WISCONSIN'S HEALTHY WATERSHEDS TOOL

Looking ahead
to target protection efforts

What I'll cover…

- What is the Healthy Watersheds Initiative?
- Results!
  Nested Maps/Scores
- How can we use the information?
- Getting the Data

Goals of Healthy Watersheds Assessments

National EPA effort
to help states:

- Rank watersheds based on their level of "health" and "vulnerability"
  - Use it *comparatively*, not Good/Bad
- Based on a range of metrics & datasets
  - Geospatial data & modeled predictions
- Broad-level screening tool
- Make strategic decisions for protection

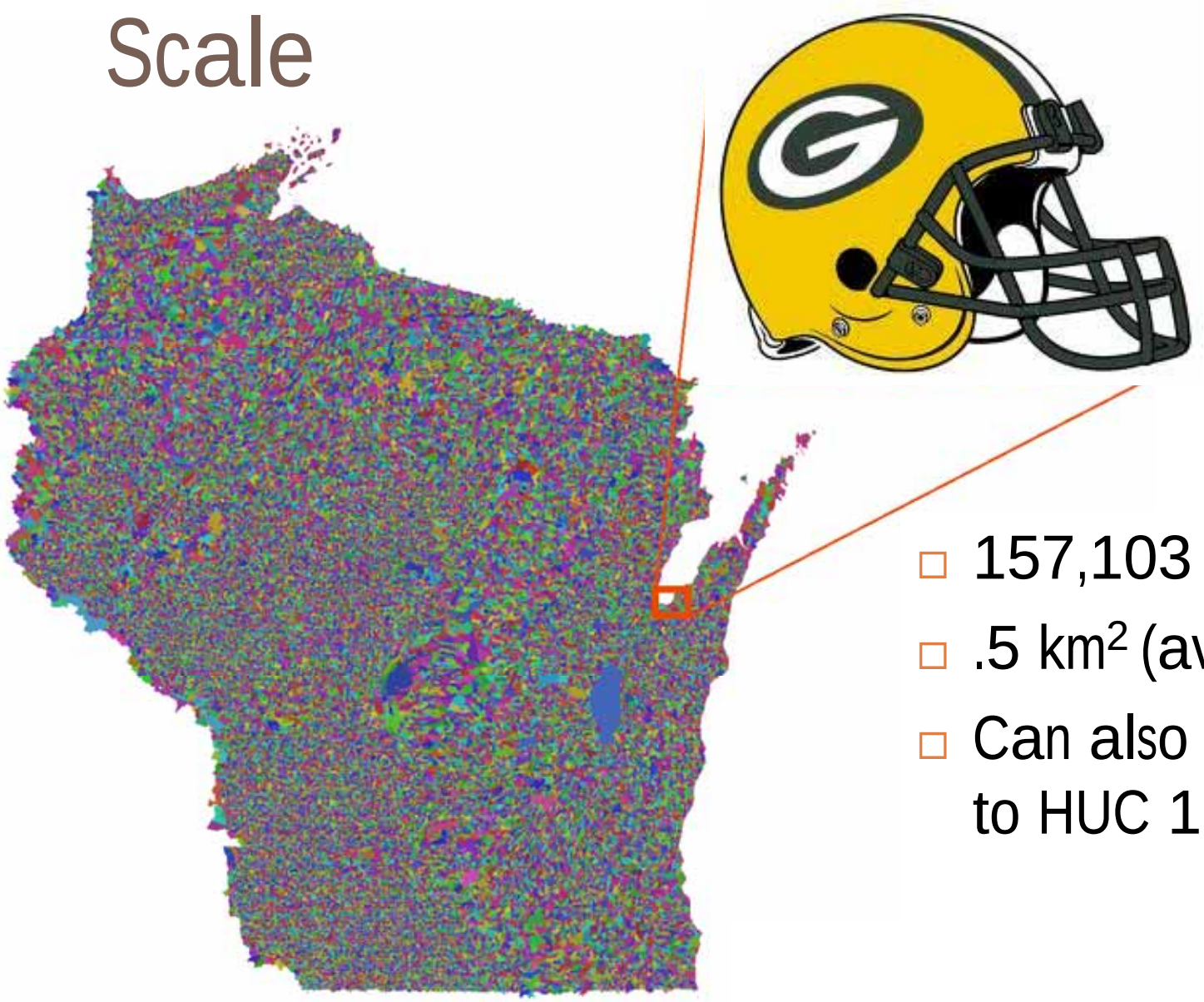
➡ Wisconsin is one of the early states to adopt this

Project Partners

- WI DNR
- EPA Headquarters
- EPA Region 5
- The Nature Conservancy
- USGS
- Cadmus consulting

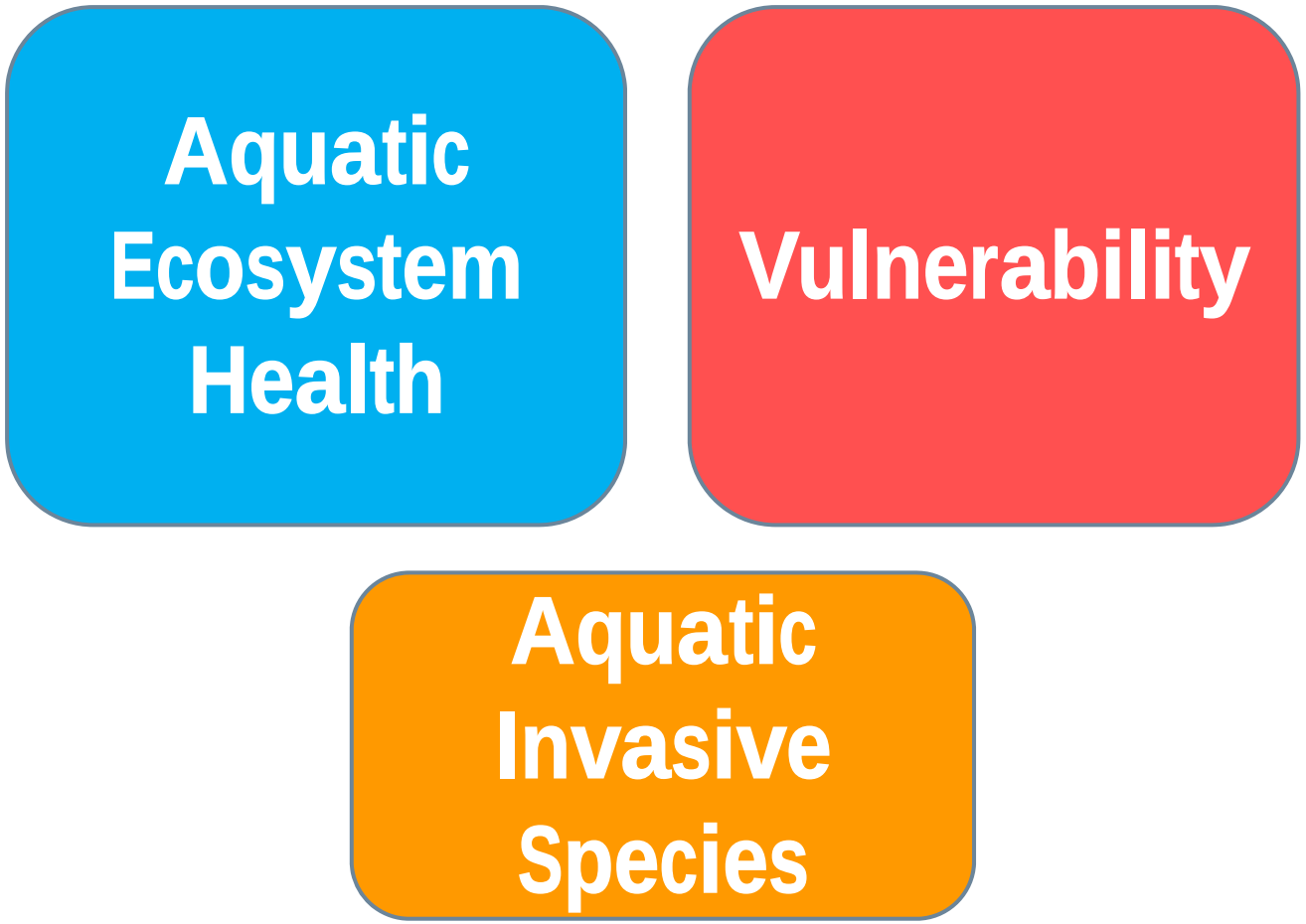
- Lakes, Rivers & Wetlands
- Monitoring
- Water Quality Standards
- Drinking Water & Groundwater
- Runoff Management
- Fisheries
- Office of Great Lakes
- Forestry
- Research

Scale

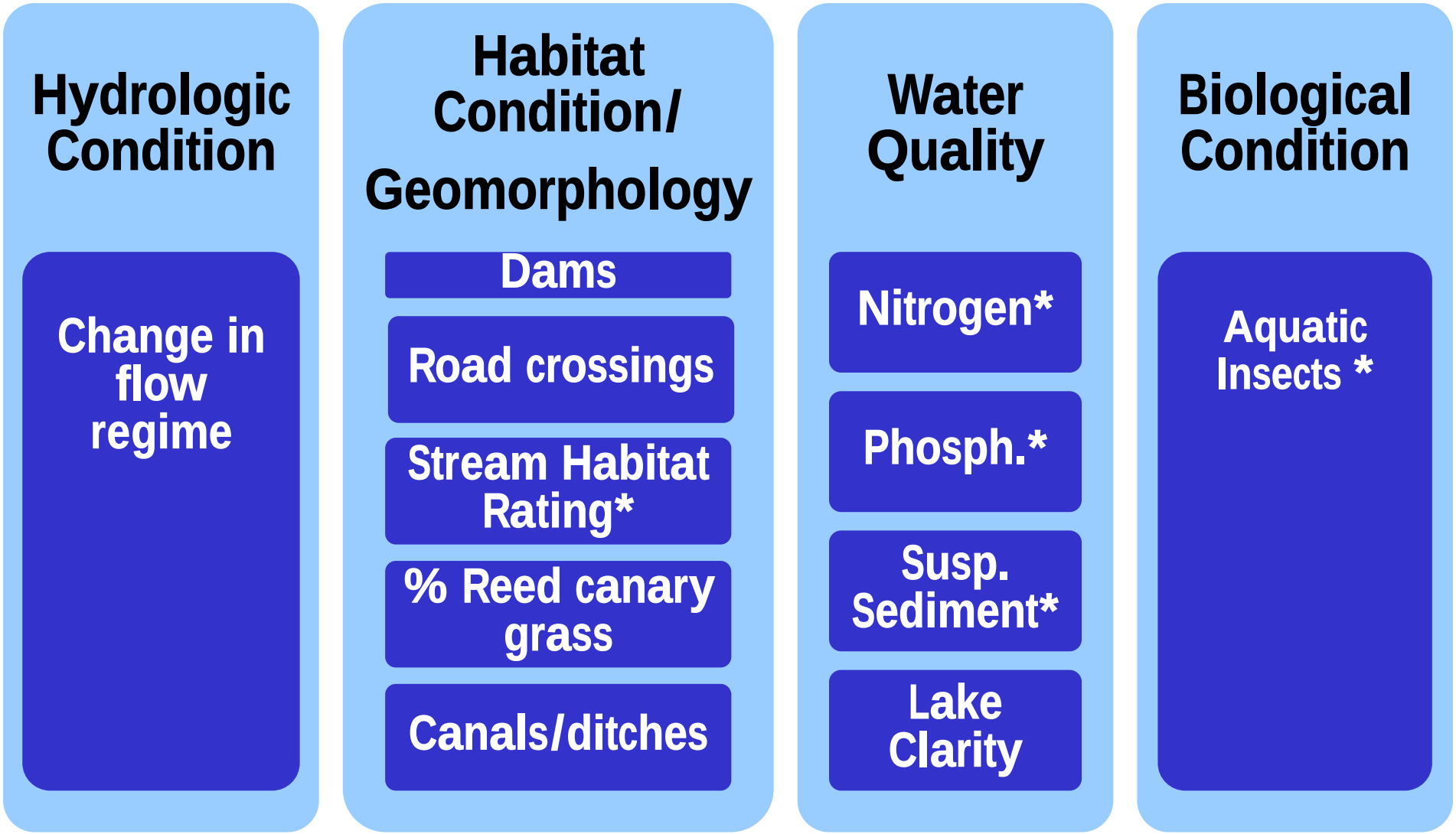


- 157,103 catchments
- .5 km^2 (ave)
- Can also be ‘rolled up’ to HUC 12, etc.

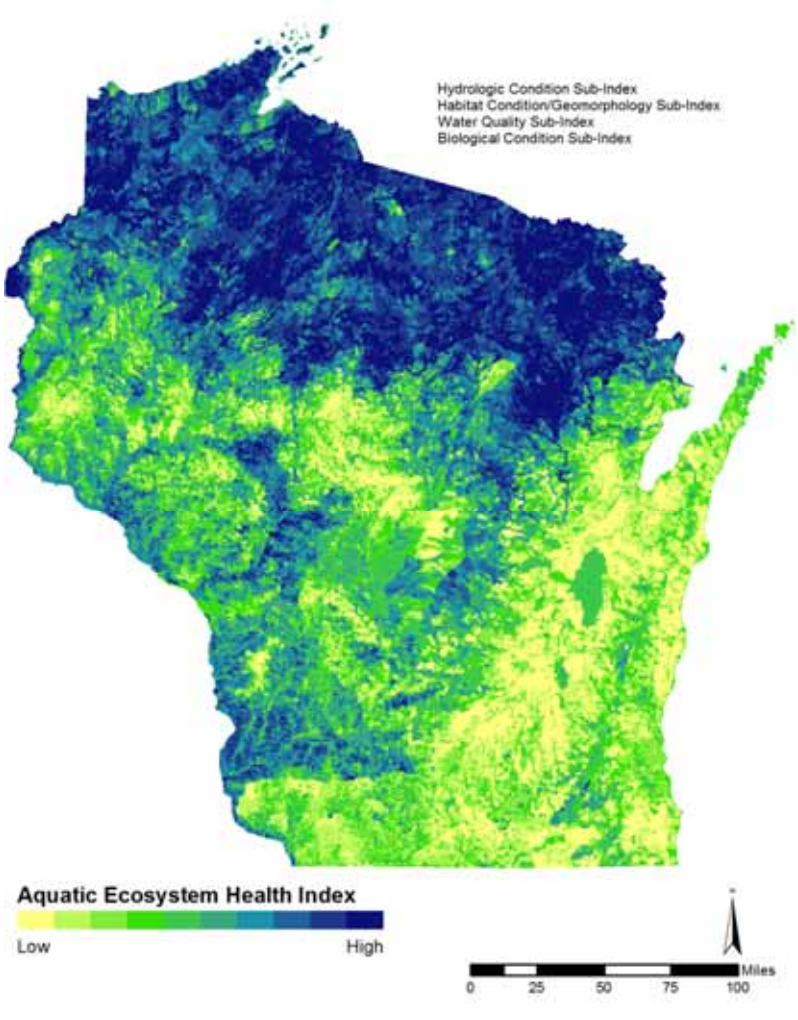
Products: 2 Main Indices (Maps & Data)



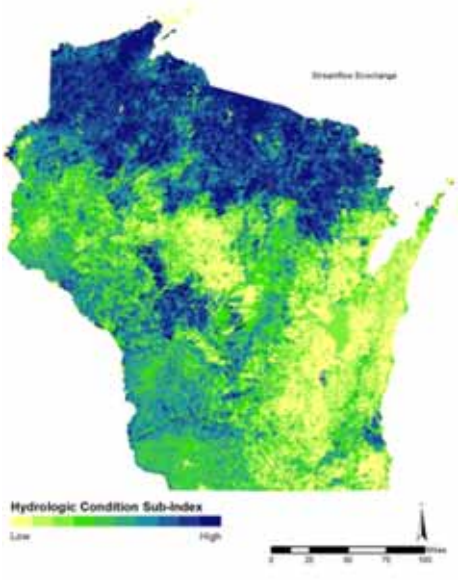
Aquatic Ecosystem Health



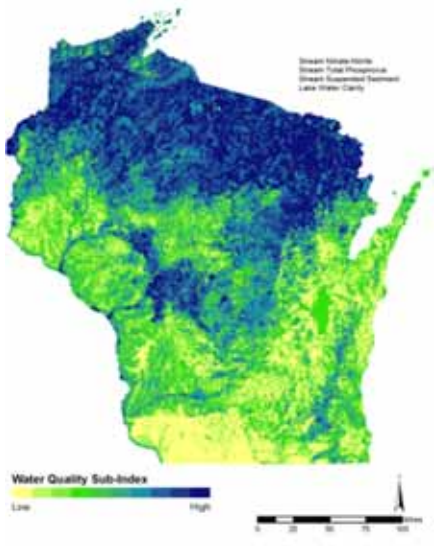
Aquatic Ecosystem Health



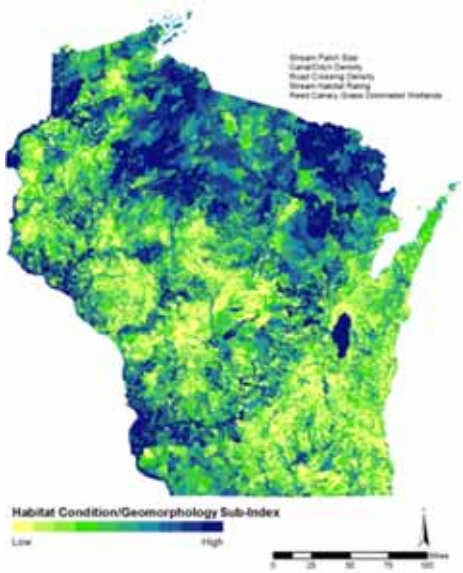
SUBINDICES



Hydrology



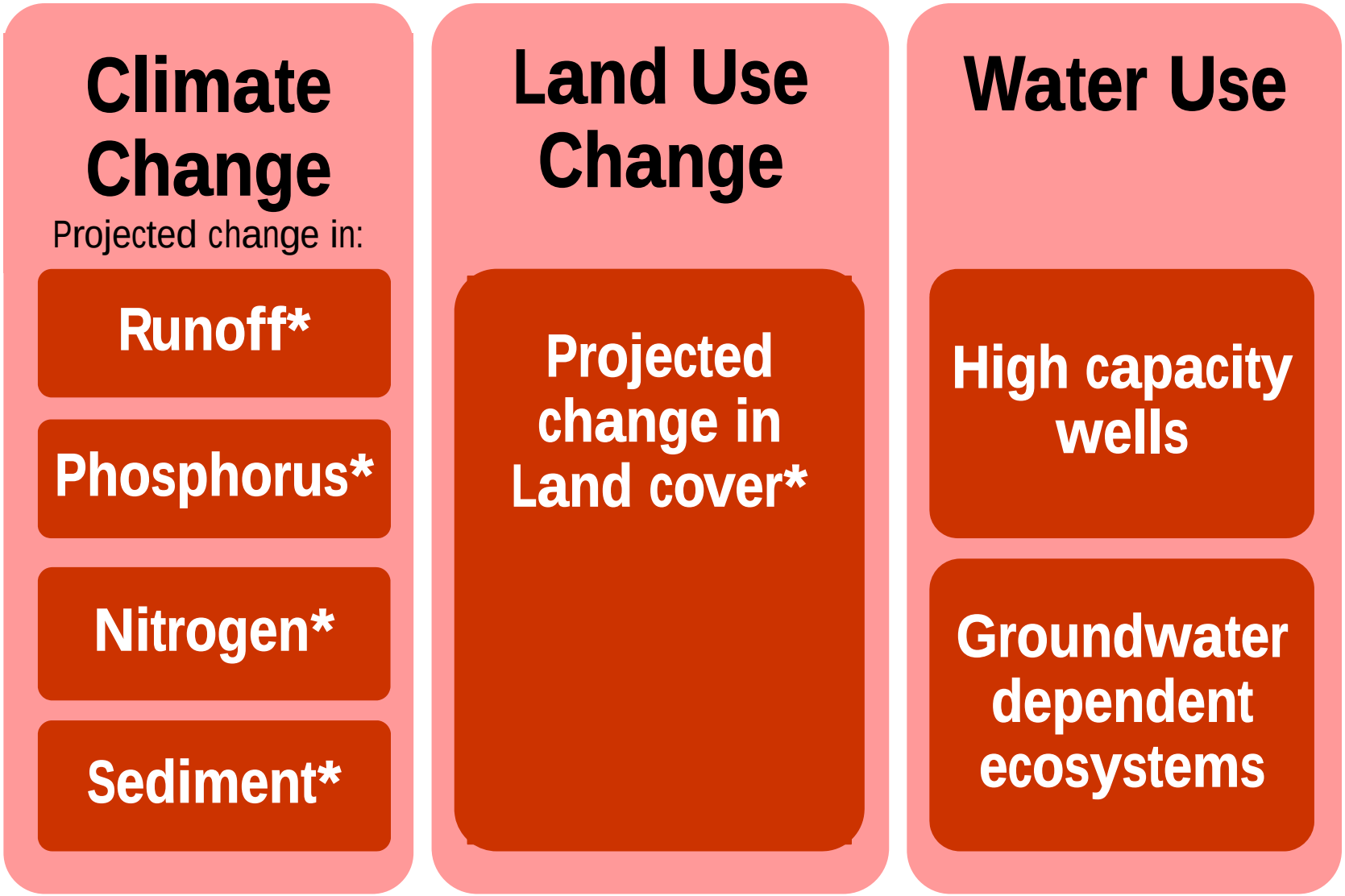
Water Quality



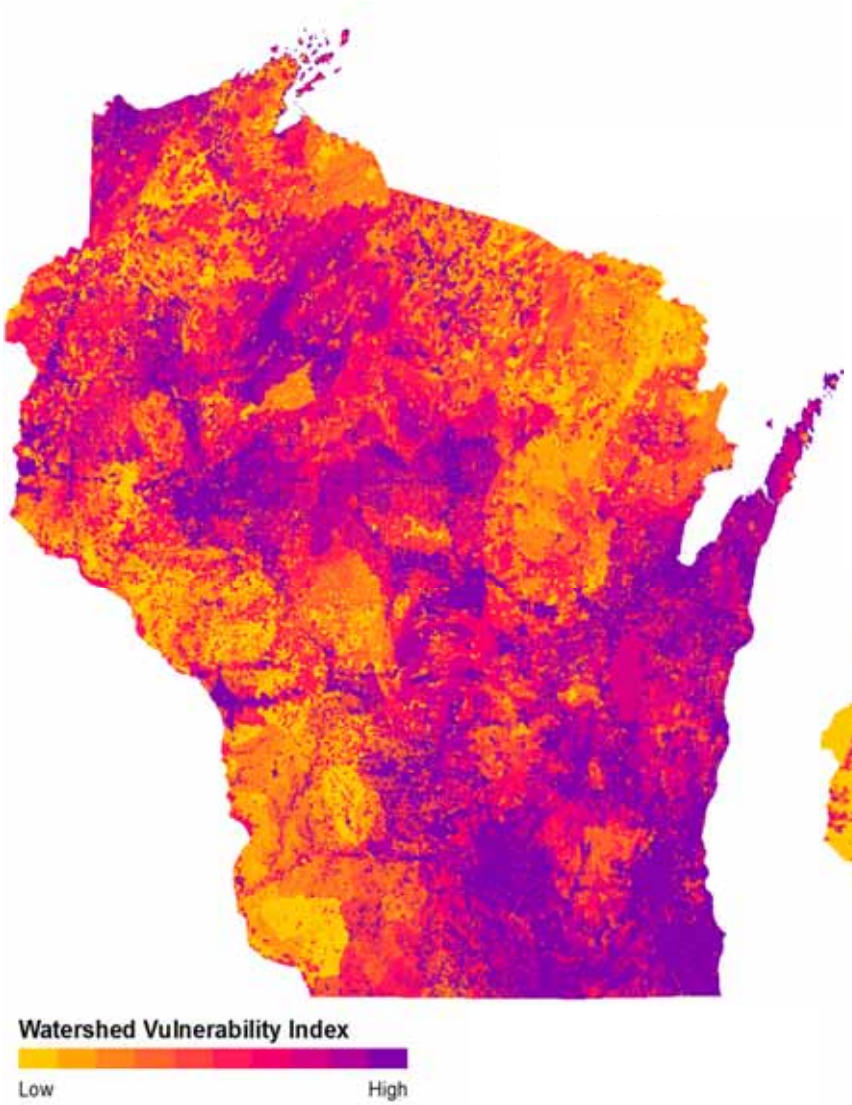
Habitat/Geomorphology

Biology

Watershed Vulnerability

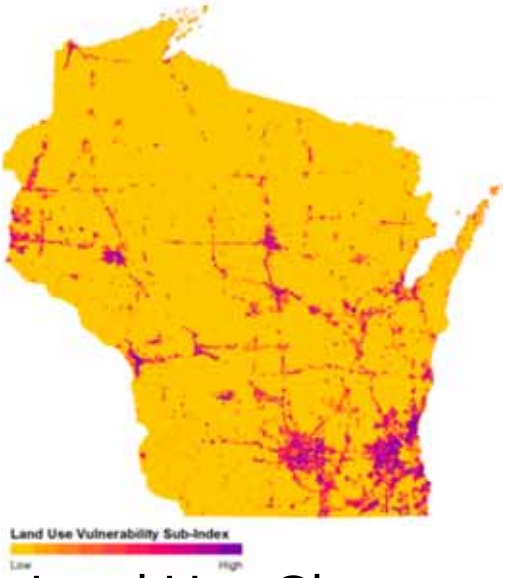


Vulnerability



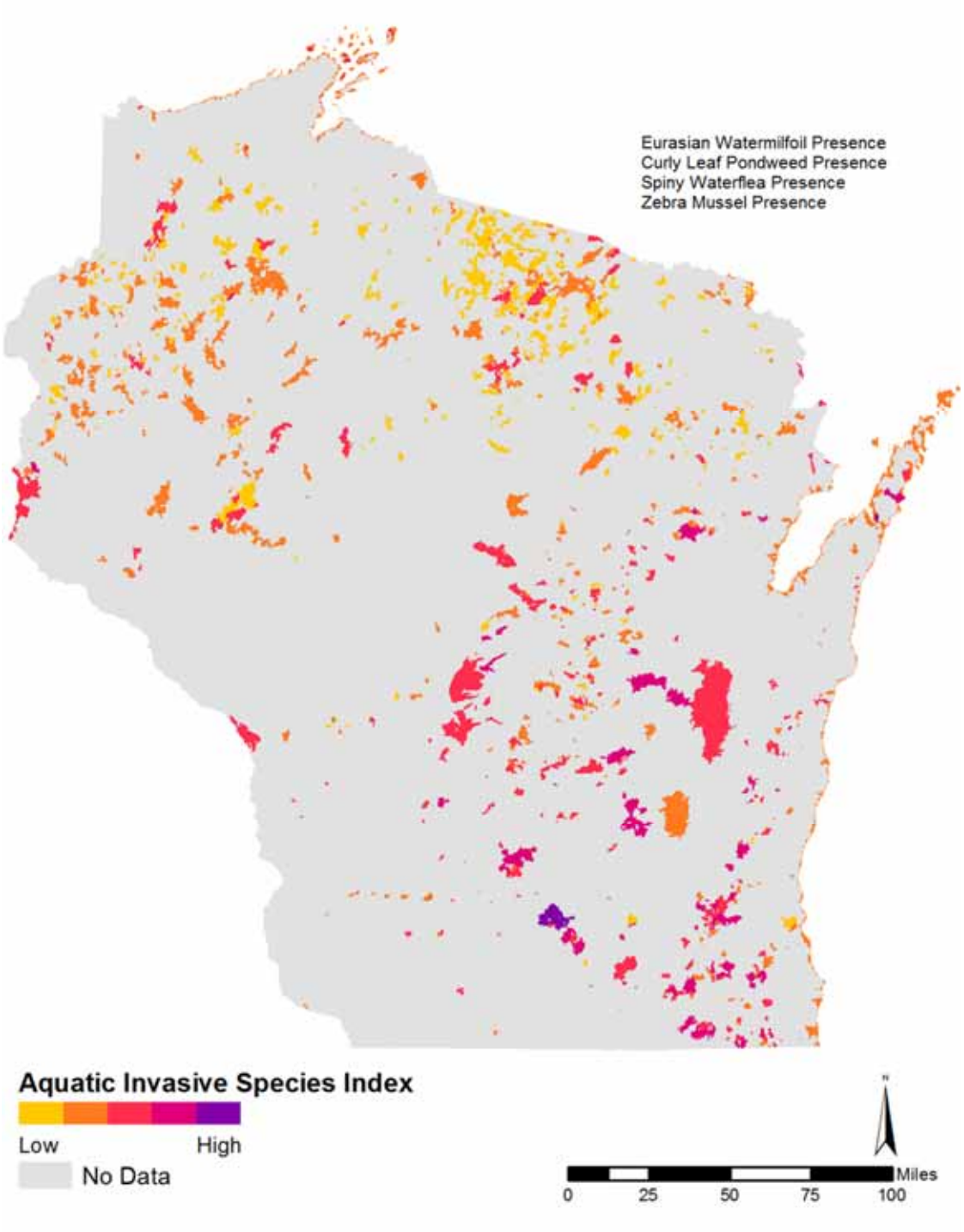
SUBINDICES

Climate Change



Land Use Change

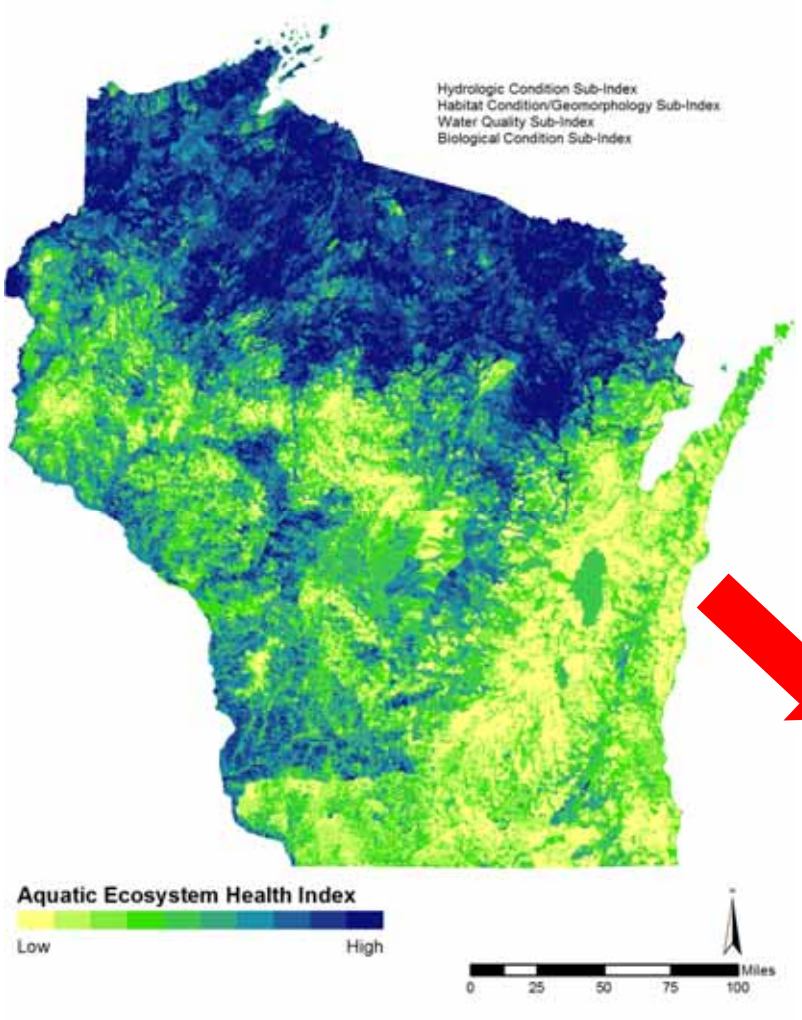
Water Use



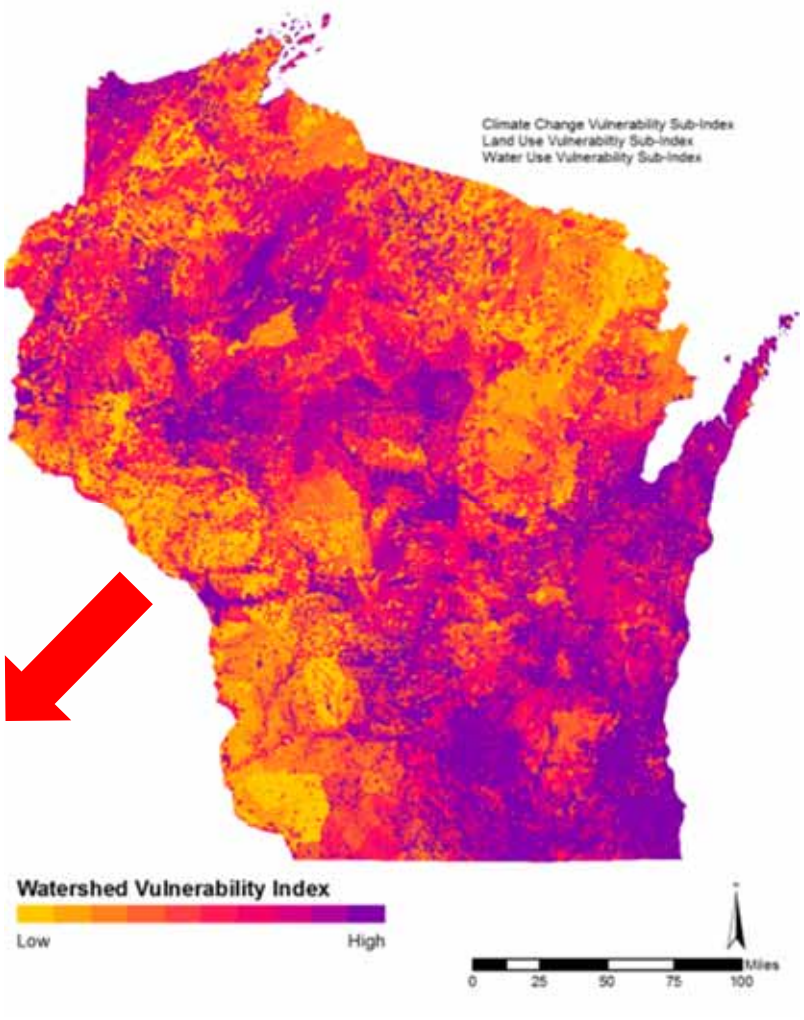
Aquatic Invasives

- Eurasian Water Milfoil
- Curly Leaf Pondweed
- Zebra Mussels
- Spiny Waterflea

Aquatic Ecosystem Health

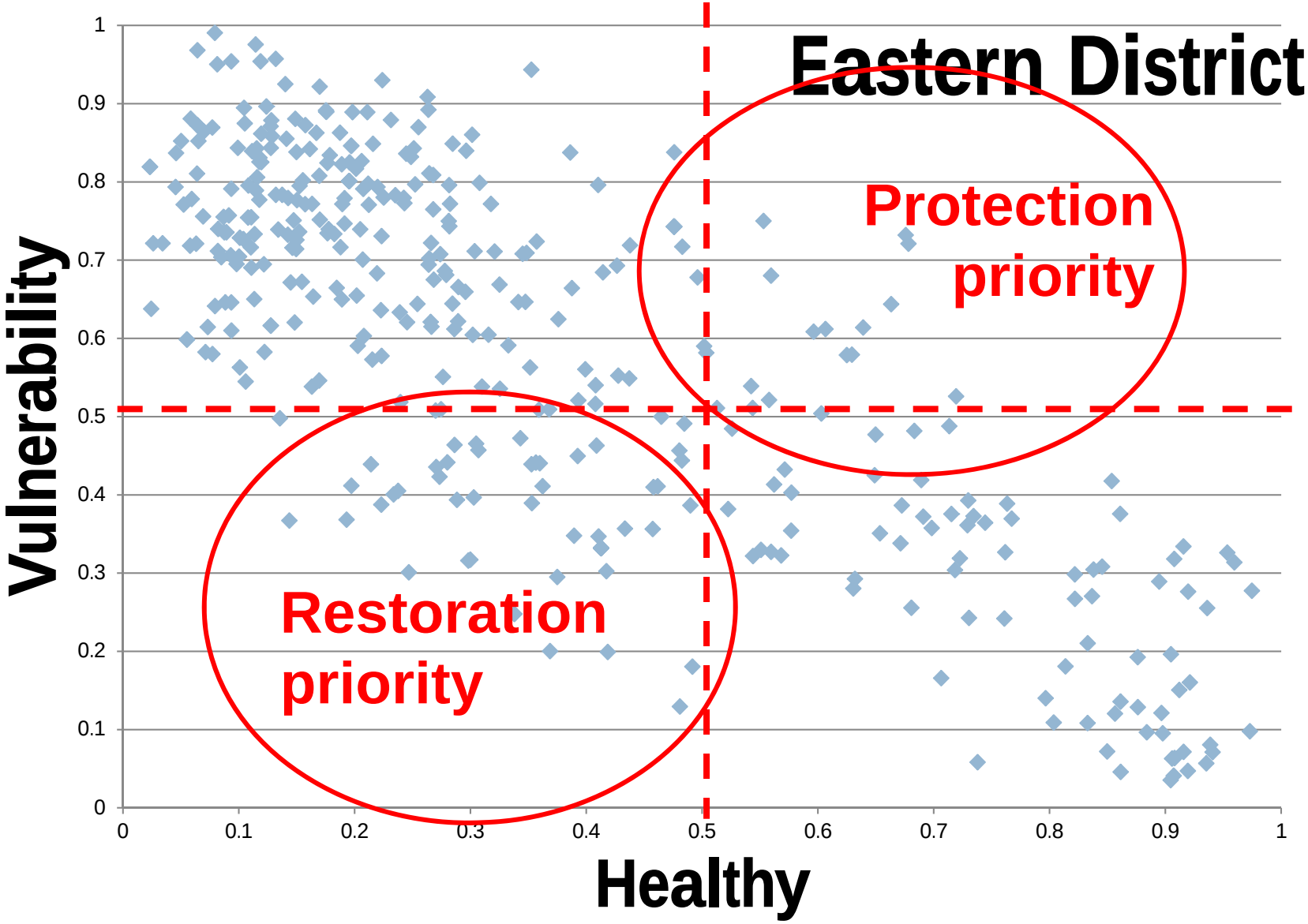


Vulnerability



?

Combine Health & Vulnerability Scores…



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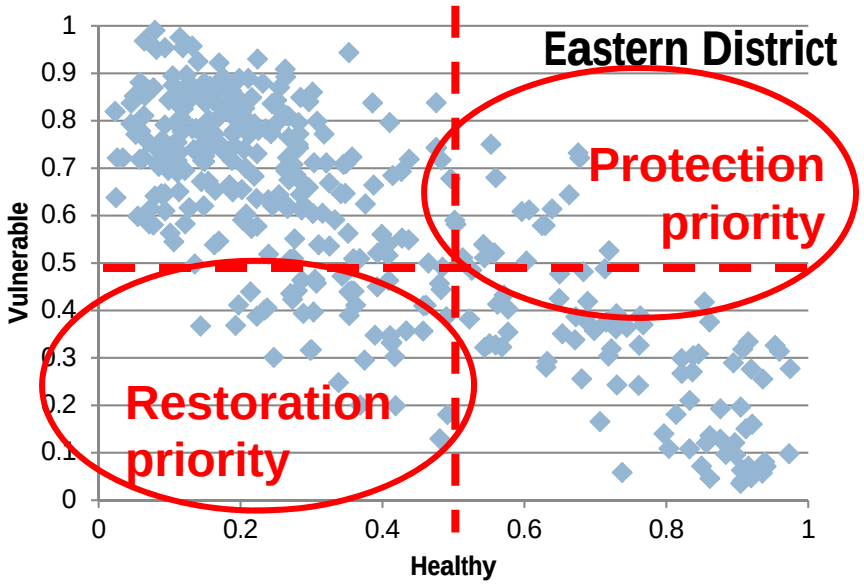
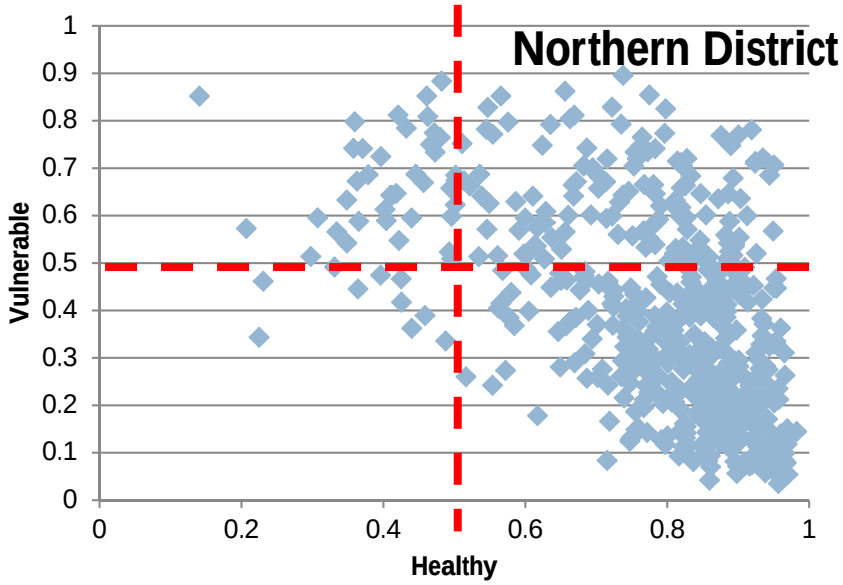
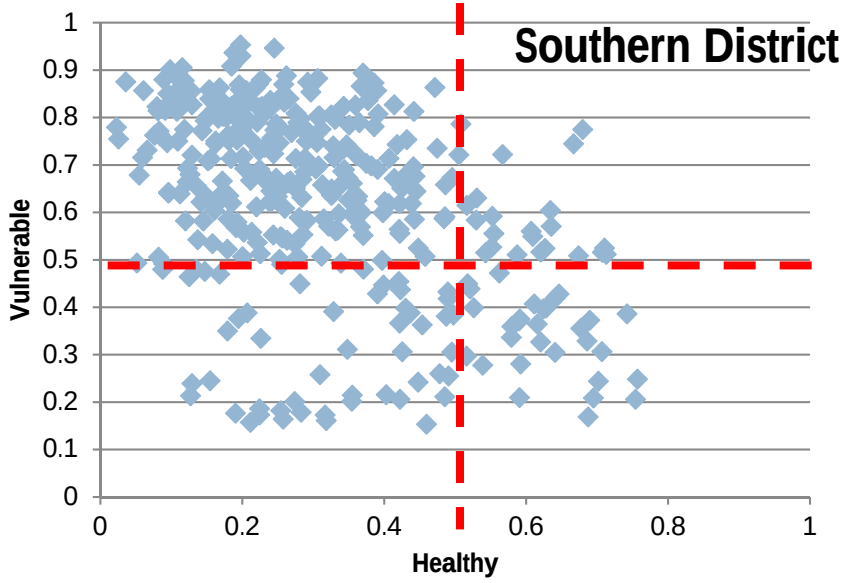
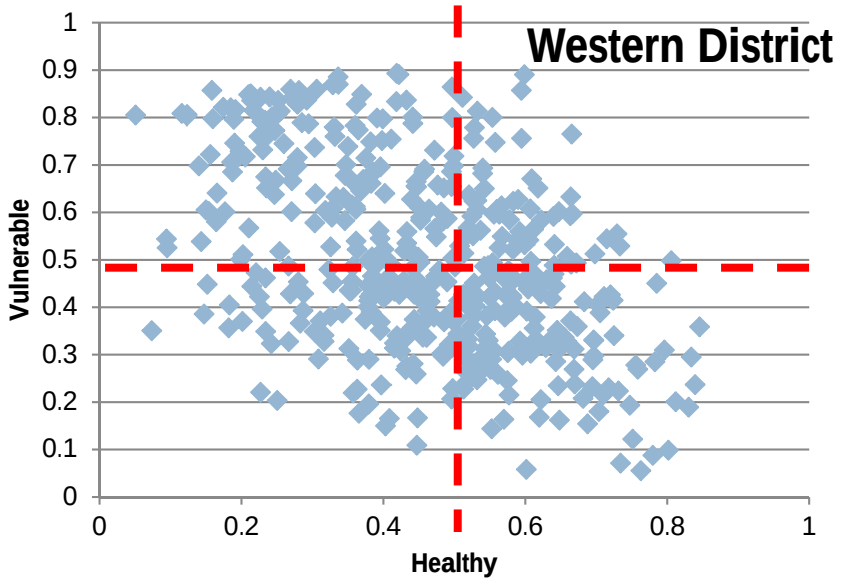
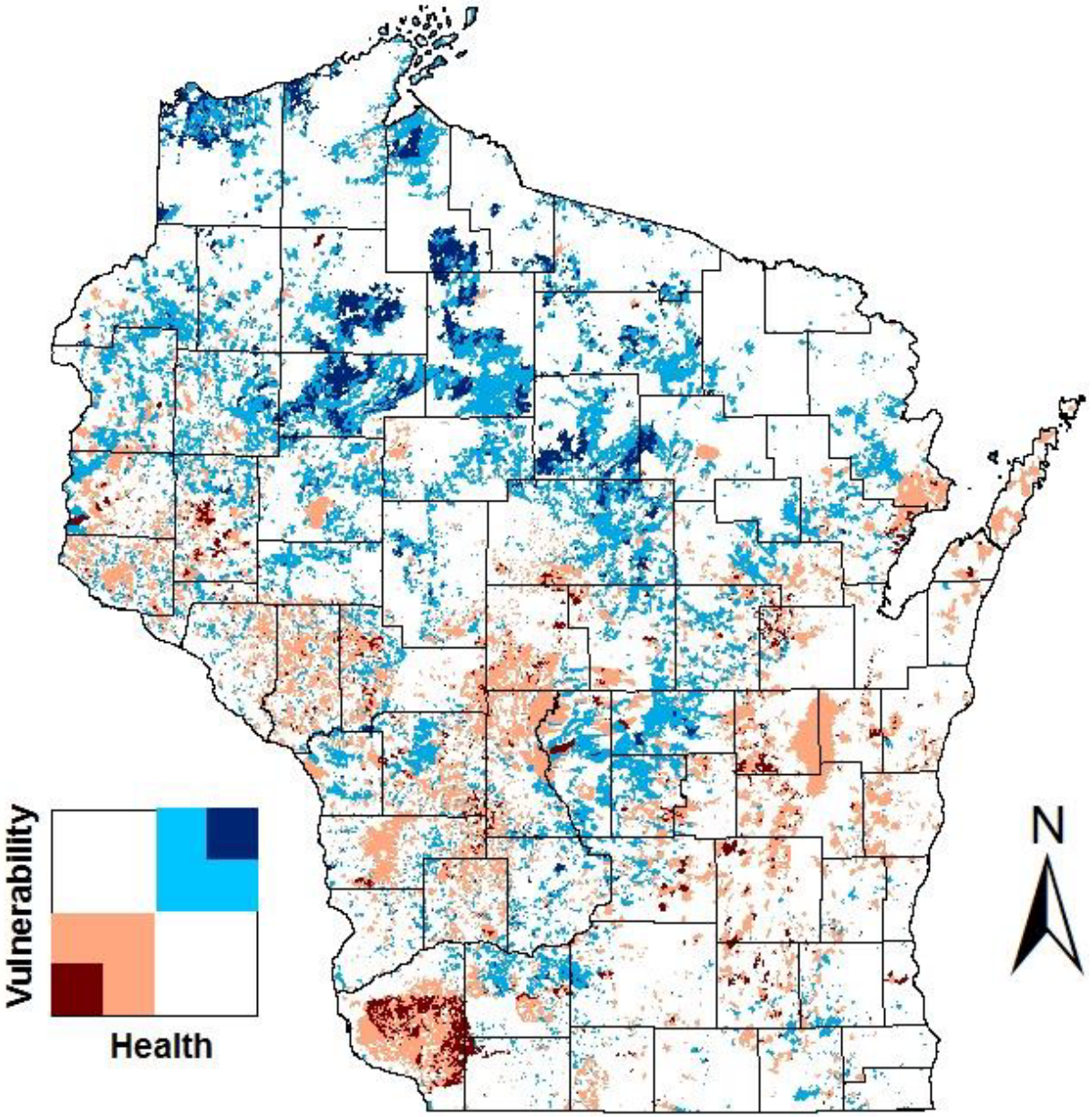


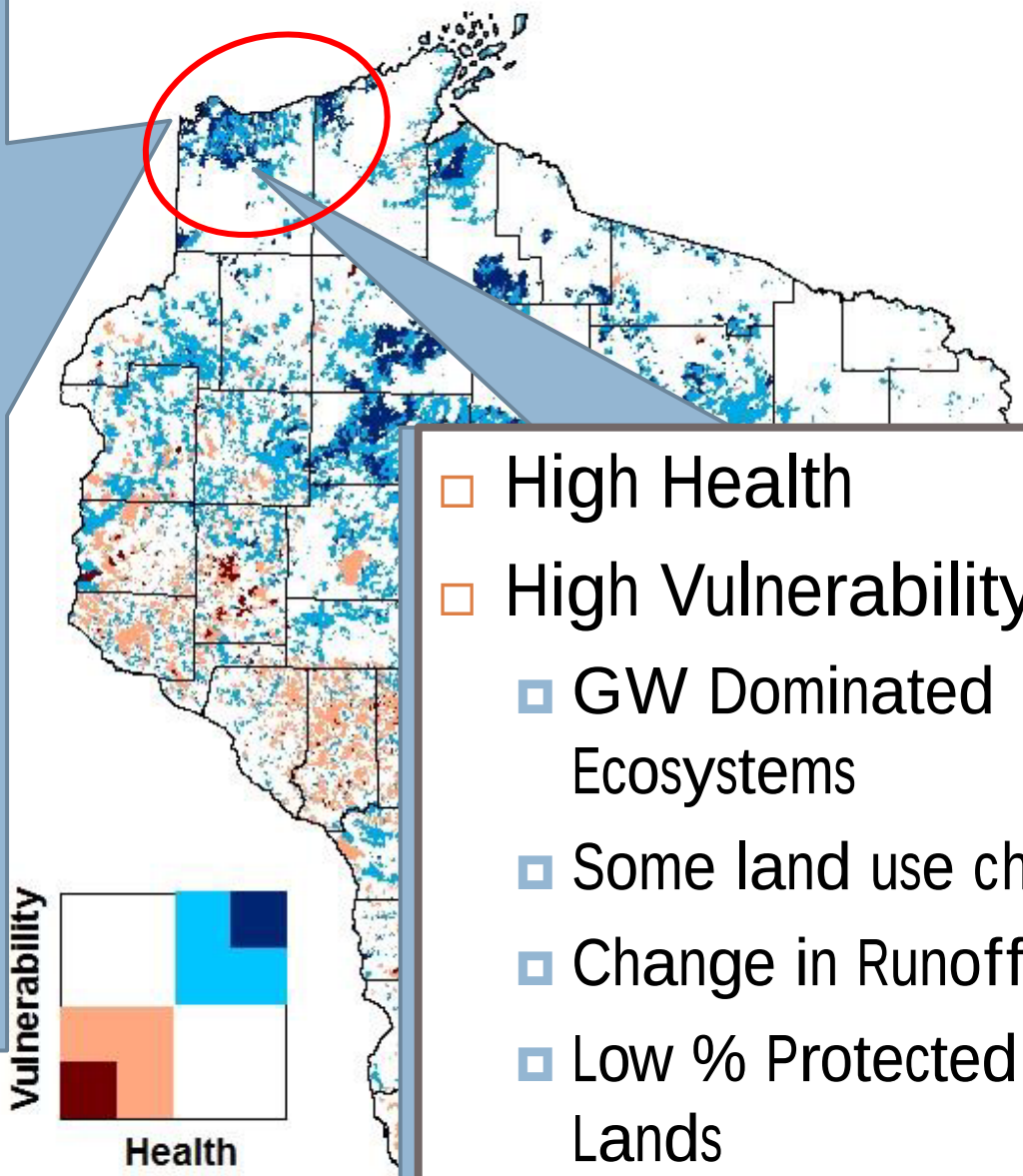






Combine Health & Vulnurability Scores…





- High Health
- High Vulnerability
  - GW Dominated Ecosystems
  - Some land use change
  - Change in Runoff
  - Low % Protected Lands

Using the Results

- Wisconsin DNR – many program areas
- County Conservationists
- Local governments
- Watershed groups
- Lake Associations
- The Nature Conservancy

Specific Applications: Planning

- County/ Local Planning
  - County Conservationists
  - Select watersheds for planning
  - Where is more monitoring needed?
- Watershed/Lake Planning
  - Determine which management practices may be appropriate
  - Help bolster efforts with local government

Specific Applications: Grants

- Use as scoring criteria
- Funding for local groups & on-the ground projects
- DNR Grants:
  - Targeted Runoff Mgmt Grants
  - Urban Grants
  - Lake or River Grants
  - Great Lakes Grants

Specific Applications: Wetlands

- Wetland Rapid Assessment Methods; Mitigation
  - Provides watershed context for wetland projects
  - Where to restore/preserve wetlands
  - Where to establish wetland mitigation banks

Specific Applications: Protecting Lands

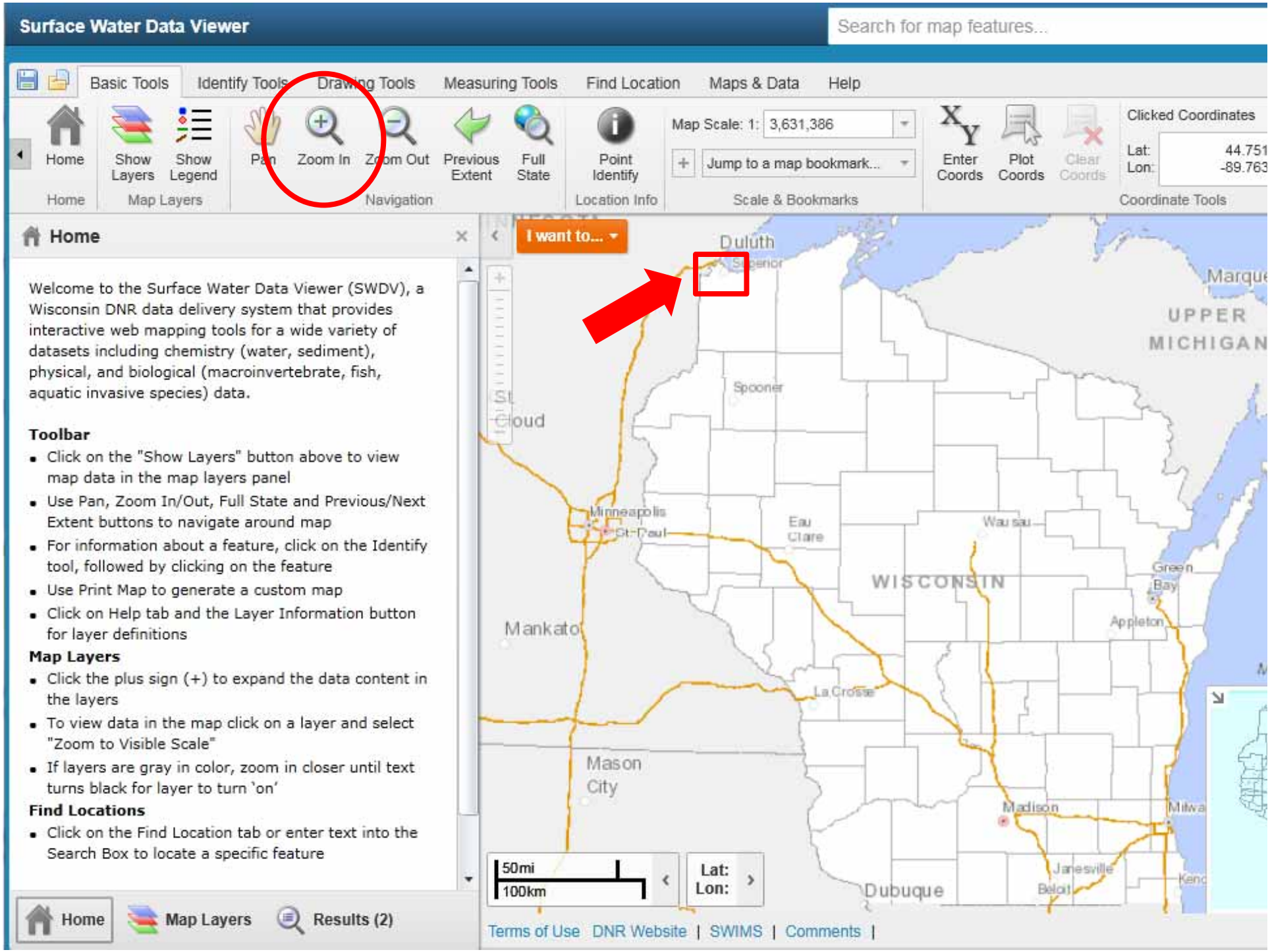
- Land Acquisition
  - Purchase sensitive lands
- Easements
  - Purchase development rights
- Ordinances
  - Strengthen protections
- Best Management Practices for Development

Healthy Watersheds Website!

http://dnr.wi.gov/topic/Watersheds/HWA.html

- Download:
  - Final Report
  - PDF maps
  - Shape files
  - Raw data

- Online Mapping Tool (coming soon!)
  - Zoom to your watershed
  - Select map layers
  - See ranking scores


Surface Water Data Viewer
Search for map features...
Basic Tools
Identify Tools
Drawing Tools
Measuring Tools
Find Location
Maps & Data
Help
Home
Show Layers
Show Legend
Pan
Zoom In
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Previous Extent
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Point Identify
Map Scale: 1: 3,631,386
Jump to a map bookmark...
Enter Coords
Plot Coords
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Clicked Coordinates
Lat: 44.751
Lon: -89.763
Home
Map Layers
Navigation
Location Info
Scale & Bookmarks
Coordinate Tools
Home
Welcome to the Surface Water Data Viewer (SWDV), a Wisconsin DNR data delivery system that provides interactive web mapping tools for a wide variety of datasets including chemistry (water, sediment), physical, and biological (macroinvertebrate, fish, aquatic invasive species) data.
Toolbar
Click on the "Show Layers" button above to view map data in the map layers panel
Use Pan, Zoom In/Out, Full State and Previous/Next Extent buttons to navigate around map
For information about a feature, click on the Identify tool, followed by clicking on the feature
Use Print Map to generate a custom map
Click on Help tab and the Layer Information button for layer definitions
Map Layers
Click the plus sign (+) to expand the data content in the layers
To view data in the map click on a layer and select "Zoom to Visible Scale"
If layers are gray in color, zoom in closer until text turns black for layer to turn 'on'
Find Locations
Click on the Find Location tab or enter text into the Search Box to locate a specific feature
I want to...
Duluth
Spooner
St Cloud
Minneapolis
St Paul
Eau Claire
Wausau
WISCONSIN
Green Bay
Appleton
Mankato
La Crosse
Mason City
Madison
Janesville
Dubuque
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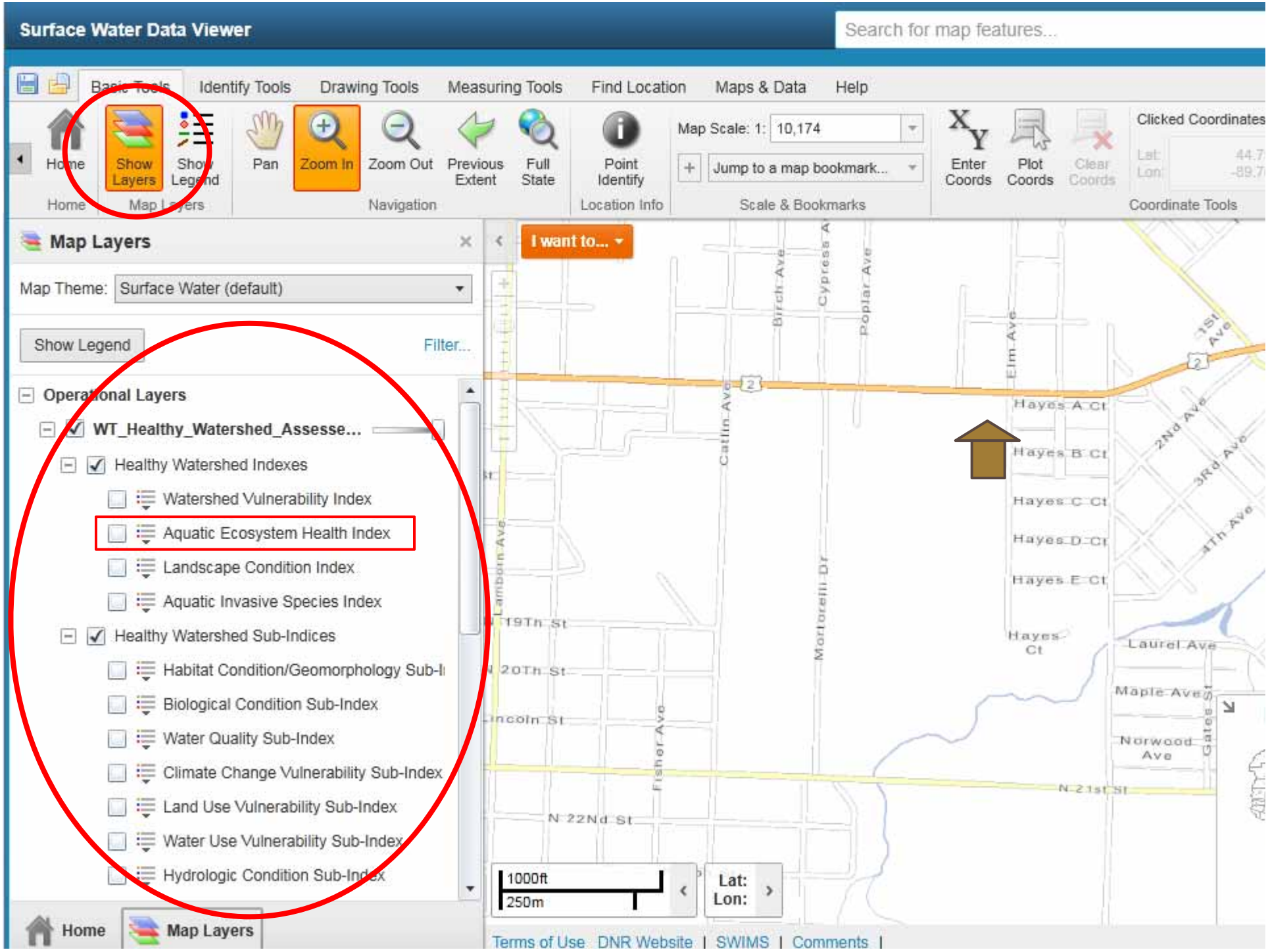
SWIMS
Comments
Home
Map Layers
Results (2)


Surface Water Data Viewer
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Map Layers
Map Theme: Surface Water (default)
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Healthy Watershed Indexes
Watershed Vulnerability Index
Aquatic Ecosystem Health Index
Landscape Condition Index
Aquatic Invasive Species Index
Healthy Watershed Sub-Indices
Habitat Condition/Geomorphology Sub-I
Biological Condition Sub-Index
Water Quality Sub-Index
Climate Change Vulnerability Sub-Index
Land Use Vulnerability Sub-Index
Water Use Vulnerability Sub-Index
Hydrologic Condition Sub-Index
I want to...
Birch Ave
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Lamborn Ave
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Norwood Ave
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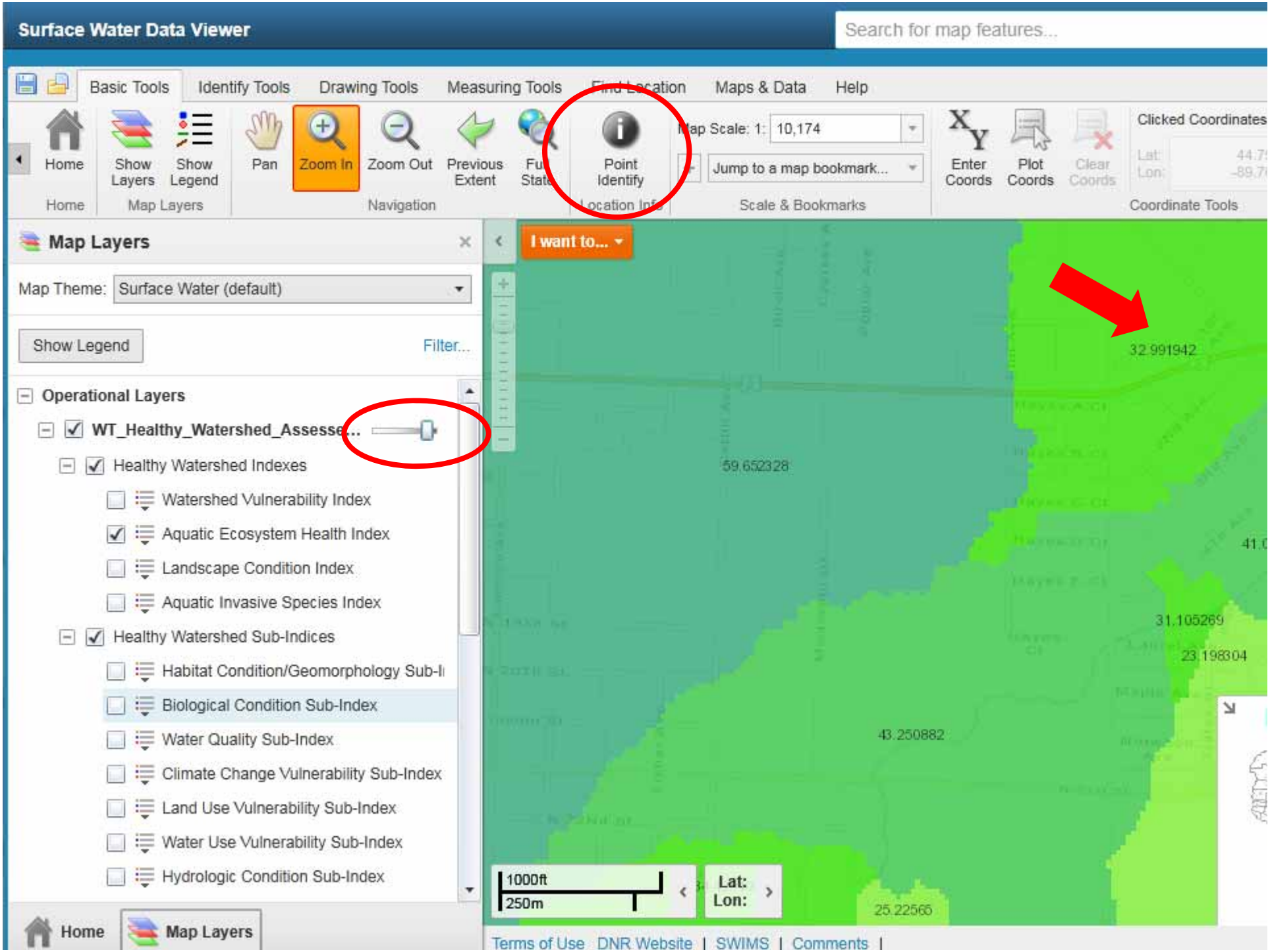
SWIMS
Comments
Home
Map Layers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Watershed Vulnerability Index
Aquatic Ecosystem Health Index
Landscape Condition Index
Aquatic Invasive Species Index
Healthy Watershed Sub-Indices
Habitat Condition/Geomorphology Sub-I
Biological Condition Sub-Index
Water Quality Sub-Index
Climate Change Vulnerability Sub-Index
Land Use Vulnerability Sub-Index
Water Use Vulnerability Sub-Index
Hydrologic Condition Sub-Index
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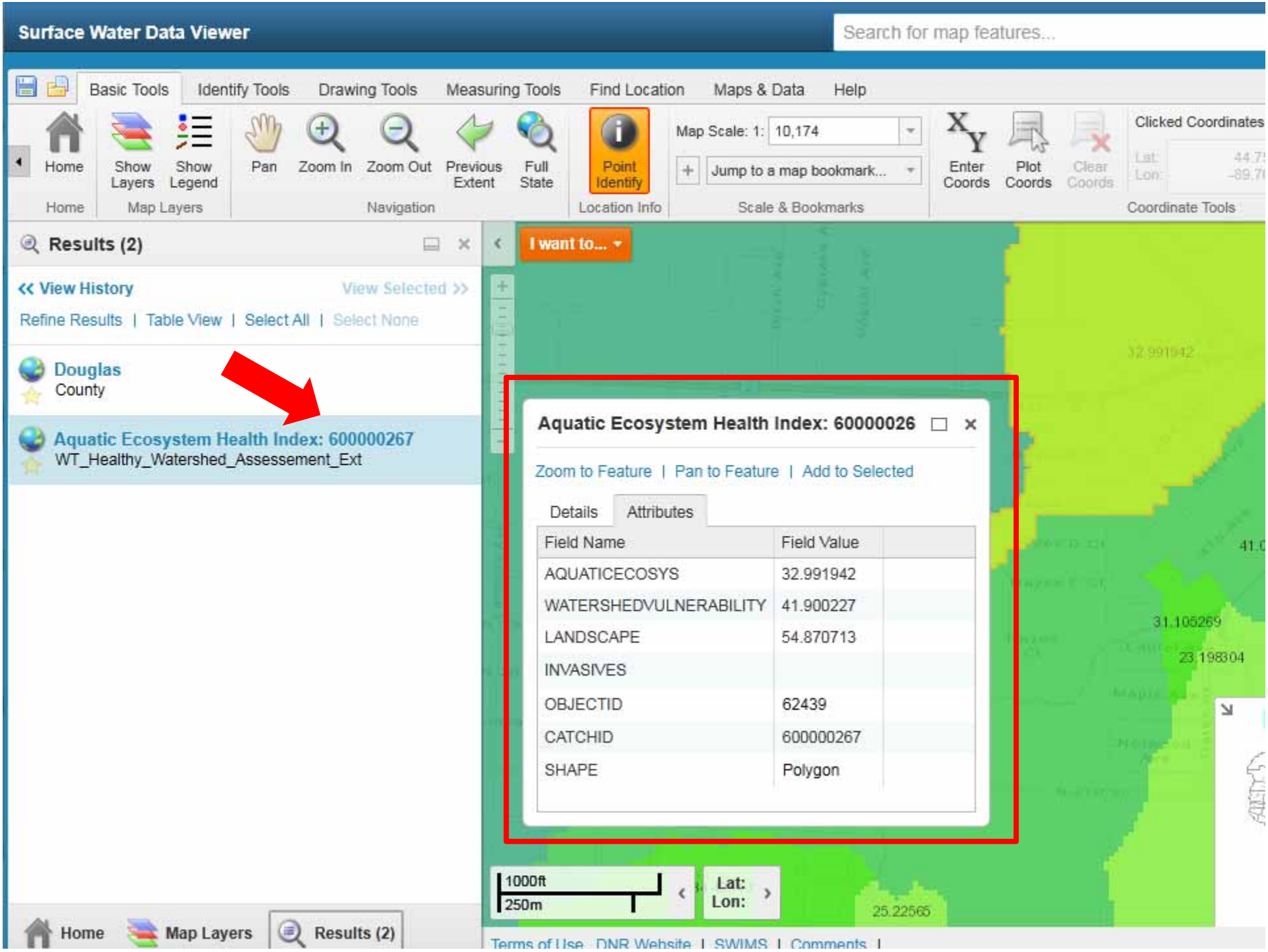
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Location Info
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Coordinate Tools
Results (2)
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View Selected »
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Douglas
County
Aquatic Ecosystem Health Index: 600000267
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Home
Map Layers
Results (2)
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- Use your Catchment ID # to find all the ranked scores for each metric in the Excel table
  - Where did we score low? High?

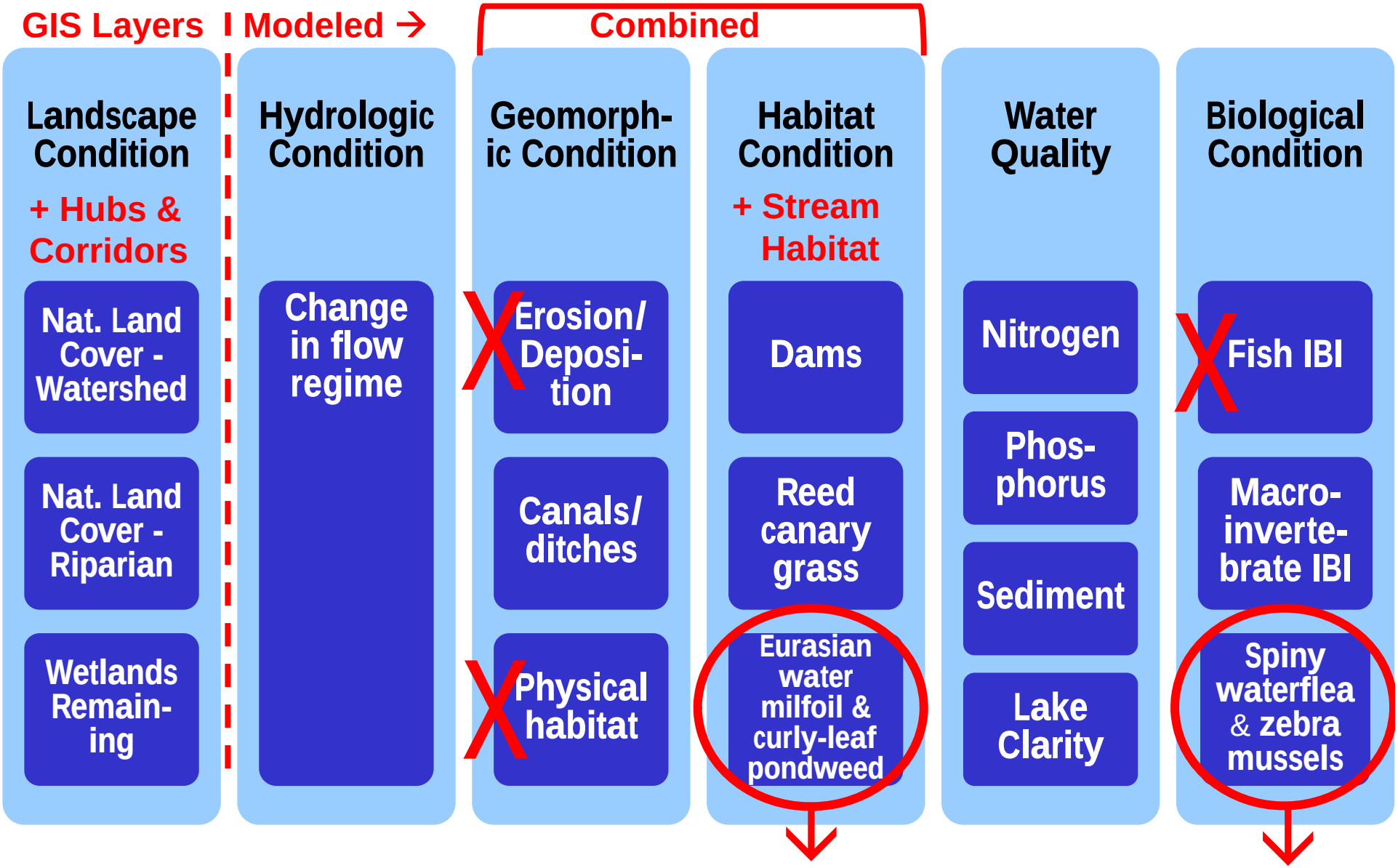
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	Catchment ID	Aquatic Ecosystem	Hydrology & Geomorphology	Streamflow EcoChange	Habitat Subindex	Stream Patch Size	Road Crossing Density	% Wetlands in Road Canary Grass	% Streams in Canals/Ditches	Stream Habitat Score	Water Quality Subindex	Lake Clarity	NO2-NO3	Suspended Sediment	Total Phosphorus	Biology Subindex	MIBI Score (Aquatic Invertr)	Watershed Vulnerability	Climate Change Subindex	Runoff Change	Total Nitrogen Change
2	200000014	35.30	34.08	34.87	81.56	94.67	98.00	0.00	100.00	34.16	19.03	0.00	25.61	33.47	16.91	17.32	17.32	93.69	97.65	98.95	97.1
3	200000028	31.68	17.06	17.46	76.92	94.67	90.16	0.00	100.00	34.16	12.07	0.00	5.02	24.97	29.83	35.09	35.09	71.68	96.69	99.93	94.3
4	200000029	7.59	3.58	3.66	41.34	47.33	75.12	0.00	100.00	34.16	9.37	0.00	7.45	12.74	32.42	14.15	14.15	76.78	97.24	99.53	97.0
5	200000035	7.58	14.21	14.54	46.73	33.91	98.46	0.00	100.00	34.16	0.29	0.00	5.40	1.17	1.59	7.16	7.16	59.76	99.92	99.90	99.8
6	200000039	7.90	22.01	22.52	31.75	42.52	61.55	0.00	100.00	34.16	3.93	0.00	7.65	17.05	8.06	11.93	11.93	76.93	98.94	92.53	99.1
7	200000040	2.17	2.29	2.35	31.75	42.52	61.55	0.00	100.00	34.16	2.02	0.00	4.42	3.93	15.77	6.09	6.09	74.81	98.94	92.53	99.1
8	200000043	14.38	15.29	15.64	50.55	42.52	37.85	0.00	100.00	92.21	11.78	0.00	10.35	11.80	36.94	14.25	14.25	99.03	99.27	99.67	98.2
9	200000046	29.88	17.25	17.65	47.14	42.52	57.23	100.00	100.00	34.16	18.87	0.00	4.10	22.39	49.12	52.84	52.84	99.29	98.94	92.53	99.1
10	200000050	39.76	10.92	11.18	98.81	94.67	90.16	0.00	100.00	92.21	17.69	0.00	6.53	44.01	22.52	38.19	38.19	79.03	96.69	99.93	94.3
11	200000051	7.41	11.80	12.08	46.73	33.91	98.46	0.00	100.00	34.16	0.16	0.00	1.83	2.78	0.34	9.07	9.07	60.45	99.92	99.90	99.8
12	200000054	0.80	3.87	3.96	17.44	47.33	75.12	0.00	100.00	34.16	4.34	0.00	8.63	3.97	22.01	4.27	4.27	73.17	97.24	99.53	97.0
13	200000055	17.65	1.72	1.76	62.47	94.67	98.00	0.00	100.00	0.00	20.58	0.00	55.03	17.40	7.00	16.85	16.85	88.92	97.65	98.95	97.1
14	200000056	32.57	7.65	7.83	76.92	94.67	90.16	0.00	100.00	34.16	12.55	0.00	9.57	33.87	17.52	46.72	46.72	77.01	96.69	99.93	94.3
15	200000058	7.52	17.46	17.87	30.96	47.33	54.97	0.00	100.00	34.16	12.11	0.00	6.82	11.36	41.72	7.63	7.63	74.47	97.24	99.53	97.0
16	200000064	56.07	17.70	18.11	86.53	94.67	35.48	100.00	100.00	92.21	11.51	0.00	4.96	26.34	27.11	99.44	99.44	91.52	97.65	98.95	97.1
17	200000065	24.18	22.00	22.51	43.80	2.32	90.16	100.00	100.00	34.16	9.87	0.00	4.57	24.22	25.21	44.62	44.62	75.97	96.69	99.93	94.3
18	200000066	39.92	16.97	17.37	83.27	94.67	35.48	0.00	100.00	100.00	11.47	0.00	11.15	24.88	22.29	54.41	54.41	90.92	97.65	98.95	97.1
19	200000068	26.76	50.35	51.52	70.57	94.67	78.02	0.00	100.00	34.16	3.74	0.00	0.95	8.18	22.78	2.67	2.67	62.00	90.19	71.35	92.9
20	200000071	13.03	15.54	15.90	26.39	1.94	90.16	0.00	100.00	34.16	11.83	0.00	7.32	32.61	19.30	33.99	33.99	95.26	96.69	99.93	94.3
21	200000073	14.78	16.45	16.84	26.39	1.94	90.16	0.00	100.00	34.16	12.15	0.00	12.19	29.99	17.86	38.08	38.08	78.03	96.69	99.93	94.3
22	200000074	17.03	15.85	16.22	26.55	2.32	90.16	0.00	100.00	34.16	9.86	0.00	11.25	28.36	14.37	47.54	47.54	95.14	96.69	99.93	94.3
23	200000077	2.62	21.22	21.72	17.15	42.52	61.55	0.00	100.00	0.00	3.65	0.00	2.42	20.07	9.06	3.11	3.11	95.54	98.94	92.53	99.1
24	200000078	10.76	21.38	21.88	22.31	94.67	77.14	0.00	100.00	0.00	5.41	0.00	14.38	5.62	18.97	31.16	31.16	87.45	95.43	85.72	96.0
25	200000081	11.25	4.34	4.44	50.11	94.67	77.14	0.00	100.00	0.00	3.03	0.00	18.22	5.68	4.94	24.37	24.37	55.04	95.43	85.72	96.0
26	200000082	28.80	21.86	22.37	80.29	94.67	77.14	100.00	100.00	34.16	3.53	0.00	16.28	4.32	10.40	27.30	27.30	53.68	95.43	85.72	96.0
27	200000084	20.89	45.73	46.80	62.12	94.67	97.49	0.00	100.00	0.00	0.16	0.00	0.43	2.03	2.47	3.09	3.09	37.68	72.18	76.56	62.8
28	200000085	42.51	60.21	61.62	82.54	94.67	99.99	0.00	100.00	34.16	6.57	0.00	6.39	14.84	22.18	24.68	24.68	26.56	42.51	99.97	23.5
29	200000086	30.66	53.46	54.71	81.32	94.67	97.49	0.00	100.00	34.16	0.72	0.00	3.29	3.26	10.38	2.80	2.80	33.31	72.18	76.56	62.8
30	200000087	40.42	21.42	21.92	70.93	2.32	90.16	100.00	100.00	92.21	20.81	0.00	11.52	26.14	42.23	54.48	54.48	61.40	96.69	99.93	94.3
31	200000088	36.86	16.19	16.57	70.93	2.32	90.16	100.00	100.00	92.21	20.24	0.00	15.33	31.69	31.65	49.44	49.44	46.62	96.69	99.93	94.3
32	200000089	33.14	54.42	55.69	81.32	94.67	97.49	0.00	100.00	34.16	4.17	0.00	3.38	10.12	20.36	5.63	5.63	42.71	72.18	76.56	62.8


Check out your watersheds!
http://dnr.wi.gov/topic/Watersheds/HWA.html
Kristi.minahan@wisconsin.gov
608-266-7055

Why Wisconsin wanted to participate

- Balance previous focus on impaired waters with a focus on protecting healthy waters
- About to embark on an update to WI's Water Monitoring Strategy
  - Use results to target monitoring efforts
- Lots of good datasets; combine for a systems approach
- Make strategic decisions for protection

Initial Indicators of Aquatic Ecosystem Health



Challenges: Metrics Used

- Metrics morphed a lot from initial group
  - Appropriateness of datasets
  - Predictive ability of models – how good is good enough?
    - Left some categories under-represented
- Would have liked to have used more metrics for lakes, wetlands, and groundwater
  - First state to try to incorporate these
  - Data sets were not appropriate for this tool
  - Hope to update tool in future years

Challenges: Developing the Model/Index

- Tradeoffs: Ranking the watersheds ("normalizing") vs using actual scores
  - [Katie insert examples here] [See hidden slide on Normalizing w/graph examples]
- Tradeoffs: Weighting the metrics, or not?
  - Couldn't determine justification to weight
  - Categories all got equal weight, but some metrics received much more weight than others [Katie, see hidden slide on weighting with an example of 2 categories]

Challenges: Messaging to Public

- Need to be careful in how we message to the public
  - Use to *compare* one watershed to others in the state
  - Doesn't necessarily indicate "Good/Bad" quality
  - Some residents/groups may be upset to receive lower scores
- The results are a *modeled prediction*
- Should be used as a broad screening tool
  - Not appropriate for all applications

Products: 4 Main Indices (Maps & Data)

Landscape Condition

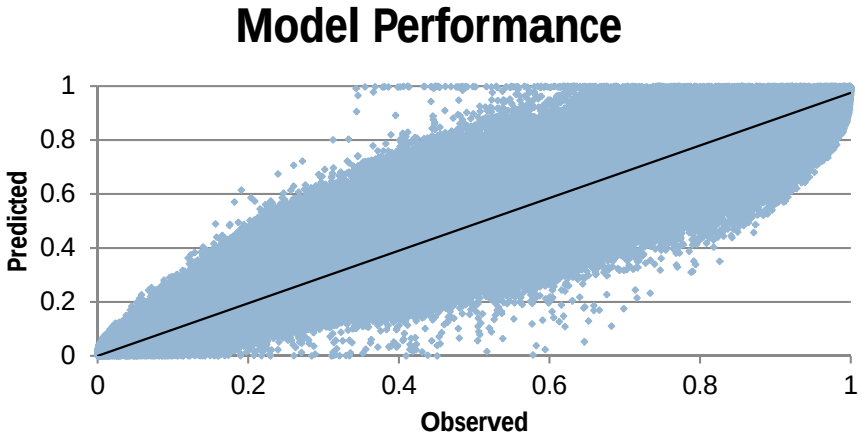
Vulnerability

Aquatic Ecosystem Health

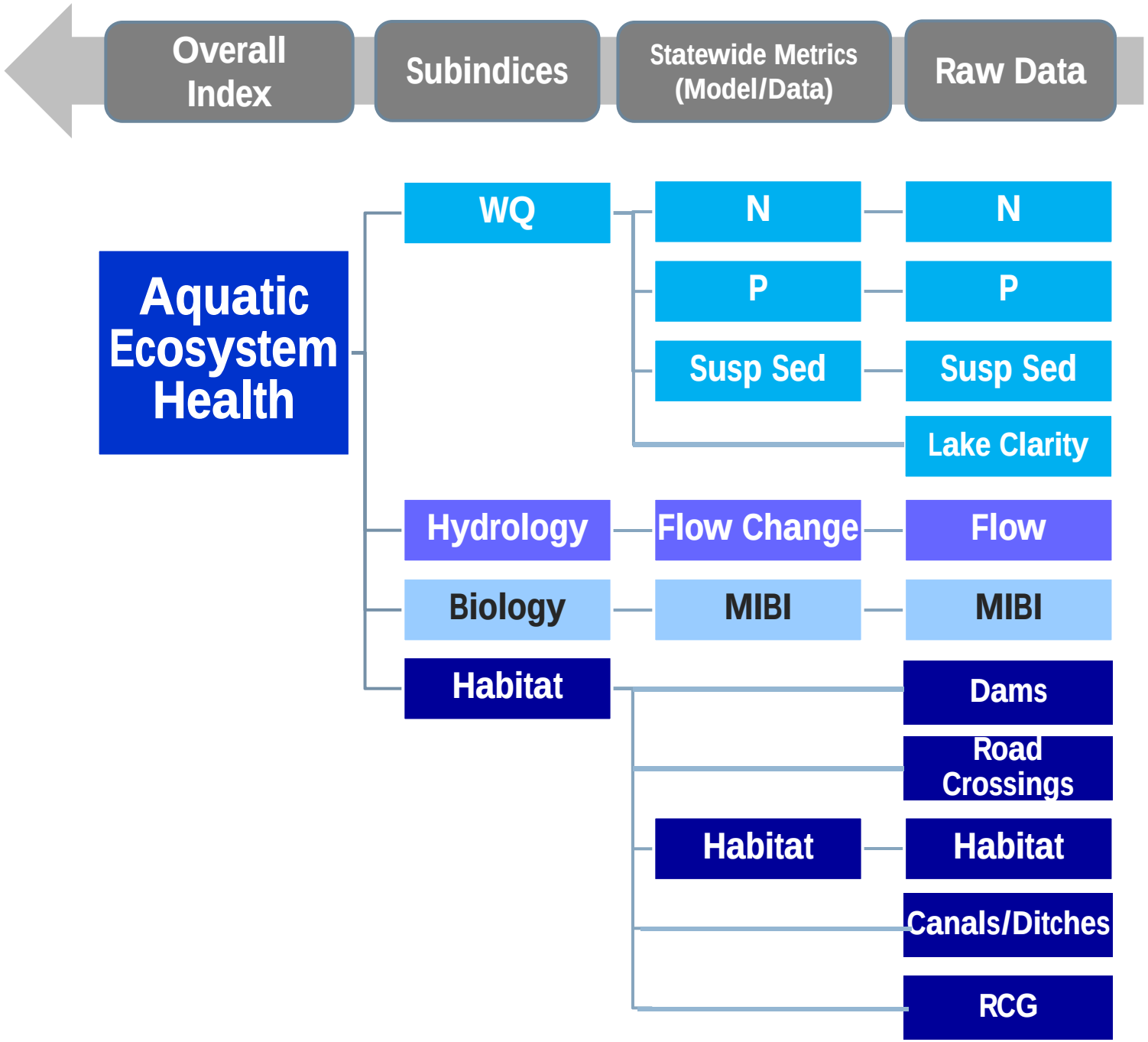
Aquatic Invasive Species

Supporting information we will receive

- Maps
- Raw data
  - In each watershed, scores for each metric & category
- Data on how well each model performed
- Boxplots by ecoregion showing central tendencies & range of results
- Documentation of methods



Building Each Index



Our HWI Team:

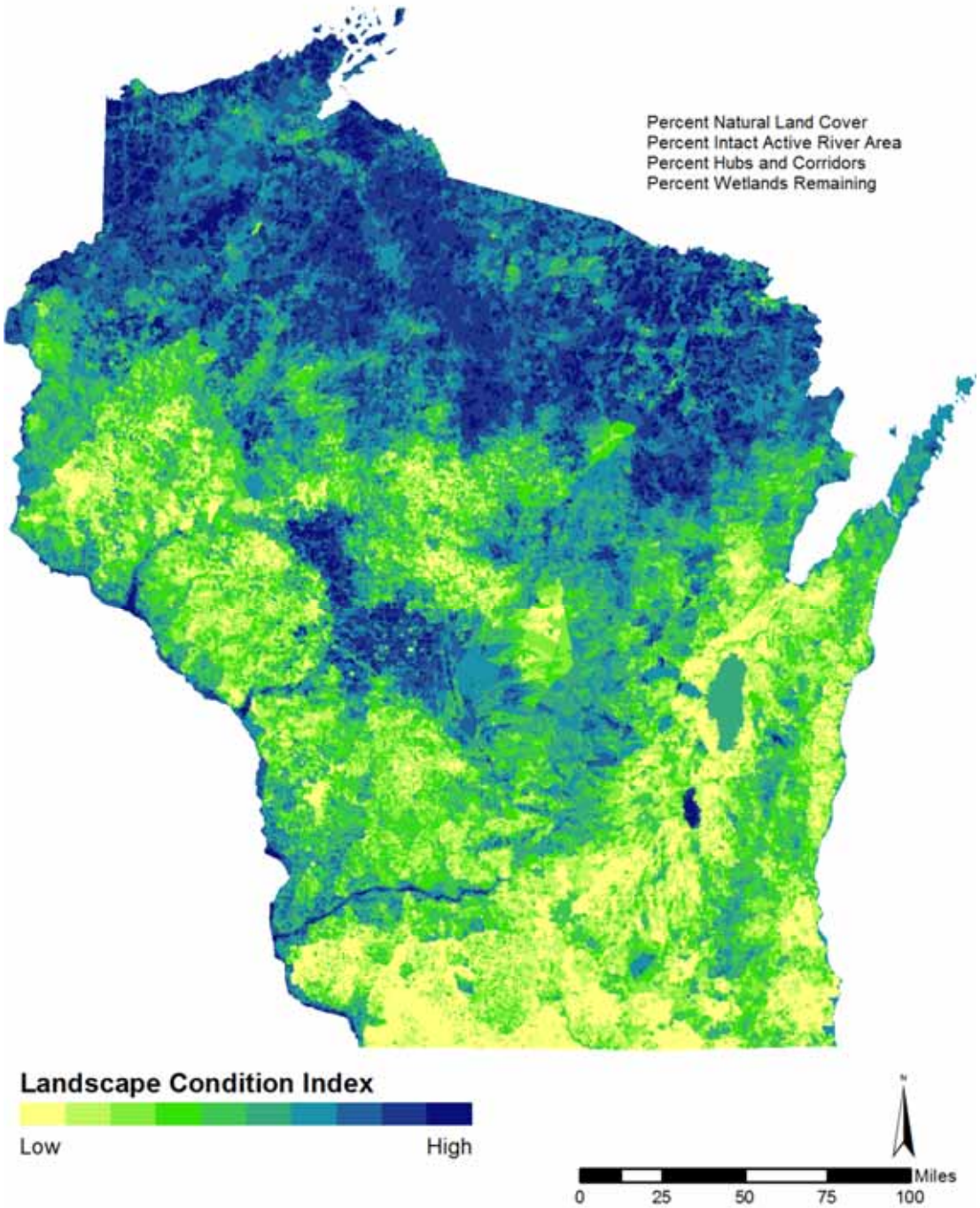
EPA, DNR, Cadmus, TNC

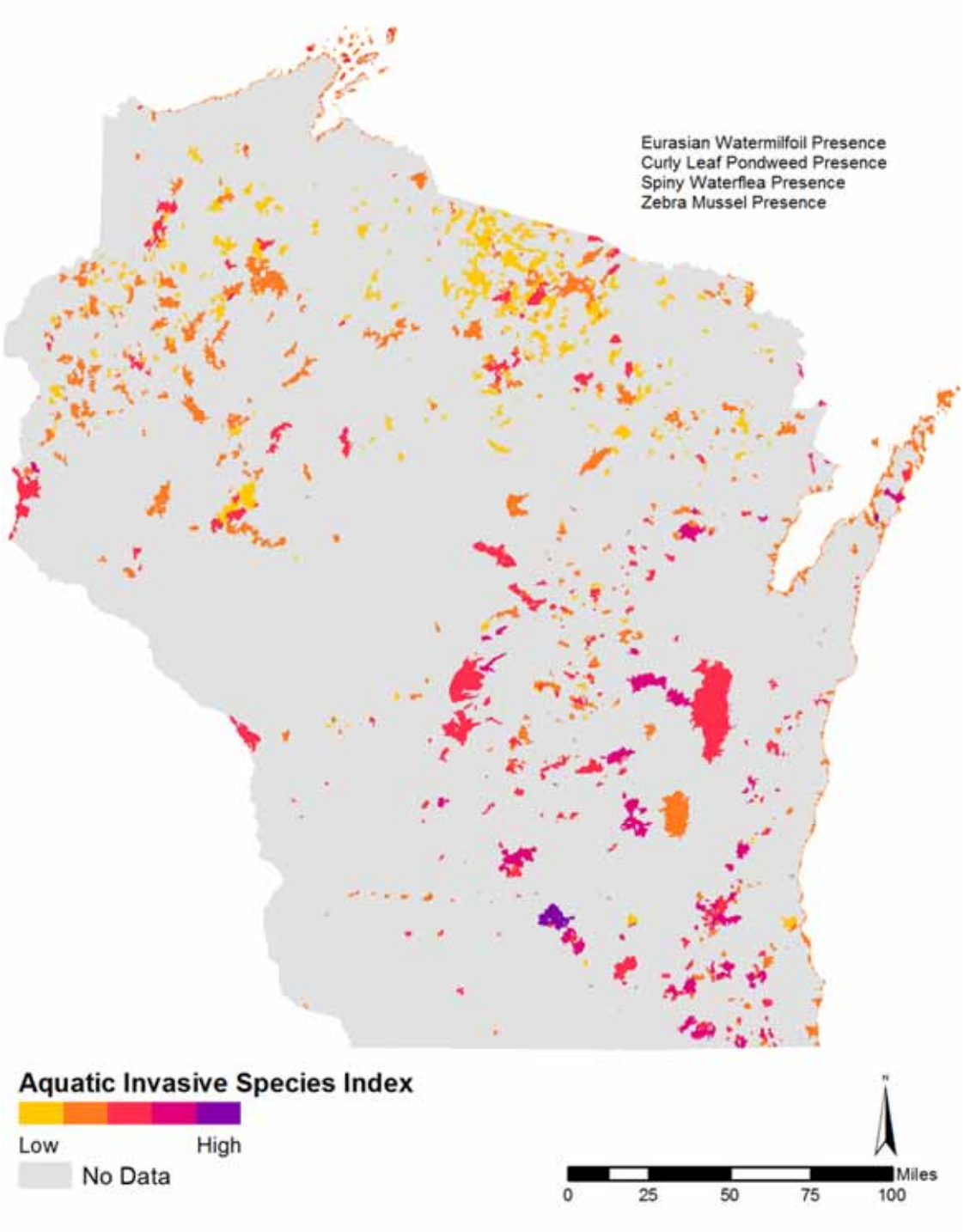
At the upcoming meeting:

- Cadmus will present the final maps
  - An earlier iteration was vetted through the Team
- Sneak peek
- We'd like to get your gut-check on accuracy
- Can't make changes at this point, but
  - we can add caveats to the final report
  - we can include a list of things that should be checked/updated next time
- Look for an invitation, forthcoming

Landscape Condition

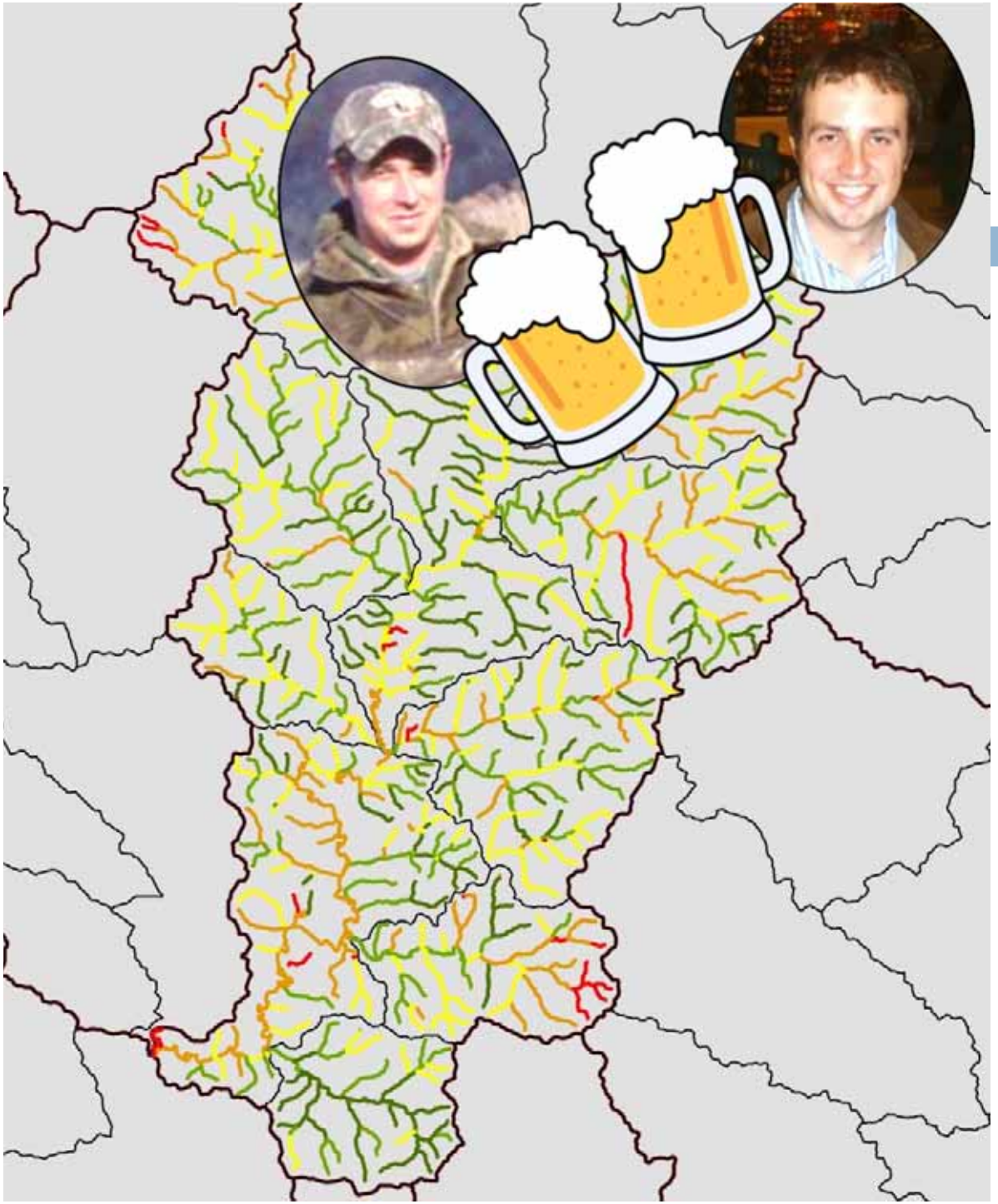
- Natural Land Cover in Watershed
- Natural Land Cover in Active River Area
- Wetlands Remaining
- Hubs & Corridors





Aquatic Invasives

- Eurasian Water Milfoil
- Curly Leaf Pondweed
- Zebra Mussels
- Spiny Waterflea



Beer Creek

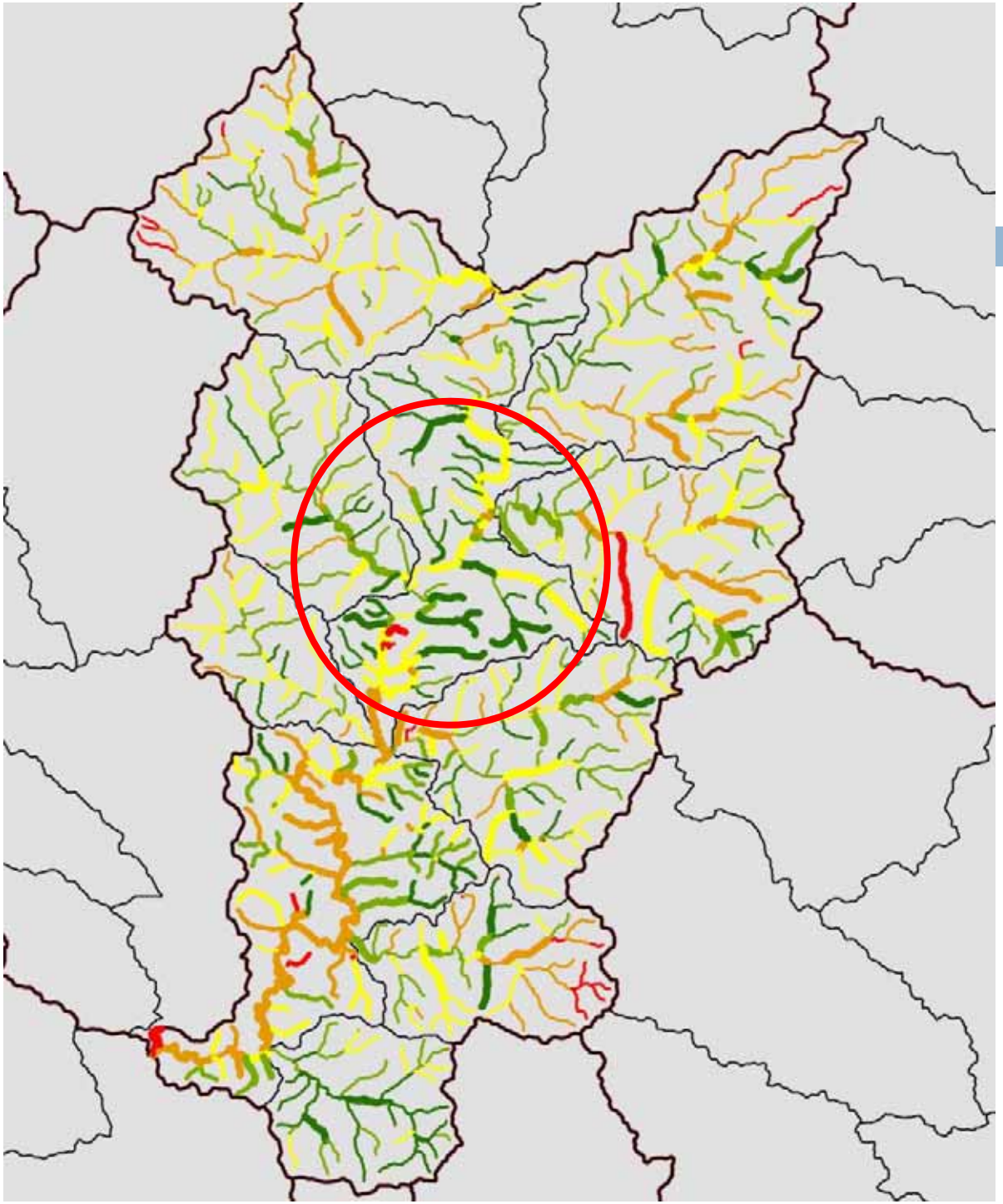
(oh wait…that was *Bear*…)

Kickapoo HUC10, Vernon Co.

Color =Aquatic Ecosystem Health

Major boundary = HUC10

Finer boundaries = HUC12



Beer Creek

(oh wait…that was *Bear*…)
Kickapoo HUC10, Vernon Co.

Color =Aquatic Ecosystem Health

Line size = Vulnerability- thicker line high vulnerability

Major boundary = HUC10

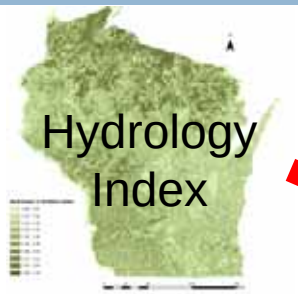
Finer boundaries = HUC12

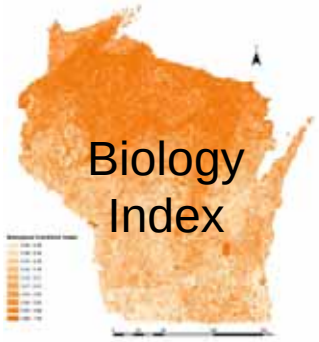
Result: A bunch of maps… combined into one score

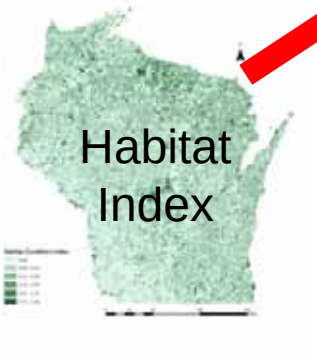
Raw data:
Fish & Bug IBI
monitoring sites

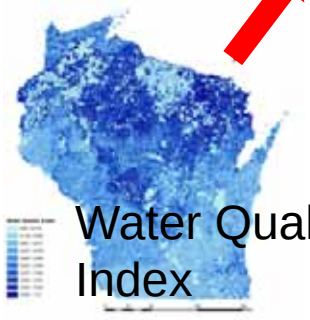
Model each metric,

Then combine into category index scores

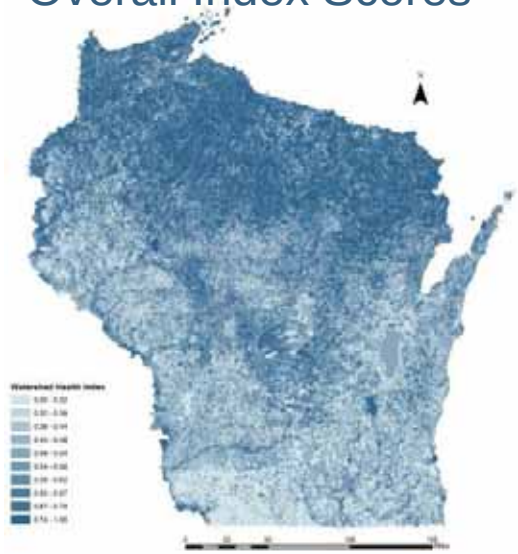








Watershed Health
Overall Index Scores



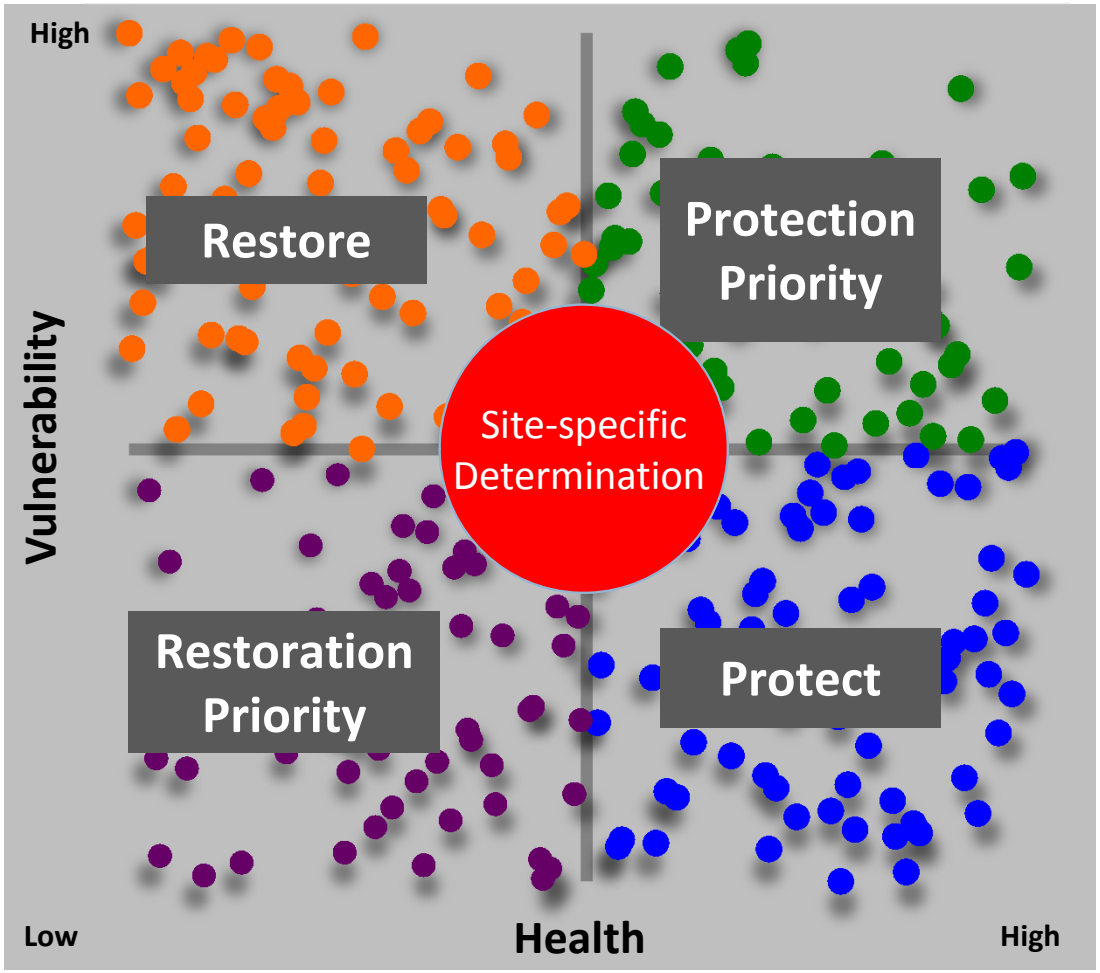
1. Hydrology
2. Water Quality
3. Biological integrity
4. Habitat/Geomorph.

Aquatic Ecosystem Health Ranking

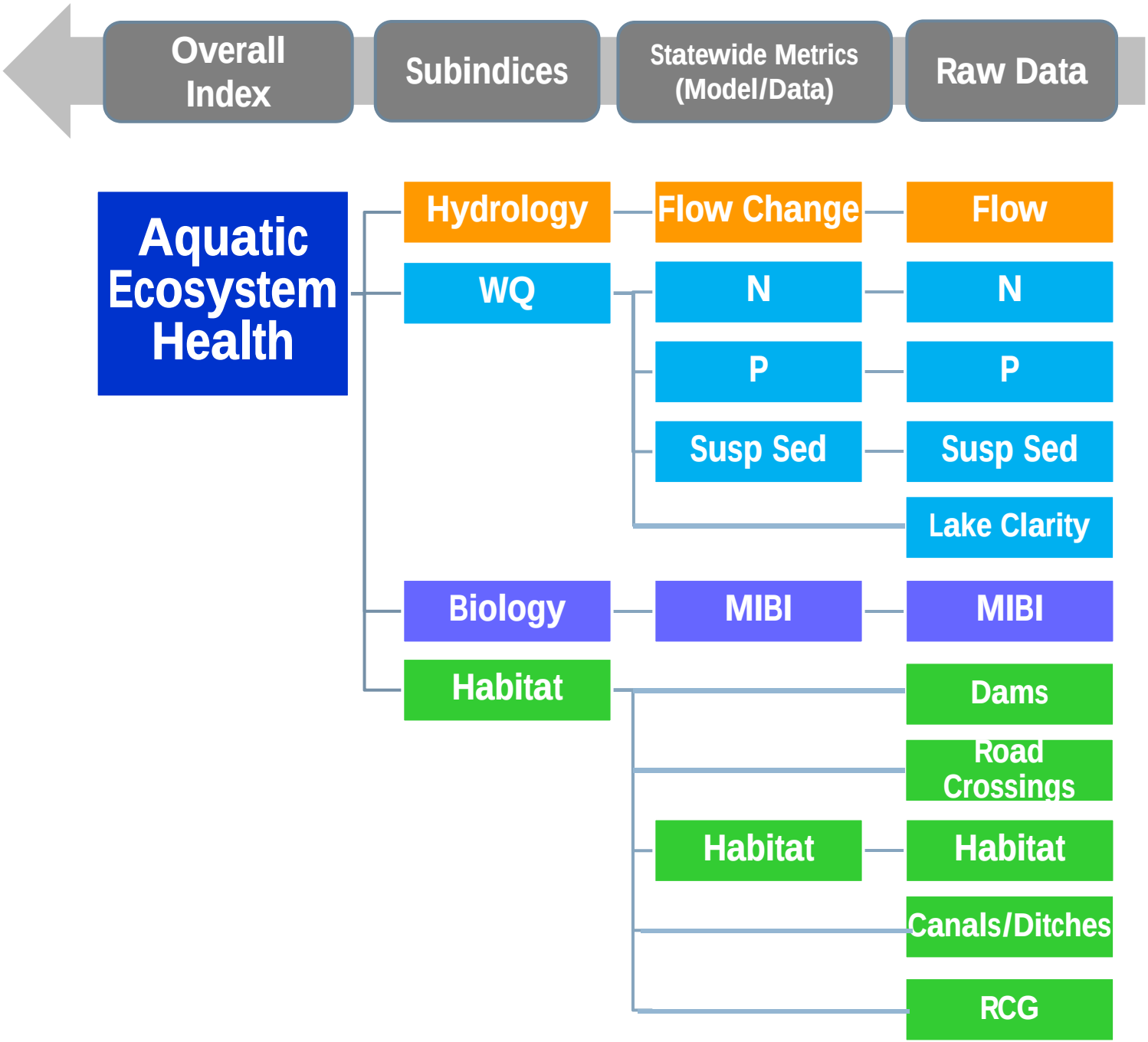
1. Climate Change
2. Land Use Change
3. Water Use

Vulnerability Ranking

Example Results: Vermont Combining Health & Vulnerability

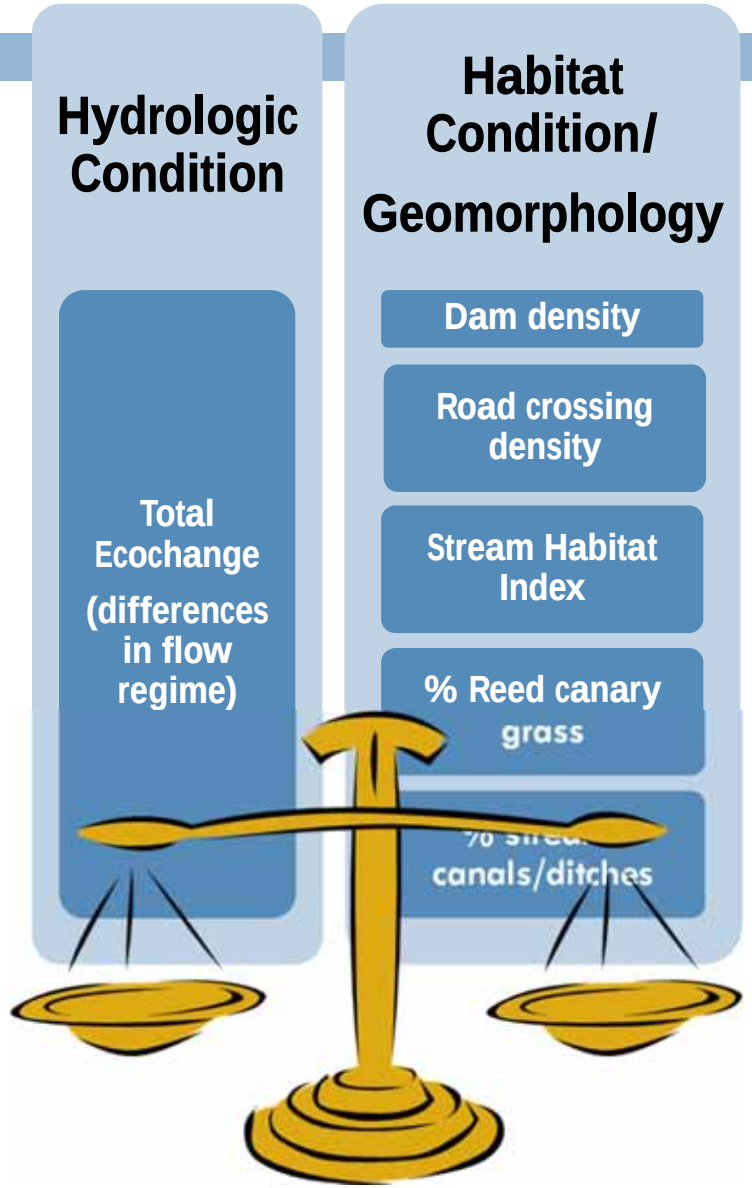


Building Each Index



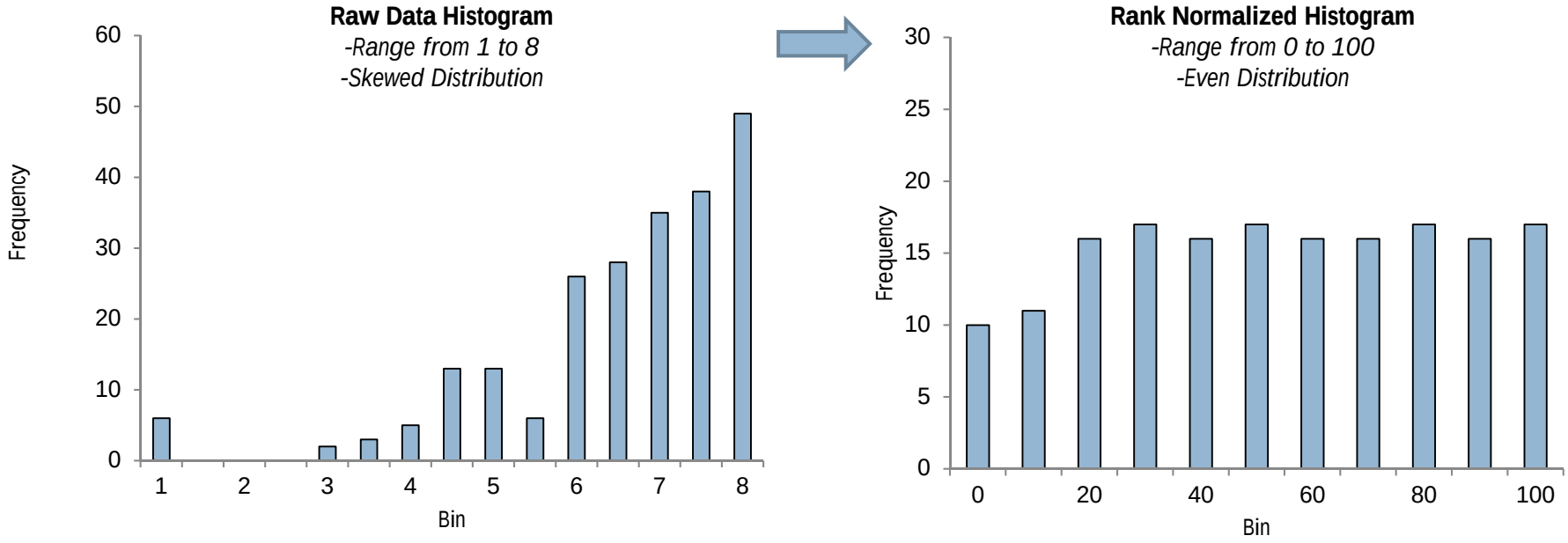
Weighting Metrics/Categories

- No weighting of metrics or categories
- In most cases, do not have justification
- Gives each metric within a Category equal weight; & gives each Category equal weight

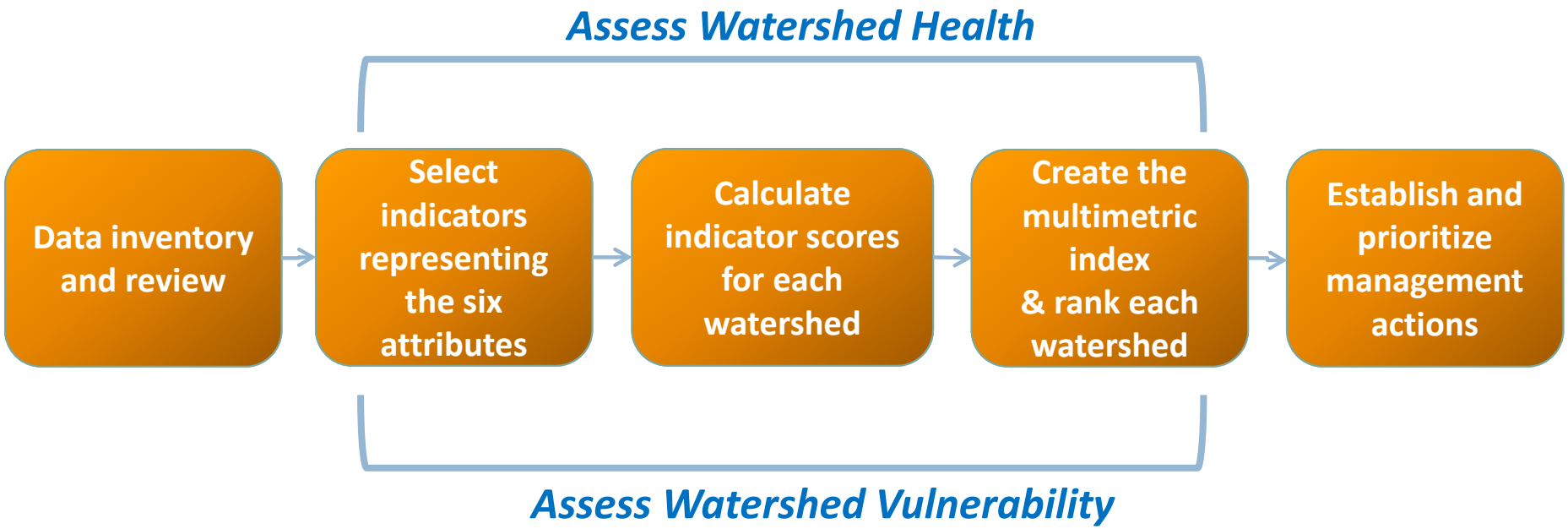


Normalizing the results

- Goal is to compare watersheds against one another
- Normalizing is used to spread out the results onto a scale of 0-100.



Process Steps



Combining a lot of info into an index score….

- Benefit: Summarizes complex information into one overall score.
- Drawback: Summarizes complex information into one overall score.
  - Trying for the best of both worlds by calculating one broad overall score but having access to all the component scores.

Application Ideas: Program-Specific Uses

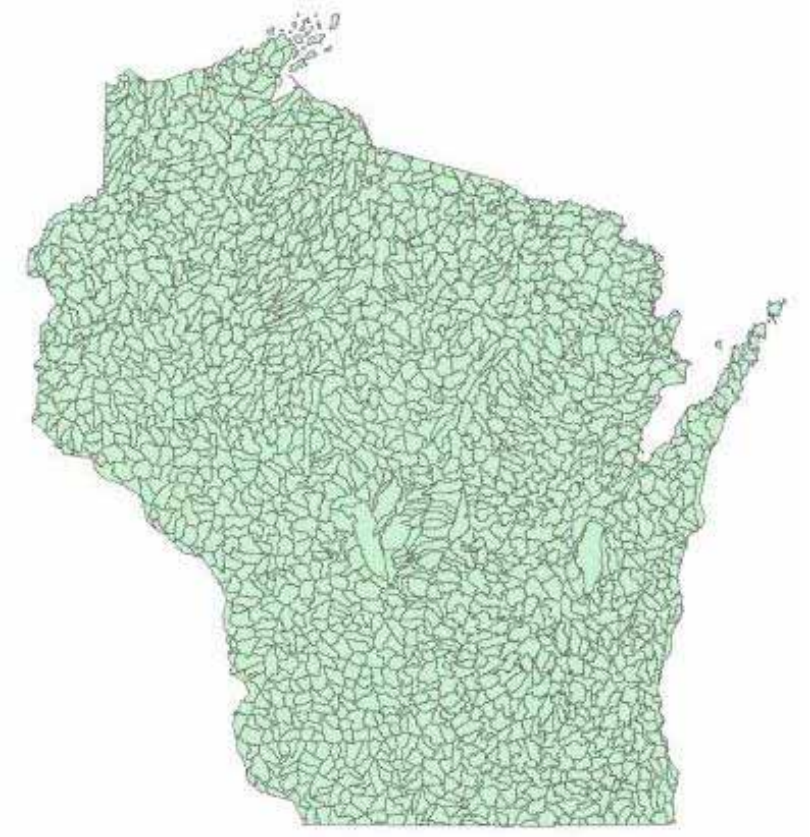
- Use for wetland rapid assessments
- Target wetland mitigation efforts
- Prioritize grant funding - Runoff grant scoring
- Target TMDL implementation efforts
- Inform land acquisitions
- Prioritize which watersheds need further monitoring
- Track trends over time

Application Ideas: Communication Uses

- Educate the public about specific programs: e.g. areas vulnerable to groundwater/well issues
- Use in interactions between DNR and county staff during county land and water management plan development
- Build public support for protection by informing people about vulnerabilities in certain watersheds
- Communicate economic benefits of protecting *healthy* watersheds—preventing degradation—to "sell" the value of environmental programs

Spatial and Temporal Scale

- Screening-level assessment
- Broad spatial/temporal scale
- USGS 12-Digit Hydrologic Unit Code (HUC12) subwatersheds
  - Preferred management unit
  - HUC system is hierarchical
  - Average 30 square miles
  - 1,853 HUC12 subwatersheds
- Recent, long-term average conditions



1. Landscape Condition

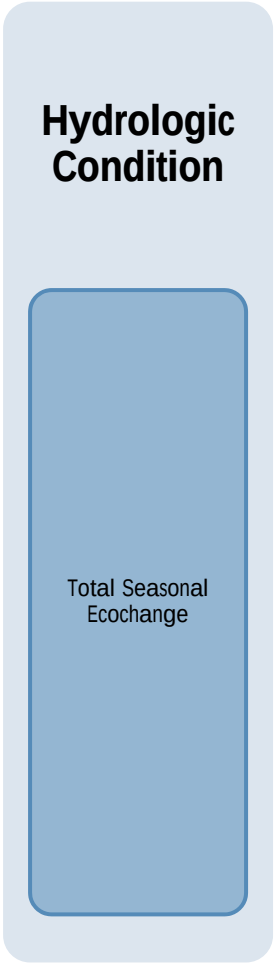
Natural vegetative cover stabilizes soil, regulates watershed hydrology, and provides habitat to terrestrial and riparian species.

- Indicators:
  - Percent natural land cover in the watershed.
  - Percent natural land cover in the Active River Area.
  - Percent wetlands remaining in watershed.

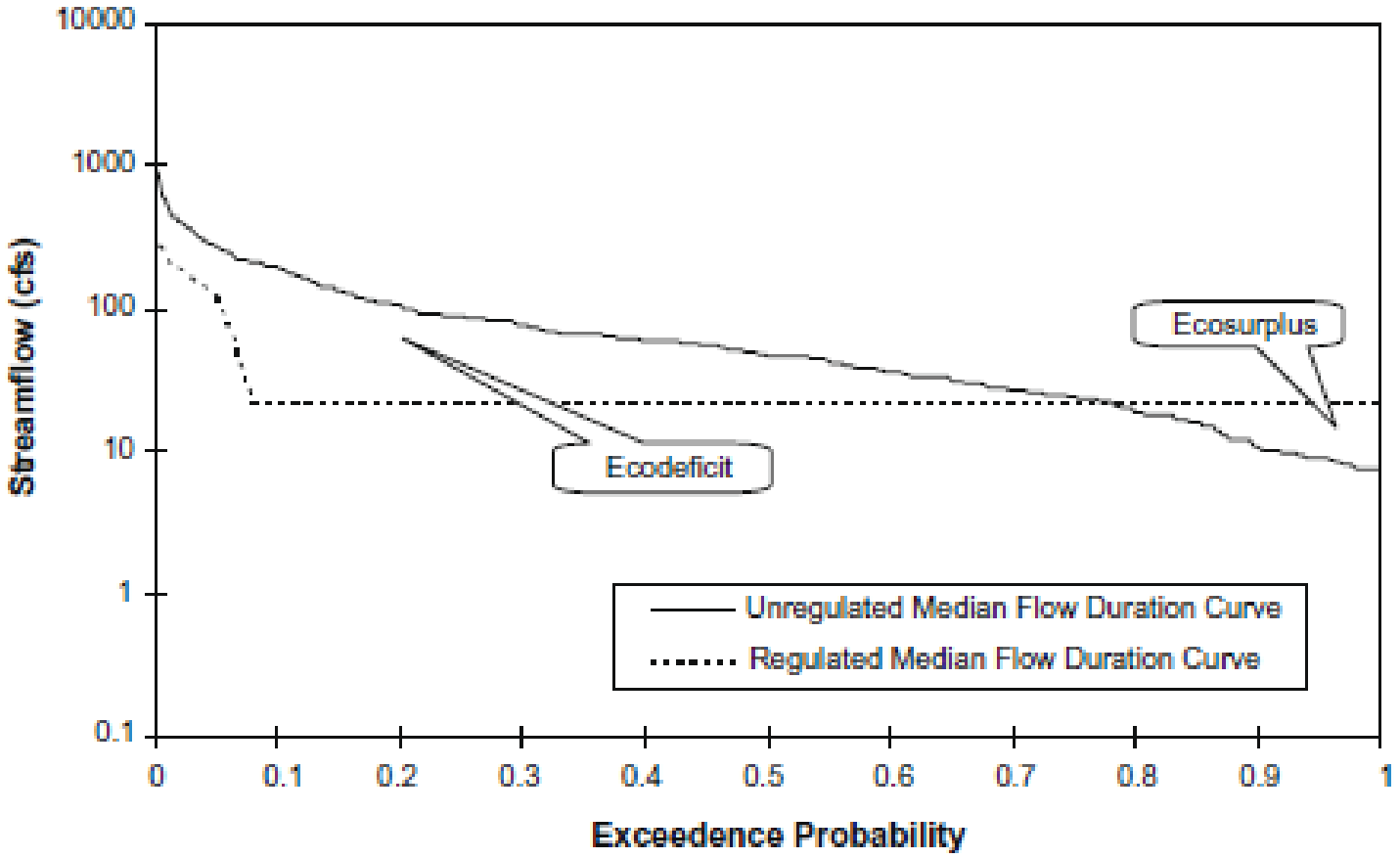
2. Hydrologic Condition

The Natural Flow Regime organizes and defines river ecosystems.

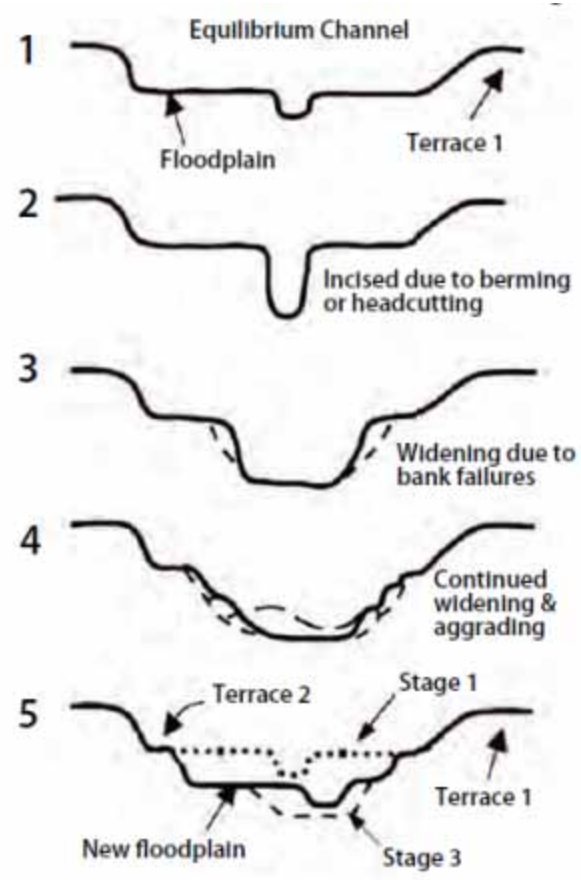
- Indicator:
  - Total Seasonal Ecochange – Difference between pre-development and current flow duration curves.
- Statistical modeling will be used to estimate pre-development and current flow duration curves for all streams in the state.



Total Seasonal Ecochange



3. Geomorphic Condition



- Evaluate changes in elevation using satellite data from 2 time periods:
  - Erosion
  - Deposition
- % of streams that are canals/ditches
- Field indicators of physical habitat where available

Geomorphic Condition

Watershed-wide Geomorphic Change in the Active River Area

% streams canals/ditches

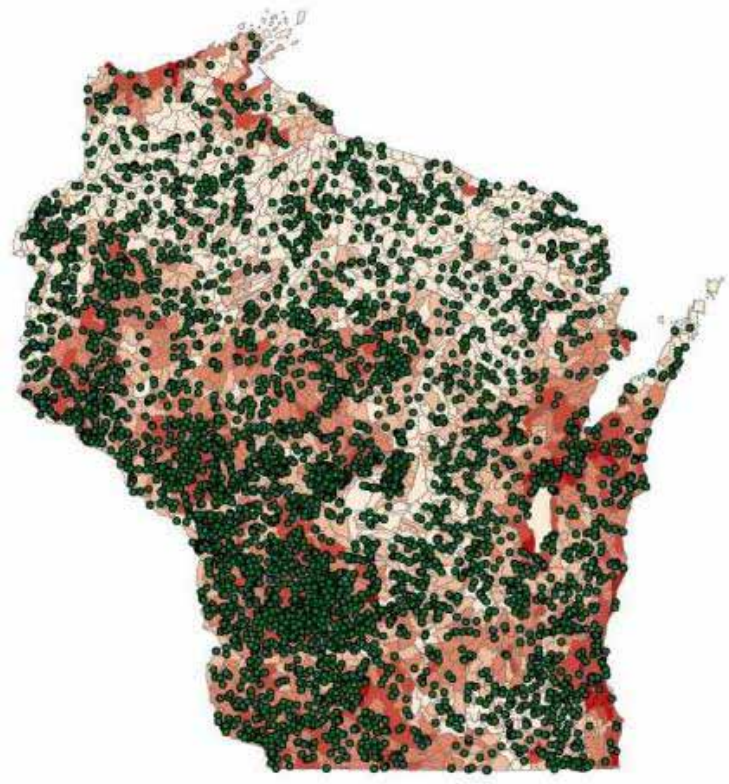
Physical habitat database

4. Habitat Condition

Habitat Condition

- Aquatic Connectivity
- Absence of reed canary grass
- Absence of eurasian water milfoil and curly-leaf pondweed

- Aquatic Connectivity
  - Road/stream crossings
  - Dams
- Absence of Aquatic Invasive Species that impact habitat:
  - Reed Canary Grass
  - Eurasian Water Milfoil
  - Curly-leaf Pondweed

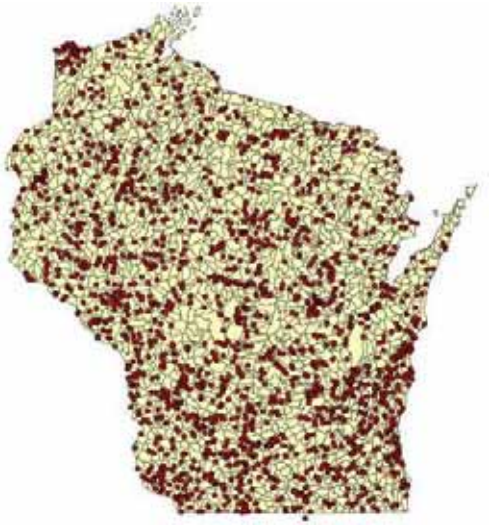


5. Water Quality

Water Quality

- Nitrogen (SW/GW)
- Phosphorus
- Sediment
- Lake Clarity

- Phosphorus – Streams
- Nitrogen – Streams and Groundwater
- Sediment – Streams
- Lake Clarity – via Remote Sensing data
- Statistical modeling to evaluate water quality statewide



6. Biological Condition

- Fish IBI
- Macroinvertebrate IBI
- Absence of aquatic invasive species that change trophic state of lakes:
  - Zebra mussel
  - Spiny waterflea

Biological Condition

Fish IBI

Macro-invertebrate IBI

Absence of spiny waterflea and zebra mussels

And…Watershed Vulnerability

Changes that will increase as population grows and are known to have widespread, long-term consequences for aquatic ecosystems and their watersheds:

- Climate
  - Projected change in runoff
  - Projected change in nutrients & sediment
  - Projected fish distribution changes
- Land Use
  - Projected land cover change
  - Protected areas
- Water Use
  - High Capacity Water Withdrawals
  - Groundwater Dependent Ecosystems

Multimetric Index

- What is a multimetric index?
  - "A dimensionless numeric combination of scores derived from ecological measures called metrics. A metric is a characteristic of the ecosystem that can be scored according to conditions."
- Benefit: Summarizes complex information into one overall score.
- Drawback: Summarizes complex information into one overall score.

Index Development

- Directionally align each indicator so that higher values equal greater health.
- Normalize each indicator so that they are all on the same scale (e.g., 0 – 100)
  - Define thresholds if appropriate (healthy/unhealthy)
- Determine whether weighting should be applied
- Calculate Index

Application Ideas: Program-Specific Uses

- Use for wetland rapid assessments
- Target wetland mitigation efforts
- Prioritize grant funding - Runoff grant scoring
- Prioritize which watersheds need further monitoring
- Target TMDL implementation efforts
- Inform watershed planning process
- Inform land acquisitions
- Track trends over time
- Identify nutrient reduction needs