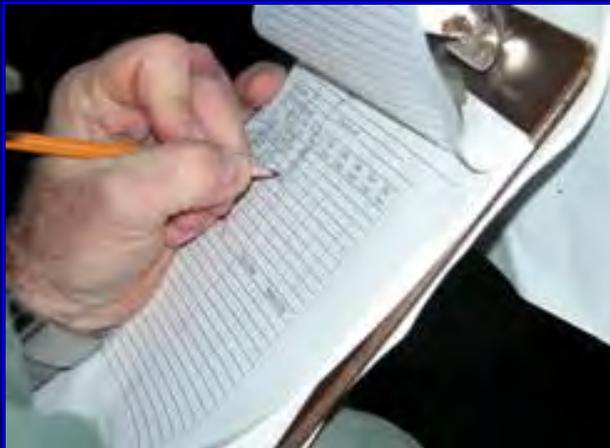


# Fish passage barrier inventory, assessment, and prioritization



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Matt Diebel, [matthew.diebel@wisconsin.gov](mailto:matthew.diebel@wisconsin.gov)

# Inventory, assessment, and prioritization

- How many crossings are out there?
- How many are bad?
- Where do we begin fixing problem sites?



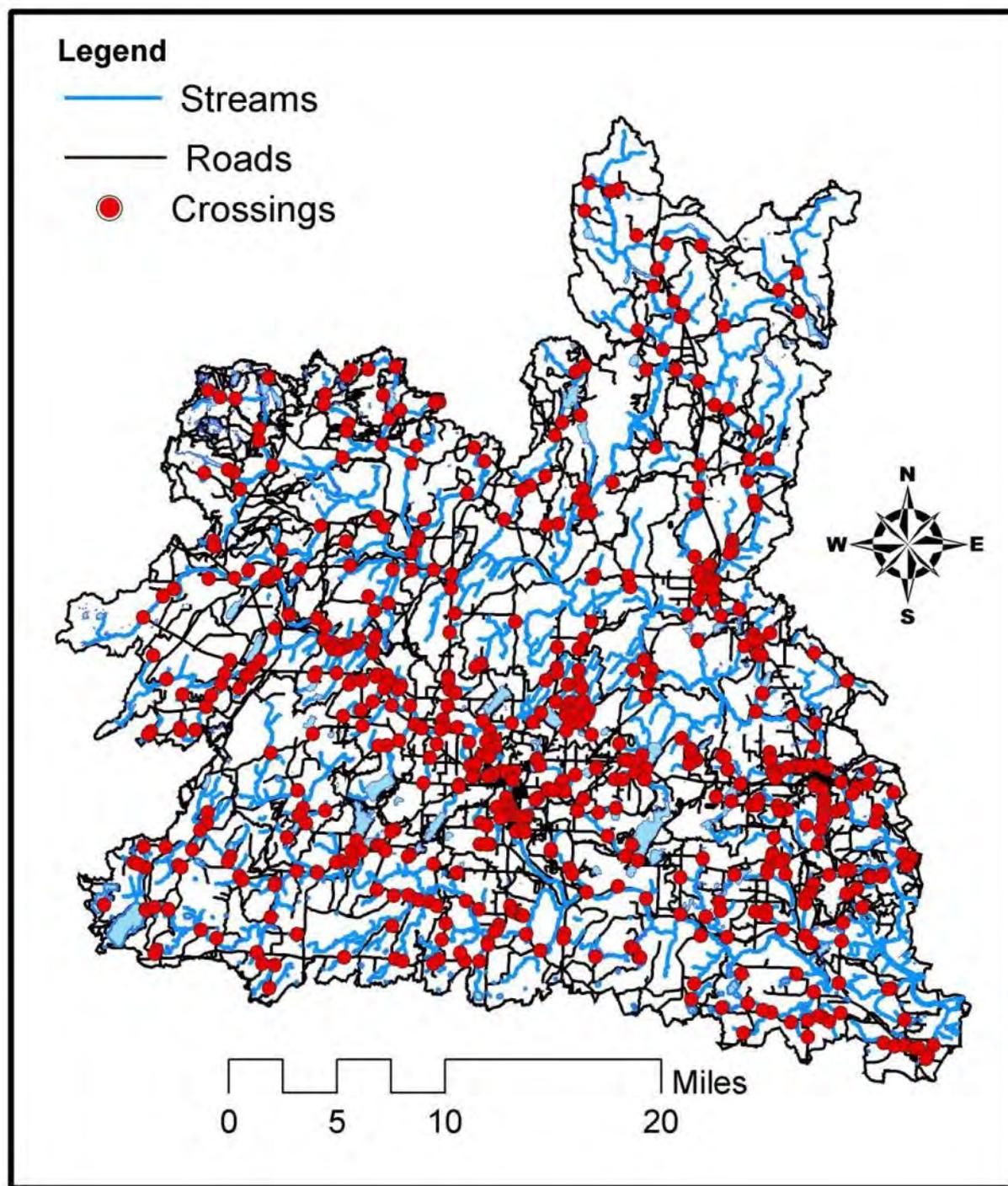
# How many road/stream crossings are out there?

(Velocity barrier)



# Upper Menominee Watershed

649  
Crossings!

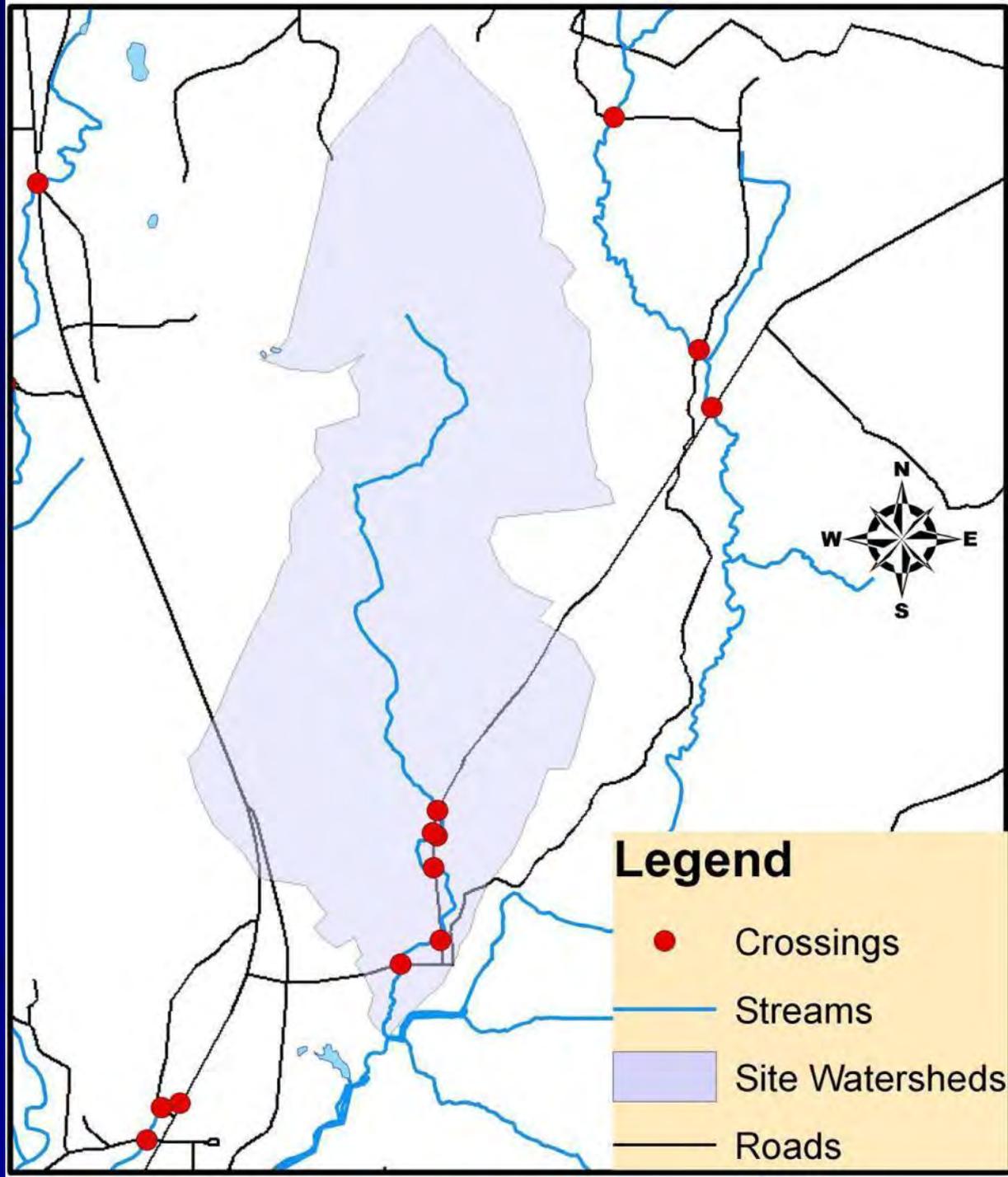


# A few cautions

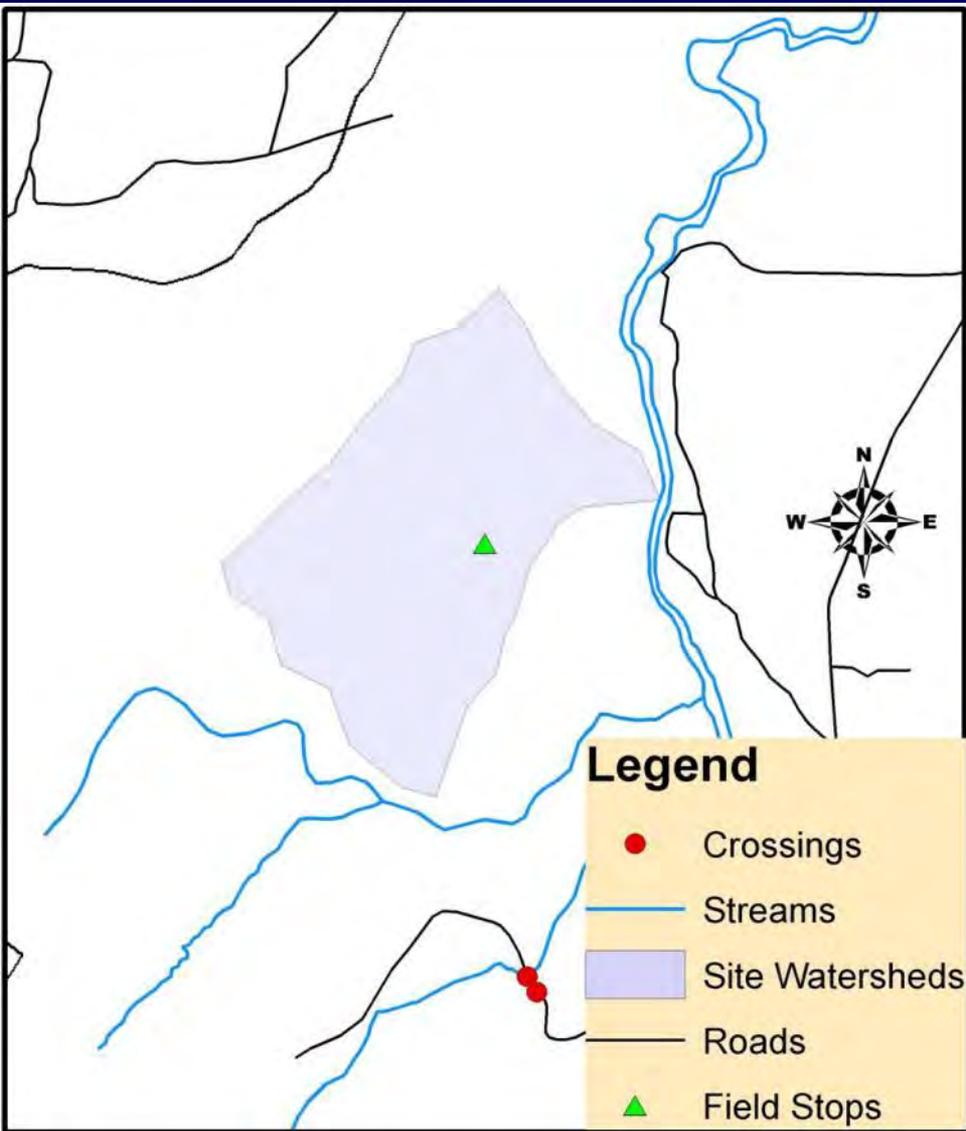
- Scale matters
- Some roads are not mapped
- Some streams are not streams
- Some roads are not roads
- Some crossings are not crossings
- Some crossings don't show up

Zoom in to  
field sites

Looks good!

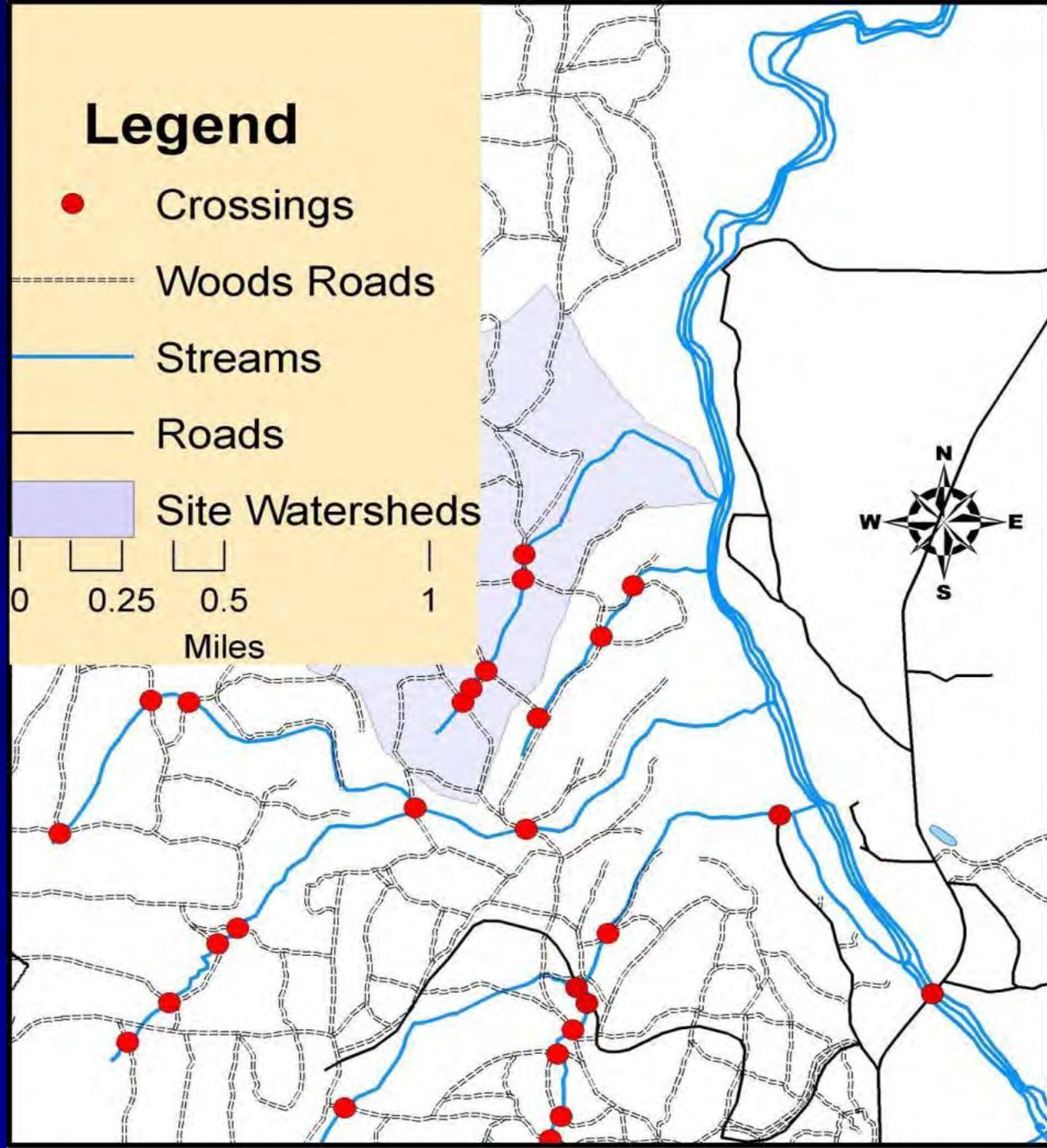


# What crossing?



27  
Crossings  
in 4  
Square  
Miles

Scale Matters –  
Use the finest  
scale possible



# Some roads are not mapped

1,462 miles mapped

3,050 miles unmapped



# Unmapped stream crossings

789 mapped crossings

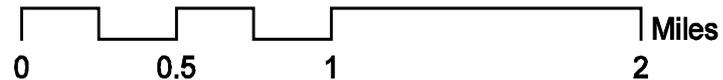
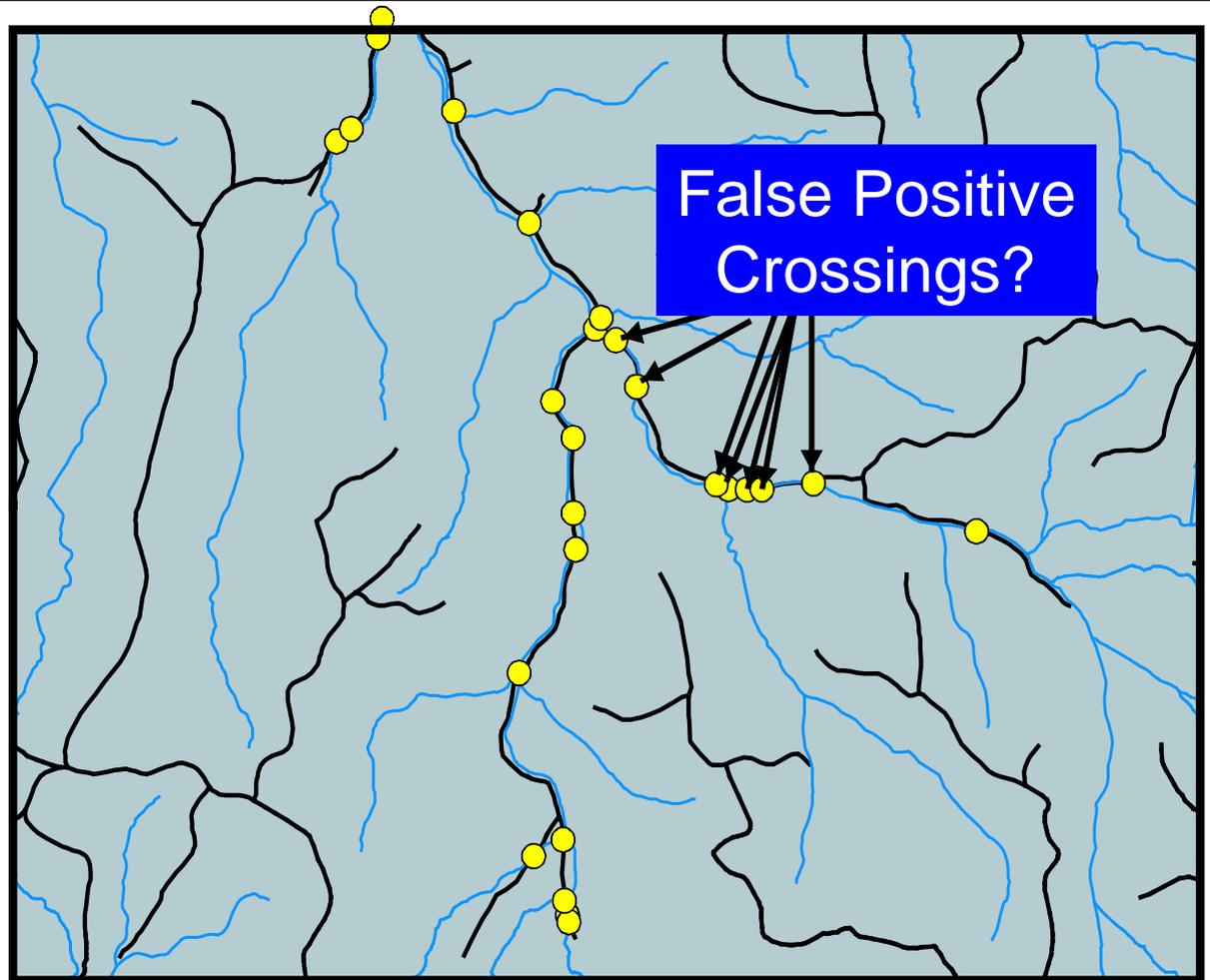
1,441 unmapped



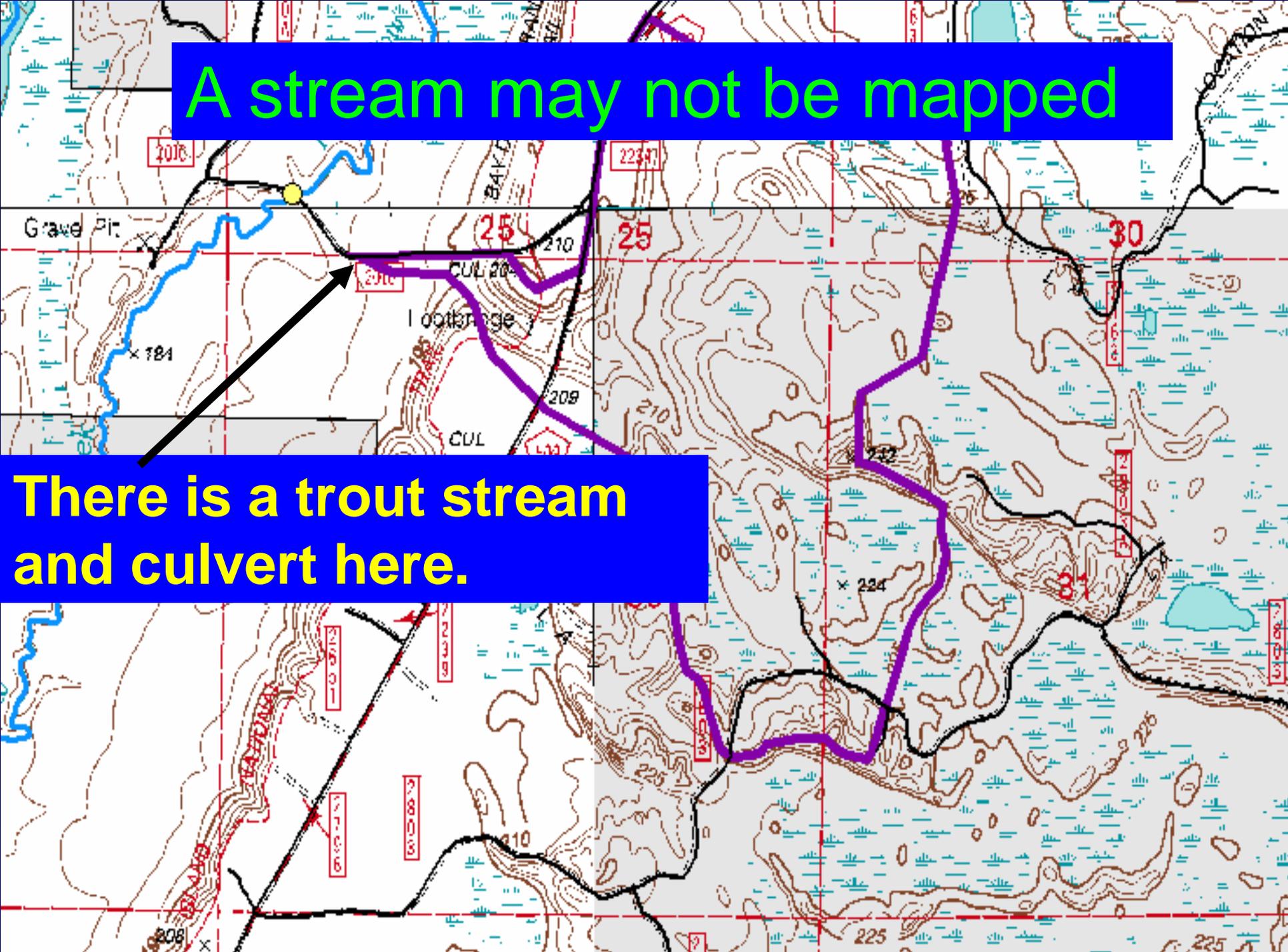
# Some crossings may not be crossings

## Legend

-  National Forest
-  Watersheds
-  Watershed 7140102040
-  Clip FS Roads
-  Clip FS Streams
-  FS\_crossings



**A stream may not be mapped**



**There is a trout stream and culvert here.**

# Inventory and assessment

## ■ Goals:

- What kinds of problems are out there?
- How bad are they?



# Two tier approach to inventory

- Tier 1– Rapid assessment (volunteers)
- Tier 2 – More in-depth (more equipment and skills required)



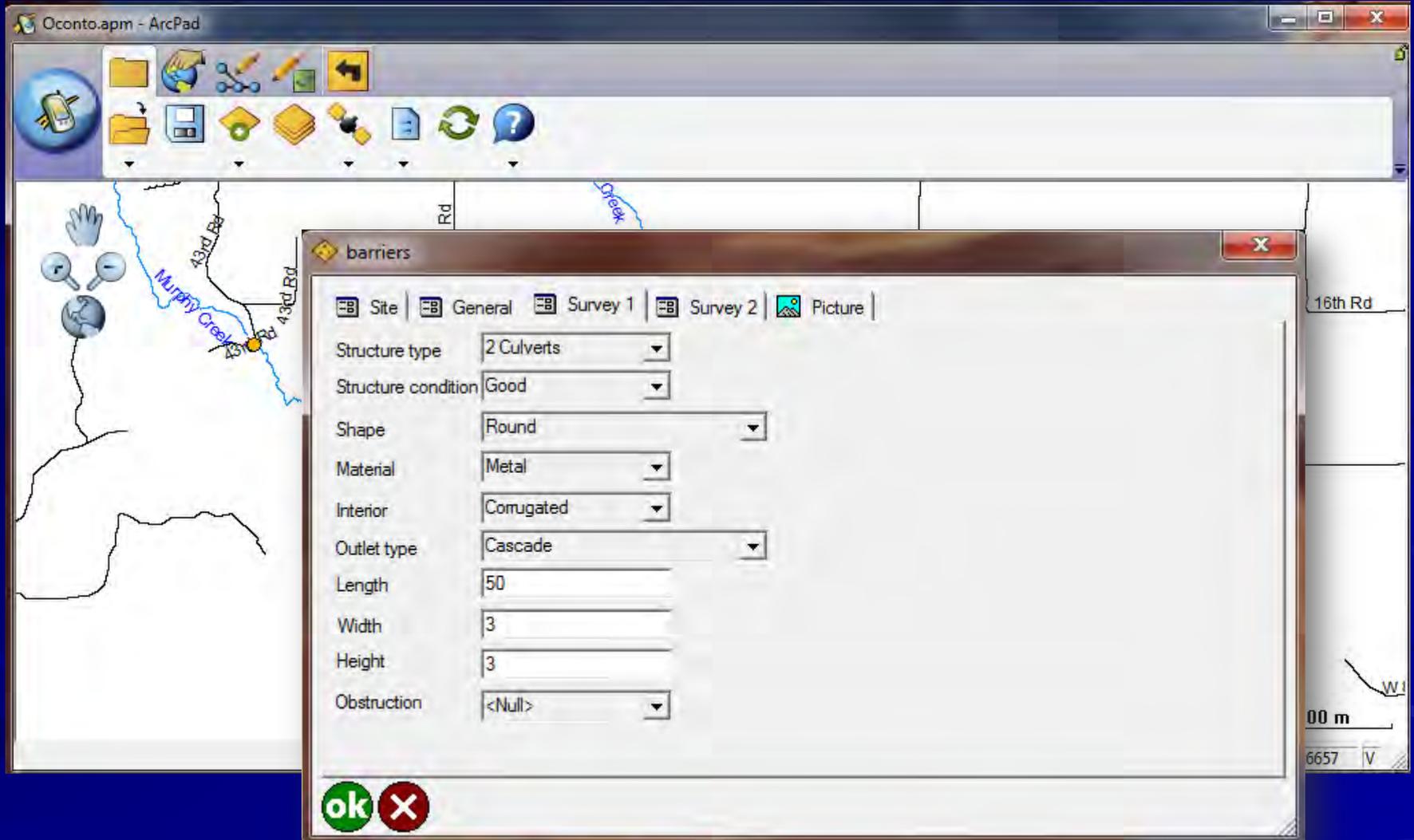


Communication plan, first aid kit,  
sunscreen, insect repellent, water,  
knowledge of safety hazards.

# Data Collection

<b>Stream Crossing Data Sheet</b>				Site ID: _____
<b>General Information</b>				
Stream Name: _____	Road Name: _____			
Name of Observer(s): _____			Date: _____	
GPS Waypoint: _____	GPS Lat/Long: _____			
County: _____	Township: _____	Range: _____	Sec: _____	
Adjacent Landowner Information: _____		Additional Comments: _____		

# Data Collection



# Site sketch



# Database

Site ID	1926-6918	Stream	Little Fishdam River	Road	Garden Grade Rd	Date	09/06/2012
Outcome	Survey 2	Structure type	1 Culvert	Surveyed by	DNR		
Road type	Road	Shape	Round	Owner	Michigan town		
Road surface	Gravel	Material	Metal	Passability	0		
Road width	11 ft	Length	32 ft	Pass Method	Outlet drop		
Scour pool	Yes	Width	3.5 ft	April flow	4.62 cfs		
Upstream pond	No	Height	3.5 ft	Cost	\$68,246		
Obstruction		Measured velocity	1.4 ft/s	Rank	27		
Condition	Fair	Modeled velocity		Habitat Gain	103.7 acres		
Bankfull width	9 ft	Outlet drop	1.3 ft	Outlet type	Freefall		

## NOTES:

second smaller rusted out culvert must carry water, see "other" photo

OUTLET



INLET

No Image Available

# Quick assessment metrics

- Outlet drop
- Compare culvert geometry and hydraulics to natural channel
  - Water velocity
  - Water depth
  - Structure width
- Substrate?

0

# Estimating passability

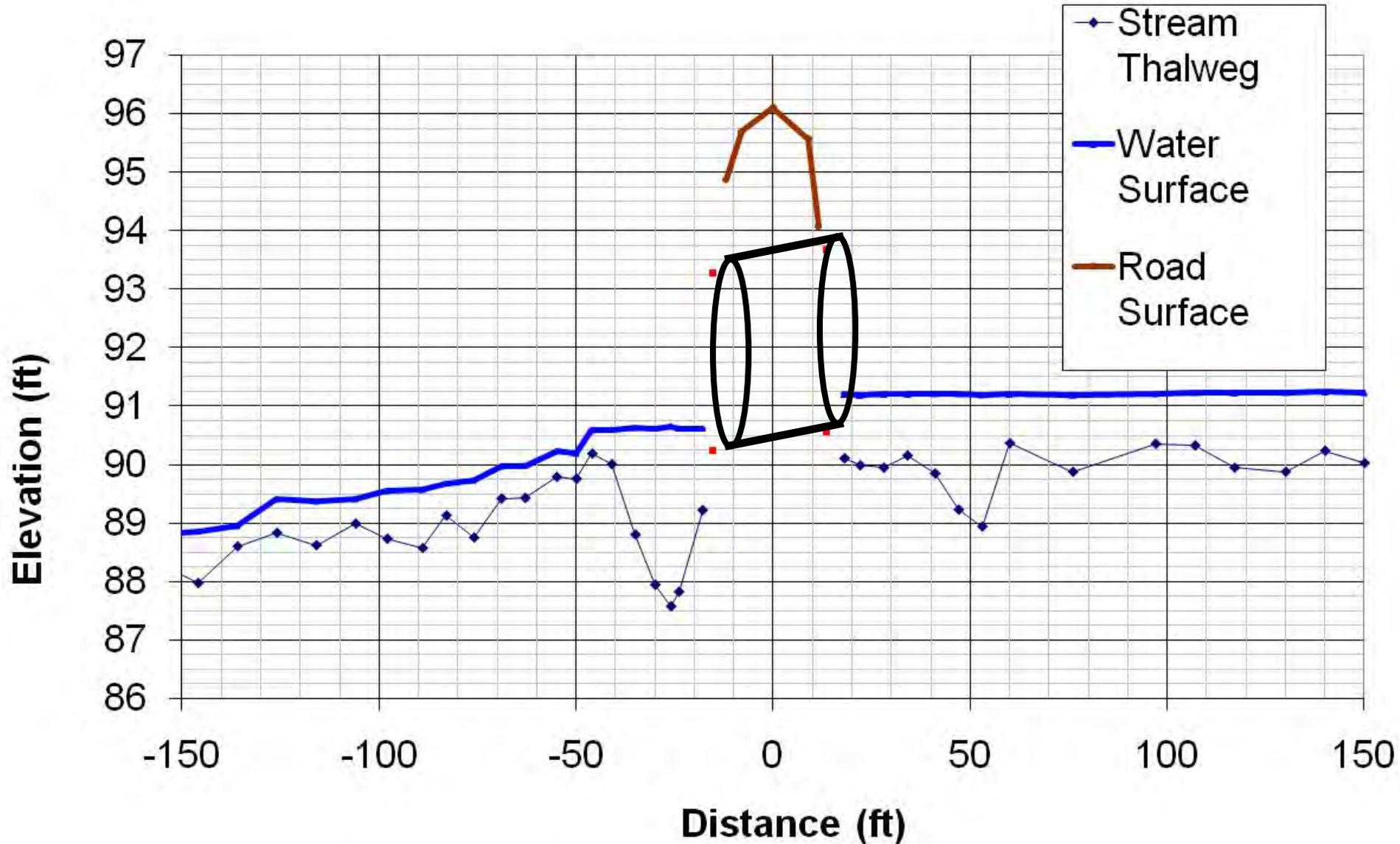
0.5



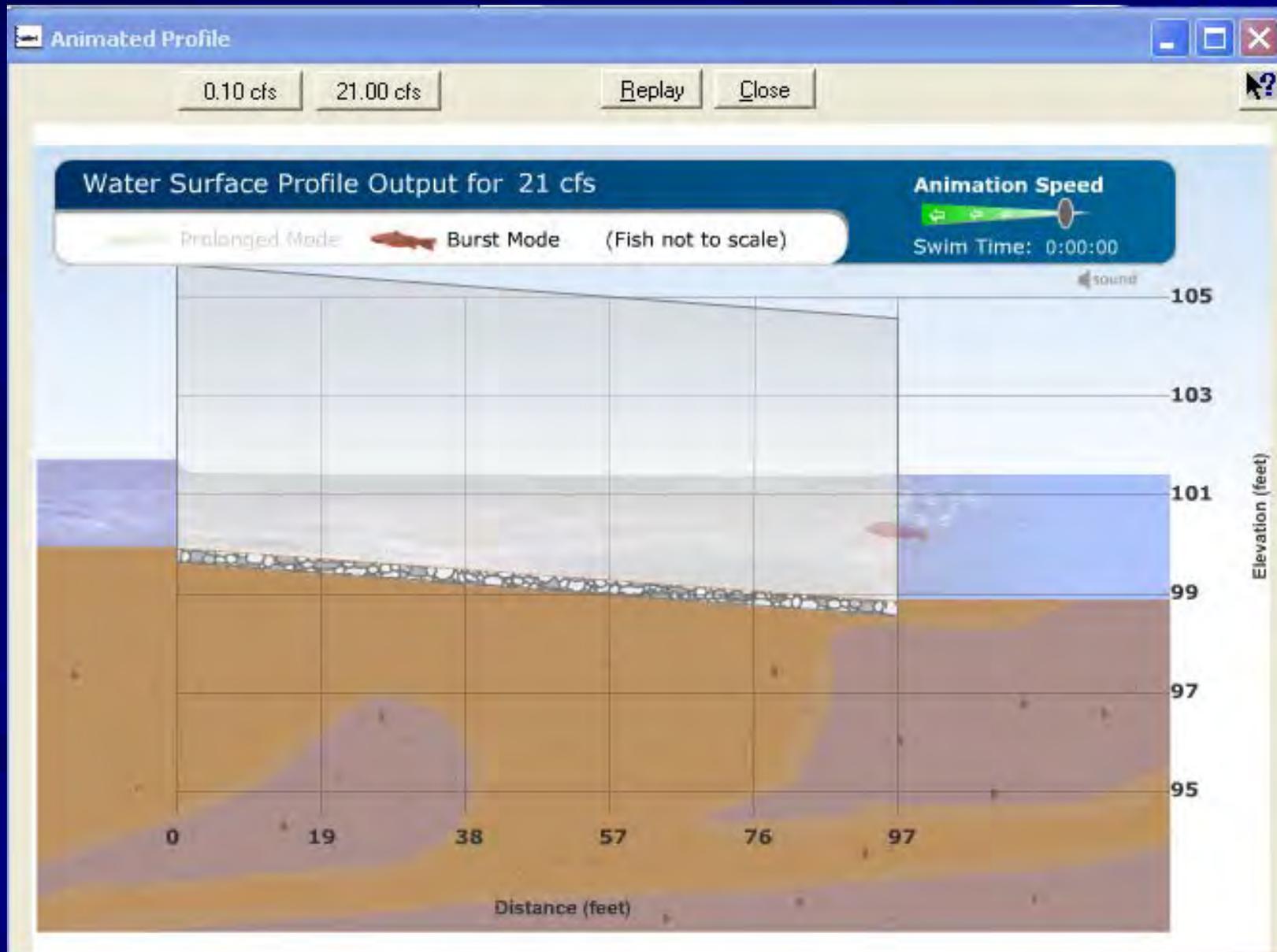
0.9

1

# Tier 2 assessment



# FishXing <http://stream.fs.fed.us/fishxing/>

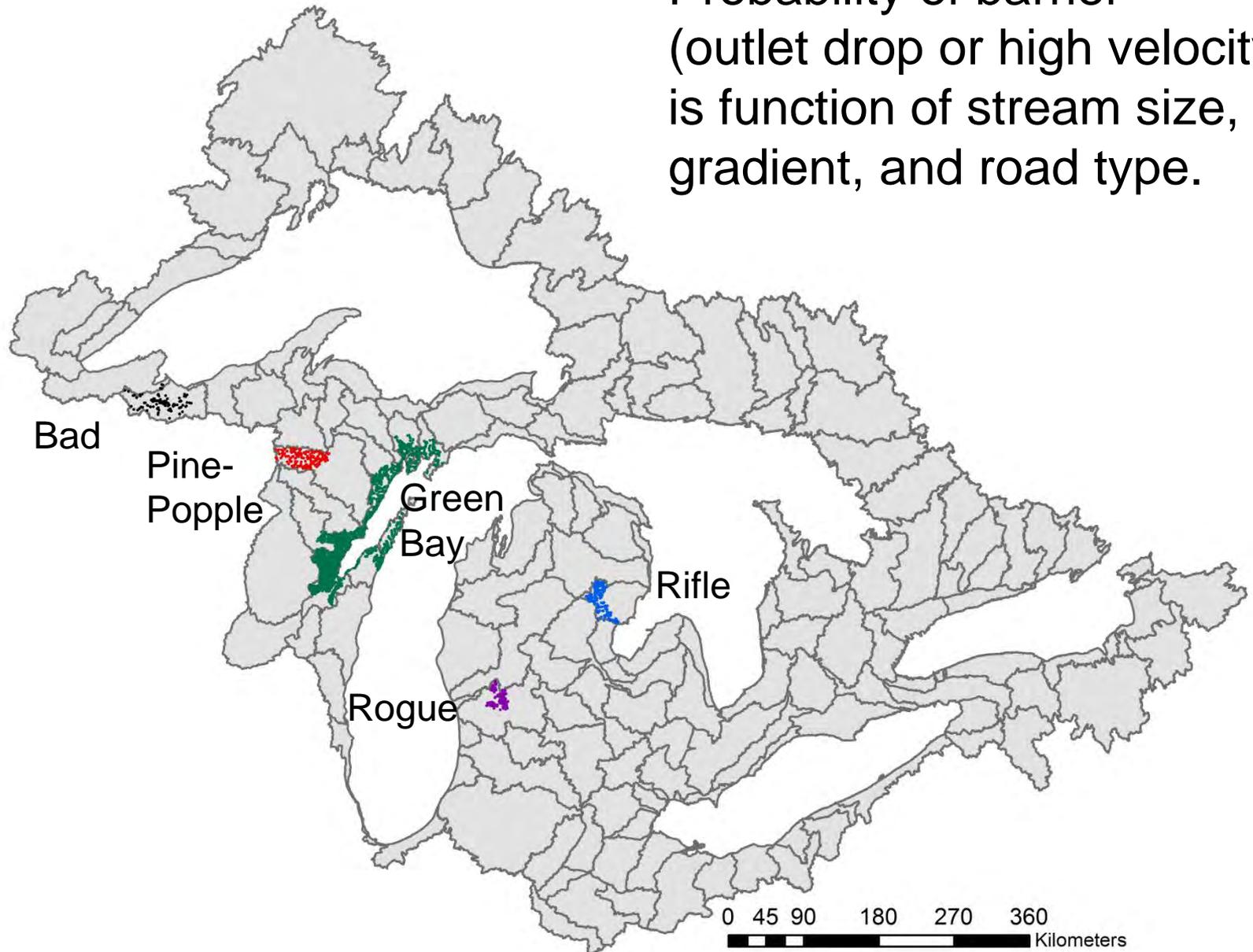


# Prioritization

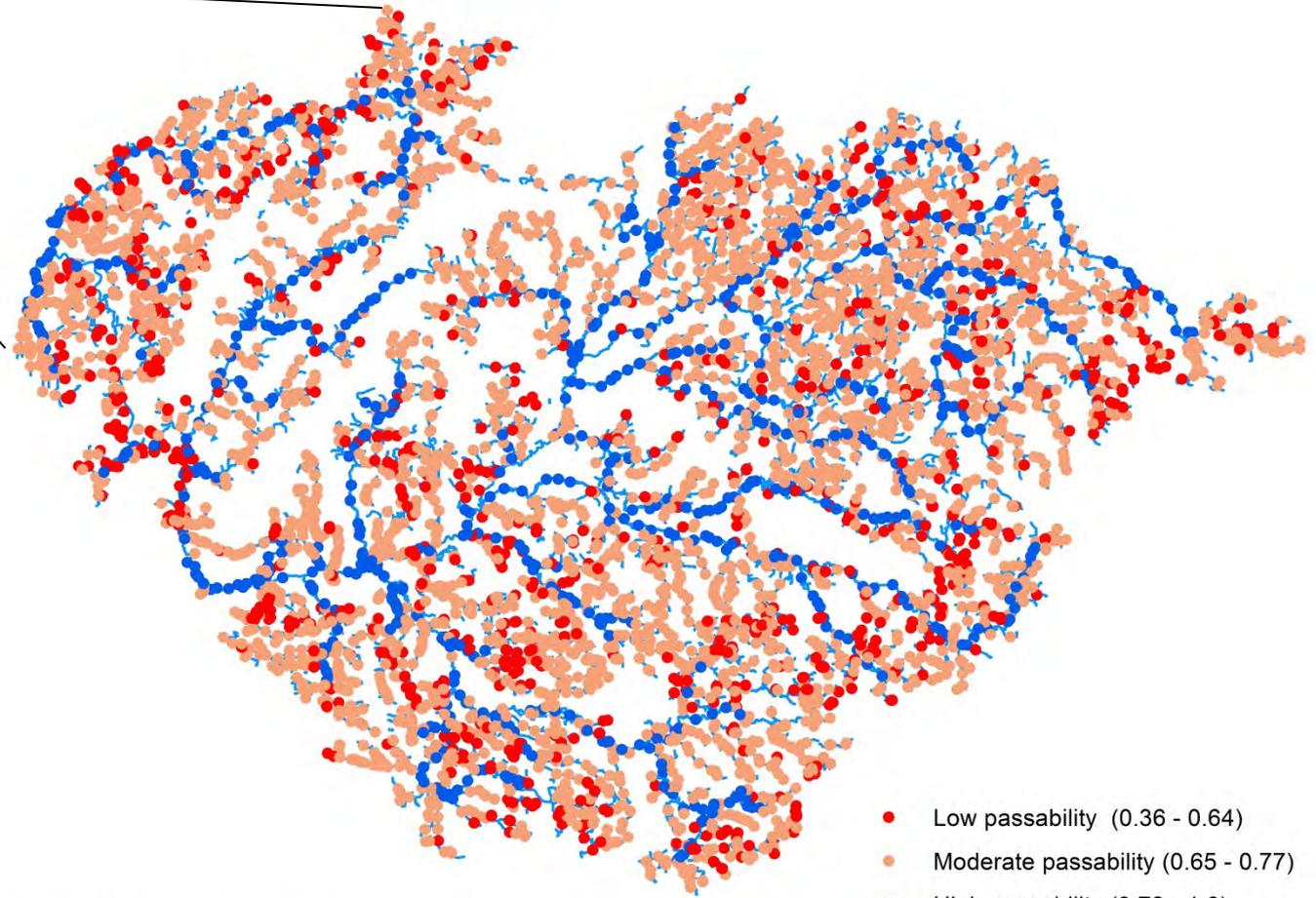
- Screening tools
  - Passability model
  - LiDAR assessment
- Selecting projects
  - Factors to consider
  - Tools

# Passability Model

Probability of barrier  
(outlet drop or high velocity)  
is function of stream size,  
gradient, and road type.



# Passability Model



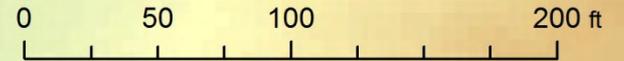
0 5 10 20 30 40  
Kilometers

- Low passability (0.36 - 0.64)
- Moderate passability (0.65 - 0.77)
- High passability (0.78 - 1.0)
- St Joseph river and tributaries

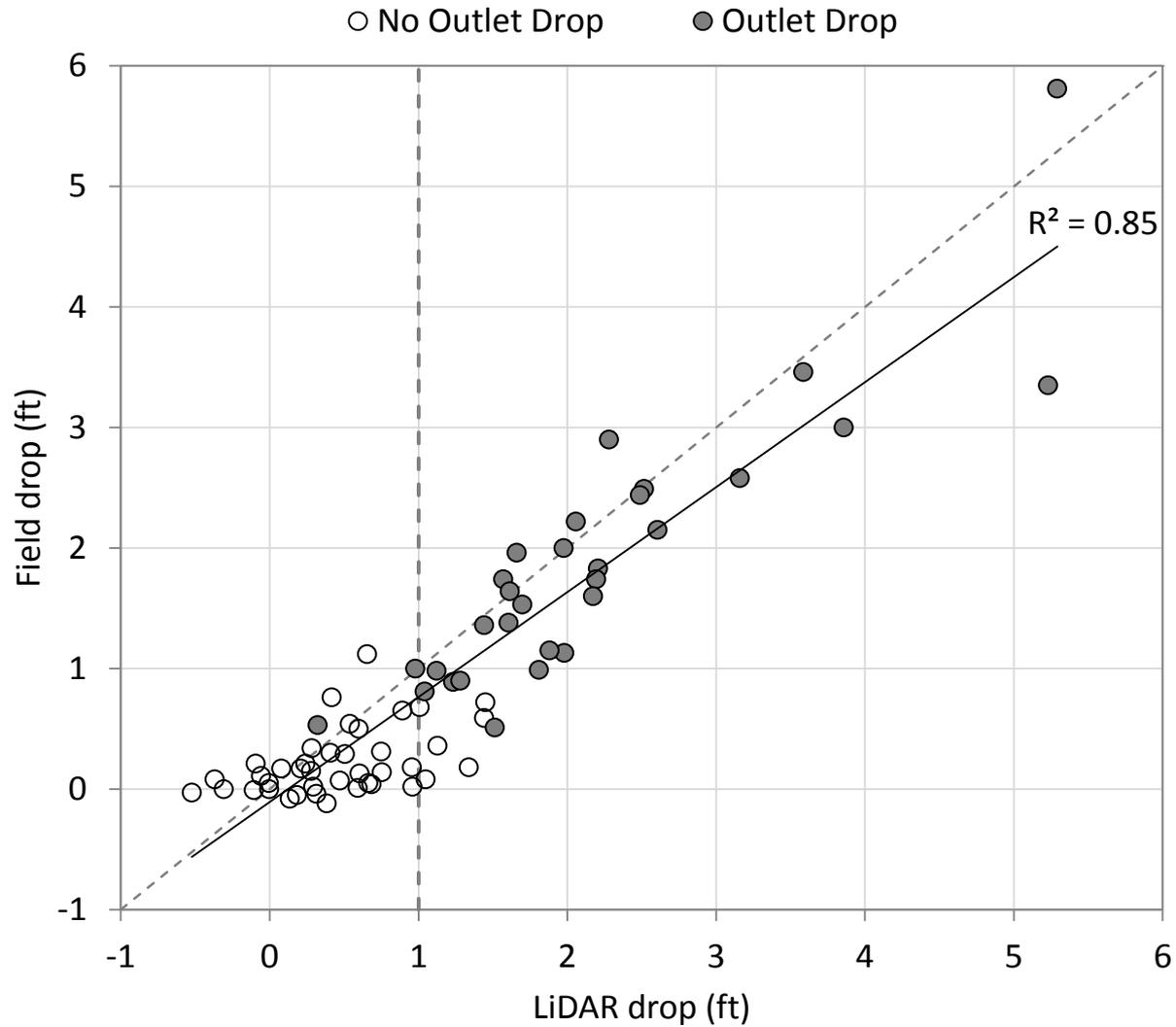
# LiDAR Screening

899.5 ft

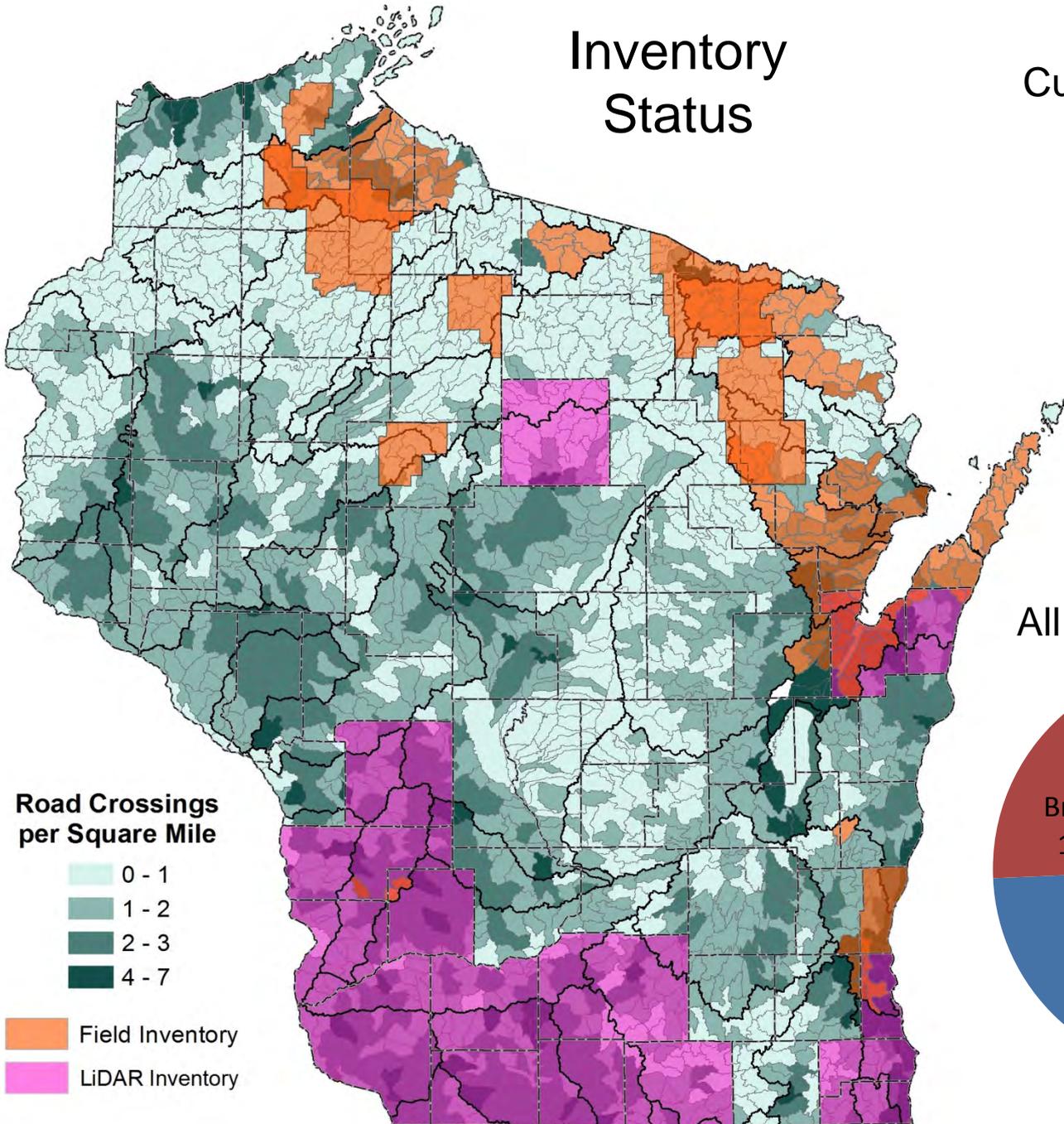
896.0 ft



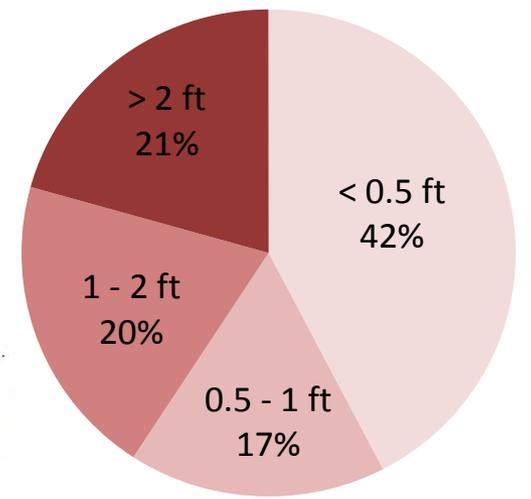
# Accuracy of LiDAR Assessment



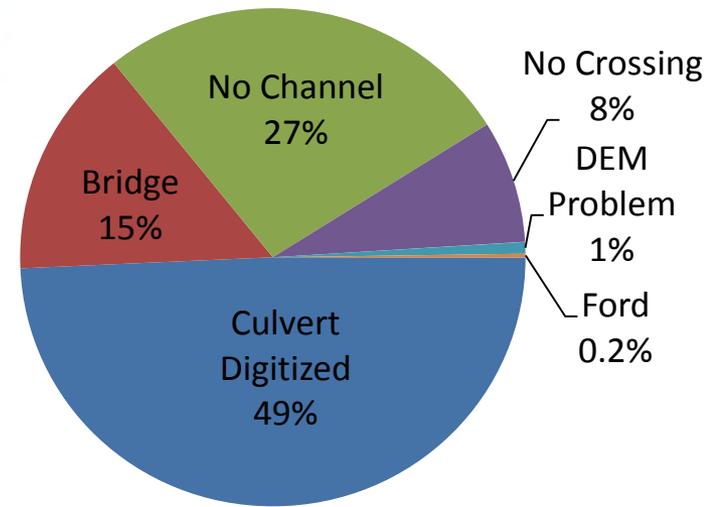
# Inventory Status



## Culvert Vertical Drop (8,760)

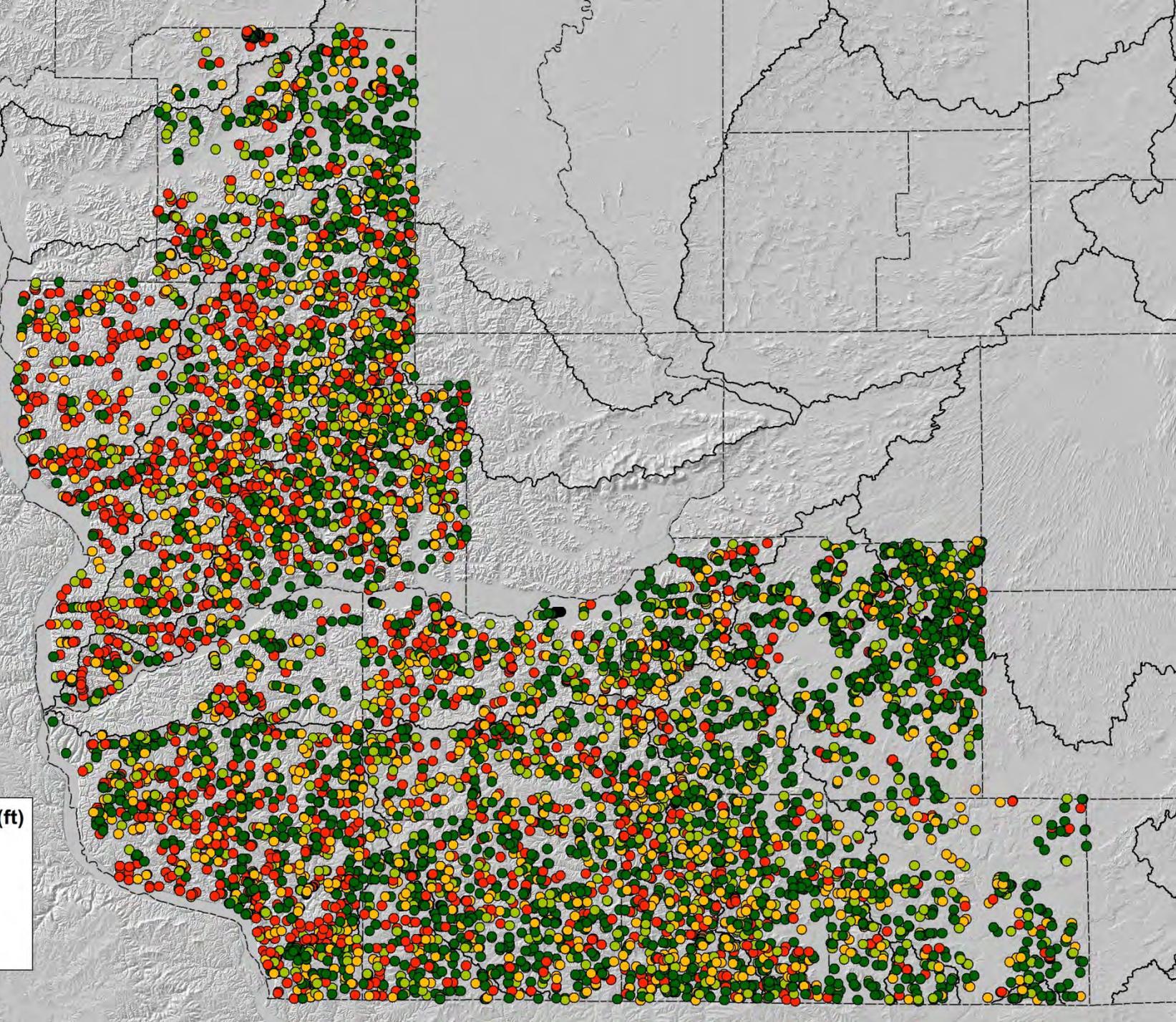


## All Road Crossings (19,420)



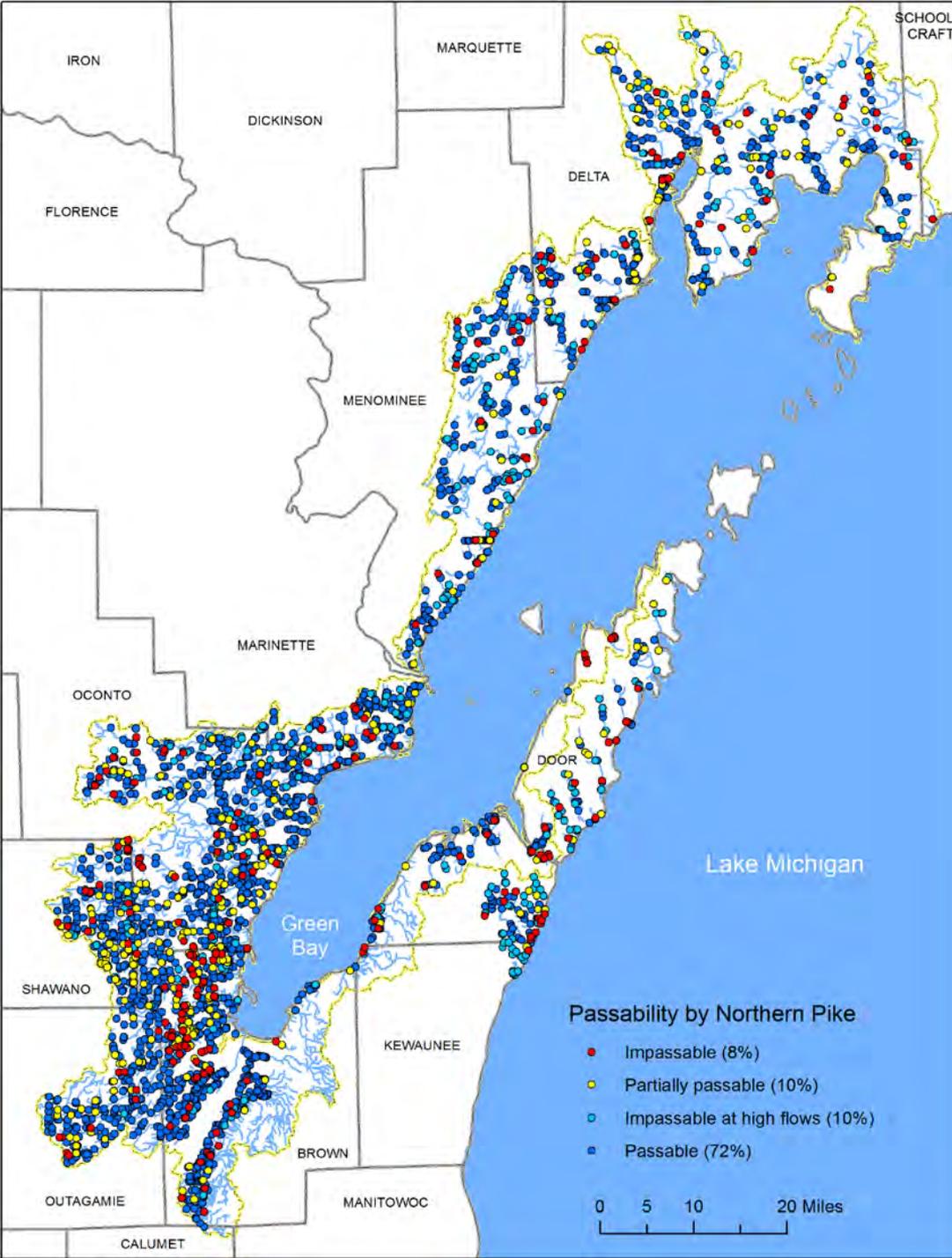
**Elevation Drop (ft)**

- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- > 2

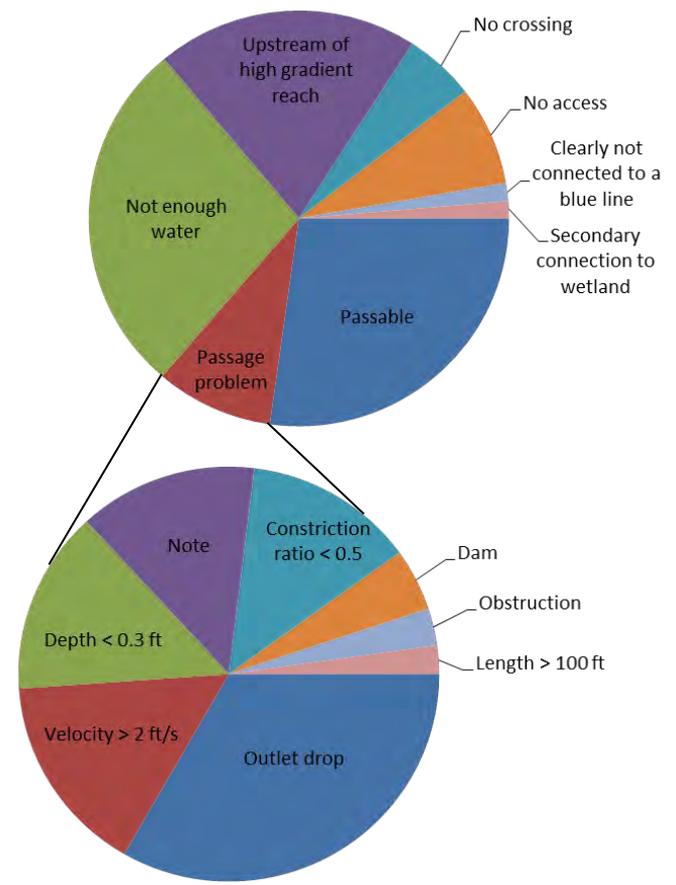


# Comparison of Methods

Criteria		Fish Xing	Field Surveys	LiDAR	Statistical Model
Accuracy	Passability	Highest	High	Moderate-High	Low-Moderate
	Cost	Highest	High	Moderate-High	Low-Moderate
Speed		1 site/day	20 sites/day	200 sites/day	Completed for all RSX in GL Basin
Completeness		Depends on methods used to identify crossings for field surveys		Highest	Moderate
Other		Estimate how passability varies with flow	Identify defined channels / fish habitat		Evaluate landscape factors that influence passability
		Identify site-specific factors that influence replacement cost		Condition DEM for hydrography development	



# Need for Prioritization



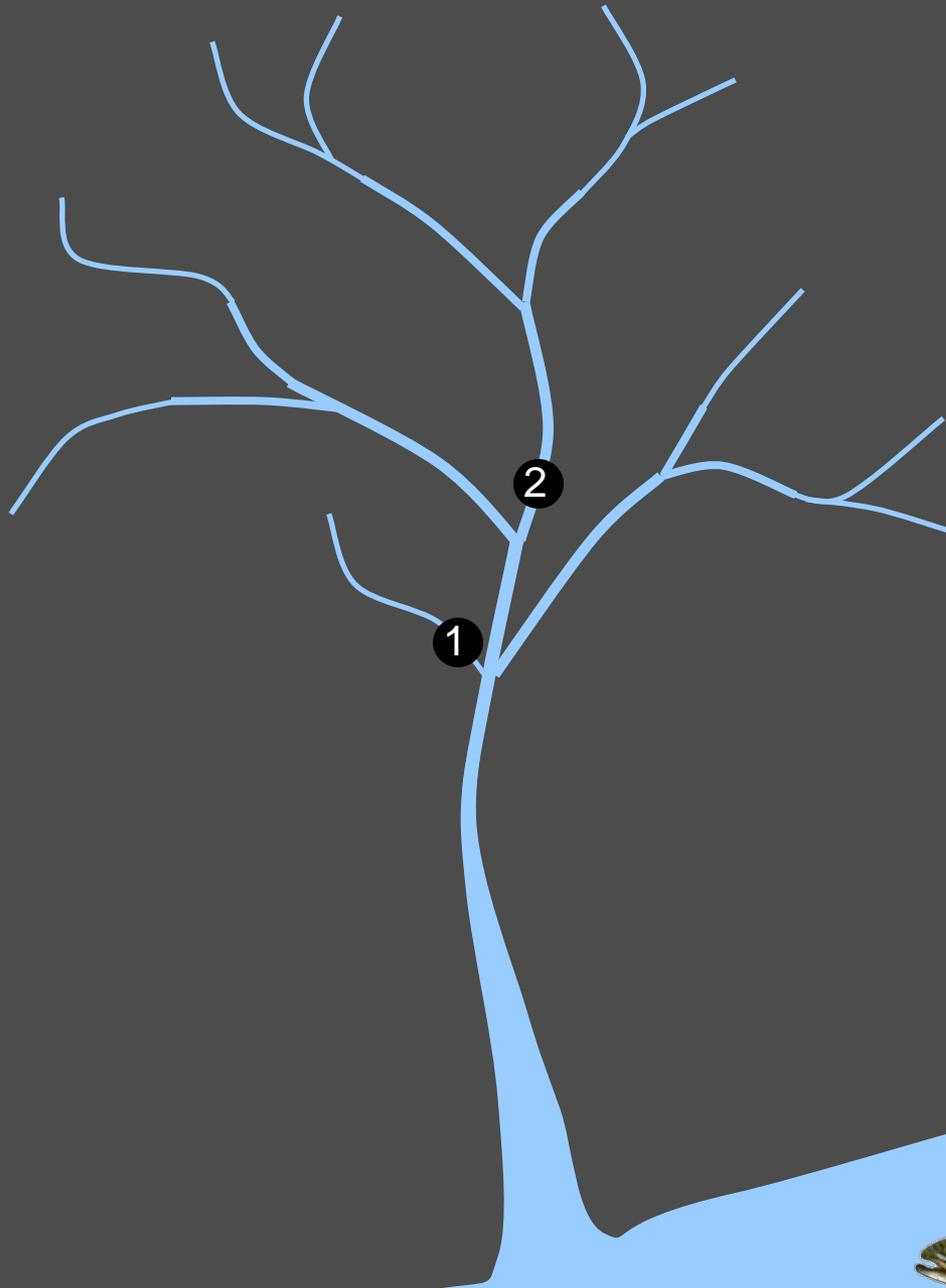
Habitat Quantity

Habitat Quality

Habitat Type

Migration Distance

Natural Barriers



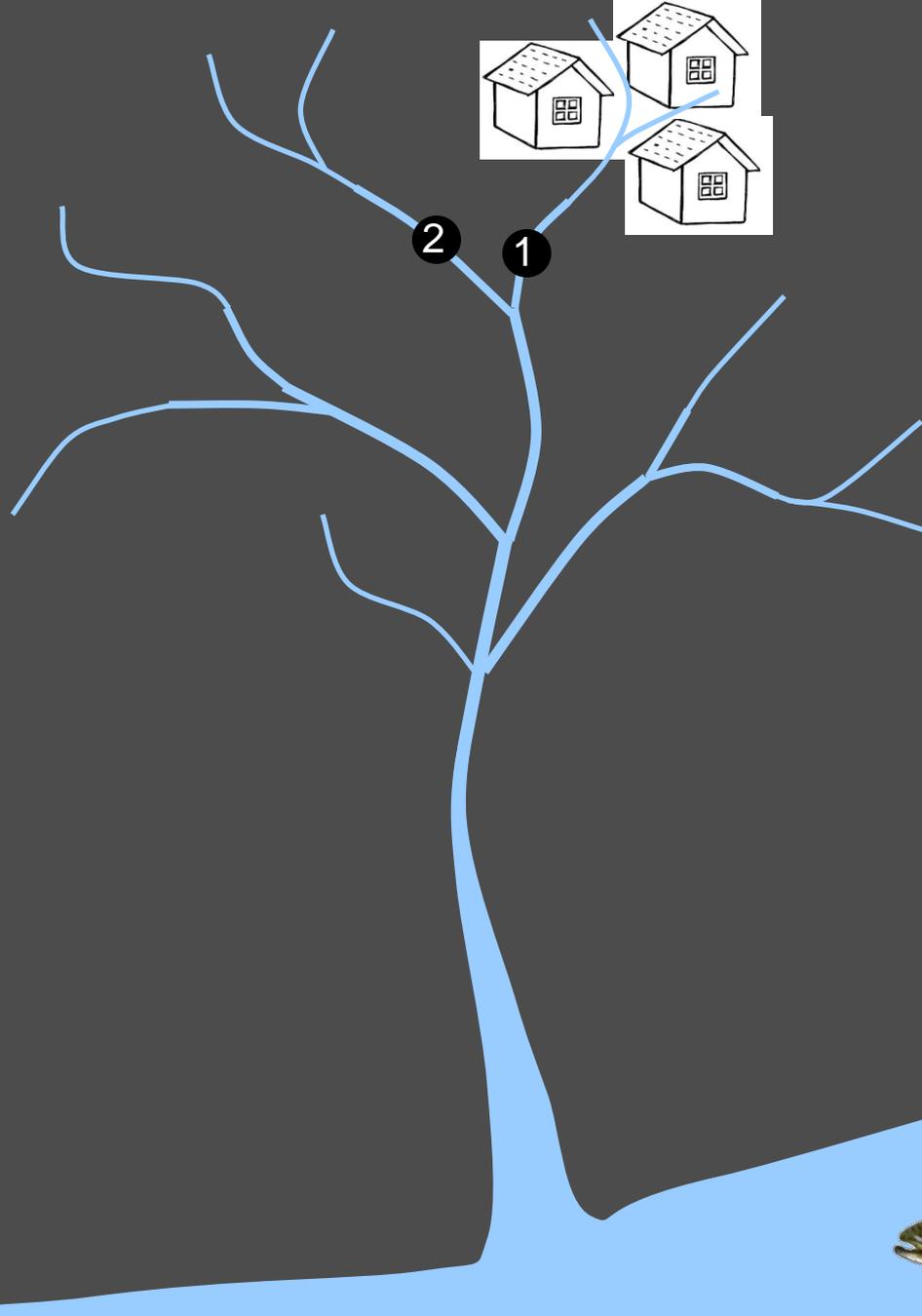
Habitat Quantity

Habitat Quality

Habitat Type

Migration Distance

Natural Barriers



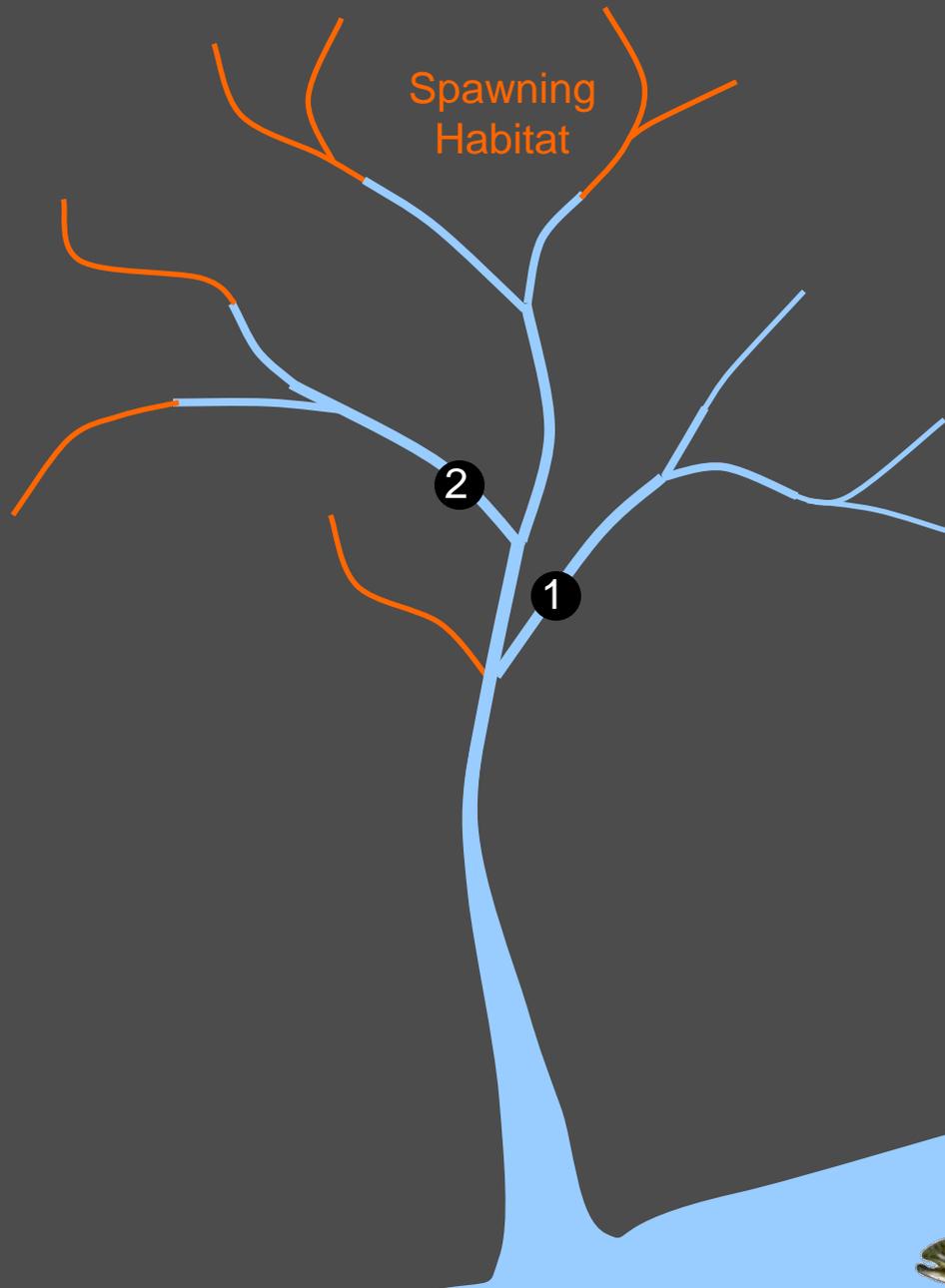
Habitat Quantity

Habitat Quality

Habitat Type

Migration Distance

Natural Barriers



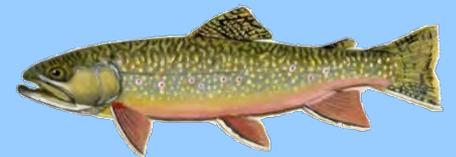
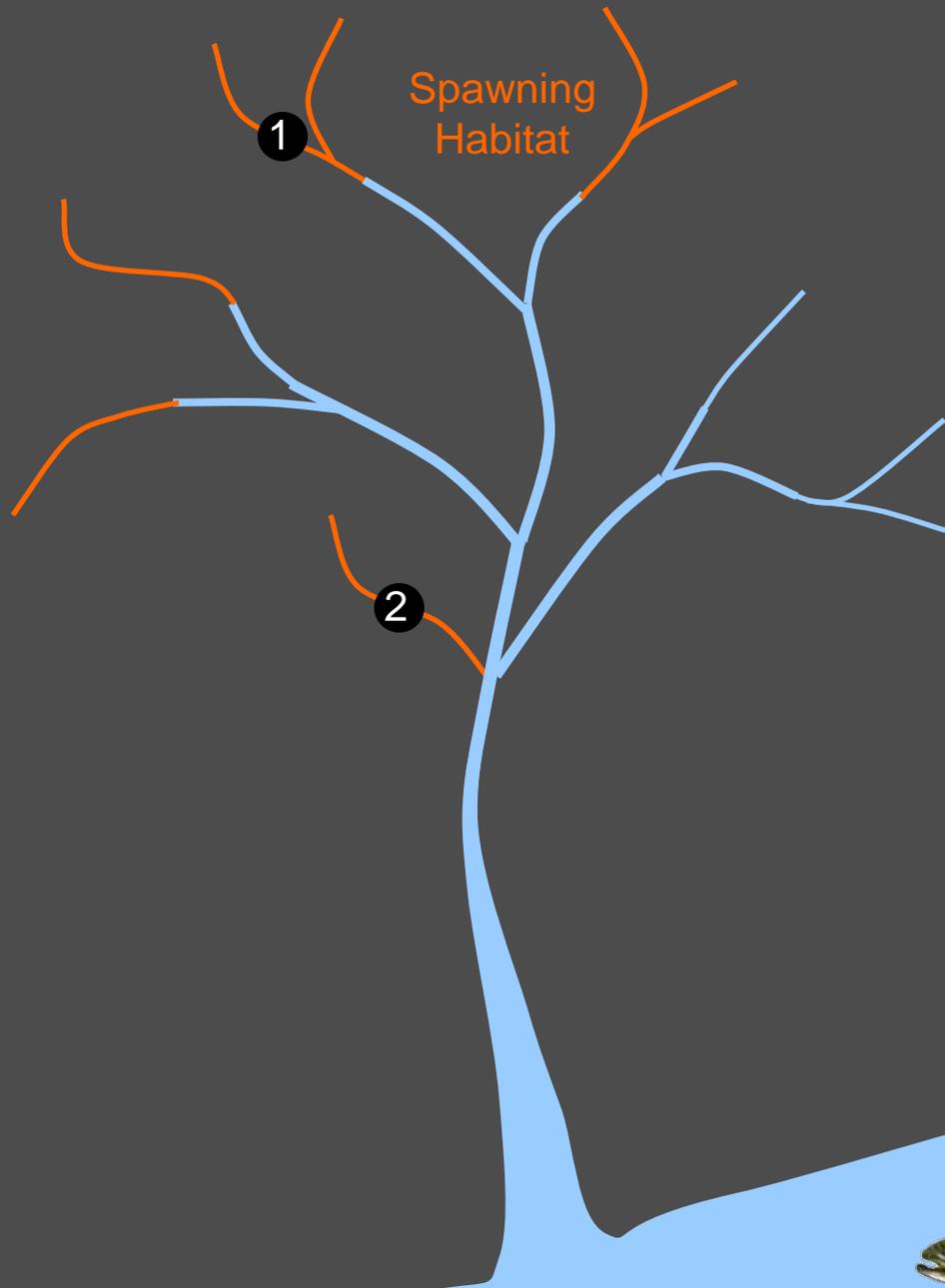
Habitat Quantity

Habitat Quality

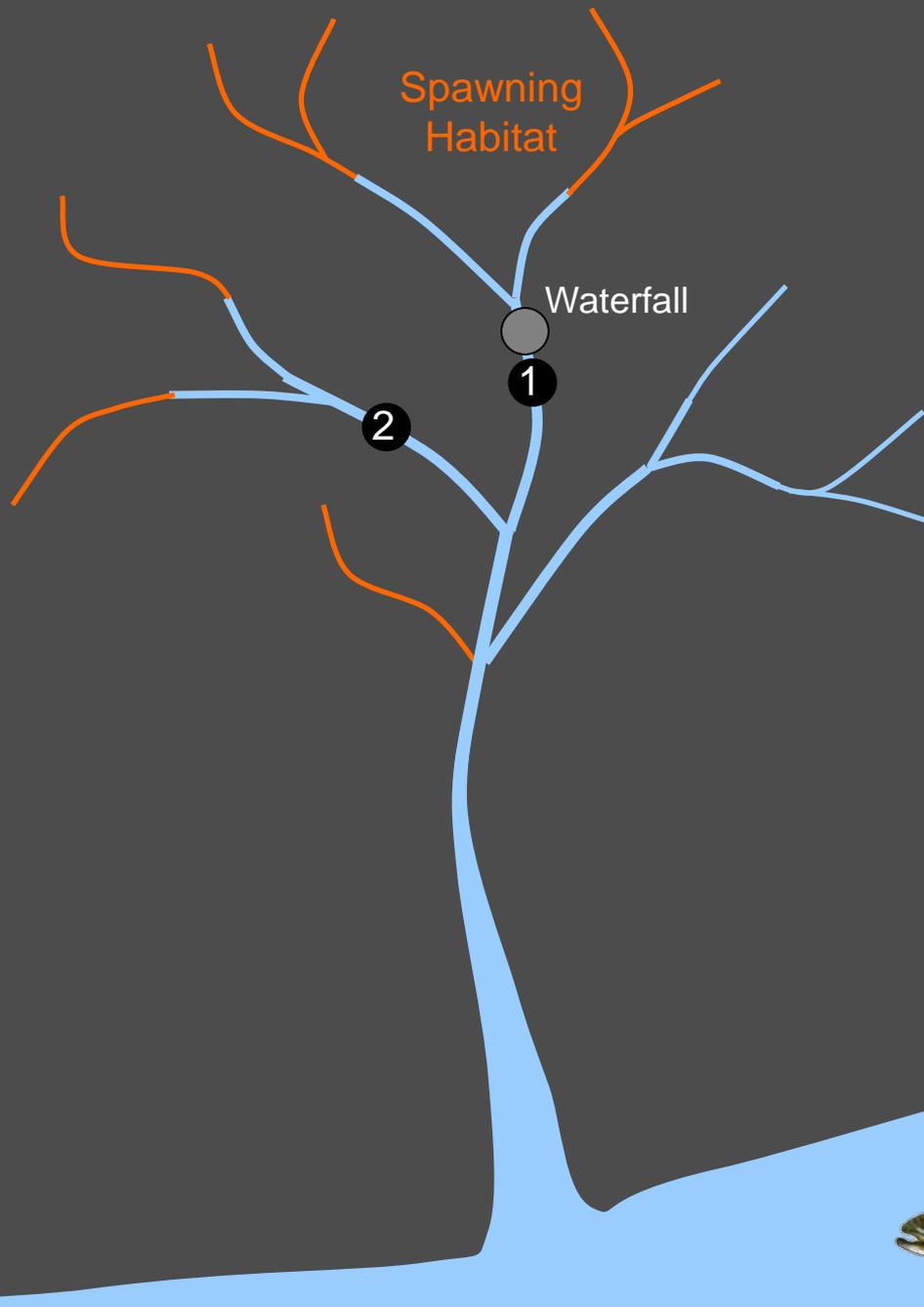
Habitat Type

Migration Distance

Natural Barriers



- Habitat Quantity
- Habitat Quality
- Habitat Type
- Migration Distance
- Natural Barriers



# OptiPass

- ArcGIS Toolbox (10.1)
- Recommends a set of projects to maximize increase in accessible habitat for a given budget
- Developed by The Cadmus Group, Inc., and Ecotelligence, LLC for The Nature Conservancy
- Input requirements
  - Barriers
    - Passability
    - Cost to replace/remove
  - Streams
    - Quality index
    - Habitat type

# Online decision support tool

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

The screenshot displays the Fishworks web application interface. The main map area is labeled "Visualize" and shows a map of the Great Lakes region with various barriers overlaid. On the left, a "Filter Barriers" panel is labeled "Explore" and includes filters for Removal Cost Per Barrier, Passability Rating, Upstream Habitat, Great Lake Basin, Counties, Watersheds, State / Province, Nation, Barrier Type, First Barrier, and Barrier ID. Below the map, the "Inspect Barrier Attributes" table is labeled "Inspect" and lists barrier details. On the right, the "View Scenario Results" panel is labeled "Results" and includes a table for "Compare Existing Scenarios", a "Quick Summary" table, a "Change in Habitat (%)" bar chart, and sections for "Removed Barriers" and "Simulation Detail".

### Visualize

### Explore

### Scenarios

### Inspect

### Results

Barrier ID	Nation	Basin	State	Cost	Is Dam	Guild 1	Guild 7	Guild 4	Up Hab
500766	USA	Lake Michigan	Michigan	112969.9399	<input checked="" type="checkbox"/>	0.099539453	0.078336376	0.007512716	1.54717886
519133	USA	Lake Michigan	Michigan	169800	<input checked="" type="checkbox"/>	0.084521573	0.066058165	0.760745187	2435.800462
519037	USA	Lake Michigan	Michigan	169800	<input checked="" type="checkbox"/>	0.084521573	0.066058165	0.800453774	4431.917709
525593	USA	Lake Michigan	Michigan	169800	<input checked="" type="checkbox"/>	0.084521573	0.066058165	0.680228942	2156.562322
518479	USA	Lake Michigan	Michigan	169800	<input checked="" type="checkbox"/>	0.084521573	0.066058165	0.658830663	0.055097867
526857	USA	Lake Michigan	Michigan	169800	<input checked="" type="checkbox"/>	0.084521573	0.066058165	0.686470216	3309.724572
526856	USA	Lake Michigan	Michigan	300000	<input type="checkbox"/>	0.869122413	0.82945631	0.710370462	3098.046255
526855	USA	Lake Michigan	Michigan	39099.24006	<input type="checkbox"/>	0.662635684	0.648359038	0.584859104	619.6556113
519039	USA	Lake Michigan	Michigan	100000	<input type="checkbox"/>	0.940928511	0.939059385	0.773407575	256.8130055

Compare	Scenario Name	Total Cost	Habitat (km)	Date
<input type="checkbox"/>	UNMODIFIED / DEFAULT	\$0.00	0.0	2014-01-01
<input type="checkbox"/>	test1	\$8,927,594.15	143,679.5	2015-01-21
<input checked="" type="checkbox"/>	county_all	\$987,882.13	144,212.1	2015-01-28
<input checked="" type="checkbox"/>	county_all_S2	\$0.00	143,667.2	2015-01-28
<input checked="" type="checkbox"/>	county_all2	\$1,990,509.92	144,274.2	2015-01-28
<input checked="" type="checkbox"/>	county_all3	\$5,369,523.59	144,261.7	2015-01-28

Quick Summary	Count	Total Cost	Habitat (km)
county_all	8	\$987,882.13	144,212.1 km
county_all2	18	\$1,990,509.92	144,274.2 km
county_all3	26	\$5,369,523.59	144,261.7 km

Habitat Change (%)

Classification	Habitat Change (%)
Guild 1	~0.40
Guild 2	~0.35
Guild 3	~0.40
Invasives	~0.40

# Summary

- How many crossings are out there?
  - Use GIS to get an estimate of road/stream crossing numbers and locations
- How many are bad?
  - Simple inventories can be conducted quickly
  - More detailed assessments require surveying skills
- Where do we begin?
  - Prioritization can identify where you can get the most bang for the buck



Questions?