Lac Vieux Desert

Vilas County, WI & Gogebic County, MI

Aquatic Plant Management Update

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Lac View Desert: Aquatic Plant Management Update

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PREFACE

In 2012, a detailed comprehensive lake management plan (LMP) was completed for Lac Vieux Desert.[1] This plan inventoried a wealth of ecological information important to lake health and laid the framework for lake planning and management goals to date. A written survey gathered information on stakeholder demographics, views, and concerns on a variety of lake issues. In addition, this plan described the intricacies of multiple agency/entity involvement including two States, two USFS National Forests, Lac Vieux Desert Band of Lake Superior Chippewa, Wisconsin Valley Improvement Company (WVIC), Great Lake Indian Fish and Wildlife Commission (GLIFWC) and grass root organizations such as the Invasive Species Control Coalition of Watersmeet (ISCCW).

The purpose of this project is to update data relevant to aquatic plant management, including updates to water quality, aquatic plants, aquatic invasive species (AIS), and their management. Likewise, this plan seeks to meet NR 198.43 requirements, allowing the Lac Vieux Desert Lake Association (LVDLA) to be eligible for further Wisconsin DNR Surface Water Grants. The existing plan will continue to function as the main planning document, while updates would accompany the existing plan as an addendum. Some description of the data, even though it is represented in the current plan, is included to provide readers some background without having to flip back and forth between the original plan and the addendum. This project does include a shoreland habitat section, not covered in the original LMP. Finally, a review of the existing implementation plan will highlight accomplishments under current management goals, provide insight on what is working or what should be adapted, and update contact information when appropriate.

[1] This plan can be found at https://dnr.wi.gov/water/projectDetail.aspx?key=29304970 (12/2019)

INTRODUCTION

Lac Vieux Desert (LVD) is a shallow lowland lake located in Vilas County, WI and Gogebic County, MI, with a mean depth of 12 ft and a maximum depth of 40 feet (Onterra, 2012). This 4,247-acre lake is the largest in Vilas County and the second largest lake in Gogebic County, MI. Riparian ownership includes the United States Forest Service Ottawa National Forest, Chequamegon-Nicolet National Forest, the Lac Vieux Desert Band of Lake Superior Chippewa, Michigan Department of Natural Resources (MDNR), Wisconsin Department of Natural Resources (WDNR), Wisconsin Valley Improvement Company (WVIC) and MI and WI riparians. WVIC owns and operates a water level control structure at the outlet to the Wisconsin River.

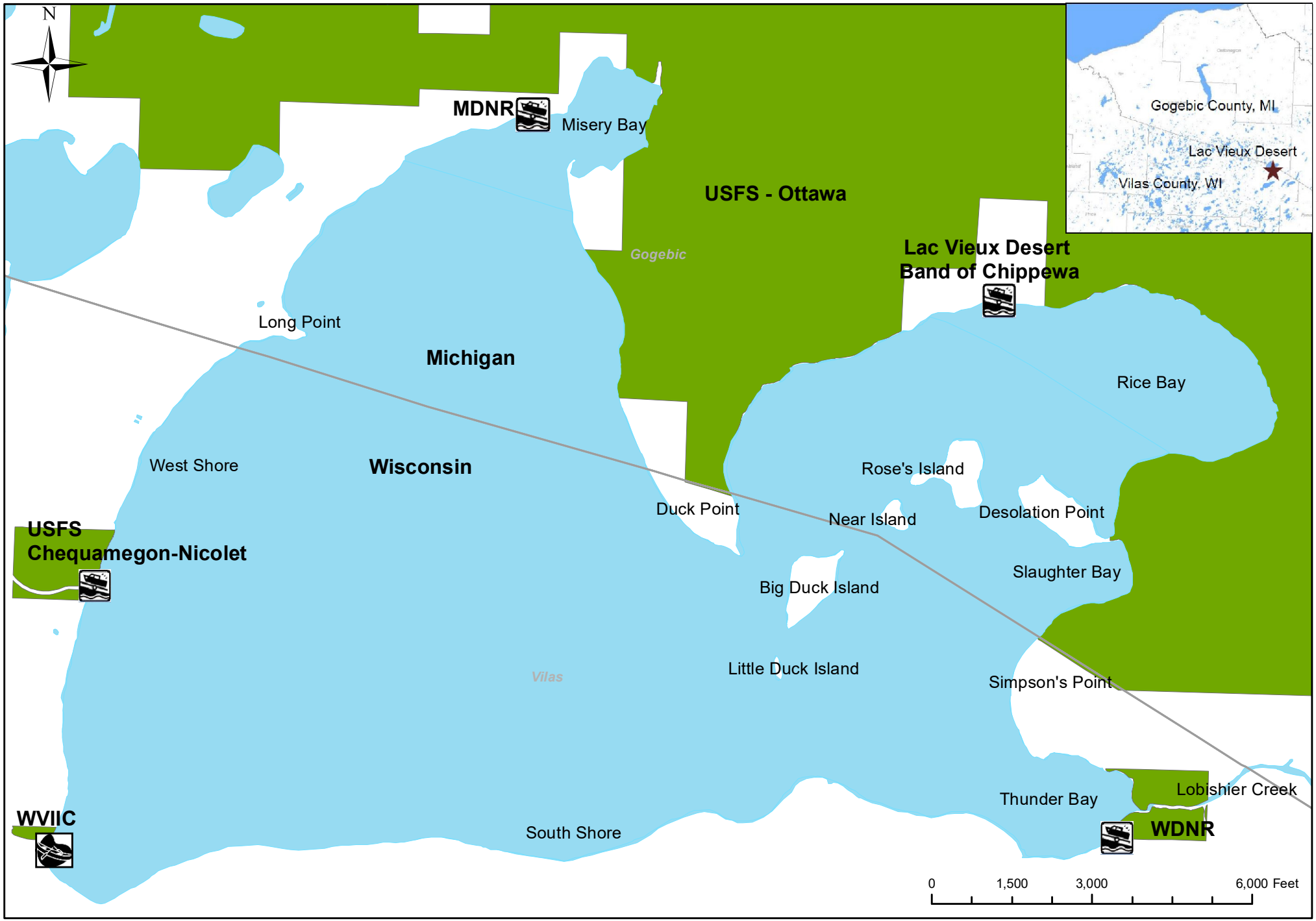
Adjacent public lands and vast open water vistas make LVD a year round recreational attraction for locals and visitors alike. The WDNR, MDNR, WVIC, Lac Vieux Desert Band of Lake Superior Chippewa, and the Chequamegon-Nicolet National Forest own several public access points. The Chequamegon-Nicolet National Forest operates a campground with 31 campsites and a picnic and beach area. WVIC has a park located at the headwaters to the Wisconsin River. In addition to public access, there is a private campground and six private resorts on LVD.

LVD is an Outstanding Resource under WDNR 102 Fisheries program. Outstanding Resource Waters are those that "provide outstanding recreational opportunities, support valuable fisheries, and wildlife habitat, have good water quality, and are not significantly impacted by human activities." Located in the Tamarack Pioneer River Watershed, this watershed consists mainly of forests (63%), wetlands (18%), and open water (10%) and is ranked medium for non-point source issues affecting lakes. The floristic quality index[2] (FQI) is 38.5[3], above the State (WI) median value. Aquatic invasive species known to occur in include, Eurasian watermilfoil, curly leaf pondweed, banded & Chinese mystery snails, purple loosestrife, freshwater jellyfish, yellow perch parasite and rusty crayfish.

In addition to being an Outstanding Resource Water, Rice Bay (see map on page) is designated on the USDI-NPS National Register of Historic Places as a Traditional Cultural Property. Which means the property is federally recognized as a place of "cultural practices, traditions, beliefs….or social institutions of a living community" (USDI NSP, NRB 38). Wild rice, the food that grows on the water, has nourished generations of Ojibwe both physically and spiritually and is central to perpetuating tribal life-ways, tribal identity, and culture. Rice also forms the foundation of other resource-harvesting activities related to fish, furbearers, and waterfowl.

As the name suggests, Rice Bay supports wild rice, an emergent aquatic plant that inhabits shallow waters of lakes or slow-moving rivers. Rice beds provide habitat for a variety of wildlife and spawning fish and the seed is an excellent food source for wildlife. A ten-year wild rice restoration and monitoring plan took place from 2003 to 2012. Since then, an adaptive (water level) monitoring plan developed by engaged entities review and outline WVIC operations and reserve priorities for the Lac Vieux Desert Reservoir annually.

[2] FQI is a measure of an aquatic plant community's nearness to pristine like conditions.
[3] Taken from DRAFT WDNR Aquatic plant data explorer (Accessed 12/2019): http://34.223.230.186:3838/mikula/AquaticPlantDataExplorer/



Lake: Lac Vieux Desert, Vilas Co., WI & Gogebic Co., MI
Map Created: 1.29.2020
Source: MiGDL Lake_polygons_200403, Ottawa_NF_land
WDNR, ESRI Base Maps,VilasCountyParcelOutlines
File: LVD_LocationMapUpdated2020

Public Lands

Lac Vieux Desert
Vilas County, MI & Gogebic County, MI

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1 - Aquatic Plants

Introduction

Some lake users may consider aquatic plants a nuisance and aesthetically displeasing. Others may recognize that aquatic plants are important to lake health, but may not be familiar with the specific roles that plants have within a lake's ecosystem. Aquatic plants provide habitat, refuge and food sources for fish, mammals, birds, insects, and amphibians. In addition, aquatic plants replenish lakes with oxygen, stabilize sediments, minimize erosion, and filter water. Aquatic plants are limited to areas of a lake where light can penetrate to the bottom; this area, commonly referred to as the littoral zone, is where most aquatic life lives**.** Additional factors that affect the distribution, abundance, and types of aquatic plants present in a lake include water levels, water temperature, sediment type, wave action, and nutrients.

Lac Vieux Desert's Aquatic Vegetation

Assessing a lake's aquatic plants provides detailed information on the types and distribution of aquatic plants in a lake, useful to understand habitat characteristics, ecosystem stability, and identify high quality sites. Furthermore, repeating this assessment provides comparisons of these data over time.

Figure 1.1: Rake fullness description.

Fullness Rating	Coverage	Description
1		Only few plants. There are not enough plants to entirely cover the length of the rake head in a single layer.
2		There are enough plants to cover the length of the rake head in a single layer, but not enough to fully cover the tines.
3		The rake is completely covered and tines are not visible.

Aquatic plant assessments included a point intercept survey and emergent/floating leaf plant community mapping. Point intercept (PI) surveys follow the WDNR Monitoring of Aquatic Plants in Wisconsin (2010) protocol, which uses a grid of predetermined points evenly spaced across the lake. These points are up-loaded into a GPS for field navigation**.** At each site, a double-sided rake lowered over the side of the boat collects a sample of aquatic vegetation. Each plant species on the rake is identified[4] and the abundance or rake-fullness for the rake and each species is estimated **(Figure 1.1[5]).** At each sampling site, water depth and sediment type is recorded. Emergent/floating leaf community surveys circumnavigated the entire lake identifying all observed emergent and floating leaf plant locations. Small locations (<1/10 acre) were geo referenced with a GPS point whereas the outer edges of larger locations were traced to create geo-spatially referenced beds**.**

Point intercept surveys took place from July 28th to August 14th, 2019. This survey sampled 835 locations, identifying a total of 50 native aquatic plant species and one invasive plant species. Rake samples detected 35 native plants species and one invasive plant species, whereas the remaining species were visual observations **(Appendix A).** Maximum depth of plant

[4] Nomenclature follows Michigan Flora Online (Voss & Reznicek, 2019) http://michiganflora.net/home.aspx (Accessed January 22, 2020)

[5] Taken from Recommended Baseline Monitoring of Aquatic Plants in Wisconsin, (Hauxwell et al, 2010).

colonization occurred at 16 feet, with the majority of vegetated sites occurring between 11 to 12 feet **(Figure 1.2).** Most sites sampled consisted of soft or mucky sediments (79%) followed by sand (19%) and rock (2%) **(Figure 1.3).** Total species detected per rake sample ranged from 1 to 9 with an average of 2.19 species. For comparison, the 2009 survey results showed the maximum depth of colonization at 21 feet and total species detected per rake sample ranging between 1 and 11, with 3.24 species average per rake sample **(Table 1.1).**

Figure 1.2: *Depth of aquatic plant colonization - Lac Vieux Desert – 2019.*

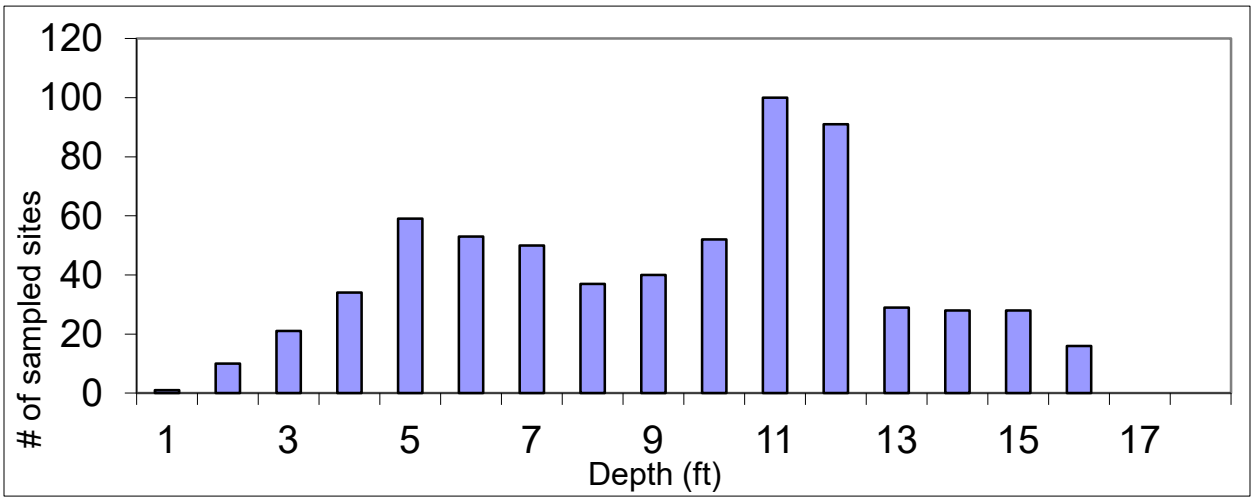
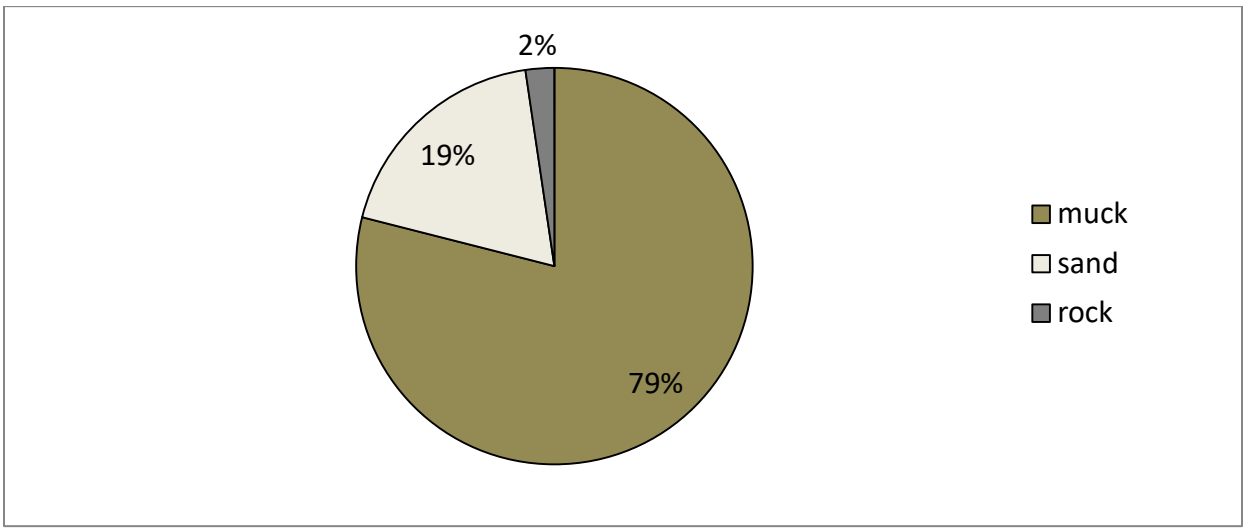
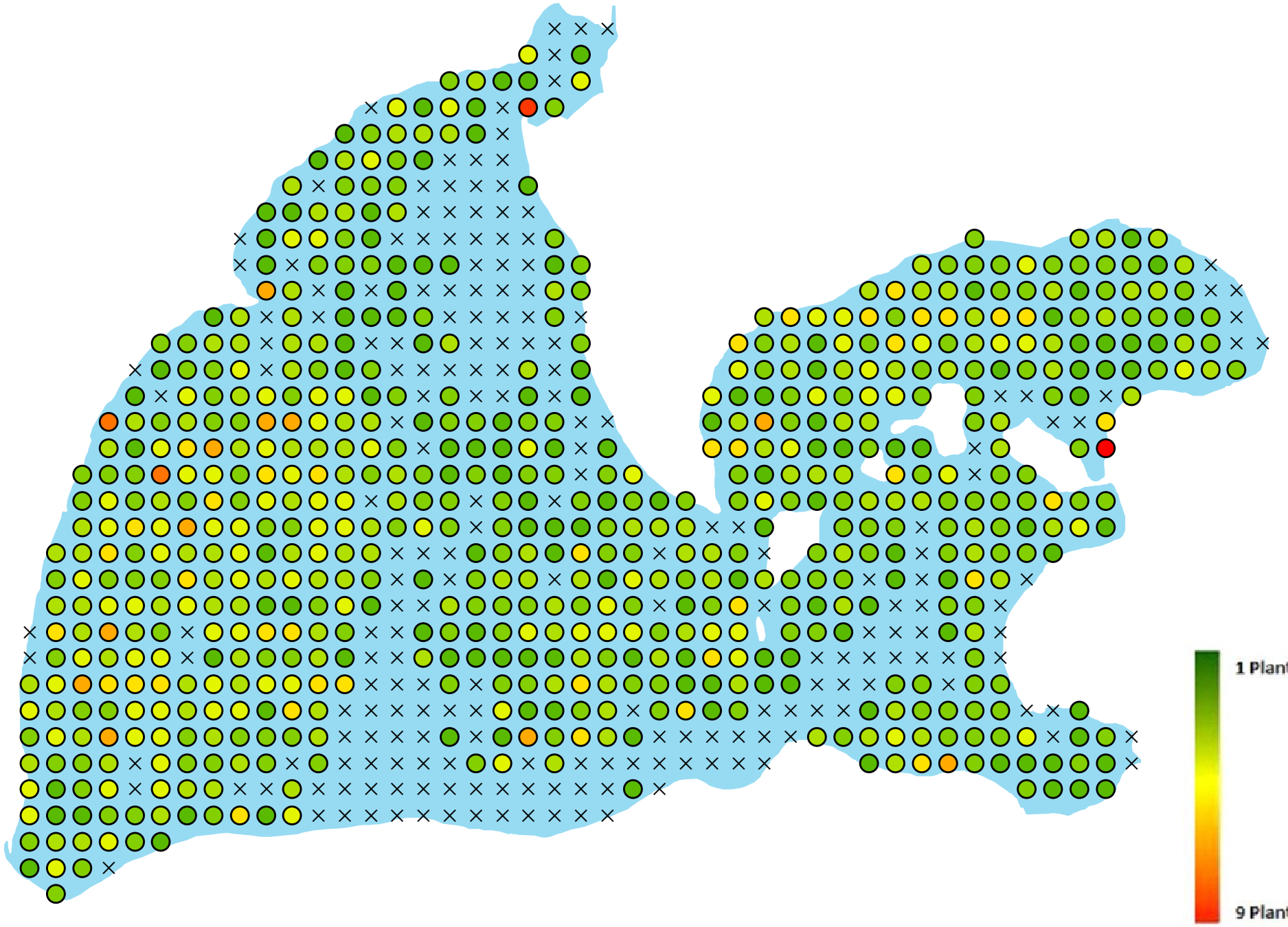


Figure 1.3: *Lake-wide percentage of substrate types - Lac Vieux Desert – 2019.*



Species Richness Per Rake Sample - Lac Vieux Desert, 2019



Rake Fullness Per Rake Sample - Lac Vieux Desert, 2019

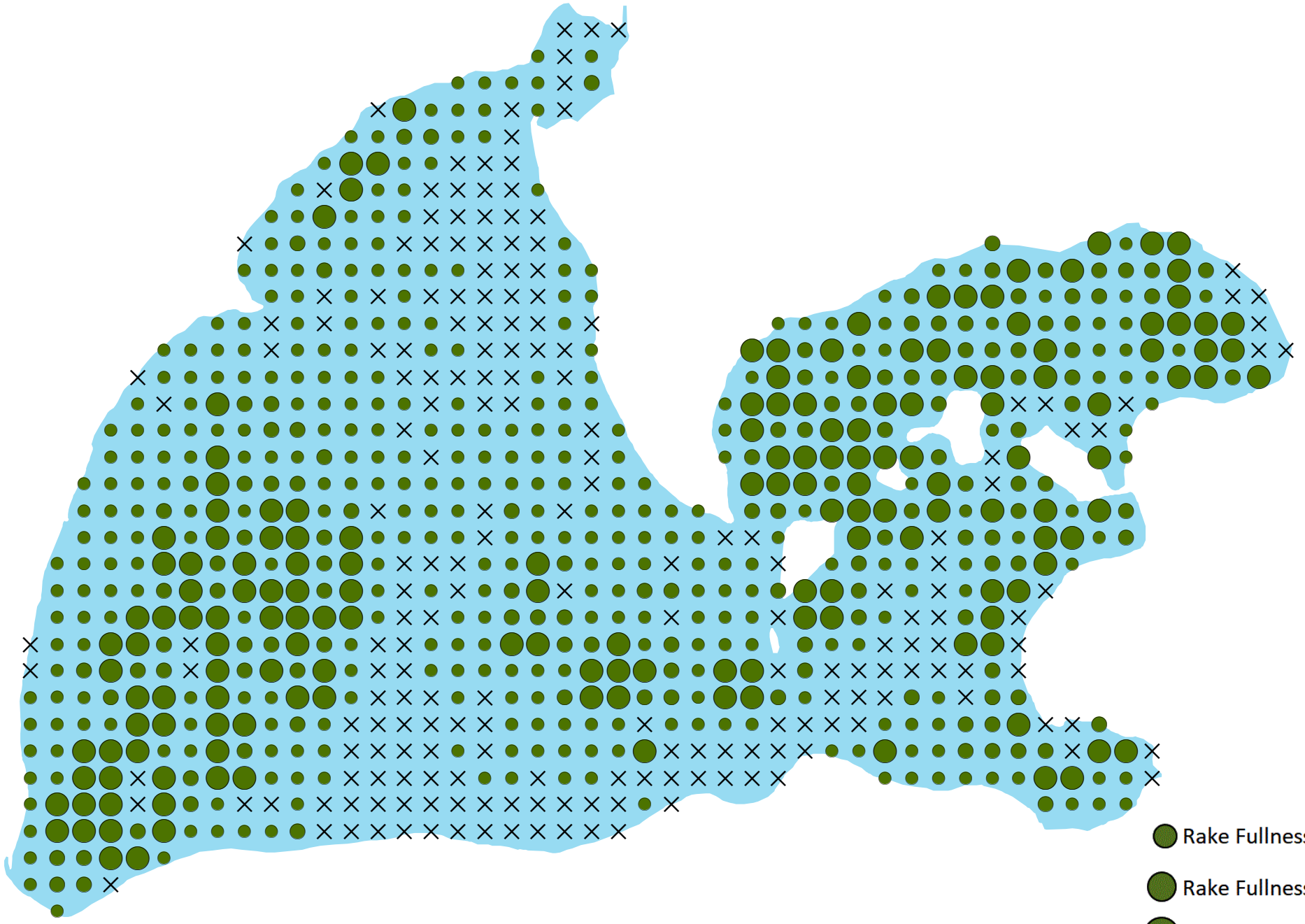


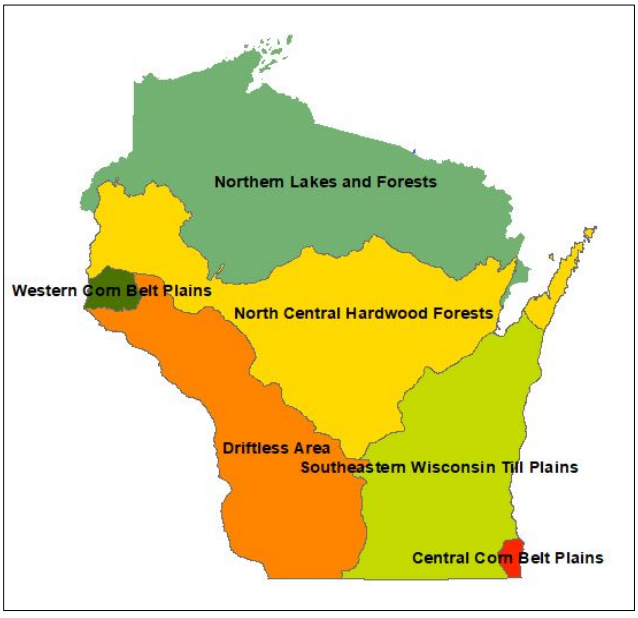
Table 1.1: *Point intercept survey summary statistics for 2009 and 2019 – Lac Vieux Desert.*

	2009	2019
Total number of points sampled	832	835
Total number of sites with vegetation	732	649
Total number of sites shallower than maximum depth of plants	811	764
Frequency of occurrence at sites shallower than maximum depth of plants	90.26	84.95
Simpson Diversity Index	0.89	0.88
Maximum depth of plants (ft)	21	16
Average number of all species per site (shallower than max depth)	3.2	2.2
Average number of all species per site (veg. sites only)	3.6	2.6
Average number of native species per site (shallower than max depth)	3.2	2.2
Average number of native species per site (veg. sites only)	3.6	2.6
Species Richness (Rake samples only, including invasives)	33	36
Species Richness (Including visuals within 6 feet of sampling point and invasives)	37	39
Species Richness* (Including all visual observation and invasives)	53	52

* Includes PI data and emergent/floating leaf community mapping

Plant Analysis Primer

Figure 1.4: *Wisconsin's Ecoregions.*



Floristic Quality Index (FQI) measures the natural quality of a lake's aquatic plant community or nearness of the lake's aquatic plants to those seen in undisturbed conditions. This value specifically uses a combination of species richness and coefficients of conservatism to calculate a value useful to monitor changes to plant communities over time (Nichols, 1999). Species richness can often be confused with species diversity. Species richness refers to the total number of different species, whereas species diversity considers how evenly within the lake species occur. A lake with 15 species may not be as diverse as a lake with ten species based on how evenly those ten species are distributed. The second value used in a floristic quality index is a coefficient of conservatism. This is an integer value ranging from zero and ten assigned to each native plant species that relates to its tolerance to degradation and the degree to which it is faithful to remnant natural habitats. For example, a plant that inhabits a broad range of natural communities and disturbed sites may have a value of one or two, whereas a plant that is usually restricted to a high quality natural habitat might have a value of nine or ten. Most plants are tolerant of some community changes or degradations and have values that fall between these two extremes. By definition non-

native plants species do not have an affinity to any high-quality natural habitats, and are assigned a value of zero.

Floristic quality assessments generally compare the floristic quality of lakes within a similar Ecoregion **(Figure 1.4).** An Ecoregion is a defined landscape that has similar characteristics including land-use, vegetation, soils, and landscape formations. Lac Vieux Desert is located within the Northern Lakes and Forests Ecoregion, which consists of conifer and northern hardwood forests, with numerous wetlands, lakes, and perennial streams. This ecoregion has poor agricultural potential (Omernic, 1998)**.**

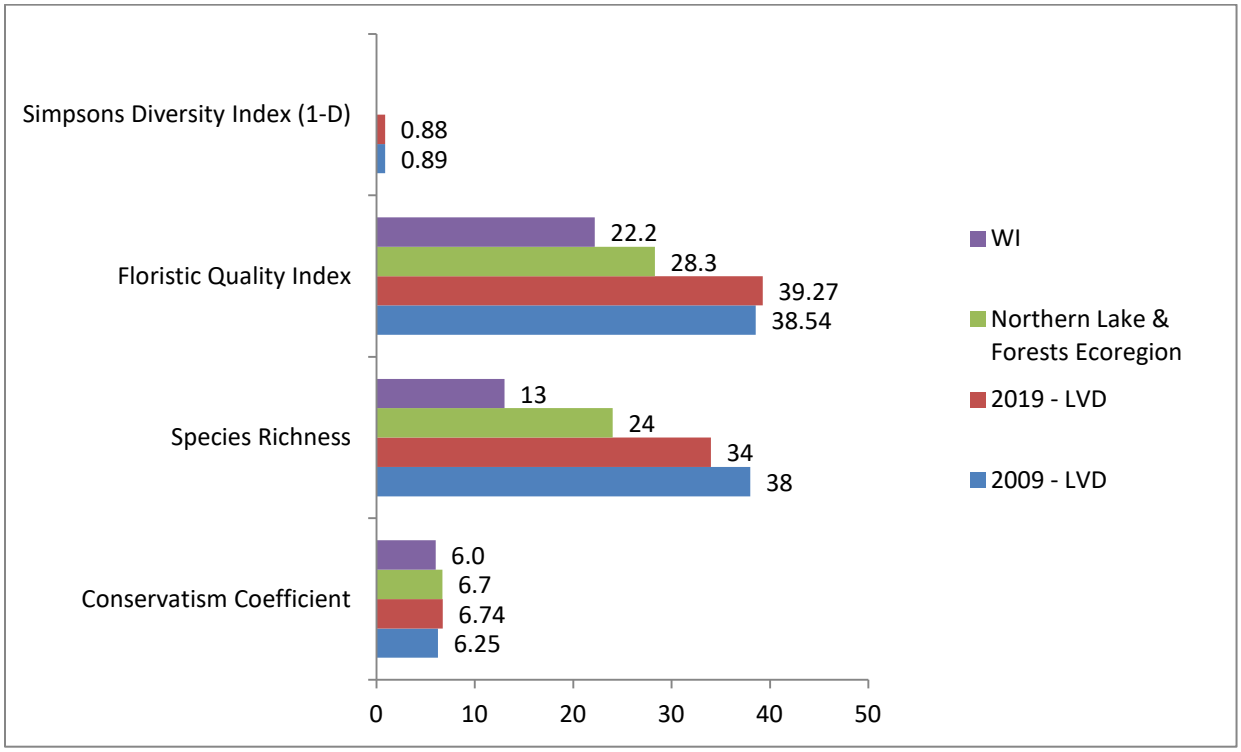
Aquatic Plant Analysis

Lac Vieux Desert's FQI rose slightly in 2019 (39.27) compared to 2009 (38.54) with an overall ranking above the median[6] value for the Northern Lakes and Forests region and Wisconsin statewide values **(Figure 1.5).** Lac Vieux Desert also sits at the upper end of floristic quality for northern drainage lakes[7] **(Figure 1.6).** Average species conservatism ranged from 6.25 in 2009 to 6.74 in 2019. Floristic data used for this 2019 analysis differs slightly from the data represented in the 2012 lake management plan. Floristic data in the 2012 plan took into account all species detected between the point intercept survey and other plant survey work. This resulted in 51 native species used to calculate floristic quality. The number of species used to calculate floristic quality would affect the numerical values for average species conservatism and the floristic quality index. The floristic quality analysis presented here only takes into account species detected while conducting the point intercept survey, as reported using the WDNR standardized point intercept template and does not include additional species observations made while conducting other plant survey work.

In addition to floristic quality, the Simpson's Diversity Index, is one of many indices useful in measuring ecological diversity. Diversity simply looks at the variability amongst living organisms and ecosystems including genetic diversity to ecosystem diversity. Understanding diversity is important because diversity in a lake may protect or buffer a lake from change over time, and improve its resilience to outside "stressors" and other vulnerabilities. A Simpson's Diversity Index measures species diversity and takes into account both richness and abundance of each species. This index is different from floristic quality that uses species richness and species conservatism. Simpson's Diversity Index values range from zero to one. The closer the value is to one, the more diverse the measured population is considered to be. Simpson Diversity Index values for Lac Vieux Desert fell slightly from 0.89 in 2009 to 0.88 in 2019.

[6] Median values represent the middle of the total set of numbers used, whereas the average looks at the general trend of a data set. These values may be different, depending on the statistical distribution of the data being analyzed.
[7] Taken from WDNR Aquatic Plant Data Explorer - draft (Accesse12/2019)

***Figure 1.5**: Summary of Lac Vieux Desert's floristic quality and diversity.*



Frequency of littoral occurrence of a species is the percentage of the total surveyed points that a species was present on a rake sample divided by the total number of points sampled within the littoral zone **(Figure 1.7).** Over time, these values can provide evidence of change at the species level. This level of detail is important for several reasons. Shifts or change to aquatic plant communities may indicate changes within the watershed, shoreland and aquatic plant management practices, water levels, climate change or other disturbances. Of the species in 2009 that had 10% or greater frequencies of occurrence, all except for Robbins pondweed had decreased by 2019. Southern naiad, which was not detected in 2009, had a frequency of littoral occurrence of 11.65%.

Native species do exhibit inter-annual variation, meaning their populations ebb and flow from year to year. It is speculative to determine the exact cause of decline seen in certain species, because relatively little direct aquatic plant and watershed manipulation has occurred during this timeframe (2009-2019). In addition, the period between plant surveys is 10 years. Aquatic plants may be trending up or down throughout the entire 10-year timeframe, but the data only captured two points in time. For this reason, a statistical analysis is not included. If large changes in the watershed or large scale aquatic plant management and/or manipulation were taking place over the past 10 years, then a statistical evaluation of the plant data would be more relevant.

Figure 1.6: *Floristic Quality Index Scores for Northern Drainage Lakes (WDNR Aquatic Plant Explorer -draft).*

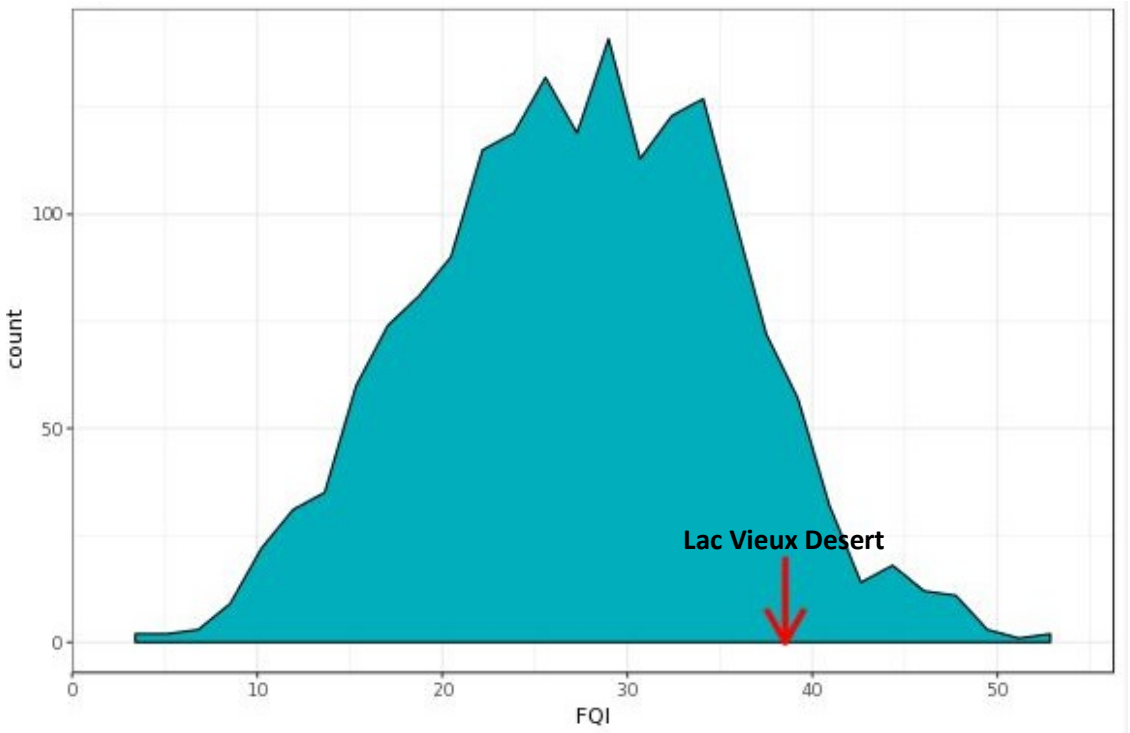
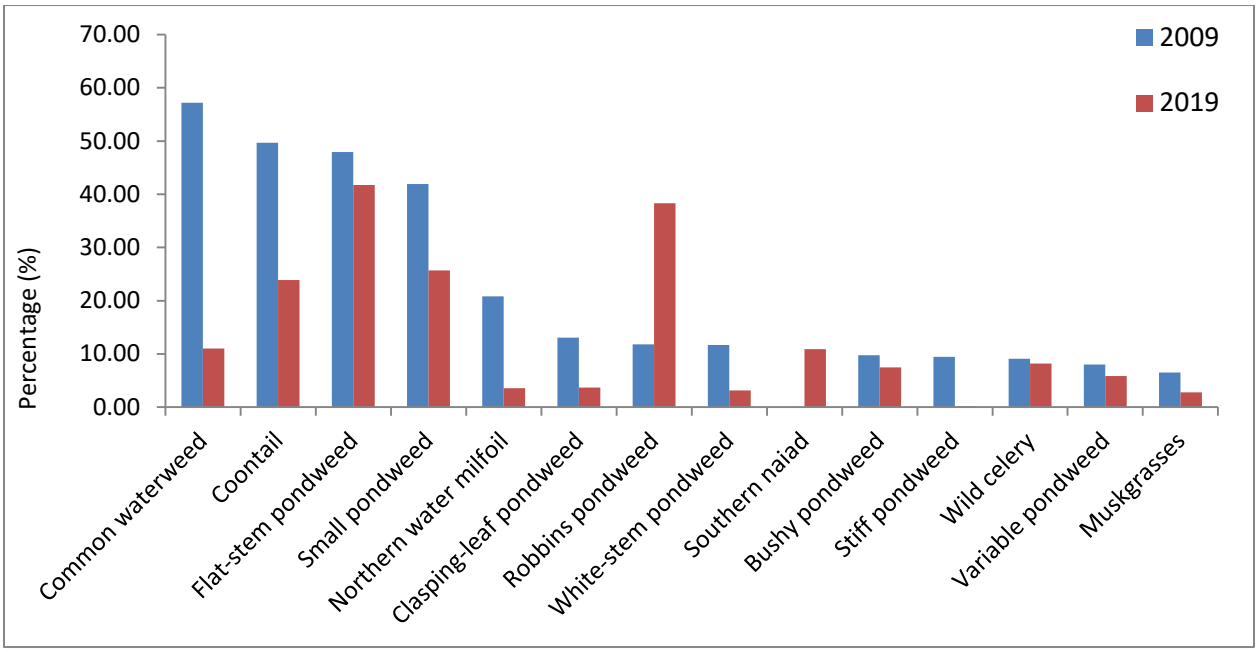
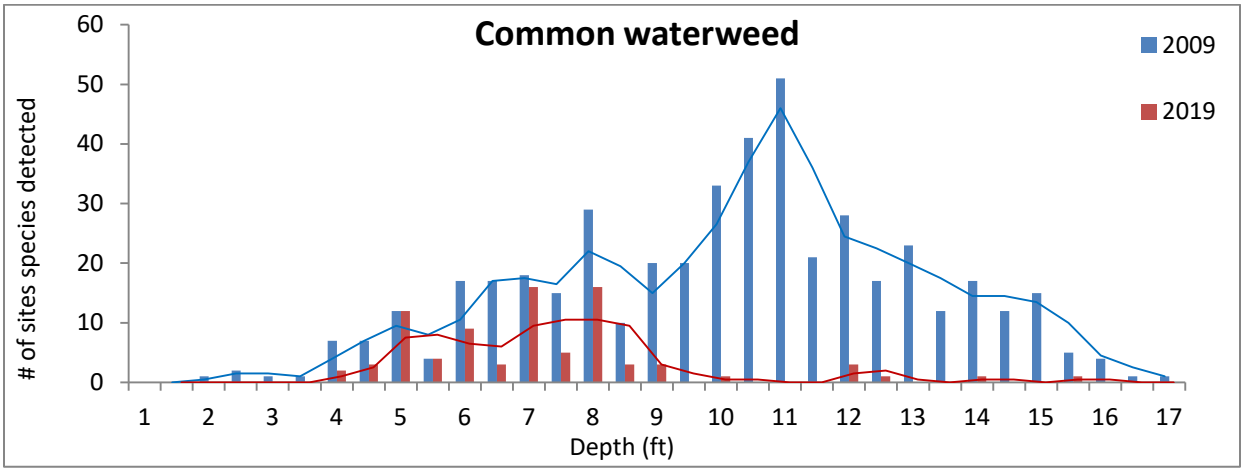


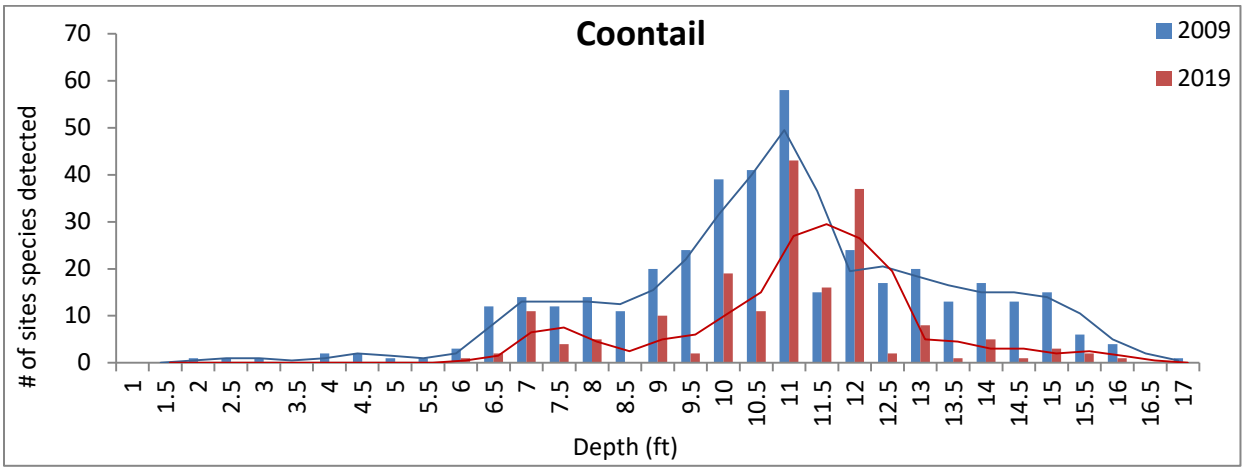
Figure 1.7: *Comparisons of littoral frequency of occurrence in Lac Vieux Desert, in 2009 and 2019. Only species with a 5% or greater littoral frequency of occurrence are represented.*

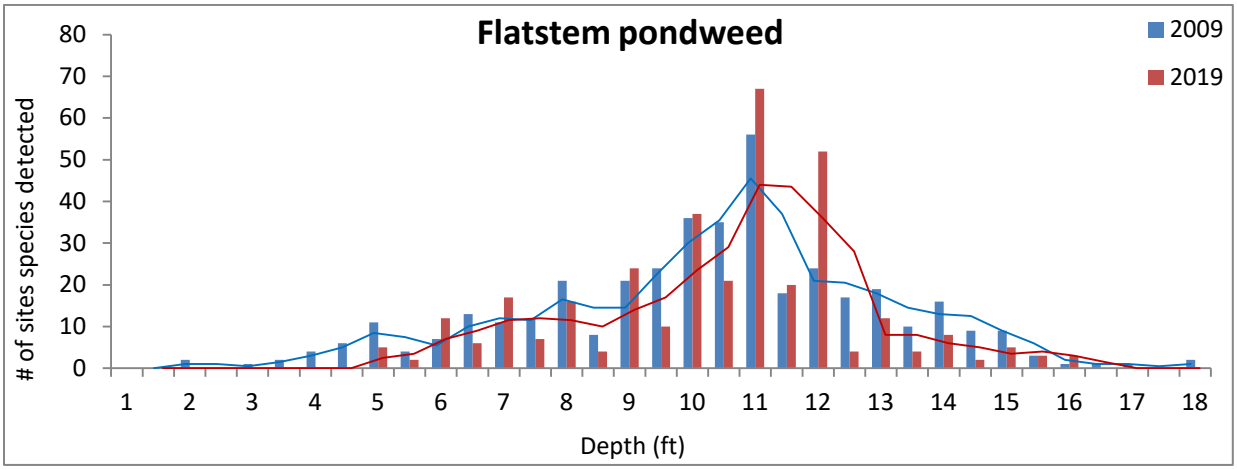


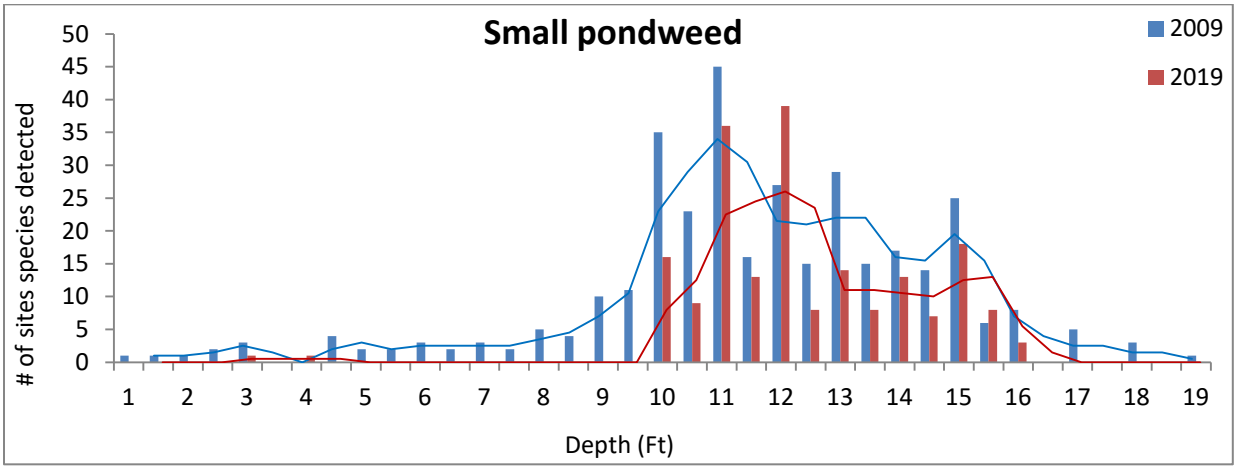
As suggested by the frequencies of littoral occurrence, some of the more common species declined from 2009 to 2019. Again, there may be many reasons for this decline/shift including limited data giving the appearance of substantial change. An interesting non statistical way to look at differences in frequency is to look at the total number of samples where a species was detected and compare that to depth **(Figures 1.8-1.12).** These comparisons may show general trends across all depths or possible shifts in preferred depths for that specific timeframe. Aquatic plants adapt to fluctuating lake conditions and will take advantage of certain conditions to expand or relocate. In addition, some species are equipped with different growth "habits" depending if life is occurring in the water or along an exposed shoreline. For example, brown-fruited rush has two growth forms. Both forms have leaves; however, the out of water form is when this species produces flower stalks and fruits.

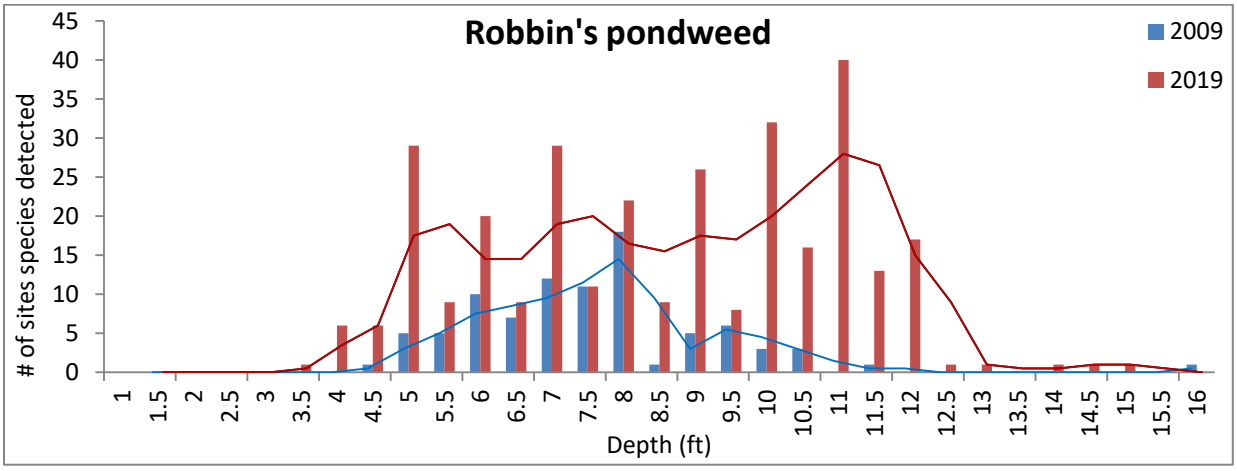
Figures 1.8-1.12: *Comparison of depth to sampled points for five common plants sampled in 2009 and 2009 – Lac Vieux Desert.*





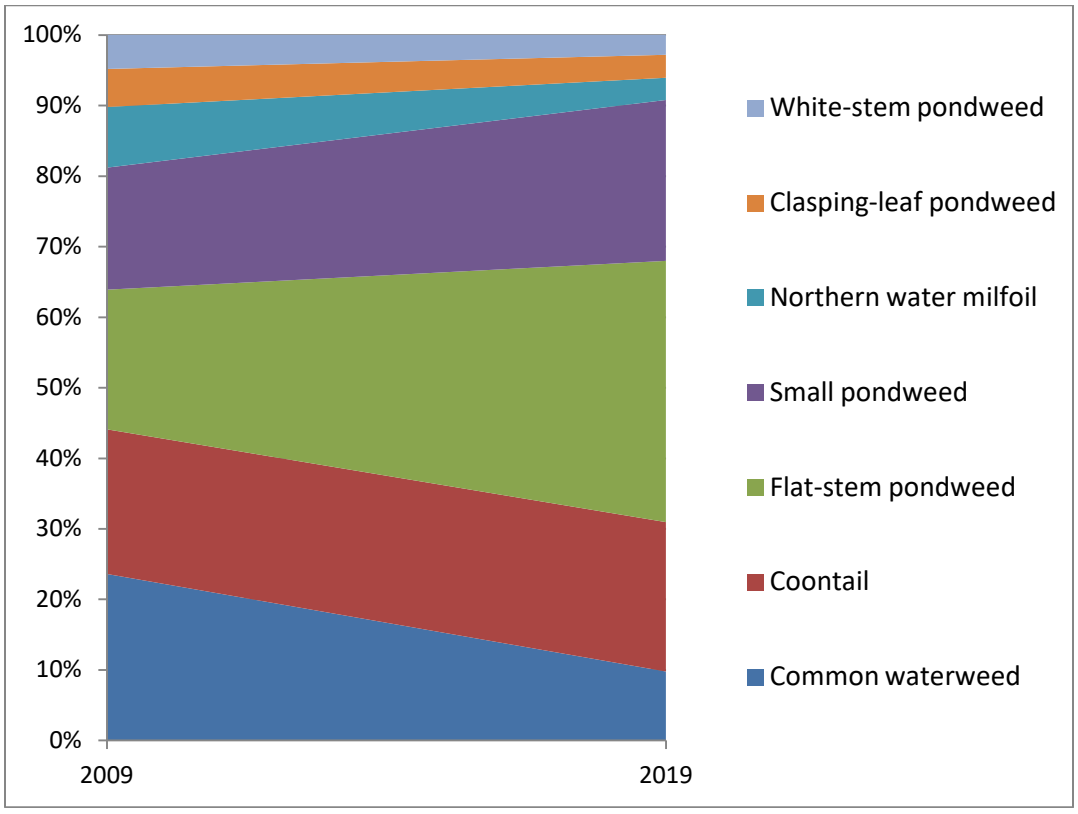

Flatstem pondweed
2009
2019
# of sites species detected
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Depth (ft)


Small pondweed
2009
2019
# of sites species detected
0
5
10
15
20
25
30
35
40
45
50
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Depth (Ft)


Robbin's pondweed
2009
2019
# of sites species detected
0
5
10
15
20
25
30
35
40
45
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
15.5
16
Depth (ft)

As mentioned above, frequency of littoral occurrence is the percentage of time a species is detected across the sampled littoral area. These values are sampling event dependent, meaning this value represents how often each plant is detected for that survey. You could not assume that 45% frequency of littoral occurrence for a particular species means that each time you sample there is a 45% chance of sampling that species. To look at the number of times a species is likely to occur (or be sampled), relative frequency of occurrence is calculated. Relative frequency of occurrence is the proportion of times that a species is sampled relative to the total population. The four most common species in 2019 based on relative frequency are flat stem pondweed (20%), Robbins pondweed (18%), small pondweed (12%), and coontail (12%) **(Figure 1.13).** Whereas the three most common species based on relative frequency in 2009 were common waterweed (18%), coontail (15%) and flat stem pondweed (15%). Common waterweed showed the greatest decrease in relative frequency with a -12% change. The greatest increase in relative frequency occurred for Robbins pondweed with a +15% change.

Figure 1.13: *Relative frequency of occurrence of aquatic plants (5% occurrence or greater) – Lac Vieux Desert 2009 & 2019.*



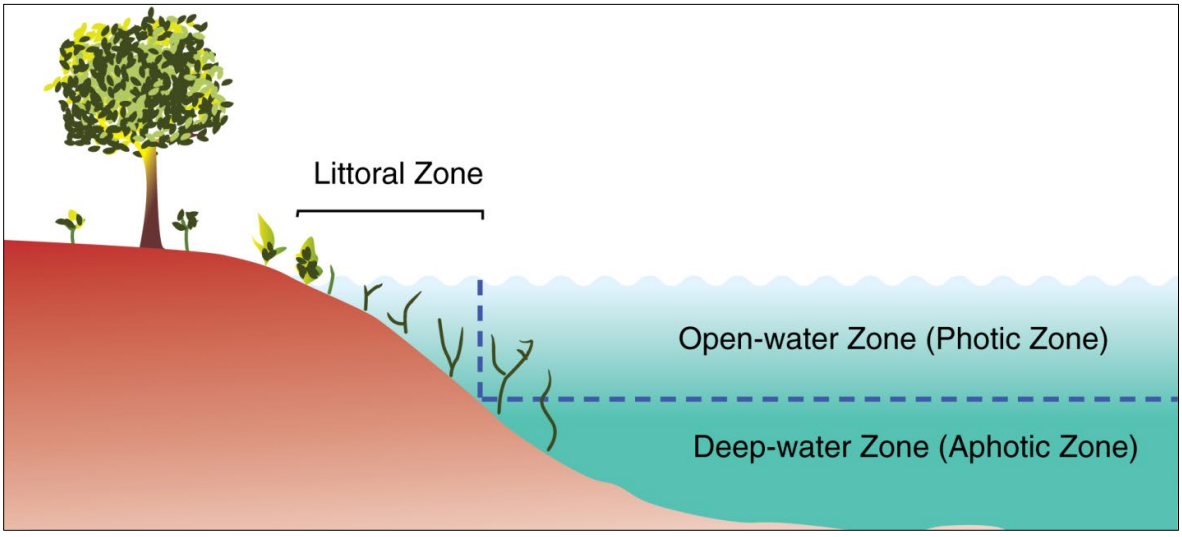
Emergent and Floating Leaf Community Mapping

Emergent & Floating Leaf Plants

Emergent plants are typically associated with the shallowest portion of the littoral zone **(Figure 1.14).** They tolerate fluctuating water levels, and usually root along the shoreline. They naturally protect shorelines from erosion by reducing wave action, and their roots create a woven barrier that stabilizes sediments. In many cases, these plants are the most impacted by shoreline development. Examples of emergent plants include cattails, bulrushes, irises, and wild rice.

Floating leaf plants gradually replace emergent plants with increasing water depth. Floating leaf plants common to Northern Wisconsin and the Upper Peninsula of Michigan often have circular, heart-shaped, or elliptical shaped leaves with a leathery texture to resist tearing from waves and wind, making them ideal to dissipate wave energy reaching shore. Exceptions include some bur-reeds, northern and American manna grass, which have linear floating leaves. Common floating leaf plants include white water lilies, watershield, and the American lotus. Floating leaf plants includes free-floating plants. Like their name suggests, free-floating plants are not rooted in the lakebed and easily transported around a lake. These plants include duckweeds and some bladderworts. Duckweed is an important food resource to waterfowl, particularly dabbling ducks. The smallest known flowering plant in the world is the free-floating aquatic plant watermeal (*Wolffia spp.*).

Figure 1.14: *Littoral Zone.*[8]



[8] Geoff Ruth [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

Mapping of the emergent and floating leaf plant communities resulted in estimates of 257 acres of mixed emergent and floating leaf plant beds and 119 acres of emergent plant beds[9] **(Appendix B).** This represents an estimated decline of 113.5 acres (-30%) in mixed emergent and floating leaf plant beds and an increase of 52 acres (+44%) of emergent plant beds. While this decline may seem substantial, it represents only a 1% decrease in the total surface waters occupied by these types of plant communities between 2009 and 2019. Approximately 9% of the surface waters (4,247 acres) of LVD support these two plant communities.

White water lilies along the northeastern end of Rice Bay, Lac Vieux Desert - 2019.

While the point intercept data is valuable for lake-wide trends, it may not be sensitive enough to detect small-scale changes within a lake. The sampling resolution for the point intercept survey of 144 meters (474 feet) may have been too coarse to reliably detect species of near shore habitats, where most emergent and floating leaf vegetation grows. Mapped emergent plant communities rose 44% and mixed emergent and floating leaf communities declined 30% from 2009 to 2019. Whereas, the 2009 and 2019 point intercept data indicated no change to the relative frequency and only a somewhat statistically significant change (-) for wild rice. There is a notable expansion of floating leaf plants in areas of Rice and Misery Bays, which the point intercept survey does not adequately represent. However, lack of competition from the normally dense wild rice could also be an important factor in the apparent increase in floating-leaved vegetation in these two bays.

The 2012 LMP documents the presence of common reed *(Phragmites australis)* and purple loosestrife (*Lythrum salicaria*) on Lac Vieux Desert. Common reed specimens submitted to UWSP were morphologically identified as a native strain of common reed, not the invasive strain. See Appendix C for more information about *Phragmites.* However, the historical sites appear to be expanding and several new locations of common reed were observed during both the PI and emergent/floating leaf plant surveys **(Appendices A & B).** Purple loosestrife was not detected on LVD in 2019, nor has it been found since 2010, when the initial population was hand pulled.

[9] Locations of emergent and floating leaf plants less than 1/10 of an acre in size where documented, but not included in these bed mapping estimates.

2 - Aquatic Plant Management

The goals of aquatic plant management will vary. One individual may prefer fewer aquatic plants to minimize interference with swimming or boating, while another may prefer more aquatic plants to improve fishing habitat. Aquatic plants are an important component of a healthy functioning ecosystem. However, they can become problematic, interfering with lake access and use. Non-native invasive plants, species not native and introduced to new habitats, are capable of causing ecological and economic harm, and can disrupt the balance of natural ecosystems. Invasive plants such as Eurasian watermilfoil (*Myriophyllum spicatum*), hybrid water milfoil (*Myriophyllum spicatum x M. sibericum*), and curly-leaf pondweed (*Potamogeton crispus)* may grow excessively, forming dense stands that out-compete native plants thereby reducing diversity and limiting recreational and navigational use of a water body.

The non-native watermilfoils, Eurasian watermilfoil (EWM) and hybrid watermilfoil (HWM), are notoriously troublesome invasive aquatic plant taxa.[10] They colonize a variety of habitats including reservoirs, lakes, ponds, low-energy streams and rivers, and brackish waters of estuaries and bays. Rapid growth rates allow these plants to form thick mats on the surface of the water. Transport on boats and boating equipment plays by far the largest role in introducing these species to new water bodies. Because of the negative impacts of these two taxa, EWM and HWM are frequently targeted for management.

A comprehensive review and details on management techniques commonly used in aquatic plant management and those applicable to Lac Vieux Desert are included in the 2012 lake management plan. More information on aquatic plant management in Wisconsin can be found in the WDNR's Strategic Analysis of Aquatic Plant Management in Wisconsin (6/2019).[11]

Permitting

Michigan-Agency Update

The State of Michigan may require a permit for certain aquatic plant control activities. Most activities are permitted through the Michigan Department of Environment, Great Lakes, and Energy (EGLE), formerly known as the Michigan Department of Environmental Quality (MDEQ). For permit requirement information, please contact EGLE staff for more information. Additional permits through the Michigan Department of Natural Resources may be required when a state-listed threatened and endangered species is known to occur. Please contact the MDNR Wildlife Division for information on permitting.

Wisconsin

Aquatic plant management and nuisance control activities require a permit issued by the Wisconsin Department of Natural Resources (WDNR). Depending on the criteria and the type of activity, different permits will apply. Please contact the local aquatic plant management coordinator for WDNR permitting requirements.

[10] Taxa, in biology are a group of similar organisms.

[11] https://dnr.wi.gov/topic/EIA/documents/APMSA/APMSA_Final_2019-06-14.pdf (Accessed 12/2019)

Aquatic Plant Management Guiding Principles & Framework

Eurasian watermilfoil can potentially alter native aquatic plant ecosystems and interfere with recreational uses. However, not all lakes may experience high populations of Eurasian watermilfoil, particularly in northern Wisconsin (Nault, 2016). Recent WDNR research suggests that many Wisconsin lakes do not reach lake-wide high densities, as previously thought. Nonetheless, it is important to recognize that aquatic ecosystems are dynamic. Annual variation does occur, and further research is needed to understand how lake ecology and climate may play a role in EWM population variability.

Management of aquatic invasive species should be done in such a way as to provide benefit to waterway use/access without interfering with the ecological function and stability of the waterway and its surrounding watershed. Management should include the use of control techniques that support the best use of resources, are best fit and adaptive to address the population at that time, are stakeholder supported, and follow well-accepted best management practices.

Actions to manage aquatic invasive species should consider the following guiding principles:

- Provide management aimed at reducing population (abundance and distribution).
- Provide recreational nuisance relief caused by invasive species.
- Improve early detection and response to new aquatic invasive species.
- Include an AIS prevention component.
- Continue to monitor and collect baseline data.
- Improve upon and generate site-specific adaptive framework to manage for and control aquatic invasive species.
- Provide accountability for management actions – management evaluation.
- Reduce risk to non-target species including those of ecological or cultural value.
- Continue to work towards long term strategies to reduce excess nutrients and other pollutants that may exacerbate aquatic plant growth.

Using a balance of social perspective, conservation, and acknowledgement of risk to non-target species, annual management objectives using these guiding principles should be adaptive: taking into account the current condition of the invasive population and using an integrative framework. Integrative frameworks use a combination of management techniques to manage the invasive species to an acceptable level. Eradication is usually not a feasible option and should not be the end goal of any management approach.

Regardless of the options adopted, management should follow well-accepted best management practices and include evaluation monitoring. Quantitative evaluation metrics are favored, however limited in practice especially in small-scale management. Challenges to quantitative evaluations include sampling size (replicates), controls (which are used to verify effects), non-uniform treatments (varying types of management and monitoring dates), and pseudo-replication (sample units not being independent but rather subsamples of the same unit). It is important to mention these limitations and the potential for management decisions to rely more on qualitative than quantitative evaluation methods.

Specific recommendations by the WDNR, MDNR, EGLE, or other agencies will be included in monitoring and evaluation efforts. Otherwise, monitoring and management evaluations will use qualitative metrics, which collects information that describes the condition of target species rather than using measured or quantitatively calculated values. For example, information collected during monitoring or pre/post evaluation efforts may use a scale from very sparse to dense to describe the condition or abundance of EWM found. The distribution of EWM would be represented with spatially GPS collected information.

History of Eurasian Watermilfoil Management 2008-2019

The discovery of Eurasian watermilfoil in 2008, and curly leaf pondweed in 2009, initiated efforts by the Lac Vieux Desert Lake Association (LVDLA) to support work to minimize the ecological and recreational impacts that these aquatic invasive species may pose. In 2009, the LVDLA received a WDNR Aquatic Invasive Species Control Grant for Early Detection and Response to support efforts to control Eurasian watermilfoil. These grants funded efforts from 2009 to 2013.

In 2009, the LVDLA began a comprehensive lake management planning project. This plan received WDNR approval in the fall of 2012. The LVDLA funded EWM management from 2014-2018 in part with a WDNR grant for Aquatic Control Established Infestations (ACEI). Partners that provided match towards this grant include the ISCCW, USFS – Ottawa National Forest and GLIFWC. In addition to WDNR grants, the ISCCW sponsored a Title II[12] grant for EWM management (2017-2018) and has made additional financial contributions to the LVDLA. **Appendix D** provides AIS location maps for years they were available.

2008-2009

The initial discovery of Eurasian watermilfoil in Lac Vieux Desert occurred near the Thunder Bay boat landing in 2008. This population consisted of approximately seven locations of single to small clusters of plants. By 2009, several small yet contiguous colonies of EWM were identified in two areas and treated with aquatic herbicides. A treatment of 1.8 acres occurred in early summer, using granular 2,4-D at an application rate of 150 lbs./acre, which is the equivalent of 2.10 ppm (ae) at an average depth of 5 feet (Onterra, 2012). A 2009 point-intercept survey conducted by the WDNR found the frequency of littoral occurrence of EWM at 0%.

2010

Four colonies of EWM were relocated within the 2009 treatment areas. These colonies consisted of a few individual plants and were hand removed. Lake wide monitoring efforts completed in May 2010 did not locate any additional occurrences of EWM or CLP on Lac Vieux Desert (Onterra, 2012).

[12] Secure Rural Schools, Public Law 110-343, Title II Project, USDA Forest Service

2011

In September of 2011, three new EWM locations consisting of one plant each were located in Slaughter Bay. These locations were hand removed by personnel from the Ottawa National Forest on September 26th, 2011. Conditions during removal efforts were poor, with blowing wind and sleet. USFS botanist Ian Shackleford and John Pagel were able to relocate and hand pull two of the three locations with some success reported. The depth and weather conditions made hand removal that day difficult.

2012

EWM expanded from its previously known locations within Thunder Bay and Slaughter Bay to several sites along Simpson's Point and Rice Bay. Most locations consisted of single to few plants, with a few colonies consisting of patchy to moderately dense EWM (October 12th survey, Onterra, 2012). During the summer months, EWM identified prior to the October survey was hand removed by the Ottawa National Forest and the Lac Vieux Desert tribal youth program. A total of 18 plants were removed.

Until 2012, no additional locations of CLP had been identified. The only CLP occurrence known up to this point was discovered during a point intercept survey completed by the WDNR in 2009. In 2012, CLP was identified at 12 locations. Eleven of these locations consisted of individual plants to small colonies, but one location in Outlet Bay consisted of a contiguous bed of 1.1 acres.

2013

In 2013, EWM continued to expand from the southern tip of Simpson's point into Slaughter Bay. Several new colonies around the islands and into Rice Bay were detected. Curly leaf pondweed was found at six locations between Thunder Bay and Outlet Bay - three sites consisted of 1-10 plants; one site consisted of 50-100 plants and two small colonies measured at 0.18 and 0.07 acres.

Up until 2013, the only control efforts included the initial herbicide treatment and hand removal by the staff of the Ottawa National Forest and the Lac Vieux Desert tribal youth program. Starting in 2013, manual removal by individual scuba divers and manual removal by Diver Assisted Suction Harvesting (DASH) was employed.

For manual removal using scuba divers, divers locate EWM plants visually from the boat and mark them with buoys before entering the water. The first diver reaches down into the substrate and slowly works the plant's roots free of the sediment. The plant is rolled up and carefully placed into an open bag held by the second diver and then closed prior to moving to the next plant. While one diver is hand pulling the second diver is watching for any fragments and collecting them in the bag. Divers inspect the general area for any remaining plants and fragments before moving to the next location.

The DASH technique typically begins with a diver locating a EWM plant from the surface. The diver then descends next to the plant while lowering the nozzle. Divers works along the bottom by using fin pivots, kneeling on the bottom or hovering above the bottom at a distance where

the root mass of the plant is within reach. Divers either feed the top of the plant into the hose first and then uproot the plant or uproot the plant and feed the root wad first into the hose.

Once plants reach the surface, a hose dispenses the plant material into a series of screened bins located on the deck of the boat. These bins capture plants and allow water to drain out back into the lake. Plants are placed in sealed bags or other containers for transport to the dumping site. The dumping site is pre-determined site upland, away from any water body.

In 2013, divers worked a total of 119 dive hours to removed roughly 1,214 EWM plants. DASH efforts included six sites in both Michigan and Wisconsin. In 17 DASH hours, a total of 1,033.5 pounds of EWM was removed. At the end of 2013, the remaining sparse and very sparse EWM colonies were estimated to cover 0.56 acres.

2014

EWM distribution remained similar to observations made in 2013. A few additional colonies were detected along the south and west shores. Beds of CLP mapped in 2012 and 2013 within Outlet Bay were still present, though less dense and smaller in size. At the end of 2014, the area inhabited by sparse and very sparse EWM colonies was estimated at 0.57 acres.

Unseasonably cool air and water temperatures affected hand removal efforts. Ninety-eight dive hours removed approximately 780 plants. Eight and three quarters DASH hours removed 312.5 pounds of EWM. Ottawa National Forest staff spent one day hand pulling in Thunder Bay.

2015

End of the season EWM distribution and abundance declined slightly from 2014 to 2015 with mainly sparse and very sparse colonies estimated at 0.36 acres. New EWM locations included sites along the south shore and around the islands. Observations of curly leaf pondweed, only detected in Outlet Bay, continued to decline from previous years. Hand removal efforts totaled 140.5 dive hours, removing roughly 1,242 EWM plants. Twelve DASH hours removed 428 pounds of EWM. Ottawa National Forest staff spent two days in Thunder Bay hand pulling.

2016

EWM distribution rose from 2015 to 2016. Abundance remained relatively low, with mainly sparse and very sparse colonies detected. However, overall total acreage increased from 0.36 acres in 2015 to 5.27 acres in 2016. The main change occurred along the southern stretch of shoreline in Slaughter Bay. Curley leaf pondweed continued to be present as sparse to very sparse colonies within Outlet Bay and a few very small but dense locations in Slaughter Bay. One hundred and ninety six dive hours removed roughly 2,082 EWM plants. Five and three-quarter DASH hours removed 158 pounds of EWM. Ottawa National Forest staff spent one day within Thunder Bay hand pulling.

2017

EWM abundance and distribution rose in 2017, with 7.71 acres estimated at the end of 2017. Small sparse and moderate density colonies made up most of the increase in area seen from 2016 to 2017. Curly leaf pondweed distribution and abundance rose somewhat within Outlet

Bay, and a few new single plant locations were detected in Lobischer Creek. Hand removal totaled 172 dive hours removing roughly 3,303 plants. Thirty-eight DASH hours removed 2,217 pounds of EWM. Ottawa National Forest staff spent one day hand pulling in Thunder Bay.

2018

The greatest increase in abundance and distribution occurred from 2017 to 2018, with 17.12 acres estimated at the end of 2018. The largest EWM beds were located in Slaughter Bay, the southern tip of Simpson's Point, and the South Shore. No curly leaf pondweed was detected in Outlet Bay, with only a few individual plants observed east of the Misery Creek inlet in Misery Bay. Two hundred and fifty-eight dive hours removed roughly 4,517 plants. Seven DASH hours removed 358 pounds of EWM. Ottawa National Forest staff spent one day hand pulling in Thunder Bay.

LVDLA's WDNR Established Control Population grant ran from 2013-2018. Under this grant, participating partners and other stakeholders received annual updates (2013-2018) on EWM monitoring (deliverable under this grant) and management through a combination of meetings and annual reporting. These reports were delivered annually to the ISCCW, WDNR, USFS-Ottawa, GLIFWC, LVD Tribe, LVDLA, Vilas County Land and Water Conservation Department and UW Trout Lake. In addition, EWM monitoring and management updates for LVD are included in Many Water's reporting given at monthly ISCCW meetings. These meeting minutes are available at the ISCCW website[13] and attended regularly by representatives from the LVDLA and the USFS – Ottawa. Additional entities, outside of those identified above, receive briefings on EWM management and walleye hatchery activities by LVDLA representatives at WVIC hosted annual adaptive management plan (AMP) meetings.

2019

Lake-wide EWM abundance and distribution declined somewhat from 2018, with an estimated lake wide acreage of 16.13 acres at the end of 2019. Sparse to very sparse scattered colonies remained somewhat similar in distribution compared to 2018. The largest reduction occurred in sparse EWM scattered colonies and larger beds. The largest increase occurred in moderate-dense EWM beds, however, the total change in EWM beds from 2018 to 2019 did decline by about .40 of an acre total. One hundred and forty-four dive hours removed 2,165 plants. Twenty-eight and a half DASH hours removed 1,564 pounds of EWM. Based on the 2019 point-intercept aquatic plant survey, frequency of littoral occurrence of EWM was 1.71%. Ottawa National Forest staff spent one day hand pulling in Thunder Bay.

[13] lakeguards.org

Figure 2.1: *EWM Point Based Mapping Abundance Estimates – Lac Vieux Desert 2013-2019.*

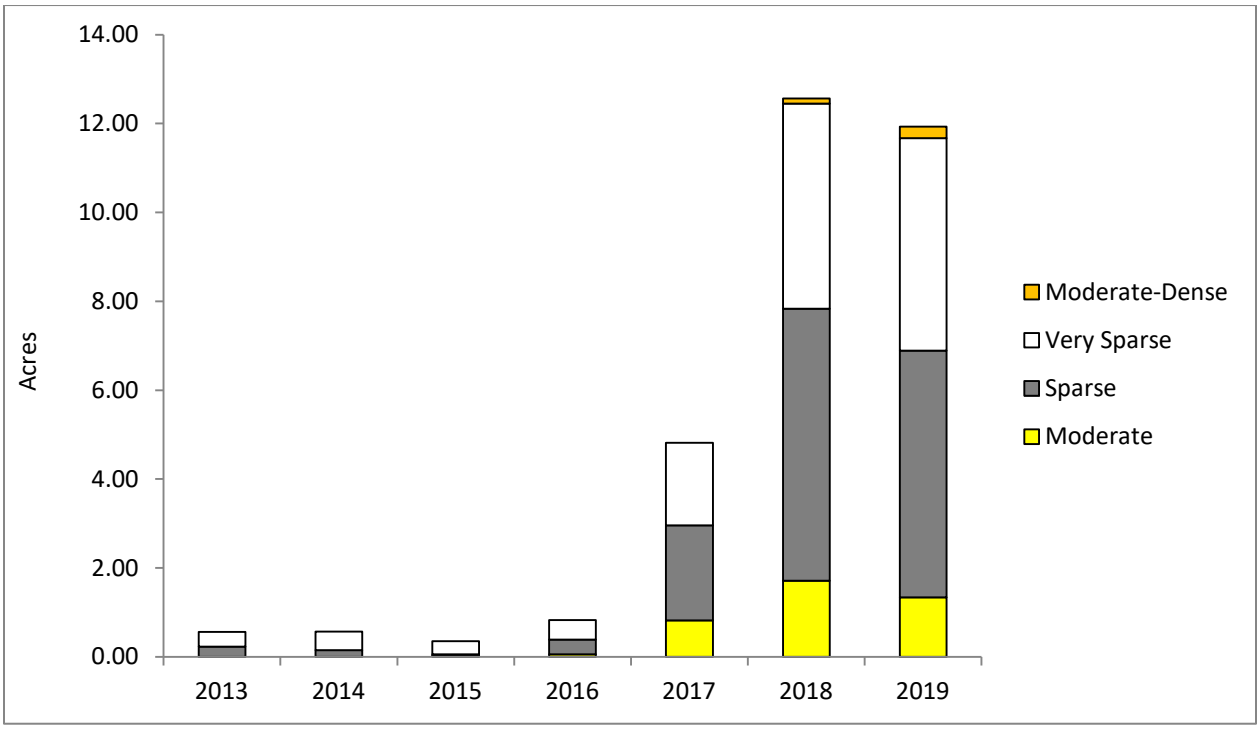


Table 2.1: *EWM Point Based Mapping Abundance Estimates – Lac Vieux Desert 2013-2019.*

EWM Abundance Estimate	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Dense	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Moderate-Dense	0.00	0.00	0.00	0.00	0.00	0.12	0.26
Moderate	0.00	0.00	0.03	0.06	0.82	1.72	1.34
Sparse	0.23	0.15	0.03	0.33	2.14	6.12	5.55
Very Sparse	0.33	0.42	0.30	0.44	1.85	4.61	4.79
TOTALS (acres)	**0.56**	**0.57**	**0.36**	**0.83**	**4.82**	**12.57**	**11.93**

Figure 2.2: *EWM Polygon Based Mapping Abundance Estimates – Lac Vieux Desert 2013-2019.*

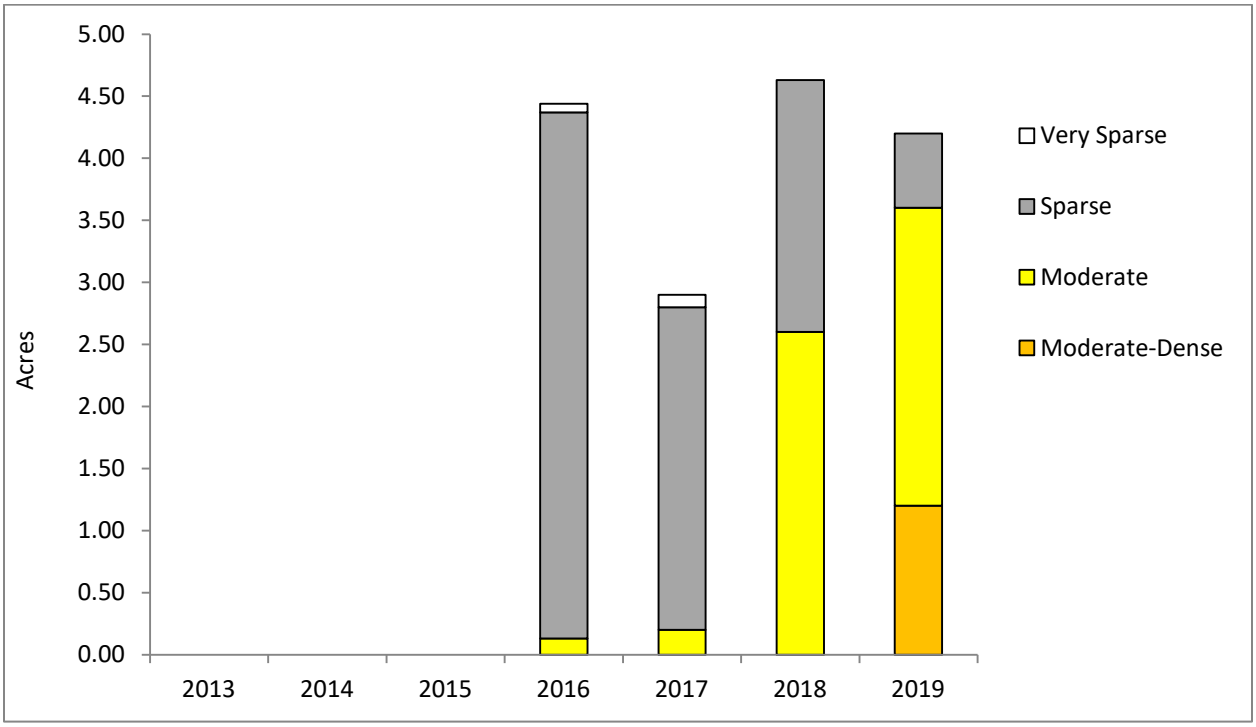


Table 2.2: *EWM Polygon Based Mapping Abundance Estimates – Lac Vieux Desert 2013-2019.*

EWM Abundance Estimate	2013	2014	2015	2016	2017	2018	2019
Dense	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Moderate-Dense	0.00	0.00	0.00	0.00	0.00	0.00	1.20
Moderate	0.00	0.00	0.00	0.13	0.20	2.60	2.40
Sparse	0.00	0.00	0.00	4.24	2.60	2.03	0.60
Very Sparse	0.00	0.00	0.00	0.07	0.10	0.00	0.00
TOTALS (acres)	**0.00**	**0.00**	**0.00**	**4.44**	**2.90**	**4.63**	**4.20**

3 - Shoreland Assessments

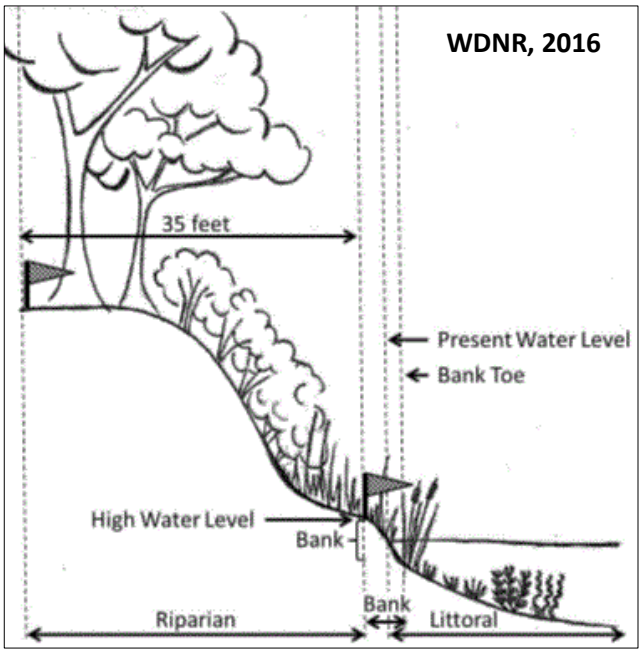
Shoreland Habitat Overview

As lakes become developed, piece-by-piece manipulations of natural landscapes result in fragmentation and loss of critical habitat that many species rely on. By themselves, each of the manipulations may seem insignificant. However, over time, the cumulative effects of these small habitat changes may result in irreversible ecosystem degradation and species loss. Based on the U.S. EPA National Lakes Assessment, lakeshore disturbance is increasing**.** Subsequently lakes with poor lakeshore habitats are three times more likely to have impaired biological conditions (U.S. Environmental Protection Agency, 2009)**.** These disturbances potentially affect water quality, in-lake habitat, and increase the likelihood of spreading aquatic invasive species. A substantial portion aquatic life depends on shoreland areas to provide shelter, spawning and nursery grounds, and food sources. Understanding the role of shoreland habitats in maintaining lake health allows lakeshore owners to make informed and wise decisions on how to enjoy their place on a lake while continuing to provide a home, shelter, and food for the plants and animals that share this space.

Shoreland Survey Methods

Shoreland assessments conducted by Many Waters, LLC took place in early September of 2019 and used the WDNR Lake Shoreland and Shallows Habitat Monitoring Field Protocol (WDNR, 2016)**.** This protocol provides standard methodologies used across the State to survey, assess, and map habitat characteristics in the shoreland area. Information from these surveys is useful to stakeholder groups, allowing them to make informed decisions about habitat protection, prioritize restoration efforts, and address potential erosion concerns. In addition, this information may be used for aquatic plant management planning and to understand long-term trends in shoreland habitat and lake ecology.

Figure 3.1: *Lakeshore habitat area definitions.*



This protocol emphasizes habitat features key to lake health and focus on the riparian buffer, bank, and littoral zones **(Figure 3.1).** The riparian buffer zone measures from the observed high water level to 35 feet landward from shore. The bank zone starts where the riparian zone ends and extends lake-ward to the bank toe, which may or may not be underwater. Often piers are anchored to shore in the bank zone. The littoral zone generally starts at the water line and

extends into the lake, including the lakebed where most aquatic plant life grows. Low water levels may expose the lakebed; exposed lakebeds are considered part of the littoral zone.

Habitat assessments included three loops around the lake. The first loop took geo-referenced photographs of the entire shoreline in spaced intervals. Photos were not taken when people were present to protect personal privacy.

The second loop assessed the riparian buffer, bank, and littoral zones of individual parcels. In cases where multiple parcels are owned by the same entity, one assessment was conducted for each parcel separately, with two exceptions. In these cases, separate assessments were conducted for each shoreland stretch of the same property. For example, a large track of Ottawa National Forest land along Duck Point touches shore on both the east and west side of the point and in Misery Bay. In this case, each section touching shore was assessed individually, even though technically considered one large parcel. Parcels with condominiums were assessed as one parcel, even though there might be several owners.

Spatial data for the Wisconsin parcels boundaries was obtained from the Vilas County Land Information Office. Gogebic County does have spatial information for parcels within the Watersmeet Township; however, communication with the Gogebic County Equalization Office revealed that it was not their policy to make these available to the public. Michigan property boundaries were estimated by using the GPS tool on the Gogebic County public GIS Map System. This digitized estimate was used to decipher parcel boundaries in the field. No spatial information was available for the parcels on Desolation Point; these parcels were not included in the shoreland parcel assessment.

Riparian features documented include:

- Percent vegetation coverage
- Impervious surface coverage
- Listing and description of human structures
- Run off concerns
- Evidence of point[14] and non-point runoff concerns
- Run off concerns present beyond the riparian area

Bank zone characteristics mainly focused on erosion and hardscape (rocks/concrete) armoring including seawalls and rock riprap. Littoral zone characteristics included human structures such as piers, boatlifts, swim rafts, and the presence of aquatic emergent and floating leaf vegetation.

The final loop included a coarse woody debris assessment.[15] This assessment documented all woody habitat located in two of feet of water or less, at least 5 feet in length and 4 inches in diameter. A geo-referenced location was collected for each piece of wood that fit the criteria and a description of the wood was noted. This description includes “branchiness,” which

[14] Point source runoff or pollution is identified by a definable source, such as a pipe

[15] Coarse woody debris assessment took place in the middle of October 2019, once most piers had been removed from the water.

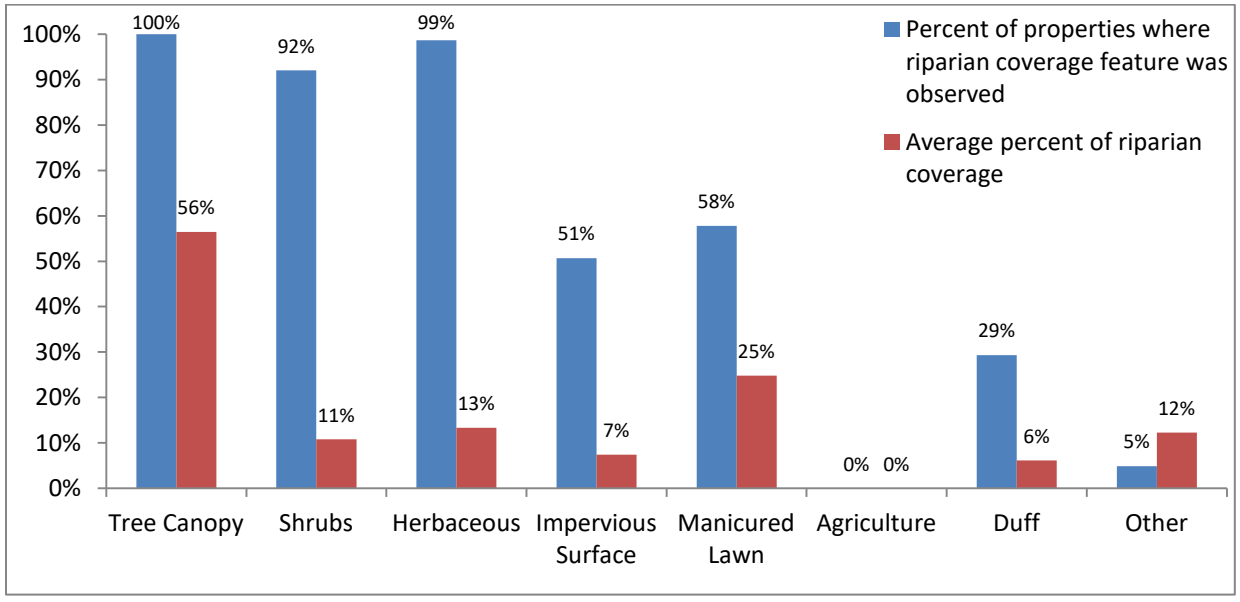
involves ranking each piece of wood from no branches to multiple branches, if the piece of wood touched the shore, crossed the high water mark, or was fully submerged in the water.

Riparian Buffer Zone - Results

Percent cover for each individual parcel assessed included trees, shrubs, herbaceous vegetation, impervious surfaces, manicured lawns, agriculture, and duff. Impervious surfaces include anything that would shed rather than absorb water including but not limited to decking, stone, rooftops, and compacted soils. Duff is a layer of leaves, pine needles, twigs, and other natural organic materials. Generally, duff regions on Lac Vieux Desert support little to no natural vegetation, but do allow water to infiltrate.

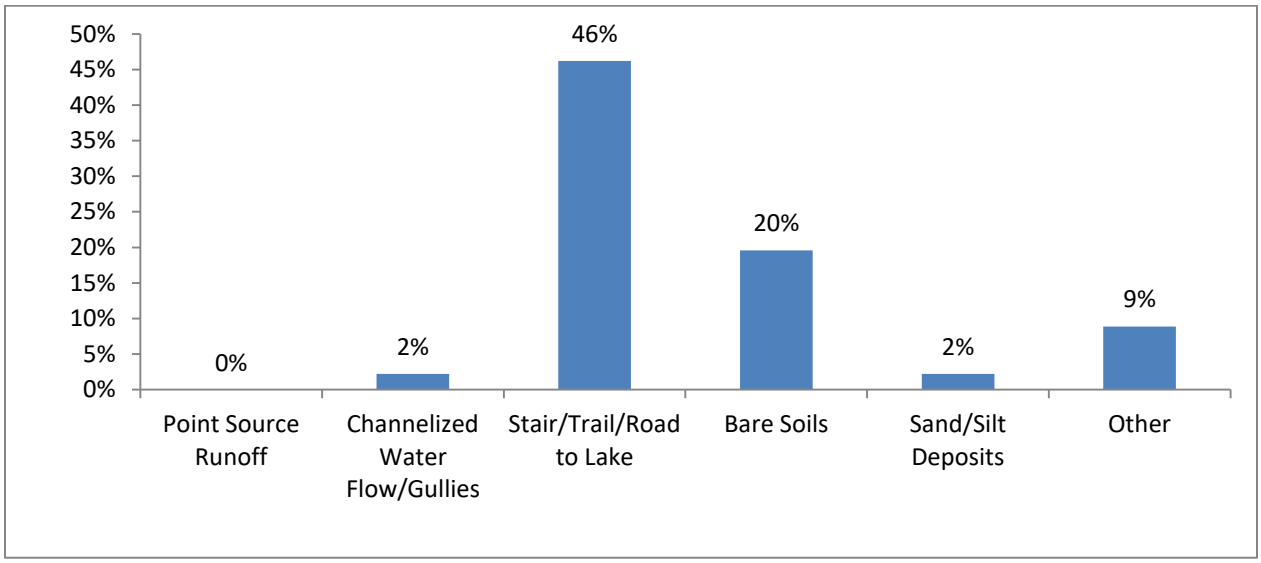
All assessed properties had a canopy (tree) layer, and most had a shrub and herbaceous layer **(Figure 3.2).** Fifty-eight percent of the total properties had manicured lawns. Of these 58%, total riparian coverage ranged from 5% to 85%, with an average of 25%. Fifty-one percent of the total properties had some degree of impervious surface. Of these 51%, total riparian coverage ranged from 5% to 35% with an average of 7%. When looking at properties as a whole, the most frequent observed coverage (mode) for lawns and impervious surfaces was 0%. Compacted soils, mainly from pathways to the lake, account for the majority of the impervious surfaces observed. Other observed riparian coverage included bare soils, landscape mulch, and beaches.

Figure 3.2: *Percent of total properties with riparian coverage & coverage estimates, Lac Vieux Desert – 2019.*



No point source runoff was observed within the riparian area. Stairs or trails to the lake represented the highest observed potential runoff issue observed. Roads also potentially contribute to runoff, however, very few roads were observed within the riparian zone. Other runoff issues include steep banks and private/public paved boat launches. Boat launches were considered separate from roads leading to the lake (**Figure 3.3**).

Figure 3.3: *Percent of total properties with features contributing to runoff by type, Lac Vieux Desert – 2019.*



Bank Zone – Results

Hardscape armoring of bank zones may include the use of vertical sea walls made of concrete or other building materials and more commonly rip-rap or rocks of various sizes stacked along the water's edge. Hardscapes create impervious surfaces allowing water to run directly into the lake. Hardscapes also disrupt the water-to-shore corridor or transitional areas that many organisms, both aquatic and terrestrial rely on to live. The most common bank zone modification observed was rip-rap, observed on 32% of the total properties with an average length of 50 feet of shoreline **(Figures 3.4 & 3.5).** Some sections of shoreline do maintain what appeared to be a natural layer of rock, stacked similar to but much more sporadic than human placed rip-rap. Trying to differentiate between the two was challenging on a few properties. Observations of bank zone rip-rap may be slightly over estimated due to this challenge.

Of those properties that had sea walls and/or rip-rap, roughly 13% had these features across the entire length of the property. A few properties maintain artificial beaches (3%) with an average length of 32 feet. Other observed bank zone modifications included a wall made of cement and rock (which did not fit into either the rip-rap or seawall category), temporary silt fencing, and a fabricated soil berm. Erosion greater than one foot in height was observed on 8% of the properties with an average length of 11 feet of shoreline. Erosion less than one foot in height was observed on 12% of the properties with an average length of 10 feet of shoreline **(Figure 3.6).** Roughly, a quarter of the observed erosion appears to be the result of ice scouring.

Figure 3.4: *Percent of properties with observed bank zone modifications and type – Lac Vieux Desert, 2019.*

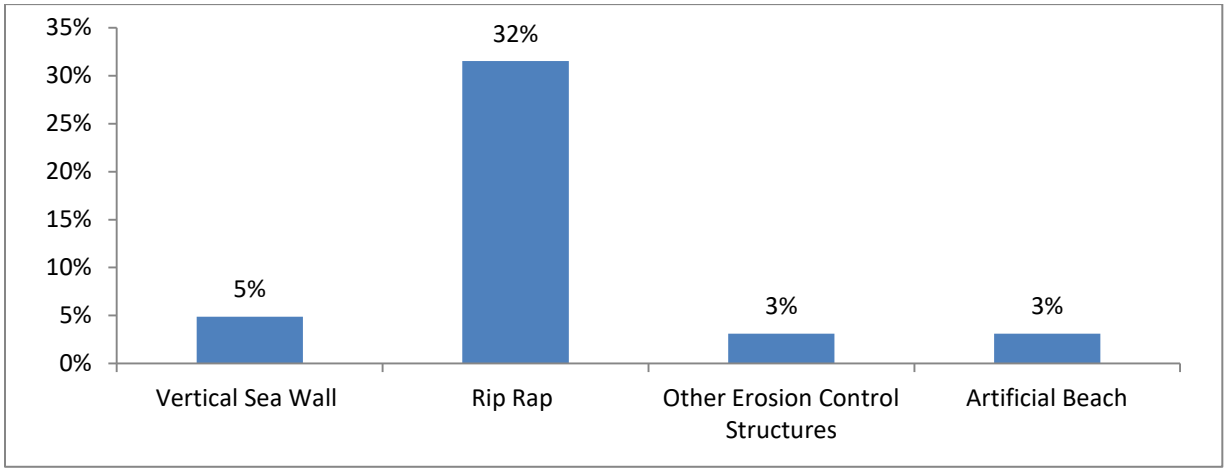


Figure 3.5: *Average length (ft) of bank zone modification for properties where each feature was observed – Lac Vieux Desert, 2019.*

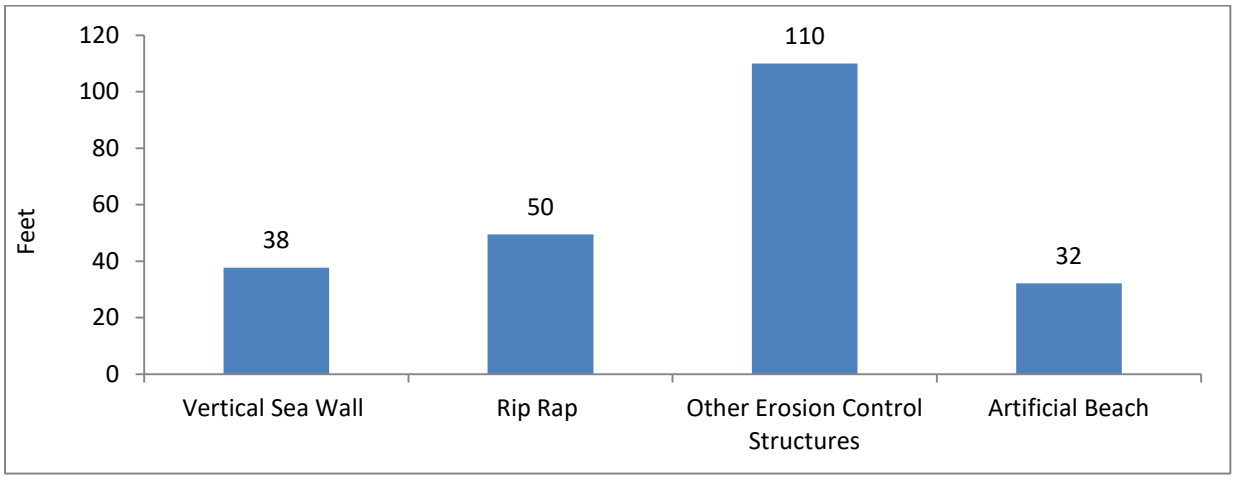
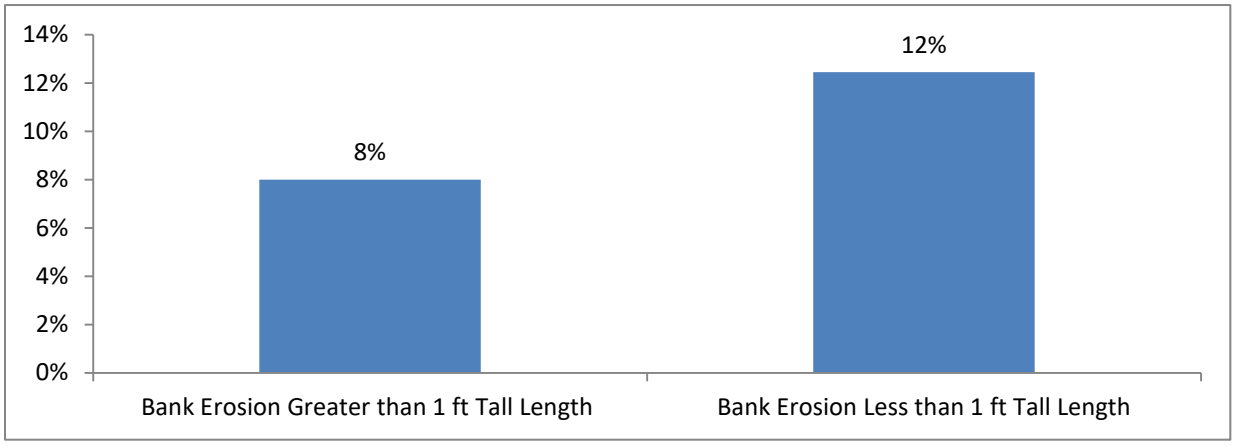


Figure 3.6: *Percent of properties with bank zone erosion and estimated height– Lac Vieux Desert, 2019*



Littoral Zone – Results

Littoral zone observations included noting the number of piers, boat lifts, swim rafts, and other near shore features. A pier was defined as a "structure leading out from shore into the waterbody." One pier was counted for each access to shore even if the pier split into two or more piers or had a more complex configuration. Seventy-two percent of properties had piers and just over half (51%) of properties had boat lifts **(Figure 3.7).** Each property with piers and boat lifts averaged 1.3 piers and 1.6 boat lifts per property. Three percent of properties observed had additional structures including swim rafts and water trampolines and one private marina. Emergent leaf and floating leaf aquatic vegetation was observed along 38% and 18% of the properties respectfully. Emergent and floating leaf plant removal was observed on 12% of the properties, this does include paths through the vegetation probably as a result of watercraft going to and from the property **(Figure 3.8.)**

Figure 3.7*: Percent of properties with observed littoral zone features–Lac Vieux Desert, 2019.*

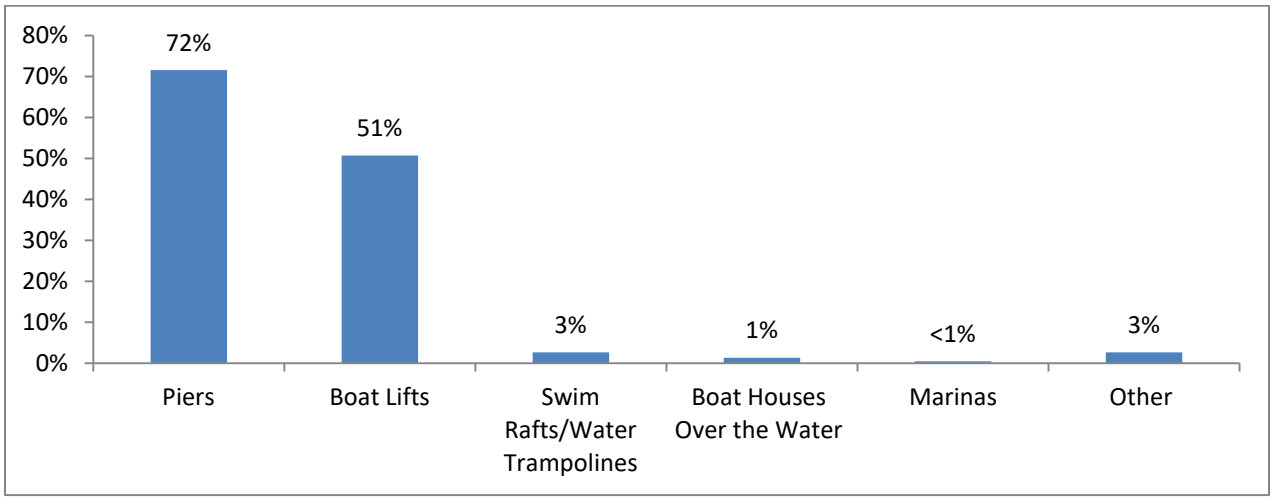
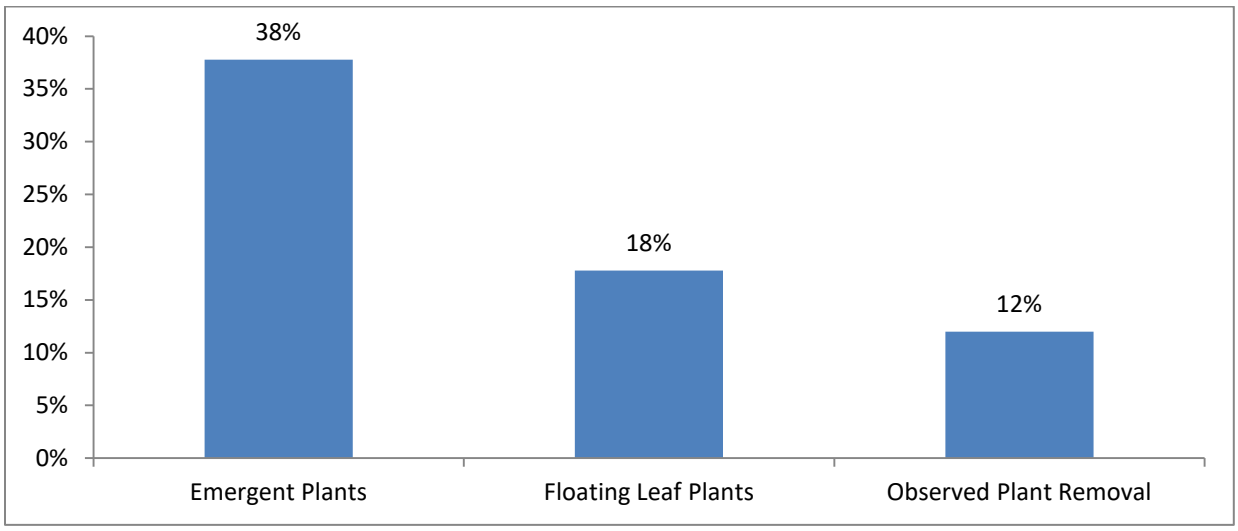


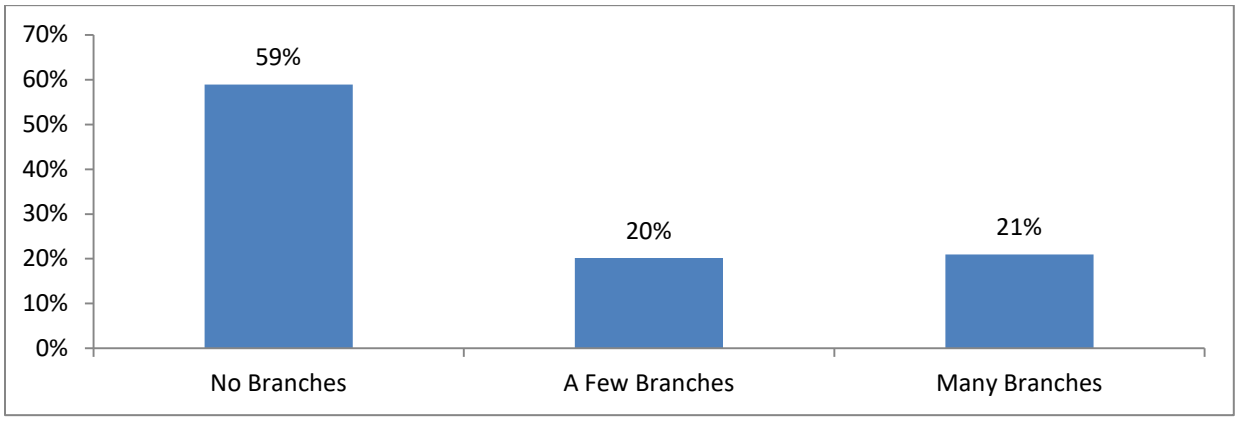
Figure 3.8: *Percent of properties with littoral zone feature– Lac Vieux Desert, 2019.*



Coarse Woody Debris – Results

One thousand two hundred and seventy-five (1,275) pieces of wood that fit the pre-determined categories were recorded. Fifty-nine percent of wood observed did not have any branches followed by 20% had a few branches and 21% had full crowns **(Figure 3.9).** Forty-four percent of the wood observed crossed the observed high-water level whereas 56% did not. Sixty percent of the wood had at least five feet currently underwater, whereas the remaining 40% had less than five feet underwater.

Figure 3.9: *Percent of coarse wood debris by branching type – Lac Vieux Desert, 2019.*



Shoreland Habitat Importance

As stated above, shoreland disturbances as a whole are rising on lakes within the Upper Midwest Region, translating to increases in water quality impairments and overall habitat degradation. Over the course of the past 50 years, home building along lakeshore areas in Northern Wisconsin and the Upper Peninsula of Michigan has continued to increase. The WDNR estimates that from 1965 to 1995 alone, Wisconsin shoreland building increased on average by 216%.[16] Like many Northern Wisconsin and U.P. lakes, shoreline development has continued to expand on Lac Vieux Desert, following patterns of shoreline development seen across the local landscape.

Shoreland development results in increased runoff, resulting in more phosphorous and sediment to a lake. For comparisons, a 100 ft by 200 ft undeveloped lake lot located within an upland forest with sandy-loam soils will add approximately 1,000 cubic feet of runoff, transporting .03 pounds of phosphorus and five pounds of sediment to a lake annually. In contrast, the same lot that is developed with a large home, maintained lawn and a paved driveway will add 5,000 cubic feet of runoff, transporting .20 pounds of phosphorous and 90 pounds of sediment to a lake annually.[17] While this comparison is somewhat generalized, it illustrates the potential impact that lake-lot development can have on water quality.

[16] http://clean-water.uwex.edu/pubs/pdf/margin/sld013.htm
[17] http://clean-water.uwex.edu/pubs/pdf/margin/sld038.htm

Maintaining good water quality is important for overall lake health and protects the economic investment lake residents put into their properties. Work by economists at UW Eau Claire on local lakes in Vilas and Oneida Counties (WI) found that water clarity matters to home prices. This study found that a three-foot increase in water clarity translates to an $8,090.87 to $32,171.12 improvement in the market price for the average lake property.[18]

These shoreland assessments provide a wealth of information useful in educating lake residents on the importance of shoreland habitat protection and improvement. In addition, some of this information can be useful when looking at the quality and function of a lake's natural habitat. For example, does pier density or the removal of coarse woody debris affect certain lake organisms? Work completed by the Minnesota DNR found 10 piers per kilometer (or 6.25 piers per mile) of shoreline resulted in substantial shoreline disturbances that negatively affected habitat function and fish communities (Jacobson, 2016). Other work suggests shoreline disturbances began to disrupt habitat function at five piers per kilometer (Beck, 2013). Removal of coarse woody debris and alterations to riparian and littoral habitat affect many other organisms as well. Green frog populations are lower on lakes with shoreland development versus non-developed lakes (Woodford, 2003).

The importance of coarse woody debris on fish populations has been studied extensively. A Wisconsin study found that when coarse woody debris was removed from a lake, predator-prey and growth relationships among largemouth bass and yellow perch were negatively affected compared to an unaltered reference lakes (Sass, 2006). This study showed that in the absence of woody debris, bass initially consumed perch at high rates, because of the loss of shelter that coarse woody debris provided to the perch. Once perch availability diminished, bass relied more on terrestrial prey organisms to make up their food diet. The authors suggest that the shift in diet resulted in slower growth of bass in the study lake (coarse woody debris removed) versus bass from the reference lake. Perch populations from the study lake decreased in abundance and showed very little recruitment. (Recruitment refers to the number of young-of-the-year fish that survive to enter the fishery in future years.) Declines in perch resulted from the initial elevated consumption of perch by bass, and the possible reduction of food available to perch caused by the removal of woody habitat. This study is one of many examples that show the intricate relationships between fish and other aquatic organisms, and the links between lake organisms and nearshore habitat.

Shoreland Habitat Considerations for Lac Vieux Desert

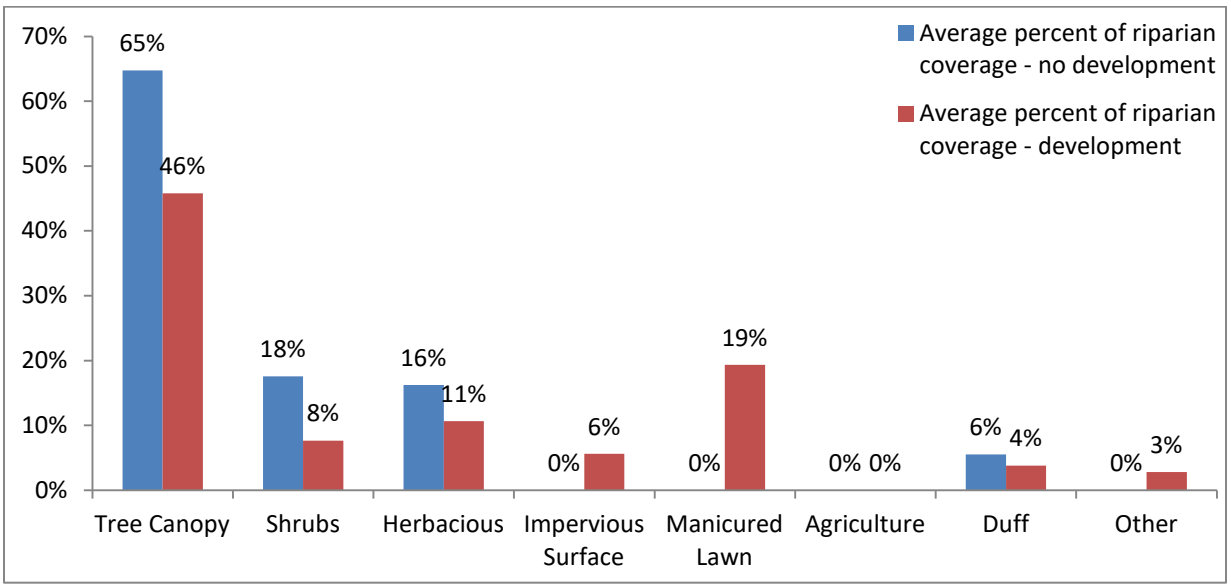
The adjacent riparian property to Lac Vieux Desert encompasses approximately 3,642 acres of land. This may appears to be quite high. Some tracts of land bordering Lac Vieux Desert are quite large, including 400+ to 500+ acre parcels owned by the Ottawa National Forest. Of these 3,642 acres, approximately 2,651 acres are considered public lands, leaving approximately 990 acres under private ownership. Along with vast tracts of Ottawa National Forest lands, public lands include tracts of the Chequamegon-Nicolet National Forest, MDNR, WDNR, and WVIC. About 95% of total parcel are under private ownership, with private parcels accounting for about 27% of the adjacent land base.

[18] Wisconsin Lakes Convention, 2019. Presentation - Economic Data on Oneida and Vilas County Waters. Thomas Kemp, Department Chair, and Professor of Economics, UW-Eau Claire.

Roughly eighty-four percent of the total parcels (public and private), accounting for about 861 riparian acres, exhibited some degree of human influence, ranging from just a pier or small footpath to highly manipulated shoreland areas. No development was observed on the remaining 16% accounting for about 2,780 acres. Roughly 91% of the 2,780 acres are considered public.

Tree canopy coverage averaged 46% on developed parcels versus 65% on undeveloped parcels **(Figure 3.10).** Shrubs and herbaceous cover show similar trends being lower on developed parcels versus undeveloped parcels. The most notable difference in cover types between developed and undeveloped parcels was in percentage of tree canopy coverage and manicured lawns, with a 19% decrease for trees and a 19% increase for lawns on developed parcels.

Figure 3.10: *Comparison of average riparian coverage of undeveloped and developed parcels – Lac Vieux Desert, 2019*



Bank zone soil erosion did not appear to be higher on developed parcels versus undeveloped parcels. Bank zone erosion greater than one foot in height was observed on about 11% of the undeveloped parcels versus 7% on developed parcels, with an average shoreline length of 8.5 feet and 12.4 feet respectfully. Bank zone erosion less than one foot in height was observed on about 8% of the undeveloped parcels versus 13% on developed parcels, with an average length of 11.7 feet and 6.8 feet respectfully.

The presence of aquatic emergent plants and floating leaf plants was higher along undeveloped parcels than along developed parcels **(Figure 3.10).** Emergent plants were observed along 63% of undeveloped parcels compared to 32% of the developed parcels. Floating leaf plants were observed along 45% of the undeveloped parcels compared to 12% of developed parcels.

Pier density on Lac Vieux Desert averaged 1.3 piers across all properties, with an average of 6.8 piers/km. The highest pier density observed on any individual property was 10 piers. Pier densities are not exceeding the described “threshold” of 10 piers per kilometer. However,

densities are exceeding five piers/km, a level at which some estimates indicate negative impacts to shoreland habitat.

Coarse woody debris (CWD) provides a multitude of habitat functions to lakes. Coarse woody debris enters a lake from fallen snags, weather events, and logging activities. Generally, lakes with more trees along the riparian area have reserves and the potential for replacement of woody debris to a lake, once older wood decomposes. As dwelling density around a lake increases, the number of riparian trees and pieces of CWD in the lake decrease (Christensen, 1996). Studies on lakes within Northern Wisconsin and the Upper Peninsula comparing coarse woody debris around undeveloped and developed lakes show that as dwellings increase, the total amount of coarse woody debris in the littoral area diminishes. The amount of CWD per kilometer of lakeshore on undeveloped lakes in this study ranged from 338 to 965 pieces per kilometer of shoreline. On lakes with a mixture of properties with and without shoreland dwellings, CWD per kilometer varied from 48 to 637 pieces of wood per kilometer of shoreline. Lac Vieux Desert's estimated density of CWD is ~41 pieces per kilometer of shoreline. Structure estimates within the riparian zone totaled 51 structures, averaging 1.6 structures/kilometer (2.6 structures/mile). It is important to note that the survey methods from the example study and the data collected on LVD do vary, and should not be a direct comparison, but rather provides an illustration on the overall importance of CWD to a lake.

Shoreland Protection & Restoration

Minimizing shoreline disturbance by protecting native vegetation may increase nature's ability to ward off colonization of invasive species. More important, intact shorelines reduce nutrients entering a lake that feed aquatic plant growth. When lakefront property owners develop their shorelines by removing what is naturally occurring, negative affects to a lake's ecosystem follow. Mammals, birds, amphibians, reptiles, and insects depend on the habitat that natural shorelines provide. Removing this sustaining habitat ultimately can reduce the diversity of life that naturally exists in these ecosystems. Removal of shoreline vegetation increases the susceptibility of erosion, leading to excessive sediments and nutrients running into a lake. Loose sediments can affect water clarity and nutrients can fuel excessive aquatic plant and algae growth.

Examples of shoreline development that can contribute to poor lake health include:

- Mowing to the water's edge
- Fertilization
- Removing down woody debris from the water
- Rip-rap and seawalls
- Raking rooted native vegetation out of the water

Before and After: *Shoreline restoration example from the MI Natural Shoreline Partnership - Middle Lake, Oakland County, MI.*

Shoreland protection and restoration can be as simple as not using fertilizers and not mowing to the water's edge or it could include installing plants and other bank stabilization materials.

<u>Shoreland Restoration/Protection Considerations:</u>

- Provides an added barrier to minimize the establishment of invasive species
- Reduces wave action and erosion along shorelines
- Improves aquatic habitat and provides refuge for many species
- Low cost restoration sites using seed and small plant material will take several years to mature and see the benefits
- Will require maintenance until plants become established especially in drought situations
- Animal browse may be an issue, and fencing may be required until plants are established
- Check with EGLE and WDNR on permit requirements

4 - Water Quality

Overview and Importance

Why is it important to collect information on water quality? **Lille and Mason (1983)** describe three general reasons (1) assess water quality conditions for current/immediate management purposes, (2) document existing conditions to assess changes over time and (3) "gain a better understanding of the factors and interrelationships which affect water quality in lakes." Immediate management or actions may be needed for issues relating to health and human safely, for example blue-green algae blooms. Having a long-term record of specific water quality parameters also helps resource managers and lake stewards understand water quality trends and changes that may be occurring within the lake over time. For instance, to detect a 15% change in average phosphorous concentrations and 20% change in water clarity in a lake, 10 years of consecutive monitoring is required (National Park Service, 2008)**.**

WDNR Water Quality Standards and Assessment Process

Three general elements guide water quality standards for Wisconsin waters, including designated waterbody uses, water quality criteria, and anti-degradation provisions. Designated uses define goals for that water body based on water body use and include fish and aquatic life, recreational use, public health and welfare and wildlife.[19] To determine if a waterway meets these goals, specific water quality criteria using numerical (quantitative) values or narrative (qualitative) criteria are used. Numerical data designates acceptable values whereas the narrative criteria[20] describes water conditions that are unacceptable such as nuisance algal blooms, floating solids, scum or conditions that interfere with public rights. Anti-degradation policies maintain and protect existing water quality condition, to prevent water quality degradation when reasonable control measures are available.[21]

Wisconsin uses a tiered approach to water quality monitoring. Beginning at Tier 1, baseline monitoring collects information across the State to establish water quality trends. Using this data, Tier 2 – site-specific monitoring follows up on specific water bodies that may have potential water quality issues. If specific water quality issues are identified, these water bodies may be place on the State Impaired Waters List. The final tier, Tier 3, includes following up on impaired waters that are making water quality improvement.

Using data from the tiered monitoring strategy, a waterbody is assessed to determine if the water quality condition meets the criteria for designated use. This assessment describes a continuum of water quality conditions from "excellent" to "poor." Excellent means the water body fully supports designated uses whereas poor would mean a waterbody is not meeting water quality standards for a designated use.

A lake's general condition is assessed by comparing the lake's natural community type to a tropic state index (TSI) or lake productivity. The WDNR recognizes 10 natural community types for Wisconsin Lakes. Lac Vieux Desert is considered a shallow lowland lake. Shallow lowland

[19] NR 102, Wis. Adm. Code
[20] NR 102.04(1) Wis. Adm. Code
[21] NR 102.05(1) Wis. Adm. Code

lakes are large (>10 acres), shallow (<18ft) with both an inlet and an outlet. The main source of water to these lakes is from streams. The **trophic state index** uses measurements for lake **water transparency**, **total phosphorous** and **chlorophyll *a*** to determine trophic status.

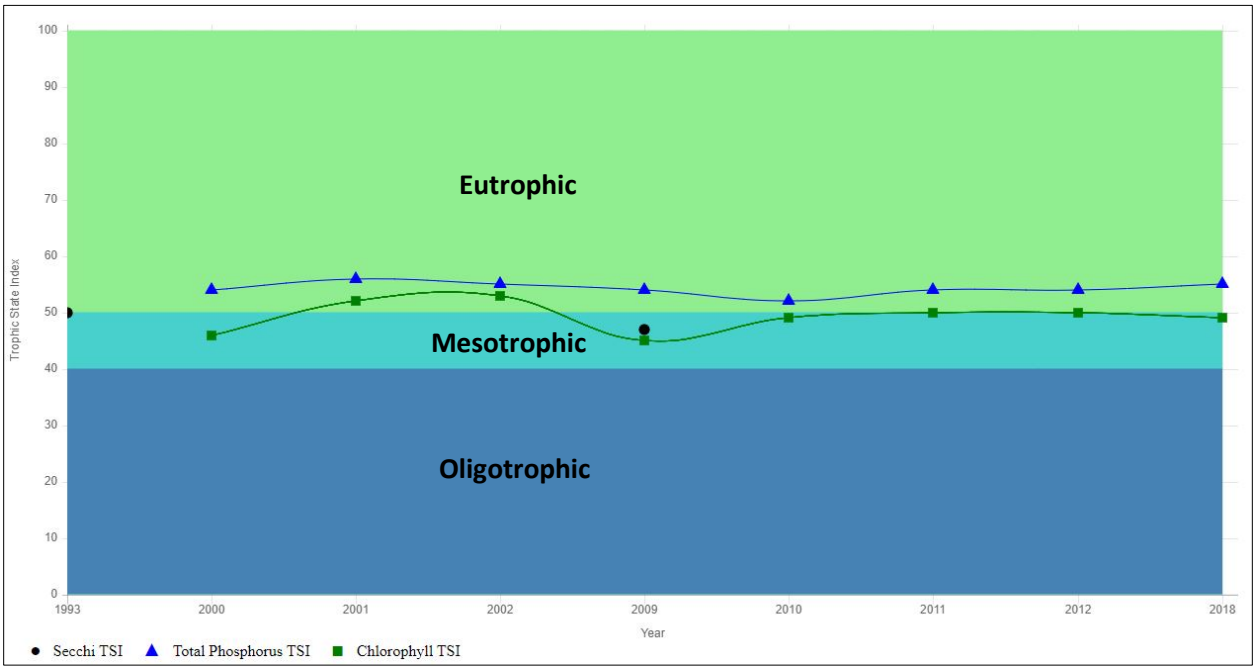
Water transparency, or clarity, is measured using a secchi disc, which is an 8-inch disk painted black and white and attached to a long rope. Measurements are taken by lowering the disk into the water until it just disappears out of sight and then slowly raising the disk until it barely becomes visible. The average of the two depths is recorded, typically in feet. Water transparency is affected by several factors including the abundance of algae, (which can vary throughout the growing season,) and suspended materials such as silt and other particulate matter dissolved in the water.

Phosphorous is the nutrient most responsible for excessive aquatic plant and algae growth. Some sources of phosphorous are natural but many are from human activities on the lake and in the surrounding watershed. Total phosphorous in natural waters is often expresses as a concentration, for example milligrams/liter.

Algae abundance is difficult to measure directly, so it is common to measure the green pigments or the **chlorophyll *a*** in algae, which is responsible for photosynthesis. Chlorophyll *a* values are also representation as a concentration, similar to phosphorous.

Using water transparency, total phosphorous, and chlorophyll *a* measurements, a trophic status value for each parameter can be calculated. Based on those values, lakes are divided into three general categories: oligotrophic, mesotrophic and eutrophic. Oligotrophic lakes are generally deep, clear lakes that are low in nutrients and have relatively few aquatic plants and algae. These lakes may support a desirable game fishery, but because they are low in nutrients, may not support a large fish population. Eutrophic lakes typically have high levels of nutrients, aquatic plants, and algae. Seasonal algae blooms and dense plant growth during certain times of the year are common. Moderate eutrophic lakes often support an abundant fish population, though winterkill can be a serious problem. Mesotrophic lakes fall in between oligotrophic and eutrophic lakes. The WDNR considers Lac Vieux Desert to be at the lower end of the eutrophic spectrum **(Figure 4.1).**

Figure 4.1: *Lac Vieux Desert's trophic status based on water transparency, total phosphorous, and chlorophyll a.*[22]



Comparing TSI values to Lac Vieux Desert's natural community type, Lac Vieux Desert's general condition is considered to be "excellent[23]", meaning water quality parameters are at or below designated thresholds for that particular lake use designation **(Figure 4.2).** In addition, the WDNR designates Lac Vieux Desert as an Outstanding Resource Water (ORWs). Outstanding Resource Waters "provide outstanding recreational opportunities, support valuable fisheries, and wildlife habitat, have good water quality, and are not significantly impacted by human activities." Less than 1% of all lakes in Wisconsin have this type of designation.

Figure 4.2: *General condition assessment for designated lake use – Lac Vieux Desert, 2019.*

Water Quality Trends

Historical water quality data varies for Lac Vieux Desert, limiting the ability to make inference of historical trends or changes to water over time. Being a high value lake, several agencies and entities have collected water quality information dating from 1979 to present, including data collected in 2018 as part of this project. However, not all the data is consistent with WDNR water quality trends monitoring, including collection of TSI parameters

[22] https://dnr.wi.gov/lakes/clmn/reports/tsigraph.aspx?stationid=643206 (Accessed 2.28.20)
[23] WDNR 2018 WisCALM listing thresholds – taken from https://dnr.wi.gov/water/waterDetail.aspx?key=128513 (Accessed 12.9.19)

within the summer index period from July 15th to September 15th. Water quality data presented uses a combination of data from the current lake management plan, WVIC, USGS and data collected from other WDNR sponsored grants **(APPENDIX E).**

Figure 4.3: *July 15th- September 15th average secchi (ft) from 1979 to 2018. (1979-1983 data estimated from current lake management plan.)*

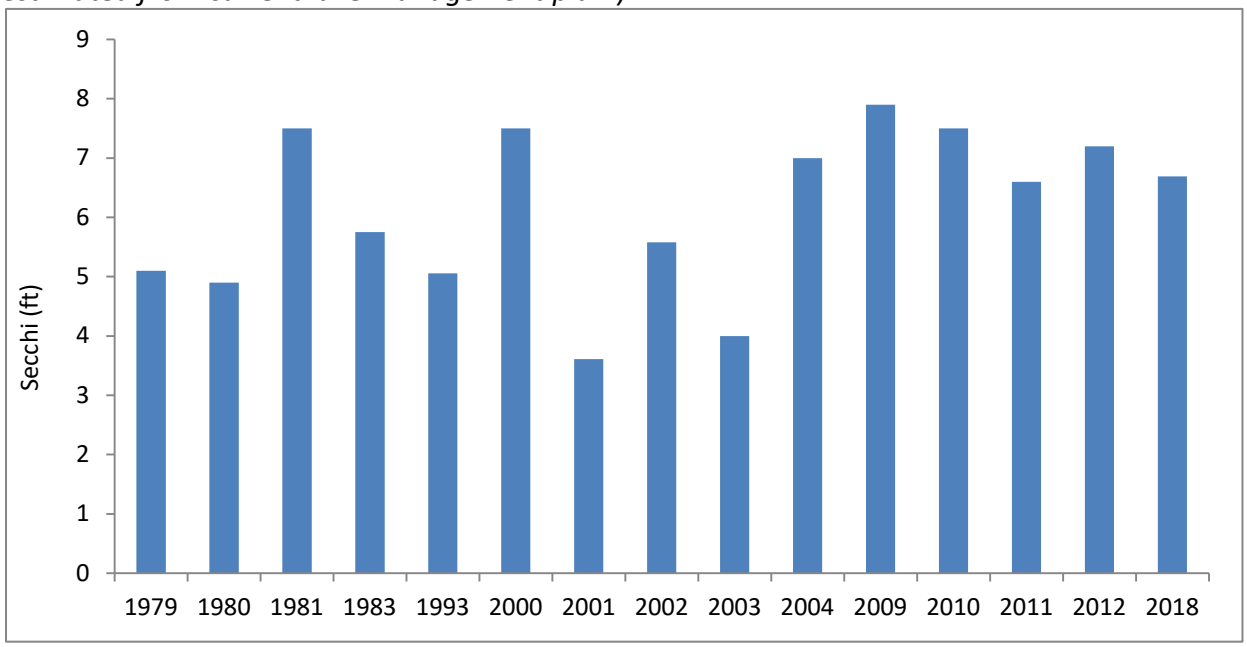


Figure 4.4: *July 15th - September 15th average total phosphorus concentrations (ug/l) from 1979 to 2018. (1979-1983 data estimated from current lake management plan.)*

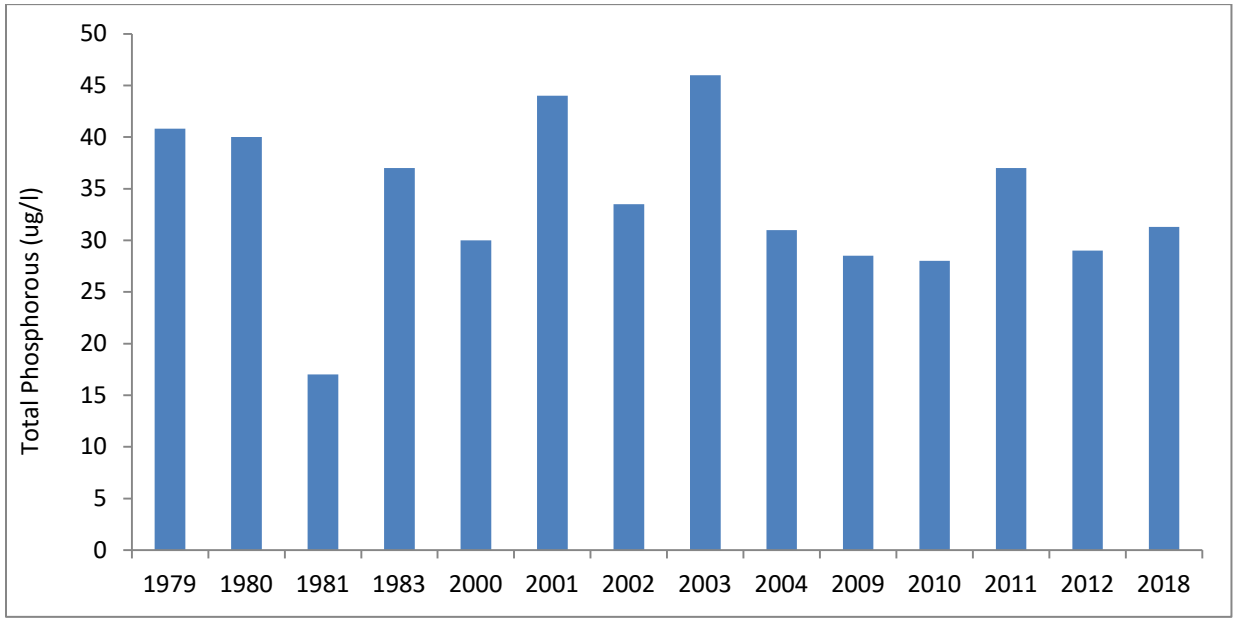
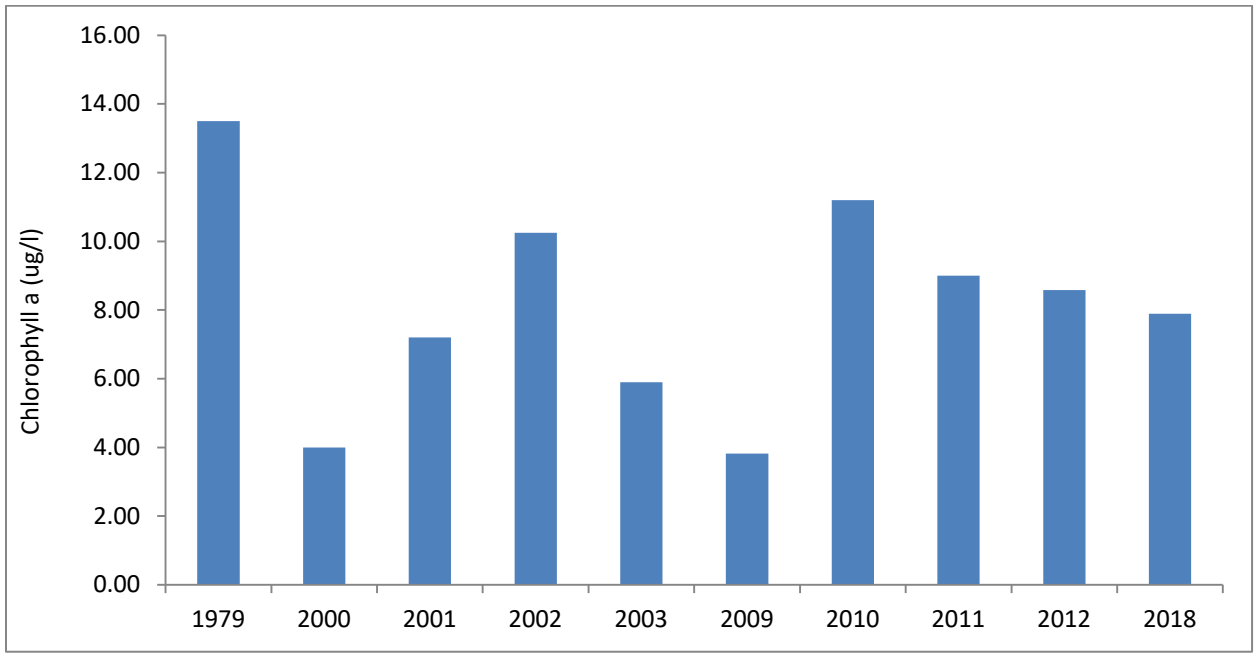


Figure 4.5: *July 15th -September 15th average chlorophyll a concentrations (ug/l) from 1979 to 2018. (1979 data estimated from current lake management plan.)*



Phosphorous and Nitrogen Relationship

In most Wisconsin Lakes, phosphorous is the key nutrient for plant and algae growth. Excessive phosphorous in lakes may allow plants and algae to grow excessively. Phosphorous in lakes comes from a variety of sources, most of which are results of human activity. These include soil erosion from poor land practices, runoff from the surrounding landscape, septic systems, and detergents.

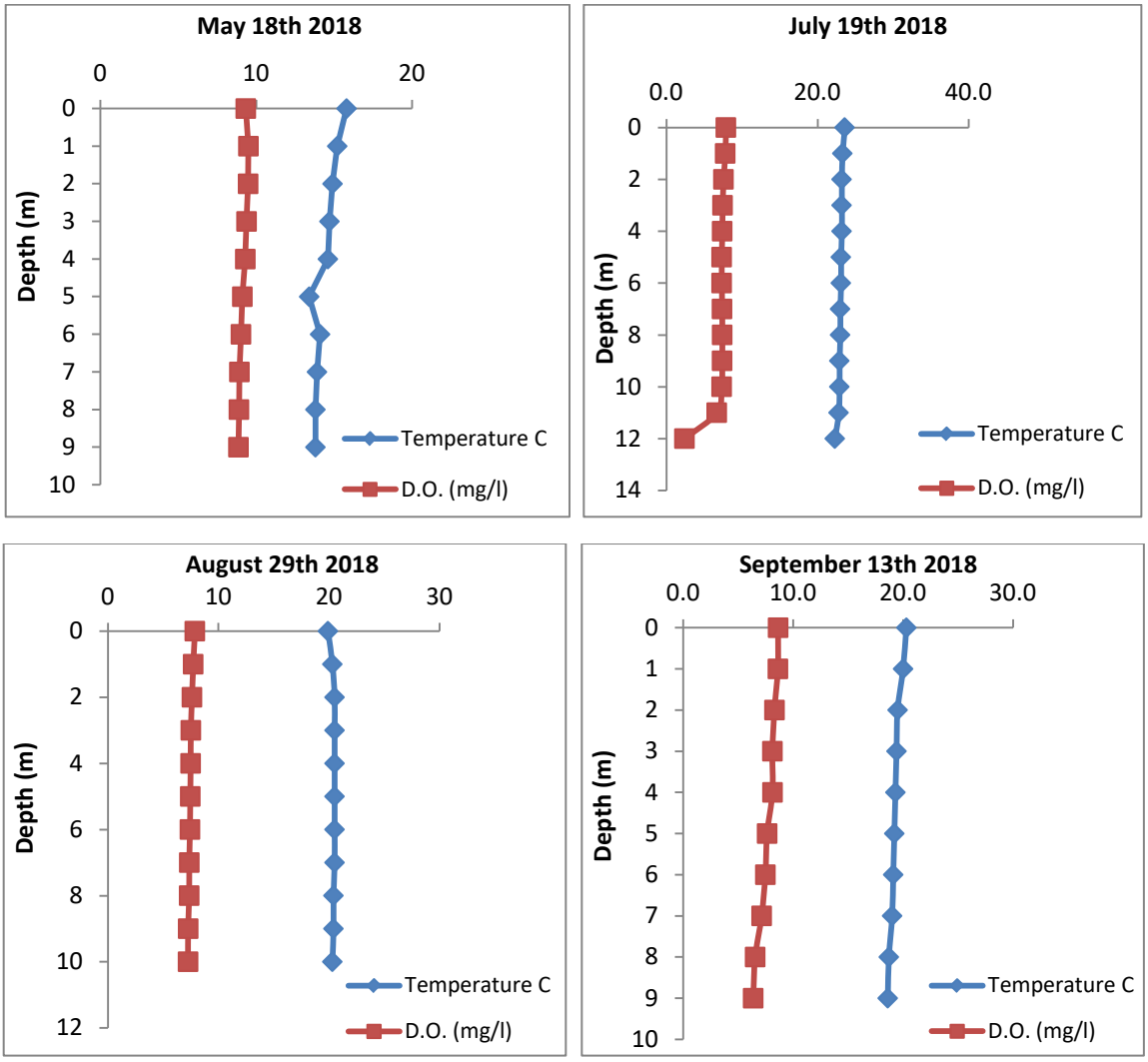
After phosphorous, nitrogen is the second most important nutrient for plants and algae. Sources of nitrogen in a lake vary, and include atmospheric inputs from rain and ground water and surface water runoff from the surrounding watershed. Mineral soils, created by weathered rocks, do not naturally contain nitrogen. However organic soils, created by decomposing plants and animal materials do. This is important because the amount of nitrogen in a lake may be directly related to the types of human activities within the watershed. Watershed sources of nitrogen include fertilizers, animal waste from agricultural practices, and human waste from sewage treatment plants and septic systems.

The nutrient in the shortest supply to algae in a lake is considered the limiting nutrient because it limits growth of algae in a lake. For most lakes in Wisconsin, phosphorous is the limiting nutrient. To determine if a lake is nitrogen limited or phosphorous limited, the ratio of nitrogen to phosphorous is used. Nitrogen limited lakes have a N/P ratio of less than 10:1, whereas phosphorous limited lakes have a N/P ratio of greater than 15:1. Lakes that fall in between these two ratios are considered transitional. Based on in-season 2018 water quality data, Lac Vieux Desert continues to be phosphorous limited with a ratio of 23:1 as compared to a ratio of 19:1 in 2009.

Dissolved Oxygen

Most aquatic life depends on oxygen, making it one of the most important dissolved gases in a lake. The amount of dissolved oxygen present in a lake is influenced by winds (which mix lake water - exposing it to the atmosphere), groundwater, amount of surface water entering a lake, and biological activity. Lake stratification, or thermal separation of warmer surface waters from deeper cooler waters, affects dissolved oxygen. In lakes that strongly stratify, the water above the thermocline remains oxygenated due to continued mixing with the atmosphere and oxygen production by plants and algae. Below the thermocline, the waters are cooler, and oxygen levels will decline throughout the summer months due to lack of atmospheric input and respiration from organisms that consume oxygen. In lakes that continuously mix, dissolved oxygen and temperature will remain similar from top to bottom, depending on the time of year. Dissolved oxygen and temperature monitoring for Lac Vieux Desert suggests that oxygen remains available from top to bottom throughout the growing season.

Figures 4.6-4.9: *Dissolved oxygen and temperature profiles for Lac Vieux Desert.*



pH – Lake Acidity

pH measures the acidity of water. Values range from 0 -14, where "0" would indicate high acidity, "14" would indicate high alkalinity and "7" would be considered neutral. Natural lakes in Wisconsin range in pH from 4.5 in acidic boggy lakes to above 8.4 in hard water/marl lakes (Shaw B. M., 2004). pH on Lac Vieux Desert (2018) measured 7.56. This is lower than reported in 2009 (pH 8.01), but still within the normal range for natural lakes (Horne, 1994).

Lake water acidity is an important part of a lake's carbonate system. Simply put, a lake's carbonate system has a variety of naturally occurring chemical reactions that affect a lake's ability to buffer acid rain, regulate the solubility of many toxic compounds, and affect basic biological processes. Most rainwater in the western portion of the Upper Peninsula of Michigan and Northeastern Wisconsin ranges in pH from 4.8 to 5.1.[24] Without a lake's carbonate system, helping raise pH levels from (buffering) water sources to a lake, biological processes in a lake would be affected. Lower pH levels in water allow metals such as aluminum,

[24] Taken from https://water.usgs.gov/edu/ph.html

mercury, and zinc if present in the lake sediment or watershed soils to become soluble. High levels of mercury and aluminum are toxic to fish and may be harmful if consumed by humans and other animals such as loons, eagles, and ospreys. Acidic pH levels (<7) may inhibit fish spawning in some species, including walleye and lake trout and at very low pH levels many fish species just cannot survive.

Lake Alkalinity - Hardness

Alkalinity measured as $CaCO_3$, measures water's ability to resist changes in pH and predicts a lake's overall sensitivity to acid rain. Like pH, it is an important component of a lake's carbonate system. Hardness is simply the amount of dissolved calcium and magnesium in the water. Minerals in the soil and bedrock influence lake alkalinity, and hardness. Soft water lakes, which are lakes with hardness values of less than 60 mg/l of $CaCO_3$, are common in Northern Wisconsin, due to types of glacial deposits and minerals present. Lac Vieux Desert's 2018 alkalinity levels (38.1 mg/l) are similar to 2009 levels (40.3 mg/l) and indicate a soft water lake with low sensitivity to acid rain (Shaw B. M., 2004)**.**

Other water quality parameters

The underlying bedrock of a region directly influences the amount of calcium and magnesium in a lake. Lakes with limestone and dolomite bedrock layers, mainly in southeastern Wisconsin, account for the highest calcium and magnesium lakes in Wisconsin, with values 40 mg/l or greater for both calcium and magnesium **(Lille & Mason, 1983).** Similar limestone and dolomite bedrock exists in the eastern portion of the Upper Peninsula of Michigan, from Dickinson County eastward. Fifty five percent of Wisconsin Lakes have calcium levels of less than 10 mg/l whereas 77% of Wisconsin lakes have 20 mg/l or less. Most Wisconsin Lakes (77%) have magnesium levels below 10 mg/l **(Lille & Mason, 1983).**

Calcium and magnesium levels for Lac Vieux Desert were 10.1 mg/l and 3.28 mg/l respectfully. Calcium levels remained unchanged from 2009 values compared to 2018 values. Magnesium was not reported in 2009. Calcium is important to organisms like mussels that need calcium to build shells. Lake suitability research suggests that calcium may predict the ability for zebra mussels (a major invasive species) to colonize a lake. Based on calcium levels of less than 10 mg/l, Lac Vieux Desert is considered unsuitable for zebra mussels (Papes, 2011)**.**

5 - Watershed

A watershed is an area of land where all water drains and collects at a central location, to a river or lake at a lower elevation. Land use in the surrounding watershed is important to lake health because water flowing across the land picks up pollutants such as nutrients and sediment that may run off into a stream or lake. Pollutants are broadly categorized as point sources and non-point sources. Point sources originate from a distinct location, such as a wastewater treatment plants and are traceable to the source. Point sources are often monitored and regulated under state and federal permits. Non-point sources do not originate from a distinct location. These sources typically come from precipitation and runoff, but can come from groundwater. Examples of non-point pollution sources include water running down a driveway or across a lawn into a lake. Heavily forested watersheds infiltrate precipitation better than urbanized or agricultural watersheds, which often have impervious surfaces and compacted soils, resulting in more runoff.

Lac Vieux Desert is located at the western end of the Lac Vieux Desert – Tamarack Pioneer River Watershed, and is the headwaters to the Wisconsin River. The Wisconsin River feeds the larger Upper Wisconsin River Basin. Primary land cover in the Lac Vieux Desert – Tamarack Pioneer River watershed is forest (69%) and wetland (18%) (WDNR, 2019).

The current LVD Comprehensive Management Plan provides a detailed description and assessment of Lac Vieux Desert's watershed, including watershed modeling using the Wisconsin Lake Modeling Suite (WiLMS). Based on these assessments, both Lac Vieux Desert and its watershed are *relatively* large, with a watershed to lake area ratio of 4/1. This means that land cover within the watershed is an important influence to lake health. WiLMS modeling predicts an input of 2,578 pounds of phosphorous to Lac Vieux Desert annually (Onterra, 2012). Atmospheric deposition and the forested landscape account for most of this phosphorous.

More recently, tools developed by the WDNR allow for relatively easy assessments of watershed factors key to lake health **(Appendix F).** These tools do not replace the detailed assessment completed in the current lake management plan or extensive studies by the USGS[25] and others, but rather provide a snapshot of current watershed condition. These assessments include predictive pollutant loads for phosphorous, which is the nutrient many times most responsible for lake eutrophication.[26] Estimated annual phosphorous loads to Lac Vieux Desert ranged from 680 pounds/yr to 2,540 pounds/yr (WDNR PRESTO, 2013).

[25] More details on Lac Vieux Desert's watershed can be found in the USGS (2005) document titled Water Quality and Hydrology of Lac Vieux Desert Watershed, Gogebic County MI and Vilas County WI, 2002-2004. (SIR 2005-5237). This document can be found at https://pubs.usgs.gov/sir/2005/5237/

[26] Eutrophication is when a body of water becomes overly enriched with nutrients causing excessive growth of plants and algae. When these organisms die, respiration by bacteria and other decay organisms may severely deplete dissolved oxygen in a lake.

Land use and Lac Vieux Desert location in the Tamarack Pioneer River Watershed

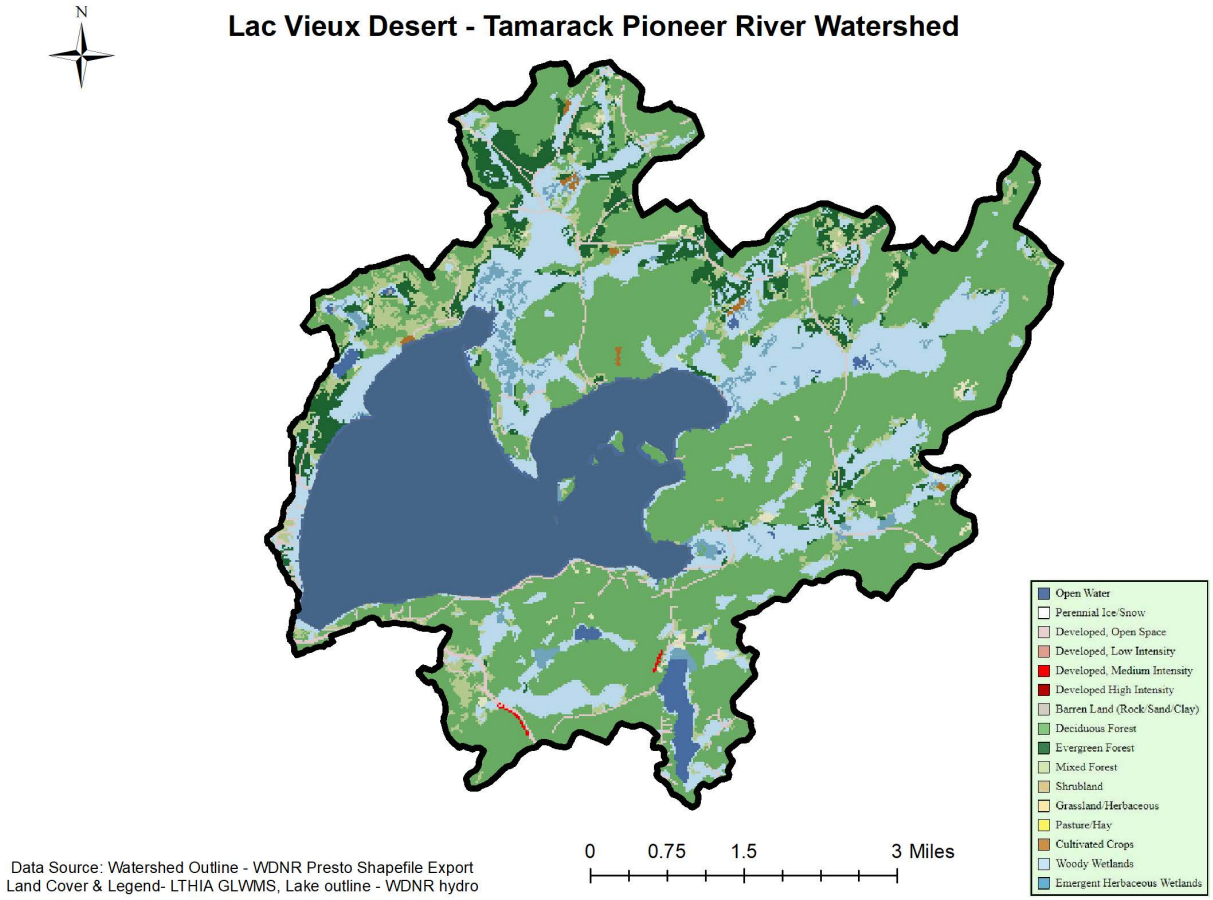


Table 5.1: *Average annual total phosphorus load (lbs) to Lac Vieux Desert predicted by land cover export coefficients (WDNR PRESTO-2013)*

680 lbs	average annual total phosphorus load - low estimate
1,373 lbs	average annual total phosphorus load - median estimate
2,540 lbs	average annual total phosphorus load - high estimate

6 - PLANNING REIVEW

On December 19th, 2019, Many Waters met with the LVDLA board to discuss lake data findings including EWM status, and to review key elements to update the current LMP implementation document. Lake data findings included a discussion on water quality results, historical monitoring, and trends. Shoreland assessments, not part of the current LMP, provided a variety of information on riparian buffers, runoff information, and coarse woody habitat. Aquatic plant survey findings included data from the point intercept and emergent/float leaf community mapping surveys.

The status of EWM included results from the point intercept (2019) and EWM mapping surveys (2019). Tables and graphs presented displayed the change in EWM abundance from 2013 to 2019.[27] A summary of management from 2013 to 2019 included results of diving and DASH efforts. This information segued into a key discussion regarding the future of EWM management on LVD.

A number of options for future management were discussed, including:

- Active management, which only includes EWM monitoring and population evaluations (i.e., no physical management such as hand pulling).
- Increase management from historical efforts to try to address all known EWM locations across the lake.
- Regardless of management efforts, EWM will not be eradicated from the lake.
- Only manage denser EWM locations and not manage scattered low-density locations. This would more or less mean only doing DASH, no diver only hand removal.
- Only manage the low-density scattered locations and not manage the denser areas. This would more or less mean only using divers without the use of DASH.
- Continue control efforts similar to previous years with a combination of DASH and hand removal.
- Prioritize dense areas in high traffic sites on the lake.
- Prioritize early colonization sites on the lake.
- Use a combination of DASH and diver hand pulling to manage EWM at specific regions of the lake.
- Early season monitoring focuses on shallower regions of the lake, these locations set up the initial diving strategy for the season.
- Mid/late season surveys include deeper area on the lake; by this point in the season EWM has grown closer to the surface and is easier to detect. Diving strategies may be adapted depending on these results.
- Because of the lake size and weather conditions on any given day, it is not feasible to complete an entire lake survey in one day. These surveys are broken down to cover different areas of the lake as weather allows.
- Budgets to continue management will depend on the Association's ability to acquire grants to help offset management costs.

[27] These tables and graphs are the same ones found in the Aquatic Plant Management section of this document.

The LVDLA agrees that EWM will not be eradicated from LVD and that only monitoring and evaluating (no physical management) would not be desired by Association membership, which the board represents. Consensus on future EWM management includes continuing at similar levels as in previous years as fiscal resources allow. This may mean not all EWM locations will be managed in any given year. Annual early season monitoring will determine initial hand pulling strategy and can be adapted depending on the situation throughout the summer. Low-density sites will be targeted with hand removal alone. Historically, these low density sites are scattered, requiring a great deal of mobility by the divers. Using DASH in these instances would not be the most effective use of resources. Potential priority sites would include new (early colonization) sites, and colonies that are isolated and in locations from which they are more likely to spread (e.g. boat landings). Denser sites, especially deeper water sites later in the season, would be targeted using DASH. Tall plants in these deeper waters later in the season are better suited for DASH, where relatively little mobility between sites is required. Priority considerations include high traffic/ use areas and again intra specific pathways to spread. Weather, specifically wind impact dive and DASH efforts on any given week, affecting which regions of the lake are accessible and what priority regions can be treated on any given day.

The final portion of the meeting dedicated time to reviewing the current implementation plan and "checking in" on actions that have been taken to work towards management goals and determine if the current goals are still relevant within the scope of this planning update. Overall, the board agreed that current implementation plan is active and still relevant to the goals and objectives of this project with some modifications.

Plan Review and Adoption

A copy of the plan draft was circulated for review to the LVDLA, WDNR, MDNR-fisheries, WVIC, Ottawa National Forest, ISCCW, GLIFWC, and LVD Tribe. Comments received from entities were incorporated into the plan and email copies of the comments were forwarded to the WDNR. Upon plan completion, the LVDLA board will vote at their April 2020 board meeting to adopt the finalized plan.

7 - SUMMARY & CONCLUSIONS

As mentioned in the preface, several entities and agencies are involved in the resource management of LVD. Over the years, these agencies have completed a number of scientific studies, reports, and plans for LVD's fisheries, water levels, wild rice, watershed hydrology, non-point pollution, aquatic invasive species, and water quality monitoring. Though historical water quality data on LVD is somewhat limited, some level of monitoring continues by WVIC. The next round of monitoring for LVD by WVIC is proposed for 2020, 2021, and 2022. A 10-year wild rice restoration plan was implemented from 2002 to 2012. While the current LMP does provide a summary of this project, the final report[28] was not available when the LMP was completed. This document details 10 years of studies on water levels, hydrology, water quality, aquatic macrophytes, wild rice, fisheries, creel surveys, and recreational surveys conducted during this period.

The social perception of water quality is often complex, but defining what impacts water quality is well known. Land cover and land use play an important role in the amount of sediment and nutrients entering a lake, affecting water quality. Roughly, 18% of Lac Vieux Desert's total watershed consists of adjacent riparian parcels. Of that 18%, approximately 73% are in public ownership. Even though most of these riparian lands are under public ownership, private riparian landowners can ensure that clean, pollutant free water enters Lac Vieux Desert by reducing nutrient sources and runoff on their properties. Natural vegetation and duff absorb rain and runoff coming from the surrounding landscape better than shallow rooted lawns. Diverting runoff from impervious surfaces such as rooftops and driveways to areas where water can infiltrate into the soil will also minimize runoff to the lake.

Scaling to the watershed level. Most land cover within the watershed consists of forests and wetlands that allow water to infiltrate rather than run over the landscape and picking up pollutants that may enter the lake. Careful watershed management, which is outside the scope of this project, is important to maintain the current water quality conditions of LVD. Future predictions for Wisconsin estimate that by 2050, an average increase in temperature of 4-9˚F, an increased number of 90˚F plus days, and warming winters will occur (Wisconsin Initiative on Climate Change Impacts, 2019). Higher precipitation predicted during the winter and increases in heavy precipitation events (at least 2 inches or greater) will result in more water running across the landscape and possibly higher groundwater levels. The LVDLA and riparian owners can help by keeping a pulse on land use and proposed changes to land use within the watershed, and do what they can on their properties to reduce runoff into the lake.

The current LMP's implementation section includes an action item to *"complete shoreland condition assessments as a part of next management plan update*." As recommended, this was completed as part of this planning update. Most properties assessed (92%-100%) support some natural cover, which helps infiltrate water and provide nearshore habitat. On average, across all parcels assessed, impervious surfaces and lawns account for 4% and 14% of the total riparian

[28] Lac Vieux Desert Wilde Rice Enhancement Plan Final Monitoring Report. FERC Project 2113 Article 114.

buffer cover observed, respectively. Large public tracts of land currently provide the majority of undeveloped shoreland, whereas most private parcels (84%) show some degree of human influence.

Shoreland development continues to increase on lakes within the Upper Midwest Region, which trends towards poor water quality and overall nearshore habitat degradation. Watershed land use and cover may drive the "big picture" of Lac Vieux Desert's long-term water quality. However, the quality of nearshore habitat is something riparian owners can directly engage in. Encouraging natural buffers along shorelines, remediating active erosion, and leaving downed wood in place along the water's edge will provide critical habitat and refuge for most aquatic life.

Lac Vieux Desert supports a robust and diverse aquatic plant community. The overall floristic quality suggests that LVD is above average for lakes in the State (WI) and within the Northern Lake and Forest Region. A small change in the lake wide littoral presence of EWM occurred between 2009 (0%) to 2019 (1.71%). Though this 2019 value appears low, annual EWM monitoring suggests that EWM has increased annually from 2013 to 2018, with large increases seen in 2017 to 2018. A slight reduction in both point and polygon-based mapping occurred in 2019 (-1.07 acres). The future approach for EWM management may vary from year to year depending on resources and annual conditions observed, but, will seek to continue to manage the population and not just monitoring annual change. Education and prevention should be key elements to any management program in the future.

This planning project updated data relevant to water quality, shoreland health, aquatic plants, aquatic invasive species, and their management. The existing plan will continue to serve as the main planning document, with this document serving as an addendum. Furthermore, current goals for this water body described in the existing LMP remain relevant. These goals include:

(1) "Increase the Lac Vieux Desert Lake Associations capacity to communicate with lake stakeholders."
(2) "Facilitate partnerships with other management entities."
(3) "Maintain current water quality conditions."
(4) "Control existing AIS within Lac Vieux Desert while preventing introductions of other AIS."
(5) "Improve fishery resource and fishing."

IMPLEMENTATION PLAN UPDATES

As mentioned above, the LVDLA board discussed the current implementation plan, "checking in" on actions that have been taken to work towards management goals, and determining if the current goals are still relevant within the scope of this planning update. Overall, the board agreed that current implementation plan is active and still relevant to the goals and objectives of this planning project. Some changes need to reflect current conditions, for example updating agency and contact information.

Below is an updated version of the 2012 implementation plan. Standard text represents original language, whereas italic text represents changes to the original language. At the bottom of each management goal, there is a box describing accomplishments to date and changes made to the original (2012) implementation plan. A copy of the 2012 implementation plan can be found in Appendix G.

Management Goal 1: Increase Lac Vieux Desert Association's Capacity to Communicate with Lake Stakeholders

Management Action: Promote safe boating, water quality, public safety, and quality of life on Lac Vieux Desert.
Timeframe: *Continuous*
Facilitator: *LVDLA Board*
Description: Education represents an effective tool to address issues that impact water quality such as lake shore development, lawn fertilization, and other issues such as air quality, noise pollution, and boating safety.

Currently, the LVDLA periodically distributes newsletters to association members, which allow for exceptional communication within the lake group. This level of communication is important within a management group because it builds a sense of community while facilitating the spread of important association news, educational topics, and even social happenings. It also provides a medium for the recruitment and recognition of volunteers. Perhaps most importantly, the dispersal of a well written newsletter can be used as a tool to increase awareness of many aspects of lake ecology and management among association members. By doing this, meetings can often be conducted more efficiently and misunderstandings based upon misinformation can be avoided. Educational pieces within the association newsletter may contain monitoring results, association management history, as well as other educational topics listed below.

Example Educational Topics:

- Specific topics brought forth in other management actions
- Aquatic invasive species monitoring updates
- Boating safety and ordinances (slow-no-wake zones and hours)
- Catch and release fishing
- Noise, air, and light pollution

Shoreland restoration and protection
Septic system maintenance
Fishing regulations
Walleye hatchery updates
Angling reports

Action Steps:

1. *The LVDLA Board will facilitate activities under this management action.*
2. *The LVDLA Board* will identify a base level of annual financial support for educational activities to be undertaken.

Accomplishments and Changes to Original Action

The current structure of the LVDLA Board facilitates ongoing association communication capacity; therefore, a formal educational committee was not formed. In addition to board, business and tasks, including those that are educational in nature, are delegated to board members, versus forming committees or subcommittees. Newsletters are published twice a year. Newsletters continue to be the main form of communication to association members. Alternative communication avenues including websites and Facebook were explored, however, at this time, the board feels written, and mailed newsletters reach the largest proportion of association membership.

Management Goal 2: Facilitate Partnerships with Other Management Entities

Management Action: Enhance LVDLA's involvement with other entities that have a hand in managing (management units) Lac Vieux Desert.
Timeframe: *Ongoing*
Facilitator: Board of Directors to appoint LVDLA representatives
Description: The LVDLA's initial purpose was to create a group of interested lake owners to establish a fish stocking initiative for the lake. Over time, the Association expanded its purpose to preserve and protect the lake and its surroundings to enhance the water quality, fishery, safety, and aesthetic value of the lake as a public recreational facility for today and future generations. *The waters belong to everyone* and therefore this goal of protecting and enhancing these shared resources is also held by other entities. Some of these entities are governmental while other organizations are similar to the LVDLA in that they rely on voluntary participation.

It is important that the LVDLA actively engage with all management entities to enhance the association's understanding of common management goals and to participate in the development of those goals. This also helps all management entities understand the actions that others are taking to reduce duplication of efforts. While not an inclusive list, the primary management units regarding Lac Vieux Desert are the WDNR, MDNR, *EGLE (formerly Michigan Department of Environmental Quality, MDEQ),* Lac Vieux Desert Band of Lake Superior Chippewa Indians (LVD Tribe), Vilas County Land and Water Conservation Department (VCLWCD), the Vilas County Lakes Association (VCLA), the Invasive Species Control Coalition of

Watersmeet (ISCCW), the US Forest Service, including the Ottawa National Forest in Michigan, and the Chequamegon-Nicolet National Forest in Wisconsin), Wisconsin Valley Improvement Company (WVIC), and the *Great Lakes Indian Fish & Wildlife Commission (GLIFWC.)* Each entity will be specifically addressed below.

States of Wisconsin and Michigan

The WDNR, *MDNR, and EGLE* are responsible for managing the natural resources of the State of Wisconsin and Michigan, respectively. Primary interaction with the WDNR, *MDNR and EGLE* is from an advisory and regulatory perspective. The LVDLA has worked closely with the WDNR Regional Lakes Coordinator (Kevin Gauthier – *715.356.5211 ext 214)* and that relationship should continue *with water resource related issues that are not AIS focused. Aquatic invasive species management questions should be directed to Carol Warden, the Aquatic Invasive Species Specialist with University of Wisconsin – Trout Lake (warden@wisc.edu/608.890.4721).* Lac Vieux Desert is a popular recreational fishing destination. The LVDLA should be in contact with the WDNR *Northern Region Team Supervisor (Steve Gilbert – 715.356.5211 ext 229)* and the MDNR *West Lake Superior Management Unit Fisheries Manager* (George Madison – 906.353.6651) at least once a year to discuss fish stocking plans and other pertinent fisheries-related issues. As discussed within the Fisheries Section *(of the original plan),* Lac Vieux Desert falls within the ceded territory based on the Treaty of 1842. This treaty grants specific off-reservation rights to the Native American community including a regulated spear fishery. WDNR and *MDNR fisheries* biologists are involved with this process and a direct link to GLIFWC biologists is not necessary.

County Governments & Local Interest Groups

Lake conservation specialists at the VCLWCD *(Carolyn Scholl – Conservationist Administration – 715.479.3682, Quita Sheehan – Conservation Specialist – 715.479.3721 & Cathy Higley – Lake Conservation Specialist – 715.479.3738)* are available to discuss specific conservation projects applicable to Lac Vieux Desert. While it is important to foster a direct relationship with these entities, having *representation in local organizations* such as the *Vilas County Lakes and Rivers Association (vclra.org), Phelps Town Lakes Committee (Dave Roberts - Chair – robertsd54521@gmail.com)* and the ISCCW *Lakeguards (isccw.org)* is the best way to ensure the association gains from this pooled knowledge base of lake management and awareness.

Lac Vieux Desert Band of Lake Superior Chippewa

Coordination between the LVDLA and the LVD Tribe is critical to effectively manage this system. Likely the best way to keep continued contact with the LVD Tribe is through conversations with the *Planning and Environmental Office (Main Administration Office Phone 906.358.4577) and the Cultural and Historic Preservation Officer (906.358.0137).*

USFS

Stretches of Lac Vieux Desert's shoreline are part of the Ottawa National Forest (MI) and Chequamegon-Nicolet National Forest (WI). Ian Shackleford (906.932.1330 ext 331), USFS *botanist,* is a great resource for invasive species issues. In March 2011, Mr. Shackleford was awarded the National Invasive Species Award for Excellence in Washington D.C. *For issues other than invasive species the primary contact would be the USFS – Ottawa National Forest*

District Ranger (Supervisor's Office 906.932.1330). Chequamegon-Nicolet National Forest questions can be directed to the Forest Headquarters Office is located in Rhinelander, WI (715.362.1300).

WVIC

Lac Vieux Desert is operated under a Federal Energy Regulatory Commission (FERC) License held by WVIC that requires the reservoir be operated between a maximum and minimum water level. WVIC has historical and ongoing reservoir operating data and environmental data that has been collected as part of its FERC license requirements. WVIC could help "reduce the duplication of efforts" stated above particularly as they relate to the collection of water quality data. The WVIC could also assist in educating other entities as well as lake owners about the operation of the reservoir and the role it plays in the Wisconsin River system.

GLIFWC

The Great Lakes Indian Fish and Wildlife commission "is actively involved in a broad spectrum of resource related activities aimed at protecting and enhancing the natural resources and habitat in the treaty-ceded territories…" GLIFWC regularly conducts annual invasive species surveys within the ceded territories. Checking in annually with the GLIFWC Wildlife Biologist (Travis Bartnick 715.682.6619 ext 2166) and the Invasive Species Specialist (Steve Garske 715.682.6619) would minimize any redundancy in AIS survey efforts.

Accomplishments and Changes to Original Action

From 2013 to 2018, participating partners and other stakeholders received annual updates on EWM monitoring and management through a combination of meetings and annual reporting. These reports were delivered to the ISCCW, WDNR, USFS-Ottawa, GLIFWC, LVD Tribe, LVDLA, Vilas County Land and Water Conservation Department and UW Trout Lake. LVDLA representatives regularly attend and provide updates at monthly ISCCW meetings. Highlights from these meeting are reported back to the LVDLA board. In 2015, the LVDLA constructed a portable walleye hatchery system. The Association maintains communication with the WDNR fisheries and the LVD Tribe on walleye rearing efforts. Additional entities, outside of those identified above, receive briefings on EWM management and walleye hatchery activities by LVDLA representatives at WVIC hosted annual adaptive management plan (AMP) meetings.

Management Goal 3: Maintain Current Water Quality Conditions

Management Action: Monitor water quality through WDNR Citizen Lake Monitoring Network.[29]

Timeframe: *Ongoing*

Facilitator: *LVDLA Board*

Description: Monitoring water quality is an important aspect of every lake management planning activity. Collection of water quality data at regular intervals aids in the management of the lake by building a database that can be used for long-term trend analysis. Early discovery of negative trends may lead to the reason as of why the trend is developing.

[29] Michigan has an equivalent citizen monitoring program called the Michigan Clean Water Corps (MiCorp's) Cooperative Lakes Monitoring Program (CLMP). Funding for this program is uncertain; therefore, it is intentionally not included as a sustainable long term monitoring option for volunteers at this time. If sustainable funding for this program occurs in the future, it could be an alternative option to the WDNR CLMP. More information on this program can be found at https://micorps.net/lake-monitoring/.

The Citizens Lake Monitoring Network (CLMN) is a WDNR program in which volunteers are trained to collect water quality information on their lake. At this time, there are no LVDLA members currently collecting data as a part of the CLMN. Volunteers trained by the WDNR as part of the CLMN program begin by collecting secchi disk transparency data for at least one year, then if the WDNR has availability in the program, the volunteer may enter into the advanced program and collect water chemistry data including chlorophyll *a*, and total phosphorous. The secchi disk readings and water chemistry samples are collected three times during the summer and once during the spring. Note: as a part of this program, these data are automatically added to the WDNR database and available through their Surface Water Integrated Monitoring System (SWIMS).

At a minimum, CLMN volunteers collecting secchi disk data should be in place on Lac Vieux Desert. *Enrollment availability in the advanced CLMN program varies. There may be a waiting list to enroll.* However, it is important to get volunteers on board with the basic secchi disk data CLMN program so that when additional spots open in the advanced monitoring program, volunteers from the Lac Vieux Desert will be ready to make the transition into more advanced monitoring.

It is the responsibility of *LVDLA board representative(s)* to coordinate new volunteers as needed. When a change in the collection volunteer occurs, it will be the responsibility of the *representative(s)* to contact *the CLMN Regional Coordinator* Sandra Wickman (715.365.8951) or the appropriate WDNR/*University of Wisconsin* Extension staff to ensure the proper training occurs and the necessary sampling materials are received by the new volunteer.

Action Steps:

1. *At a minimum, enroll in the CLMP for secchi disk monitoring and request to be put on a waiting list for more advanced monitoring parameters. Note: Since WVIC does collect similar water quality data, coordinating volunteer efforts for years when WVIC is scheduled to monitor LVD would reduce duplication of efforts. WVIC is tentatively scheduled to monitor LVD in 2020, 2021 and 2022.*

Management Action: *Reduce phosphorous and sediment loads to Lac Vieux Desert.*
Timeframe: *Ongoing*
Facilitator: *LVLDA Board*
Description: As the watershed section discusses, the Lac Vieux Desert watershed is in good condition; however, watershed inputs still need to be focused upon, especially in terms of shoreland properties. These sources include faulty septic systems, shoreland areas that are maintained in an unnatural manner, and impervious surfaces.

To reduce these negative impacts, the LVDLA will initiate an educational initiative aimed at raising awareness among shoreland property owners concerning their impacts on the lake. This will include newsletter articles and guest speakers at association meetings.

Topics of educational items may include benefits of proper septic system maintenance, methods and benefits of shoreland restoration, including reduction in impervious surfaces, and the options available regarding conservation easements and land trusts.

Action Steps:

1. *Provide information to association membership on the educational topics described above in newsletter articles and guest speakers.*
2. *Inform membership on opportunities, such as events and conferences, that focuses on riparian action to shoreland protection and restoration.*

Management Action: Complete Shoreland Condition Assessment as part of the next management plan update.
Timeframe: *Management Plan Update Period*
Facilitator: *LVDLA Board*
Description: As discussed above, unnatural and developed shorelands can negatively impact the health of a lake, both by decreasing water quality conditions as well as removing valuable habitat for fish and other animal species that reside in and around the lake. Understanding the shoreland conditions around Lac Vieux Desert will serve as an educational tool for lake stakeholders as well as identifying areas that would be suitable for restoration. In-lake enhancements would include the introduction of coarse woody debris into the littoral zone, a valuable fisheries habitat component around the shores of Lac Vieux Desert. Shoreline enhancements would include leaving 35-foot no-mow zones to act as a buffer between residences and the lake or by planting native herbaceous, shrub and tree species appropriate for Vilas, *Oneida and Gogebic* Counties in this sensitive area. Ecologically high-valued areas delineated during the survey would also be selected for protection possibly through conservation easements or land trusts. *Local land trusts include the Northwoods Land Trust (WI) (www.northwoodslandtrust.org) and the Keweenaw Land Trust (MI) (keweenawlandtrust.org).*

Projects that include shoreline condition assessment and restoration activities will be better qualified to receive state funding in the future. These activities could be completed as an amendment to *the 2012 management plan or the aquatic plant management planning update (2020)* and would be appropriate for funding through the WDNR small-scale Lake Planning Grant *or Healthy Lakes programs.*
Action Steps: See description above.

Accomplishments and Changes to Original Action

During the December 19th, 2019 meeting with the LVDLA board, a discussion on the importance of long term water quality data and the lack of data for Lac Vieux Desert arose. Having this data, as suggested under the water quality monitoring actions, allows for "early discovery of negative trends," may identify the reason for the trend, and when appropriate, may lead to action to improve water quality. The LVDLA board expressed interest in initiating a volunteer program and will look into enrolling in the CLMN for secchi and possibly other parameters.

From 2014 to 2018, the LVDLA undertook a shoreland stewardship campaign to encourage riparian owners not to use phosphorous-based fertilizers on their properties and not to remove rooted aquatic vegetation in front of their shoreline. Newsletter articles educated association members to why these actions are important to water quality and overall lake health. To date, a total of 110 riparian owners signed pledges to avoid phosphorus fertilizers and retain rooted aquatic vegetation in front of their shoreline. A "refresher" to this pledge can be included in future newsletter articles. During the same time period, the LVDLA offered a monetary match to landowners wanting to plant native vegetation on their properties up to $250.00 annually. Announcements of this opportunity were included in Association newsletters and mailings. The LVDLA did not find willing participants, mainly because landowners were more than willing to pay for this type of planting out of pocket, rather than receive Association funds to offset any costs.

As part of this planning update, a shoreland condition assessment was completed. Maps and data generated from these assessments will be useful to educate riparian owners, as well as identify shoreland enhancement and protection areas. Once maps are produced by the WDNR, the LVDLA board should meet to discuss findings and possible actions or activities that can be taken towards shoreland health.

Management Goal 4: Control Existing AIS within Lac Vieux Desert While Preventing Introduction of Other AIS.

Management Action: Continue Clean Boats Clean Waters inspections at Lac Vieux Desert public access locations.
Timeframe: *Ongoing*
Facilitator: *LVDLA Board*
Description: Lac Vieux Desert is a popular destination by recreationists and anglers, making the lake vulnerable to new infestations of exotic species. The intent of the boat inspections would not only be to prevent additional invasives from entering the lake through its public access points, but to prevent the infestation of other waterways with invasives that originated in Lac Vieux Desert. The goal would be to cover the landings during the busiest times in order to maximize contact with lake users, spreading the word about the negative impacts of AIS on our lakes and educating people about how they are the primary vector of its spread.

While members of the LVDLA have been trained on Clean Boats Clean Waters (CBCW) protocols, low volunteerism has not provided a consistent monitoring program at the landing. The LVDLA understands this limitation *and regularly applies for WDNR CBCW grant funds to hire a CBCW inspector. In conjunction with this inspector, the ISCCW staffs a CBCW inspector and provides a decontamination station (high pressured/hot water) for lake users to have their boats washed before and after launching at Thunder Bay and Misery Bay public launches.*

In addition to continuing these efforts, an Education Initiative comprised of developing materials and programs that will promote clean boating and responsible use of these waters (See Management Goal #1) should be enacted.

Action Steps:

1. *Continue to apply for WDNR CBCW grant funds to hire a CBCW inspector. Coordinate any training required with Vilas County or UWEX CBCW coordinators (Cathy Higley – Vilas County Lake Conservation Specialist, 715.479.3738, or Erin McFarlane – UWEX CBCW Educator, 715.346.4978).*
2. *Coordinate WDNR CBCW inspector efforts and ISCCW efforts to minimize duplicating landing efforts. The current ISCCW educator is Denise Fauntleroy – fishhawk0106@gmail.com.*
3. Enter data into SWIMS and reports results to the LVDLA.

Management Action: Coordinate annual monitoring for Aquatic Invasive Species.
Timeframe: Ongoing
Facilitators: *LVDLA Board with support from the ISCCW*
Description: In lakes without Eurasian water milfoil and other invasive species, early detection of pioneer colonies commonly leads to successful control and in cases of very small infestation, possibly even eradication. Even in lakes where these plants occur, monitoring for new colonies is essential for successful control. Coordination of these activities is important to limit duplication of efforts and ensure that Lac Vieux Desert's entire littoral zone is monitored annually for aquatic invasive species, especially Eurasian water milfoil and curly-leaf pondweed.

Management Action: Initiative aquatic invasive species rapid response plan upon new or recurring exotic infestation.
Timeframe: Initiate upon exotic infestation
Facilitators: *LVDLA Board with support from the ISCCW*
Description: In the event that an aquatic invasive species is located during the monitoring activities discussed in the previous Management Action, the areas would be marked using a GPS and would serve as focus area *for further investigation. Results would be used to adapt the existing management strategy or create a prospective management strategy for the following year. Management strategies will use the "Aquatic Plant Management Guiding Principles & Framework" discussed in this plan and follow established early detection and rapid response protocols (either WDNR or EGLE).*

As indicated within Management Goal 2, there are a number of agencies involved in the management of Lac Vieux Desert. Successful partnerships between all stakeholders are important to formulate and implement a successful response and control program.
Action Steps:

1. *Keep stakeholders engaged and informed in management planning and strategies.*
2. *When funding is available, annually map invasive species occurrences.*
3. *Management strategies will use the "Aquatic Plant Management Guiding Principles & Framework" discussed in this plan.*
4. *If new invasive species is detected, use existing rapid response frameworks, such as Wisconsin's Rapid Response Framework for Aquatic Invasive Species.*[30]

[30] https://dnr.wi.gov/lakes/invasives/WIAISRapidResponseFramework2012.pdf

Management Action: Reduce *the* occurrence of purple loosestrife on Lac Vieux Desert shorelands.
Timeframe: *Ongoing*
Facilitator: *LVDLA Board*
Description: *In 2009, purple loosestrife was found at low occurrences at the southern portion of Little Duck Island and Near Islands.*[31] *Manual removal of these isolated plants was the "Action Step" proposed at that time. Since the initial removal in 2010, no purple loosestrife has been documented on the shores of Lac Vieux Desert.*

Action Steps:

1. *Continue to monitor for purple loosestrife.*
2. *Document any new locations and determine the best control strategy.*
3. *Report findings to partners and keep MISIN*[32] *records updated.*

NEW Management Action: *Revisit native status of common reed on Lac Vieux Desert.*
Timeframe: *2020 and beyond*
Facilitator: *LVDLA board and partners*
Description: *As described in the aquatic plant section of this plan, populations of common reed were located along the shoreline of Lac Vieux Desert in 2009.*[33] *Morphological verification by UW Stevens Point Herbarium determined the common reed plant to be the native strain. The current LMP recommends continued monitoring to determine "if the plant is acting invasively". In 2019, the historical sites appear to be expanding and several new locations of common reed were observed. Additional morphological verification and/or genetic analysis of these populations are advisable.*

Action Steps:

1. *Collect additional occurrence information on common reed on Lac Vieux Desert.*
2. *Re-confirm native status of common reed.*
3. *If questionable specimens of common reed are found, investigate the feasibility of genetic analysis.*
4. *If non-native common reed is present on Lac Vieux Desert, work with agencies, existing partners, Cooperative Weed Management Areas (WePIC*[34] *& WHIP*[35]*) and Upper Peninsula Resource Conservation and Development Council-De-Phrag the UP Project*[36] *(or a WI equivalent) on management options and resources.*

Accomplishments and Changes to Original Action

Acknowledging that AIS prevention is critical, the LVDLA, and its partners (ISCCW) annually participate in CBCW landing inspections (MI & WI). LVDLA and partners have promoted the use of volunteers, however mainly relied on the use of paid staff. From 2014 to 2019, roughly

[31] Maps of original locations can be found in the 2012 LMP.
[32] Midwest Invasive Species Network (misin.msu.edu)
[33] Maps of original locations can be found in the 2012 LMP.
[34] https://www.michiganinvasives.org/wepic/
[35] http://www.whipinvasives.org/
[36] http://www.uprcd.org/

5,811 paid hours inspected 11,211 boats, decontaminated 5,810 boats, and contacted 28,036 people. Additional educational efforts on LVD include an ISCCW educator attending Association meetings and distributing educational materials at August Fest, which is the Association's annual fund-raiser. About 200-250 meal tickets are sold annually for this event.

The 2012 LMP called for the coordination of monitoring efforts to be lead by the Invasive Species Coordinator for Vilas County, until the LVDLA was able to take over aspects of this role. Since 2012, the LVDLA board and partners have coordinated efforts of partners and entities involved. From 2014 to 2019, these efforts have been a combination of the LVDLA hired contractor, ISCCW, and GLIFWC. Early season surveys have been a joint effort between the ISCCW and GLIFWC. ISCCW biologists and GLIFWC biologists coordinate efforts by sharing locations of areas already surveyed and working together to ensure efforts are not duplicated. Mid/late season surveys have been the responsibility of the LVDLA hired contractor. Project scopes and ability to contribute to seasonal AIS monitoring will vary, however, there has been a good track record of continued vested interest in AIS monitoring on Lac Vieux Desert by partners. When grant funds (e.g. WDNR or RAC) are being used for survey efforts, reports with maps are provided to the list of partners and stakeholders listed in the first paragraph of the planning review section of this plan. WVIC should be included on this list. This plan would serve as a report of 2019 monitoring findings.

No new AIS occurrences have been documented on Lac Vieux Desert since the completion of the 2012 LMP. New species detected would follow well established rapid response frameworks. Management of existing populations will use the "Aquatic Plant Management Guiding Principles & Framework" discussed in this plan.

Management Goal 5: Improve Fishery Resource and Fishing

No changes to this goal are proposed.

Management Action: Work with fisheries managers to enhance the walleye fishery on Lac Vieux Desert.
Timeframe: Ongoing
Facilitator: *LVDLA President* - Rob Andersen
Description: As stated within the Fisheries Section, Lac Vieux Desert stakeholders, and fisheries managers would like to see an increase in the walleye populations. The WDNR and the LVDLA have entered an informal agreement where the lake association will be permitted to fund the stocking of the lake every-other-year *if* fall recruitment surveys continually show low results. Pulse, or every-other year stocking, can lead to an understanding of natural reproduction versus stocking.

As a part of the Lac Vieux Desert Wild Rice Plan, intense fish surveys have been completed in 2000, 2006, 2009, *and 2012*. These surveys are aimed at evaluating whether the altered water level regime is impacting the fisheries. Once all this data is analyzed, the fisheries biologists will likely come forth with solid recommendations for the future management of the lake.

The LVDLA would like to continue its relationship with the WDNR, stocking walleye consistent with their informal agreement until a formal plan is reached. The LVDLA would also like to foster a relationship with the LVD Tribe where fish can be stocked into Lac Vieux Desert from the tribe's nearby rearing ponds.

Action Steps:

1. See description above

WORKS CITED

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