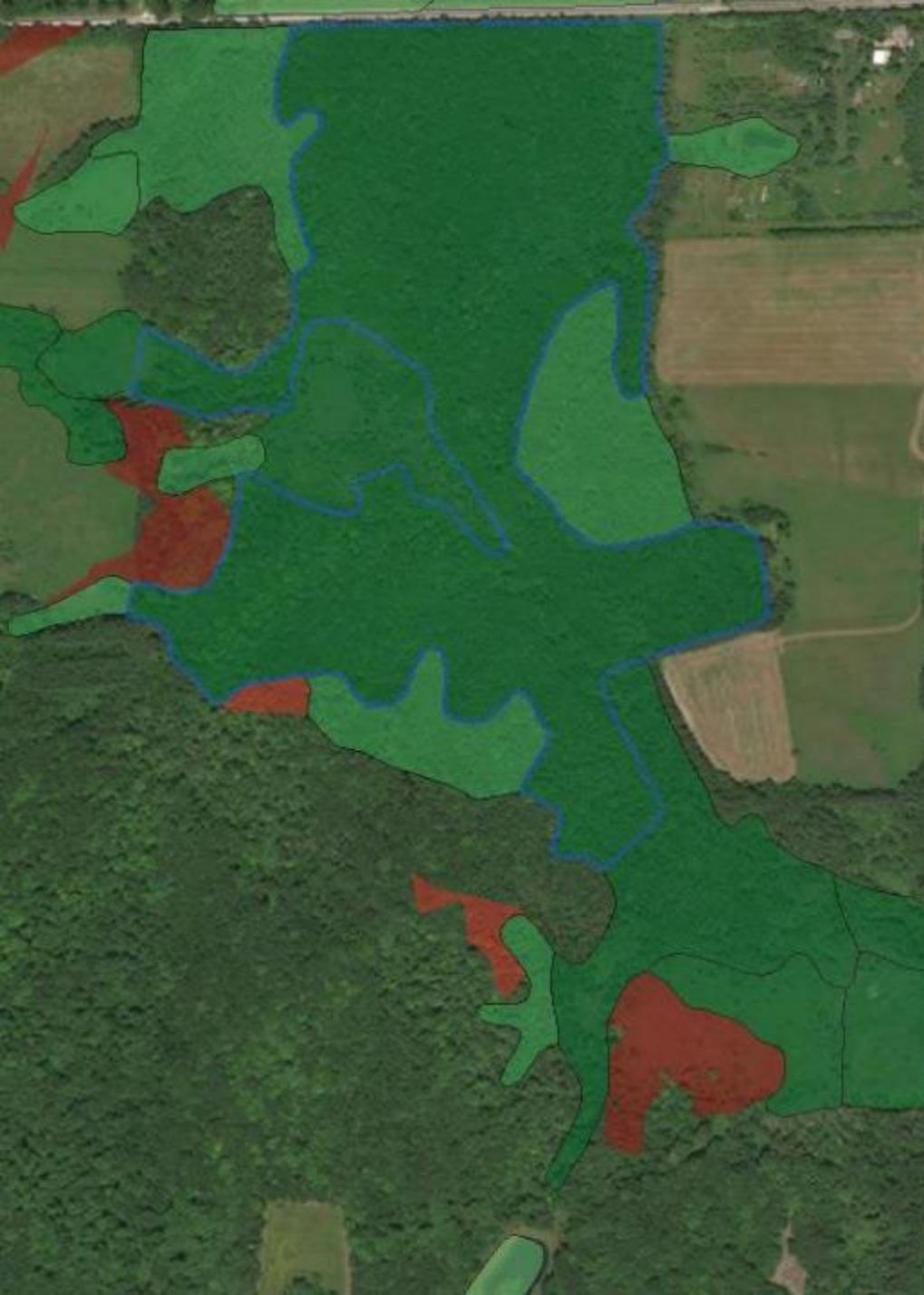
### GIS-RAM: Flood Abatement (FA)

Code	Criterion	Rationale	Assessment Resource		Unit of Analysis			Datasets	GIS-based Criterion
			Wetland	PRW	Polygon	Complex	Catchment		
FA_O1	Site is connected to a lake, stream, or river, OR receives concentrated inflow and/or outflow or is connected through an existing wetland to outflow. <b>This criterion is necessary to the service.</b>	Runoff accumulated at a point or channel contributes to more stream flow during storm events. Wetlands connected to streams can help to slow floodwaters.	X	X		X		WWI/PRW Plus	LLWW Functional Significance is High or Moderate = YES
FA_O2	Local topography near a site includes steep slopes.	Steep slopes contribute to rapid runoff and increased stream flow during storm events. Wetlands below these slopes will intercept and slow more stormwater runoff and floodwater.	X	X			X	WWI/PRW, WI DNR 24k VA dataset,	Slopes within the site's catchment exceed the median slope value for the WHUC 10 = YES
FA_O3	Site is in a catchment with high runoff potential.	Land cover and soil type in the catchment determine runoff volume.	X	X		X	X	WWI/PRW Plus, WDNR 24K Hydrography Value Added	Site is in a catchment whose runoff Curve Number value exceeds the median Curve Number value for the WHUC 10 = YES
FA_E2	Dominant vegetation of site is dense and persistent.	Dense wetland vegetation impedes water flow. Persistent vegetation (e.g. woody plants, robust persistent emergent species) can provide this service even outside of the growing season.	X		X			WWI	Forest, scrub-shrub and persistent emergent marsh wetland types, with modified wetlands (f, g, v and x) excluded = YES
FA_E3	Site is in a topographic depression or floodplain setting.	Floodplain wetlands store floodwaters temporarily after storms.	X	X	X			WWI/PRW Plus Active River Area	Landform = BA, FR, FF, FP, and inside ARA = YES
FA_E4	Internal flow path distance within a site.	The longer the flow path within the site, the greater the friction that will slow water movement.	X	X		X		WWI/PRW Plus, WDNR 24K Hydrography Geodatabase	Length of a site's shoreline interface exceeds the WHUC10 non-zero median interface length, with entrenched and artificial waterways excluded = YES

## Flood Abatement: Site Example A



Code	O,E,S	Criterion	1=YES, 0=NO
FA_O1	O	Site is connected to a lake, stream, or river, OR receives concentrated inflow and/or outflow or is connected through an existing wetland to outflow.	1
FA_O2	O	Steep slopes in catchment	0
FA_O3	O	Runoff potential of catchment	0
FA_E2	E	Dominant vegetation of site is dense and persistent	1
FA_E3	E	Site is in a topographic depression or floodplain setting	1
FA_E4	E	Internal flow path distance within site	1
FA_E5	E	Ratio of catchment area to site area	1
FA_E9	E	Stream order associated with site connection	1
FA_S1	S	Site outflow contributes to downstream economically valuable flood-prone areas	0
		O-E Score (sum of O+E answered 'yes' / # of O+E questions)	0.75
		O-E-S Score (add +0.1 for each S answered 'yes')	0.75
		Size Factor (1, 1.5, 2)	2
		Site Score (O-E-S Score * Size Factor)	1.5
		<b>GISRAM Rank (1 = Very High, Top Third within HUC12)</b>	<b>1 (Very High)</b>
		<b>WISRAM (Field) Rank</b>	<b>1 (Very High)</b>



## Flood Abatement: Site Example B

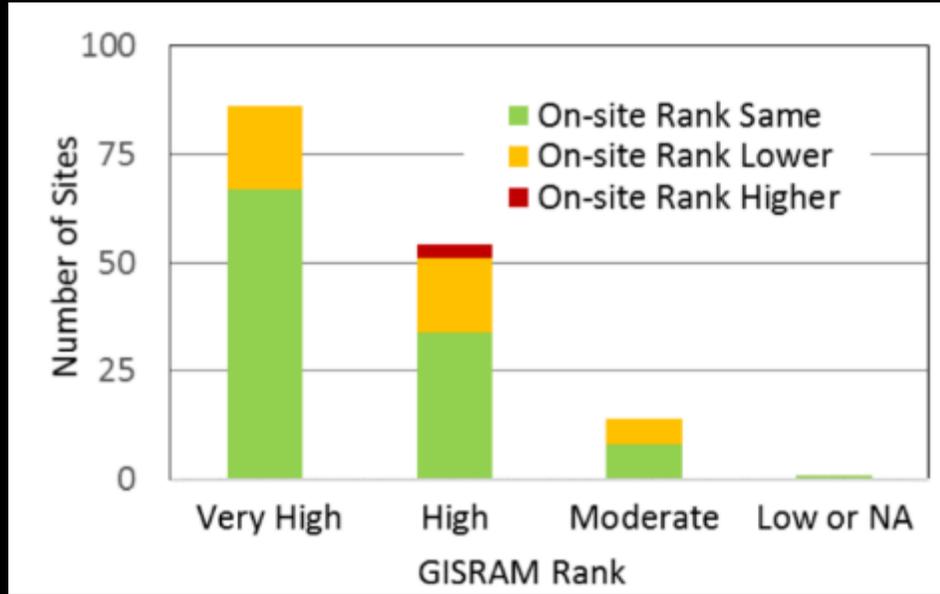
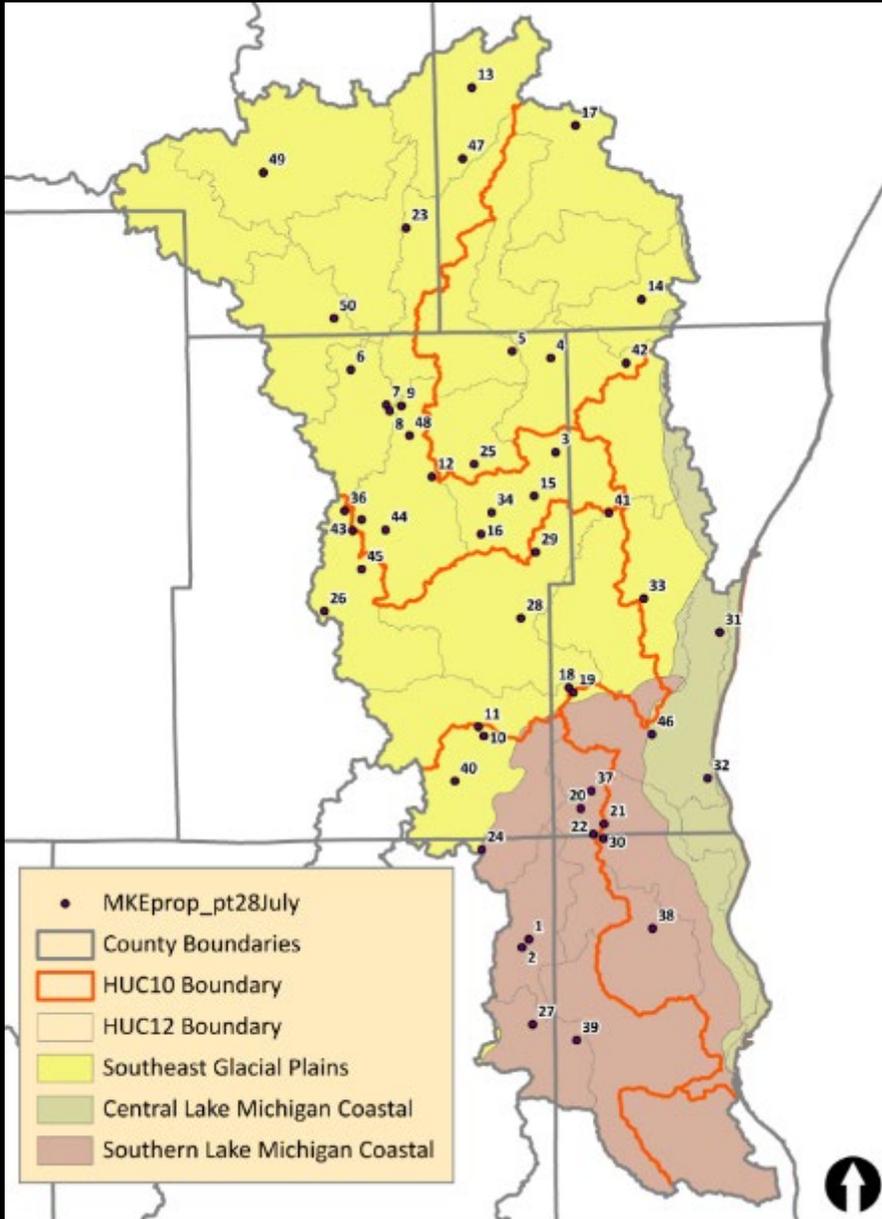
Code	O,E,S	Criterion	1=YES, 0=NO
FA_O1	O	Site is connected to a lake, stream, or river, OR receives concentrated inflow and/or outflow or is connected through an existing wetland to outflow.	1
FA_O2	O	Steep slopes in catchment	1
FA_O3	O	Runoff potential of catchment	0
FA_E2	E	Dominant vegetation of site is dense and persistent	1
FA_E3	E	Site is in a topographic depression or floodplain setting	1
FA_E4	E	Internal flow path distance within site	1
FA_E5	E	Ratio of catchment area to site area	1
FA_E9	E	Stream order associated with site connection	0
FA_S1	S	Site outflow contributes to downstream economically valuable flood-prone areas	1
O-E Score (sum of O+E answered 'yes' / # of O+E questions)			0.75
O-E-S Score (add +0.1 for each S answered 'yes')			0.85
Size Factor (1, 1.5, 2)			2
Site Score (Raw Score * Size Factor)			1.7
<b>GISRAM Rank (1 = Very High, Top Third within HUC12)</b>			<b>1 (Very High)</b>
<b>WISRAM (Field) Rank</b>			<b>2 (High)</b>



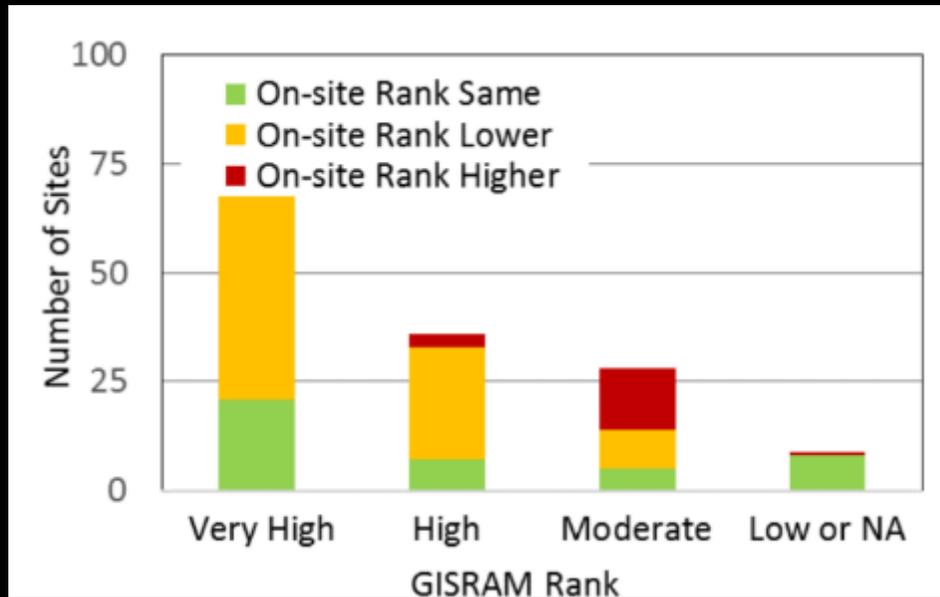
## Floristic Integrity: Site Example C

Code	O,E,S	Criterion	1=YES, 0=NO
FQ_01	O	Site is vegetated	1
FQ_02	O	Site does not have documented invasives	0
FQ_03	O	Site receives groundwater discharge	0
FQ_04	O	Catchment is largely composed of natural cover	0
FQ_05	O	Site not within invasives dispersal zone	0
FQ_07	O	Site recognized as high quality plant community	0
FQ_E1	E	Site buffer is composed of natural land cover	0
O-E Score (sum of O+E answered 'yes' / # of O+E questions)			0.14
O-E-S Score (add +0.1 for each S answered 'yes')			NA (0.14)
Size Factor (1, 1.5, 2)			NA
Site Score (Raw Score * Size Factor)			0.14
<b>GISRAM Rank (3 = Moderate, Bottom 1/3 in HUC12)</b>			<b>3 (Moderate)</b>
<b>WISRAM (Field) Rank</b>			<b>1 (Very High)</b>

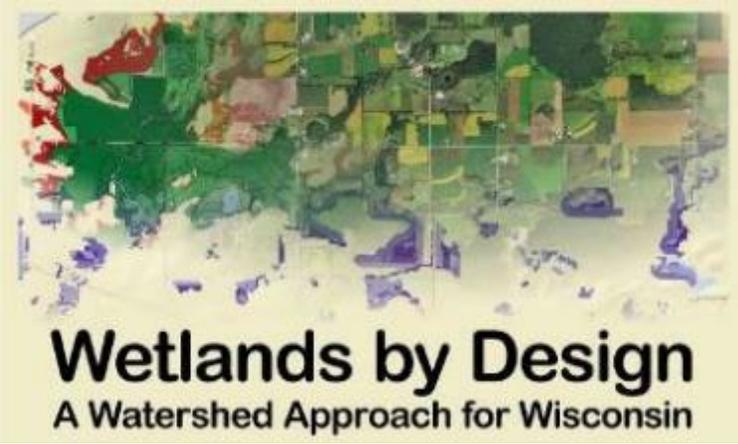
# GIS RAM Field Validation



**Flood  
Abatement**



**Floristic  
Quality**



- Overview
- Examples: Decision Support Tool
- Methods
  - Watershed Assessment
  - Site Assessment
  - Wetland Wildlife Assessment

# Wetland Wildlife Assessment

Land Cover Types		Wetland Wildlife Habitat Guilds			
		Open Water	Shallow Marsh	Shrub Swamp	Forest Interior
UPLAND	Urban/Developed, high intensity	0	0	0	0
	Urban/Developed, low intensity	0	0	0	0
	Grasslands and Pasture	0	2*	0	0
	Forest, evergreen	0	0	0	1*
	Forest, deciduous	0	0	0	1*
	Forest, mixed	0	0	0	1*
	Shrub Land ( <u>not</u> shrub-carr)	0	0	0	0
	Cultivated Land	0	0	0	0
LARGE OPEN WATER	Surface Water, rivers	0	1	0	0
	Surface Water, lakes	3	1	0	0
WETLAND	Open Water Wetlands	1*	3	0	0
	Aquatic Bed/Deep Marsh	3	3	0	0
	Shallow Marsh <= 5 acres	2*	3	0	0
	Shallow Marsh > 5 acres	3*	3	0	0
	Wetland Meadows	1*	3	2*	0
	Wetland Forest, broad leaved	0	2*	0	3#*
	Wetland Forest, coniferous	0	2*	0	3#*
	Wetland Forest, mixed	0	2*	0	3#
	Shrub Bog, evergreen	0	0	2*	0
	Shrub-carr, deciduous	0	2*	3	2#*
	Cultivated flat	0	0	0	0
Natural flats	0	0	0	0	
SPECIAL TYPES	Reed canarygrass	0	1	0	0
	Cattail	2*	3	0	0
	Road corridor	1	1	1	1

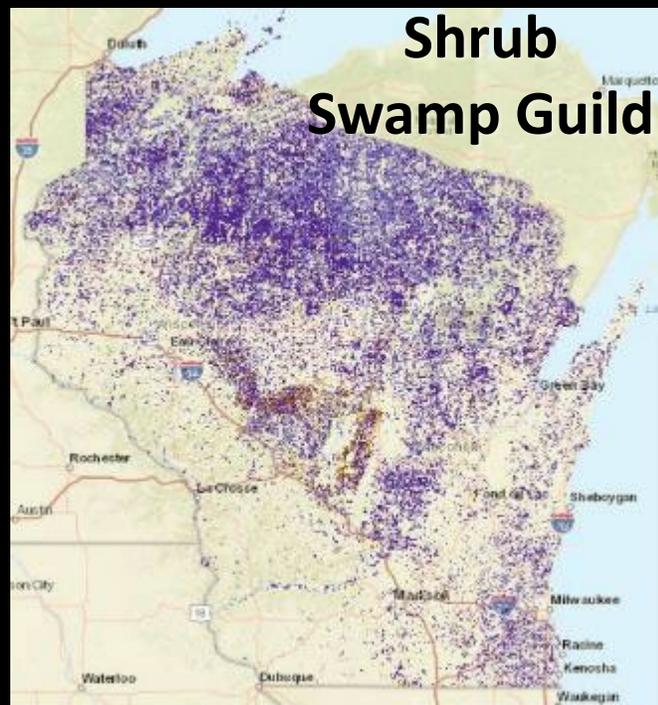
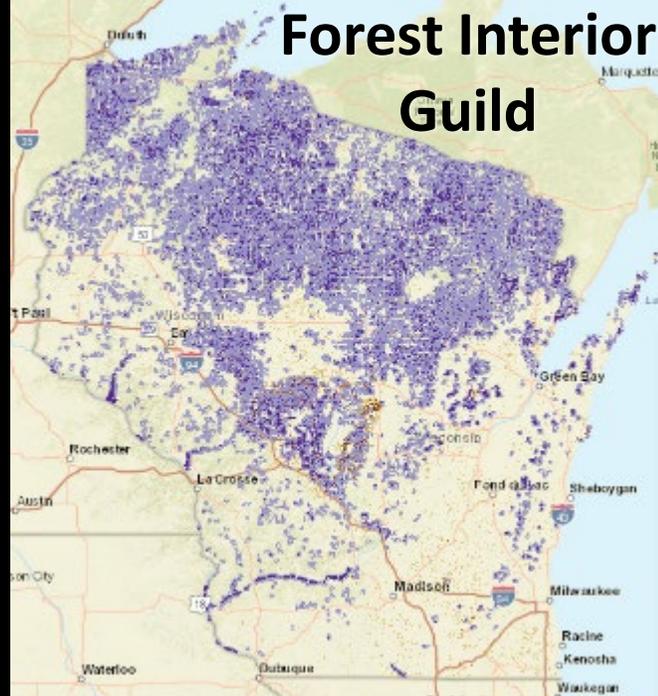
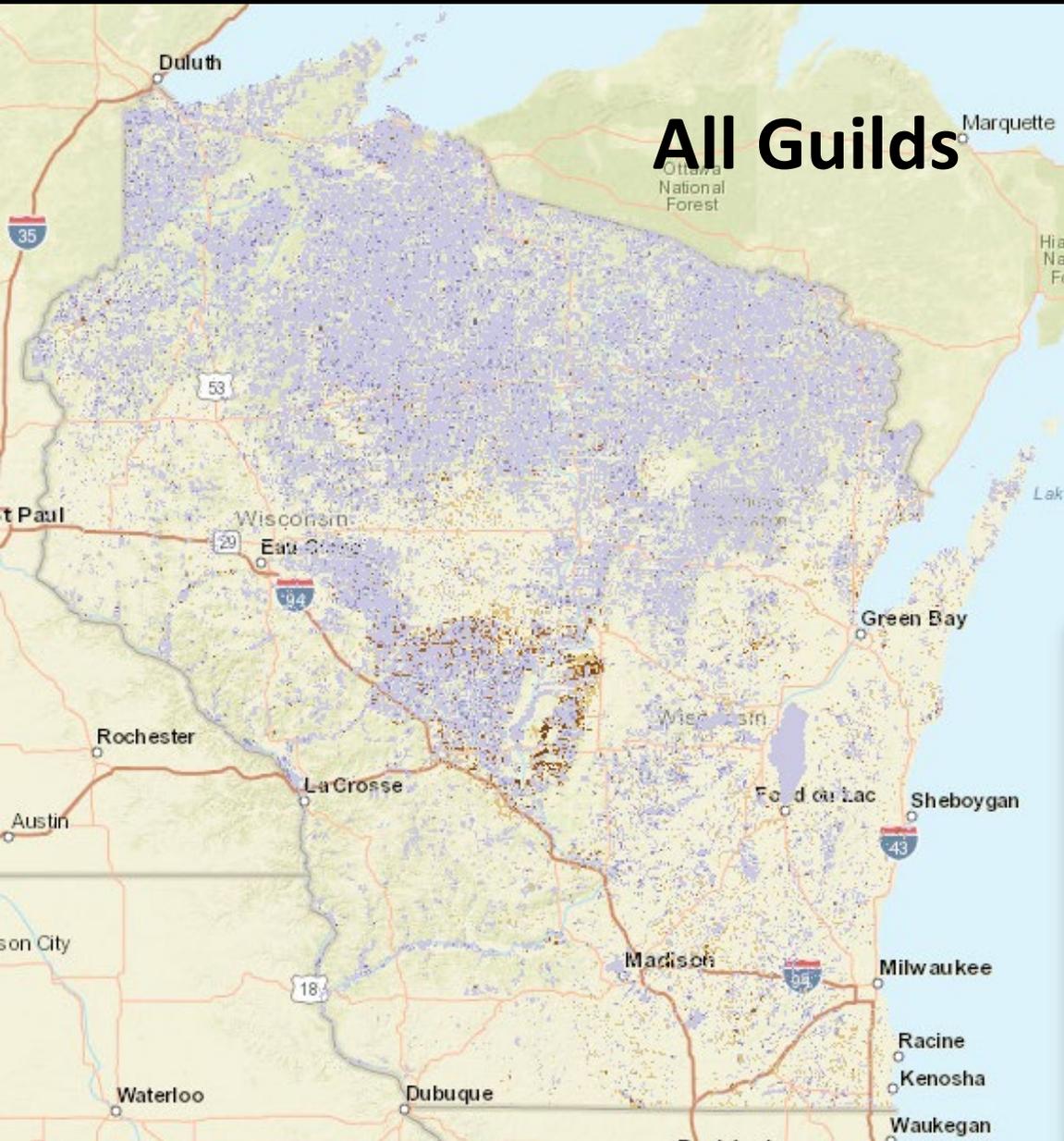
**Guilds**  
 Open Water  
 Shallow Marsh  
 Shrub Swamp  
 Forest Interior

**Landcovers**  
 Wetland types  
 Upland types  
 Open waters

## 'Proximity' (Landscape) Factors

Guild	Primary Habitat Selection	Additional Primary Habitat (#) for Forest Interior Guild	Ancillary Habitat (*) Selection
Open Water	Combine all rank 3 land cover types.		Selected Rank 1* and 2* cover within 100 m of primary habitat is added.
Shallow Marsh	Combine all rank 3 land cover types.		Selected Rank 2* cover within 100 m of primary habitat is added.
Shrub Swamp	Combine all rank 3 land cover types.		Selected Rank 2* cover within 100 m of primary habitat is added.
Forest Interior	Combine all rank 3 land cover types. Combined patches must be >75 ha.	Patches of rank 2 and 3 cover types less than 75 ha if forest cover within 1 km of the patch is greater than 50%.	Selected Rank 1* and 2* cover within 100 m of primary habitat is added.

# Wetland Wildlife Habitat



# Wetland Wildlife: Pheasant Branch Marsh

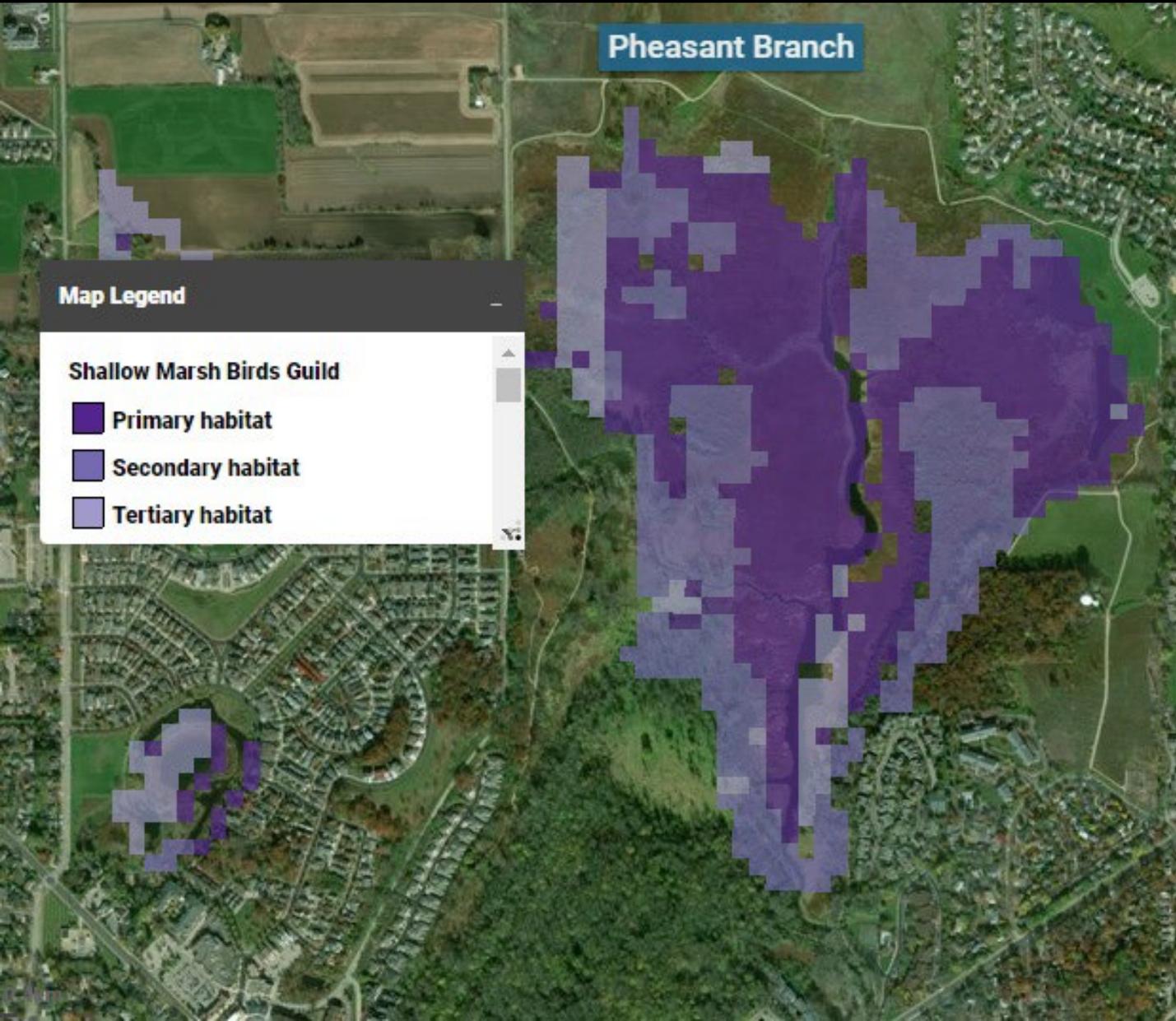


# Wetland Wildlife: Pheasant Branch Marsh



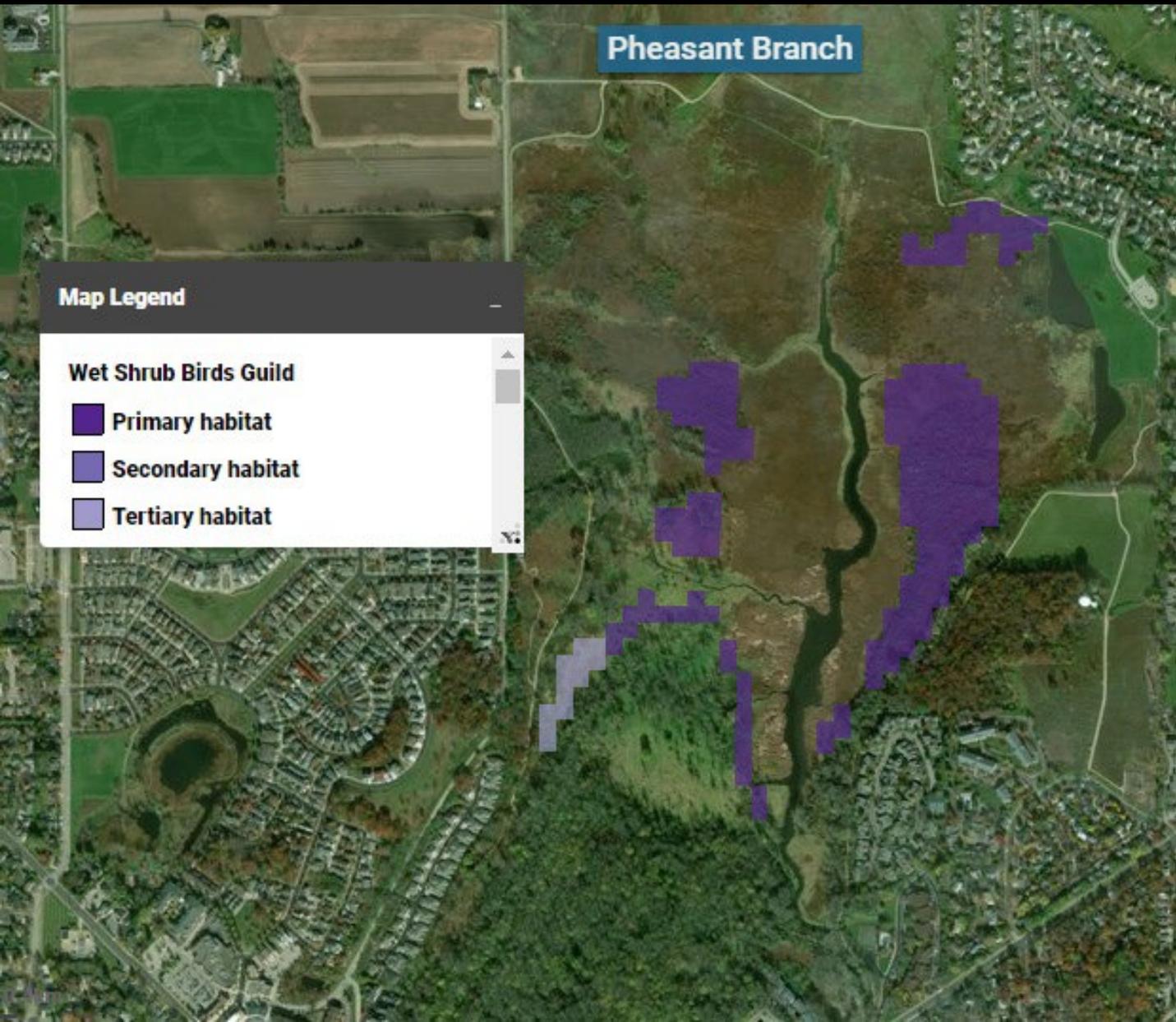
**Aerial View**

# Wetland Wildlife: Pheasant Branch Marsh



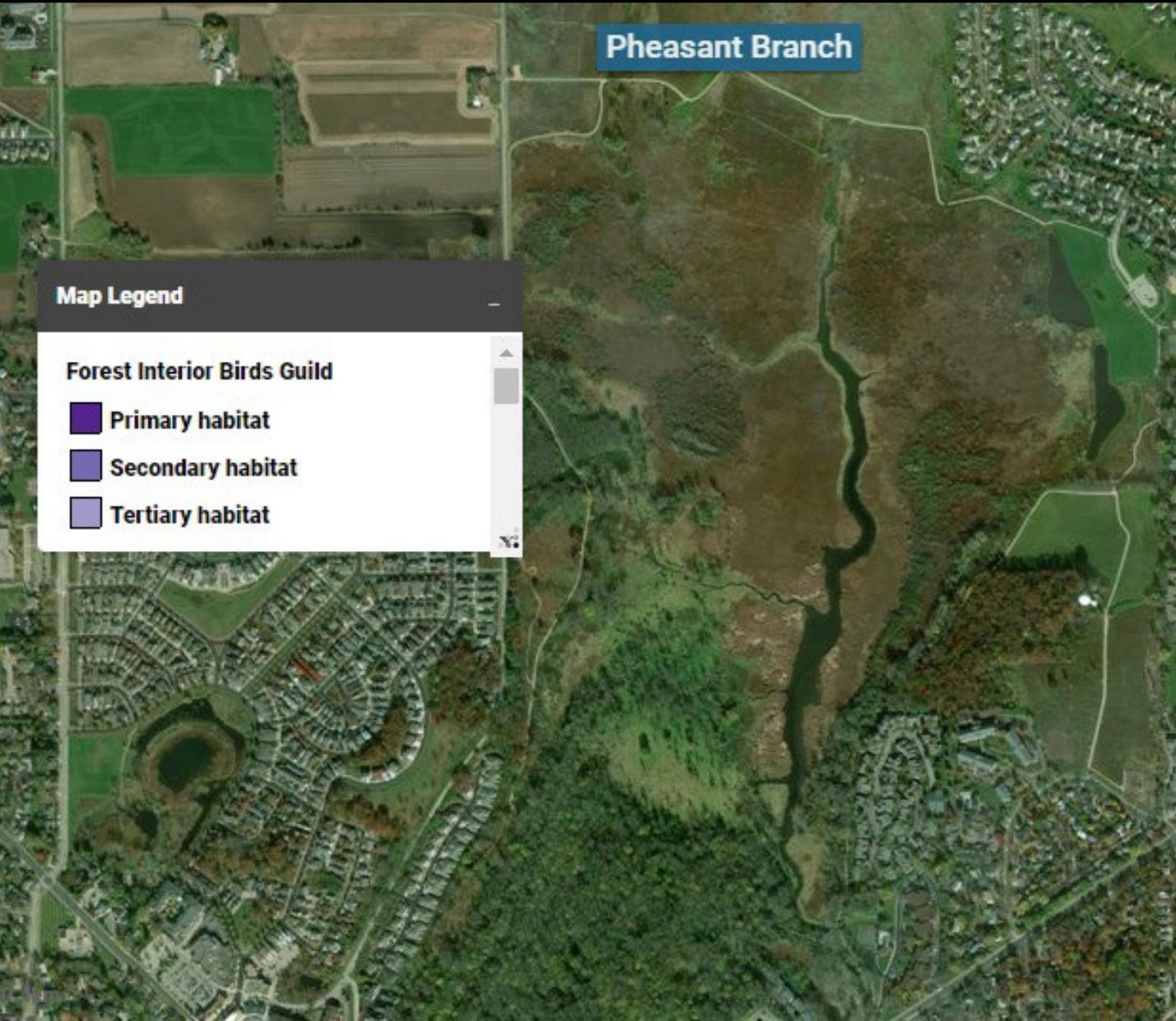
Shallow Marsh Guild

# Wetland Wildlife: Pheasant Branch Marsh



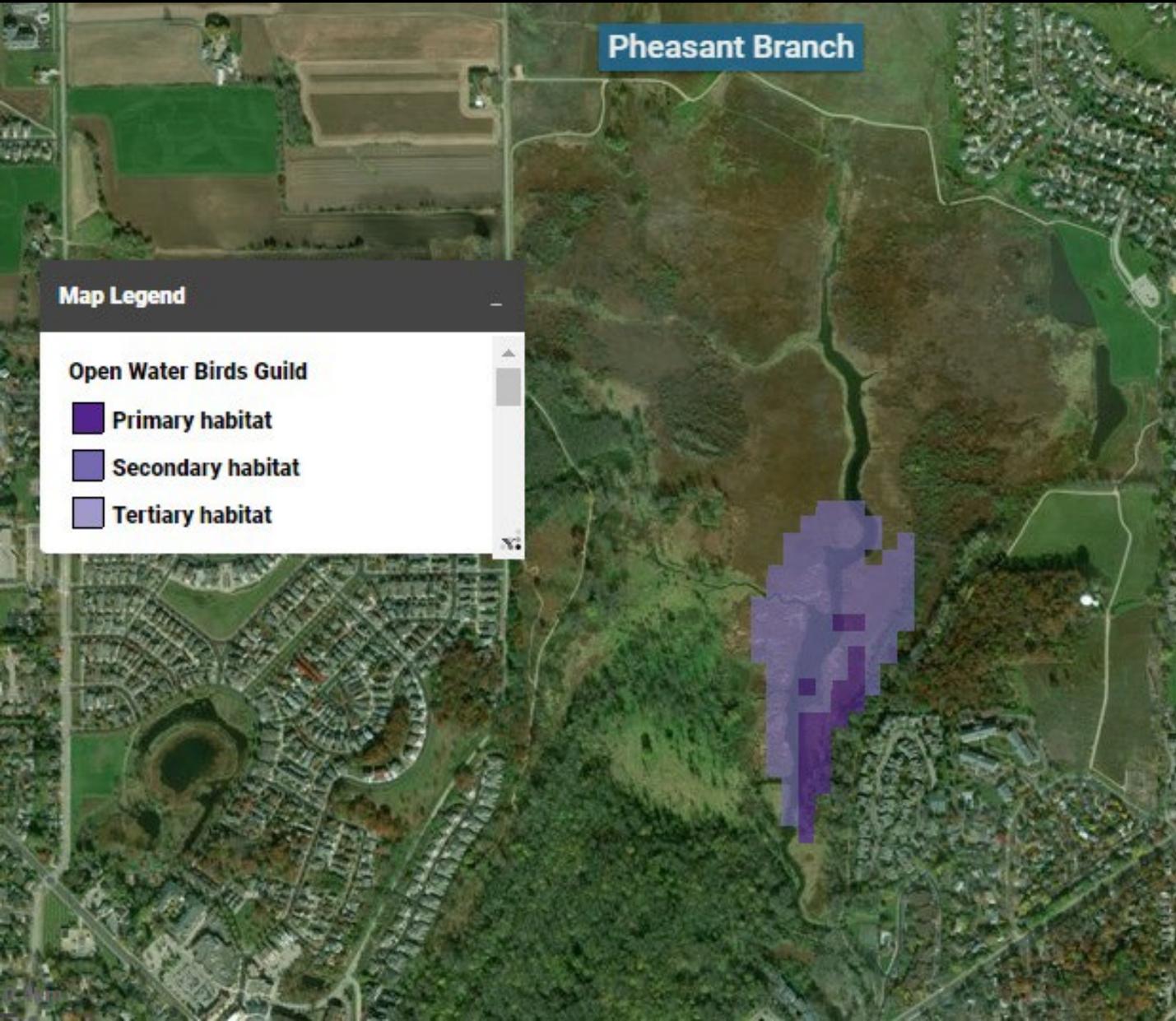
**Shrub Swamp Guild**

# Wetland Wildlife: Pheasant Branch Marsh



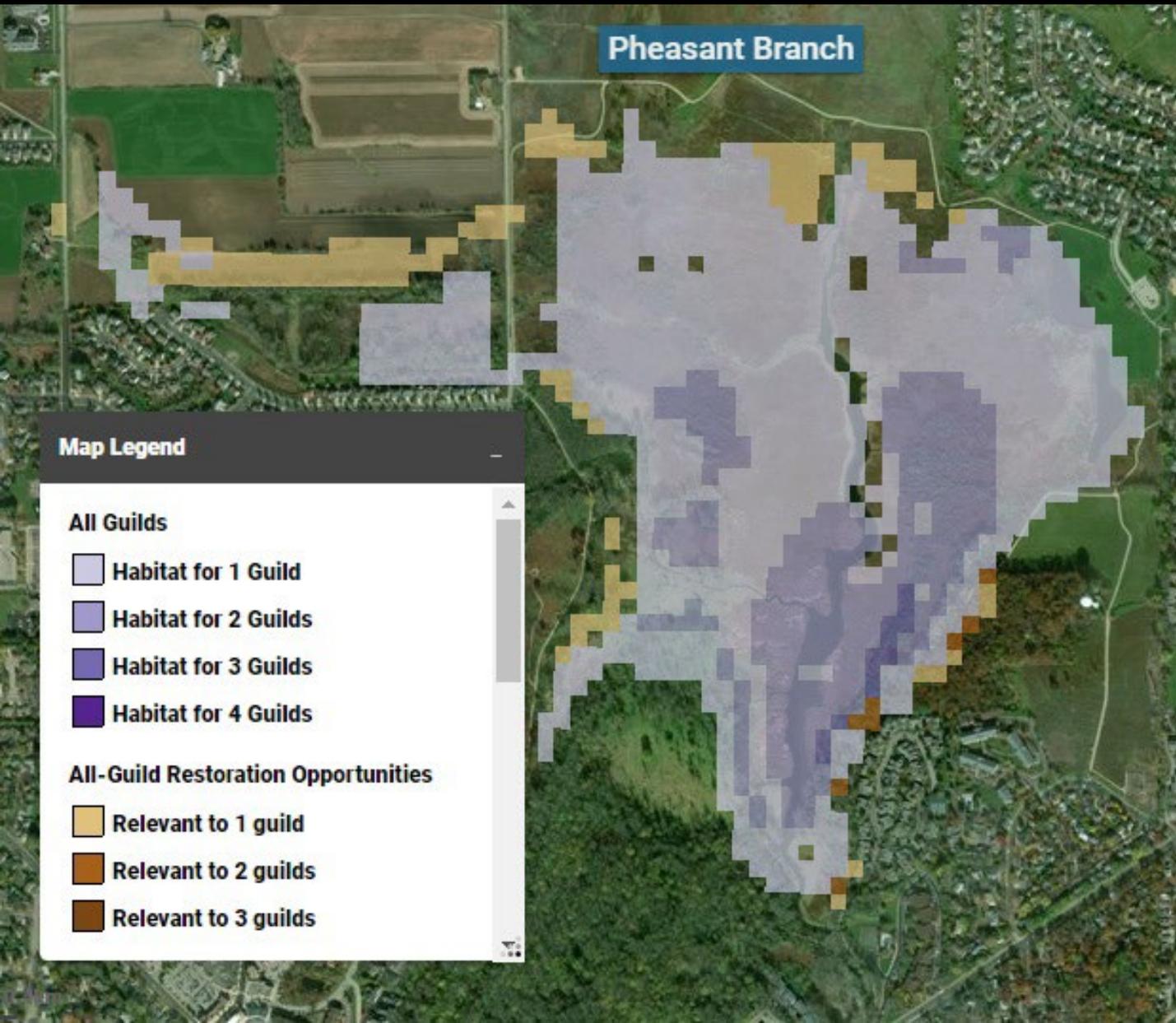
Forest Interior Guild

# Wetland Wildlife: Pheasant Branch Marsh



**Open Water Guild**

# Wetland Wildlife: Pheasant Branch Marsh

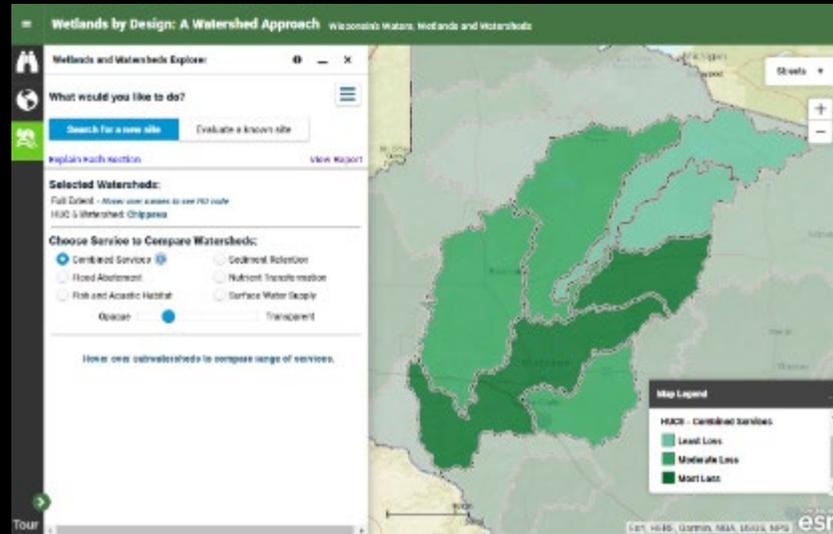


All Guilds  
&  
Restoration Opportunities

# www.WetlandsByDesign.org



Report



Wetlands & Watersheds Explorer



Webinar training



# Questions?

[www.WetlandsByDesign.org](http://www.WetlandsByDesign.org)

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