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Shoreland Assessments and Critical Habitat Mapping of Alma and Moon Lakes, Vilas County, Wisconsin

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Project Description

The goal of this project is to encourage landowners to implement shoreland best management practices in ecologically sensitive shoreland regions of Alma and Moon Lakes where needed. It is our working assumption that knowledge of the lakes' important ecological features will motivate lake property owners to initiate practices that conserve or restore native shoreland vegetation, protect the near-shore lake environment, and minimize erosion and surface water run-off to the lake.

Lakeshore property development and recreational use often leads to degraded fish and wildlife habitat quality as well as increased sediment and nutrient run-off. Best management practices which reduce run-off and improve habitat quality are available and can mitigate the impacts of development. There are 42 individual tax parcels on Moon Lake and 58 on Alma Lake – the goal is to use the results of this project to prioritize education and outreach efforts to target landowners and shoreland areas that will benefit most from shoreland best management practices.

We undertook 3 boat surveys of Moon and Alma Lakes in 2023 and used the data collected to complete GIS mapping projects to accomplish this goal. First, we conducted boat surveys in May along the Moon and Alma Lakes shorelines and mapped two Critical Habitat features, coarse wood, and rock/rubble/ gravel substrate in the littoral zones. During the 2nd survey conducted in July we assessed the shoreland condition at each individual tax parcel adjacent to the two lakes, using the WDNR Lake Shoreland & Shallows Habitat Monitoring Field Protocol (Hein et al. 2020). The 3rd survey was conducted in late August and early September to map sites with natural shoreline, high quality fish and wildlife habitat, diverse aquatic plant communities, shorelands with natural scenic beauty that are protective of water quality, and important wetland areas. We followed the Wisconsin Department of Natural Resources Critical Habitat Program (Cunningham 2008 Draft WDNR Critical Habitat Designation Manual) to designate these Critical Habitat sites (Critical Habitat Areas | | Wisconsin DNR).

Results from these efforts are used in a GIS project to identify individual properties for shoreland management education and outreach efforts including site assessments and recommendations for best management practices. We focus on properties that exhibit degraded buffer conditions, have evident erosion and run-off issues, and are near shoreland areas of high ecological value (e.g. Critical Habitat).

The study results and recommendations are delivered to the Alma-Moon Lake P&R District to assist in management of surface waters within their jurisdiction.

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Project Outcomes

All products from this project can be posted on the Alma-Moon Lake P&R District web page. Information could also be posted on social media sites such as Facebook, YouTube, and contained in printed brochures. The purpose will be to:

- Inform the Alma-Moon Lake P&R District and lake neighbors of the existing critical habitat features and shoreland conditions on Alma and Moon Lakes.
- Educate property owners on best management practices to improve the water quality, fisheries, wildlife, wetlands, and natural scenic beauty of the lakes.
- Promote projects that demonstrate best management practices which improve shoreland and aquatic habitat.
- Identify shoreland areas which would lend themselves to neighbor-to-neighbor shoreland restoration discussions – with a goal of focusing property owners on the Healthy Lakes Program of Wisconsin for a discussion of management practices and potential project funding. Let's make Healthy Lakes together! - Wisconsin's Healthy Lakes Program (healthylakeswi.com)

Methods

Shoreland and Shallows Habitat Monitoring Surveys on Moon and Alma Lakes

We conducted boat surveys July – August 2023 of the Moon and Alma Lake shorelands and assessed the upland and shoreland buffer condition and identified erosion and run-off issues on 42 tax parcels adjacent to Moon Lake and 58 tax parcels adjacent to Alma Lake using the WDNR Lake Shoreland & Shallows Habitat Monitoring Field Protocol (Hein et al. 2020). We estimated 1) canopy coverage, 2) the amount of shoreland buffer in native shrub and herbaceous cover and/or impervious surface and/or manicured lawn, 3) the extent of bank erosion and gullying/channeling run-off and the amount of riprap, and seawall present, 4) the amount of artificial beach and aquatic plant removal. In addition we counted the number of piers, swim rafts, boat lifts, boats on shore, buildings within the shoreland buffer, fire rings, boat houses and marinas on the lakes' shoreline. This data was entered into standardized WDNR reporting forms and tables and GIS maps were made from the results and included in this report.

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Critical Habitat Mapping on Moon and Alma Lakes

Nova Ecological Services (NES) identified 6 critical habitat sites on Moon Lake and 4 critical habitat sites on Alma Lake in 2023. Prior to field work an extensive data review was conducted to gather preliminary data about critical habitat on Moon and Alma Lakes. Data sources reviewed include: 1) WDNR fish survey data and reports, 2) Natural Heritage Inventory data, 3) Lake Management Plans, 4) Wisconsin Wetland Inventory, 5) Waterbody Designations, 6) Riparian Areas under Public Ownership, 7) Aquatic Plant Survey Data, 8) DNR Surface Water Data Viewer database and 9) Watershed Delineation Maps. Critical habitat sites selected contained 3 or more of the following characteristics - high quality 1) fish habitat, 2) wildlife habitat, 3) water quality protection, 4) wetlands, 5) aquatic plant communities, and 6) natural scenic beauty.

An initial lake-wide boat survey was conducted by NES in May 2023 to identify important fish habitat (presence of rock/rubble/gravel and/or coarse woody habitat in the littoral zone). A GPS waypoint was generated for the location of all coarse wood following the WDNR Lake Shoreland & Shallows Habitat Monitoring Field Protocol (Hein et al. 2020). Waypoints were also generated for locations of shoreland areas containing rock/rubble, gravel substrates that may be suitable for walleye, white sucker, and nongame fish spawning. Diverse aquatic plant communities were located using the 201O and 2019 Aquatic Plant Point-Intercept survey data collected by Onterra LLC on Moon and Alma Lakes. Wetland areas and plant beds adjacent and within Moon and Alma Lakes was determined from the Wisconsin Wetland Inventory shapefile for Vilas County. All this information was transferred to a lake map and areas that were designated as potential critical habitat sites were evaluated in the field during late summer boat surveys.

A lake-wide critical habitat survey was conducted by boat on Moon, Alma, and Engel Lakes in late August - September 2023 where the mapped critical habitat sites were visited and verified. Narratives were developed for each Critical Habitat site, numbered Alma-1 through Alma-4, and Moon-5 through Moon-10 (including Engel Lake) which includes a description of the public rights habitat characteristics, a map of the site, and photographs of the important features. We ranked (1-6) the Critical Habitat sites based on the presence of the following attributes – quality fish habitat, quality wildlife habitat, quality wetlands, diverse aquatic plant communities, water quality protection, natural scenic beauty. Each attribute provided a value of 0 or 1 with a maximum of 6 attributes per site. Management recommendations are also made for each site.

At the present time the 4 Critical Habitat designations made by NES on Alma Lake and 6 Critical Habitat designations on Moon Lake are ***advisory***, and the Alma-Moon Lake P&R District would have to request the WDNR initiate the procedure described in the section, Formally Designating the Critical Habitat Features on Alma and Moon Lakes, if there is a desire to make the designations legally binding.

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Contents of this Report

In this report we present the Shoreland Assessment results for Alma and Moon Lakes separately from the Critical Habitat mapping results. Within each Shoreland Assessment section is a summary table of shoreland assessment results and GIS maps displaying important findings. At the end of the section, shoreland conditions are compared between Alma and Moon Lakes.

This is followed by a description of Critical Habitat features on both lakes, and GIS maps displaying these features. Where Critical Habitat features are present in 3 or more defined categories, GIS is used to create polygon boundaries for each Critical Habitat site. A description and photos of each of ten Critical Habitat site is included, along with management recommendations.

We complete the report with recommendations for use of this report by the Alma-Moon Lake P&R District as well as specific lake management recommendations for Alma and Moon Lakes going forward.

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Alma Lake, Vilas County, WBIC (Waterbody I.D. Code) 967900

Alma Lake is a 58-acre deep seepage lake located in Vilas County. It is connected to Moon Lake through a throughfare located on the northern portion of the lake. It has a mean depth of 11 feet and a maximum depth of 20 feet (Wisconsin Lakes). Average water clarity (secchi disk) over the last 10 years was 11 feet. It is a mesotrophic lake (mid-range in fertility, Figure 1) with average total phosphorus values of 14 parts per billion (ppb) and Chlorophyll A values of 3.8 ppb. The water quality of Alma Lake is like other deep seepage Lakes in Wisconsin (Figure 2) WEx WDNR (shinyapps.io) .

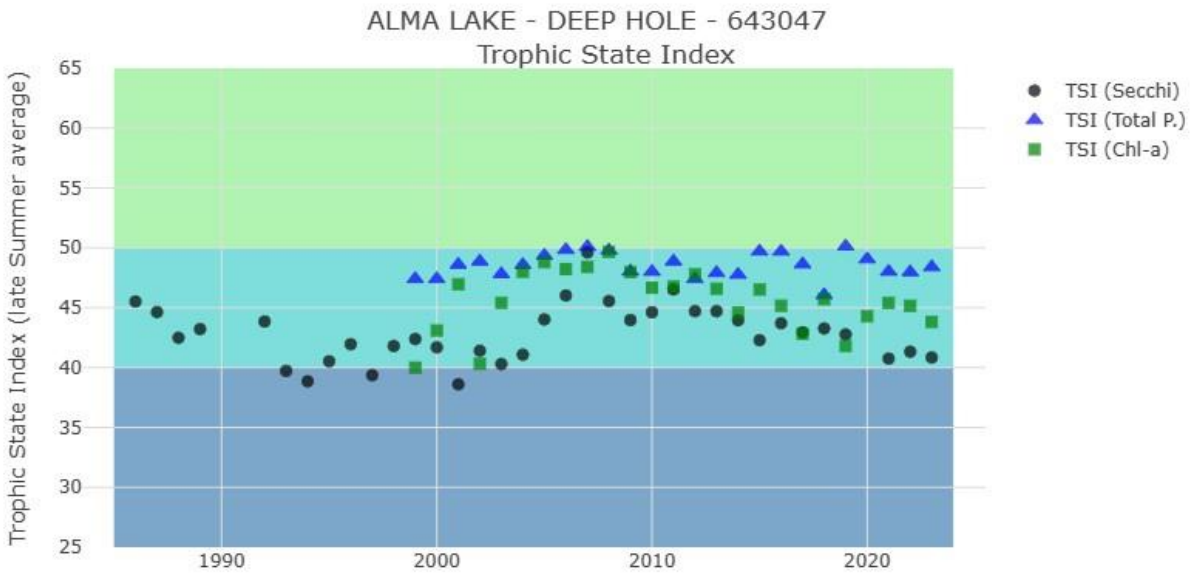

Figure 1. Trophic State of Alma Lake

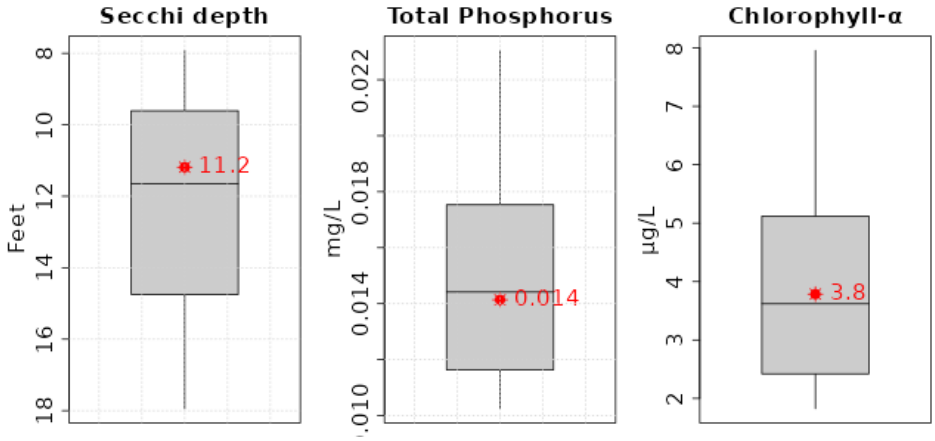

Figure 2. The trophic state of Alma Lake compared to similar lakes. Summer trophic indicator averages (red) from the last 10 years compared to other **DEEP SEEPAGE** lakes (gray box and whiskers).

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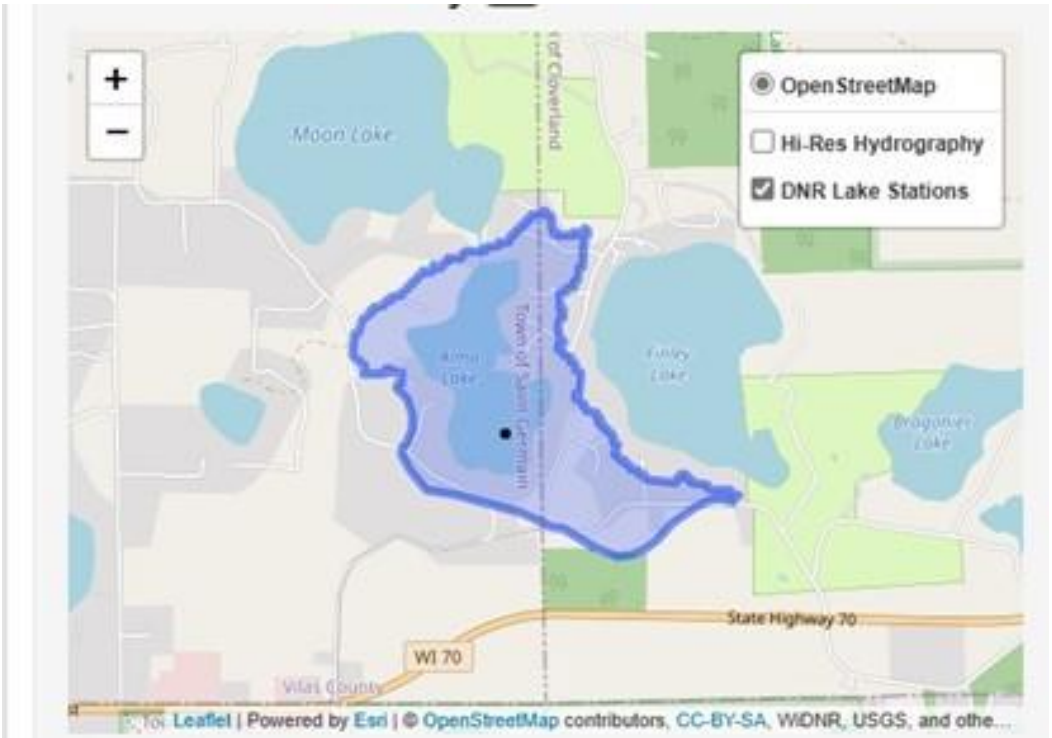
The Alma Lake drainage area (watershed) is 203 acres and consists of 20 acres of rural residential, 94 acres of forest, 27 acres of wetland and 62 acres of water (WDNR Lake Data). The drainage area to lake area ratio is 3.5-1 indicating a small watershed. The lake water residence time is about 7.1 years (WILMS Modeling) and annual phosphorus loads range from 11-13 pounds per year (lbs./year) averaging 13 lbs./year (WDNR WILMS Modeling).



Reach information

Waterbody name: Alma Lake
Waterbody type: Lake
Natural Community: NA
Watershed size (sq mi; sq km): 0.317; 0.82
HYDROID: 600010652
HUC12: 070700010403
Ecoregion: Northern Lakes and Forests
Sinuosity (m/m): NA
Minimum elevation (ft; m): NA; NA
Maximum elevation (ft; m): NA; NA
Average gradient (%): NA
Stream order: NA
Dam directly above: Not Present
Drainage: Internally drained

Figure 3. Land Area Draining to Alma Lake.

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Alma Lake was assessed by the WDNR and is not considered impaired under Wisconsin's Consolidated Assessment and Listing Methodology (WisCALM) and meets water quality standards. The lake supports a warmwater fishery and is managed for panfish, musky, largemouth bass, smallmouth bass, and walleye.

All of Alma Lake shoreline is in private ownership.

Shoreland Condition adjacent to Alma Lake – Buffer Zone

Shoreland development often degrades the habitat quality of lakeshore buffer zones. In this study, we define the buffer zone to be from the ordinary high-water mark (OHWM) to 35' inland. Manicured lawns reduce wildlife habitat, and impervious surfaces (rooftops, driveways, etc.) increase nutrient and sediment run-off. We identified properties where the buffer zone is greater than 40% manicured lawn and impervious surface (Figure 4, shaded pink). These landowners should be encouraged via education and outreach to increase native plantings along their lakeshores. Lake managers recommend leaving at least 70% of the buffer in native vegetation. As stated in Wisconsin Shoreland Zoning Minimum Standards (Wisconsin's Shoreland Management Program | Wisconsin DNR NR115.05(3)(c), Wis. Admin. Code): **"The county may allow removal of trees and shrubs in the vegetative buffer zone to create access and viewing corridors, provided that the combined width of all access and viewing corridors on a riparian lot or parcel may not exceed the lesser of 30 percent of the shoreline frontage or 200 feet"** **(**https://docs.legis.wisconsin.gov/code/admin_code/nr/100/115/05/1/c/2/b**).**

On Alma Lake, tax parcels with impaired buffers comprise 3939 feet of shoreline, which is 45.2% of the shoreline, or 2387 feet of impaired buffer/mile shoreline. During our lake surveys we also identified shoreland properties where the buffer is in a natural shoreland condition (Figure 5, shaded green). At these properties the buffer is 90% or more in native trees, shrubs, forbs, and grasses. On Alma Lake, tax parcels with buffers in natural shoreline condition comprised 2606 feet of shoreline which is 29.8% of the shoreline, or 1579 feet per mile of Alma Lake shoreline. The remainder of the tax parcels (25% of the shoreline) are developed with 40-89% of buffer in native grasses, forbs, and shrubs. There are detailed descriptions of practices landowners can adopt to improve their shoreland habitat buffers in the Wisconsin Healthy Lakes Program (Let's make Healthy Lakes together! - Wisconsin's Healthy Lakes Program (healthylakeswi.com)) along with grants property owners can acquire to pay for the costs of these improvements.

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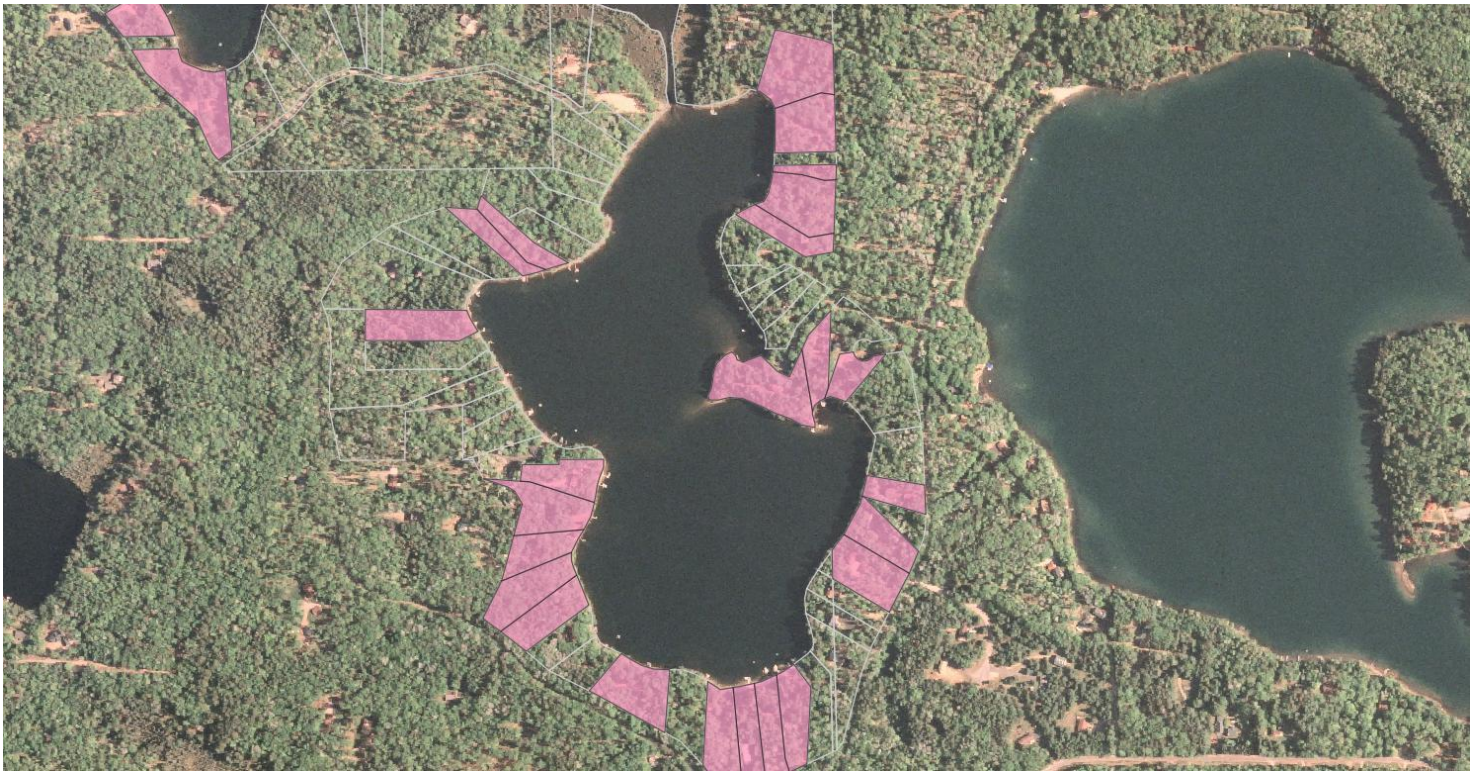

Figure 4. Alma Lake tax parcels shaded in pink have shoreland buffers with greater than 40% of the area cleared of native vegetation - often in lawns, impervious surfaces, and other shoreland development.

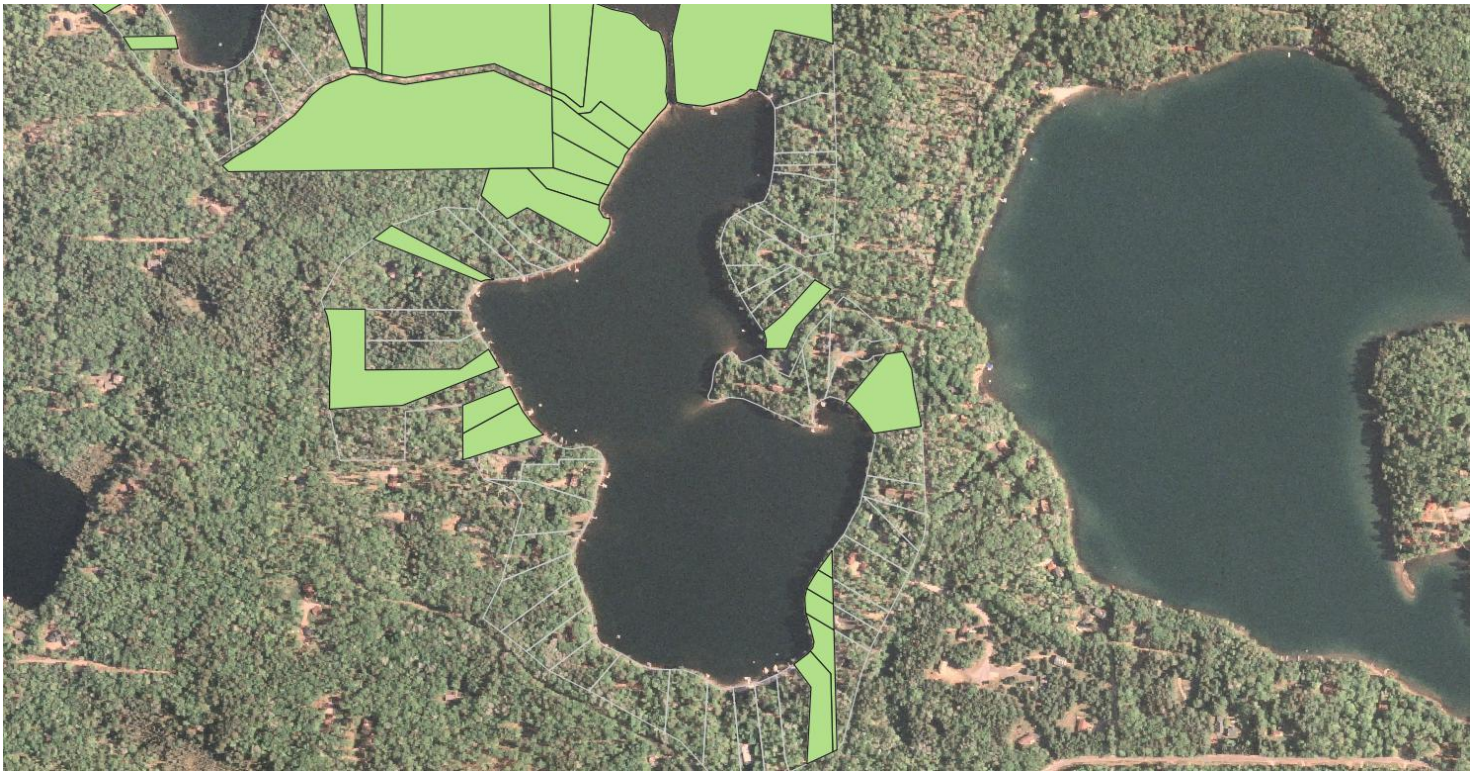

Figure 5. Alma Lake tax parcels shared in light green have shoreland buffers in a natural state – where greater than 90% of the area is in native trees, shrubs, and herbaceous plants.

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Shoreland Condition adjacent to Alma Lake – Erosion Issues

Shoreland erosion issues are not a great concern on Alma Lake, despite the high level of development and relatively steep slopes on parts of the lake. Lakeshore development for housing and recreation can result in removal of native vegetation, disturbance of soil, and introduction of impervious surfaces such as concrete, roof tops, asphalts – materials where rainfall and snow melt cannot percolate through to the soil. The parcels shaded brown in Figure 6 represent parcels where surface water run-off was creating shoreland erosion and/or gullying. These parcels can be improved by implementing practices to redirect overland movement of precipitation and snowmelt. There are detailed descriptions of practices landowners can adopt to decrease shoreland run-off in the Wisconsin Healthy Lakes Program (Let's make Healthy Lakes together! - Wisconsin's Healthy Lakes Program (healthylakeswi.com)) along with application for grants property owners can obtain to pay for the costs of these improvements.

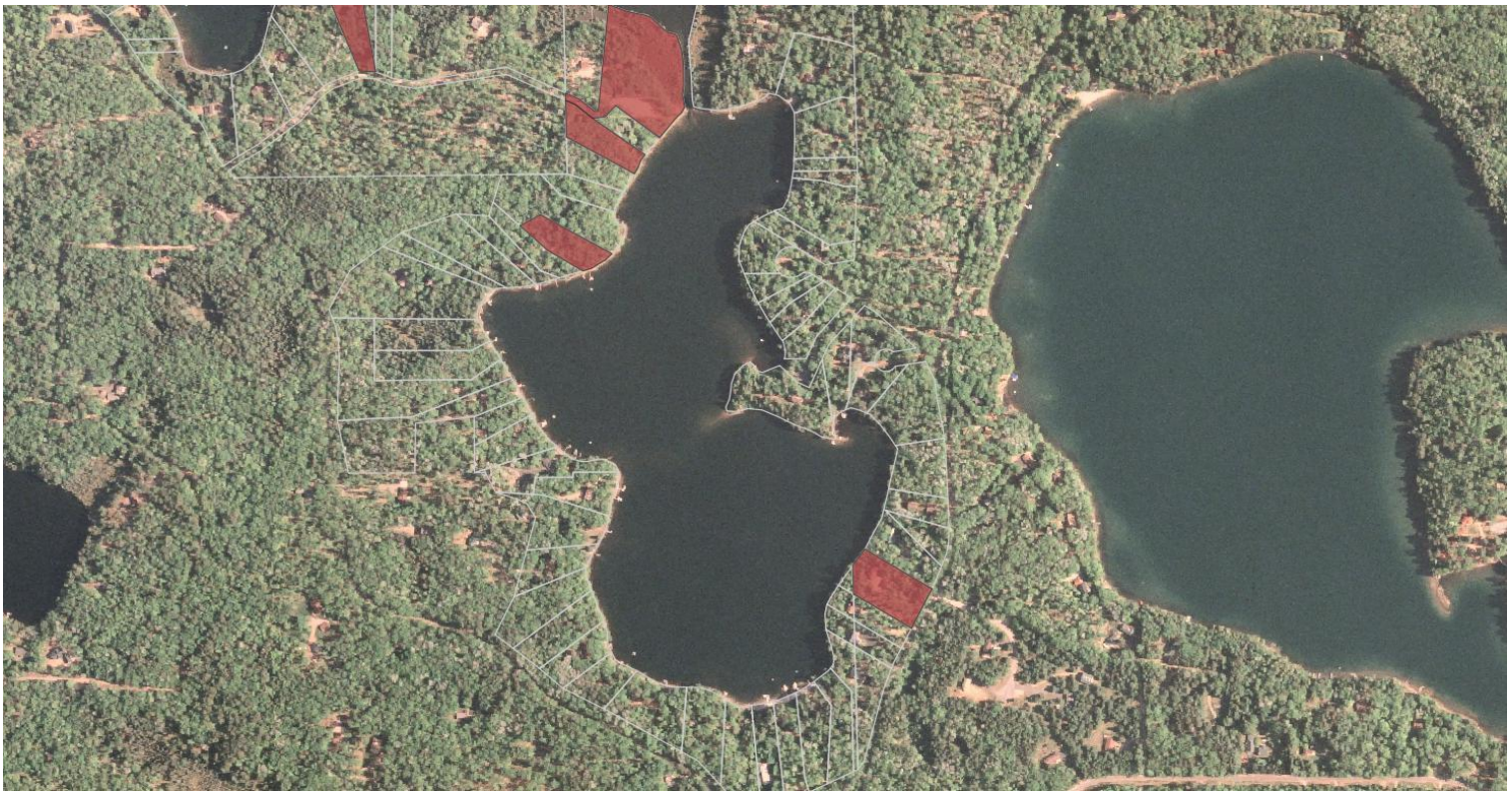

Figure 6a. Alma Lake tax parcels shaded in brown have evidence of shoreland run-off from rainfall and/or snow melt.

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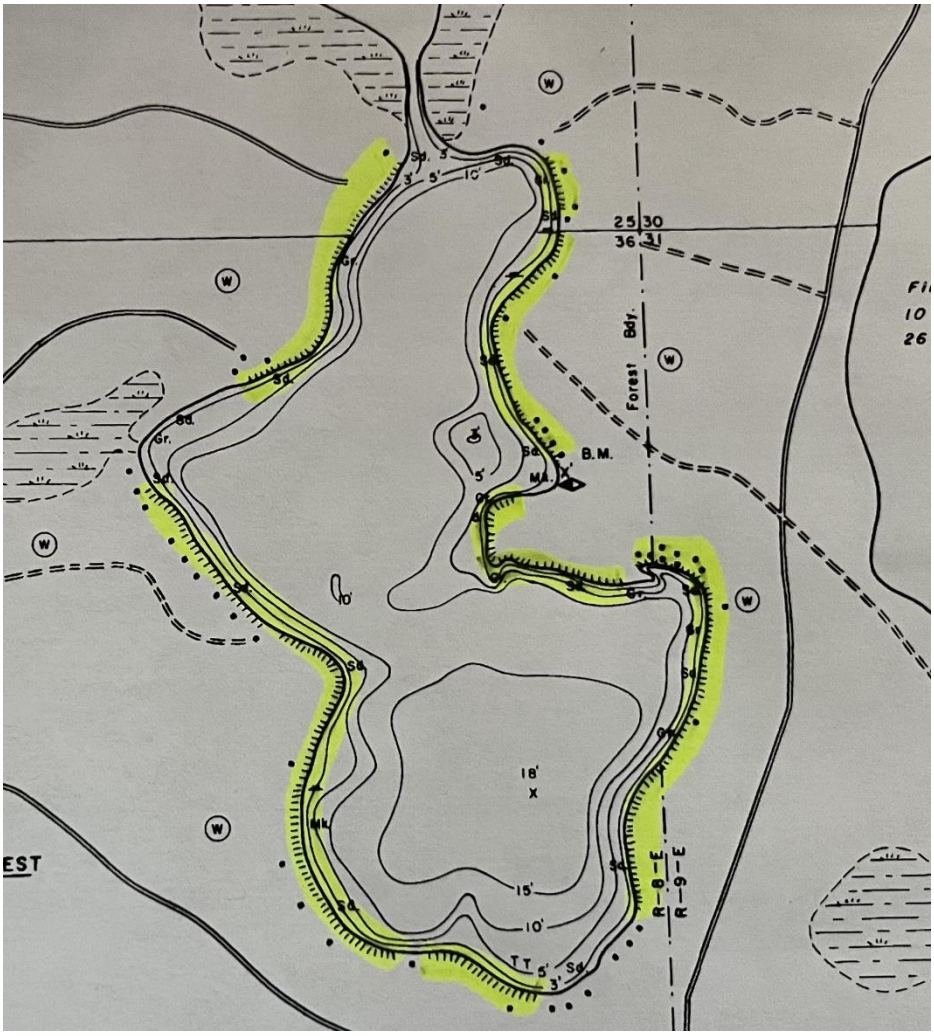

Figure 6b. Location of steep slopes in the Alma Lake shoreland as identified by WDNR lake bathymetry map. Hatch marks shaded in yellow = steep slopes. Alma Lake - Vilas County, Wisconsin DNR Lake Map, Sep 1977, Not for Navigation

Wave action and boat wakes can also result in bank erosion, the loss of shoreland habitat right at the water's edge. Despite the high level of shoreland development on Alma Lake, there was no evidence of bank erosion – likely a consequence of the small lake size minimizing natural wave action, as well as the no wake boating ordinance in place on Alma Lake.

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Moon Lake, Vilas County, WBIC 1005800

Moon Lake is a 131-acre deep seepage lake located in Vilas County. It is connected to Alma Lake through a throughfare located on the southern portion of the lake. It has a mean depth of 17 feet and a maximum depth of 38 feet (Wisconsin Lakes). Average water clarity (secchi disk) over the last 10 years was 13.9 feet. It is classified as an oligotrophic- mesotrophic lake (low to mid-range in fertility; Figure 7) with average total phosphorus values over the last 10 years of 12 parts per billion (ppb) and chlorophyll A values of 3.6 ppb (Figure 8). The water quality of Moon Lake is like other deep seepage Lakes in Wisconsin WEx WDNR (shinyapps.io)

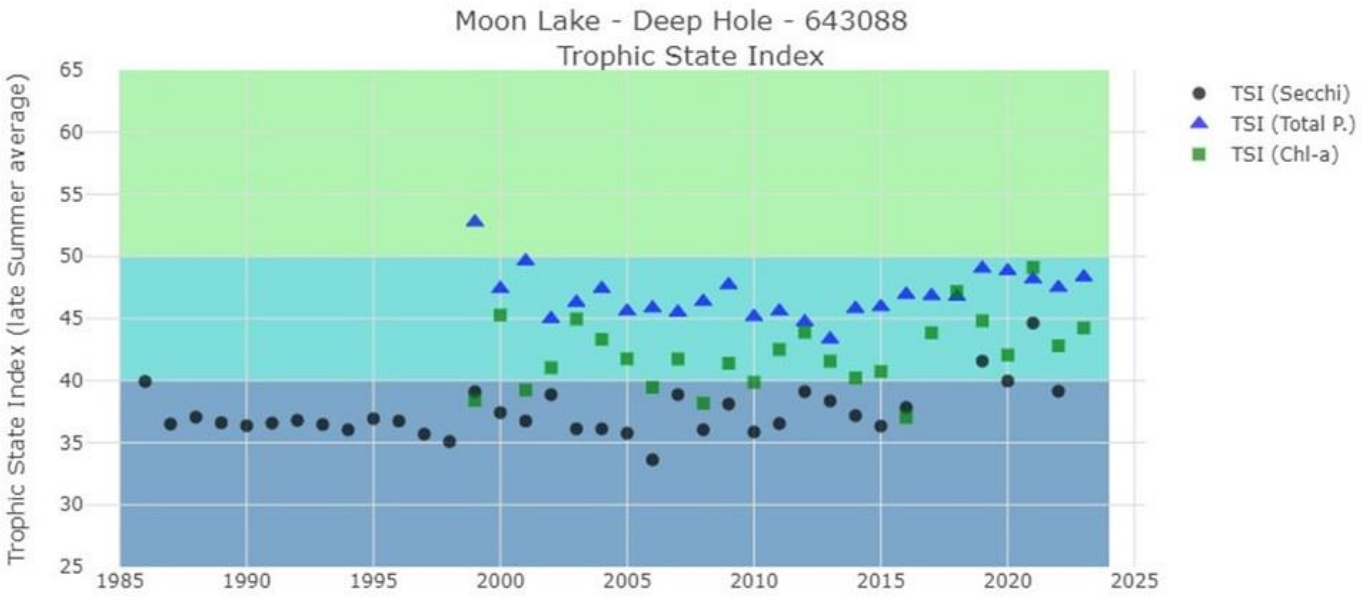

Figure 7. Trophic State of Moon Lake.

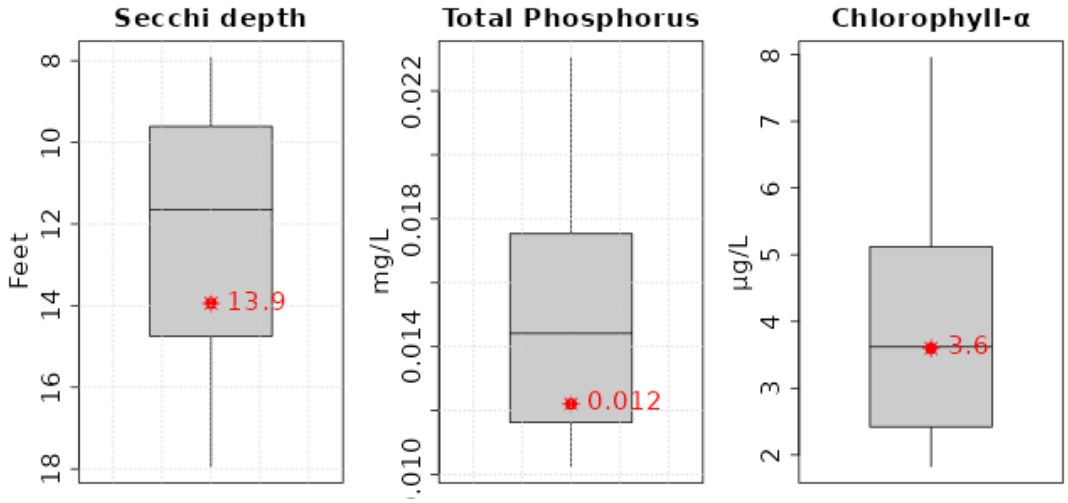

Figure 8. Trophic status compared to similar lakes. Late summer trophic indicator averages (red) from the last 10 years compared to other **DEEP SEEPAGE** lake (gray box and whiskers).

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The drainage area (watershed) of Moon Lake is 763 acres and consists of 56 acres of rural residential, 333 acres of forest, 159 acres of wetland and 215 acres of water (Figure 9, Wisconsin DNR Lake Data). The drainage area to lake area ratio is 5.73-1 indicating a small watershed. The lake water residence time is about 6.1 years (WDNR WILMS Modeling) and annual phosphorus loads range from 46-51 pounds per year (lbs./yr.) and average about 48 lbs./yr. (WILMS Modeling).

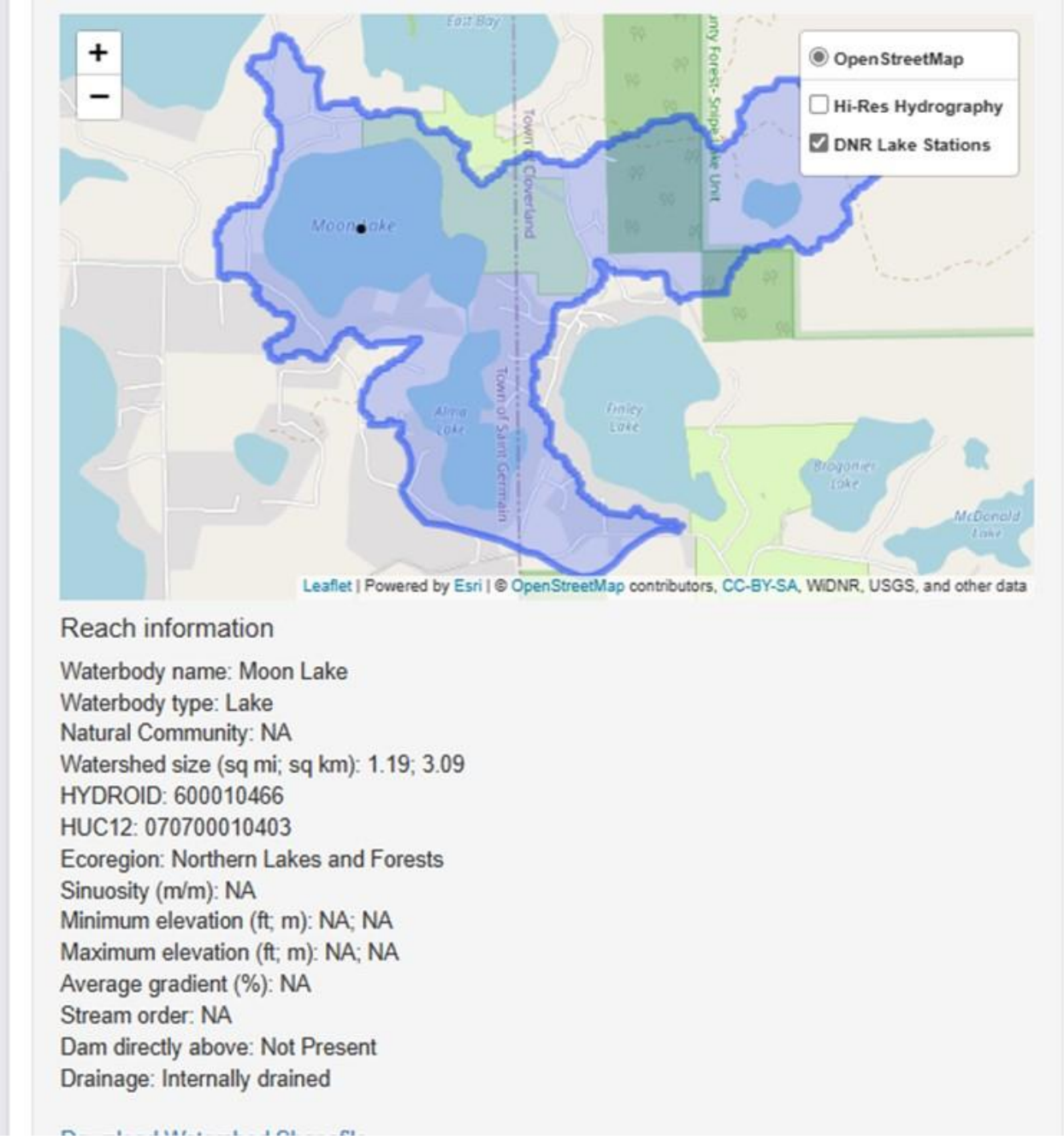

Figure 9. Land Area Draining to Moon Lake.

Moon Lake was assessed by WDNR and is not considered impaired under Wisconsin's Consolidated Assessment and Listing Methodology (WisCALM) and meets water quality standards. The lake supports a

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warmwater fishery and is managed for panfish, northern pike, musky, largemouth bass, smallmouth bass, and walleye.

All of Moon Lake shoreline is in private ownership.

Shoreland Buffer Condition adjacent to Moon Lake

Shoreland development often degrades the habitat quality of lakeshore buffer zones. In this study, we define the buffer zone to be from the ordinary high-water mark (OHWM) to 35' inland. Manicured lawns reduce wildlife habitat, and impervious surfaces (rooftops, driveways, etc.) increase nutrient and sediment run-off. We identified properties where the buffer zone is greater than 40% manicured lawn and impervious surface (Figure 10, shaded pink). These landowners should be encouraged via education and outreach to increase native plantings along their lakeshores. Lake managers recommend leaving at least 70% of the buffer in native vegetation. As stated in Wisconsin Shoreland Zoning Minimum Standards (Wisconsin's Shoreland Management Program | Wisconsin DNR NR115.05(3)(c), Wis. Admin. Code): **"The county may allow removal of trees and shrubs in the vegetative buffer zone to create access and viewing corridors, provided that the combined width of all access and viewing corridors on a riparian lot or parcel may not exceed the lesser of 30 percent of the shoreline frontage or 200 feet"**
(https://docs.legis.wisconsin.gov/code/admin_code/nr/100/115/05/1/c/2/b**).**

On Moon Lake, tax parcels with impaired buffers comprise 3057 feet of shoreline, which is 29.2% of the shoreline, or 1543 feet of impaired buffer/mile shoreline. During our lake surveys we also identified shoreland properties where the buffer is in a natural shoreland condition (Figure 11, shaded green). At these properties the buffer is 90% or more in native trees, shrubs, forbs, and grasses. On Moon Lake, tax parcels with buffers in natural shoreline condition comprised 2396 feet of shoreline which is 22.9% of the shoreline, or 1210 feet of natural shoreline per mile of Moon Lake shoreline. The remainder of the tax parcels (47.9% of the shoreline) are developed with 40-89% of buffer in native grasses, forbs, and shrubs.

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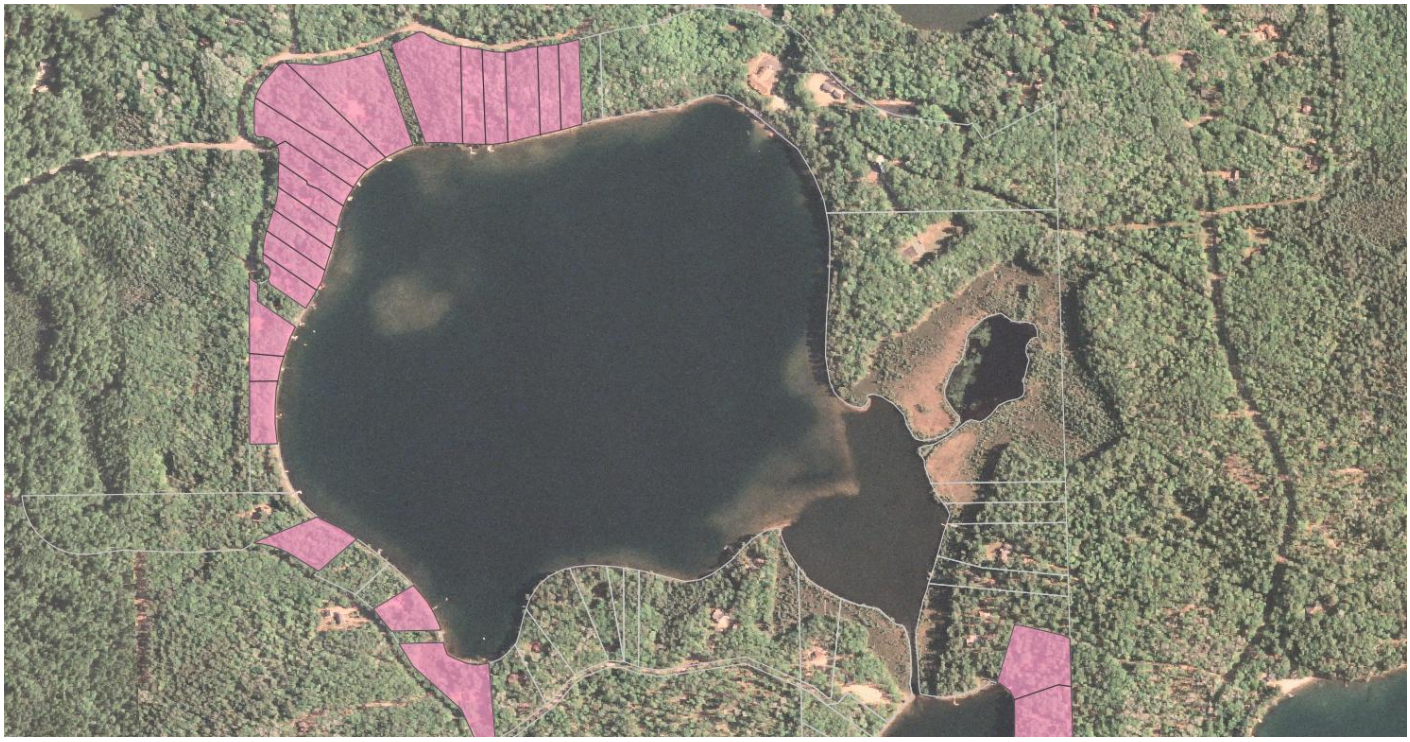

Figure 10. Moon Lake tax parcels shaded in pink have shoreland buffers with greater than 40% of the area cleared of native vegetation - often in lawns, impervious surfaces, and other shoreland development.

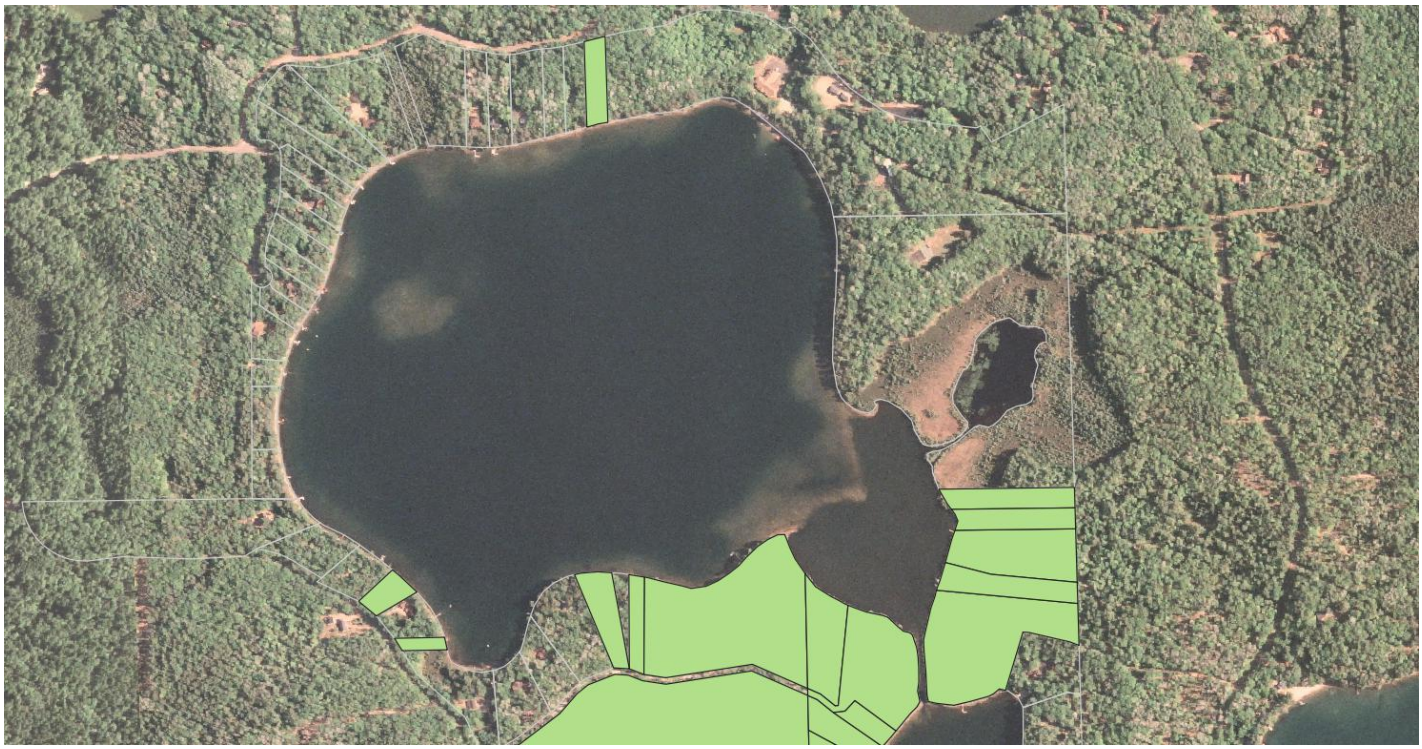

Figure 11. Moon Lake tax parcels shared in light green have shoreland buffers in a natural state – where greater than 90% of the area is in native trees, shrubs, and herbaceous plants.

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Shoreland Condition adjacent to Moon Lake – Erosion Issues

Shoreland erosion issues were observed on Moon Lake, but only moderate erosion was present when it occurred. Erosion is most evident in the north and west quadrant of the lake where there is a high level of development and relatively steep slopes on parts of the lakeshore. Development for housing and recreation can result in removal of native vegetation, disturbance of soil, and introduction of impervious surfaces such as concrete, roof tops, asphalts – any materials where rainfall and snow melt cannot percolate through to the soil. The parcels shaded brown in Figure 12a represent parcels where surface water run-off was creating shoreland erosion and/or gullying. Steep slopes dominate the Moon Lake shorelands (Figure 12b) thus landowners should be diligent to prevent the development of shoreland erosion problems. These parcels can be improved by implementing practices to redirect overland movement of precipitation and snowmelt. There are detailed descriptions of practices landowners can adopt to decrease shoreland run-off in the Wisconsin Healthy Lakes Program (Let's make Healthy Lakes together! - Wisconsin's Healthy Lakes Program (healthylakeswi.com)) along with application for grants property owners can obtain to pay for the costs of these improvements.

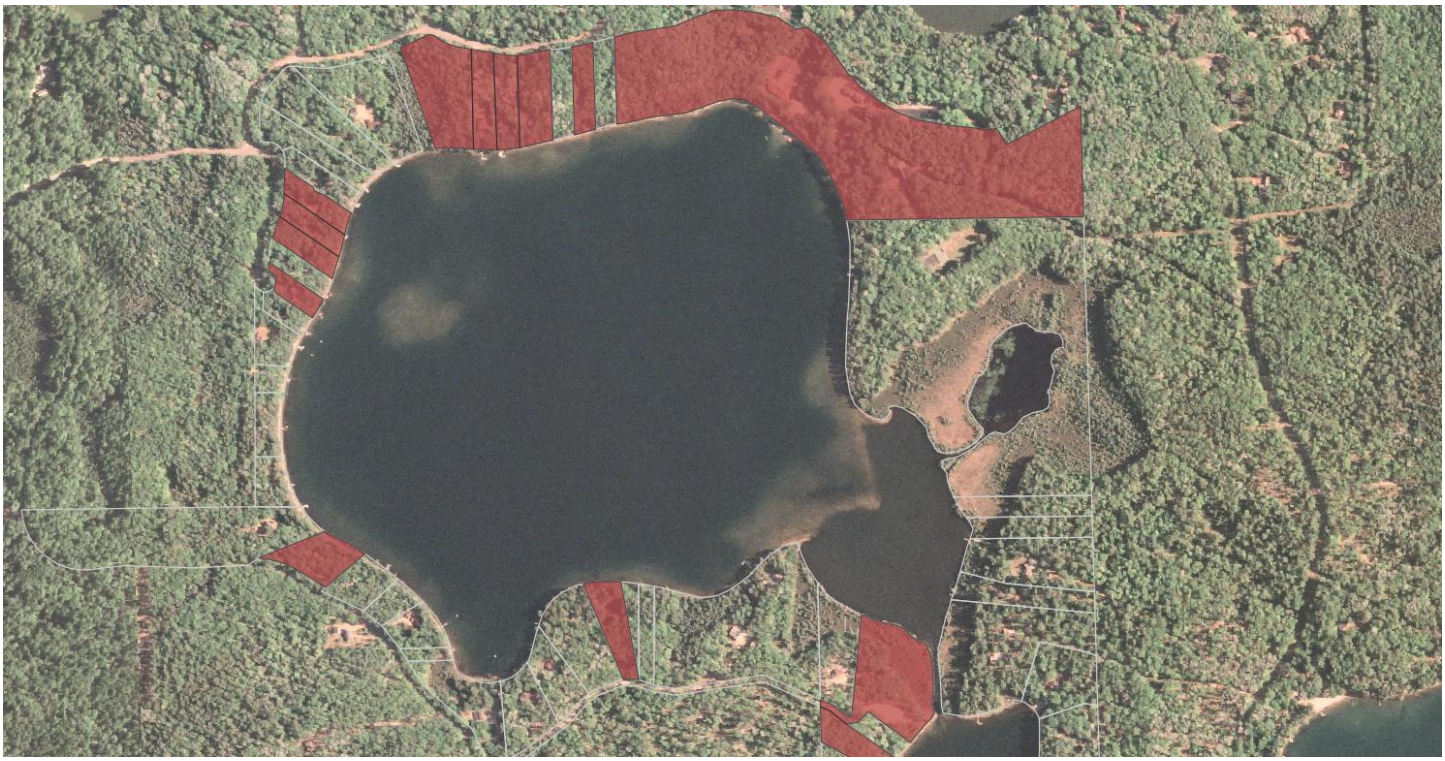

Figure 12a. Moon Lake tax parcels shaded in brown have evidence of shoreland run-off from rainfall and/or snow melt.

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Figure 12b. Location of steep slopes in the Moon Lake shoreland as identified by WDNR lake bathymetry map. Hatch marks shaded in yellow = steep slopes. [Moon Lake - Vilas County, Wisconsin DNR Lake Map, Sep 1977, Not for Navigation]

Wave action and boat wakes can also result in bank erosion, the loss of shoreland habitat right at the water's edge. Despite the high level of shoreland development, bank erosion was limited to a few parcels in the north and west shoreland areas (Figure 13).

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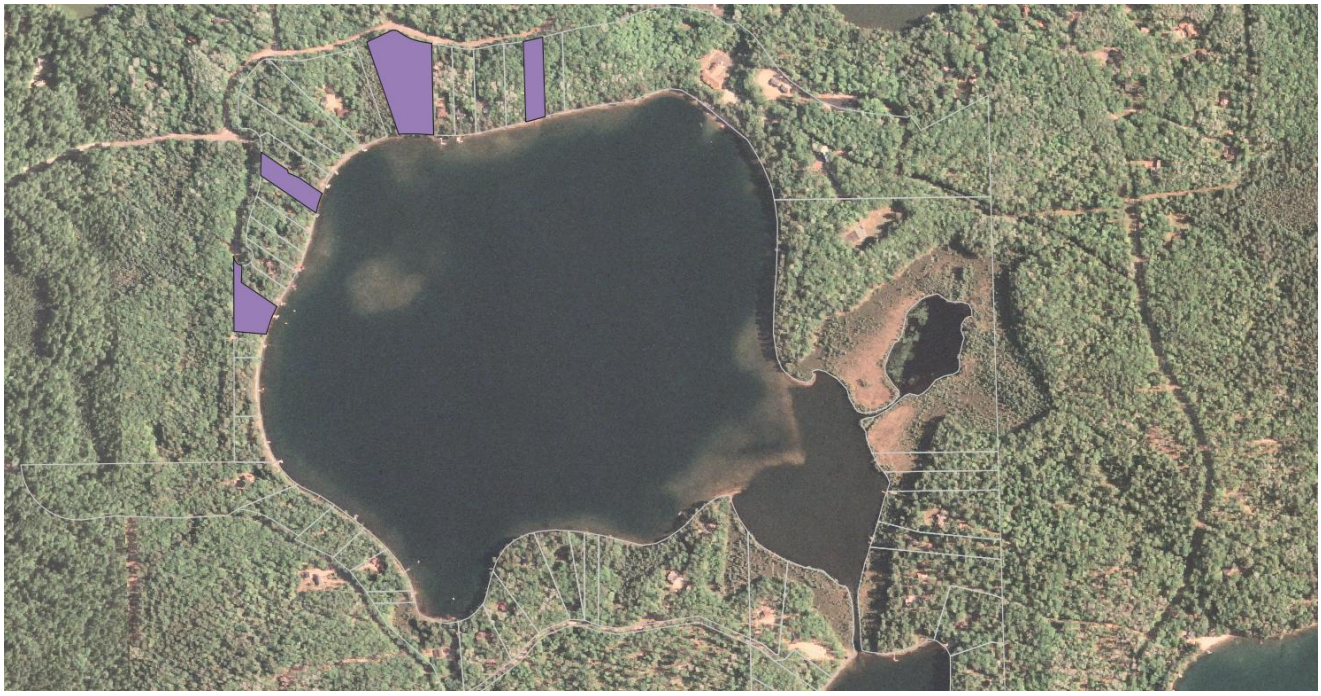

Figure 13. Moon Lake tax parcels where bank erosion was observed.

A Comparison of Alma Lake and Moon Lake Physical and Shoreland Features

The surface water area of Alma Lake is 40% less than that of Moon Lake, despite shoreline length being relatively similar (Table 1). Consequently, there are 66 acres of surface water area per mile of shoreline on Moon Lake vs. 37 acres of surface water area per mile of shoreline on Alma Lake.

There are no publicly held tax parcels on the shoreline of either lake therefore shoreland management is exclusively a responsibility of private landowners. There is one public boat landing on Alma Lake – public access to Moon Lake is via the Alma boat landing and the channel between the lakes.

Nearly all the tax parcels on Alma and Moon Lakes have been developed for housing and recreation. The shoreland dimensions of tax parcels on Alma Lake (35 tax parcels/mile shoreline) are greater than on Moon Lake (21 tax parcels/mile shoreline) (Table 1). Many features associated with development were more common on Alma Lake. For example, there are more than twice as many piers, swim rafts, buildings within the buffer, and artificial beach per mile of shoreline on Alma Lake as compared to Moon Lake. Also, 45% of the buffer on Alma Lake is classified as impaired and compared to 29% on Moon Lake. There was a greater amount of seawall on Moon vs. Alma Lake likely due to greater wave action on Moon.

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To improve the shoreland condition on both lakes, restoration of habitat on properties could be encouraged by promoting a “no-mow” and buffer restoration practice near the lake shore and pointing property owners to the Healthy Lakes program of Wisconsin with a description of methods of shoreland restoration and protection projects Healthy Lakes Program of WI. Let's Make Healthy Lakes Together! (healthylakeswi.com). These activities include run-off diversion and retention, planting of native species in the buffer, and placement of coarse wood in the littoral zone. Because some of the properties have buildings within the shoreland buffer, run-off from these impervious surfaces should be diverted from the lake and an attempt should be made to return at least a narrow vegetative buffer along the lakeshore. The program also provides a grant program to financially support these activities.

Table 1. A comparison of lake physical and biological features, as well as shoreland modifications, on Alma and Moon Lakes in Vilas County, Wisconsin. Results in bold font represent differences of at least 2x between lakes.

	Alma Lake	**per mile shoreline**	**per surface water acre**	**Moon Lake**	**per mile shoreline**	**per surface acre**
Surface Water (Acres)	**57.7**	**35.0**	1.00	**142.6**	**72.0**	1.00
Shoreline (miles)	1.65	1.0	**0.03**	1.98	1.0	**0.02**
Shoreland Tax Parcels	57	34.5	**0.99**	42	21.2	**0.32**
Buildings in Buffer	12	7.3	**0.21**	7	3.5	**0.05**
Boats on Shore	124	75.2	**2.15**	97	49.0	**0.74**
Fire Pits	7	4.2	**0.12**	8	4.0	**0.06**
Seawall (feet)	**30**	**18.2**	0.52	**100**	**50.5**	0.76
Rip Rap (feet)	370	224.2	6.41	590	298.0	4.50
Bank Erosion (feet)	0	0	**0**	60	30.3	**0.46**
Piers	59	35.8	**1.02**	38	19.2	**0.29**
Boat Lifts	10	**6.06**	0.17	5	**2.53**	0.04
Swim Rafts	8	4.85	**0.14**	9	4.55	**0.07**
Boat Houses	0	0	O	0	0	0
Marinas	0	0	0	0	0	0
Artificial Beach (feet)	330	**200**	**5.72**	100	**50.5**	**0.76**
Natural Shoreline (feet)	2606	1579.4	**45.16**	2396	1210.1	**18.29**
Impaired Buffer (feet)	3939	2387.3	**68.27**	3057	1543.9	**23.34**

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Critical Habitat Mapping – Alma and Moon Lakes

Critical Habitat Designations - Wisconsin's Waters Belong to Everyone

Wisconsin lakes and rivers are public resources, owned in common by all Wisconsin citizens under the state's Public Trust Doctrine. Based on the state constitution, this doctrine has been further defined by case law and statute. It declares that all navigable waters are "common highways and forever free", held in trust by the Department of Natural Resources.

Assures Public Rights in Waters

Wisconsin's Public Trust Doctrine requires the state to intervene to protect public rights in the commercial or recreational use of navigable waters. The WDNR, as the state agent charged with this responsibility, can do so through permitting requirements for water projects, through court action to stop nuisances in navigable waters, and through statutes authorizing local zoning ordinances that limit development along navigable waterways.

The Role of Critical Habitat Designation

By developing statutory language, administrative code, and from previous case law, Wisconsin has developed broad regulations related to structures and alterations of public waters. At the forefront of each of these regulatory mechanisms is the idea of public interest and rights. For numerous waterway and wetland permits, the WDNR has developed factors identified in the Administrative Code that are to be taken into consideration and to aid in following legislative and judicial mandates. The Critical Habitat Designation Program plays a pivotal role in implementing legislative and judicial mandates entrusted to the Department. Critical Habitat Designation is a program that includes formal designations of sensitive areas according to Ch. NR 107, public rights feature according to Ch. NR 1.06, and resource protection areas (areas within the shoreland zone). All these elements combine to provide regulatory and management advice to the State of Wisconsin, counties, local units of governments, and others who hold authorities or are interested in protecting and preserving these unique habitats for future generations.

Public rights features are defined in Ch. NR 1.06 include the following: (1) Fish and wildlife habitat, including specific sites necessary for breeding, nesting, nursery and feeding (Note: Physical features constituting fish and wildlife habitat include stands of aquatic plants; riffles and pools in streams; undercut banks with overhanging vegetation or that are vegetated above; areas of lake or streambed where fish nests are visible; large woody cover); (2) Physical features of lakes and streams that ensure protection of water quality ((Note: Physical features that protect water quality include stands of aquatic plants (that protect against erosion and so minimize sedimentation), natural streambed features such as riffles or boulders (that cause turbulent stream flow and so provide aeration)); (3) Reaches of bank, shore or bed that are predominantly natural in appearance (not man−made or artificial) or that screen man−made or artificial features (Note: Reaches include those with stands of vegetation that include intermixed trees, shrubs and grasses; stands of mature pines or other conifer species; bog fringe; bluffs rising from the water's edge; beds of emergent plants such as wild rice, wild celery, reeds, arrowhead); and 4) Navigation thoroughfares or areas traditionally used for navigation during recreational boating, angling, hunting or enjoyment of natural scenic beauty (Note: Physical features indicative of navigation thoroughfares include shallow water areas typically used by wading anglers or areas frequently occupied by regularly repeated public uses such as water shows). Sensitive areas (defined in Ch. NR

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107) are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or life stage requirements, or offering water quality or erosion control benefits to the body of water.

What is the procedure for identifying public rights features?

After survey data shows possible locations of public rights features, the WDNR must give notice in the official state newspaper or other local media the WDNR selects in the area affected which is likely to inform residents. Next, the WDNR must notify the county clerk of any county bordering the lake, legislators whose districts include the affected public waters and the chairpersons of the committees of the legislature with jurisdiction for natural resource issues, and local, regional, or state lake. The notice needs to contain the location and description of the possible public rights features and the basis for its determination that the location is likely to contain public rights features. If a hearing is not requested in writing within 30 days after the mailing of the notice, the WDNR may waive the hearing. Upon receipt of a request for a hearing, the department must, not less than 10 days before the hearing, mail a written notice thereof to each person notified under par. (b), and shall provide notice on its website and through its system of electronic notices to state media. Finally, at each hearing, the WDNR must take evidence offered by persons in support of or in opposition to the determination. If the WDNR finds any location not properly classified, the location may not be identified as the location containing public rights features. A description of the WDNR Critical Habitat program is found at this link Critical Habitat Areas | Wisconsin DNR. From this website, the WDNR describes the potential impact this designation may have on shoreland property owners:

"HOW THIS PROGRAM AFFECTS WATERFRONT OWNERS - Critical Habitat Designations provide advance information to waterfront owners, to clarify the regulations that will apply when they want to do a construction project or activity along their shoreline. If a project is proposed in a designated Critical Habitat area, the permit jurisdiction or the permit process may change. This allows DNR to ensure that proposed projects will not harm these sensitive resources".

Critical Habitat Features on Alma and Moon Lakes

Fish Habitat - Coarse Wood in littoral zone

Waypoints were collected of all coarse wood (pieces >4" diameter, >5' length) along the shoreline of Alma and Moon Lakes (Figure 14). The individual coarse wood was further delineated as submerged logs, logs touching shore, full tree crowns, and logs with some branching, following the Hein et al. (2020) protocol. While not equally distributed, there were 231 pieces of coarse wood on Alma Lake, or 140 pieces per mile of shoreline. While the best structure for fish habitat is downed trees with whole crowns, only 4 of the 231 pieces (2%) on Alma Lake were of that type. An additional 14 pieces of coarse wood had some branching (6%), but the majority were either submerged logs or logs touching the shore (203 pieces – 92%). Moon Lake had less coarse wood per mile shoreline (190 pieces, 96 pieces/mile) but it was of greater habitat value with 22 downed trees with crowns (12%), 38 pieces of downed wood with some branching (20%), and 130 submerged logs or logs touching shore (62%).

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Figure 14. Red dots represent waypoints of all coarse wood (pieces >4” diameter, >5’ length) along the shoreline of Alma and Moon Lakes

Fish Habitat – Rock/Rubble Substrate

Waypoints (yellow dots, Figure 15) were collected at shorelines where the lake bottom is dominated by rock and rubble and gravel during the fish habitat surveys in May 2023. As can be seen in Figure 15 there were continuous extents of gravel on the north and south shores of Moon Lake, with other less extensive areas in

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other areas of the lake. Mostly, these were narrow bands of gravel with little rock or rubble on Moon Lake. Differently, there were few and small extents of gravel on Alma Lake.

Figure 15. Waypoints (yellow dots) were collected at shorelines where the lake bottom is dominated by rock, rubble and gravel during the fish habitat surveys in May 2023.

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Results of Onterra LLC Aquatic Macrophyte Point-Intercept Surveys

Point-intercept aquatic plant surveys of Alma and Moon Lakes were conducted by Onterra LLC in 2010 and 2019 (Figure 16 and Figure 17). Engel Lake was not sampled. A Floristic Quality Assessment is a tool used to assess each lake's ecological integrity based on its plant species composition. Each plant species is assigned a coefficient of conservatism (C-value) ranging between 0-10. A plant species with a higher score has a lower tolerance to environmental degradation.

Twenty-five species of plants were found on Moon Lake in 2010 and twenty-two in 2019. The mean C (coefficient of conservatism) was 7.7 in 2010 and 6.63 in 2019 and the Floristic Quality Index (FQI) was 31. 09 and 28.9. The median values for the Northern Lakes and Forest Ecoregion (Nichol's) are Floristic Quality (FQI)-24.3, number of species (N)-13, and Average Conservatism (C)-6.2. Moon Lake exceeds the average in all categories. The maximum depth of plant growth was 26 feet. The results indicate a diverse plant community. Extensive native species plant beds occur in the southeast bay and in the northwest quadrat. It is recommended that another plant survey be conducted on Moon Lake in 2024. An invasive species survey was conducted in 2005. Chinese Mystery Snail were found. No invasive aquatic plants were detected.

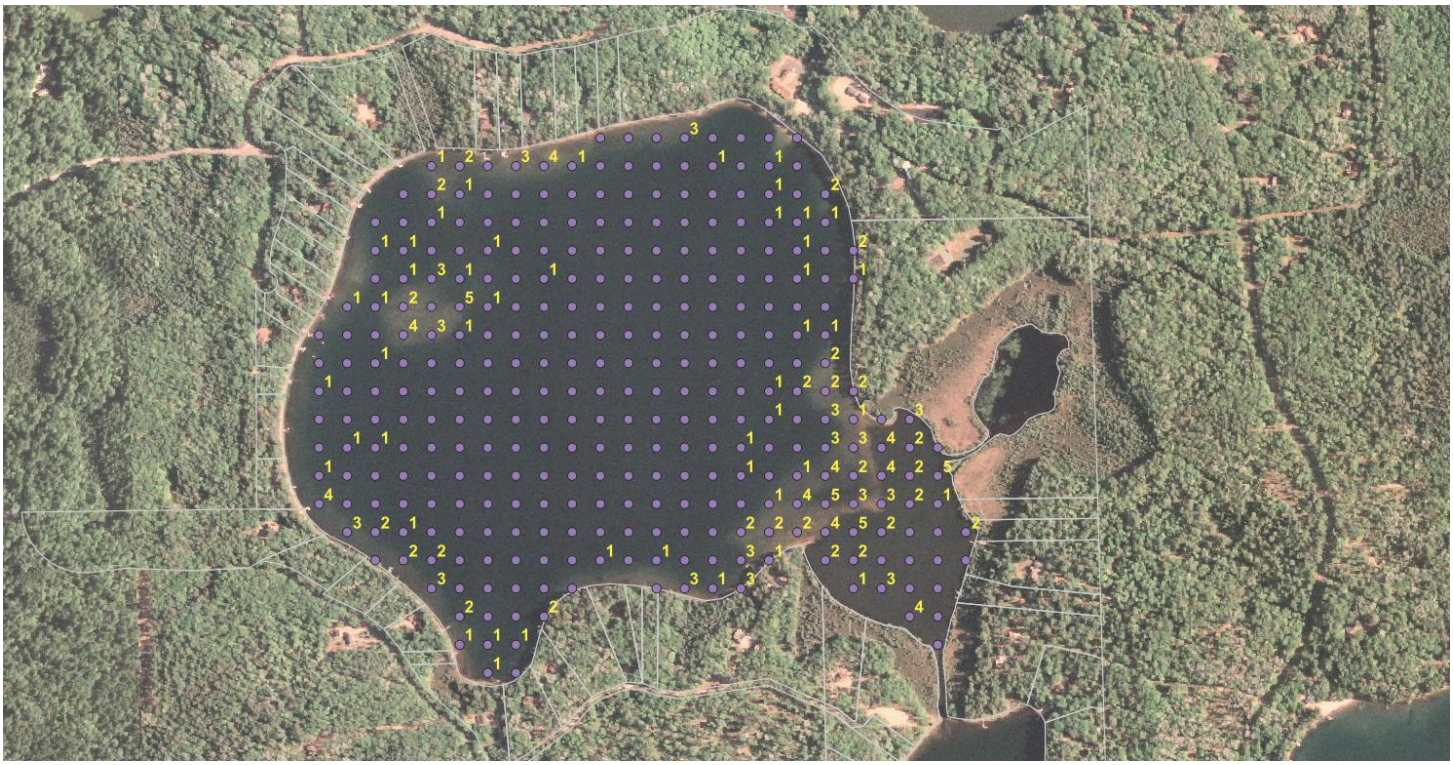

Figure 16. Purple dots represent the location of 2019 Point-intercept sampling on Moon Lake. Yellow numerals represent the number of native plant species at each sample point.

Twenty-one species of plants were found on Alma Lake in 2010 and 20 species in 2019. The mean C (coefficient of conservatism) was 7.9 in 2010 and 6.85 in 2019 and the Floristic Quality Index (FQI) was 36.4 and 30.63. The median values for the Northern Lakes and Forest Ecoregion (Nichol's) are Floristic Quality (FQI)-24.3, number of species (N)-13, and Average Conservatism (C)-6.2. Alma Lake exceeds the average in all categories. The maximum depth of plant growth was 20 feet. The results indicate a diverse plant community. It is recommended that another plant survey be conducted on Alma Lake in 2024 to track trends. An invasive

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species survey was conducted in 2014. Chinese Mystery Snail were found. No invasive aquatic plants were detected.

Figure 17. Purple dots represent the location of 2019 Point-intercept sampling Alma Lake. Yellow numerals represent the number of native plant species at each sample point.

Wetland Characteristics Adjacent to Alma and Moon Lake Shorelands

We obtained Wisconsin Wetland Inventory shapefiles for the survey area from the WDNR which show graphic representations of the type, size, and location of wetlands in proximity to Alma and Moon Lakes. These maps have been prepared from the analysis of high-altitude imagery in conjunction with soil surveys, topographic maps, previous wetland inventories and field work. We used QGIS to produce a geo-referenced overlay of wetlands adjacent to Alma and Moon Lakes (Figure 18). The wetland descriptions and naming follow the Wisconsin Wetland Inventory Classification Guide (1992) WDNR Publ. WZ-WZ023. Wetlands predominate the shoreline of the southeast bay of Moon Lake, Engel Lake, and the channel between Alma and Moon Lakes. Only small patches of wetland shoreline are found on the remainder of Moon Lake and only one small area on Alma Lake.

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Figure 18. Green polygons show the type, size, and location of wetlands in proximity to Alma and Moon Lakes.

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Designating Critical Habitat Areas on Alma and Moon Lakes

Nova Ecological Services has identified 4 critical habitat sites on Alma Lake and 6 on Moon (including Engle Lake) Lake during July of 2023. At the present time they are advisory. Below (Table 2) is a list of the critical habitat areas identified on Alma/Moon Lakes along with the critical habitat features present at each site (fish habitat, wildlife habitat, wetlands/aquatic beds, diverse aquatic plant communities, features protective of water quality, and shorelands in natural vegetation – natural scenic beauty). The presence of at least 3 habitat features was required for designation.

Table 2. Attributes of Critical Habitat Sites on Alma and Moon Lakes

CriticalHabitat	FishHab	WildlifeHab	Wetland	AquaticPlant	WaterQuality	NaturalShores	Total Attributes
Alma1	Y	Y		Y	Y	Y	5
Alma2	Y			Y	Y	Y	4
Alma3	Y	Y		Y	Y		4
Alma4	Y	Y		Y	Y	Y	5
Moon5	Y	Y	Y	Y	Y	Y	6
Moon6	Y	Y	Y	Y	Y	Y	6
Moon7	Y			Y	Y		3
Moon8	Y	Y		Y	Y	Y	5
Moon 9	y	y			y		3
Moon 10	Y	y	y	y	y	y	6

Figures 19 and 20 show the location of the Critical Habitat locations while Figures 21 and 22 show the location of the natural features (coarse wood, rock/rubble/gravel, wetlands, aquatic macrophyte beds, natural shorelands, and wetlands) overlaying the Critical Habitat sites.

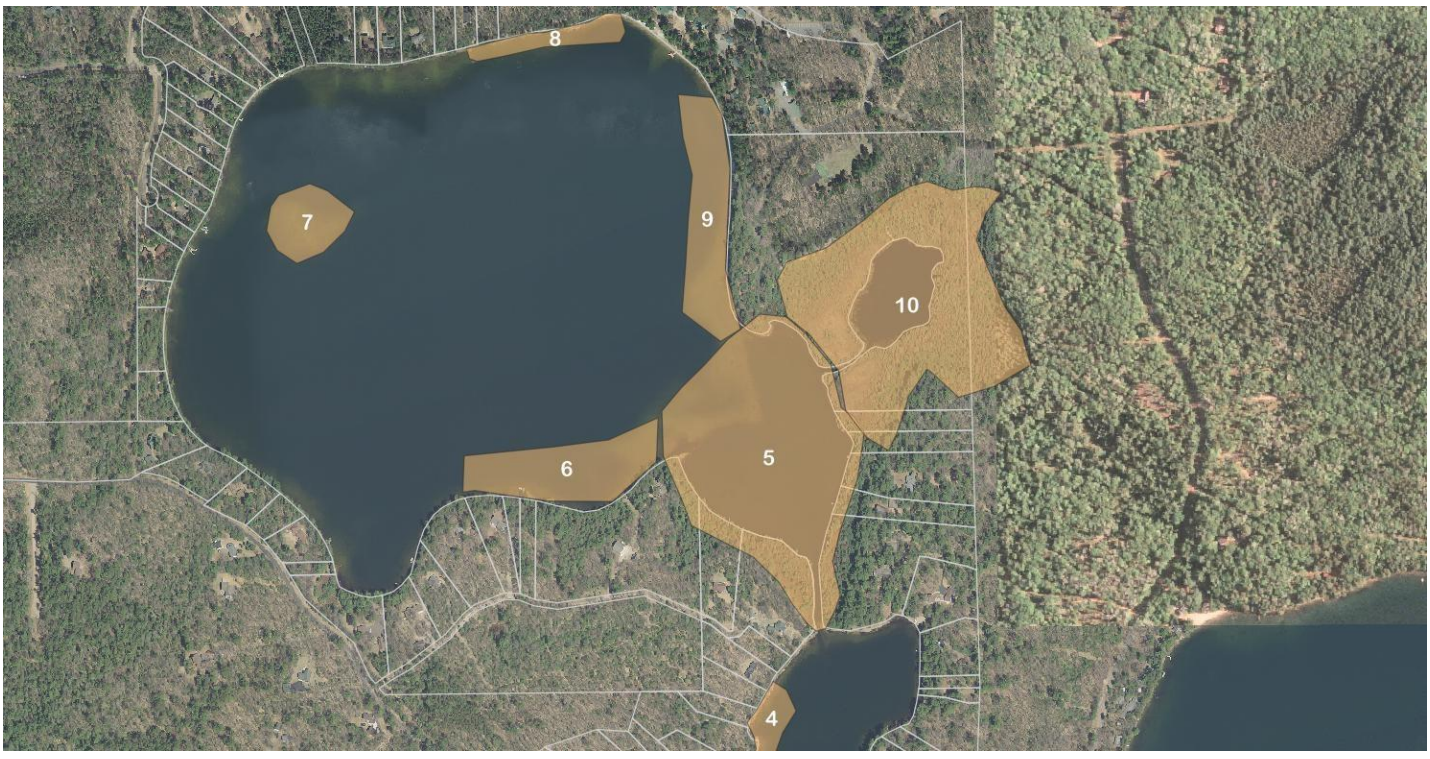

Figure 19. Location of the six areas on Moon Lake recommended for consideration as Critical Habitat (orange shading) by Nova Ecological Services during 2023 surveys and adjacent properties (white lines)

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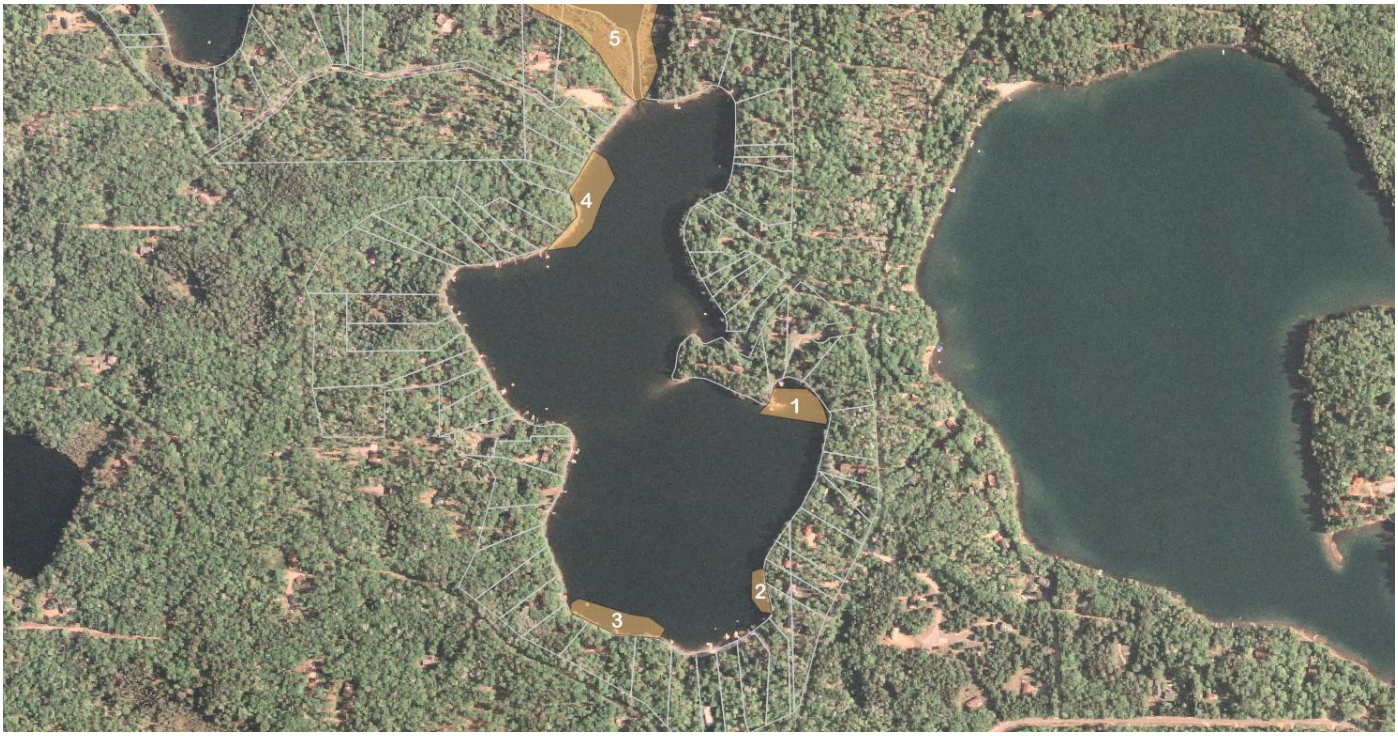

Figure 20. Location of the four areas on Alma Lake recommended for consideration as Critical Habitat (orange shading) by Nova Ecological Services during 2023 surveys and adjacent property lines (white lines).

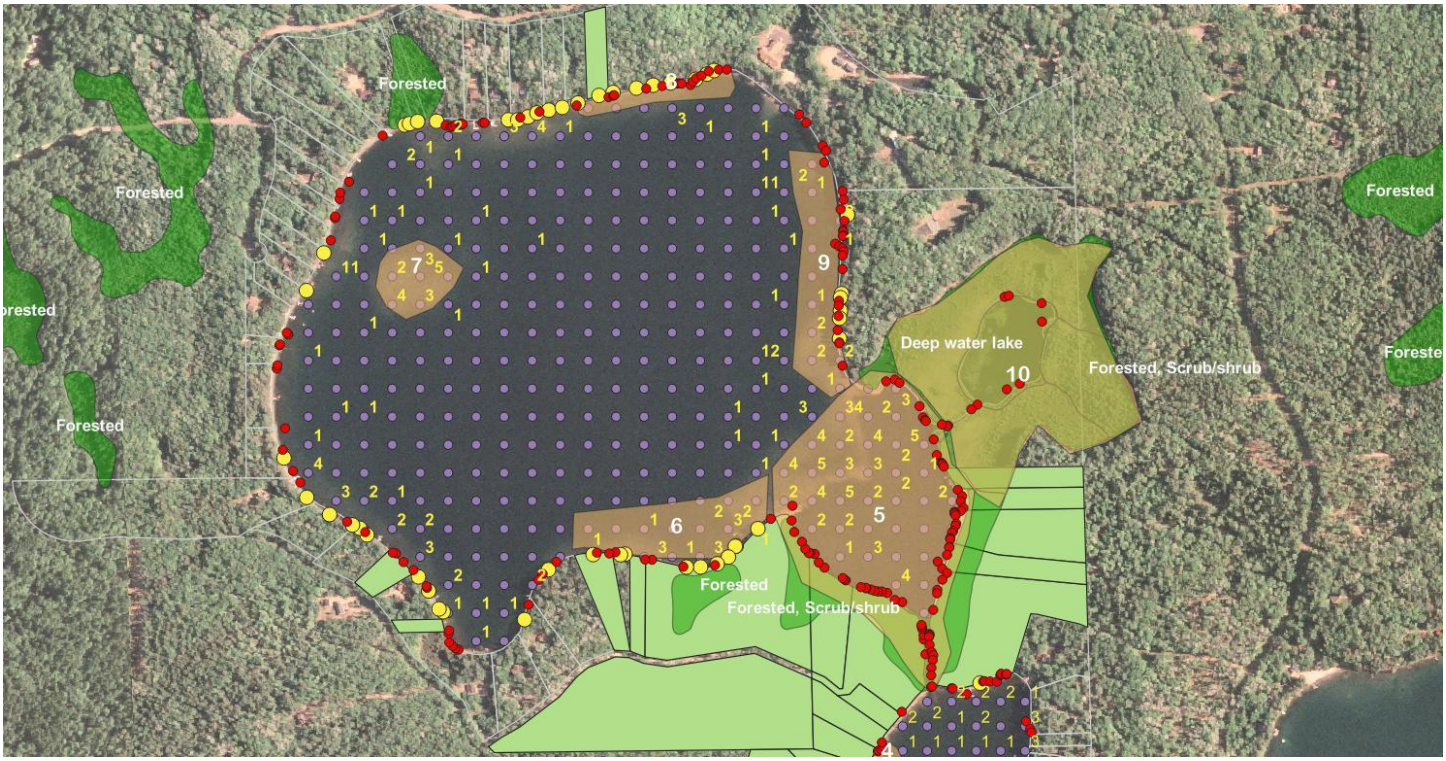

Figure 21. Location of Moon Lake Critical Habitat sites (orange polygons, white numerals) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland; dark green polygons=wetlands).

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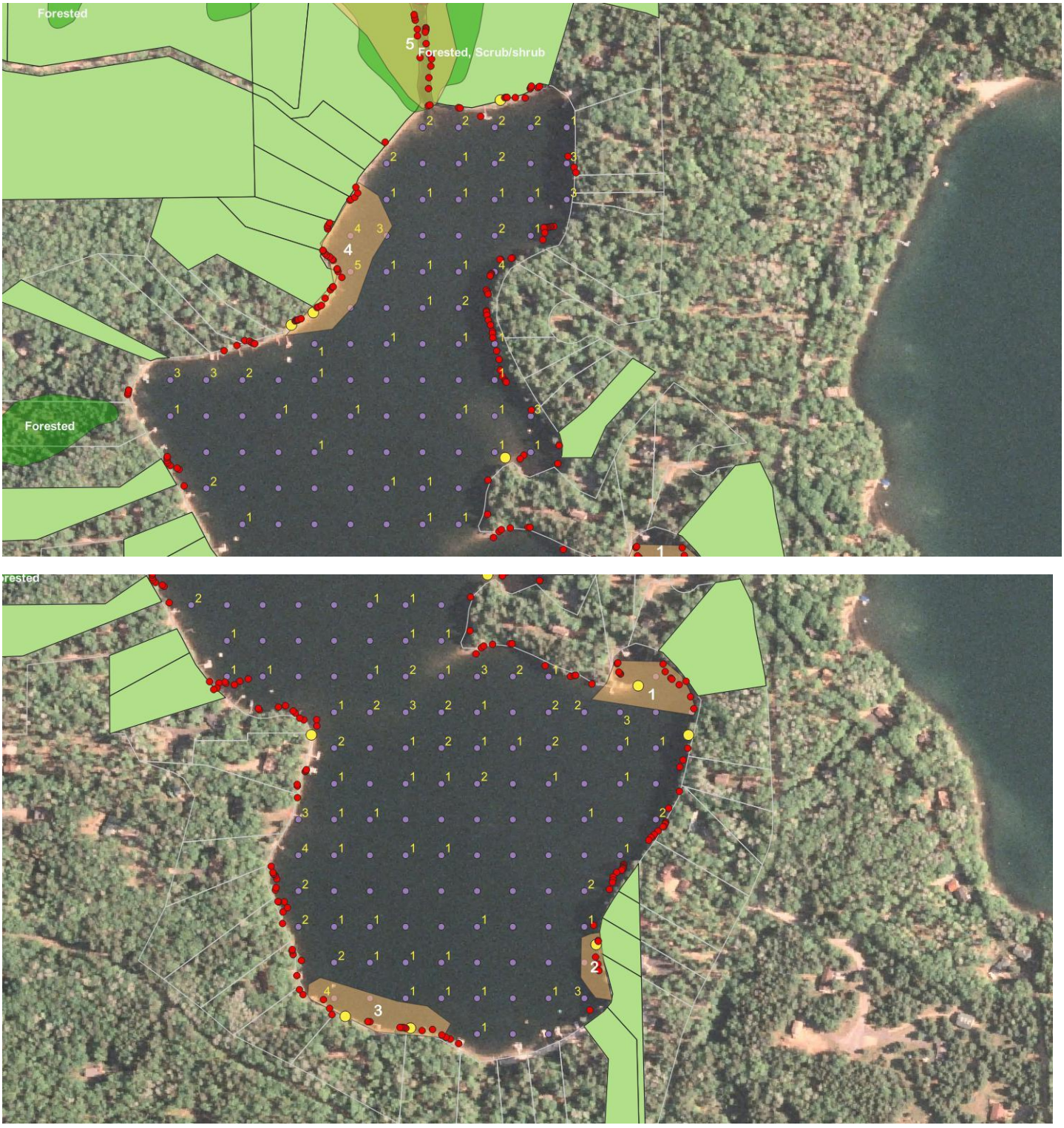

Figure 22. Location of Alma Lake Critical Habitat sites (orange polygons, white numerals) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland; dark green polygons=wetlands).

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The following sections contain detailed information specific to each of ten Critical Habitat sites, including maps, photos, and management recommendations.

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Alma Lake-1 Protected Bay on the east central side of lake.

This is a protected bay that provides good habitat despite some shoreline development. It was selected for its fish and wildlife values, diverse aquatic (see Table 3) and terrestrial vegetation, water quality protection and natural scenic beauty.

Physical Description of the Site

The site includes nearshore terrestrial, shoreline, and littoral zone habitats. The riparian type is 50% developed and 50% wooded. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, trees with some lawn present. Roughly half of this site contains a natural shoreline. Coarse woody cover is abundant (see Figure 23).

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1. Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone.

Fish Habitat

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include largemouth bass and panfish.

Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, waterfowl, shore birds, marsh birds, amphibians, and reptiles utilize this site.

Table 3. Aquatic plants found at Site 1 from previous plant surveys by Onterra LLC (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Emergent	*Glyceria canadensis*	Rattlesnake grass	7
Emergent	*Juncus effusus*	Common rush	4
Floating leaf	*Brasenia schreberi*	Watershield	7
Floating leaf	*Nymphaea ordonata*	White water lily	6
Floating leaf and emergent	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
Submergent	*Chara*	Muskgrasses	7
Submergent	*Elodea nutalli*	Slender waterweed	7
Submergent	*Isoetes sp.*	Quillworts	8
Submergent	*Myriophyllum*	Dwarf water milfoil	10

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	tenellum		
Submergent	*Potamogeton pusillis*	Small pondweed	7
Submergent and emergent	*Sagittaria graminea*	Grass-leaved arrowhead	9

Management Recommendations

1. No alteration of littoral zone.

2. Maintain existing buffer/riparian zone which is primarily intact.

3.. Maintain and do not remove existing coarse wood.

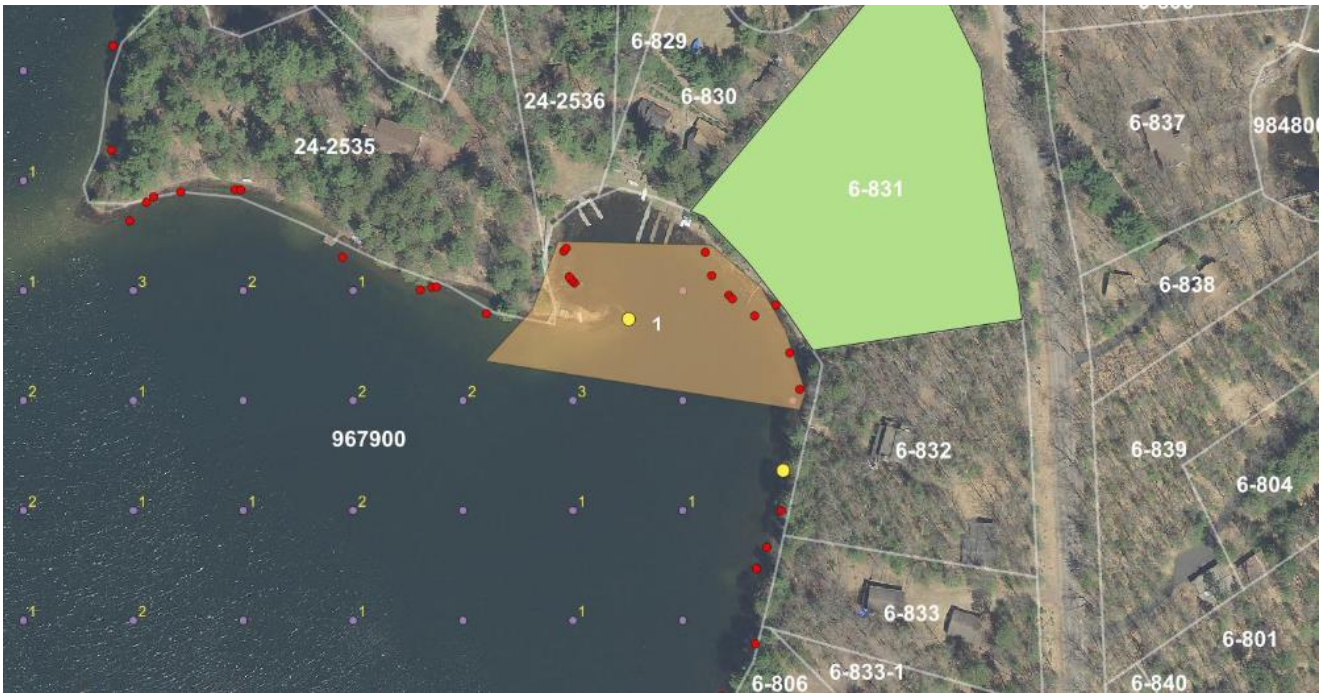

Figure 23. Alma Lake Site 1 - Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland). Tax parcels white lines, white numerals.

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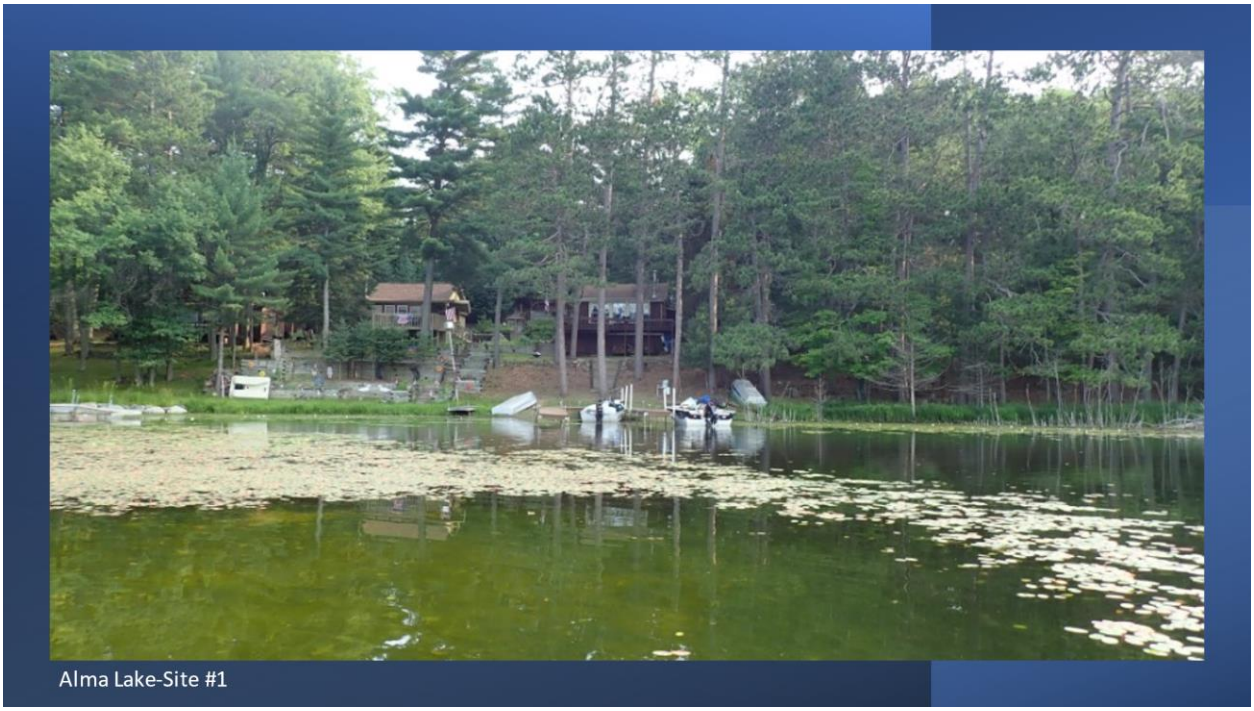
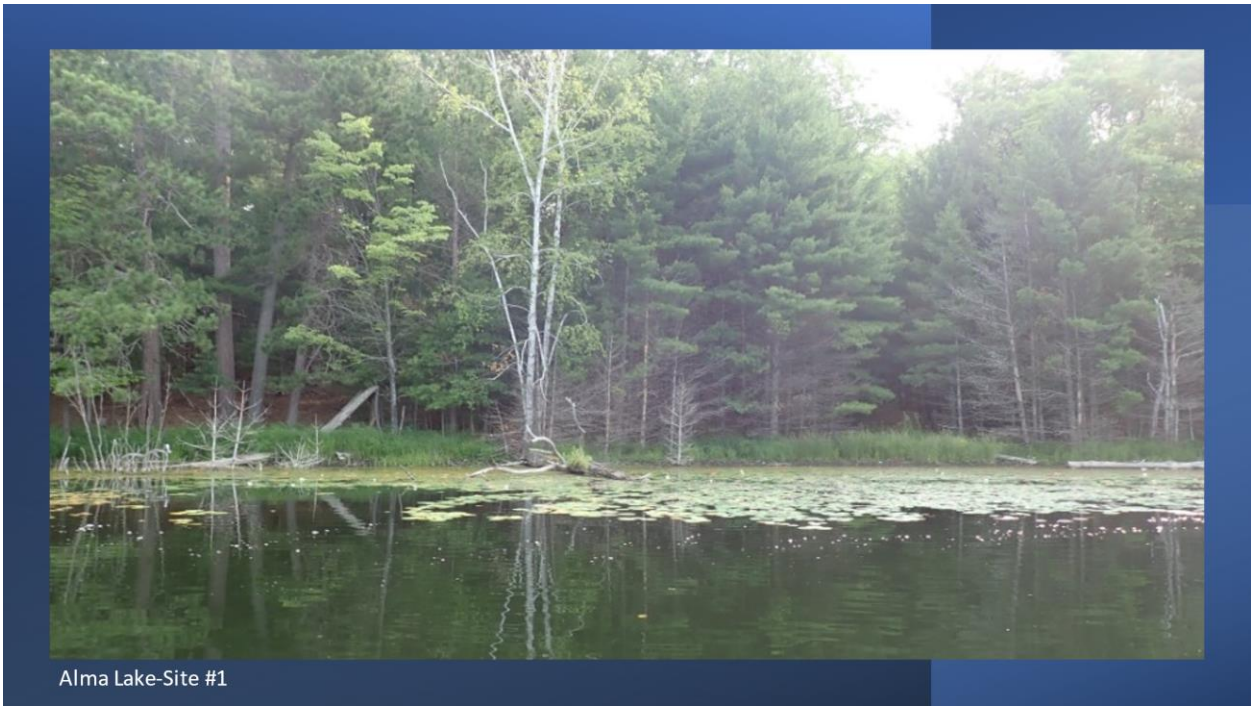
Photos taken in a clockwise direction.



Alma Lake-Site #1



Alma Lake-Site #1

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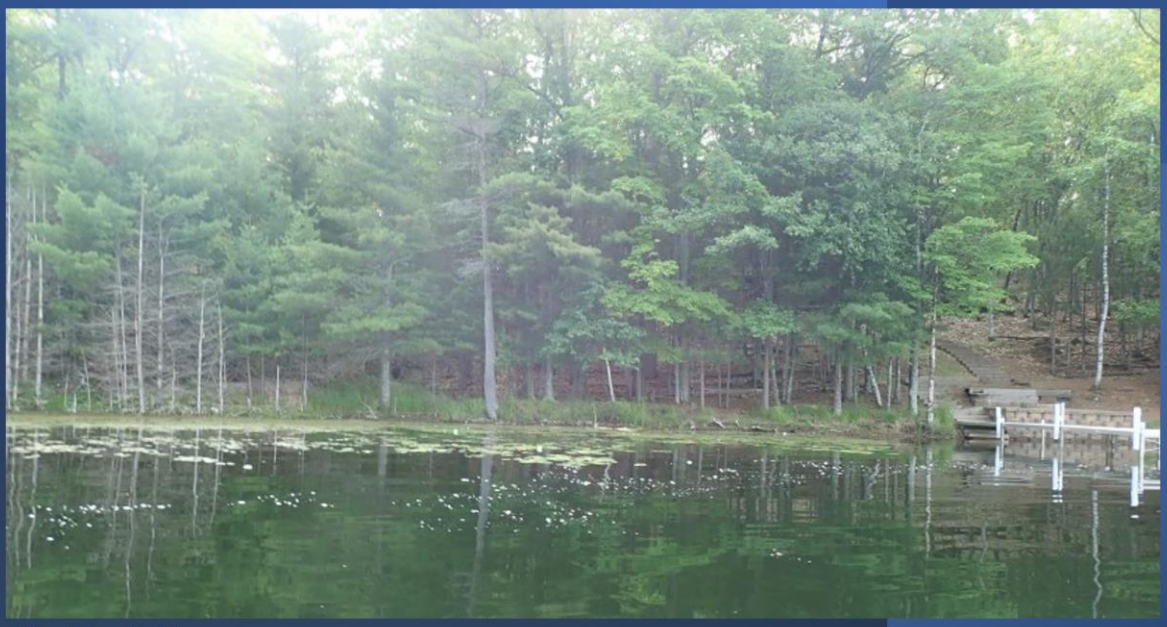

Alma Lake-Site #1

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Alma Lake - 2 Diverse aquatic plant bed/intact shoreland buffer (southeast portion of lake)

This site provides good habitat despite some shoreline development. It was selected for its fish and wildlife values, diverse aquatic vegetation (see Table 4) and water quality protection.

Physical Description of the Site

The site includes nearshore terrestrial, shoreline, and littoral zone habitats. The riparian type is 20% developed and 80% wooded. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, and trees. Most of this site contains a natural shoreline. Coarse woody cover is common (see Figure 24).

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1. Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone (Anchor sediment).

Fish Habitat

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include largemouth bass and panfish.

Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, waterfowl, shore birds, marsh birds, amphibians, and reptiles utilize this site.

Table 4. Aquatic plants found at Site 2 from previous plant surveys by Onterra LLC (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Floating leaf	*Brasenia schreberi*	Watershield	7
Floating leaf	*Nymphaea ordonata*	White water lily	6
Floating leaf/emergent	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
Submergent	*Myriophyllum tenellum*	Dwarf water milfoil	10
Submergent	*Potamogeton amplifolius*	Large-leaf pondweed	7
Submergent	*Potamogeton pusillus*	Small pondweed	7
Submergent/emergent	*Sagittaria graminia*	Grass-leaved arrowhead	9

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Management Recommendations

1. No alteration of littoral zone.

2. Maintain existing buffer/riparian zone which is primarily intact.

3.. Maintain and do not remove existing coarse wood.

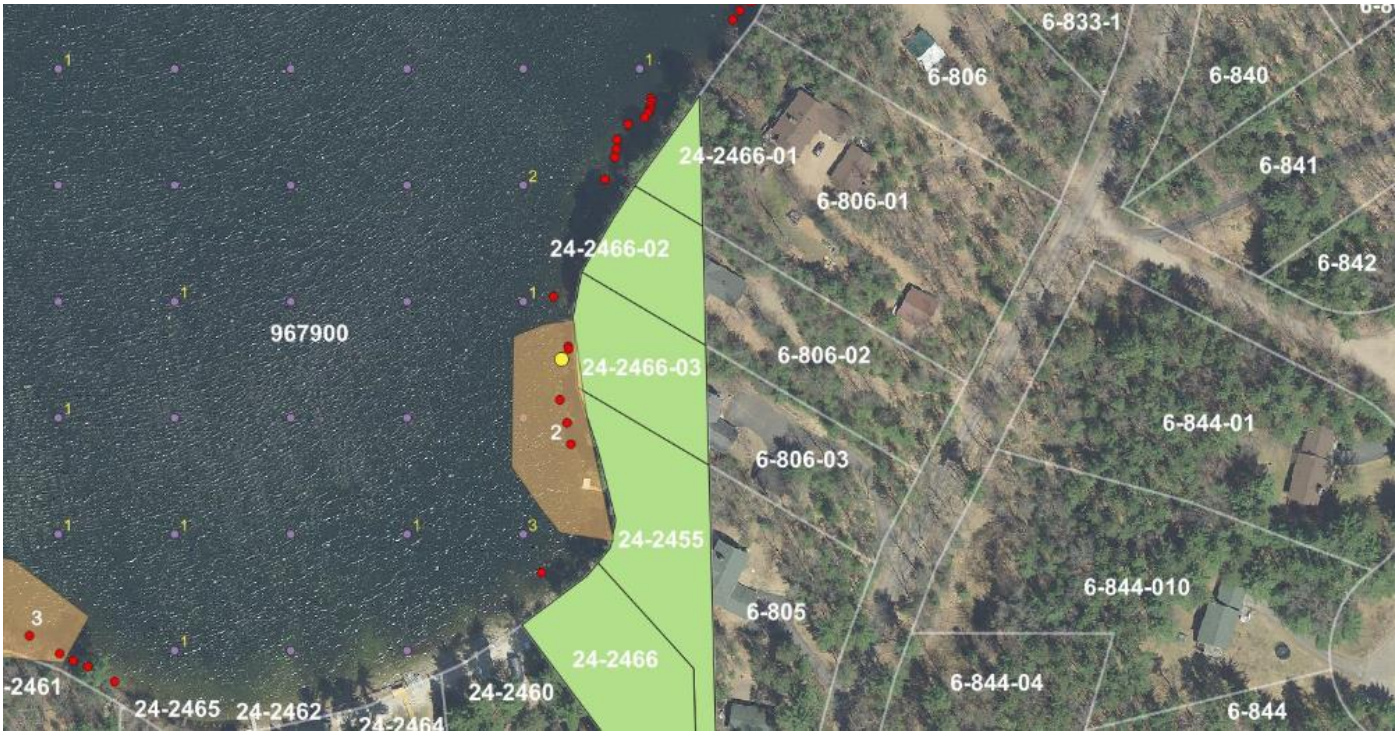

Figure 24. Alma Lake Site 2 - Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland). Tax parcels white lines, white numerals.

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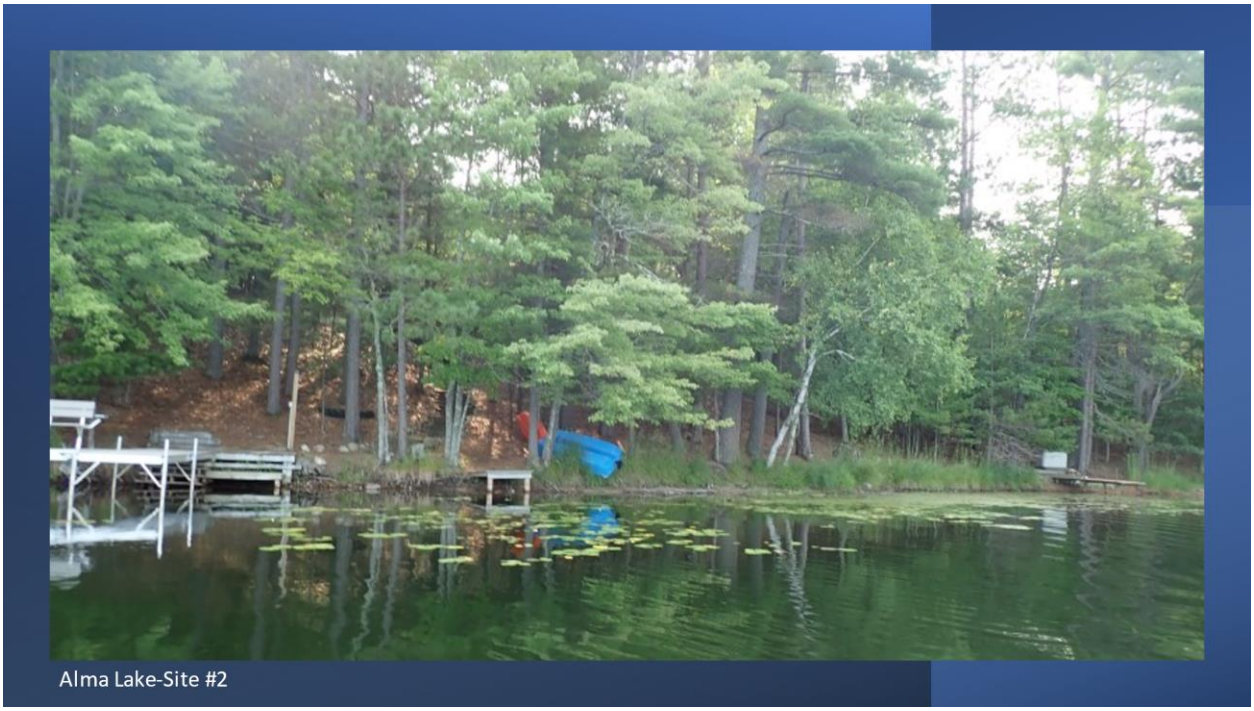
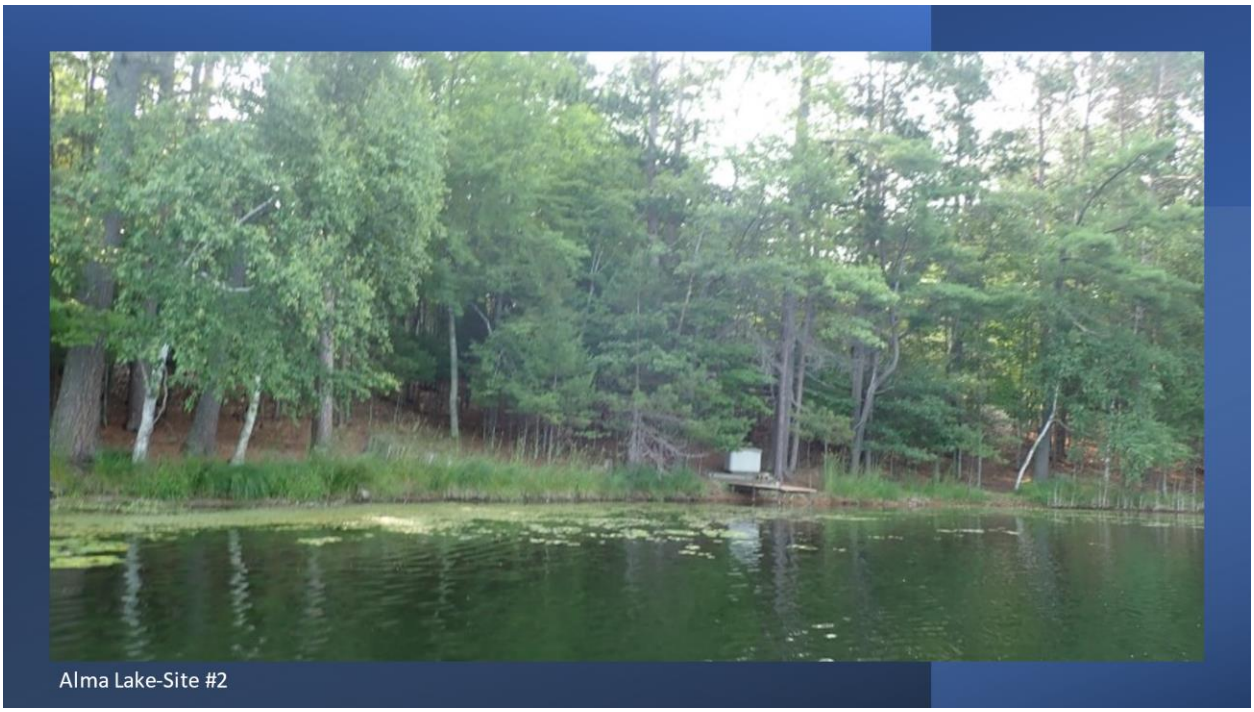
Photos taken in a clockwise direction.



Alma Lake-Site #2



Alma Lake-Site #2

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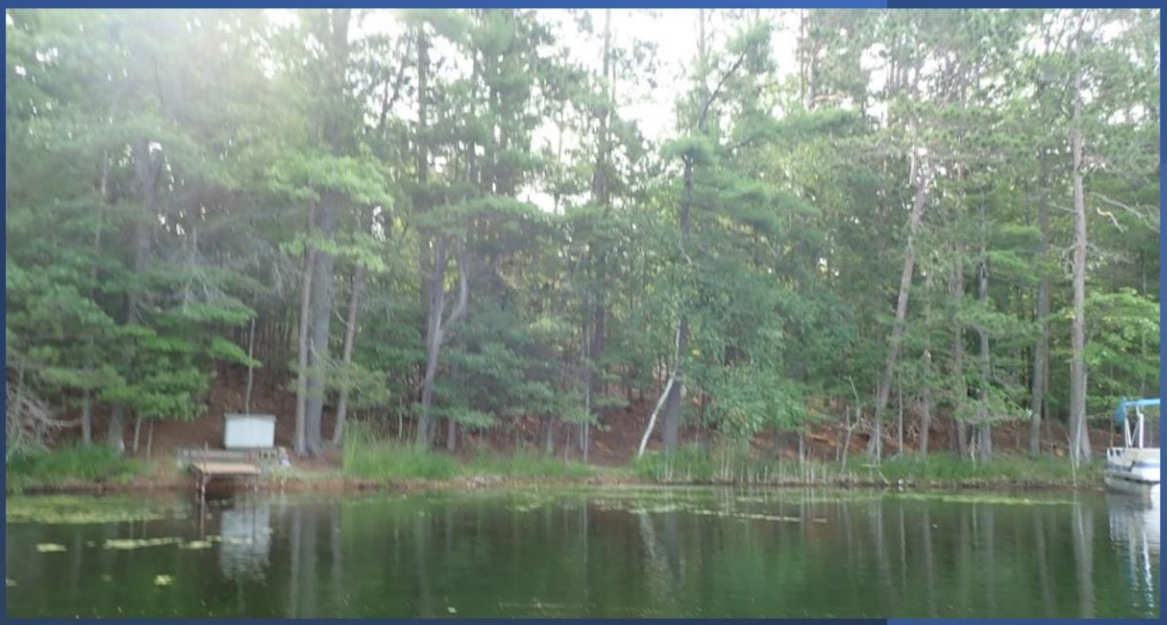

Alma Lake-Site #2

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Alma Lake -3 Diverse aquatic plant bed/intact shoreland buffer (southwest portion of lake)

This site provides good habitat with minimal shoreline development along a steep shoreline. It was selected for its fish and wildlife values, diverse aquatic vegetation (see Table 5), water quality protection and natural scenic beauty.

Physical Description of the Site

The site includes nearshore terrestrial, shoreline, and littoral zone habitats. The riparian type is 10% developed and 90% wooded. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, and trees. Coarse woody cover is common (see Figure 25).

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1. Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone.

Fish Habitat

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include largemouth bass and panfish.

Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, waterfowl, shore birds, marsh birds, amphibians, and reptiles utilize this site.

Table 5. Aquatic plants found at Site 3 from previous plant surveys by Onterra LLC (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Emergent	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
Emergent	*Sagittaria graminia*	Grass-leaved arrowhead	9
Floating leaf	*Brasenia schreberi*	Watershield	7
Floating leaf	*Nymphaea ordonata*	White water lily	6
Submergent	*Elodea nutalli*	Slender waterweed	7
Submergent	*Nitella*	Stoneworts	7
Submergent	*Potamogeton amplifolius*	Large-leaf pondweed	7
Submergent	*Utricularia*	Small purple	9

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	resupinata	bladderwort	
Submergent/emergent	*Eleocharis acicularis*	Needle spikerush	5

Management Recommendations

1. No alteration of littoral zone.
2. Because of the steep shoreline, maintain the existing buffer/riparian zone which is primarily intact.
3. Maintain and do not remove existing coarse wood.

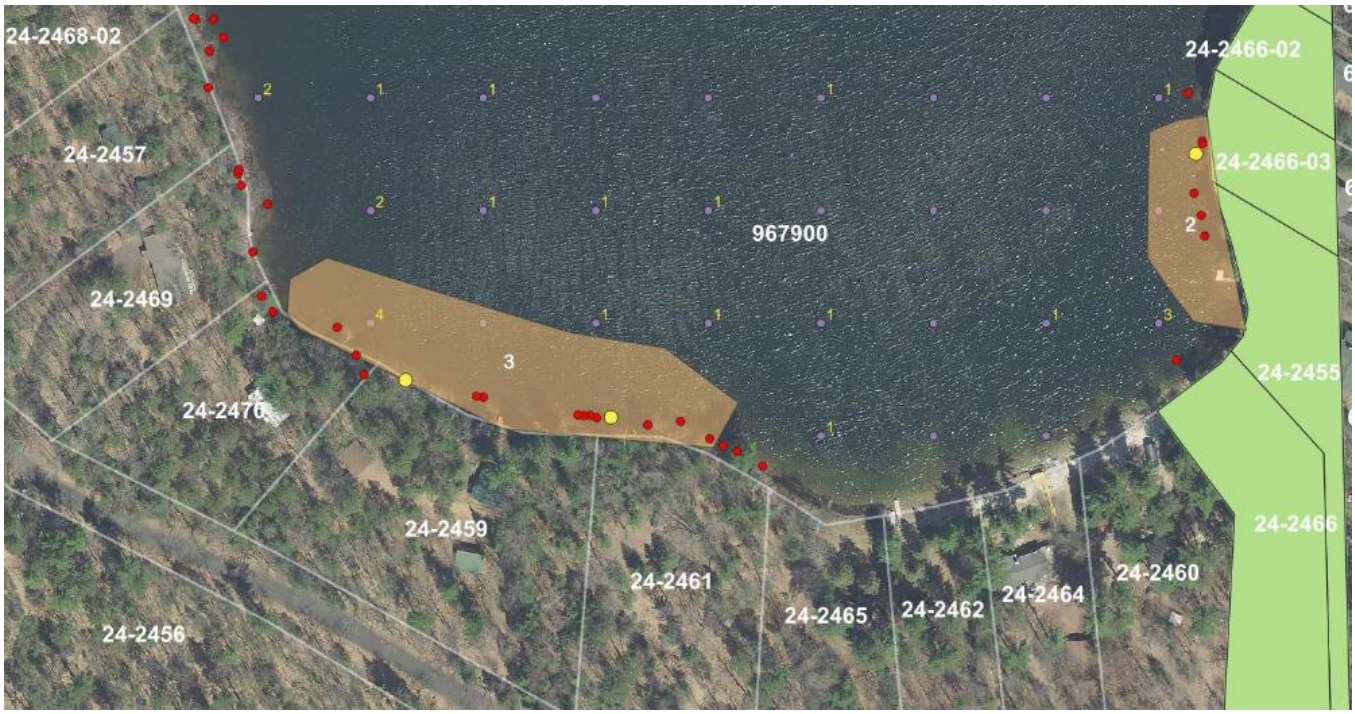

Figure 25. Alma Lake Site 3. Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland). Tax parcels white lines, white numerals.

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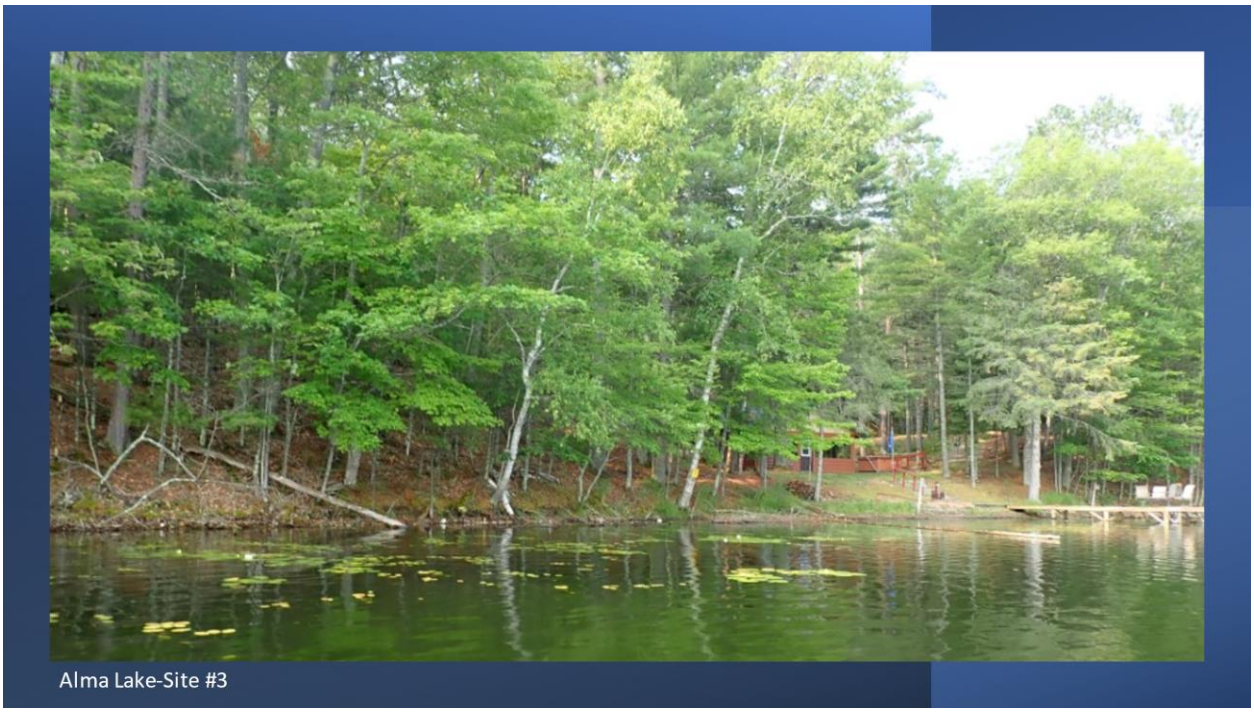
Photos taken in a clockwise direction.

Alma Lake-Site #3



Alma Lake-Site #3

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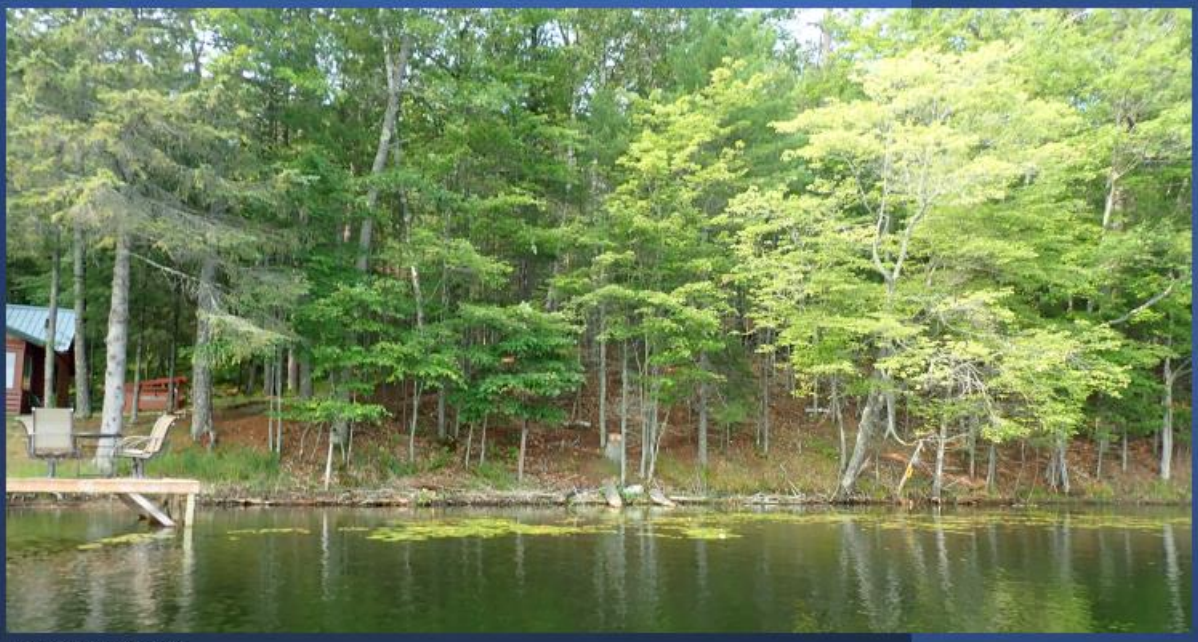

Alma Lake-Site #3

Alma Lake-Site #3

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Alma Lake-4 Diverse aquatic plant bed/intact shoreland buffer (northwest portion of lake)

This site provides good habitat with minimal shoreline development along a steep shoreline. It was selected for its fish and wildlife values, diverse aquatic vegetation (see Table 6), water quality protection and natural scenic beauty.

Physical Description of the Site

The site includes nearshore terrestrial, shoreline, and littoral zone habitats. The riparian type (%) is 100% wooded. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, and trees. This site contains a natural shoreline. Coarse woody cover is abundant (see Figure 26).

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1. Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone.

Fish Habitat

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include largemouth bass and panfish.

Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, waterfowl, shore birds, marsh birds, amphibians, and reptiles utilize this site.

Table 6. Aquatic plants found at Site 4 from previous plant surveys by Onterra LLC (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Emergent	*Carex crawfordii*	Crawford's sedge	5
Floating leaf	*Brasenia schreberi*	Watershield	7
Floating leaf	*Nymphaea ordonata*	White water lily	6
Floating leaf/emergent	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
Submergent	*Elodea canadensis*	Common waterweed	3
Submergent	*Elodea nutalli*	Slender waterweed	7
Submergent	*Isoetes sp.*	Quillworts	8
Submergent	*Myriophyllum tenellum*	Dwarf water milfoil	10
Submergent	*Nitella*	Stoneworts	7

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Submergent	*Ranunculus flammula*	Creeping spearwort	9
Submergent	*Utricularia resupinata*	Small purple bladderwort	9
Submergent	*Potamogeton amplifolius*	Large-leaf pondweed	7
Submergent	*Potamogeton illinoensis*	Illinois pondweed	6
Submergent	*Vallisnaria americana*	Wild celery	6
Submergent/emergent	*Juncus pleocarpus*	Brown-fruited rush	8
Submergent/emergent	*Sagittaria graminia*	Grass-leaved arrowhead	9

Management Recommendations

1. No alteration of littoral zone.
2. Because of the steep shoreline, maintain the existing buffer/riparian zone which is primarily intact.
3. Maintain and do not remove existing coarse wood.
4. Maintain snag/perch trees.

Figure 26. Alma Lake Site 4. Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland). Tax parcels white lines, white numerals.

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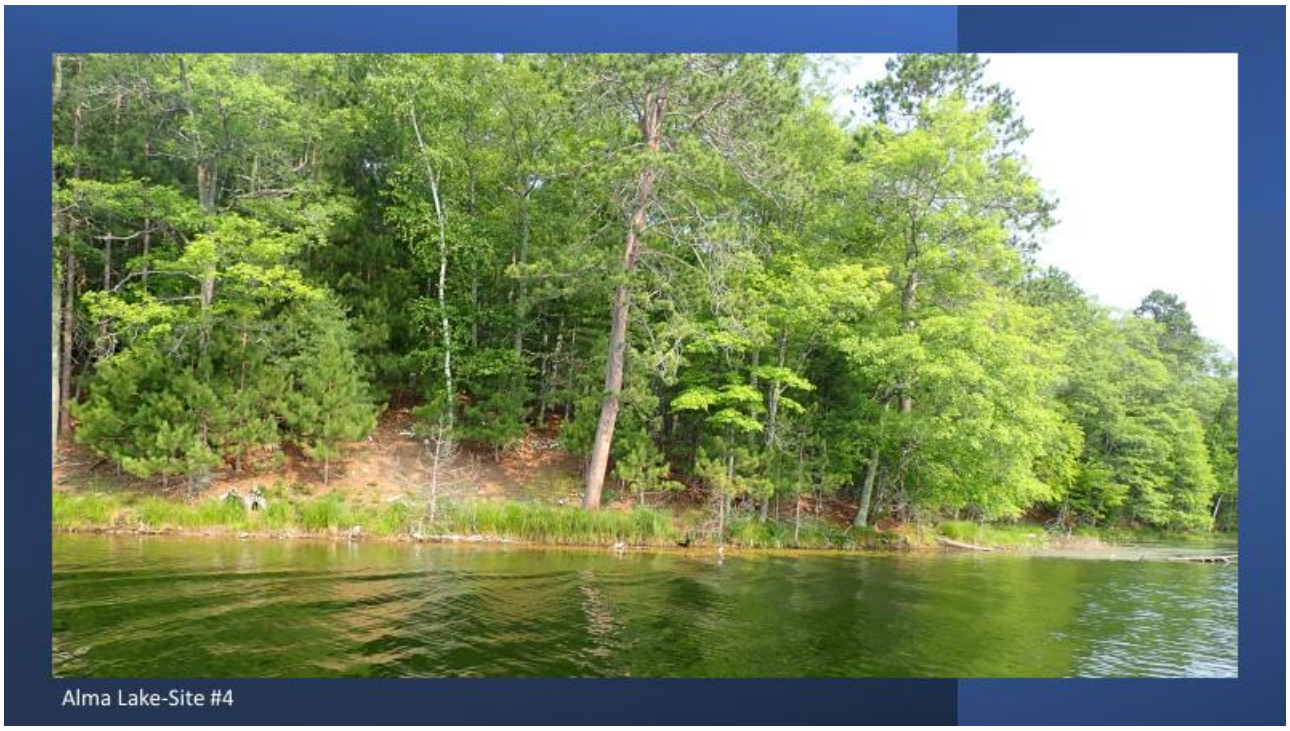
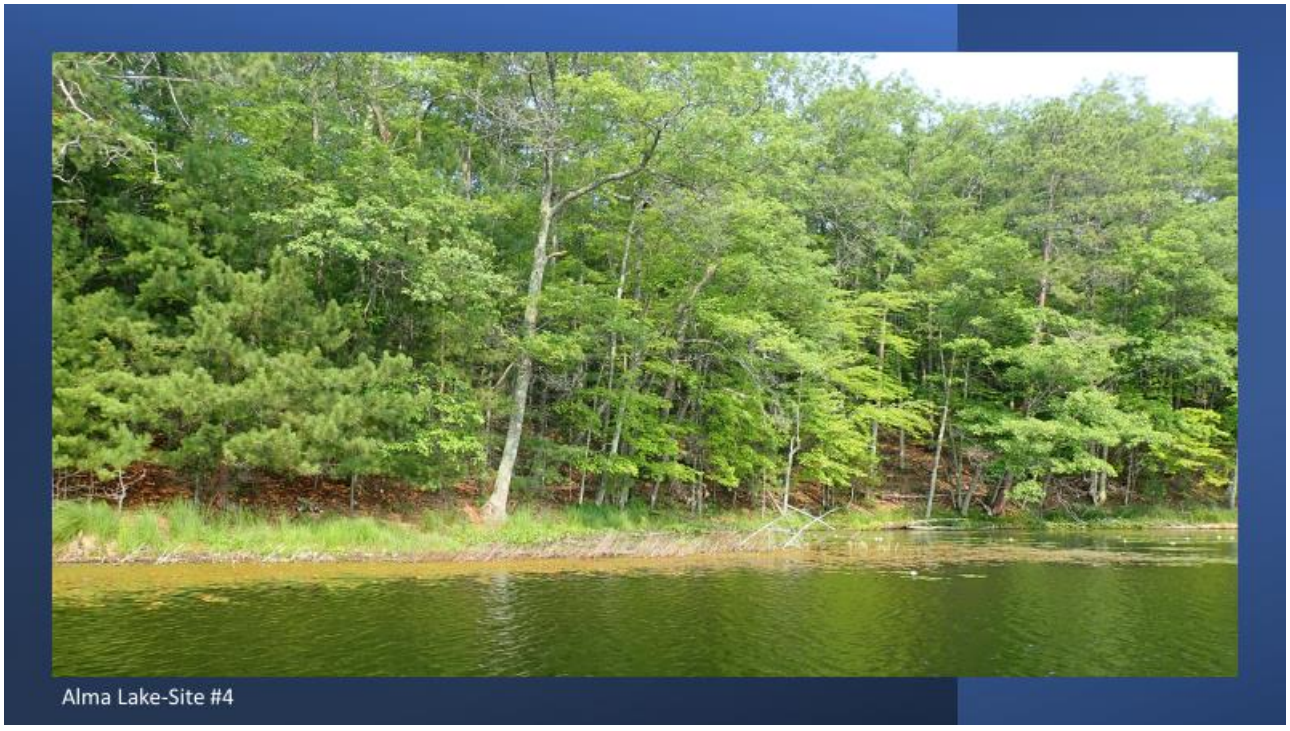
Photos taken in a clockwise direction.



Alma Lake-Site #4



Alma Lake-Site #4

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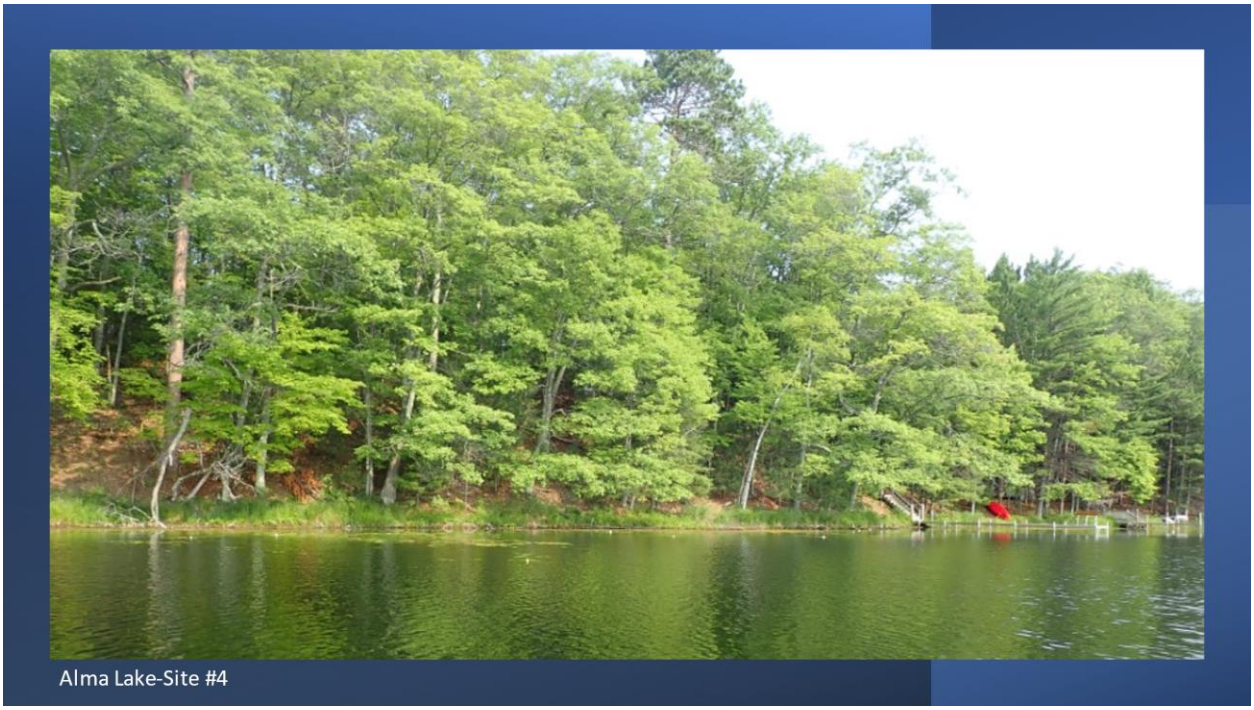
Alma Lake-Site #4



Alma Lake-Site #4

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Moon Lake-5 Diverse aquatic plant bed/forested, scrub/shrub wetland (southern portion of Moon Lake and includes channel to Alma Lake.)

This site provides good habitat with minimal shoreline development. It was selected for its fish and wildlife values, diverse aquatic vegetation (see Table 7), wetland buffer, water quality protection and natural scenic beauty.

Physical Description of the Site

The site includes nearshore terrestrial, wetland, and littoral zone habitats. The riparian type is 80% wetland and 20% wooded. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, and trees. This site contains a natural shoreline. Coarse woody cover is abundant (see Figure 27). There is some wild rice growing in the littoral zone, but it is not abundant. The scrub shrub wetland consists of broad-leaved evergreen (Labrador tea and leatherleaf). The forested wetland consists of needle leafed coniferous trees (white cedar, balsam fir and black spruce) (see Figure 27).

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1. Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone.

Fish Habitat

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include northern pike, largemouth bass and panfish.

Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, waterfowl, shore birds, marsh birds, amphibians, and reptiles utilize this site.

Table 7. Aquatic plants found at Site 5 from previous plant surveys by Onterra LLC (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Emergent	*Calla palustris*	Water arum	9
Emergent	*Decodon verticulatus*	Swamp loosestrife	7
Emergent	*Dulichium arundinaceum*	Three-way sedge	9
Emergent	*Schoenoplectus*	Water bulrush	9

.

	acutus		
Emergent	*Zizania palustris*	Northen wild rice	8
Floating Leaf	*Brasenia schreberi*	Watershield	7
Floating Leaf	*Nuphar variegata*	Spatterdock	6
Floating Leaf	*Nymphaea ordonata*	White water lily	6
Floating Leaf/Emergent	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
Submergent	*Chara*	Muskgrasses	7
Submergent	*Ceratophyllum demersum*	Coontail	3
Submergent	*Elodea canadensis*	Common waterweed	3
Submergent	*Eriocaulon aquaticum*	Pipewort	9
Submergent	*Isoetes lacustris*	Lake quillwort	8
Submergent	*Myriophyllum tenellum*	Dwarf water milfoil	10
Submergent	*Najas flexilus*	Slender naiad	6
Submergent	*Nitella*	Stoneworts	7
Submergent	*Ranunculus flammula*	Creeping spearwort	9
Submergent	*Potamogeton pusillus*	Small Pondweed	7
Submergent	*Utricularia resupinata*	Small purple bladderwort	9
Submergent	*Utricularia vulgaris*	Common bladderwort	7
Submergent/Emergent	*Eleocharis acicularis*	Needle spikerush	5
Submergent/Emergent	*Juncus pleocarpus*	Brown-fruited rush	8
Submergent/Emergent	*Sagittaria graminea*	Grass-leaved arrowhead	9

Management Recommendations

1. No alteration of littoral zone.
2. Maintain existing buffer/riparian zone which is primarily intact.
3. Maintain and do not remove existing coarse wood.
4. Maintain snag/perch trees.
5. Maintain the thoroughfare between Alma and Moon Lakes.

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Figure 27. Moon Lake Site 5. Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland; dark green polygons=wetlands). Tax parcels white lines, white numerals.

Photos taken in counterclockwise direction.

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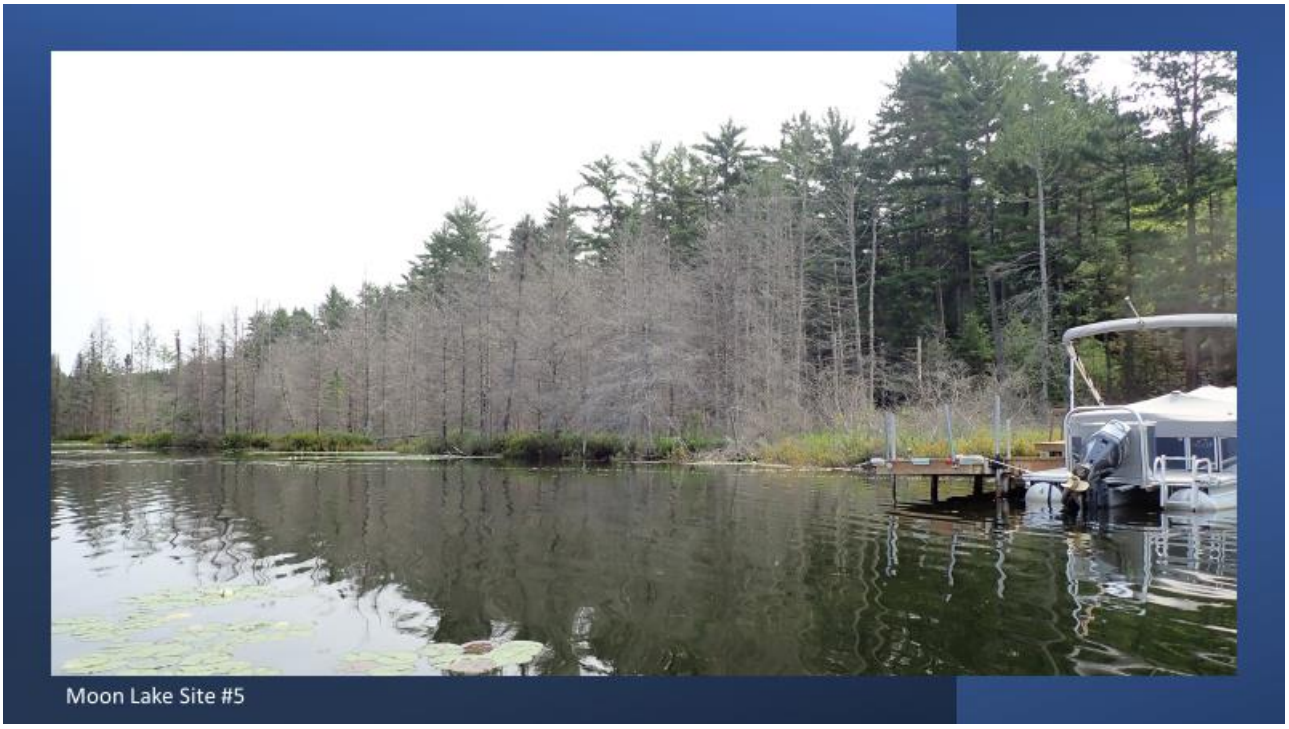
Moon Lake Site #5



Moon Lake Site #5

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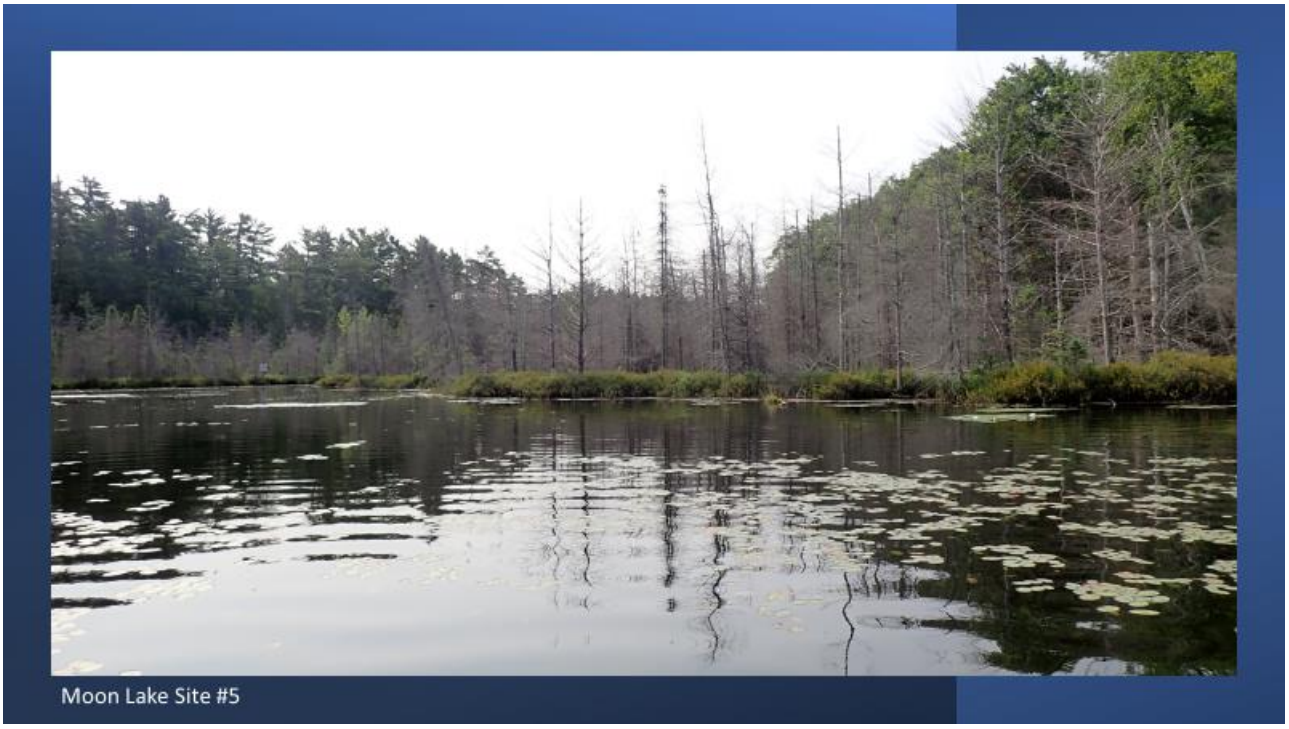

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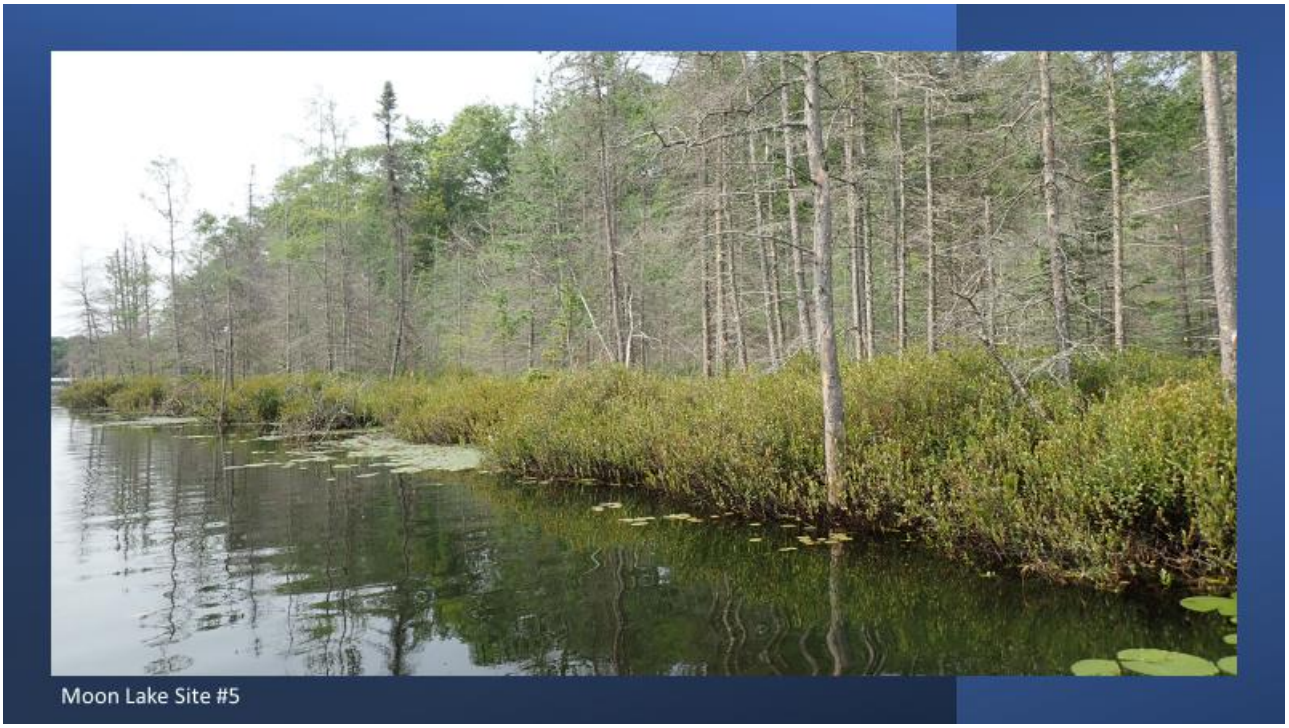

Moon Lake Site #5

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Moon Lake-6 Diverse aquatic plant bed/forested wetland and natural shoreline (southeastern portion of Moon Lake.)

This site provides good habitat with minimal shoreline development. It was selected for its fish and wildlife values, diverse aquatic vegetation (see Table 8), wetland buffer, water quality protection and natural scenic beauty.

Physical Description of the Site

The site includes nearshore terrestrial, wetland, and littoral zone habitats. The riparian type is 50% wetland and 50% wooded. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, and trees. This site contains a natural shoreline. Coarse woody cover is present along with gravel tight to shore (see Figure 28). The forested wetland consists of needle leafed evergreen trees (white cedar, balsam fir and black spruce) (see Figure 28).

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1. Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone.

Fish Habitat

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include northern pike, largemouth bass and panfish. The gravel may be too tight to shore for walleye spawning but could be used by other non-game species.

Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, waterfowl, shore birds, marsh birds, amphibians, and reptiles utilize this site.

Table 8. Aquatic plants found at Site 6 from previous plant surveys by Onterra LLC (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Emergent	*Eleocharis palustris*	Creeping spikerush	6
Floating leaf/Emergent	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
Submergent	*Chara*	Muskgrasses	7

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Submergent	*Isoetes sp.*	Quillworts	8
Submergent	*Myriophyllum tenellum*	Dwarf water milfoil	10
Submergent	*Potamogeton pusillus*	Small pondweed	7
Submergent	*Potamogeton spirillus*	Spiral-fruited pondweed	8
Submergent	*Ranunculus flammula*	Creeping spearwort	9
Submergent	*Utricularia resupinata*	Small purple bladderwort	9
Submergent	*Vallisneria americana*	Wild celery	6
Submergent/emergent	*Eleocharis acicularis*	Needle spikerush	5
Submergent/emergent	*Juncus pleocarpus*	Brown-fruited rush	8

Management Recommendations

1. No alteration of littoral zone.
2. Maintain existing buffer/riparian zone which is primarily intact.
3. Maintain and do not remove existing coarse wood.
4. Maintain snag/perch trees.

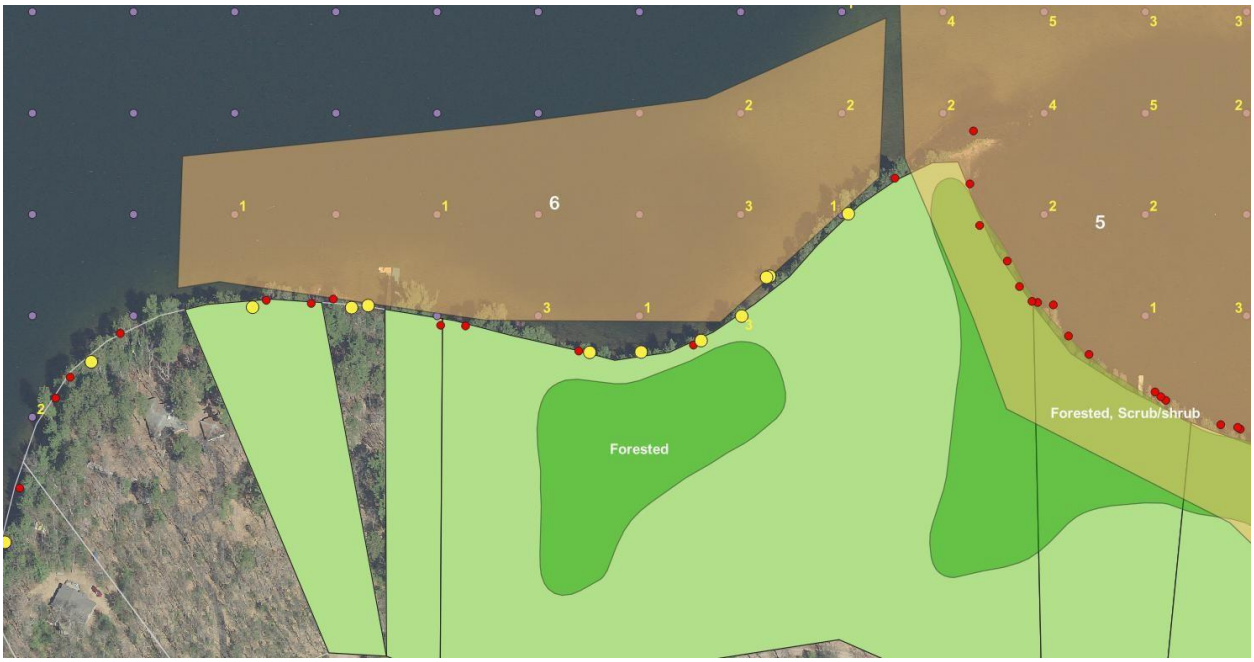

Figure 28. Moon Lake Site 6. Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland; dark green polygons=wetlands). Tax parcels white lines.

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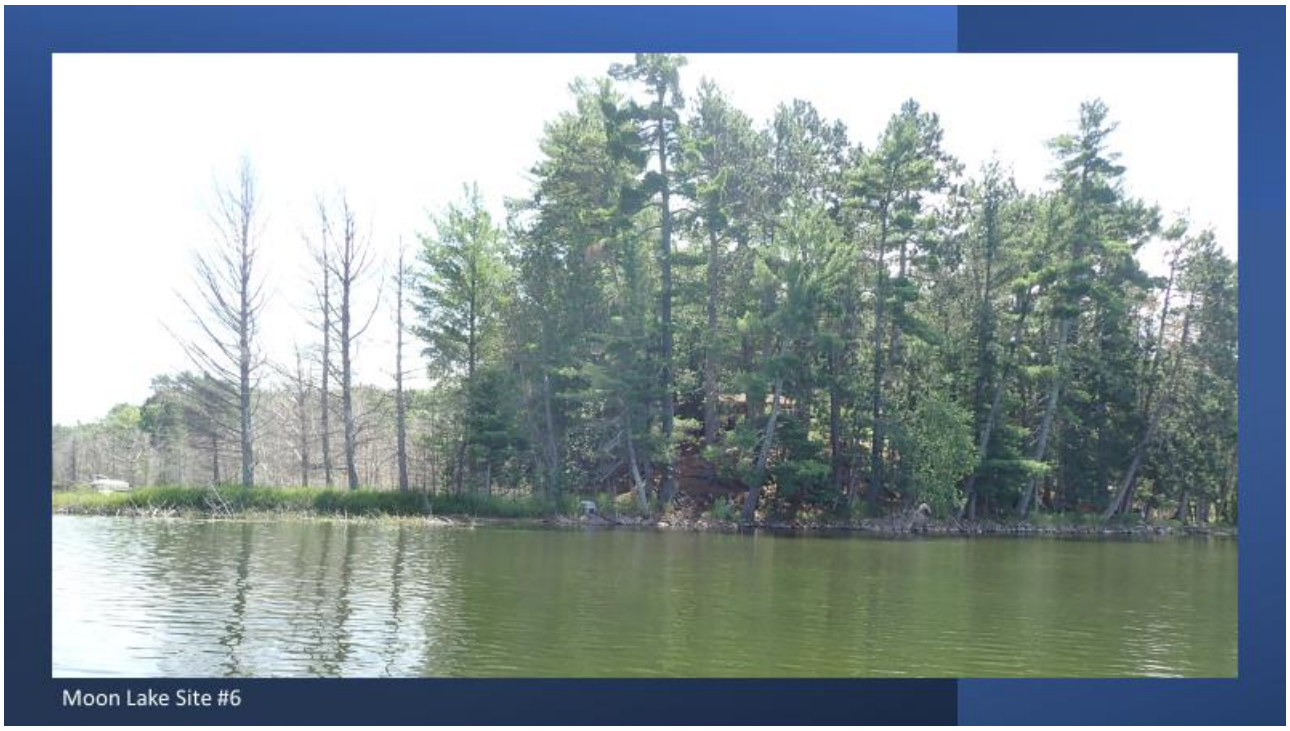
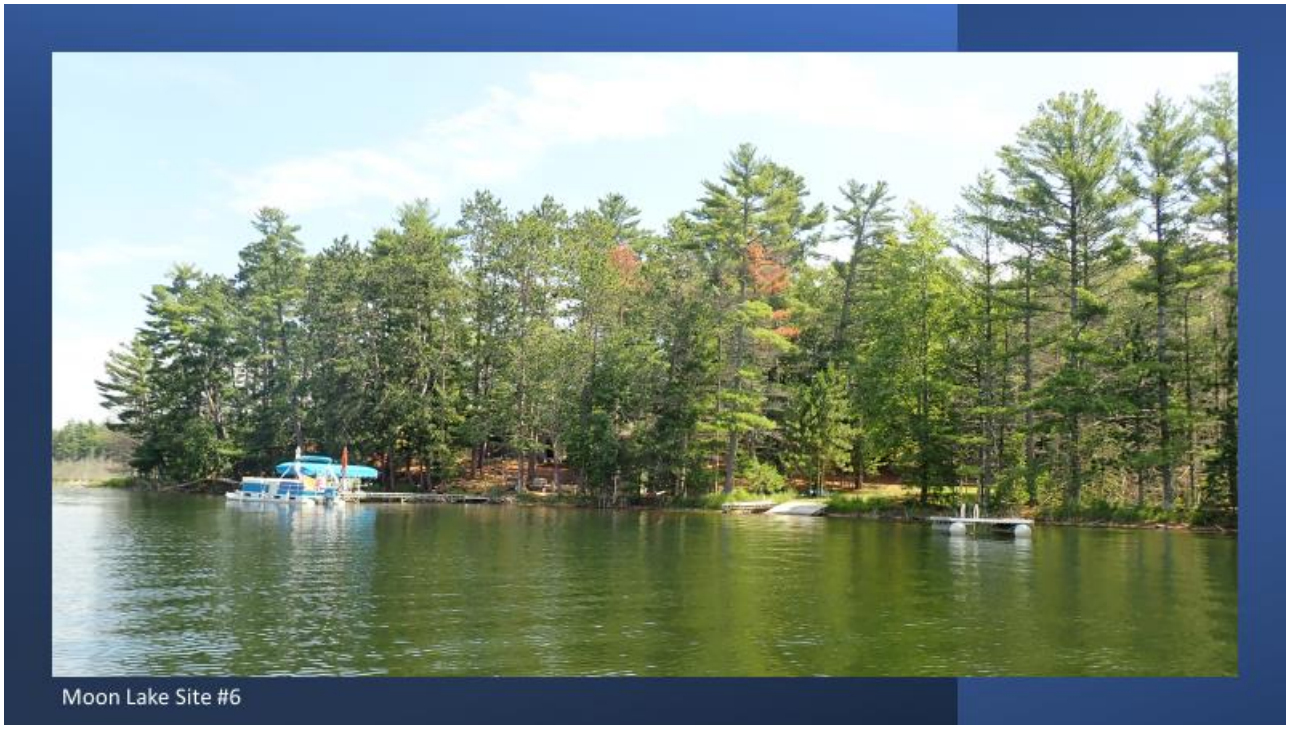
Photos taken in a clockwise direction.



Moon Lake Site #6



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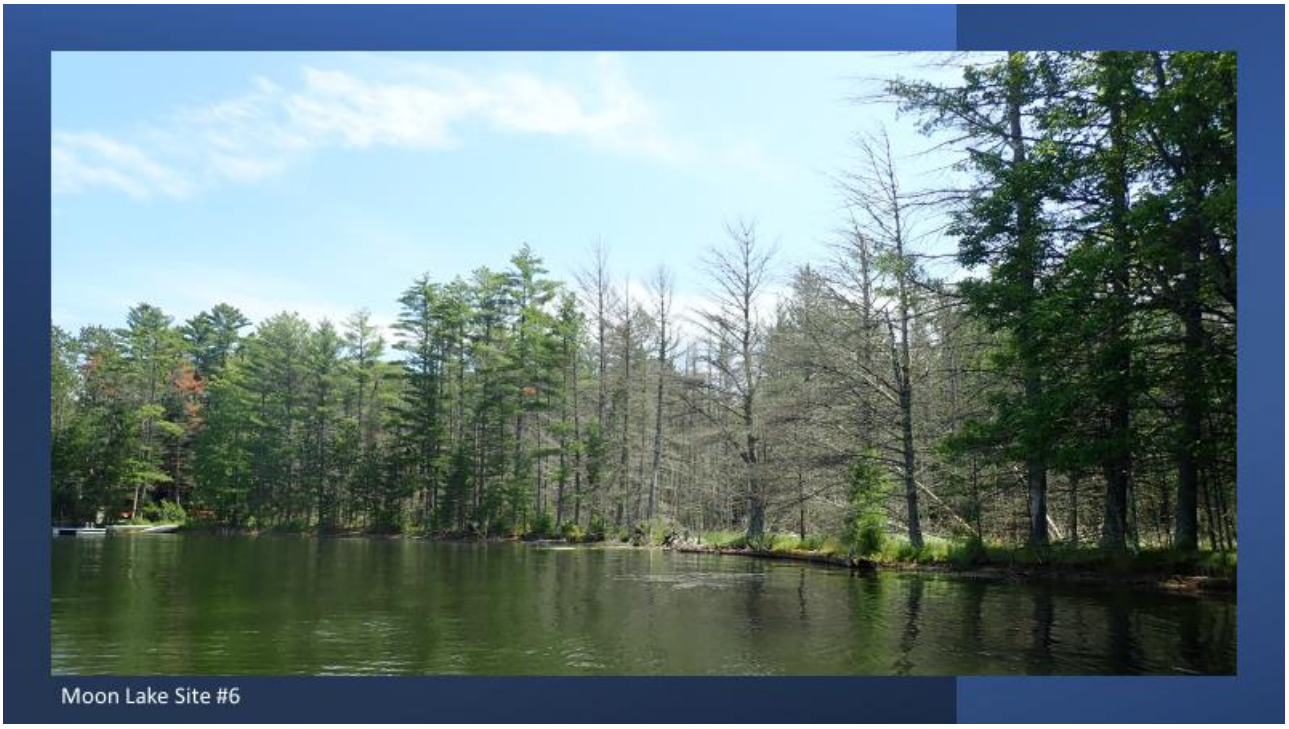

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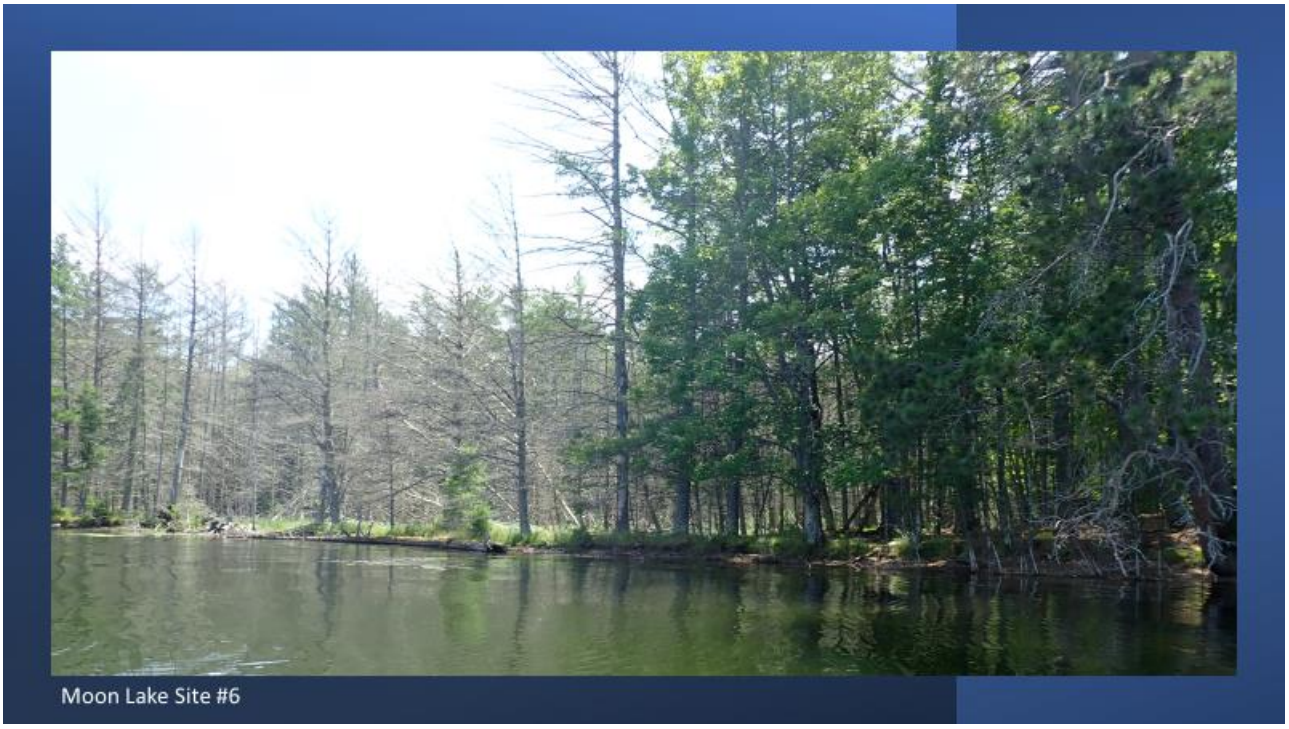

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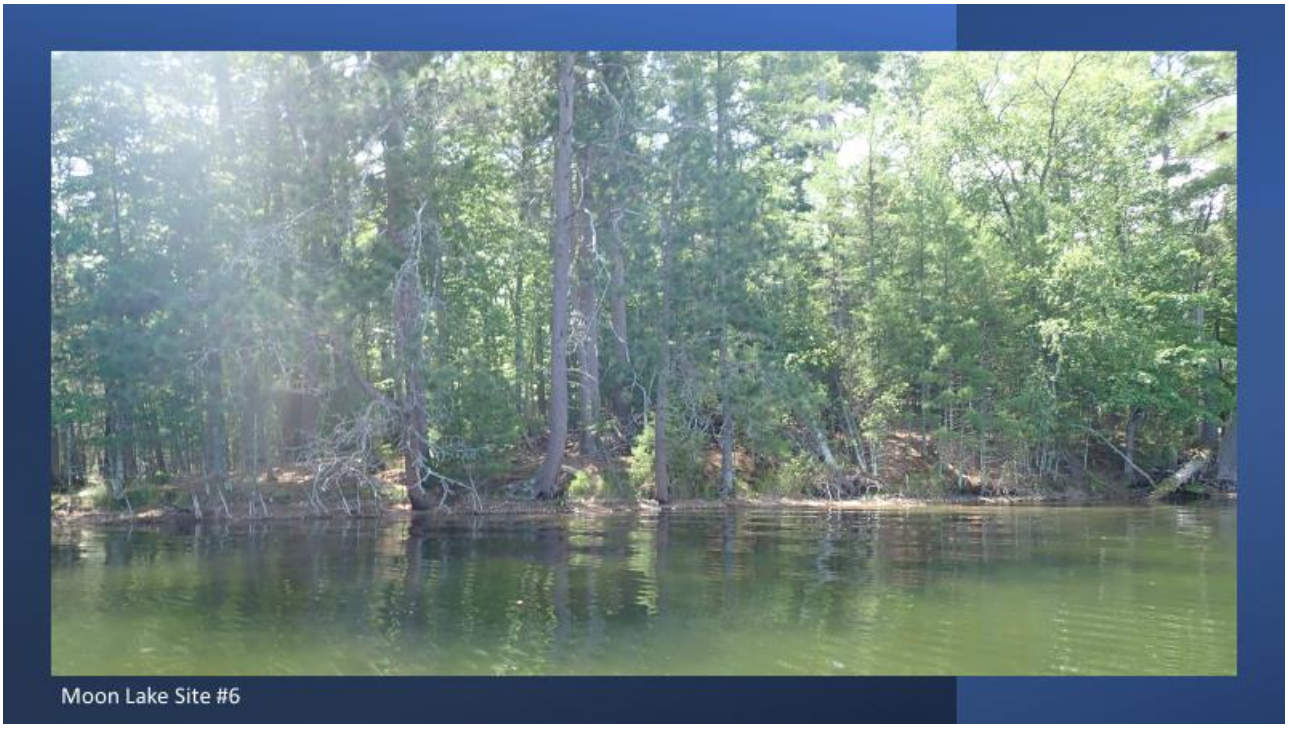

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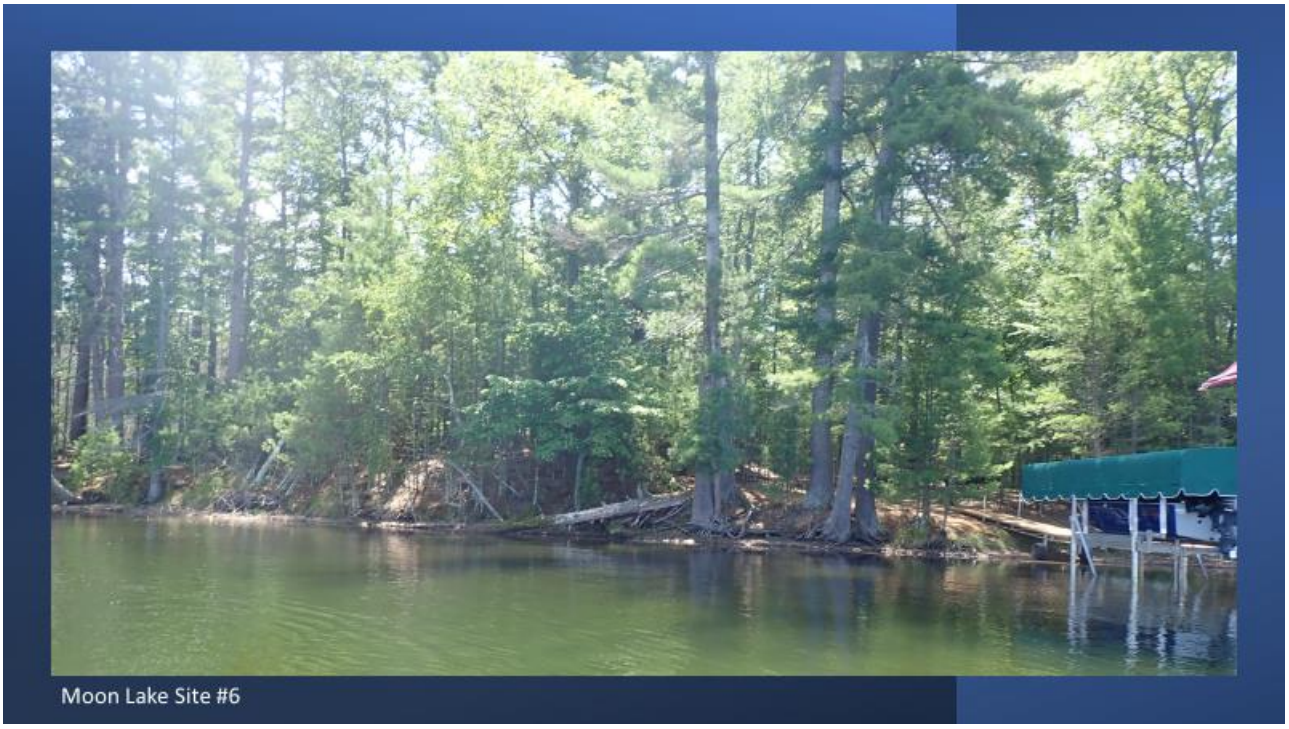

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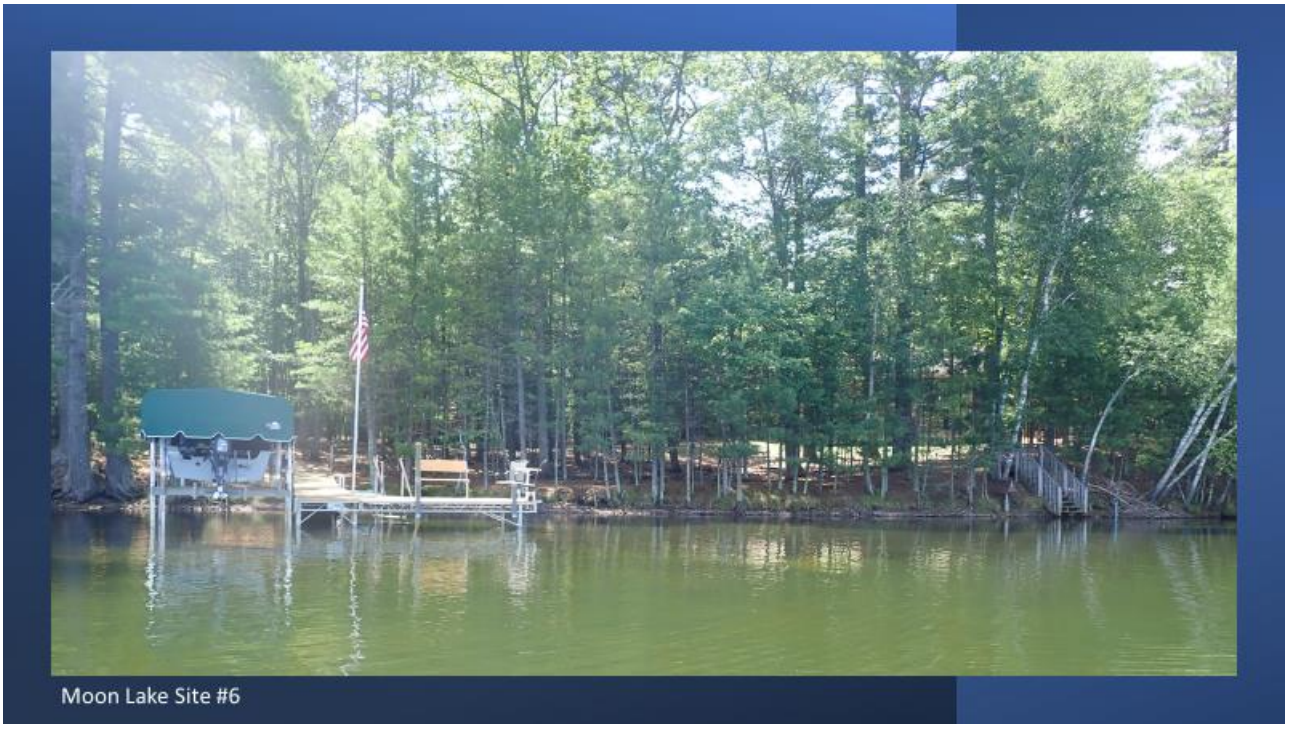

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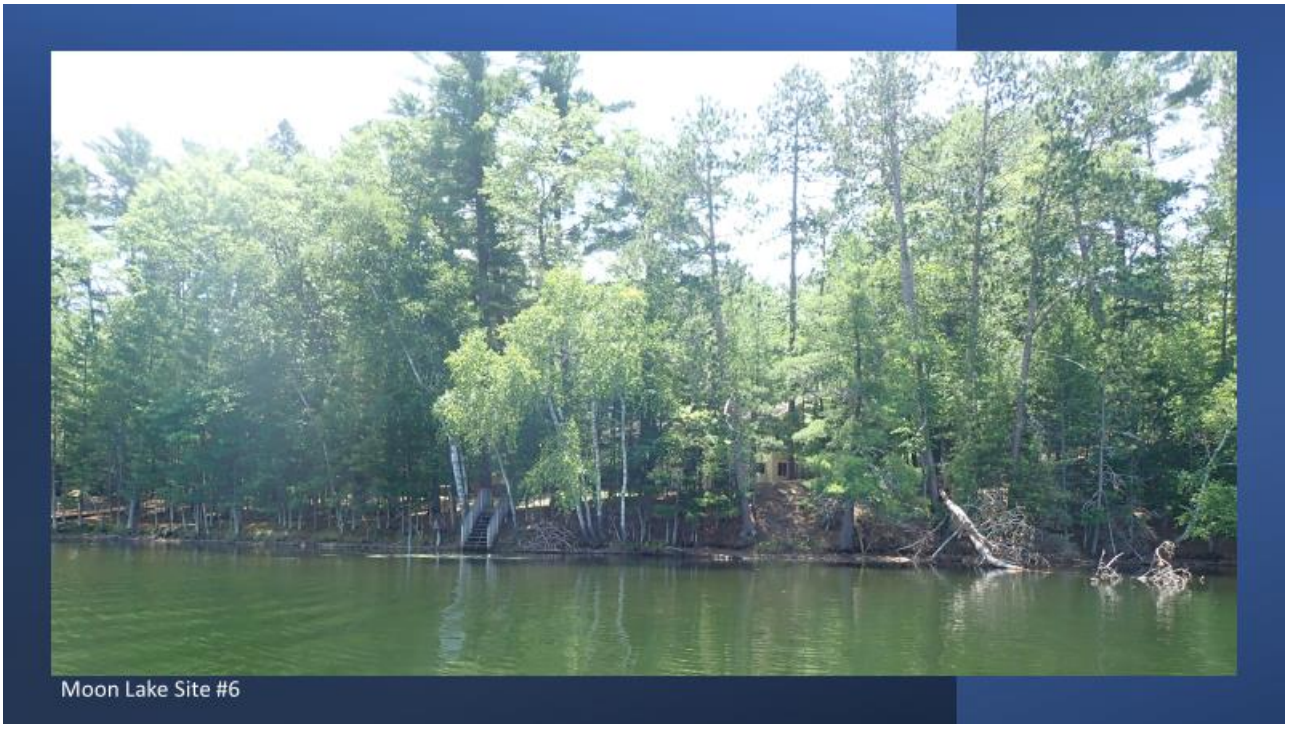

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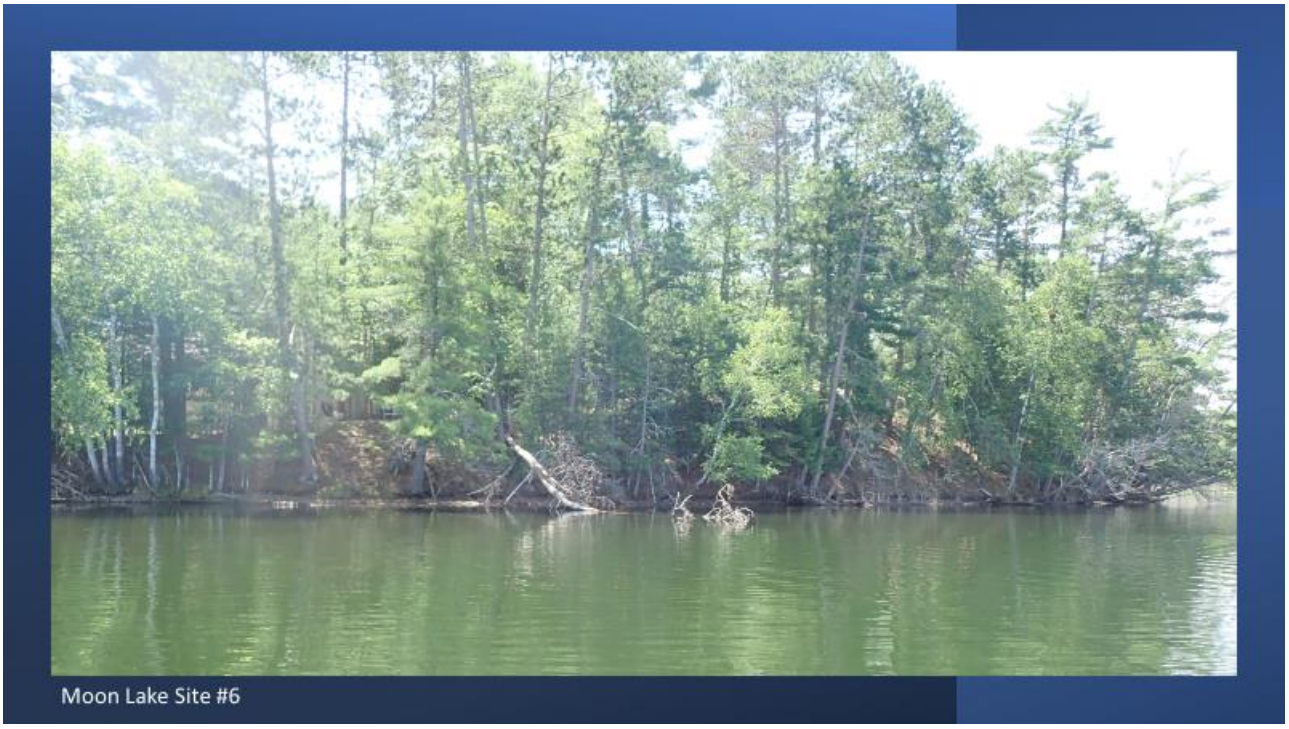

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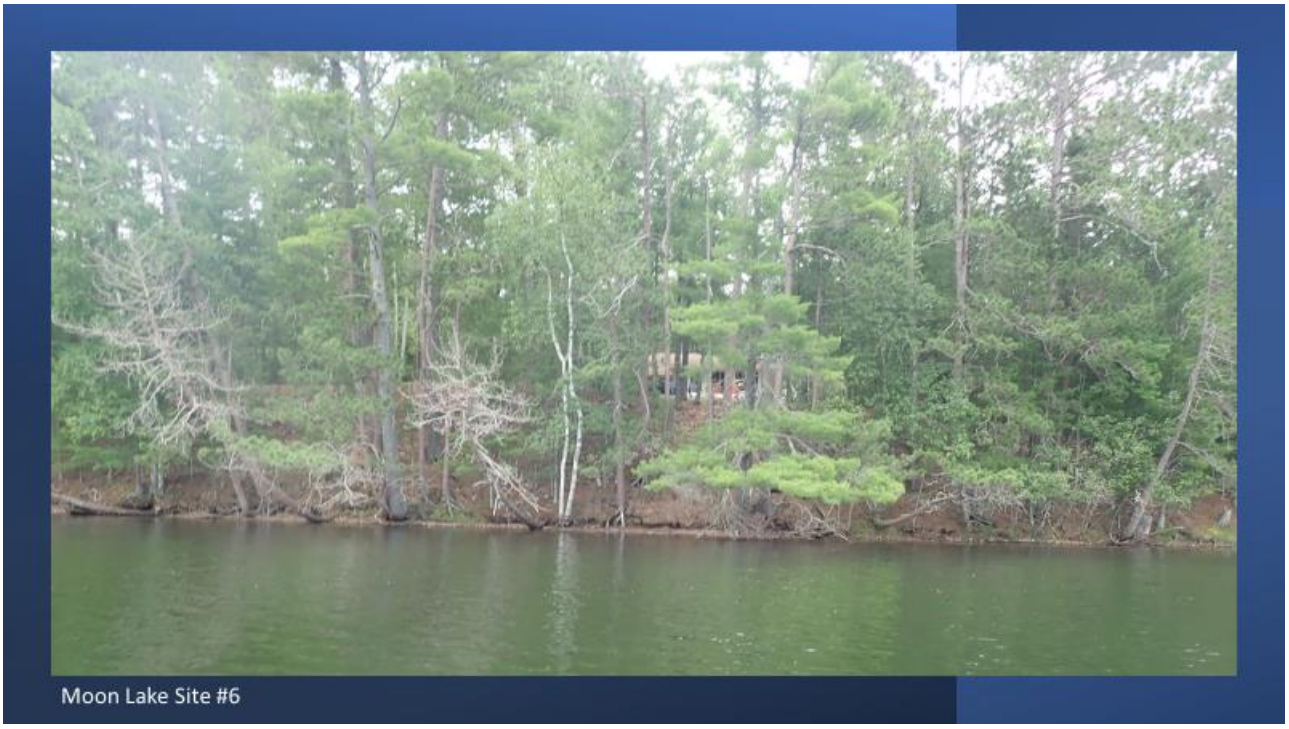

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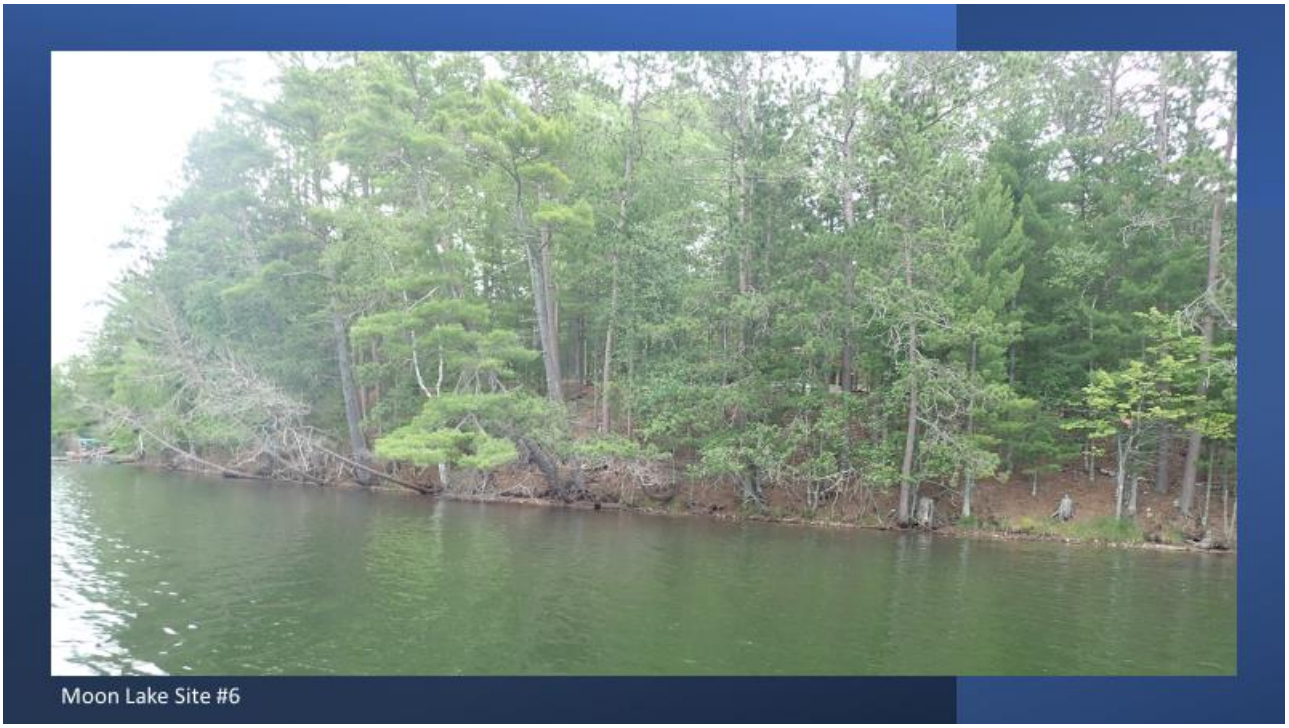

Moon Lake Site #6

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Moon Lake-7 Diverse Plant Bed (Northwestern portion of lake)

This is a diverse open water submerged aquatic plant bed (see Table 9), identified during the 2019-point intercept plant survey (Onterra). It was selected primarily for its fishery and water quality value.

Physical Description of the Site

The site includes open water littoral zone habitats (see figure 29). Diverse submergent aquatic vegetation is abundant. The 2019 plant survey showed 2-5 species of plants were found on each rake sample.

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1. Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone.

Fish Habitat

Diverse submergent plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include walleye, northern pike, largemouth bass, and panfish.

Wildlife Habitat

Diverse submergent plants provide the functional needs (feeding) for a variety of waterfowl.

Table 9. Aquatic plants found at Site 7 from previous plant surveys by Onterra LLC (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Submergent	*Chara*	Muskgrasses	7
Submergent	*Elodea nutalli*	Slender waterweed	7
Submergent	*Isoetes sp.*	Quillworts	8
Submergent	*Myriophyllum tenellum*	Dwarf water milfoil	10
Submergent	*Potamogeton pusillus*	Small pondweed	7
Submergent	*Ranunculus flammula*	Creeping spearwort	9
Submergent	*Utricularia resupinata*	Small purple bladderwort	9

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Management Recommendations

1. Protect this diverse plant bed

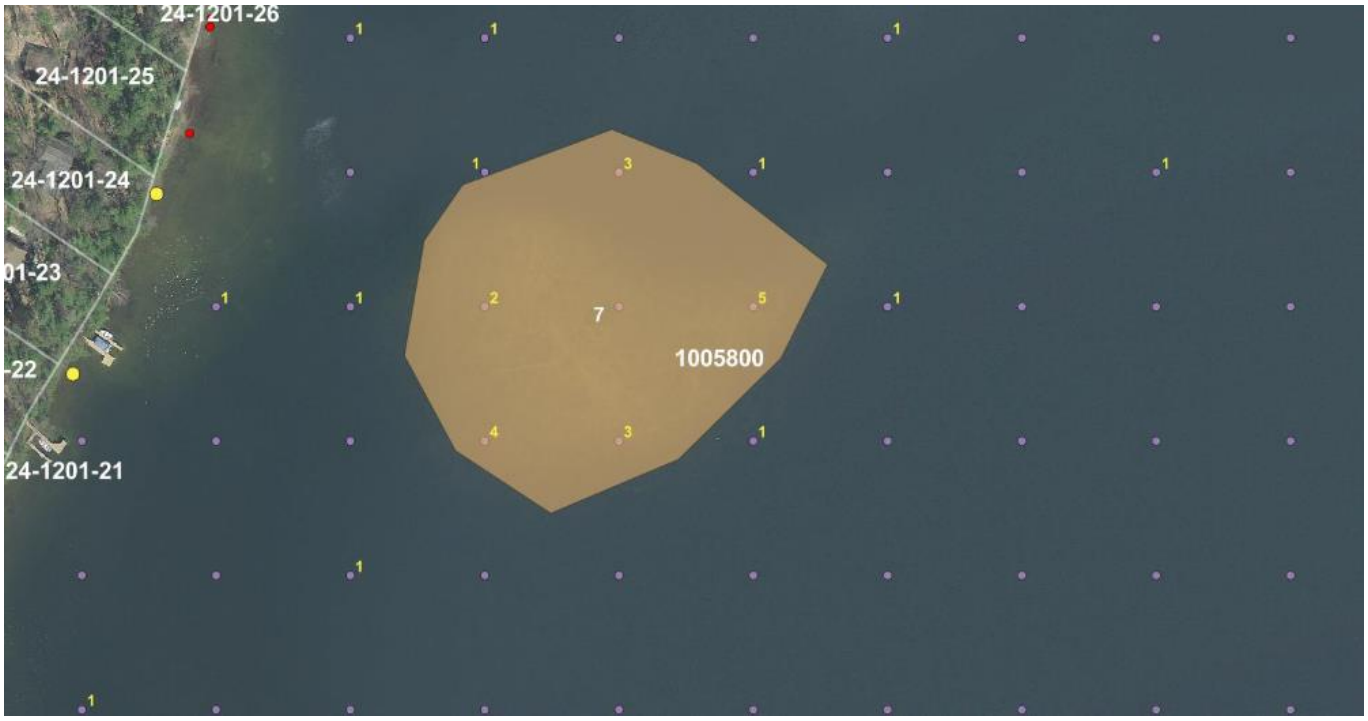

Figure 28. Moon Lake Site 7. Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point. Tax parcels white lines, white numerals.

No Photos taken.

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Moon Lake-8 Intact undeveloped shoreland buffer (northern portion of lake)

This site provides good habitat with minimal shoreline development along a steep shoreline. It was selected for its fish and wildlife values, diverse aquatic vegetation (see Table 10), water quality protection and natural scenic beauty.

Physical Description of the Site

The site includes nearshore terrestrial, shoreline, and littoral zone habitats. The riparian type is 100% wooded. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, and trees. Gravel is present along this stretch, but it is tight to shore. This site contains a natural shoreline. Coarse woody cover is present (see Figure 30).

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1 Nutrient buffer zone (provides a sink for nutrients).
2 Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3 Sediment stabilization zone.

Fish Habitat

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include musky and northern pike, largemouth bass and panfish. The gravel may be too tight to shore for walleye spawning but could be used by other non-game species.

Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, waterfowl, shore birds, marsh birds, amphibians, and reptiles utilize this site.

Table 10. Aquatic plants found at Site 8 from previous plant surveys by Onterra LLC (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Emergent	*Eleocharis palustris*	Creeping spikerush	6
Emergent	*Schoenoplectus acutus*	Hardstem bulrush	7
Emergent/Floating	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
Submergent	*Chara*	Muskgrasses	7
Submergent	*Isoetes sp.*	Quillworts	8
Submergent	*Vallisneria americana*	Wild celery	6
Submergent/Emergent	*Eleocharis acicularis*	Needle spikerush	5

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Management Recommendations

1. No alteration of littoral zone.
2. Because of the steep shoreline, maintain the existing buffer/riparian zone which is primarily intact.
3. Maintain and do not remove existing coarse wood.
4. Maintain snag/perch trees.

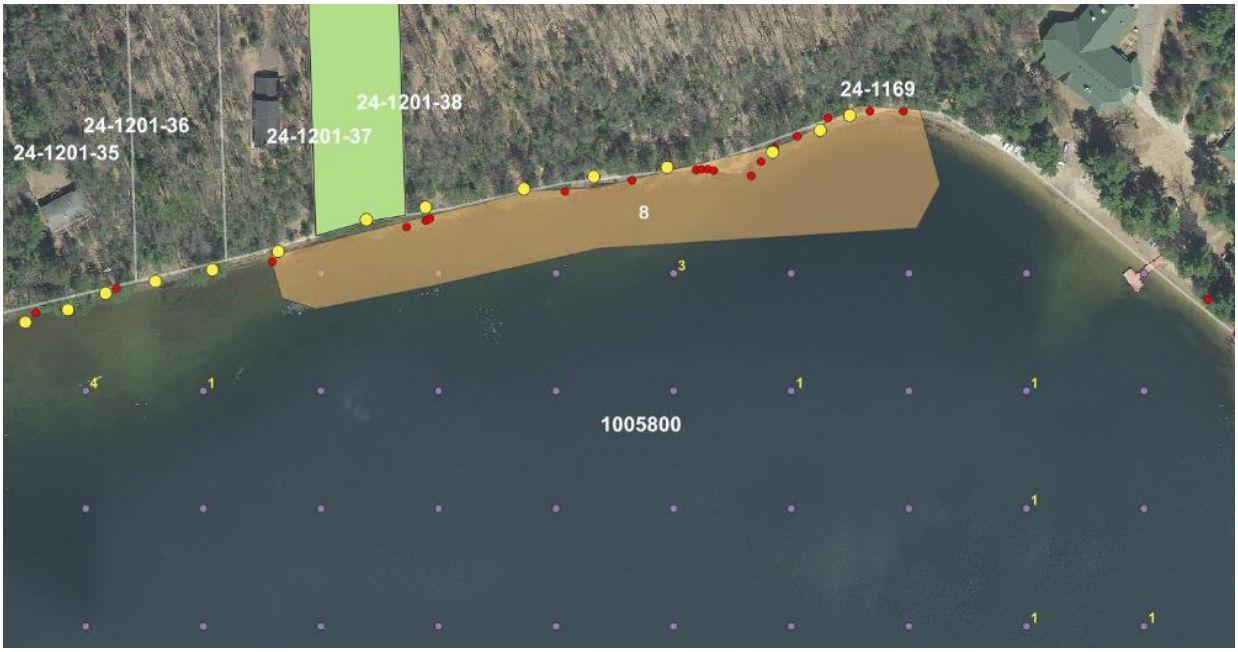

Figure 30. Moon Lake Site 8. Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland). Tax parcels white lines, white numerals.

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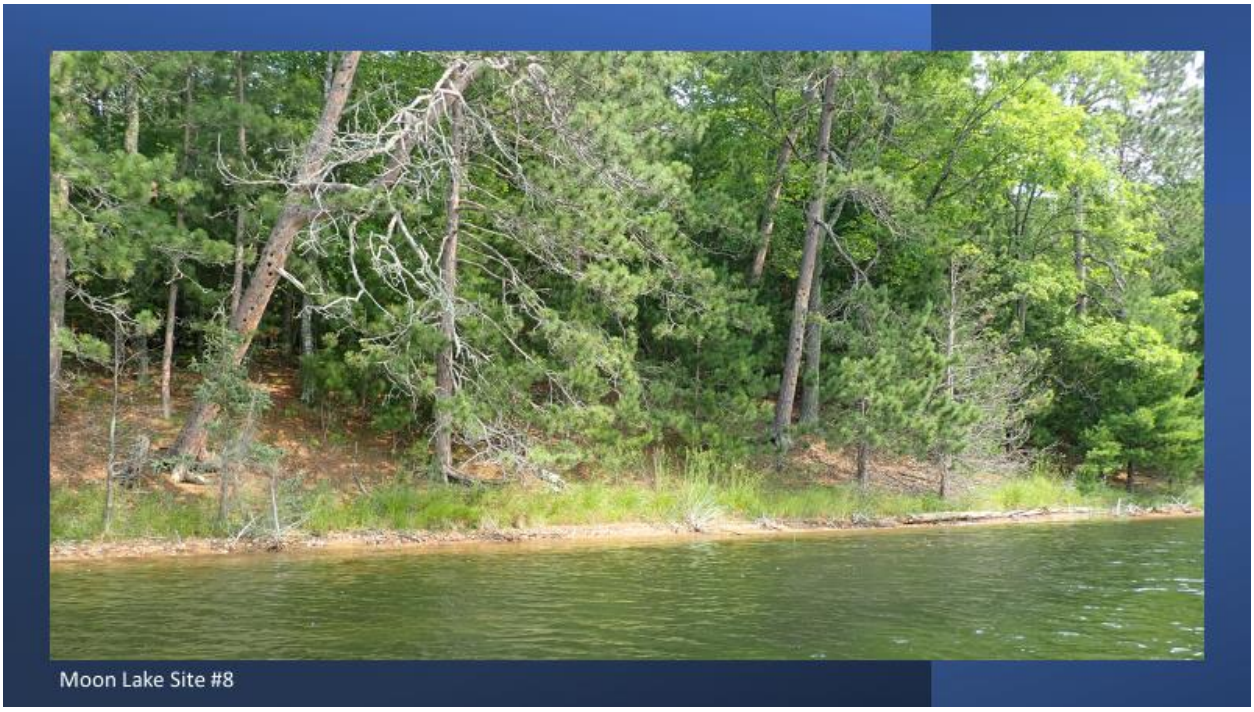
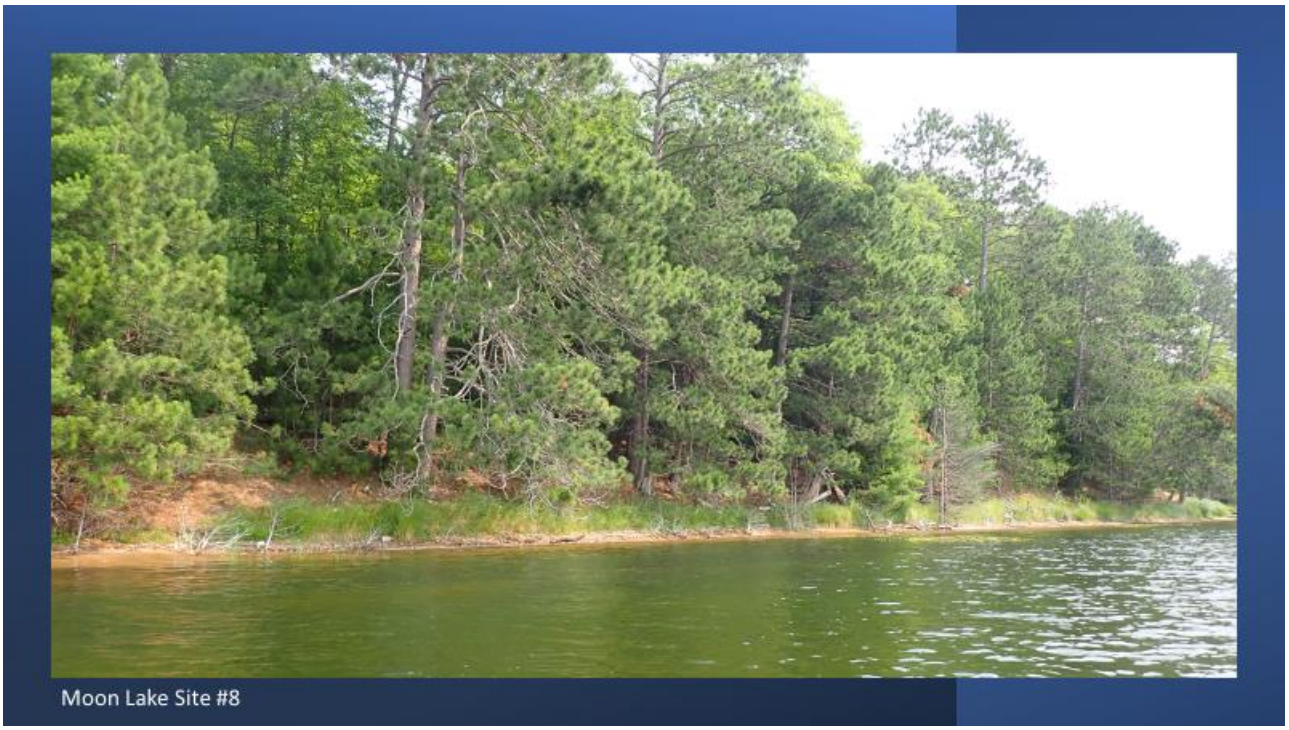
Photos taken in a clockwise direction.



Moon Lake Site #8



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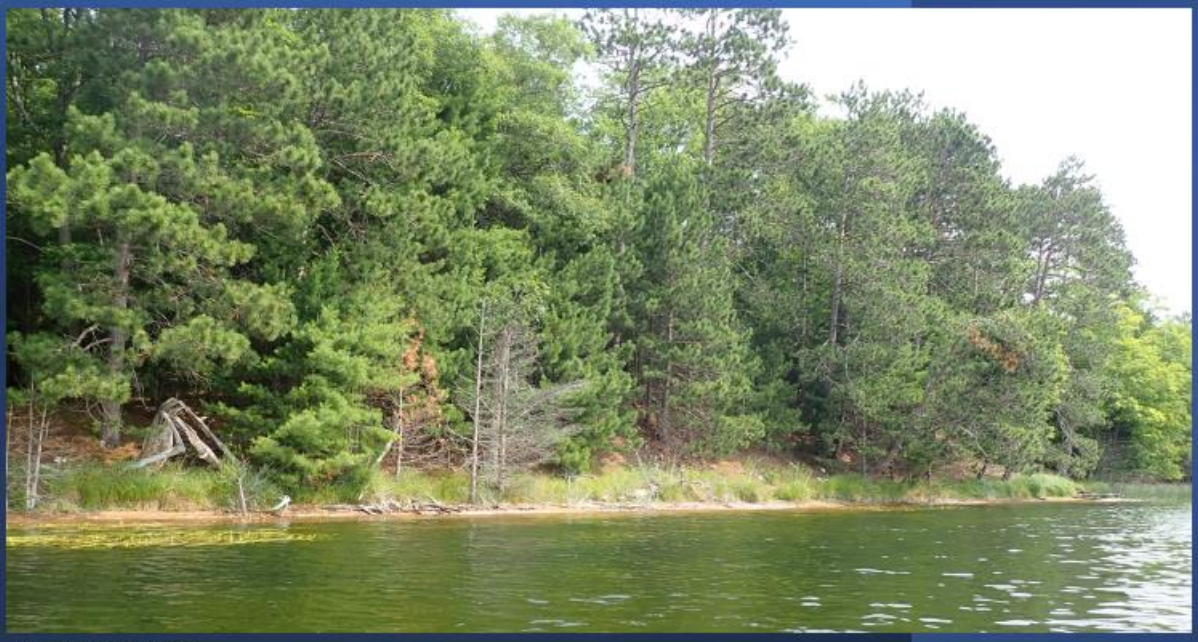

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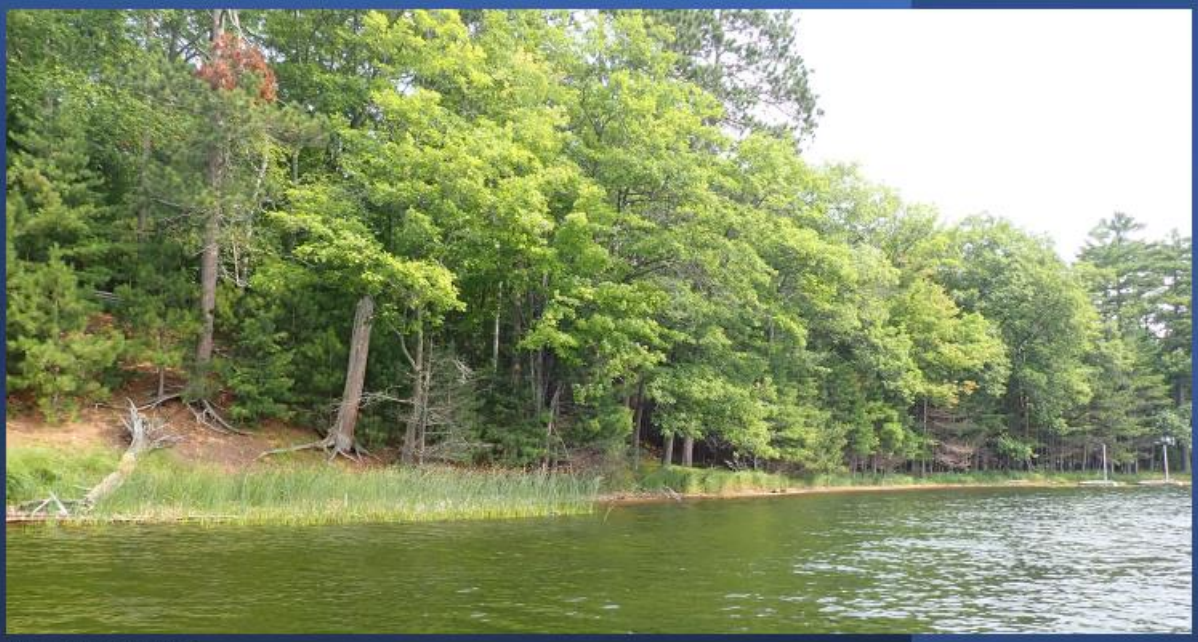

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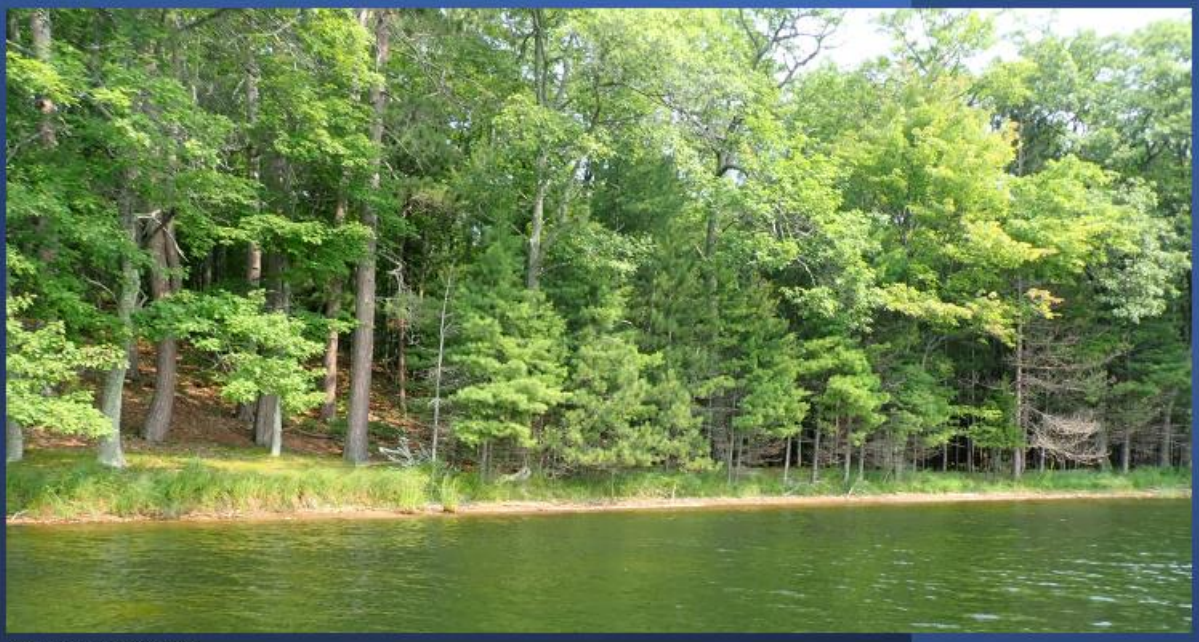

Moon Lake Site #8

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Moon Lake-9 Diverse aquatic plant bed/intact shoreland buffer, Moon Beach Shoreland Restoration Site (Eastern portion of lake)

This site provides good habitat along a restored steep shoreline. It was selected for its fish and wildlife values, diverse aquatic vegetation (see Table 11), water quality protection, and natural scenic beauty.

Physical Description of the Site

The site includes nearshore terrestrial, shoreline, and littoral zone habitats. The riparian type is 100% wooded. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, and trees. Coarse woody cover is abundant (see Figure 31). A large shoreline restoration project was coordinated by WDNR and was conducted on the Moon Beach Camp property from May 2008 through August 2010. Fifty plus years of operation of the facility resulted in moderate to severe shoreline erosion. Much of the impacted stretch of shoreline had little native vegetation and contributed large quantities sediment to the lake during heavy rain events. In addition, there was a lack of in water coarse woody material, few downed trees, and sparse aquatic plant beds resulting in little habitat for fish and wildlife. During the 2010 Onterra aquatic plant PI surveys only 8 of 18 sample points (44%) had plants present but by 2019 the number of sample points with aquatic plants increased to 13 of 18 sample points (72%) – with the points sampled at depth showing new plant growth (Onterra LLC 2010 and 2019).

Erosion problems were corrected through development of rain gardens to capture run-off, as well as use of biodegradable erosion control products to reduce bank erosion. The shoreline was replanted with native trees, shrubs and ground cover that are appropriate for the Moon Lake ecosystem. Tree drops were also added.

Thirteen years after the restoration the results are telling. Erosion has been eliminated; the steep shoreline buffer restored with native vegetation. In-water recruitment of wood and re-establishment of aquatic plant beds has provided habitat for fish and wildlife. See before and after photos below.

Critical Habitat Values

<u>Attributes of Water Quality</u>

This site serves as a:

1. Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone.

<u>Fish Habitat</u>

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include largemouth bass and panfish.

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Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, waterfowl, shore birds, marsh birds, amphibians, and reptiles utilize this site.

Management Recommendations

1. No alteration of littoral zone.
2. Maintain existing buffer/riparian zone which is primarily intact.
3. Maintain and do not remove existing coarse wood.
4. Maintain snag/perch trees.

Table 11. Aquatic plants found at Site 9 from previous plant surveys (2010 and 2019).

Life Form	Scientific Name	Common Name	Coeff. of Conservatism (C)
Emergent	*Eleocharis palustris*	Creeping spikerush	6
Emergent		Water willow	
Emergent	*Zizania palustris*	Northen wild rice	8
Floating leaf/ Emergent	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
Submergent	*Elodea canadensis*	Common waterweed	3
Submergent	*Isoetes sp.*	Quillworts	8
Submergent	*Myriophyllum tenellum*	Dwarf water milfoil	10
Submergent	*Potamogeton amplifolius*	Large-leaf pondweed	7
Submergent	*Ranunculus flammula*	Creeping spearwort	9
Submergent	*Sagittaria sp.*	Arrowhead (rosette)	N/A
Submergent	*Utricularia resupinata*	Small purple bladderwort	9
Submergent	*Vallisneria americana*	Wild celery	6
Submergent/emergent	*Eleocharis acicularis*	Needle spikerush	5
Submergent/emergent	*Juncus pleocarpus*	Brown-fruited rush	8

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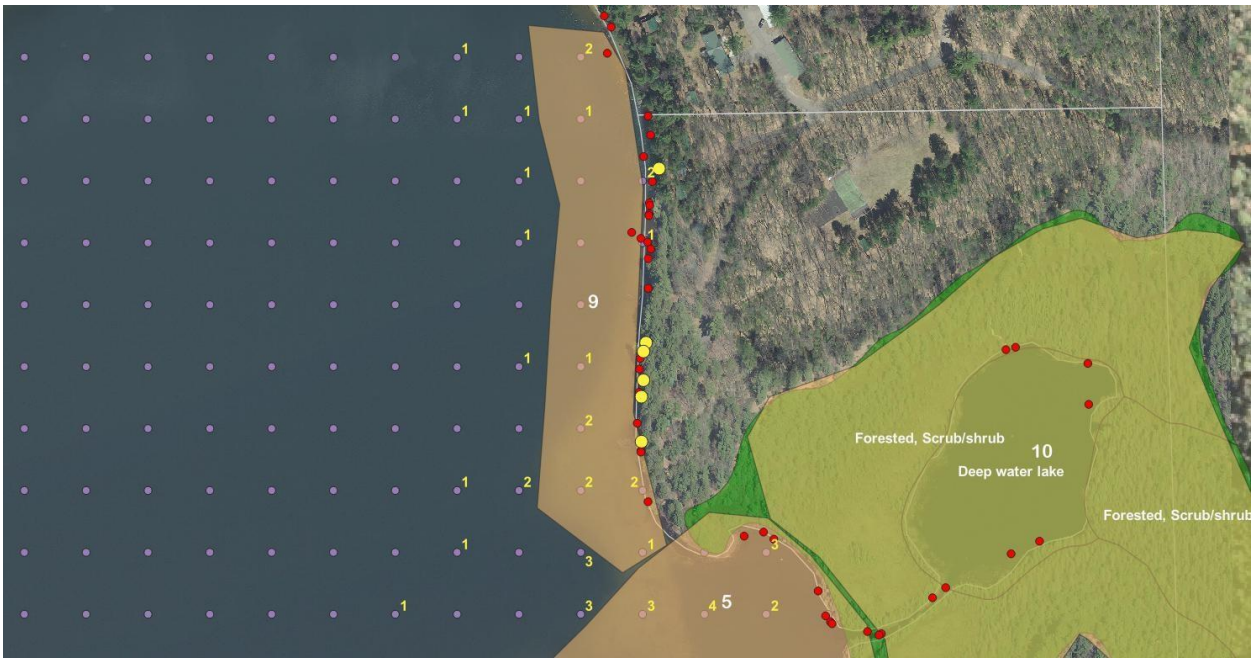

Figure 31. Moon Lake Site 9. Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland; dark green polygons=wetlands). Tax parcels white lines.

Moon Beach critical habitat photos before and after restoration.

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Moon Beach Shoreline before restoration (2008)

Moon Beach Camp Shoreline Post Restoration Site #9

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Moon Beach Shoreline before restoration (2008)

Moon Beach Camp Shoreline Post Restoration Site #9

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Moon Beach Camp Shoreline Post Restoration Site #9

Moon Beach Shoreline before restoration (2008)

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Moon Lake-10 Diverse aquatic plant bed/forested, scrub/shrub wetland and includes Engel Lake (Unnamed Lake WBIC 1161500).

This site provides excellent habitat with no shoreline development. It was selected for its fish and wildlife values, diverse aquatic vegetation, terrestrial vegetation, wetland buffer, water quality protection and natural scenic beauty. Engle Lake is 3.65 acres in size and has a maximum depth of 8 feet.

Physical Description of the Site

The site includes nearshore terrestrial, wetland, and littoral zone habitats. The riparian type (%) is 100% wetland. The riparian character (from water's edge to 35 feet back) is dominated by herbaceous plants, shrubs, and trees. This site contains a natural shoreline. Coarse woody cover is present (see Figure 32). The scrub shrub wetland consists of broad-leaved evergreen (Labrador tea and leatherleaf). The forested wetland consists of needle leafed coniferous trees (white cedar, balsam fir and black spruce) (see Figure 32).

Critical Habitat Values

Attributes of Water Quality

This site serves as a:

1 Nutrient buffer zone (provides a sink for nutrients).
2. Physical buffer zone (provides protection against shoreline erosion and plant fragmentation).
3. Sediment stabilization zone.

Fish Habitat

Coarse wood, emergent, submergent and floating leaf plants provide excellent habitat for invertebrates and the functional needs (spawning, nursery area, feeding, shade and protective cover) for a variety of game and forage fish. Game fish species utilizing the site include musky and northern pike, largemouth bass and panfish.

Wildlife Habitat

Diverse emergent, floating leaf plants, shrubs/brush in riparian zone, snag/perch trees and fallen logs provide the functional needs (shelter/cover, nesting area, feeding) for a variety of wildlife. Upland wildlife, furbearers, birds (loons, herons, and waterfowl), furbearers, amphibians, and reptiles utilize this site.

Management Recommendations

1. No alteration of littoral zone.
2. Maintain existing buffer/riparian zone which is primarily intact.
3. Maintain and do not remove existing coarse wood.
4. Maintain snag/perch trees.
5. A plant survey should be conducted on Engle Lake in 2024.

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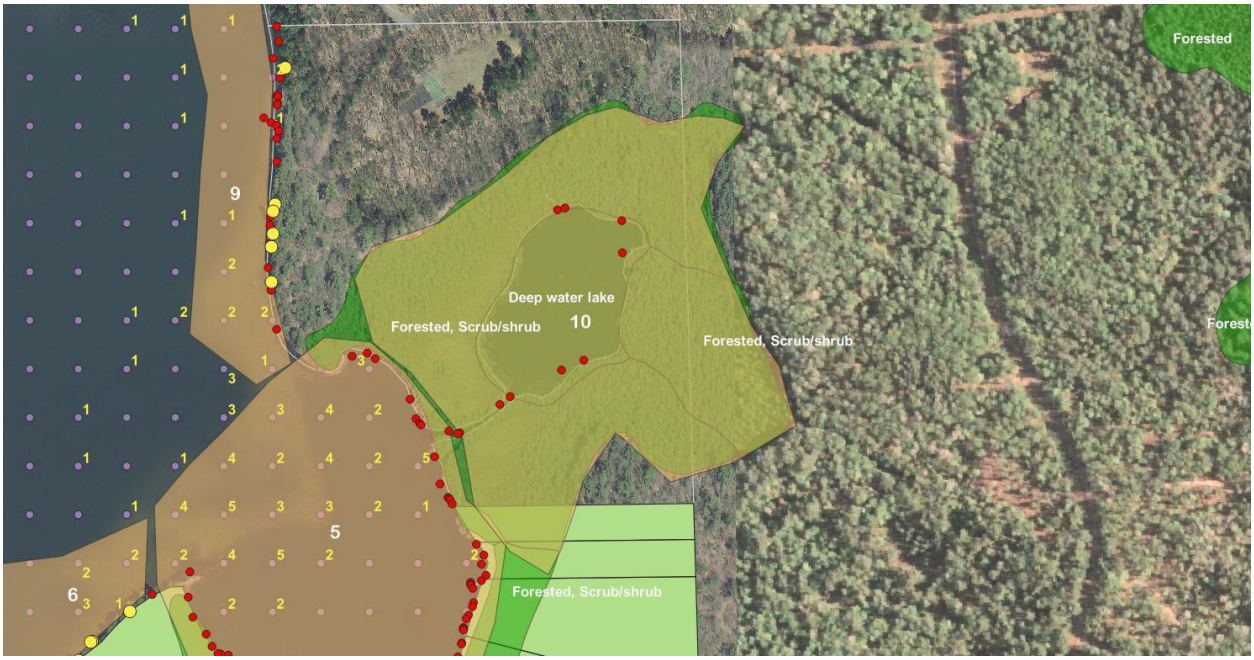
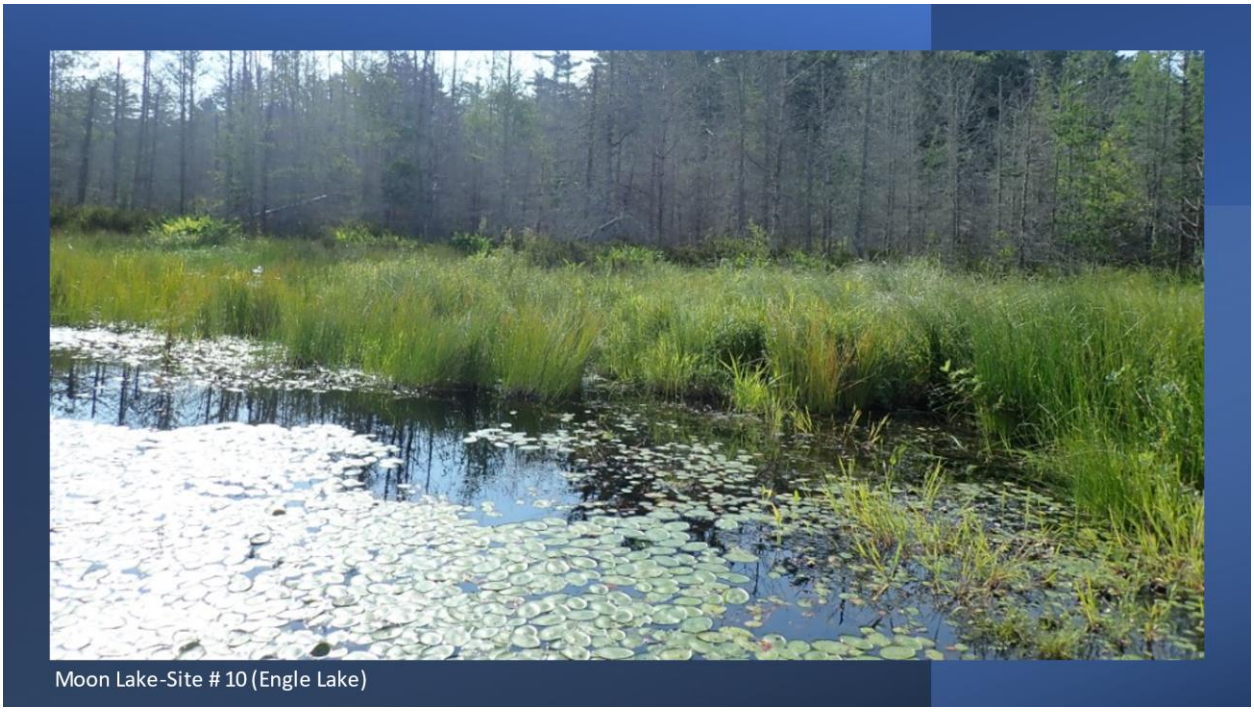


Figure 32. Moon Lake (Engle Lake) Site 10. Critical Habitat site (orange polygon, white numeral) in relation to natural features (red dots=coarse wood; yellow dots=rock/rubble/gravel; purple dots and yellow numerals=2019 Onterra PI Survey results with number of native species per point; light green polygons=natural shoreland; dark green polygons=wetlands). Tax parcels white lines.

Photos taken in a counterclockwise direction.



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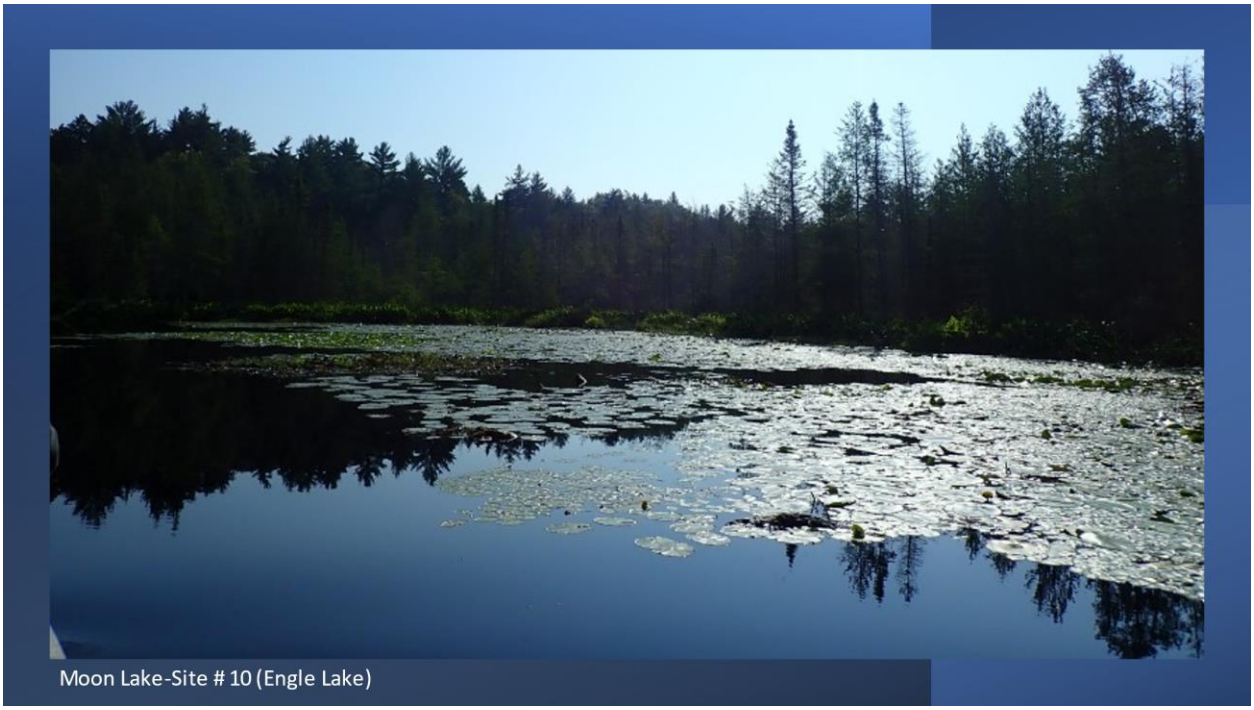
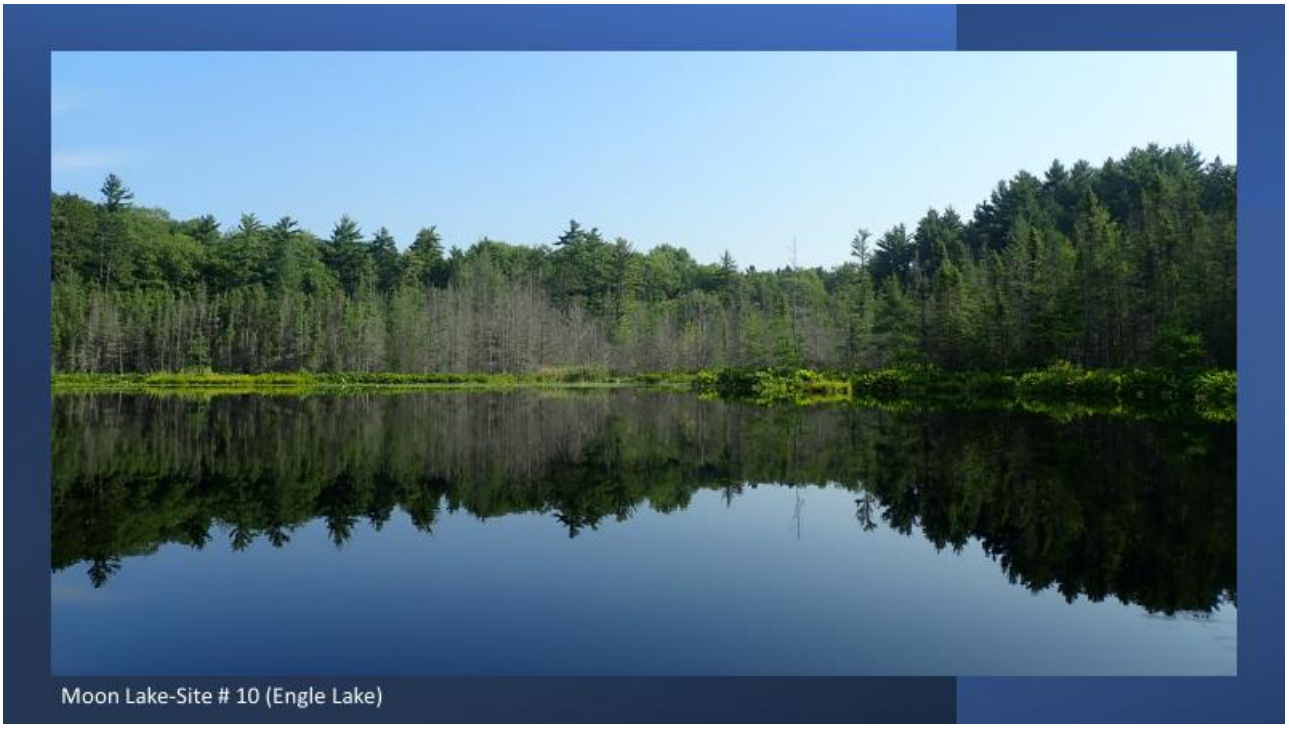


Moon Lake-Site # 10 (Engle Lake)



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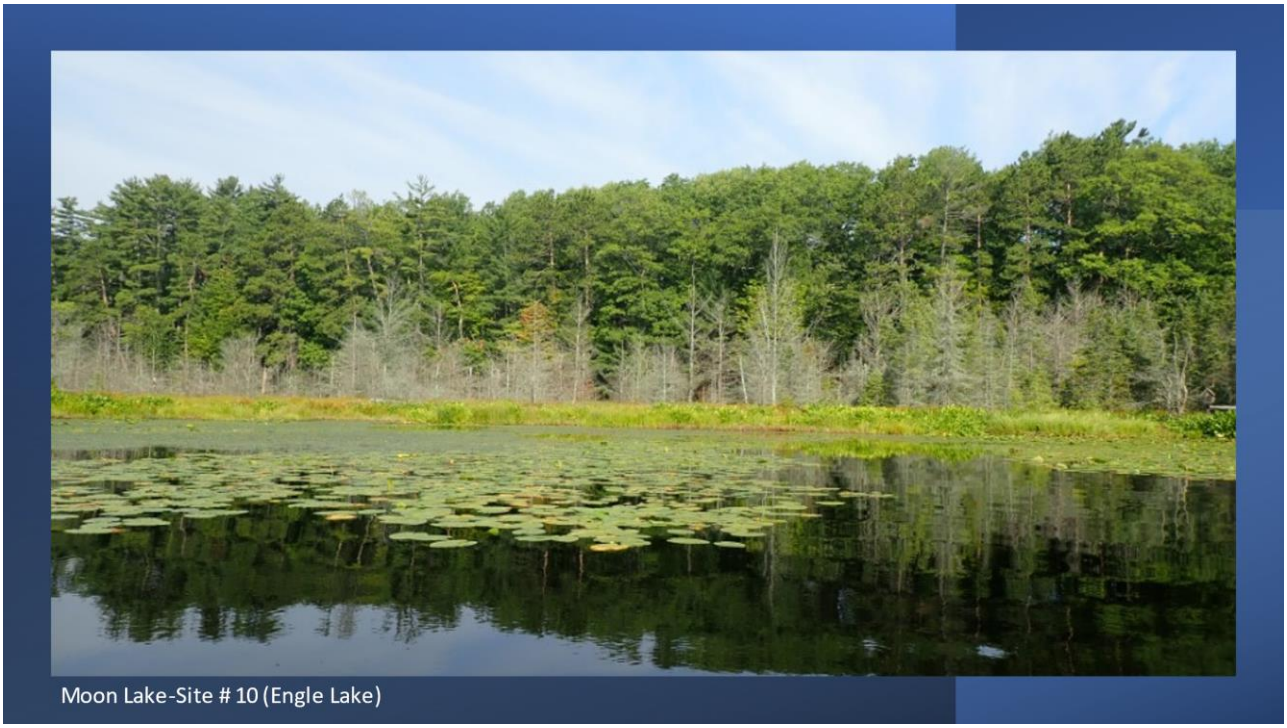

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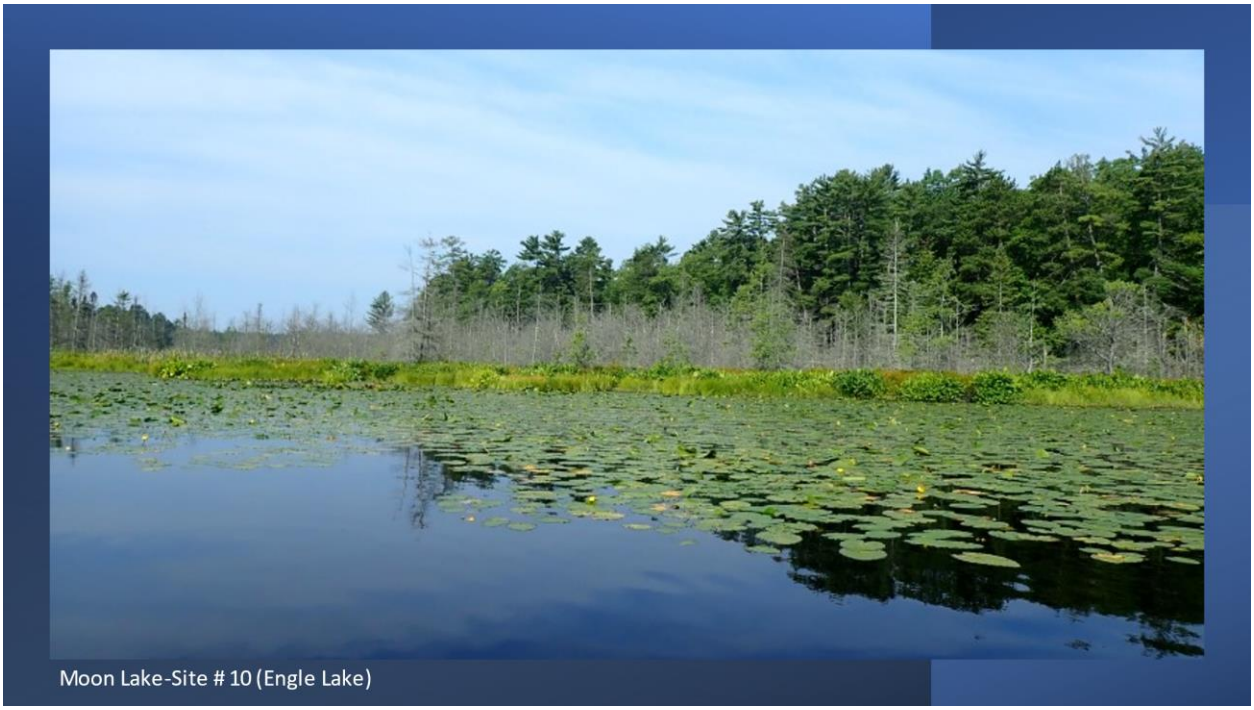

Moon Lake-Site # 10 (Engle Lake)

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Moon Lake-Site # 10 (Engle Lake)

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Recommendations for Use of this Report and Best Lake Management Practices

The goal of this project is to inform the Alma-Moon Lake P&R District and lake neighbors of the important ecological features of the Alma and Moon Lakes (e.g., Critical Habitat Sites). We are assuming this knowledge will help the Lake District incentivize Alma and Moon Lake property owners to more broadly adopt shoreland best management practices to protect these features, their lake's water quality, thus their property values. To accomplish this goal, we recommend the following:

1) Post an abbreviated version of this report on the Alma-Moon Lake P&R District website including the most significant findings and recommendations. Consider posting on other social media sites such as Facebook and YouTube.

2) The Alma-Moon Lake P&R District could recruit property owners on both lakes to participate in the Healthy Lakes of Wisconsin Program and apply for grants to support the shoreland management and restoration work on Alma and Moon Lakes Let's make Healthy Lakes together! - Wisconsin's Healthy Lakes Program (healthylakeswi.com)

3) A Shoreland Steward Education and Outreach package should be developed to share with Alma and Moon Lake property owners. The package could include:
    - Information on Critical Habitat sites near their property (this report).
    - Wisconsin Lakes Partnership/UW Extension Lakes outreach materials Home - Extension Lakes | UWSP
    - Wisconsin Healthy Lakes grant opportunities and best management recommendations Let's make Healthy Lakes together! - Wisconsin's Healthy Lakes Program (healthylakeswi.com)

4) Some Alma and Moon Lake properties have manicured lawn and impervious surfaces in the shoreland buffer. Owners should be encouraged to take steps to restore native plants in the shoreland buffer – the most effective approach may be to establish a no-mow zone adjacent to the lake and allow native plants to return passively. Active restoration of the sites could also be encouraged by pointing property owners to the Healthy Lakes program of Wisconsin with a description of methods and funding of shoreland restoration and protection projects Healthy Lakes Program of WI. Let's Make Healthy Lakes Together! (healthylakeswi.com). These activities include run-off diversion and retention, planting of native species in the buffer, and placement of coarse wood in the littoral zone. Because

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many of the properties have buildings within the shoreland buffer, run-off from these impervious surfaces should be diverted from the lake and an attempt should be made to return at least a narrow vegetative buffer along the lakeshore.

5) Several areas of Alma and Moon Lakes have multiple properties near to one another that would benefit from shoreland best management practices. These areas provide an opportunity for neighbor-to-neighbor discussions and implementation. The Alma-Moon Lake P&R District could initiate and facilitate these meetings and consider promoting shoreland restoration demonstration projects at properties where owners are willing to demonstrate the best management techniques for shorelands. One practice that would improve fish habitat on both lakes would be tree drop or placement of "fish sticks" as described at this link Let's make Healthy Lakes together! - Wisconsin's Healthy Lakes Program (healthylakeswi.com).

6) The Alma-Moon Lake P&R District should discuss whether to request formal designation of the Critical Habitat Sites on Alma and Moon Lakes, with the formal process as described in this report. If this designation is desired, lake leaders should first consult with Mr. Kevin Gauthier, WDNR lake biologist, as wildlife and fishery managers may also need to evaluate this request before proceeding.

7) During our 2023 Alma and Moon Lake surveys, physical characteristics of the shorelands were used to identify critical habitat, but no plant or animal surveys were conducted. Onterra conducted aquatic plant point-intercept surveys in 2010 and 2019. The Alma-Moon Lake P&R District could consider conducting additional plant, fish, wildlife surveys in each of the Critical Habitat Sites to further describe the species and abundance of plants and animals present in these sites. Knowledge of which species are present at the sites would further landowner understanding and appreciation of what is being conserved.

8) The Alma-Moon Lake P&R District should consider another aquatic macrophyte survey (point-intercept) on Alma and Moon Lakes as in 2024 it will be 5 years since the last survey. Engel Lake was not included in the previous surveys and should be included in future surveys as an abundant, diverse aquatic plant community is present.

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9) Numerous floating mats of aquatic vegetation was seen in the southeast bay of Moon Lake, just outside of the channel and the entrance to Engel Lake. That bay has the most diverse aquatic plant community on either Alma or Moon Lake. Some wild rice was also observed in the shallow areas. It would be worth considering extending the no-wake zone from the channel through the shallow areas of the southeast to protect the aquatic plant community from damage due to props and boating activities.

10) As mentioned previously, Engel Lake has a unique aquatic plant community as well as pristine wetlands. It is also the location of a productive loon platform, essentially the only location on the two lakes suitable for loon nesting. The current practice of restricting access to the lake during the loon nesting season should be continued as well as restricting access to only non-motorized boats. The loon nesting platform should be inspected and refurbished annually to encourage loon nesting success.

11) The coarse wood habitat quality on Alma Lake is primarily logs – submerged or touching shore. Several tree drops of whole tree crowns would enhance the fish habitat quality on the lake.

12) We used the WDNR Shoreland and Shallows Assessment Protocol and data entry methods when conducting the surveys on Alma and Moon Lake. This data will be shared with the WDNR in the final grant report, and they are compiling comparable data on numerous lakes in northern Wisconsin which will prescribe specific management recommendations for individual property owners based on their shoreland condition. Alma and Moon Lake property owners should be made aware of this useful feature offered by WDNR.

13) The Alma-Moon Lake P&R District can take a proactive role in protecting lake water quality by recruiting landowners to participate in the Healthy Lakes Program of Wisconsin. Shoreland management project guidelines are provided as are grant application instructions at the Healthy Lakes of Wisconsin website Best Practices » Wisconsin's Healthy Lakes Program (healthylakeswi.com).

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14) Signage at the boat landing should remind boaters and fishermen to clean their boats, trailers, and gear of plants and dump and bilge water when leaving the lake. Boaters should be encouraged to power wash or allow 5 days of drying of their boat, trailer, and gear before use on another lake.

15) Each Critical Habitat narrative provides specific management recommendations that should be referenced when new shoreland projects are contemplated within the 10 Critical Habitat Areas on Alma and Moon Lakes.

16) Property owners with buffer or erosion issues near Critical Habitat sites (Figures 33-35) should be provided with information on the Wisconsin Healthy Lakes Program for best management advice to improve their shorelines.

17) Protection of critical habitat features, particularly undeveloped shorelands and wetlands can be facilitated through Land Trust organizations such as the Northwoods Land Trust (NLT) Northwoods Land Trust . The NLT specializes in developing conservation plans for private lake property owners in Vilas County and adjacent lake country. They could be contacted for advice on conservation plans for the Alma-Moon critical habitat shorelands, such as those around Engel Lake, should the property owners have an interest.

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Figure 33. Critical Habitat locations on Alma and Moon Lakes (orange polygons, white numerals) and properties with buffers having less than 60% native trees, shrubs, and herbaceous cover.

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Figure 34. Critical Habitat locations on Alma and Moon Lakes (orange polygons, white numerals) and properties with surface water run-off and/or gullying in the shoreland.

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Figure 35. Critical Habitat locations on Alma and Moon Lakes (orange polygons, white numerals) and properties with bank erosion at the shoreland/lake interface.

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References

1. Through the Looking Glass. A Field Guide to Aquatic Plants. Sue Borman, Robert Korth, Jo Temte. 1997.

2. Water Explorer Website: Wisconsin Lake Modeling suite (WILM's).

3. Toolbox: Finding Lake Data. Mike Meyer, Jim Kreitlow, Nova Ecological Services.

4. Onterra LLC: 2010- and 2019-Point Intercept Plant Surveys in Alma/Moon Lakes. Excel spreadsheets.

5. Town of St. Germain Lakes Management Planning, Alma/Moon Lake. Onterra LLC. 2013.