Lake Windermere
Aquatic Invasive Plant Inventory 2023

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goldeneye
ECOLOGICAL SERVICES

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1. Introduction

1.1. Invasive aquatic plants

An invasive species is a plant, animal, or fungus species that is deliberately or unintentionally introduced into an area that is outside of their natural habitat (ISCBC, 2017). Invasive species are one of the largest known threats contributing to widespread species extinctions and habitat destruction (Gurevitch & Padilla, 2004; Mooney & Cleland, 2001). Alongside other major threats to biodiversity such as habitat loss and climate change, invasive species can be devastating for native plants, animals and ecosystems.

Aquatic invasive plants can take over native ecosystem and destroy wildlife habitat (Blossey, Skinner & Taylor, 2001), they reduce invertebrate productivity that fish and other animals use for food (Keast, 1984), alter natural wetland processes, reduce water flow and quality, disrupt recreational activities, cause socio-economic problems, and reduce overall biodiversity of native plants and animals. One established, aquatic invasive plant species [e.g., Eurasian Watermilfoil (*Myriophyllum spicatum*), Brazilian Elodea (*Egeria densa*), Curlyleaf Pondweed (*Potamogeton crispus*)] can be challenging or impossible to eliminate. Some of these aquatic invasive plants are already well-established in nearby waterbodies such as Kootenay Lake and Shuswap Lake. To date, no aquatic invasive plants have been detected in Lake Windermere. If aquatic invasive plants are introduced and become established in Lake Windermere or in the Columbia River marshes, there will be severe ecological, economic and social consequences (Hammond, 2007).

Purple Loosestrife is an invasive, herbaceous wetland perennial that was first detected in the Columbia Wetlands in 2017, within Burges James Gadsden Provincial Park located north of Golden, British Columbia. This is the only aquatic invasive plant that is known to occur in the Columbia Valley bottom from Canal Flats to Donald. This infestation was detected early in its growth. It was an isolated patch with a small distribution and abundance. It has been treated by BC Parks and they continue to check for potential re-growth on an annual basis. Purple loosestrife is known to alter nutrient cycling and decomposition rates, it also leads to reductions in wetland plant diversity. This invasive plant can also reduce habitat suitability for wetland habitat specialists such as the at-risk Eared Grebe (*Podiceps nigricollis*) and Marsh Wren (*Cistothorus palustris*). Marsh dependant bird species like these can become excluded from breeding habitat by encroachment of invasive plants (Blossey, Skinner & Taylor, 2001).

In 2007, the Canadian Wildlife Service determined that there were three possible ecosystem level threats to the Columbia Wetlands; invasive species, pollution events, and severe erosion (Hammond, 2007). Invasive plant and animal species were determined to be the most likely to

occur in the Columbia Wetlands and if introduced, would pose the "greatest potential consequence" (Hammond, 2007).

1.2. Benefits of native aquatic plants

"Aquatic macrophytes are aquatic photosynthetic organisms, large enough to see with the naked eye, that actively grow permanently or periodically submerged below, floating on, or growing up through the water surface" (Chambers, Lacoul, Murphy and Thomaz, 2007). There are numerous studies demonstrating the importance of native aquatic plants (or macrophytes) to a healthy lake ecosystem (e.g., Bormann, 2012; Dhode, 2007; Dick et al., 2013; Petruzzella et al., 2020; Slagle & Allen, 2018; Thomaz, 2021; Van Nes et al., 1999). Macrophytes are primary producers, the first links in the food chain and vital to the survival of a healthy ecosystem (Sciencing, 2022); a key component of aquatic ecosystems and form the base of most aquatic food chains. They provide habitat for aquatic life and produce life-giving oxygen that most aquatic species need to survive (Liddle & Scorgie, 1980). They provide food and structure for other organisms and provide resistance to alien invasions (Petruzzella et al., 2020). They help with soil stabilization, absorb access nutrients, reduce turbidity, and emergent plants like cattail can help filter runoff from uplands to protect lake water quality (Aron et al., 2008). Their roots create complex networks that stabilize sediments at the water's edge where buffering waves might otherwise erode the lakeshore. These plant beds are essential to the spawning success of many fish species, and provide cover and nesting for marshbirds, songbirds and waterfowl (Aron et al., 2008). Native aquatic plants provide at least 26 different types of ecosystem services, including nutrient cycling, shoreline stabilization, habitat provisioning, water purification, disease control and aesthetic values (Thomaz, 2021). They also have a remarkable capability of removing toxins and excessive nutrient loads from water (Barznji, 2014), are bio-filters and can remove pollutants (Dhote, 2007).

1.3. Aquatic invasive plant sampling on Lake Windermere

In 2008, the author developed the Columbia Headwaters Invasive Plant Species Project (CHIPSP) (administered by Wildsight) to collect baseline data on invasive plants in the Columbia Wetlands, Lake Windermere, Columbia Lake and higher elevation lakes of the Columbia Valley. The CHIPSP operated as an effective baseline inventory and management project for the Columbia Wetlands and surrounding region from 2008-2012. As a contractor to the Lake Windermere Ambassadors, R. Darvill (Goldeneye Ecological Services), has been conducting annual aquatic invasive plant species inventories on Lake Windermere.

The major goal of annual aquatic invasive plant sampling in Lake Windermere is early detection of aquatic invasive plant species in Lake Windermere, leading to a rapid response with any detection. We must ensure that aquatic invaders are not present in the ecosystem. To-date, no aquatic invasive plants have been detected at the long-term sampling sites. The ever-increasing popularity of boating in Lake Windermere poses a high risk to the introduction and spread of aquatic invasive plant species in the lake and potentially spreading into the Columbia Wetlands ecosystem thereafter. Motor and non-motorized watercrafts are common vectors for transmitting aquatic invasive species. This project remains diligent in its annual efforts of early detection so that a rapid management response can be implemented if an aquatic invasive plant is detected.

2. Study Area

Lake Windermere (UTM: 571182; 5590080) is located within the Regional District of East Kootenay (RDEK) of southeastern BC, near the headwaters of the Columbia River. The Columbia River begins in Canal Flats, which is located approximately 30kms south of the most southerly end of Lake Windermere. There are three main communities (Invermere, Windermere, Fairmont) around the periphery of the lake. The largest community is Invermere with a population of 3,917 people (Wikipedia, 2024). The first 180 kilometers of the Columbia River are known as the Columbia Wetlands, a Ramsar site recognized for its international significance. However, while Lake Windermere is within the continuous Columbia Wetlands ecosystem, the Ramsar designation excludes most of Lake Windermere except for the south end (Figure 1).

Lake Windermere extends for approximately 17.7 kilometers and is 0.7 to 2 kilometers wide. Much of Lake Windermere is classified as a shallow open water wetland, a transition zone between lakes and marshes where the depth of water is often less than 2 meters (Alberta Wetland Policy, 2017). The deepest area of the lake it located near the northwest end and measures approximately 5.5 meters deep. Lake Windermere is important to humans for a variety of purposes including freshwater provisioning, but also for its significant cultural ecosystem services such as aesthetic views, fishing, birding, recreational boating, and cross-country skiing.

Lake Windermere is designated as Critical Habitat for Bank Swallows under the Recovery Strategy for the Bank Swallow (*Riparia riparia*) (Environment and Climate Change Canada, 2021). Twenty-nine Bank Swallow colonies have been identified along the foreshore of Lake Windermere (Darvill, 2022a). The 'Key Biodiversity Area' KBA designation is bring pursued by Goldeneye Ecological Services due to the demonstrated importance of the area as breeding habitat to at-risk Bank Swallow (Darvill, 2022a; Ian Adams, personal communication, May 2022). There is a high diversity and abundance of migratory waterbirds that use Lake Windermere as stopover grounds during both the spring and fall migration; several at-risk bird species use this lake as migration staging area for resting and for feeding (Darvill, 2020). Some of the at-risk birds that utilize Lake Windermere during migration periods are as follows: Western Grebe (*Aechmophorus occidentalis*), Eared Grebe (*Podiceps nigricollis*), Horned Grebe (*Podiceps auritus*), Double-crested Cormorant (*Phalacrocorax auritus*), American White Pelican (*Pelecanus erythrorhynchos*) (Darvill, 2019; Darvill, 2020). One hundred and sixty-five bird species have been recorded at Lake Windermere. The lake also provides habitat for many other species including at least nine different species of fish, of which seven are native (Hildebrand, 2022).

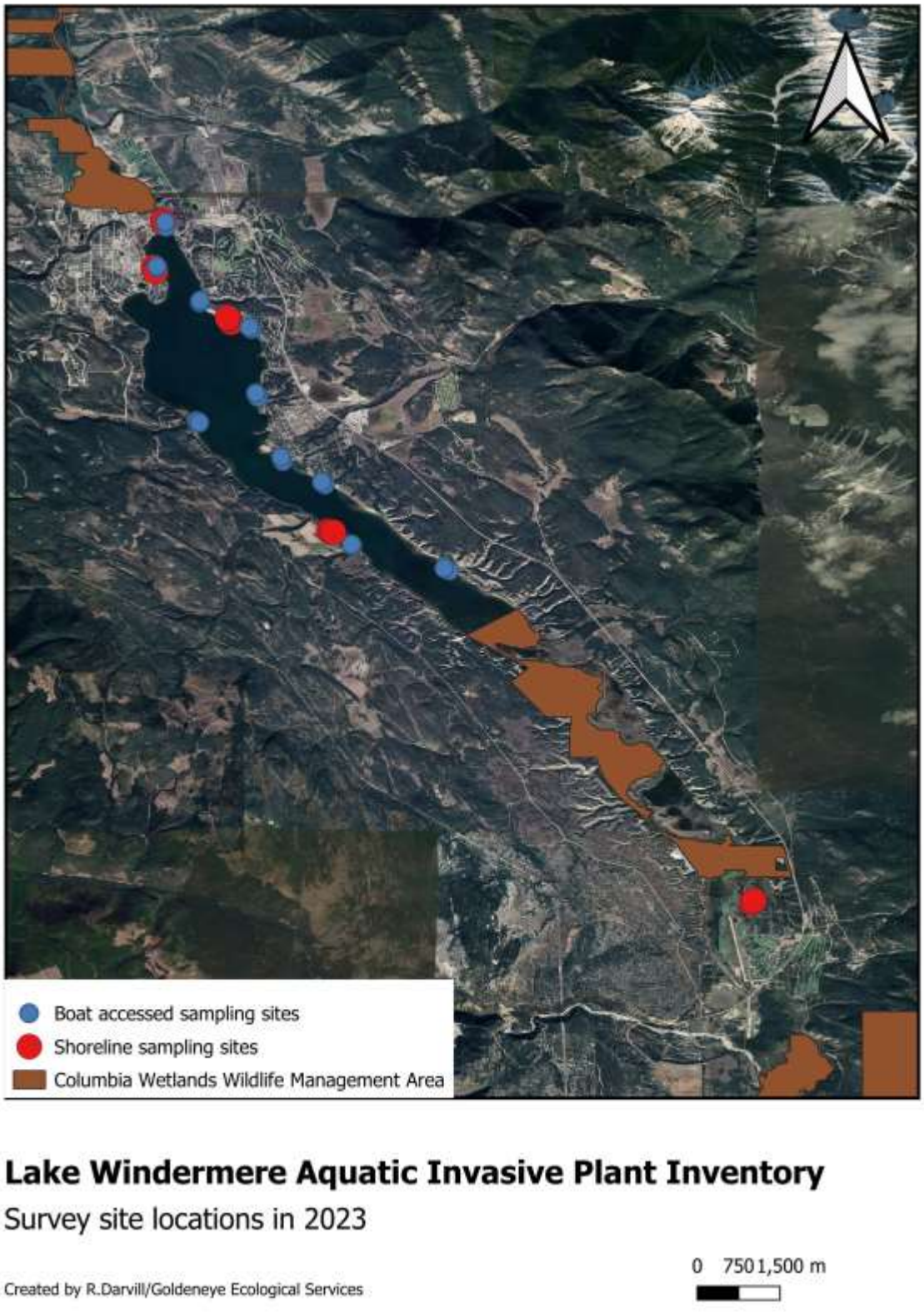

Figure 1. Map showing Lake Windermere's aquatic invasive plant survey station locations in 2023.

3. Methods

3.1. Shoreline surveys

Aquatic plant sampling followed the protocol outlined in the 'Canadian Columbia Basin Regional Framework for an Aquatic Invasive Species Program: 2015 to 2020 [Inter-Ministry Invasive Species Working Group (IMISWG), 2015]. Shoreline surveys for aquatic invasive plant species were conducted over a seven-hour period on September 12, 2023. Shoreline sampling occurred at five pre-established survey stations (Figure 1). The pre-established surveys stations were chosen because those sites pose a higher risk of invasion compared to other shoreline locations. High-risk sites include locations that are known to have higher amounts of trailered boat traffic (boats coming in from other areas that could be affected by aquatic invasive species), public boat launches, and/or boat marinas with multiple boat docking slips.

A field crew of two people (R. Darvill, volunteer) conducted the aquatic invasive plant sampling at each station. A thatched rake with a 9.7-meter-long rope was use for sampling aquatic plants in the water. The rake was tossed into the water as far as possible and pulled back to the shoreline. This enabled the rake to collect freshwater plants below the surface of the water at the specific location where it was thrown. All aquatic plants collected on the rake were recorded to the family level; where possible the species level was identified and recorded. Rake pulls occurred at the initial feature (e.g., public boat launch) as well as at three sites (where assessable) located 25, 50 and 75 meters both upstream and downstream of the initial feature. Two rake throws were conducted at each of the seven sites at each station. The five shoreline survey stations were as follows: Baltac Beach, Fairmont Side Channel, end of Ruault Road, Unofficial boat launch near Bayshore Condos and Althalmer/Pete's Marina.

3.2. Offshore surveys using a boat

The 2023 offshore surveys followed IMISWG (2015) methods for sampling aquatic invasive plants on a lake from a boat. Using IMISWG methodology ensures that inventories can be repeatable over time to maintain consistency with previous years of survey effort. Given the relatively large spatial scale of Lake Windermere and limited resources, as in previous years of sampling effort a modification was made to the IMISWG protocol. The IMISWG protocol recommends continuous surveys be conducted every 100 meters. However, this project's scaled-down survey effort continues to focus on high-risk locations, as was done during 2015-2018 years of survey effort.

An aluminum boat with outboard motor (provided by the District of Invermere) was used to conduct offshore boat surveys. A crew of two people conducted the surveys: R. Darvill, P. Saunders. All offshore sampling occurred on October 6, 2023 at 10 pre-established survey stations considered to be at high-risk for introduction of aquatic invasive plant species. As with shoreline surveys, high risk locations were considered to be those areas with an increased incidence of trailered boat traffic (boats coming from other waterbodies), public boat launches, and boat marinas. At each survey location, four rake pulls were conducted (two off the right side and two off left side of boat). The rake was tossed into the water as far as possible (approximately 7 meters) and pulled back to the boat, enabling the rake to collect plants present on the lake bottom. An additional four rake toss/pulls were conducted at the end of a 100 meter transect, two off the right and two off the left-hand side of boat. All aquatic plants collected on the thatched rake were recorded to the family level and where possible to the species level.

During the 100 meter transect between the two rake toss sites, a single observer would record all additional plant species seen with the naked eye from the boat. For all 100 meter transects, the boat travelled northward, parallel to the shoreline. The 10 survey stations were sampled in the following order: Indigenous Beach (formally referred to as Indian Beach in previous years or survey effort), Lakeshore Resort, Ruault Road, Tretheway Docks, Akiskinook Resort, end of Coy Road, Baltac Beach, Lakeview Meadows, ‘unofficial boat launch near the Bayshore Condos’ and Althalmer/Pete’s Marina. In previous years of sampling, offshore surveys were also done at Rushmere, but due to the low water level combined with dense aquatic plant growth, the boat was unable to reach that site.

4. Results

4.1. Shoreline surveys

Shoreline surveys were conducted at five locations or survey stations. The same stations were also surveyed in previous years of survey effort, with the exception of one station (Rushmere) that was not visited in 2022 or 2023 due to private property concerns. At two of the survey stations (i.e., Fairmont Side Channel, End of Ruault Road), it was not possible to sample at all seven sites per survey station due to private property and the obstruction of riparian vegetation (Giant Bullrush, a blue-listed and at-risk ecological community) (figure 2).

No aquatic invasive plant species were detected during shoreline surveys in 2023. A list of native aquatic plant species that were observed at each station are listed in Appendix 1. All watermilfoil species (*Myriophyllum sp.)* detected during surveys had ten (or less) leaflet pairs per leaf. Native watermilfoil species have 5-10 leaflet pairs, whereas invasive Eurasian Watermilfoil (*Myriophyllum spicatum*) has leaves with 12-21 leaflet pairs (Minnesota Sea Grant, 2016). Therefore, all watermilfoil species detected in 2023 were native aquatic plant species. The Potamogeton species identified in the excel table (Appendix 1 and 2) with parenthesis stating 'short/narrow leaves', could be either *P. gramineus* or *P. obtusifolious*, or possibly another related to Potamogeton species. Potamogeton species can be hard to identify, depending on condition/stage of the plant and they hybridize fairly frequently to produce plants with hybrid characteristics (Thomas Wolf, personal communication, 2017; Washington State Department of Ecology, 2001). Since the purpose of these surveys is to detect invasive plants, species level determination for native aquatic plants is not required.

During aquatic plant surveys, in additional to unusually low water levels, an orange color was observed on the shoreline sediment at Pete's Marina/Athalmer (figures 3 and 4). Some of the aquatic plants at this location were also coated with sediment (figures 5) and there was a noticeable decrease in the abundance and diversity of native aquatic plants present at this station in comparison to all other years of survey effort. Other sampling stations continued to have a lack of abundant and diverse aquatic plant communities as was observed in previous years, such as Lakeshore Resort, Baltac Beach, Tretheway Docks and the 'unofficial boat launch near Bayshore Condos.'

Figure 2. Provincially blue-listed (at-risk) hard-stemmed bullrush Deep Marsh ecological community occurrence at the Ruault Rd survey station, preventing access to the 50m north and 75m north sites.

Figure 3. Orange color of sediment and reduced amount of aquatic plants seen at shoreline of Pete's Marina.

Figure 4. Orange color of sediment and reduced amount of aquatic plants on shoreline at Pete's Marina.

4.2. Offshore surveys using a boat

No aquatic invasive plant species were detected during offshore (boat) surveys. As with previous years of survey effort, abundant beds of diverse native aquatic plants were observed at the Ruault Road sampling site (figure 5). Consistent with past years of survey effort, some survey stations had a lack of abundant and/or diverse aquatic plant communities, such as Lakeshore Resort, Baltac Beach, the 'unofficial boat launch near Bayshore Condos' and Tretheway Docks. At two of the sampling sites (i.e., Tretheway Docks, Baltac Beach), a thick and crusty coating of sediment was observed to be coasting the plants retrieved through rake tosses.

Figure 5. Abundant and diverse beds of aquatic plants at the Ruault Rd public access area, photo taken October 6, 2023.

Figure 6. Thick sediment on *Chara sp*. at the Tretheway Docks, Windermere.

Figure 7. Chara sp. at Tretheway Docks, coating in sediment. Area lacking diversity of other macrophytic species (aquatic plants).

5. Discussion/Recommendations

Due to the ongoing diligence of annual aquatic plant sampling, we know that aquatic invasive plants are not present in Lake Windermere at the 10 shoreline sampling stations (20 sites/station), or at the 20 sites at the five boat-accessed sampling stations. Those sites represent the areas with the highest potential for introducing invaders. While not the intention of this project, additional concurrent observations of the lake's ecology have been made, with recommendations made in this report and in previous reports (e.g., Darvill 2021; Darvill 2022b). Past recommendations have included an assessment of native aquatic mussel distribution and abundance, sampling of invasive mussel veliger's (now done annually by the provincial government) and a fish inventory of Lake Windermere. The Lake Windermere Ambassadors (LWA) now has baseline information on the fish species present (Hildebrand, 2022) and the LWA is currently seeking funding for a freshwater mussel study.

In 2023, an unnatural coloration (orange) was observed along the shoreline of Pete's Marina/Athalmer (figures 3 and 4). This unnatural coloration warrants investigation to determine what is occurring to make those changes. Additionally, in 2023 as in previous years of sampling (Darvill 2022b, Darvill 2021), there was a noticeable lack of native aquatic plants at some sampling locations (e.g., Lakeshore Resort, Baltac Beach), and an observed decrease in the abundance and diversity of plants at some locations (e.g., Pete's Marina/Athalmer, Tretheway Docks). In 2023 it was observed that two of the survey stations (i.e., Tretheway Docks, Baltac Beach) had a thick and crusty coating of sediment on aquatic plants present at those sites.

The accumulation of fine sediment are important in affecting the growth of submersed aquatic vegetation (Barko & Smart, 1986; Collins, Naden & Sear, 2012). A layer of deposited sediment will result in reduced photosynthesis and decreased growth of macrophytes (Collins, Naden & Sear, 2012). Barko and Smart (1986) have shown a demonstrated negative relationship between high sediment inputs on plants and the growth of submersed macrophytes, leading to a cascade of events. "Autumn/winter reduces the strength of macrophytes as they die back, which leads to increased likelihood of breakage or uprooting of macrophytes and the remobilisation of accumulated sediment, a process that is exacerbated by the lower stability and poor rooting medium presented by the accumulated sediment (Kleeberg et al., 2009)" (in Collins, Naden & Sear, 2012). As stands of submerged macrophytes grow the following spring, flow is directed into unvegetated areas where erosion of the lake bed occurs (Dawson, Castellano & Ladle, 1978; Kleeberg et al., 2009). Regrowth and occurrence of different macrophyte species is in turn influenced by substrate composition (highly influenced by

sediment deposition the following year), as well as water depth, chemistry and velocity (Haslam, 1978).

While beyond the scope of this project to precisely define causation of noted changes to aquatic plant communities in Lake Windermere, anthropogenic factors are having an influence. For instance, it is known that motor boats dramatically reduce plant biomass primarily through scouring of the sediment substrate and through direct cutting (Asplund, 2000; Asplund & Cook, 1997). Some evidence of this has been shown in aerial photographs provided in previous reports (e.g., Darvill 2022b). However, a number environmental factors are involved with affecting submersed macrophyte growth. Given the numerous critical ecological health benefits provided to Lake Windermere by freshwater macrophytes (refer to Introduction for benefits), it is recommended to identify all environmental factors that influence submerged macrophyte communities (Liu et al., 2017). It is challenging to have a positive effect on the native aquatic plants and associated health of Lake Windermere without first addressing all of the factors affecting macrophyte growth and distribution. Without a healthy community of native aquatic plants, you cannot have a healthy lake ecosystem (Thomaz, 2023).

There are certain areas of Lake Windermere that still hold diverse and abundant beds of native aquatic plants. It is recommended to evaluate the diversity, abundance and distribution of native aquatic plant species in the entire lake. Since maintaining native plant species is one of the major keys to keeping a lake healthy (Aron et al., 2008), it is recommended to designate special management zones for parts of Lake Windermere where plants are found to be either abundant or scarce. Van Nes et al., (1999) suggested that in areas where there are competing interests between nature conservation and recreation, that a compromise can be achieved by assigning certain areas of a lake to recreation and other parts should be left for nature conservation. For instance, Asplund and Cook (1997) found that “excluding motor boats from small experimental plots in a lake with heavy boat traffic significantly increased macrophyte biomass, coverage, and shoot height compared to impacted areas.” This is something to strongly consider. This should include the hard-stemmed bullrush Deep Marsh ecological communities on several sites along the shoreline of Lake Windermere. This ecological community is blue-listed in BC, meaning that it is at-risk in the province. It appears that none of the hard-stemmed bulrush Deep Marsh communities in Lake Windermere have been recorded into BC’s Conservation Data Centre database. It is recommended that these locations be identified and entered into the provincial database and into the regional Official Community Plan for Lake Windermere, and subsequently conserved.

Submerged aquatic plants can be a measurable indicator of the ecological health of Lake Windermere. Annual sampling could be conducted that uses a method focusing on lake littoral

margins where there is the greatest public interaction and interest (Clayton & Edwards, 2006). To mitigate for anthropogenic disturbances that have removed native aquatic plants in certain areas (e.g., Baltac Beach), aquatic habitat restoration could be considered by planting macrophytes (Slagle & Allen, 2018). If this is considered, the effectiveness of macrophyte planting for aquatic habitat restoration should first be thoroughly investigated. Also, the acquisition of large numbers of appropriate plant propagules in a timely manner can be difficult, so maintaining healthy beds of aquatic plants should be a priority.

As an immediate first step to addressing the conservation needs of macrophytes or native aquatic plants in Lake Windermere, the LWA should strongly consider ramping up educational efforts about the vital ecological health benefits provided by native aquatic plants. Education could include social media posts, presentations, developing a brochure for events, metal signage at public boat launch areas – all highlighting the critical importance of native aquatic plants to Lake Windermere's ecological health. In order to have a healthy lake, it's imperative to maintain the primary producers (e.g., native aquatic plants) in Lake Windermere, while at the same time find a way to balance economic and social interests. "Because macrophyte communities provide important benefits for humans, their conservation and restoration, where necessary, are important for human well-being" (Thomaz, 2021). It is also important to recognize that aquatic plants due pose a problem for some boaters at Lake Windermere. Energy should be directed towards attaining an integrated approach with long-term solutions to both aquatic plant problems faced by some recreational users, and towards the conservation needed of the diverse aquatic habitats containing submersed aquatic vegetation critical for lake health.

6. Acknowledgements

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Prepared by: This document is intended to provide adequate information to describe the aquatic invasive plant inventory that was completed on Lake Windermere in 2023. Please do not hesitate to contact the consulting biologist with any inquiries about this inventory and document.

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8. Appendices

Appendix 1. Results from the Lake Windermere shoreline surveys for aquatic invasive plants on September 12, 2023.

Site	AIS sampling location	Aquatic Plants Identified (ranked in order of abundance in the pull)	Observations/Notes
Baltac Beach	Launch (Public Boat Launch) UTM: 0570747; 5593610	**Pull 1:** *Chara sp.* **Pull 2:** *Chara sp.*	nearly bare ground, gravel substrate. Layer of periphyton noted on rocks.
	South 1 (25m) UTM: 0570749; 5593585	**Pull 1**: No plants. **Pull 2:** *Chara sp.*	Few fragments of Chara on second rake pull.
	South 2 (50m) UTM: 0570757; 5593564	**Pull 1**: No plants. **Pull 2:** *Chara sp.*	One fragment of Chara on second rake pull.
	South 3 (75m) UTM: 0570774; 5593545	**Pull 1:** No plants **Pull 2**: No plants	Bare ground, gravel substrate.
	North 1 (25m) UTM: 0570738; 5593634	**Pull 1:** *Chara sp., Myriophyllum sp.* **Pull 2:** *Chara sp.*	Active excavator work on shoreline. Came from private property adjacent to the shore.
	North 2 (50m) UTM: 0570724; 5593661	**Pull 1:** No plants. **Pull 2**: *Chara sp.*	Small fragment of plants on second pull. Primarily bare ground.
	North 3 (75m) UTM: 0570711; 5593678	**Pull 1:** *Chara sp.* **Pull 2:** *Chara sp.*	Few small fragments on each rake pull.
Fairmont Side Channel	Boat launch UTM: 0580438; 5577293	**Pull 1:** *Potamogeton sp.*(likely *P. vaginatus), Chara sp.* **Pull 2:** *Potamogeton sp.*(likely *P. vaginatus), Chara sp.*	Outhouse, picnic tables, garbage cans. Plant diversity and abundance looks the same as previous years.
	South 1 (25m) UTM: 0580421; 5577270	**Pull 1:** Chara sp., *Potamogeton sp.(likely P. vaginatus), Potamogeton richardsonii.* **Pull 2:** *Chara sp., Potamogeton sp.(likely P. vaginatus), Najas sp., Elodea canadensis.*	Plant diversity and abundance looks the same as previous years. Could not go further south to sample; private property. Did not sample here 2015-2022.
	North 1 (25m) UTM: 0580451; 5577311	**Pull 1:** *Potamogeton sp. (likely P. vaginatus), Chara sp., Potamogeton richardsonii.* **Pull 2:** *Potamogeton sp. (likely P. vaginatus), Chara sp., Potamogeton richardsonii.*	Plant diversity and abundance looks the same as previous years.
	North 2 (50m) UTM: 0580451; 5577335	**Pull 1:** *Chara sp., Potamogeton richardsonii, Potamogeton sp.*(likely *P. vaginatus),* **Pull 2:** *Chara sp., Potamogeton richardsonii, Elodea canadensis*	
End of Ruault Road	UTM: 0572637; 5587668	**Pull 1:** *Chara sp., Potamogeton richardsonii* **Pull 2:** Myriophyllum sp., *Chara sp.*	
	North 1 (25m) UTM: 0572620; 5587677	**Pull 1:** *Chara sp., Myriophyllum sp., Potamogeton robbinsii, Potamogeton richardsonii.* **Pull 2:** *Chara sp., Potamogeton robbinsii.*	Bed of bullrush does not allow for rake toss at 50m or 75m N.

	South 1 (25m) UTM: 0572658; 5587659	**Pull 1**: *Chara sp., Potamogeton sp. (short/narrow leaves), Myriophyllum sp.* **Pull 2:** *Potamogeton sp. (short/narrow leaves).*	I small fragment of each plant pulled up. Empty mussel shell on rake during Pull 1.
	South 2 (50m) UTM: 0572682; 5587653	**Pull 1**: No plants. **Pull 2:** No plants.	
	South 3 (75m) UTM: 0572704; 5587640	**Pull 1**: No plants. **Pull 2:** No plants.	1 empty mussel shell pulled up on rake. Could see several additional empty mussel shells on lake bottom, about 6-8m offshore.
Unofficial boat launch near Bayshore Condos	Boat Launch UTM: 0569395; 5595026	**Pull 1:** No plants. **Pull 2:** *Myriophyllum sp.* (1 fragment)	Gravel/rocky substrate. Several boats moored in area with many buoys.
	North 1 (25m) UTM: 0569388; 5595050	**Pull 1**: No plants. **Pull 2:** No plants.	Gravel/rocky substrate. Several boats moored in area with many buoys.
	North 2 (50m) UTM: 0569372; 5595074	**Pull 1**: *Chara sp., Najas sp., Myriophyllum sp., Elodea canadensis, Potamogeton richardsonii, Potamogeton robbinsii, Potamogeton pectinatus, Potamogeton sp. (short/narrow leaves), Potamogeton natans.* **Pull 2:** *Chara sp., Elodea canadensis, Potamogeton richardsonii, Najas sp., Potamogeton sp. (short/narrow leaves).*	Gravel/rocky substrate. Several boats moored in area with many buoys. No plants detected here last year.
	North 3 (75m) UTM: 0569359; 5595089	**Pull 1:** *Chara sp., Najas sp., Potamogeton sp. (short/narrow leaves), Potamogeton robbinsii.* **Pull 2***: Chara sp., Potamogeton sp. (short/narrow leaves).*	1 empty mussel shell pulled up on rake
	South 1 (25m) UTM: 0569391; 5595004	**Pull 1:** No plants. **Pull 2:** No plants.	No plants last year either.
	South 2 (50m) UTM: 0569392; 5594980	**Pull 1:** No plants. **Pull 2:** No plants.	
	South 3 (75m) UTM: 0569396; 5594957	**Pull 1:** *Chara sp., Najas sp., Utricularia sp.*. **Pull 2:** *Chara sp., Najas sp., Potamogeton sp. (short/narrow leaves).*	
Athalmer/ Pete's Marina	Boat launch UTM: 0569522; 5596331	Pill 1: *Chara sp., Elodea canadensis, Myriophyllum sp.* Pull 2: *Myriophyllum sp., Elodea canadensis, Potamogeton richardsonii*	
	North 1 (25m) UTM: 0569525; 5596357	**Pull 1:** *Najas sp., Chara sp., Potamogeton sp. (short/narrow leaves), Elodea canadensis, Myriophyllum sp., Potamogeton richardsonii.* **Pull 2:** *Najas sp., Chara sp., Potamogeton sp. (short/narrow leaves), Elodea canadensis, Potamogeton richardsonii.*	
	North 2 (50m) UTM: 0569514; 5596380	**Pull 1:** *Chara sp., Najas sp., P. richardsonii, Elodea canadensis..* **Pull 2:** *Najas sp., Chara sp., Elodea canadensis, P. richardsonii, Myriophyllum sp., Potamogeton pectinatus.*	
	North 3 (75m) UTM: 0569508; 5596407	**Pull 1***: Chara sp., Najas sp., Potamogeton richardsonii, Potamogeton pectinatus.* **Pull 2:** *Chara sp., Najas sp., , Potamogeton pectinatus.*	Submergent beds of aquatic plants at the docks of Pete's Marina are noticeably smaller then previous years of aquatic plant sampling. Orange-colored film on sediment surface; low water.

	South 1 (25m) UTM: 0569537; 5596346	**Pull 1:** *Chara sp., Potamogeton richardsonii, Najas sp., Myriophyllum sp.* **Pull 2***: Chara sp., Najas sp., Potamogeton richardsonii, Potamogeton sp. (short/narrow leaves), Myriophyllum sp., Utricularia sp.*	Empty mussel shells found on ground.
	South 2 (50m) UTM: 059537; 5596333	**Pull 1:** *Chara sp., Myriophyllum sp., Najas sp., Potamogeton pectinatus, Potamogeton richardsonii, Hippuris vulgaris. Pull 2: Chara sp., Myriophyllum sp., Najas sp., Ranunculus aquatilis, Potamogeton richardsonii*	Spawning area for Kokanee salmon.

Appendix 2. Results from the rake pulls conducted during offshore aquatic invasive plant inventories at 11 survey stations on Lake Windermere, on October 6, 2023**.**

Site Name	GPS coordinates (UTM Easting; Northing)	Rake Pull # or transect survey	Aquatic Plant Species	Notes/Observations/Additional species
Lakeshore Resort	574815; 5586589	1	*Chara sp., Najas sp., Elodea canadensis*	
	574815; 5586589	2	*Chara sp.*	freshwater sponge
		100m transect	No additional plant species seen.	
	574722; 5586647	1	*Chara sp.*	2 empty mussel shells
	574722; 5586647	2	*Chara sp., Utricularia sp.*	freshwater sponge
Ruault Road	573050; 5587269	1	*Myriophyllum sp.*	Abundant bed of native milfoil at this site.
	573050; 5587269	2	*Myriophyllum sp., Ceratophyllum demersum (1 fragment)*	
		100m transect	*Potamogeton praelongus, Potamogeton natans, Utricularia sp., Potamogeton pectinatus*	
	573036; 5587301	1	*Myriophyllum sp., Potamogeton natans, Elodea canadensis, Potamogeton pectinatus, Megalodonta beckii, Hippuris vulgaris*	
	573036; 5587301	2	*Elodea canadensis, Myriophyllum sp., Potamogeton natans*	
Indigenous Beach	572532; 5588986	1	No plants.	sandy bottom
	572532; 5588986	2	No plants.	
		100m transect	No plants, bare ground.	Sparse accounts on Chara at this site during 2022 surveys.
	572475; 5589056	1	*Chara sp.* (1 fragment)	
	572475; 5589056	2	No plants.	
Trethewey Docks	571764; 5589637	1	*Chara sp., Potamogeton robbinsii, Myriophyllum sp.*	Primarily bare ground. Sparse plants. Sandy bottom.
	571764; 5589637	2	*Chara sp., Elodea canadensis*	Decomposed floating stems of P.natans
		100m transect	No additional plant species seen. Sandy substrate; mainly bare ground.	
	571730; 5589751	1	*No plants.*	
	571730; 5589751	2	*Chara sp.*	Small amount of *Chara sp. Chara around docks had thick, crusty coating of sediment.*
Akisknook Docks	571292; 5591441	1	*Myriophyllum sp.*	
	571292; 5591441	2	*Myriophyllum sp., Chara sp.*	
		100m transect	Deep water, could not see lake bottom during transect.	
	571251; 5591549	1	*Myriophyllum sp., Potamogeton praelongus, Elodea canadensis, Potamogeton robbinsii*	Abundant bed of native milfoil at this site.
	571251; 5591549	2	*Myriophyllum sp., Potamogeton praelongus, Elodea canadensis*	Abundant bed of native milfoil at this site.
End of Coy Road	570193; 5590753	1	*Chara sp. (small amount).*	Mainly bare ground at this site.
	570193; 5590753	2	*Chara sp., Potamogeton robbinsii* (1 fragment)	

		100m transect	*Myriophyllum sp., Potamogeton pectinatus, Potamogeton natans, Potamogeton richardsonii*	
	570242; 5590709	1	*Potamogeton natans, Potamogeton richardsonii, Chara sp., Myriophyllum sp., Elodea canadensis*	
	570242; 5590709	2	*Potamogeton natans, Myriophyllum sp., Potamogeton richardsonii, Chara sp., Potamogeton sp. (short/thin species)*	
Baltac Beach	571148; 5593366	1	*Chara sp.*	Some crusty sediment on plants.
	571148; 5593366	2	*Chara sp.*	Small amount of *Chara sp.*
		100m transect	No additional plant species seen. Too deep to see lake bottom.	
	571109; 5593415	1	*Chara sp.*	1 fragment of *Chara sp.*
	571109; 5593415	2	*Chara sp.*	Few fragments of *Chara sp.* Mainly bare ground.
Lakeview Meadows/Timber Ridge	570206; 5594102	1	*Myriophyllum sp., Potamogeton richardsonii.*	Abundant bed of native milfoil at this site.
	570206; 5594102	2	*Myriophyllum sp., Elodea canadensis*	
		100m transect		Dense beds of Myriophyllum interspersed with patches of bare ground.
	570212; 5594158	1	No plants.	
	570212; 5594158	2	*Elodea canaadensis.*	
Unofficial boat launch near Bayshore Condos	569427; 5595064	1	*Chara sp., Potamogeton pectinatus, Najas sp..*	
	569427; 5595064	2	*Chara sp., Najas sp.*	
		100m transect	Deep water, could not see lake bottom during transect.	
	569416; 5595117	1	Chara sp.	A few fragments of Chara.
	569416; 5595117	2	Chara sp.	
Althalmer/Pete's Marina	569571; 5596238	1	*Chara sp., Myriophyllum sp., Hippuris vulgaris, Potamogeton sp (long/thin leaves), Potamogeton richardsonii, Najas sp.*	freshwater sponge, aquatic moss
	569571; 5596238	2	*Chara sp., Potamogeton sp (*long/thin leaves*), Myriophyllum sp., Potamogeton sp.* (short/thin/flat leaves)*, Najas sp.*	aquatic moss
		100m transect	*Potamogeton pectinatus, Potamogeton praelongus*	
	569552; 5596364	1	*Chara sp., Myriophyllum sp.*	
	569552; 5596364	2	*Chara sp., Elodea canadensis, Najas sp.*	aquatic moss