Water Quality Assessment Report (TAR)
2023

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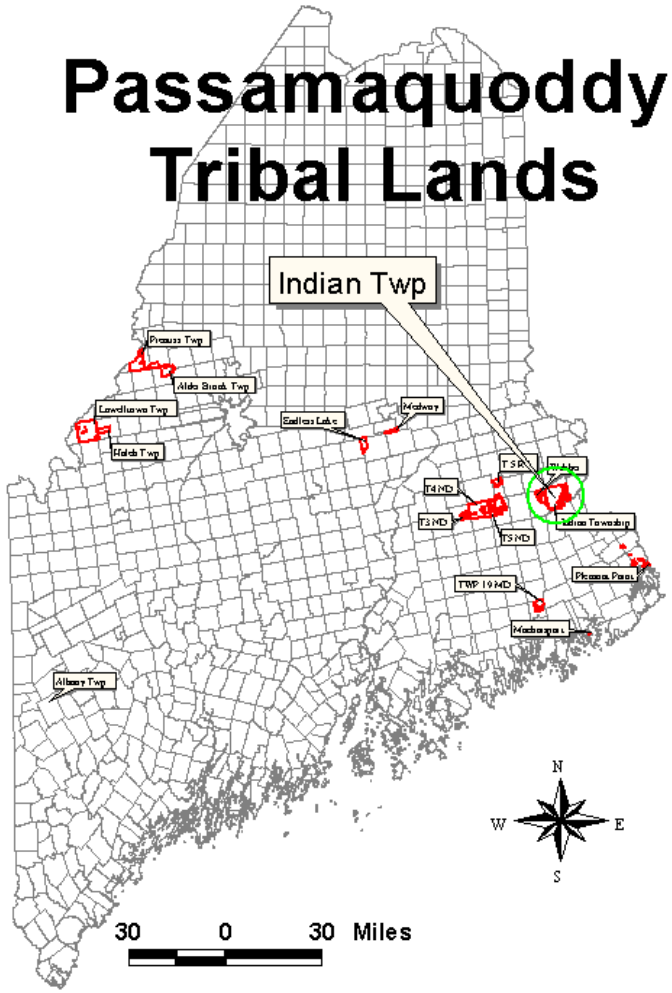


Figure 1: Location of Indian Township, Maine.

Introduction

Background

The Passamaquoddy Tribe at Indian Township (PIT) began its Water Resources Planning and Inventory Program in April 1993 with funding from a Multi-Media grant from the U.S. Environmental Protection Agency (US EPA), and a Bureau of Indian Affairs (BIA) Water Resources contract. The US EPA requires a Quality Assurance Project Plan (QAPP) as a prerequisite for funding of monitoring programs. The QAPP details the program's procedures for field work, transportation, data use, laboratory and field protocols, and safety. For data to be useful, procedures must be consistent and reliable. The QAPP is submitted to, reviewed, and approved by the US EPA for each year of monitoring.

Indian Township has a wealth of water resources. Bordering the southern edge of the Reservation is part of a long series of reservoirs controlled by Woodland Pulp LLC as part of the St. Croix River drainage. The Reservation waters include Big Lake, Long Lake, Lewey Lake, Grand Falls Flowage and its tributary Tomah Stream. These water bodies make up a significant section of the 647 mi^2 West Branch of the St. Croix River basin. Reservoir water levels are controlled and used for power generation, mill effluent dilution, fisheries, and flood control. Indian Township's lake levels are controlled at the Grand Falls Dam in Woodland. In addition to Tribal land inside Indian Township, the Passamaquoddy Tribe has in Trust over 115,000 acres distributed over 7 counties in the State of Maine.

Purpose

The Indian Township Water Quality Monitoring Program was undertaken to compile baseline data for reservation water bodies. Water quality is the biological, chemical, and physical composition of the water in its natural state, taking into account any human inputs and alterations. In order to protect water quality in the future, one must have an idea of the current water quality, the sources of pollution currently entering the system, and the trends of the system. Determining trophic state and water quality trends are nearly impossible without data to back up those determinations. A reliable, long term monitoring program can help identify problems before the degradation of water quality is irreversible. To further complicate the water quality issue, watersheds cross municipal, state, tribal and national boundaries. Reliable data can also provide the necessary scientific backing to elicit the political will to address pollution sources.

General Program Summary

We restarted the Water Quality Sampling Program in 2008 with sampling the original four Township lakes: Big Lake, Long Lake, Lewey Lake, and Grand Falls Flowage. The 2009 season built on this foundation by continuing sampling of the Township lakes, as well as adding in monthly sampling of 13 other lakes and ponds, most of which had been regularly sampled in the past. The 2010 Water Quality Sampling Season continued on our 2009 season with sampling of the same 17 lakes and ponds. In 2011 we continued to build on 2010 by adding in 4 more lakes: East and West Musquash Lake, Pleasant Lake, and West Grand Lake. We also added in sampling of a small pond known locally as Bassett Pond, which is evidently fishless, in the summer of 2013.

All those additions combined with slowly eroding budgets and, of course, inflation, have caught up to us. We were forced to cut back sampling to reduce costs and man hours. Bassett Pond, while interesting and unique, was given the axe for now. It would be best focused on with a special project. Shaw and Mill Privilege were also cut after just one visit in 2017, as the access is poor and causes damage to equipment. The three ponds in the Jackman area were also cut for now, as they require the most resources to get to for data gained. In 2021 sampling was scaled back to once a month instead of twice. Staffing limits and the emergence of variable-leaved water milfoil as a serious aquatic invasive issue in Big Lake has the Department reorganizing priorities. Starting in August of 2022 we again scaled down our water quality sampling regiment to prioritize invasive milfoil surveys: down from 16 lakes once a month to 6 lakes once a month. Big, Long, Lewey, Grand Falls, Side Pistol, and Killman were sampled May – September. The remaining lakes listed below only sampled May – July. 2023 completed the downsizing, limiting our water quality program to once a month testing on just Big, Long, Lewey, Grand Falls, Side Pistol, and Killman.

An updated look at our sampling lakes are as follows: **Big Lake**, **Long Lake**, **Lewey Lake**, and **Grand Falls Flowage** (the original four lakes to be sampled), **Side Pistol Lake** (drains into the Passadumkeag River, and eventually the Penobscot River), and **Killman Pond** (drains into Upper Chain Lake). If looked at the watershed level, five of our lakes and ponds sampled are part of the St. Croix River watershed, while only one remains (Side Pistol) included of the extensive Penobscot River watershed.

A full sampling regiment of parameters in 2023 includes the following: **Dissolved Oxygen** (DO), **Temperature**, **pH**, **Conductivity**, **Transparency** (Secchi depth), **Chlorophyll-a** (Chla), **Total Phosphorus** (TP), **Alkalinity**, and **True Color** analysis. Each one of those parameters will be explained in greater detail later on in the report.

Monthly Program Summary

May Our weather station on the reservation recorded about 1.9" of rain this month, compared to 2.4" of rain for May 2022, 3.6" for 2021, 3.4" for 2020, 4.90" for 2019, 2.20" for 2018, 4.75" for 2017, 2.75" for 2016. The season started a bit dry with two decent rain events in the month.

A full Quality Assurance Project Plan (QAPP) rewrite was completed and approved in May 2021 (which has a five year rotation), some slight adjustments were made to the QAPP for the 2023 season, mostly just the sampling sites and frequency changes mentioned earlier. Our 2020 16' boat was serviced in May and is running great, truck was serviced Oct 2022 and is running great. Ryan Gabriel returns for another season as our field assistant. Our yearly retraining with Lake Stewards of Maine happened in July. **(Sampling Events: (6/6): 100%)**

June Our weather station on the reservation recorded about 4.7" of rain for June 2023. For comparison, we had 2" of rain for June 2022, 2" for 2021, 2.75" for 2020, 7.3" for 2019, 5.0" for 2018, 1.9" for 2017, and 2.80" for 2016. Most of June seemed to be raining, or at least very overcast. It was a difficult month for field work, especially if you need sun. Water levels remain high. **(Sampling Events: 6/6: 100%)**

July All six sites were sampled on time and as expected in July. Our weather station on the reservation recorded 6.2" of rain for July 2023, which is quite high. This continues the trend of a very wet summer for 2023. Compare this to 4.3" for July 2022, 5.8" for 2021, 1.75" for 2020, 3.8" for 2019, 1.5" for 2018, 1.4" of rain in 2017, 3.8" of rain for July 2016. **(Sampling Events: 6/6: 100%)**

August was our best month of the summer so far; the driest and finally brought some sunshine. We did still have some rainfall at 3.95". We had 1.8" for August 2021, 2.6" 2020, 4.2" for 2019, 4.5" for 2018, only 1.0" of rain for August 2017, about 3.25" of rain for 2016. Water levels on the lakes were very high until August, some drier weather helped clear up the turbidity as well. **(Sampling Events: 6/6: 100%)**

September We had a dry August (for 2023) with just under 4" of rain. Water levels were coming down to a more seasonal depth, water clarity also peaked in response in late August. However, on Sept 16th the remnants of hurricane Lee dropped around 4" of rain, giving us a total of 7.05" for the month. In comparison 6.7" of rain fell in September 2021, 1.3" in 2020, 4.2" in 2019, 2.4" in 2018, 1.4" in 2017, 2.0" of rain for September 2016. This large jolt of precipitation flipped our water quality parameters on their head, taking secchi depths from 5+ meters in late August to 3+ meters in late September. True color values went from 30-40 pcu to 70-80 pcu in reservation lakes. Flushing dark water and sediment from tributaries into the main lakes is the likely culprit. **(Sampling Events: 6/6: 100%)**

Parameter Summary

In order to further measure our sampling success, the following shows each parameter sampled and its associated success rate (measured by valid samples taken/possible samples taken) not including quality control duplicate samples.

- **Dissolved Oxygen/Temperature Profiles:** 30/30 (100%) The 2023 season finished what 2022 and 2021 started: Going down to 6 lakes surveyed each once per month. We replace the ProDO probe tip every Spring and that's normally the only maintenance required. Our ProDO was upgrade to the newer model ProSOLO early in the season. These meters have both shown to be extremely accurate in DO and Temp readings and having a 40m cable allows us to take readings to the bottom of even the deepest lakes in the area.

- **Chlorophyll-a:** *26/30 (87%) One day's worth of samples (4) were not filtered over the weekend and ended up being discarded. In general the readings had a larger than usual range, perhaps being affected by the very wet field season, with fluctuating water levels on township lakes. Chl-a readings ranged from a low of <1.0 ppb (the reporting limit is 1ppb) on Side Pistol and Lewey once each, to a high of 8.0ppb (Grand Falls Flowage).

- **Transparency/Secchi:** 30/30 (100%) No secchi readings were missed in 2023. The secchi disk didn't hit bottom at all this season. We generally had higher water situations with more turbidity in 2023, with a low, clear water period in August. September 16th brought in hurricane Lee and a large amount of rainfall into an already saturated environment, causing large amounts of runoff. Secchi values were cut in half from late August to late September on township lakes. Secchi depth ranged from 3.15m (Long) in the shallowest to 6.80m (Side Pistol) at the deepest. Big Lake had an honorable mention with 6.15m on August 29th.

- **Total Phosphorus: ***30/30 (100%) No TP samples were missed in 2023, but a number of them were tested 1-2 days past the 28 day holding time by HETL. We've done all we can to get them there with 2+ weeks of time remaining but some are still getting flagged. Our TP range for 2023 was a low of 5ppb (Side Pistol) with a high of 15ppb (Grand Falls Flowage).

- **pH:** 30/30 (100%) No major issues to report. The refillable probe continues to be reliable. We emptied and flushed the old fluid at the start of the season, replacing it with fresh solution. Our pH low for the season was 6.72 (Grand Falls Flowage) and a high of 7.15 (Long).

- **Alkalinity:** 30/30 (100%) No additional samples were lost. No problems to report. Our low alkalinity reading for the season was 6.5 mg/l of CaCO3 (Side Pistol) with a high of 10.0 mg/l of CaCO3 (Grand Falls Flowage). These readings are very stable

from year to year, usually trending up slightly as the summer goes on. This season's steady rains kept the readings similar the entire season.

- **Conductivity:** 26/30 (87%) We lost one day of readings (4) due to a failed QA check at the end of the day. The meter seemed to be a bit less precise than past years, maybe it's nearing time to upgrade it. Our low conductivity reading was 19.6 UMHOS/cm (Side Pistol) with a high of 25.7 UMHOS/cm (Lewey).

- **Color:** 30/30 (100%) We didn't lose any true color readings for 2023. Our lowest true color reading was 7 PCU (Side Pistol Lake), with a high reading of 80 PCU (Grand Falls Flowage). While Side Pistol kept consistent single digit color values in the wet 2023 season, township lakes did not. Values that were in the 30s in August jumped to 70-80 a month later in late September due to hurricane Lee's precipitation on Sept 16th, 2023.

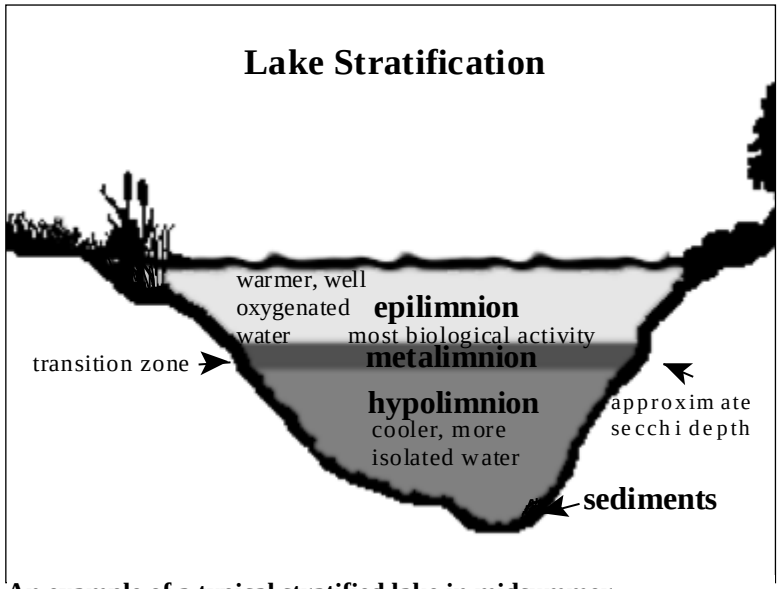
General Information

Stratification

Holdren et al (2001) defines stratification as a process in which several horizontal water layers of different density form in some lakes. These layers are classified as follows:

Epilimnion – the well-mixed and uniformly warm surface waters
Hypolimnion – the uniformly unmixed bottom waters
Metaliminion - zone of rapidly changing temperature and density separating the epilimnion and the hypolimnion

The lake is stratified when warm water, the epilimnion, floats on the significantly colder water, the hypolimnion. The metalimnion is formed in the region where the temperature gradient decreases markedly. This separation also allows little mixing of the upper layer with the bottom waters. After stratification, the hypolimnion has a finite quantity of oxygen until fall turnover.



An example of a typical stratified lake in midsummer.
Hill, R., Williams, S. 2008 Maine Lakes Report

Dissolved Oxygen

Dissolved Oxygen (D.O.) is the measure of the amount of oxygen dissolved in the water. All living organisms, except for certain types of bacteria, need oxygen to survive. Organisms living in the water have the ability to use the oxygen dissolved in the water to breathe. Too little oxygen severely reduces the diversity and population of aquatic communities. Therefore the amount of D.O.in the water is very important to aquatic life. Low oxygen can directly kill or stress organisms such that they will not be able to successfully reproduce or grow. Water with less than 1 part per million (ppm) of oxygen is considered anoxic (no oxygen present); less than 5 ppm of oxygen is generally considered so stressful that most coldwater fish will avoid these areas. Anoxic conditions can also promote TP release from sediments (VLMP, 2008 Maine Lakes Report).

Chlorophyll-a

A pigment found in algae and other plants used to estimate biological productivity of lake ecosystems. By measuring the concentration of Chl-a in lake water, the algae population can be estimated. Chl-a is measured in parts per billion (ppb). Chlorophyll-a samples are generally obtained from an integrated water column sample because the greatest concentration of algal growth typically occurs from the surface of the lake to the bottom of the epilimnion or the top of the thermocline (VLMP, 2008 Maine Lakes Report).

Chlorophyll is what makes plants green. Some nice Spring poison ivy with fresh green leaves and flowers. The flowers often open before the leaves come out.

Transparency

A measure of water clarity; the distance one can see down into the water column. Factors that affect transparency include algal growth, zooplankton, natural watercolor, and suspended silt particles. Because algae are the most abundant particles in most lakes, transparency indirectly measures algal growth. Transparency values vary widely in Maine lakes. Unless a lake is highly colored or turbid from suspended sediment, transparency readings of 2 meters or less generally indicates a severe algal bloom (VLMP, 2008 Maine Lakes Report).

Situations like a blocked culvert shown here cause water to run over roads, picking up sediments that will reduce a lake's transparency.

Total Phosphorous

A measure of all forms of phosphorus (organic and inorganic) in the water. Phosphorus is one of the major nutrients needed for plant growth. Because its natural occurrence in lakes is very small, phosphorus "limits" the growth of algae in lake ecosystems. Small increases in phosphorus in lake water can cause substantial increases in algal growth.

Phosphorus is measured in parts per billion (ppb). Phosphorus concentrations may be based on samples taken from the surface of the lake or from discrete samples taken at specific depths, or from an integrated water column (epilimnetic core) sample (VLMP, 2008 Maine Lakes Report).

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Manure is great for plants, but the nitogren and phosphorus it contains is not good for the health of our waters.

pH

A measure of the relative acid-base status of lake water, pH helps determine which plant and animal species can live in the lake, and it governs biochemical processes that take place. The pH scale ranges from 0-14, with 7 being neutral. Water is increasingly acidic below 7, and increasingly alkaline above 7. A one unit change in pH represents a tenfold change in acidity or alkalinity. The pH scale is the inverse log of the hydrogen ion concentration (VLMP, 2008 Maine Lakes Report).

Some plants prefer different levels of soil pH. This iris likes it a bit acidic with lots of moisture.

Alkalinity

A measure of the capacity of water to neutralize acids, or buffer against changes in pH, alkalinity is also referred to as "buffering capacity." It is a measure primarily of naturally available bicarbonate, carbonate, and hydroxide ions in the water. Alkalinity is measured in milligrams per liter (mg/l) (VLMP, 2008 Maine Lakes Report).

Too much acidity eats away at the shells of things like big mama snapping turtle here, or clams, mussels, and snails.

Specific Conductance

A measure of the ability of water to carry an electrical current, conductivity is directly related to the level of dissolved ions in the water. Conductivity levels will generally increase if there is an increase in the concentration of pollutants in the water. Conductivity is measured in micro-siemens per centimeter (µS/cm) or micro-mhos per centimeter (or µmhos/cm) (VLMP, 2008 Maine Lakes Report).

Our remote floating lake 'lab' hard at work. Testing around the West Branch of the St Croix every summer.

Color

The concentration of natural, dissolved, humic acids in lake water, organic "Humic" acids leach from vegetation in the lake watershed. Color is measured in Standard Platinum Units (SPU). Lakes with color levels greater than 25 SPU are considered to be colored. This can cause transparency to be reduced, and phosphorus levels to be elevated. The water in highly colored lakes often has the appearance of tea. When lakes are highly colored, the best indicator of algal growth is chlorophyll-a (VLMP, 2008 Maine Lakes Report).

A pair of loon eggs on a floating bog island. Their color reminds you of a very humic lake, filled with tannins seeping out of the peat.

Methods

Site Selection

Lakes on or near tribal lands to be included in the monitoring program were selected according to accessibility by road. Bathymetric maps were obtained from the Maine Department of Inland Fisheries and Wildlife for the following water bodies: **Killman Pond, Side Pistol Lake.** These were all incorporated into the monitoring program along with the four lakes on Indian Township: **Big Lake, Long Lake, Lewey Lake, Grand Falls Flowage**. See Table 1 for summary of water bodies sampled each season.

Joe Musante and Ryan Gabriel taking samples on Lewey Lake, July 2019.

Table 1. Waterbodies included in ITTG Monitoring Program

Waterbodies Sampled in the ITTG Water Quality Program by Year														
93-'99	**00-'02**	**2002**	**03-'04**	**2005**	**06-'07**	**2008**	**09-'10**	**11-'12**	**13-'16**	**2017**	**18-'19**	**2020**	**21-'22**	**2023**
Big	Big	Big	Big	Big (2)	No	Big	Big	Big	Big	Big	Big	*Big	Big	Big
Long	Long	Long	Long	Long	sampling	Long	Long	Long	Long	Long	Long	*Long	Long	Long
Lewey	Lewey	Lewey	Lewey	Lewey	done	Lewey	Lewey	Lewey	Lewey	Lewey	Lewey	*Lewey	Lewey	Lewey
Grand Falls	Grand Falls	Grand Falls	Grand Falls	Grand Falls(2)	these	Grand Falls	Grand Falls	Grand Falls	Grand Falls	Grand Falls	Grand Falls	*Grand Falls	Grand Falls	Grand Falls
			Tomah Str.	Tomah Str	two	Tomah Str	Tomah Str							
	*Side Pistol	Side Pistol	Side Pistol	Side Pistol	years.		Side Pistol	Side Pistol	Side Pistol	Side Pistol	Side Pistol	*Side Pistol	Side Pistol	Side Pistol
	*Upper Chain	Upper Chain	Upper Chain	Upper Chain		*Upper Chain	Upper Chain	Upper Chain	Upper Chain	Upper Chain	Upper Chain	*Upper Chain	Upper Chain	
		Duncan	Duncan	Duncan		*Duncan	Duncan	*Duncan	*Duncan					
		Junior	Junior	Junior			Junior	Junior	Junior	Junior	Junior	*Junior	Junior	
		Killman	Killman	Killman		*Killman	Killman	Killman	Killman	Killman	Killman	*Killman	Killman	Killman
		Mill Privilege	Mill Privilege	Mill Privilege			Mill Privilege	Mill Privilege	Mill Privilege	*Mill Privilege				
		Pocumcus	Pocumcus	Pocumcus			Pocumcus	Pocumcus	Pocumcus	Pocumcus	Pocumcus	*Pocumcus	Pocumcus	
		Scraggly	Scraggly	Scraggly			Scraggly	Scraggly	Scraggly	Scraggly	Scraggly	*Scraggly	Scraggly	
		Shaw	Shaw	Shaw			Shaw	Shaw	Shaw	*Shaw				
		Sysladobsis	Sysladobsis	Sysladobsis			Sysladobsis	Sysladobsis	Sysladobsis	Sysladobsis	Sysladobsis		Sysladobsis	
				Mary Petuche		*Mary Petuche	Mary Petuche	*Mary Petuche	*Mary Petuche					
						*Hall	Hall	*Hall	*Hall					
				East Grand			Middle Chain	Middle Chain	Middle Chain	Middle Chain	Middle Chain	*Middle Chain	Middle Chain	
								West Grand	West Grand	West Grand	West Grand	*West Grand	West Grand	
								Pleasant	Pleasant	Pleasant	Pleasant	*Pleasant	Pleasant	
								E. Musquash	E. Musquash	E. Musquash	E. Musquash	*E. Musquash	E. Musquash	
								W. Musquash	W. Musquash	W. Musquash	W. Musquash	*W. Musquash	W. Musquash	
									Bassett					

*Only sampled once or twice this year

Sample Collection and Field Measurements

Samples were collected and *in situ* measurements were taken according to procedures outlined in *Maine Department of Environmental Protection's 1993 Standard Field Methods for Lake Water Quality Monitoring by Judy Potvin and Linda Bacon.* These methods have been updated throughout the years, but that document was the start of our program!

Laboratory Analysis

Alkalinity samples are typically titrated within 48 hours of collection by staff in the office, some however are tested later, but well within the 14 day holding time. True color samples are processed by staff in the office within 48 hours of collection. Chl *a* samples are filtered within 24 hours using a hand held filter apparatus. The filter is then stored in the freezer waiting to be sent to the Health and Environmental Testing Lab (HETL) in Augusta to be processed. TP samples are immediately placed in the fridge. Within the appropriate time period (generally 1-2 weeks) Chl a and TP samples are mailed to HETL for analysis. The holding time for Chl-a and TP samples to be processed by the lab (assuming the Chl-a has been filtered and frozen) is 28 days.

Statistical Analysis

The formulas for calculating the Carlson Trophic State Index values for Secchi disk, chlorophyll *a*, and total phosphorus are presented below. Also presented is a table that lists the trophic state values and the corresponding measurements of the three parameters. Ranges of trophic state index values are often grouped into trophic state classifications. The range between 40 and 50 is usually associated with mesotrophy (moderate productivity). Index values greater than 50 are associated with eutrophy (high productivity). Values less than 40 are associated with oligotrophy (low productivity).

Maine DEP Lake Assessment Criteria for Calculating Valid TSIs

1. Samples are to be taken from open water.
2. Five months of data are necessary; one reading per month is acceptable, but 2 readings per month are preferred.
3. Sampling period is May through November.
4. It is not permissible to be missing any 2 consecutive months of data.
5. The mean used in the equations shall be calculated as the mean of the monthly means in order that all months be equally weighted in the calculation.
6. Integrated cores should be taken to a depth equal to that of the late summer epilimnion or to the 2.0 mg/l D.O. level, whichever is less.
7. Secchi Transparency readings must not have hit the lake bottom.

Formulas

All lakes: TSIc = 70 log (mean Chlorophyll a in ppb + 0.71)

Lakes having color less than or equal to 25 Standard Platinum Units:

TSIp = 70 log (0.33 mean total phosphorus in ppb + 0.7)

TSIsd = 70 log [(105 / mean Secchi transparency^2) + 0.7]

Note: Secchi transparency in meters

TSI Table

TSI	Chlorophyll a (ppb)	Secchi Transparency (m)	Total Phosphorus (ppb)
0	0.3	18.7	0.9
10	0.7	12.3	2.1
20	1.2	9.2	3.1
30	2.0	7.3	6.0
40	3.0	5.9	9.2
50	4.5	4.8	13.6
60	6.5	4.0	19.7
70	9.3	3.4	28.2
80	13.2	2.8	40
90	18.6	2.4	56.4
100	26.1	2.0	79.2

Note: Avoid making comparisons using raw data for the various parameters; the criteria assure that the TSIs are representative of the water quality for the open water season of May through November.

Results: Reservation Waters

Big Lake, Washington County, Maine

Table 2, Big Lake

2023 Big Lake			Site: BIG2				
Date	Chl-a(µg/L)	TP(µg/L)	Secchi(m)	Alka(mg/l CaCO3)	pH	Cond(UMHOS/CM)	Color (PCU)
06/01/23	NONE	10	5.60	8.0	7.07	22.5	32
06/20/23	1.0	7	4.75	9.0	7.06	23.8	32
07/18/23	3.0	9	4.10	8.0	6.99	25.0	40
08/29/23	3.0	6	6.15	9.0	7.11	NONE	28
09/27/23	5.0	9	3.60	7.5	6.74	23.9	61
Year Mean:	**3.0**	**8**	**4.84**	**8.3**	**6.99**	**23.8**	**39**
Maximum:	**5.0**	**10**	**6.15**	**9.0**	**7.11**	**25.0**	**61**
Minimum:	**1.0**	**6**	**3.60**	**7.5**	**6.74**	**22.5**	**28**
Stand Dev:	**1.63**	**1.64**	**1.05**	**0.67**	**0.15**	**1.02**	**13.26**
TSI:	**40**	**37**	**50**				
			***CHLA Only valid TSI due to mean color >25**				
			****CHLA not truly valid due to less than 5 months of data.**				

Table 2 shows Chl-*a*, TP, Secchi, Alkalinity, pH, Conductivity, and True Color mean, max, min, standard deviations, and TSI values for Big Lake for May – September 2023. Big Lake is about 10,300 acres, with a max depth of 70 feet (21m) and is part of the St. Croix River watershed. Our sample site is in a shallower basin of 30 feet (9m). Sampling has been done on this lake since 1993. The staggering change in values between August and September are due to heavy rains of hurricane Lee on 9/16/23.

Long Lake, Washington County, Maine

Table 3, Long Lake

2023 Long Lake			Site: LNG2				
Date	Chl-a(µg/L)	TP(µg/L)	Secchi(m)	Alka(mg/l CaCO3)	pH	Cond(UMHOS/CM)	Color (PCU)
06/01/23	NONE	12	5.15	8.0	6.96	22.2	34
06/20/23	1.0	9	4.40	8.5	7.01	23.9	37
07/18/23	4.0	8	4.10	9.5	6.91	25.6	38
08/29/23	6.0	8	5.60	9.0	7.15	NONE	29
09/27/23	3.0	8	3.15	7.5	6.74	23.7	72
Year Mean:	**3.5**	**9**	**4.48**	**8.5**	**6.95**	**23.9**	**42**
Maximum:	**6.0**	**12**	**5.60**	**9.5**	**7.15**	**25.6**	**72**
Minimum:	**1.0**	**8**	**3.15**	**7.5**	**6.74**	**22.2**	**29**
Stand Dev:	**2.08**	**1.73**	**0.95**	**0.79**	**0.15**	**1.39**	**17.13**
TSI:	**44**	**40**	**54**				
			***CHLA only valid TSI due to mean color >25**				
			****CHLA not truly valid due to less than 5 months of data.**				

Table 3 shows Chl-*a*, TP, Secchi, Alkalinity, pH, Conductivity, and True Color; mean, max, min, and standard deviations for Long Lake for May – September 2023. Long Lake is about 595 acres and is part of the St. Croix River watershed. It has been sampled since 1993. It also should be noted in Long Lake that from June to late August the hypoliminion usually becomes anoxic. This results in an increase of anaerobic bacteria and production of hydrogen sulfide. Water collected from the hypolimnion typically has a rotten egg odor when anoxic. Numerous seasonal and year-round residences and camps occur on its western and southern shores. The staggering change in values between August and September are due to heavy rains of hurricane Lee on 9/16/23.

Lewey Lake, Washington County, Maine

Table 4, Lewey Lake

2023 Lewey Lake			Site: LWY1				
Date	Chl-a(µg/L)	TP(µg/L)	Secchi(m)	Alka(mg/l CaCO3)	pH	Cond(UMHOS/CM)	Color (PCU)
06/01/23	NONE	12	4.60	8.5	7.10	22.4	35
06/20/23	1.0	8	4.40	9.0	7.09	24.1	36
07/18/23	5.0	9	3.80	9.5	7.02	25.7	36
08/29/23	3.0	8	5.05	9.0	7.13	NONE	30
09/27/23	0.5	9	3.55	8.0	6.76	23.9	70
Year Mean:	**2.4**	**9**	**4.28**	**8.8**	**7.02**	**24.0**	**41**
Maximum:	**5.0**	**12**	**5.05**	**9.5**	**7.13**	**25.7**	**70**
Minimum:	**0.5**	**8**	**3.55**	**8.0**	**6.76**	**22.4**	**30**
Stand Dev:	**2.06**	**1.64**	**0.61**	**0.57**	**0.15**	**1.35**	**16.18**
TSI:	**34**	**40**	**57**				
***CHLA Only valid TSI due to mean color >25**							
****CHLA not truly valid due to less than 5 months of data.**							

Table 4 shows Chl-*a*, TP, Secchi, Alkalinity, pH, Conductivity, and True Color; mean, max, min, and standard deviations values for Lewey Lake for May – September 2023. Lewey Lake is about 447 acres, and is part of the St. Croix River watershed. It has been sampled since 1993. It is very populated along its eastern and southern shores, Indian Township and Princeton respectively. The staggering change in values between August and September are due to heavy rains of hurricane Lee on 9/16/23.

Grand Falls Flowage, Washington County, Maine

Table 5, Grand Falls Flowage

2023 Grand Falls Flowage			Site: GFF1				
Date	Chl-a(µg/L)	TP(µg/L)	Secchi(m)	Alka(mg/l CaCO3)	pH	Cond(UMHOS/CM)	Color (PCU)
06/01/23	NONE	15	4.40	8.0	7.06	23.3	39
06/20/23	8.0	10	3.90	9.0	7.07	25.0	43
07/18/23	6.0	11	3.20	10.0	7.02	25.6	37
08/29/23	6.0	9	5.30	9.0	7.12	NONE	35
09/27/23	4.0	9	3.25	8.0	6.72	24.9	80
Year Mean:	**6.0**	**11**	**4.01**	**8.8**	**7.00**	**24.7**	**47**
Maximum:	**8.0**	**15**	**5.30**	**10.0**	**7.12**	**25.6**	**80**
Minimum:	**4.0**	**9**	**3.20**	**8.0**	**6.72**	**23.3**	**35**
Stand Dev:	**1.63**	**2.49**	**0.87**	**0.84**	**0.16**	**0.98**	**18.79**
TSI:	**58**	**45**	**60**				
***CHLA Only valid TSI due to mean color >25**							
****CHLA not truly valid due to less than 5 months of data.**							

Table 5 shows Chl-*a*, TP, Secchi, Alkalinity, pH, Conductivity, and True Color; mean, max, min, and standard deviations values for Grand Falls Flowage for May – September 2023. Grand Falls Flowage expands to 6,691 acres of mostly shallow coves due to the impoundment of the dam. Not far below the dam does this watershed finally meet the St. Croix River. Maximum depth is listed at 29 feet (9 m), but our sampling site is located at 20 feet (6m). There are numerous seasonal and year-round residences along its shores, primarily to the south. The staggering change in values between August and September are due to heavy rains of hurricane Lee on 9/16/23.

Results: Trust Lands

Killman Pond, Hancock County, Maine

Table 6, Killman Pond

2023 Killman Pond			Site: KLL1				
Date	Chl-a(µg/L)	TP(µg/L)	Secchi(m)	Alka(mg/l CaCO3)	pH	Cond(UMHOS/CM)	Color (PCU)
05/31/23	3.0	10	4.75	8.5	6.76	21.8	25
06/27/23	4.0	8	3.80	7.0	6.83	22.0	24
07/19/23	3.0	8	3.95	7.5	6.79	21.7	26
09/01/23	4.0	9	4.40	7.0	6.98	20.7	26
09/28/23	5.0	8	3.40	8.0	6.84	22.7	29
Year Mean:	**3.8**	**9**	**4.06**	**7.6**	**6.84**	**21.8**	**26**
Maximum:	**5.0**	**10**	**4.75**	**8.5**	**6.98**	**22.7**	**29**
Minimum:	**3.0**	**8**	**3.40**	**7.0**	**6.76**	**20.7**	**24**
Stand Dev:	**0.84**	**0.89**	**0.53**	**0.65**	**0.08**	**0.72**	**1.87**
TSI:	**46**	**40**	**59**				
		***CHLA Only valid TSI due to mean color >25**					

Table 6 shows Chl-*a*, TP, Secchi, Alkalinity, pH, Conductivity, and True Color; mean, max, min, and standard deviations values for Killman Pond for May – September 2023. Killman Pond is a small pond of about 17 acres flowing into Upper Chain Lake via a small stream. It is part of the St. Croix River watershed. There are no camps or structures along its shores, but it does have a maintained dirt road within 100 feet along its north shore, which undoubtedly adds runoff and sediments. The boat launch is only accessible to canoes and the like. This pond is strongly stratified most of the field season and is about 23 feet (7m) at its deepest. This pond has been sampled most years since 2002.

Side Pistol Lake, Hancock County, Maine

Table 7, Side Pistol Lake

2023 Side Pistol Lake			Site: SPL1				
Date	Chl-a(µg/L)	TP(µg/L)	Secchi(m)	Alka(mg/l CaCO3)	pH	Cond(UMHOS/CM)	Color (PCU)
05/31/23	2.0	5	6.80	8.0	7.12	20.6	8
06/27/23	3.0	9	6.75	6.5	6.99	20.8	7
07/19/23	5.0	7	5.80	7.5	6.99	20.6	7
09/01/23	5.0	12	5.05	7.5	7.14	19.6	8
09/28/23	0.5	7	5.15	8.0	6.99	21.1	10
Year Mean:	**3.1**	**8**	**5.91**	**7.5**	**7.05**	**20.5**	**8**
Maximum:	**5.0**	**12**	**6.80**	**8.0**	**7.14**	**21.1**	**10**
Minimum:	**0.5**	**5**	**5.05**	**6.5**	**6.99**	**19.6**	**7**
Stand Dev:	**1.95**	**2.65**	**0.84**	**0.61**	**0.08**	**0.56**	**1.22**
TSI:	**41**	**37**	**40**				

Table 7 shows Chl-*a*, TP, Secchi, Alkalinity, pH, Conductivity, and True Color; mean, max, min, and standard deviations values for Side Pistol Lake for May – September 2023. Side Pistol Lake is a small lake of 147 acres in a series of small lakes known as the Pistol's. Maximum depth of the lake is 26 feet (8m). There are only a few seasonal camps on this lake, as well as a small boat launch able to handle small trailered boats. This lake is mostly sand bottomed near the launch (NE corner), and is very clear, almost blue-green colored. This lake chain is the only lake sampled in the Springfield or Township area that isn't part of the St. Croix River watershed; it flows into the Passadumkeag River, and finally the Penobscot River. Side Pistol Lake has been sampled somewhat since 2000.

Invasive Aquatic Species Program 2023

Passamaquoddy Tribe at Indian Township

Since its discovery in Clifford Bay, Big Lake in the fall of 2019, variable watermilfoil (VWM), *Myriophyllum heterophyllum,* has been a large piece of the Environmental Department's focus. Being a new threat to the water resources of the Passamaquoddy Tribe, it's been a process to mold and adapt our current programs to face this new challenge. Our focus is on building our invasive aquatic species program to **Locate**, **Remove**, and **Restore** resources affected by invasive aquatic species.

This threat of VWM to the Tribe's surface water resources cannot be understated. The window to try to get this infestation under control is short. The littoral habitat for VWM here is extensive in this dammed river system. Much of the flooded land is very shallow, soft bottomed and sheltered. These conditions describe entire coves: hundreds of acres each. If VWM was thoroughly established in these areas, they would no longer be accessible to many tribal and non-tribal traditions and uses.

To accomplish this long-term goal, the Tribe has been very fortunate to have numerous allies to assist in funding, setting up the program, and doing this important work. Environmental Protection Agency (EPA) 319 and 106 funding, as well as additional monies from the Bureau of Indian Affairs (BIA) have provided staff, development and equipment needed to start getting the work done. The Maine Department of Environmental Protection (MDEP) has also been heavily involved in the response to the VWM discovery, providing training and removal work to the Tribe and other local stakeholders (especially Downeast Lakes Land Trust and Big Lake Camp Meeting) through their invasive aquatic species program. Lake Stewards of Maine (LSM), a nonprofit organization, having worked with our water resources program for many years, has been an immense help in setting up the response with our program and the local communities. All these partners have worked together in assembling a defense against invasive aquatic species (IAS) threatening our local water resources.

Locate: Part A

Locating any aquatic invasive plant is a time-consuming endeavor. The more eyes on the lookout the more efficient the work. For these reasons we've divided this goal into two parts: *Education* and *Surveys*. These two parts are discussed below along with what we've done over the last year to address them.

Education is the building block of developing any program. We've broken down our education component into three different categories: build staff capacity, build local capacity, and build partnerships.

Staff Capacity

Building staff capacity is comprised of both funding to support staff time, as well as training opportunities to build skills. Without these dedicated funding agencies none of this work would be possible.

- Full time staff consists of a water resources biologist (WRB) and a field assistant (FA). The staff split their time between water quality sampling and IAS.

- The water resources biologist completed the PADI introduction to open water scuba diving certification in spring 2022. This certification, coupled with a set of scuba dive gear, gives the department the ability to do deeper water surveys and removal activities. Spring of 2023 we trained two additional staff from the Tribe's Natural Resources Department in open water scuba. Going from one diver to three really boosted our removal capacity for 2023 and beyond.

- MDEP trained these two new divers in underwater removal techniques, shallow water removal and benthic barrier deployments on August 9th, 2023. MDEP also trained some other local divers in the same skills that day in case they were able to assist with removal work in the future.

- Two high school students and one supervisor worked with the IAS Program in 2023. Kaiden, Frank, and Matt participated in the tribal Summer Youth Program, which trains and employs young tribal members (16-25 years of age) and their supervisors in identifying and surveying for VWM. These extra staff really added in critical manpower during the height of the summer season. Their primary duties are assisting in VWM surveys and being surface support for divers removing VWM on the lake bottom. We're looking forward to building on this program in 2024 and beyond.

Local Capacity

Building up local capacity is an important piece to the long-term success of any invasive species project. Without the assistance and buy-in of residents it would be just too difficult to monitor such a large area for species of concern. The more concerned and educated residents we have keeping an eye out the better. The most formal tool we have in place for building local capacity is to host a regular 'on the water' 'plant paddle' training. This training is used to introduce people to the program (and points of contact), what VWM looks like, and get them familiar with native plant species verses invasive aquatic plants. Taking them out on the water and showing them just what VWM looks like growing in the lake gives a good mental picture to recognize it later on. While we would love to have residents volunteering to do formal IAS surveys around the lakes, we recognize for most this is a big ask. Just having them recognize something as suspicious, (or likely VWM) while out on the lake is still very valuable. Many of our VWM populations found in 2022 were reported by bass fisherman in the Spring.

- There were approximately 15 people who attended the Plant Paddle this year at Peter Dana Point. This was a mix of ENV staff, wildlife staff, tribal members, local non-tribal residents, a lake association member from Cathance Lake in Washington County, and DLLT staff. Some of these attendees attended in the past, but repeated attendance only helps in the learning process.

Impromptu discussions when the opportunity presented itself are also an important piece of building local capacity. VWM samples were kept on hand in the office to show to any and all that came in for whatever reason. Having live samples on hand to show people was especially helpful since many that were on the water could connect them to floating fragments they would see on the lake. The next step hopefully will be to go out in boats with them, individually or through future Plant Paddles to show them what they look like growing out of the sediment in the lake bottom. We feel like we've made a lot of progress as a staff and community in education and outreach.

- 5+ Office interactions with the community and another 5-10 interactions with landowners/boaters while on the water working.
- The ENV Department also had a booth at the tribal Health Faire in October, showing and speaking with children and adults from the local community on invasive milfoil. (Approximately 55 adults and 25 children spoken with)

We are involved with our partners in the Big Lake Milfoil Coalition in getting educational information out into local businesses to increase exposure. ENV staff have also been involved in virtual presentations and meetings with other regional stakeholders to increase awareness and build on relationships for the future.

- Monthly Zoom calls with stakeholders during most of the year.

***Left*: A zoomed-in section of the flower stalk of VWM. A fully definitive ID of VWM is impossible without seeing this, and most colonies that are young won't develop them. To get around this problem many samples get genetically tested by MDEP for new infestations.**

Partnerships

Lakes and ponds are not a water resource for a singular entity, nor are they singular units on the landscape. Lakes, ponds, and streams are parts of huge, sprawling watersheds moving across the landscape to the ocean. Just as you need to manage these water resources as part of a larger watershed, the same holds true for communities intwined with that watershed. The Passamaquoddy Tribe is but one stakeholder in the west branch of the St Croix River watershed. For this reason, the Tribe has joined the Big Lake Milfoil Coalition, a group of state and regional stakeholders working together to fight the VWM infestation of the Big Lake area. This coalition asks members to bring whatever resources they can contribute to the VWM battle.

To facilitate, organize, and invest stakeholders, LSM started regular Zoom calls to bring all those interested to the table. These meetings range from monthly to weekly, depending on the season. Attending and participating in these regular meetings has become an important part of developing the Tribe's IAS Program, as well as reinforcing partnerships with stakeholders, volunteers, and community members.

***Right*: Downeast Lakes Land Trust organized a milfoil removal mission with the Combat Wounded Veteran's Challenge for four days. Milfoil coalition members (Camp Meeting, MDEP, PIT, and DLLT) and local residents helped support the event by providing boats, captains, training, and meals to the mission. Photo: Prepping for an afternoon training dive at Big Lake.**

***Left*: PIT dive crew after a day on and under the water removing VWM in Cass Cove, Big Lake with resident volunteer Brenda Smith and LSM uber IPPer Bunny Wescott. Photo left to right: Joe Musante, Ryan Gabriel, Brenda Smith, Justin Socobasin, Matt Dana I, and Bunny Wescott and Ross Wescott manning the camera. Working side by side with residents to eliminate invasive plants are one of the key pieces of this program. The more eyes the better.**

***Right*: Summer Youth student Kaiden with supervisor Matt preparing to help support removal divers for safety while collecting any escaped VWM fragments that may float off on Long Lake.**

Locate: Part B

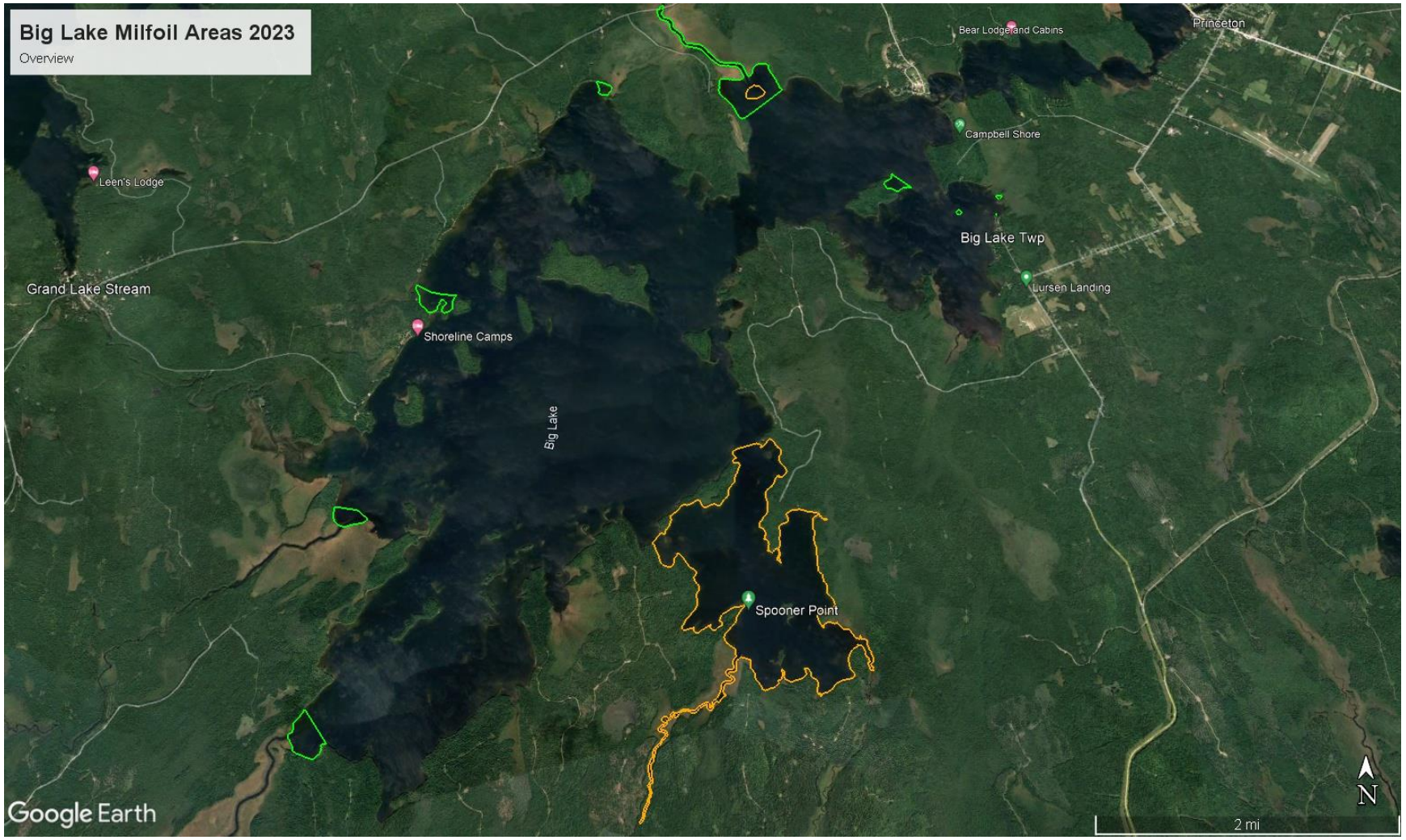
The second half of Locate is getting out on the water to conduct some form of a survey. These surveys are not all conducted the same way, but they are all after the same result: *is there an invasive aquatic plant here or not*? In our Quality Assurance Project Plan (QAPP) we've put specific guidelines on how surveys are conducted by department staff. These survey plans have specific goals in mind, based on limitations due to survey conditions, training, or equipment. While it would be beneficial for volunteers and community members to also follow these QAPP guidelines, we recognize there is still significant value to their eyes on the water looking for plants. Simply spotting something suspicious, grabbing a sample or taking down a location is an important piece of developing local capacity to fight invasive aquatic species.

Pre-removal Surveys

Big Lake was surveyed heavily in 2021, Long and Lewey Lakes, along with a large amount of Grand Falls Flowage were completed in 2022. The 2023 season consisted of a lesser amount of pre-removal surveys as much of that work had already been completed along with a lack of suitable weather for surveying. The 2023 field season in Washington County Maine could be summed up in three letters: W E T. The month of June was mostly lost to constant rain, or overcast skies, and sometimes smoky haze coming down from the Canadian wildfires. This caused a bit of a pivot in our plans. Priority for good survey weather was shifted to known infestations, or post-removal surveys. These pre-removal survey maps are included in the post-removal survey maps for less confusion and duplication.

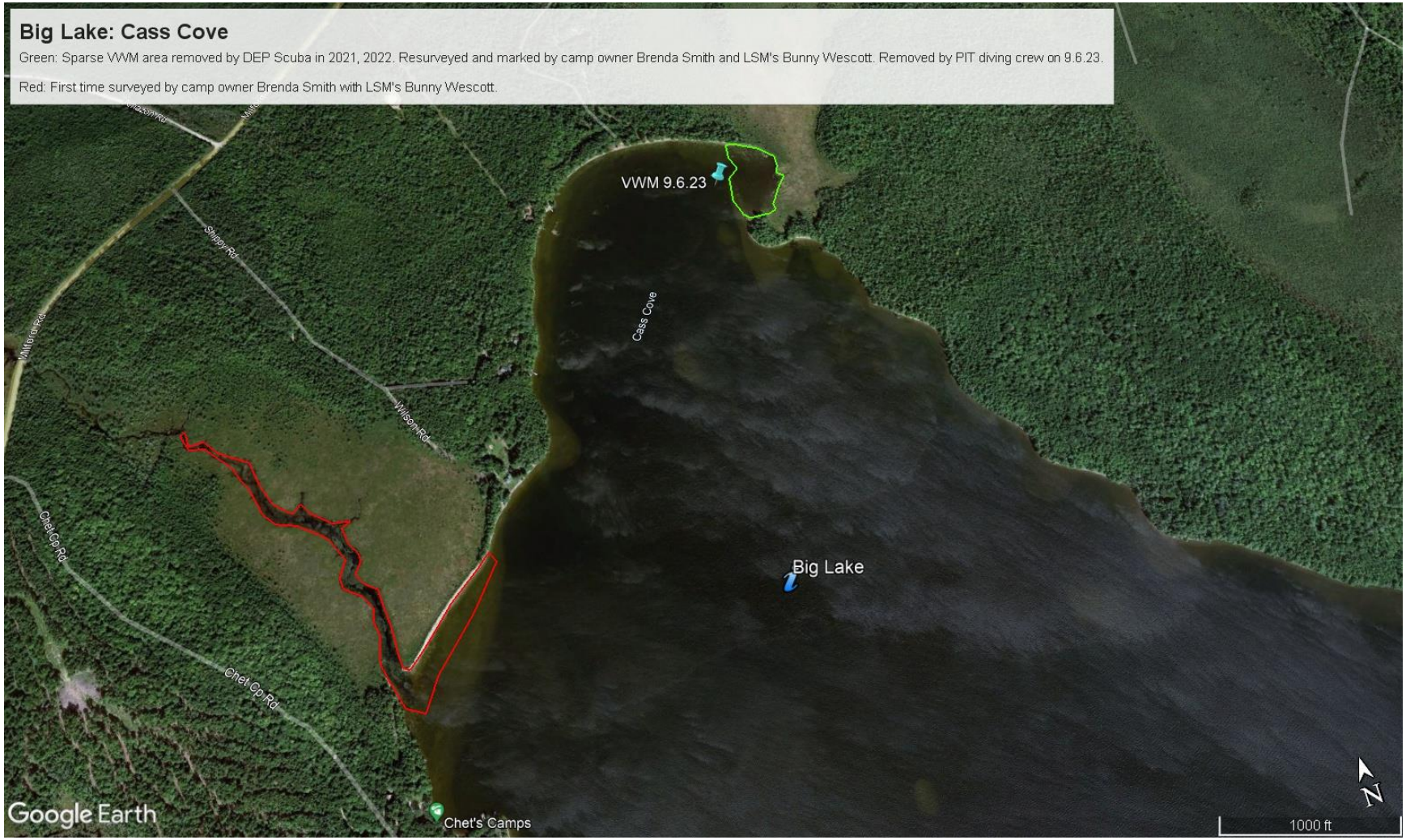
Post-removal Surveys

Most of the surveys at this point would be classified as post-removal surveys: a situation where we go back to known infestations to look for new or regrown VWM. This includes areas near other infestations where we expect VWM to become established, or areas surveyed in lesser conditions in the past. The following maps are broken up by lake.

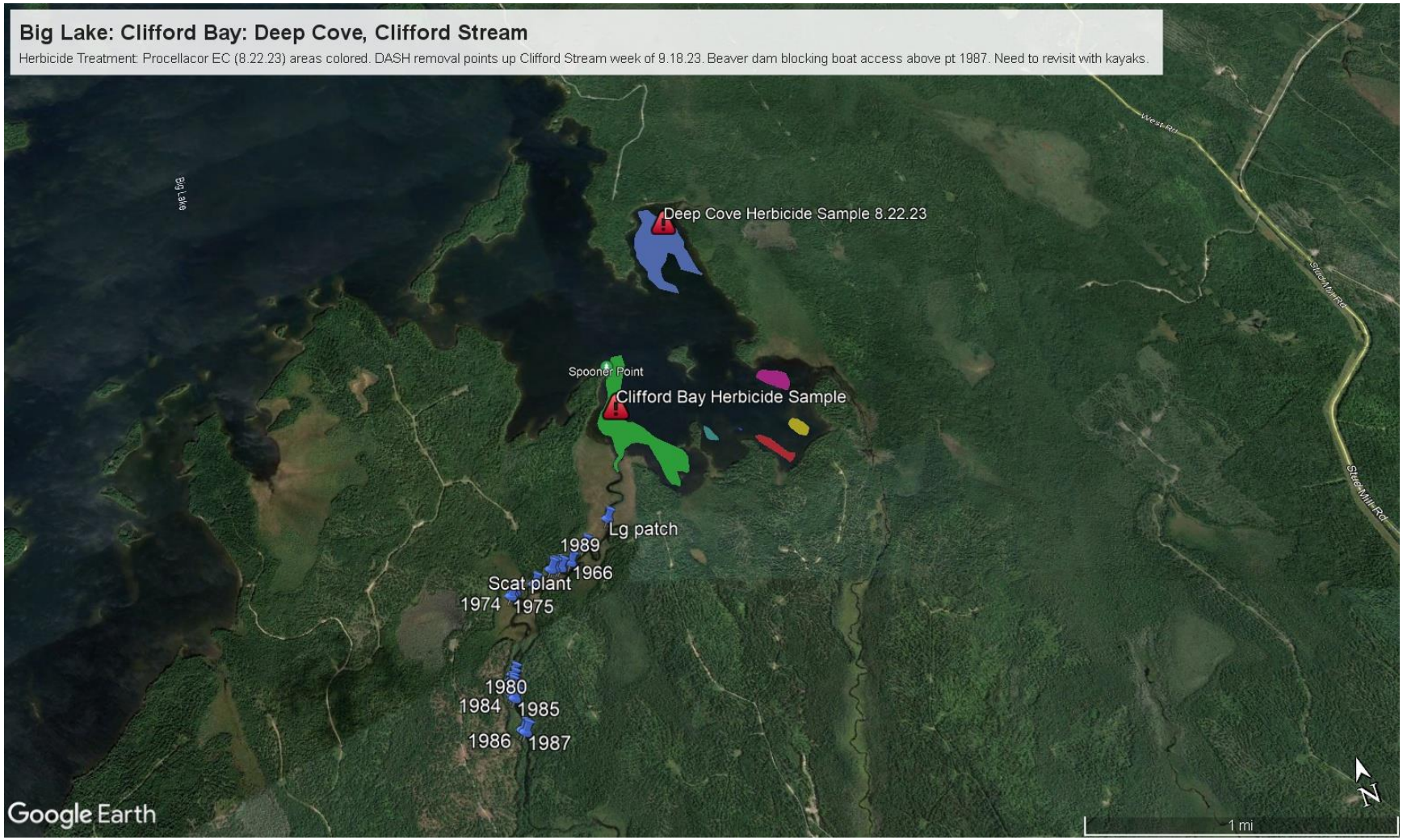


This overview map should help give the readers an idea on the spread of VWM found in Big Lake. The green areas are areas surrounding smaller populations, while the orange indicates a larger, more dense population. The highlighted areas do not accurately gauge the boundaries of the infestation, but instead represent an area of concern for yearly surveys.

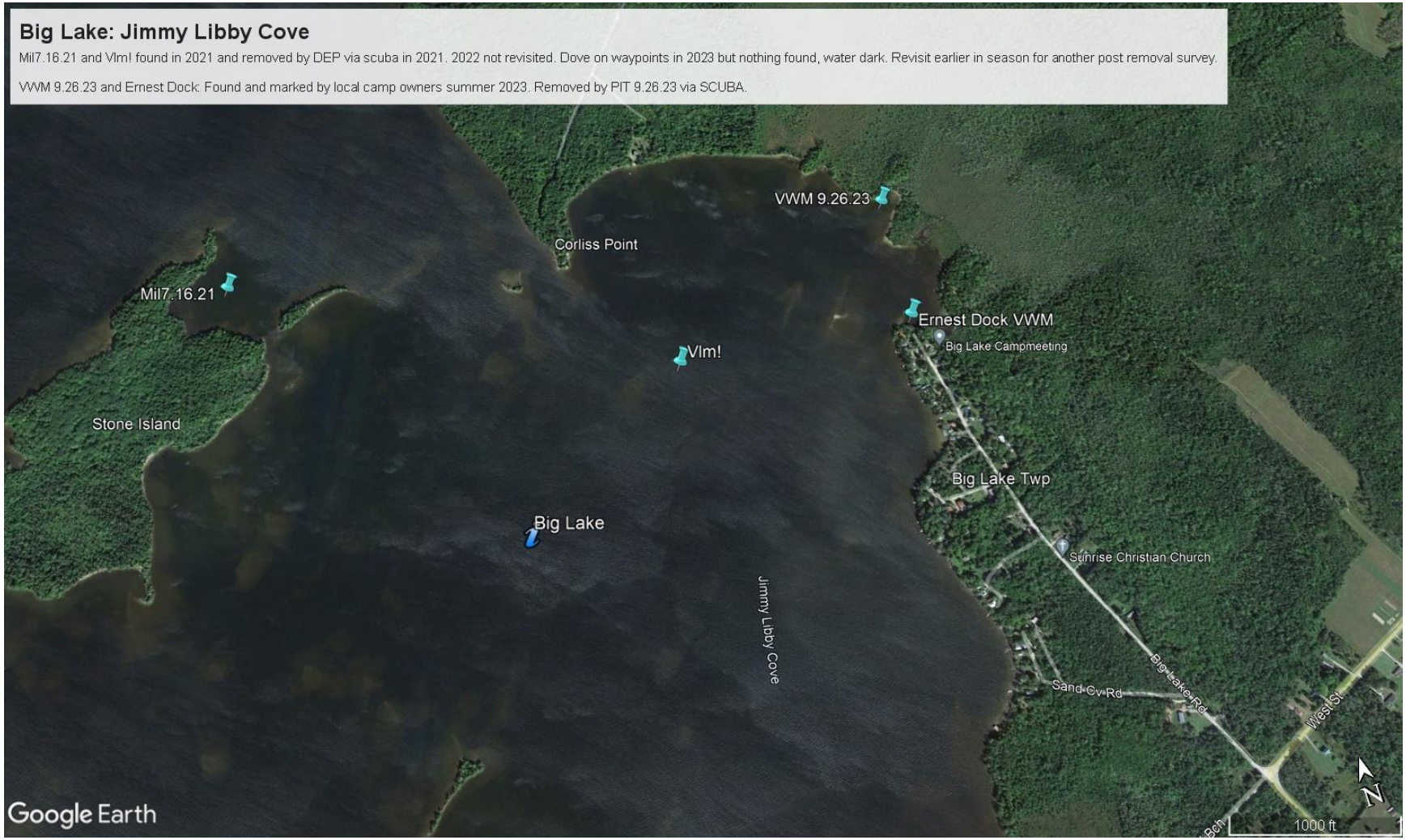
The mouth of big musquash stream is the next largest infestation of VWM in the system outside of Clifford Bay. This area was worked on by NEMilfoil's DASH crew for most of the season and will be a focus for years to come.



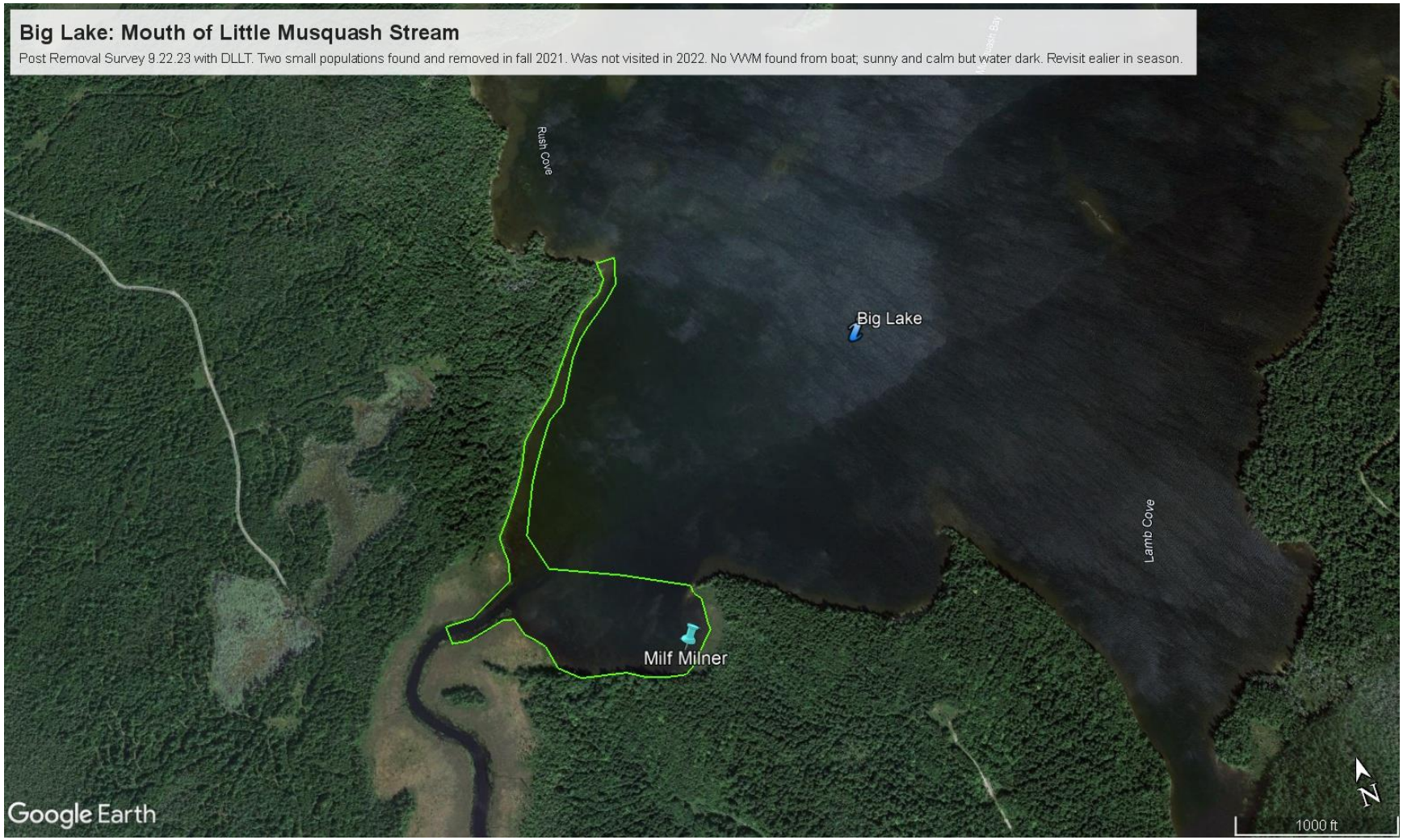
If dealt with yearly, the known infestation in Cass Cove will take a diver a day or less to remove once things are marked.



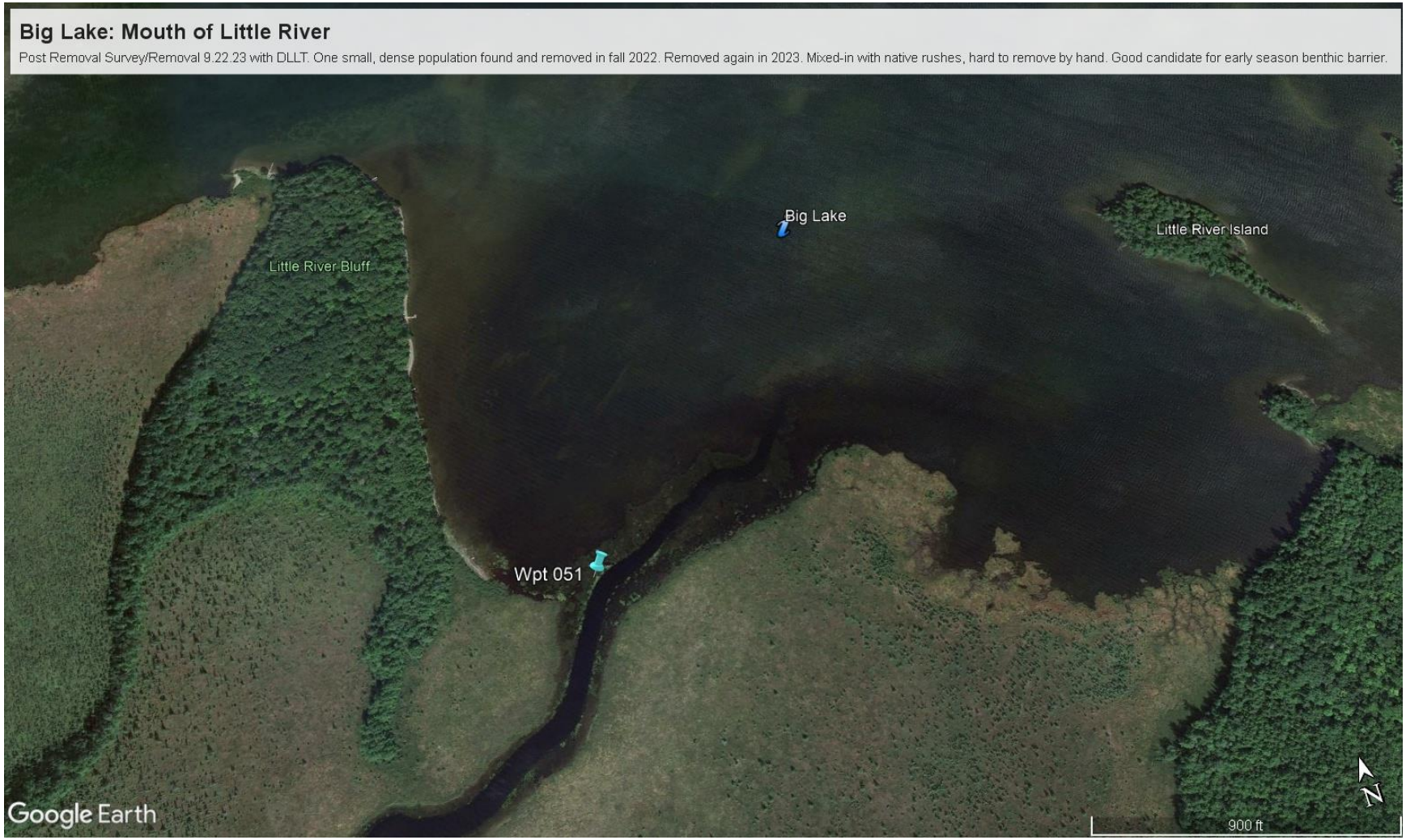
Maine DEP contracted to have the largest (and likely initial colonization) populations of VWM treated with a milfoil specific herbicide in August 2023, about 85 acres in total. The hope is the treatment knocks it back enough to make DASH removal a viable option going forward. NEMilfoil removed VWM found up Clifford Stream via DASH. It will be very interesting to see what the regrowth is from the initially very successful looking herbicide treatment.



Jimmy Libby Cove is completely within the 10ft depth requirements of VWM and some locations are starting to be found in this area. The regular flow of the lakes does not come into this extensive cove, only boats and wind driven fragments.

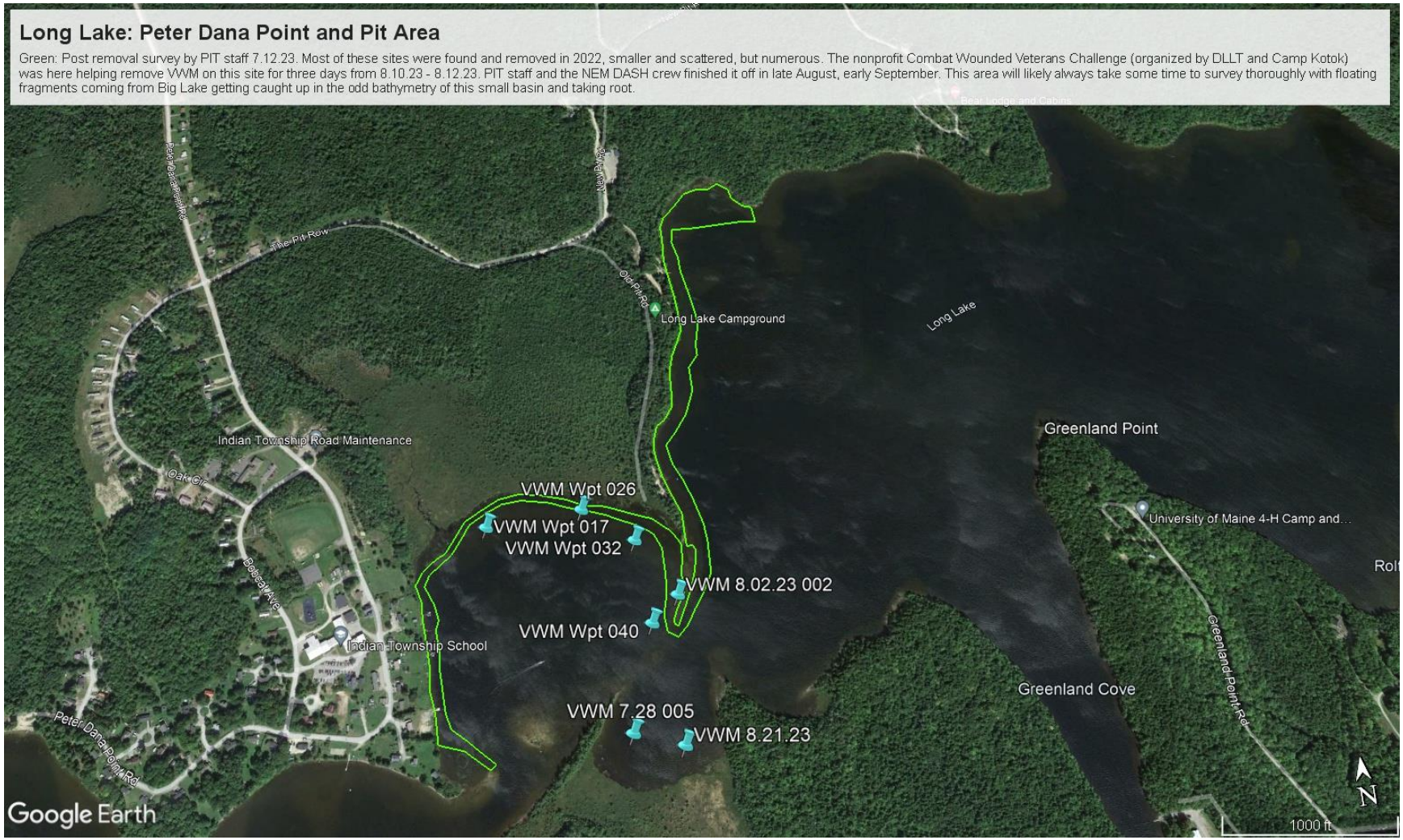


There are reported VWM populations located far upstream in little musquash stream. This needs to be investigated in 2024.

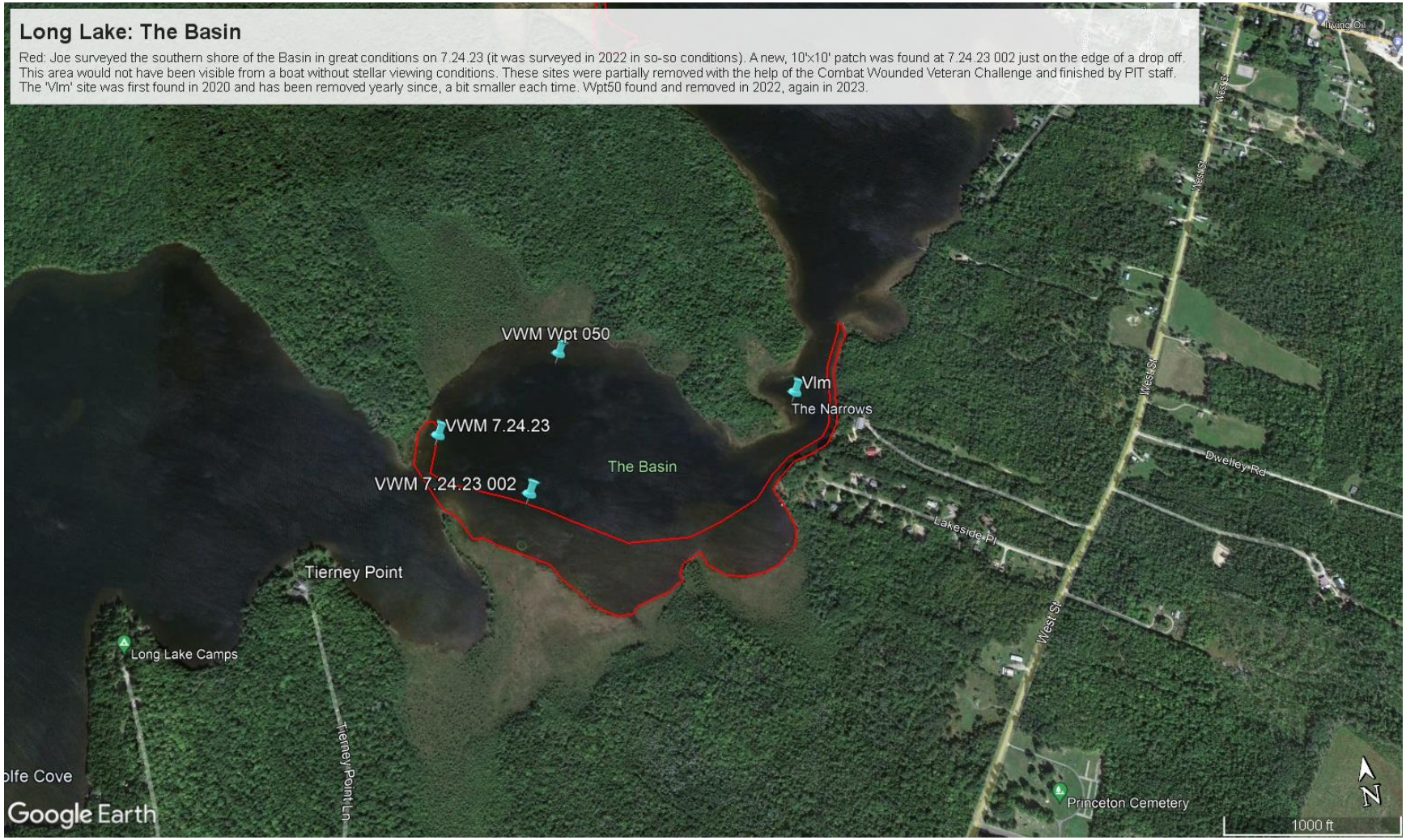


No other populations of VWM have been found in this area, which is odd considering how this populations looks to have been here a while, tucked into the rushes.

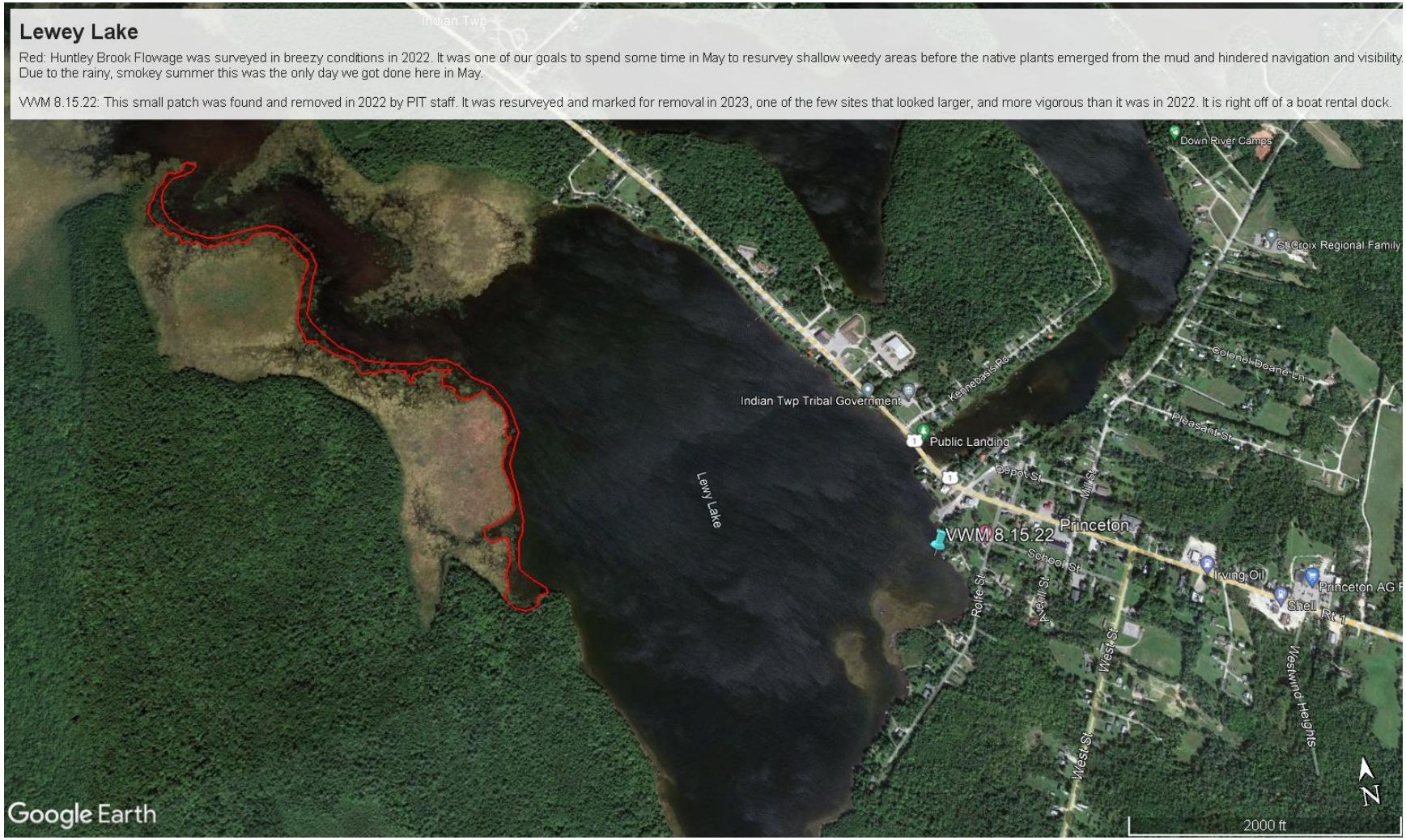
This overview map should help give the readers an idea on the spread of VWM found in Long and Lewey Lakes. The green areas are areas surrounding smaller populations. The highlighted areas do not accurately gauge the boundaries of the infestation, but instead represent an area of concern for yearly surveys.



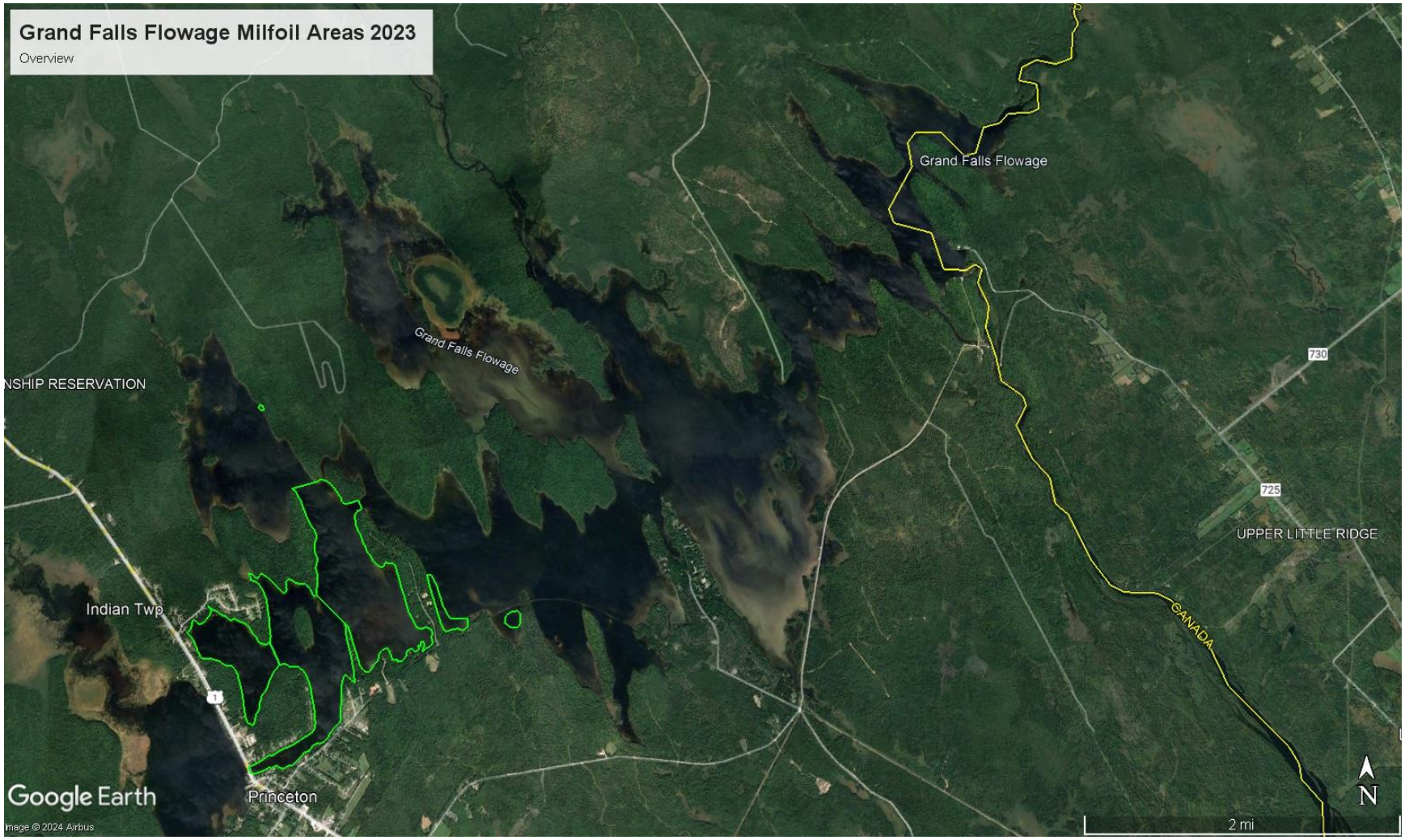
This area off Peter Dana Point in Long Lake will take some consistent work to keep under control and remove newly rooted fragments. It is heavily fished, and the boat traffic spreads fragments. Fragments coming out of Big Lake get hung up here and establish themselves. Once marked a DASH boat could spend up to a week here pulling.



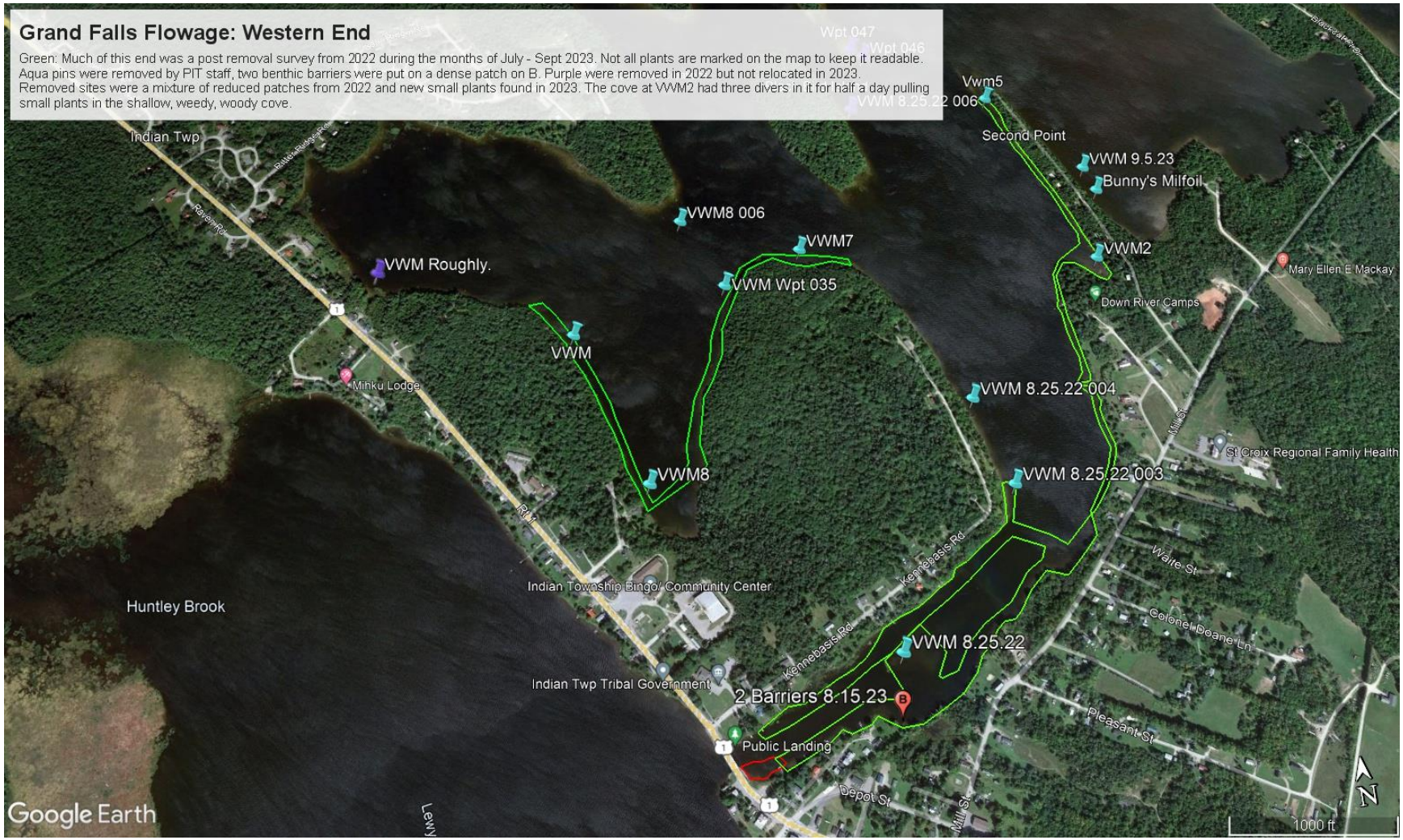
The second area downstream in Long Lake, some scattered VWM populations.



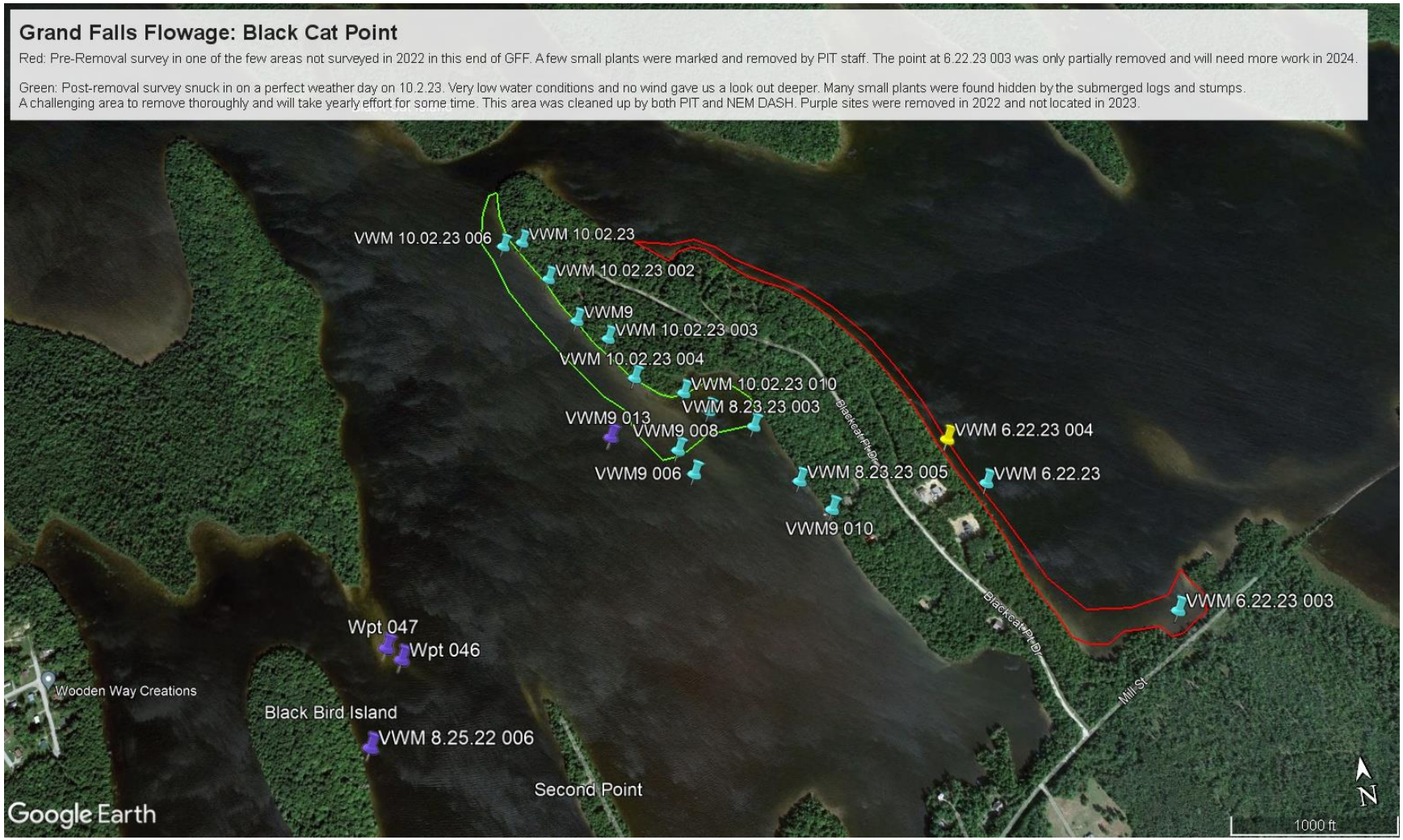
So far most of Lewey Lake has been found to be VWM free besides one point off a rental dock near the public launch. The area going up into Huntley Flowage is prime VWM habitat.



This overview map should help give the readers an idea on the spread of VWM found in Grand Falls Flowage. The green areas are areas surrounding smaller populations. The highlighted areas do not accurately gauge the boundaries of the infestation, but instead represent an area of concern for yearly surveys.



This map shows the start of Grand Falls Flowage at the US Rt 1 bridge in Princeton. Numerous small populations were found and removed in 2022, and again the green marks the resurvey in 2023. Aqua pins are plant locations with removal work done in 2023, purple was removed in 2022 but not located again in 2023.



Just downstream of the map on the previous page. This area will take regular work to locate the established populations and remove any new ones popping up. Aqua pins are plant locations with removal work done in 2023, purple was removed in 2022 but not located again in 2023.

These locations mark the furthest found VWM downstream in Grand Falls Flowage. Seeing how extensive the population was behind the old railroad bed, we'll be resurveying the next cove down in 2024.

The northwestern shore of George Brook Flowage still needs its initial survey, one small pair of plants were found on the eastern side mixed in with downed wood along the lake bottom.

The red survey area also shows the reach of Tomah Stream that is inundated due to the Grand Falls Dam downstream. Not far bove the red are natural stream conditions too rocky for motorboat travel.

Remove

After all the leg work has been done, the most satisfying step of the project is the removal work. Putting your wetsuit on, getting in the water, digging VWM out of the mud and sending it off to the compost pile. In 2023 we had three different organizations contributing to removal activities on our four lakes. The following few pages highlight their work.

The picture to the right shows some fresh green growth on VWM, along with some new roots forming along the older growth. These older stems vegetatively reproduce in two ways. One: fragment in the spring or fall and float off to sink and root in a new location. Two: they will also lay down in place, still attached to the mother plant, and root all along the stem. Then from there they put up new vertical stems all along the length of the old stem. Think of it like an old tree that blows down and sends up new shoots all along its trunk. This form of spread creates dense monocultures in a location, while the fragmentation helps colonize new areas, perhaps miles and miles away. Both methods produce genetically identical plants.

The Passamaquoddy Tribe at Indian Township

The Tribe has worked over the last two years to develop their own trained and equipped dive team (described more thoroughly earlier in this report). Removal activities in 2023 for PIT began with MDEP's removal training on August 9th, 2023 and continued through the first week of October. We are still working on acquiring and outfitting our own DASH boat, so all of this removal was done by hand. We are digging and pulling VWM with scuba or snorkel gear, stuffing it into a mesh bag, then bringing it to a boat to be disposed of.

Depending on the size of the patch and the number of staff available, sometimes a kayak aids in the process: floating around to keep tabs on the diver, shuttling full bags to the 'mothership', marking more plants, and chasing down fragments. This works very well, especially when dealing with lots of small patches in a small area. Seeing as we are hand pulling plants, the tribal team focuses its efforts on smaller, more scattered populations that are less efficient for a DASH crew to set up on. When an area is too large and dense, then the NEM DASH crew was called in to finish it off (more on that on the next page).

Most of the work done by the tribal crew was in Grand Falls Flowage, while also doing the few locations in Lewey Lake, about half of Long Lake infestations, and finally a few smaller locations in Big Lake.

Downeast Lakes Land Trust

Downeast Lakes Land Trust has been a key partner for VWM removal activities in and around Big Lake. In 2023 DLLT organized and supported two main pieces of our removal puzzle: contracted NE Milfoil DASH crew and the Combat Wounded Veteran's Challenge.

NE Milfoil: (http://www.newenglandmilfoil.com/) was contracted by DLLT through granted MDEP funding for new aquatic invasive species infestations. This contracted work by NEMilfoil has been going on for 4-12 weeks per summer since 2020, with 11 weeks of work done in 2023. This photo to the right is of their DASH boat (Diver Assisted Suction Harvest) with owner/operator Cliff. The general operation of the boat/system is as follows:

A scuba (or surface supplied air as in this case) diver digs and pulls up rooted vegetation on the lake bottom, feeding it into a vacuum nozzle, giving the invasive VWM a quick ride onto the boat. The water and material dump over the side of the boat through a mesh net, capturing all the plant material, and flushing the water and sediment back into the lake. This suction harvest system gives the diver much higher work efficiency than a hand pulling diver since they can remain on target the entire dive. A hand pulling diver must surface to shuttle material to the support boat. This not only saves dive time, but also helps with preserving some of the precious visibility lost during ascent and descent.

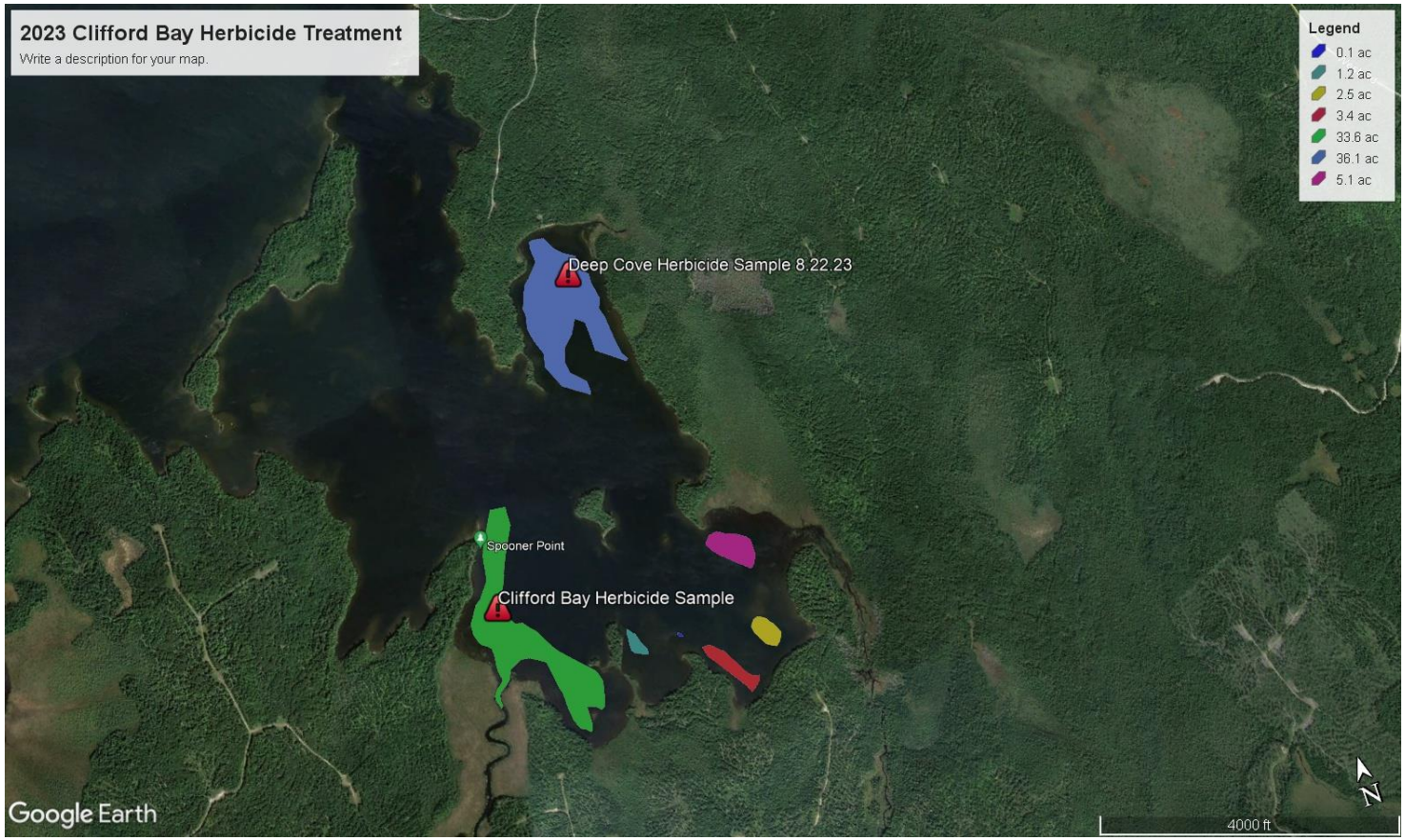
As the plant material piles up onboard, the deckhand fills 10 gallon fish crates and stacks them on the deck. The more deck space the more material can be stored before having to head to shore to offload. DLLT has purchased a dump trailer and contracted to have it emptied weekly in a gravel pit for safe composting.

The second piece of DLLT removal contribution was the organization and support of the Combat Wounded Veteran's Challenge (CWVC). *Combat Wounded Veteran Challenge is a Florida based, national non-profit organization dedicated to improving the quality of life for our returning American combat wounded and injured military service veterans. The basis for our mission centers upon 3 core principles –* ***Challenge, Research and most importantly Inspire.*** CWVC and its two dive teams spent part of the second week of August being trained and then removing VWM in Long Lake for three days. Divers were divided into morning and afternoon teams made up of 4 divers each. Divers used SCUBA gear and hand pulling techniques to clear VWM marked by the tribal dive crew earlier that month. Their work helped clear the bulk of VWM sites marked in Long Lake for 2023. The picture below shows the afternoon dive crew working on VWM marked with buoys with paddle board support.

It was great to work with their dive teams, many had never been or dove in Maine. Their organization primarily works in and around Florida. We thank them for their service to our country and community.

Maine Department of Environmental Protection

Maine DEP's primary contribution to VWM removal in 2023 was contracting an herbicide application that specifically targets milfoils. The map below shows the delineated treatment locations within Clifford Bay, Big Lake. The legend on the map lists the acreage of each specific treatment site. These sites were chosen for herbicide treatment due to their large size and density of VWM. Traditional DASH, barriers, or hand pulling methods would not be able to make a dent. This treatment is planned to be a 'one and done', allowing enough fragmentation of the extensive monocultures for more traditional methods to make headway in the future. The early returns on the treatment in September looked very promising, full visible die-off of the target species, and very minor damage to a limited number of native plant species.



Restore

Restoration activities currently are not a priority. Most of the sites we've removed were very small and should be recolonized quickly by nearby native plants. If a site is heavily disturbed, we will want to look into recolonizing with local native plants. This is something that will need to be investigated for the future.

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