2017

Lake Wausau Shoreland Survey

Marathon County, Wisconsin

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This shoreland survey was conducted to understand conditions related to the health of the Lake Wausau system, to inform the development of a plan, and ultimately, to improve conditions in Lake Wausau.

Project Partners include:

Lake Wausau Association

City of Wausau, Town of Rib Mountain, City of Schofield, Village of Rothschild, Marathon County

US Army Corps of Engineers

University of Wisconsin-Stevens Point

Wisconsin Dept. of Natural Resources

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Introduction

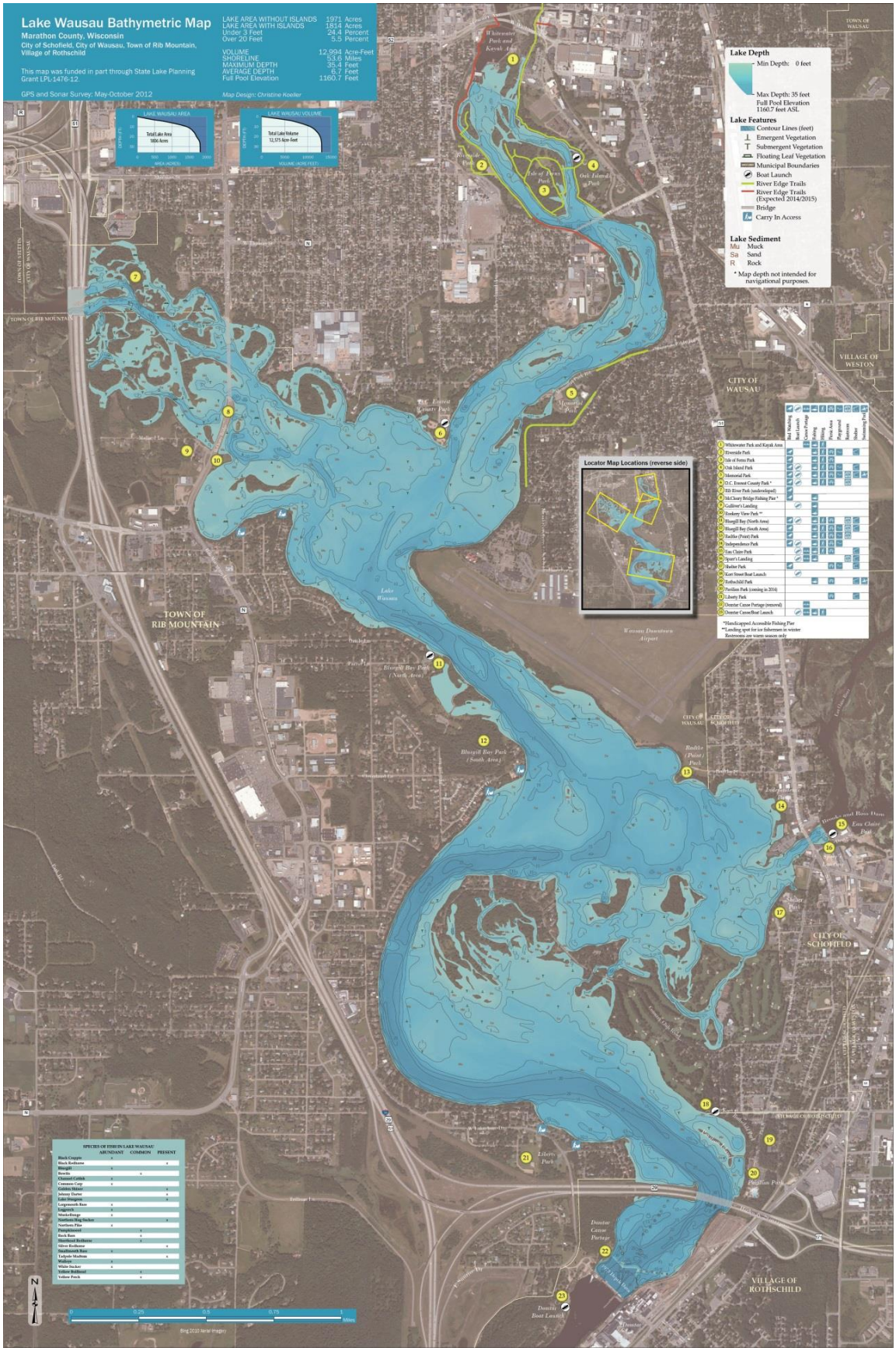
The Lake Wausau system comprises 1,918 acres (Figure 1) with 30.6 miles of shoreland along the flowage sides and 43.3 miles of island shoreline (WDNR 1973). Located in Marathon County Wisconsin, it has shorelands within the City of Schofield, Village of Rothschild, and Towns of Rib Mountain and Wausau. Inventories of the 51 miles of shoreland along Lake Wausau and the confluence of the Rib River were conducted during the summer of 2013 as part of a larger effort to collect the information necessary to make management decisions about Lake Wausau aimed at improving water quality, habitat, and recreational opportunities. This effort was a partnership between Lake Wausau Association, City of Wausau, Towns of Rib Mountain and Wausau, the Wisconsin Department of Natural Resources, the Army Corps of Engineers, and University of Wisconsin-Stevens Point Center for Watershed Science and Education (CWSE). The field inventory was conducted by staff from CWSE. Assistance with GIS was provided by staff from the Center for Land Use Education at the University of Wisconsin-Stevens Point.

Shoreland vegetation is critical to a healthy lake ecosystem. It helps to improve the quality of runoff flowing across the landscape towards the lake. It also provides habitat for many animals including birds, frogs, turtles, and many small and large mammals. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs, and trees which extending at least 35 feet landward from the water's edge. Shorelands include adjacent wetlands, which also serve the lake by allowing contaminants to settle out, providing shelter for fish and wildlife, and decreasing shoreline erosion by providing a shoreland barrier from waves and wind.

Near shore and in the watershed, land use and land management practices can affect water quality in Lake Wausau. While forests, grasslands, and wetlands allow a fair amount of precipitation to soak into the ground, resulting in more groundwater and improved water quality, other types of land uses may result in increased runoff, and may be sources of pollutants that can influence the lake, its inhabitants, and aquatic plant growth. Areas of land with exposed soil can produce soil erosion. Soil entering the lake can make the water cloudy and cover fish spawning beds. Soil also contains nutrients that increase the growth of algae and aquatic plants. Deeply rooted vegetation can help to hold soil in place on the landscape.

Development on the land may result in changes to natural drainage patterns, alterations to vegetation on the landscape, and may be a source of pollutants. Impervious (hard) surfaces such as roads, rooftops, parking lots, and compacted soil prevent rainfall from soaking into the ground, which may result in more runoff carrying pollutants to the lake. Storm water, wastewater, animal waste, and fertilizers used on lawns, gardens and crops can contribute nutrients that enhance the growth of algae and aquatic plants in Lake Wausau. Land management practices used to mimic some of the natural processes, and reduction or elimination of nutrients added to the landscape will help prevent the nutrients from reaching the water. In general, the land nearest the lake has the greatest impact on the lake water quality and habitat.

Figure 1: Lake Wausau and Rib River survey area, Marathon County Wisconsin.



Methods

During the summer of 2013, the shoreland assessment of Lake Wausau was conducted by boat and canoe by staff from CWSE. The Lake Wausau assessment included two survey components: estimates of shoreland vegetation and shoreland disturbance. The two surveys were conducted independently. The assessment also included photo-documenting the shoreline. The assessment was conducted as a whole lake inventory; parcel boundaries were not identified. GPS points were marked at the beginning and end of a similar stretch of vegetation. Disturbance sites were marked as a single point near the location by GPS. Primary data collection occurred in the following locations on Lake Wausau: Rib River 6/11 - 6/14/2013, Oak Island 6/18 – 6/25/2013, Airport 7/3 - 7/8/2013, Golf Course 6/26 - 7/3/2013 and 39 7/17 - 7/17/2013 (Appendix A – Location of individual maps and associated identification code.). In total, nineteen maps were generated to display shoreland vegetation around Lake Wausau.

During the shoreland vegetation survey, distance was estimated from the water's edge inland for the dominant ground cover or short unmowed vegetation (0.5 to 3 feet high). The dominant ground cover/vegetation was selected from one of the following categories: wetlands, organic (pine needles/leaves), barren/disturbed, new shoreland restoration, mowed vegetation, short unmowed vegetation (less than 3 feet tall), and impervious surface. As a reference, photographic examples of these categories are located in Appendix B – Photographic examples of shoreland categories. Also noted, but not mapped, was less dominant ground cover/vegetation. At the beginning and end of each segment of similar dominant shoreland ground cover/vegetation, a waypoint was marked using a handheld Garmin GPSmap 78s unit. The name of each waypoint was entered into the GPS to match the waypoint name noted on the survey data form and corresponding paper map. Taller shoreland vegetation (greater than 3 feet high) was identified as present or absent within each segment.

The shoreland disturbance survey was broken into four primary categories: shoreland alterations, erosion, culverts/outfalls, and structures/building. All categories included a GPS waypoint, with the exception of docks/piers and structures/building. Estimates of the length were made for riprap, seawalls, and erosion. Areas with erosion were identified as either undercut banks/slumping or furrow/gullies and the slope was estimated as a percent. The diameter of each culvert and outfall was estimated along with the shape and the type of material. Structures/buildings were marked as 0-35 estimated feet inland or 35-75 estimated feet inland from water's edge.

Field datasheets can be found in Appendix C – Example field datasheets. All GPS-marked features were also recorded at their approximate location on paper copies of aerial maps using their respective waypoint names. These maps served as a back-up to the electronic data. Any specific notes about features were also recorded on the maps, as needed.

Shoreland Photographs

A second pass around Lake Wausau was performed to photograph the shoreland. When possible, the operator of the watercraft maintained a 100-foot distance from the shoreline as a digital camera was used (RICOH Caplio 500SE GPS enabled digital camera system). Each consecutive photograph overlapped to ensure complete coverage of the shoreland. The photographs retain a record of current conditions in the summer of 2013 and can serve as a reference for future surveys or be used to evaluate and interpret changes in the future.

Data Management and Mapping

All GPS data were uploaded at the end of each day to a computer equipped with ArcGIS 10.2 software. The photographs were also uploaded into ArcGIS 10.2 and converted to geotagged photo points. The GPS data points

were overlaid onto a map of Lake Wausau to validate their correct locations. Field data sheets were reviewed and discrepancies were verified during a subsequent visit.

Data from the field survey sheets were input into an ArcGIS geodatabase at UWSP. Line features were created for each shoreland vegetation segment. The GPS points and photographs were used to locate the point features and the beginning and ending points of each shoreland vegetation line segment. Each line segment was attributed with the beginning and ending waypoint numbers, which was recorded on the vegetation survey data sheets, along with the dominant ground cover, estimated buffer depth, and the presence of trees, shrubs, and in-lake woody habitat. Quality control was conducted in areas with the greatest amount of shoreland variation using field comparison with the draft maps. Data input into the ArcGIS geodatabase were used to calculate the survey statistics for Lake Wausau. The number of sites exhibiting manmade disturbance was summed along with the total length of each category of vegetation.

Not all locations were accessible by boat. Every effort was made to reach difficult areas in canoes; however, some locations were either impassable due to fallen trees or dense aquatic vegetation or too shallow to navigate. If a location was too shallow or inaccessible, it was marked as inaccessible on the aerial photographs and if possible, visual observations were recorded and photographed from a distance. For those areas, photos, areal images, and Google Earth were used to determine the dominant cover type and vegetated buffer depth. Areas that were determined inaccessible are as follows: GC-H, GC-F, RR-A, RR-B, RR-C, and RR-D (Appendix A – Location of individual maps and associated identification code.).

Survey Results

Shoreland Vegetation Survey

In 2013, two surveys were conducted to assess the health of the shorelands around Lake Wausau. The first survey assessed the shoreland vegetation (buffer) and its distance landward onto Lake Wausau's shoreland. The second survey identified disturbance sites at or near the water's edge. The results of these two surveys can serve as guidance for citizens and staff to identify shoreland areas in need of restoration, as well as recognize natural shorelines for protection. In addition, this information will provide a baseline database from which to measure success.

Healthy shoreland vegetation should extend at least 35 feet from the water's edge back onto land and include a mixture of native grasses and flowers, trees, and shrubs. Greater depths of shoreland vegetation provides more habitat, protection from erosion, and improved water quality. Not only does vegetation help slow the flow of runoff, it holds the soil in place and stabilizes the shoreland. The cavities created by roots can enhance the ability for water to soak into the ground. In addition, healthy shorelands provide privacy for people on land and on the lake. Trees and shrubs lessen the impact of rain on barren ground and provides habitat for song birds and other wild life. Natural leaf litter or pine needles act as a sponge, retaining water and reducing runoff.

Woody habitat consists of downed trees and logs that extend partially into the water, which provides structure used by birds, turtles, young fish, and other aquatic organisms for foraging, spawning, and sun bathing. Woody habitat also reduces wave action, which reduces shoreline erosion. Results of the presence/absence data for the woody habitat from the shoreland survey were incorporated with a more detailed assessment of woody structure below the water. The detailed survey was conducted in limited areas of Lake Wausau, which were recommended by the WDNR Fishery Biologist to further evaluate fish habitat (Appendix E – Woody Habitat – Side Scan Sonar Report).

Wetlands occurring on the shoreland provide critical services to Lake Wausau and its ecosystem. They are defined as "… an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions" (Braden and Johnston, 2004). Wetlands are a dynamic environment that supports a wide variety of aquatic and terrestrial organisms and are an important spawning and breeding area for these animals (Clemens, 2008). Wetlands can hold water from runoff events. In doing so, they reduce the amount of runoff moving directly downstream and release it to the lake slowly over time rather than all at once. Wetlands also reduce wave energy and runoff motion that can damage or erode shorelands (Braden and Johnston, 2004). Wetlands also provide areas on Lake Wausau for recreational activities such as canoeing, hunting, and bird watching; as well as supporting foods like wild rice.

The following categories were used in the Lake Wausau shoreland vegetation survey: organic, barren, new shoreland restoration, mowed vegetation, and short un-mowed vegetation. *Organic cover* was identified when there was the dominance of pine needles or leaf litter. Although there is little plant life associated with this category, the complete coverage of the ground helps to reduce the amount of sediment in runoff and lessens the amount of runoff. *Barren* was selected when little to nothing covered the exposed soil. This category is very susceptible to erosion and movement of the soil with runoff. during this survey. *Short unmowed vegetation* cover type was selected where there was non-woody vegetation that was less than 3 feet tall. This is a desirable cover because it will slow runoff and reduce the amount of sediment entering the water. New shoreland restorations are typically identified by the presence of young plants surrounded by mulch. No new shoreland

re*storations* were observed. As a reference, photographic examples of these classifications are located in Appendix B – Photographic examples of shoreland categories..

On a waterbody the size of Lake Wausau, it is desirable to summarize data in sections to improve the resolution of the results and development of strategies to improve shorelands or protect healthy ones. The Lake Wausau shoreland vegetation survey results were displayed on 19 sub-maps (

Municipality	Shoreland vegetation: distance Inland from water (feet)					Other Dominant Cover (feet)		
	0	1-5	>5-15	>15-35	>35-50	Leaf Litter	Wetlands	Not Surveyed
Rib Mountain	9,654	5,575	4,506	18,970	15,701	1,541	0	3,436
Rothschild	965	1,250	2,939	1,280	1,371	224	0	2,168
Schofield	8,965	8,046	13,163	11,408	6,288	4,193	665	206
Wausau	8,084	4,447	10,418	14,156	10,987	156	0	2,614

to Figure 20) and summarized in
. The maps were created using a 1:4,800 scale. Some overlap of the sub-maps exists. In the summary tables, the category, *Not Surveyed*, consisted of areas beyond the survey boundaries, islands, and areas too difficult or unsafe to survey.

A desirable depth of shoreland vegetative "buffer" to provide habitat and help to cleanse runoff water is 35 feet (inland from the water). The findings showed that short unmowed grasses and flowers (vegetation 0.5- 3 feet tall), extending inland for 35 or more feet, occurred on approximately 24 linear miles of Lake Wausau's shorelands. Approximately 190,500 feet of Lake Wausau's shoreland did not meet the 35-foot goal. Trees/shrubs were present on approximately 86% of Lake Wausau's shoreland (Figure 2 - Figure 20). Similar summary statistics were created for the municipalities that share Lake Wausau's shoreline: Rib Mountain, Rothschild, Schofield, and Wausau (
).

Table 1: Survey results summarizing depth classes of unmowed shoreland vegetation (grasses and flowers) and dominant groundcover for each survey map. Some overlap of maps exist (

Municipality	Shoreland vegetation: distance Inland from water (feet)					Other Dominant Cover (feet)		
	0	1-5	>5-15	>15-35	>35-50	Leaf Litter	Wetlands	Not Surveyed
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to Figure 20). 2013.

	Shoreland vegetation: distance Inland from water (feet)					Other Dominant Cover (feet)		
Map Number	**0 ft**	**1-5**	**>5-15**	**>15-35**	**>35-50**	**Leaf Litter**	**Wetlands**	**Not Surveyed**
1	2,709	1,630	4,280	4,162	2,775	-	-	869
2	2,634	823	2,896	4,638	4,713	-	-	446
3	3,113	1,460	1,755	3,126	2,266	157	-	-
4	482	1,181	256	154	177	-	-	-
5	705	886	121	-	-	-	-	259
6	1,627	1,660	2,017	2,401	941	915	-	-
7	1,135	4,713	6,147	2,939	1,273	682	118	-
8	2,719	5,205	7,150	3,903	833	2,430	118	98
9	5,606	1,633	4,048	4,799	2,162	1,883	548	207
10	1,463	2,440	3,152	1,732	1,486	223	-	2,168
11	2,132	676	338	1,089	604	-	-	-
12	2,119	531	1,597	4,500	4,212	-	-	-
13	3,457	197	2,043	4,277	5,346	594	-	-
14	1,469	3,329	335	535	43	-	-	-
15	1,023	453	364	794	4,313	485	-	-
16	3,654	689	1,456	10,991	9,533	1,424	-	1,991
17	705	-	4,828	14,753	9,535	233	-	1,063
18	2,722	613	738	8,823	5,779	39	-	3,677
19	2,027	1,332	1,014	1,466	2,982	-	-	1,086
Lake Wausau Total Shoreland	**41,501**	**29,451**	**44,535**	**75,082**	**58,973**	**9,065**	**784**	**11,864**

Table 2. Survey results summarizing depth classes of unmowed shoreland vegetation (grasses and flowers) and dominant groundcover by municipality. 2013.

Municipality	Shoreland vegetation: distance Inland from water (feet)					Other Dominant Cover (feet)		
	0	1-5	>5-15	>15-35	>35-50	Leaf Litter	Wetlands	Not Surveyed
Rib Mountain	9,654	5,575	4,506	18,970	15,701	1,541	0	3,436
Rothschild	965	1,250	2,939	1,280	1,371	224	0	2,168
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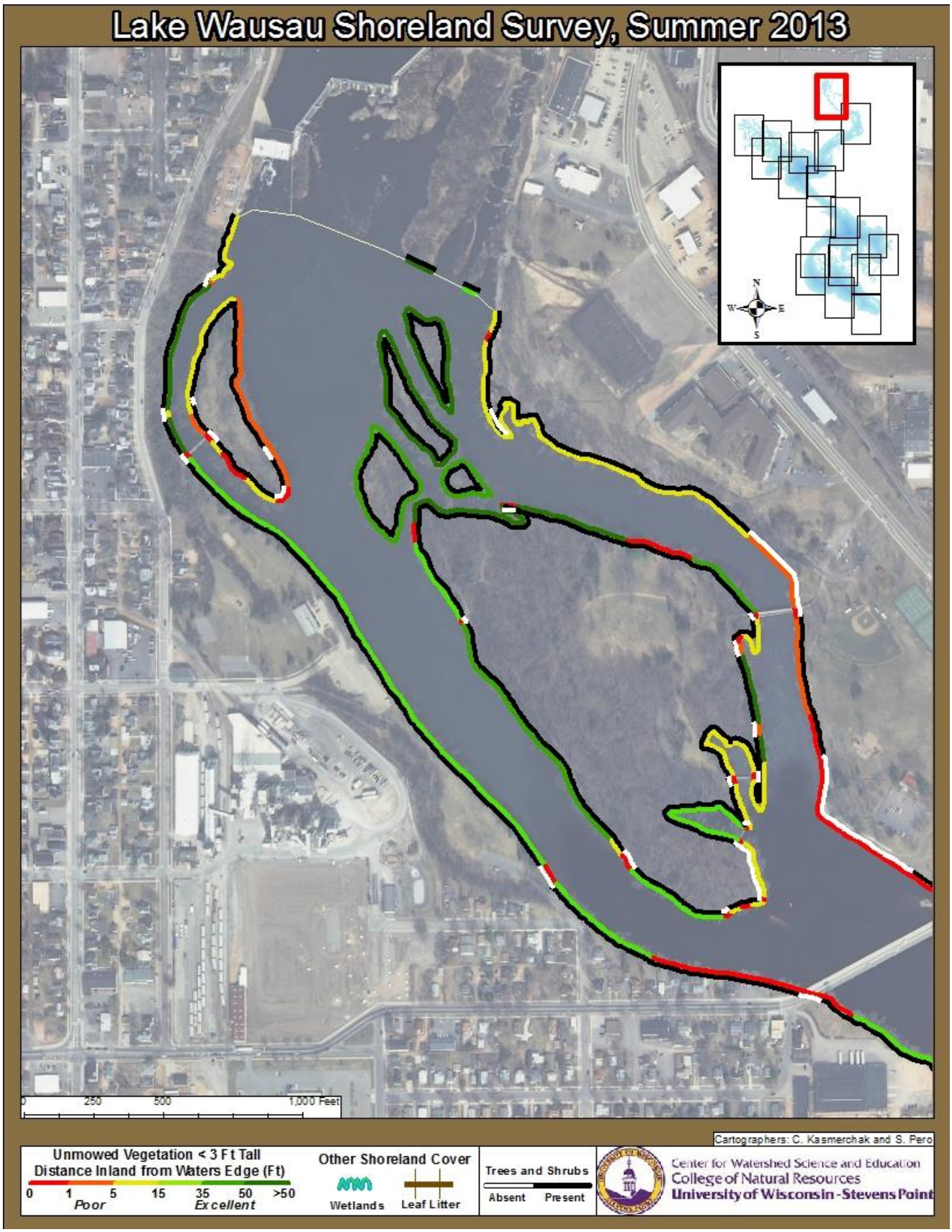

Figure 2: Shoreland vegetation survey of Lake Wausau. 2013

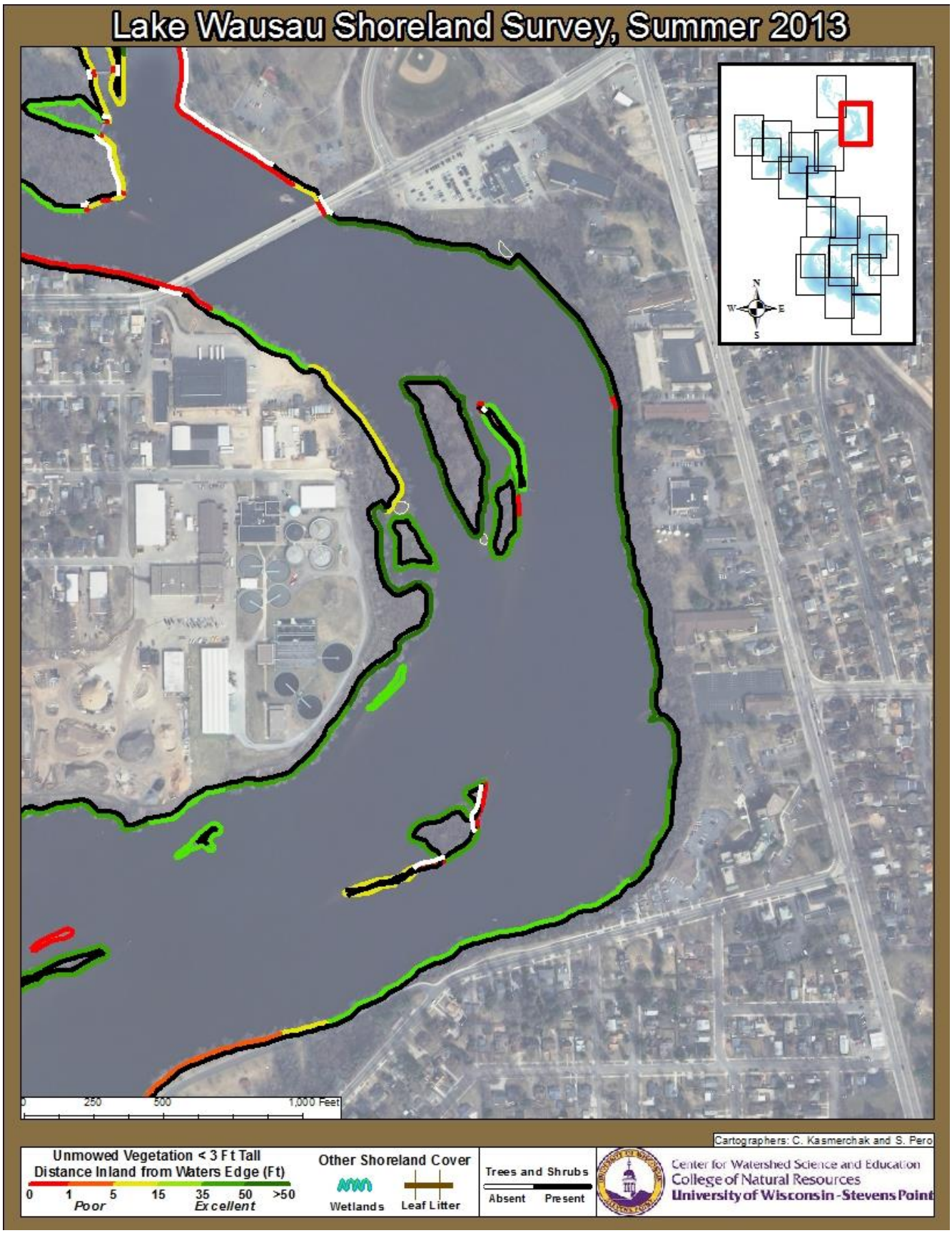

Figure 3: Shoreland vegetation survey of Lake Wausau. 2013

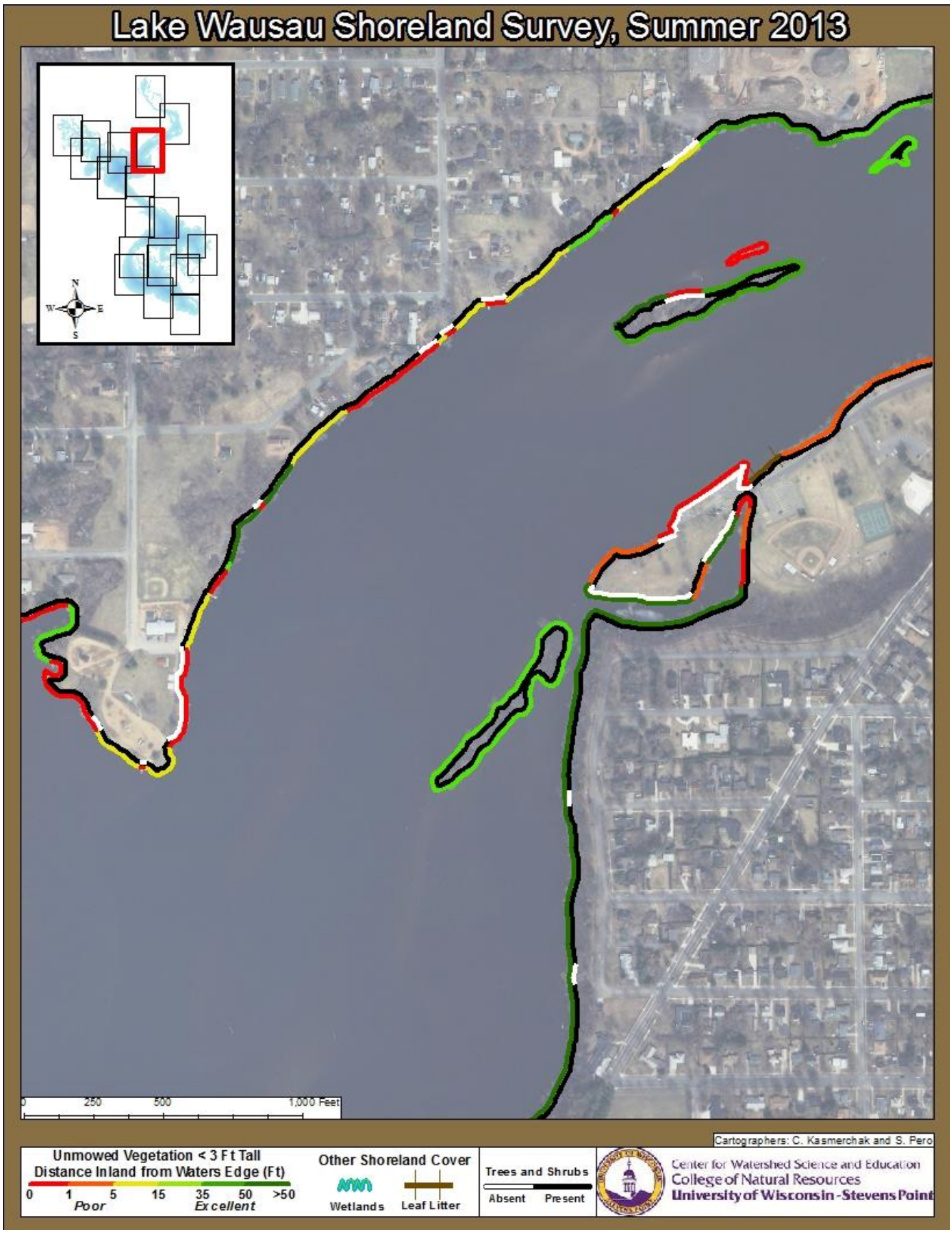

Figure 4: Shoreland vegetation survey of Lake Wausau. 2013

Figure 5: Shoreland vegetation survey of Lake Wausau. 2013

Figure 6: Shoreland vegetation survey of Lake Wausau. 2013

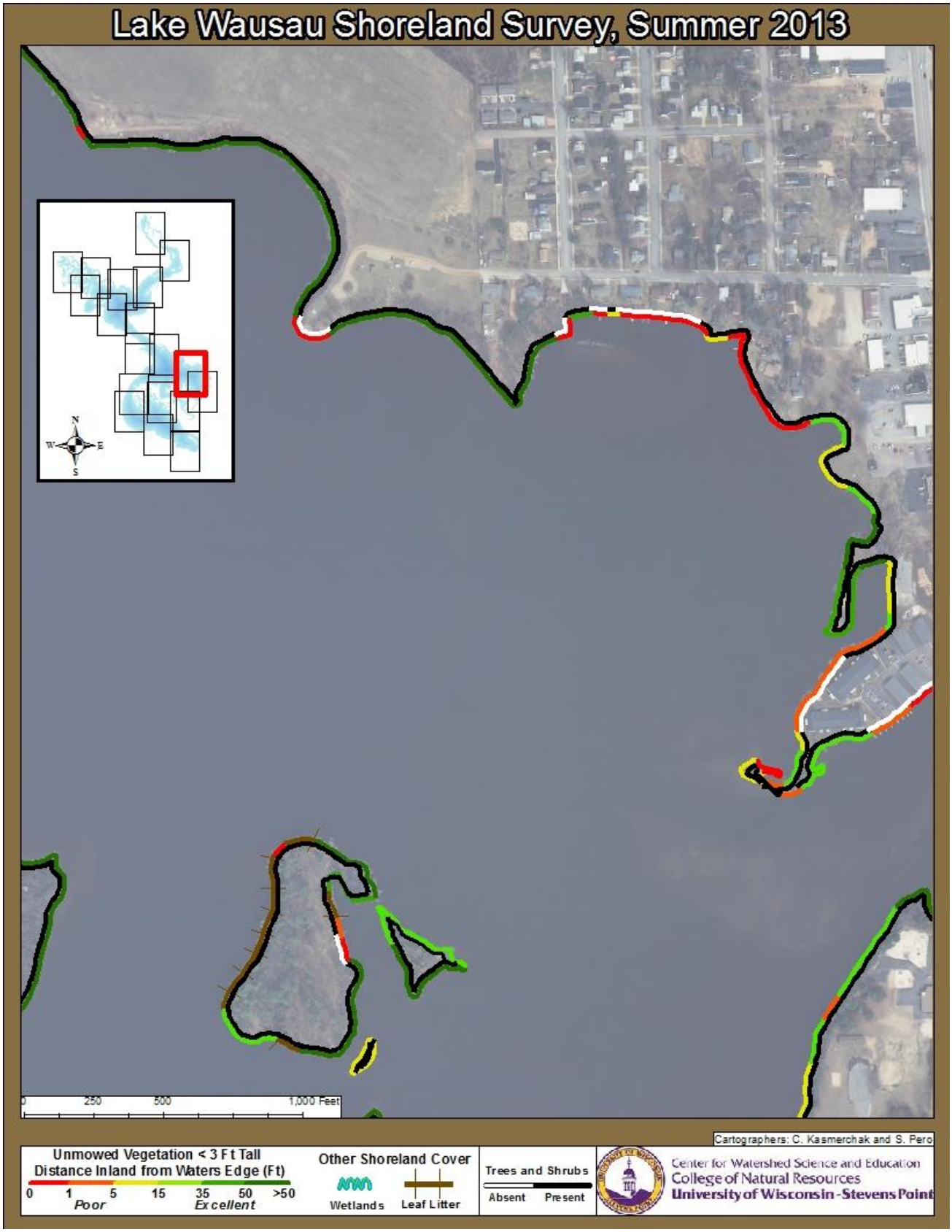

Figure 7: Shoreland vegetation survey of Lake Wausau. 2013

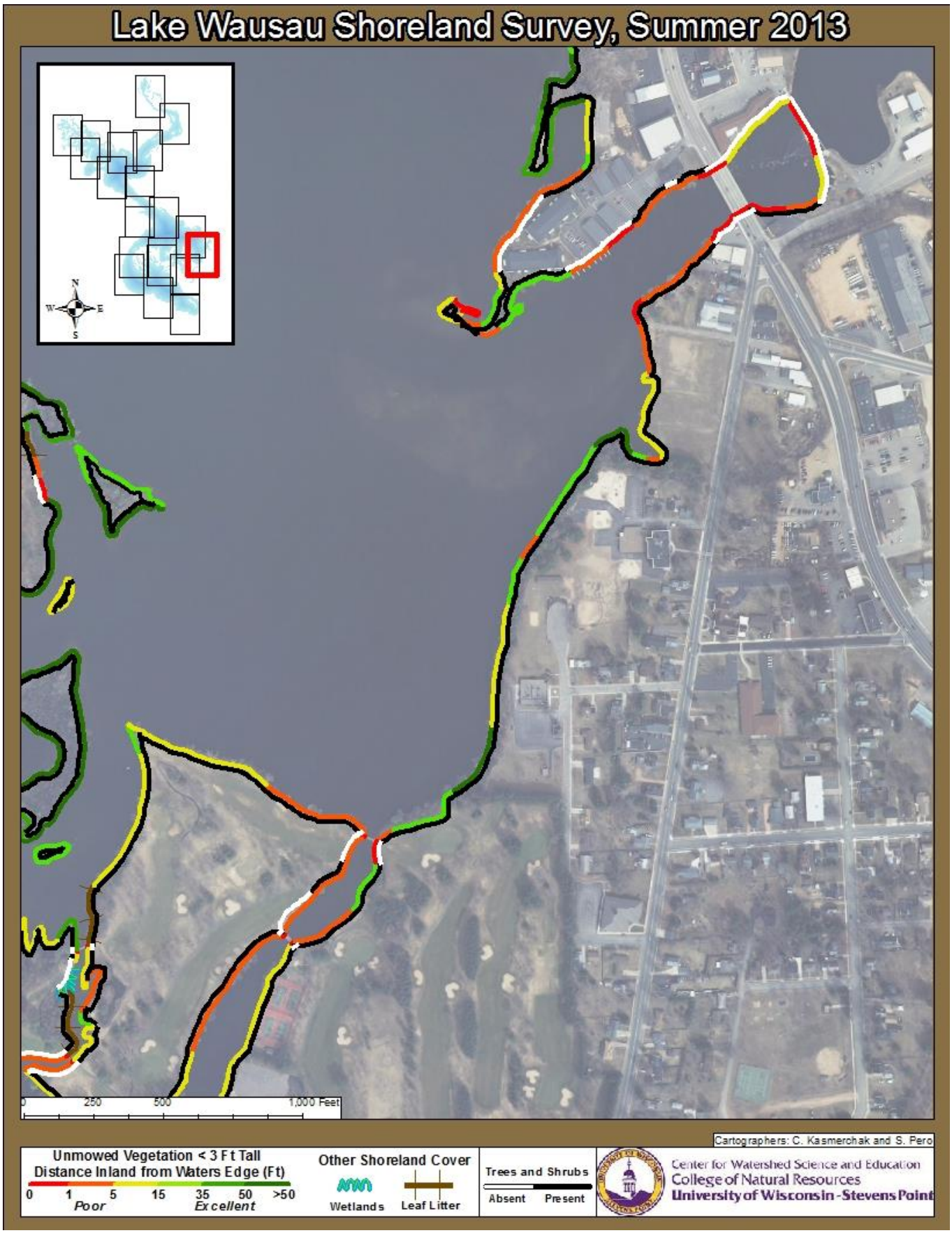

Figure 8: Shoreland vegetation survey of Lake Wausau. 2013

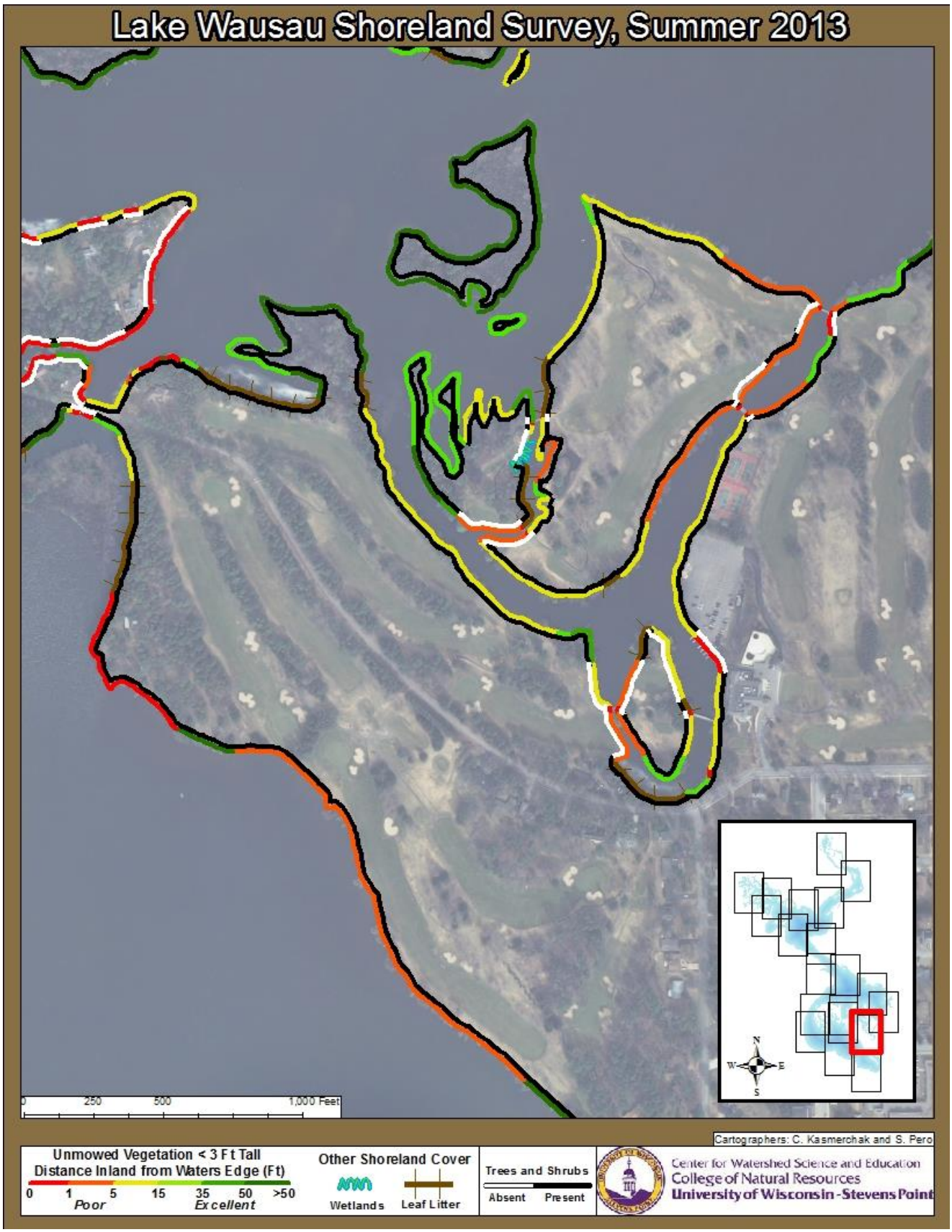

Figure 9: Shoreland vegetation survey of Lake Wausau. 2013

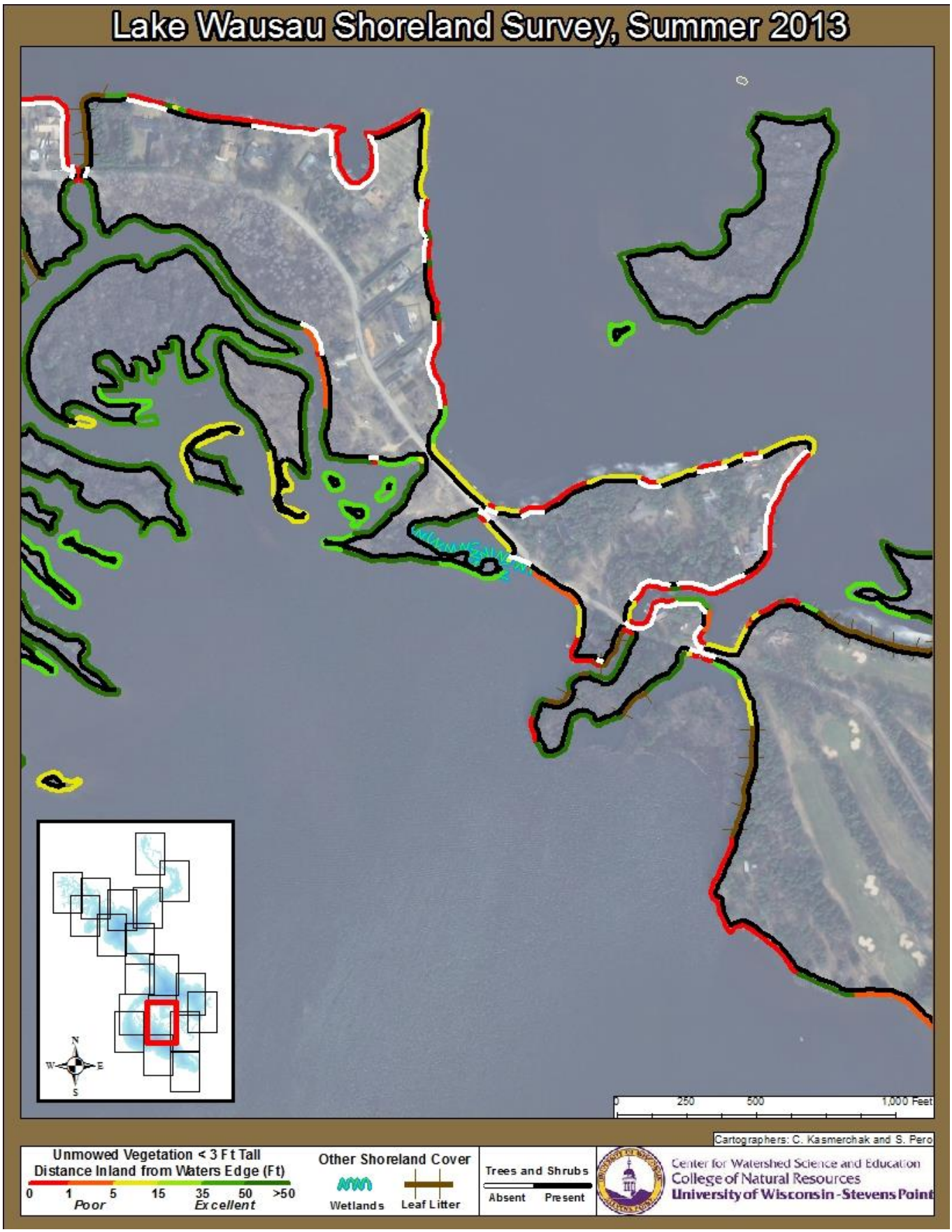

Figure 10: Shoreland vegetation survey of Lake Wausau. 2013

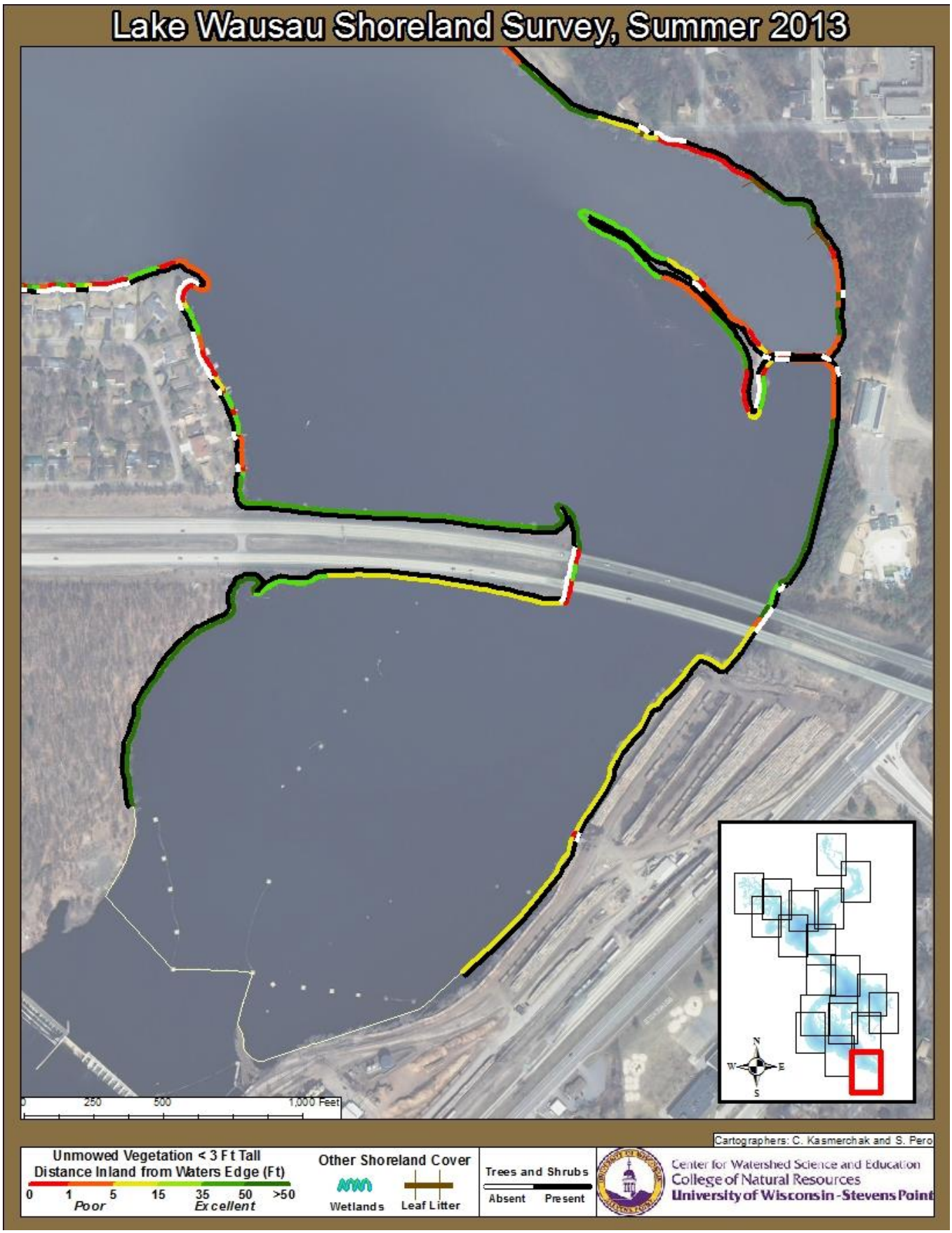

Figure 11: Shoreland vegetation survey of Lake Wausau. 2013

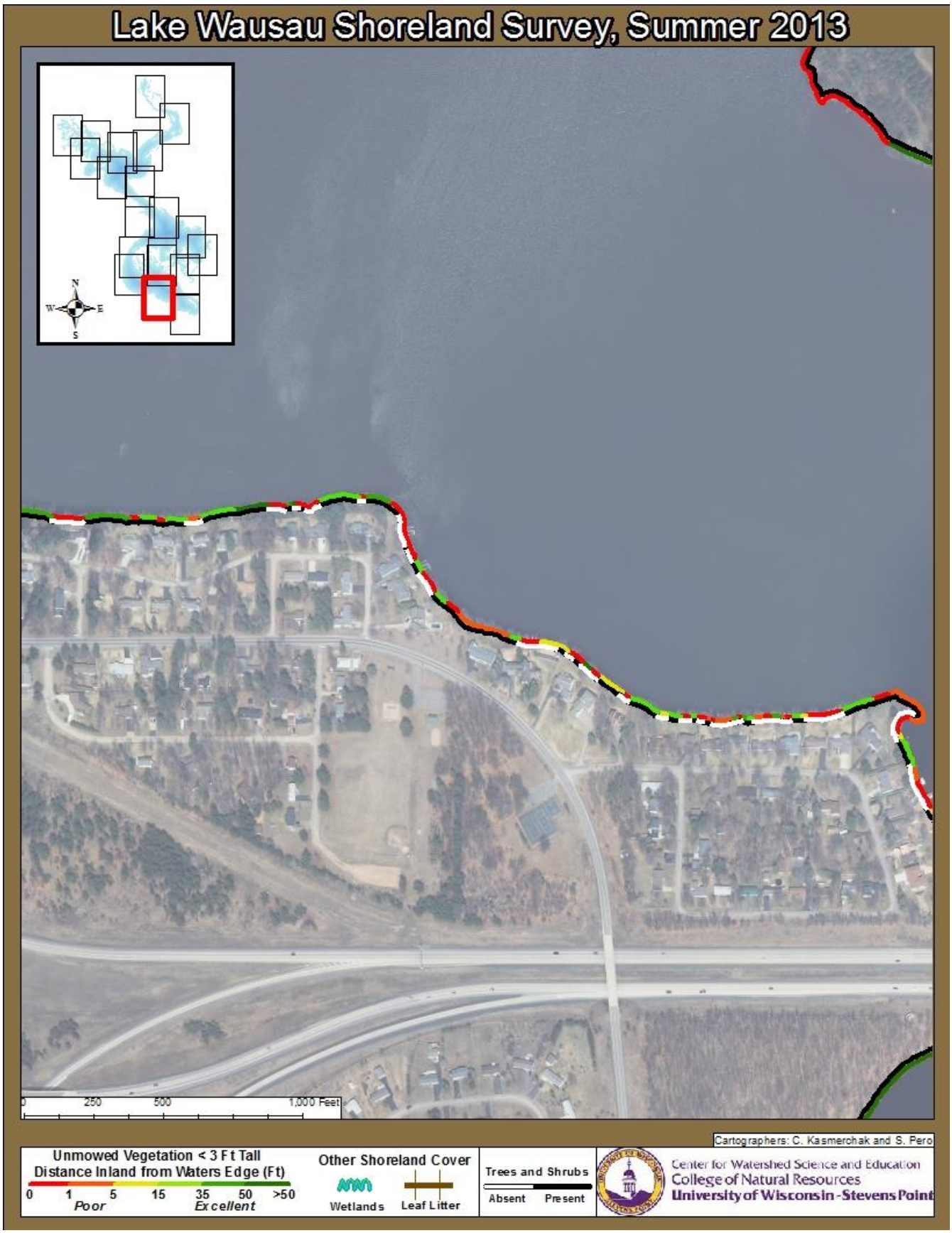

Figure 12: Shoreland vegetation survey of Lake Wausau. 2013

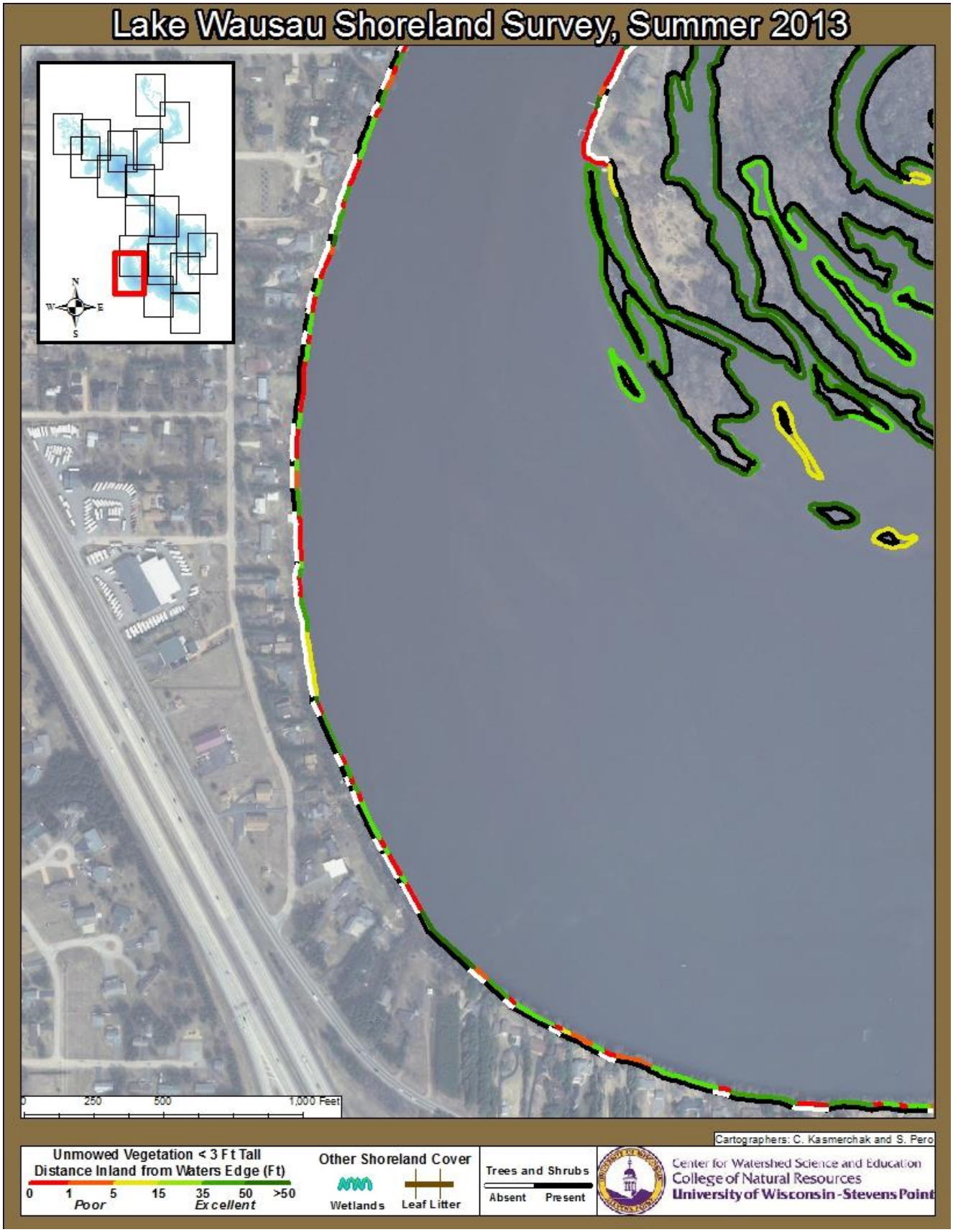

Figure 13: Shoreland vegetation survey of Lake Wausau. 2013

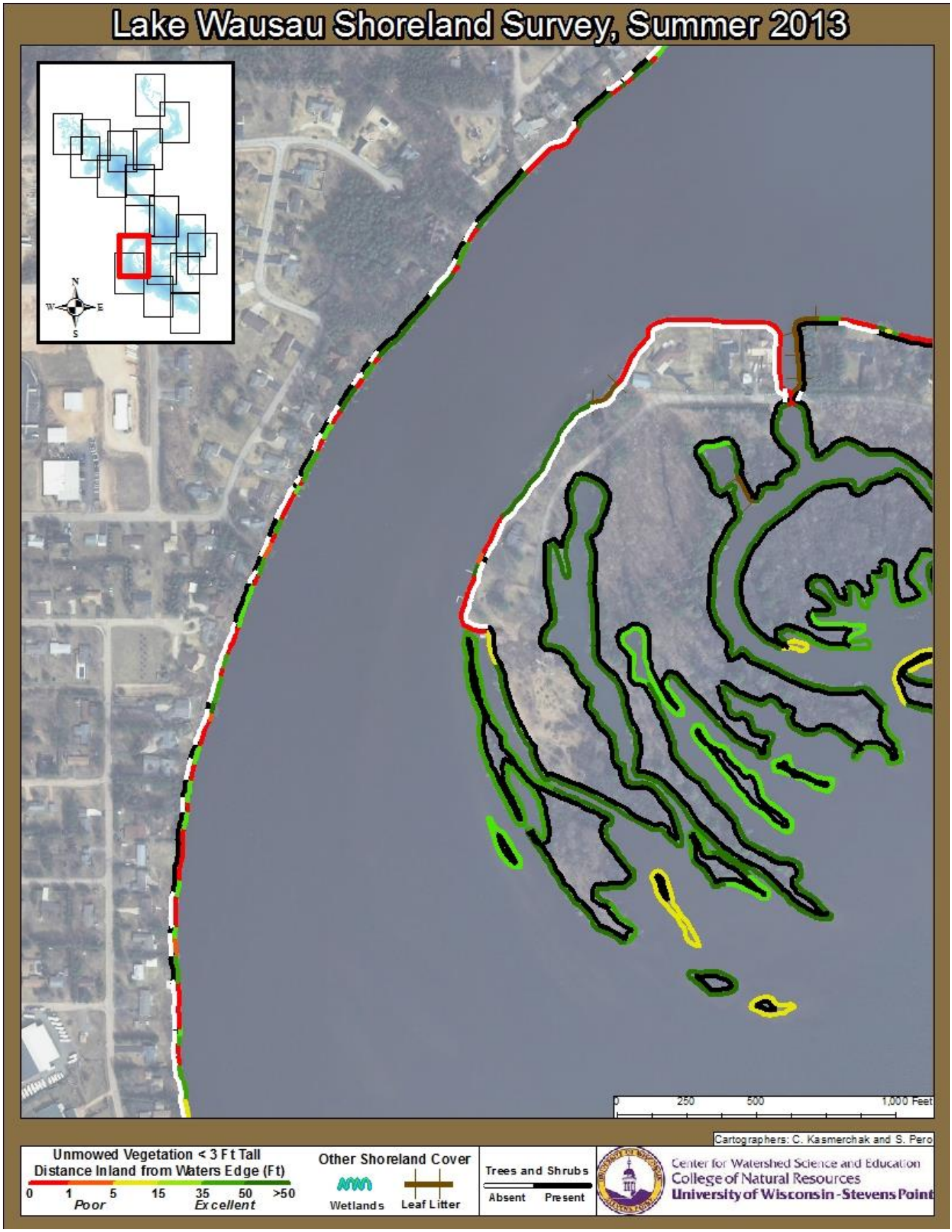

Figure 14: Shoreland vegetation survey of Lake Wausau. 2013

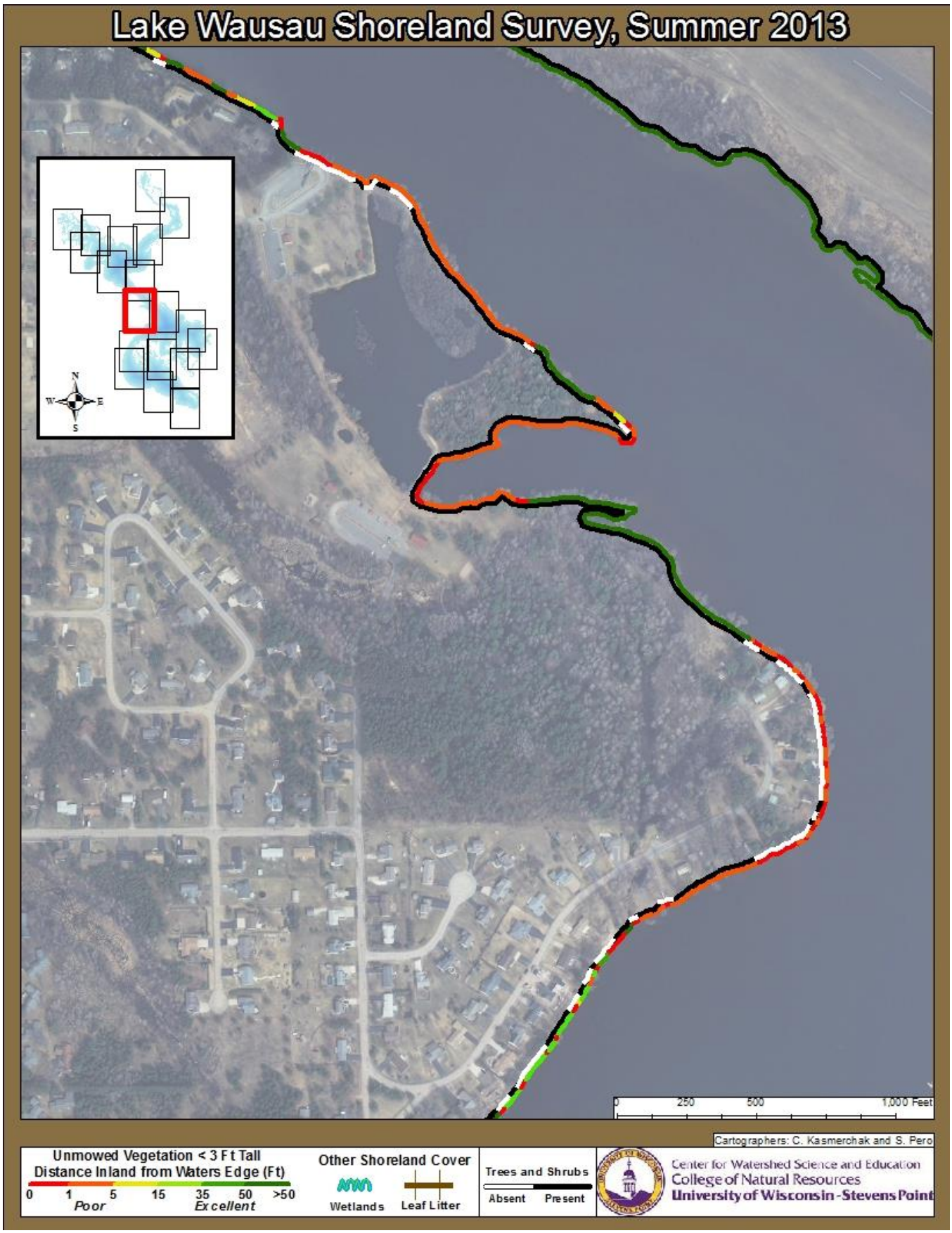

Figure 15: Shoreland vegetation survey of Lake Wausau. 2013.

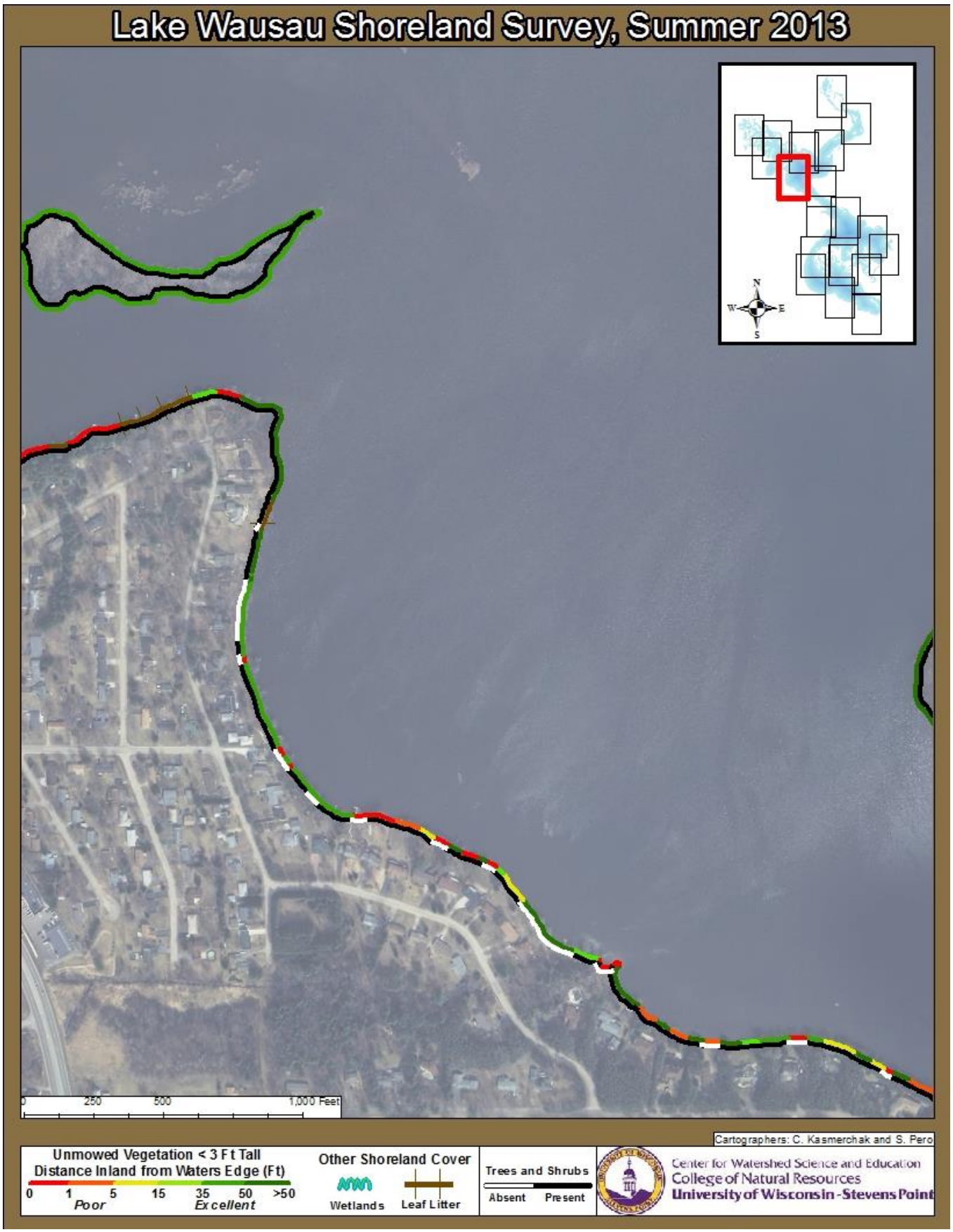

Figure 16: Shoreland vegetation survey of Lake Wausau. 2013.

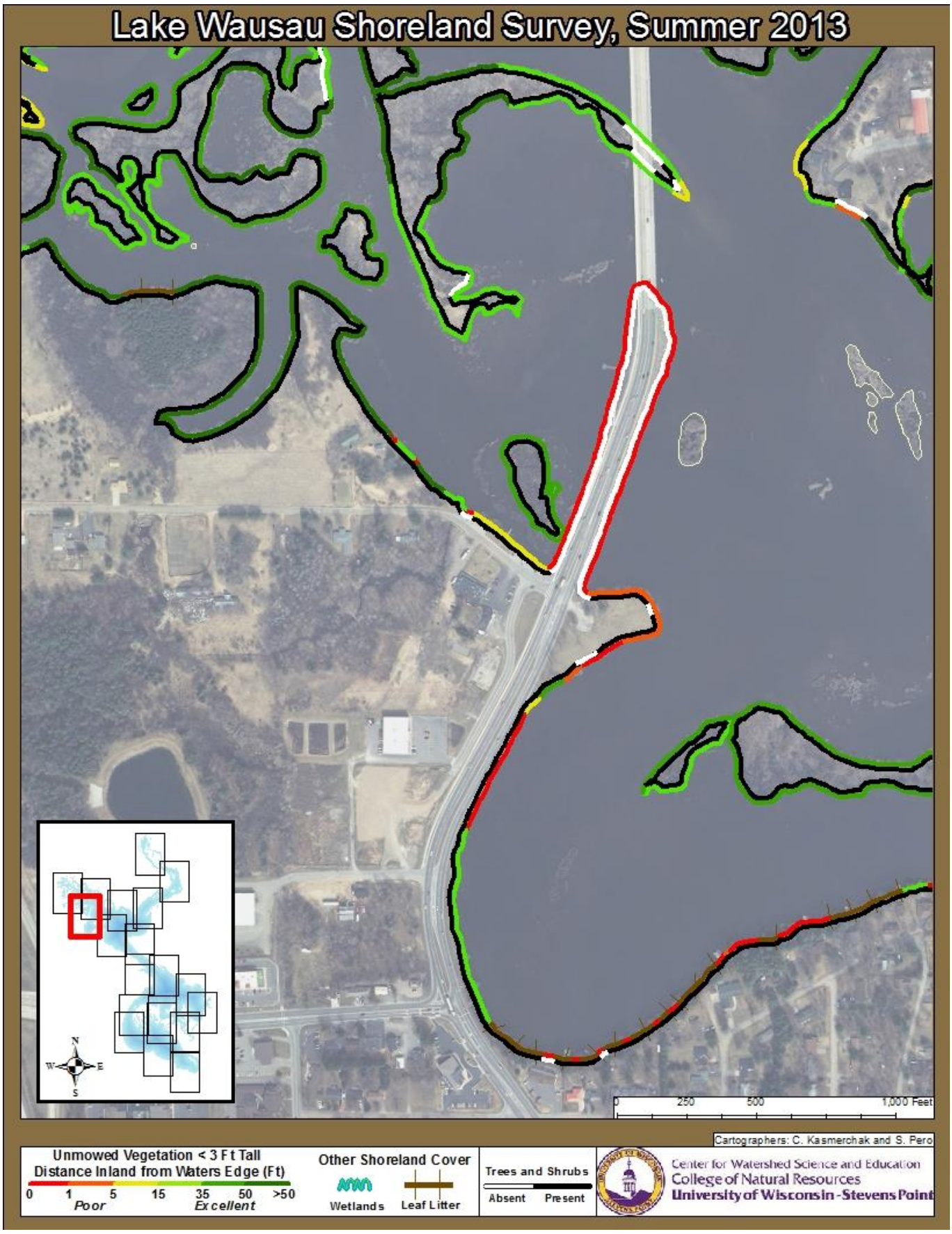

Figure 17: Shoreland vegetation survey of Lake Wausau. 2013.

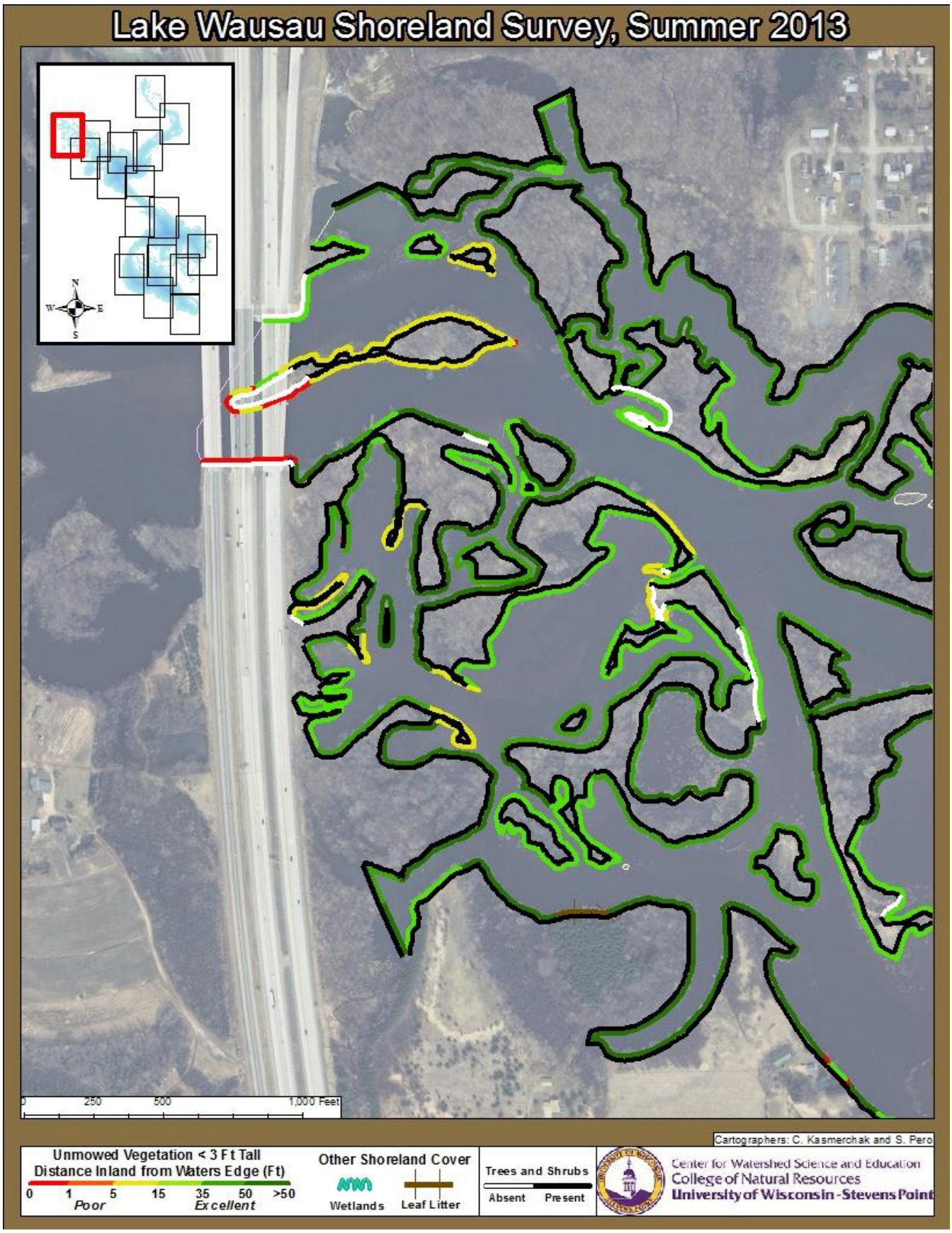

Figure 18: Shoreland vegetation survey of Lake Wausau. 2013.

Figure 19: Shoreland vegetation survey of Lake Wausau. 2013.

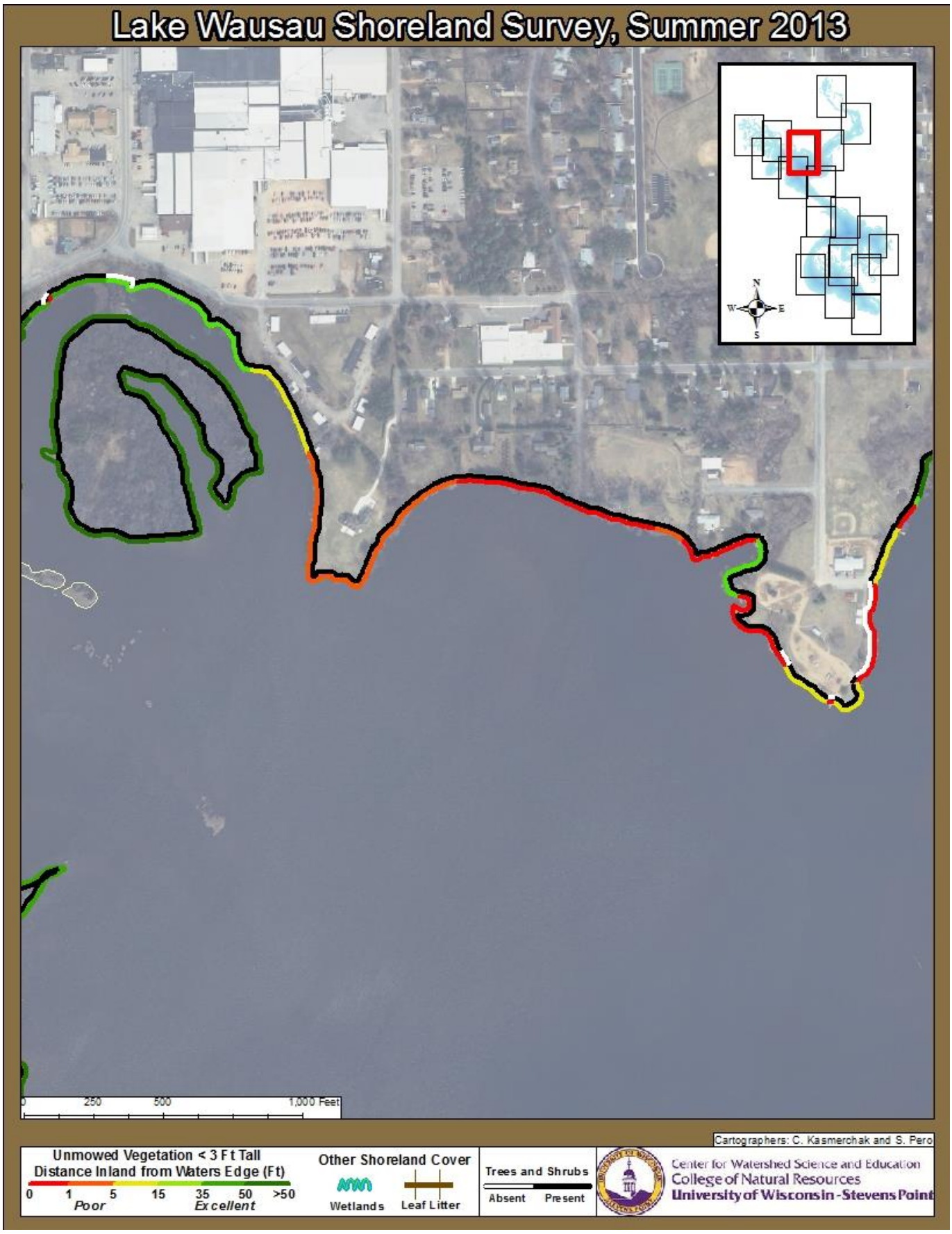

Figure 20: Shoreland vegetation survey of Lake Wausau. 2013.

Shoreland Disturbance Survey

A shoreland disturbance survey was conducted around Lake Wausau. To provide a better resolution to view and utilize these results, Lake Wausau was divided into five sections, using a 1:11,070 scale. Each map overlaps the adjacent map to ensure complete coverage of the survey area.

This survey identified disturbances at or near the water's edge. These attributes can potentially effect in-lake and shoreland habitat, which can have negative impacts on fish spawning grounds, wildlife habitat, and shoreland resilience. *Seawalls, riprap*, and *artificial beach* typically result in the reduction of habitat. Even boat landings and docks reduce the natural shoreland and the cumulative effects can reduce habitat. While these individual sites may not result in a quantifiable impact on the water quality of the lake, the collective effects of many disturbances can be significant. Summaries of the disturbance types and lengths of effected shoreland for riprap, sea walls, and erosion are displayed by map number in Table 3 and by municipality in

Table 4.

Shoreland soil erosion is often the loss of soil due to water movement across the landscape, but may also include undercut banks. Not only does erosion create the loss of land for the landowner, it adds sediment and nutrients to the water. The increased sediment can reduce spawning areas for fish by blanketing spawning habitat. Increasing the amount of runoff from impervious surfaces and structures leads to more runoff, increasing the amount of erosion (Deng, et. al., 2005). More loose sediment in the lake can also alter the ability for rooted aquatic plants to grow, resulting in more frequent and intense algal blooms. The addition of sediment in the water can also impede navigation to recreational boaters (Braden and Johnston, 2004).

Figures 21-25 display the results of the erosion, sea wall, riprap, and barren shorelands elements of the disturbance survey. Estimates of erosion on the shores of Lake Wausau totaled 3,172 linear feet. Shorelands with greater slopes along Lake Wausau are particularly vulnerable to erosion. Reducing runoff from the top of a steep bank or slope can reduce erosion over the long term; however, in addition, it may be necessary to stabilize erosive sites on the hillside. Diversions, rain gardens, terraces, and native vegetation are some of the practices that can be employed to reduce runoff and erosion. Marathon County staff and knowledgeable landscapers can assist interested landowners to ascertain the best approaches for a specific site.

Riprap was identified at 186 sites with an estimated length of 38,750 feet. This may be a slight underestimate since all sites categorized as being greater than 100 feet in length were adjusted to 100 feet for the calculation. Seawalls comprised an estimated 2,837 feet of Lake Wausau's shoreline. Depending on the location within Lake Wausau, riprap or sea walls may or may not be needed to armor shorelands. In some cases, natural bio-logs may be used to replace the rock armament, providing shoreland stability and as well as habitat. Barren shorelands were identified on 4,503 feet of Lake Wausau's shoreline. During the 2013 survey 257 docks, 11 boat landings, and 3 dams existed on Lake Wausau (Table 3). The locations of these features are displayed in Figures 26-30.

A total of 50 culverts were inventoried around Lake Wausau, ranging in diameter from 0.5-3.5 feet (Table 3 and

Table 4). The composition of the culverts were predominantly metal, plastic, or cement. Two types of culverts were surveyed on Lake Wausau. One type was a storm water culvert, designed to discharge water from streets during storm or snow melt events. Storm water runoff is a type of non-point source pollution and can be one of the foremost risks to water quality (Deng et. al., 2005). Culverts transport debris that includes nutrients from fertilizer, soil, and pet waste, chemicals from street maintenance and lawns, oil, grease, and metals from motorized vehicles trash, and other organic material. Runoff management and the use of raingardens, retention basins, and swales in the urban areas could help to reduce the amount of storm water delivered directly to Lake Wausau. Identifying storm drains with "drains directly to the river" signs may reduce the disposal of oil and other substances into the street drains and street cleaning can reduce the amount of solids and pollutants delivered to Lake Wausau. The other type of culvert inventoried was a backwater culvert which was designed to enhance water flow between a backwater area and the main lake. Distribution of the culverts are shown in Figures 31-35.

Structures such as roofs or driveways are impervious; which does not allow runoff to soak into the soil (Clemens, 2008). The increased runoff from these surfaces increase the amount of sediment and pollutants delivered to the lake, create a greater potential for erosion, and increase the temperature of the water. In an attempt to reduce impacts to Wisconsin waterbodies, requirements have been designated by the state for buildings and pathways that are near the water's edge. Siting buildings further from the shoreline is beneficial, as is managing the runoff from impervious surfaces by employing practices such as rain gardens and diversions. In this survey, estimated distance from the water's edge inland of all structures and accessory buildings were placed into one of the two categories: 0-35 feet inland or 35-75 feet inland. Maps used by the field researchers had both 35 and 75-foot setback lines identified on them to assist in estimating distances. Structures included principle buildings, detached decks, patios, gazebos, boathouses, and large storage containers. One hundred fifty-six structures were observed within the survey zones around Lake Wausau. The summaries of the structure survey results are displayed in Table 3 and

Table 4. Figures displaying structures near the shoreland as well as an outline of principle structures are located in Appendix D – Maps of structures and principle buildings around Lake Wausau in Marathon Co. This information is intended to provide perspective and help guide restoration and mitigation activities.

Table 3: Summary of disturbance survey results by map and the lake. Marathon County, Lake Wausau, 2013. Riprap, seawalls, erosion, and barren categories are displayed as linear feet of the shoreline.

Map Number	1	2	3	4	5	Lake Wausau
Culverts #	15	9	8	18	19	50
Structures #	11	48	35	56	56	156
Docks #	21	58	72	71	130	257
Boat Landings #	5	1	3	2	3	11
Dams #	1	0	0	1	1	3
Riprap (ft)	6,347	7,429	9,259	17,968	19,050	38,747
Seawall (ft)	1,296	0	820	394	1,542	2,837
Erosion (ft)	853	607	476	1,597	1,581	3,172
Barren (ft)	1,613	1,066	918	1,065	1,095	4,503

Table 4. Lake Wausau shoreland disturbance survey results by municipality and total shoreland results. Riprap, seawalls, erosion, and barren categories are displayed as linear feet of the shoreline.

Disturbance	Rib	Rothschild	Schofield	Wausau
Culverts	11	3	18	18
Structures	81	3	57	15
Docks	161	4	65	27
Boat	2	1	3	5
Dams	0	1	1	1
Riprap (ft)	10,225	565	4,768	2,190
Seawall (ft)	170	0	300	395
Erosion (ft)	178	82	432	275
Barren (ft)	1,918	84	595	1,287

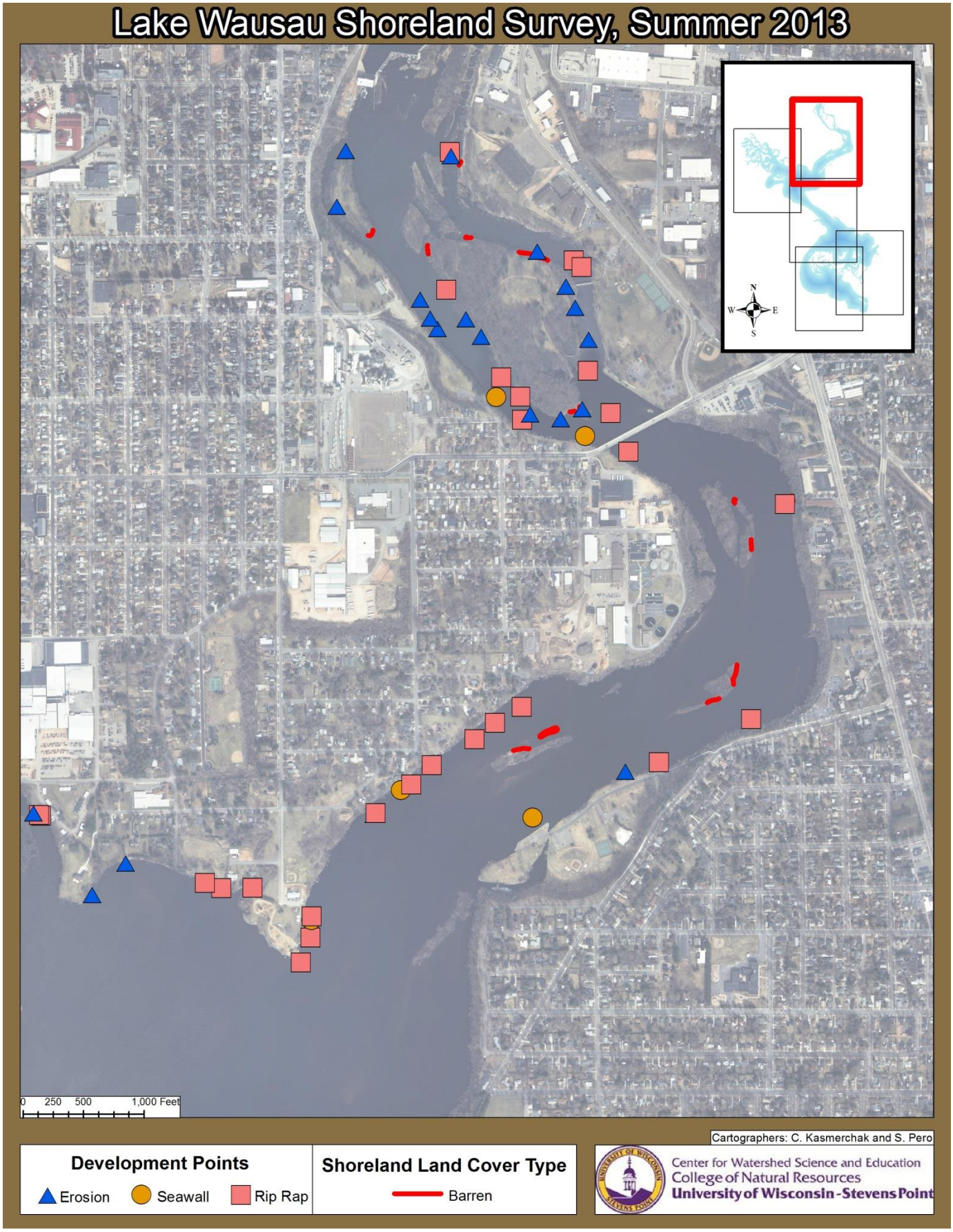

Figure 21: Disturbance survey results, erosion, seawall, riprap, and barren shorelands, Map 1.

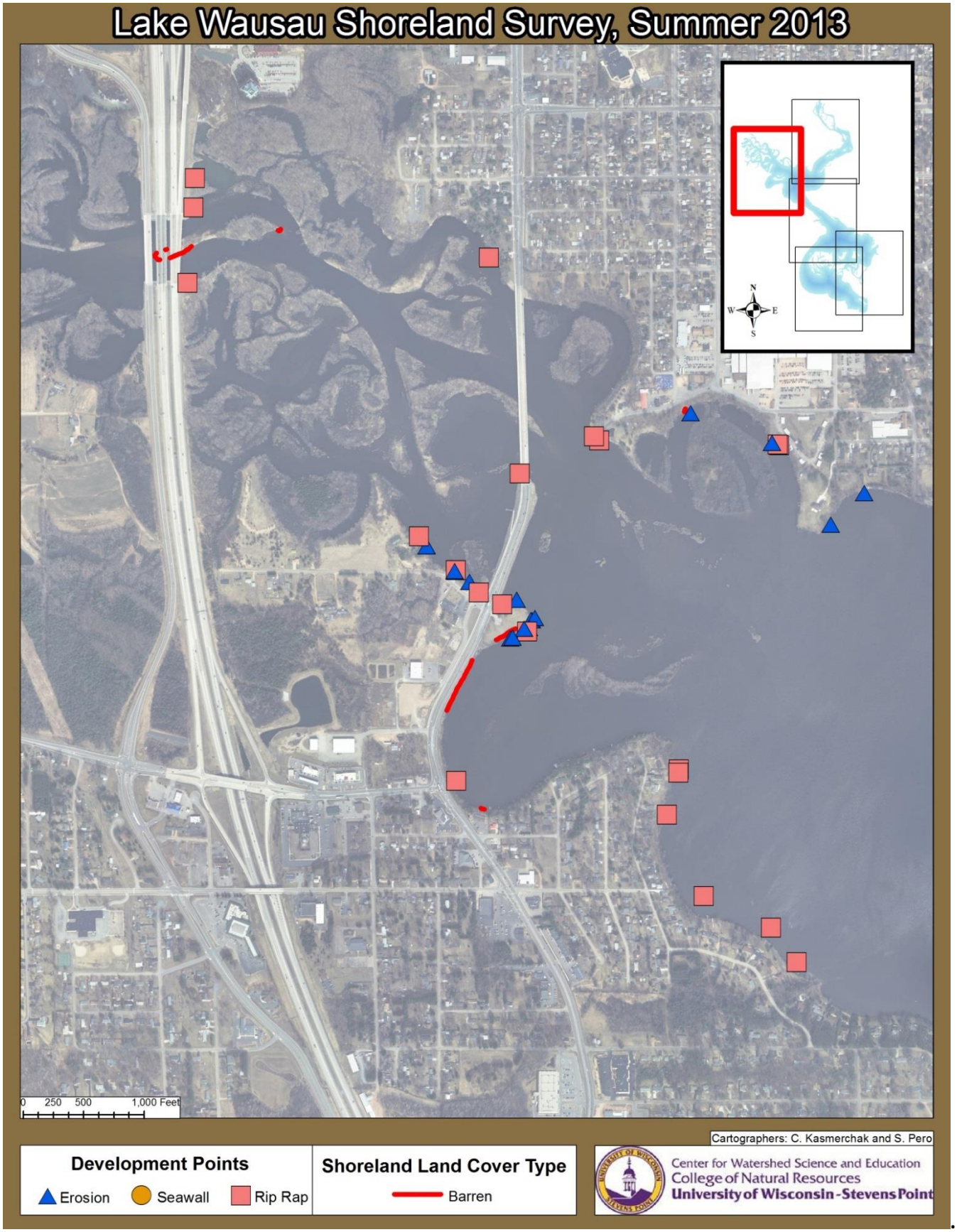

Figure 22: Disturbance survey results, erosion, seawall, riprap, and barren shorelands, Map 2

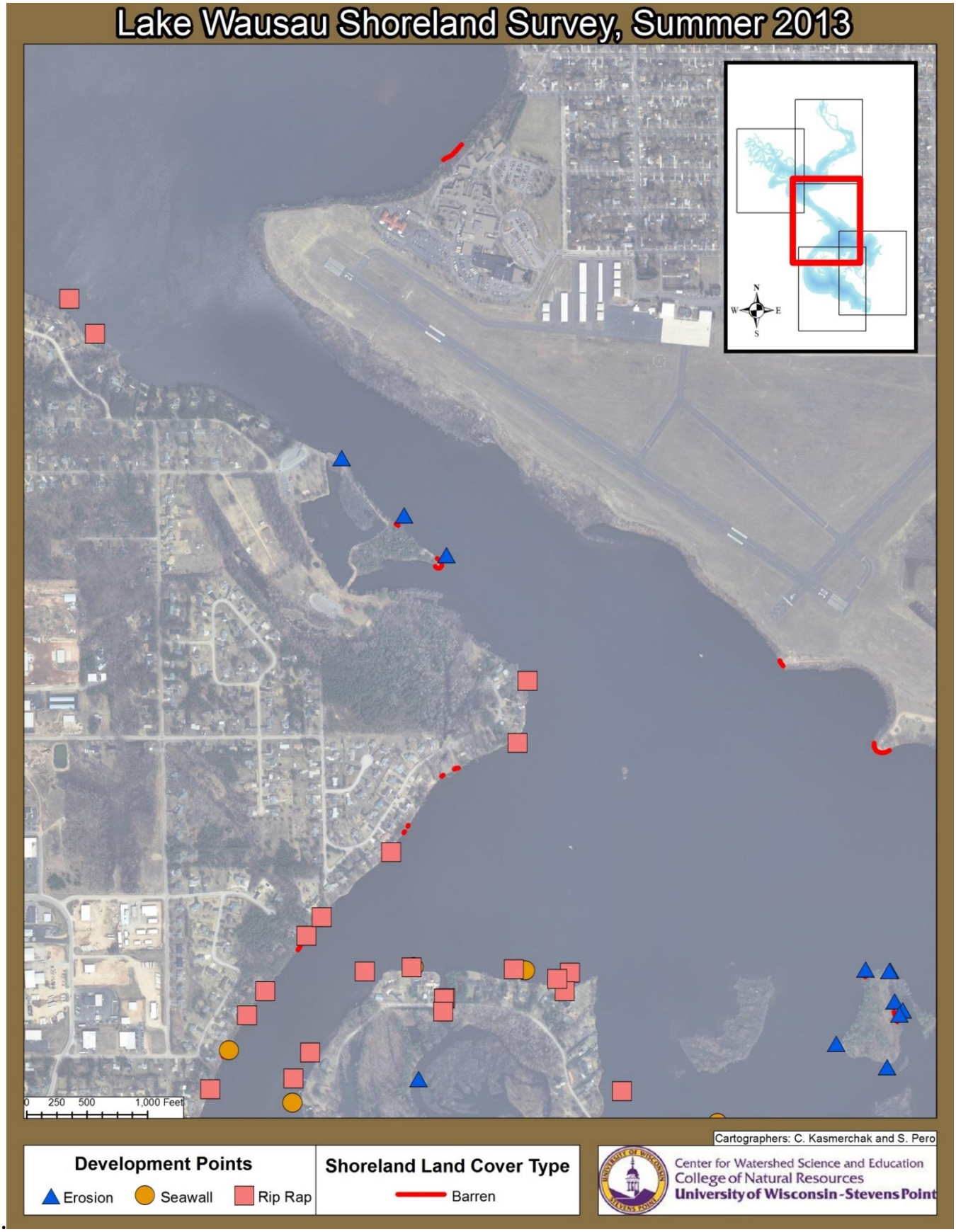

Figure 23: Disturbance survey results, erosion, seawall, riprap, and barren shorelands, Map 3

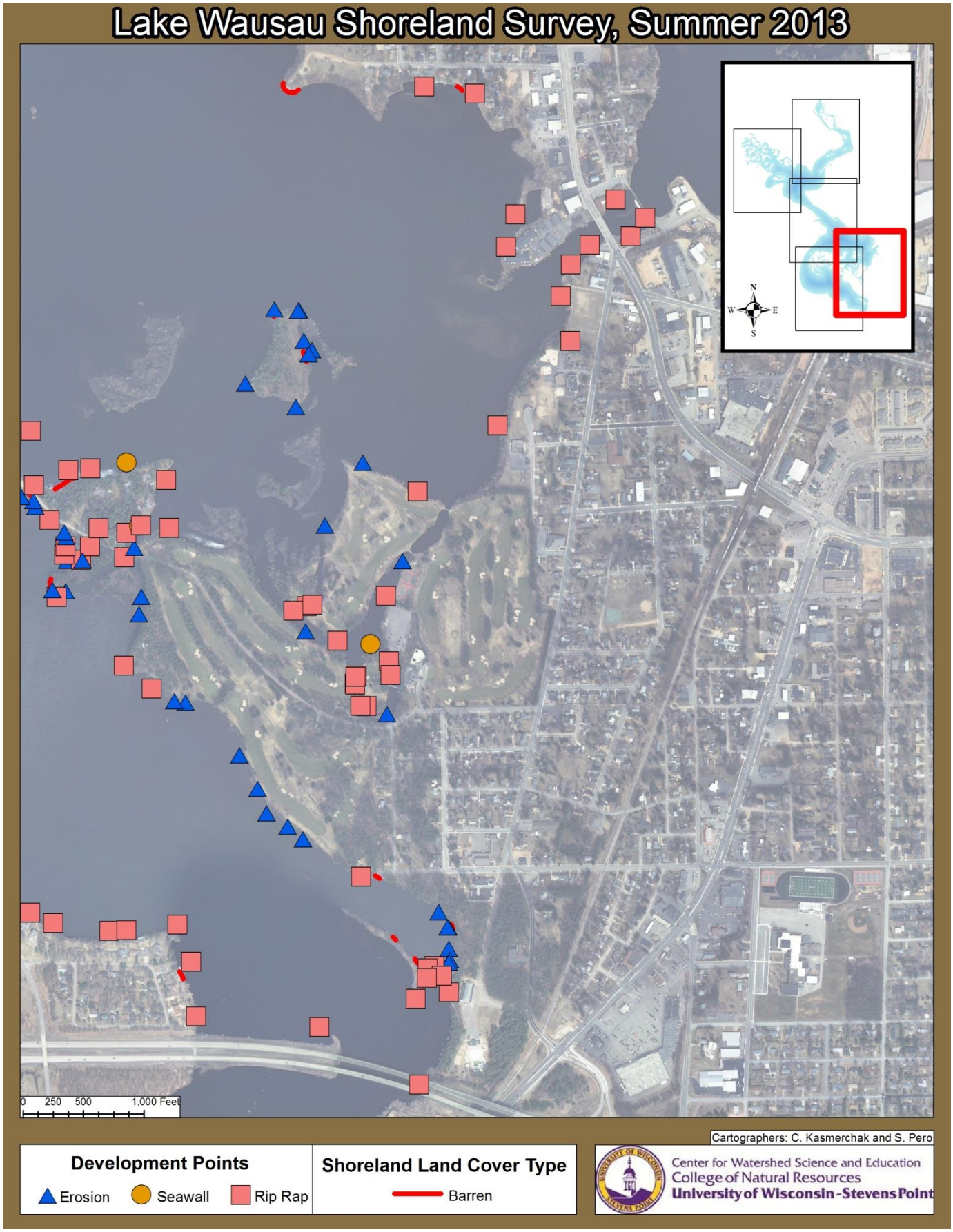

Figure 24: Disturbance survey results, erosion, seawall, riprap, and barren shorelands, Map 4.

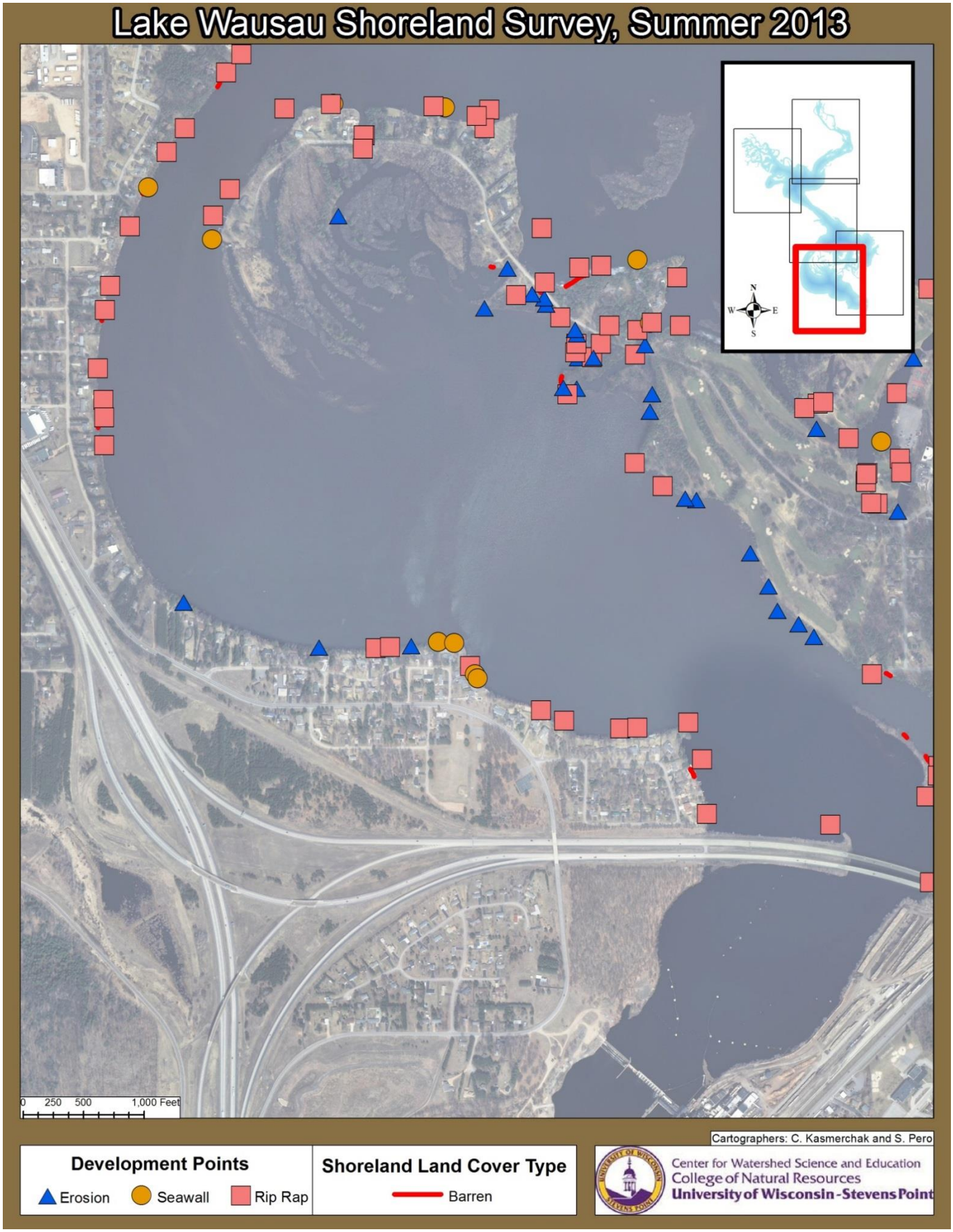

Figure 25: Disturbance survey results, erosion, seawall, riprap, and barren shorelands, Map 5.

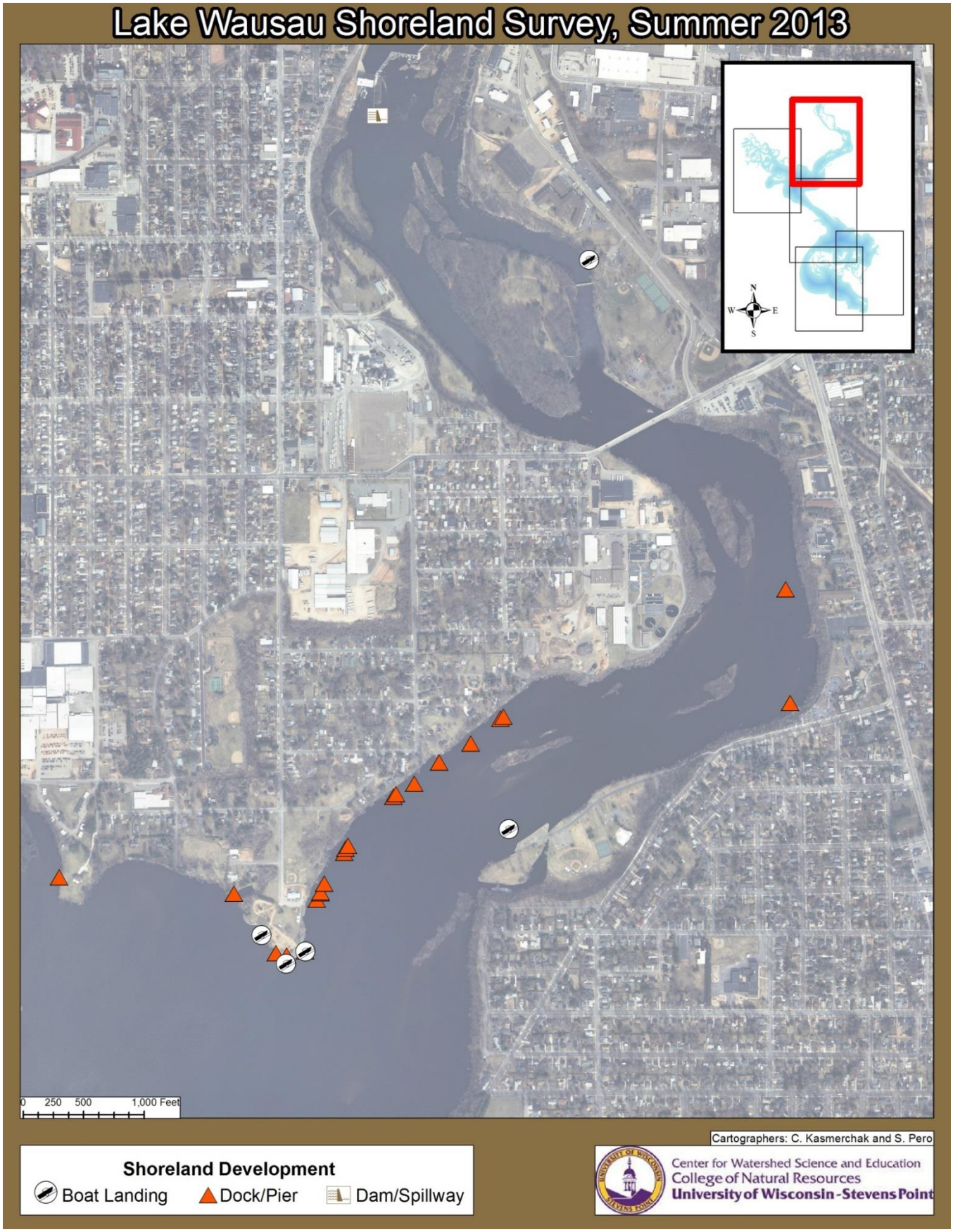

Figure 26: Disturbance survey results, boat landings, docks, dams. Map 1.

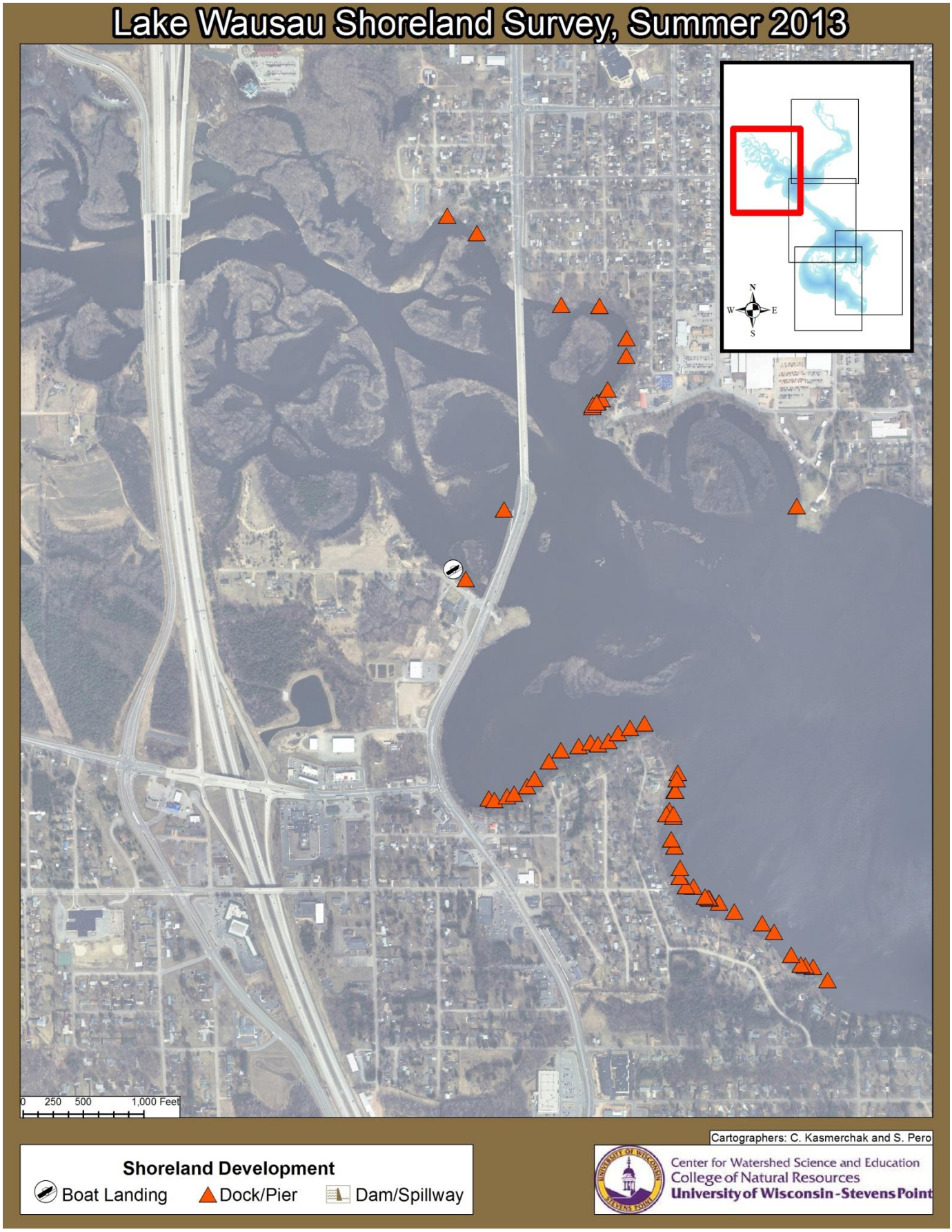

Figure 27: Disturbance survey results, boat landings, docks, dams. Map 2.

Figure 28: Disturbance survey results, boat landings, docks, dams. Map 3.

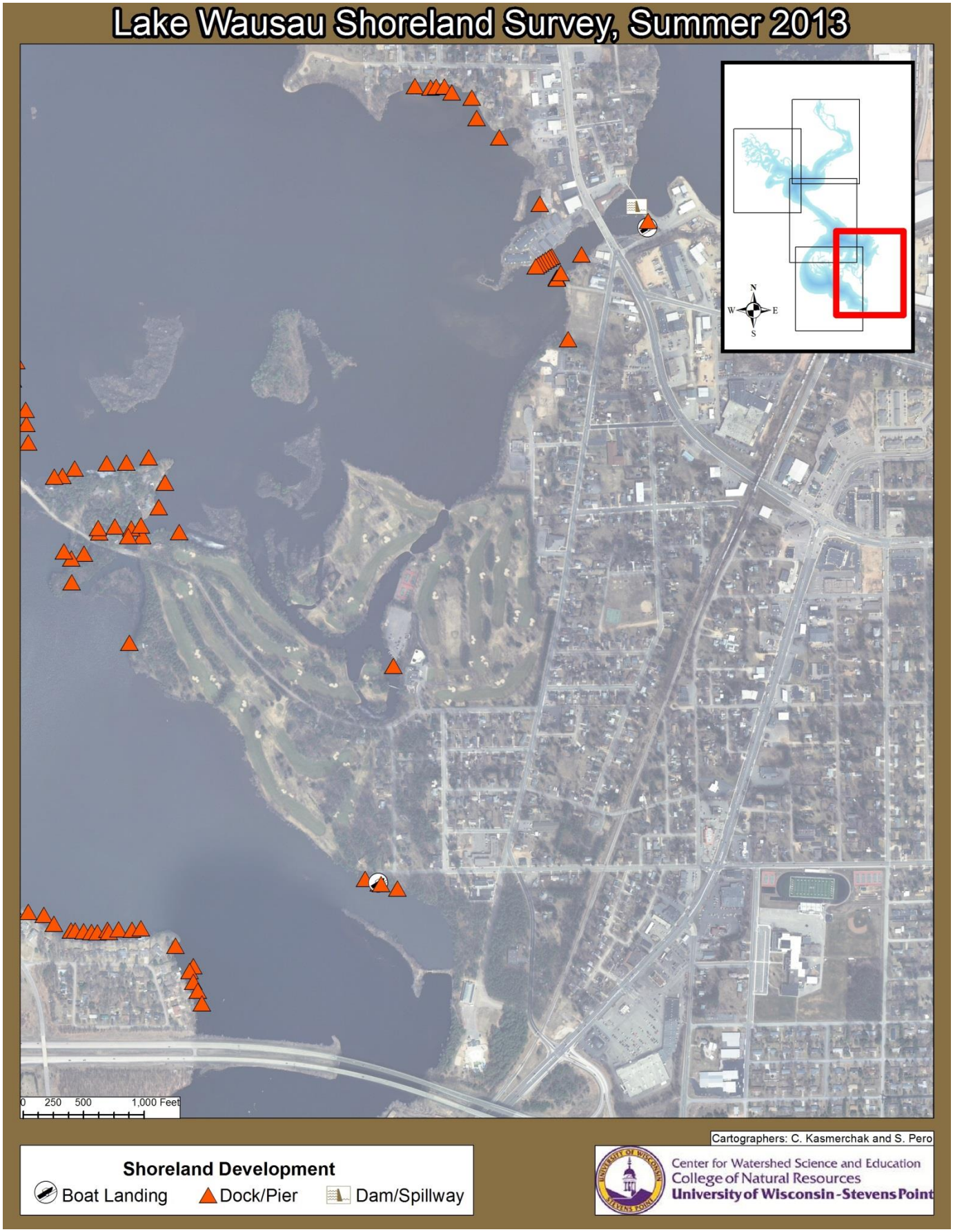

Figure 29: Disturbance survey results, boat landings, docks, dams. Map 4.

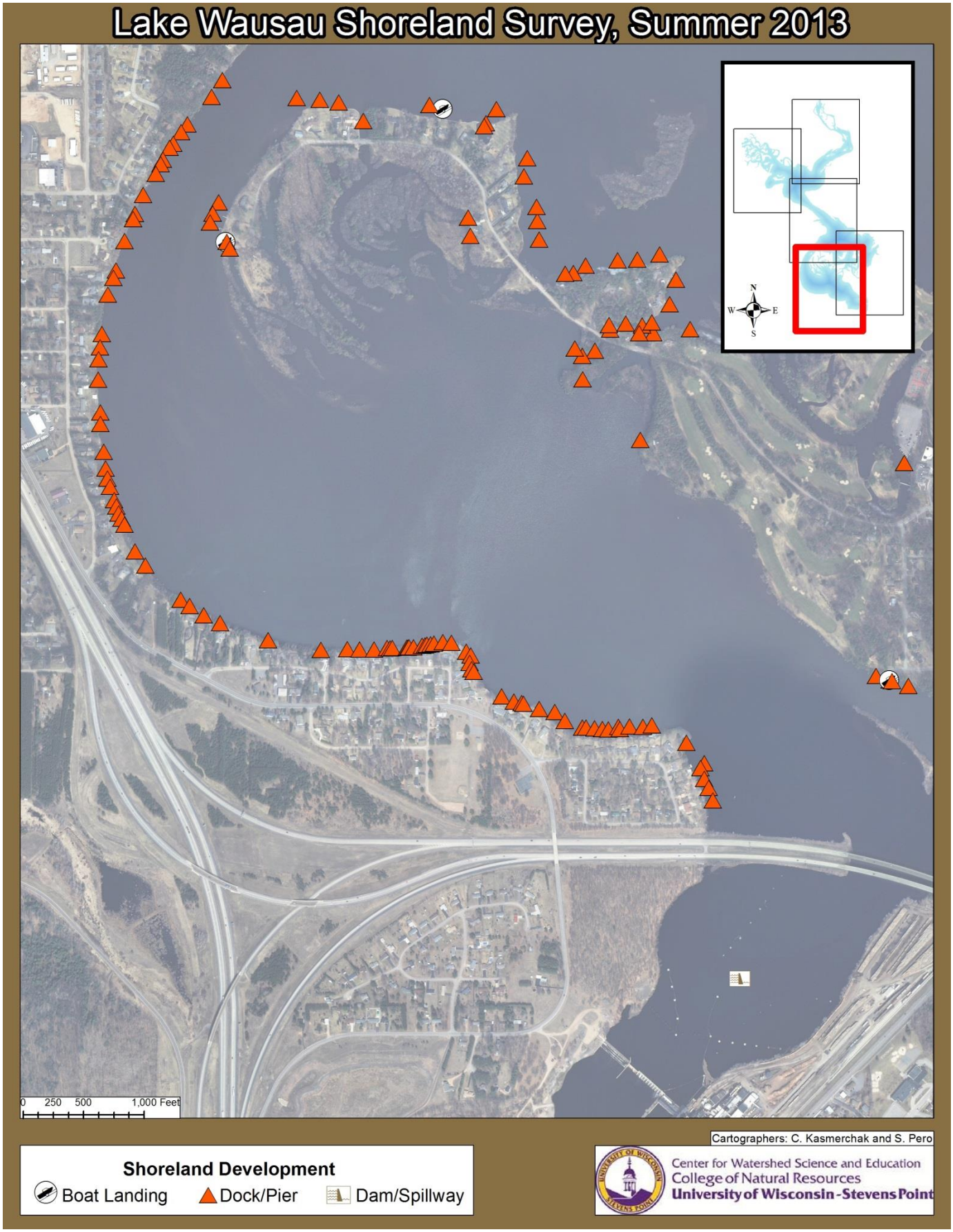

Figure 30: Disturbance survey results, boat landings, docks, dams. Map 5.

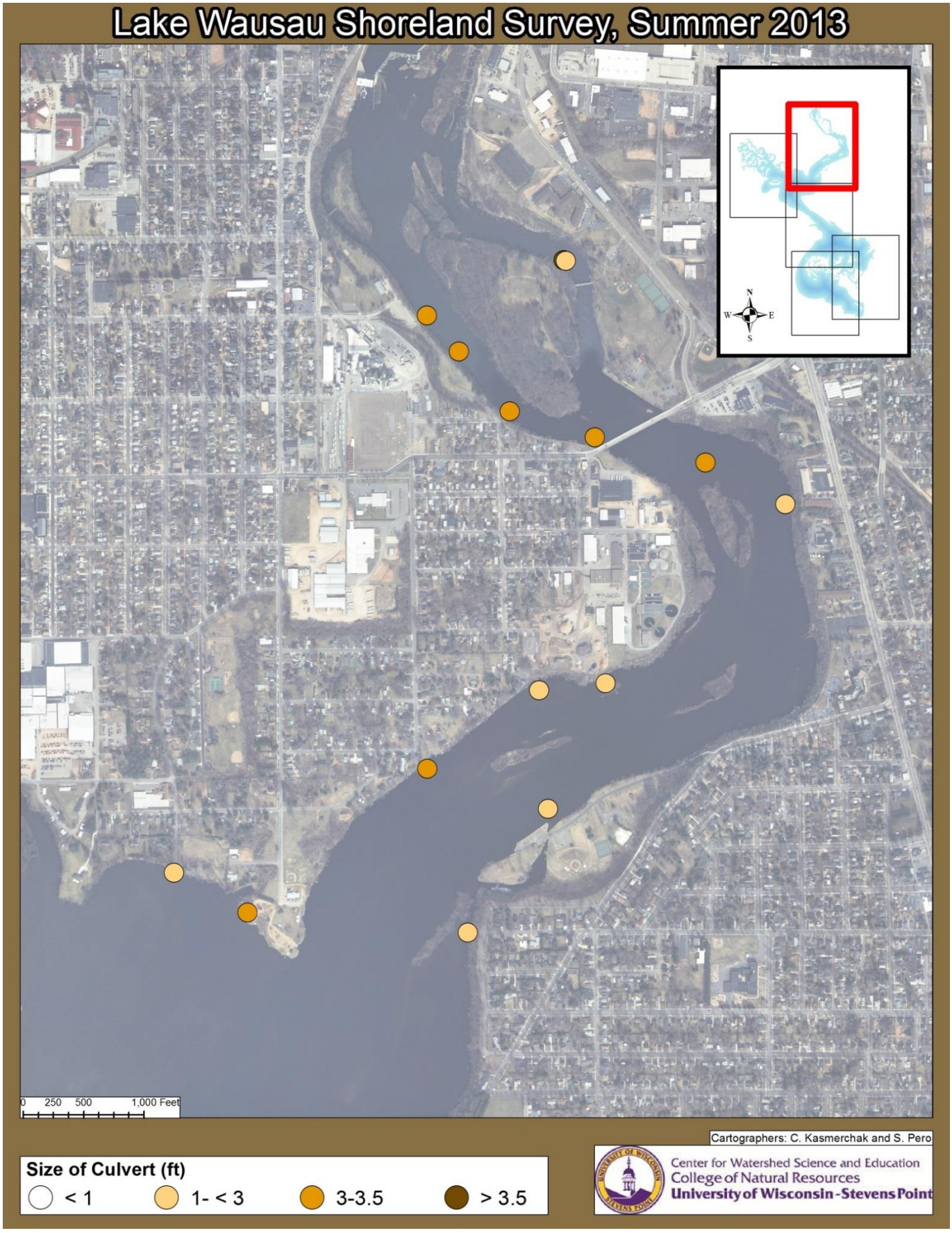

Figure 31: Disturbance survey results, culverts. Map 1.

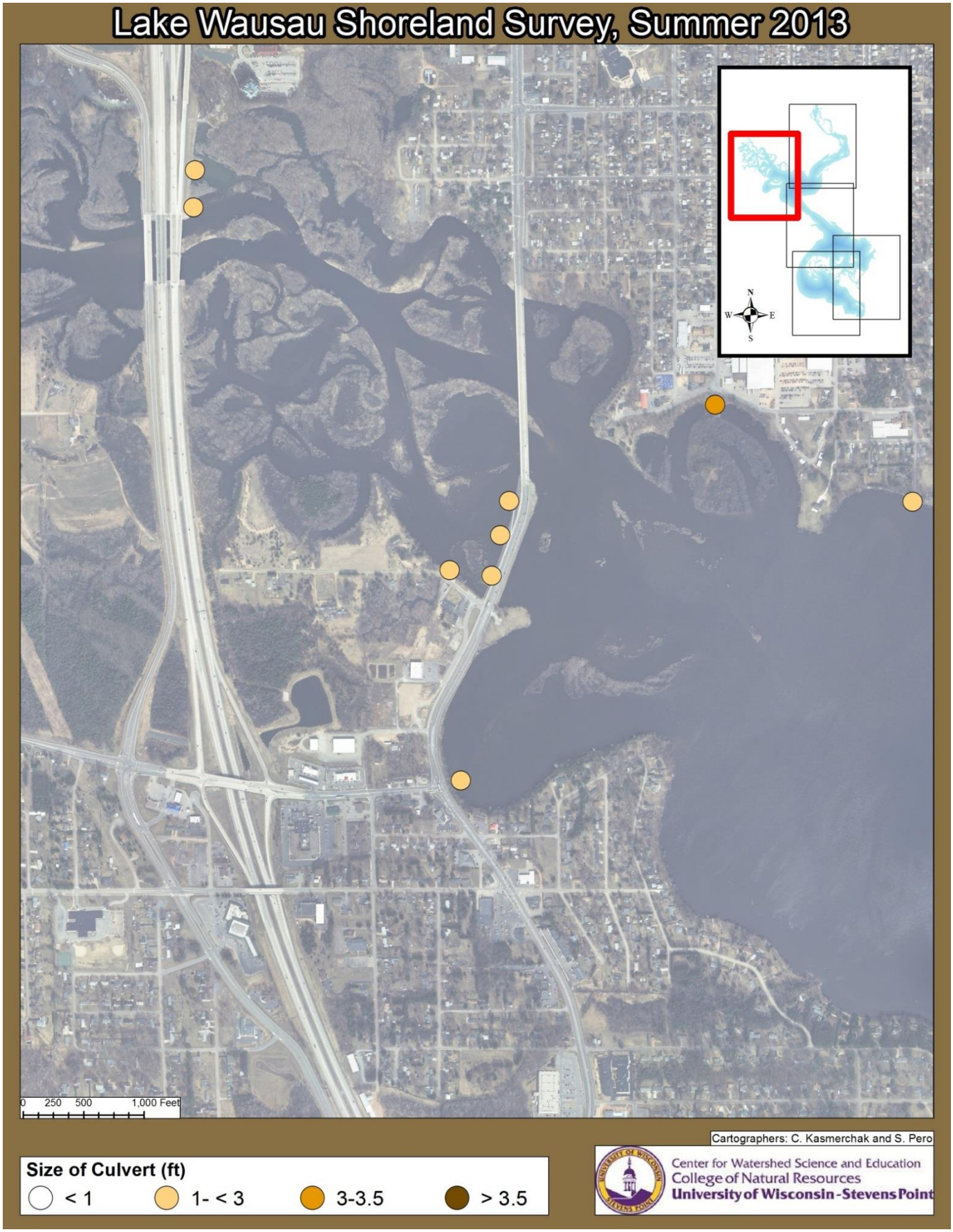

Figure 32: Disturbance survey results, culverts. Map 2.

Figure 33: Disturbance survey results, culverts. Map 3.

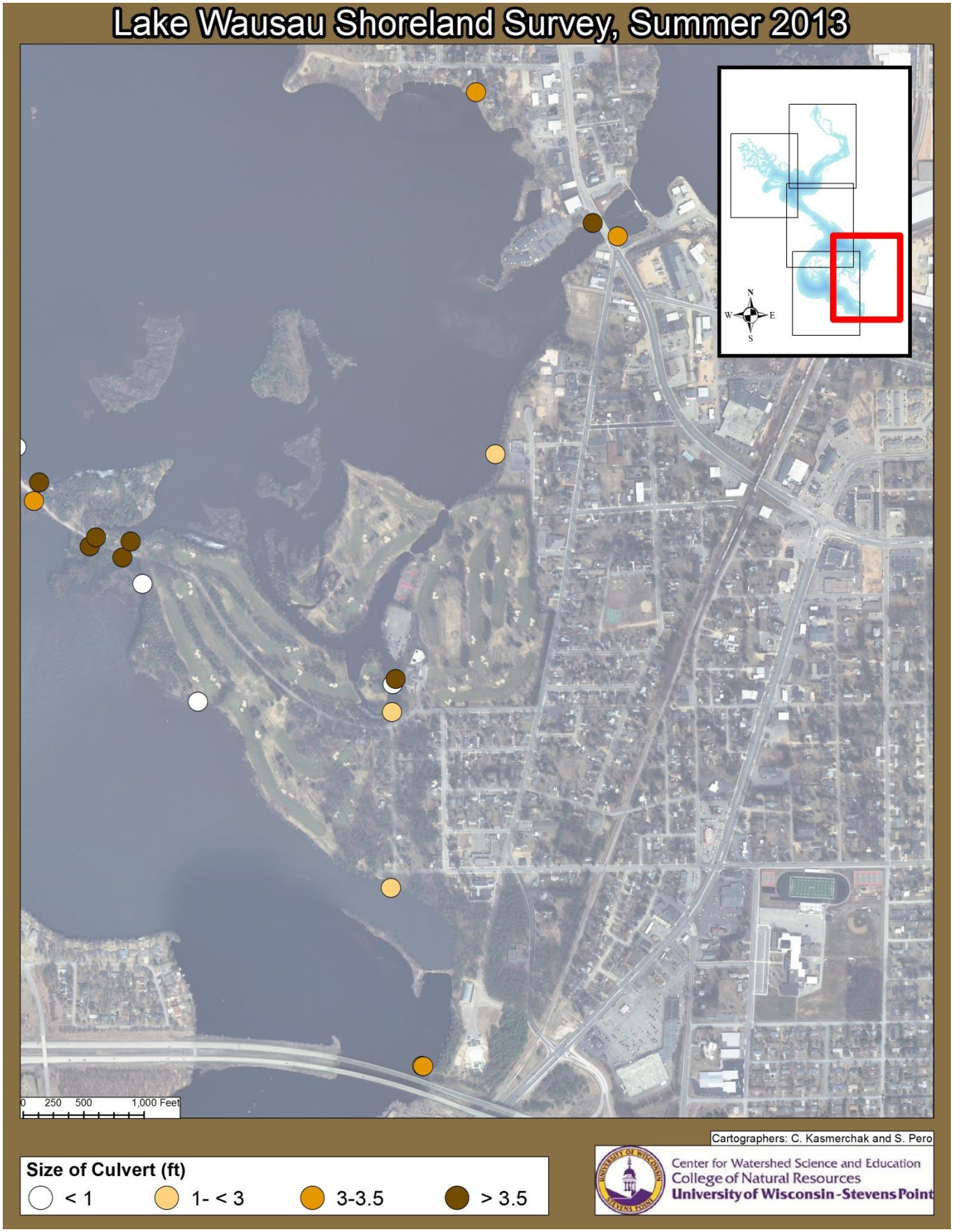

Figure 34: Disturbance survey results, culverts. Map 4.

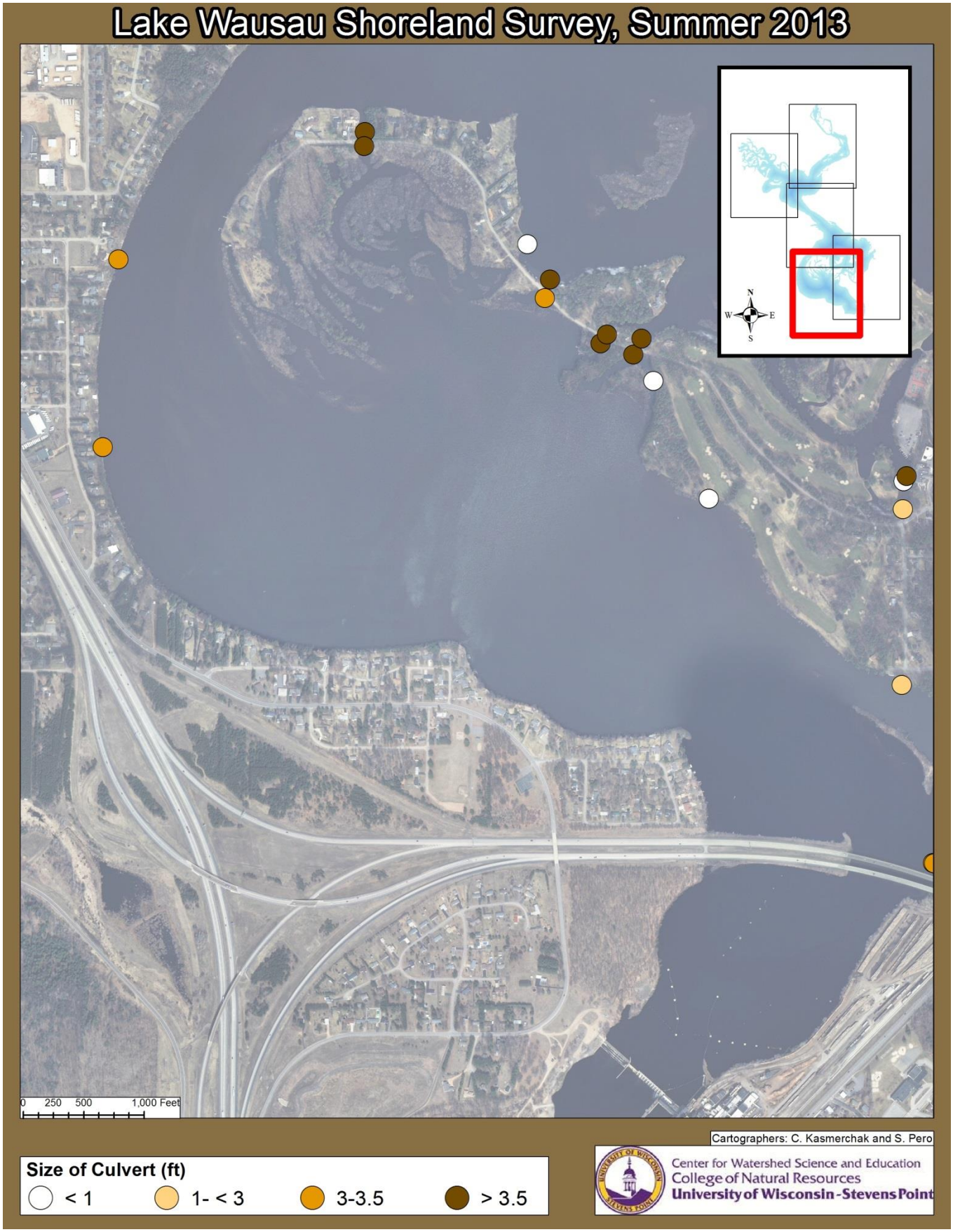

Figure 35: Disturbance survey results, culverts. Map 5.

Summary and Recommendations

Land management practices near Lake Wausau can affect both its water quantity and quality. While forests, grasslands, and wetlands allow a fair amount of precipitation to soak into the ground, resulting in more groundwater and good water quality, other types of land uses may result in increased runoff and less groundwater recharge, and may also be sources of pollutants that can impact the lake and its inhabitants. Areas of land with exposed soil can produce soil erosion. Soil entering the lake can make the water cloudy and cover fish spawning beds. Soil also contains nutrients that increase the growth of algae and aquatic plants. Development on the land may result in changes to natural drainage patterns and alterations to vegetation on the landscape, and may be a source of pollutants. Impervious (hard) surfaces such as roads, rooftops, and compacted soil prevent rainfall from soaking into the ground, which may result in more runoff that carries pollutants to the lake. In areas where the shoreland is steep, runoff management practices should be utilized to reduce the amount of runoff that is directed towards the slope. Storm water, wastewater, pet waste, and fertilizers used on lawns, gardens and crops can contribute nutrients that enhance the growth of algae and aquatic plants in the lake. Land management practices can be put into place that better mimic some of the natural processes, and reduction or elimination of nutrients added to the landscape will help prevent the nutrients from reaching the water. In general, the land nearest the lake has the greatest impact on the lake water quality and habitat.

Land management practices designed to reduce runoff from rooftops and other hard surfaces include protecting and restoring wetlands, installing rain gardens, swales, and rain barrels, controlling erosion, and protecting and restoring native vegetation in the shoreland. Shoreland vegetation is critical to the lake's ecosystem. It helps improve the quality of the runoff that is flowing across the landscape towards the lake. It also provides habitat for many aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs, and trees, which extend at least 35 feet landward from the water's edge. Restorations and management should be designed in a way that is appealing to the landowner, while retaining functionality. Shorelands include adjacent wetlands, which also serve the lake by allowing contaminants to settle out, providing shelter for fish and wildlife, and decreasing the hazard of shoreline erosion by providing a shoreland barrier from waves and wind. The simplest of shoreland management practices is to allow vegetation to grow and become the dominant cover type. Start out small and work up to the larger zones.

Access to the lake, especially from steep shorelands should be designed to reduce erosion. Options include winding pathways that are covered with impervious materials such as wood chips, secured gravel, or stepping stones. Stairs with open backs allow water to infiltrate into the soil behind the stairway.

Lake Wausau hosts a mix of urban and rural settings; therefore, there is not a "one size fits all" design for a healthy shoreland. Some of the healthy lake land management practices may be perceived as being outside of the "norm" for a city; however; there are many examples on Lake Wausau and around the state that exemplify runoff reductions, habitat, and an appealing look. Efforts could be made to help shoreland property owners recognize the importance of their shorelands to Lake Wausau and its ecosystem. Communication could include articles in the media, signage in public areas with healthy shorelands describing the benefits of the shorelands, discussions with neighbors and municipalities, informative backyard walks with professionals, healthy shoreland "open house" tours, awards and acknowledgements for people making an effort, informing people about financial incentives, involving youth in design, restoration, or maintenance of restorations. Especially in urban areas, ask folks to take a few small steps at the beginning.

In summer 2015, as a part of a larger project to talk about shoreland health with homeowners, UWSP staff visited 25 residents in the Rib Mountain area on the western side of Lake Wausau. Conversations were held with 17 of the 25 properties visited. Many people expressed interest in healthy shorelands (7) or appeared neutral (9) about the subject, while one person indicated no interest in healthy shorelands. Their primary topics of interests related to Lake Wausau included fish, wildlife and recreation; no one expressed an interest in the economics associated with a healthy lake. The remaining eight property owners only received informational materials. Conversations at these properties did not occur because no one was home or the property owner was too busy to talk. These types of conversations were initiated by 36 volunteers on 22 lakes in central Wisconsin. Overall, the volunteers reported good experiences. This approach allowed them to have conversations with people who may not attend meetings. Neighborly conversations can create a less intimidating first step in talking about the importance of shorelands. To enhance the success of an informational effort, follow-up support should be offered to homeowners in the means of technical and/or financial assistance.

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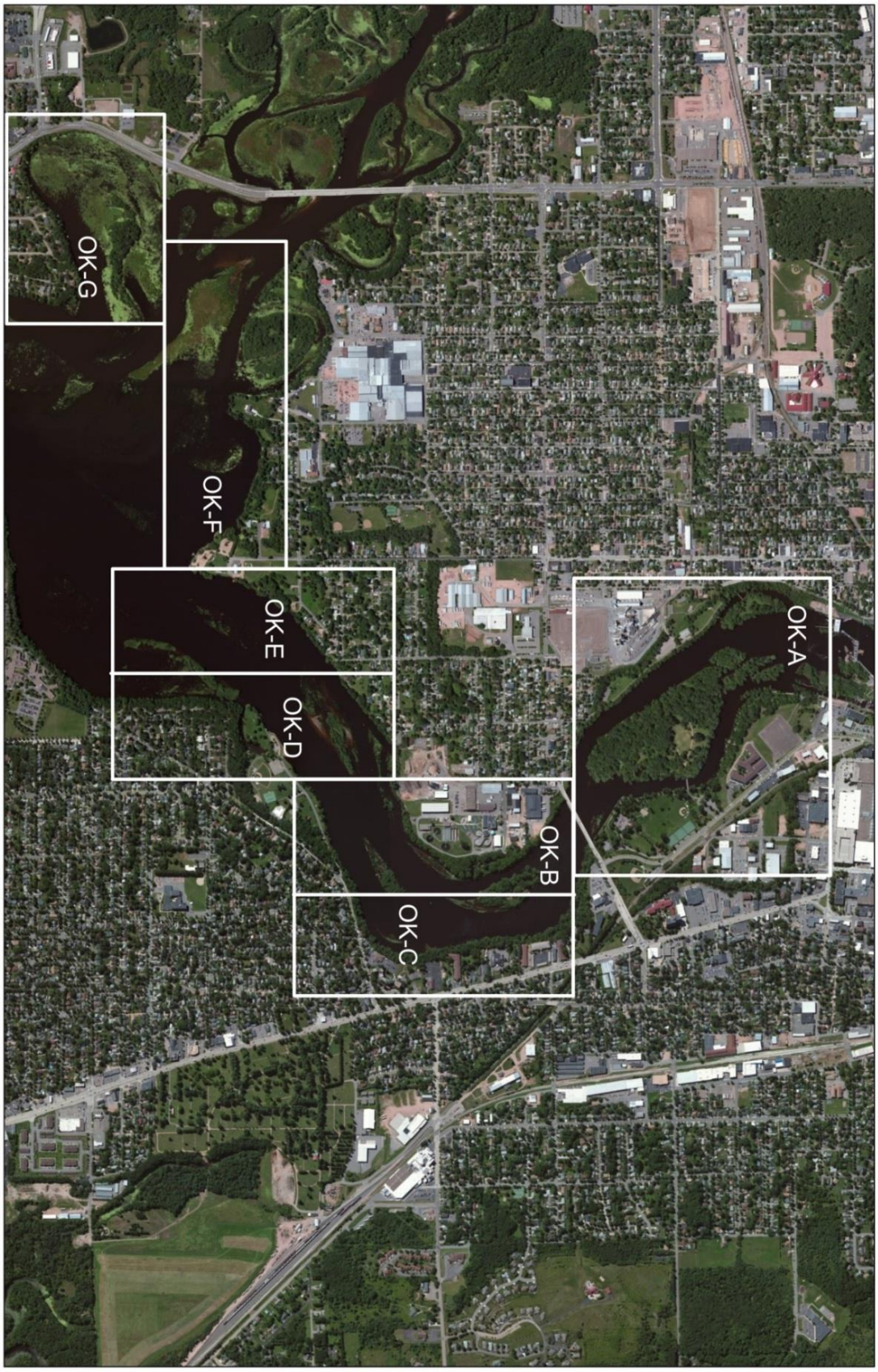
Appendices

Appendix A – Location of individual maps and associated identification code.

Rib River Section of Lake Wausau

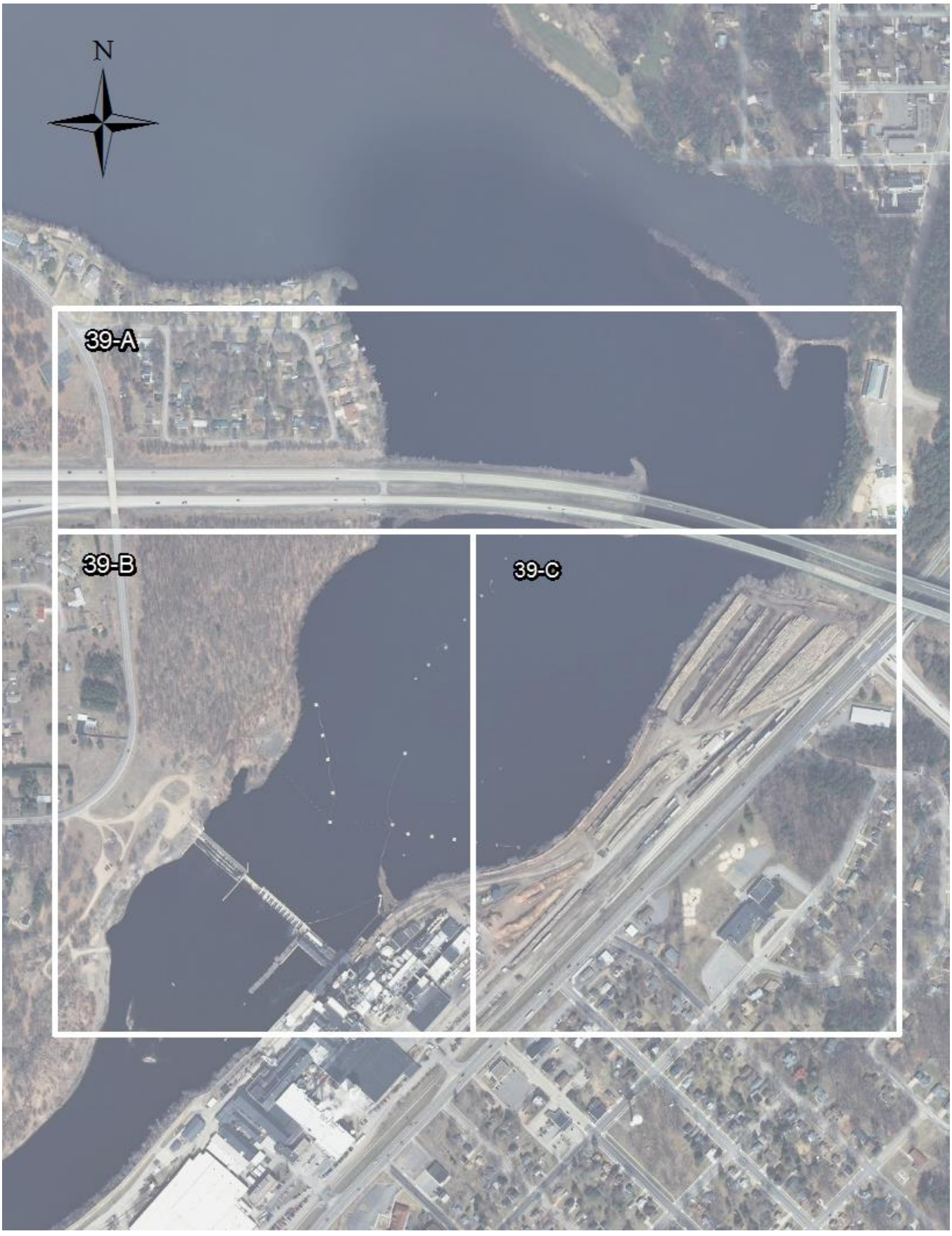
Oak Island section of Lake Wausau



Airport section of Lake Wausau

Gulf Course section of Lake Wausau

Highway 39 section of Lake Wausau



Appendix B – Photographic examples of shoreland categories.

Wetlands (excluding cattails) from the water's edge inland




Leaf Litter: Pine needles covering ground. Shading can prevent the growth of vegetation.

Leaf litter: Leaves and other organic matter cover the ground where with poor growing conditions for understory vegetation.

Barren describes the areas devoid of vegetation.

Mowed vegetation to water's edge (unmowed vegetation 0 feet inland from water's edge) with the absence of trees and shrubs

Unmowed vegetation 1 foot inland from water's edge with the absence of trees and shrubs.

Unmowed vegetation 5 feet inland from water's edge with the presence of trees and shrubs.

Unmowed vegetation 15 feet inland from water's edge with the presence of trees and shrubs.

Unmowed vegetation >35 feet inland from water's edge with the presence of trees and shrubs.

Shoreland Alterations

	Waypoint ID	Est Length (ft)
Dock/Pier		
Seawall		
Rip-rap		
Artificial Beach		
Boat Landing		
Dam/ Spillway		
Other (Specify)		

Erosion

Erosion - Type	Waypoint ID	Est. Length (ft)	Est. Slope (%)
Undercut banks/slumping			
Furrow/gullies			

Culverts/Outfalls

	Waypoint ID
Size and measurement units	
Shape	
Material	
Photo Taken?	Yes ☐ No ☐

Structures (within 75 feet of Ordinary High Water Mark)

Building Type	Waypoint ID	0-35 feet inland	35-75 feet inland
Principal Structure		☐	☐
Detached Deck/Patio/Gazebo/ Boathouse		☐	☐
Other Accessory Building/Impervious		☐	☐

Area BELOW the Ordinary High Water Mark

	Waypoint ID	Present
Cut/mowed area >30 ft wide		☐
Tilled or erosion		☐
Motor vehicle tire imprints		☐
Woody structure		☐
Other		☐

Mark on Map

Approx location of waypoints
Erosion
Preferred flow channels/Culverts

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Lake Name _____
Date _____
Weather _____

Survey Segment GPS Start and End Points

	Start (from)	End (to)
Waypoint ID		

Short Shoreland Vegetation and Ground Conditions

(estimates from the shoreland/water's edge **INLAND**)

Category	Max Distance Inland (ft)	Not Dominant	Not Present
Wetlands (NOT CATTAILS)		☐	☐
Organic - leaf pack/needles UNDISTURBED		☐	☐
Barren, bare dirt (erosion) DISTURBED		☐	☐
New shoreland restoration		☐	☐
Mowed vegetation		☐	☐
Short **Unmowed** Vegetation <3 ft tall		☐	☐
Impervious surface		☐	☐

Tall Shoreland Vegetation

(estimates from the shoreland/water's edge **INLAND**)

	Present	Absent
>3 ft tall (shrubs and trees)	☐	☐

In-Lake Woody Structure at Water Interface

(presence determined from water's edge **LAKEWARD**)

Present	Absent
☐	☐

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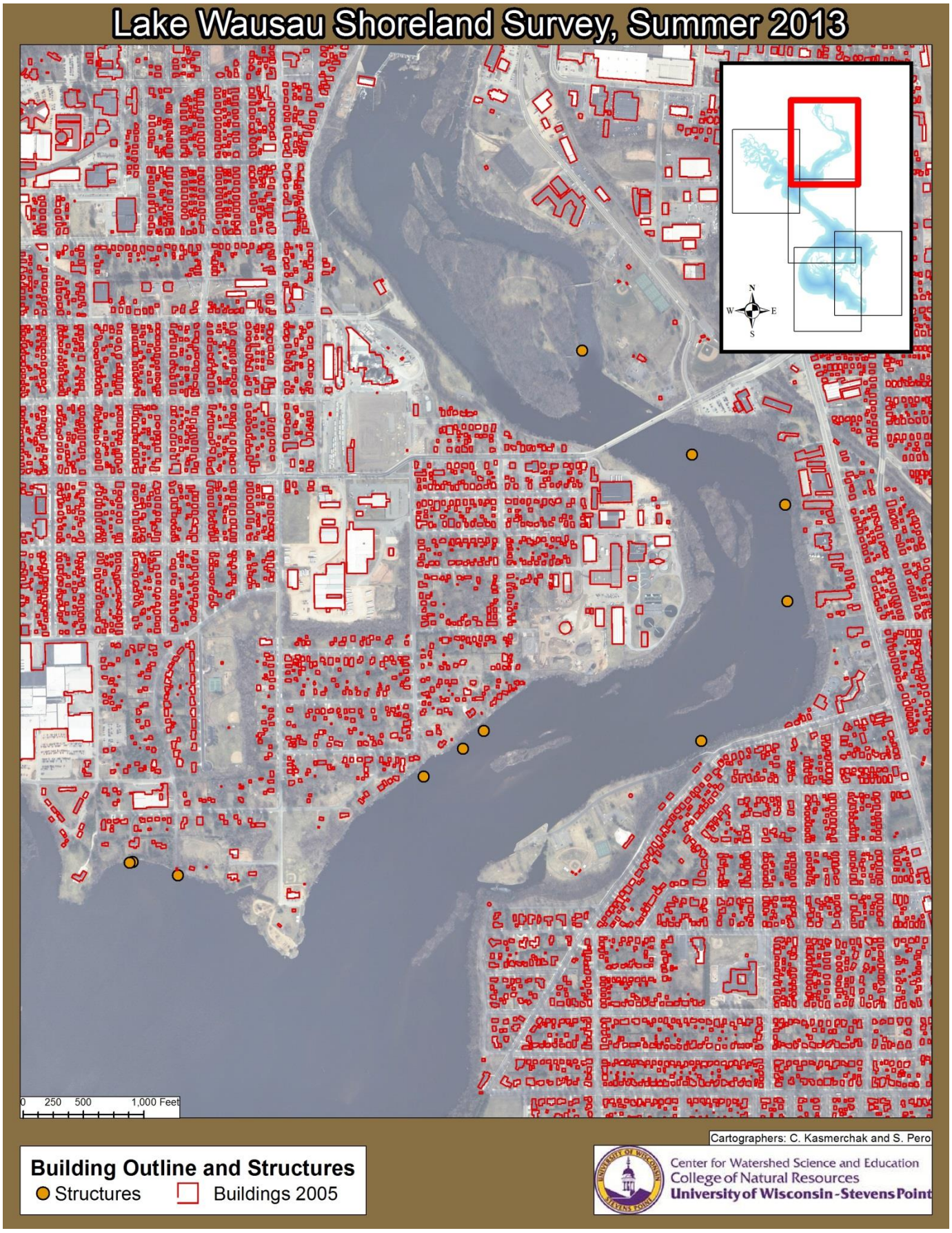
Lake Wausau Shoreland Survey, Summer 2013
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Building Outline and Structures
Structures
Buildings 2005
Cartographers: C. Kasmerchak and S. Pero
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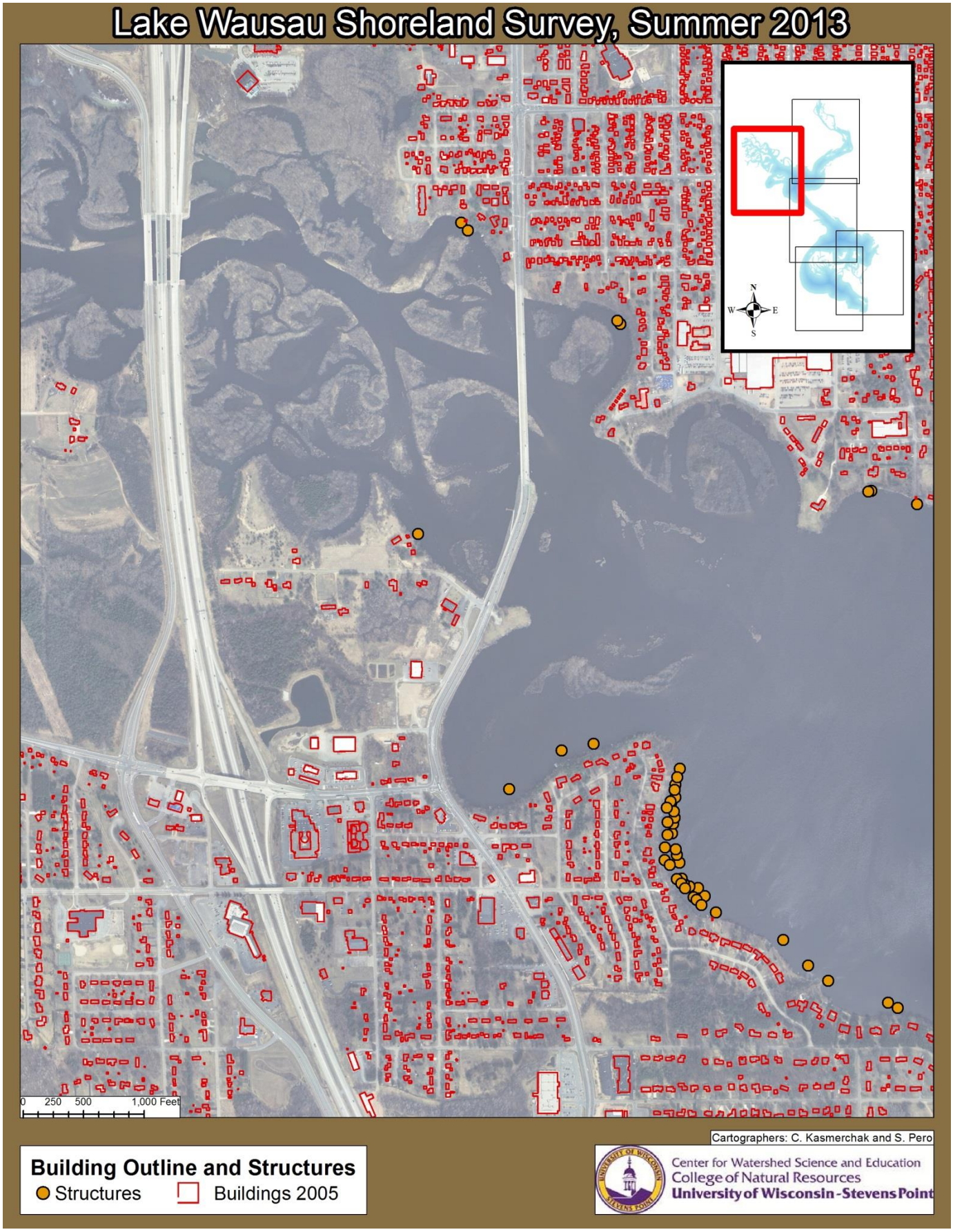
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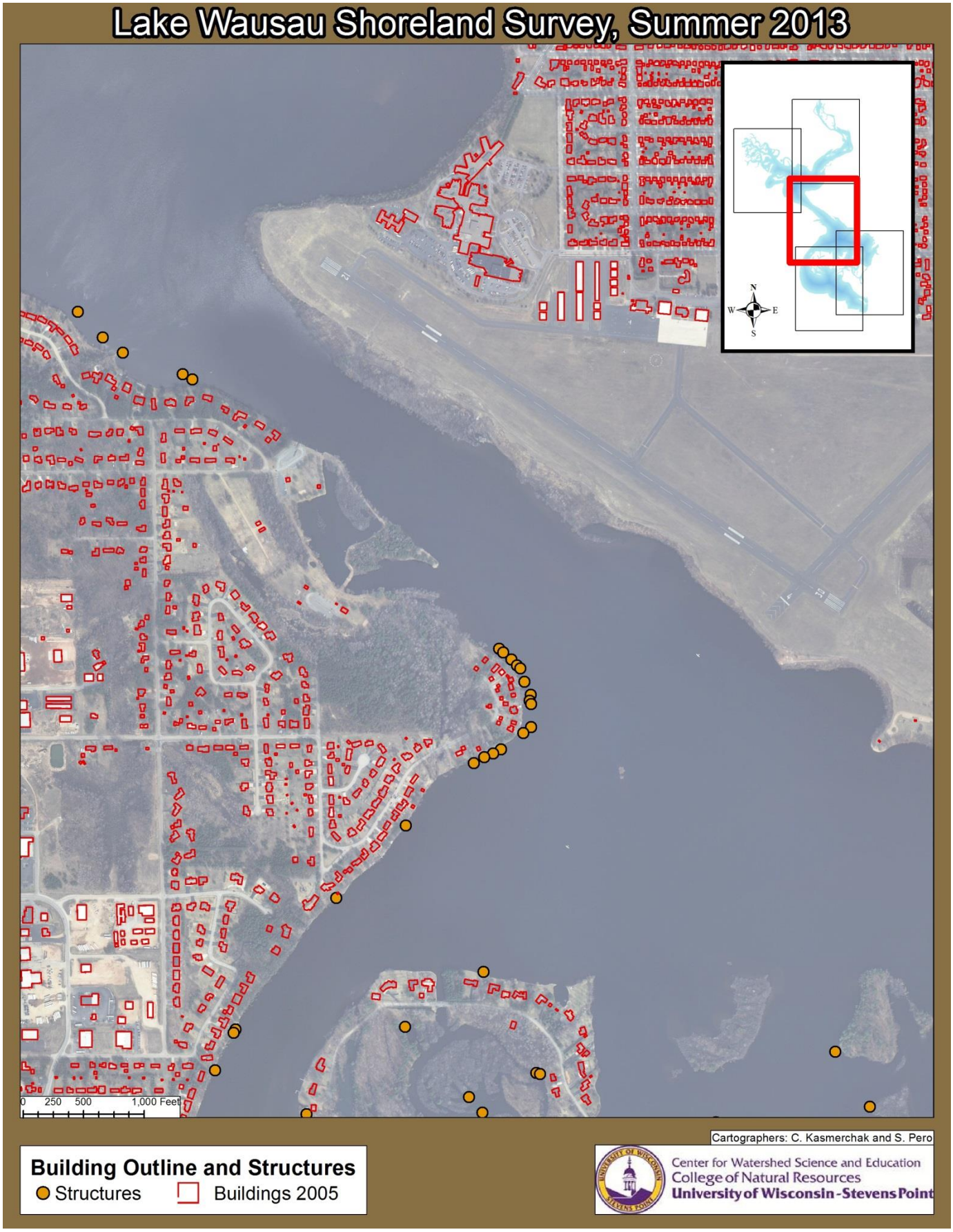
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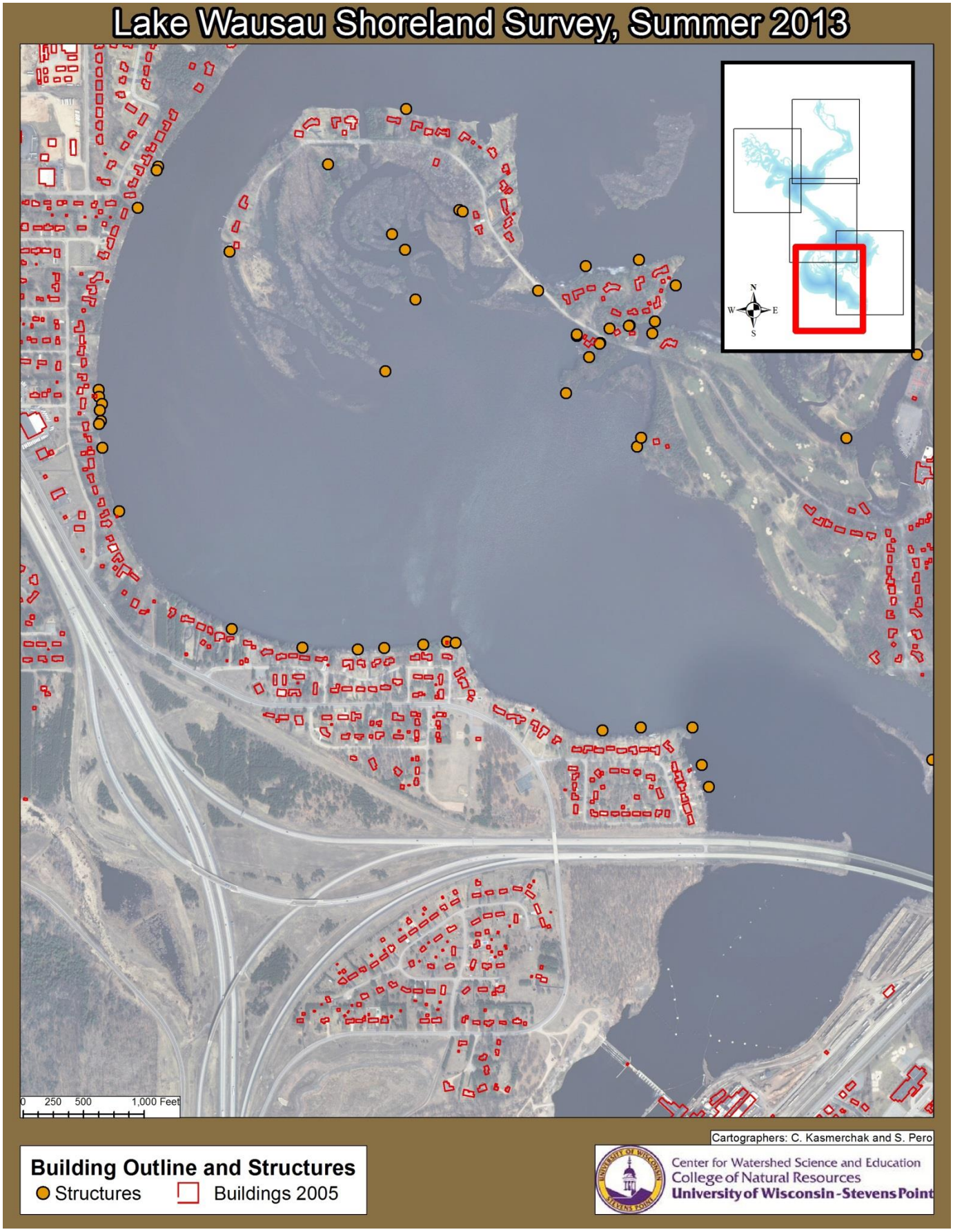
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Appendix E – Woody Habitat – Side Scan Sonar Report