Van Vliet Lake

Vilas Counties, Wisconsin

Aquatic Plant Management Plan Update –

Mechanical Harvesting Feasibility Study & Planning Project

June 2015

Sponsored by:

Van Vliet Lake Association

WDNR Grant Program

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Onterra, LLC
Lake Management Planning

Van Vliet Lake
Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project

Vilas County, Wisconsin

June 2015

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This management planning effort was truly a team-based project and could not have been completed without the input of the following individuals:

Van Vliet Lake Planning Committee

Ed Brodsky	Bill Schroeder	Mike Czarny
Jeff Burke	Diane Schroeder	Ronie Jacobsen
Tom Olson	Jim Sprester	Mark Osberg

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1.0 INTRODUCTION

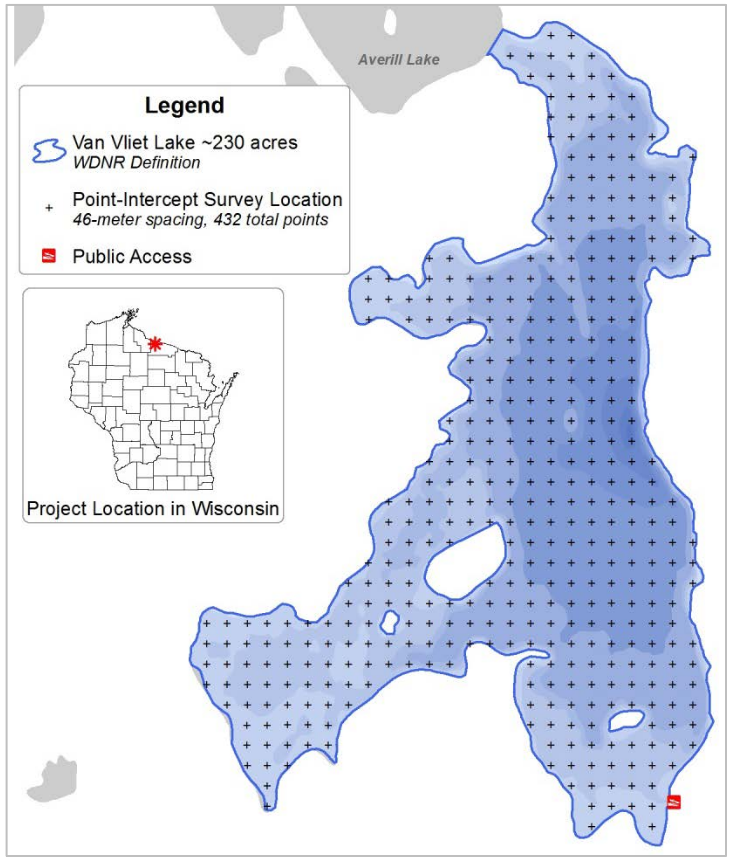

Figure 1.0-1. Van Vliet Lake project location and lake boundaries.

According to the historic WDNR Lake Survey Map (date unknown), Van Vliet Lake, Vilas County, is an approximately 230-acre mesotrophic spring lake with a maximum depth of 20 feet and a mean depth of 9 feet. Information collected during this project found that the lake was 236.6 acres with a maximum depth of 24 feet (Figure 1.0-1). The differences between these measurements are due to the methodologies and do not suggest a change in morphology has occurred between these surveys. Possessing no inlet, Van Vliet Lake lies at the headwaters of the Presque Isle River and flows into Averill and Presque Isle Lakes. Its surficial watershed encompasses approximately 1,433 acres of land comprised of mainly forests and wetlands.

A prior lake association existed on Van Vliet Lake, being formed in the 1960s. According to reliable anecdotal evidence, the lake association owned and operated a mechanical harvester as well as conducted at least one herbicide application to target nuisance levels of aquatic plants.

The Van Vliet Lake Association (VVLA) was formed in 1995 after an initial organizational meeting in September, 1994. From the association's bylaws: "*The purpose of the Association is to preserve and protect Van Vliet Lake and its surroundings, and to enhance the water quality, fishery, boating safety, and aesthetic values of Van Vliet Lake as a public recreational facility for today and for future generations*." Since the VVLA's creation, numerous studies have been conducted on Van Vliet Lake assessing water quality, algae blooms, excess aquatic plant growth, shoreline development, fishing quality, and potential septic system impacts.

In 2004, the VVLA received a Wisconsin Department of Natural Resources (WDNR) Lake Management Planning Grant to conduct a comprehensive study of the lake and create a lake management plan. The project was overseen by Blue Water Science of St. Paul, MN, and the resulting Van Vliet Lake Management Plan was adopted in 2005. In 2008, the Presque Isle Town Lakes Committee (Van Vliet Lake has representatives on this committee known as PITLC) obtained a grant to conduct studies on several lakes including Van Vliet Lake with the purpose of creating an Aquatic Plant Management Plan for each lake. This study was completed by Northern Environmental, now Bonestroo, Inc. of Waupun, WI. In 2012, the PITLC obtained another grant to update the point-intercept aquatic plant studies on these lakes including Van Vliet Lake in 2013. The point-intercept studies were completed by White Water Associates of Amasa, MI.

A portion of Van Vliet Lake stakeholders have increasingly become concerned with excessive aquatic plant growth in the lake which they believe has hindered navigation in certain areas as well as caused other user conflicts (e.g. fishing and swimming opportunities). The following text displays the timeline of events the VVLA Board of Directors took to arrive at this document.

- Subset of VVLA stakeholders raise concerns about nuisance levels of aquatic plants
- VVLA Board of Directors polls property owners through a referendum question to determine if this is majority of its constituents
- 60% of respondents indicate they are in favor of allowing the VVLA to work towards the development of a plan to mechanically harvest nuisance weeds.
- VVLA creates an operating plan, solicits bids from a mechanical harvesting firm, and applies to the WDNR for a permit
- WDNR indicated that the VVLA’s mechanical harvesting permit and plan were incomplete
- VVLA selects Onterra, LLC to create an **Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project.**
- With the assistance of Onterra, the VVLA successfully applied for a WDNR Lake Planning Grant (February 2013) aimed at conducting the appropriate studies and information gathering to determine if mechanical harvesting is feasible on Van Vliet Lake

Following the Introduction (Section 1.0), this document provides an overview of the Stakeholder Participation (Section 2.0) components of this project as well as the Results and Discussion (Section 3.0) of the various studies that took place or were referenced during the planning effort. The Summary & Conclusion Section (4.0) outlines the steps taken to determine if a mechanical harvesting plan is feasible for Van Vliet Lake, referencing information from Sections 2.0 and 3.0 within. The Implementation Plan Section (5.0) outlines the specific goals created during this planning project and the actions steps that will work towards achieving the goals. The remaining sections outline the Methodologies (6.0) and the Literature Cited (7.0) during this project.

2.0 STAKEHOLDER PARTICIPATION

Stakeholder participation is an important part of any management planning exercise. During this project, stakeholders (riparians and lake users, VVLA members, WDNR, Vilas County, etc) were not only informed about the project and its results, but also introduced to important concepts in lake ecology. The objective of this component in the planning process is to accommodate communication between the planners (Onterra ecologists) and the stakeholders. The communication is educational in nature, both in terms of the planners educating the stakeholders and vice-versa. The planners educate the stakeholders about the planning process, the functions of their lake ecosystem, their impact on the lake, and what can realistically be expected regarding the management of the aquatic system.

The stakeholders educate the planners by describing how they would like the lake to be, how they use the lake, and how they would like to be involved in managing it. For this project, this information was communicated in multiple ways. One way was through a meeting that involved a focus group called the Planning Committee. A second way was through solicitation of thoughts and ideas through a stakeholder survey regarding aquatic plant management. Additionally, all stakeholders were encouraged to provide feedback comments to multiple drafts of the Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project. The highlights of these components are described below. Materials used during the planning process can be found in Appendix A, Appendix D, and Appendix E.

2012 Stakeholder Referendum Question

In 2012, the VVLA distributed a referendum question to 76 Van Vliet Lake parcels in order to gauge their level of support for mechanical harvesting of aquatic plants within the lake. Each parcel had a vote, and the property owners were asked to respond 'yes' or 'no' as to whether or not they supported the development of a mechanical harvesting plan for Van Vliet Lake. Over 76% of the surveys were returned and the results were entered into a spreadsheet by members of the VVLA.

The stakeholder response data from the referendum question indicate that the majority of Van Vliet Lake property owners (60% of respondents) support the development of mechanical harvesting plan, 38% were not supportive, and 2% indicated a neutral position (Figure 2.0-1). Looking at the data based upon the location of the respondent's property on the lake (east versus west) indicates that 73% (30 respondents) of property owners on the west side of Van Vliet Lake support developing a mechanical harvesting plan, while the majority of property owners on the east side of the lake (71%, 12 respondents) do not support the development of a mechanical harvesting plan (Figure 2.0-1). As will be discussed in the Aquatic Plant Section, the east and west respondents likely differ on their support for mechanical harvesting because nuisance levels of aquatic plants are found along the shallower, western side of the lake.

As discussed within the Introduction Section (1.0), the results of the stakeholder referendum question initiated the VVLA Board of Directors to contract with Onterra to develop the Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project that comprises this document. These data have been posted on the VVLA website (www.vanvlietlake.com) under *Projects > Aquatic Plant Mgmt Plan > 2012 Aquatic Plants Committee.*

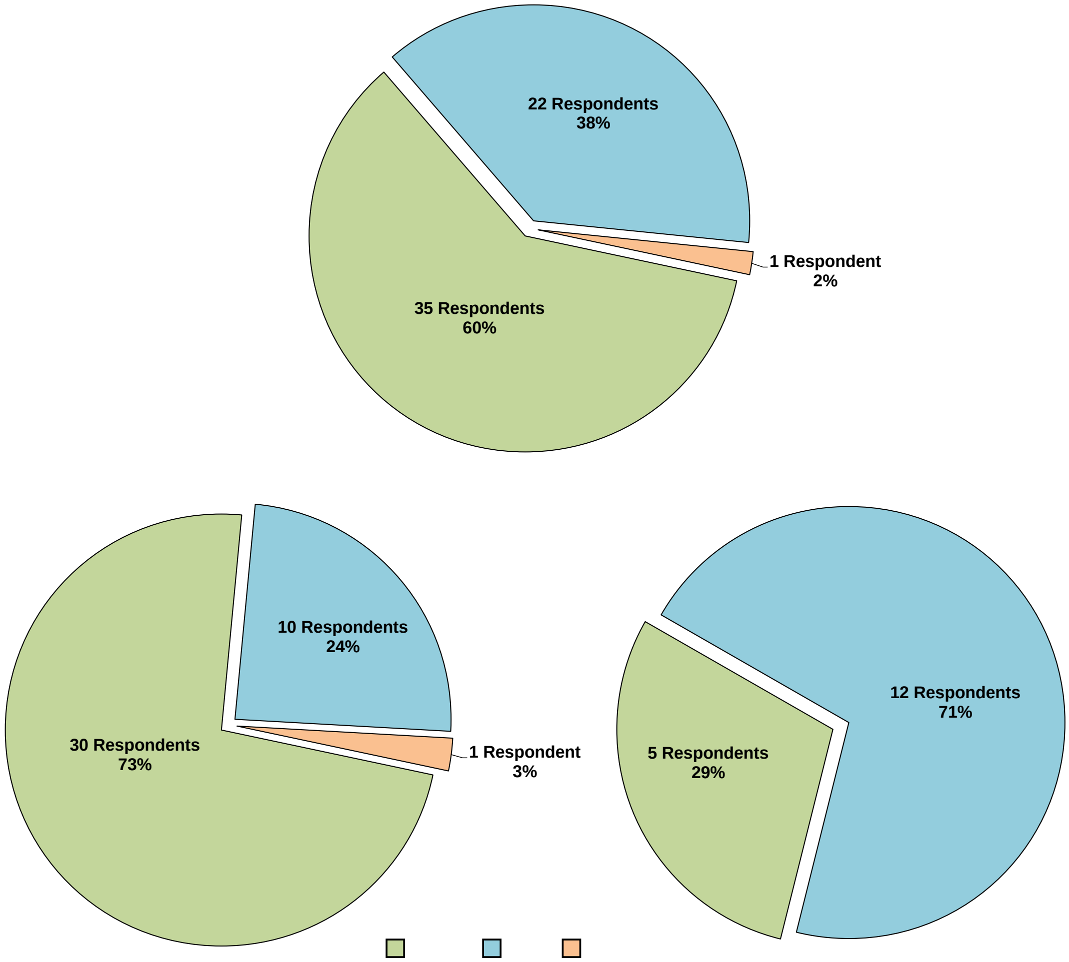

Figure 2.0-1. Survey response from the 2012 Van Vliet Lake Referendum Question "Are you in favor of the VVLA work towards the development of a plan to mechanically harvest nuisance weeds?"

Planning Committee

The VVLA Planning Committee was put together by the VVLA Board of Directors, an elected body of the VVLA. The committee members included property owners from both the east and west sides of the lake. Criticism surfaced that this committee comprised folks that were either neutral or in favor of mechanical harvesting and did not include members that were opposed to mechanical harvesting. The belief of the VVLA Board of Directors was that the opposition was too fierce to produce an implementable mechanical harvesting plan. While imperfect, the process required a mechanical harvesting plan be created to allow the Van Vliet Lake stakeholders a plan of which to vote on.

Planning Committee Meeting

On February 10, 2014, Eddie Heath and Tim Hoyman met with nine VVLA Planning Committee members as well as WDNR Lakes Coordinator, Kevin Gauthier, and WDNR Fisheries Biologist, Steve Gilbert, to discuss the results of studies that had taken place on Van Vliet Lake. During this almost three hour meeting, all project components were discussed extensively with the majority of the attention being paid to the creation of a mechanical harvesting plan. Prior to this meeting, the VVLA Planning Committee and other meeting attendees were provided with an early draft of the report sections of this document to aid in the quality of the meeting. The VVLA Planning Committee also provided editorial feedback on the draft reports sections, which was integrated into the first draft.

Management Plan Review and Adoption Process

Prior to the Planning Committee Meeting, a draft of the Results and Discussion Sections (3.0) were provided to the meeting attendees to aid in the delivery of these materials at the meeting. Based upon the discussions that occurred at the Planning Committee Meeting, a draft of the Implementation Plan Section (5.0) was created by Onterra and provided to the Planning Committee for review.

In April 2014, the first draft of the Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project was distributed for official review. Comments on the draft plan were received and integrated into a second draft. The second draft of the Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project was distributed for review in October 2014. Additional comments on the plan were received, including an official review from the WDNR in late-January 2015.

Following the WDNR comments to the second draft of the Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project, a WDNR-initiated meeting was held in early-March 2015 in Woodruff, WI. The meeting participants included representation from Onterra (Eddie Heath), the WDNR (Kevin Gauthier, Dr. Susan Knight), the VVLA planning committee (Ronie Jacobsen, Jim Sprester, Tom Olson), and a VVLA member opposed to mechanical harvesting (Paul Specht). Also sitting in on part of the meeting was Steve Peterson, Northern Highland State Forest Supervisor.

This report reflects the integration of all comments received, including those verbalized at the March 2015 meeting. The final report will be reviewed by the VVLA Board of Directors and a vote to adopt the management plan will be held during the association's next annual meeting.

Project Wrap-up Meeting

The wrap-up meeting was conducted on June 21, 2014. During this meeting Eddie Heath presented the highlights of scientific studies to 19 members of the VVLA general membership as well as presented the draft Implementation Plan that was crafted during the planning process to date.

2014 Stakeholder Survey

During the summer of 2014, members of the VVLA Planning Committee worked with Onterra staff to develop an anonymous stakeholder survey, which would be distributed to all VVLA members and non-members with property along Van Vliet Lake. This survey was approved by a WDNR sociologist in June of 2014, and during that same month, a six-page, 20-question survey was either hand-delivered or mailed to 75 riparian parcels. Approximately 51 percent of the surveys were returned and those results were entered into a spreadsheet by members of the

VVLA Planning Committee. The data were summarized and analyzed by Onterra for use within the Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project. The full survey and results can be found in Appendix E, while discussion of those results is integrated within the appropriate sections of the management plan and a general summary is discussed below.

In instances where stakeholder survey response rates are below 60%, the results should not be interpreted as being a statistical representation of the population. However, the results *may* follow public opinion, particularly on contentious issues. Based upon the results of the 2014 stakeholder survey, much was learned about the people that use and care for Van Vliet Lake. A plurality of stakeholders who returned the survey (41%) are year-round residents, while 17% visit on weekends through the year and 21% live on the lake during the summer months only (Appendix E, Question #1). About 50% of stakeholder respondents have owned their Van Vliet Lake property for over 25 years (Question #3).

Van Vliet Lake stakeholders were asked a series of questions in order to understand if aquatic plant growth negatively impacted the respondents' enjoyment of the lake, how often it occurred, and at what time of year it occured (Appendix E, Question #10 & #11). The responses of two of these questions are displayed in Figure 2.0-2. Approximately 29% of these respondents conveyed that their enjoyment was negatively impacted *Often* or *Always* during the **early** open water season (51% if include *Sometimes*); whereas 50% indicated their enjoyment was negatively impacted *Often* or *Always* during the **late** open water season (69% if include *Sometimes*). This demonstrates that nuisance aquatic plant issues are more prevalent as the summer progresses, but also exist throughout the open water season.

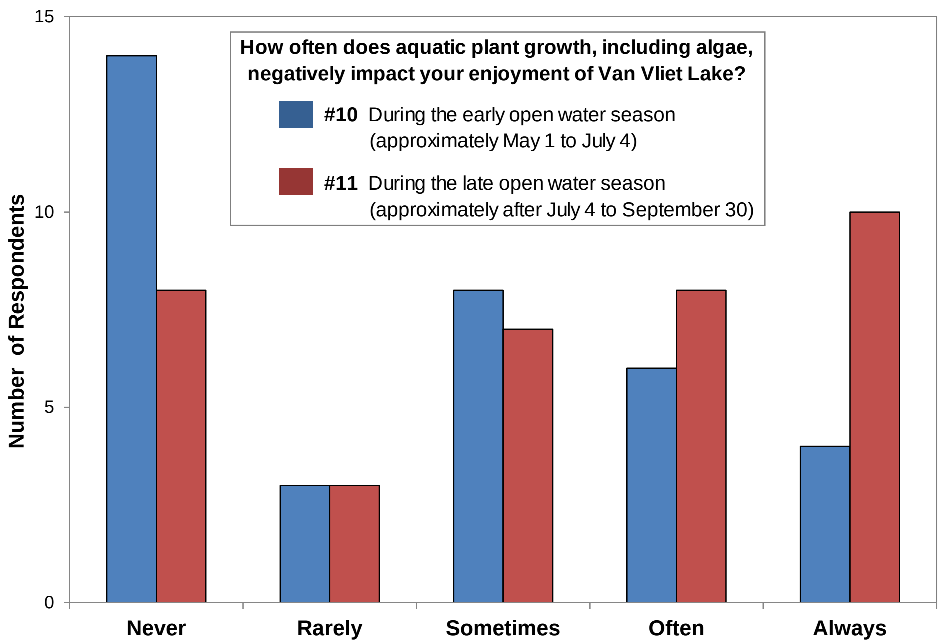

Figure 2.0-2. Select survey responses from the Van Vliet Lake Stakeholder Survey – Question #10 & #11. Additional questions and response charts may be found in Appendix E.

Based upon the stakeholder respondents' answer to questions #10 and #11, they were then asked whether they believe aquatic plant control is needed on Van Vliet Lake. Approximately 67% of these respondents indicated they believe aquatic plant control is needed on Van Vliet Lake by answering either *Definitely Yes* or *Probably Yes*, whereas approximately 28% of respondents did not feel aquatic plant control was needed by answering either *Definitely No* or *Probably No* (Figure 2.0-3).

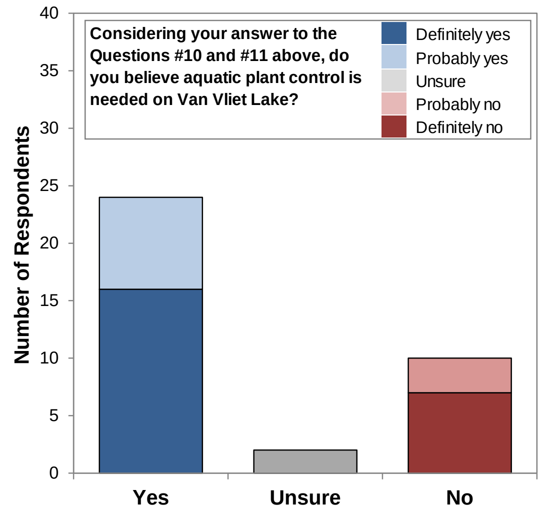

Figure 2.0-3. Select survey responses from the Van Vliet Lake Stakeholder Survey – Question #12. Additional questions and response charts may be found in Appendix E.

While being an anonymous survey, stakeholders were asked what region their property was in (Appendix E, Question # 2). This allowed the survey results to be understood by region in a similar fashion to the earlier 2012 referendum question. As shown on Map 2 of Appendix E, stakeholder respondent opinions on whether aquatic plant control was needed on Van Vliet Lake varied slightly between regions. However, a majority (over 50%) of stakeholder respondents in all 4 regions that contain private residences indicated they believe aquatic plant control is need on Van Vliet Lake by answering either *Definitely Yes* or *Probably Yes*.

Stakeholder respondents indicated they were largely unsupportive of the use of *Herbicide (Chemical) Control* methods to manage aquatic plants, but were more supportive of *Manual Removal by Property Owners* and *Mechanical Harvesting* (Appendix E, Question #13). Figure 2.0-4 shows the level of stakeholder respondent support for the responsible use of mechanical harvesting. The majority (55%) of respondents were supportive (either *Highly Support* or *Moderately Supportive*) of mechanical harvesting, whereas just over a third (35%) were not supportive (either *Not Supportive* or *Moderately Unsupportive*).

Native aquatic plants can be managed using many techniques. In general, what is your level of support for the responsible use of *Mechanical Harvesting* on Van Vliet Lake?

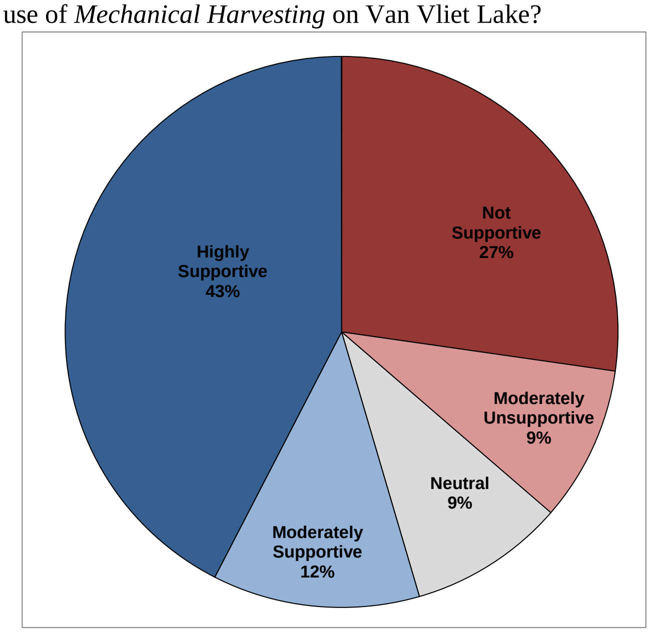

Figure 2.0-4. Select survey responses from the Van Vliet Lake Stakeholder Survey – Question #13. Additional questions and response charts may be found in Appendix E.

As discussed above, stakeholders were given the opportunity to review the draft Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project prior to responding to the stakeholder survey. Within the survey, 88% of respondents indicated that they had read it (Appendix E, Question #14). Of the stakeholder respondents that read the draft plan, 50% indicated they supported the plan by answering either *Completely Support* or *Moderately Support*, whereas approximately 30% of respondents were not supportive by answering either *Completely Oppose* or *Moderately Oppose* (Appendix E, Question #15). A large number of stakeholder respondents (20%) indicated they were unsure or had neutral support for the draft mechanical harvesting plan (Figure 2.0-5). The same question was asked later in the survey, but qualified as, "if the respondent was not expected to help pay for the mechanical harvesting." As shown on Figure 2.0-5, some of the respondents that had a neutral position were supportive if they were not required to pay.

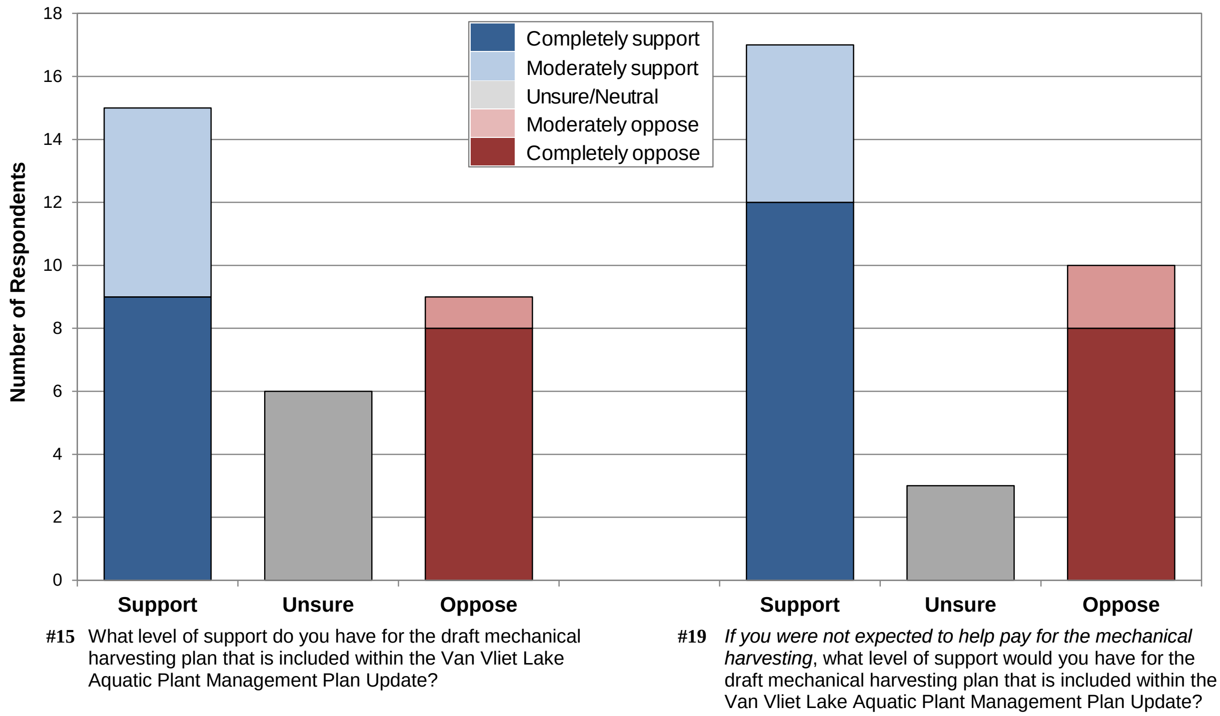

Figure 2.0-5. Select survey responses from the Van Vliet Lake Stakeholder Survey – Question #15 & #19. Additional questions and response charts may be found in Appendix E.

If respondents indicated they were *Unsure/Neutral*, *Moderately Opposed*, or *Completely Opposed* to the draft mechanical harvesting plan, an effort was made to understand the objection(s). The number one reason for opposition was a *Concern of Negative Ecological Impacts to Van Vliet Lake*, followed next by *Cost* (Figure 2.0-5). The third most popular reason for opposition to the draft mechanical harvesting plan was that *There is an Insufficient Amount of Area Being Harvested* – suggesting some folks are in favor of mechanical harvesting but not in favor of the draft plan because the harvesting footprint is too small. There were several *Other* reasons why stakeholder respondents were *Unsure/Neutral*, *Moderately Opposed*, or *Completely Opposed* to the draft mechanical harvesting plan. The unedited comments are included within Appendix E and are summarized/categorized in the bulleted list below:

- Does not address root problems
- Short-term fix
- Property owners bought in weedy areas and should consider selling their property

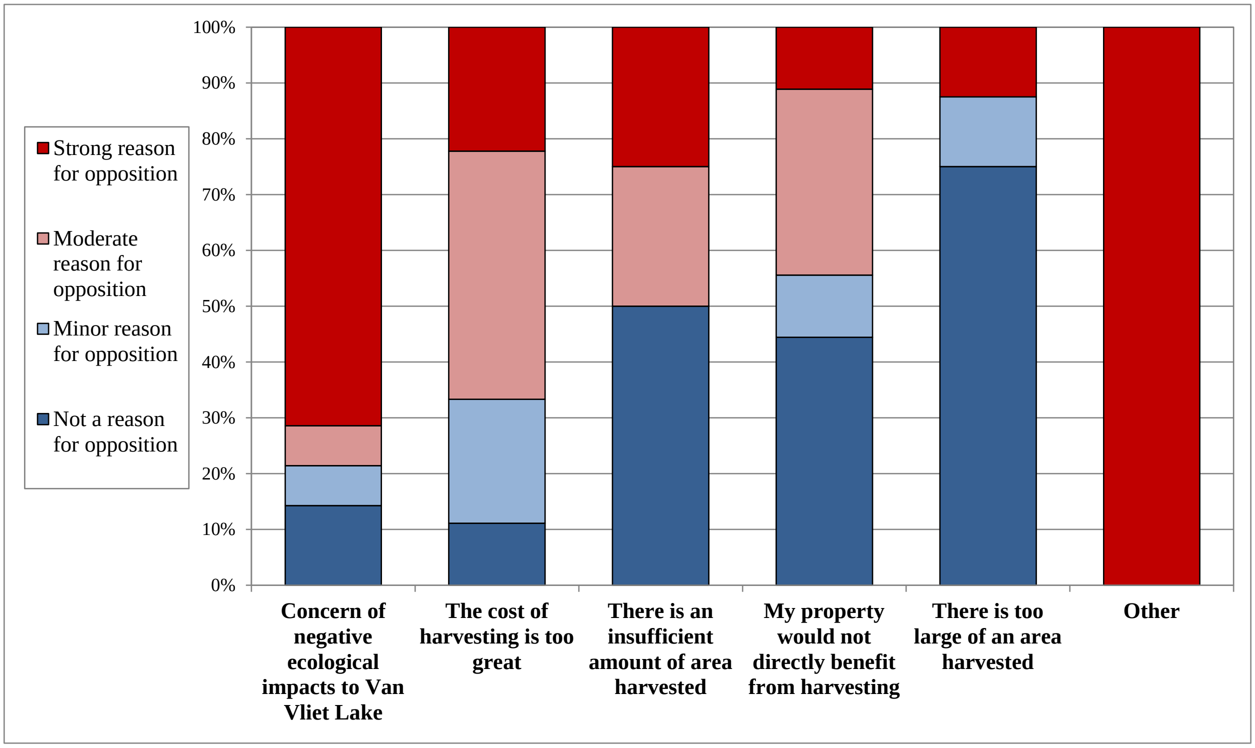

Figure 2.0-6. Select survey responses from the Van Vliet Lake Stakeholder Survey – Question #16. Additional questions and response charts may be found in Appendix E.

Map 3 of Appendix E displays the level of support for the draft mechanical harvesting plan by region. A majority (over 50%) of stakeholder respondents in 3 of the 4 regions that contain private residences indicated they were supportive of the draft plan by answering either *Completely Support* or *Moderately Support*. Only 30% support (by answering either *Completely Support* or *Moderately Support*) for the draft plan was evident in Region 1, however 77% indicated they believe aquatic plant control was needed by answering either *Definitely Yes* or *Probably Yes* to Question #12 (Appendix E, Map 2). When cross referencing the answers of those that were neutral on question #15 in Region 1 with their answers to question #16, 75% of those that were neutral (3 of 4) indicated it was because there was an insufficient amount of harvested area.

3.0 RESULTS AND DISCUSSION

3.1 Shoreland Condition

One of the most vulnerable areas of a lake's watershed is the immediate shoreland zone (approximately from the water's edge to at least 35 feet shoreland). When a lake's shoreland is developed, the increased impervious surface, removal of natural vegetation, and other human practices can severely increase pollutant loads to the lake while degrading important habitat. Limiting these anthropogenic (man-made) effects on the lake is important in maintaining the quality of the lake's water and habitat. Along with this, the immediate shoreland area is often one of the easiest areas to restore.

The intrinsic value of natural shorelands is found in numerous forms. Vegetated shorelands prevent polluted runoff from entering lakes by filtering this water or allowing it to slow to the point where particulates settle. The roots of shoreland plants stabilize the soil, thereby preventing shoreland erosion. Shorelands also provide habitat for both aquatic and terrestrial animal species. Many species rely on natural shorelands for all or part of their life cycle as a source of food, cover from predators, and as a place to raise their young. Shorelands and the nearby shallow waters serve as spawning grounds for fish and nesting sites for birds. Thus, both the removal of vegetation and the inclusion of development reduce many forms of habitat for wildlife.

Some forms of development may provide habitat for less than desirable species. Disturbed areas are often overtaken by invasive species, which are sometimes termed "pioneer species" for this reason. Some waterfowl, such as geese, prefer to linger upon open lawns near waterbodies because of the lack of cover for potential predators. The presence of geese on a lake resident's beach may not be an issue; however the feces the geese leave are unsightly and pose a health risk. Geese feces may become a source of fecal coliforms as well as flatworms that can lead to swimmers itch. Development such as rip rap or masonry, steel or wooden seawalls completely remove natural habitat for most animals, but may also create some habitat for snails; this is not desirable for lakes that experience problems with swimmers itch, as the flatworms that cause this skin reaction utilize snails as a secondary host after waterfowl.

In the end, natural shorelines provide many ecological and other benefits. Between the abundant wildlife, the lush vegetation, and the presence of native flowers, shorelands also provide natural scenic beauty and a sense of tranquility for humans.

Shoreland Zone Regulations

Wisconsin has numerous regulations in place at the state level which aim to enhance and protect shorelands. Additionally, counties, townships and other municipalities have developed their own (often more comprehensive or stronger) policies. At the state level, the following shoreland regulations exist:

Wisconsin-NR 115: Wisconsin's Shoreland Protection Program

Wisconsin's shoreland zoning rule, NR 115, sets the minimum standards for shoreland development. First adopted in 1966, the code set a deadline for county adoption of January 1, 1968. By 1971, all counties in Wisconsin had adopted the code and were administering the shoreland ordinances it specified. Interestingly, in 2007 it was noted that many (27) counties had recognized inadequacies within the 1968 ordinance and had actually adopted more strict shoreland ordinances. Passed in February of 2010, the final NR 115 allowed many standards to remain the same, such as lot sizes, shoreland setbacks and buffer sizes. However, several standards changed as a result of efforts to balance public rights to lake use with private property rights. The regulation sets minimum standards for the shoreland zone, and requires all counties in the state to adopt shoreland zoning ordinances of their own. County ordinances may be more restrictive than NR 115, but not less so. These policy regulations require each county to amend ordinances for vegetation removal on shorelands, impervious surface standards, nonconforming structures and establishing mitigation requirements for development. Minimum requirements for each of these categories are as follows (Note: counties must adopt these standards by February 2014, counties may not have these standards in place at this time):

- Vegetation Removal: For the first 35 feet of property (shoreland zone), no vegetation removal is permitted except for: sound forestry practices on larger pieces of land, access and viewing corridors (may not exceed the lesser of 30 percent of the shoreline frontage or 200 feet), invasive species removal, or damaged, diseased, or dying vegetation. Vegetation removed must be replaced by replanting in the same area (native species only).

- Impervious surface standards: The amount of impervious surface is restricted to 15% of the total lot size, on lots that are within 300 feet of the ordinary high-water mark of the waterbody. A county may allow more than 15% impervious surface (but not more than 30%) on a lot provided that the county issues a permit and that an approved mitigation plan is implemented by the property owner.

- Nonconforming structures: Nonconforming structures are structures that were lawfully placed when constructed but do not comply with distance of water setback. Originally, structures within 75 ft of the shoreline had limitations on structural repair and expansion. New language in NR-115 allows construction projects on structures within 75 feet with the following caveats:
    - No expansion or complete reconstruction within 0-35 feet of shoreline
    - Re-construction may occur if no other build-able location exists within 35-75 feet, dependent on the county.
    - Construction may occur if mitigation measures are included either within the footprint or beyond 75 feet.
    - Vertical expansion cannot exceed 35 feet

- Mitigation requirements: New language in NR-115 specifies mitigation techniques that may be incorporated on a property to offset the impacts of impervious surface, replacement of nonconforming structure, or other development projects. Practices such as buffer restorations along the shoreland zone, rain gardens, removal of fire pits, and beaches all may be acceptable mitigation methods, dependent on the county.

- Contact the county's regulations/zoning department for all minimum requirements.

Wisconsin Act 31

While not directly aimed at regulating shoreland practices, the State of Wisconsin passed Wisconsin Act 31 in 2009 in an effort to minimize watercraft impacts upon shorelines. This act prohibits a person from operating a watercraft (other than personal watercraft) at a speed in excess of slow-no-wake speed within 100 feet of a pier, raft, buoyed area or the shoreline of a lake. Additionally, personal watercraft must abide by slow-no-wake speeds while within 200 feet of these same areas. Act 31 was put into place to reduce wave action upon the sensitive shoreland zone of a lake. The legislation does state that pickup and drop off areas marked with regulatory markers and that are open to personal watercraft operators and motorboats engaged in waterskiing/a similar activity may be exempt from this distance restriction. Additionally, a city, village, town, public inland lake protection and rehabilitation district or town sanitary district may provide an exemption from the 100 foot requirement or may substitute a lesser number of feet.

Shoreland Research

Studies conducted on nutrient runoff from Wisconsin lake shorelands have produced interesting results. For example, a USGS study on several Northwoods Wisconsin lakes was conducted to determine the impact of shoreland development on nutrient (phosphorus and nitrogen) export to these lakes (Graczyk et al. 2003). During the study period, water samples were collected from surface runoff and ground water and analyzed for nutrients. These studies were conducted on several developed (lawn covered) and undeveloped (undisturbed forest) areas on each lake. The study found that nutrient yields were greater from lawns than from forested catchments, but also that runoff water volumes were the most important factor in determining whether lawns or wooded catchments contributed more nutrients to the lake. Ground-water inputs to the lake were found to be significant in terms of water flow and nutrient input. Nitrate plus nitrite nitrogen and total phosphorus yields to the ground-water system from a lawn catchment were three or sometimes four times greater than those from wooded catchments.

A separate USGS study was conducted on the Lauderdale Lakes in southern Wisconsin, looking at nutrient runoff from different types of developed shorelands – regular fertilizer application lawns (fertilizer with phosphorus), non-phosphorus fertilizer application sites, and unfertilized sites (Garn 2002). One of the important findings stemming from this study was that the amount of dissolved phosphorus coming off of regular fertilizer application lawns was twice that of lawns with non-phosphorus or no fertilizer. Dissolved phosphorus is a form in which the phosphorus molecule is not bound to a particle of any kind; in this respect, it is readily available to algae. Therefore, these studies show us that it is a developed shoreland that is continuously maintained in an unnatural manner (receiving phosphorus rich fertilizer) that impacts lakes the greatest. This understanding led former Governor Jim Doyle into passing the Wisconsin Zero-Phosphorus Fertilizer Law (Wis Statue 94.643), which restricts the use, sale and display of lawn and turf fertilizer which contains phosphorus. Certain exceptions apply, but after April 1 2010, use of this type of fertilizer is prohibited on lawns and turf in Wisconsin. The goal of this action is to reduce the impact of developed lawns, and is particularly helpful to developed lawns situated near Wisconsin waterbodies.

Shorelands provide much in terms of nutrient retention and mitigation, but also play an important role in wildlife habitat. Woodford and Meyer (2003) found that green frog density was negatively correlated with development density in Wisconsin lakes. As development increased, the habitat for green frogs decreased and thus populations became significantly lower. Common loons, a bird species notorious for its haunting call that echoes across Wisconsin lakes, are often associated more so with undeveloped lakes than developed lakes (Lindsay et al. 2002). And studies on shoreland development and fish nests show that undeveloped shorelands are preferred as well. In a study conducted on three Minnesota lakes, researchers found that only 74 of 852 black crappie nests were found near shorelines that had any type of dwelling on it (Reed 2001). The remaining nests were all located along undeveloped shoreland.

Emerging research in Wisconsin has shown that coarse woody habitat (sometimes called "coarse woody debris"), often stemming from natural or undeveloped shorelands, provides many ecosystem benefits in a lake. Coarse woody habitat describes habitat consisting of trees, limbs, branches, roots and wood fragments at least two inches in diameter that enter a lake by natural or human means (Photo 3.1-1). Coarse woody habitat provides shoreland erosion control, a carbon source for the lake, prevents suspension of sediments and provides a surface for algal growth which important for aquatic macroinvertebrates (Sass 2009). While it impacts these aspects considerably, one of the greatest benefits coarse woody habitat provides is habitat for fish species.

Photo 3.1-1. Example of a coarse woody habitat along shoreline. Van Vliet Lake, Vilas Co.

Coarse woody habitat has shown to be advantageous for fisheries in terms of providing refuge, foraging area as well as spawning habitat (Hanchin et al 2003). In one study, researchers observed 16 different species occupying coarse woody habitat areas in a Wisconsin lake (Newbrey et al. 2005). Bluegill and bass species in particular are attracted to this habitat type; largemouth bass stalk bluegill in these areas while the bluegill hide amongst the debris and often feed upon in many macroinvertebrates found in these areas, who themselves are feeding upon algae and periphyton growing on the wood surface. Newbrey et al. (2005) found that some fish species prefer different complexity of branching on coarse woody habitat, though in general some degree of branching is preferred over coarse woody habitat that has no branching.

With development of a lake's shoreland zone, much of the coarse woody habitat that was once found in Wisconsin lakes has disappeared. Prior to human establishment and development on lakes (mid to late 1800's), the amount of coarse woody habitat in lakes was likely greater than under completely natural conditions due to logging practices. However, with changes in the logging industry and increasing development along lake shorelands, coarse woody habitat has decreased substantially. Shoreland residents are removing woody debris to improve aesthetics or for recreational opportunities (boating, swimming, and, ironically, fishing).

National Lakes Assessment

Unfortunately, along with Wisconsin's lakes, waterbodies within the entire United States have shown to have increasing amounts of developed shorelands. The National Lakes Assessment (NLA) is an Environmental Protection Agency sponsored assessment that has successfully pooled together resource managers from all 50 U.S. states in an effort to assess waterbodies, both natural and man-made, from each state. Through this collaborative effort, over 1,000 lakes were sampled in 2007, pooling together the first statistical analysis of the nation's lakes and reservoirs.

Through the National Lakes Assessment, a number of potential stressors were examined, including nutrient impairment, algal toxins, fish tissue contaminants, physical habitat, and others. The 2007 NLA report states that "*of the stressors examined, poor lakeshore habitat is the biggest problem in the nations lakes; over one-third exhibit poor shoreline habitat condition*" (USEPA 2009). Furthermore, the report states that "*poor biological health is three times more likely in lakes with poor lakeshore habitat*".

The results indicate that stronger management of shoreline development is absolutely necessary to preserve, protect and restore lakes. This will become increasingly important as development pressures on lakes continue to steadily grow.

Native Species Enhancement

Photo 3.1-2. Example of a bio-log restoration site. Long Lake, Manitowoc Co.

The development of Wisconsin's shorelands has increased dramatically over the last century and with this increase in development a decrease in water quality and wildlife habitat has occurred. Many people that move to or build in shoreland areas attempt to replicate the suburban landscapes they are accustomed to by converting natural shoreland areas to the "neat and clean" appearance of manicured lawns and flowerbeds. The conversion of these areas immediately leads to destruction of habitat utilized by birds, mammals, reptiles, amphibians, and insects (Jennings et al. 2003). The maintenance of the newly created area helps to decrease water quality by considerably increasing inputs of phosphorus and sediments into the lake. The negative impact of human development does not stop at the shoreland. Removal of native plants and dead, fallen timbers from shallow, near-shore areas for boating and swimming activities destroys habitat used by fish, mammals, birds, insects, and amphibians, while leaving bottom and shoreland sediments vulnerable to wave action caused by boating and wind (Jennings et al. 2003, Radomski and Goeman 2001, and Elias & Meyer 2003). Many homeowners significantly decrease the number of trees and shrubs along the water's edge in an effort to increase their view of the lake. However, this has been shown to locally increase water temperatures, and decrease infiltration rates of potentially harmful nutrients and pollutants. Furthermore, the dumping of sand to create beach areas destroys spawning, cover and feeding areas utilized by aquatic wildlife (Scheuerell and Schindler 2004).

In recent years, many lakefront property owners have realized increased aesthetics, fisheries, property values, and water quality by restoring portions of their shoreland to mimic its unaltered state (Photo 3.1-2). An area of shore restored to its natural condition, both in the water and on shore, is commonly called a shoreland buffer zone. The shoreland buffer zone creates or restores the ecological habitat and benefits lost by traditional suburban landscaping. Simply not mowing within the buffer zone does wonders to restore some of the shoreland's natural function.

Enhancement activities also include additions of submergent, emergent, and floating-leaf plants within the lake itself. These additions can provide greater species diversity and may compete against exotic species.

Cost

The cost of native, aquatic, and shoreland plant restorations is highly variable and depends on the size of the restoration area, the depth of buffer zone required to be restored, the existing plant density, the planting density required, the species planted, and the type of planting (e.g. seeds, bare-roots, plugs, live-stakes) being conducted. Other sites may require erosion control stabilization measures, which could be as simple as using erosion control blankets and plants and/or seeds or more extensive techniques such as geotextile bags (vegetated retaining walls), geogrids (vegetated soil lifts), or bio-logs (see above picture). Some of these erosion control techniques may reduce the need for rip-rap or seawalls which are sterile environments that do nott allow for plant growth or natural shorelines. Questions about rip-rap or seawalls should be directed to the local Wisconsin DNR Water Resources Management Specialist. Other measures possibly required include protective measures used to guard newly planted area from wildlife predation, wave-action, and erosion, such as fencing, erosion control matting, and animal deterrent sprays. One of the most important aspects of planting is maintaining moisture levels. This is done by watering regularly for the first two years until plants establish themselves, using soil amendments (i.e., peat, compost) while planting, and using mulch to help retain moisture.

Most restoration work can be completed by the landowner themselves. To decrease costs further, bare-root form of trees and shrubs should be purchased in early spring. If additional assistance is needed, the lakefront property owner could contact an experienced landscaper. For properties with erosion issues, owners should contact their local county conservation office to discuss cost-share options.

In general, a restoration project with the characteristics described below would have an estimated materials and supplies cost of approximately $1,400. The more native vegetation a site has, the lower the cost. Owners should contact the county's regulations/zoning department for all minimum requirements. The single site used for the estimate indicated above has the following characteristics:

- Spring planting timeframe.
- 100' of shoreline.
- An upland buffer zone depth of 35'.
- An access and viewing corridor 30' x 35' free of planting (recreation area).
- Planting area of upland buffer zone 2- 35' x 35' areas
- Site is assumed to need little invasive species removal prior to restoration.
- Site has only turf grass (no existing trees or shrubs), a moderate slope, sandy-loam soils, and partial shade.

- Trees and shrubs planted at a density of 1 tree/100 sq ft and 2 shrubs/100 sq ft, therefore, 24 native trees and 48 native shrubs would need to be planted.
- Turf grass would be removed by hand.
- A native seed mix is used in bare areas of the upland buffer zone.
- An aquatic zone with shallow-water 2 - 5' x 35' areas.
- Plant spacing for the aquatic zone would be 3 feet.
- Each site would need 70' of erosion control fabric to protect plants and sediment near the shoreland (the remainder of the site would be mulched).
- Soil amendment (peat, compost) would be needed during planting.
- There is no hard-armor (rip-rap or seawall) that would need to be removed.
- The property owner would maintain the site for weed control and watering.

Advantages	***Disadvantages***
• Improves the aquatic ecosystem through species diversification and habitat enhancement. • Assists native plant populations to compete with exotic species. • Increases natural aesthetics sought by many lake users. • Decreases sediment and nutrient loads entering the lake from developed properties. • Reduces bottom sediment re-suspension and shoreland erosion. • Lower cost when compared to rip-rap and seawalls. • Restoration projects can be completed in phases to spread out costs. • Once native plants are established, they require less water, maintenance, no fertilizer; provide wildlife food and habitat, and natural aesthetics compared to ornamental (non-native) varieties. • Many educational and volunteer opportunities are available with each project.	• Property owners need to be educated on the benefits of native plant restoration before they are willing to participate. • Stakeholders must be willing to wait 3-4 years for restoration areas to mature and fill-in. • Monitoring and maintenance are required to assure that newly planted areas will thrive. • Harsh environmental conditions (e.g., drought, intense storms) may partially or completely destroy project plantings before they become well established.

Van Vliet Lake Shoreland Zone Condition

Shoreland Development

Van Vliet Lake's shoreland zone can be classified in terms of its degree of development. In general, more developed shorelands are more stressful on a lake ecosystem, while definite benefits occur from shorelands that are left in their natural state. Figure 3.1-1 displays a diagram of shoreland categories, from "Urbanized", meaning the shoreland zone is completely disturbed by human influence, to "Natural/Undeveloped", meaning the shoreland has been left in its original state.

Urbanized: This type of shoreland has essentially no natural habitat. Areas that are mowed or unnaturally landscaped to the water's edge and areas that are rip-rapped or include a seawall would be placed in this category.

Developed-Unnatural: This category includes shorelands that have been developed, but only have small remnants of natural habitat yet intact. A property with many trees, but no remaining understory or herbaceous layer would be included within this category. Also, a property that has left a small (less than 30 feet), natural buffer in place, but has urbanized the areas behind the buffer would be included in this category.

Developed-Semi-Natural: This is a developed shoreland that is mostly in a natural state. Developed properties that have left much of the natural habitat in state, but have added gathering areas, small beaches, etc within those natural areas would likely fall into this category. An urbanized shoreland that was restored would likely be included here, also.

Developed-Natural: This category includes shorelands that are developed property, but essentially no modifications to the natural habitat have been made. Developed properties that have maintained the natural habitat and only added a path leading to a single pier would fall into this category.

Natural/Undeveloped: This category includes shorelands in a natural, undisturbed state. No signs of anthropogenic impact can be found on these shorelands. In forested areas, herbaceous, understory, and canopy layers would be intact.

Figure 3.1-1. Shoreland assessment category descriptions. Developed by Onterra.

On Van Vliet Lake, the development stage of the entire shoreland was surveyed during the fall of 2013, using a GPS unit to map the shoreland. Onterra staff only considered the area of shoreland 35 feet inland from the water's edge, and did not assess the shoreland on a property-by-property basis. During the survey, Onterra staff examined the shoreland for signs of development and assigned areas of the shoreland one of the five descriptive categories in Figure 3.1-2.

Van Vliet Lake has stretches of shoreland that fit all of the five shoreland assessment categories (Map 1). In all, 2.4 miles of natural/undeveloped and developed-natural shoreland were observed during the survey (Figure 3.1-2). These shoreland types provide the most benefit to the lake and should be left in their natural state. During the survey, 0.3 miles of urbanized and developed–unnatural shoreland were observed. If restoration of the Van Vliet Lake shoreland 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. These two shoreland condition types are those that likely do not meet established WDNR best management practice (BMP) guidelines. More information on WDNR shoreland BMPs can be found within Appendix C.

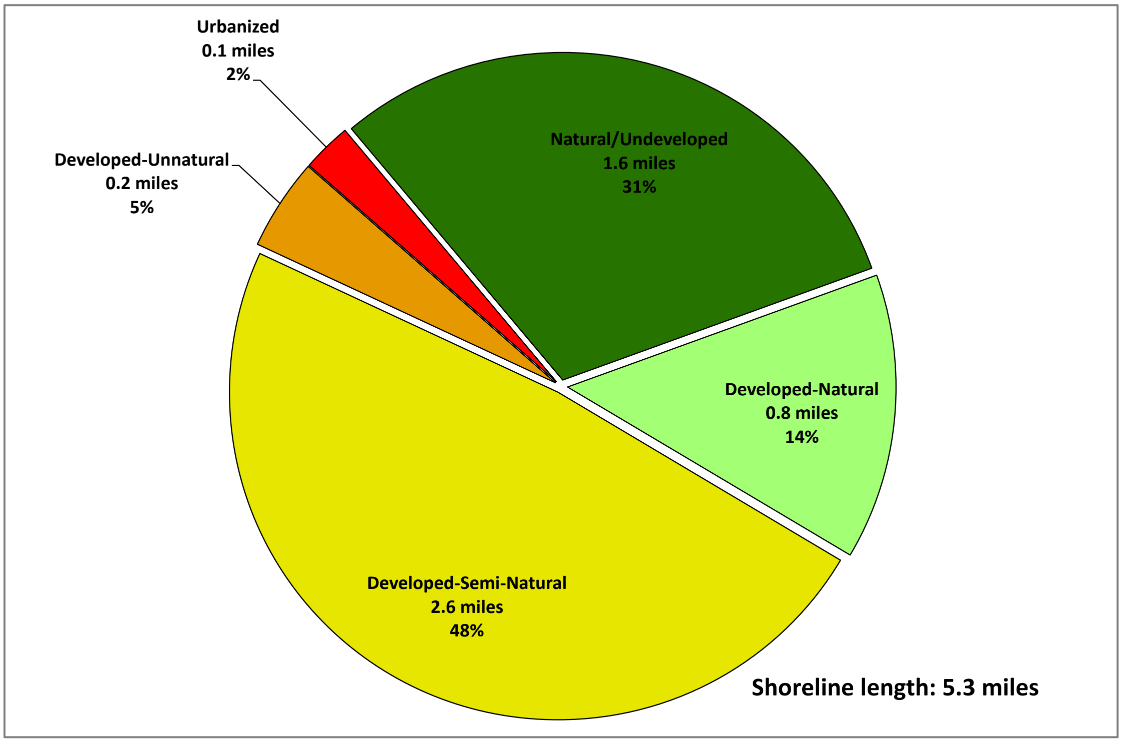

Figure 3.1-2. Van Vliet Lake shoreland categories and total lengths. Based upon a fall 2013 survey. Locations of these categorized shorelands can be found on Map 1.

While producing a completely natural shoreland is ideal for a lake ecosystem, it is not always practical from a human's perspective. However, riparian property owners can take small steps in ensuring their property's impact upon the lake is minimal. Choosing an appropriate landscape position for lawns is one option to consider. Placing lawns on flat, unsloped areas or in areas that do not terminate at the lake's edge is one way to reduce the amount of runoff a lake receives from a developed site. And, allowing tree falls and other natural habitat features to remain along a shoreline may result not only in reducing shoreline erosion, but creating wildlife habitat also.

As a part of the 2011 Aquatic Plant Management Planning project, Bonestroo conducted a similar shoreland characterization to Onterra's 2013 survey. This survey was coarser-scale, utilized a generalized categorical ranking system, and was intended to provide a general basis for discussing the concept of shoreland condition. The survey conducted by Onterra in 2013 was a finer-scale census of the shoreland areas and utilized a more defined categorical ranking system that will allow the VVLA to prioritize specific areas for shoreland conservation and remediation.

Coarse Woody Habitat

Van Vliet Lake was also surveyed in the fall of 2013 to determine the extent of its 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 diameter pieces, >8 inches diameter pieces, 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.

During this survey, 371 total pieces of coarse woody habitat were observed along 5.3 miles of shoreline, which gives Van Vliet Lake a coarse woody habitat pieces to shoreline mile ratio of 70:1 (Map 2, Figure 3.1-3). To put this into perspective, Wisconsin researchers have found that in completely undeveloped lakes, an average of 345 coarse woody habitat pieces may be found per mile (Christensen et al. 1996). However, the ratio found on the survey of Van Vliet Lake likely underestimates the total amount of coarse woody habitat within the littoral zone (are of lakes in which plants grow) of the lake. The methodology used in this survey limits coarse woody habitat to what is visible above the surface of the water and extends from the shoreline into the lake. Other studies have employed more elaborate and time consuming methods of quantifying coarse woody habitat within the littoral zone of lakes and thus are not directly comparable to this study. One recent study used a transect sampling method in which 50 or 100 transects were carefully assessed and required accurate measuring of transects and often required snorkel gear (Schmidt 2010). The methodology used within this survey does allow for a visual representation of the locations of coarse woody habitat along the shoreline of Van Vliet Lake and are displayed on Map 2.

The **Littoral Zone (Photic Zone)** is the area of the lake where sunlight is able to penetrate and provide aquatic plants with sufficient light to carry out photosynthesis.

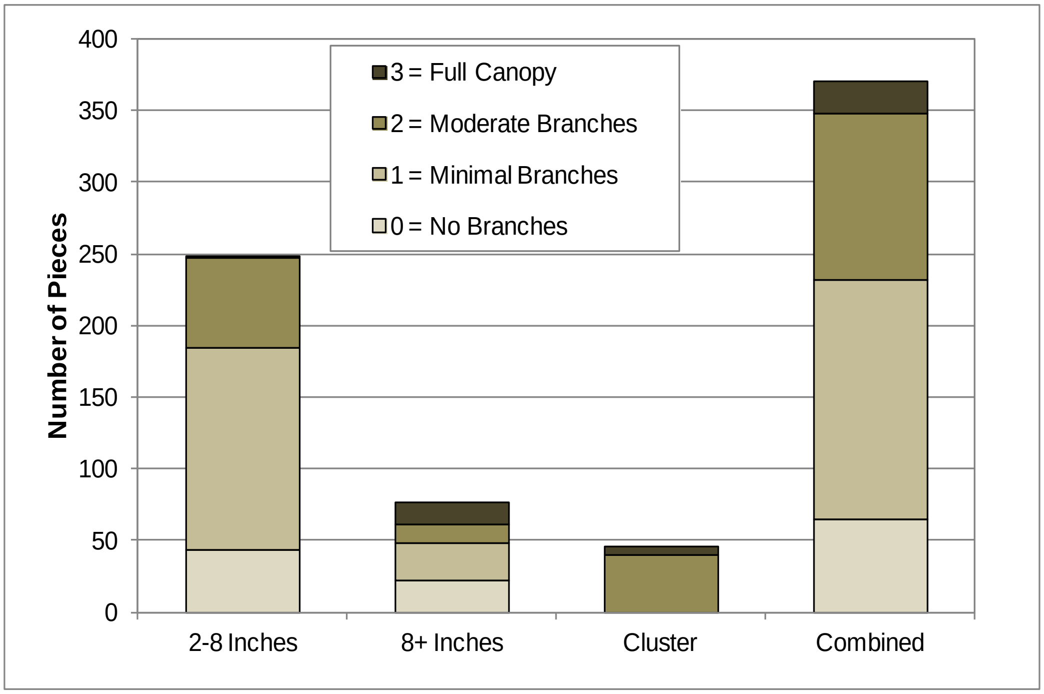

Figure 3.1-3. Van Vliet Lake coarse woody habitat survey results. Based upon a fall 2013 survey. Locations of Van Vliet Lake coarse woody habitat can be found on Map 2.

3.2 Aquatic Plants

Aquatic Plant Sampling Methodology and Data Analysis

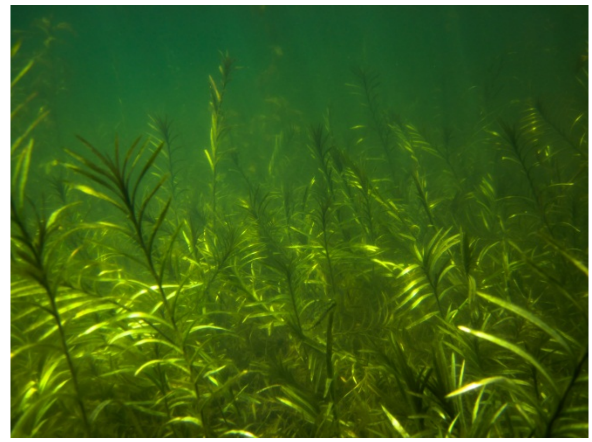

Photo 3.2-1. Native aquatic plants are an important component in maintaining a healthy aquatic ecosystem.

Native aquatic plants are an important element in every healthy aquatic ecosystem, providing food and habitat to wildlife, improving water quality, and stabilizing bottom sediments (Photo 3.2-1). Because most aquatic plants are rooted in place and are unable to relocate in wake of environmental alterations, they are often the first community to indicate that changes may be occurring within the system. Aquatic plant communities can respond in variety of ways; there may be increases or declines in the occurrences of some species, or a complete loss. Or, certain growth forms, such as emergent and floating-leaf communities may disappear from certain areas of the waterbody. With periodic monitoring and proper analysis, these changes are relatively easy to detect and provide relevant information for making management decisions.

The point-intercept method as described Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS-1068 2010 (Hauxwell et al. 2010) was conducted in Van Vliet Lake in 2008 by Bonestroo, Inc. and in 2013 by White Water Associates. Based upon guidance from the WDNR, a point spacing (resolution) of 46 meters was used resulting in 432 sampling points being evenly distributed across the lake (Figure 1.0-1). At each point-intercept location within the *littoral zone*, information regarding the depth, substrate type (muck, sand, or rock), and the plant species sampled along with their relative abundance (Figure 3.2-1) on the sampling rake was recorded. The littoral zone, or photic zone, is the area of the lake where sunlight is able to penetrate through the water and provide aquatic plants with sufficient light to carry out photosynthesis.

A pole-mounted rake was used to collect the plant samples, depth, and sediment information at point locations of 16 feet or less. A rake head tied to a rope (rope rake) was used at sites greater than 16 feet. Depth information was collected using graduated marks on the pole of the rake or using an onboard sonar unit at depths greater than 16 feet. Also, when a rope rake was used, information regarding substrate type was not collected due to the inability of the sampler to accurately feel the bottom with this sampling device. The point-intercept survey produces a great deal of information about a lake's aquatic vegetation and overall health. The 2008 and 2013 data are analyzed and compared and are presented in numerous ways; each is discussed in more detail the following section.

Figure 3.2-1. Aquatic plant rake-fullness ratings. Adapted from Hauxwell et al (2010).

Primer on Data Analysis & Data Interpretation

Species List

The species list is simply a list of all of the species, both native and non-native, that were located during the 2008 and 2013 surveys on Van Vliet Lake. The list also contains the growth-form of each plant found (e.g. submergent, emergent, etc.), its scientific name, common name, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in growth forms that are present, can be an early indicator of changes in the ecosystem.

Frequency of Occurrence

Frequency of occurrence describes how often a certain species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of the whole-lake point-intercept survey conducted on Van Vliet Lake in 2008 and 2013, plant samples were collected from plots laid out on a grid that covered the lake. Using the data collected from these plots, an estimate of occurrence of each plant species can be determined. In this section, the occurrences of aquatic plant species are displayed as their *littoral frequency of occurrence*. Littoral frequency of occurrence is used to describe how often each species occurred in the plots that are equal to or less than the maximum depth of plant growth (littoral zone), and is displayed as a percentage.

Floristic Quality Assessment

The floristic quality of a lake is calculated using its native aquatic plant species richness and those species' average conservatism values. Species richness is simply the number of aquatic plant species that occur in the lake, and for this analysis, only native species are utilized. Average species conservatism utilizes the coefficient of conservatism values (C-value) for each of those species in its calculation. A species coefficient of conservatism value indicates that species' likelihood of being found in an undisturbed system.

The values range from 1 to 10. Species that can tolerate environmental disturbance and can survive in disturbed systems have lower coefficients, while species that are less tolerant to environmental disturbance and are restricted to high quality systems have higher values. For example, coontail (*Ceratophyllum demersum*), a submergent native aquatic plant species with a C-value of 3, has a higher tolerance to disturbed conditions, often thriving in lakes with higher nutrient levels and low water clarity, while other species like algal-leaf pondweed (*Potamogeton confervoides*) with a C-value of 10, are intolerant of environmental disturbance and require high quality environments to survive.

On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality. The floristic quality is calculated using the species richness and average conservatism value of the aquatic plant species that were solely encountered on the rake during the point-intercept survey (equation shown below).

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

The floristic quality of Van Vliet Lake's aquatic plant community will be compared to other lakes within the same *ecoregion*. Ecoregions are areas related by similar climate, physiography, hydrology, vegetation and wildlife potential. Comparing ecosystems in the same ecoregion is sounder than comparing systems within manmade boundaries such as counties, towns, or states. Van Vliet Lake falls within the Northern Lakes and Forests Ecoregion of Wisconsin (Figure 3.2-2).

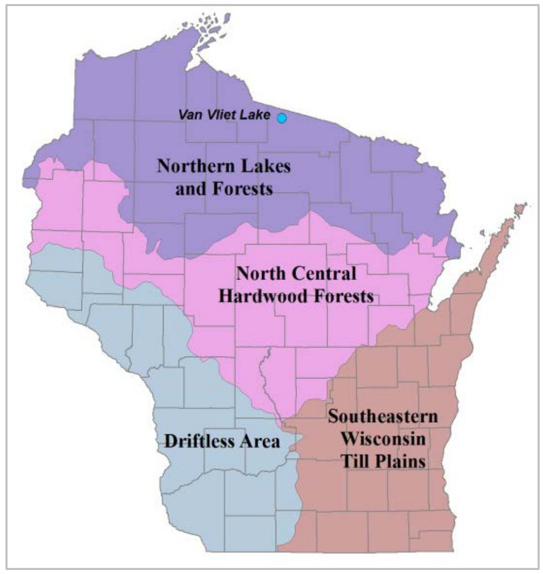

Figure 3.2-2. Location of Van Vliet Lake within the ecoregions of Wisconsin. After Nichols (1999).

Species Diversity

Species diversity is probably the most misused value in ecology because it is often confused with species richness. As defined previously, species richness is simply the number of species found within a system or community. Although these values are related, they are far from the same because species diversity also takes into account how evenly the species are distributed within the system. A lake with 25 species may not be more diverse than a lake with 10 if the first lake is highly dominated by one or two species and the second lake has a more even distribution.

An aquatic system with high species diversity is much more stable than a system with a low diversity. This is analogous to a diverse financial portfolio in that a diverse aquatic plant community can withstand environmental fluctuations much like a diverse portfolio can handle economic fluctuations. For example, a lake with a diverse plant community is much better suited to compete against exotic infestation than a lake with a lower diversity. Simpson's diversity index is used to determine this diversity in a lake ecosystem.

Simpson's diversity (1-D) is calculated as:

$$D = \sum (n/N)^2$$

where:
n = the total number of instances of a particular species
N = the total number of instances of all species and
D is a value between 0 and 1

If a lake has a diversity index value of 0.90, it means that if two plants were randomly sampled from the lake there is a 90% probability that the two individuals would be of a different species. Between 2005 and 2009, WDNR Science Services conducted point-intercept surveys on 252 lakes within the state. In the absence of comparative data from Nichols (1999), the Simpson's Diversity Index values of the lakes within the WDNR Science Services dataset will be compared to Van Vliet Lake. Comparisons will be displayed using *boxplots* that show median values and upper/lower quartiles of lakes in the same ecoregion and in the state. Please note for this parameter, the Northern Lakes and Forests data includes both natural and flowage lakes.

Community Mapping

A key component to understanding a lake's aquatic plant community is the creation of an aquatic plant community map. The map represents a snapshot of the important emergent and floating-leaf plant communities in the lake as they existed during the survey and is valuable in the development of the management plan and in comparisons with surveys completed in the future. Examples of these communities include emergent species like cattails, bulrushes, and arrowheads, and floating-leaf species like white and yellow pond lilies. Emergents and floating-leaf communities lend themselves well to mapping because there are distinct boundaries between communities. Submergent species are often mixed throughout large areas of the lake and are seldom visible from the surface; therefore, mapping of submergent communities is more difficult and often impossible.

Aquatic Plant Survey Results

On July 1, 2, and 8, 2013, White Water Associates staff conducted the whole-lake point-intercept survey on Van Vliet Lake, while the aquatic plant community mapping survey was conducted by Onterra on August 20-22, 2013. During these surveys, a total of 39 aquatic plant species were located, none of which are considered to be non-native, invasive species (Table 3.2-1). Most of the aquatic plant species that were located during the 2008 survey were relocated in 2013, with the exception of water bulrush (Table 3.2-1).

As discussed, during the 2008 and 2013 whole-lake point-intercept surveys, information regarding substrate type was collected at locations sampled with a pole-mounted rake (less than 17 feet). These data indicate that over 90% of the sampling locations where the sediment type was able to be determined contain soft sediments, while approximately 5% contain sand, and 2% contain rock. Map 3 displays the sediment composition of Van Vliet Lake as determined from the 2013 acoustic mapping survey and point-intercept survey. Like terrestrial plants, different aquatic plant species are adapted to grow in certain substrate types; some species are only found growing in soft substrates, others only in sandy areas, and some can be found growing in either. The substrate found in Van Vliet Lake is very conducive for supporting abundant aquatic plant growth.

Table 3.2-1. Aquatic plant species located in Van Vliet Lake during 2008 and 2013 surveys.

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2008	2013
Emergent	*Calla palustris*	Water arum	9		I
	Carex comosa	Bristly sedge	5		I
	Carex sp. (sterile)	Sedge sp. (sterile)	N/A		I
	Dulichium arundinaceum	Three-way sedge	10		I
	Eleocharis palustris	Creeping spikerush	6	X	I
	Equisetum fluviatile	Water horsetail	7		I
	Iris versicolor	Northern blue flag	5		I
	Pontederia cordata	Pickerelweed	9		I
	Sagittaria latifolia	Common arrowhead	3		I
	Sagittaria sp. 1	Arrowhead sp. 1	N/A		X
	Sagittaria sp. 2	Arrowhead sp. 2	N/A		X
	Schoenoplectus acutus	Hardstem bulrush	5		I
	Scirpus cyperinus	Wool-grass	4		I
	Typha spp.	Cattail spp.	1		I
FL	*Brasenia schreberi*	Watershield	7	X	X
	Nuphar variegata	Spatterdock	6		I
	Nymphaea odorata	White water lily	6	X	X
	Persicaria amphibia	Water smartweed	5		I
FL/E	*Sparganium americanum*	Eastern bur-reed	8		I
Submergent	*Bidens beckii*	Water marigold	8	X	X
	Ceratophyllum demersum	Coontail	3	X	X
	Chara spp.	Muskgrasses	7	X	X
	Elodea canadensis	Common waterweed	3	X	X
	Elodea nuttallii	Slender waterweed	7	X	X
	Heteranthera dubia	Water stargrass	6	X	X
	Myriophyllum sibiricum	Northern water milfoil	7	X	X
	Najas flexilis	Slender naiad	6	X	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X	X
	Potamogeton foliosus	Leafy pondweed	6		X
	Potamogeton illinoensis	Illinois pondweed	6	X	I
	Potamogeton praelongus	White-stem pondweed	8	X	X
	Potamogeton pusillus	Small pondweed	7	X	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X	X
	Potamogeton robbinsii	Fern pondweed	8	X	X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X	X
	Stuckenia pectinata	Sago pondweed	3	X	X
	Utricularia vulgaris	Common bladderwort	7		X
	Vallisneria americana	Wild celery	6	X	X
S/E	*Eleocharis acicularis*	Needle spikerush	5		X
	Schoenoplectus subterminalis	Water bulrush	9	X	

FL = Floating-leaf; FL/E = Floating-leaf and Emergent; S/E = Submergent and Emergent
X = Located on rake during point-intercept survey; I = Incidental species

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Lake Management Planning

During the 2013 point-intercept survey, aquatic plants were found growing to a maximum depth of 16 feet, while they were found growing to a depth of 19 feet in 2008. The maximum depth of aquatic plant growth depends on sunlight's ability to penetrate into the water column. Aquatic plants generally grow two to three times the depth of the average Secchi disk depth. In 2008, average growing season Secchi disk depth was approximately 9.8 feet, while it was 7.8 feet in 2013. This difference in water clarity is likely the reason aquatic plants were not found growing as deep in 2013.

Of the 375 point-intercept location that fell within the maximum depth of plant growth in 2013, approximately 80% contained aquatic vegetation. This was slightly lower than the 88% frequency of occurrence of vegetation recorded in 2008. Figure 3.2-3 displays the distribution of aquatic vegetation in Van Vliet Lake as determined from the 2008 and 2013 point-intercept surveys, and as illustrated, aquatic vegetation was not observed growing in deeper areas of the lake as was observed in 2008.

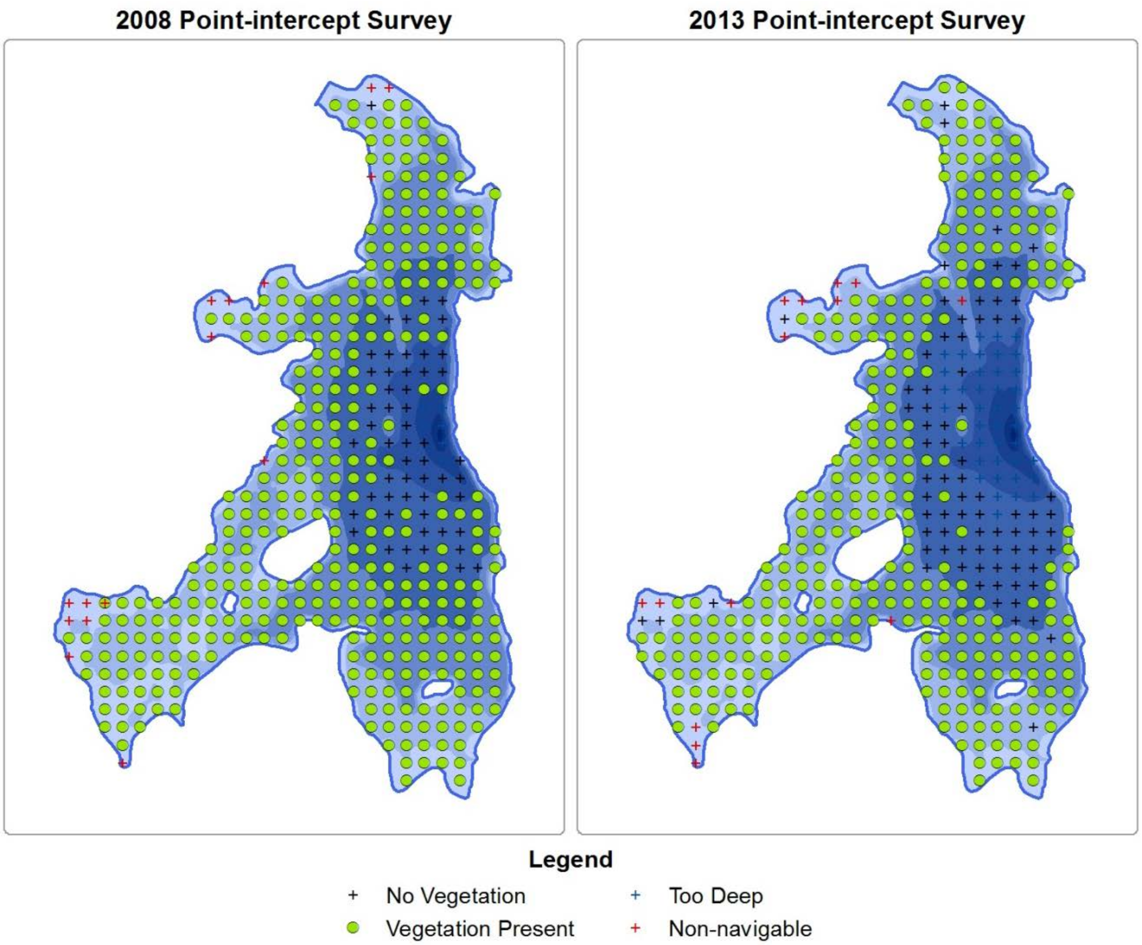

Figure 3.2-3 Distribution of aquatic vegetation in Van Vliet Lake in 2008 and 2013. Created using data from Bonestroo, Inc. 2008 and White Water Associates 2013 point-intercept surveys.

Like most spring (drained) lakes, Van Vliet's water level fluctuates depending on various hydrologic factors. A program started by the North Lakeland Discovery Center has volunteers read a staff gauge weekly during the ice-off season. Unfortunately, this program was not started until 2010, and cannot be used to understand if there was a difference in water levels between the 2008 and 2013 point-intercept surveys. Since the volunteer-based water level monitoring program has been put into effect, the summer of 2013 contained the highest water levels (Figure 3.2-4).

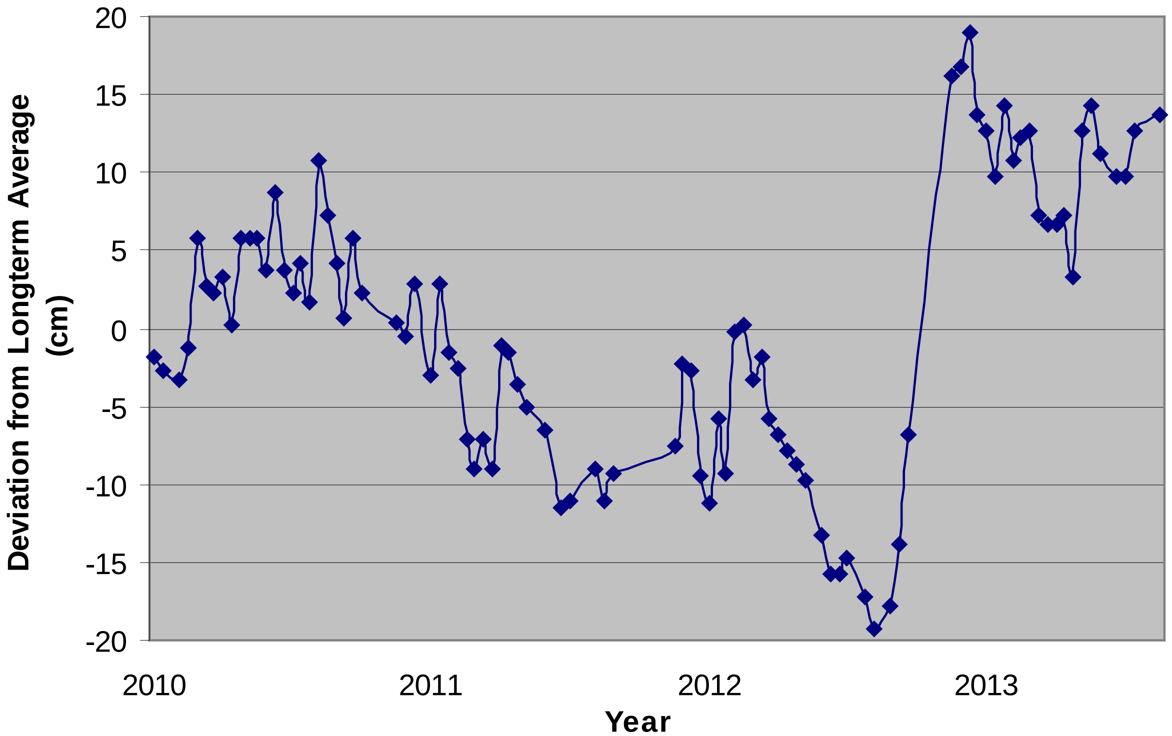

Figure 3.2-4. 2010-2013 Van Vliet Lake level anomaly recorded through a citizen science program for monitoring lake stages in northern Wisconsin, preliminary results. Credit: A. Kretschmann, A. Drum: North Lakeland Discovery Center, Manitowish Waters, WI; and C.J. Watras, J. Rubsam: Fishery and Aquatic Sciences, Wisconsin Department of Natural Resources; Trout Lake Research Station, Center for Limnology, University of Wisconsin-Madison.

Of the 39 aquatic plant species located during 2013 surveys on Van Vliet Lake, 23 were physically encountered on the rake during the whole-lake point-intercept survey. The remaining 16 species were located incidentally. Of the 23 species encountered on the rake, fern pondweed, common waterweed, flat-stem pondweed, and coontail were the four-most frequently encountered (Figure 3.2-5). Fern pondweed, the most frequently encountered aquatic plant species in 2013, had a littoral frequency of occurrence of approximately 62% and was most abundant between 4 and 12 feet of water. As its name suggests, fern pondweed resembles the appearance of a terrestrial fern frond, and is a common plant of lakes in northern Wisconsin. It is generally found growing in thick beds over soft sediments, where it provides structural habitat for aquatic organisms and its extensive network of rhizomes help to prevent re-suspension of bottom sediments. However in Van Vliet Lake, is found growing to the surface and holding matted plants such as coontail and elodea.

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Lake Management Planning

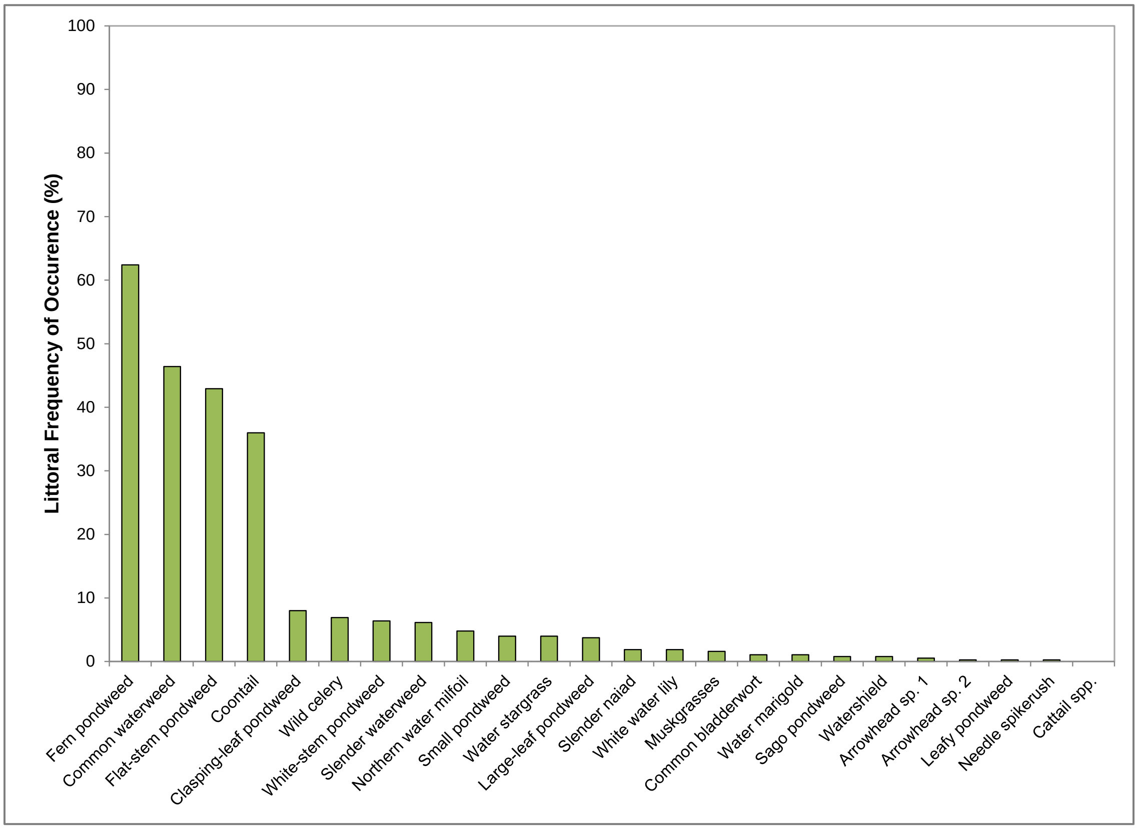

Figure 3.2-5. 2013 littoral frequency of occurrence of aquatic plant species in Van Vliet Lake. Created using data from White Water Associates 2013 point-intercept survey.

Common waterweed, the second-most abundant aquatic plant in Van Vliet Lake in 2013 with a littoral frequency of occurrence of approximately 46% (Figure 3.2-5), is often one of the more dominant aquatic plants in Wisconsin's lakes and can be found throughout North America. Able to tolerate low-light conditions and obtain the majority of its nutrients directly from the water, common waterweed can thrive in more productive lakes. Because of its prevalence in many of Wisconsin's lakes, common waterweed is an important component of many aquatic ecosystems where it provides structural habitat and absorbs nutrients that would otherwise be available to free-floating algae. However, under certain conditions, common waterweed can grow to excessive levels where it mats on the water's surface and can hinder navigation. In Van Vliet Lake, common waterweed was most abundant between 3 and 8 feet of water.

The third-most frequently encountered aquatic plant in Van Vliet Lake in 2013 was flat-stem pondweed with a littoral frequency of occurrence of approximately 43% (Figure 3.2-5). Like common waterweed, flat-stem pondweed is generally found in lakes with higher productivity. It contains long, slender leaves and a conspicuously flattened stem. Its tall stature offers good habitat while its fruit has been shown to be a good source of food for waterfowl (Borman 2007).

With a littoral frequency of occurrence of 36%, coontail was the fourth-most frequently encountered aquatic plant in Van Vliet Lake in 2013. Arguably the most common aquatic plant in Wisconsin, coontail possesses whorls of stiff leaves. Lacking roots, coontail can grow entangled amongst rooted vegetation and obtain all of its nutrients directly from the water. Also able to tolerate low-light conditions, it is often one of the most abundant aquatic plants in highly productive lakes. Its dense foliage offers excellent habitat to aquatic organisms, especially in deeper water where many other plants are unable to grow. Like common waterweed, coontail has the capacity to grow to levels which can hinder navigation. In Van Vliet Lake, coontail was most abundant between 8 and 11 feet of water.

As discussed previously, Bonestroo, Inc. conducted a whole-lake point-intercept survey on Van Vliet Lake in 2008. Since the sampling methodology and sampling locations were the same as the survey conducted in 2013, the data that were collected during these surveys can be compared to determine if any changes in the occurrences of aquatic plant species occurred over this five-year period. Figure 3.4-6 displays the 2008 and 2013 littoral frequencies of occurrence of aquatic plant species in Van Vliet Lake.

Of the four-most frequently encountered aquatic plant species in Van Vliet Lake that were discussed previously, coontail was the only one to exhibit a statistical difference in its occurrence over this time period (Chi-Square $\alpha = 0.05$), declining in occurrence by approximately 34% (Figure 3.4-6). Three other less-frequently encountered aquatic plant species also exhibited statistically valid reductions in their occurrence over this time period: Illinois pondweed (100% decline), white-stem pondweed (41% decline), and northern water milfoil (51% decline).

Aquatic plant communities are dynamic, and the abundance of certain species can fluctuate from year to year depending on climatic conditions, herbivory, competition, and disease among other factors, and slight fluctuations are to be expected. However, the 100% decline in the occurrence of Illinois pondweed and the reductions observed in white-stem pondweed and northern water milfoil are concerning. These three species require higher water clarity conditions to survive, and decline when water clarity declines or becomes more turbid. The reductions observed in these species may indicate declining water clarity conditions in Van Vliet Lake.

Figure 3.4-7 displays the average growing season Secchi disk transparency, chlorophyll-α, and near-surface total phosphorus data collected by the Van Vliet Citizens Lake Monitoring Program (CLMN) from 2003 to 2013. Secchi disk transparency data indicate that a decreasing trend in water clarity has occurred over this time period. There has also been a slight positive trend in the level of free-floating algae as measured via chlorophyll-α, most notably from 2008 to 2013. And finally, near-surface total phosphorus concentrations have also increased from 2003 to 2013. These three variables are usually correlated with one another; as total phosphorus increases, chlorophyll-α increases, and Secchi disk transparency declines. While the investigation into what may be causing these trends is outside the scope of this project, these data indicate that water quality as it relates to total phosphorus, chlorophyll-α, and Secchi disk transparency in Van Vliet Lake may be declining, and may be worth investigating in the future.

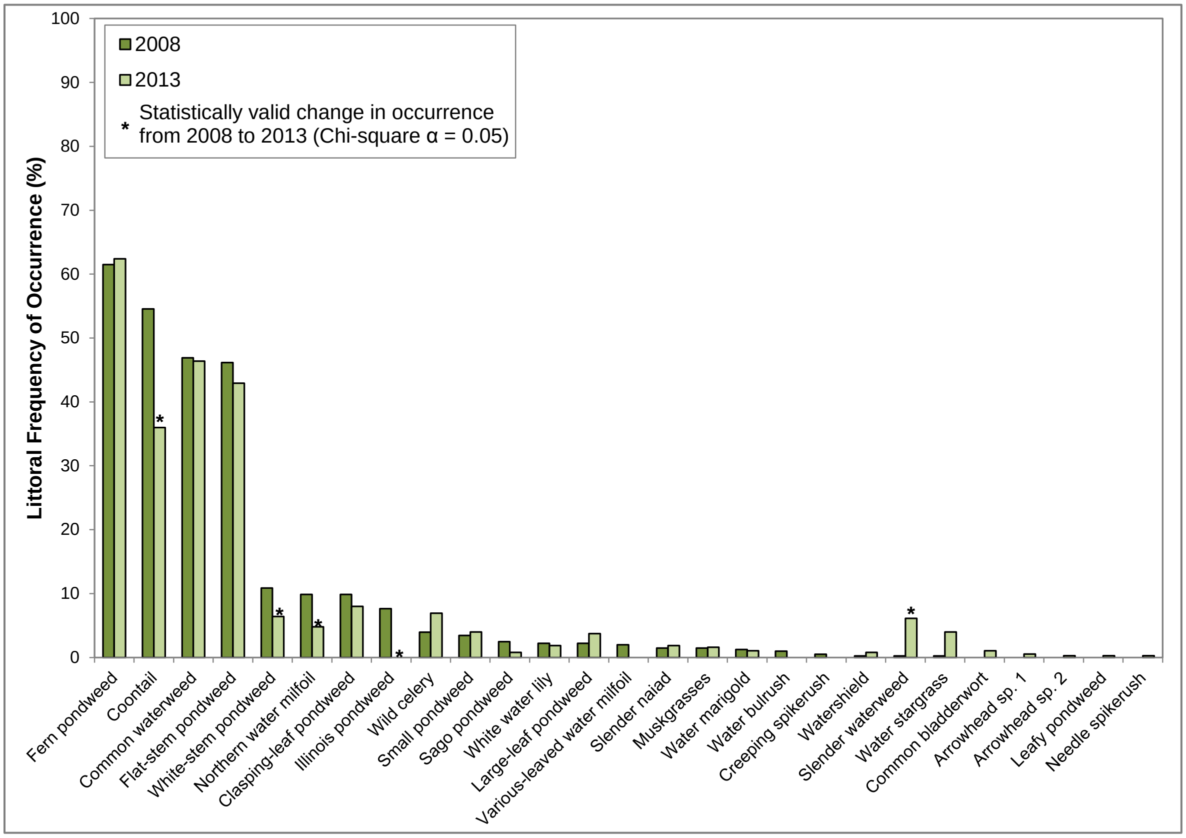

Figure 3.2-6. 2008 and 2013 littoral frequency of occurrence of aquatic plant species in Van Vliet Lake. Created using data from Bonestroo, Inc. 2008 and White Water Associates 2013 point-intercept surveys.

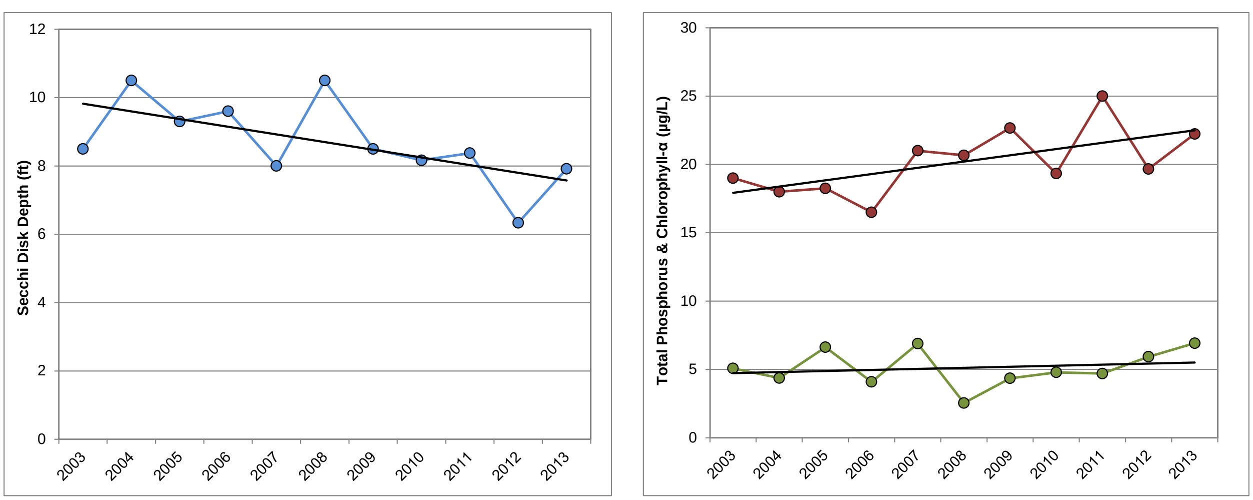

Figure 3.2-7. Van Vliet Lake 2003-2013 average annual Secchi disk transparency, chlorophyll-α, and near-surface total phosphorus. Created using data collected by the Van Vliet Lake Citizens Lake Monitoring Program.

As discussed in the primer section, the calculations used for 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 does not include incidental species. For example, while a total 39 native aquatic plant species were located in Van Vliet Lake during the 2013 surveys, 23 were encountered on the rake during the point-intercept survey. These 23 native species and their conservatism values were used to calculate the FQI of Van Vliet Lake's aquatic plant community in 2013

Figure 3.2-8 compares the FQI components of Van Vliet Lake from the 2008 and 2013 point-intercept surveys to median values of lakes within the Northern Lakes and Forests Lakes (NLFL) Ecoregion as well as the entire State of Wisconsin. Twenty-three native aquatic plant species were located in both the 2008 and 2013 point-intercept surveys on Van Vliet Lake, and this number of native species exceeds the upper quartile values for both lakes within the NLFL Ecoregion and for lakes throughout Wisconsin. The average conservatism value declined slightly from 6.4 to 6.1, which falls below the median value for lakes within the NLFL ecoregion, indicating Van Vliet Lake contains a lower number of sensitive (high C-value) aquatic plant species. However, the 2008 and 2013 conservatism values fall above the median value for lakes throughout the state.

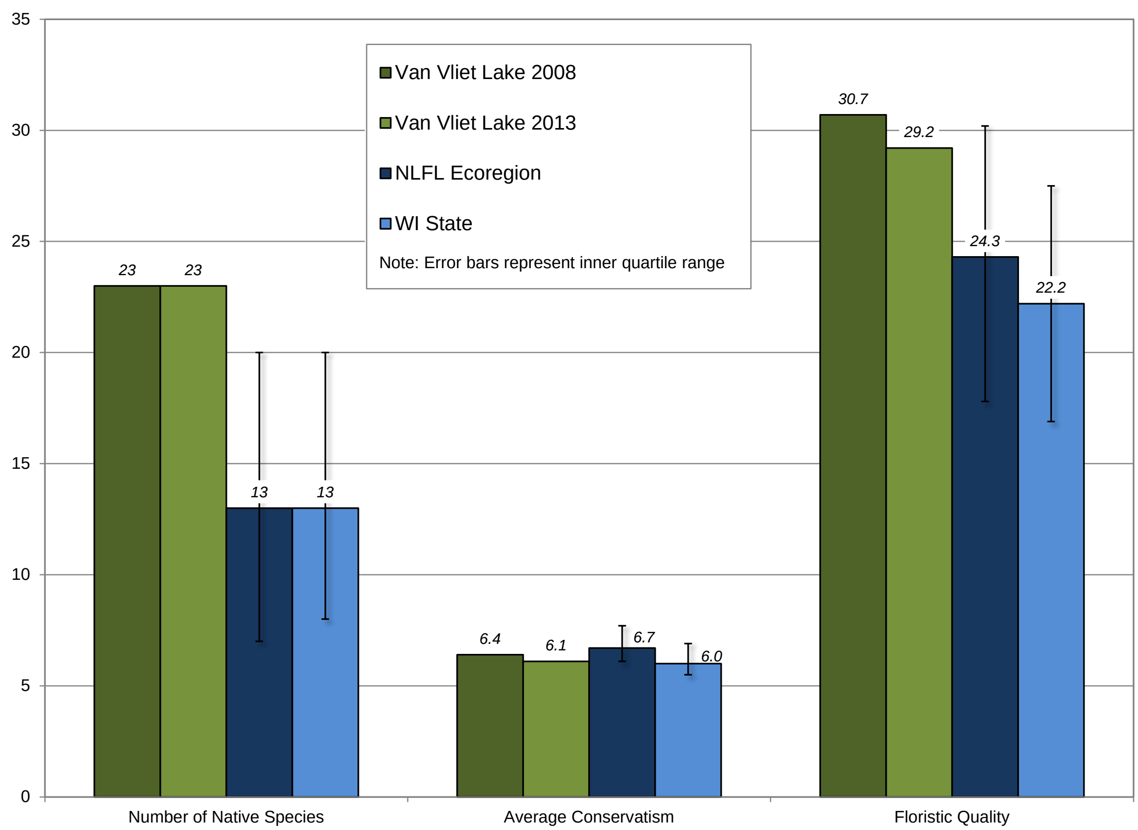

Figure 3.2-8. Van Vliet Lake Floristic Quality Analysis. Created using data from Bonestroo, Inc. 2008 and Van Vliet Lake 2013 point-intercept surveys. Analysis follows Nichols (1999) where NLFL = Northern Lakes and Forests Lakes Ecoregion.

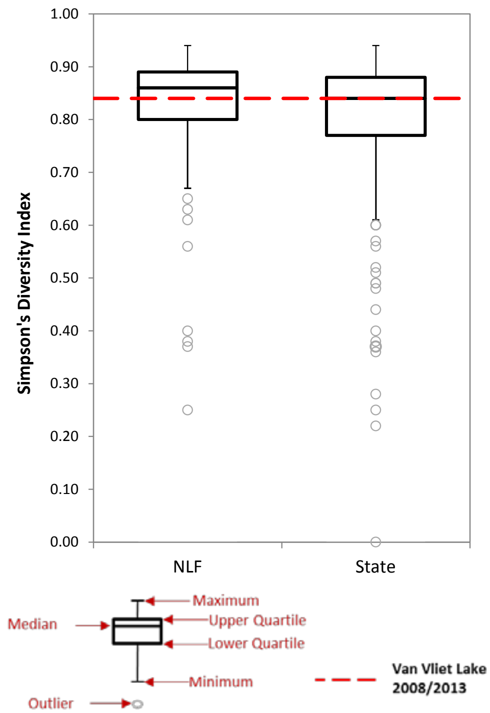

Figure 3.2-9. Van Vliet Lake Simpson's Diversity Index. Created using data from Bonestroo, Inc. 2008 and White Water Associates 2013 point-intercept surveys. Ecoregion and state data provided by WDNR Science Services.

Combining the native species richness and average conservatism values yields a value of 30.7 for 2008 and 29.2 for 2013. Both the 2008 and 2013 FQI values fall near the upper quartile for lakes in the NFLF ecoregion and above the upper quartile value for lakes throughout Wisconsin. This analysis indicates that Van Vliet Lake's aquatic plant community is of higher quality than the majority of the lakes in the NLFL Ecoregion and in Wisconsin.

As explained earlier, 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 Van Vliet Lake contains a relatively high 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 Van Vliet Lake's diversity value ranks. Using data obtained from WDNR Science Services, quartiles were calculated for 109 lakes within the NLFL Ecoregion (Figure 3.2-9). Using the data collected from the 2008 and 2013 point-intercept surveys, Van Vliet Lake's aquatic plant community was shown to have low species diversity with a Simpson's diversity value of 0.84 in each year. This value falls below the median value for lakes in the NLFL ecoregion and is even with the median value for lakes in Wisconsin.

Van Vliet Lake's littoral zone is relatively homogenous (>90% soft sediments) and does not possesses a wide variety habitat types. Because of this, the majority of Van Vliet Lake's aquatic plant community is comprised of a small number of aquatic plant species, reducing the community's diversity. As explained earlier, the littoral frequency of occurrence analysis allows for an understanding of how often each of the plants is located during the point-intercept survey. 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, fern pondweed was found at approximately 62% of the littoral sampling locations in Van Vliet Lake in 2013, its relative frequency of occurrence was 26%. Explained another way, if 100 plants were randomly sampled from Van Vliet Lake, 26 of them would be fern pondweed. Figure 3.2-10 displays the relative occurrence of aquatic plant species from Van Vliet Lake in 2013, and illustrates that 78% of the aquatic plant community is comprised of just four species, while 20 species account for the remaining 22%.

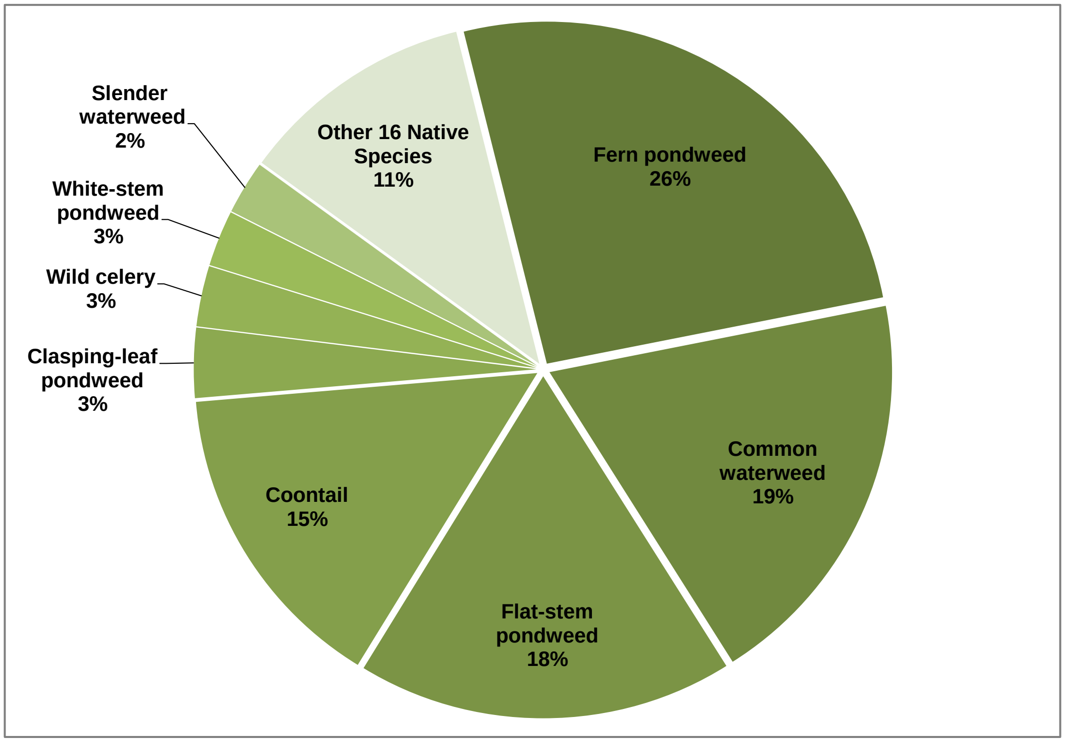

Figure 3.2-10. 2013 relative frequency of occurrence of aquatic plant species in Van Vliet Lake. Created using data from White Water Associates 2013 point-intercept survey.

The point-intercept survey is an excellent method for assessing a lake's submergent aquatic plant community; however, it tends to underestimate the occurrence of emergent and floating-leaf aquatic plants that tend to grow in shallower, near-shore areas. Because of the importance of these communities, the community mapping survey is designed to map and identify the species that comprise these communities.

The 2013 community mapping survey conducted by Onterra on Van Vliet Lake indicates that approximately 23 acres of the lake contains floating-leaf and emergent aquatic plant communities (Table 3.2-2, Map 4). Nineteen emergent and floating-leaf aquatic plant species were located in the lake in 2013 (Table 3.2-1). These plant communities provide valuable fish and wildlife habitat important to the ecosystem of the lake. 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 Van Vliet Lake. This is important, because these communities are often negatively affected by recreational use and shoreland development.

Table 3.2-2. Acres of emergent and floating-leaf aquatic plant communities in Van Vliet Lake in 2013. Created using data from Onterra 2013 community mapping survey.

Plant Community	Acres
Emergent	0.0
Floating-leaf	1.4
Mixed Emergent and Floating-leaf	21.5
Total	**22.9**

Nuisance-Native Aquatic Plant Growth in Van Vliet Lake

For many years, Van Vliet Lake stakeholders have had concerns regarding the excessive levels of plant growth within the lake that impede navigation in many areas. Previous studies conducted on Van Vliet Lake have documented the nuisance levels of native aquatic plants within the lake, and indicate that these conditions can mainly be attributed to growth of fern pondweed and common waterweed (Blue Water Science 2005, Bonestroo, Inc. 2011). WDNR records indicate that herbicides were used to target nuisance aquatic plants as early as 1967, 1985 and 1986.

It is unrealistic to quantitatively define the term “nuisance,” as this designation is subjective by nature. However, Onterra’s experience is that nuisance levels of certain plant species likely occur when their frequency of occurrences exceed approximately 35%. Plants that can potentially cause nuisance conditions are those that can grow to and/or near the water surface and contain a high biomass (i.e bushy appearance) at or near the surface. Figure 3.2-5 shows that fern pondweed, common waterweed, flat-stem pondweed, and coontail exceed this somewhat arbitrary benchmark in Van Vliet Lake. Fern pondweed, coontail, and common waterweed all exhibit growth characteristics within Van Vliet Lake that may lead them to having nuisance qualities when found in high abundance.

In 2013, Onterra ecologists conducted an acoustic survey designed to quantitatively document the level of aquatic plant growth throughout the entire lake. Using sonar technology developed by a Minnesota-based company (Contour Innovations, LLC), this survey measures the bio-volume of aquatic plants throughout the lake, or the percentage of the water column occupied by aquatic plants. Aareas where aquatic plants occupy most or all of the water column are indicated in red while areas of little to no aquatic plant growth are displayed in blue (Figure 3.2-11). Map 5 also displays the total rake fullness ratings recorded at each point-intercept survey location in 2013, and shows that most of the rake fullness ratings of 2 and 3 were recorded within areas of high aquatic plant bio-volume. These surveys quantitatively indicate that shallow areas of Van Vliet Lake contain high levels of aquatic plant growth.

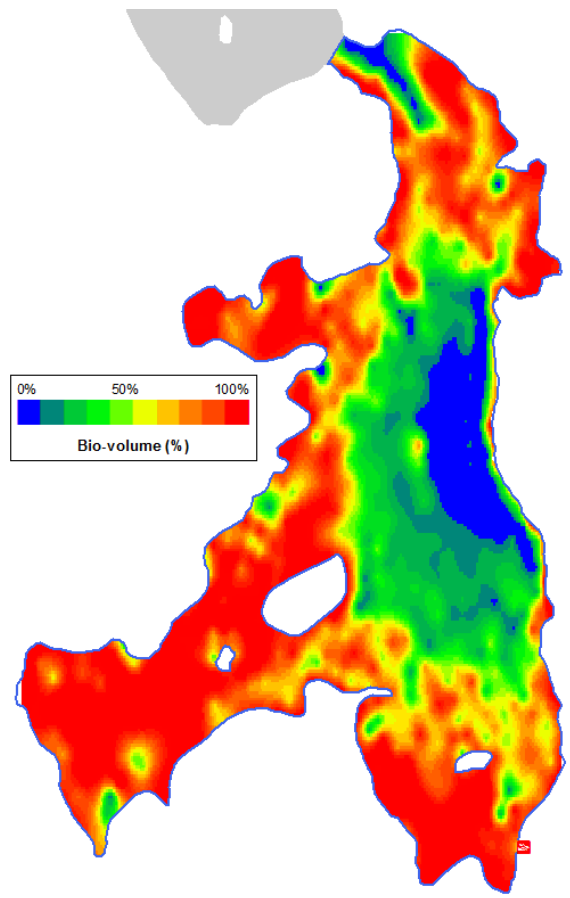

Figure 3.2-11. Van Vliet Lake Aquatic Plant Bio-Volumes. Modeled from August 2013 survey.

Photo. 3.2-2. Surface-matted native aquatic vegetation on Van Vliet Lake. Taken during August 2013 survey.

While the acoustic mapping is an excellent survey for quantifying the levels of aquatic plant growth throughout the lake, this survey does not differentiate between different aquatic plant species, and thus does not provide information on which species are causing the nuisance conditions. Map 6 displays the locations of the four species that exceeded a littoral frequency of occurrence of 35% as determined from the 2013 point-intercept survey. This map indicates that fern pondweed and common waterweed were most prevalent in shallower areas of the lake with the highest aquatic plant bio-volume. While flat-stem pondweed and coontail were abundant in 2013, they were mainly found growing on the deeper edges of the areas with higher bio-volume.

In addition to the acoustic mapping survey, Onterra ecologists also mapped areas of submersed vegetation that were matted on the water's surface and impeding navigation (Figure 3.2-12). These areas were divided into two categories: areas defined as having *persistent navigational impediment* or areas with *variable navigational impediment*. *Persistent navigation impediment* are those areas that were entirely impassible with any form or watercraft. Aquatic plants within these areas were completely surface matted and were intertwined with mats of dislodged native plants. Some areas even contained matted algae (mostly *Cladophera* spp.). Areas delineated as having *variable navigational impediment* contained an abundance of submersed native vegetation that alone made navigation difficult, but possible. However, these areas contained matted dislodged native plants (southern naiad, common waterweed, fern pondweed) in a spotty fashion. These mats likely fluctuate in location as they dislodge and get re-tangled up in a slightly different spot from day to day.

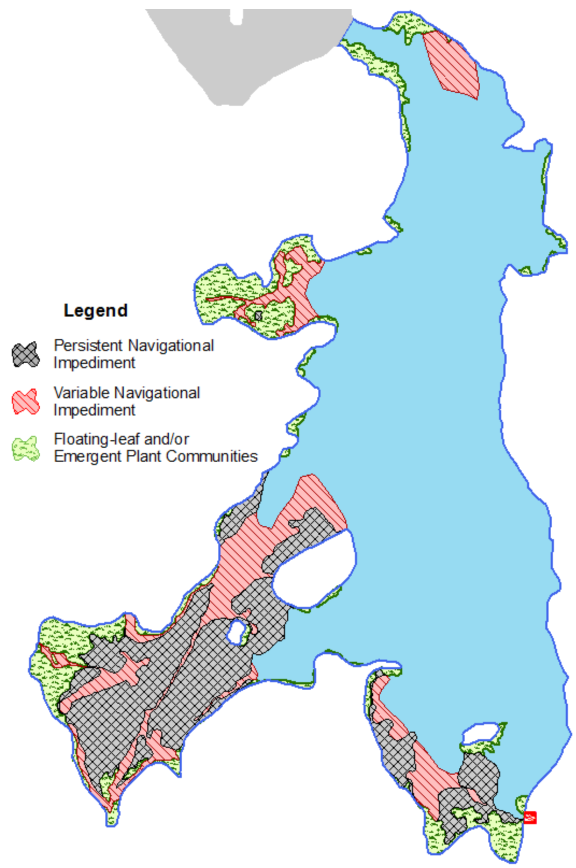

Figure 3.2-12. Van Vliet Lake Surface-Matted Aquatic Plants. Mapped with sub-meter GPS accuracy during August 2013.

This survey indicated that approximately 33 acres of Van Vliet Lake contained areas of persistent navigational impediment while approximately 22 acres contained areas of variable navigational impediment. All of the areas defined as having persistent navigational impairment were located in the shallow areas of the southwestern and southern portions of the lake. Areas of variable navigational impediment were also mapped in these areas, along with two other areas in the western and northeastern portions of the lake (Figure 3.2-12).

High levels of aquatic plant growth can come and go on certain lakes depending on environmental conditions. Some Van Vliet Lake Stakeholders have indicated that the excessive growth of aquatic plants in Van Vliet Lake seems to be an annual occurrence. While some years may be better than others, these stakeholders indicate there are always areas with some level of navigational impediment. Other stakeholders have expressed a cyclic nature of aquatic plant growth where only in some years does it cause navigational impediment. These stakeholders also indicate that the impediment is typically contained within a short window of time towards the end of the summer.

In many lakes, aquatic plant growth that could cause navigation impairment may be an indicator of high levels of nutrients within the lake. These nutrients are often associated with human development (e.g. agricultural, urban, etc.) within the lake's watershed. The nuisance conditions found in Van Vliet Lake are likely due to the lake's morphology, specifically the combination of shallow water and a littoral zone dominated by soft sediments. Fern pondweed and common waterweed are often abundant in mesotrophic lakes with soft sediments in northern Wisconsin; however, it is relatively rare that they grow to the water's surface and interfere with navigation. Van Vliet Lake contains large areas with relatively shallow water where the plants do not have to grow very tall before they reach the surface. In addition, the soft sediments do not allow the plants to become strongly anchored, and they are easily uprooted via wind and wave action whereupon they then float up to the surface.

In cases where aquatic plant growth is restricting access from a developed property to open water areas of the lake, the WDNR may provide a mechanical harvesting permit to create navigational lanes in these areas. Aquatic plant harvesting is frequently used in Wisconsin and involves the cutting and removal of plants much like mowing and bagging a lawn. Plant harvesting speeds vary with the size of the harvester, density and types of plants, and the distance to the off-loading area. Equipment requirements do not end with the harvester. In addition to the harvester, a shore-conveyor would be required to transfer plant material from the harvester to a dump truck for transport to a landfill or compost site. Furthermore, if off-loading sites are limited and/or the lake is large, a transport barge may be needed to move the harvested plants from the harvester to the shore in order to cut back on the time that the harvester spends traveling to the shore conveyor. Some lake organizations contract to have nuisance plants harvested, while others choose to purchase their own equipment. If the latter route is chosen, it is especially important for the lake group to be very organized and realize that there is a great deal of work and expense involved with the purchase, operation, maintenance, and storage of an aquatic plant harvester. In either case, planning is very important to minimize environmental effects and maximize benefits.

Based upon the navigational impediment mapping conducted by Onterra, established navigation lanes could be detected which have formed from repetitive boat traffic within these areas (Figure 3.2-13, left). The established navigation lanes were then divided into three categories based upon their logistical ability to serve as mechanical harvesting lanes: impractical, potential, and practical (Figure 3.2-13, right). Mechanical harvesters are produced in many sizes that can cut to depths ranging from 3 to 6 feet. Segments of the established navigation lanes denoted as *impractical for mechanical harvesting* are in water that is less than 3 feet deep as determined from the acoustic survey, and mechanical harvesting would likely not be logistically possible or permit-able in these areas. Segments of the established navigation lanes denoted as *potential for mechanical harvesting* are located in 3 to 5 feet of water, and some contractors indicate that they will be able to harvest aquatic plants in these areas, while others cannot. Segments of the established navigation lanes denoted as being *practical for mechanical harvesting* are located in water greater than 5 feet in depth, and would likely be able to be mechanically harvested with little difficulty.

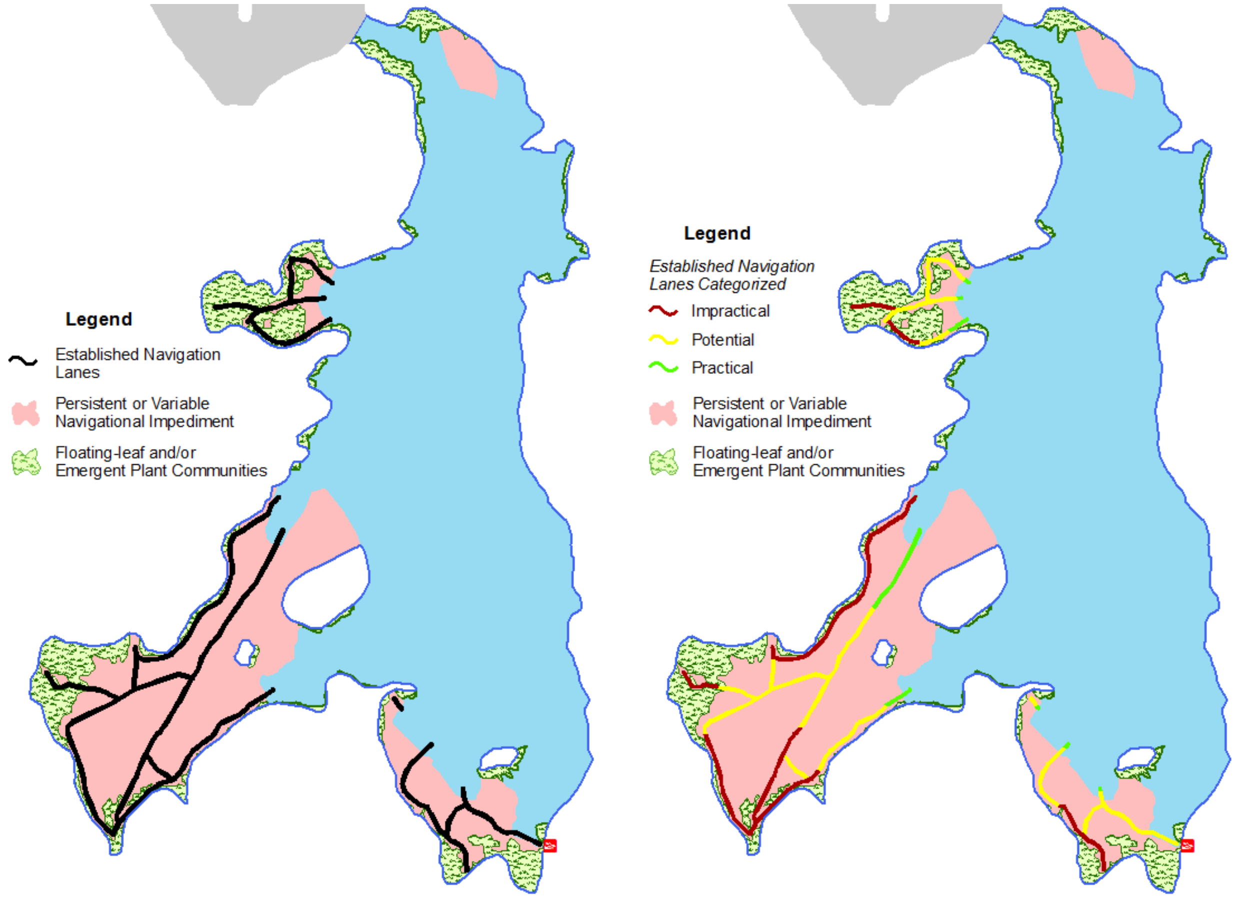

Figure 3.2-13. Established Navigation Lanes (left) and Applicability to Serve as Mechanical Harvesting Lanes (right). Mapped with sub-meter GPS accuracy during August 2013.

Based upon this analysis, a mechanical harvesting plan was created that minimized the footprint within areas that are *impractical for mechanical harvesting*, but still allowing for a natural flow of navigation (i.e. loops). The developed mechanical harvesting plan shown on Figure 3.2-14, Map 7 include 30-foot wide navigation lanes totaling 6.1 acres. This plan originally outlined 6.6 acres for mechanical harvesting, however a common-use lane from the public boat landing extending south of the island was removed following a March 2015 meeting with WDNR staff. Individual riparians would be responsible for manually removing vegetation within a 30-foot lane out from their property to the developed common-use mechanical harvesting lane. As discussed above, the individual riparian use lanes (i.e. spokes) do not require a WDNR permit so long as they are maintained using manual removal techniques, encompass the riparian's pier/swim area, all removed plants are taken out of the lake, and wild rice is not present.

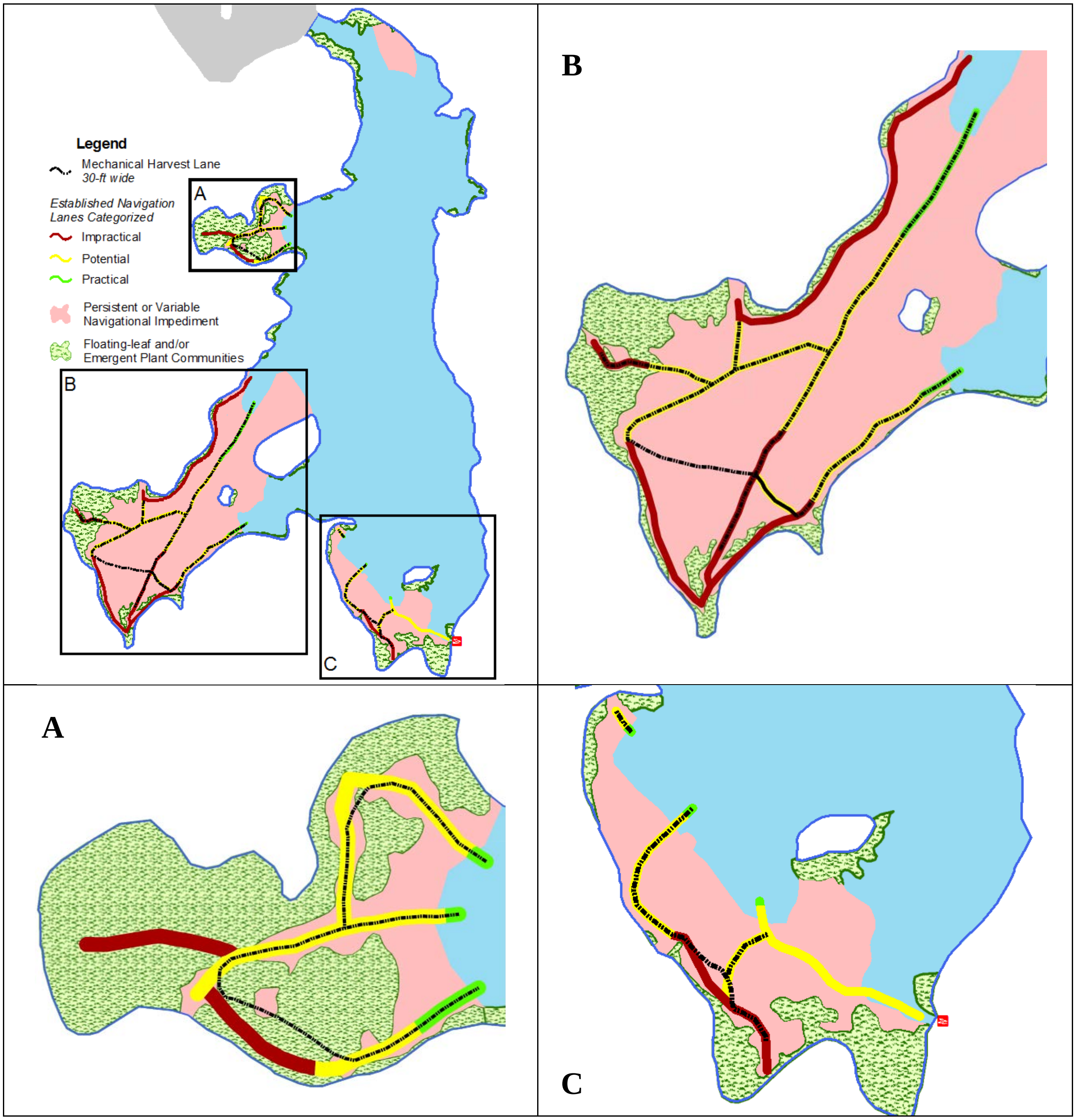

Figure 3.2-14. Mechanical Harvesting Plan. Mapped with sub-meter GPS accuracy during August 2013.

Identifying a mechanical harvesting firm that will be able to operate in waters 3 feet and greater may be difficult, but not impossible. The VVLA has identified a company that builds compact mechanical harvesting devices and may be willing to contract with the VVLA to conduct this work.

For budgetary estimation purposes, Onterra uses the following information to determine mechanical harvesting costs:

- Cutting approximately half an acre an hour, the 6.1 acres of harvesting lanes will take approximately 13 hours plus 10% additional time for cleanup (~15 hours).
- At a rate of $170 an hour plus a $1000 travel and equipment mobilization charge, the potential costs for a single cutting would be $3,550.
- Additional fees include trucking and disposal of harvested plants.
- Some firms have a 40-hour minimum commitment, which could greatly increase the costs of the mechanical harvesting project.
- Mechanical harvesting on Van Vliet Lake may be required more than once per year to achieve desired results.

In September 2012, the VVLA solicited a bid for mechanically harvesting portions of Van Vliet Lake. While the specifics of the plan were different from that outlined within this project, the scope of the activities were roughly the same. The estimate for this mechanical harvesting operation was approximately $6,900.

Many questions and concerns were raised regarding the potential effects mechanical harvesting of aquatic plants may have on Van Vliet Lake's ecosystem. Some of these questions and concerns along with information pertaining to each can be found below. They are lumped into two main groups.

Group 1 – Steps can be taken to minimize impact

Will harvesting of native aquatic plants lead to the introduction of aquatic invasive species (AIS)?
The mechanical harvesting of native aquatic plants will not directly lead to the introduction of AIS. Along with motorboat activity, mechanical harvesting causes a "disturbance" to the existing aquatic plant community. Referred to by Onterra as the *Open Niche Principal*, it is postulated that the removal of native aquatic plants can create "openings" for AIS if they are ever introduced and make it easier for them to become established in harvested areas due to lack of competition with native species. While in general terms the principal has merit, it assumes that the entire littoral area is populated with aquatic plants. In reality, there are open areas that do not contain aquatic plants in even the most plant-rich areas that could serve as areas for AIS introduction. However, reducing disturbance and the open niches caused by disturbance makes it more difficult for AIS to become established if exposed to a given system.

AIS can be introduced if the machinery used for mechanical harvesting is not properly cleaned and inspected after use at another lake containing AIS. However, the risk from transient boaters moving AIS into the system is higher than from the mechanical harvester that will be heavily scrutinized upon arrival by a predetermined team of VVLA volunteers.

Will harvesting stir up the muck?
Yes, temporarily. Given the soft sediments found in Van Vliet Lake, bottom sediments will likely be re-suspended in areas where mechanical harvesting is taking place. However, by minimizing the amount of harvesting that is conducted in areas less than 3 feet, the amount of sediment being re-suspended would also be minimized. Sediment that is re-suspended should settle back out in two to three days. The VVLA may choose to coordinate a volunteer to collect Secchi disk transparency data at the deep hole during the days following the harvesting activity

to have a better understanding of the sediment suspension that accompanies the mechanical harvesting activities.

Will harvesting add nutrients to the lake, lower water quality and lead to algae blooms?

When mechanical harvesting re-suspends bottom sediments, this also may release some nutrients into the water column. However, the level of mechanical harvesting that is proposed for Van Vliet Lake would likely not have a detectable impact on the lake's water quality. In some cases, mechanical harvesting has been shown to improve a lake's water quality by removing the nutrients stored within the plants that would otherwise have been released into the lake when the plants die (Wile 1978). However, this depends on a number of factors including the amount of plants removed, the lake's nutrient budget, and water volume amongst others. Again, the amount of plant material that would be removed in Van Vliet Lake would likely not have a detectable effect on the lake's water quality (negative or positive).

Will plant fragments from harvesting end up on the east shoreline, take root, and create new vegetation issues?

Many aquatic plants rely on natural fragmentation for dispersal and reproduction. The aquatic plants in Van Vliet Lake have existed in the lake for thousands of years, naturally fragmenting and spreading since their establishment within the lake. Of the potential areas for aquatic plants to grow, they are likely already colonized. During the days following the mechanical harvesting activity, riparians may experience a greater amount of plant fragments wash up against their shores. However, fragments from harvesting are not going to lead to nuisance areas of aquatic plants in areas where they do not already occur, either within Van Vliet Lake or in downstream lakes of the Presque Isle Chain. Currently, without harvesting, fragments of aquatic plants float to the eastern shore, but the deeper water and sediment composition do not support excessive growth conditions. Also, some plants do not have the capacity to spread via fragmentation.

Will harvesting of native aquatic plants be detrimental to the lake's fishery?

The fisheries of many systems rely on plant structure for spawning, nursery, forage, refugia, etc. This extremely important habitat requirement is lacking on some lakes (e.g. downstream lakes within the Presque Isle Chain). However, the plant abundance is so dense on some lakes that lake and fishery managers support using a mechanical harvester to cut predatory fish cruising lanes to increase natural predation of certain fish species. Based upon the footprint of the mechanical harvesting plan developed within this project, the WDNR Fisheries biologist for Vilas County, Steve Gilbert, informally suggested at the Planning Committee Meeting that this plan would likely have no negative or positive impact on the system's fishery.

Group 2 – Root cause of the phenomenon

Will natural lake cycles correct the vegetation issue?

As discussed earlier, nuisance levels of aquatic plants are periodic on some lakes due to varying environmental conditions (temperature, water levels, etc.). While the density of aquatic plant growth on Van Vliet Lake certainly fluctuates from year to year, the shallow nature of the lake in combination with soft sediments will likely always produce areas of aquatic plant growth that impede navigation in particular locations.

Is there a way to manage the root cause of the increased aquatic plant levels?

As discussed previously, the high volume of aquatic plant growth in Van Vliet Lake may not be due to a factor that can be controlled such as excessive nutrient inputs. It is a combination of shallow water and soft sediments that produce the surface-matted vegetation that hinders navigation. However, additional nutrient inputs may intensify the conditions. This is why the WDNR scrutinizes the shoreland condition of adjacent riparian properties that wish to conduct mechanical harvesting. If the property is exacerbating the existing conditions, the WDNR would like to see steps taken to reduce nutrient loads (part of the problem) before a temporary solution (mechanical harvesting) is permitted.

Native vegetation should be protected and preserved.

As discussed above, native aquatic plants are an essential component of lake ecosystems, and they most certainly should be protected and preserved. A goal of this project was to conduct a comprehensive assessment of Van Vliet Lake's aquatic plant community and determine if mechanical harvesting was a method for improving navigation in certain areas of the lake without unnecessary harm to the native vegetation.

4.0 SUMMARY & CONCLUSIONS

The ecological studies conducted as a part of this project have led to a greater understanding of the aquatic plant community of Van Vliet Lake. Thirty native aquatic plant species (23 within the point-intercept survey) and no non-native species were found during the summer 2013 plant surveys – an outstanding level of species richness when compared to other lakes within the state and the Northern Lakes and Forests ecoregion. While a large number of species are present within Van Vliet Lake, the plant community is overwhelmingly dominated by fern pondweed, common waterweed, flat-stem pondweed, and coontail. All of these species have the capacity to cause recreational and navigational issues, which was apparent on the lake in 2013.

As discussed in many of the sections above, nuisance levels of native aquatic plants within Van Vliet Lake ultimately spurred the VVLA to initiate this planning effort. The goal of the project was designed to assess the aquatic plant communities in Van Vliet Lake and create a mechanical harvesting plan, if feasible, which would aim to improve navigability and recreational opportunity on the lake. During this project, Onterra identified three main components which required addressing within this project: documentation of navigation impediment, practicality of harvesting, and determining the level of stakeholder support for carrying out a developed mechanical harvesting plan (Figure 4.0-1).

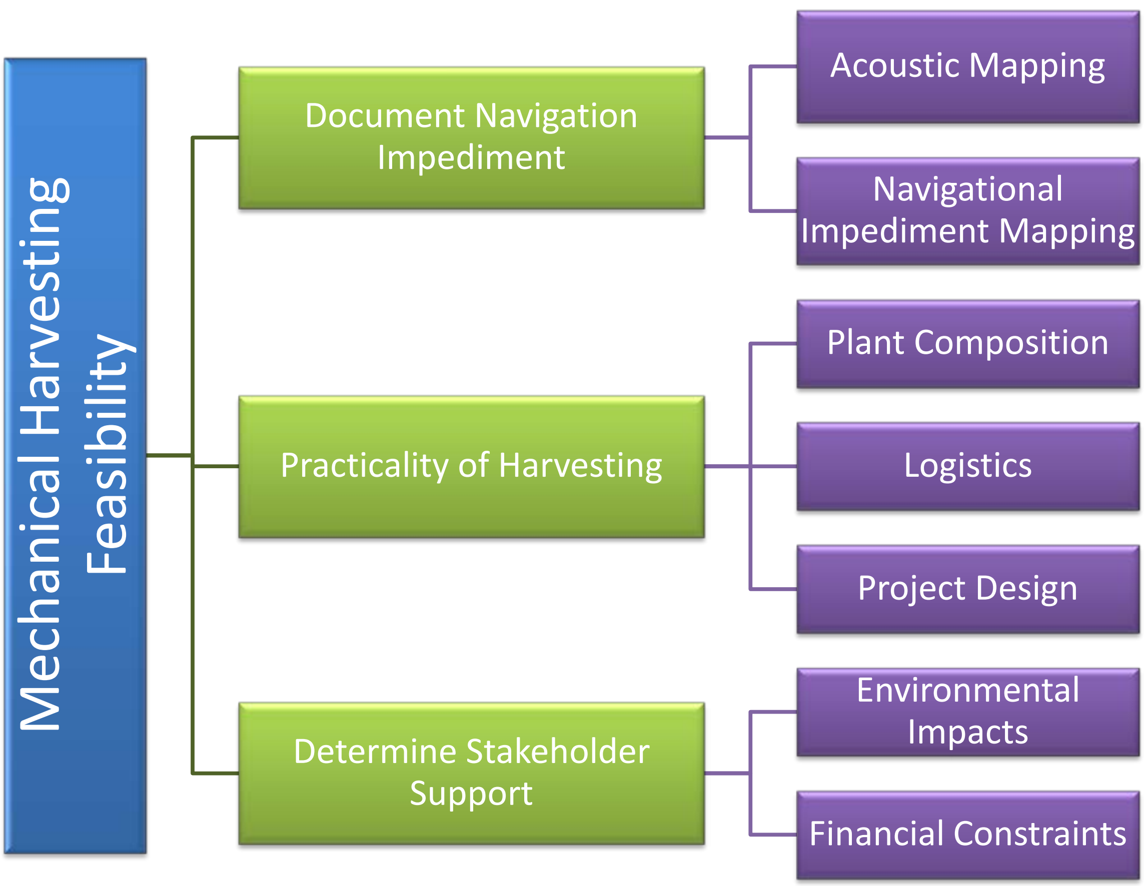

Figure 4.0-1. Flow chart addressing steps taken to address the feasibility of mechanically harvesting on Van Vliet Lake.

The first step that was taken to determine if mechanical harvesting is applicable for Van Vliet Lake was to define and document if and where navigational issues exist. Both the acoustic survey and the navigation impediment mapping survey clearly defined their existence and where the navigational impediments exist on Van Vliet Lake during late summer.

The second step to determine if a mechanical harvesting plan is feasible was to determine if the activity is applicable/practical for the given situation. This component addressed issues of 1) plant composition, 2) logistics, and 3) project design. The outcome of this component resulted in the mechanical harvesting plan shown on Map 7. Ultimately, 30-foot wide common-use lanes were created for the sole purpose of allowing riparian access to deeper water parts of the lake, not for the purpose of increasing fishing or recreational opportunities. The largest obstacle of determining a feasible mechanical harvesting solution for Van Vliet Lake related to the shallow water in which much of the nuisance conditions were documented. But through the process displayed on Map 7, a mechanical harvesting plan was created with minimal footprint in shallow areas (i.e. waters less than 3 feet deep). Implementing the mechanical harvesting plan will pose challenges to the VVLA, most notably due to shallow water in some years and the small scale of the operation.

The last step required to determine if mechanical harvesting is feasible for Van Vliet Lake is to determine if stakeholder support exists to carry out the plan. Mechanical harvesting is an active management technique utilized to reduce user issues. When carrying out any active management technique (e.g. mechanical harvesting, herbicide treatment, dredging, water level draw down, etc.), it is important for lake stakeholders to be educated about the benefits and risks in order to make an educated decision about the lake's future management and condition. As outlined within the previous section, many steps can be taken to help reduce the negative consequences of implementing a mechanical harvesting plan on Van Vliet Lake, but in some instances cannot diminish the impacts/risks to zero.

As outlined within the Implementation Plan Section (5.0), the process taken to create the Aquatic Plant Management Plan Update – Mechanical Harvesting Feasibility Study and Planning Project allows solicitation of stakeholder support for the activity to take place. Various initiatives for understanding stakeholder support were outlined within the Stakeholder Participation Section (2.0), including the formal reviews of draft versions of the plan, meetings, and a formal WDNR-approved stakeholder user survey. Within the implementation Plan Section (5.0) that follows, the VVLA has roughly outlined an educational campaign, that will also be initiated to understand/gain support for future control actions.

Following the completing of this effort, the VVLA will need to bridge the financial constraints of implementing the mechanical harvesting plan by soliciting financial contributions from VVLA members and Van Vliet Lake riparians. The amount of funds raised by the VVLA will further document whether or not support for implementing this activity exists amongst lake stakeholders.

Overall, this document outlines a minimally invasive plan for allowing riparian access to deeper parts of Van Vliet Lake and ultimately the Presque Isle system. This document does not attempt to determine the root causes of the native plant conditions (ie perceived nuisance levels) on the lake. The high levels of native plants could largely be a natural condition of Van Vliet Lake that may (or may not) be exacerbated by human's impact on the environment (increased nutrients from the watershed and adjacent shorelands). The conditions may also be a product of more direct sources of nutrients, such as faulty septic inputs. Greater water quality and watershed issues are currently being addressed in a system-wide management plan underway for the Presque Isle system.

5.0 IMPLEMENTATION PLAN

During the planning meeting that took place during February 2014, the Van Vliet Lake Planning Committee discussed the results of the 2013 aquatic plant management plan study with ecologists/planners from Onterra and WDNR. The Planning Committee discussed the condition of the lake's shoreline, the health and structure of the aquatic plant community, and how both of these components contribute to the navigational and recreational use impediments on the system.

The implementation plan presented below represents the path the VVLA will follow in order to meet their lake management goals. The goals detailed within the plan are realistic and achievable, as are the action steps required to reach these goals. The implementation plan is a living document that will be under constant review and adjustment depending on the condition of the lake, the availability of funds, the level of volunteer involvement, and the needs of the lake's stakeholders.

While the Planning Committee *or* Board of Directors is listed as the facilitator of the majority of management actions listed below, many of the actions may be better facilitated by a sub-committee of the VVLA (e.g. Invasive Species Committee). The Planning Committee will be responsible for deciding whether the formation of sub-committees is needed to achieve the various management goals.

Management Goal 1: Maintain Riparian Navigability on Van Vliet Lake

Management Action:	Make available the draft and finalized version of the Van Vliet Lake Aquatic Plant Management Plan Update
Timeframe:	Adjusted Completion Target: June 2015
Facilitator:	Planning Committee *or* Board of Directors
Description:	As outlined within the Stakeholder Participation Section (2.0), 60% of the Van Vliet Lake stakeholder respondents support the VVLA in working towards the development of a plan to mechanically harvest nuisance aquatic plants. Once a mechanical harvesting plan was developed, the VVLA sought an understanding of the social and financial support for carrying out the mechanical harvesting plan. The VVLA started by making a draft version of this document available for review by all interested parties prior to finalization. This allowed any perspectives and opinions to be known and addressed. As comments to the draft plan were received, the VVLA posted them on their website (www.vanvlietlake.com). All comments were individually addressed and are included within Appendix D. The information contained within the report was also presented by Onterra at a public meeting conducted on June 21, 2014. The VVLA may also decide to disseminate the information within the report and distribute it to the public through a coordinated educational campaign. Public education of the development process of the mechanical harvesting plan will be important to allow stakeholders to have an

	educated opinion about the benefits and risks of moving forward with this strategy.
Action Steps:	

1.	Draft report is made available for review after initial review by VVLA Planning Committee and WDNR. Draft report will be available for download during the review period on VVLA's website. Review comments from WDNR and County staff are provided directly to Onterra. Review comments from interested stakeholders will be sent to the VVLA Planning Committee per instructions on the VVLA website. These comments will be pooled together and sent to Onterra.	**COMPLETED**
2.	Onterra presents draft management plan to general public during a wrap-up meeting. Funding for this meeting will be sought through an amendment to the existing WDNR grant. The scope and associated cost amendment would require VVLA Board of Directors approval.	**COMPLETED**
3.	Review comments will be integrated as appropriate by Onterra into a second draft of the report. All comments will be made available within an appendix of the finalized management plan. This report will be sent to the WDNR for approval. Upon approval, Onterra will finalize plan and provide WDNR and VVLA with agreed upon hard and electronic copies.	**COMPLETED**
4.	VVLA distributes educational materials through the VVLA website, covering past speakers & information events, links to various county and state agencies, and VVLA future plans.	**IN PROGRESS**

Management Action:	Support reasonable and responsible actions by shoreland property owners to gain navigational access to open water areas of Van Vliet Lake
Timeframe:	Upon plan acceptance
Facilitator:	Planning Committee *or* Board of Directors
Description:	The VVLA members enjoy Van Vliet Lake for its aesthetic beauty, wildlife habitat, and fisheries. As indicated within the Aquatic Plant Section (3.2), Van Vliet Lake contains a high quantity of aquatic plants which has led to navigational concerns and riparian user conflicts. The response data of a stakeholder 2012 referendum question indicate that the majority of Van Vliet Lake respondents (60%) supported the VVLA to develop a mechanical harvesting plan. Within the 2014 stakeholder survey, the majority (55%) of respondents were supportive (either *Highly Support* or *Moderately Supportive*) of mechanical harvesting (Appendix E, Question #13) and 50% indicated they supported (either *Completely Support* or *Moderately Support*) the draft mechanical harvesting plan (Appendix E, Question #15). A large

number of stakeholder respondents (20%) indicated they were *Unsure* or had *Neutral* support for the draft mechanical harvesting plan, and approximately 30% of respondents were not supportive (either *Completely Oppose* or *Moderately Oppose*) of the draft plan.

The WDNR oversees the management of aquatic plants on inland lakes. The manual cutting and raking of native aquatic plant species within a 30-foot-wide area containing a pier, boatlift, or swim raft is exempt from a state permit. However, the use of mechanized or mechanical devices requires a WDNR permit.

During the fieldwork that was conducted in 2013, Onterra ecologists demonstrated that impairment of navigation exists within Van Vliet, per the definitions included within *Aquatic Plant Management Strategy, Northern Region WDNR* (Appendix B).

The WDNR will not issue a harvesting permit without this assessment to ensure that there will not be any adverse impacts to certain species or to the community as a whole. The potential mechanical harvesting areas to be harvested are only 30 feet wide and are mainly comprised of two species (fern pondweed and common waterweed) which are widely distributed throughout the lake.

The developed mechanical harvesting plan outlines 30-foot common use lanes, which would be harvested in a manner that would allow riparian access to the main part of the lake. These lanes were adapted from already established riparian navigation use patterns. Individual riparians would be tasked with manually creating their individual use lanes (spokes) to attach to the common use lanes. If all lanes require cutting, the total would be 6.1 acres (Map 7).

Aquatic Plant Management Strategy, Northern Region WDNR (Appendix B) clearly states that no individual permits will be issued by the WDNR and if a permit for aquatic plant control is required, the lake organization is the applicant of the permit. A single permit application from the VVLA would be applied for annually from the WDNR, likely during January-February of each year preceding the activities. The WDNR mechanical harvesting fees are $30 per acre, rounded up to the whole acre. The permit fees for the 6.1 acres shown on Map 7 would be $210 (7 acres x $30/acre). A condition of the WDNR permit would include a site visit to confirm that impairment of navigation exists in each of the areas during that particular year.

Along with other state statues, the WDNR administrative code NR 109 is followed regarding permit issuance for removal of aquatic plants. The purpose of this code is to ensure that control of aquatic plants is permitted "in a manner consistent with sound ecosystem management,

	shall consider cumulative impacts, and shall minimize the loss of ecological values in the body of water." Excessive plant growth is often associated with increased nutrient levels. In order to minimize cumulative impacts to the ecosystem, shoreland best management practices (BMPs) for shoreland properties would need to be in place (or are in the process of being implemented) for a mechanical harvesting plan to be implemented in that immediate area. Shoreland property owners should use the information provided within the Shoreland Condition Assessment Section (3.1) as well as Appendix C to determine if their individual shoreland is in healthy condition and follows BMPs. The VVLA have made plans to accompanying the WDNR during a secondary site visits during the summer of 2015 to confirm that shoreland BMPs are being followed in the areas requesting a permit The VVLA would like the WDNR to consider granting a multi-year permit after an agreed upon strategy has been implemented successfully for a number of years. The VVLA understand that while a multiyear permit may be in place, they would not be able to conduct the mechanical harvesting activities until receiving approval from the WDNR that the impairment exists or if there is insufficient water depth to conduct the mechanical harvesting activities. All lake groups conducting active management on their lake, whether targeted AIS control measures or mechanical harvesting activities, must have a WDNR-approved Lake Management Plan in place, following guidance within *Aquatic Plant Management in Wisconsin* (WDNR 2008). Current guidelines suggest that a Lake Management Plan, at least the portion of the plan dealing with the active management component, require updating every 3-5 years. In order to understand the cumulative impacts of the mechanical harvesting activities, the VVLA would have studies conducted similar to those completed in 2013 once every five years to understand the continued health of the lake. The WDNR has also expressed that it would like to have the VVLA investigate storm water management on individual properties in the future. The VVLA will work to understand the specifics of this request and how it applies to Van Vliet Lake.
Action Steps:	
	See description above

Management Goal 2: Prevent Aquatic Invasive Species Infestations within Van Vliet Lake

Management Action:	Continue Clean Boats Clean Waters watercraft inspections at Van Vliet Lake public access location
Timeframe:	Continuation of current effort
Facilitator:	Planning Committee *or* Board of Directors
Description:	Currently members of the VVLA monitor the public boat landing using training provided by the Clean Boats Clean Waters program. The intent of the boat inspections would be to prevent invasives from entering the lake through its public access point. The goal would be to cover the landing during the busiest times in order to maximize contact with lake users, spreading the word about the negative impacts of AIS on lakes and educating people about how they are the primary vector of its spread. In 2012 and 2013, Van Vliet Lake's boat landing was monitored for approximately 56 and 112 hours, respectively. The VVLA would also like to target inspections of mid-week transient boaters, particularly muskellunge fisherman that likely visited large area lakes containing Eurasian water milfoil.
Action Steps:	
	See description above as this is an established program.

Management Action:	Enhance volunteer AIS surveillance monitoring
Timeframe:	Begin 2015
Facilitator:	Planning Committee *or* Board of Directors
Description:	In lakes without AIS, early detection of pioneer colonies commonly leads to successful control and, in cases of very small infestations, possibly even eradication. The Citizen Lake Monitoring Network (CLMN) is a program that coordinates citizen-based data collection. Along with water quality data collection programs, the CLMN also has developed an AIS Monitoring plan. The goals of the CLMN aquatic invasive monitoring program are as follows: • Help you become familiar with some of the more common native aquatic plants and animals in your lake. • Help you monitor for the more common aquatic invasive species. • Help you to communicate information to others.

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	VVLA volunteers would conduct AIS surveillance monitoring on Van Vliet Lake with coordination from the Vilas County AIS Coordinator following CLMN protocols, which are outlined within the AIS Monitoring Handbook and can be found at the CLMN website: www4.uwsp.edu/cnr/uwexlakes/clmn The volunteers would continue to use an "adopt-a-shoreline" approach where volunteers are responsible for surveying specified areas of the lake. They would also investigate the mechanical harvesting lanes, as these areas continually entertain boat traffic that causes a disturbance and is potentially a vector of AIS spread. In order for accurate data to be collected during these surveys, volunteers must be able to identify non-native species such as Eurasian water milfoil, curly-leaf pondweed, pale yellow iris, and common reed. Distinguishing these plants from native look-a-likes is very important. VVLA volunteers would attend CLMN workshops to gain this training. The VVLA would also encourage its volunteer monitors to purchase a field guide to aquatic plants, such as *Through the Looking Glass* (Borman et al. 1997) which can be purchased through the CLMN website under 'publications.'
Action Steps:	
1.	See description above.

Management Goal 3: Protect and restore the shoreland condition of Van Vliet Lake

Management Action:	Investigate restoring developed shoreland areas around Van Vliet Lake
Timeframe:	Initiate 2015
Facilitator:	Planning Committee *or* Board of Directors
Description:	As discussed in the Shoreland Condition Section (3.1), the shoreland zone of a lake is highly important to the ecology of a lake. When shorelands are developed, the resulting impacts on a lake range from a loss of biological diversity to impaired water quality. Because of its proximity to the waters of the lake, even small disturbances to a natural shoreland area can produce ill effects. In 2013, the shoreland assessment survey indicated that 0.3 miles, or approximately 7% of Van Vliet Lake's 5.3-mile shoreline, consists of Urbanized or Developed-Unnatural areas. Fortunately, restoration of the shoreland zone can be less expensive, less time-consuming and much easier to accomplish than restoration efforts in other parts of the watershed. Cost-sharing grants and Vilas

	County staff devoted to these types of projects give private property owners the funds and informational resources to restore quality shoreland habitat to their lakeside residence. Map 1 indicates the locations of Urbanized and Developed-Unnatural shorelands on Van Vliet Lake. These shorelands should be prioritized for restoration. The VVLA would acquire information from and work with appropriate entities such as Quita Sheehan from Vilas County Land & Water Conservation Department to research grant programs, shoreland restoration techniques and other pertinent information that will help the VVLA. Because property owners may have little experience with or be uncertain about restoring a shoreland to its natural state, properties with restoration on their shorelands could serve as demonstration sites. Other lakeside property owners could have the opportunity to view a shoreland that has been restored to a more natural state, and learn about the maintenance, labor, and cost-sharing opportunities associated with these projects. The WDNR's Healthy Lakes Implementation Plan allows partial cost coverage for native plantings in transition areas. This reimbursable grant program is intended for relatively straightforward and simple projects. More advanced projects that require advanced engineering design may seek alternative funding opportunities, potentially through the county. • 75% state share grant with maximum award of $25,000; up to 10% state share for technical assistance • Maximum of $1,000 per 350 ft^2 of native plantings (best practice cap) • Implemented according to approved technical requirements (WDNR, County, Municipal, etc.) and complies with local shoreland zoning ordinances • Must be at least 350 ft^2 of contiguous lakeshore; 10 feet wide • Landowner must sign Conservation Commitment pledge to leave project in place and provide continued maintenance for 10 years • Additional funding opportunities for water diversion projects and rain gardens (maximum of $1,000 per practice) also available
Action Steps:	
1.	Recruit facilitator from Planning Committee
2.	Facilitator contacts Quita Sheehan (715.479.3721; mashee@co.vilas.wi.us) from the Vilas County Land & Water Conservation department to gather information on initiating and conducting shoreland restoration projects. If able, Ms. Sheehan would

	be asked to speak to VVLA members about shoreland restoration at their annual meeting.
3.	The VVLA would encourage property owners that have restored their shorelines to serve as demonstration sites.

Management Action:	Protect natural shoreland zones around Van Vliet Lake
Timeframe:	Initiate 2015
Facilitator:	Planning Committee *or* Board of Directors
Description:	Approximately 2.4 miles (45 %) of Van Vliet Lake's shoreline was found to be in either a natural or developed-natural state. It is therefore important that owners of these properties become educated on the benefits their shoreland is providing to Van Vliet Lake, and that these shorelands remain in a natural state. Map 1 indicates the locations of Natural and Developed-Natural shorelands on Van Vliet Lake. These shorelands should be prioritized for education initiatives and physical preservation. A Planning Committee appointed person will work with appropriate entities to research grant programs and other pertinent information that will aid the VVLA in preserving the Van Vliet Lake shoreland. This would be accomplished through education of property owners, or direct preservation of land through implementation of conservation easements or land trusts that the property owner would approve of. Valuable resources for this type of conservation work include the WDNR, UW-Extension, and Vilas County Land & Water Conservation Department. Several websites of interest include: • Wisconsin Lakes website: www.wisconsinlakes.org/shorelands) • Conservation easements or land trusts: (www.northwoodslandtrust.org) • UW-Extension Shoreland Restoration: http://www.uwex.edu/ces/shoreland/Why1/whyres.htm) • WDNR Shoreland Zoning website: (http://dnr.wi.gov/topic/ShorelandZoning/)
Action Steps:	
1.	Recruit facilitator (potentially same facilitator as previous management action).
2.	Facilitator gathers appropriate information from sources described above.

6.0 METHODS

Nuisance Aquatic Plant Mapping Survey

Nuisance aquatic plant mapping surveys were completed on Van Vliet Lake during an August 20-22, 2013 field visit, in order to correspond with the anticipated peak growth of native aquatic plants. Visual inspections were completed throughout the lake by completing a meander survey by boat. Point, polyline, and polygon data were recorded directly in ArcPad (ESRI) on a Microsoft Windows-based ruggedized Panasonic Toughbook computer, blue-toothed Global Positioning System (GPS) data through a Trimble GeoXT data collector with sub-meter accuracy.

Point-intercept Survey

The point-intercept method as described Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS-1068 2010 (Hauxwell et al. 2010) was conducted in Van Vliet Lake in 2008 by Boestroo, Inc. and in 2013 by White Water Associates. Based upon guidance from the WDNR, a point spacing (resolution) of 46 meters was used resulting in 432 sampling points being evenly distributed across the lake.

Floating-leaf and Emergent Plant Community Mapping Survey

On August 20-22, 2013, the aquatic vegetation community types within Van Vliet Lake (emergent and floating-leaved vegetation) were mapped. Point, polyline, and polygon data were recorded using the computer/GPS methodology described above.

Furthermore, all species found during the point-intercept surveys (White Water Associates) and the community mapping surveys (Onterra) were recorded to provide a complete species list for the lake. Representatives of all plant species located during the point-intercept and community mapping survey were collected and vouchered by the University of Wisconsin – Steven’s Point Herbarium.

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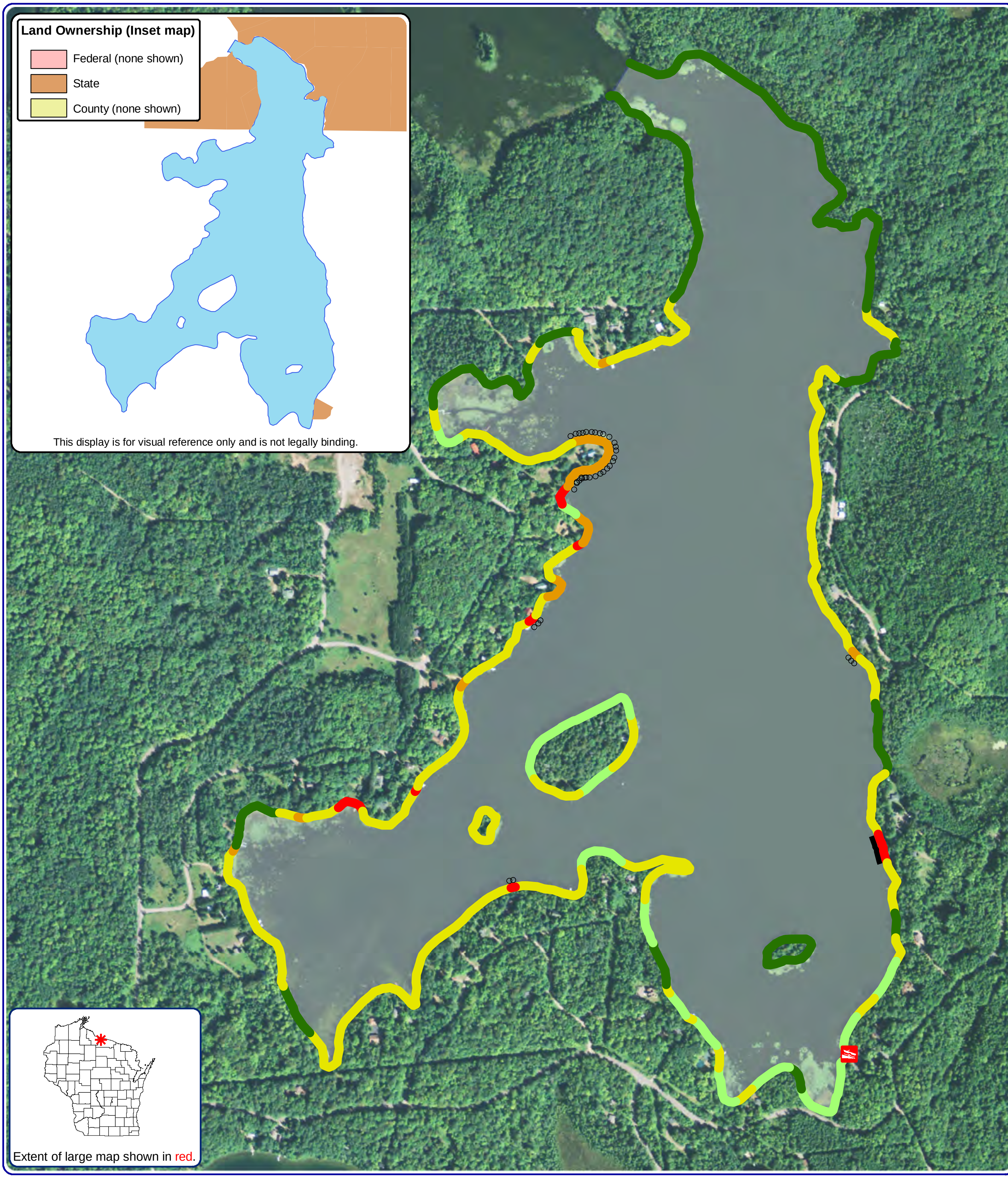

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Feet

Onterra LLC
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815 Prosper Rd
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920.338.8860
www.onterra-eco.com

Sources:
Orthophotography: NAIP, 2013
SCA Survey: Onterra, 2013

Map date: November 27, 2013
Filename: Map1_VanVliet_SCA_2013.mxd

Legend

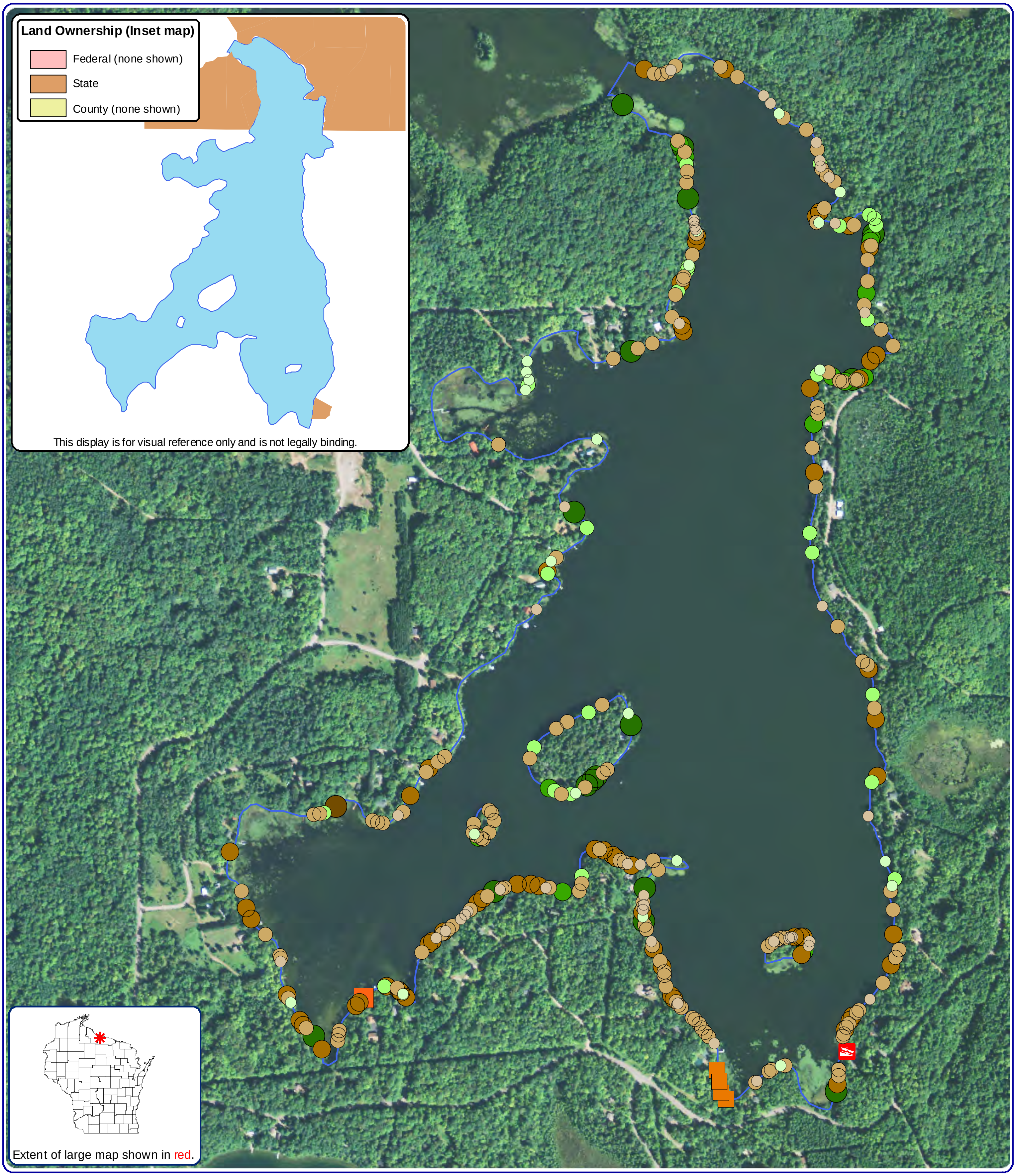
- Natural/Undeveloped
- Developed-Natural
- Developed-Semi-Natural
- Developed-Unnatural
- Urbanized

Seawall

- Masonary/Wood
- Rip-Rap

Map 1
VanVliet Lake
Vilas County, Wisconsin

Shoreland Condition Assessment



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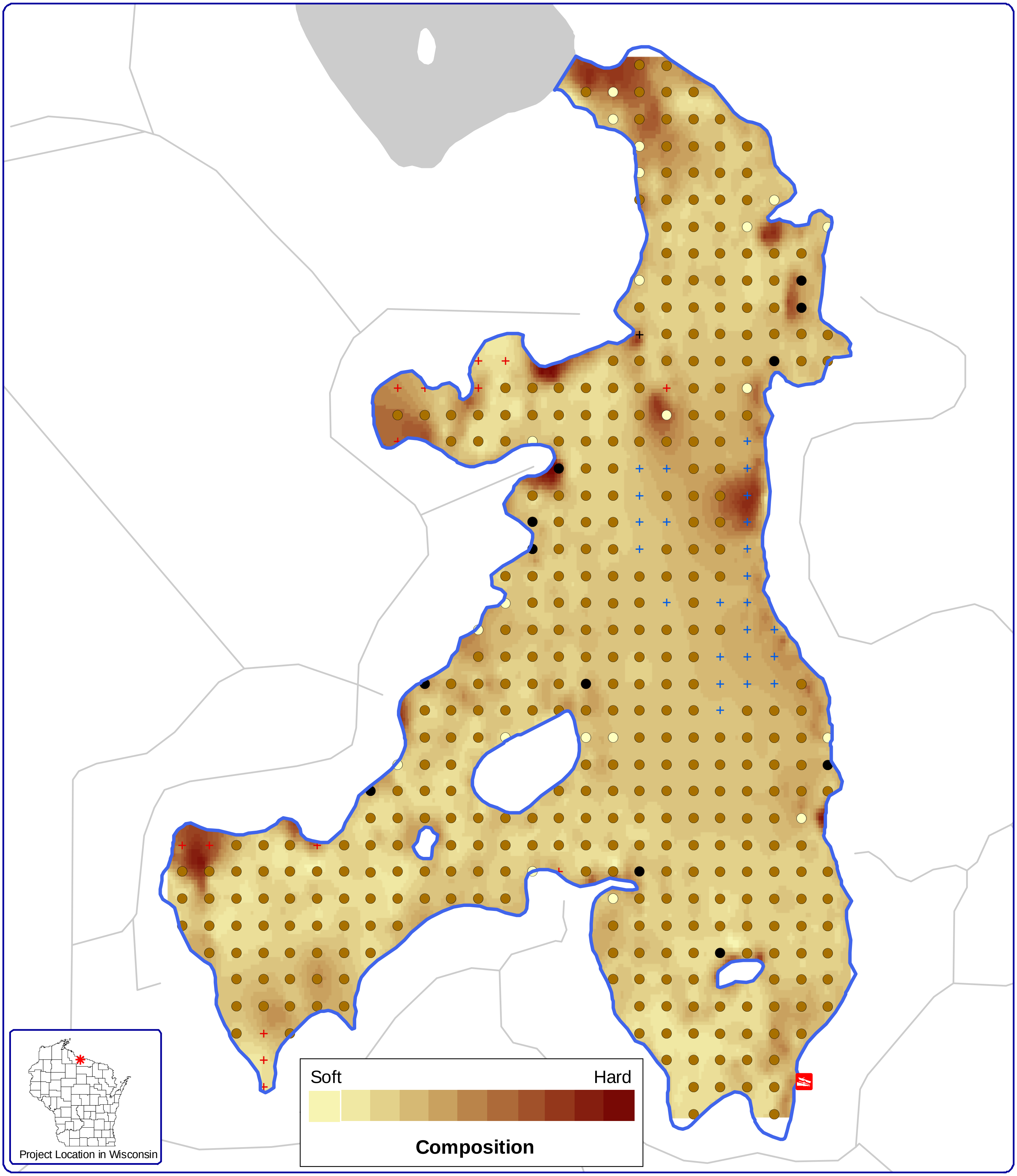
Sources:
Orthophotography: NAIP, 2013
CWH Survey: Onterra, 2013

Map date: November 27, 2013
Filename: Map2_VanVliet_CWH_2013.mxd

Legend

2-8 Inch Pieces	8+ Inch Pieces	Cluster of Pieces
No Branches	No Branches	No Branches (none)
Minimal Branches	Minimal Branches	Minimal Branches (none)
Moderate Branches	Moderate Branches	Moderate Branches
Full Canopy	Full Canopy	Full Canopy

Map 2
VanVliet Lake
Vilas County, Wisconsin
Coarse Woody Habitat Assessment



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Sources:
Roads and Hydro: WDNR
PI Survey: Whitewater and Assoc., 2013
Acoustics Survey: Onterra, 2013
Acoustics Data Processed: Contour Innovations, LLC
Map Date: December 19, 2013
Filename: MapX_VanVliet_Sediment.mxd

Legend

2013 Point-Intercept Sediment Data

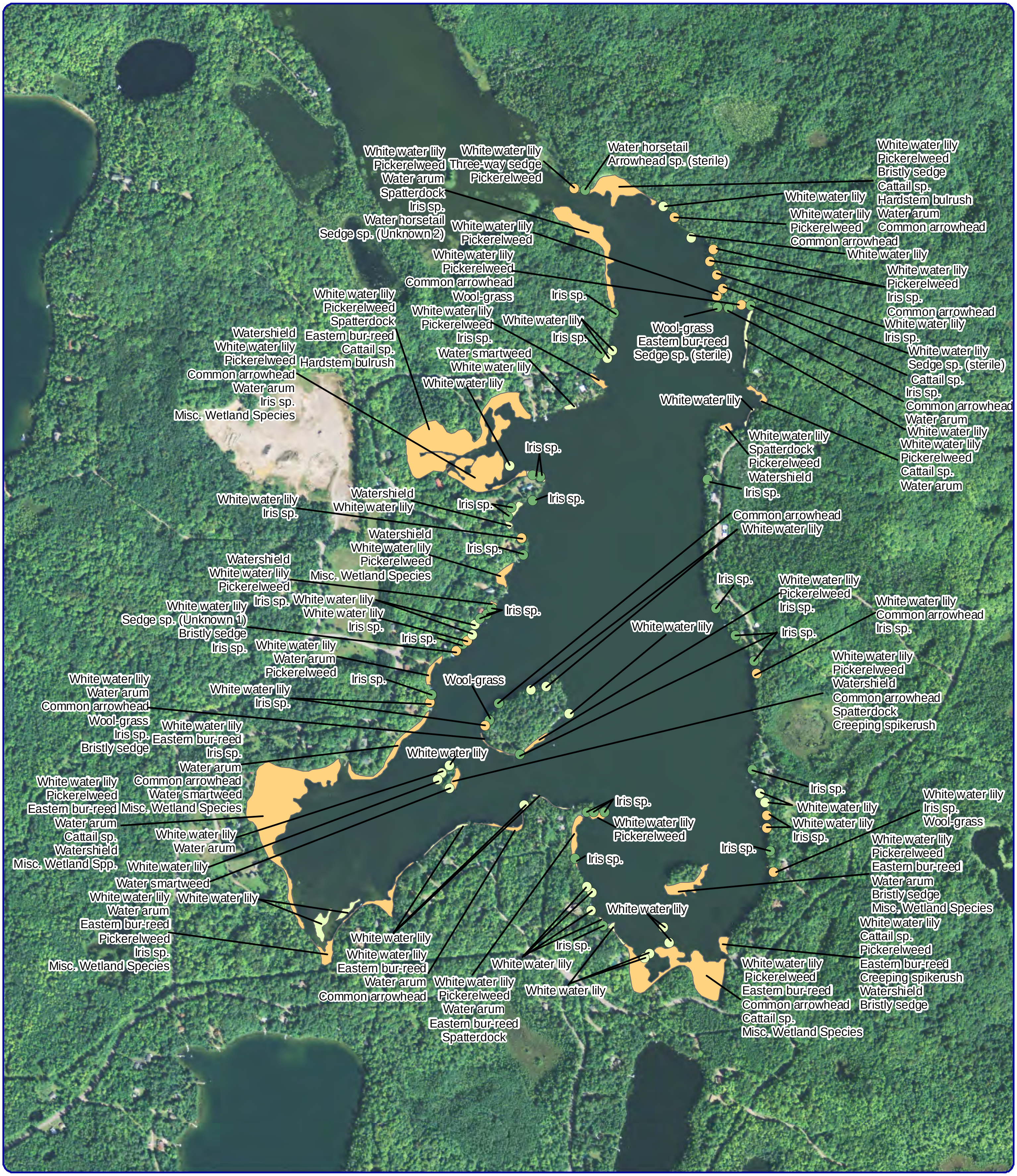
- Sand
- Fine Organic Material
- Rock
- Too Deep
- Non-navigable or Temporary Obstacle

Map 3

Van Vliet Lake

Vilas County, Wisconsin

Sediment Type & Composition



950

Feet

Onterra LLC
Lake Management Planning

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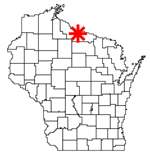
Sources:
Hydro: WDNR
Aquatic Plants: Onterra, 2013
Orthophotography: NAIP, 2013
Map date: November 6, 2013
Filename: *VanVliet_Comm_2013.mxd*



Project Location in Wisconsin

Legend

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

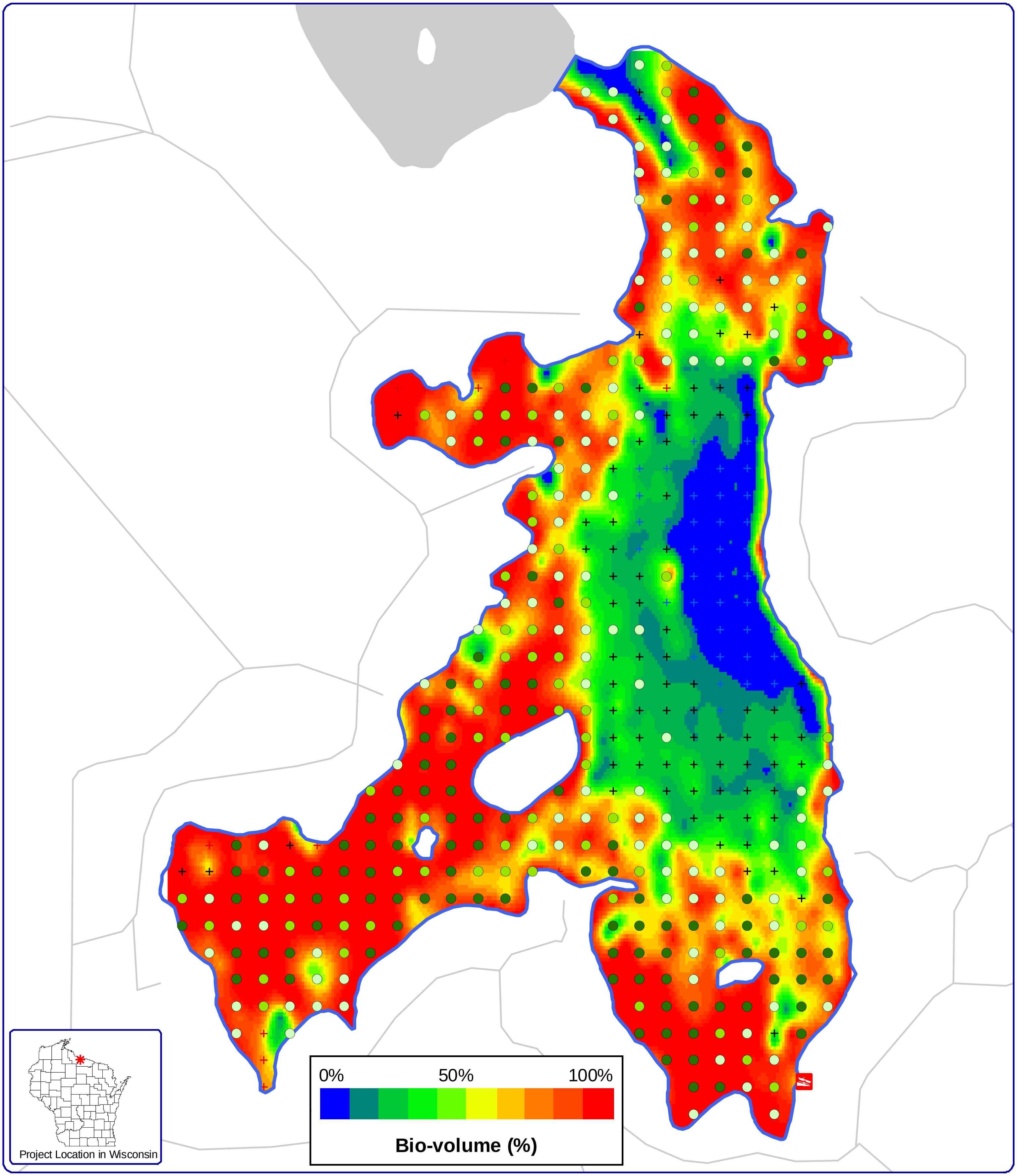
Large Plant Communities
- Emergent
- Floating-leaf
- Mixed Floating-leaf & Emergent

Map 4

Van Vliet Lake

Vilas County, Wisconsin

Aquatic Plant Communities



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2013 Point-Intercept Survey Total Rake Fullness

- + No Vegetation
- Total Rake Fullness = 1
- Total Rake Fullness = 2
- Total Rake Fullness = 3
- + Too Deep
- + Non-navigable or Temporary Obstacle

Map 5

Van Vliet Lake
Vilas County, Wisconsin

Aquatic Vegetation Distribution & Bio-volume

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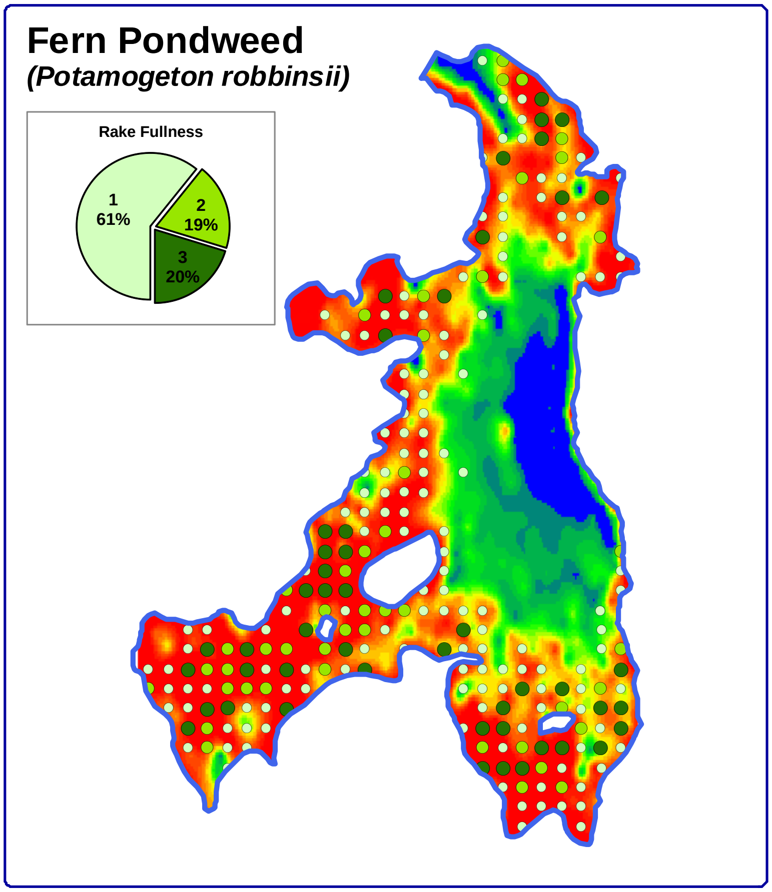
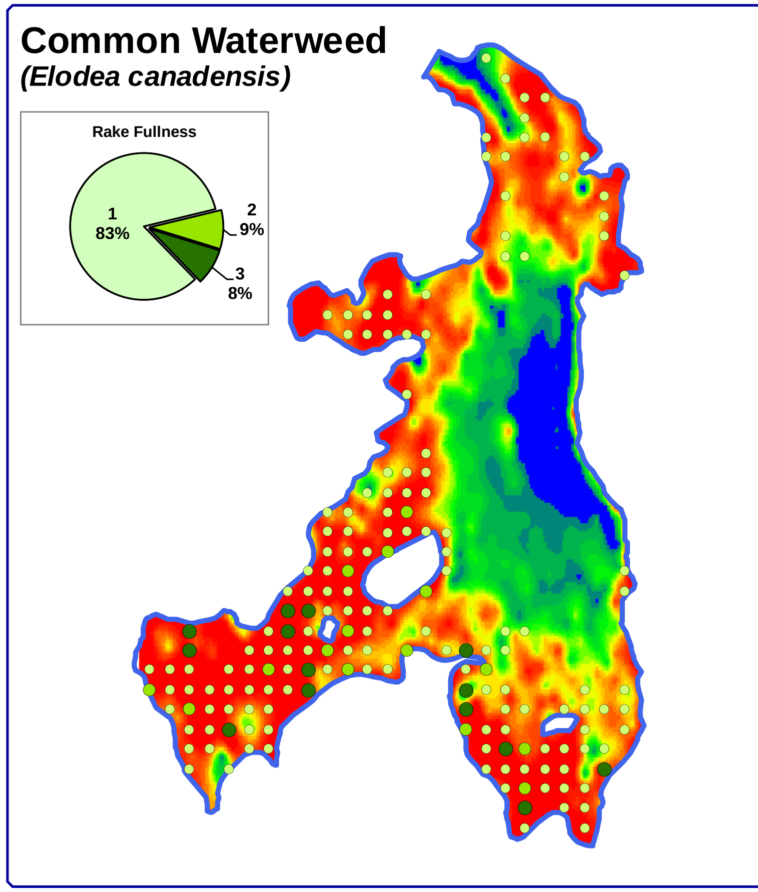
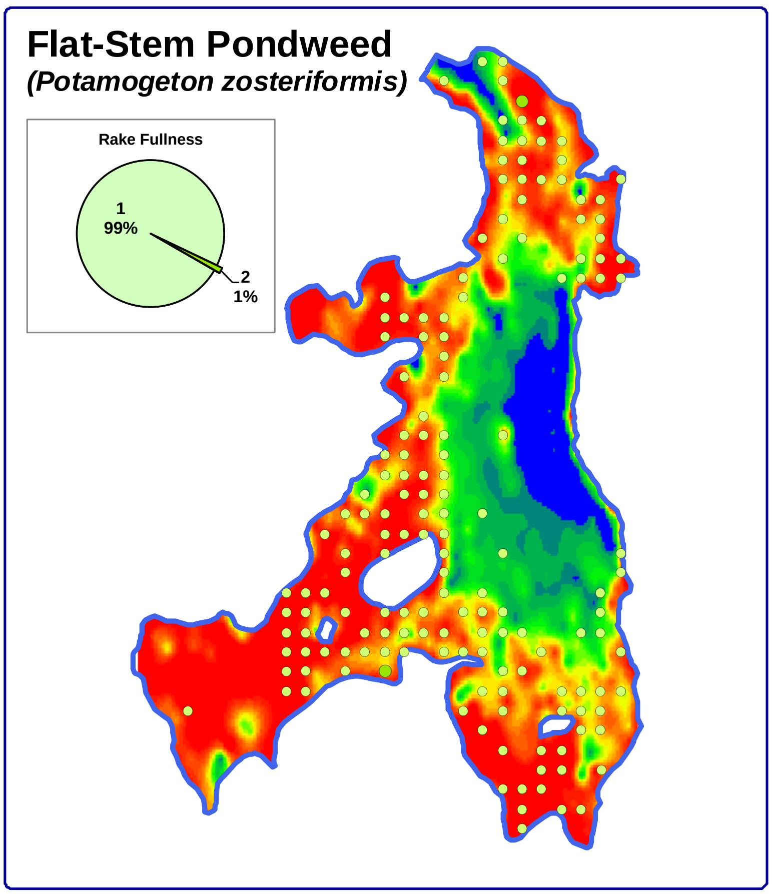
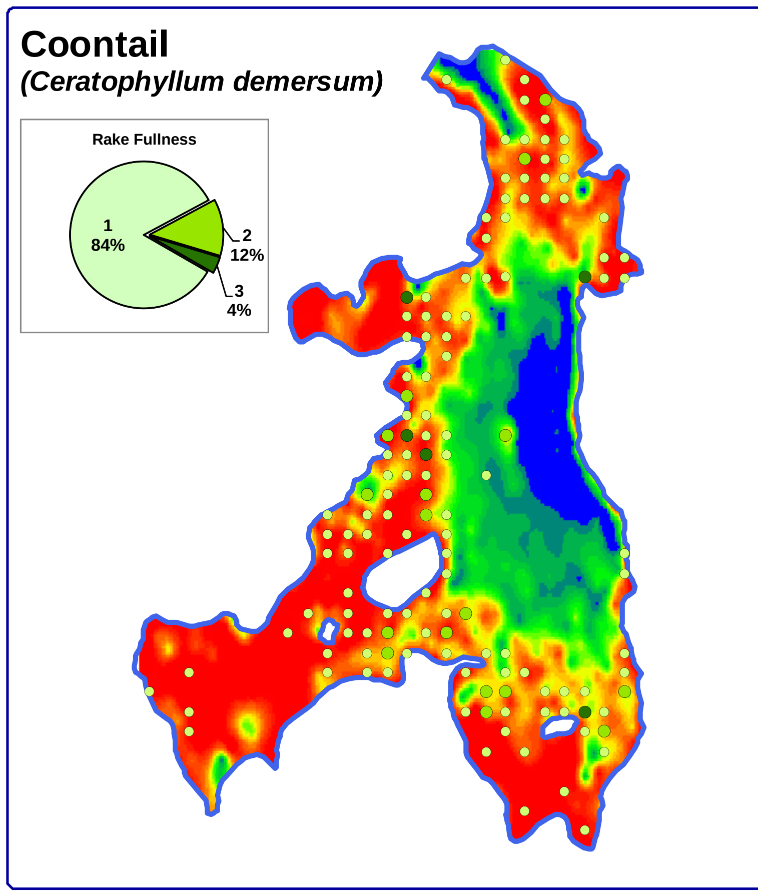
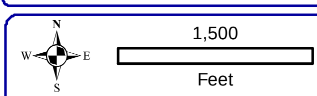
<Bol>Sources:</Bol>
Roads and Hydro: WDNR
PI Survey: Whitewater & Assoc., 2013
Acoustics Survey: Onterra, 2013
Acoustics Data Processed: Contour Innovations, LLC
Map Date: December 19, 2013
Filename: Map5_VanVliet_VegDist.mxd











Onterra LLC
Lake Management Planning

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

Sources:
Aquatic Plant Biovolume: Onterra, 2013
Aquatic Plant PI Survey: White Water Associates, 2013
Hydro: WDNR
Map Date: December 19, 2013
Filename: Map6_VanVliet_BioVol_PI.mxd

Legend

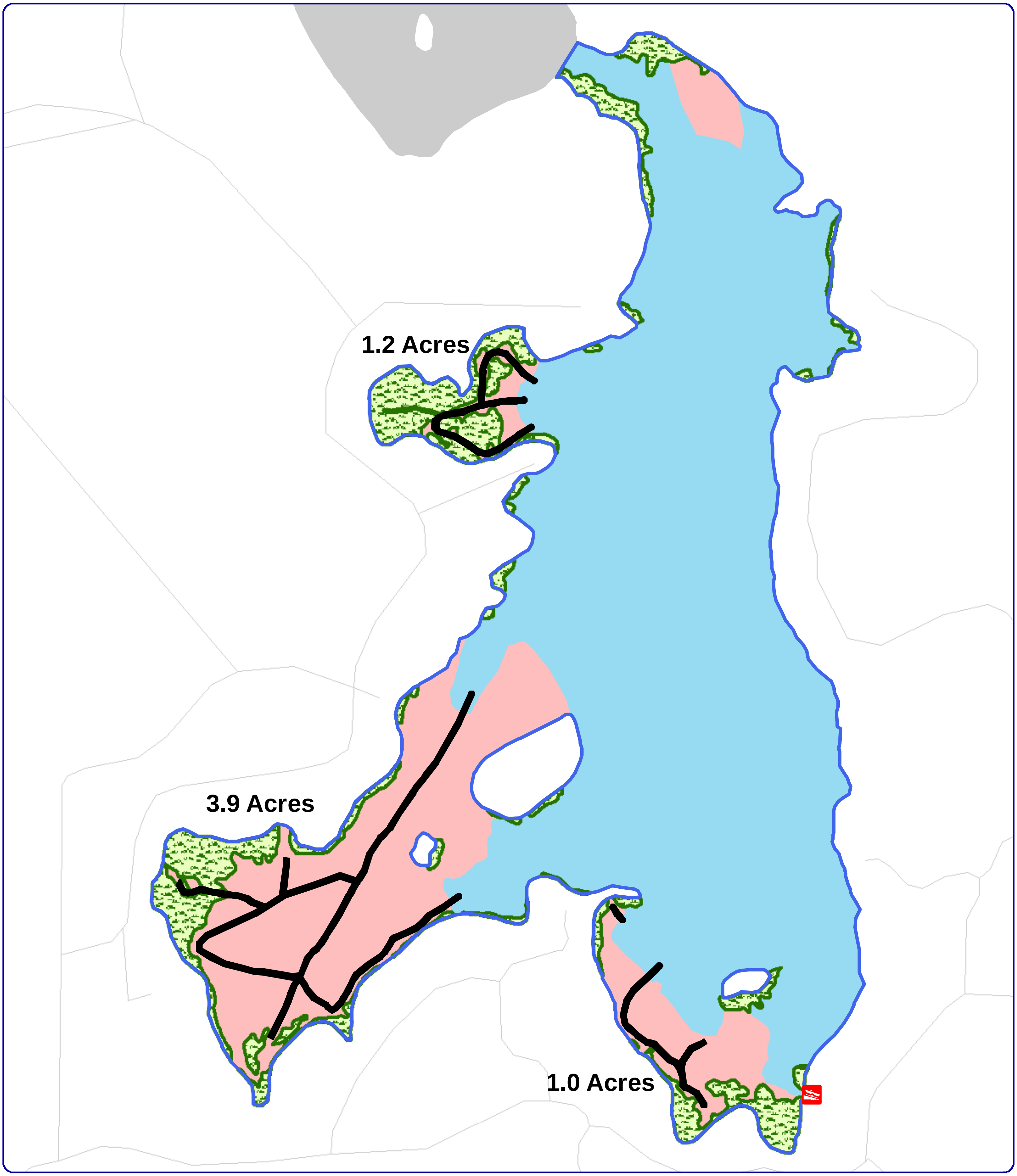
2013 PI Survey Total Rake Fullness

- \+ No Vegetation
- Total Rake Fullness = 1
- Total Rake Fullness = 2
- Total Rake Fullness = 3

0% 50% 100%
Aquatic Plant Bio-volume (%)

Map 6
Van Vliet Lake
Vilas County, Wisconsin

2013 Aquatic Plant Biovolume & PI Distribution of Dominant Aquatic Plant Species



N
W E
S

700

Feet

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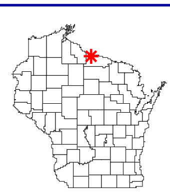
Sources:
Roads and Hydro: WDNR
Navigation Impariment: Onterra, 2013

Map Date: March 24, 2015
Filename: Map7_VanVliet_HarvestPlan.mxd



Project Location in Wisconsin

Legend

Mechanical Harvest Lane
30-ft wide, 6.1 Acres

Persistent or Variable
Navigational Impediment

Floating-leaf and/or
Emergent Plant Communities

Map 7

Van Vliet Lake
Vilas County, Wisconsin

Mechanical Harvest Plan