

2014 Water Chestnut Management Program: Lake Champlain and Inland Vermont Waters

FINAL REPORT

4 March 2015

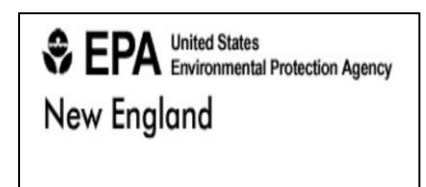
A Report Prepared for the Lake Champlain Basin Program

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Cover photo: Water chestnut in Lake Carmi outlet (VTDEC photo)

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2014 Water Chestnut Management Programs: Lake Champlain and Inland Vermont Water Final Report

Introduction

Water chestnut is an invasive aquatic plant with an annual life cycle first confirmed in Vermont in Lake Champlain in the 1940s. In addition to Lake Champlain, it is known from 27 other Vermont water bodies. This report describes all aspects of 2014 water chestnut management activities conducted by the Vermont Department of Environmental Conservation (VTDEC) [Part 1], The Nature Conservancy (TNC) [Part 2] and other groups (Part 3).

The Lake Champlain Basin Program, a funder and supporter of this program since 1991, identifies water chestnut control and spread prevention as a top priority in the Lake Champlain Basin. In the 2010 *Opportunities for Action Plan*, water chestnut management is discussed in Chapter 7. *Managing Aquatic Invasive Plants and Animals* and specifically, Priority Actions 7.2.1-7.2.4. Water chestnut management can also be linked to priorities set forth in other *Opportunities for Action* Chapters: *Informing and Involving the Public*; *Managing Fish, Wildlife and Plants*; *Effects of a Changing Climate on the Lake Champlain Ecosystem*; *Cultural Heritage and Recreation Resources*; and *Sustainable Economic Development in the Lake Champlain Basin*.

VTDEC water chestnut management has occurred annually since 1982 and in partnership with TNC since 1998. Management goals are to significantly reduce the negative impacts of this invasive plant in Lake Champlain and other waters in Vermont, and to prevent further spread. VTDEC's program involves control in a north to south direction. Handpulling and mechanical harvesting are the control methods used with the majority of the work being conducted under contract. Handpulling is used to control sparse populations of water chestnut or populations inaccessible to mechanical harvesting equipment. Mechanical harvesting is used to control dense and easily accessible mats. When possible, each site is harvested twice during the growing season to control regrowth. TNC employs staff leaders and an all-volunteer workforce to handpull ecologically significant wetland areas concentrated primarily near their Southern Lake Champlain Valley Preserve Office in West Haven, Vermont. A number of other partners also contribute to control water chestnut in other areas of the Lake Champlain Basin.

Funds spent on water chestnut management efforts in Lake Champlain and other waters in Vermont in 2014 totaled \$704,469 (Figure 1-1). Funds spent on management since 1982 are estimated at almost 11.5 million dollars (Table 1-1).

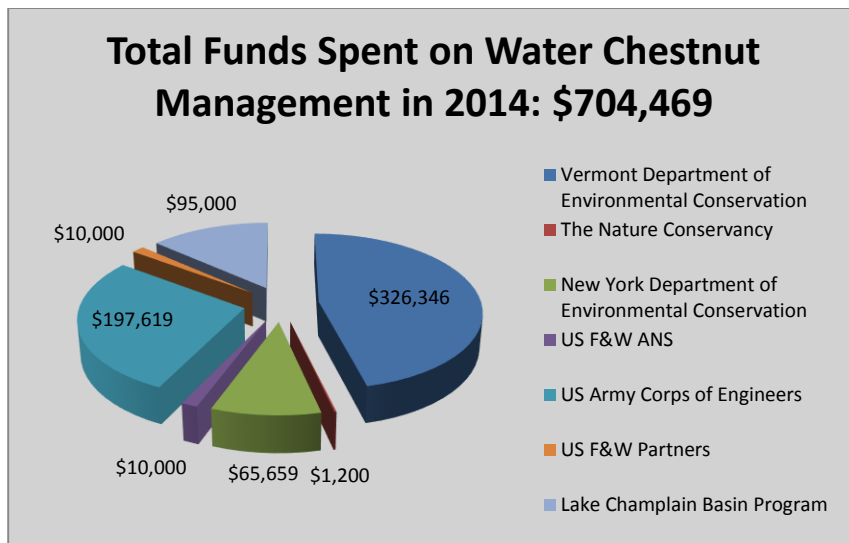


Figure 1-1: Summary of funds spent managing water chestnut in Lake Champlain and in other Vermont water bodies in 2014

Table 1-1: Summary of funds spent on water chestnut management 1982 – 2014

Year	Vermont	New York	USACOE	USFWS ANS	USDA Whip	USFWS Partners Program	Ducks Unlimited	LCBP		TNC	Year Totals
								VT DEC	TNC		
1982	51,556		120,298								171,854
1983	40,700		95,000								135,700
1984	40,700		95,000								135,700
1985	73,000		170,000								243,000
1986	73,000		170,000								243,000
1987	73,000		170,000								243,000
1988	140,000		140,000								280,000
1989	110,000		110,000								220,000
1990	80,000		80,000								160,000
1991	16,667							50,000			66,667
1992		25,000						50,000			75,000
1993		16,667						50,000			66,667
1994	41,846		19,154					50,000			111,000
1995	21,727	7,000	12,060					50,000			90,787
1996	52,806	7,000	20,972					25,000			105,778
1997	136,000							36,000			172,000
1998	150,640		125,000					6,454	19,546		301,640
1999	141,000							160,504	23,040		324,544
2000	160,000	229,126	212,423	14,497				35,000	18,000		669,046
2001	160,000	112,464	157,000	45,503				33,000	14,000		521,967
2002	150,000	90,554	180,000				3,713	40,000	13,000		477,267
2003	133,854	42,147	220,846	11,000			6,287	50,000	13,000		477,134
2004	156,081		252,250	24,000		10,000	5,000	50,000	13,000		510,331
2005	186,919		188,000	13,215		10,000		50,000	13,000	11,917	473,051
2006	150,000	36,298	200,045	2,955	7,650	10,000		50,000	13,000	19,653	489,601
2007	187,592	56,004	276,654	1,500	2,550			56,000	13,000	11,948	605,248
2008	158,738	60,000	208,169	14,026		12,900		69,500	15,000	11,578	549,911
2009	157,049	53,000	98,965			12,000		72,500	15,000	2,653	411,167
2010	159,590	53,000	332,310	20,000		10,000		75,000		2,780	652,680
2011	135,527	63,737	269,563			10,000		76,235	20,000	950	576,012
2012	230,253	59,630	130,890	14,000		10,000		75,000	20,000	150	539,923
2013	330,995	80,640	142,500	10,000		10,000		75,000	20,000	1,200	670,335
2014	326,346	65,659	197,619	8,645		10,000		75,000	20,000	1,200	704,469
Total	4,025,586	1,057,926	4,394,718	179,341	10,200	104,900	15,000	1,360,193	262,586	64,029	11,474,479

To support the goals of the LCBP Ecological Indicators Task Force, water chestnut indicators were developed and are presented in Table 1-2.

Table 1-2: Water chestnut indicators for 2014 management efforts

Indicator	P S R *	Suggested Measures	Values	Currently Collected?	Who Should Collect?	Numerical values	Spatial Resolution	Collection Frequency (minimum)	Reported Frequency (minimum)
Area infested with water chestnut	P	Total number of infested acres ¹	3,930	Y	VTDEC	3,136		Annual	Annual
					NYSDEC				
					TNC				
					QUBEC				
		Number of acres <25% surface coverage	3,462	Y	VTDEC	1,862		Annual	Annual
					NYSDEC				
					TNC				
		QUBEC	808						
Location of mechanical harvesting: miles north of Whitehall, NY	9.7	Y	VTDEC	10	South Lake	Annual	Annual		
Number of lake segments infested	6	Y	VTDEC	6	Lake Segment	Annual	Annual		
Management resources	R	Total Dollars spent on management ²	\$734,769	Y	VTDEC	\$607,510		Annual	Annual
					NYSDEC	\$65,659			
					TNC	\$21,200			
					QUEBEC	\$40,000 (est.)			
Mechanical management	R	Tons of water chestnut removed through mechanical harvesting	2,190.5	Y	VTDEC	997.5		Annual	Annual
					NYSDEC	1,193			
Handpulling management	R	Tons of water chestnut removed through handpulling	20.175	Y	VTDEC	16.1		Annual	Annual
					TNC	3			
					USF&W	0.075			
					QUEBEC	1 (est.)			
		Number of handpulling hours in Lake Champlain and tributaries	5,419.25	Y	VT contracted	4,267.5		Annual	Annual
					TNC	362.25			
					USF&W	397			
					QUEBEC	300 (est.)			
VTDEC	52.5								
Others	40								

¹ Total acreage increased as known sites were added to the acreage map. Quebec acreages in the Basin added 2013.

² Figure includes VTDEC field supervisor salary, TNC total funds, mechanical harvesting, handpulling and composting amount spent, cost of improvements to the offloading/access site and equipment, and, as of 2014, Quebec and NYSDEC funding.

* Pressure, State, Response Column: framework for monitoring water chestnut indicators

Part 1: VTDEC Water Chestnut Management

The majority of VTDEC's annual water chestnut management is carried out under contract. 2014 represented a new contract cycle; RFP's were publicized for all three program elements – mechanical harvesting, handpulling and composting. Contracts were awarded in 2014. During the summer season, a VTDEC field supervisor provided contract oversight, obtained landowner permission for access and disposal of water chestnut, and conducted surveys, searches, and some removal of water chestnut by hand. Other VTDEC Lakes and Ponds Management Section staff assisted with removal efforts, surveys and searches, and conducted outreach efforts.

Authorization

Water chestnut mechanical harvesting activities in Vermont are authorized under, Aquatic Nuisance Control Permit 2005-H01 issued to VTDEC on June 8, 2005. Mechanical harvesting activities in Lake Champlain are authorized from sites located in the towns of Ferrisburgh, Panton, Addison, Bridport, Shoreham, Orwell, Benson, and West Haven for ten years. Handpulling activities do not require a permit in Vermont.

In New York, water chestnut control activities in Lake Champlain and associated waters are authorized under Adirondack Park Agency Permit 2001-47A issued April 26, 2011 to New York State Department of Environmental Conservation (NYSDEC) and VTDEC jointly. This permit authorizes mechanical harvesting and handpulling of water chestnut from Lake Champlain in the towns of Dresden, Putnam, Ticonderoga, Crown Point, and Moriah, New York expires in April 2020. NYSDEC and the Town of Dresden applied for and received a Vermont Aquatic Nuisance Control Permit, #2014-H04, authorizing New York mechanical harvesting activities in Vermont beginning in 2015.

Budget

VTDEC had \$636,093 for 2014 water chestnut management, an increase of more than \$25,000 over the 2013 budget. Management contracts awarded included \$287,619 for mechanical harvesting, \$150,000 for handpulling, and \$6,300 for water chestnut spoils composting. Additional program costs included: support of a VTDEC field oversight position, administrative support, access cost, and access road and compost site improvement. Table 2-1 summarizes the distribution and sources of 2014 funds available.

Approximately 57% of VTDEC's 2014 contract budget was spent on sites located on the New York side of Lake Champlain from Port Henry south to Dresden. The remaining 43% was spent on the Vermont side of the lake from Ferrisburgh south to West Haven.

Table 2-1: Allocation of funds available for VTDEC 2014 water chestnut management

	USFWS Partners	USFWS ANS	LCBP	VTDEC	USACOE	Total
Personal, Fringe, and Indirect (estimated): Field supervisor full time May – October 2014, part-time the rest of the year				\$154,094		\$154,094
Contractual:						
handpulling	\$10,000	\$8,645	\$75,000	\$56,355		\$150,000
mechanical harvesting				\$90,000	\$197,619	\$287,619
composting				\$6,300		\$6,300
Other:						
administration				\$15,000		\$15,000
grant to TNC			\$20,000			\$20,000
Access cost, and roads improvement;				\$3,080		\$3,080
TOTAL	\$10,000	\$8,645	\$95,000	\$324,829	\$197,619	\$636,093

Equipment

Contracted mechanical harvesting equipment used in 2014 included: two mechanical harvesters each with 800 cubic feet storage capacity; a high-speed transport barge; a shore conveyor; and three, four-wheel drive, one-ton dump trucks. Contracted handpulling activities utilized 16 kayaks, several motorized aluminum boats, and a motorized pontoon boat.

VTDEC staff utilized a motorboat and kayaks for survey and search efforts, handpulling, and contractor oversight.

Results

As of 2014, 77 Lake Champlain water chestnut sites are confirmed. Of the 77 sites, 76 were managed in 2014 with mechanical harvesting, handpulling, or use of both methods. Sixty-eight Lake Champlain sites were handpulled only, 7 sites were mechanically harvested only, and 1 site was mechanically harvested and handpulled. Where only handpulling occurred, 60 sites were pulled by contracted crews, 2 sites by contracted crews and partners, and 8 sites were handpulled by non-contracted groups or management partners.

Control efforts progressed approximately 1.5 miles below the Narrows of Dresden in 2014. The northern most mechanical harvesting site was #41Peters Bay located in Benson, Vermont. No new Lake Champlain handpulling sites were added. However, two new “other” water body sites were discovered in 2014 and managed by handpulling only: the outlet area of Lake Carmi in Franklin and in a drainage ditch on the Duval Farm where water chestnut is composted. A new section of Dead Creek in Addison at Nortontown Road was discovered in mid - July.

The estimated total weight of water chestnut removed from Lake Champlain and associated tributaries utilizing both management methods and all partners in 2014 was 1,015.8 tons wet weight. The estimated total

weight of water chestnut removed from all “other” water body sites in Vermont in 2014 was in excess of one ton wet weight.

A breakdown of management techniques for all water chestnut sites in 2014 is provided in Appendix 1 and 2. All of the “other” water body water chestnut sites are included in Appendix 2. A map of Missisquoi Bay and Missisquoi National Wildlife Refuge with water chestnut sites is shown in Appendix 3, Map 1.

A summary of the results of each program element follows.

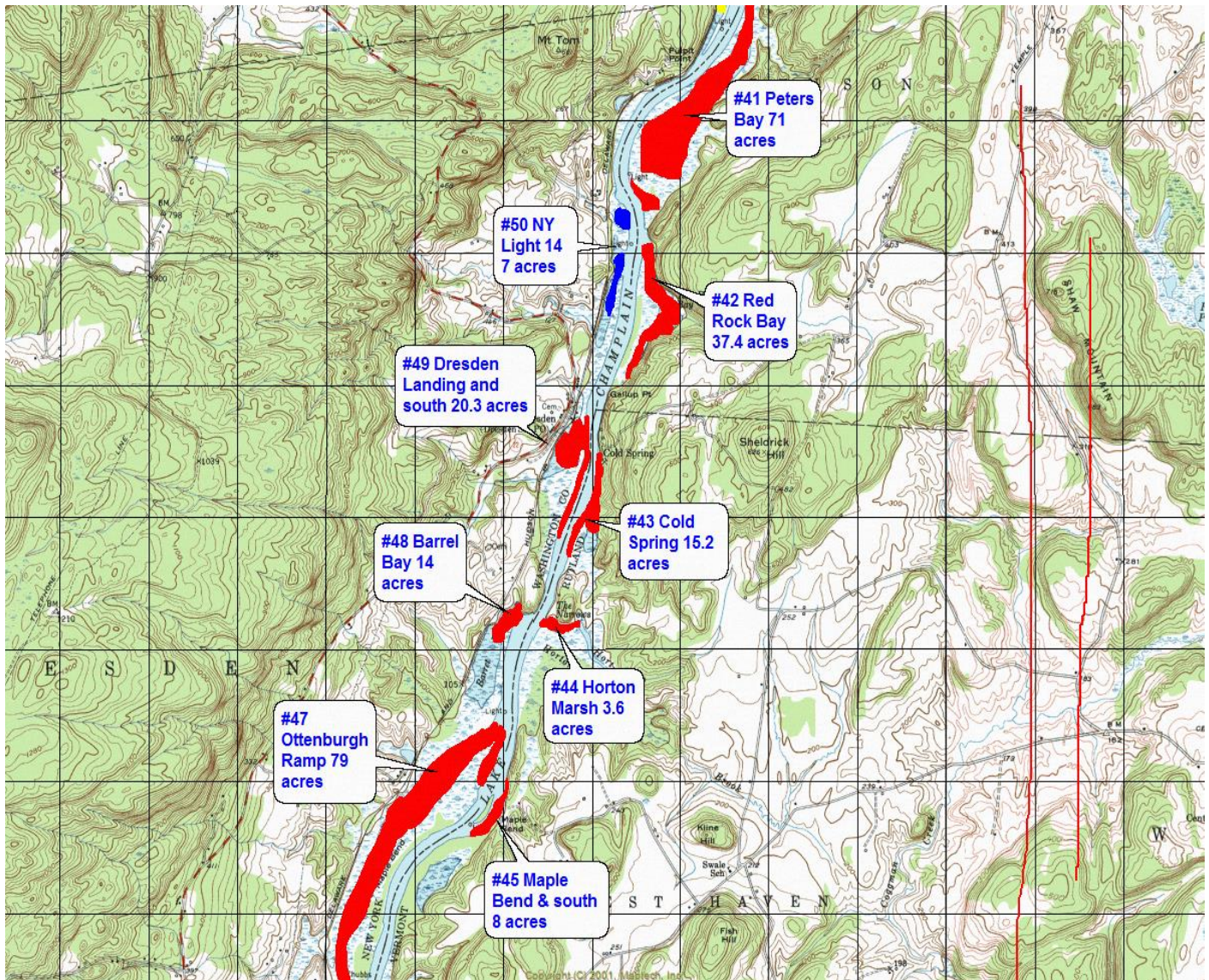
Surveying

- VTDEC staff conducted 20 water chestnut surveys and searches between June 30th and September 29th: 7 surveys of water chestnut populations in Lake Champlain and tributaries, and 12 surveys of “other” water body sites.
- VTDEC staff spent 52.5 hours searching Lake Champlain sites and other water body sites for water chestnut, and removed 551 pounds of water chestnut.

Mechanical Harvesting

- The 2014-2017 contract was awarded to Aquatic Control Technology, Inc. of Sutton, Massachusetts.
- Mechanical harvesting of water chestnut is conducted only in southern Lake Champlain.
- Mechanical harvesting occurred during a seven week period beginning July 7th in Red Rock Bay (Appendix 3, Map 3, site #42) and concluding August 15th south of the Narrows of Dresden at Ottenburgh Ramp (Appendix 3, Map 3, site #47).
- A total of seven Lake Champlain sites were mechanically harvested in 2014 (see Figure 2-1). Water levels were lower than in 2013 and allowed harvesters to access all proposed sites.
- Total mechanical harvesting hours were 752, an increase of 25 hours from 2013.
- All mechanically harvested spoils were offloaded at the Duval Farm 846 Cold Spring Road, Benson, Vermont for composting.
- The offloading/access site at Red Rock Bay on private property again required only minor maintenance this season. Maintenance was conducted in the fall.
- Six long-term Lake Champlain mechanical harvesting sites continued to require handpulling only. One of these six, site #53 New York Light 4, needed mechanical harvesting in 2012, but was handpulled only in 2013 and 2014 (see Figure 2-2).
- As of 2014, the northernmost mechanical harvesting site in Lake Champlain is Peters Bay (Figure 2-1 site #41) in Benson, Vermont, approximately 10 miles north of Whitehall, New York.
- Approximately 7,350 cubic yards, an estimated 997.5 tons of water chestnut spoils were removed via 525 harvester loads from approximately 170 acres of the south lake in 2014 (172 acres in 2013).
- Offload travel distances remained the same as in 2013, however, as a result of more loads harvested (for less funds), the cost of an average mechanically harvested water chestnut load increased from \$435 in 2013 to \$547 in 2014.
- The composting management contract was awarded to Champlain Valley Compost Company (CVCC) of Charlotte, Vermont for the first year of the three-year contract period.
- All composting activities were overseen and performed by CVCC. Dried, bedded cow manure was turned into rows of chestnut spoils to improve the composting process. The compost was turned twice in the fall of 2014 and will be spread on the Daryl Duval farm fields in the spring of 2015.

Figure 2-1: 2014 Lake Champlain mechanical harvesting sites and approximate site acreages



- 2014 mechanical harvesting sites.
- Prior mechanical harvesting site; 2014 coverage less than 25% coverage but too far south to handpull.
- Shallow water sites with less than 25% water chestnut coverage, handpulled in 2014.

Figure 2-2: Six long-term Lake Champlain mechanical harvesting sites trending to handpulling

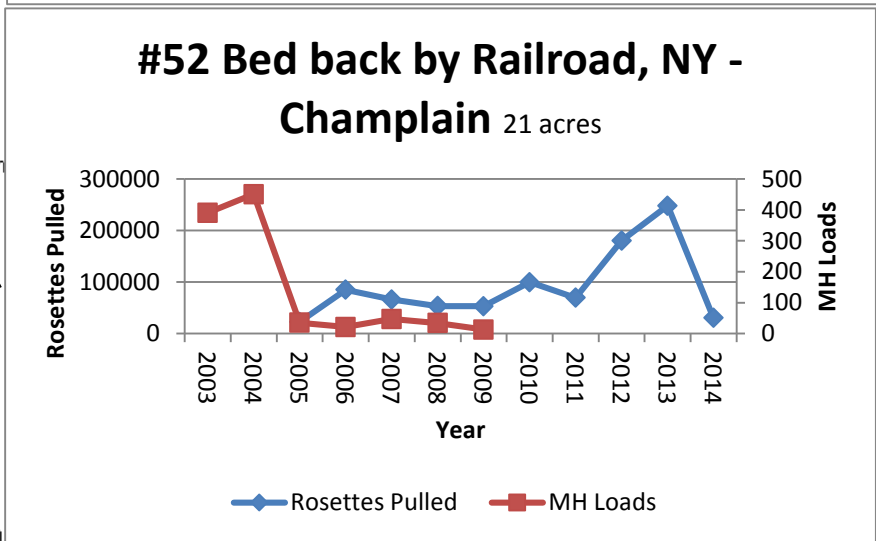
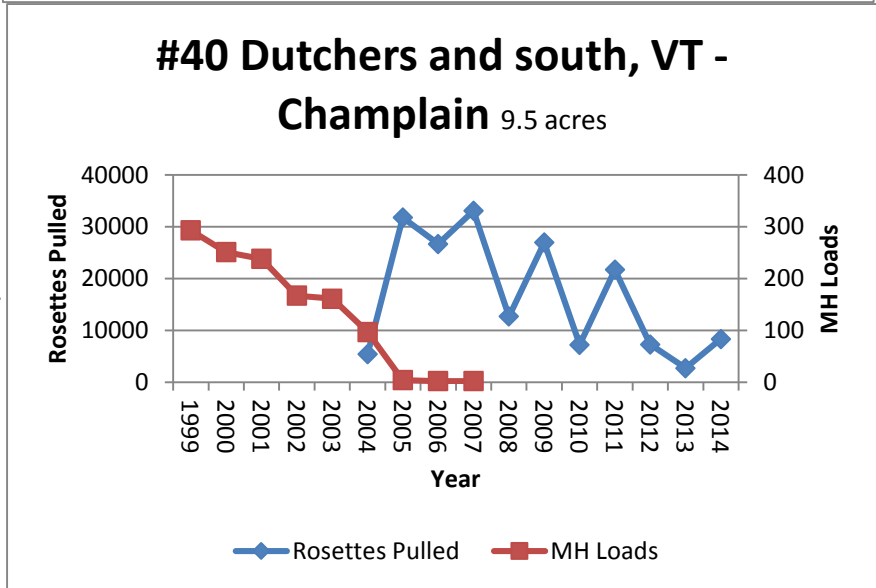
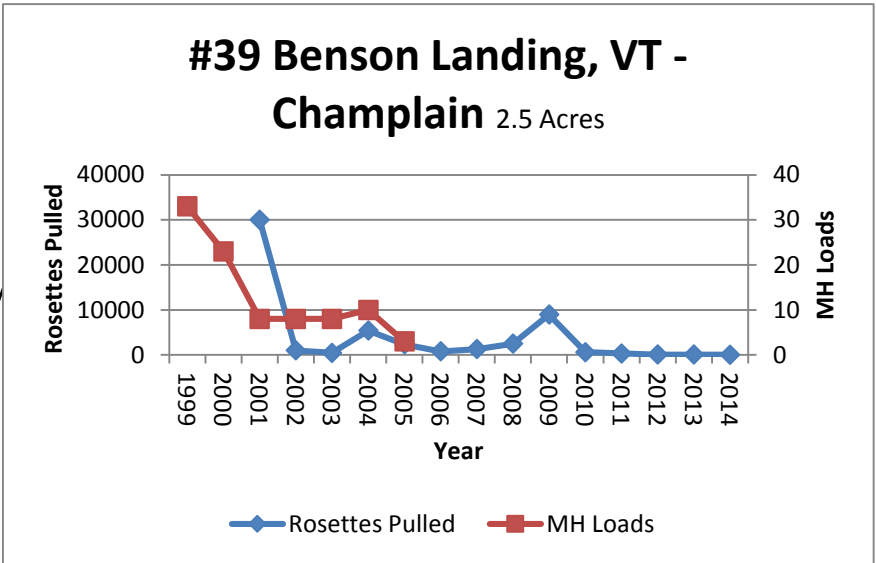
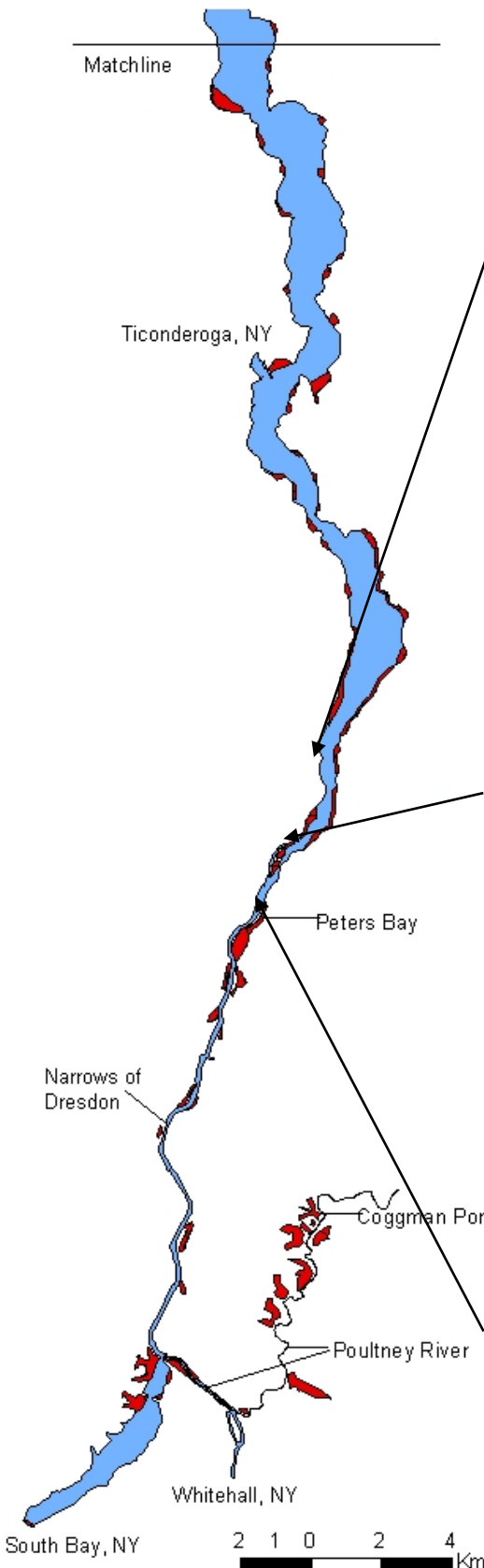
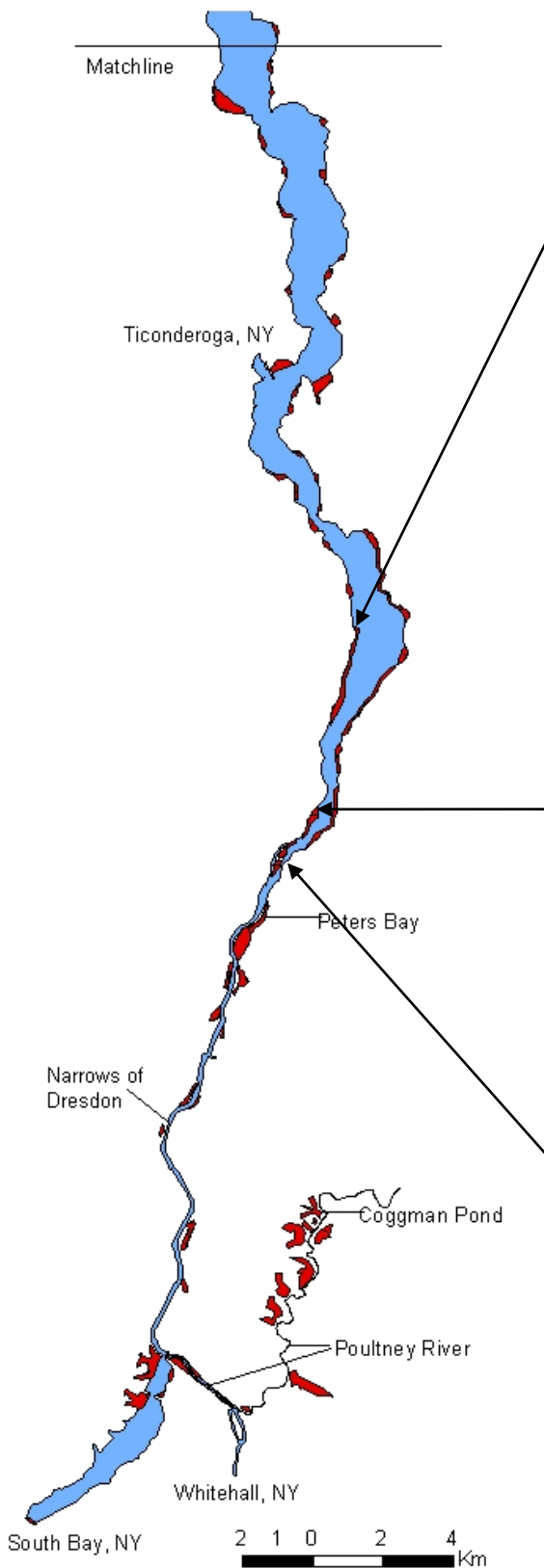
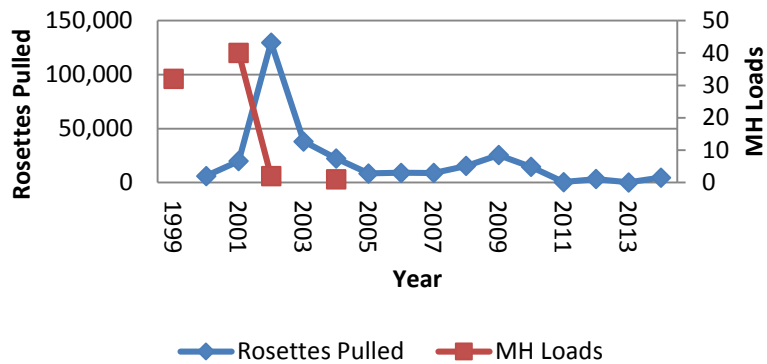


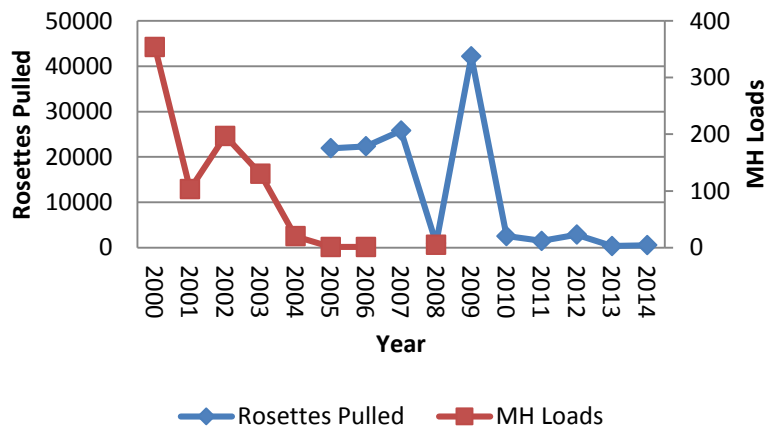
Figure 2-2 continued



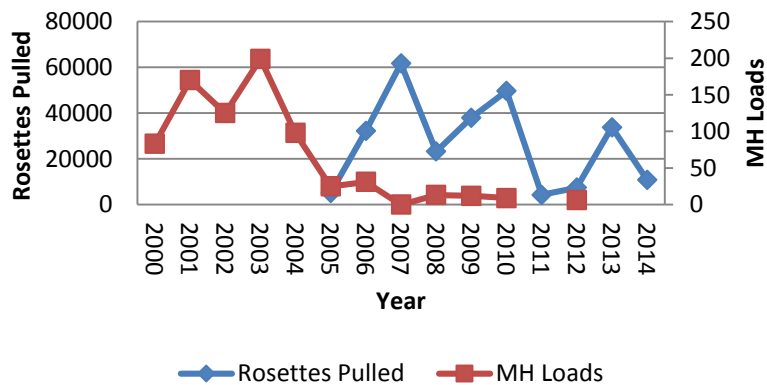
#55 Sixmile Point and south, NY - Champlain 32 acres



#54 60 Acre Site, NY - Champlain



#53 NY Light 4, NY - Champlain 12.5 acres



Handpulling

- The 2014-2017 contract was awarded to Lakeside Restoration Services of Fair Haven, Vermont. Hourly handpulling rates were up considerably as a result of a new three-year contract cycle.
- Contracted handpulling commenced on June 23rd in Whitney Creek, Addison, Vermont (Appendix 2, site #15) and ended on August 19th north of Fort Ticonderoga, Ticonderoga, New York (Appendix 2, site #63).
- Sixteen contracted handpullers worked an average of 40 hours per week throughout the 8 week season.
- Contracted crews targeted 61 Lake Champlain and associated tributaries sites, and 7 “other” water body sites. Crews spent 4,267.5 hours removing approximately 15.3 tons of water chestnut from all 61 handpulling sites.
- More than 1,000 acres of water chestnut were handpulled. The area covered represents an estimated 129 miles of Lake Champlain shoreline - approximately 88 miles in Vermont and 41 miles in New York, spanning the area between Ferrisburgh and Benson, Vermont.
- Other partners, handpulled water chestnut from Lake Champlain and “other” waters. Handpulling hours by all groups – contractors, and TNC, LCBP, USACOE, USFWS, VTFPR, private citizens, and VTDEC staff - totaled 5,120.
- At 20 Lake Champlain water chestnut sites, 10 or less rosettes were found and removed. Figure 2-2 provides trends in handpulling data for six long-term handpulling sites in Lake Champlain.
- At 10 of the 27 “other” water body sites, less than 10 rosettes were found and removed. Figure 2-3 provides trends in handpulling data for six long-term “other” water body sites.
- Three new “other” waterbody sites were discovered in 2014. In September, more than 6,481 water chestnut rosettes were found and removed by hand from the outlet of Lake Carmi in Franklin, Vermont. In mid-July, a new site within Dead Creek near Nortontown Road, Addison, Vermont was found; 25,131 rosettes were removed by hand. In late September, 36 water chestnut rosettes were pulled from a drainage ditch at the Duval compost site in Benson, Vermont.

Figure 2-3: Control trends for six Lake Champlain long-term handpulling sites

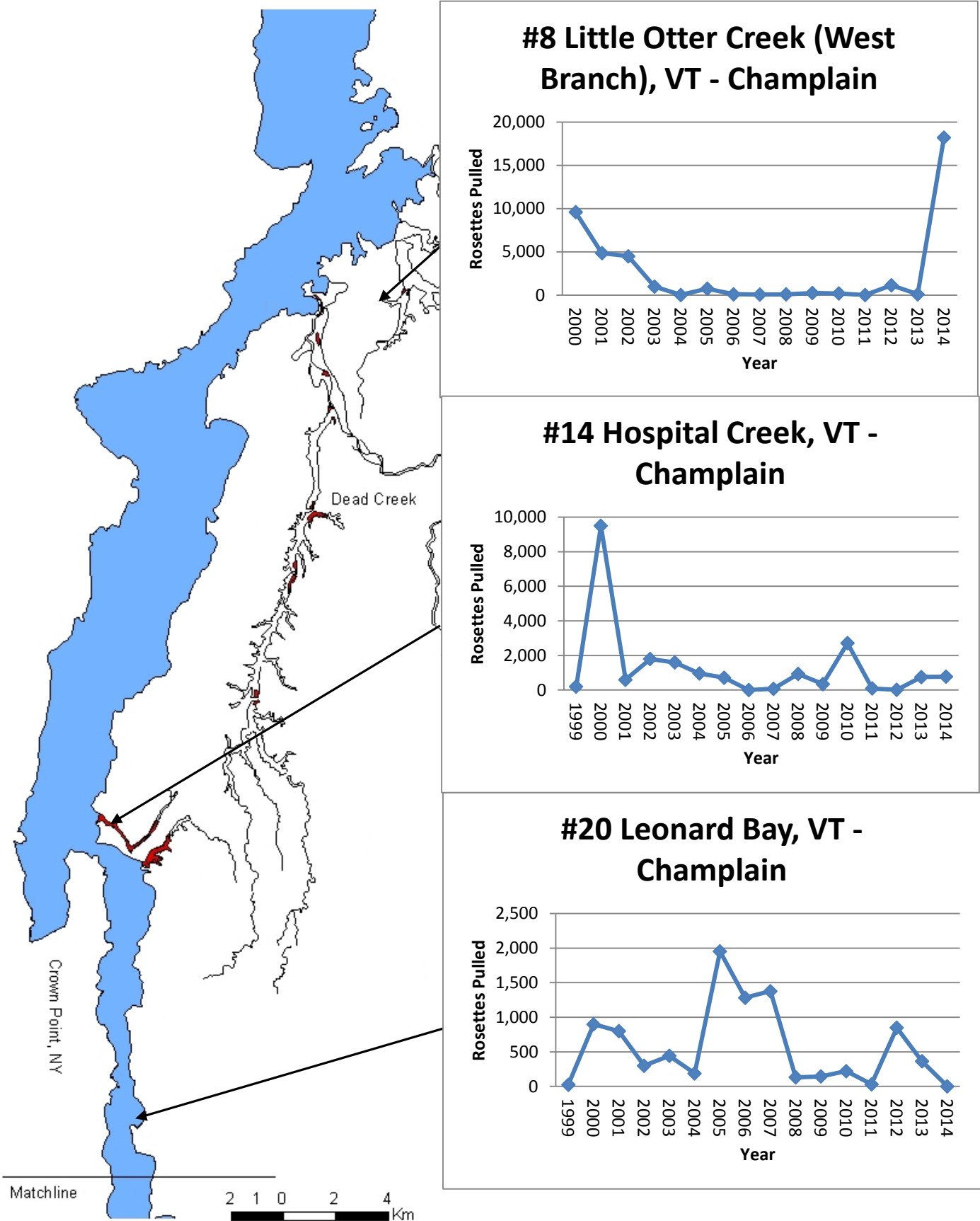


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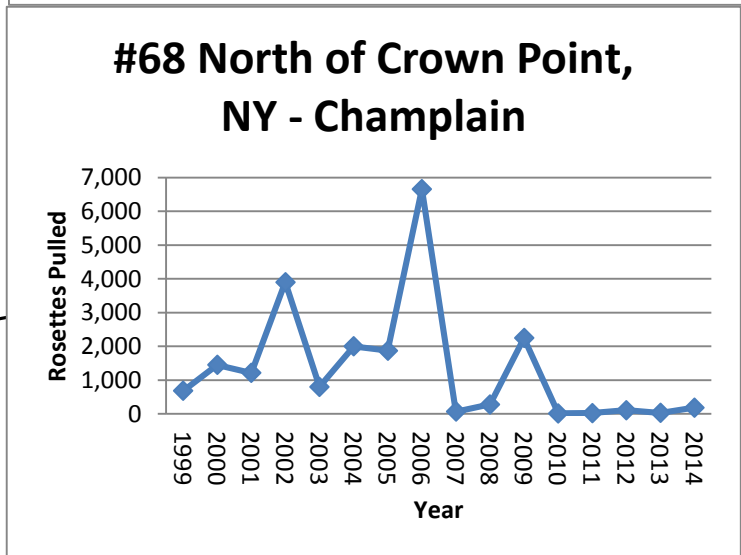
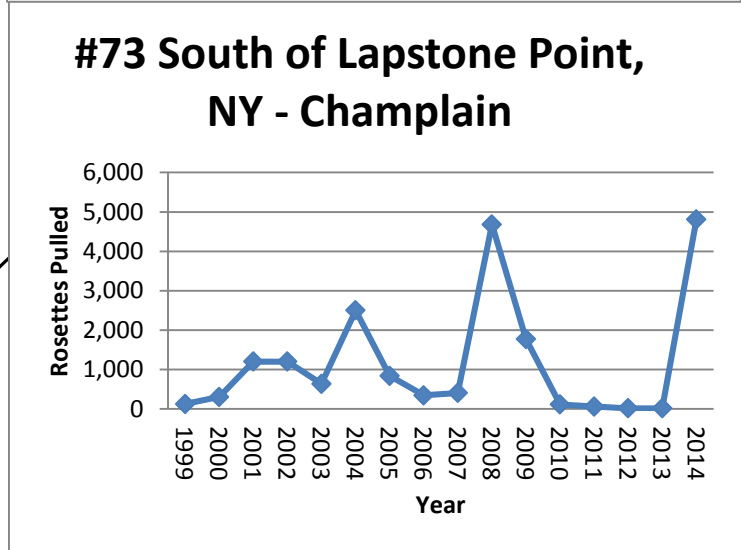
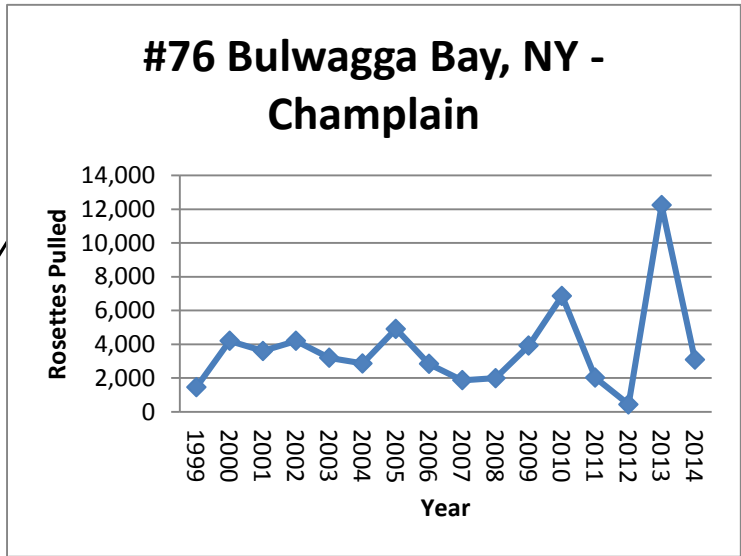
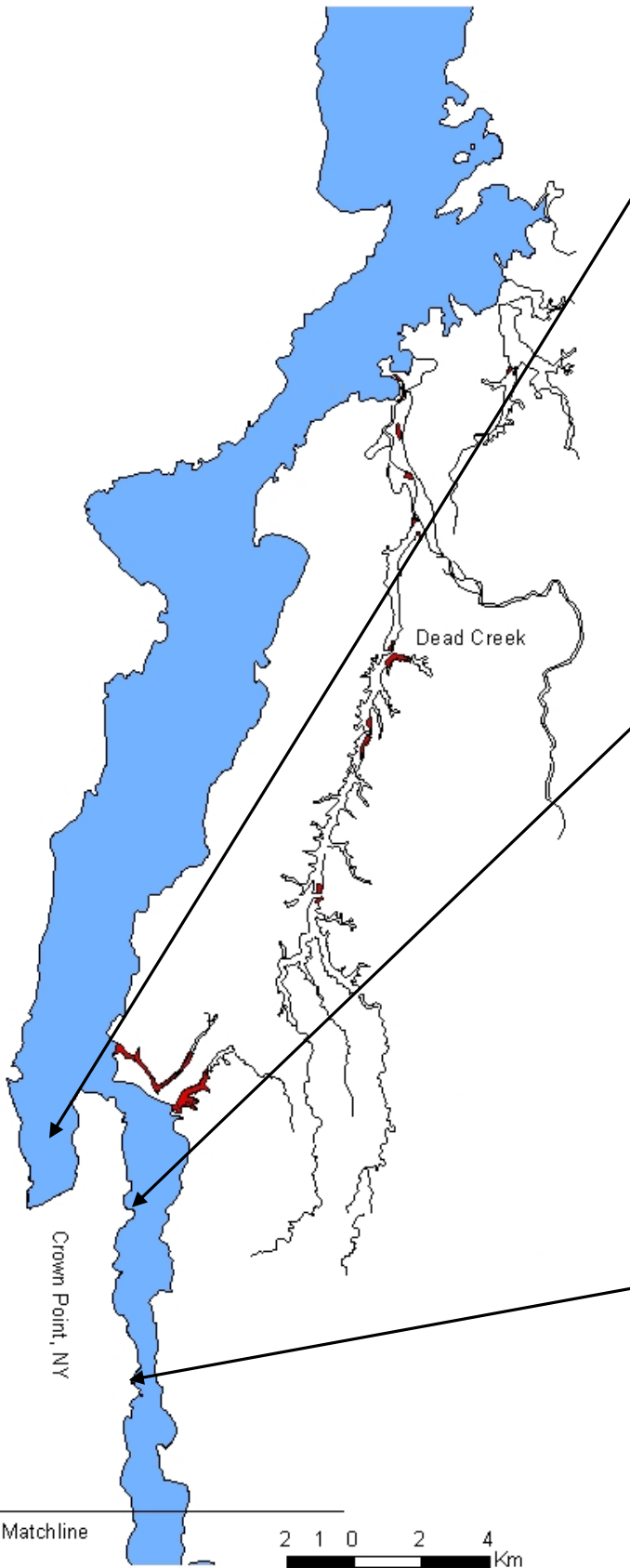
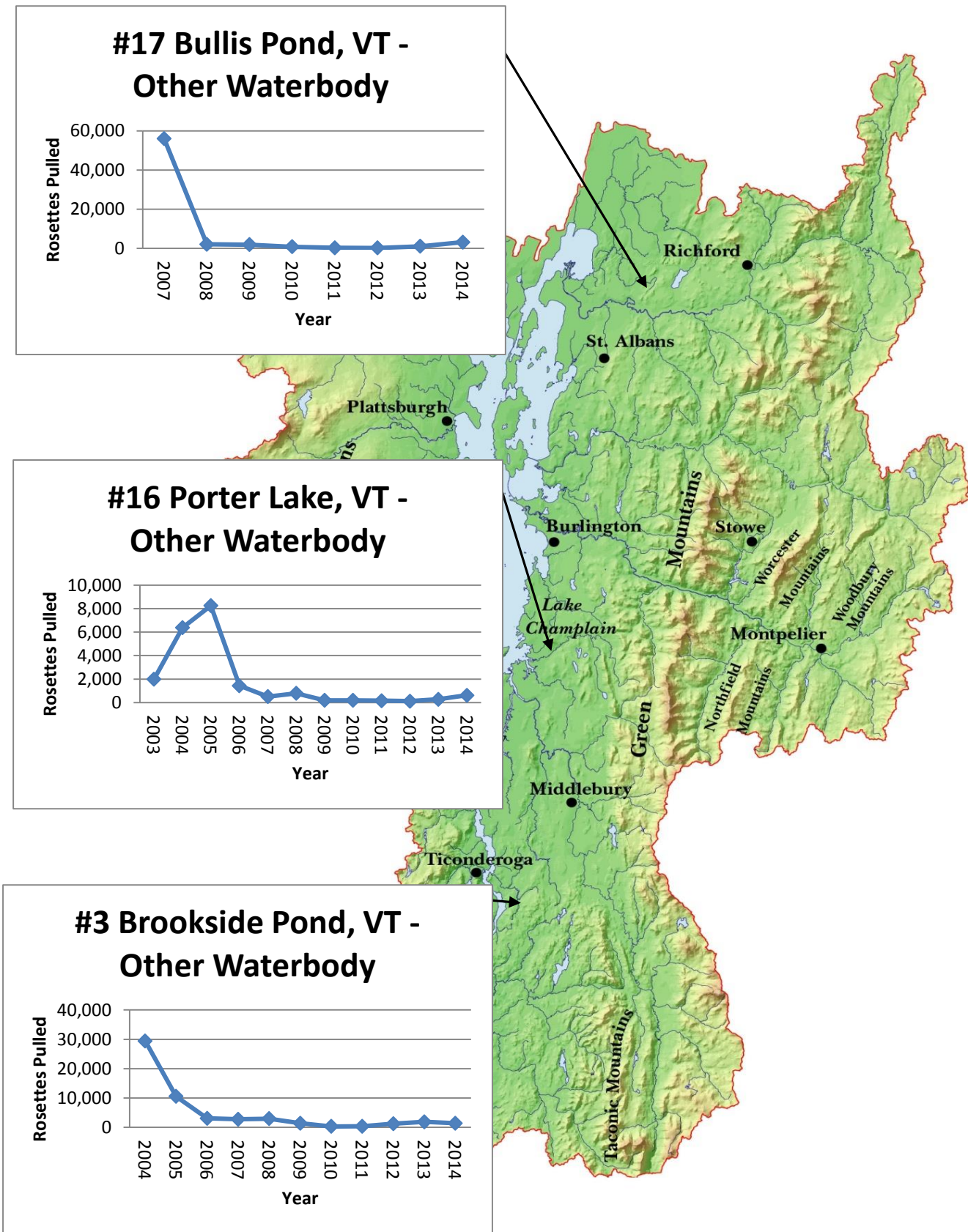
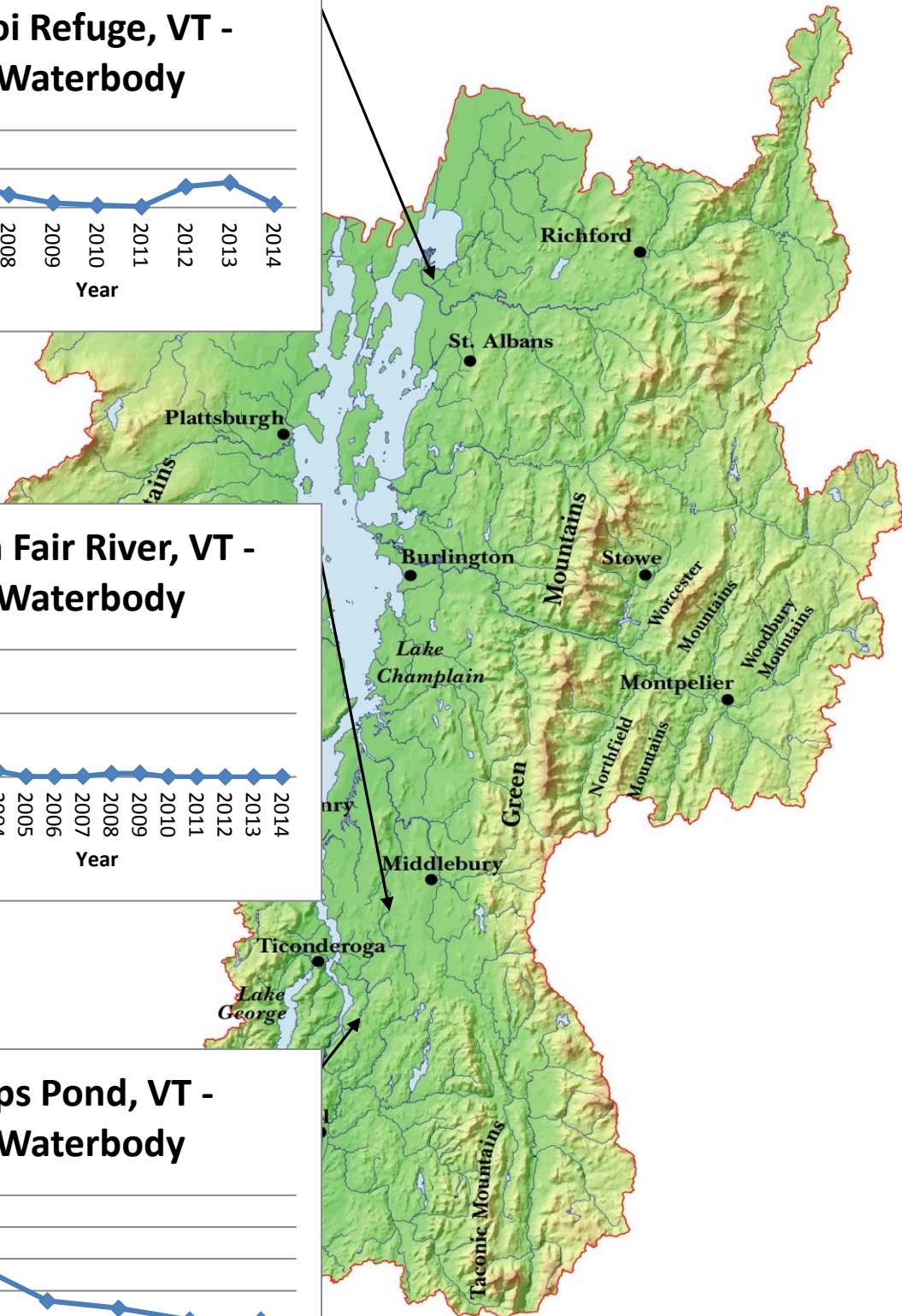
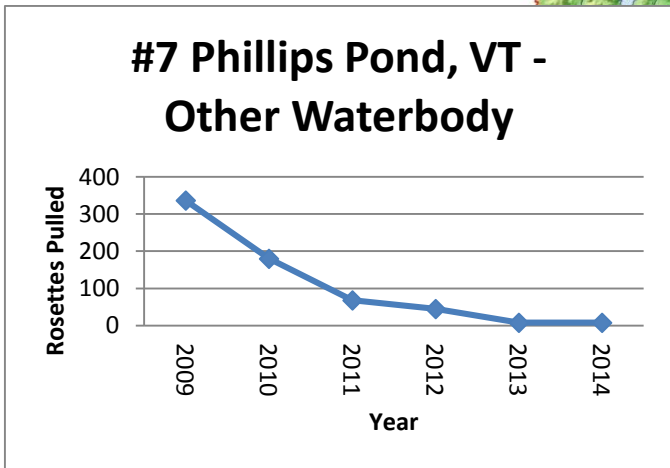
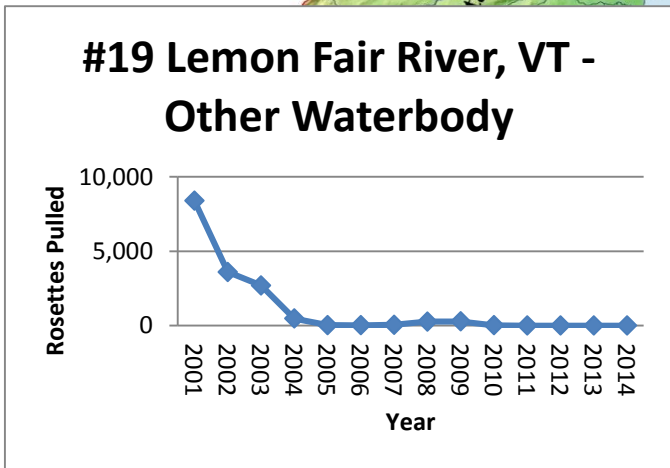
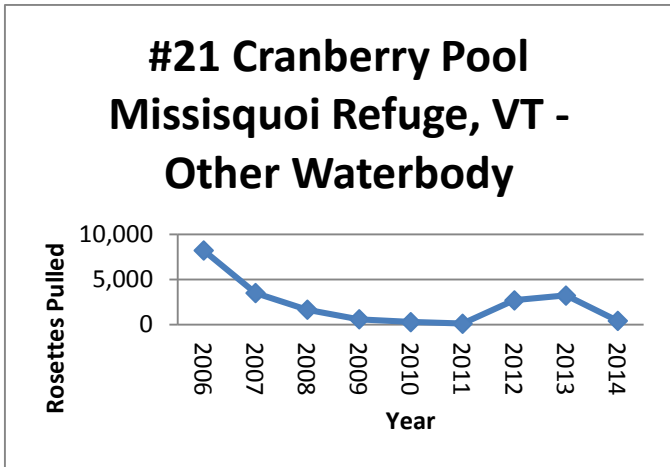


Figure 2-4: Control trends for six “other” water body handpulling sites in Vermont



Map credit LCBP

Figure 2-4: Control trends for six “other” water body handpulling sites in Vermont continued



Map credit LCBP

Education and Outreach Efforts

All Vermont Department of Fish and Wildlife public boat accesses in the Lake Champlain Basin were visited winter, spring or fall to maintain aquatic invasive species warning signs with information about water chestnut and current Vermont transport laws. Aquatic invasive species rack cards were stocked at these accesses and any damaged brochure boxes replaced.

Two Vermont Invasive Patrollers (VIP) workshops were attended by 26 people in 2014: one workshop hosted by the Northern Forest Canoe Trail and held at Missisquoi National Wildlife Refuge Visitor Center, and the other hosted by the Memphremagog Watershed Association and held at the Hebard State Office Building in Newport. Water chestnut is one of a number of species participants are trained on. Fifty VIP volunteers contributed over 215 hours collectively in their surveying efforts of 17 Vermont lakes in 2014. No new invasive species infestations were reported as a result of these efforts.

Staff held seven public water body access training workshops: four specifically for the Vermont Greeter Program and three for Vermont State Park employees. In addition to greeter etiquette, these workshops provide specific information on water chestnut and other aquatic invasive species, and current Vermont transport laws. A total of 113 individuals were trained representing 30 bodies of water.

Conclusions

In 2014, 76 of 77 Lake Champlain water chestnut sites were managed. Control methods used included mechanical harvesting and handpulling. Contracted handpulling crews targeted 61 sites, including one mechanical harvesting site and 7 sites were mechanically harvested only. Eight Lake Champlain sites were handpulled by other management partners, and two other sites were handpulled by VTDEC contract handpullers and partners.

No water chestnut was found at 14 Lake Champlain sites and 9 “other” water body sites in 2014, and 10 or less water chestnut rosettes were found and removed at 6 Lake Champlain sites and 1 “other” water body site.

Contracted mechanical harvesting efforts progressed 1.5 miles south of the Narrows of Dresden in Lake Champlain to Ottenburgh Ramp, Dresden, New York. The northernmost mechanical harvesting site in Lake Champlain was Peters Bay, Benson, Vermont. Densities at most mechanical harvesting sites were lower than in 2013 except for site #45 Maple Bend and site #47 Ottenburgh Ramp which had thick mat conditions. Site #53 at New York Light 4 required only handpulling again in 2014, and the northern most mechanical harvesting site #41 Peters Bay needed only harvesting in approximately 50% of the bay as densities were reduced by long term management. Water chestnut densities were also down in site #42 Red Rock Bay, site #49 Dresden Landing and #43 Cold Spring Landing.

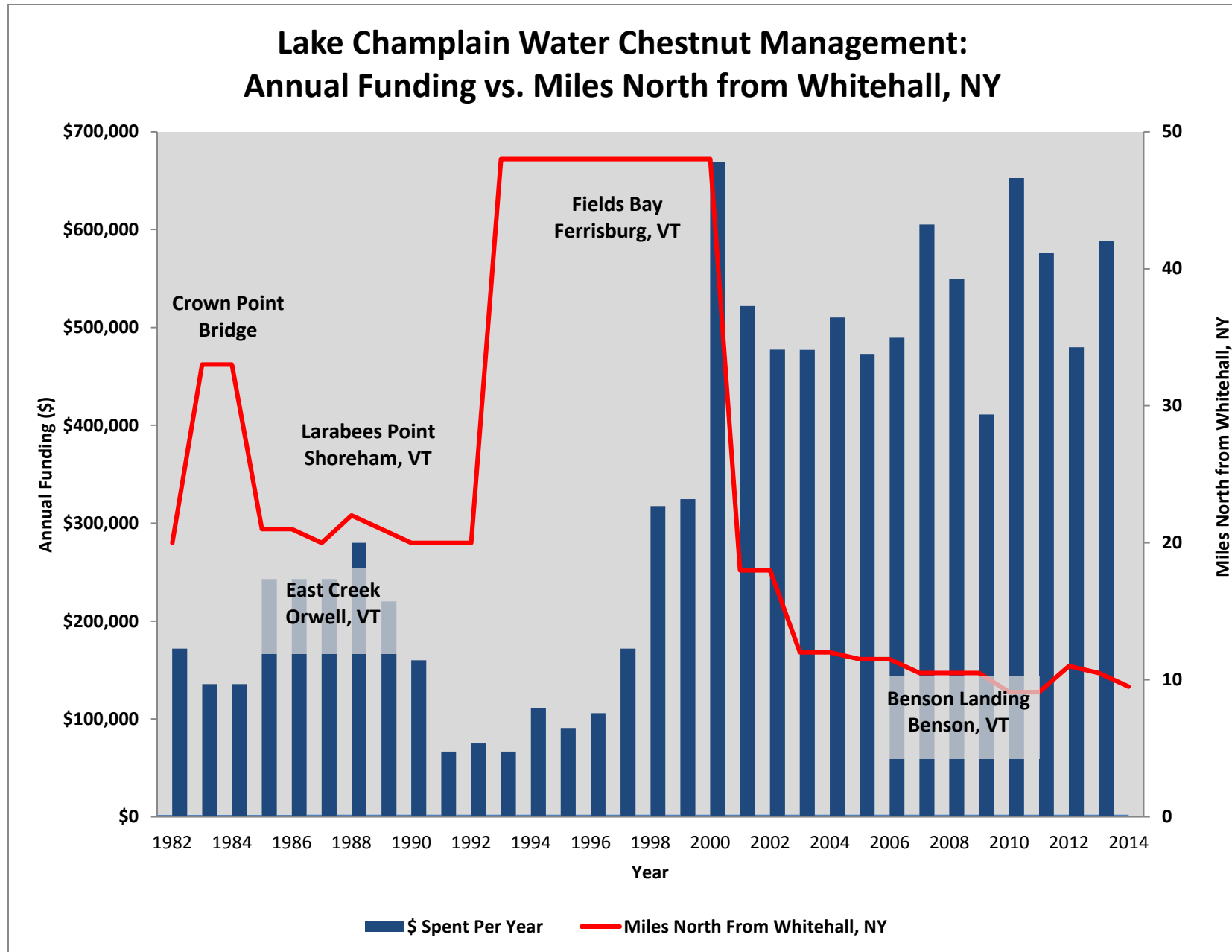
Approximately 7,350 cubic yards, an estimated 997.5 tons, of water chestnut were removed in 525 harvester loads from approximately 170 acres at 7 sites. Use of the Red Rock Bay privately owned access for a mechanical harvesting base of operations and offloading continues to improve efficiency of management efforts, although mechanical harvesting sites are more than three miles south of this access site. The approximate cost per load transported in 2014 increased from \$435 in 2013 to \$531, a difference of \$96 per load. All 525 mechanically harvested water chestnut loads were composted on one farm in Benson, Vermont near the access site. Two turns of these spoils were completed by the end of October. The finished compost will be spread on the farm's fields in the spring of 2015.

Twenty-one previously infested Lake Champlain handpulling sites had less than 10 water chestnut rosettes. Dramatic increases in water chestnut populations were noted at 13 Lake Champlain handpulling sites. The most significant increase was at site #8 Little Otter; water chestnut rosette numbers spiked from 102 in 2013 to over 18,000 in 2014. The most significant decrease was at site #53 Bed back by railroad; rosette numbers pulled dropped from over 248,000 in 2013 to 30,301 in 2014. No water chestnut was found at 14 Lake Champlain sites, and 10 or less water chestnut rosettes were found and removed at 6 sites. Handpulling efforts ended at the southern end of Peters Bay, 2.75 miles north of where mechanical harvesting efforts ended. Contracted handpulling crews removed more than 16.1 tons of water chestnut from 61 handpulling sites.

Water chestnut at all “other” water body sites was managed by handpulling only. Four “other” water body sites had significantly larger populations than in 2013. No water chestnut was found at 9 “other” water body sites, and 1 site had less than 10 rosettes were found and removed.

Two new Vermont “other” water body sites were discovered in 2014: Lake Carmi in Franklin, and a drainage ditch at the Duval Farm in Benson, Vermont. Additionally, Dead Creek in Addison, previously confirmed with water chestnut, had a new site confirmed. Long-term water chestnut management trends continue to show positive advances in the reduction of all known water chestnut populations in Lake Champlain – a result of 33 years of effort and approximately 11.5 million dollars. The northernmost mechanical harvesting site has been reduced from 46 miles north of Whitehall, NY to less than 11 miles (Figure 2-5). The goal of the current program remains to shift from expensive mechanical harvesting to maintenance handpulling, with ongoing surveillance in all areas. There is a five mile section of Lake Champlain between Ottenburgh Ramp site, New York and Whitehall, New York where water chestnut sites have not been delineated. In this section, there is one large water chestnut mat site in West Haven, Vermont estimated at 60 acres, known as the Drowned Lands, and numerous small areas (handpulling only required) along both sides of the lake. Although water chestnut has been found in 27 “other” waterbodies in Vermont, early detection and rapid response efforts has led to effective control using handpulling only, and in some waters, water chestnut elimination.

Figure 2-5: Annual water chestnut funding vs. northernmost mechanical harvest site in Lake Champlain, 1982-2014



Part 2: TNC Water Chestnut Management

Objectives

The Vermont Chapter of The Nature Conservancy (TNC) has organized its ongoing water chestnut management program every summer since 1998 to reduce the threats that water chestnut (*Trapa natans*) poses to conservation targets in the Lake Champlain Basin. The Conservancy has identified eight conservation targets in the Southern Lake Champlain Valley. Two of these eight targets are adversely affected by water chestnut: 1) wetland, floodplain, and riparian natural communities; and 2) the littoral aquatic communities.

Management Summary and Changes to the Program in 2014

TNC staff organized 42 workdays in 2014 between June 25 and September 2nd, handpulling 7,315 pounds of water chestnut. Handpulling activities were conducted at 23 sites, and volunteers donated a total of 165 hours of labor to water chestnut management (Table 3-1). As in past years, TNC staff continued to focus on sites considered ecologically significant¹: East Creek, Poultney River Wetlands, and South Bay's southern end. In addition, inland sites continued to be handpulled, including Parson's Mill Pond, Root Pond, and Pelkeys Swamp.

In 2014, Betsy Johnson was hired as the seasonal Water Chestnut Field Coordinator, and led most of the fieldwork. Paul Marangelo, Senior Conservation Ecologist for TNC's Vermont Chapter, supervised the Field Coordinator, provided administrative, logistical, and field support, and worked on volunteer recruitment.

As in past years, workdays are scheduled to minimize the probability of inadvertently dispersing zebra mussels to non-infested waters. Canoes were washed and sun-dried after each workday, and TNC staff made an attempt to not schedule any workdays at non-infested sites immediately after a workday at an infested site.

Volunteers

TNC continued to recruit volunteers to assist with water chestnut management efforts via newspaper calendar announcements, bulk mailing to previous years volunteers, flyer postings, and handouts. This year, 34 volunteers contributed 164 hours (Table 3-1).

Given the progress the program has made in controlling water chestnut populations, there are now fewer sites with large numbers of plants that are well-suited for volunteer work groups. TNC has accordingly evolved its approach for water chestnut management towards using volunteers on a more limited basis at a smaller set of sites than in the early years of the program. Their effort to recruit new volunteers has therefore been reduced to a level that is commensurate with meeting the goal of maintaining an optimum level of volunteer engagement, where the time spent orchestrating volunteer workdays and managing individual and group of volunteers is most efficient in terms of programmatic cost, time, effort, and work achieved.

¹ Sites that are noted by the Vermont and/or New York Natural Heritage Program databases as containing rare/high quality natural communities and/or rare species.

One volunteer group returned from previous years to pull water chestnuts: Barn Day Camp of Plymouth, Vermont. In addition to youth groups, four interns from TNC's Leaders in Environmental Action for the Future program contributed to water chestnut management efforts in July, as did staff from the Lake Champlain Basin Program during a staff outing. In addition to volunteer hours, TNC staff and Americorps staff provided 336 hours of field work.

Table 3-1: Volunteer hours and water chestnut harvest summary data by year

	Days	Volunteers	Hours	Sites	Pounds	Rosettes
1998		64	1,088	12	17,775	X
1999	33	282	1,554	11	154,620	X
2000	46	315	1,861.5	15	109,170	X
2001	45	259	1,463.5	20	87,435	X
2002	34	148	724.5	17	14,219	X
2003	34	238	941	17	30,225	X
2004	42	222	1,143	21	17,651	X
2005	45	292	1,225.5	29	16,412	187,568
2006	49	232	1,384	22	12,864	60,244
2007	49	307	1,380	23	9,771	47,956
2008	45	253	1,212	24	17,270	81,462
2009	39	203	787	23	6,845	29,297
2010	40	185	681	24	5,445	30,527
2011	48	64	537	26	6,903	34,323
2012	38	55	347	21	5,756	30,787
2013	40	51	373	21	9,024	44,661
2014	42	34	164	24	7,315	55,891
Total			16,866		528,700	602,716

Methods

Since water chestnut is an annual plant, repeated annual handpulling of rosettes before mature seed drop is an effective way of controlling populations. TNC staff and volunteers search for and handpull water chestnut rosettes in targeted wetland sites throughout the growing season via visual searches from canoes and/or kayaks.

The objective for each managed site is to search for, and handpull all existing water chestnut rosettes. Once pulled, harvested water chestnut is placed in Gardener's Supply bags and weighed with a spring scale. TNC staff estimates the number of rosettes handpulled by weighing and counting a subset of handpulled rosettes. The total daily rosette harvest is estimated by extrapolating the measured rosette per pound ratio to the entire harvest weight at a given site.

In order to better characterize existing conditions and trends in water chestnut infestation numbers, sites are classified according to their infestation intensity. Classification categories are defined in terms of number of harvested water chestnut rosettes per acre, according to the scheme depicted in Table 3-2.

The upper limits of this classification were derived from an estimate of water chestnut rosettes per acre from handpulling efforts in dense water chestnut mats in the Drowned Lands (south of the Narrows of Dresden on the Vermont side of the lake) in 2005, where an estimated 400,000 rosettes per acre were pulled.

Since water chestnut harvests were recorded as numbers of bags full of pulled water chestnut in the initial years of this program (1998-2000), in order to compare harvest data over the years, the harvest weight recorded during this period is estimated by multiplying the number of bags by the approximate weight of a full bag of handpulled water chestnut (90 lbs).

Table 3-2: Water chestnut infestation intensity classification

Infestation intensity	Rosettes/acre
Negligible	< 10
Low	10 – 350
Moderate	350 – 800
High	800 – 5,000
Mats	> 5,000

Results and Discussion

Water chestnut harvests generally continue to exhibit a pattern of decline or stabilization at most of the sites under active handpulling management. However, a small number of notable exceptions have occurred over the past few years, where anomalous increases in harvests were found. While no such increases were noted this past season, two sites maintained anomalously high abundances of water chestnut (Nichols Marsh and East Bay).

Sixteen of TNC’s management sites are isolated ponds or wetlands, and therefore receive few if any water chestnut seeds from other infested sites. These sites therefore can be considered directly responsive to site specific management efforts: because there are no seeds entering these sites from other infested areas, our annual hand pulling efforts can be expected to vastly diminish if not curtail the reproductive success of water chestnut populations within a given site, and any changes can be attributed by patterns of water chestnut abundance over a series of years to the effectiveness of the annual handpulling efforts.

In addition to the 21 sites managed for water chestnut, two additional inland ponds were scouted for the presence of water chestnut in 2014. Loves Mash and Old Marsh Pond have been searched every couple of years for more than 10 years, no water chestnut has ever been found. TNC hand-pulling efforts were supplemented by VTDEC-contracted hand-pulling crews in 2014 at East Creek and La Chute River Wetlands.

The most noteworthy site-specific results in 2014 are as follows:

Little Cat Den Bay, West Haven, VT

In 2014, TNC staff was able to access for the first time a large marsh that is directly connected to area that has been referred to as “Little Cat Den Bay”, increasing the size of this site from 0.4 to 8.9 acres. Higher numbers of water chestnut pulled at this site in 2014 are due to the increased area rather than to increased densities of plants.

Nichols Wetland, West Haven, VT

This site yielded large amounts of water chestnut for the second consecutive year. Though harvest weights were less in 2014 (247 lbs) than 2013 (359 lbs), this site had remarkably large numbers of water chestnut compared to previous years. The large number of rosettes per acre (914 in Table 3-4) were realized partially because a second late season visit to the site yielded a high number of small second-growth rosettes. These additional rosettes pushed this site into the “high” infestation intensity category (Table 3-2). The two year spike in numbers of rosettes at this site is surprising, given that it is a very small, easily searched wetland (2.5 acres) with no direct connection to another water body.

East Bay, West Haven, VT

In 2013, this site was not completely managed, because of work demands from other project sites. Accordingly, staff found large numbers of plants at a portion of this site in 2014 in the wetlands flanking the railroad bridge to South Bay. The westernmost of these wetlands in particular had a large mat of water chestnut plants. Efforts to pull in these areas continued into early September, when further efforts were deemed ineffective because most of the plants had dropped mature seeds. A lower priority is placed on this site, since it is comprised of wetlands and shoreline that constitute part of Lake Champlain and frequently accumulate water chestnut from drifting plants dislodged further south in the lake.

Finch Marsh, Whitehall, NY

After a dramatic spike in abundance at this site in 2013, water chestnut rosette numbers declined to levels that are more “normal” for this site (45 lbs). This site was dewatered by the breach of a beaver dam in 2012, and no water chestnut was able to be handpulled at all during that year.

Table 3-3: Pounds of water chestnut harvested by year per site, 2002 – 2014

Site Name	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Billings Marsh	53	50	132	975	157	275	149	118	2135	3866	310	233
Brookside Pond	X	VTDEC	957	412	693	705	51	37 ⁵	30 ⁵	286 ⁵	6	6
Coggman Pond	211	87	18	26	39	84	74	35	37	24	140	25
Cook Island West	X	173	X	X	1839	1109	105	175	14	149	73	959
Culvert Bay NY	X	X	X	X	X	X	X	X	X	X	143	234
East Creek	1034	996 ²	1281	2315	341	565 ⁵	2429 ⁵	992 ⁵	136 ⁵	437 ⁵	2092 ⁵	2426 ⁵
Finch Marsh	55	413	178	124	187	189	61	137	208	X	1726	45
Finch Marsh Outlet	X	490	15	0	0	10	51	0	X	14	X	X
Hubbarton Ponds	X	X	0	X	X	X	0	X	X	X	0	X
Inman Pond	X	X	0	X	X	X	X	X	X	X	X	X
La Chute River Marshes	VTDEC	VTDEC	VTDEC	418	334	3606 ⁵	3495 ⁵	1848 ⁵	1919 ⁵	360 ⁵	223 ⁵	187 ⁵
Little Cat Den Bay	X	X	X	X	X	X	X	X	X	63	20	237
Nichols Wetland	75	31	203	280	18	44	5	113	48	38	359	247
Mill Bay	X	X	X	X	X	3220	X	X	X	X	X	X
Old Marsh Pond	X	X	0	X	X	0	X	X	0	X	X	0
Parsons Mill Pond	635	365	400	697	181	199	198	137	360	110 ⁵	36 ⁵	64
Pelkey Swamp	0	2 plants	0	1 plant	15	20	36	56	15	35	127	49
Reed Marsh	147	183	264	94	287	236	64	61	25	64.5	84	56
Rogers Marsh	0	3 plants	6 plants	2 plants	26 plants	93	28	1	5	10	1	4
Root Pond	X	10 plants	X	10 plants	6 plants	6	2	17	4 plants	0	1	9
East Bay	259	1241	270	981	1042	2091	191	1035	1417	164.7	8	3012
Saslow Marsh	X	70	48	76	94	133	88	206	58	15	106	12
Schoolhouse Marsh	128	57	43	20	4	7	5	51	18	118	130	61
Schoolhouse Marsh North	587	83	51	43	70	133	22	99	495	6	23	8
South Bay	492	173	30	43	91	53	83	53	32	33	210	49
South Bay/Timber Marsh	X	X	644	826	153	641	698	293	172	326	4343	1049
South Bay/Harvester sites	X	X	X	X	3120	2366	X	X	X	X	X	X
South Fork	421	87	263	324	134	17	66	200	213	265	582	322
The Drowned Lands	25479	13006	10359	X	X	X	X	X	X	X	X	X

¹ 2001 pounds are estimates made from a number of bags filled: 1 full bag = 90lbs of water chestnut.

² Additional harvest conducted by VTDEC at the mouth of the creek.

³ From mouth of Poultney River to Buoy 33 – formerly called “South Lake Champlain.”

⁴ Includes Timber Marsh area of South Bay

⁵ Combined harvest from VTDEC and TNC

⁶ VTDEC – site treated by the Vermont Department of Environmental Conservation

X – Site not visited by TNC;

Table 3-4: Area-based harvest statistics (number of rosettes/acre) for select sites, 2007 - 2014

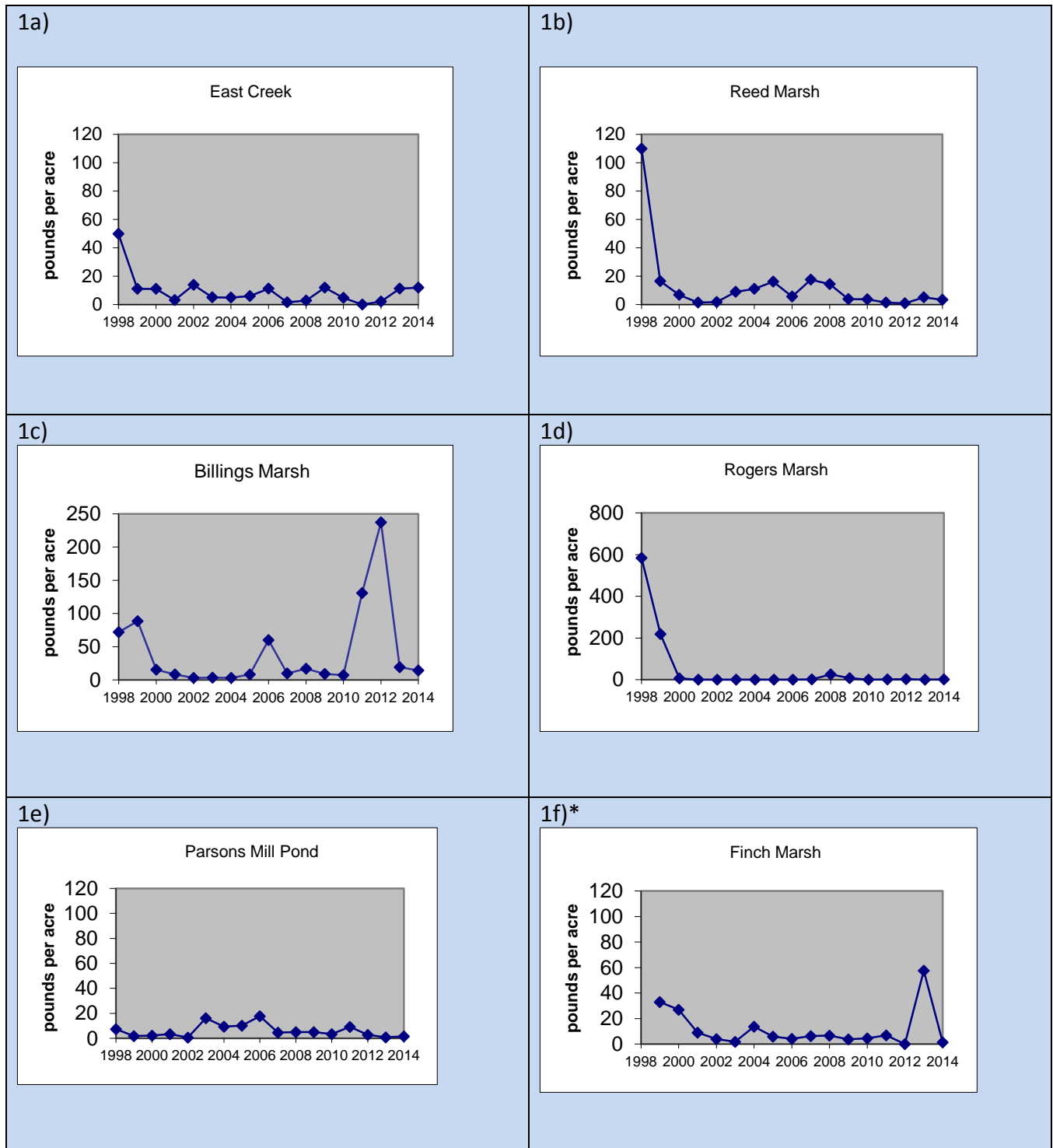
Site	2007	2008	2009	2010	2011	2012	2013	2014
Billings Marsh	66	75	35	26	298	1,151	83	39
Brookside Pond	194	227	34	13	29*	97	VTDEC	VTDEC
Buoy 33 wetlands	449	702	XX	XX	XX	XX	XX	XX
Coggman Pond	2	17	9	8	6	4	32	14
East Bay ²	199	208	24	181	323	42	1	641
East Creek	11	21*	38*	46*	9*	34*	81*	269*
Finch Marsh	2	60	23	52	101	N/A	299	15
La Chute River Marshes	13	85*	64*	71*	60*	22	4*	16*
Nichols Wetland	28	71	4	403	142	63	553	914
Parson's Mill Pond	30	34	35	10	34	26	11*	7
Pelkey Swamp	3	2	2	10	5	13	13	7
Reed Marsh	63	191	12	25	13	19	31	20
Rogers Marsh	7	231	17	2	18	14	1	3
Root Pond	<1	3	1	10	<1	0	<1	2
Saslow Marsh	74	151	165	173	86	12	56	6
Schoolhouse Marsh	<1	1	1	11	3	8	14	4
Schoolhouse Marsh North	23	44	19	27	168	9	11	6
South Bay	53	4	7	3	2	2	11	9
South Bay/Timber Marsh	17	92	66	17	32	34	396	70
South Fork (E. Creek)	11	4	7	15	36	37	51	7
Whitney Creek	34	256*	30*	26*	8 ¹	VTDEC	VTDEC	VTDEC
NY Culvert Bay							109	273
Little Cat Den Bay						1,250	375	27

* Combined harvest from VT DEC and TNC

XX: results merged into South Lake Champlain site in 2009

¹ Handpulled only by VTDEC in 2013

Figure 3-1. Water Chestnut harvest trends at six sites in the Southern Lake Champlain Valley, 1999 – 2014



* No harvesting effort in 2012 - site dewatered by beaver dam breach

Conclusions

After 17 years of water chestnut control efforts, TNC's Water Chestnut Management Program continues to be successful at maintaining reduced levels of water chestnut infestation that were achieved after the initial years of the program. Although some sites have exhibited puzzling increases in water chestnut harvests within the past few years, staff and volunteers have been able to successfully manage these "outbreaks" and diminish water chestnut populations in subsequent years with persistent management. This is exemplified by the contrast between 2013 vs. 2011/12 results at Billings Marsh. Program-wide results illustrate that substantial gains in water chestnut management have been maintained at a majority of TNC managed sites. There is an anticipated need for continual maintenance handpulling at these sites in future years.

In the early years of TNC's Water Chestnut Management Program, the volunteer-based focus provided the capacity to achieve substantial gains in managing this infestation in a cost effective way that also provided ancillary benefits of educating volunteers about water chestnut, Lake Champlain, and Aquatic Nuisance Species issues. TNC's program still continues to manage water chestnut, but now uses volunteers to a lesser degree, focusing volunteer use where they can provide the most benefit. Experience has shown that the use of volunteers is most effective where water chestnut is abundant and easy to find and pull. The work is less suited to volunteers as sites transition to lower levels of water chestnut rosettes, where the work requires painstaking searches through emergent wetland vegetation. The program continues to manage large proportion of the total area of infested habitat in Lake Champlain, nearly 800 acres, which represents more than 30% of the entire infested habitat that exists in the basin.

Part 3: Other Basin Water Chestnut Management Efforts

New York

New York water chestnut mechanical harvesting operations were conducted by the Town of Dresden working under a contract with the Washington County Soil and Water Conservation District and utilizing a NYS Canal Corporation mechanical harvester and transporter. The project is supported with funding from the Environmental Protection Fund and facilitated by a memorandum of understanding between the New York State Department of Environmental Conservation (NYSDEC) and New York Department of Agriculture and Markets.

The Town of Dresden received the mechanical harvesting equipment from the NYS Canal Corporation on July 1 at Whitehall and moved to Chubb's Dock at Ottenburgh Ramp site (Appendix 3, Map 3, Site #47). Harvesting operations commenced on July 2 at the southern end of the Ottenburgh Ramp site. There were 20 days of harvesting effort in this region resulting in the removal of 352 loads of water chestnut spoils or approximately 2,883 cubic yards. The harvesting equipment was then relocated to South Bay near Whitehall for 27 days of harvesting, resulting in 723 loads, or approximately 5,921 cubic yards of plant material being removed. Harvesting operations concluded on August 29 with the harvesting equipment being returned to the Canal Corporation for winter storage (Table 4.1).

For the 2014 water chestnut management season, the Town of Dresden expended 1,669 person hours conducting the harvesting. There was one major mechanical issue with the off-loading conveyor during the season which was repaired by the Canal Corporation. Most of the equipment/supply expenses were for fuel (Table 4.2).

Table 4.1. Town of Dresden water chestnut mechanical harvesting summary, 2014

Site	Days	Loads	Estimated cubic yards removed
Chubb's Dock, NY	20	352	2,883
South Bay, NY	27	723	5,921
TOTAL	47	1,075	8,804

Table 4-2. Costs for the 2014 Town of Dresden water chestnut management effort

Type of Expense	Cost
Labor and equipment (trucks, loader, etc.)	\$55,430.00
Mechanical harvesting equipment maintenance, (parts, supplies, fuel)	\$5,933.31
Indirect costs (contract management by Washington County SWCD)	\$4,295.43
Total Cost	\$65,658.74

The availability of Canal Corporation's harvesting equipment and the use of a municipal workforce continues to produce an extremely cost efficient operation for NYSDEC.

Quebec/Ontario

In Quebec, approximately 28,000 water chestnut rosettes were harvested between June 25th and September 5th, down 68,000 from 2013. Only 12,000 rosettes were harvested from the South River (the main infestation site in Québec). In the Richelieu River, quantities of water chestnut removed were less than last year but were found in different areas of the river.

The water chestnut population in the Pike River increased greatly in 2014; 1,750 rosettes were handpulled. In 2013, 147 were found and removed, and before that, no water chestnut rosettes were found over a several year period. In two small ponds adjacent to Missisquoi Bay, where 1,200 rosettes were removed in 2012, 400 rosettes were found in 2013 and only 270 were removed in 2014. The Quebec portion of Missisquoi Bay remained clear of any water chestnut.

Two Mountain Lake, located in Quebec had the most dramatic increase compared to results from 2013. Eleven thousand water chestnut rosettes were found in the area this season. Last year 6,000 rosettes were found in 5 different bays in the lake as well as those found around the dam and locks in the lake. In 2012, fifteen hundred rosettes were found in only one bay in the area.

Water chestnut was first confirmed in Ontario in 2007. In Voyageur Provincial Park, 11,000 rosettes were pulled in 2014, an increase over 2013. From the Canadian shore of the Ottawa River, 270 rosettes were pulled.

U. S. Fish & Wildlife Service, Missisquoi National Wildlife Refuge

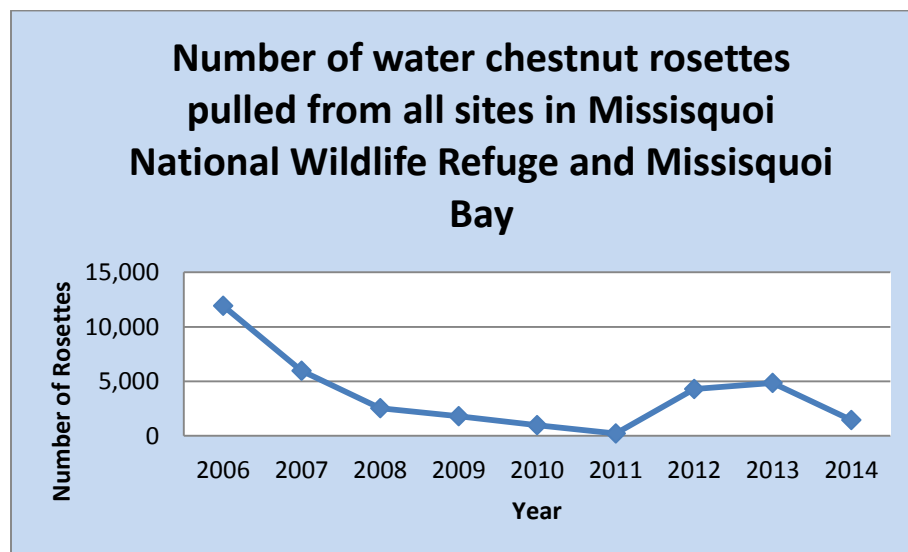
The Friends of the Missisquoi National Wildlife Refuge received 2013 USFWS ANS Plan funds thru a grant from VTDEC in 2014 as well as a grant from New England Interstate Water Pollution Control Commission (NEIWPCC) and funds from Friends of the Missisquoi Refuge to control water chestnut on wetlands owned by the Missisquoi National Wildlife Refuge and in other areas of Missisquoi Bay. Funds available for water chestnut work in 2014 totaled \$8,580. The money was used for surveying and water chestnut removal from approximately 376 acres of Refuge wetlands and other areas of Missisquoi Bay such as the area the mouth of the Rock River where water chestnut had been found for the first time in 2013. Most of the handpulling and surveying work was done from “Go Devil” boats provided by the Refuge.

Priority survey areas were determined by previous control operations as well as biological sensitivity of Refuge wetlands during black tern breeding season. Operations were coordinated by a Refuge biologist to manage any potential conflict with other Refuge work, but also to maximize water chestnut removal in key problem areas.

Work began on July 15, so as not to disturb sensitive nesting marsh birds, and continued until August 17. Surveys and control operations occurred on 35 days during this period and included all Refuge wetland areas as well as two locations outside of the Refuge boundaries where water chestnut was known to occur last year.

A total of 776 acres were surveyed during the 2014 season. Three hundred and ninety seven hours were spent removing 1,451 water chestnut rosettes (4,657 in 2013) which weighed 154 lbs. Though numbers were down considerably from 2013, most of the water chestnut rosettes were in areas that had been infested for years. Results from all sites in the Missisquoi Bay area are shown in Appendix 1 and 2. Table 4-3 shows the total number of rosettes pulled from all Refuge sites by year. The non-Refuge site totals are also included in the 2013 and 2014 year’s data.

Table 4-3: Number of water chestnut rosettes pulled from Missisquoi National Wildlife Refuge and Missisquoi Bay, 2006 – 2014



Appendix 1. Water chestnut management program summary: 2014 Lake Champlain and associated sites

2014 Lake Champlain and Associated Water Chestnut Sites Combined							
Lake Champlain - Vermont Sites							
Missisquoi Bay							
Site number, name and location	Town	Control Type	Dates Targeted	Hours worked at site	Estimated pounds removed	Number of rosettes pulled or MH loads	
1	Missisquoi Bay Mouth of East Branch Missisquoi River 45°00'33 N / 73°07'54 W	Highgate Springs	HP USF&W	Lumped in with other sites	0	0	
2	Dead Creek Delta 44°58'30N / 73°07'46	Highgate Springs	HP USF&W	7/17, 7/26 7/31, 8/10, 8/11	34	51	501
3	Outside Entrance to Big Marsh Slough 44°58'32 N / 73°08'03 W	Highgate Springs	HP USF&W	Lumped in with other sites	0	0	
4	Shad Island 45°00'33 N / 73°08'45 W	Highgate Springs	HP USF&W	7/15, 7/25, 8/12, 8/15	32	10	94
5	Rock River Bay 44°59'32N / 73°05'29W	Highgate Springs	HP USF&W	7/26, 8/11	6	0	0
Main Lake							
	McNeil Cove 44°18'03N / 73°17'47W	Charlotte	HP-DEC	8/19	.5	0	0
6	Converse Bay F&W Access & Bay South 44°17'19N / 73°16'01W	Charlotte	HP-DEC	8/19	.5	0	0
Otter Creek							
7	Town Farm Bay/Kimball Brook 44°16'60N / 73°16'01W	Charlotte	HP-DEC	8/19	.5	0	0
			HP-LCA	7/24, 8/10	.5	1	10
8	Little Otter Creek (West Branch) 44°13'28N / 73°01'38W	Ferrisburgh	HP	8/4, 8/5 8/6, 8/7	244	3,346.2	18,219
9	Porter Bay 44°13'37N / 73°18'58N	Ferrisburgh	HP	8/4	4	1	19

Key:

- HP = Handpulling contracted
- MH = Mechanical Harvesting contracted
- DEC = Vermont Department of Environmental Conservation
- USF&W = U.S. Fish & Wildlife Service
- TNC = The Nature Conservancy
- H800 load=approximately 18,000 rosettes
- (L) = Lakeside

Site number, name and location		Town	Control Type	Dates Targeted	Hours worked at site	Estimated pounds removed	Number of rosettes pulled or MH loads
10	Mouth of Otter Creek to Fort Cassin Access 44°13'31N / 73°19'27W	Ferrisburgh	HP	6/26	8.5	0	0
11	Fields Bay 44°13'15N / 73°19'09W	Ferrisburgh	HP	6/26, 8/4	48	44	658
12	Fort Cassin F&W Access South to Dead Creek 44°12'23N / 73°19'16W	Ferrisburgh	HP	8/4	4	0.2	3
Port Henry							
13	Basin Harbor 44°11'46N / 73°21'52W	Panton	HP	8/4	2	0	0
South Lake							
14	Hospital Creek a. 44°02'32N/73°25'06W (L)	Addison	HP	8/1	8	70.2	777
	b. 44°02'20N/73°24'40W			8/1	4	0	0
15	Whitney Creek a. 44°01'40N / 73°24'05W (L)	Addison	HP	6/23	8.5	1.4	30
	b. 44°02'50N / 73°24'40W			6/23, 8/1	48.5	33	564
16	McCuen Slang 44°01'28N / 73°23'67W	Addison	HP	6/23	17	1	21
17	Bridport Town Beach 43°59'55N / 73°24'04W	Bridport	HP	7/31	2	1.6	29
18	Giards Bay 43°58'44N / 73°24'01W	Bridport	HP	7/31	4	6.8	111
19	North of W. Bridport 43°57'34N / 73°24'21W	Bridport	HP	6/23, 7/31	15.5	14	273
20	Leonard Bay 43°56'16N / 73°24'00W	Bridport	HP	7/31	11	0.2	3
21	Lapham Bay 43°55'33N / 73°23'37W	Shoreham	HP	7/31	4.5	0	0
22	South of Lapham Bay 43°54'52N / 73°23'40W	Shoreham	HP	7/31	1.5	0	0
23	North of Fivemile Point 43°54'32N / 73°23'40W	Shoreham	HP	7/31	1.5	0	0

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Site number, name and location		Town	Control Type	Dates Targeted	Hours worked at site	Estimated pounds removed	Number of rosettes pulled or MH loads
24	Bays on Lake Street South of Fivemile Point 43°54'06N / 73°22'35W	Shoreham	HP	7/2	16	1.1	17
	Stony Cove 43°54'15N / 73°22'56W	Shoreham	No water chestnut since 1995				
25	Access by C. Farr Ranch 43°53'54N/73°22'30W	Shoreham	HP	7/2	16	0	0
	Watch Point 43°53'7N / 73°22'31W	Shoreham	No water chestnut since 1996				
26	N of Larrabees Point 43°51'56N / 73°22'11W	Shoreham	HP	6/25, 8/19	32.5	37	540
27	Beadles Cove and South 43°51'1N / 73°22'15W	Shoreham	HP	6/25, 8/18	59.5	89.4	1,575
28	East Creek a. 43°51'50N / 73°22'37W (mouth)	Orwell	HP	6/25, 8/18	31.5	70.6	1,428
	b. 43°49'38N/73°21'59W			6/24, 6/27 6/30	305.5	2,041.6	36,651
	b. 43°49'38N/73°21'59W		HP-TNC	b. 6/25, 7/1, 7/14, 7/29, 8/15	69.5	460	5,744
	c. South Fork			c. 7/8, 7/18, 7/21, 7/23, 7/25	101.5	3,012	24,987
29	Shoreline between East Creek & Catfish Bay 43°49'52N / 73°23'06W	Orwell	HP	8/18	2	0	0
30	Catfish Bay 43°49'40N / 73°23'09W	Orwell	HP	6/24	25.5	68.4	1,398
31	Buoy 39 Marina 43°49'21N / 73°23'25W	Orwell	HP	8/18	1	0	0
32	Dock at Curly Audette Farm 43°48'38N / 73°22'41W	Orwell	HP	7/1	16	1	13
33	North shore Chipman's Point 43°48'7N / 73°22'32W	Orwell	HP	7/1	16	1.4	23

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Site number, name and location		Town	Control Type	Dates Targeted	Hours worked at site	Estimated pounds removed	Number of rosettes pulled or MH loads
34	Shoreline between Chipman's Point and Benson Bay 43°47'07N / 73°21'10W	Orwell, Benson	HP	7/1	64	7.4	105
35	Benson Bay 43°45'50N / 73°20'41W	Benson	HP	8/19	4	0.6	7
36	Shoreline between Benson Bay & Stony Point 43°45'24N / 73°21'16W	Benson	HP	8/19	2	1.0	12
37	Stony Point 43°44'37N / 73°21'57W	Benson	HP	8/19	4	0.4	5
38	Shoreline between Stony Point & Benson Landing 43°44'16N / 73°22'05W	Benson	HP	8/19	4	4.6	57
39	Benson Landing 43°43'45N / 73°22'03W	Benson	HP	7/2, 8/8	9	3	53
40	Dutchers and South 43°43'01N / 73°22'33W	Benson	HP	7/3, 7/7 8/8	70	660	8,316
41	Peters Bay 43°38'12N / 73°25'37W	Benson, West Haven	HP	7/8, 7/10 7/17, 7/18 7/21, 7/22 7/23, 7/24 7/25, 7/28 7/29, 7/30	1,414.5	16,999.6	199,173
			MH	7/22	20	46,500	12
42	Red Rock Bay and North 43°40'57 N / 73°25'37 W	West Haven	MH	7/7, 7/8, 7/15, 7/18	27	64,600	17
43	Cold Spring Landing and South 43°40'4.7 N/ 73°24' 28 W	West Haven	MH	7.14, 7/17	7	22,800	6
44	Horton Marsh 43°39' 34N/ 73°24'41 W	West Haven	MH	7/8	21	57,000	15

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Site number, name and location		Town	Control Type	Dates Targeted	Hours worked at site	Estimated pounds removed	Number of rosettes pulled or MH loads
45	Maple Bend and South 43°38'52.7N /73°25'2.2W	West Haven	MH	7/9 – 7/11, 7/14 – 7/18, 7/21	180.5	486,400	128
46	Poultney River and Associated Sites a. Mouth of the Poultney and region 43°34'08N/ 73°24'06W	West Haven	HP-TNC	6/26, 7/10, 7/11, 8/4, 8/5, 8/11	65.75	1,004	6,721
	b. Rogers Marsh 43°34'06N/73°23'52W		HP-TNC	8/5	.5	4	12
	c. Reed Marsh 43°41'02N/73°21'23W		HP-TNC	7/31	10.5	56	324
	d. Schoolhouse Marsh & N. Schoolhouse 43°35'33N/73°23'12W		HP-TNC	7/16	8.5	691	238
	e. Billings Marsh 43°36'17N/73°22'39W		HP-TNC	7/22, 8/25	25	233	633
	f. Finch Marsh 43°34'36N/73°22'49W		HP-TNC	7/10, 8/11	5.75	45	438
	g. Nichols Wetland 43°37'03N/73°22'30W		HP-TNC	7/16	5.75	247	2,102
Lake Champlain - New York Sites							
South Lake							
	h. Saslow Marsh 43°36'50N/73°22'26W	Whitehall	HP-TNC	7/24	3	12	30
47	Ottenburgh Ramp a. Lakeside 43°38.5'72N/73°25'11.5W	Dresden	MH	7/16 -18, 7/21, 7/24, 7/25, 7/28 -8/31, 8/1, 8/4 - 8/8 8/11 - 15	481.5	1,288,200	339
	b. Channel Area 43°38'48.5N/73°25'41.1W						
48	Barrel Bay and South 43°39'28 N/ 73°24'60W	Dresden	MH	Harvested by New York in 2014			
49	Dresden Landing and South 43°40'16 N/ 73°24'37 W	Dresden	MH	7/22, 7/23	15	30,400	8

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Site number, name and location		Town	Control Type	Dates Targeted	Hours worked at site	Estimated pounds removed	Number of rosettes pulled or MH loads
50	New York Light 14 and south 43°40'45 N / 73°24'43W	Dresden	MH	To shallow to harvest in 2014			
51	Pulpit Point 43°42'45N / 73°23'43W	Putnam	HP	7/11, 7/22	101.5	703.4	9,394
52	Bed Back by Railroad NY 43°42'45N / 73°23'26W	Putnam	HP	7/3, 7/8 7/9, 7/11 8/8	301	1865.8	30,301
53	NY Light 4 43°42'48N / 73°23'09W	Putnam	HP	7/3, 7/7 8/8	172	446.2	10,810
54	60 Acre Patch 43°43'21N / 73°22'26W	Putnam	HP	7/3, 7/7 8/8	48	31.2	523
55	Sixmile Point and South 43°45'26N / 73°22'00W	Putnam	HP	7/16, 8/19	66	325.6	4,648
56	South of Gourlie Point 43°46'45N / 73°21'50W	Ticonderoga	HP	7/16	75	331.2	4,728
57	Gourlie Point Bay 43°47'38N / 73°22'25W	Ticonderoga	HP	7/16	2.5	0	0
58	North of Gourlie Point 43°47'47N / 73°22'42W	Ticonderoga	HP	7/16	2.5	0	0
59	Charter Marsh 43°48'16N / 73°23'5W	Ticonderoga	HP	6/30, 7/1	74.5	229.9	2,475
60	North of Charter Marsh 43°48'33N / 73°23'11W	Ticonderoga	HP	8/18	2	1.2	11
61	Fort Ticonderoga Bay & South 43°50'17N / 73°23'52W	Ticonderoga	HP	6/24, 8/18	60.5	84.2	1,742
62	LaChute River 43°50'42.18N/73°24'08.82W	Ticonderoga	HP	7/21	12	11.6	232
			HP-TNC	7/17	33	175	2,321
63	North of Fort Ticonderoga 43°51'29N / 73°23'20W	Ticonderoga	HP	6/25, 8/19	50.5	114.6	2,256
64	North of Kirby Point 43°52'42N / 73°23'22W	Ticonderoga	HP	7/2, 8/19	35	18.2	416
65	South of IPCO 43°53'21N / 73°23'24W	Ticonderoga	HP	7/2	24	15.8	315

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Site number, name and location		Town	Control Type	Dates Targeted	Hours worked at site	Estimated pounds removed	Number of rosettes pulled or MH loads
66	IPCO Bay 43°53'42N / 73°23'50W	Ticonderoga	HP	7/2	32	5.6	117
67	Bay North of Fivemile Point Light 43°54'17N / 73°24'45W	Ticonderoga	HP	8/1	28	65	725
68	North of Crown Point 43°57'15N / 73°24'49W	Crown Point	HP	6/23	17	8.8	185
69	Putnam Creek 43°57'22.2N / 73°24'55.5W	Crown Point	HP	6/23, 8/1	44.5	14.4	282
70	Porters Marsh 43°58'13N / 73°24'58W	Crown Point	HP	8/1	2	0.6	11
71	Bay south of Burdick Crossing 43°59'4N / 73°25'14W	Crown Point	HP	8/1	9	0.4	9
72	Bay at Burdick Crossing 43°59'10N / 73°25'13W	Crown Point	HP	8/1	2	1	18
73	South of Lapstone Point 44°00'10N / 73°25'02W	Crown Point	HP	8/1, 8/14	13	385.8	4,813
74	Shoreline between Lapstone Pt & Bay South of Crown Point Bridge 44°00'55N / 73°25'03W	Crown Point	HP	8/1, 8/14	17	25.2	204
75	Bay south of Crown Point Bridge 44°01'30N / 73°25'06W	Crown Point	HP	8/1	7.5	7.4	71
Port Henry							
76	Bulwagga Bay 44°00'17N / 73°26'51W	Crown Point, Moriah	HP	6/26, 8/14 8/15	91.5	227.6	3,096
77	Bulwagga Bay Campground 44°02'02.76N / 73°27'36.76W	Crown Point, Moriah	HP	8/7	38.5	246.4	2,499

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Appendix 2. Water chestnut management program summary: 2014 “other” water body sites

Site Number, Name, and Location	Town	Control Type	Date(s) Targeted	Hours Worked at Site	Estimated Number of Pounds Removed	Number of Rosettes Pulled or Number of MH Loads
2014 Other Waterbody Sites						
Lakes and Ponds						
1	Lake Bomoseen 43°41'18N / 73°11'57W	Hubbardton	HP-DEC	7/28	2	0
2	Coggman Pond 43°37'14N / 73°22'30W	West Haven	HP-TNC	7/7, 8/28	4	25
3	Brookside Pond 43°46'58N / 73°18'34W	Orwell	HP	6/29	9	68.8
4	Parsons Mill Pond 43°42'20 N / 73°17'04W	Benson	HP-TNC	7/30	18	64
5	Lake Paran 42°55'58N / 73°13'13W	North Bennington	HP DEC	7/22	2	0
6	Small Pond (Horton) 42°42'46N/73°15'20W	Benson	HP	7/17	2	6
			HP DEC	7/17	2	3
7	Small Pond (Phillips) 43°42'54 N / 73°21' 22 W	Benson	HP	7/17	2	1
8	Singing Wetland 42°53'46N / 73°15'20 W	North Bennington	HP	Dry / dam gone		
9	Small Pond (Glanzenberg) 42°53'28N / 73°15'9W	Bennington	HP	No water chestnut since 2010		
10	Small Pond at Benson Landing 43°43'39N/ 73°21'57W	Benson	HP	No water chestnut since 2012		
11	Root Pond including Shaw Mountain Wetlands 43°40'46N / 73°20'59W	Benson	HP-TNC	8/27	2.5	9
12	North Springfield Reservoir 44°20'55 N / 72°30'20W	North Springfield	No data for 2014			
13	Pelkeys Swamp 43°42'33N/ 73°19'18W	Benson	HP-TNC	6/24, 8/21	9	49

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Site Number, Name, and Location		Town	Control Type	Date(s) Targeted	Hours Worked at Site	Estimated Number of Pounds Removed	Number of Rosettes Pulled or Number of MH Loads
14	Lily Pond, Lake St. Catherine 43°29'32N / 73°12'23W	Poultney	HP DEC	7/8	2	0	0
15	Little Lake St. Catherine 43° 26' 12N/73°12'12W	Wells	HP DEC	7/8	2	0	0
16	Porter Lake 44°12'38N / 73°19'09W	Ferrisburgh	HP	6/26, 8/4	65	45.4	616
17	Bullis Pond 44°57'58N / 72°57'58W	Franklin	HP DEC	6/30	12	211	3,165
18	Lake Carmi NEW 44°59'18.48N / 72°51'5.95W		HP DEC & vols.	8/30, 9/3	49	2,187	6,487
19	Lake Shaftsbury 43°01'6.85N / 73°11'4.1 W	Shaftsbury	HP-DEC	7/22, 9/11	9	47.8	624
			VT Forest & Parks	7/28	unknown	12	160
Rivers, Marshes, Wetlands							
20	Dead Creek a. 44°11'01N / 73°18'53W b. 44°10'55N / 73°18'44W c. 44°09'11N / 73°19'14W d. Holcomb Slang 44°08'53N / 73°19'01W e. 44°07'53N / 73°19'42W f. 44°07'35N / 73°19'50W g. 44°05'12N / 73°20'50W	Ferrisburgh	HP	7/14	97.5	58.2	810
	h. Route 17 north and south	Addison	HP	6/28	4	4.8	96
	i. Nortontown Road NEW 44°05'20.15N / 73°20'52.74W	Addison	HP	7/14, 7/15	185.5	1,660.2	23,713
	HP-DEC		7/14	8	101	1,418	
21	Lemon Fair River 43°59'27N / 73°15'00 W	Orwell	HP	8/18	2	0	0
22	Richville Pond 43°51'33N / 73°15'26W	Orwell	HP	8/18	4	0	0
			HP DEC	7/28	3	0	0
23	Duval Drainage Ditch NEW 43°40' 48.96N / 73°23'22.2W	Benson	HP-DEC	9/29	1	7	36

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Site Number, Name, and Location	Town	Control Type	Date(s) Targeted	Hours Worked at Site	Estimated Number of Pounds Removed	Number of Rosettes Pulled or Number of MH Loads	
Missisquoi National Wildlife Refuge							
24	Cranberry Pool 44°57'16.59N 73°08'56.91"W	Highgate	HP USF&W	7/16, 7/21 7/22, 8/2 8/5, 8/5 8/16, 8/17	128	39	413
25	Big Marsh Slough 44°58'23"N 73°08'24"W	Highgate	HP USF&W	7/17, 7/18 7/30, 8/6, 8/8, 8/10	76	50	443
26	Missisquoi Refuge Long Marsh Channel 44°59'34.38"N / 73°09'20.88"W	Highgate Springs	HP USF&W	7/25, 8/11 8/12	26	0	0
27	Cabot Clark Marsh 44°58'16 N / 72°10'42W	Highgate Springs	HP USF&W	7/23, 7/24 8/1,	36	0	0

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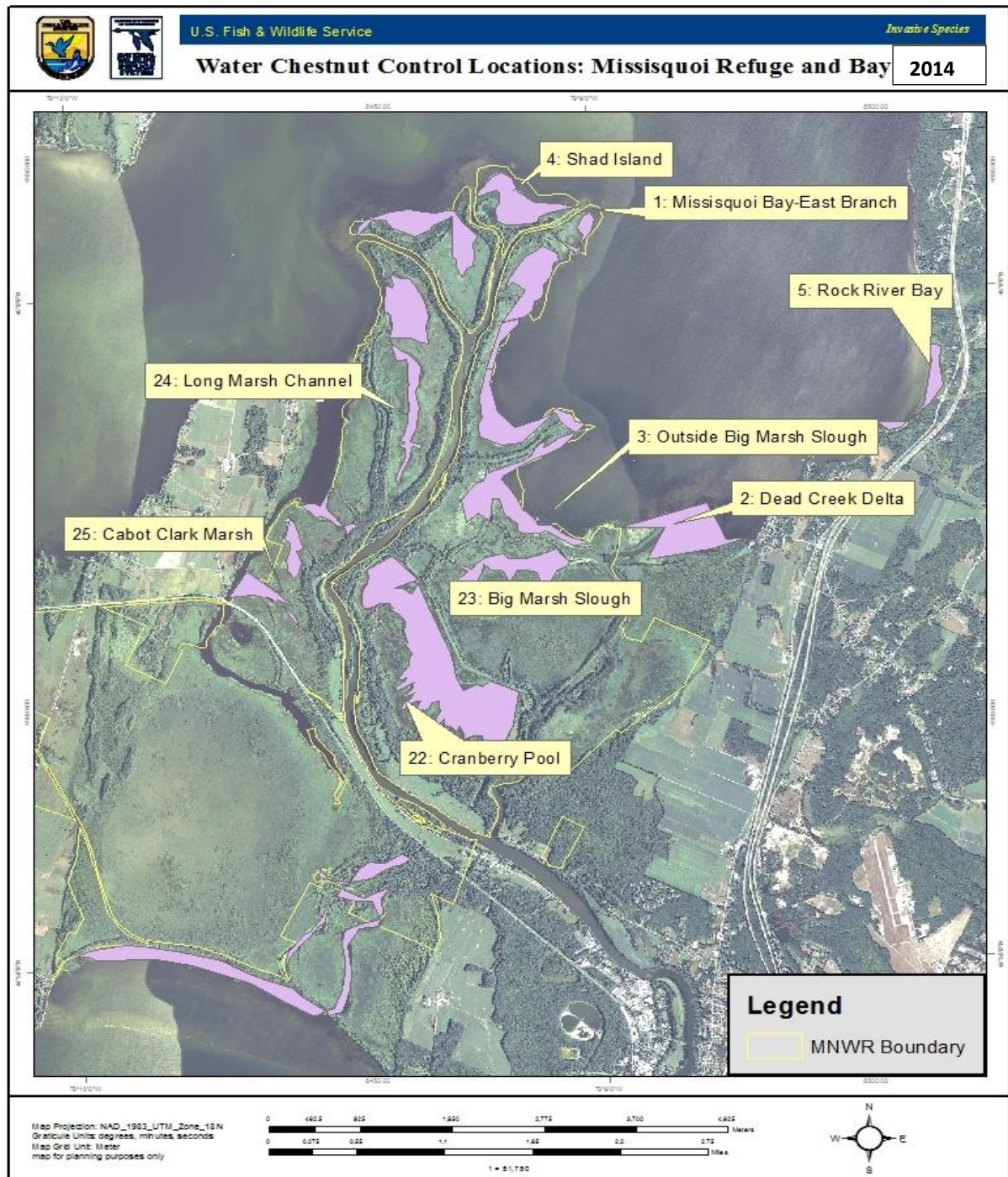
H800 load=approximately 18,000 rosettes

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Appendix 3. Water chestnut management program 2014 site maps

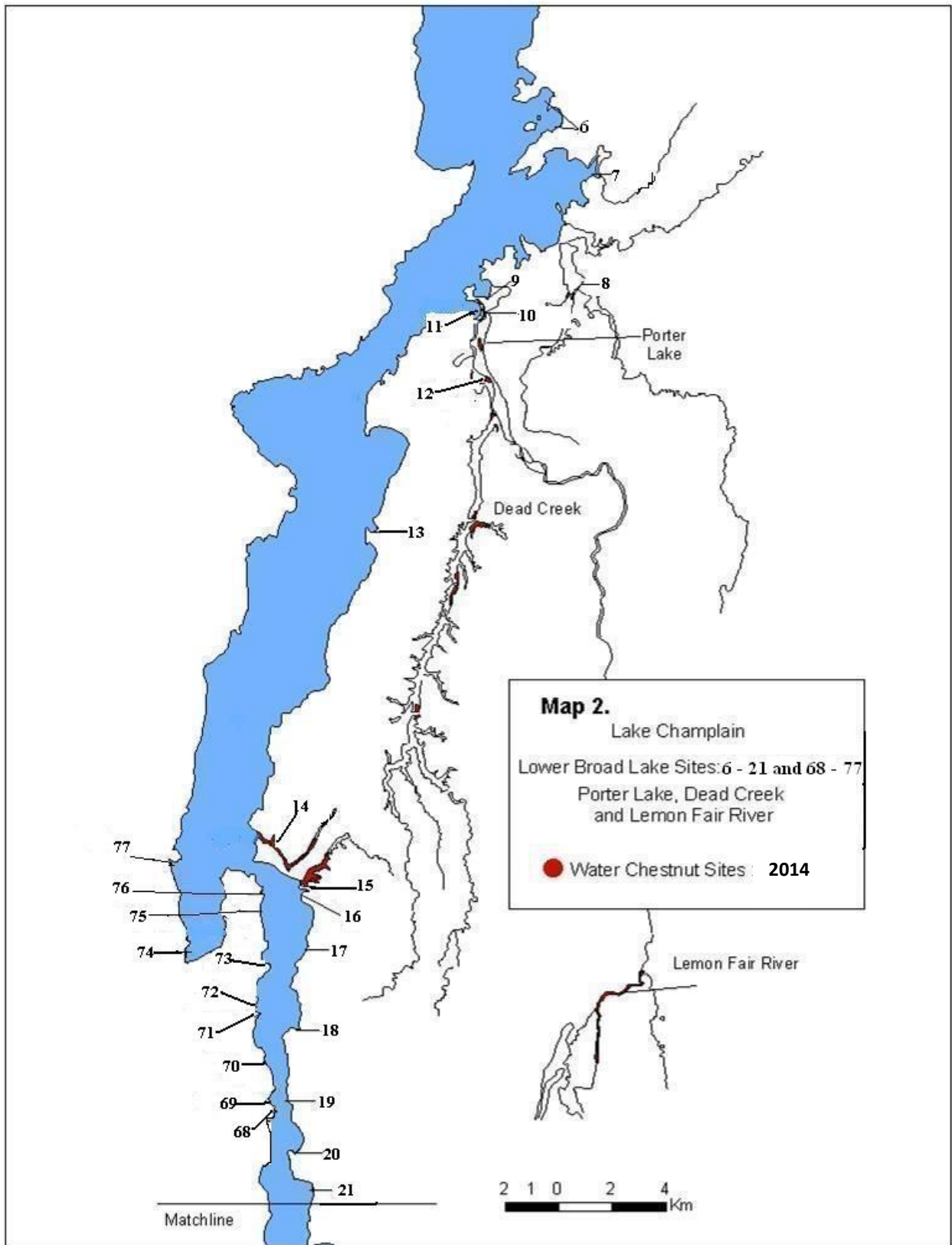
Map 1. Northern Lake Champlain sites: Missisquoi Bay

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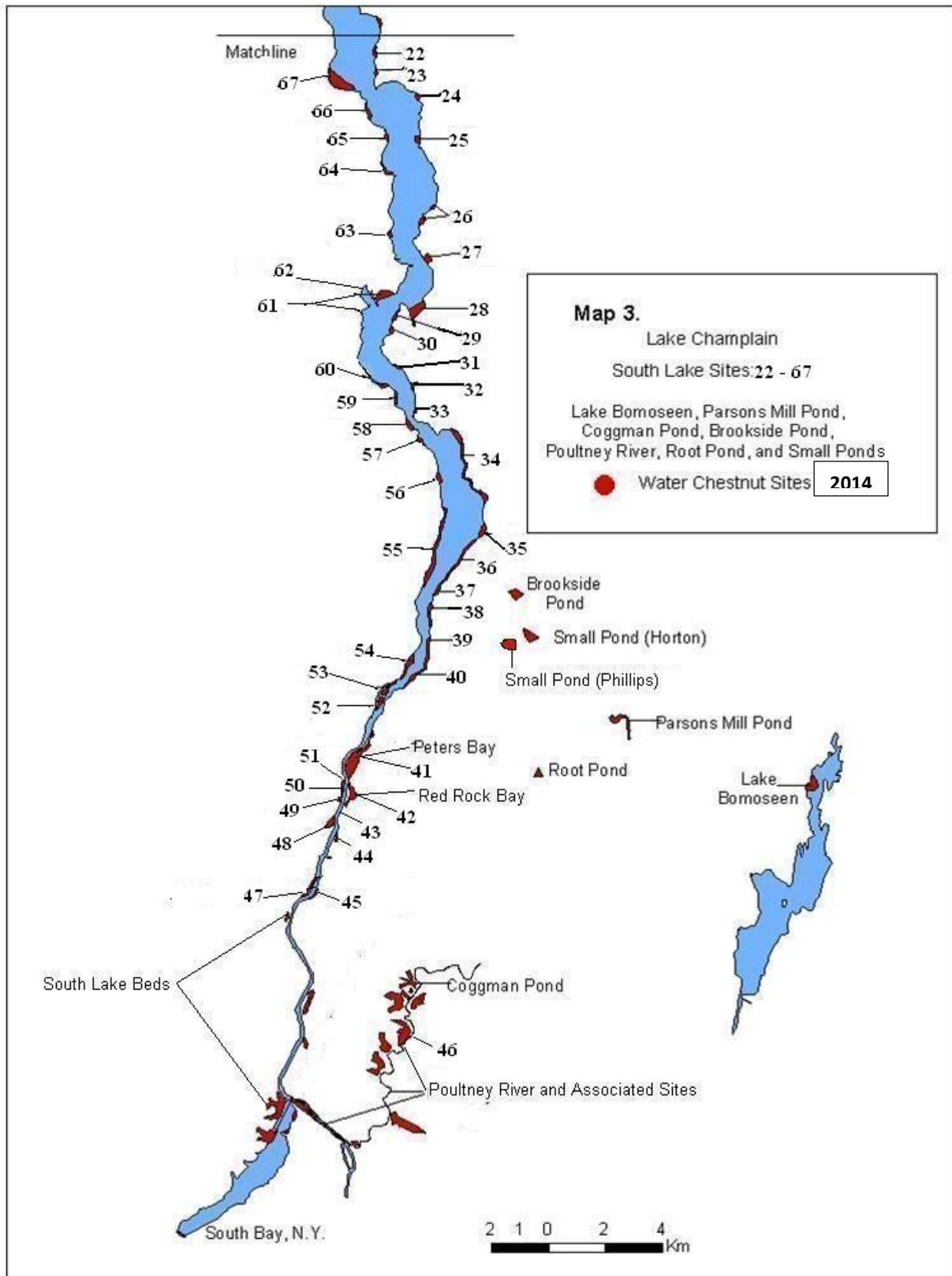


Key: =Management sites and areas surveyed by USFWS for water chestnut in 2014

Map 2. Lake Champlain: lower broad lake, Porter Lake, Dead Creek sites and the Lemon Fair River



Map 3. Lake Champlain: south lake sites, Lake Bomoseen, Parsons Mill Pond, Coggman Pond, Brookside Pond, Poultney River, Root Pond, and small ponds



Appendix 4. TNC Water Chestnut Site and Search Summary Statistics 2014

Site	Date	Pulling hours	Volunteer hours	Pounds	Rosettes
Billings Marsh	7/22/2014	21	0	186	521
	8/25/2014	4	0	47	112
Billings Marsh Total		25	0	233	633
Coggman Pond	7/7/2014	4	0	25	359
	8/28/2014	2	0	5	28
Coggman Pond Total	7/7/2014	4	0	25	359
Cooks Island	6/26/2014	45	39	93	1519
	7/11/2014	3.5	0	129	1378
	8/4/2014	5	0	318	1832
	8/5/2014	5	0	361	1717
	8/11/2014	1.5	0	58	227
Cooks Island Total		60	39	959	6,673
Culvert Bay	7/25/2014	9	6.5	216	1,695
	8/19/2014	3	2.5	18	158
Culvert Bay Total		12	9	234	1,853
East Creek	6/25/2014	15	4	93	1,678
	7/1/2014	15	0	146	1,995
	7/14/2014	24.5	0	47	1,116
	7/29/2014	8	5.5	62	360
	8/15/2014	7	5.5	112	595
East Creek Total		69.5	15	460	5,744
Finch Marsh	7/10/2014	3.75	0	38	413
	8/11/2014	2	0	7	25
Finch Marsh Outlet Total		5.75	0	45	438
Nichols Wetland	7/16/2014	4	0	201	1,920
		1.75	0	46	182
Nichols Wetland Total	7/16/2014	5.75	0	247	2,102
Parsons Mill Pond Total	7/30/2014	18	0	64	272
Pelkey Swamp	6/24/2014	6.5	1	34	263
	8/21/2014	2.5	0	15	47
Pelkey Swamp Total		9	1	49	310
Reed Marsh Total	7/31/2014	10.5	5	56	324

Site	Date	Pulling hours	Volunteer hours	Pounds	Rosettes
Rogers Marsh Total	8/5/2014	0.5	0	4	12
Root Pond Total	8/27/2014	2.5	0	9	41
N. Schoolhouse Marsh Total	7/16/2014	2.5	0	8	72
Saslow Marsh Total	7/24/2014	3	0	12	30
Schoolhouse Marsh Total	2014	6	0	61	166
South Bay Total	6/30/2014	9	0	49	1,018
South Fork (East Creek)	6/27/2014	2.5	0	19	200
	6/30/2014	6	0	72	767
	7/2/2014	2	0	27	150
	7/3/2014	8	0	180	1,133
	8/8/2014	4	0	24	74
South Fork (East Creek) Total		22.5	0	322	2,324
Little Cat Den Bay	7/9/2014	10	0	170	1,842
	8/19/2014	5	3.5	67	418
Little Cat Den Bay Total		15	3.5	237	2,260
LaChute River Wetlands Total	7/17/2014	33	31.5	175	2,321
East Bay*	7/8/2014	6.5	0	108	1,991
	7/18/2014	20	9	1099	8,792
	7/21/2014	30	6	1264	10,586
	7/23/2014	39	36	434	2,795
	7/25/2014	6	4.5	107	823
East Bay Totals		101.5	55.5	3012	24,987
South Bay (Timber Marsh)	8/7/2014	12	0	164	1,286
	8/14/2014	14	0	666	1,271
	8/18/2014	10	5.5	145	1,154
	9/2/2014	3	0	74	213
South Bay (Timber Marsh) Total		39	5.5	1049	3,924
Season Totals		456	165	7,315	55,891
* site formerly called "South Lake Champlain"					

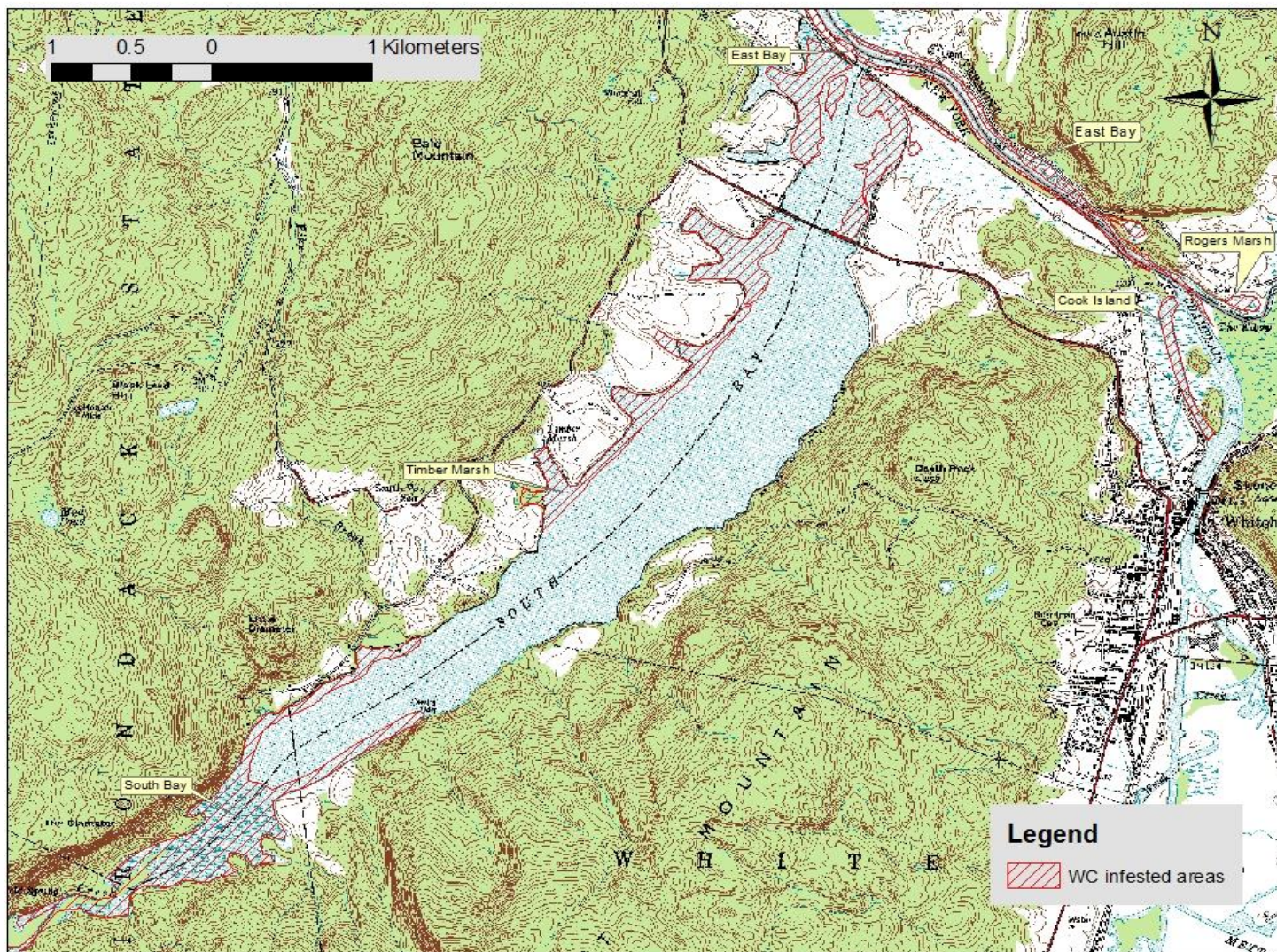
Appendix 5. TNC Program funding sources, 2005 – 2014.

Year	LCBP/VTDEC	USFWS (Partners for F&W program)	Waterwheel Foundation	South Lake Champlain Trust	USDA NRCS WHIP	Totals
2005	\$13,000.00	\$3,000.00	\$6,578.00	\$1,000.00	\$1,339.00	\$24,917.00
2006	\$13,000.00	\$2,000.00	\$15,000.00 ¹	\$0.00	\$2,653.00	\$32,653.00
2007	\$13,000.00	\$0.00	\$9,295.00	\$0.00	\$2,653.00	\$24,948.00
2008	\$13,000.00	\$0.00	\$8,925.00	\$0.00	\$2,653.00	\$24,578.00
2009	\$15,000.00	\$0.00	\$0.00	\$0.00	\$2,653.00	\$17,653.00
2010	\$20,000.00	\$0.00	\$1,450.00	\$0.00	\$1,314.00	\$22,764.00
2011	\$20,000.00	-	\$950.00	-	-	\$20,950.00
2012	\$20,000.00	-	\$150.00	-	-	\$20,150.00
2013	\$20,000.00	-	\$1,200.00	-	-	\$21,200.00
2014	\$20,000.00	-	\$1,200.00	-	-	\$21,200.00

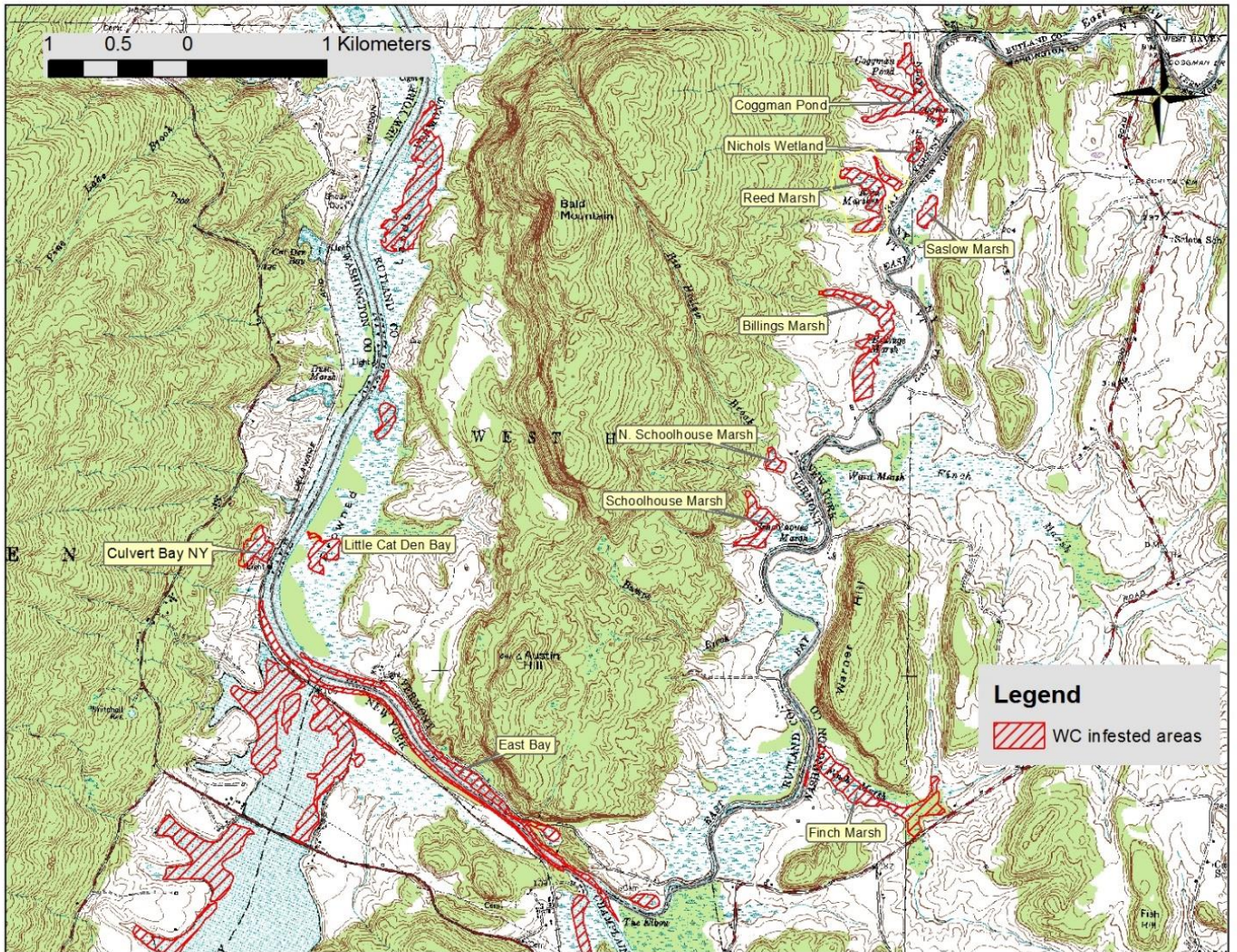
¹Funds were used to purchase a replacement truck for program use in 2006.

Appendix 6. TNC 2014 site maps

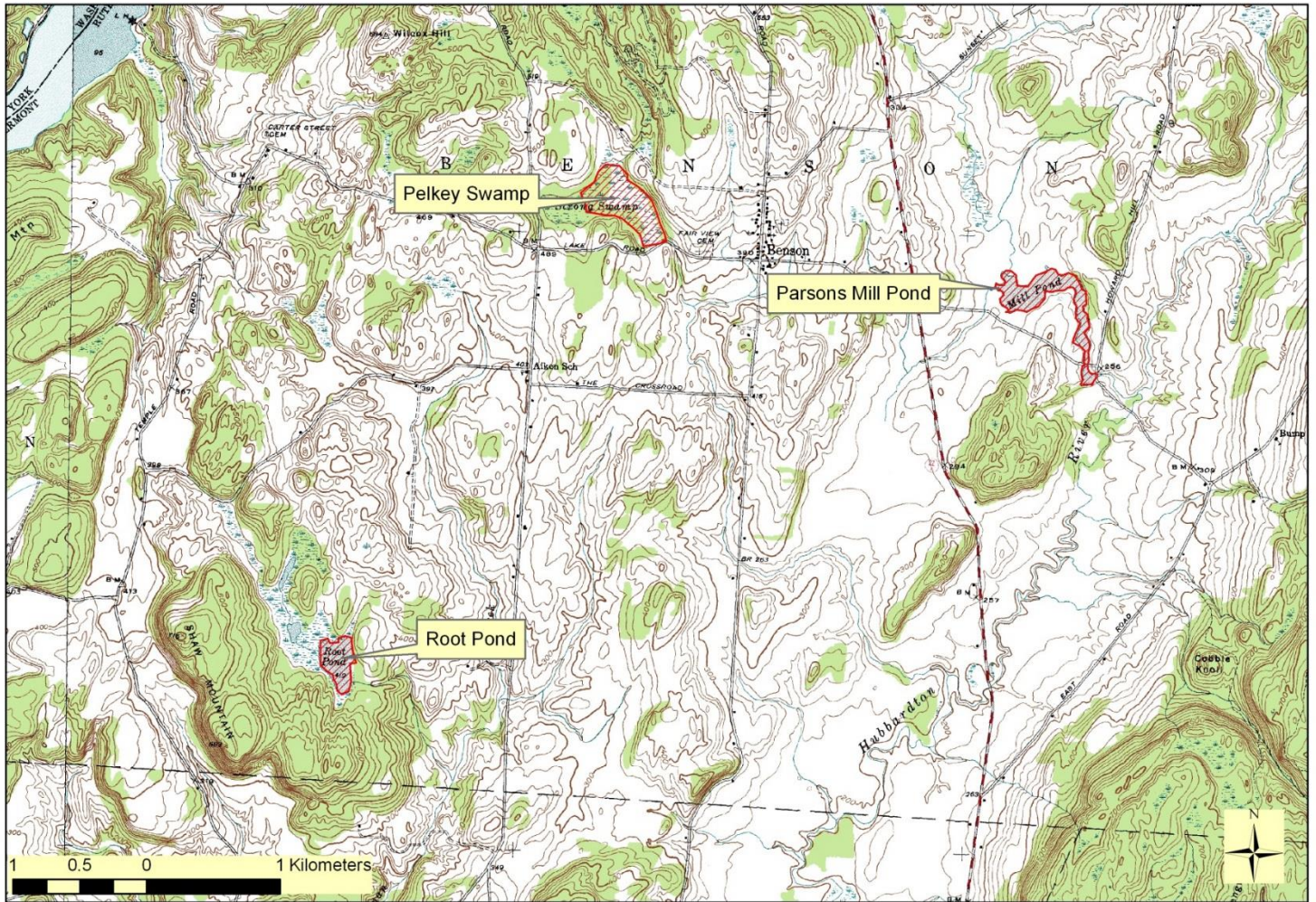
Map 1. Water chestnut hand-pulling sites around South Bay, Lake Champlain, 2014.



Map 2. Water chestnut hand-pulling sites along the lower Poultney River, VT and NY, 2014



Map 3. Water chestnut hand-pulling sites near Benson, VT, 2014.



Map 4. Water chestnut hand-pulling sites in Orwell, VT and Ticonderoga, NY, 2014.

