8.7 Lake Laura

An Introduction to Lake Laura

Lake Laura, Vilas County, is a 619-acre oligotrophic deep seepage lake with a maximum depth of 43 feet and a mean depth of 22 feet (Lake Laura – Map 1). Its watershed encompasses approximately 2,027 acres within the Manitowish River Watershed and is comprised mainly of intact forests and wetlands. In 2018, 40 native aquatic plant species were located within the lake, of which stoneworts (*Nitella* spp.) and muskgrasses (*Chara* spp.) were the most common.

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	Purple Loosestife (Citizen-located & removed)
Average Conservatism	7.1
Floristic Quality	36.3
Simpson's Diversity (1-D)	0.7

Descriptions of these parameters can be found within the town-wide portion of the management plan

8.7.1 Lake Laura Water Quality

Water quality data was collected from Lake Laura 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 were researched and are included within this report as available.

Near-surface total phosphorus data from Lake Laura are available from 1979, 1989, and 2018 (Figure 8.7.1-1). Only one sample was collected in 1979, so it may not represent a true summer average. The weighted summer average total phosphorus concentration across the three years of available data is 9.5 µg/L and falls into the *excellent* category for deep seepage lakes in Wisconsin. Lake Laura's summer average total phosphorus concentrations are lower than the median value for deep seepage lakes in the state and below than the median value for all lake types in the Northern Lakes and Forests (NLF) ecoregion.

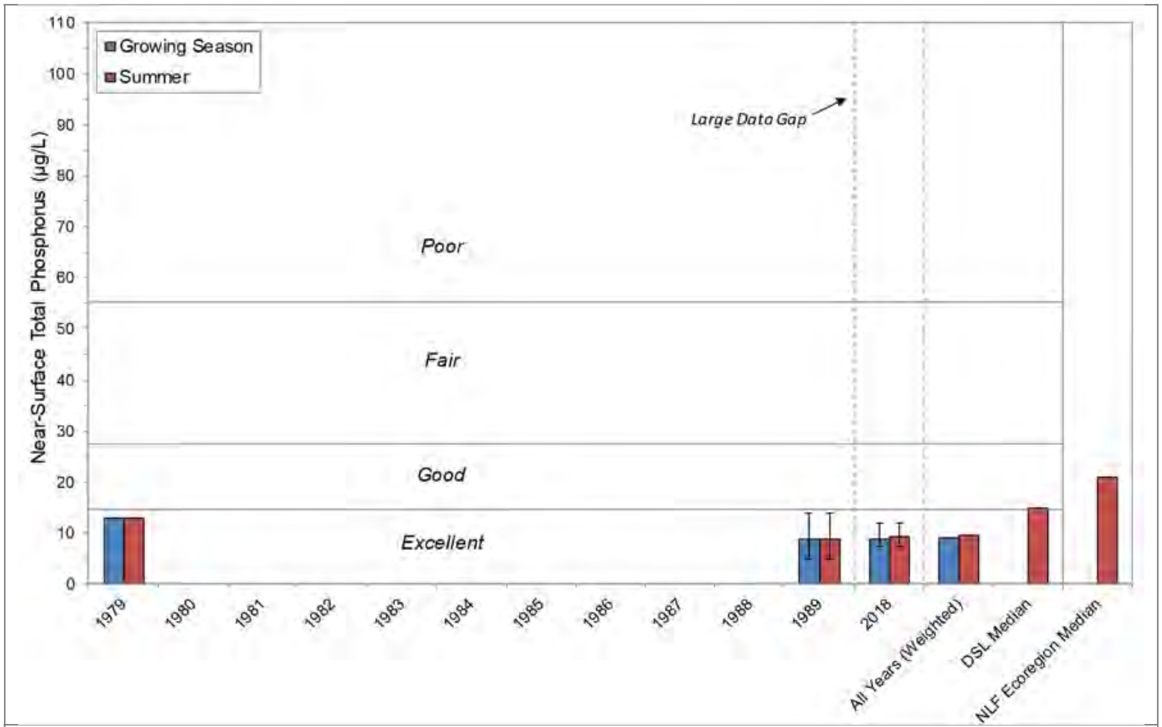


Figure 8.7.1-1. Lake Laura, statewide deep seepage lakes, and regional total phosphorus concentrations. Median values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Chlorophyll-*a* data are available from Lake Laura from 1979, 1989, and 2018 (Figure 8.7.1-2). Average summer chlorophyll-*a* concentrations ranged from 1.6 µg/L in 1979 to 2.3 µg/L in 1989; however, only one chlorophyll-*a* measurement was taken in 1979 and may not be representative of the summer average. The lowest chlorophyll- *a* value measured was 0.9 µg/L in 2018. Lake Laura's summer weighted average chlorophyll-*a* concentration is 1.6 µg/L and falls into the *excellent* category for deep seepage lakes in Wisconsin. Lake Laura's summer average chlorophyll-*a* concentrations are lower than the median value for deep seepage lakes in the state and below the median value for all lake types in the NLF ecoregion.

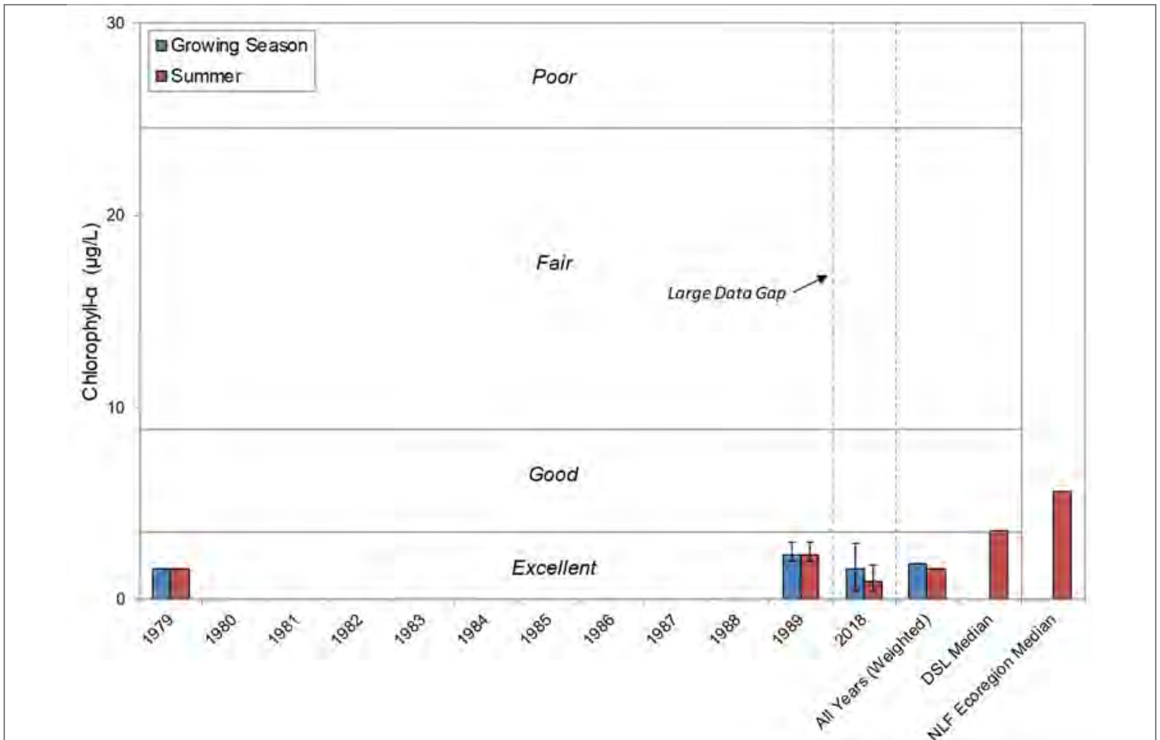


Figure 8.7.1-2. Lake Laura, statewide deep seepage lakes, and regional chlorophyll-*a* concentrations. Median values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Secchi disk transparency data are available from Lake Laura from 1979 and 2018 (Figure 8.7.1-3). The weighted summer average Secchi disk depth is 16.8 feet and falls into the *excellent* category for deep seepage lakes in Wisconsin. Lake Laura's weighted summer average Secchi disk depth is approximately 5.6 feet deeper than the median value for deep seepage lakes in the state and is approximately 7.9 feet deeper than the median value for all lakes types in the NLF ecoregion.

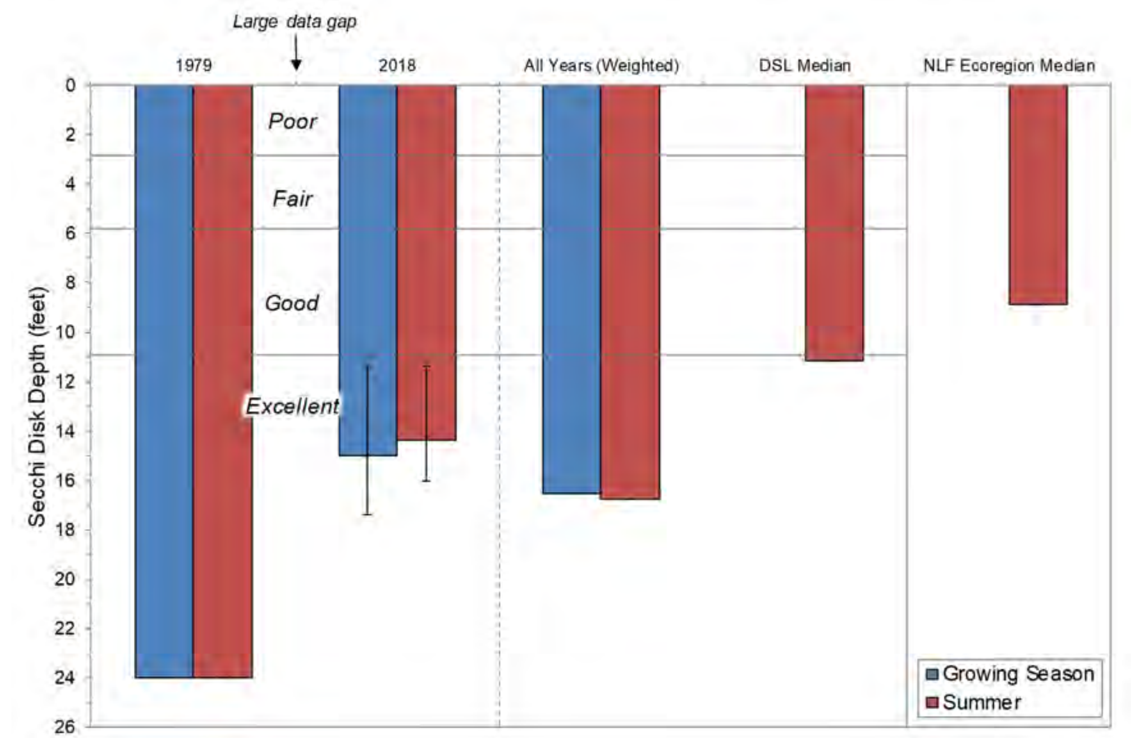


Figure 8.7.1-3. Lake Laura, statewide deep seepage lakes, and regional Secchi disk clarity values. Median values calculated with summer month sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Limiting Plant Nutrient of Lake Laura

Using midsummer nitrogen and phosphorus concentrations from Lake Laura, a nitrogen:phosphorus ratio of 36:1 was calculated. This finding indicates that Lake Laura 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.

Lake Laura Trophic State

Figure 8.7.1-4 contains the Trophic State Index (TSI) values for Lake Laura. 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 other factors other than phytoplankton such as dissolved organic compounds. The closer the calculated TSI values are 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 Lake Laura indicate the lake is at present in an oligotrophic state. Lake Laura's productivity is lower when compared to other deep seepage lakes in Wisconsin and all lake types within the NLF ecoregion.

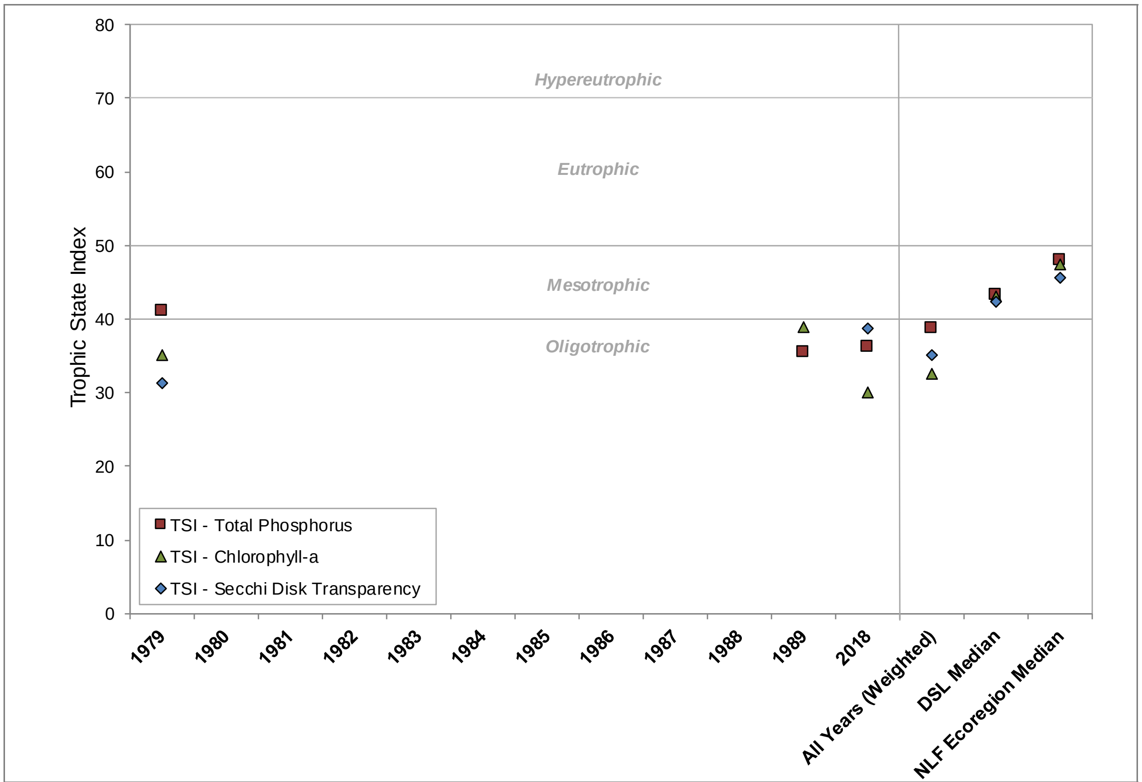


Figure 8.7.1-4. Lake Laura, statewide deep seepage lakes, and regional Trophic State Index values. Values calculated with summer month surface sample data using WDNR PUB-WT-193.

Dissolved Oxygen and Temperature in Lake Laura

Dissolved oxygen and temperature were measured during water quality sampling visits to Lake Laura by Onterra staff. Profiles depicting these data are displayed in Figure 8.7.1-5.

Lake Laura is *dimictic*, meaning the lake remains stratified during the summer (and winter) and completely mixes, or turns over, once in spring and once in fall. During the summer, the surface of the lake warms and becomes less dense than the cold layer below, and the lake thermally stratifies. Given Lake Laura's deeper nature, wind and water movement are not sufficient during the summer to mix these layers together, only the warmer upper layer will mix. The stratification in Lake Laura results in an unusual profile on June 27, 2018 when the highest oxygen concentrations occurred in the deepest waters of the lake. This is because cooler water is able to have higher dissolved oxygen concentrations. Because of the excellent water quality conditions of the lake, oxygen depletion rates in the deep water are slow allowing oxygen to be retained in the deep waters. By late July enough oxygen had been consumed in the deepest water so that the highest oxygen levels no longer occurred in the deepest waters but concentrations remained the higher in the hypolimnion compared with the surface waters. The bottom waters never became anoxic which again indicates the excellent water quality condition of the lake.

In fall, as surface temperatures cool, the entire water column is again able to mix, which re-oxygenates the hypolimnion. During the winter, the coldest temperatures are found just under the overlying ice, while oxygen gradually declines once again towards the bottom of the lake. In February of 2018, oxygen concentrations remained above 2.0 mg/L throughout the majority of the water column, indicating that fishkills as a result of winter anoxia are likely not a concern in Lake Laura.

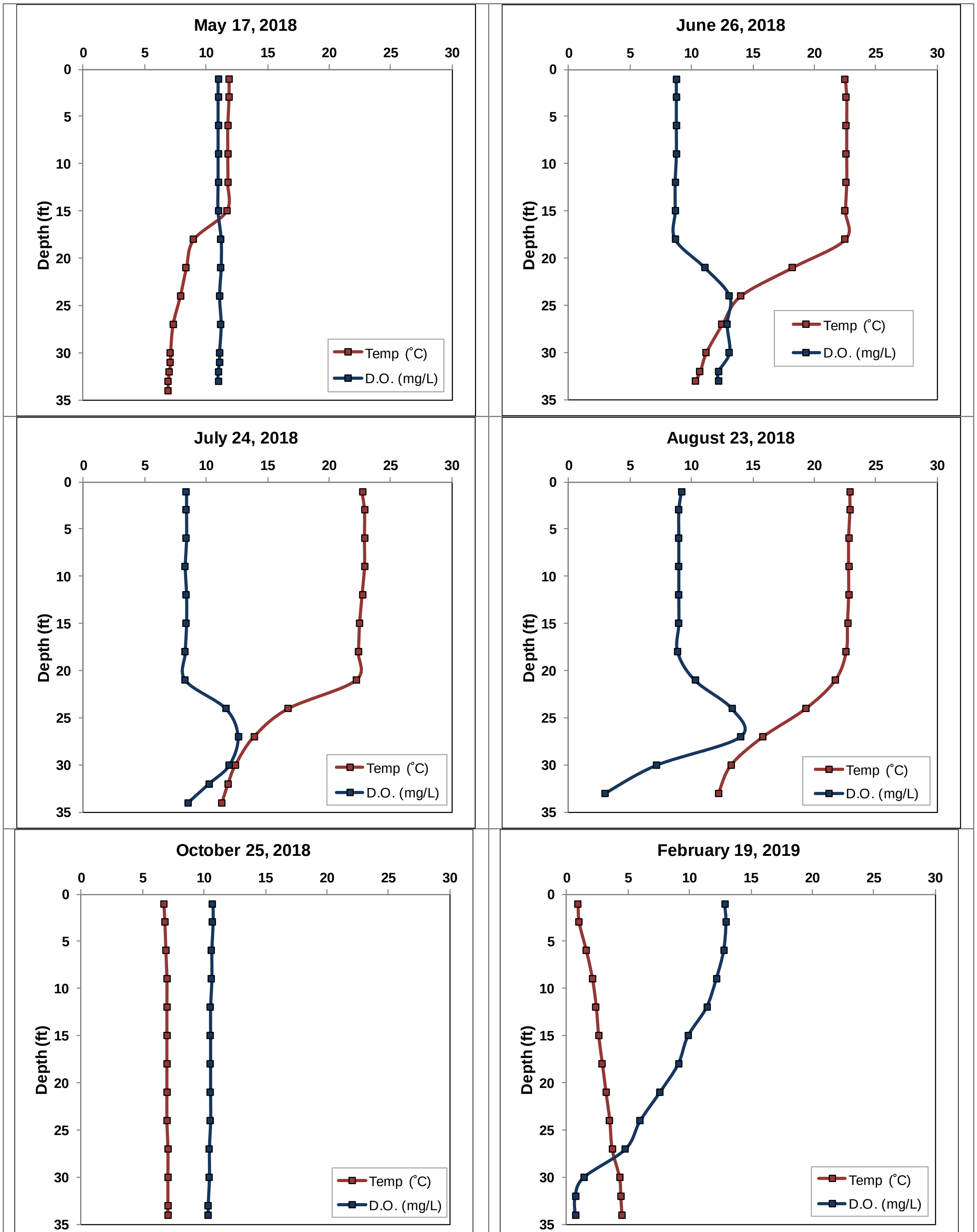


Figure 8.7.1-5. Lake Laura 2018-2019 dissolved oxygen and temperature profiles.

8.7.2 Lake Laura Watershed Assessment

Lake Laura's watershed encompasses an area of approximately 2,027 acres, yielding a very small watershed to lake area ratio of 2:1 (Figure 8.7.2-1, Lake Laura – Map 2). According to WiLMS modeling, the lake's water residence time is 7.2 years, meaning the lake water is replaced approximately 0.14 times per year (flushing rate).

Approximately 59% of Lake Laura's watershed is composed of forest, 31% of the lake's surface, 8% of wetlands, 2% of pasture/grass, and <1% of shoreland development (Figure 8.7.2-1).

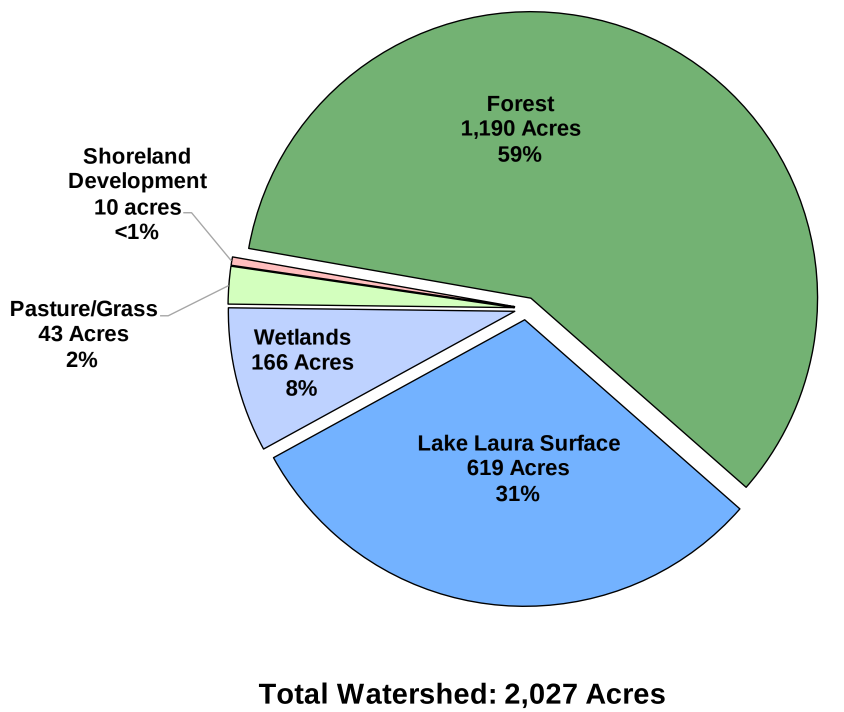


Figure 8.7.2-1. Lake Laura watershed land cover types in acres. Based upon National Land Cover Database (NLCD – Fry et. al 2011).

Using the land cover data described above, WiLMS was utilized to estimate the annual potential phosphorus load from Lake Laura's watershed. It was estimated that approximately 294 pounds of phosphorus is delivered to Lake Laura from its watershed on an annual basis (Figure 8.7.2-2).

Of the estimated 294 pounds of phosphorus being delivered annually to Lake Laura, 165 pounds (56%) is estimated to originate from direct atmospheric deposition into the lake, 95 pounds (32%) from forest, 15 pounds (5%) from wetlands, 11 pounds (4%) from pasture/grass, 4 pounds (2%) from shoreland development, and 3 pounds (<1%) from riparian septic systems (Figure 8.7.2-2).

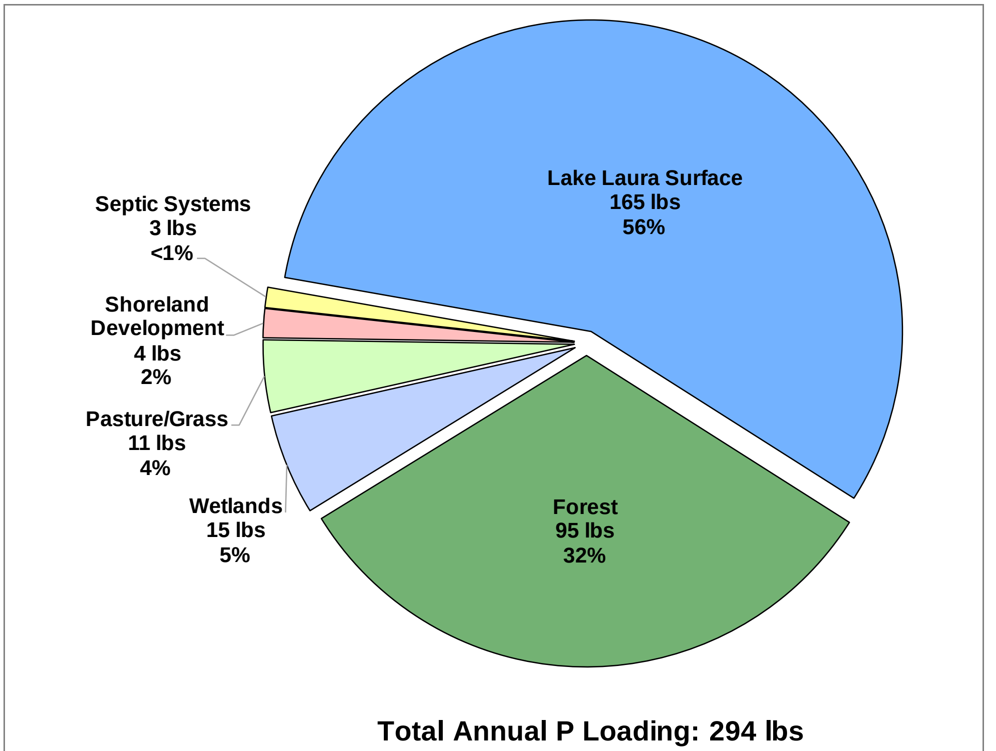


Figure 8.7.2-2. Lake Laura watershed phosphorus loading in pounds. Based upon Wisconsin Lake Modeling Suite (WiLMS) estimates.

Using predictive equations, WiLMS estimated that based on the 294 pounds of phosphorus which are estimated to be loaded to Lake Laura annually, the lake should have an in-lake growing season mean (GSM) total phosphorus concentration of approximately 14 µg/L. This predicted GSM total phosphorus concentration slightly higher than the measured value of 9 µg/L. This indicates there are not any unaccounted for phosphorus sources. The predicted value is close enough to the measured concentration that the model can be used for planning purposes.

8.7.3 Lake Laura 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, Lake Laura's immediate shoreline was assessed in terms of its development. Lake Laura has stretches of shoreland that fit all of the five shoreland assessment categories. In all, 4.7 miles of natural/undeveloped and developed-natural shoreline were observed during the survey (Figure 8.7.3-1). This constitutes about 90% of Lake Laura'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, 0.3 miles of urbanized and developed–unnatural shoreline (6%) was observed. If restoration of the Lake Laura 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. Lake Laura - Map 3 displays the location of these shoreline lengths around the entire lake.

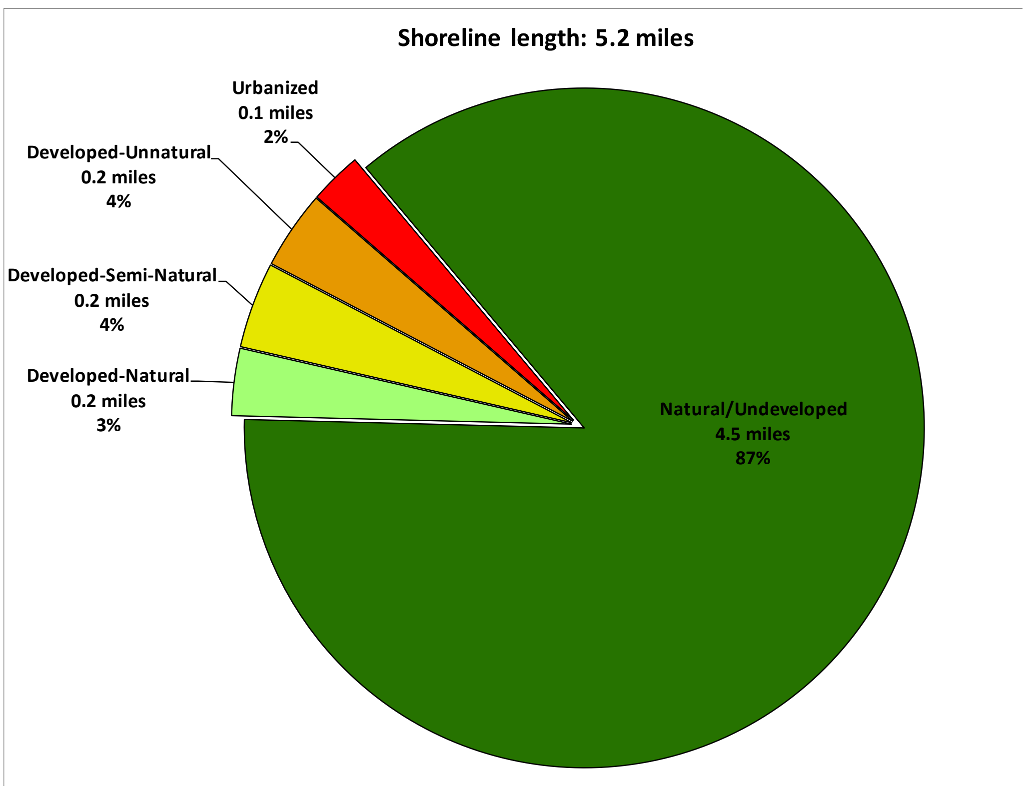


Figure 8.7.3-1. Lake Laura shoreland categories and total lengths. Based upon a fall 2018 survey. Locations of these categorized shorelands can be found on Lake Laura - Map 3.

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, 77 total pieces of coarse woody habitat were observed along 5.2 miles of shoreline (Lake Laura - Map 4), which gives Lake Laura a coarse woody habitat to shoreline mile ratio of 15:1 (Figure 8.7.3-2). Only instances where emergent coarse woody habitat extended from shore into the water were recorded during the survey. Of the 77 total pieces of coarse woody habitat observed during the survey, 50 pieces were 2-8 inches in diameters, 27 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 Lake Laura 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 Lake Laura fell below the 75th percentile of these 98 lakes (Figure 8.7.3-2).

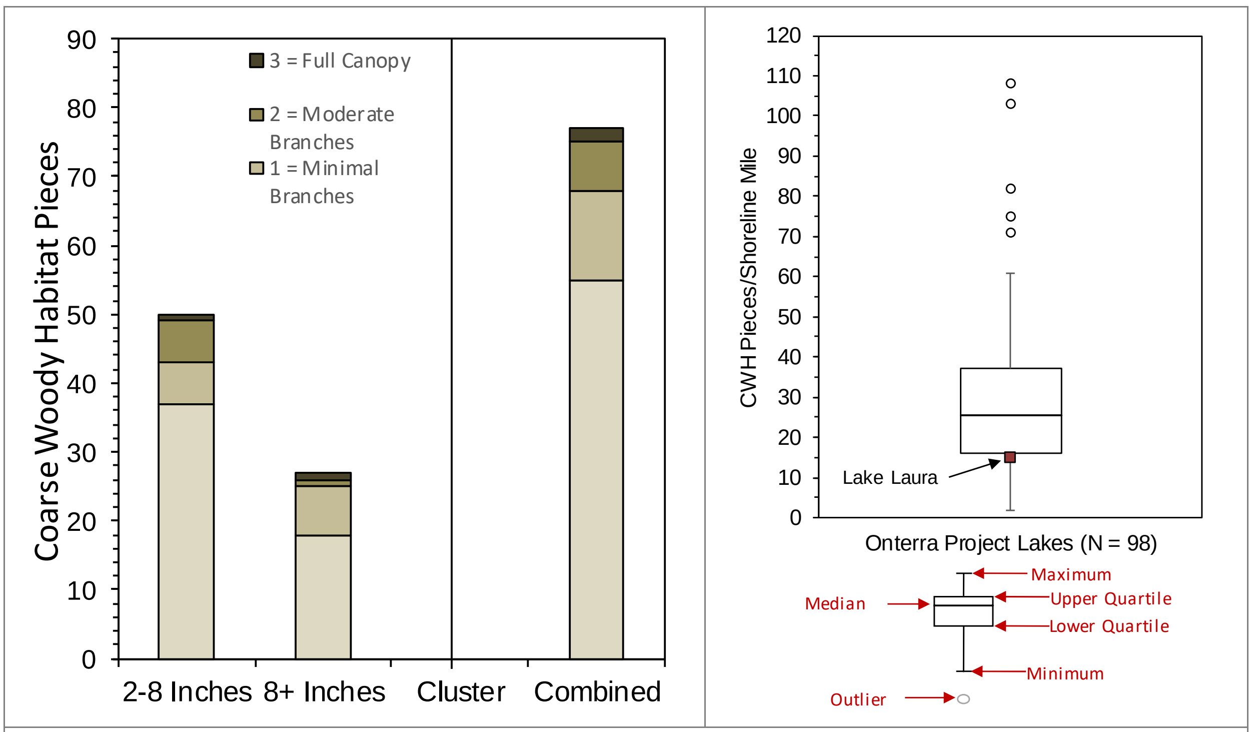


Figure 8.7.3-2. Lake Laura coarse woody habitat survey results. Based upon a fall 2018 survey. Locations of Lake Laura coarse woody habitat can be found on Lake Laura - Map 4.

8.7.4 Lake Laura Aquatic Vegetation

An Early-Season Aquatic Invasive Species (ESAIS) Survey was conducted by Onterra ecologists on Lake Laura on June 26-27, 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 or other exotic plants were located during the ESAIS survey in 2018.

Photograph 8.5.4-1. Lake Laura

The whole-lake aquatic plant point-intercept survey and emergent and floating-leaf aquatic plant community mapping survey were conducted on Lake Laura by Onterra ecologists on July 24-25, 2018. During these surveys, a total of 40 native aquatic plant species were located (Table 8.7.4-1).

As discussed in the primer section, sediment data were collected at each sampling location within the littoral zone during the point-intercept survey. Approximately 53% of the point-intercept locations within littoral areas contained fine, organic sediments (muck), 37% contained sand, and 10% contained rock (Figure 8.7.4-1; Lake Laura - Map 5). 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 the different habitat types that are available.

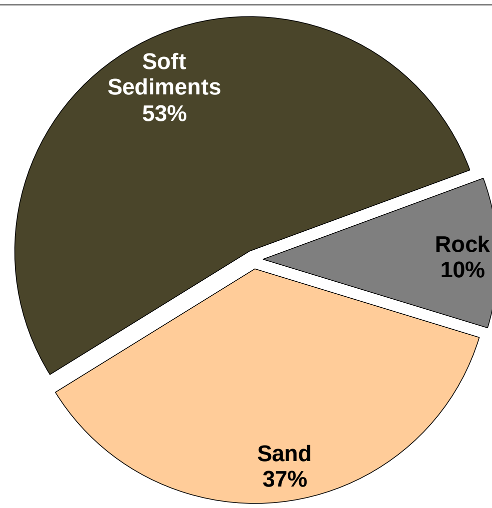


Figure 8.7.4-1. Lake Laura 2018 proportion of substrate types. Created from data collected during the 2018 whole-lake point-intercept survey (N = 203).

Table 8.7.4-1. List of aquatic plant species located in Lake Laura during Onterra 2018 aquatic plant surveys.

Lake Laura

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2018 (Onterra)
Emergent	*Carex aquatilis*	Long-bracted tussock sedge	7	I
	Carex sp. (sterile)	Sedge sp. (sterile)	N/A	I
	Cladium mariscoides	Smooth sawgrass	N/A	I
	Calamagrostis canadensis	Bluejoint grass	5	I
	Dulichium arundinaceum	Three-way sedge	9	I
	Eleocharis palustris	Creeping spikerush	6	X
	Glyceria borealis	Northern manna grass	8	I
	Phragmites australis subsp. americanus	Common reed	5	I
	Schoenoplectus acutus	Hardstem bulrush	5	I
	Schoenoplectus tabernaemontani	Softstem bulrush	4	I
	Scirpus cyperinus	Wool grass	4	I
	Typha spp.	Cattail spp.	1	I
FL	*Brasenia schreberi*	Watershield	7	X
	Nuphar variegata	Spatterdock	6	I
	Nymphaea odorata	White water lily	6	I
	Persicaria amphibia	Water smartweed	5	I
	Sparganium angustifolium	Narrow-leaf bur-reed	9	I
Submergent	*Chara spp.*	Muskgrasses	7	X
	Eriocaulon aquaticum	Pipewort	9	X
	Elodea canadensis	Common waterweed	3	X
	Isoetes echinospora	Spiny-spored quillwort	8	I
	Lobelia dortmanna	Water lobelia	10	X
	Myriophyllum alterniflorum	Alternate-flowered watermilfoil	10	X
	Myriophyllum sibiricum	Northern watermilfoil	7	X
	Myriophyllum tenellum	Dwarf watermilfoil	10	X
	Najas flexilis	Slender naiad	6	X
	Nitella spp.	Stoneworts	7	X
	Potamogeton strictifolius	Stiff pondweed	8	X
	Potamogeton praelongus	White-stem pondweed	8	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X
	Potamogeton berchtoldii	Slender pondweed	7	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X
	Potamogeton robbinsii	Fern-leaf pondweed	8	X
	Potamogeton gramineus	Variable-leaf pondweed	7	X
	Ranunculus flammula	Creeping spearwort	9	X
	Utricularia gibba	Creeping 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 cuneata	Arum-leaved arrowhead	7	X

FL = Floating Leaf; FL/E = Floating Leaf and Emergent; S/E = Submergent and Emergent; FF = Free Floating
X = Located on rake during point-intercept survey; I = Incidental Species

Of the 512 point-intercept sampling locations that fell at or below the maximum depth of plant growth in 2018, approximately 52% contained aquatic vegetation. Lake Laura – Map 6 displays the point-intercept locations that contained aquatic vegetation in 2018, and the total rake fullness ratings at those locations. Thirty-eight percent of the point-intercept locations had a total rake fullness (TRF) rating of 1, 8% had a total rake fullness rating of 2, and 6% had the highest total rake fullness rating of 3 (Figure 8.7.4-2). Forty-eight percent of the littoral zone had no vegetation. With such high percentages of points with either no vegetation or the lowest TRF rating of 1, this means that where plants are found in Lake Laura, they are quite sparse.

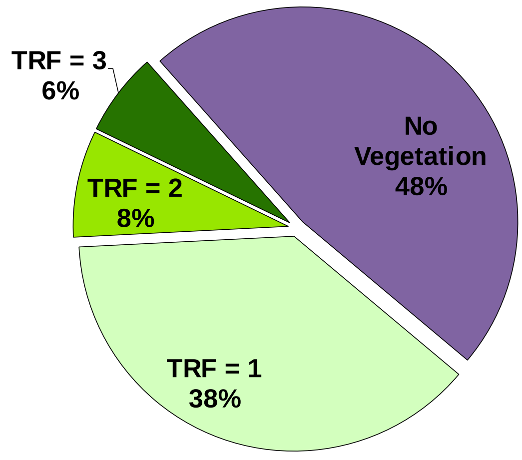


Figure 8.7.4-2. Lake Laura 2018 aquatic vegetation total rake fullness ratings (TRF). Created from data collected during the 2018 whole-lake point-intercept survey (N = 512).

Of the 40 native aquatic plant species located in Lake Laura in 2018, 24 were encountered directly on the rake during the whole-lake point-intercept survey (Figure 8.7.4-3). The remaining 16 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 24 species directly sampled with the rake during the point-intercept survey, stoneworts, muskgrasses, wild celery, and slender naiad were the four most frequently encountered plants, respectively (Figure 8.7.4-3).

Stoneworts were the most abundant aquatic plant encountered in 2018 in Lake Laura, with a littoral occurrence of 19% (Figure 8.7.4-3). Stoneworts are a species of macroalgae rather than a vascular plant. Whorls of forked branches are attached to the “stems” of the plant, which are long, slender, smooth-textured algae. Because they lack roots, stoneworts remove nutrients directly from the water.

Muskgrasses, like stoneworts, are a genus of macroalgae of which there are seven species in Wisconsin (Photograph 8.7.4-2). In 2018, muskgrasses had the second highest littoral frequency of occurrence of approximately 12.5% in Lake Laura (Figure 8.7.4-3). Dominance of the aquatic plant community by muskgrasses is common in hardwater lakes and these macroalgae have been found to more competitive against vascular plants (e.g. pondweeds, milfoils, etc.) in lakes with higher concentrations of calcium carbonate in the sediment (Kufel and Kufel 2002; Wetzel 2001). Muskgrasses require lakes with good water clarity, and their large beds stabilize bottom

Photograph 8.7.4-2. The aquatic macroalgae muskgrasses (*Chara* spp.) Photo credit Onterra.

sediments. Studies have also shown that muskgrasses sequester phosphorus in the calcium carbonate encrustations which form on these plants, aiding in improving water quality by making the phosphorus unavailable to phytoplankton (Coops 2002). Muskgrasses were found growing at a depth of 35 feet in Lake Laura, and stoneworts were found growing up to a maximum depth of 37 feet. Comparatively, this is quite deep for plants to be found growing. Excluding muskgrasses and stoneworts, plants in Lake Laura were found growing at a maximum depth of 17 feet.

Wild celery, the third most abundant aquatic plant in Lake Laura in 2018 with a littoral occurrence of 9% (Figure 8.7.4-3), 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).

Slender naiad, the fourth most abundant aquatic plant in Lake Laura in 2018 with a littoral occurrence of 8% (Figure 8.7.4-3), 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.

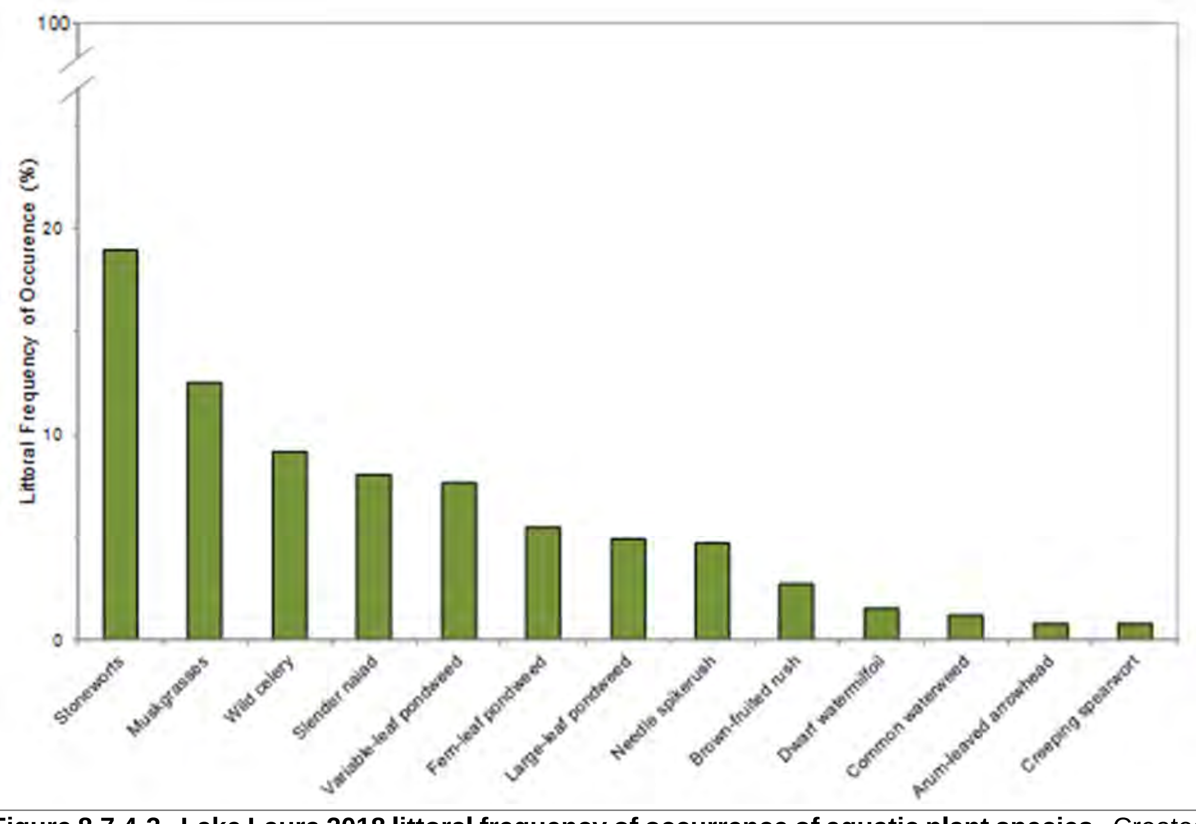


Figure 8.7.4-3. Lake Laura 2018 littoral frequency of occurrence of aquatic plant species. Created using data from 2018 whole-lake point-intercept survey. Species with a LFOO of at least 0.8% are shown.

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 Lake Laura's aquatic plant community (equation shown below).

$$FQI = \text{Average Coefficient of Conservatism} * \sqrt{\text{Number of Native Species}}$$

Figure 8.7.4-4 compares 2018 FQI components of Lake Laura 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 24 for the 2018 survey. Lake Laura's species richness is above the median value for lakes within the ecoregion and the state.

Lake Laura's average conservatism in 2018 was 7.3 (Figure 8.7.4-4). Lake Laura's average conservatism is slightly above the median values for lakes in the ecoregion and throughout Wisconsin, which indicates Lake Laura'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 Lake Laura's higher native species richness and average conservatism values from 2018, Lake Laura has a higher Floristic Quality Index value of 35.9. This FQI value is above the median values for lakes in the ecoregion and the state, and indicates that Lake Laura's aquatic plant community is of higher quality than the majority of lakes throughout Wisconsin.

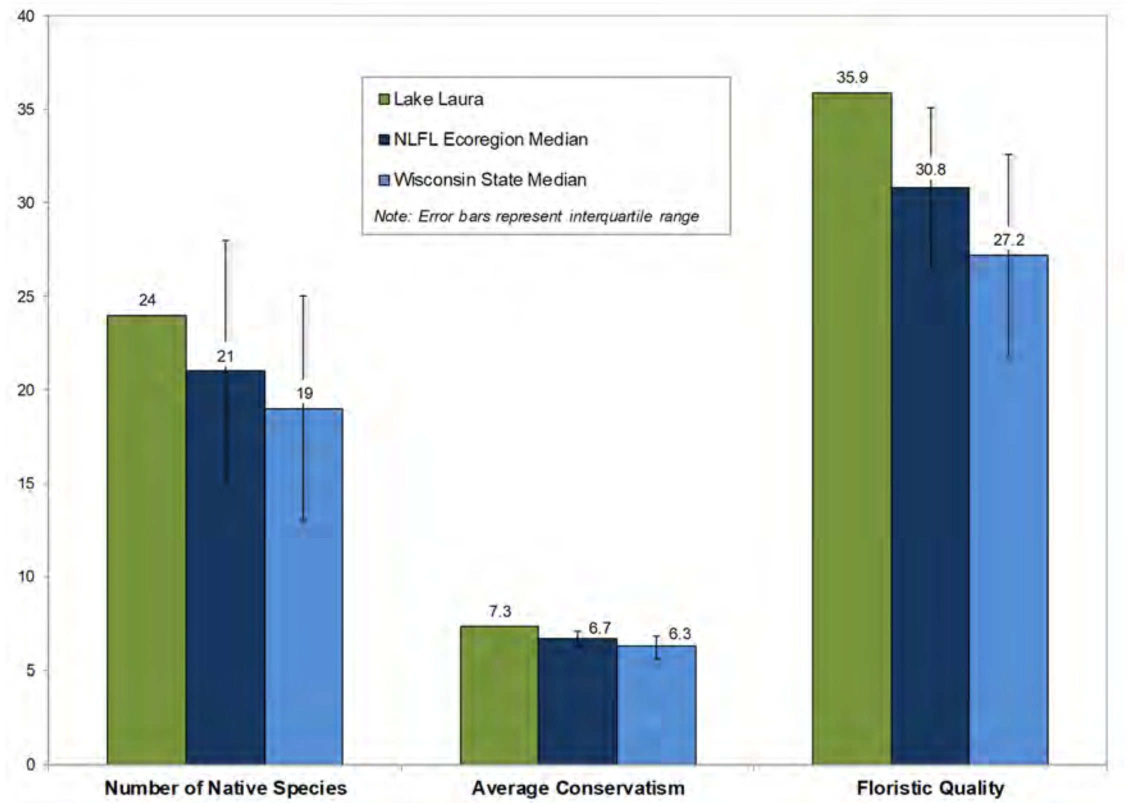


Figure 8.7.4-4. Lake Laura Floristic Quality Assessment. Created using data from Onterra 2018 whole-lake point-intercept survey. Analysis follows Nichols (1999).

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 Lake Laura 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.

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 Lake Laura's diversity value ranks. Using data collected by Onterra and WDNR Science Services, quartiles were calculated for 212 lakes within the NLF ecoregion (Figure 8.7.4-5). Using the data collected from the 2018 point-intercept survey, Lake Laura's aquatic plant community is shown to have average species diversity with a Simpson's Diversity Index value of 0.88. In other words, if two individual aquatic plants were randomly sampled from Lake Laura in 2018, there would be an 88% probability that they would be different species. This diversity value is the same as the median for the ecoregion and just slightly above the median for lakes throughout the state.

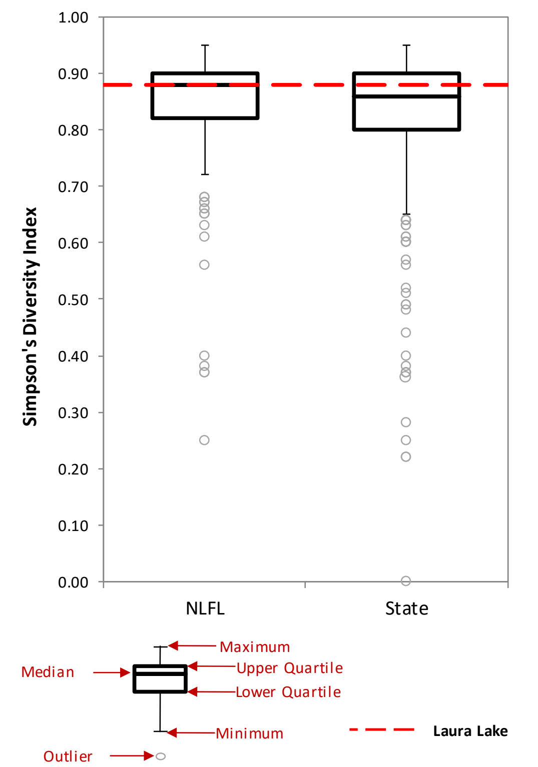


Figure 8.7.4-5. Lake Laura species diversity index. Created using data from the Onterra 2018 point-intercept survey.

One way to visualize Lake Laura's species diversity is to look at the relative occurrence of aquatic plant species. Figure 8.7.4-6 displays the relative frequency of occurrence of aquatic plant species created from the 2018 whole-lake point-intercept survey and illustrates the relatively even distribution of aquatic plant species within the community. A plant community that is

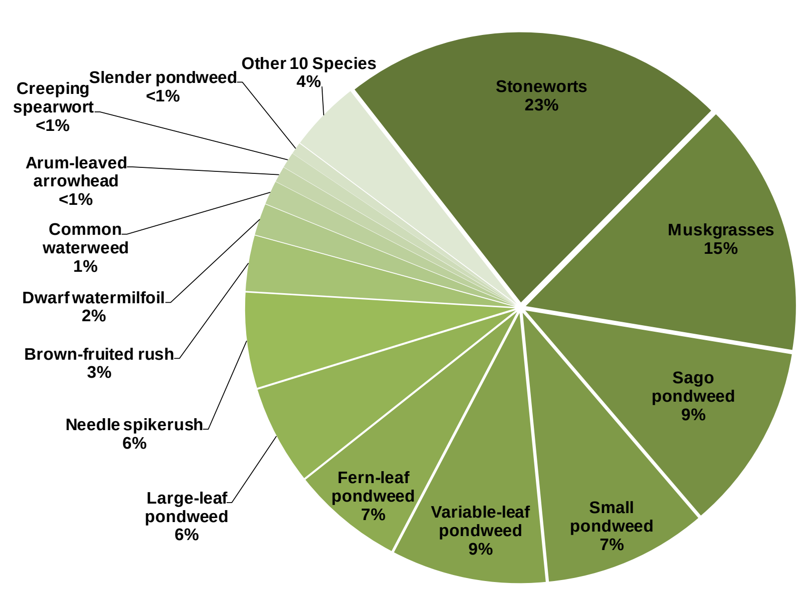


Figure 8.7.4-6. Lake Laura 2018 relative frequency of occurrence of aquatic plant species. Created using data from 2018 point-intercept survey.

dominated by just 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 stoneworts were found at 19% of the littoral sampling locations in Lake Laura in 2018, its relative frequency of occurrence is 23%. Explained another way, if 100 plants were randomly sampled from Lake Laura in 2018, 23 of them would be stoneworts. When a lake is dominated by just a few species, the diversity is affected, which would cause the lake to have a lower Simpson’s diversity index.

In 2018, Onterra ecologists also conducted a survey aimed at mapping emergent and floating-leaf aquatic plant communities in Lake Laura. This survey revealed Lake Laura contains approximately 23.7 acres of these communities comprised of 16 different aquatic plant species (Lake Laura – Map 7 and Table 8.7.4-2). 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 Lake Laura. This is important, because these communities are often negatively affected by recreational use and shoreland development.

Table 8.7.4-2. Lake Laura 2018 acres of emergent and floating-leaf aquatic plant communities. Created using data from 2018 aquatic plant community mapping survey.

Plant Community	Acres
Emergent	4.1
Floating-leaf	0.7
Mixed Emergent & Floating-leaf	19.0
Total	**23.7**

8.7.5 Aquatic Invasive Species in Lake Laura

As is discussed in section 2.0 Stakeholder Participation, the lake stakeholders were asked about aquatic invasive species (AIS) and their presence in Lake Laura within the anonymous stakeholder survey. The WDNR have confirmed that there are two AIS present (Table 8.7.5-1).

Table 8.7.5-1. AIS present within Lake Laura.

Type	Common name	Scientific name	Location within the report
Plants	Giant Reed	*Phragmites australis* subsp. *australis*	Section 3.5 – Aquatic Plants
Invertebrates	Banded Mystery Snail	*Viviparus georgianus*	Section 8.7.5 - Below

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

Giant Reed (aka Phragmites)

Giant reed (*Phragmites australis* subsp. *australis*) is a tall, perennial grass that was introduced to the United States from Europe. Giant reed forms towering, dense colonies that overtake native vegetation and replace it with a monoculture that provides inadequate sources of food and habitat for wildlife. This invasive species was verified at Lake Laura by the WDNR in 2018. A native strain (*P. australis* subsp. *americanus*) of this species also exists in Wisconsin and was identified on Lake Laura by Onterra during 2018 surveys. A voucher was collected by Onterra and sent for verification to the Robert Freckmann Herbarium where it was confirmed to be the native strain.

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). Banded mystery snails were confirmed by the WDNR to be present in Lake Laura in 2006.

8.7.6 Lake Laura 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 Lake Laura. 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).

Lake Laura 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 Lake Laura 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 8.7.6-1.

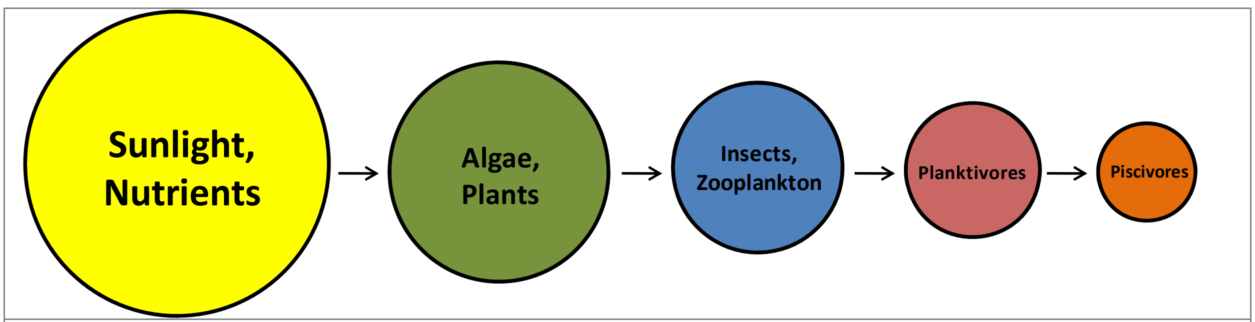


Figure 8.7.6-1. Aquatic food chain. Adapted from Carpenter et. al 1985.

As discussed in the Water Quality section, Lake Laura is oligotrophic, meaning it has high water clarity, but a low amount of nutrients and thus low primary productivity. Simply put, this means it is difficult for the lake to support a large population of predatory fish (piscivores) because the supporting food chain is relatively small. Table 8.7.6-1 shows the popular game fish present in the system. Although not an exhaustive list of fish species in the lake, additional fish species found in past WDNR surveys of Lake Laura include white sucker (*Catostomus commersonii*), bluntnose minnow (*Pimephales notatus*), mimic shiner (*Notropic volucellus*) and the Iowa darter (*Etheostoma flabellare*).

Table 8.7.6-1. Gamefish present in Lake Laura 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 8.7.6-1. 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 8.7.6-2). 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. Lake Laura was stocked from 1972 to 2018 with muskellunge, largemouth bass and walleye (Table 8.7.6-2).

Photograph 8.7.6-2. Fingerling Muskellunge.

Table 8.7.6-2. Stocking data available for Lake Laura (1972-2018).

Year	Species	Strain (Stock)	Age Class	# Fish Stocked	Avg Fish Length (in)
2018	Muskellunge	Upper Wisconsin River	Large Fingerling	149	11.6
2016	Muskellunge	Upper Wisconsin River	Large Fingerling	149	11.24
2014	Muskellunge	Upper Wisconsin River	Large Fingerling	150	11.3
2012	Muskellunge	Upper Wisconsin River	Large Fingerling	300	10.4
2008	Muskellunge	Upper Wisconsin River	Large Fingerling	299	10.3
2006	Muskellunge	Upper Wisconsin River	Large Fingerling	300	10.2
2002	Muskellunge	Unspecified	Large Fingerling	299	10.2
2000	Muskellunge	Unspecified	Large Fingerling	316	11.1
1998	Muskellunge	Unspecified	Large Fingerling	1,100	11.4
1996	Muskellunge	Unspecified	Fingerling	1,100	10.7
1993	Muskellunge	Unspecified	Fingerling	600	10
1992	Muskellunge	Unspecified	Fingerling	600	11
1991	Muskellunge	Unspecified	Fingerling	600	12
1989	Muskellunge	Unspecified	Fingerling	875	10
1987	Muskellunge	Unspecified	Fingerling	3,600	12
1985	Muskellunge	Unspecified	Fingerling	1,200	9
1972	Largemouth bass	Unspecified	Fingerling	1,500	3
1997	Walleye	Unspecified	Large Fingerling	13,872	2.1
1988	Walleye	Unspecified	Fingerling	10,000	4
1987	Walleye	Unspecified	Fingerling	42,360	1
1984	Walleye	Unspecified	Fingerling	4,180	3
1983	Walleye	Unspecified	Fingerling	3,280	2

Fishing Activity

Based on data collected from the stakeholder survey (Appendix B), fishing was the first most important reason for owning property on or near Lake Laura (Question #17). Figure 8.7.6-2 displays the fish that Lake Laura stakeholders enjoy catching the most, with smallmouth bass and walleye being the most popular. Approximately 31% of these same respondents believed that the quality of fishing on the lake was either good, fair or poor (Figure 8.7.6-3). Approximately 69%

of respondents who fish Lake Laura believe the quality of fishing has remained the same or is somewhat worse since they first started fishing the lake (Figure 8.7.6-4).

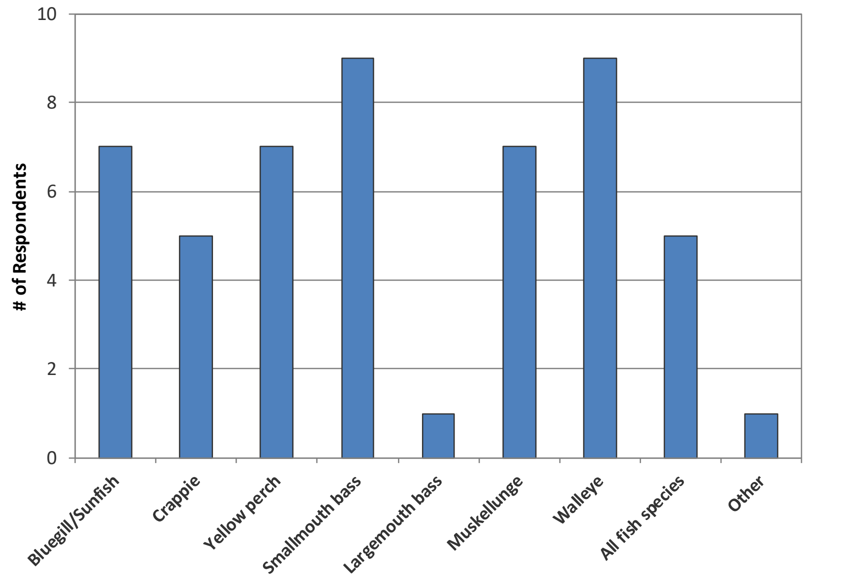


Figure 8.7.6-2. Stakeholder survey response Question #11. *What species of fish do you like to catch on Lake Laura?*

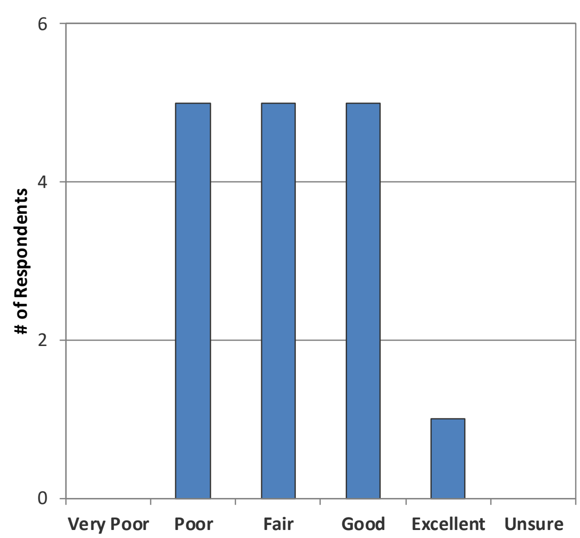


Figure 8.7.6-3. Stakeholder survey response Question #12. *How would you describe the current quality of fishing on Lake Laura?*

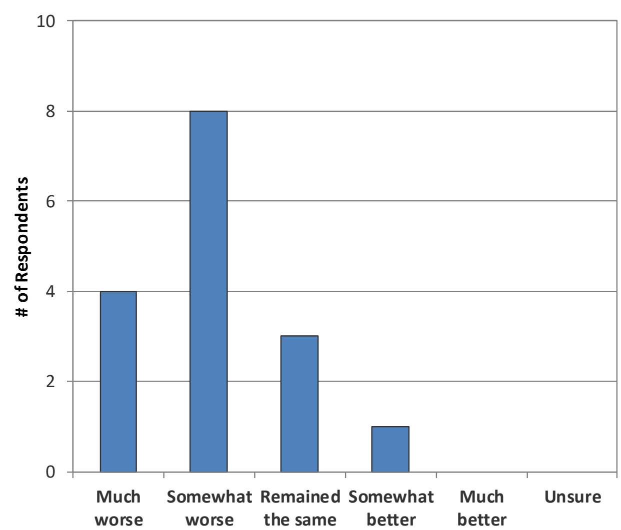


Figure 8.7.6-4. Stakeholder survey response Question #13. *How has the quality of fishing changed on Lake Laura since you started fishing the lake?*

The WDNR measures sport fishing harvest by conducting creel surveys. A Creel Survey Clerk will count the number of anglers present on a lake and interview anglers who have completed fishing for the day. Data collected from the interviews include targeted fish species, harvest, lengths of harvested fish and hours of fishing effort. Creel clerks will work on randomly-selected days and shifts to achieve a randomized census of the fish being harvested. A creel survey was completed on Lake Laura during the 1998-99 and 2016-17 fishing seasons (Table 8.7.6-3).

Total angler effort was somewhat higher in 2016-17 (12.6 hours/acre) compared to the 1998-99 season (12.3 hours/acre). Anglers directed the largest amount of effort towards muskellunge and walleye during both creel seasons (Table 8.7.6-3).

Table 8.7.6-3. Creel Survey data for 1998-99 and 2016-17 fishing seasons.

Species	Year	Directed Effort (Hours)	Percent of Total	Total Catch	Specific catch rate (Hours/Fish)	Total Harvest	Specific harvest Rate (Hours/Fish)*	Mean length of harvested fish
Walleye	2016-17	1665	20.5	125	13.6	89	18.6	15
	1998-99	3416	44.2	1381	2.5	452	7.6	14.2
Muskellunge	2016-17	2883	35.5	142	25.5	0		
	1998-99	2614	33.9	22	172.4	0	0	
Bluegill	2016-17	612	7.5	1082	8	109	5.8	6.9
	1998-99	34	0.4	25	1.4	0	0	
Smallmouth Bass	2016-17	1353	16.6	829	1.8	56	32.3	16
	1998-99	102	1.3	40	4.4	0	0	
Yellow Perch	2016-17	1391	17.1	3600	0.5	302	4.6	8.2
	1998-99	1556	20.2	3456	0.5	1702	0.9	8.8

Lake Laura Spear Harvest Records

Figure 8.7.6-5. Location of Lake Laura 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 3.6-5). Lake Laura 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 (GLIFWC 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 8.7.6-6 from 2000 to 2018. As many as 370 walleye have been harvested from the lake in the past (2017), but the average harvest is roughly 141 fish in a given year. Spear harvesters on average have taken 95% of the declared quota.

Muskellunge open water spear harvest records are provided in Figure 3.6-7 from 2000 to 2018. As many as 5 muskellunge have been harvested from the lake in the past (2008, 2009, 2010, and 2013), however the average harvest is two fish in a given year. Spear harvesters on average have taken 36% of the declared quota.

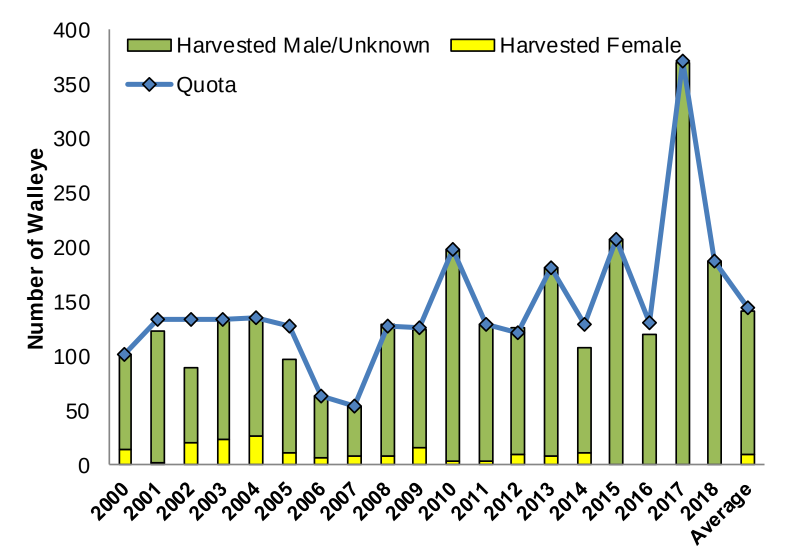


Figure 8.7.6-6. Lake Laura walleye spear harvest data. (GLIFWC 2000-2018).

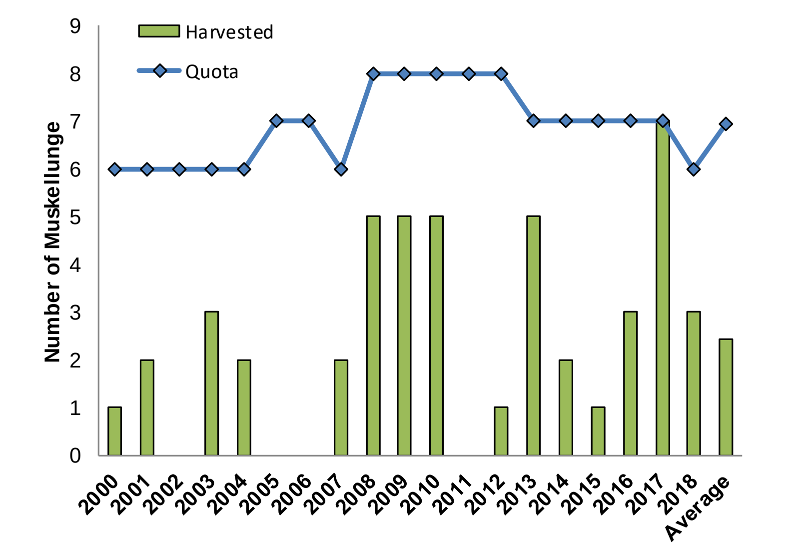


Figure 8.7.6-7. Lake Laura muskellunge spear harvest data. (GLIFWC 2000-2018).

Lake Laura 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, 53% of the substrate sampled in the littoral zone of Lake Laura were soft sediments, 36% composed of sand and 10% 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 77 pieces of coarse woody along the shores of Lake Laura, resulting in a ratio of approximately 15 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 8.7.6-3). 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 8.7.6-3. 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 8.7.6-3). 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 Lake Laura.

Regulations

Regulations for Lake Laura gamefish species as of June 2019 are displayed in Table 8.7.6-4. 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 8.7.6-4. WDNR fishing regulations for Lake Laura (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	No minimum length limit, but only 1 fish over 14" 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.

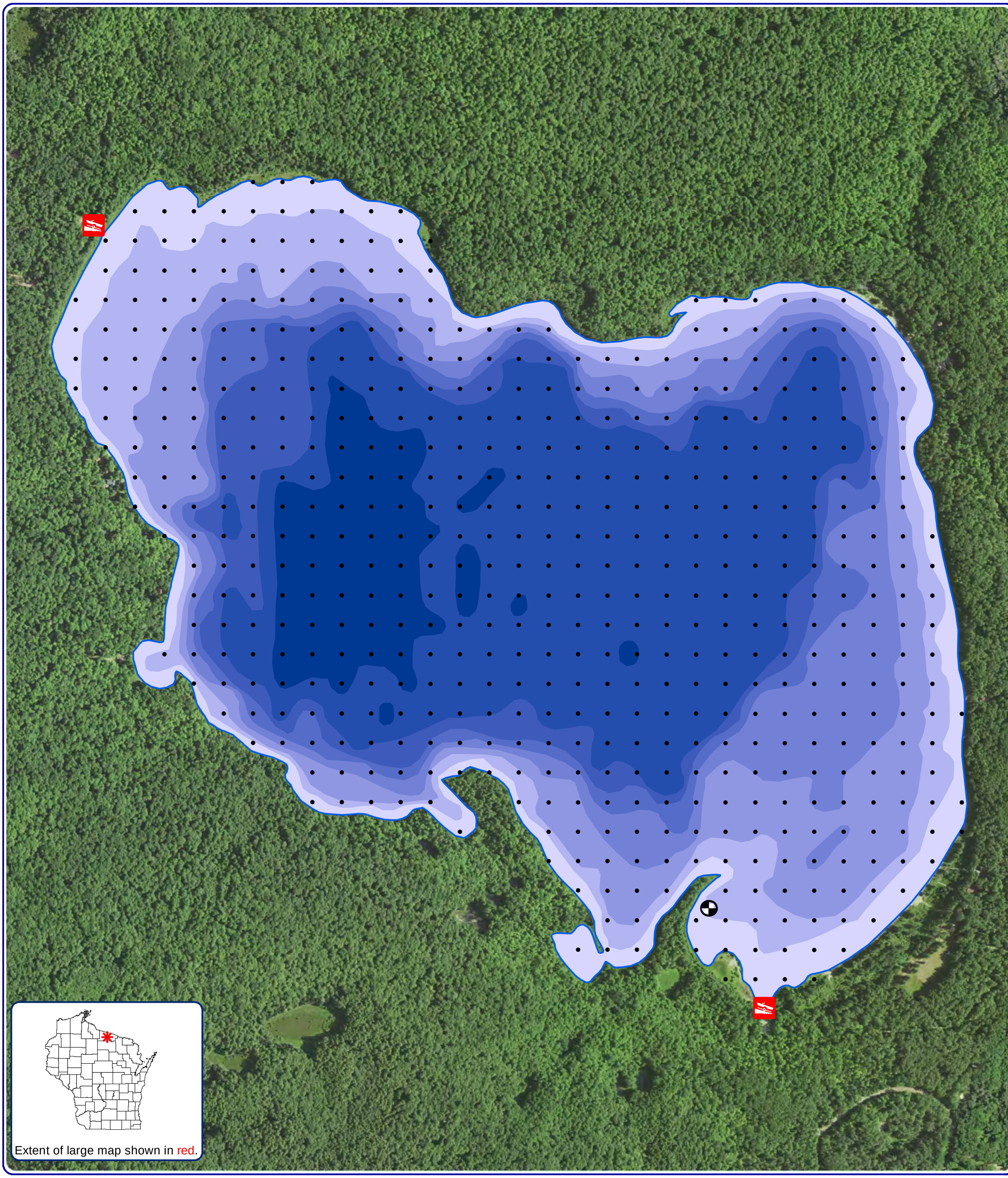
General fish consumption guidelines for Wisconsin inland waterways are presented in Figure 8.7.6-8. There is an elevated risk for children as they are in a stage of life where cognitive development is rapidly occurring. As mercury and PCB both locate to and impact the brain, there are greater restrictions 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 8.7.6-8. 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/)



N
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S

800
Feet

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

Sources
Hydro: WDNR
Survey: Onterra, 2018
Orthophotography: NAIP, 2017
Map date: July 17, 2019 HAL
Filename: Laura_Location.mxd

Legend

Lake Laura ~619 acres

Water Quality Sampling Location

Public Access

Point-intercept Sample Location *67 meter points*

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

Project Location & Lake Boundaries

N
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2,100
Feet

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 17, 2019 JMB
Filename: *Laura_WS_2019.mxd*


Project Location in Wisconsin

Legend

Land Cover Types

- Forest
- Forested Wetlands
- Wetlands
- Open Water
- Rural Open Space
- Pasture/Grass
- Rural Residential
- Laura Lake Watershed Boundary

Lake Laura - Map 2
Town of Plum Lake
Vilas County, Wisconsin

Watershed Boundaries & Land Cover Types


Extent of large map shown in red.
Land Ownership (Inset map)
Federal (none shown)
State
County (none shown)
N
W
E
S
900
Feet
Onterra LLC
Lake Management Planning
815 Prosper Rd
De Pere, WI 54115
920.338.8860
www.onterra-eco.com
Sources
Hydro: WDNR
Shoreland Assessment: Onterra, 2018
Orthophotography: NAIP, 2017
Map date: November 16, 2018 AMS
Filename: Insert Filename.mxd
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall Modifier
Masonary/Wood Seawall
Rip-Rap
Lake Laura - Map 3
Town of Plum Lake
Vilas County, Wisconsin
Shoreland Condition Assessment

N
W E
S
800
Feet

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

Sources
Hydro: WDNR
CWH Survey: Onterra, 2018
Orthophotography: NAIP, 2017
Map date: April 3, 2019 AMS
Filename: Laura_CWH_Oct18.mxd

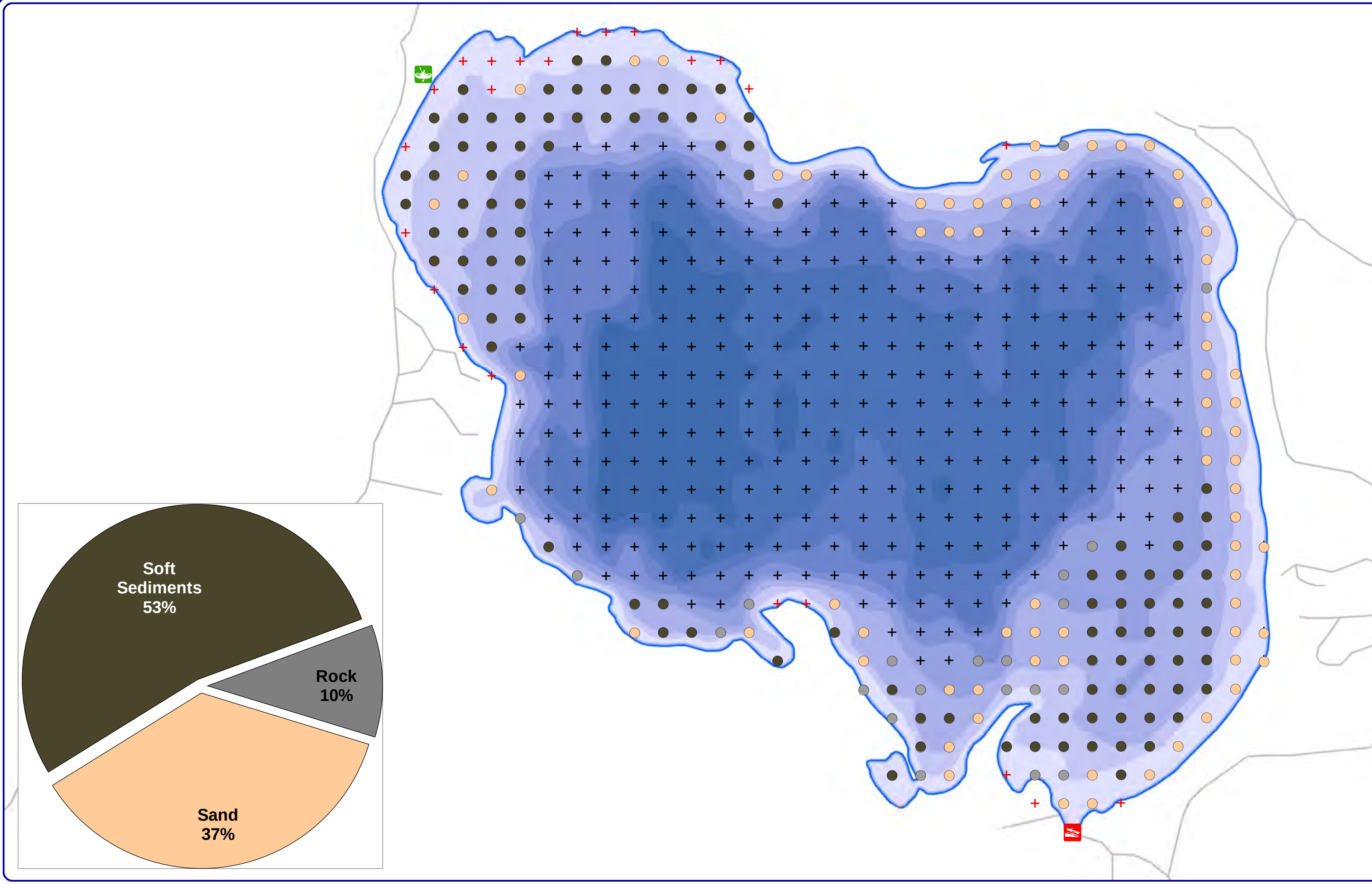
Legend

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

DNR Managed Land

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

Coarse Woody Habitat

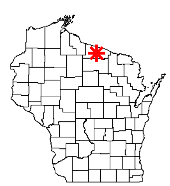


N
W E
S

1,000
Feet

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

Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Plant Survey: Onterra, 2017
Map Date: July 8, 2019
Filename: *Laura_TRFPI_2018.mxd*



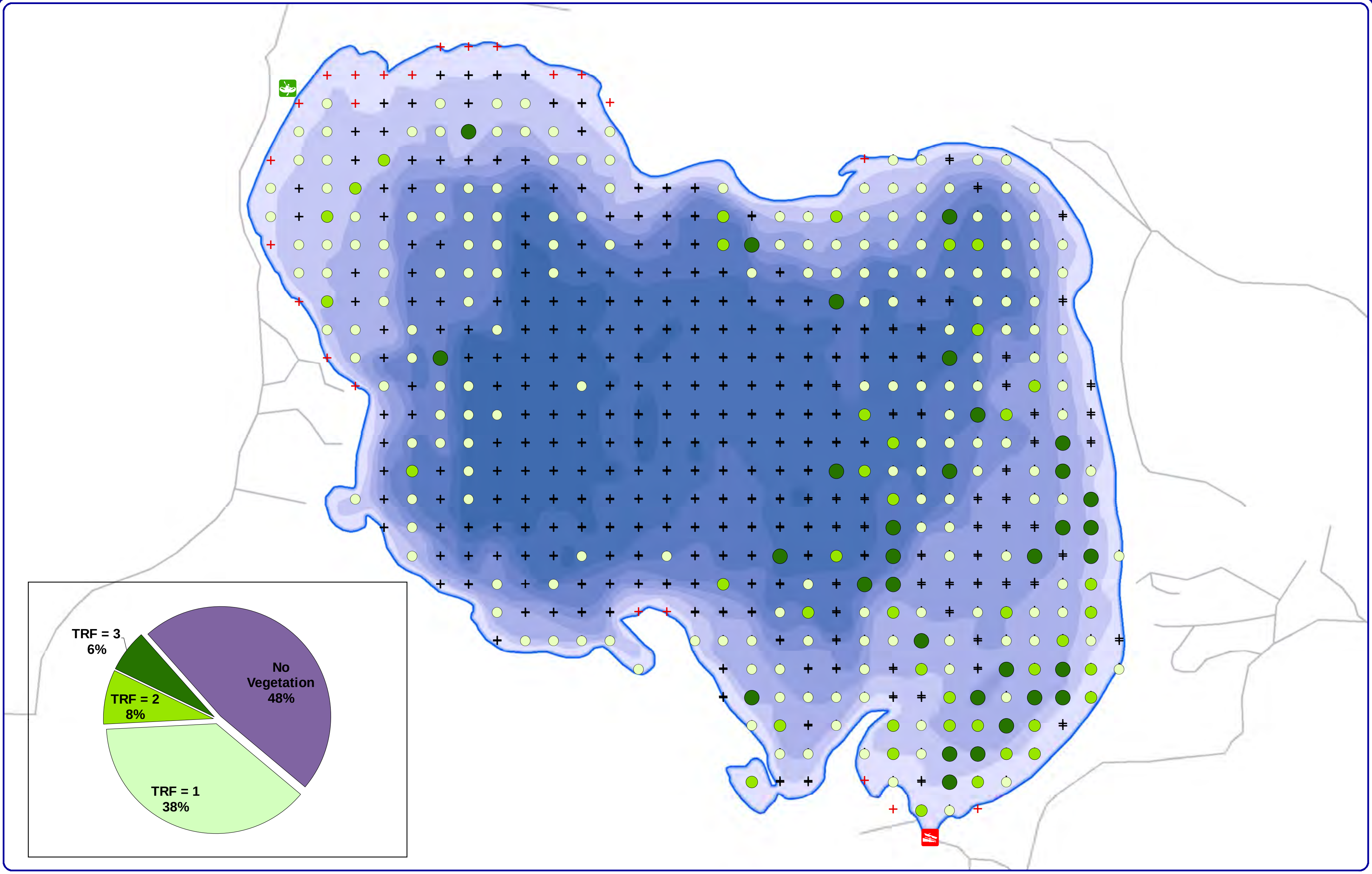
Project Location in Wisconsin

Legend

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

Lake Laura - Map 5
Town of Plum Lake
Vilas County, Wisconsin

2018 PI Survey:
Substrate Types

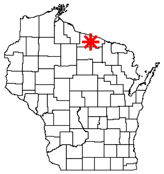


N
W
E
S

1,000
Feet

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

Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Plant Survey: Onterra, 2017
Map Date: July 8, 2019
Filename: *Laura_TRFPI_2018.mxd*



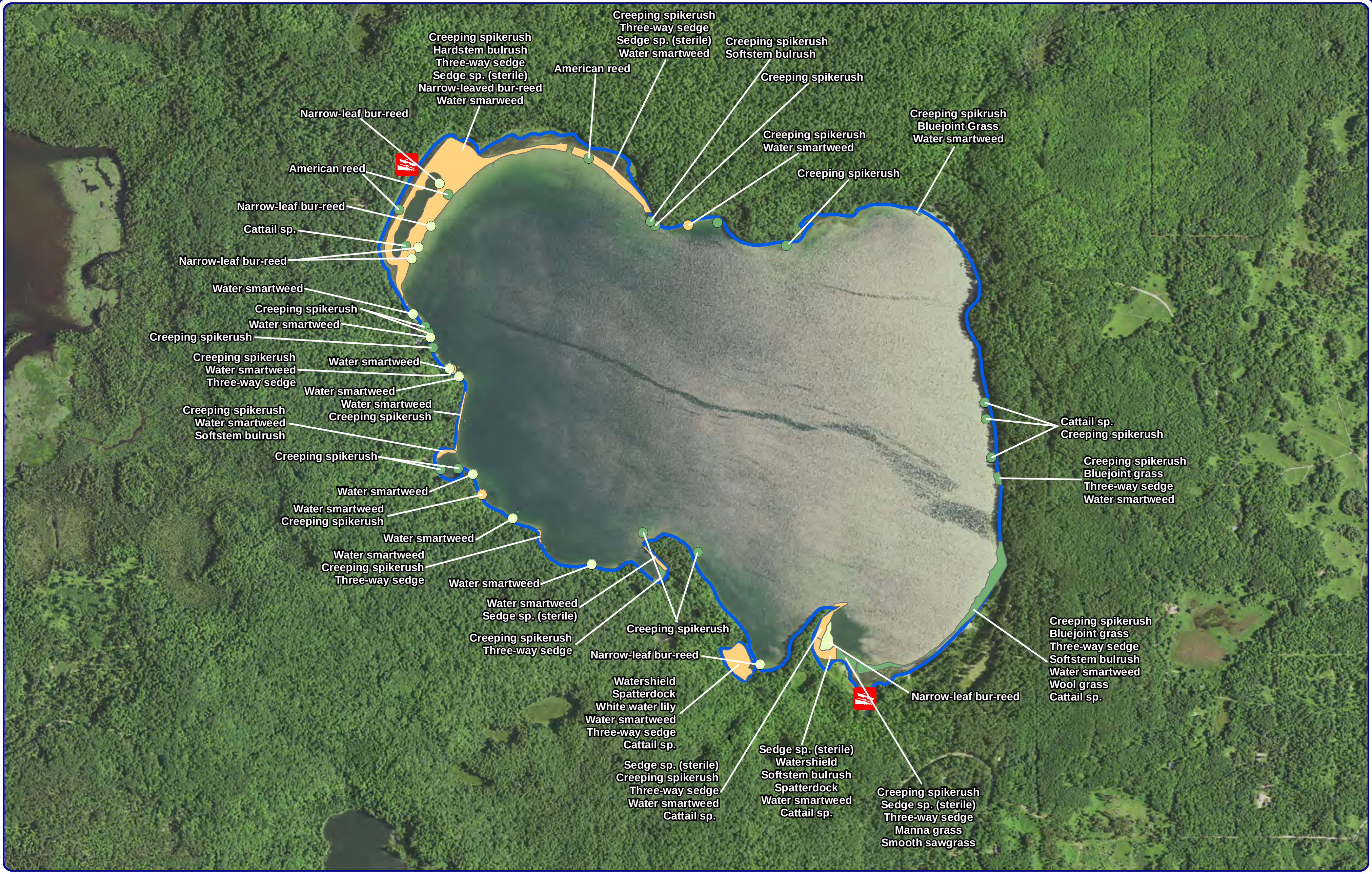
Project Location in Wisconsin

Legend

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

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

2018 PI Survey: Aquatic Vegetation Distribution



N
W E
S

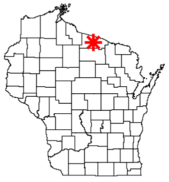
1,400

Feet

Onterra LLC
Lake Management Planning

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

Sources
Hydro: WDNR
Aquatic Plants: Onterra, 2018
Orthophotography: NAIP, 2017
Map date: December 27, 2018 AMS
Filename: Laura_Comm_2018.mxd



Project Location in Wisconsin

Legend

Small Plant Communities

- Emergent
- Floating-leaf
- Mixed Floating-leaf & Emergent

Large Plant Communities

- Emergent
- Floating-leaf
- Mixed Floating-leaf & Emergent

Lake Laura - Map 7

Town of Plum Lake

Vilas County, Wisconsin

Emergent & Floating-leaf Aquatic Plant Communities