

Spatial Survey of Aquatic Plants in Charlie Lake August 17, 2016

by

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SUMMARY

This report summarizes the results of an aquatic plant survey that was done in Charlie Lake on August 17, 2016 by volunteers from the Charlie Lake Conservation Society and staff from the Ministry of Forests, Lands and Natural Resources Operations. A similar survey was done in 2014 and with this one they represent the first time aquatic plant distribution was quantified spatially in Charlie Lake using GPS technology to map the distribution. This survey supports the findings from the 2014 survey, as well as more qualitative mapping done by Mr. Bob Ohland pre-1980's, that aquatic plants are widespread along the littoral zone in Charlie Lake. Although there are dissentive narratives by many residents around Charlie Lake on the timelines and quantity of aquatic plants, Charlie Lake is a very eutrophic (highly productive) body of water and will very likely continue to support dense plant and algal growth, as well as high production of all forms of aquatic life. The Charlie Lake Conservation Society hopes to use this and other projects to continue to educate residents about the ecology of Charlie Lake as well as promote good stewardship of its ecosystem. This survey was made possible through a grant from the Habitat Conservation Trust Fund (HCTF). Our society applied for and received funds from the Public Conservation Assistance Fund (PCAF), which is an envelope of HCTF that provides small grants to organizations and individuals who have a conservation project in mind but need financial help to make it happen (<http://www.hctf.ca/apply-for-funding/pcaf-grants>).

BACKGROUND

Charlie Lake is one of the most productive lakes in BC. Its high productivity manifests itself every year as large blooms of algae and aquatic plants. Although these blooms are not detrimental to the ecology of the lake, they do impact human recreational activities such as swimming, boating, water and visual quality. Quantitative analysis of core sediments collected from the bottom of Charlie Lake indicate that this lake has been productive long before extensive human development existed on the lake. The best available report that provides detailed and scientific analysis of the limnology of Charlie Lake is one by French and Carmichael (1999). Among the many data and conclusions they provide, regarding the high productivity of Charlie Lake they conclude that:

- 1. It is highly probable that Charlie Lake is naturally eutrophic (highly productive).*
- 2. There is evidence that human settlement in the watershed has increased phosphorous loading rates to the lake, thereby increasing algal abundance.*

The extent and relative abundance of aquatic plants reported by residents around the lake is mostly based on oral history. Consequently, the reported abundance and timeline is highly variable because it is based on memory and description by various residents. The only attempted effort to quantify aquatic plants that we are aware of,

is a descriptive survey by Mr. Bob Ohland. Bob was a long time resident on Charlie Lake and an avid fisherman as well as a passionate observer of everything that happened in and around Charlie Lake. The map of Bob's observations on the extent of the visible aquatic plant distribution in Charlie Lake is included here in Figure 1. According to Bob's map, aquatic plants were widely distributed in Charlie Lake and their distribution is not very different from what we report in this survey and a previous one done in 2014 (Baccante and Kosugi, 2014).

In the mid-1990's, Mr. Bob Ohland repeatedly expressed concerns that he felt aquatic plants had greatly diminished in abundance from what he had observed historically. His, and other residents' theory, was that the the City of Ft St John had built a weir at the outlet of Charlie Lake, thus raising the water level about 1 meter on average, and this increase resulted in a shifting of light penetration as well as increased sedimentation from shoreline erosion which impacted negatively the growth of aquatic plants. This theory was never supported by data, but subsequent increases in aquatic plants about 20 years later, was thought to be due to the re-establishment of aquatic plants in a new and stabilized water level regime.

These observations and theories are worth mentioning because they may represent what actually happened, but in the absence of quantifiable historical documentation, we are left to speculate on what may have actually happened. Oral reports by many individuals vary significantly among each other, thus making it difficult to use them as reference points.

Figure 1: Pre-1980 aquatic plant distribution as mapped by Bob Ohland.



ACTIVITIES AND OBSERVATIONS

The Charlie Lake Conservation Society (CLCS) has been very active over the years in providing a leadership role in educational and stewardship activities on Charlie Lake and its watershed. Because of the high amount of interest by lakeshore residents in Charlie Lake and its ecosystem, and particularly the algal and plant bloom we observe annually, the CLCS, in partnership with the Ministry of Forests, Lands and Natural Resources Operations (FLNRO) has conducted a spatial survey of aquatic plants in 2014 and again in 2016. These were done in an attempt to quantify the extent of aquatic plant distribution as well as documenting the plant species, to document the possibility of non-native plants which in many cases can be invasive and detrimental to native plants, and subsequently impact the ecology of the lake.

On August 17, 2016, a number of CLCS volunteers and FLNRO staff used a boat to cruise the shoreline and with a GPS record the track and waypoints to mark the visible edge of emergent aquatic plants. This was the same methodology used in the 2014 survey. The weather was sunny and clear with no wind, thus the water surface was very calm. The water temperature was 20° Celsius. The species of plants observed were:

- *Potamogeton berchtoldii* (Small Pondweed)
- *Potamogeton praelongus* (White Stemmed Pondweed)
- *Potamogeton robbinsii* (Robbins' Pondweed)
- *Callitriche palustris* (Vernal Water-starwort)
- *Myriophyllum sibiricum* (Northern Water milfoil)
- *Potamogeton zosteriformis* (Flat-stem pondweed)
- *Lemnoideae* (Duckweed)
- *Sagittaria* sp. (Arrowhead)

All of these plants are native, and there were no invasive plants identified. As a visual reference, photos some of these plants are shown in Figure 2. The extent of the emergent aquatic plant distribution observed in 2016 is shown for the whole lake in Figure 3. Figures 4-6 show the same thing but at a larger scale for the North, Central and South portions of the lake. In all figures the 2014 survey data is also shown for comparison. The 2016 distribution is larger than in 2014, but that's not surprising because the survey was done about a month later in the summer, when more plants would be visible. However it is interesting that the results from 2014 and 2016 both suggest that the distribution of aquatic plants is not very dissimilar from the map

compiled by Bob Ohland, without the aid of a GPS. Without the benefit of other data it may be argued that over the time period represented by these maps, the distribution of aquatic plants may not have changed significantly. However, we can't say a lot about the year-to-year variation that may have occurred during that time period.

Figure 2: Samples of aquatic plants from Charlie Lake.

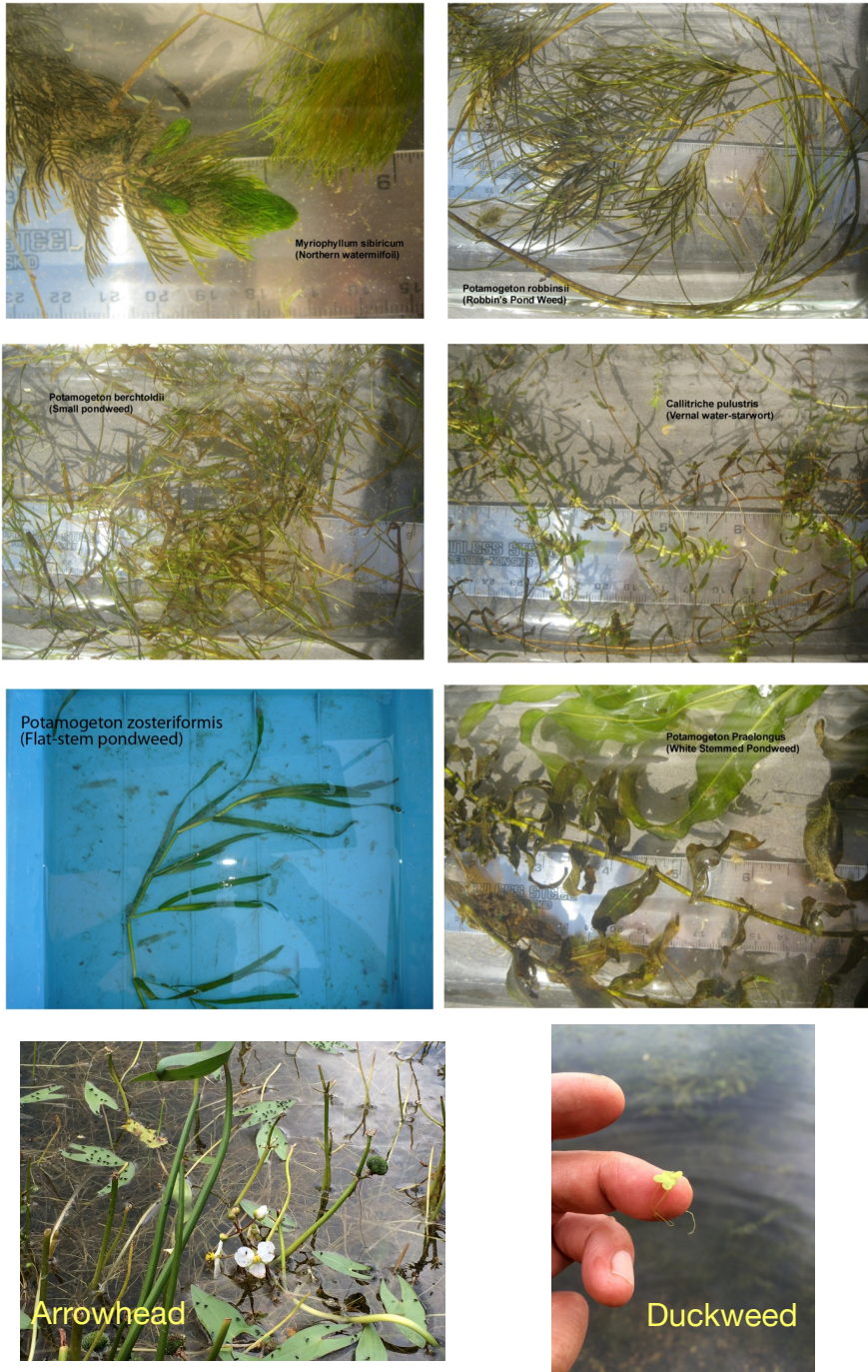


Figure 3: Map of Charlie Lake showing the edges of dense, emergent aquatic plants.

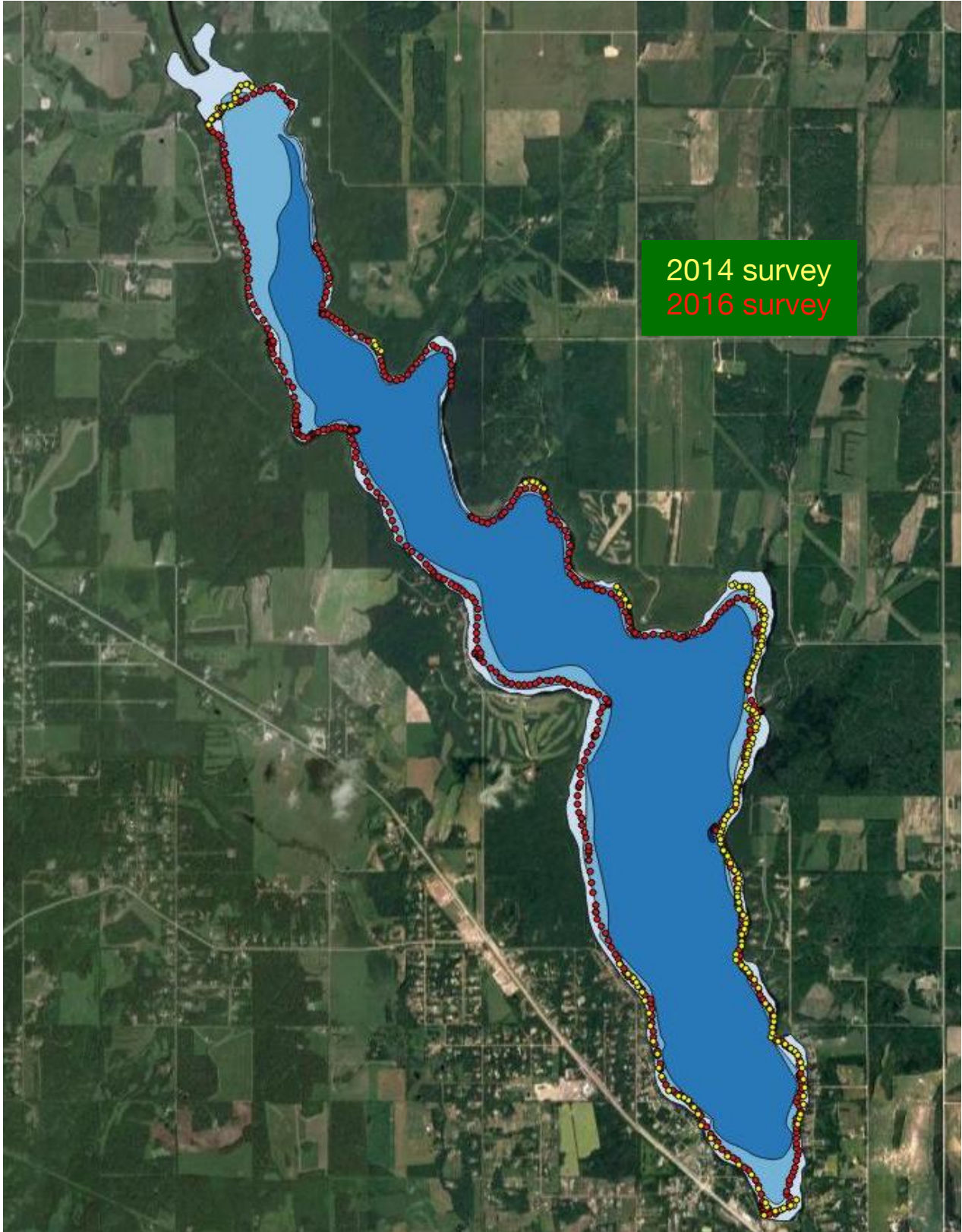


Figure 4: North Sector of Charlie Lake showing the edges of emergent aquatic plants.

Charlie Lake, B.C. North Sector

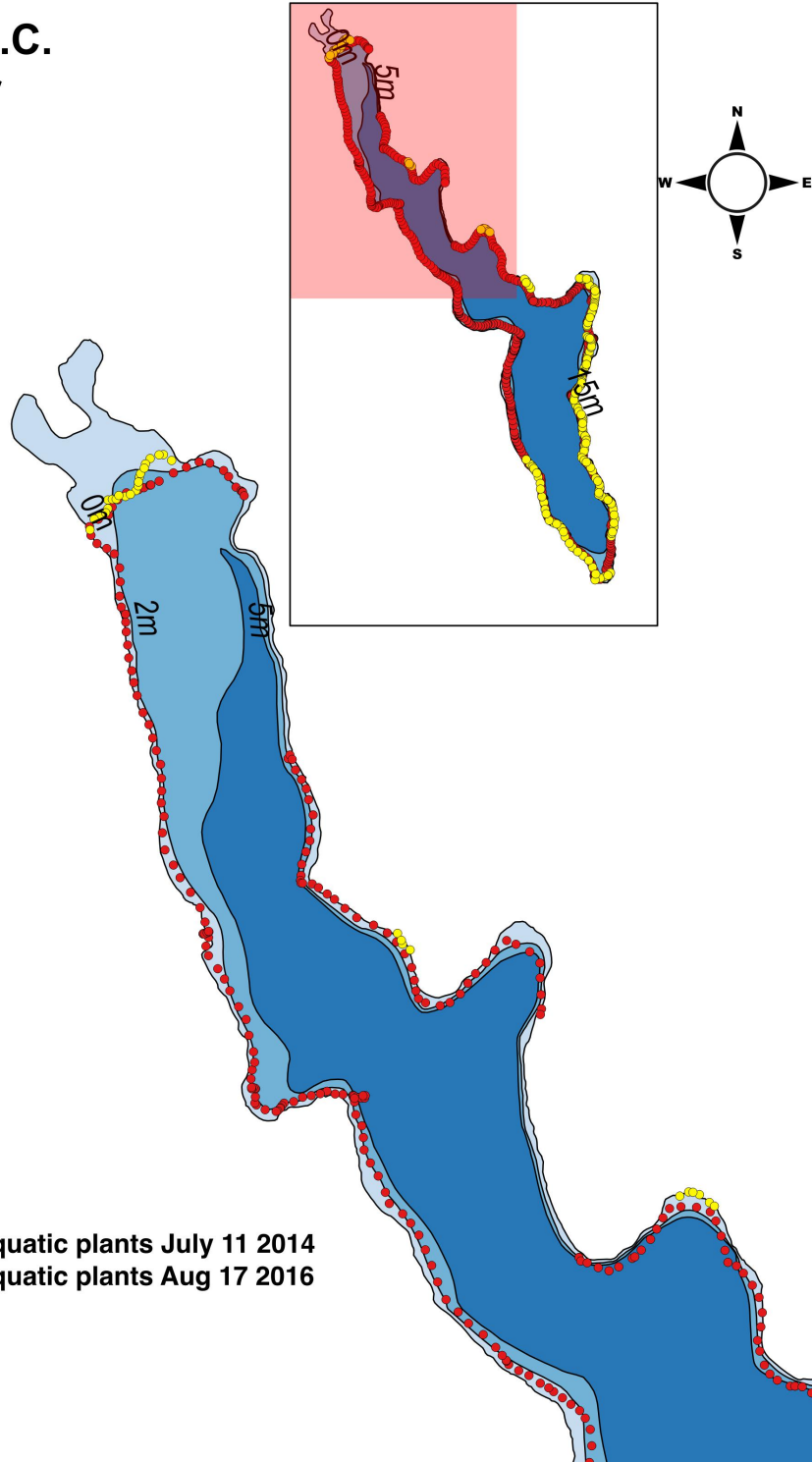


Figure 5: Middle Sector of Charlie Lake showing the edges of emergent aquatic plants.

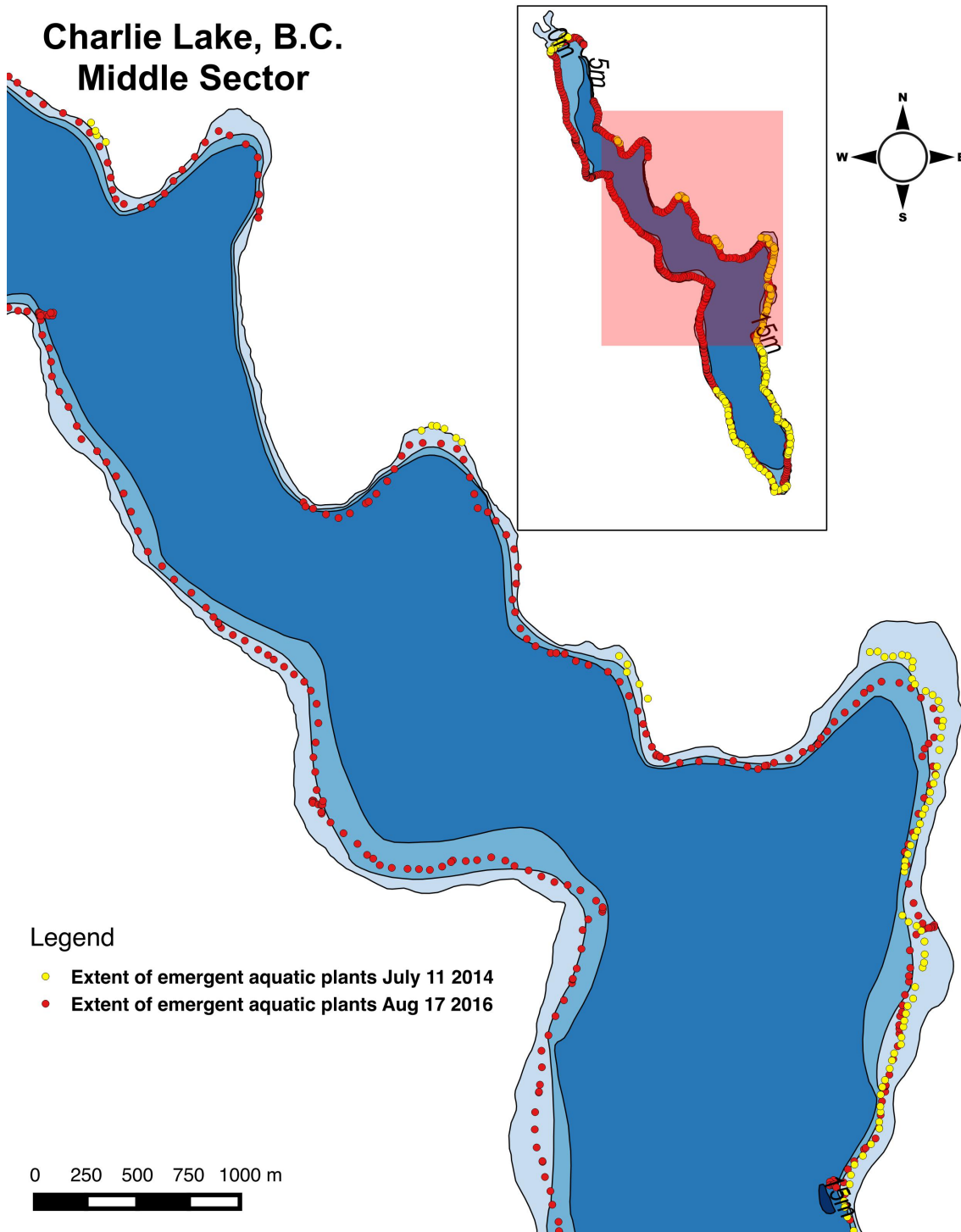
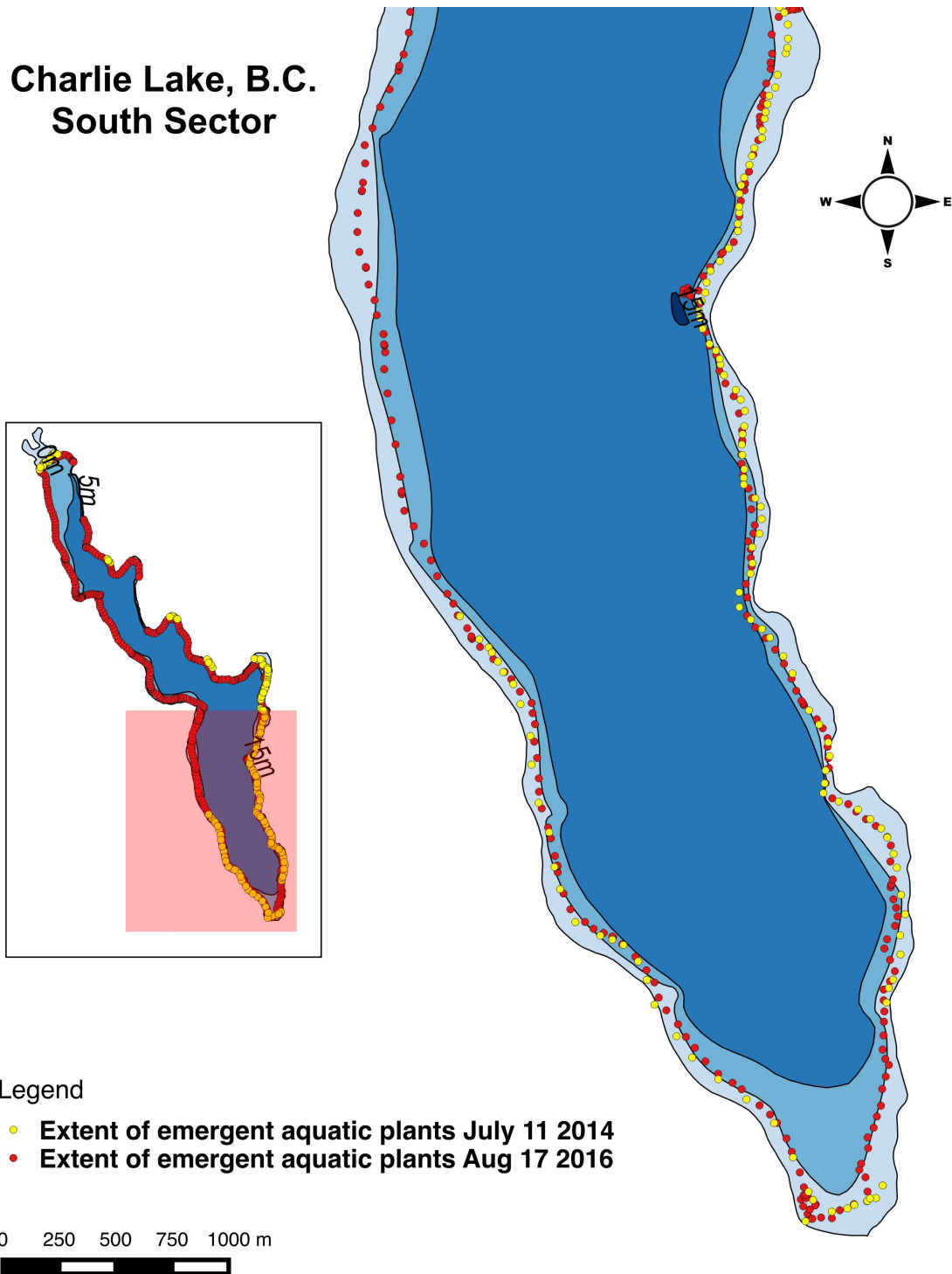


Figure 6: North Sector of Charlie Lake showing the edges of emergent aquatic plants.



ADDITIONAL RELEVANT INFORMATION

Another important feature of Charlie Lake that makes it so productive, is the high relative volume of the photic or euphotic zone. This is defined as the portion of the lake where light from the sun penetrates to a depth at which photosynthesis can occur. It extends from the surface down to a depth where light intensity falls to one percent of that at the surface, called the euphotic depth (https://en.wikipedia.org/wiki/Photic_zone).

The rule of thumb is that photic zone is about twice the depth of the Secchi disc, which is a quick and rough way to measure light penetration. In Charlie Lake the Secchi disc depth usually averages around 2.5 meters (Figure 7). This translates into a photic zone which extends to the 5 meter depth contour. Figure 8 shows the extent of the photic zone represented by the 5 meter depth contour. However it is important to remember this is a 2-dimensional representation but there's a volume of water associated with this map. The volume of Charlie Lake has been previously calculated and reported by French and Carmichael (1999) (see Appendix). Using their figures, the relative volume of each depth strata in Charlie Lake was calculated, and it turns out that the photic zone makes up about 70 percent of the whole lake volume (Figure 9). This is a very large portion of the lake where light penetrates and photosynthesis can occur. It is not surprising that Charlie Lake is so productive.

Figure 7: Secchi disc readings recorded in Charlie Lake.

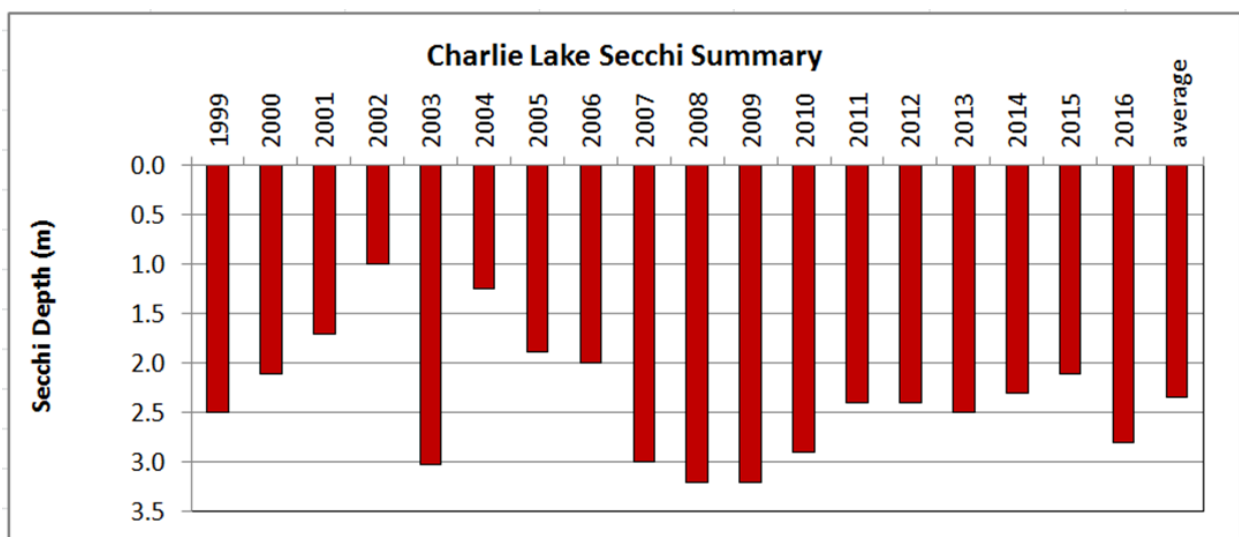


Figure 8: Extent of the photic zone in Charlie Lake shown in green.

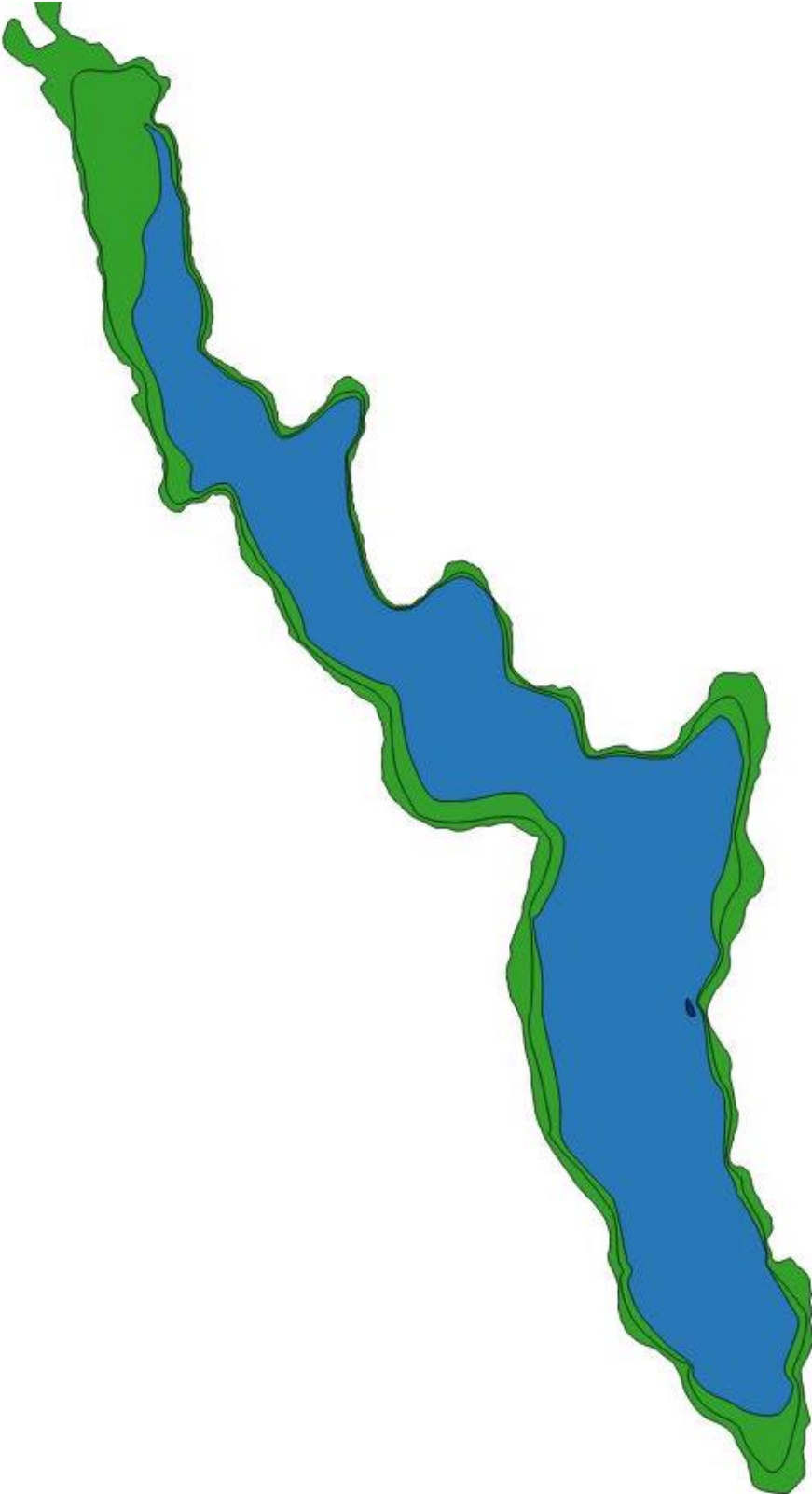
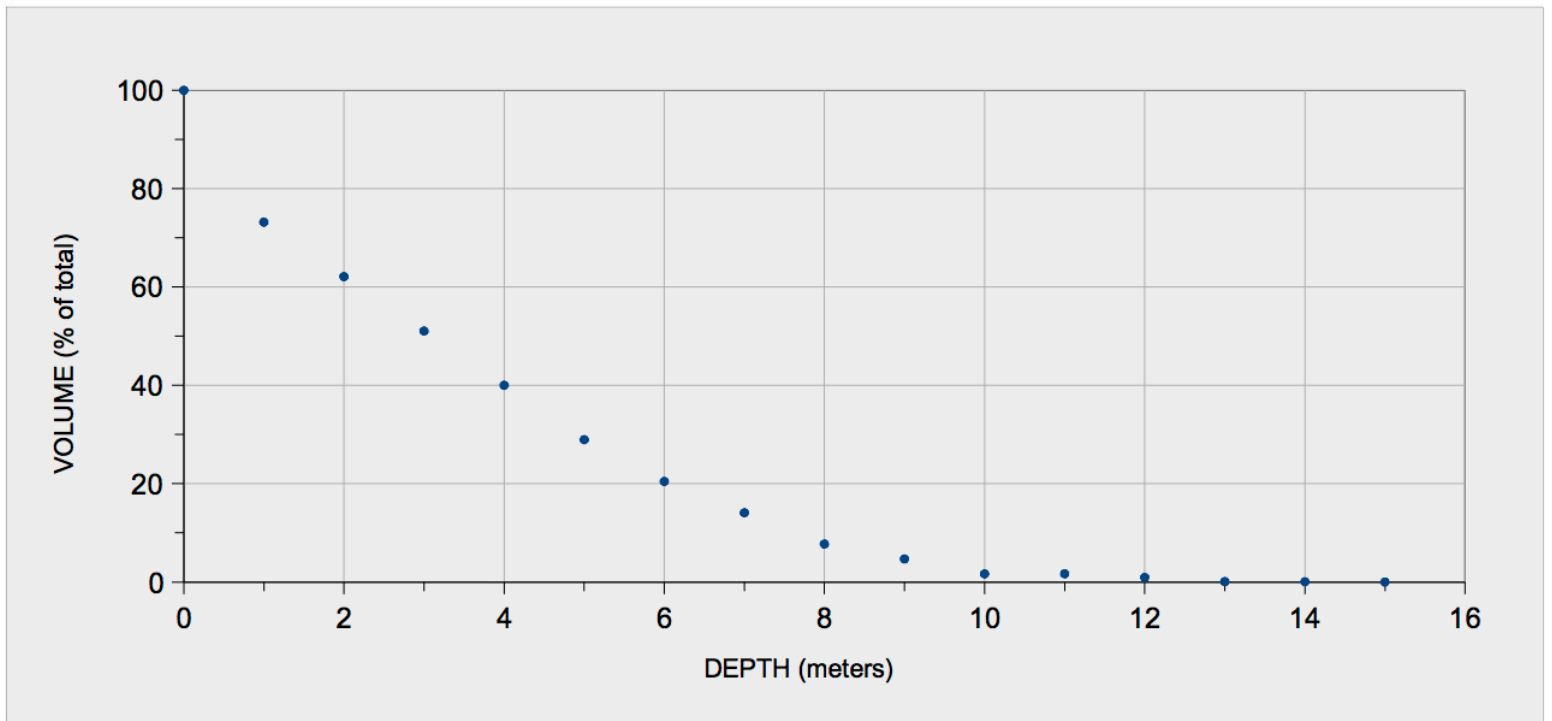


Figure 9: Volume of Charlie Lake at each meter depth (as a percent of total).



STEWARDSHIP ACTIVITIES

The mandate of the CLCS is:

To promote conservation efforts for Charlie Lake and its watershed by providing a forum for gathering, sharing and coordinating information for the purpose of developing a comprehensive management plan that will protect, preserve, enhance and support conservation efforts for Charlie Lake and its watershed to the benefit of all. CLCS also promotes and shares good science to support its activities and goals, and encourages all users of the lake to practice good resource stewardship.

Guided by its mandate, the CLCS and its volunteers have taken a leadership role in the community in fostering stewardship and educating residents on the ecology of Charlie Lake and all the potential impacts from human activities. This project has provided another opportunity to share what we learn with all those who enjoy Charlie Lake or are just interested in the issues that impact the lake and its watershed.

The CLCS participated in two, well-attended meeting in the community. The first meeting was held on November 16, 2016 and it was organized by a local company Dirty Dirt, who specializes in cleaning and remediating oil and gas sites. This company was interested in using microbes that are normally used to reduce organic content in small ponds and apply them to Charlie Lake with the intent of reducing organic content, and hopefully it would translate in clearer water and less algal blooms. The CLCS made a very detailed presentation on the ecology of Charlie Lake and we believe it helped to educate the public in attendance that this proposed treatment is way outside the scope of the intended results. Ultimately this proposal was abandoned.

Charlie Lake algae concerns addressed at public meeting

November 18, 2016 Jessica Fedigan News Comments Off



The Charlie Lake Hall was jam packed yesterday evening for a meeting regarding algae in Charlie Lake.

Image from <https://energeticcity.ca/2016/11/charlie-lake-algae-concerns-addressed-public-meeting/>

The second public meeting was organized by the CLCS and held on February 9, 2017. The purpose of this meeting was to promote the CLCS and the work of its volunteers, educate the public on the ecology of Charlie Lake and the issues that impact it, as well as provide a forum for thoughtful discussion. This was also an opportunity to showcase this and other projects by the CLCS.

Charlie Lake Conservation Society holds informative lake education meeting

🕒 February 14, 2017 👤 Jessica Fedigan 📁 News 💬 Comments Off



Image from (<https://energeticcity.ca/2017/02/charlie-lake-conservation-society-holds-informative-lake-education-meeting/>)

We believe that the efforts that the CLCS has put into these and other public meetings has fostered a better understanding and appreciation of Charlie Lake and its watershed. Exposing people to good science usually leads to more thoughtful discussions and avoids hasty decisions and actions that often lead to unintended

consequences. A more informed public is also a very desirable outcome for Government agencies responsible for the management of our resources, which usually leads to solutions based on reliable information, rather than based on unsupported opinions.

The CLCS will continue to be involved in activities that promote its mandate. Current discussions in the CLCS are focused on strategic directions for the Society, and this will help us in formulating new projects and activities that are relevant to current challenges.

ACKNOWLEDGEMENTS

Thanks to everyone from the CLCS and FLNRO who helped out on this project: Sheena Briggs, Katelyn White, Cali Seater, Audrey Gagné-Delorme, Bruce Kosugi, Bess Legault and Kim Cimini. Also thanks for Bruce Kosugi for providing constructive edits to this report as well as financial and other relevant information submitted to the PCAF as required by their conditions of funding.

LITERATURE CITED

Baccante, D.A. and B. Kosugi. 2014. Spatial survey of aquatic plants in Charlie Lake on July 11, 2014. 13 pages.

French, T.D. and N.B. Carmichael. 1999. Limnological aspects of Charlie Lake (Peace River drainage, British Columbia): A summary of data collected between 1974 and 1995. 115 pages.

APPENDIX

Water volume in Charlie Lake as calculated and reported by French and Carmichael (1999)

GEODETTIC ELEVATION (m)	DEPTH (m)	CALCULATED VOLUME (dam ³)	VOLUME (% OF TOTAL)
692	0	136839	100.0
691	1	100146	73.2
690	2	85012	62.1
689	3	69878	51.1
688	4	54744	40.0
687	5	39610	28.9
686	6	27980	20.4
685	7	19280	14.1
684	8	10579	7.7
683	9	6418	4.7
682	10	2256	1.6
681	11	2290	1.7
680	12	1267	0.9
679	13	140	0.1
678	14	70	0.1
677	15	0	0.0

5.2 MORPHOMETRY

From: French, T.D. and N. B. Carmichael (1999)

The water volume (storage, S) below any given depth contour (geodetic elevation, GE) can be computed with the following set of regression equations (Figure 6):

$$\text{When } GE \text{ is } > 686 \text{ m } S [\text{dam}^3] = 15,133.9 \times GE [\text{m}] - 10,357,379.3 \quad (24)$$

$$\text{When } GE \text{ is } 684\text{-}686 \text{ m } S [\text{dam}^3] = 8,700.5 \times GE [\text{m}] - 5,940,562.6 \quad (25)$$

$$\text{When } GE \text{ is } 682\text{-}684 \text{ m } S [\text{dam}^3] = 4,161.8 \times GE [\text{m}] - 2,836,091.8 \quad (26)$$

$$\text{When } GE \text{ is } 680\text{-}682 \text{ m } S [\text{dam}^3] = 1,023.1 \times GE [\text{m}] - 695,464.3 \quad (27)$$

$$\text{When } GE \text{ is } 677\text{-}680 \text{ m } S [\text{dam}^3] = 69.9 \times GE [\text{m}] - 47,322.3 \quad (28)$$

Having a maximum length of 15 km, a shoreline length of 38 km, a surface area of 19 km² and a volume of 136,839 dam³, Charlie Lake is considered to be a medium-sized lake. As are most naturally eutrophic lakes of glacial origin (Rawson 1955; Hutchinson 1957), Charlie Lake is shallow ($\bar{Z} = 7 \text{ m}$; $Z_m = 15 \text{ m}$). In reference to values given in Wetzel and Likens (1991), the relative depth of 0.3 suggests that the lake has little resistance to vertical mixing. Charlie Lake drains an area of about 281 km² (A_o not included).



Team Aquatic Plant Survey



PUBLIC MEETINGS TO PROMOTE THE CHARLIE LAKE CONSERVATION SOCIETY AND ITS PROJECTS

