8.5 Ballard Lake

An Introduction to Ballard Lake

Ballard Lake, Vilas County, is a 511-acre shallow headwater, mesotrophic drainage lake with a maximum depth of 25 feet and a mean depth of 11 feet (Ballard Lake – Map 1). Its watershed encompasses approximately 2,339 acres within the Manitowish River Watershed and is comprised mainly of intact forests and wetlands. Ballard Lake receives water from the east from Irving Lake and flows west into White Birch Lake. In 2018, 40 native aquatic plant species were located within the lake, of which Fern-leaf pondweed (*Potamogeton robbinsii*) was the most common. Two NHI-listed species were found in Ballard Lake: Vasey's pondweed (*Potamogeton vaseyi*) and Northeastern bladderwort (*Utricularia resupinata*).

Lake at a Glance - Ballard Lake

Morphometry	
Lake Type	Shallow Headwater Drainage Lake
Surface Area (Acres)	511
Max Depth (feet)	25
Mean Depth (feet)	11
Perimeter (Miles)	5.9
Shoreline Complexity	3.4
Watershed Area (Acres)	2,339
Watershed to Lake Area Ratio	2:1

Water Quality	
Trophic State	Mesotrophic
Limiting Nutrient	Phosphorus
Avg Summer P (μg/L)	15
Avg Summer Chl-α (μg/L)	4
Avg Summer Secchi Depth (ft)	11.7
Summer pH	8.3
Alkalinity (mg/L as $CaCO_3$)	30.3

Vegetation	
Number of Native Species	40
NHI-Listed Species	Vasey's pondweed (*Potamogeton vaseyi*), Northeastern bladderwort (*Utricularia resupinata*)
Exotic Species	-
Average Conservatism	7.1
Floristic Quality	36.3
Simpson's Diversity (1-D)	0.7

8.5.1 Ballard Lake Water Quality

Water quality data was collected from Ballard Lake on six occasions in 2018/2019. Onterra staff sampled the lake for water quality parameters including total phosphorus, chlorophyll-*a*, Secchi disk clarity, temperature, and dissolved oxygen. Please note that the data in these graphs represent concentrations and depths taken during the growing season (April-October), summer months (June-August) or winter (February-March) as indicated with each dataset. Furthermore, unless otherwise noted, the phosphorus and chlorophyll-*a* data represent only near-surface samples. In addition to sampling efforts completed in 2018/2019, any historical data was researched and are included within this report as available.

Near-surface total phosphorus data from Ballard Lake are available from 1984, 1998-1999, and 2018 (Figure 8.5.1-1). The weighted summer average total phosphorus concentration is 15.3 μg/L and falls into the *excellent* category for shallow headwater drainage lakes in Wisconsin. Ballard Lake's summer average total phosphorus concentrations are below both the median value for shallow headwater drainage lakes in the state and the median value for all lake types in the Northern Lakes and Forests (NLF) ecoregion. Total phosphorus data were also collected in 1926-1929 by Birge and Juday (Splitt 2001). The average summer concentration during this period was

24.3 µg/L, higher than the more recent measured average of 15.3 µg/L. It's important to note that phosphorus concentrations can be variable from year to year and over longer periods of time due to changes in precipitation. Higher concentrations measured in 1926-1929 can be considered a snap-shot of this period, and indicate that phosphorus concentrations likely fluctuate in Ballard Lake over longer periods of time.

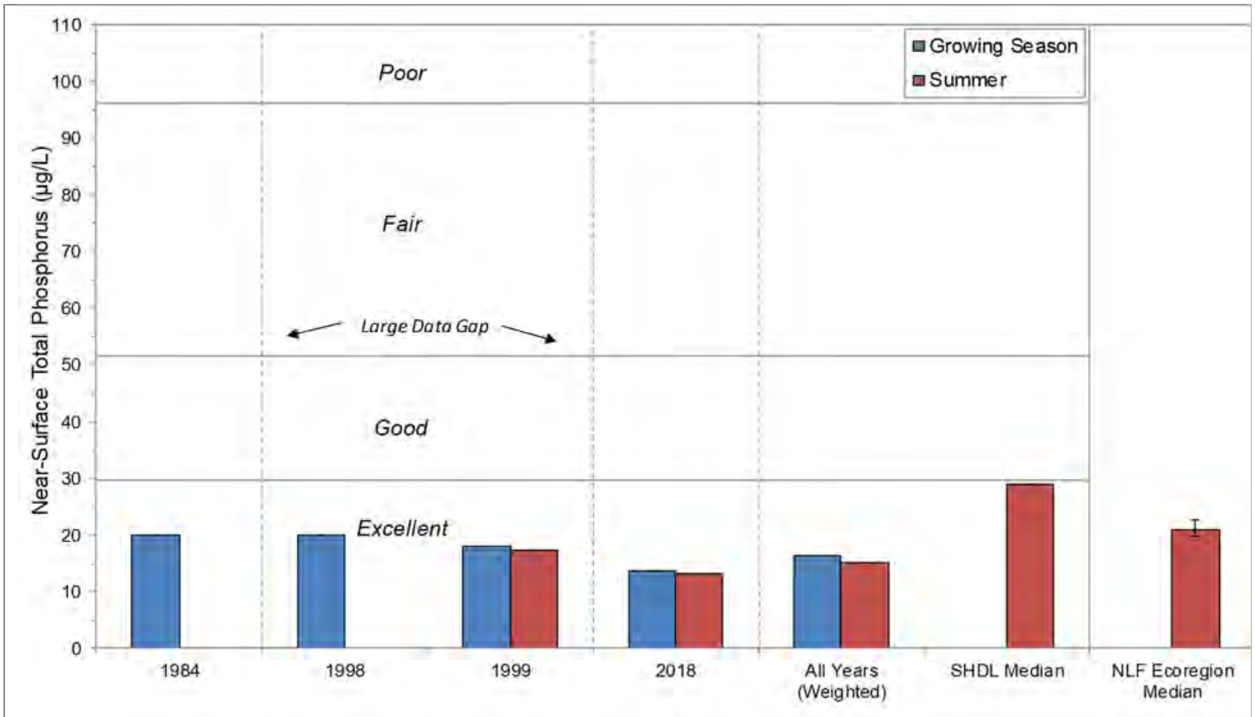


Figure 8.5.1-1. Ballard Lake, statewide shallow headwater drainage lakes, and regional total phosphorus concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Chlorophyll-*a* data are available from Ballard Lake from 1984, 1998-1999, and 2018 (Figure 8.5.1-2). Average summer chlorophyll-*a* concentrations had a small range from 2.1 µg/L in 2018 to 5.4 µg/L in 1999. Ballard Lake's summer average chlorophyll-*a* concentration is 3.6 µg/L and falls into the *excellent* category for shallow headwater drainage lakes in Wisconsin. Ballard Lake's summer average chlorophyll-*a* concentrations are below both the median value for shallow headwater drainage lakes in the state as well as the median value for all lake types in the NLF ecoregion.

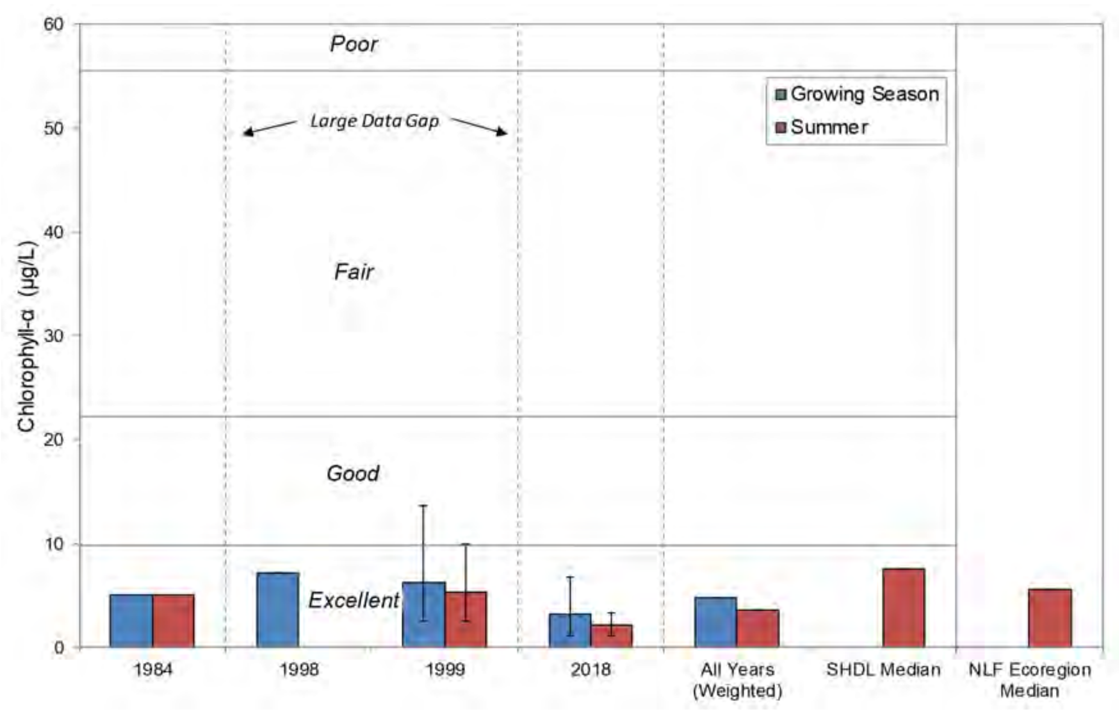


Figure 8.5.1-2. Ballard Lake, statewide shallow headwater drainage lakes, and regional chlorophyll-a concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Secchi disk transparency data are available from Ballard Lake for 1984 and from 1993-2018 (Figure 8.5.1-3). The weighted summer average Secchi disk depth is 11.7 feet and falls into the *excellent* category for shallow headwater drainage lakes in Wisconsin. Ballard Lake's weighted summer average Secchi disk depth is approximately 6.1 feet deeper than the median value for shallow headwater drainage lakes in the state and approximately 2.8 feet deeper than the median value for all lake types in the NLF ecoregion. Secchi disk depths are also available from 1927-1930 from Birge and Juday (Splitt 2001). The average Secchi disk depth from this period was 7.4 feet. A Secchi disk depth measurement of 8.5 feet was also collected in 1960 (Black et al. 1960). These values were slightly lower than measurements made more recently.

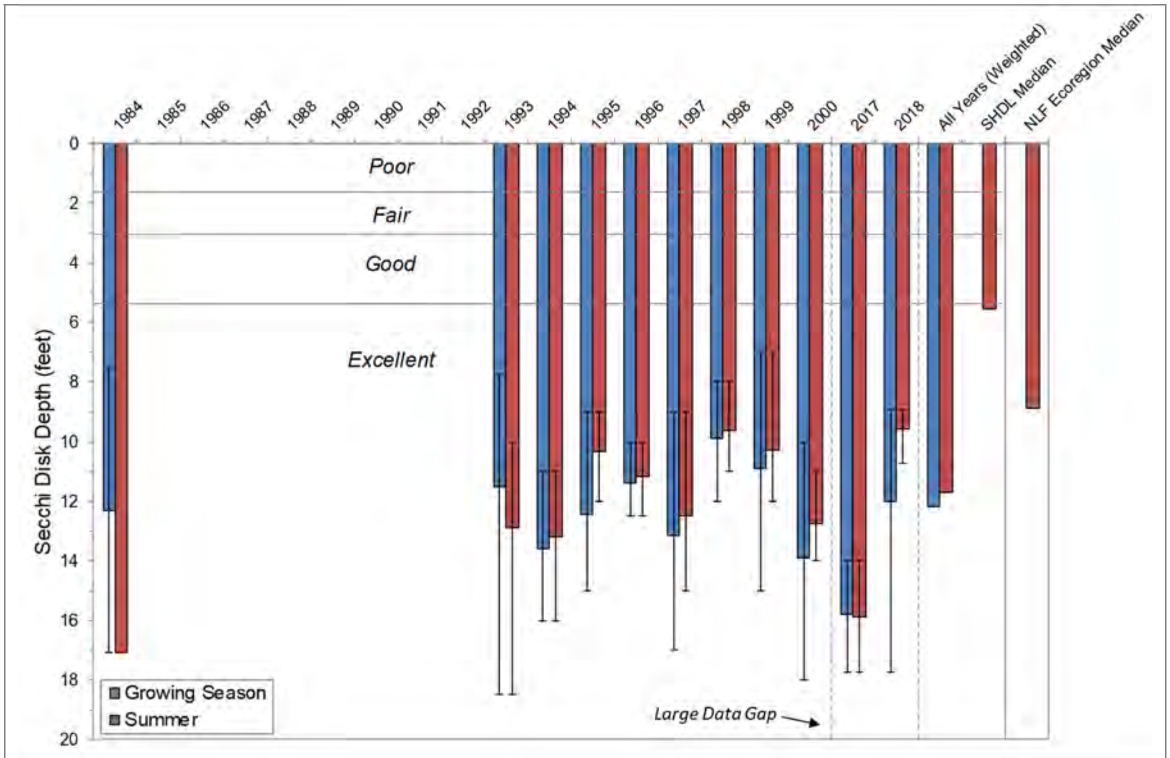


Figure 8.5.1-3. Ballard Lake, statewide shallow headwater drainage lakes, and regional Secchi disk clarity values. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Limiting Plant Nutrient of Ballard Lake

Using midsummer nitrogen and phosphorus concentrations from Ballard Lake, a nitrogen:phosphorus ratio of 36:1 was calculated. This finding indicates that Ballard Lake is indeed phosphorus limited as are the vast majority of Wisconsin lakes. In general, this means that cutting phosphorus inputs may limit plant growth within the lake.

Ballard Lake Trophic State

Figure 8.5.1-4 contains the Trophic State Index (TSI) values for Ballard Lake. These TSI values are calculated using summer near-surface total phosphorus, chlorophyll-*a*, and Secchi disk transparency data collected as part of this project along with available historical data. In general, the best values to use in assessing a lake's trophic state are chlorophyll-*a* and total phosphorus, as water clarity can be influenced by factors other than phytoplankton such as dissolved organic compounds. The closer the calculated TSI values for these three parameters are to one another indicates a higher degree of correlation.

The weighted TSI values for total phosphorus and chlorophyll-*a* (and Secchi disk transparency) in Ballard Lake indicate the lake is at present in a mesotrophic state. Ballard Lake's productivity is lower when compared to other shallow headwater drainage lakes in Wisconsin and all lake types within the NLF ecoregion.

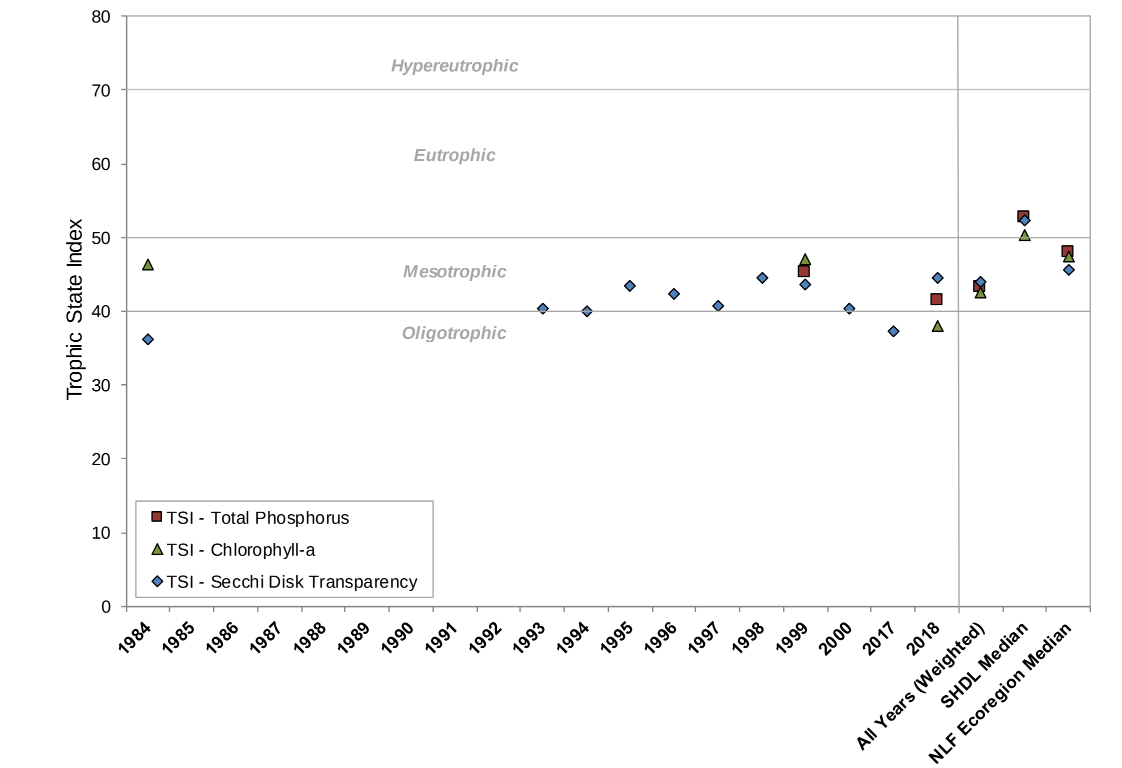


Figure 8.5.1-4. Ballard Lake, statewide shallow headwater drainage lakes, and regional Trophic State Index values. Values calculated with summer month surface sample data using WDNR PUB-WT-193.

Dissolved Oxygen and Temperature in Ballard Lake

Dissolved oxygen and temperature were measured during water quality sampling visits to Ballard Lake by Onterra staff. Profiles depicting these data are displayed in Figure 8.5.1-5.

Ballard Lake is *polymictic* [lakes that are too shallow to thermally stratify and can mix throughout the growing season] and the temperature at the bottom was over 22°C in July 2018, indicating that the lake frequently mixes (Figure 8.5.1-5). Because of its polymictic nature, there is sufficient oxygen throughout the water column during the summer to support a lake-wide fishery. The profile from February 20, 2019 shows that there is sufficient oxygen in the upper waters to prevent a winter fishkill.

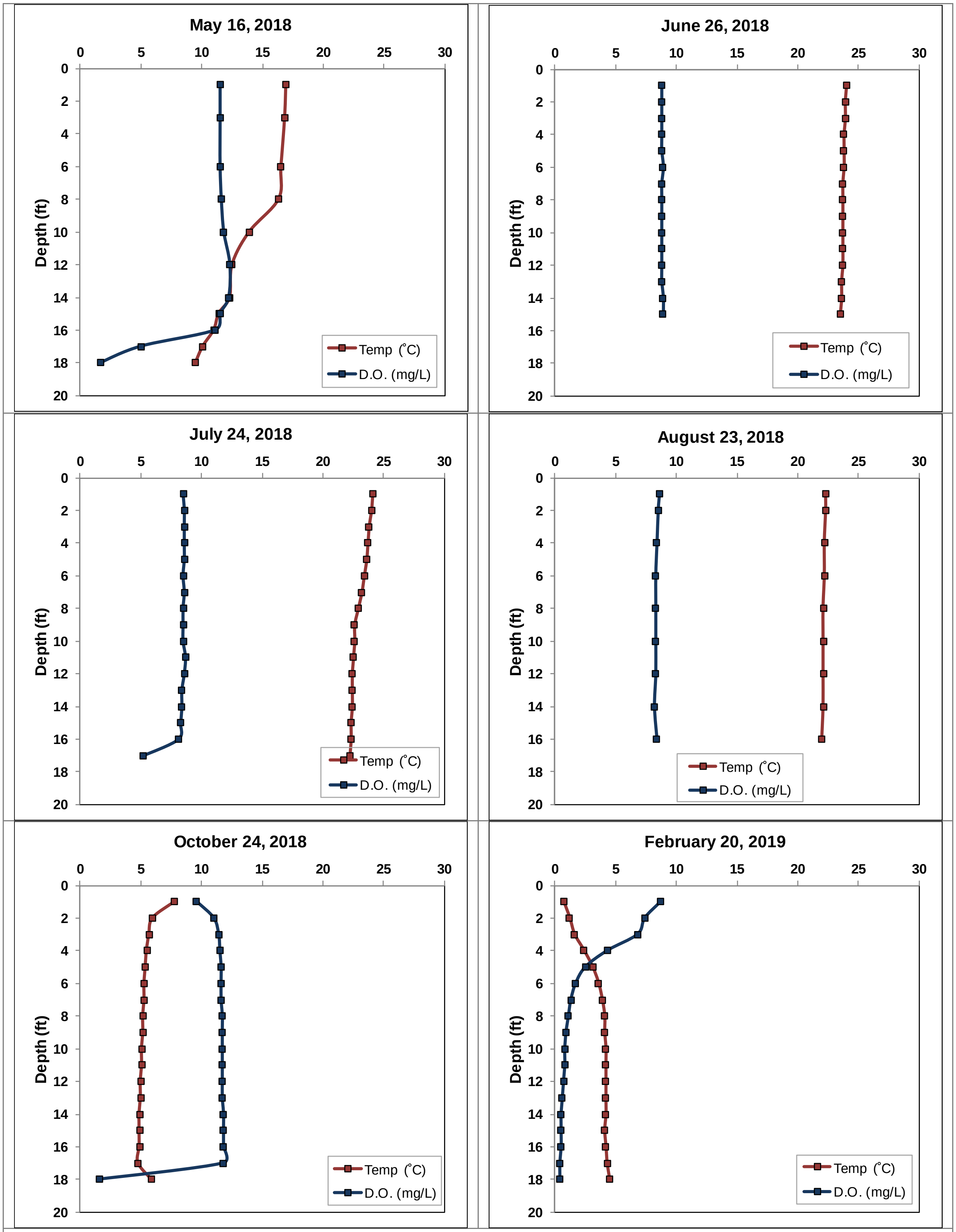


Figure 8.5.1-5. Ballard Lake 2018-2019 dissolved oxygen and temperature profiles.

8.5.2 Ballard Lake Watershed Assessment

Ballard Lake's watershed encompasses an area of approximately 2,339 acres, yielding a small watershed to lake area ratio of 4:1 (Figure 8.5.2-1, Ballard Lake – Map 2). According to WiLMS modeling, the lake's water residence time is 2.6 years or the lake water is replaced approximately 0.4 times per year (flushing rate).

The largest part of the lake's watershed is the Irving Lake watershed which is immediately upstream of Ballard Lake. Of the remaining part of the watershed, 22% of Ballard Lake's watershed is the lake's surface, 16% is forest, 8% is wetlands, 1% is pasture/grass, and <1% is shoreland development (Figure 8.5.2-1).

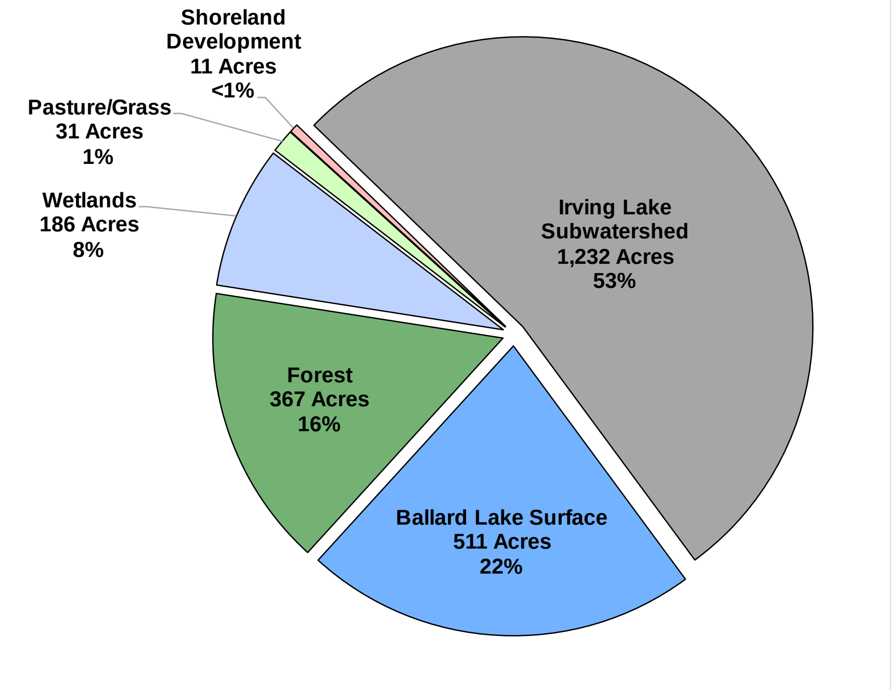
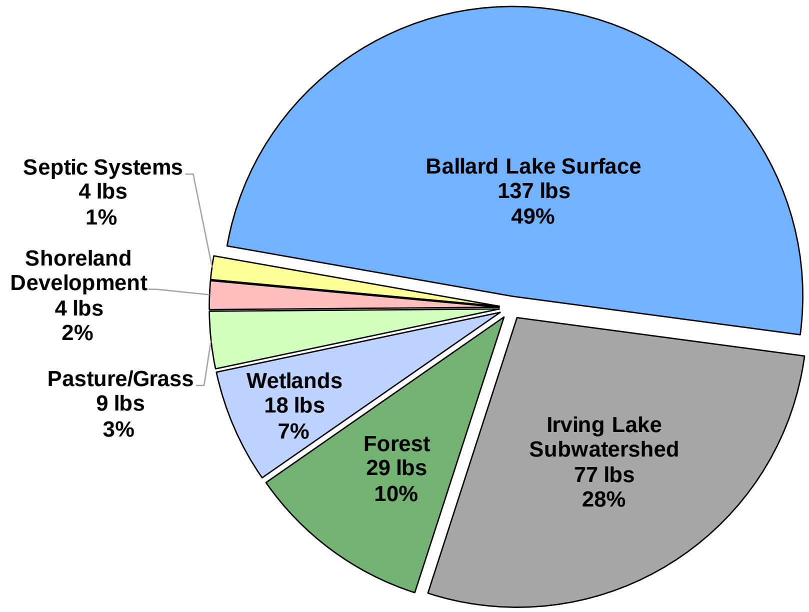


Figure 8.5.2-1. Ballard Lake watershed land cover types in acres. Based upon National Land Cover Database (NLCD – Fry et. al 2011).

Using the land cover data described above, WiLMS was utilized to estimate the annual potential phosphorus load from Ballard Lake's watershed. It was estimated that approximately 277 pounds of phosphorus is delivered to Ballard Lake from its watershed on an annual basis (Figure 8.5.2-2).

Of the estimated 277 pounds of phosphorus being delivered annually to Ballard Lake, 137 pounds (49%) is estimated to originate from direct atmospheric deposition into the lake, 77 pounds (28%) from Irving Lake, 29 pounds (10%) from forest, 18 pounds (7%) from wetlands, 9 pounds (3%) from pasture/grass, 4 pounds (2%) from shoreland development and 4 pounds (1%) from riparian septic systems (Figure 8.5.2-2).



Total Annual P Loading: 277 lbs

Figure 8.5.2-2. Ballard Lake watershed phosphorus loading in pounds. Based upon Wisconsin Lake Modeling Suite (WiLMS) estimates.

Using predictive equations, WiLMS estimated that based on the 277 pounds of phosphorus which are loaded to Ballard Lake annually, the lake should have an in-lake growing season mean (GSM) total phosphorus concentration of approximately 19 µg/L. This predicted GSM total phosphorus concentration slightly higher than the measured mean of 15 µg/L. The model slightly overpredicts the annual phosphorus loading to Ballard Lake but it is similar enough to use for planning purposes.

8.5.3 Ballard Lake Shoreland Condition

Shoreland Development

As mentioned previously in the Town-wide Shoreland Condition Section, one of the most sensitive areas of the watershed is the immediate shoreland area. This area of land is the last source of protection for a lake against surface water runoff, and is also a critical area for wildlife habitat. In the fall of 2018, Ballard Lake's immediate shoreline was assessed in terms of its development. Ballard Lake has stretches of shoreland that fit all of the five shoreland assessment categories. In all, 5.1 miles of natural/undeveloped and developed-natural shoreline were observed during the survey (Figure 8.5.3-1). This constitutes about 86% of Ballard Lake's shoreline. These shoreland types provide the most benefit to the lake and should be left in their natural state if at all possible. During the survey, 0.6 miles of urbanized and developed–unnatural shoreline (10%) was observed. If restoration of the Ballard Lake shoreline is to occur, primary focus should be placed on these shoreland areas as they currently provide little benefit to, and actually may harm, the lake ecosystem. Ballard Lake - Map 3 displays the location of these shoreline lengths around the entire lake.

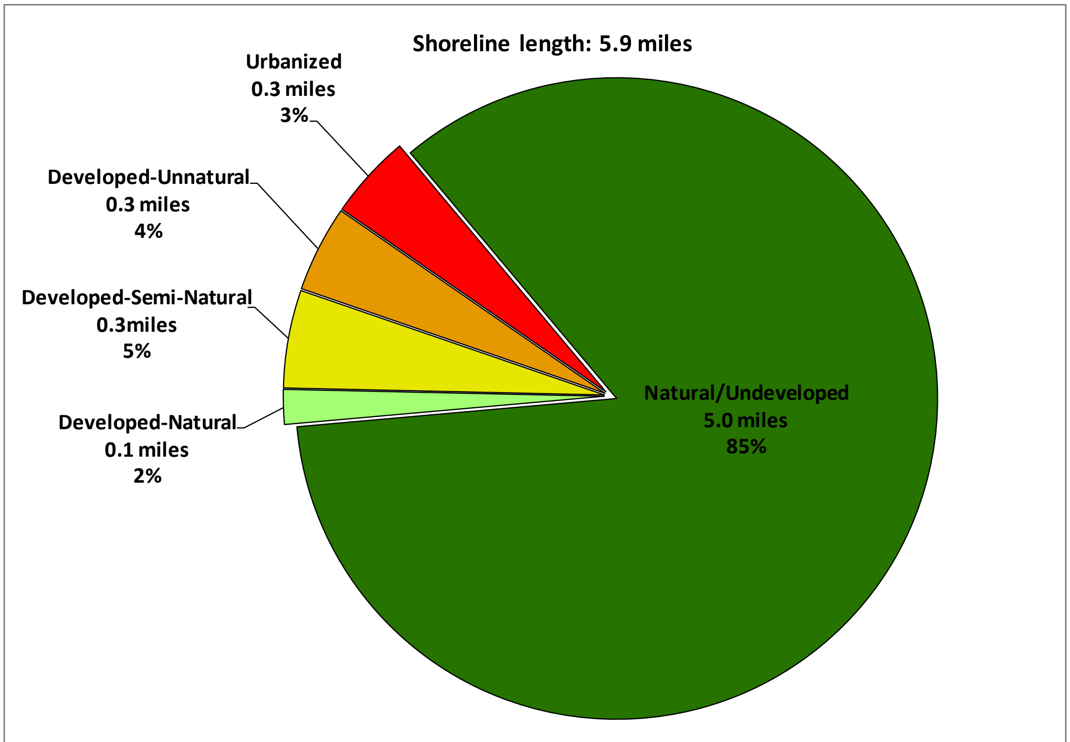


Figure 8.5.3-1. Ballard Lake shoreland categories and total lengths. Based upon a fall 2018 survey. Locations of these categorized shorelands can be found on Ballard Lake - Map 3.

Coarse Woody Habitat

A survey for coarse woody habitat was conducted in conjunction with the shoreland assessment (development) survey. Coarse woody habitat was identified, and classified in three size categories (2-8 inches in diameter, >8 inches in diameter, and cluster of pieces) as well as four branching categories: no branches, minimal branches, moderate branches, and full canopy. As discussed earlier, research indicates that fish species prefer some branching as opposed to no branching on coarse woody habitat, and increasing complexity is positively correlated with higher fish species richness, diversity and abundance (Newbrey et al. 2005).

During this survey, 333 total pieces of coarse woody habitat were observed along 5.9 miles of shoreline (Ballard Lake - Map 4), which gives Ballard Lake a coarse woody habitat to shoreline mile ratio of 57:1 (Figure 8.5.3-2). Only instances where emergent coarse woody habitat extended from shore into the water were recorded during the survey. Of the 333 total pieces of coarse woody habitat observed during the survey, 298 pieces were 2-8 inches in diameters, 35 were 8 inches in diameter or greater, and no clusters of pieces of coarse woody habitat were found.

To put this into perspective, Wisconsin researchers have found that in completely undeveloped lakes, an average of 345 coarse woody habitat structures may be found per mile (Christensen et al. 1996). Please note the methodologies between the surveys done on Ballard Lake and those cited in this literature comparison are much different, but still provide a valuable insight into what undisturbed shorelines may have in terms of coarse woody habitat.

Onterra has completed coarse woody habitat surveys on 98 lakes throughout Wisconsin since 2012, with the majority occurring in the NLF ecoregion on lakes with public access. The number of coarse woody habitat pieces per shoreline mile in Ballard Lake fell well above the 75th percentile of these 98 lakes in the 92nd percentile (Figure 8.1.3-2).

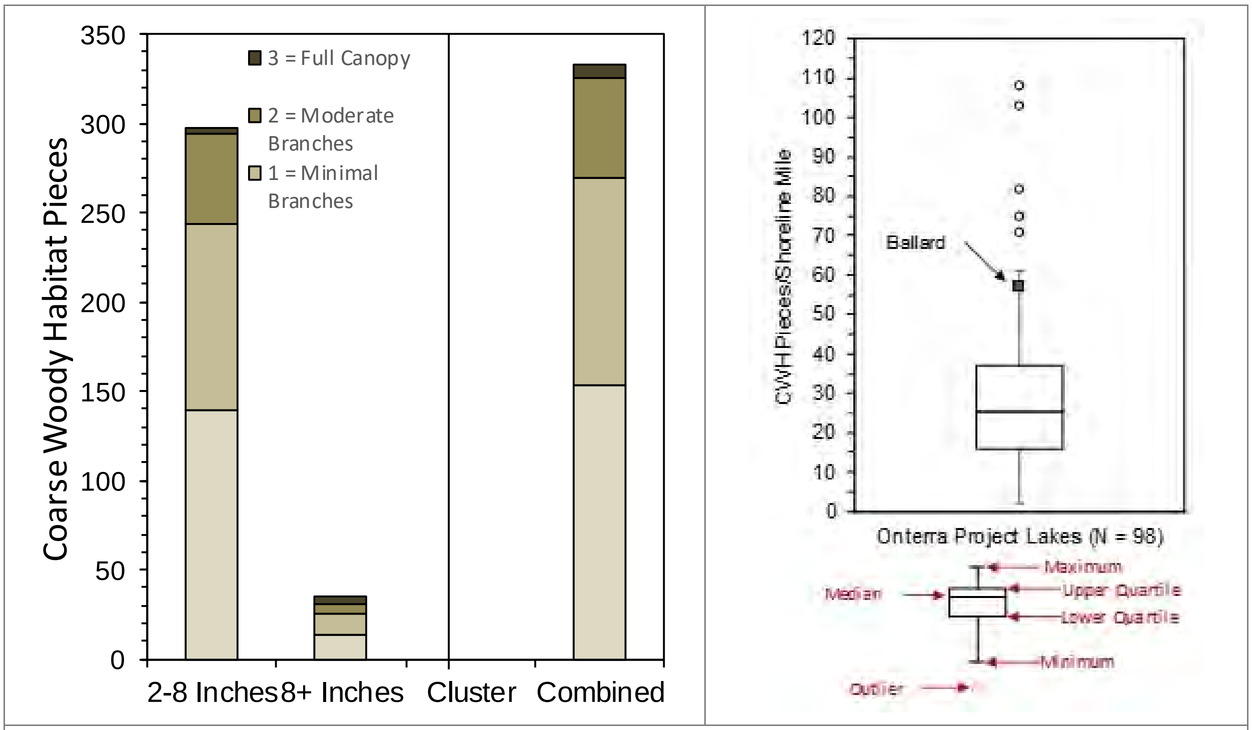


Figure 8.5.3-2. Ballard Lake coarse woody habitat survey results. Based upon a fall 2018 survey. Locations of Ballard Lake coarse woody habitat can be found on Ballard Lake - Map 4.

8.5.4 Ballard Lake Aquatic Vegetation

An Early-Season Aquatic Invasive Species (ESAIS) Survey was conducted by Onterra ecologists on Ballard Lake on June 26, 2018. While the intent of this survey is to locate any potential non-native species within the lake, the primary focus is to locate potential occurrences of the non-native curly-leaf pondweed, which should be at or near its peak growth at this time. No curly-leaf pondweed was located during the ESAIS survey in 2018.

Photograph 8.5.4-1. Ballard Lake

The whole-lake aquatic plant point-intercept survey and emergent and floating-leaf aquatic plant community mapping survey were conducted on Ballard Lake by Onterra ecologists on July 23-24, 2018. During these surveys, a total of 40 native aquatic plant species were located (Table 8.5.4-1). Two of these species present in Ballard Lake, Vasey's pondweed and Northeastern bladderwort, are listed by the Wisconsin Natural Heritage Inventory Program as species of 'special concern' because they are rare or uncommon in Wisconsin and there is uncertainty regarding their abundance and distribution within the state.

As discussed in the primer section, sediment data were collected at each sampling location within the littoral zone during the point-intercept survey. Approximately 92% of the point-intercept locations within littoral areas contained fine, organic sediments (muck), 6% contained sand, and 2% contained rock (Figure 8.5.4-1). The shallow areas on the eastern shoreline of Ballard Lake contained more sand than any other areas around the lake (Ballard Lake - Map). Like terrestrial plants, different aquatic plant species are adapted to grow in certain substrate types; some species are only found growing in mucky substrates, others only in sandy areas, and some can be found growing in either. Lakes that have varying substrate types generally support a higher number of plant species because of the different habitat types that are available.

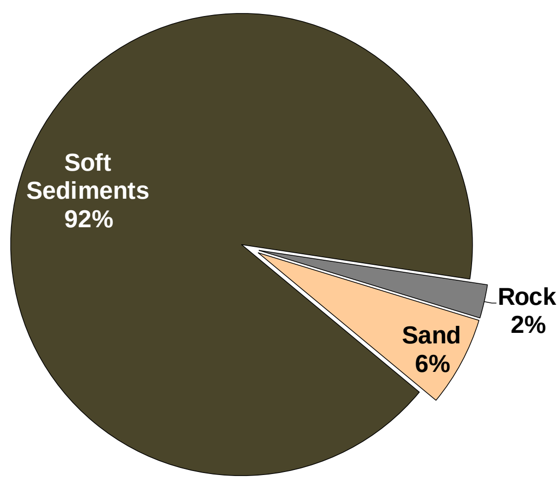


Figure 8.5.4-1. Ballard Lake 2018 proportion of substrate types. Created from data collected during the 2018 whole-lake point-intercept survey (N = 556).

Table 8.5.4-1. List of aquatic plant species located in Ballard Lake during Onterra 2018 aquatic plant surveys.

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2018 (Onterra)
Emergent	*Calla palustris*	Water arum	9	I
	Carex comosa	Bristly sedge	5	I
	Dulichium arundinaceum	Three-way sedge	9	I
	Decodon verticillatus	Water-willow	7	I
	Iris versicolor	Northern blue flag	5	I
	Pontederia cordata	Pickerelweed	9	I
	Sparganium americanum	American bur-reed	8	I
	Sagittaria latifolia	Common arrowhead	3	I
	Schoenoplectus acutus	Hardstem bulrush	5	I
	Typha spp.	Cattail spp.	1	I
	Zizania spp.	Wild rice sp.	8	I
FL	*Brasenia schreberi*	Watershield	7	I
	Nuphar variegata	Spatterdock	6	X
	Nymphaea odorata	White water lily	6	X
	Sparganium fluctuans	Floating-leaf bur-reed	10	I
	Sparganium angustifolium	Narrow-leaf bur-reed	9	X
Submergent	*Ceratophyllum demersum*	Coontail	3	X
	Chara spp.	Muskgrasses	7	X
	Eriocaulon aquaticum	Pipewort	9	X
	Elodea canadensis	Common waterweed	3	X
	Lobelia dortmanna	Water lobelia	10	X
	Myriophyllum tenellum	Dwarf watermilfoil	10	X
	Najas flexilis	Slender naiad	6	X
	Najas guadalupensis	Southern naiad	7	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X
	Potamogeton berchtoldii	Slender pondweed	7	X
	Potamogeton epihydrus	Ribbon-leaf pondweed	8	X
	Potamogeton gramineus	Variable-leaf pondweed	7	X
	Potamogeton illinoensis	Illinois pondweed	6	X
	Potamogeton robbinsii	Fern-leaf pondweed	8	X
	Potamogeton spirillus	Spiral-fruited pondweed	8	X
	*Potamogeton vaseyi**	Vasey's pondweed	10	X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X
	Ranunculus flammula	Creeping spearwort	9	X
	*Utricularia resupinata**	Northeastern bladderwort	9	X
	Vallisneria americana	Wild celery	6	X
S/E	*Eleocharis acicularis*	Needle spikerush	5	X
	Juncus pelocarpus	Brown-fruited rush	8	X
	Sagittaria graminea	Grass-leaved arrowhead	9	I
FF	*Lemna minor*	Lesser duckweed	5	X

FL = Floating Leaf; S/E = Submergent and Emergent; FF = Free Floating
X = Located on rake during point-intercept survey; I = Incidental Species
** = Species listed as special concern by WI Natural Heritage Inventory*

Of the 608 point-intercept sampling locations that fell at or below the maximum depth of plant growth in 2018, approximately 74% contained aquatic vegetation. Ballard Lake – Map 6 displays the point-intercept locations that contained aquatic vegetation in 2018, and the total rake fullness ratings at those locations. Forty-three percent of the point-intercept locations had a total rake fullness (TRF) rating of 1, 20% had a total rake fullness rating of 2, and 11% had the highest total rake fullness rating of 3 (Figure 8.5.4-2). Twenty-six percent of the littoral zone had no vegetation. With the highest percentages coming from the lowest TRF ratings, it can be said that where plants are found in Ballard Lake, they are sparse.

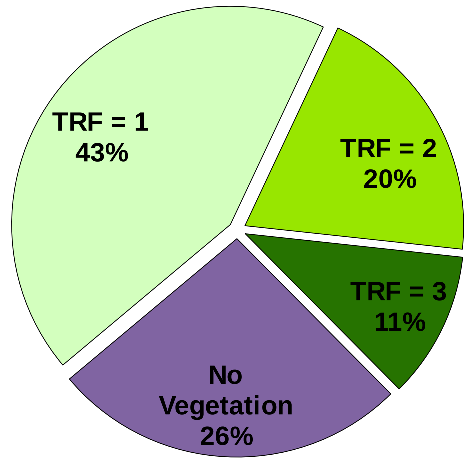


Figure 8.5.4-2. Ballard Lake 2018 aquatic vegetation total rake fullness ratings (TRF). Created from data collected during the 2018 whole-lake point-intercept survey (N = 608).

Of the 40 native aquatic plant species located in Ballard Lake in 2018, 26 were encountered directly on the rake during the whole-lake point-intercept survey (Figure 8.5.4-3). The remaining 14 plants were located incidentally, meaning they were observed by Onterra ecologists while on the lake but they were not directly sampled on the rake at any of the point-intercept sampling locations. Incidental species typically include emergent and floating-leaf species that are often found growing on the fringes of the lake and submersed species that are relatively rare within the plant community. Of the 26 species directly sampled with the rake during the point-intercept survey, fern-leaf pondweed, southern naiad, slender naiad, and wild celery were the four-most frequently encountered plants, respectively (Figure 8.5.4-3).

Fern-leaf pondweed was the most abundant plant in Ballard Lake in 2018 with a littoral occurrence of 57% (Figure 8.5.4-3). As its name suggests, has the appearance of a fern's leaf and is a common pondweed found in lakes in northern Wisconsin. This plant generally grows in dense beds which creep along the bottom of the lake, where they provide excellent structural habitat for aquatic invertebrates and fish.

Southern naiad, the second most abundant aquatic plant in Ballard Lake in 2018 with a littoral occurrence of 11% (Figure 8.5.4-3). Southern naiad can dislodge and form surface mats that interfere with navigation, recreation, and aesthetics. Often the plants are not growing in place, but rather have uprooted and aggregated on taller vegetation.

Slender naiad, the third most abundant aquatic plant in Ballard Lake in 2018 with a littoral occurrence of 10% (Figure 8.5.4-3), is one of three native naiads that can be found in Wisconsin. Being an annual, it produces numerous seeds on an annual basis and is considered to be one of the most important food sources for a number of migratory waterfowl species (Borman et al. 1997). In addition, slender naiad's small, condensed network of leaves provide excellent habitat for aquatic invertebrates.

Wild celery, the fourth most abundant aquatic plant in Ballard Lake in 2018 with a littoral occurrence of approximately 8% (Figure 8.5.4-3), has bundles of long submersed leaves that are flat and ribbon-like which emerge from a basal rosette and provide excellent structural habitat for aquatic organisms. Spreading rapidly via rhizomes, wild celery is often found growing in large colonies where their extensive root systems stabilize bottom sediments. In mid- to late-summer, the coiled flower stalks of wild celery can be observed at or near the surface, and following pollination, large banana-shaped seed pods can also be seen. These seed pods have been shown to be an important food source for waterfowl (Borman et al. 1997).

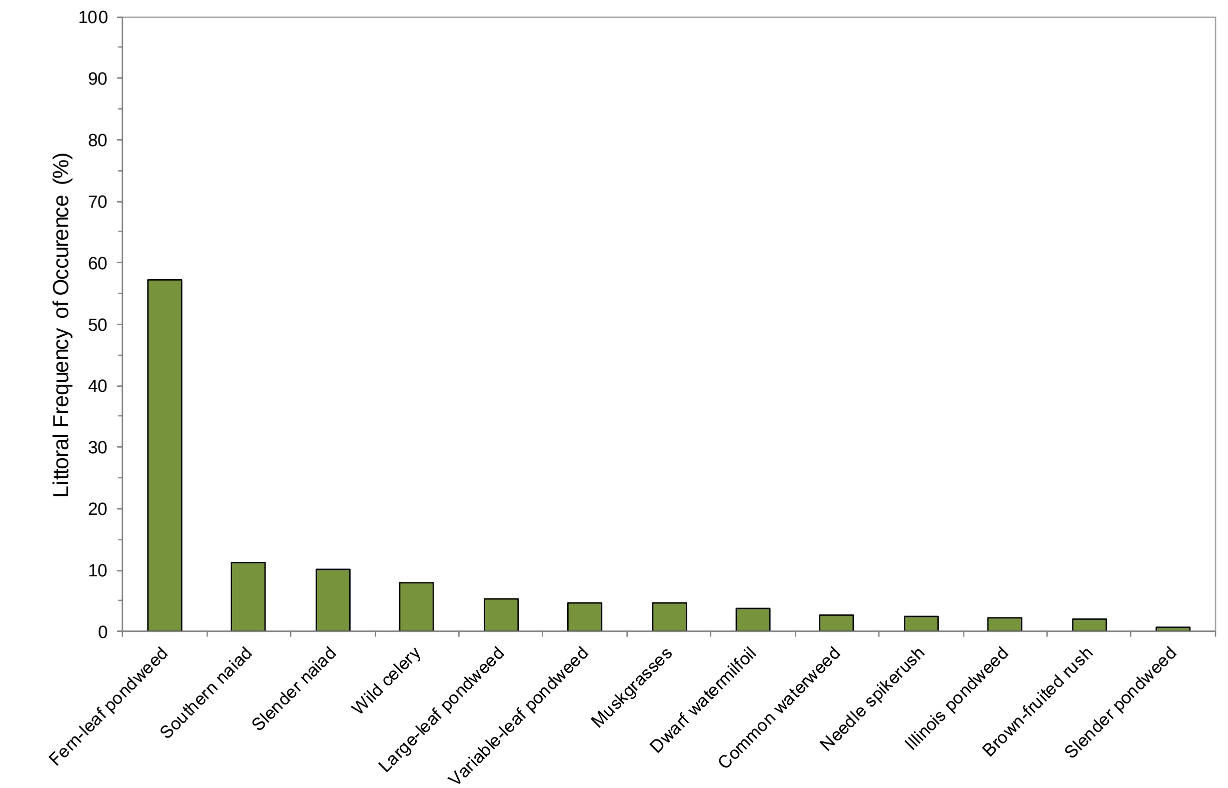


Figure 8.5.4-3. Ballard Lake 2018 littoral frequency of occurrence of aquatic plant species. Created using data from 2018 whole-lake point-intercept survey.

As discussed in the Town-wide section, the calculations used to create the Floristic Quality Index (FQI) for a lake's aquatic plant community are based on the aquatic plant species that were encountered on the rake during the point-intercept survey and do not include incidental species. The native species encountered on the rake during the 2018 point-intercept survey and their conservatism values were used to calculate the FQI of Ballard Lake's aquatic plant community (equation shown below).

FQI = Average Coefficient of Conservatism * √ Number of Native Species

Figure 8.5.4-4 compares 2018 FQI components of Ballard Lake to median values of lakes within the Northern Lakes and Forests (NLF) ecoregion and lakes throughout Wisconsin. The number of native aquatic plant species encountered on the rake, or native species richness, was 26 for the 2018 survey. Ballard Lake's species richness is above the median value for lakes within the ecoregion and the state.

Ballard Lake's average conservatism in 2018 was 7.1 (Figure 8.5.4-4). Ballard Lake's average conservatism is slightly above the median value for lakes in the ecoregion and above the median for lakes throughout Wisconsin, which indicates Ballard Lake's aquatic plant community contains a higher number of aquatic plants that are considered to be sensitive to environmental degradation and require high-quality habitats. Given Ballard Lake's high native species richness and conservatism values from 2018, Ballard Lake therefore has a high Floristic Quality Index value of 36.3. This FQI value is above the median for lakes in the ecoregion and well above the median value for the state, and indicates that Ballard Lake's aquatic plant community is of higher quality than the majority of lakes throughout Wisconsin.

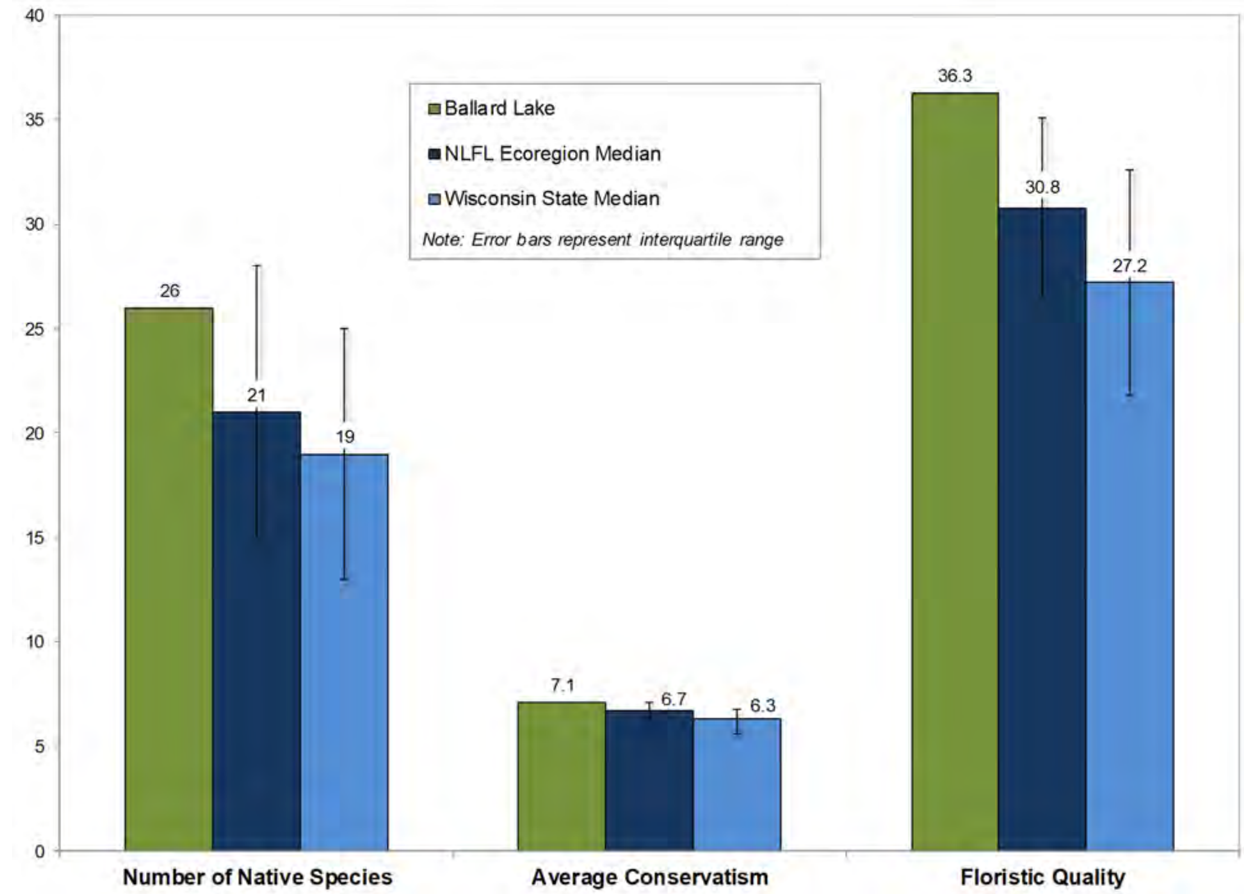


Figure 8.5.4-4. Ballard Lake Floristic Quality Assessment. Created using data from Onterra 2018 whole-lake point-intercept survey. Analysis follows Nichols (1999).

As explained in the Town-wide section, lakes with diverse aquatic plant communities have higher resilience to environmental disturbances and greater resistance to invasion by non-native plants. In addition, a plant community with a mosaic of species with differing morphological attributes provides zooplankton, macroinvertebrates, fish, and other wildlife with diverse structural habitat and various sources of food. Because Ballard Lake contains a higher number of native aquatic plant species, one may assume the aquatic plant community has high species diversity. However, species diversity is also influenced by how evenly the plant species are distributed within the community.

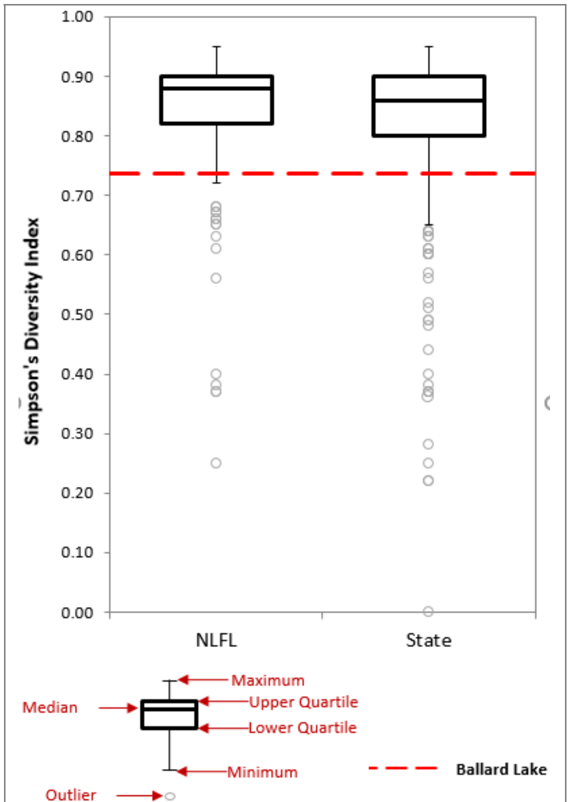


Figure 8.5.4-5. Ballard Lake species diversity index. Created using data from the Onterra 2018 point-intercept survey.

While a method for characterizing diversity values of fair, poor, etc. does not exist, lakes within the same ecoregion may be compared to provide an idea of how Ballard Lake's diversity value ranks. Using data collected by Onterra and WDNR Science Services, quartiles were calculated for 212 lakes within the NLF ecoregion (Figure 8.5.4-5). Using the data collected from the 2018 point-intercept survey, Ballard Lake's aquatic plant is shown to have lower species diversity with a Simpson's Diversity Index value of 0.74. In other words, if two individual aquatic plants were randomly sampled from Ballard Lake in 2018, there would be a 74% probability that they would be different species. This diversity value falls below the median for the ecoregion and for lakes throughout the state.

One way to visualize Ballard Lake's species diversity is to look at the relative occurrence of aquatic plant species. Figure 8.5.4-6 displays the relative frequency of occurrence of aquatic plant species created from the 2018 whole-lake point-intercept survey and illustrates the distribution of aquatic plant species within the community. A plant community that is dominated by one or a few species yields lower species diversity. Because each sampling location may contain numerous plant species, relative frequency of occurrence is one tool to evaluate how often each plant species is found in relation to all other species found (composition of population). For instance, while fern-leaf pondweed was found at 57% of the littoral sampling locations in Ballard Lake in 2018, its relative frequency of occurrence is 49%. Explained another way, if 100 plants were randomly sampled from Ballard Lake in 2018, 49 of them would be fern-leaf pondweed. In the case of Ballard Lake, despite having a higher species richness, the lower Simpson's diversity index value is caused by fern-leaf pondweed making up almost half of the relative frequency of occurrence of the aquatic plant species present.

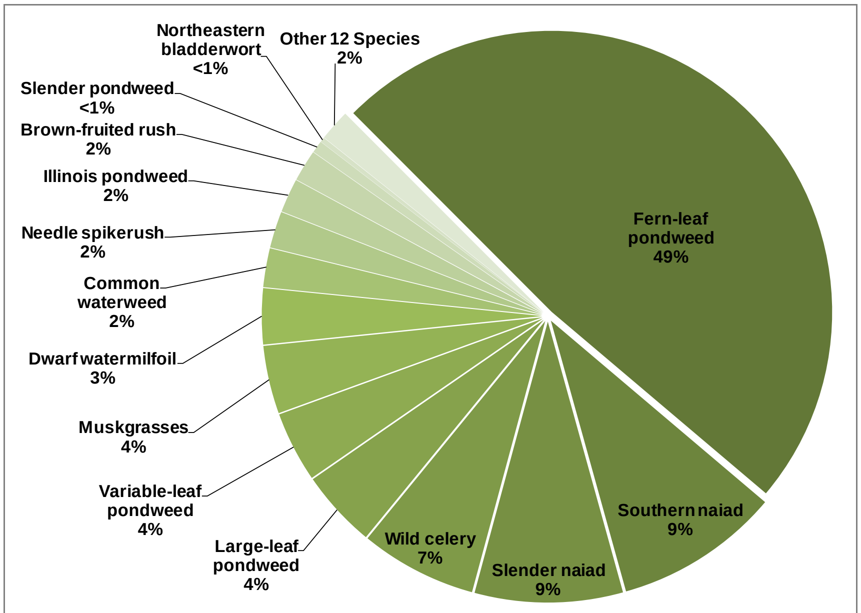


Figure 8.5.4-6. Ballard Lake 2018 relative frequency of occurrence of aquatic plant species. Created using data from 2018 point-intercept survey.

In 2018, Onterra ecologists also conducted a survey aimed at mapping emergent and floating-leaf aquatic plant communities in Ballard Lake. This survey revealed Ballard Lake contains just under 13 acres of these communities comprised of 14 different aquatic plant species (Ballard Lake – Map 7 and Table 8.5.4-2). These native emergent and floating-leaf plant communities provide valuable fish and wildlife habitat that is important to the ecosystem of the lake. These areas are particularly important during times of fluctuating water levels, since structural habitat of fallen trees and other forms of course-woody habitat can be quite sparse along the shores of receding water lines.

The community map represents a ‘snapshot’ of the important emergent and floating-leaf plant communities, and a replication of this survey in the future will provide a valuable understanding of the dynamics of these communities within Ballard Lake. This is important, because these communities are often negatively affected by recreational use and shoreland development.

Table 8.5.4-2. Ballard Lake 2018 acres of emergent and floating-leaf aquatic plant communities. Created using data from 2018 aquatic plant community mapping survey.

Plant Community	Acres
Emergent	1.7
Floating-leaf	7.1
Mixed Emergent & Floating-leaf	4.0
Total	**12.9**

8.5.5 Aquatic Invasive Species in Ballard Lake

As is discussed in section 2.0 Stakeholder Participation, the lake stakeholders were asked about aquatic invasive species (AIS) and their presence in Ballard Lake within the anonymous stakeholder survey. The WDNR have confirmed that there is one, possibly two, AIS present (Table 8.5.5-1).

Table 8.5.5-1. AIS present within Ballard Lake

Type	Common name	Scientific name	Location within the report
Plants	Purple Loosestrife	*Lythrum salicaria*	Section 8.5.5 – Aquatic Invasive Species in Ballard Lake
Invertebrates	Chinese Mystery Snail	*Cipangopaludina chinensis*	Section 8.5.5 – Aquatic Invasive Species in Ballard Lake

More information on these invasive species or any other AIS can be found at the following links:

- http://dnr.wi.gov/topic/invasives/
- https://nas.er.usgs.gov/default.aspx
- https://www.epa.gov/greatlakes/invasive-species

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) is a perennial herbaceous plant native to Europe and was likely brought over to North America as a garden ornamental (Photo 3.4-7). This plant escaped from its garden landscape into wetland environments where it is able to out-compete our native plants for space and resources. First detected in Wisconsin in the 1930's, it has now spread to 70 of the state's 72 counties. Purple loosestrife largely spreads by seed, but also can vegetatively spread from root or stem fragments. There are a number of effective control strategies for combating this aggressive plant, including herbicide application, biological control by native beetles, and manual hand removal. The WDNR lists purple loosestrife as "observed" at Ballard Lake in 2012. This status indicates that it was either not verified by an expert, or there were no established populations. Onterra did not locate any occurrences of purple loosestrife at Ballard Lake during the 2018 surveys; however, citizen monitors found and removed purple loosestrife from the east end of the island off the lake's south shore (Ballard – Map 7) in 2020. Volunteers revisited the location in 2022 and found that the invasive had not reemerged.

Photograph 8.5.5-1 Purple loosestrife in a shoreland area. Photo credit Onterra.

Aquatic Animals

Mystery snails

There are two types of mystery snails found within Wisconsin waters, the Chinese mystery snail (*Cipangopaludina chinensis*) and the banded mystery snail (*Viviparus georgianus*). Both snails can be identified by their large size, thick hard shell and hard operculum (a trap door that covers the snail's soft body). These traits also make them less edible to native predators. These species thrive in eutrophic waters with very little flow. They are bottom-dwellers eating diatoms, algae and organic and inorganic bottom materials. One study conducted in northern Wisconsin lakes found that the Chinese mystery snail did not have strong negative effects on native snail populations (Solomon et al. 2010). However, researchers did detect negative impacts to native snail communities when both Chinese mystery snails and the rusty crayfish were present (Johnson et al. 2009).

8.5.6 Ballard Lake Fisheries Data Integration

Fishery management is an important aspect in the comprehensive management of a lake ecosystem; therefore, a brief summary of available data is included here as a reference. The following section is not intended to be a comprehensive plan for the lake's fishery, as those aspects are currently being conducted by the fisheries biologists overseeing Ballard Lake. The goal of this section is to provide an overview of some of the data that exists. Although current fish data were not collected as a part of this project, the following information was compiled based upon data available from the Wisconsin Department of Natural Resources (WDNR) the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) and personal communications with DNR Fisheries Biologist Steve Gilbert (WDNR 2019 & GLIFWC 2018).

Ballard Lake Fishery

Energy Flow of a Fishery

When examining the fishery of a lake, it is important to remember what drives that fishery, or what is responsible for determining its mass and composition. The gamefish in Ballard Lake are supported by an underlying food chain. At the bottom of this food chain are the elements that fuel algae and plant growth – nutrients such as phosphorus and nitrogen, and sunlight. The next tier in the food chain belongs to zooplankton, which are tiny crustaceans that feed upon algae and plants, and insects. Smaller fish called planktivores feed upon zooplankton and insects, and in turn become food for larger fish species. The species at the top of the food chain are called piscivores and are the larger gamefish that are often sought after by anglers, such as bass and walleye.

A concept called energy flow describes how the biomass of piscivores is determined within a lake. Because algae and plant matter are generally small in energy content, it takes an incredible amount of this food type to support a sufficient biomass of zooplankton and insects. In turn, it takes a large biomass of zooplankton and insects to support planktivorous fish species. And finally, there must be a large planktivorous fish community to support a modest piscivorous fish community. Studies have shown that in natural ecosystems, it is largely the amount of primary productivity (algae and plant matter) that drives the rest of the producers and consumers in the aquatic food chain. This relationship is illustrated in Figure 8.5.6-1.

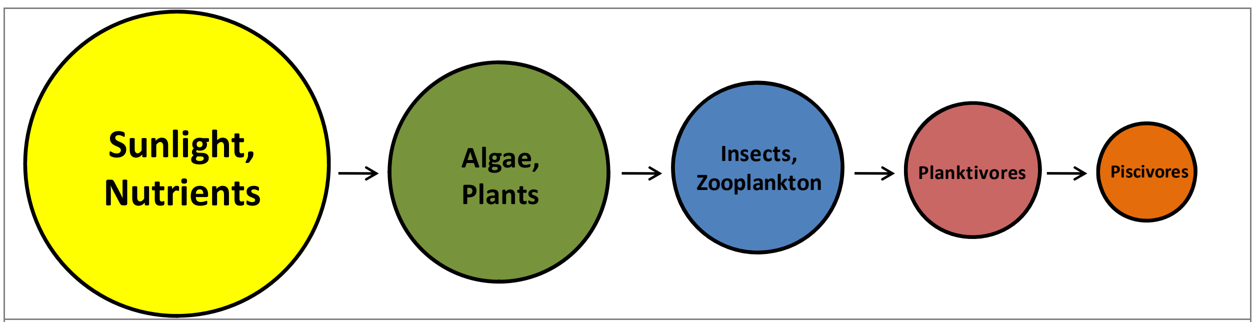


Figure 8.5.6-1. Aquatic food chain. Adapted from Carpenter et. al 1985.

As discussed in the Water Quality section, Ballard Lake is a mesotrophic system, meaning it has a moderate amount of nutrients and thus a moderate amount of primary productivity. This is relative to an oligotrophic system, which contains fewer nutrients (less productive) and a eutrophic system, which contains more nutrients (more productive). Simply put, this means Ballard Lake should be able to support an appropriately sized population of predatory fish (piscivores) when compared to eutrophic or oligotrophic systems. Table 8.5.6-1 shows the popular game fish present in the system.

Table 8.5.6-1. Gamefish present in Ballard Lake with corresponding biological information (Becker, 1983).

Common Name (*Scientific Name*)	Max Age (yrs)	Spawning Period	Spawning Habitat Requirements	Food Source
Black Crappie (*Pomoxis nigromaculatus*)	7	May - June	Near *Chara* or other vegetation, over sand or fine gravel	Fish, cladocera, insect larvae, other invertebrates
Bluegill (*Lepomis macrochirus*)	11	Late May - Early August	Shallow water with sand or gravel bottom	Fish, crayfish, aquatic insects and other invertebrates
Largemouth Bass (*Micropterus salmoides*)	13	Late April - Early July	Shallow, quiet bays with emergent vegetation	Fish, amphipods, algae, crayfish and other invertebrates
Muskellunge (*Esox masquinongy*)	30	Mid April - Mid May	Shallow bays over muck bottom with dead vegetation, 6 - 30 in.	Fish including other muskies, small mammals, shore birds, frogs
Northern Pike (*Esox lucius*)	25	Late March - Early April	Shallow, flooded marshes with emergent vegetation with fine leaves	Fish including other pike, crayfish, small mammals, water fowl, frogs
Pumpkinseed (*Lepomis gibbosus*)	12	Early May - August	Shallow warm bays 0.3 - 0.8 m, with sand or gravel bottom	Crustaceans, rotifers, mollusks, flatworms, insect larvae (terrestrial and aquatic)
Rock Bass (*Ambloplites rupestris*)	13	Late May - Early June	Bottom of course sand or gravel, 1 cm - 1 m deep	Crustaceans, insect larvae, and other invertebrates
Smallmouth Bass (*Micropterus dolomieu*)	13	Mid May - June	Nests more common on north and west shorelines over gravel	Small fish including other bass, crayfish, insects (aquatic and terrestrial)
Walleye (*Sander vitreus*)	18	Mid April - Early May	Rocky, wavewashed shallows, inlet streams on gravel bottoms	Fish, fly and other insect larvae, crayfish
Yellow Perch (*Perca flavescens*)	13	April - Early May	Sheltered areas, emergent and submergent veg	Small fish, aquatic invertebrates


Photograph 8.5.6-1. Fyke net positioned in the littoral zone of a Wisconsin Lake (left) and an electroshocking boat (right).

Fish Stocking

To assist in meeting fisheries management goals, the WDNR may permit the stocking of fry, fingerling or adult fish in a waterbody that were raised in permitted hatcheries (Photograph 8.5.6-2). Stocking of a lake may be done to assist the population of a species due to a lack of natural reproduction in the system, or to otherwise enhance angling opportunities. Ballard Lake has been stocked from 1991 to 2018 with walleye and muskellunge (Table 8.5.6-2 and 8.5.6-3).

Photograph 8.5.6-2. Fingerling Muskellunge.

Table 8.5.6-2. Stocking data available for muskellunge in Ballard Lake (1991-2018).

Year	Species	Strain (Stock)	Age Class	# Fish Stocked	Avg Fish Length (in)
1991	Muskellunge	Unspecified	Fingerling	400	12
1992	Muskellunge	Unspecified	Fingerling	1,000	10.75
1993	Muskellunge	Unspecified	Fingerling	500	10
1996	Muskellunge	Unspecified	Fingerling	500	10.7
1996	Muskellunge	Unspecified	Fry	100,000	0.5
1997	Muskellunge	Unspecified	Fry	64,800	0.5
1997	Muskellunge	Unspecified	Large Fingerling	1,000	10.8
1998	Muskellunge	Unspecified	Large Fingerling	1,000	10.8
2013	Muskellunge	Upper Wisconsin River	Large Fingerling	255	9.7
2014	Muskellunge	Upper Wisconsin River	Large Fingerling	126	11.3
2015	Muskellunge	Upper Wisconsin River	Large Fingerling	63	11.7
2016	Muskellunge	Upper Wisconsin River	Large Fingerling	126	11.24
2017	Muskellunge	Upper Wisconsin River	Large Fingerling	81	10.8
2018	Muskellunge	Upper Wisconsin River	Large Fingerling	126	11.6

Table 8.5.6-3. Stocking data available for walleye in Ballard Lake (1991-2013).

Year	Species	Strain (Stock)	Age Class	# Fish Stocked	Avg Fish Length (in)
1991	Walleye	Unspecified	Fingerling	10,017	3
1992	Walleye	Unspecified	Fingerling	12,330	2
1993	Walleye	Unspecified	Fingerling	21,887	2
1995	Walleye	Unspecified	Fingerling	28,512	1.8
1996	Walleye	Unspecified	Fingerling	26,400	1.7
1996	Walleye	Unspecified	Fry	500,000	0.3
1997	Walleye	Unspecified	Fry	600,000	0.3
1998	Walleye	Unspecified	Small Fingerling	50,028	1.5
2000	Walleye	Unspecified	Small Fingerling	50,064	1.8
2003	Walleye	Mississippi Headwaters	Small Fingerling	59,740	1.65
2005	Walleye	Mississippi Headwaters	Small Fingerling	51,450	1.5
2007	Walleye	Mississippi Headwaters	Small Fingerling	35,773	2.8
2009	Walleye	Mississippi Headwaters	Small Fingerling	20,725	1.7
2011	Walleye	Mississippi Headwaters	Small Fingerling	17,602	1.8
2013	Walleye	Mississippi Headwaters	Small Fingerling	17,205	2

Fishing Activity

Based on data collected from the stakeholder survey (Appendix B), fishing (open water) was the first most important reason for owning property on or near Ballard, Irving and White Birch Lakes (Question #18). Figure 8.5.6-2 displays the fish that Ballard, Irving and White Birch Lakes stakeholders enjoy catching the most, with muskellunge and walleye being the most popular. Approximately 78% of these same respondents believed that the quality of fishing on the lake was either good or fair (Figure 8.5.6-3). Approximately 69% of respondents who fish Ballard Lake believe the quality of fishing has remained the same or is somewhat worse since they first started fishing the lake (Figure 8.5.6-4).

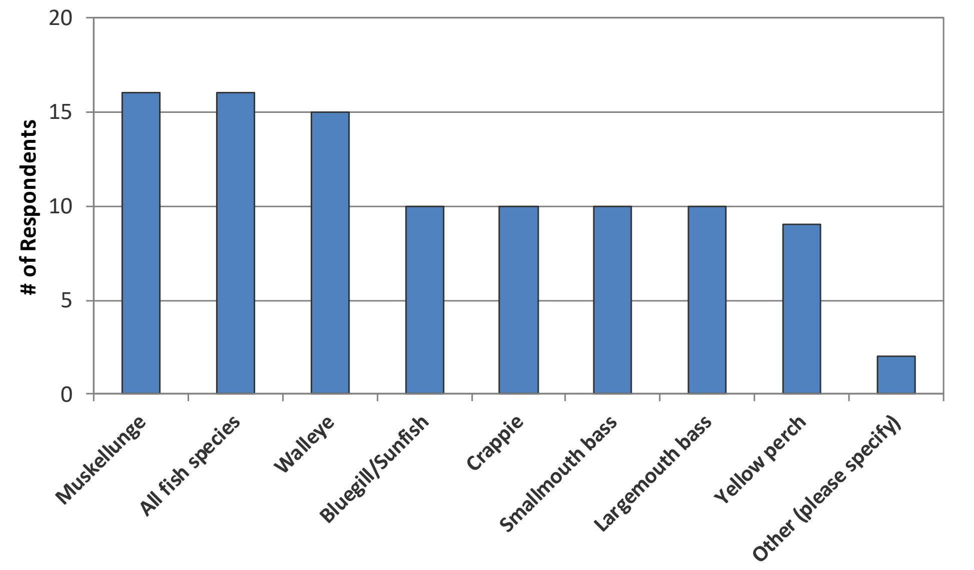


Figure 8.5.6-2. Stakeholder survey response Question #12. *What species of fish do you like to catch on your lake?*

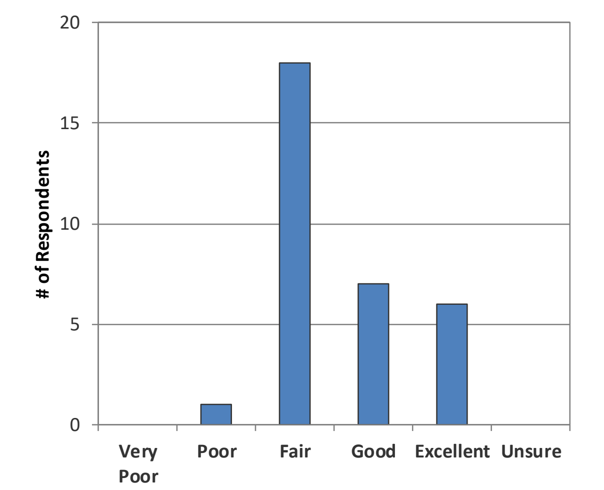


Figure 8.5.6-3. Stakeholder survey response Question #13. *How would you describe the current quality of fishing on your lake?*

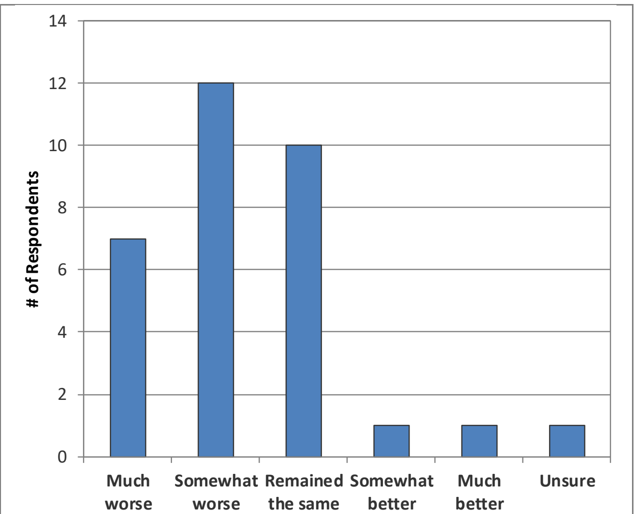


Figure 8.5.6-4. Stakeholder survey response Question #14. *How has the quality of fishing changed on your lake since you started fishing the lake?*

Fish Kill

Ballard Lake experienced a fish kill during the winter of 1995-96 caused by a lack of dissolved oxygen in the water. Anoxic conditions can develop during the winter months when dissolved oxygen is depleted from biological processes in which oxygen is consumed. During the spring of 1996, an estimated over 2,000 pounds of fish were found in old ponds of Aqualand, a retired wildlife park, seeking refuge from the low dissolved oxygen levels. These fish were placed back into the chain of Ballard, Irving and White Birch to begin the process of repopulating the fishery. The years following the 1995-96 winter kill, a goal of re-stocking gamefish to a self-sustaining population has been undertaken.

Aeration

In 1997, the Ballard – Irving – White Birch Lakes Association, along with the WDNR and Town of Plum Lake, an aeration system was installed at the Ballard boat landing to maintain sufficient dissolved oxygen levels to avoid further fish kills. Aeration is a process where air is circulated through an aquatic system for the purpose of re-oxygenating the water. To address winter oxygen depletion, aeration is a common technique. Many believe that the aeration process itself re-oxygenates a lake by providing an air source to the water. While some oxygen may be provided to the lake in this manner, the greatest oxygen accumulation actually occurs through the creation of open water during the winter months, allowing for atmospheric exchange of oxygen with the open water. The overarching goal of winter aeration is to open an area of ice for this oxygen exchange, essentially creating a refuge for fish to last through the winter months. Therefore, it is not necessary to aerate large areas of a lake. Commonly, fish biologists refer to >1 to several acres of aerated area as a "refuge" where fish can overwinter.

In general, aeration systems are best suited in waters greater than five feet of depth within several hundred feet of shoreline. Because aeration units are power operated, an electrical source must be located near the unit. The aerator must be situated on public land or on private land with the landowner's permission. Usually for an aeration system to be installed off of a private landowner's property, the landowner must obtain a water regulations permit and become liable for the system, in accordance with Wisconsin Statute 167.26. The landowner can be relieved of the liability if an easement is provided to the sponsoring lake group by the landowner.

One of the most critical responsibilities of the liable party is the erection and maintaining of a barricade. Wisconsin Statute 167.26 outlines the requirements of the barricade, including height of barricade rope off the ice, spacing around the aerated area, reflective tape / ribbon requirements, etc. When a proper barricade is made and maintained, Wisconsin Statute 167.26 specifies that the responsible party for the aeration system is exempt from liability for injury or death of any person entering the ice opening. Setting up the barricade after the onset of ice and initiation of the aeration unit does not meet the standards of Wisconsin Statute 167.26; the barricade must be initiated prior to active aeration.

Ballard Lake Spear Harvest Records

Figure 8.5.6-5. Location of Ballard Lake within the Native American Ceded Territory (GLIFWC 2017). This map was digitized by Onterra; therefore, it is a representation and not legally binding.

Approximately 22,400 square miles of northern Wisconsin was ceded to the United States by the Lake Superior Chippewa tribes in 1837 and 1842 (Figure 8.5.6-5). Ballard Lake falls within the ceded territory based on the Treaty of 1842. This allows for a regulated open water spear fishery by Native Americans on lakes located within the Ceded Territory. Determining how many fish are able to be taken from a lake by tribal harvest is a highly regimented and dictated process. This highly structured procedure begins with bi-annual meetings between tribal and state management authorities. Reviews of population estimates are made for ceded territory lakes, and then a "total allowable catch" (TAC) is established, based upon estimates of a sustainable harvest of the fishing stock. The TAC is the number of adult walleye or muskellunge that can be harvested from a lake by tribal and recreational anglers without endangering the population. A "safe harvest" value is calculated as a percentage of the TAC each year for all walleye lakes in the ceded territory. The safe harvest represents the number of fish that can be harvested by tribal members through the use of high efficiency gear such as spearing or netting without influencing the sustainability of the population. This does not apply to angling harvest which is considered a low-efficiency harvest regulated statewide by season length, size and bag limits. The safe harvest limits are set through either recent population estimates or a statistical model that ensure there is less than a 1 in 40 chance that more than 35% of the adult walleye population will be harvested in a lake through high efficiency methods. By March 15th of each year the relevant Native American communities may declare a proportion of the total safe harvest on each lake; this declaration represents the maximum number of fish that can be harvested by tribal members annually. Prior to 2015, annual walleye bag limits for anglers were adjusted in all Ceded Territory lakes based upon the percent of the safe harvest levels determined for the Native American spearfishing season. Beginning in 2015, new regulations for walleye were created to stabilize regional walleye angler bag limits. The daily bag limits for walleye in lakes located partially or wholly within the ceded territory is three. The state-wide bag limit for walleye is five. Anglers may only remove three walleye from any individual lake in the ceded territory but may fish other waters to full-fill the state bag limit (WDNR 2017).

Tribal members may harvest muskellunge, walleye, northern pike, and bass during the open water season; however, in practice walleye and muskellunge are the only species harvested in significant numbers, so conservative quotas are set for other species. The spear harvest is monitored through a nightly permit system and a complete monitoring of the harvest (GLIFWC 2016). Creel clerks and tribal wardens are assigned to each lake at the designated boat landing. A catch report is completed for each boating party upon return to the boat landing. In addition to counting every fish harvested, the first 100 walleye (plus all those in the last boat) are measured and sexed. Tribal spearers may only take two walleyes over twenty inches per nightly permit; one between 20 and 24 inches and one of any size over 20 inches (GLIWC 2016). This regulation limits the harvest of the larger, spawning female walleye. An updated nightly declaration is determined each morning by 9 a.m. based on the data collected from the successful spearers. Spearfishing of a particular species ends once the declared harvest is reached in a given lake. In 2011, a new reporting requirement went into effect on lakes with smaller declarations.

Walleye open water spear harvest records are provided in Figure 8.5.6-6 from 2000 to 2018. As many as 255 walleye have been harvested from the lake in the past (2002), but the average harvest is roughly 87 fish in a given year. Spear harvesters on average have taken 64% of the declared quota.

Muskellunge open water spear harvest records are provided in Figure 8.5.6-7 from 2000 to 2018. As many as 8 muskellunge have been harvested from the lake in the past (2008 to 2011), however the average harvest is 6 fish in a given year. Spear harvesters on average have taken 42% of the declared quota.

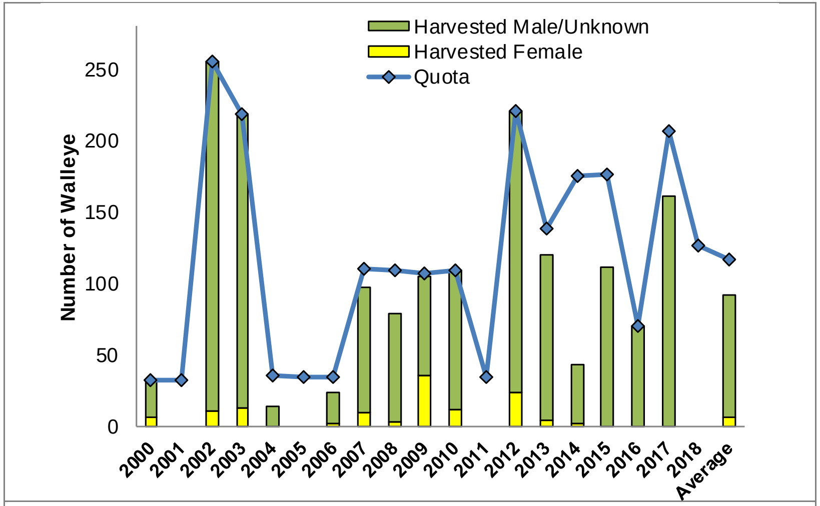


Figure 8.5.6-6. Ballard Lake walleye spear harvest data. (GLIFWC 2000-2018).

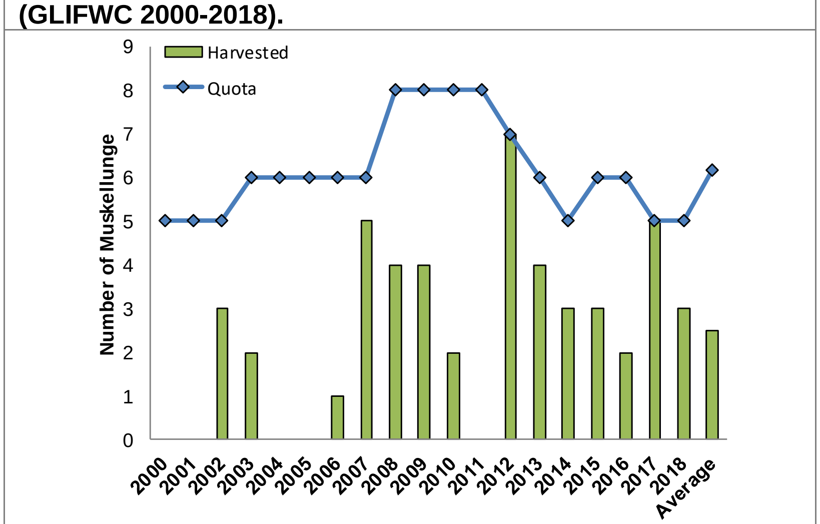


Figure 8.5.6-7. Ballard Lake muskellunge spear harvest data. (GLIFWC 2000-2018).

Ballard Lake Fish Habitat

Substrate Composition

Just as forest wildlife require proper trees and understory growth to flourish, fish require certain substrates and habitat types to nest, spawn, escape predators, and search for prey. Lakes with primarily a silty/soft substrate, many aquatic plants, and coarse woody debris may produce a completely different fishery than lakes that are largely sandy/rocky, and contain few aquatic plant species or coarse woody habitat.

Substrate and habitat are critical to fish species that do not provide parental care to their eggs. Northern pike is one species that does not provide parental care to its eggs (Becker 1983). Northern pike broadcast their eggs over woody debris and detritus, which can be found above sand or muck. This organic material suspends the eggs above the substrate, so the eggs are not buried in sediment and suffocate as a result. Walleye are another species that does not provide parental care to its eggs. Walleye preferentially spawn in areas with gravel or rock in places with moving water or wave action, which oxygenates the eggs and prevents them from getting buried in sediment. Fish that provide parental care are less selective of spawning substrates. Species such as bluegill tend to prefer a harder substrate such as rock, gravel or sandy areas if available, but have been found to spawn and care for their eggs in muck as well.

According to the point-intercept survey conducted by Onterra in 2018, 92% of the substrate sampled in the littoral zone of Ballard Lake were soft sediments, 6% composed of sand and 2% composed of rock sediments.

Woody Habitat

As discussed in the Shoreland Condition Section, the presence of coarse woody habitat is important for many stages of a fish's life cycle, including nesting or spawning, escaping predation as a juvenile, and hunting insects or smaller fish as an adult. Unfortunately, as development has increased on Wisconsin lake shorelines in the past century, this beneficial habitat has often been the first to be removed from the natural shoreland zone. Leaving these shoreland zones barren of coarse woody habitat can lead to decreased abundances and slower growth rates in fish (Sass 2009). A fall 2018 survey documented 333 pieces of coarse woody along the shores of Ballard Lake, resulting in a ratio of approximately 57 pieces per mile of shoreline.

Fish Habitat Structures

Some fisheries managers may look to incorporate fish habitat structures on the lakebed or littoral areas extending to shore for the purpose of improving fish habitats. These projects are typically conducted on lakes lacking significant coarse woody habitat in the shoreland zone. The "Fish sticks" program, outlined in the WDNR best practices manual, adds trees to the shoreland zone restoring fish habitat to critical near shore areas. Typically, every site has 3 – 5 trees which are partially or fully submerged in the water and anchored to shore (Photograph 8.5.6-3). The WDNR recommends placement of the fish sticks during the winter on ice when possible to prevent adverse impacts on fish spawning or egg incubation periods. The program requires a WDNR permit and can be funded through many different sources including the WDNR, County Land & Water Conservation Departments or partner contributions.

Photograph 8.5.6-3. Examples of fish sticks (left) and half-log habitat structures. (Photos by WDNR)

Fish cribs are a fish habitat structure that is placed on the lakebed. Installing fish cribs may be cheaper than fish sticks; however some concern exists that fish cribs can concentrate fish, which in turn leads to increased predation and angler pressure.

Half-logs are another form of fish spawning habitat placed on the bottom of the lakebed (Photograph 8.5.6-3). Smallmouth bass specifically have shown an affinity for overhead cover when creating spawning nests, which half-logs provide (Wills 2004). If the waterbody is exempt from a permit or a permit has been received, information related to the construction, placement and maintenance of half-log structures are available online.

An additional form of fish habitat structure is spawning reefs. Spawning reefs typically consist of small rubble in a shallow area near the shoreline for mainly walleye habitat. Rock reefs are sometimes utilized by fisheries managers when attempting to enhance spawning habitats for some fish species. However, a 2004 WDNR study of rock habitat projects on 20 northern Wisconsin lakes offers little hope the addition of rock substrate will improve walleye reproduction (WDNR 2004).

Placement of a fish habitat structure in a lake does not require a permit if the project meets certain conditions outlined by the WDNR's checklists available online:

(https://dnr.wi.gov/topic/waterways/Permits/Exemptions.html)

If a project does not meet all of the conditions listed on the checklist, a permit application may be sent in to the WDNR and an exemption requested. The TPL may work with the local WDNR fisheries biologist to determine if the installation of fish habitat structures should be considered in aiding fisheries management goals for Ballard Lake.

Regulations

Regulations for Ballard Lake gamefish species as of June 2019 are displayed in Table 8.5.6-4. For specific fishing regulations on all fish species, anglers should visit the WDNR website (*www.http://dnr.wi.gov/topic/fishing/regulations/hookline.html)* or visit their local bait and tackle shop to receive a free fishing pamphlet that contains this information.

Table 8.5.6-4. WDNR fishing regulations for Ballard Lake (As of June 2019).

Species	Daily bag limit	Length Restrictions	Season
Panfish (bluegill, pumpkinseed, sunfish, crappie and yellow perch)	25	None	Open All Year
Smallmouth bass (Early Season)	Catch and release only	None	May 4, 2019 to June 14, 2019
Largemouth and Smallmouth bass	5	14"	June 15, 2019 to March 1, 2020
Largemouth bass	5	14"	May 4, 2019 to June 14, 2019
Muskellunge and hybrids	1	40"	May 25, 2019 to November 30, 2019
Northern pike	5	None	May 4, 2019 to March 1, 2020
Walleye, sauger, and hybrids	3	The minimum length is 15", but walleye, sauger, and hybrids from 20" to 24" may not be kept, and only 1 fish over 24" is allowed.	May 4, 2019 to March 1, 2020
Bullheads	Unlimited	None	Open All Year

General Waterbody Restrictions: Motor Trolling is allowed with 1 hook, bait, or lure per angler, and 2 hooks, baits, or lures

Mercury Contamination and Fish Consumption Advisories

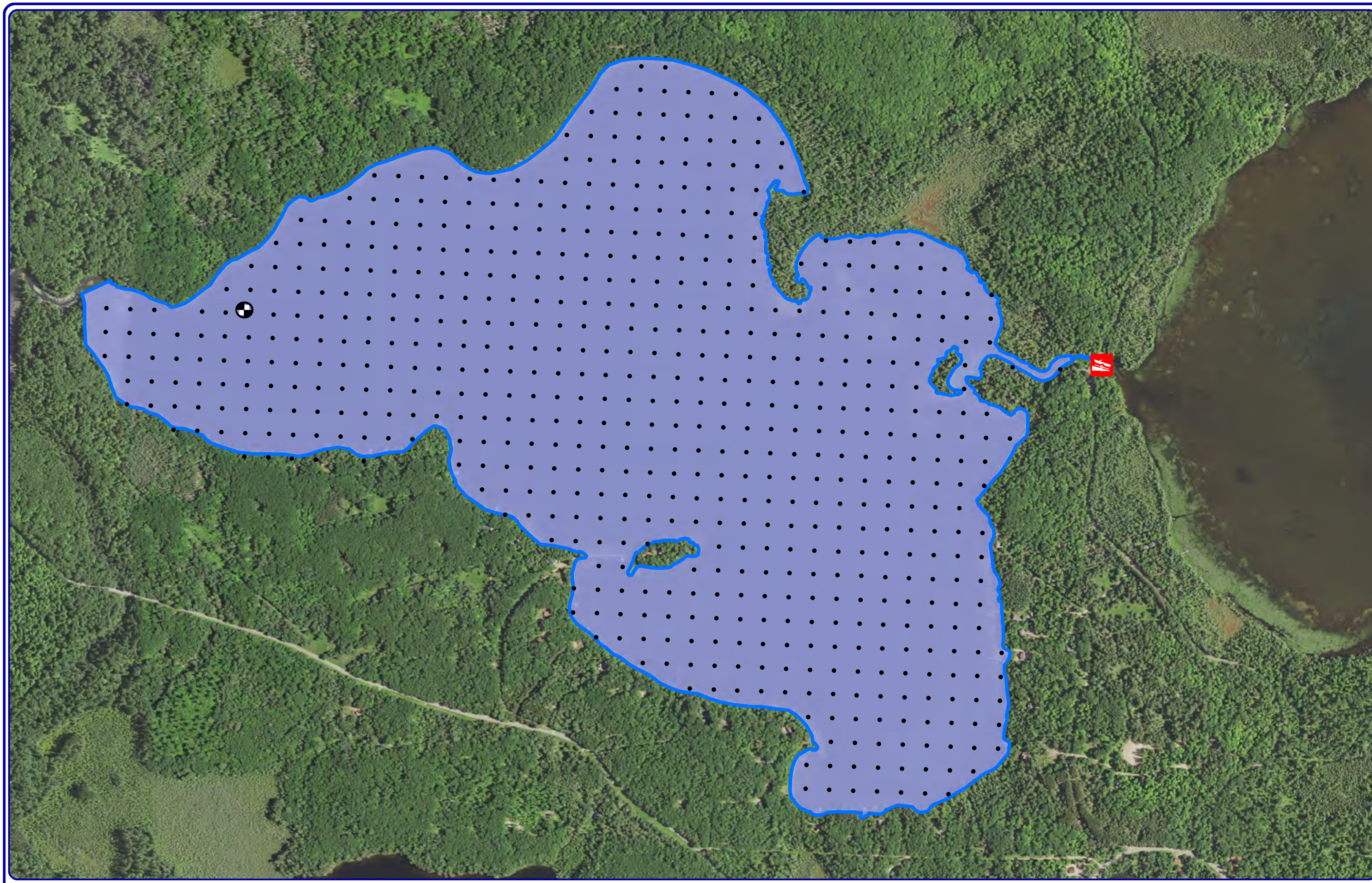
Freshwater fish are amongst the healthiest of choices you can make for a home-cooked meal. Unfortunately, fish in some regions of Wisconsin are known to hold levels of contaminants that are harmful to human health when consumed in great abundance. The two most common contaminants are polychlorinated biphenyls (PCBs) and mercury. These contaminants may be found in very small amounts within a single fish, but their concentration may build up in your body over time if you consume many fish. Health concerns linked to these contaminants range from poor balance and problems with memory to more serious conditions such as diabetes or cancer. These contaminants, particularly mercury, may be found naturally to some degree. However, the majority of fish contamination has come from industrial practices such as coal-burning facilities, waste incinerators, paper industry effluent and others. Though environmental regulations have reduced emissions over the past few decades, these contaminants are greatly resistant to breakdown and may persist in the environment for a long time. Fortunately, the human body is able to eliminate contaminants that are consumed however this can take a long time depending upon the type of contaminant, rate of consumption, and overall diet. Therefore, guidelines are set upon the consumption of fish as a means of regulating how much contaminant could be consumed over time.

General fish consumption guidelines for Wisconsin inland waterways are presented in Figure 8.5.6-8. There is an elevated risk for children as they are in a stage of life where cognitive development is rapidly occurring. As mercury and PCB both locate to and impact the brain, there are greater restrictions on women who may have children or are nursing children, and also for children under 15.

Fish Consumption Guidelines for Most Wisconsin Inland Waterways		
	Women of childbearing age, nursing mothers and all children under 15	**Women beyond their childbearing years and men**
Unrestricted*	-	Bluegill, crappies, yellow perch, sunfish, bullhead and inland trout
1 meal per week	Bluegill, crappies, yellow perch, sunfish, bullhead and inland trout	Walleye, pike, bass, catfish and all other species
1 meal per month	Walleye, pike, bass, catfish and all other species	Muskellunge
Do not eat	Muskellunge	-

**Doctors suggest that eating 1-2 servings per week of low-contaminant fish or shellfish can benefit your health. Little additional benefit is obtained by consuming more than that amount, and you should rarely eat more than 4 servings of fish within a week.*

Figure 8.5.6-8. Wisconsin statewide safe fish consumption guidelines. Graphic displays consumption guidance for most Wisconsin waterways. Figure adapted from WDNR website graphic (http://dnr.wi.gov/topic/fishing/consumption/)



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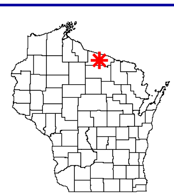
Sources
Hydro: WDNR
Survey: Onterra, 2018
Orthophotography: NAIP, 2017
Map date: July 15, 2019 HAL
Filename: Ballard_Location.mxd



Project Location in Wisconsin

Legend

Ballard Lake ~511 acres

Public Access

Water Quality Sampling Location

Point-intercept Sample Location
65 meter points

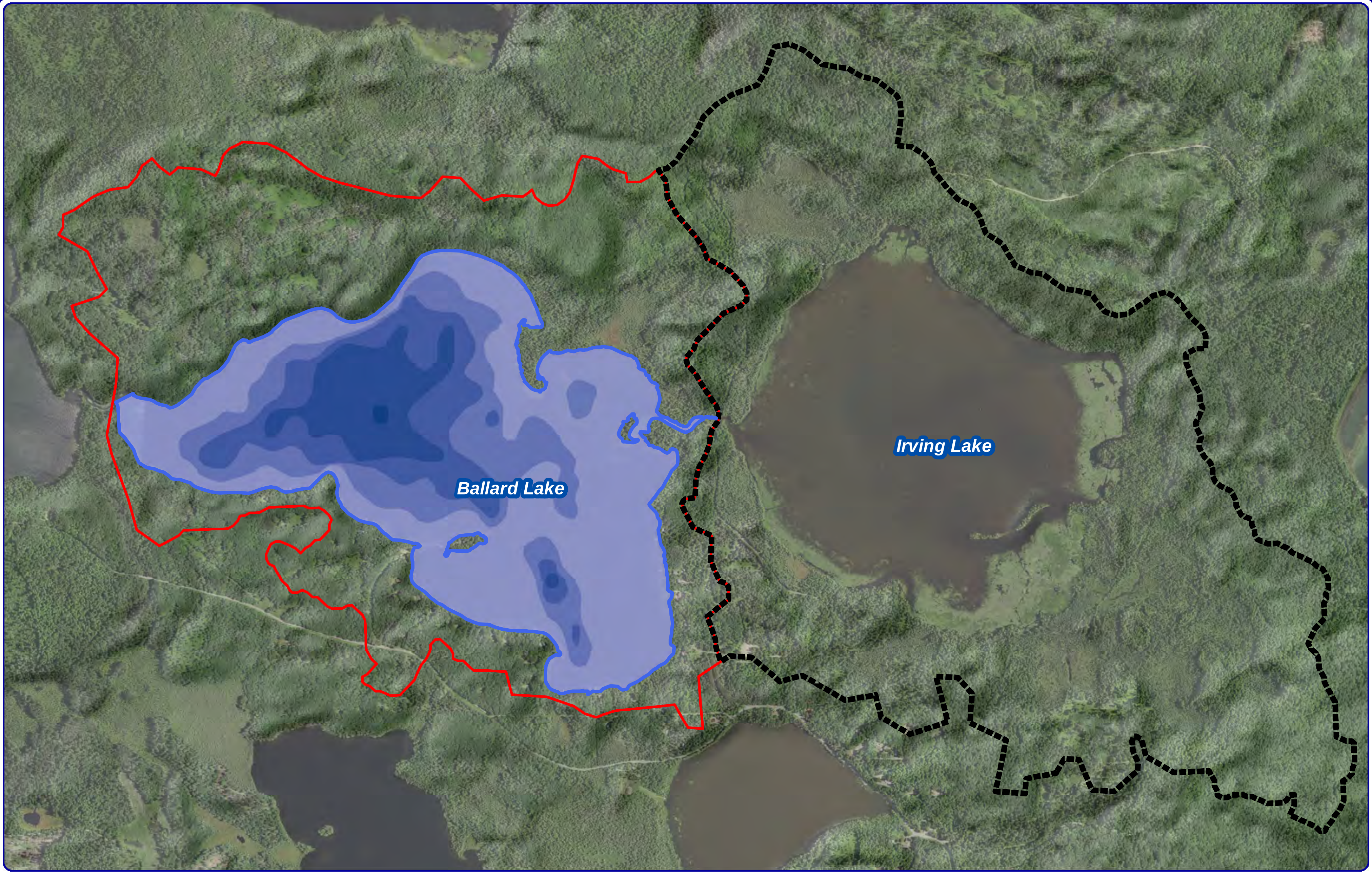
Ballard Lake - Map 1
Town of Plum Lake
Vilas County, Wisconsin

Project Location & Lake Boundaries

Ballard Lake - Map 2

Town of Plum Lake
Vilas County, Wisconsin

Watershed Boundaries & Land Cover Types



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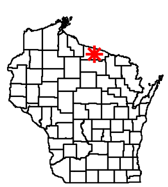
1,700
Feet



Project Location in Wisconsin

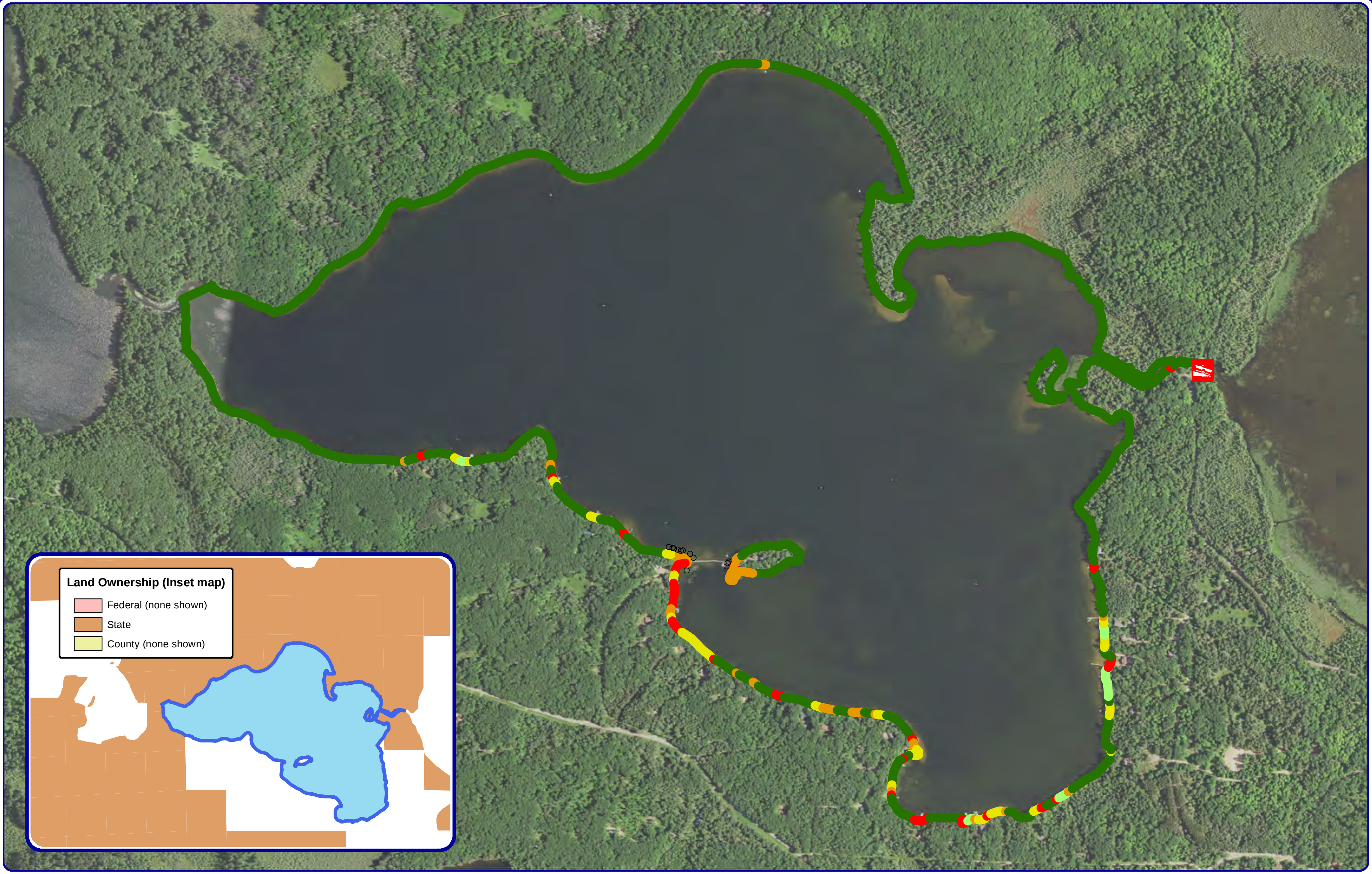
Legend

Land Cover Types

- Forest
- Forested Wetlands
- Wetlands
- Open Water
- Rural Open Space
- Pasture/Grass
- Rural Residential
- Ballard Lake Direct Watershed Boundary
- Subwatershed Boundary

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Orthophotography: NAIP 2015
Land Cover: NLCD 2011
Watershed Boundaries: Onterra 2019
Map Date: July 19, 2019 AMS
Filename: *Ballard_WS_2019.mxd*



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Feet

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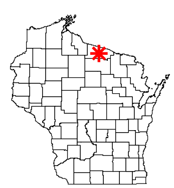
Sources
Hydro: WDNR
Shoreland Assessment: Onterra, 2018
Orthophotography: NAIP, 2017
Map date: November 13, 2018, 2018 AMS
Filename: Ballard_SA_Oct18.mxd



Project Location in Wisconsin

Legend

- Natural/Undeveloped
- Developed-Natural
- Developed-Semi-Natural
- Developed-Unnatural
- Urbanized

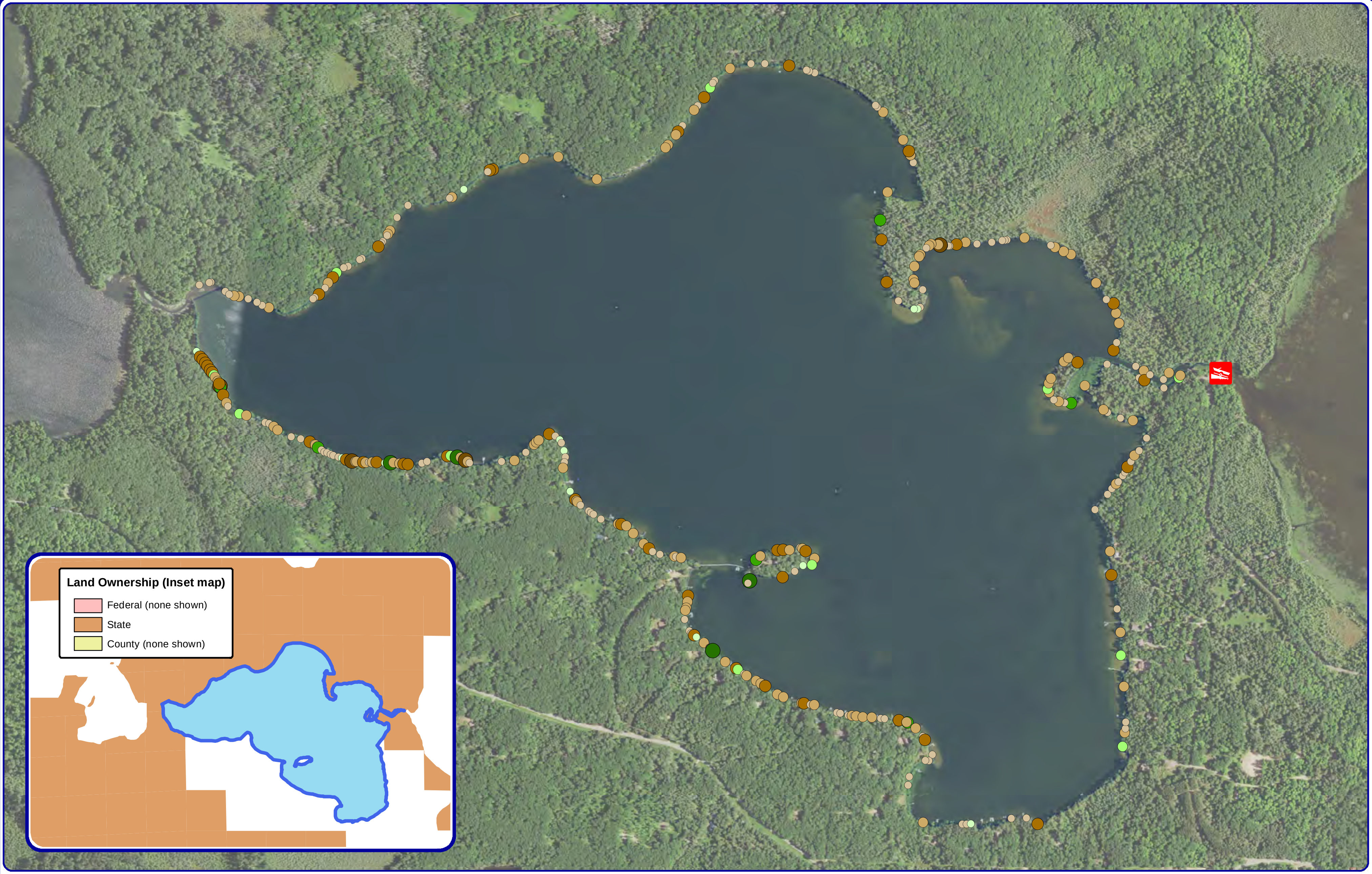
Seawall Modifier

- Masonary/Metal/Wood
- Rip-Rap

Ballard Lake - Map 3

Town of Plum Lake
Vilas County, Wisconsin

Shoreland Condition Assessment



1,000

Feet

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Lake Management Planning
815 Prosper Rd
De Pere, WI 54115
920.338.8860
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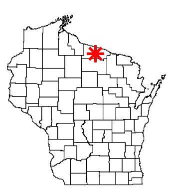
Sources
Hydro: WDNR
CWH Survey: Onterra, 2018
Orthophotography: NAIP, 2017
Map date: November 15, 2018 AMS
Filename: Ballard_CWH_Oct18.mxd



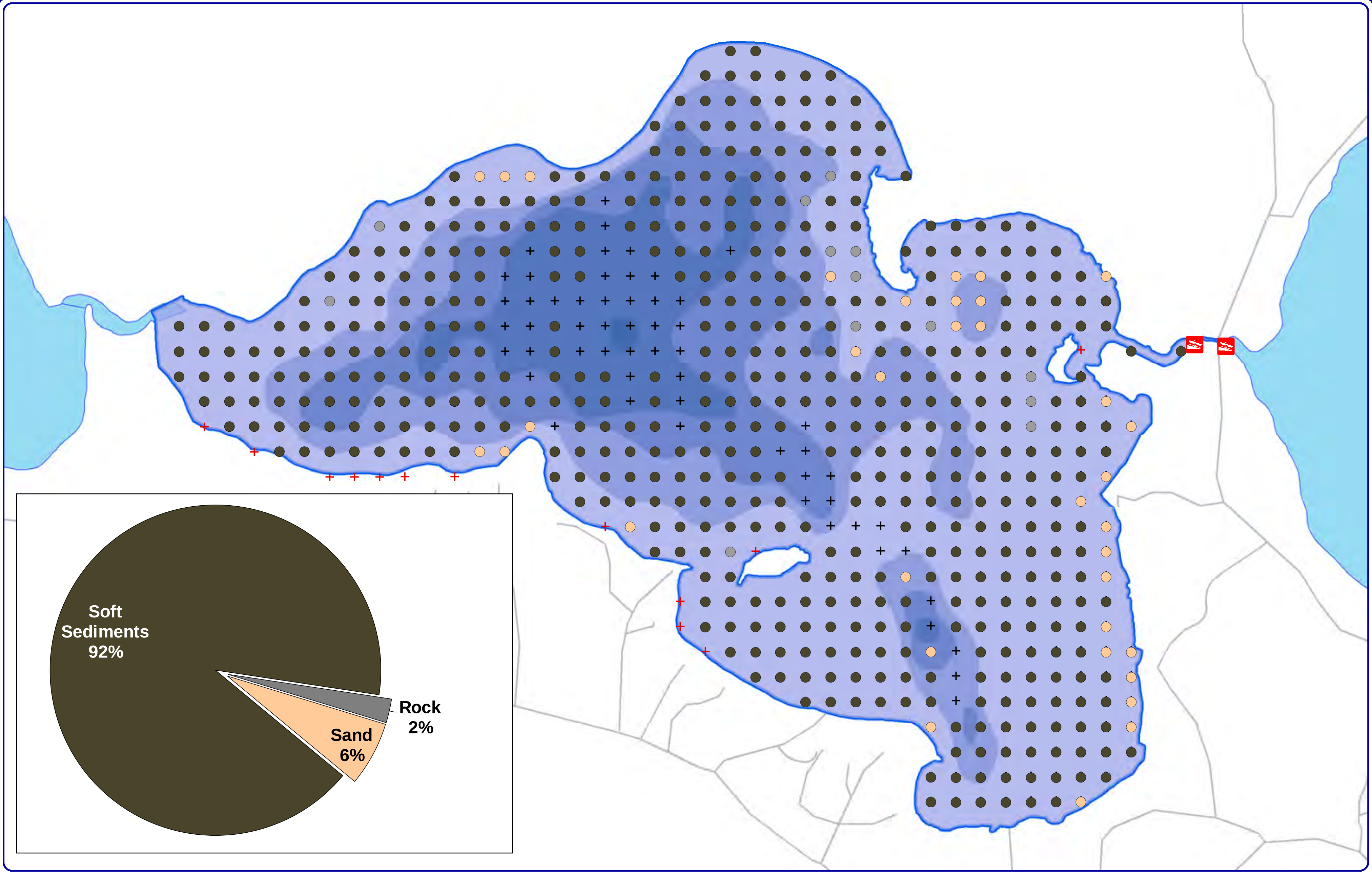
Project Location in Wisconsin

Legend

2-8 Inch Pieces	8+ Inch Pieces	Cluster of Pieces
No Branches	No Branches	No Branches
Minimal Branches	Minimal Branches	Minimal Branches
Moderate Branches	Moderate Branches	Moderate Branches
Full Canopy	Full Canopy	Full Canopy

Ballard Lake - Map 4
Town of Plum Lake
Vilas County, Wisconsin

Coarse Woody Habitat



960
Feet

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815 Prosper Road
De Pere, WI 54115
920.338.8860
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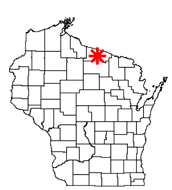
Sources:
Hydro and Roads: WDNR
Bathymetry: WDNR, digitized by Onterra
Aquatic Plant Survey: Onterra, 2018
Map Date: July 19, 2019 AMS
Filename: Ballard_SubstratePI_2018.mxd



Project Location in Wisconsin

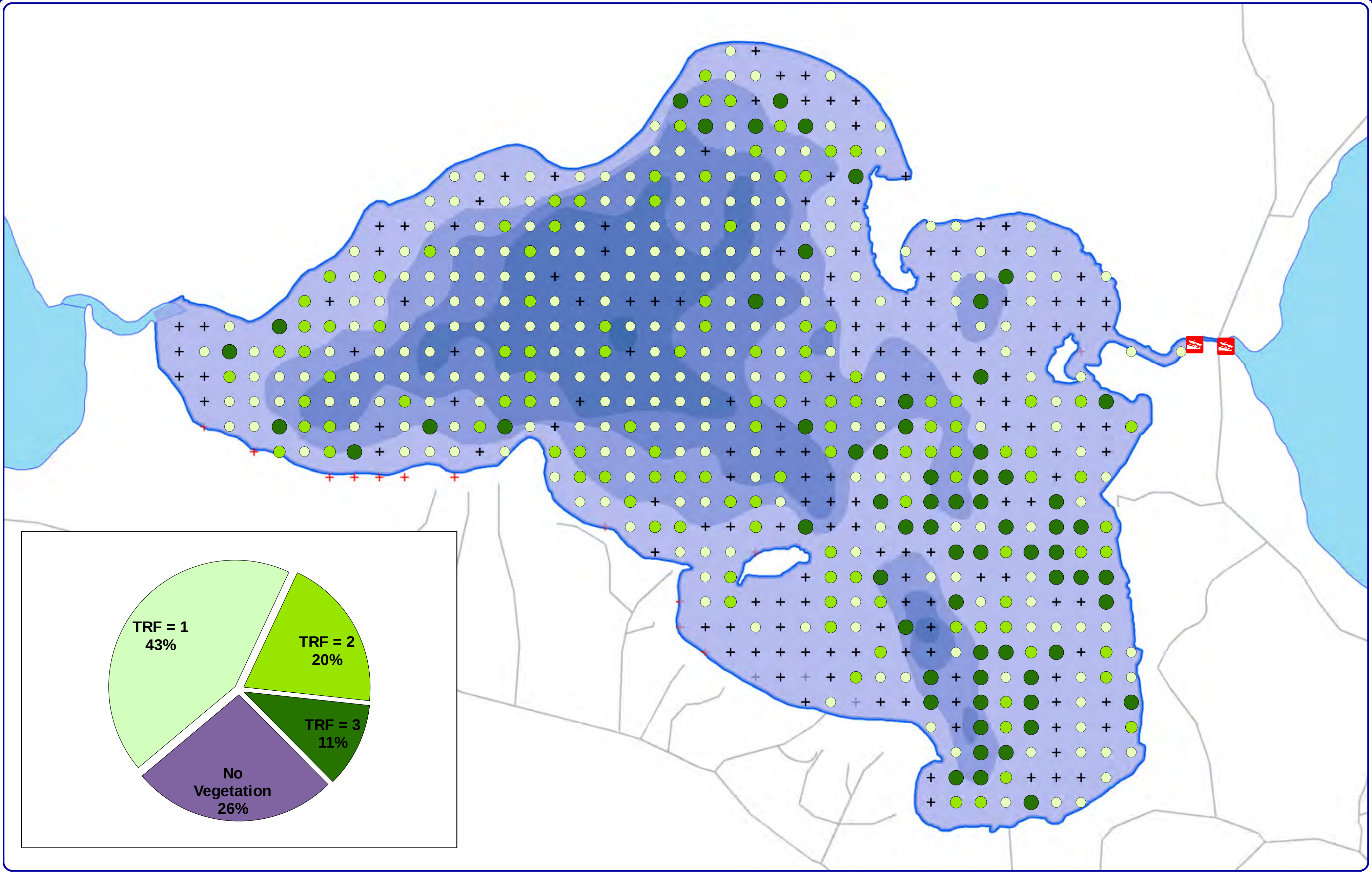
Legend

- Soft/Organic Sediments
- Rock
- Sand
- Too Deep
- Non-navigable

Ballard Lake- Map 5

Town of Plum Lake
Vilas County, Wisconsin

2018 PI Survey: Substrate Types



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Feet

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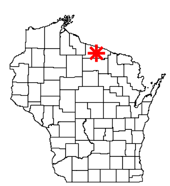
Sources:
Hydro and Roads: WDNR
Bathymetry: WDNR, digitized by Onterra
Aquatic Plant Survey: Onterra, 2017
Map Date: July 8, 2019
Filename: Ballard_TRFPI_2018.mxd


Project Location in Wisconsin

Legend

- Total Rake Fullness = 1
- Total Rake Fullness = 2
- Total Rake Fullness = 3
- + No Vegetation
- + Non-Navigable

Ballard Lake - Map 6
Town of Plum Lake
Vilas County, Wisconsin

2018 PI Survey: Aquatic Vegetation Distribution

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1,000
Feet

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De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources
Hydro: WDNR
Aquatic Plants: Onterra, 2018
Orthophotography: NAIP, 2017
Map date: December 20, 2018 AMS
Filename: Ballard_Comm_2018.mxd

Legend

Small Plant Communities
- Emergent
- Floating-leaf
- Mixed Floating-leaf & Emergent

Purple Loosestrife
(2020, citizen reported and removed)

Large Plant Communities
- Emergent
- Floating-leaf
- Mixed Floating-leaf & Emergent

Ballard Lake - Map 7
Town of Plum Lake
Vilas County, Wisconsin
Emergent & Floating-leaf Aquatic Plant Communities