DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Department of Natural Resources (DNR)

Region or Bureau
Bureau of Drinking Water and Groundwater

NOTE TO REVIEWERS: This document is a DNR draft environmental impact statement (dEIS) that evaluates probable environmental effects. Your comments should address the completeness and accuracy of the dEIS. For your comments to be considered, they must be received by the contact person before 4:30 p.m., Insert Date.

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Applicant: Lake Lucerne Camp & Retreat, Wisconsin Conference United Methodist Church

Address: W6460 CTH YY, Neshkoro, WI 54960

Title of Proposal: High Capacity Well – Camp Lucerne

Location: County: Waushara City/Town/Village: Town of Marion

Township Range Section(s): Section 21, T18N, R11E

PROJECT SUMMARY

1. Overview

The applicant has proposed to construct a 25 gallon per minute (gpm) potable well that will serve one area of the existing Camp facility in Waushara County, Town of Marion. Under Ch. 281, Wis. Stats., and Chapter NR 812, Wis. Adm. Code, the proposed well is considered a high capacity well because the proposed well, along with several other wells on the larger Lake Lucerne Camp & Retreat property, have a combined capacity of more than 100,000 gallons per day (≈ 70 gpm). The well would be located on property owned by Wisconsin Conference United Methodist Church on which the church operates a camp and retreat facility. The well would be constructed to a depth of approximately 220 feet and would be equipped with a submersible pump capable of pumping 25 gallons per minute (gpm); the maximum proposed water usage is 10,000 gallons per day. The well would replace an existing 48gpm well.

2. Purpose and Need

The well would be used to supply potable water to the cabins in the immediate vicinity. The camp is divided into several areas, and each is supplied by an independent well. There are a total of six wells on the property with a combined capacity of 285,120 gallons per day (≈ 198 gpm). Reported total pumpage from the property in 2012 was 2,129,694 gallons.

3. Authorities and Approvals

In order to construct the well, the owner must obtain a high capacity well approval under section 281.34, of the Wisconsin Statutes and Chapter NR 812, of the Wisconsin Administrative Code. Chapter NR 812 specifies detailed well construction and operation requirements. In addition, because the proposed well location is within 1,200 feet of an Outstanding Resource Water, the well must also be reviewed under Ch. NR 820, Wis. Adm. Code, to determine whether it could result in significant adverse environmental impacts. The Department previously approved applications for the other potable wells on the property, most recently in 2012.

PROPOSED PHYSICAL CHANGES

4. Manipulation of Terrestrial Resources

The proposed well is expected to be completed using conventional cable rig equipment and methods. The well will be completed in sandstone bedrock, and constructed to a depth of approximately 220 feet below ground surface, with 6-inch diameter steel casing to a depth of 180 feet. The remaining depth of the drillhole (180-220 feet) would be an open hole in bedrock. The well would be located within the existing camp area, and because it is a replacement well that will discharge to a pitless unit, existing infrastructure will be used minimizing terrestrial disturbance.

5. Manipulation of Aquatic Resources

The application indicates that the maximum daily pumping from the well would be 10,000 gallons per day. Because the well is a transient non-community well used for drinking water and shower facilities for campers, it is unlikely that the maximum pumping level will occur during the five month season of camp use. Monthly pumping in 2012 for all wells on site had a mean of 177,500 gallons and a median of 93,700 gallons. The discrepancy between mean and median highlights the fact that water use is typically about 30,000 gallons per month during the off-season (October to April) and is often around 300,000 gallons per month between May and September, with a peak of 465,000 gallons in June 2012. The total pumpage from all wells on the property in 2012 was 2,129,694 gallons.

6. Buildings, Treatment Units, Roads and Other Structures

The proposed well would be located within the existing camp facility. Permanent infrastructure at the site includes numerous cabins, a dining hall (served by its own well) a lodge and a retreat center.

No buildings or additional roads would be associated with the installation of the proposed well.

7. Emissions and Discharges

No significant emissions or discharges will be associated with the proposed well. Water will be pumped to a pressure tank via existing infrastructure and a pitless unit.

8. Other Changes

None

9. Maps, plans and other descriptive material attached

Attachment 1 USGS topographic map
Attachment 2 DNR county wetlands map
Attachment 3 Plat Map
Attachment 4 Lake Lucerne Plant Report

AFFECTED ENVIRONMENT

10. Information Based On:

☒ Literature/correspondence

Application for High Capacity Well Approval

http://quickfacts.census.gov/qfd/states/55/55137lk.html

Hamilton, D.A. and P.W. Seelbach, 2011. Michigan's Water Withdrawal Assessment Process and Internet Screening Tool. Michigan Department of Natural Resources. Fisheries Special Report 55, Lansing.

Lippelt, I.D., 1981. Water Table Map of Waushara County. WGNHS. http://wisconsingeologicalsurvey.org/pdfs/M076_web.pdf

WiscLith: A Digital Lithologic and Stratigraphic Database of Wisconsin Geology, Open File Report 2003-05, Wisconsin Geological & Natural History Survey

Wisconsin Well Construction Reports

☒ Personal Contacts (list in item 26)

Field Analysis By: ☐ Author ☐ Other (list in item 26)

Past Experience With Site By: ☐ Other (list in item 26)

11. Physical Environment

The proposed well site is located on an approximately 419-acre parcel owned by WI Conference United Methodist Church. The property is within the Town of Marion in Waushara County. The proposed well site is located in the SW ¼ of the NW ¼ of Section 21 T18N R11E.

The proposed well site is within the Central Sands Hills of Wisconsin. The landscape is dominated by till and morainal deposits and falls east of the moraine that separates the Central Sands plains to the west from the Central Sands hills to the east. Relief is moderate as numerous drumlins dot the landscape, but low enough to allow for lake formation. Surface soils are primarily mapped as sands and loamy sands with moderate to high permeability. Underlying soils are glacial deposits of the Horicon Member.

Bedrock consists of Cambrian sandstone of the Elk Mound Group, overlying Precambrian granitic basement rocks.

Groundwater is the main source of drinking water in the area of the proposed well. The primary aquifer in the area is the unconsolidated glacial drift and till, with some wells completed in the Cambrian sandstone aquifer. Five of the existing wells on the Camp property are completed in the sand and gravel, while one well is completed in the underlying sandstone.

The existing well that is being replaced was completed in the unconsolidated sand and gravel. The proposed well would be cased through the sand and gravel units and draw water from the Cambrian Sandstone.

The nearest municipal public water supply wells are those owned by the Village of Redgranite. Wells #1 and 2 are about 5.4 miles northeast of the proposed well site. Both are sand and gravel wells. Well #1 is 120 feet deep, Well #2 is 180 feet deep.

The proposed well location is about 300 feet from Lake Lucerne, which is an Outstanding Resource Water (ORW) and about 2,400 feet from Sucker Creek, a Class 1 Trout Stream.

The glacial topography of the area influences the groundwater flow system. Regional groundwater flow in the deep aquifer (Cambrian sandstone aquifer) is generally to the southeast, while the upper unconsolidated aquifer (sand and gravel) is dominated by local flow systems that closely mirror the surface watersheds.

Lake Lucerne is a 48-acre, deep seepage lake, with no surface water outlet. It has a maximum depth of 34 feet and shoreline is characterized by steep slopes. Virtually all of the shoreline is owned by the Camp. The lake basin is slightly irregular. The shallow water zones are quite restricted around the lake. A small border shelf surrounds the lake before the drop-off. The primary water source is from seepage and small springs. The bottom material in the littoral zone consists primarily of sand and mud. The lake develops an upper thermocline at 20 feet during midsummer.

Sucker Creek is a class 1 trout stream with headwaters in the area of the proposed well. Directly east of Lake Lucerne, Sucker Creek is mapped as intermittent, which is consistent with aerial photographs. Sucker Creek picks up perennial flow to the south, near the crossing of CTH YY about 2400 feet southeast of the proposed well. Sucker Creek is a cool-cold headwater natural community and has a median August flow (AugQ50) of 2.6 cubic feet per second (cfs). It flows into the White River about 10 miles southeast of the proposed well.

No concentrated springs have been identified in Lake Lucerne or Sucker Creek adjacent to the Camp, although both are fed by

groundwater seepage, and several springs are mapped 2-3 miles southeast of the proposed well that feed Spring Lake and Sucker Creek.

12. Biological Environment

The fishery of the lake includes largemouth bass, bluegill, perch, sunfish, and walleye. In an attempt to introduce walleye, a plant of 4,500 fingerling fish was made in 1963. During a shocker survey in the fall of 1965, only 16 walleyes from this planting, ranging in length between 12.0-14.9 inches, were sampled. The lake is known locally for good bluegill fishing in the spring of the year. The surrounding habitat supports nesting for mallards and bluewing teal, and the lake is used during the spring and fall migrations by mallards and bluewing teal. Sucker creek is classified as a Class 1 Trout Stream which is defined as a stream with a naturally reproducing trout population. Two threatened/endangered species were identified through a review of the Natural Heritage Inventory; historical records indicate that the *Buteo lineatus* (Red-shouldered Hawk) was observed in the area in 2004. The area has also been identified as Karner Blue Butterfly High Potential Range. There are no mapped wetlands within a mile of the proposed well.

13. Cultural Environment

a. Land use and zoning

Land use in the immediate vicinity of the proposed well and Lake Lucerne is exclusively forested land occupied by the camp. The larger area surrounding the well and lake includes agricultural land, forested land and some residential areas.

b. Social/Economic

The area in the vicinity of the proposed well is predominantly rural land use, as described above. There are several heavily developed lakes within 2-3 miles of the proposed well that have lakeshore surrounded by cottages, homes and resorts. There is also a golf course about a mile to the north. The population of Waushara County has remained relatively stable over the last thirty years and is 90.1% white, 6.1% Hispanic or Latino 3.8% other ethnic groups (2012). As of 2012, the largest employment sectors in Waushara County were: Educational, health and social services (21.5%), Manufacturing (20.1%), Retail trade (9.4%), and Arts, Entertainment and recreation, and Accommodation and food services (8.4%).

c. Archaeological/Historical

There are no known features of archaeological or historical significance within the area to be disturbed by well construction.

14. Other Special Resources

None

ENVIRONMENTAL CONSEQUENCES

15. Physical

The well will be constructed adjacent to the existing well (Hi Cap #3249) and will result in minimal disturbance of the physical environment. Construction activities will include installation of the well and a pitless unit to connect to existing infrastructure. The existing well will be abandoned.

Groundwater pumped from the proposed well would otherwise discharge into Lake Lucerne, Sucker Creek, or other surface waters. The maximum requested pumping rate is 25 gallons per minute (gpm), with a daily requested maximum of 10,000 gallons. The well will only be pumped during the camp season (May through September) as needed to meet demand.

Sucker Creek has an August median flow of about 2.6 cfs in the reach nearest to the proposed well (according to WDNR streamflow modeling). If groundwater recharge to Sucker Creek was reduced by an amount equivalent to the water pumped from the proposed well, the effect would be insignificant. Pumping the well at full capacity for three months straight would result in a 0.37% decrease in flow in Sucker creek.

Impacts to Lake Lucerne are also expected to be minimal. The average monthly withdrawal for the existing well was 136,200 gallons, equivalent to 3.15gpm on average. At this rate, applied for 365 days, the drawdown to Lake Lucerne would be 0.30 feet. The maximum monthly withdrawal in 2012—a particularly dry year—was 465,000 gallons, equivalent to 10.7gpm on average. At

this rate, applied for 30 days, the predicted drawdown to the lake would be 0.42 feet. Since the water use will be decreased at the site, and the replacement well will have slightly more than half the capacity of the previous well, it is unlikely that the well will come close to the predicted drawdown calculated using the average monthly withdrawal from 2012.

The total volume pumped at Camp Lucerne in 2012 was 2,129,694 gallons. This is equal to about 6.5 acre-feet of water, or 1.6 inches spread out over the 48 acre surface of Lake Lucerne if the entire volume was directly removed from the lake. Given that the consumptive use coefficient for residential, municipal and other public use wells is 12%, the total decrease in Lake level would be approximately 0.20 inches assuming that all consumed water originated from the lake.

The nearest existing private wells are about 750 feet south of the proposed well. This distance is beyond the edge of the cone of depression for average use of the proposed well.

16. Biological

Potential impacts of groundwater pumping include adverse impacts to aquatic populations, especially in temperature-sensitive fish species such as trout. Reduced groundwater input to streamflow can result in increased stream temperature and decreased dissolved oxygen concentration. Both of these conditions can inhibit trout development. In cold-transitional streams such as Sucker Creek, Michigan studies of fish populations determined that a flow reduction of less than 4% will not result in an observable change in fish population, and a reduction of less than 20% will not result in a significant change (Hamilton and Seelbach, 2011). The maximum possible flow reduction in Sucker Creek during the summer camp season would be less than 1%. Therefore, no significant impact to Sucker Creek is expected. Predicted drawdown at the lakeshore is approximately 0.3 feet. This will result in minimal loss of aquatic habitat, especially given the steep slopes of the lake bottom. Since there are no mapped wetlands, or sensitive species, no significant effects are expected on near-shore flora and fauna.

Because the proposed well would be tied into existing infrastructure, there would be minimal impact to terrestrial biota, including the Red-shouldered Hawk and the potential range of the Karner Blue Butterfly.

17. Cultural

a. Land Use

The proposed well would be located within the Lake Lucerne Camp & Retreat and will not result in any change in land use.

b. Social/Economic

The proposed well would allow the Camp to keep this area open, providing a nominal economic benefit. It would not impact the operation of private or municipal water supply wells.

c. Archaeological/Historical

None

18. Other Special Resources

The proposed activity will not have any impacts on any special resources.

19. Summary of Adverse Impacts That Cannot Be Avoided (more fully discussed in 15 through 18)

Groundwater that is pumped from the proposed well would result in a small seasonal decrease in groundwater inflow to nearby Lake Lucerne and Sucker Creek, a Class 1 Trout Stream. There will also be minor drawdown in the water levels of nearby existing wells. Neither of these impacts is expected to cause a significant environmental impact to waters of the state.

20. Environmental Effects

a. Long-term or short-term primary and secondary effects

The environmental effects related to the proposed high capacity well would generally be limited in areal extent. Pumping from the well would be mostly seasonal, and would occur for limited periods during a given day (two hours per day maximum) allowing the water table to recover during "off" periods. Impact to streamflows and water table levels would cease if pumping were permanently terminated. If flow reduction altered stream habitat to the extent that the aquatic population changed, this could have a long-term environmental effect; however, this type of impact is highly unlikely from the type of water use proposed.

b. Primary and secondary environmental effects on geographically scarce resources

The proposed well would not have an effect on geographically scarce resources.

c. Reversibility of primary and secondary environmental effects

The impacts associated with the proposed high capacity well are reversible. Groundwater levels would rebound following the cessation of pumping, and groundwater inputs to streams would go back to pre-pumping conditions. Any changes in the streams' biological community would also be reversible due to the localized nature of the potential impacts.

21. Cumulative Effects

Past, present and reasonably anticipated wells:
On the property:
There are currently six wells on the property with a combined capacity of 198 gpm the largest of which is approved for a capacity of 75gpm. The wells are distributed spatially, such that their respective cones of depression will not intersect. As such, no one area of Lake Lucerne would be impacted by multiple wells on camp property. In fact, the only well predicted to directly impact the lake at all, based on historical pumping, is the proposed well (see section 15 above). The proposed high capacity well is a replacement for an existing well and will have a smaller capacity pump than the existing well. The land surrounding Lake Lucerne is almost entirely owned by the Camp. Because of this, it is unlikely that similar projects or wells would be reasonably anticipated to be proposed on the property or in the immediate vicinity, without a significant change in land use.

The predicted cones of depression from the camp wells do not cross the property boundary. The well with the greatest predicted drawdown (well #3250) has a 40gpm capacity and is operated, at least to a degree, year round. The predicted five-foot drawdown from well #3250 has a radius of about 140 feet. Therefore, no impact to existing private wells is expected.

The cumulative withdrawals from all wells on camp property will have a negligible impact on Sucker Creek. If all existing wells were pumped at their maximum capacity from May through September, the total depletion from Sucker Creek would be approximately 3% of the modeled August median flow value. Predicted Stream depletion based on reported pumping volumes from 2012 would be about 0.65% from all wells on the camp property.

Nearby properties:
Cumulative impact analyses were restricted to the area within two miles of the proposed well and the lake, because drawdown and depletion analyses (see below) indicated that wells more than two miles away are unlikely to have more than a miniscule impact on waters of the state. There are 20 high capacity wells within two miles of Lake Lucerne. Of these, five are wells on the camp property with a capacity of 48 gpm or less; one is a 75 gpm well on the camp property; three are low capacity wells on nearby high properties,; one is a golf course irrigation well; and the remaining ten are agricultural irrigation wells on nearby properties. There are 11 high capacity wells within one mile of the lake, including the six wells on the camp property, three wells on the golf course property (two low capacity and one irrigation) and two agricultural irrigation wells.

Four of the twelve high capacity wells within two miles of Lake Lucerne were constructed between 1958 and 1962, four were constructed between 1975 and 1979, two were constructed between 1991and 1994, and two have been constructed since 2012. This averages out to about two wells every decade, although two thirds of the high capacity wells are more than 30 years old.

Lake Lucerne is entirely surrounded by camp property, with the exception of a four acre area on the west side of the lake (see

attachment 2). The distance from the lake to the camp property line ranges from about 540 feet on the west side of the lake to about 2000 feet on the east side of the lake. Any additional wells would most likely be residential, since most agricultural sites are already irrigated. This means that that it is unlikely that reasonably anticipated changes in land use would lead to significant cumulative impact.

According to the Department's calculations, the cones of depression associated with the high capacity wells in the area, ranged from 1,800 feet to 2,900 feet, depending on capacity and geologic material. This means that even the nearest high capacity well to the lake would have negligible impact on the lake if pumped at full capacity for 60 days nonstop. Given the localized effects of the wells in the area, the cumulative effects of the proposed well, in conjunction with past, present and reasonably anticipated wells in the area, are not significant with respect to Lake Lucerne, nor are significant cumulative effects likely to develop, given the slow historic pace of high capacity well construction in the area of the proposed replacement well, and other properties near Lake Lucerne.

An analysis of potential drawdown to private wells indicates that there could be cumulative impact to private wells about 2 miles northeast of the camp on CTH F between 22nd Avenue and CTH Z. There are five irrigation wells in that area that could, if pumped at or near maximum capacity, result in drawdown of greater than 5 feet. This is an unlikely scenario, however because the five wells in the area averaged between 2.6% and 22.6% of capacity during the summer of 2012. Predicted drawdown resultant from reported pumping rates would be well below five feet. It is important to note that the proposed well would not contribute to, or compound any impacts to these private wells, since they are well beyond the zone of influence for the proposed well.

There is a potential for cumulative impact on Sucker Creek from high capacity wells on nearby properties, based on an analysis of stream flow depletion from the four nearest high capacity irrigation wells. When these four wells (high capacity wells #s 36364, 36362, 36680 and 36727) are modeled using reported pumping values from July 2012 for 30 days per year over 5 years, a total of 0.18 cubic feet per second (cfs) would be depleted from Sucker Creek. This is equal to 6.9% of the modeled August median flow of 2.6 cfs, and exceeds the 4% depletion used to flag a potentially significant impact for a cold-transitional stream. In comparison, the proposed well itself would contribute 0.076% to the depletion, and all wells on camp property combined would contribute 0.65% depletion to Sucker Creek August median flows, based on average pumping rates from 2012. As such, repeated actions of this same type (installation of a low capacity replacement well on a high capacity property) would not compound existing or reasonably anticipated cumulative impacts to Sucker Creek, Lake Lucerne, or any other water of the state.

22. Risk

a. Unknowns that create substantial uncertainty in predicting effects on the quality of the environment and additional studies or analysis that would eliminate or reduce unknowns

Groundwater flow conditions in the vicinity of the proposed well are inferred from information gathered in well construction reports, research in similar areas, and general geologic reports. The degree of connection of the surface water resources in the area is also inferred from work in areas of similar geologic characteristics. Impacts to the surface waters could be more or less severe depending on the actual degree and nature of the hydrologic connection. Stream flow in Sucker creek is based upon statistical modeling. This type of modeling, as with all modeling, carries some level of uncertainty. The review of physical impacts in section 21 considers a worst-case scenario where all water pumped from the well is removed from the resource being analyzed (i.e. Lake Lucerne or Sucker Creek); and the review did not identify a potential for significant impacts. However, collection of additional field data, particularly coupled with multiple stream flow and groundwater data, completion of an aquifer pumping test, and construction of a groundwater model to analyze various well construction configurations and pumping scenarios would lead to a more definitive analysis of the impacts.

b. Reasonably anticipated operating problems such as malfunctions, spills, fires or other hazards

The operation of the proposed well is unlikely to result in spills, fires or other hazards. Any water inadvertently spilled from the well or associated piping would drain to the lake and back into the underlying aquifer. The well will have electric line power; so no diesel or other fuel is associated with well operation.

23. Precedent

Influence of this proposal on future decisions that may additionally affect the quality of the environment. Conflicts with plans or policy of local, state or federal agencies.

Since the proposal is for a replacement of an existing well that will subsequently be abandoned, approval of this high capacity well application would not be a precedent-setting decision.

24. Controversy Over Environmental Effects

Any proposed high capacity well has the potential to generate significant public interest and controversy, especially in the vicinity of high-quality surface water features such as trout streams and outstanding resource waters. However, because the amount of water proposed to be withdrawn from the proposed well is relatively low (10,000gpd maximum) and the well is a replacement well that represents a decrease in capacity and its installation does not involve a change in land use, the likelihood of significant controversy is quite low.

ALTERNATIVES

25. Impacts of no action and other alternatives

Applicant Alternatives

- No build option. Without the installation of a replacement high capacity well, a portion of the camp would not be usable.
- Other water sources. The only other logistically viable water sources would be to withdraw from the surface waters themselves, which would not decrease impact.
- Alternate well location. Ideally, the proposed well would be located outside of the Groundwater Protection Areas (GPAs) associated with Lake Lucerne. However, the entire portion of the camp this well is intended to serve is located within the GPA. An alternate location outside of the GPA would significantly increase the cost of the project, so this is not a viable option.

DNR Alternatives

The Department's alternatives for review of high capacity well application are:

- Deny the application for high capacity well based on probable significant adverse environmental impacts to waters of the state that cannot be avoided by placing conditions on the construction or use of the well.
- Approve the application for high capacity well without conditions.
- Approve the application for high capacity well with conditions designed to prevent significant adverse environmental impacts to waters of the state.

The Department's selected alternative is to approve the high capacity well application without conditions since no significant adverse environmental impact is expected.

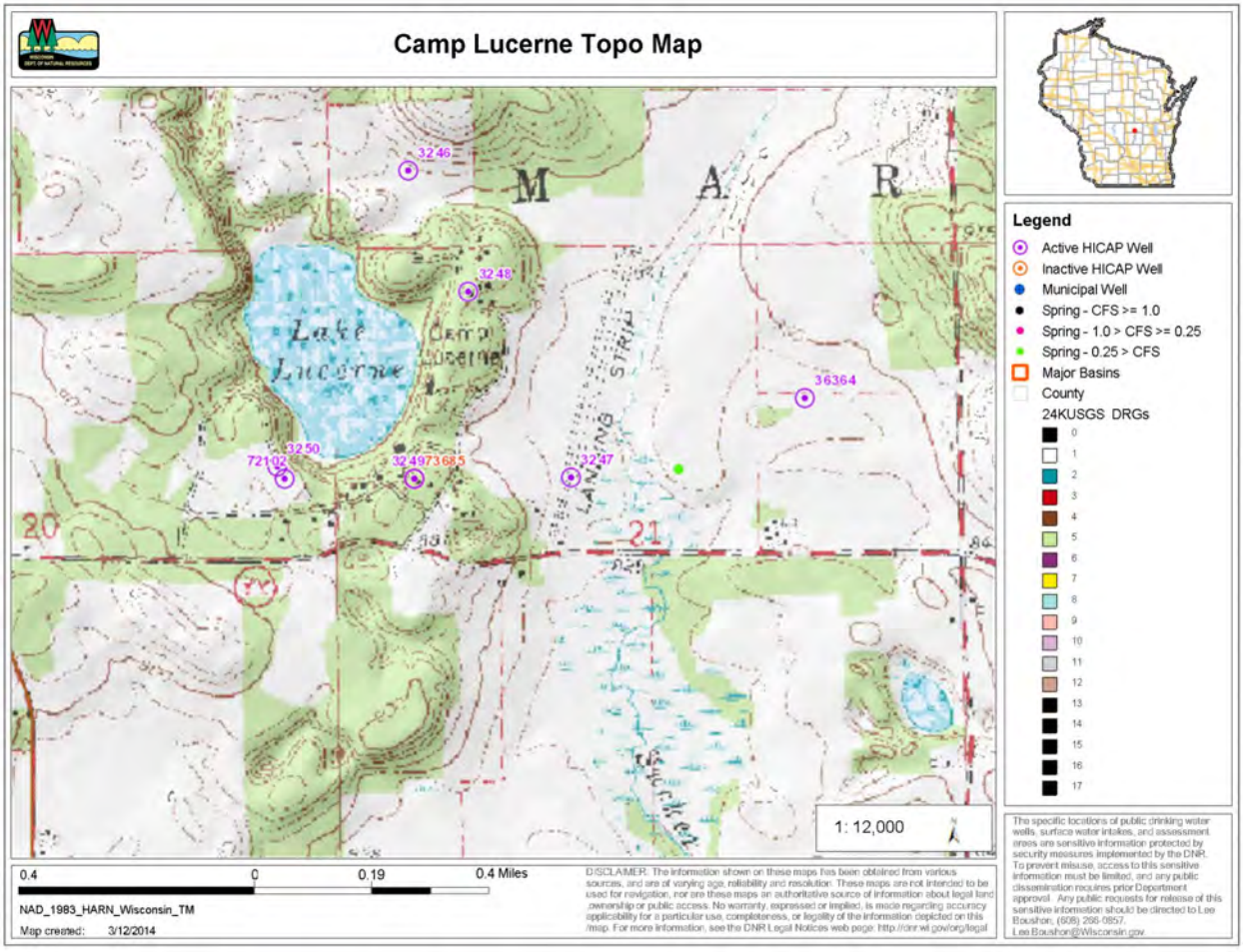
SUMMARY OF ISSUE IDENTIFICATION ACTIVITIES

26. Agencies, citizen groups and individuals contacted regarding the project

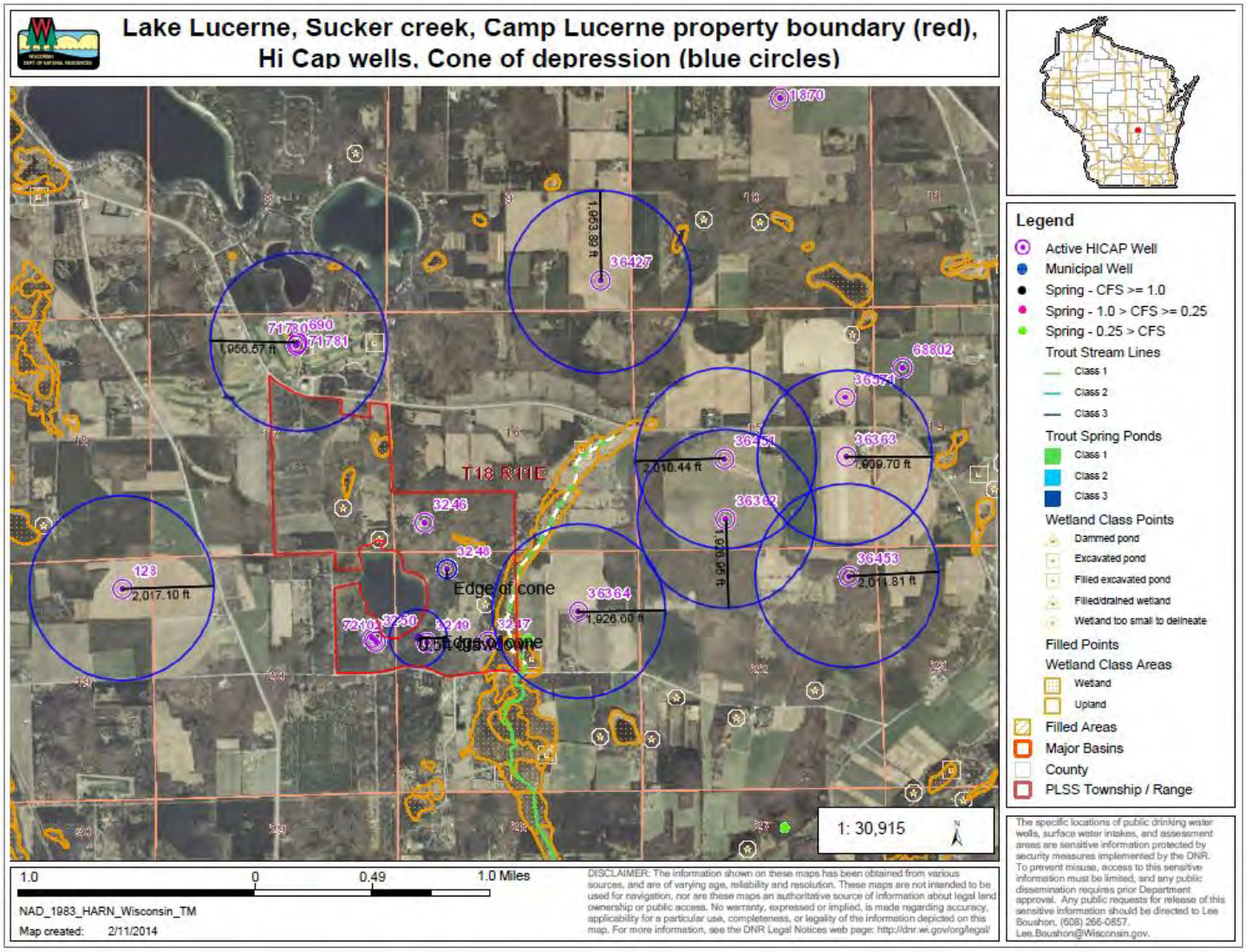
Date	Contact	Comment Summary
2/18/14	Ted Johnson	Lake Lucerne Water Level Measurements
2/27/14	Ted Johnson	Lake Lucerne Plant Survey

Attachments

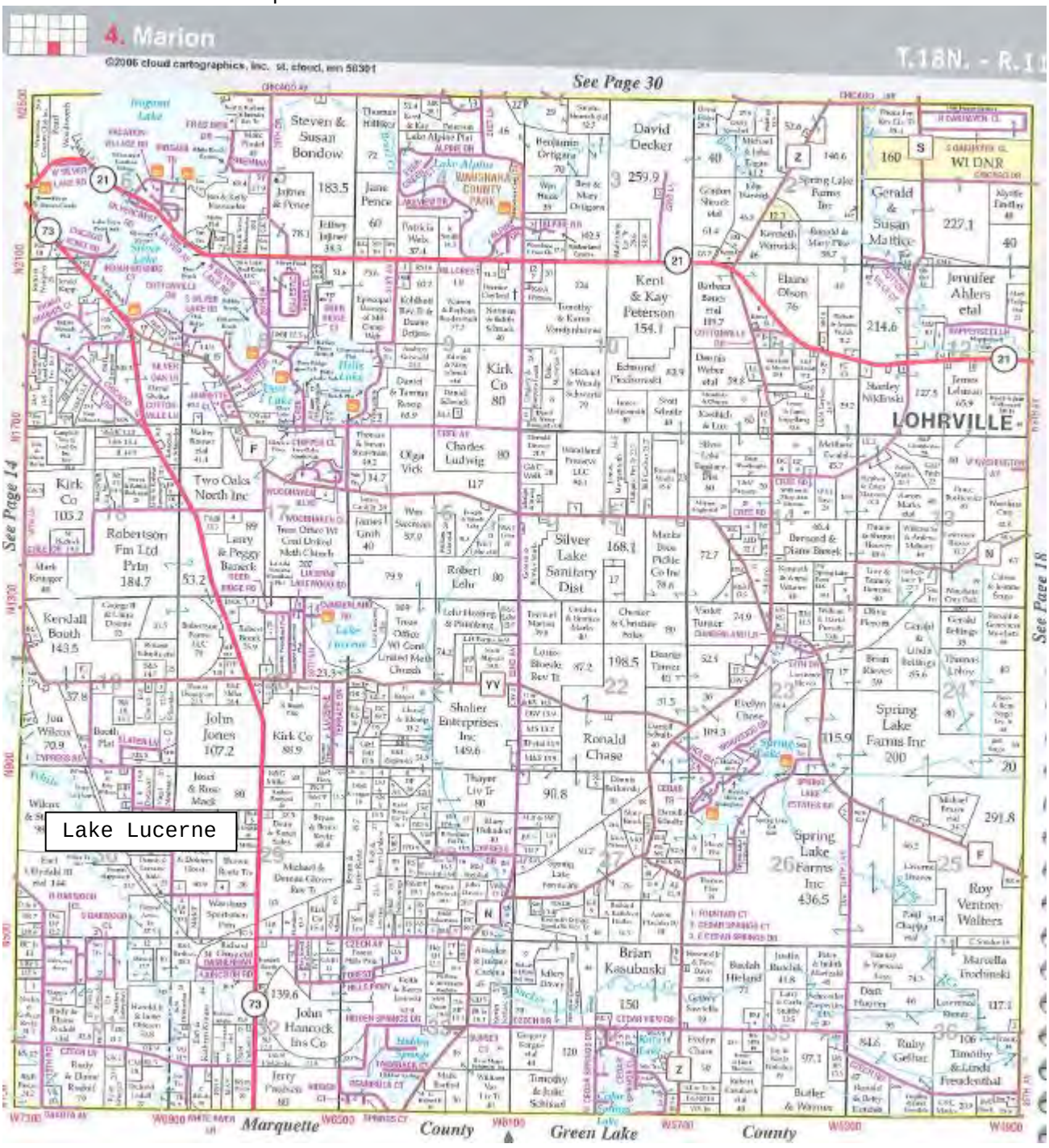
Attachment 1: Topographic Map



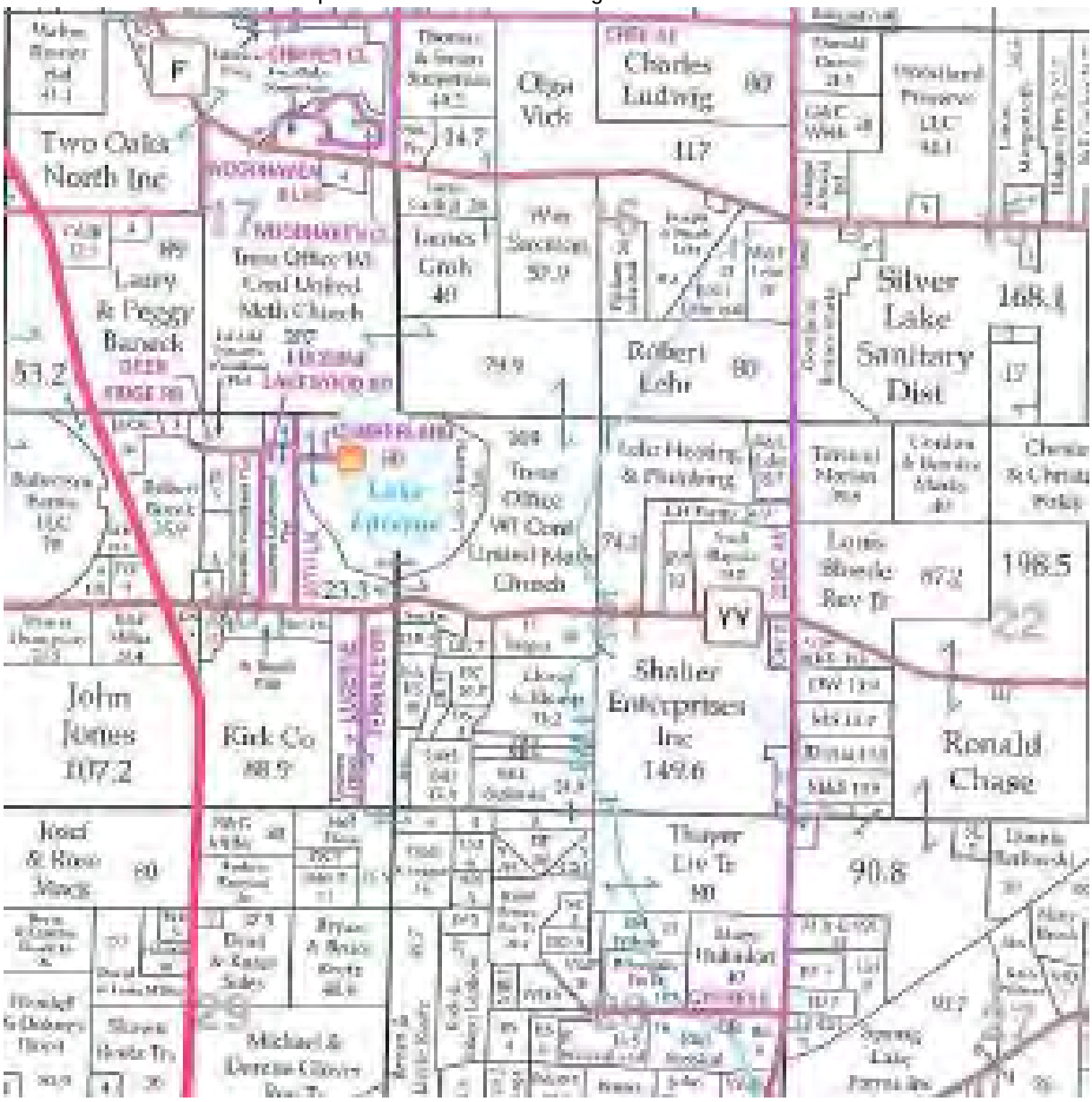
Attachment 2: Aerial Photo with Property Boundary(red), Wetland Inventory(orange), High Capacity Wells(purple) and Associated Cone of Depression(blue)



Attachment 3: Plat Map



Attachment 3a: Plat Map – Area of Investigation



Introduction

A healthy aquatic plant community is vital component of a lake community. Aquatic plants play a role in improving water quality, providing valuable habitat resources for fish and wildlife, resisting invasions of non-native species and checking excessive growth of tolerant species that could out-compete sensitive species, thus reducing diversity.

Lake Lucerne is located in Waushara County, southeast of Wautoma, Wisconsin. Lake Lucerne is a 47 acre hard water Lake. The aquatic plant community of Lake Lucerne is characterized by fair species diversity and is impacted by relatively low amount of development. Large portions of the shoreline have been left intact. An aquatic plant survey was conducted in 2011. Twelve species of aquatic plants were found in Lake Lucerne. Aquatic Plants are distributed throughout the littoral zone of the lake, however the greatest diversity of species was on the northern and southern sides of the lake in the shallow areas. The dominant plant species in the survey was Muskgrass (*Chara sp.*). Plants grew to a maximum rooting depth of 28 feet.

Methods

The aquatic plant survey in Lake Lucerne was conducted by UW-Stevens Point on August 13, 2011. The survey included 204 sampling points throughout Lake Lucerne (Figure 1). The aquatic plant surveys were accomplished using the Wisconsin Department of Natural Resources (WDNR) point intercept sampling protocol. The GPS coordinates for the sampling grid was provided by the WDNR. The grid was laid out with equal spacing between all points; the shape of the lake and the size of the littoral zone are the two factors used to determine the number of points and their spacing. The GPS points were uploaded onto an aerial photograph that was used in the field. A handheld GPS unit was used to locate sampling sites while in the field.

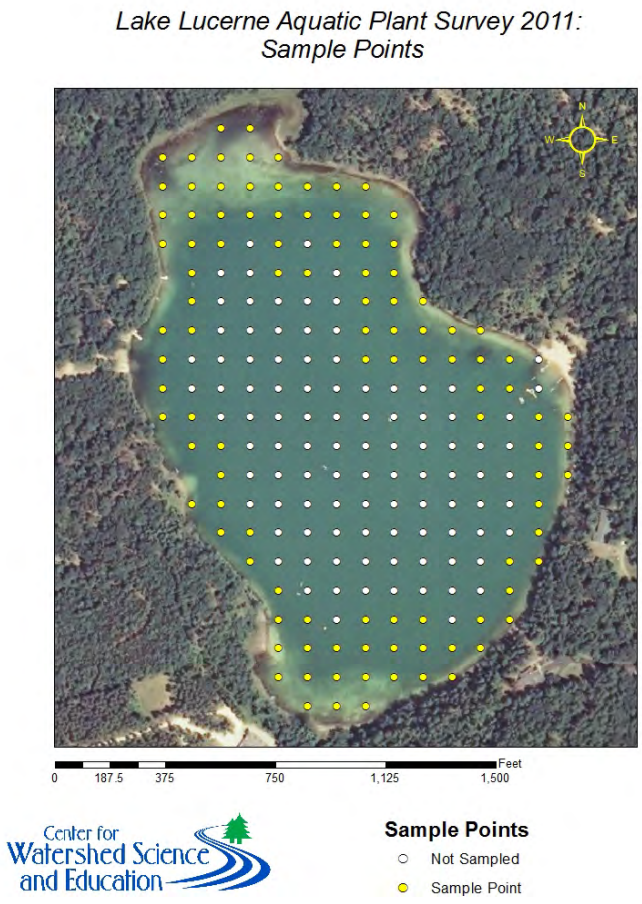


Fig. 1 Aquatic vegetation sites sampled on Lake Lucerne

A pole mounted rake was used to collect an aquatic plant sample at each accessible site. The rake had a double rake head with fourteen teeth on each side with a width of 13.8 inches. After the rake was brought up each species present was assigned a fullness rating. Ratings ranged from 0 (plants not present) to 3 (plants overflowing the rake tines) (Figure 2). Depth and dominant sediment type were also recorded at each site.

Results and Discussion

The survey was based on 204 sites that were assigned within Lake Lucerne using the WDNR's point-intercept protocol; of these points 108 were sampled during this survey. Eighty eight percent (95) of the 108 sampled sites had vegetative growth. The points that were not surveyed were points were too deep for plant growth, the points were placed on land, or the points were in water which was landlocked.

The average depth of the sampled sites was 14 ft, and the deepest site in Lake Lucerne that was sampled was 28 ft. The maximum depth that aquatic plants can grow is often limited by light penetration; in Lake Lucerne, the depth of the lake is the limiting factor. During the 2011 aquatic plant survey 12 species of submerged and emergent aquatic plant species were identified (Figure 3 and Table 1).

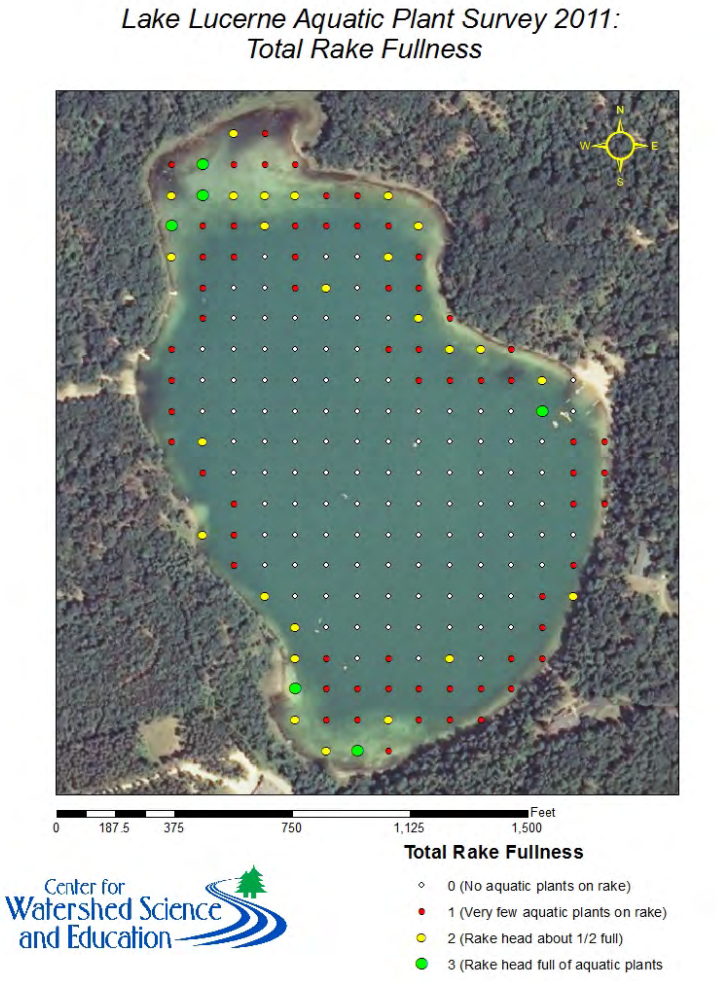


Fig. 2 Rake fullness at sample sites on Lake Lucerne

Table 1. List of aquatic plants identified in the 2011 aquatic plant survey on Lake Lucerne.

Common Name	Scientific Name	Coefficient of Conservatism Value
Emergent Species		
Scirpus validus	Softstem bulrush	4
Floating Leaf Species		
Nymphaea odorata	White water lily	6
Subergent Species		
Ceratophyllum demersum	Coontail	3
Chara	Muskgrasses	7
Najas flexilis	Slender naiad	6
Potamogeton alpinus	Alpine pondweed	9
Potamogeton diversifolius	Water-thread pondweed	8
Potamogeton friessi	Fries' pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton zosteriformis	Flat-stem pondweed	6
Vallisneria americana	Wild celery	6

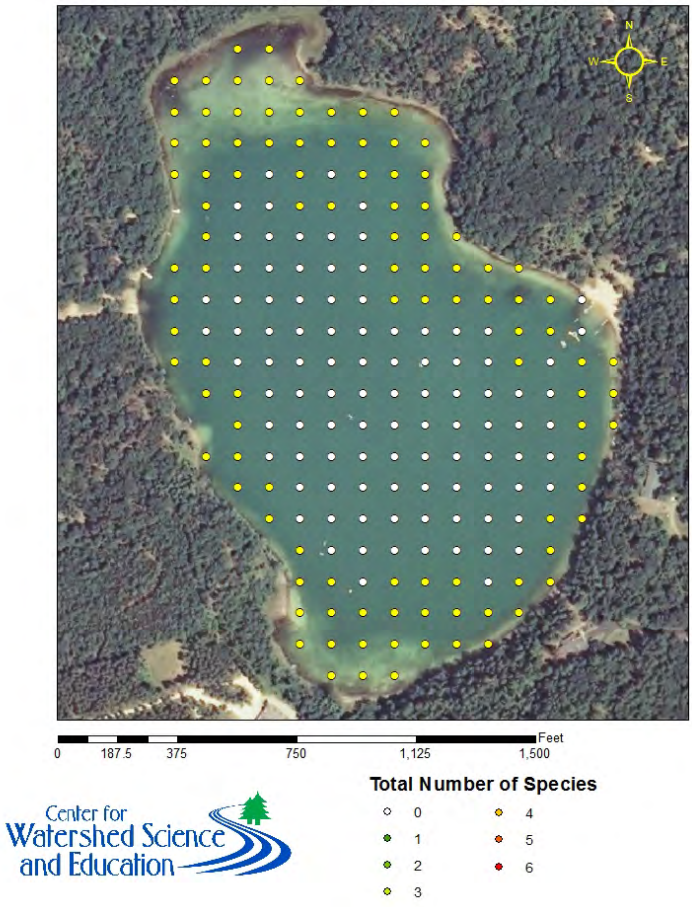
The dominant sediment type was assessed at each site. Using the DNR protocol for aquatic plant surveys the categories of sand, muck, or rock were given for dominant sediment type; only one classification was allowed per site. Eighty three percent of the sites had muck bottom; this material provides ideal rooting conditions for aquatic plants. The remaining sites were comprised of sand or rock.

Frequency of Occurrence

The frequency of occurrence (FO) value is a measure of the percent of the sample points that had vegetation below the maximum rooting depth. The FO for Lake Lucerne was 89%. Of the sites that were vegetated, muskgrass (*Chara*) was collected at 90% of the vegetated sites, Fries' pondweed (*Potamogeton Friesii*)

and Slender naiad (*Najas flexilus*) were found at 27% of the sites (Figures 4, 5, and 6). Muskgrass, slender naiad, and fries' pondweed are all native, relatively common aquatic plants. Muskgrass or

Lake Lucerne Aquatic Plant Survey 2011: Total Number of Species



Chara, is a macrophytic algae found growing on the floor of the lake, often in large dense mats. Muskgrass is characterized by a rough texture and musky odor. Slender naiad has glossy, green, finely toothed, narrow leaves. Fries' pondweed is a submersed aquatic plant with blunt, green to reddish leaves with blunt tips.

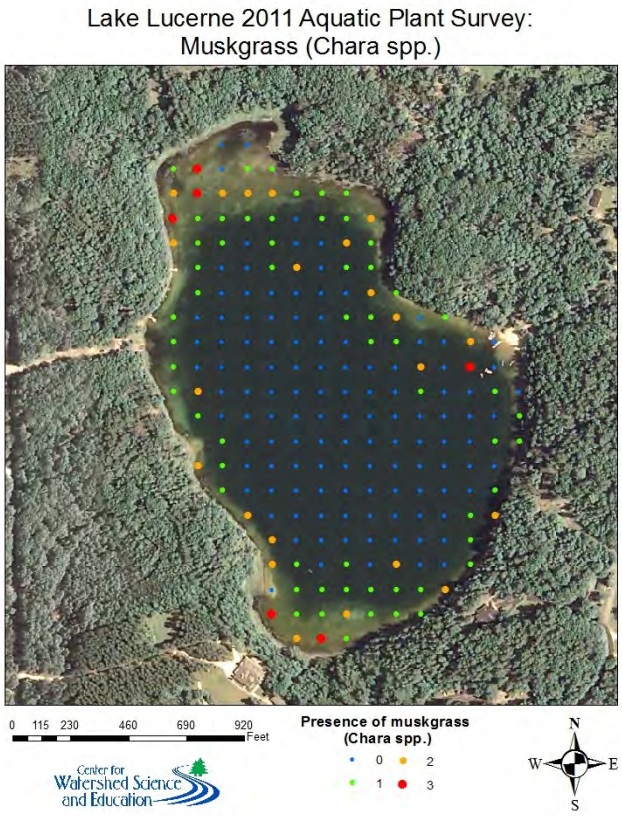


Figure 4. Occurrence of Muskgrass *(Chara)* in Lake Lucerne

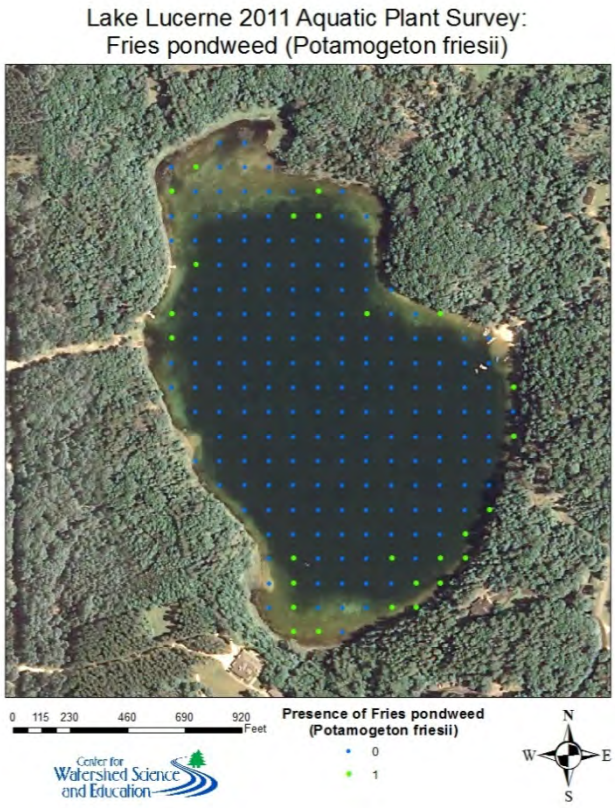


Figure 5. Occurrence of Fries pondweed (*Potamogeton friesii)* in Lake Lucerne

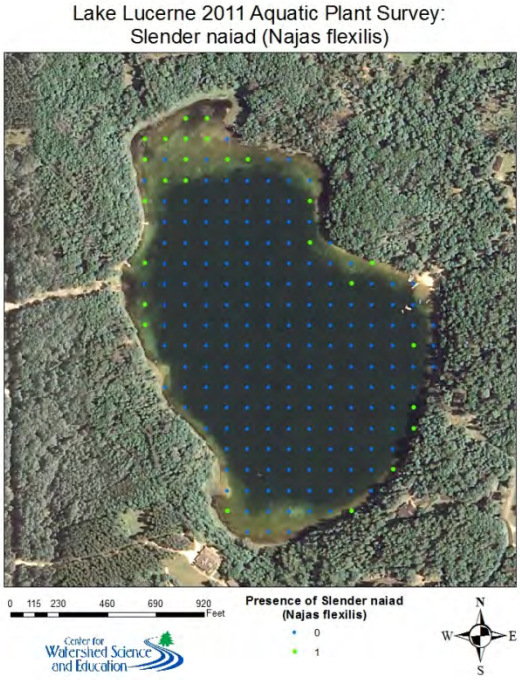


Figure 6. Occurrence of Slender naiad *(Najas flexilis)* in Lake Lucerne

Aquatic Invasive Species

In 2012 a Curly-Leaf Pondweed (CLP) was conducted on Lake Lucerne. Lake Lucerne was identified by the WDNR as having CLP, however no CLP was found on Lake Lucerne. Lake Lucerne should continue to be monitored for CLP.

Simpson Diversity Index

The Simpson Diversity Index (SDI) quantifies biodiversity based on a formula that uses the number of species surveyed and the number of individuals per site. The SDI uses a decimal scale; values closer to one represent higher amounts of biodiversity. Data collected from the 2011 Lake Lucerne survey result in an SDI of 0.71. A diverse community of aquatic plants tends to be more stable. In Lake Lucerne, there was fairly good diversity throughout the lake but the northern and southern shallow areas of the lake had the greatest diversity.

Floristic Quality Index

The Floristic Quality Index (FQI) evaluates the closeness of a plant community to undisturbed conditions. Each plant is assigned a coefficient of conservatism (c value) that reflects its sensitivity to disturbance; these numbers are used to calculate the FQI. C values range from 0 to 10, the higher the number, the more intolerant of disturbance. A c value of zero is assigned to exotic and most nonvascular species; therefore, these species are not included in the calculation. The 2011 FQI for Lake Lucerne was 21.65.

The c values in Lake Lucerne ranged from 3 to 9 (See Table 1). One of the 12 aquatic plant species, Alpine pondweed (*Potamogeton alpinus*) found in Lake Lucerne had a c value of 9. This species is generally less tolerant of disturbance. Most of the plant species are common throughout lakes in Wisconsin.

Conclusion

The aquatic plant community in Lake Lucerne is characterized by fair species diversity and a condition that has little impact by disturbance. Aquatic plants are distributed throughout the littoral zone of the lake (87%), up to a maximum rooting depth of 28 feet. Even where there are areas of shoreline development the aquatic plant communities are still intact. The only area where it appears that plants have been removed is the camp swimming area. In 2011, the dominant plant species was Muskgrass (*Chara*) was the dominant plant species occurring at more than the half the sites. Slender naiad (*Najas* flexilis) and Fries' pondweed (*Potamogeton friessi*) each made up one quarter of the lakes vegetation. These species both have a higher c-value and therefor are important in maintaining a healthy aquatic plant community. Healthy aquatic plant communities provide many invaluable benefits to the lake ecosystem. The native plant community improves water quality, provides lake fish and wildlife habitat. Therefore the aquatic plant communities that are in Lake Lucerne should be protected.