Lake Eden
Eurasian Water Milfoil Inventory

August 30, 2022

Lake Champlain Basin Program

NE IW PCC

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON, VT 05462
(802 434-7276 FAX: (802) 329-2259

This project has been funded by an agreement awarded by the Great Lakes Fishery Commission (GLFC) to NEIWPCC in partnership with the Lake Champlain Basin Program (LCBP). The contents of this document do not necessarily reflect the views and policies of NEIWPCC, LCBP, or GLFC, nor does NEIWPCC, LCBP, or GLFC endorse trade names or recommend the use of commercial products mentioned in this document.

1. Introduction

In July of 2022, Vermont Department of Environmental Conservation (VTDEC) was made aware of the presence of Eurasian water milfoil (EWM) in Lake Eden, Vermont. Arrowwood Environmental (AE) was retained by the Lake Champlain Basin Program (LCBP) to conduct an inventory of EWM in the Lake to aid in the control efforts being undertaken by VTDEC. This brief report summarizes the methods and findings of that inventory.

2. Methods

The study area for the inventory consisted of the entire waterbody of Lake Eden with the exception of the areas that VTDEC had previously demarcated as containing EWM. The shoreline boundary was derived from the Vermont Hydrography Dataset (VHD).

Three different methods were used to inventory for the presence of invasive species: 1) Visual Littoral Surveys; 2) Grid Point Sampling, and; 3) Underwater Transects. The methodology used for each of these survey types is outlined below.

a. Visual Littoral Survey

The entire perimeter of the lake was circumnavigated in a motor boat and the littoral zone was visually surveyed for the presence EWM. Water visibility allowed for the survey of areas 8 feet deep and less with this method. The map in Appendix 2 shows the areas that were surveyed using this method. When EWM was detected, a GPS point was taken along with a count of the number of plants present and the water depth.

b. Grid Point Sampling

The Grid Point Sampling method provides a standardized procedure of inventorying deeper areas of the lake that cannot be otherwise sampled by the Visual Littoral Survey method. A grid of points 60m apart was overlaid on areas within the lake that were 20’ deep and shallower. This resulted in a total of 132 grid points throughout the lake. Grid points that were within demarcated swimming areas or areas with EWM were not sampled during the field work, resulting in data

collected from a total of 123 grid points. Locations of the grid points are shown on the map in Appendix 2.

The lake boundary and predetermined grid point locations were uploaded to an iPhone XR data collector, running ArcGIS Collector and Survey123 field data collection applications. This system was used to navigate to each grid point using a motorboat. An aquatic survey rake was used to take a vegetation sample at each point location. In waters shallower than 8', a rake on a pole was used to sample vegetation. In waters deeper than 8', a survey rake attached to a rope was used to sample vegetation. Rake fullness, as outlined in Table 1, was recorded for each sample to obtain information about vegetation density (Hauxwell et al. 2010; Madsen et al. 1996). Each aquatic plant on the rake was identified to species. All data was recorded using a digital data form on the data collection unit.

Table 1. Vegetation Abundance Categories for Grid Point Sampling Method

Rake Category	Abundance
None	No plants present on rake
Single	A single plant present on rake
Low	Sparse vegetation present on rake
Medium	Moderate amount of vegetation on rake, typically enough to cover center of the rake but not the tines
High	Large amount of vegetation on rake, typically enough to cover the rake tines

c. Underwater Transects

The Underwater transects consisted of three different methods: 1) Snorkeling; 2) SCUBA and 3) Remotely Operated Vehicle (ROV). Snorkeling was used in the vicinity of the Boy Scout camp where the water was too deep to allow viewing EWM from the boat but shallow enough to allow viewing of EWM from the surface while snorkeling. The SCUBA and ROV transects were

conducted in deeper areas (8'-15' depths) where viewing EWM was only visible while underwater. The locations of underwater transects were selected based on the vicinity of known EWM and the presence of appropriate habitat in deeper areas. The locations of the underwater transects is shown on the map in Appendix 2.

When EWM was found during the underwater transects, a marker buoy was placed at the location and GPS data collection occurred from the motorboat.

3. Results

A total of 43 locations of EWM were documented during the inventory. In some cases, only a single EWM plant was documented at a specific location, in other cases, as many as 120 plants were documented. Data for each of these locations is presented in the table in Appendix 1 and shown on the map in Appendix 2. Most of the occurrences were in the northeastern part of the lake. The southeastern half of the lake did not contain any rooted EWM, though a few floating fragments of this species were noted and removed. No EWM was discovered on the sampling rake while conducting the grid point sampling, though in 2 grid points, EWM was noted nearby. Grid point sampling is useful for conducting sampling in deeper waters and may detect EWM if there are dense infestations but did not prove a useful tool if EWM plants are sparsely distributed and abundant in low numbers.

A total of 13 aquatic species were noted during the inventory and are listed in Table 1. This is not a complete species list for the lake, only those species that were documented on the sampling rake or noted incidentally. Of particular note is the presence of Vasey's pondweed (*Potamogeton vaseyii*) throughout the lake. This is a rare (S2-ranked) species in Vermont that was present throughout the lake and appeared to be a healthy population with many individuals in flower or fruit.

Latin Name	Common Name	S-Rank	Plant family
Eleocharis palustris	marsh spike-rush		Cyperaceae
Equisetum fluviatile	water horsetail		Equisetaceae
Eriocaulon aquaticum	pipewort		Eriocaulaceae
Elodea canadensis	water-weed		Hydrocharitaceae
Najas flexilis	common naiad		Hydrocharitaceae
Nymphaea odorata	waterlily		Nymphaeaceae
Potamogeton amplifolius	broad-leaved pondweed		Potamogetonaceae
Potamogeton epihydrus	ribbon-leaved pondweed		Potamogetonaceae
Potamogeton gramineus	grass-leaved pondweed		Potamogetonaceae
Potamogeton illinoensis	Illinois pondweed		Potamogetonaceae
Potamogeton robbinsii	Robbins' pondweed		Potamogetonaceae
Potamogeton spirillus	common snailseed pondweed		Potamogetonaceae
Potamogeton vaseyi	Vasey's pondweed	S2	Potamogetonaceae

References Cited

Arrowwood Environmental. 2018. Lake Ninevah Aquatic Plant Inventory. Report submitted to the Town of Mount Holly and the Ninevah Foundation. 22 pages. December 7, 2018.

Hauxwell, Jennifer, Susan Knight, Kelly Wagner, Alison Mikulyuk, Michelle Nault, Meghan Porzky, Shaunna Chase, and J Hauxwell. 2010. "Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications." https://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/ecology/Aquatic Plants/PI-Protocol-2010.pdf.

Madsen, John D, Jay A Bloomfield, James W Sutherland, Lawrence W Eichler, and Charles W Boylen. 1996. "The Aquatic Macrophyte Community of Onondaga Lake: Field Survey and Plant Growth Bioassays of Lake Sediments." *Lake and Reservoir Management* 12 (1): 73–79. https://doi.org/10.1080/07438149609353998.

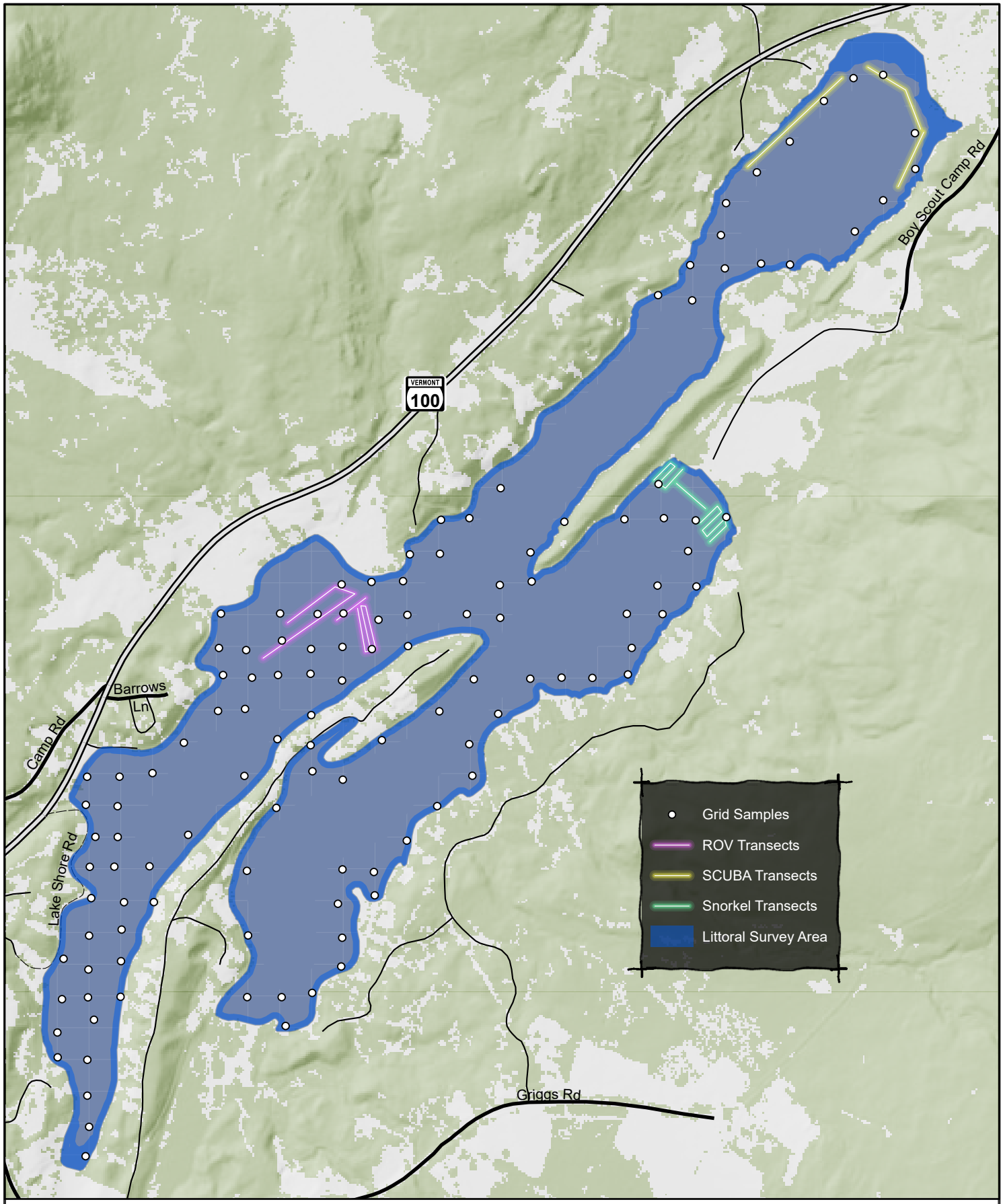
Appendix 1

Table of EWM Occurrences

ID	DEPTH	# Plants	Area	Creation Date	Lat	Long
3	6	2 plants	5' diameter area	8/15/2022	44.727716	-72.497252
16	7	1 plant		8/15/2022	44.726406	-72.494935
17	7	1 plant		8/15/2022	44.724776	-72.497973
18	5	2 plants		8/15/2022	44.724743	-72.498333
19	1	1 plant		8/15/2022	44.724713	-72.498644
20	1	2 plants		8/15/2022	44.724530	-72.499298
23	13	4 plants		8/15/2022	44.724224	-72.501131
24	7	1 plant		8/15/2022	44.724185	-72.501310
25	2	1 plant		8/15/2022	44.723998	-72.501614
26	4	1 plant		8/15/2022	44.723792	-72.501654
27	8	1 plant		8/15/2022	44.722010	-72.504054
36	9	3 plants		8/15/2022	44.719239	-72.508827
37	10	1 plant		8/15/2022	44.719112	-72.508438
101	8	2 plants		8/16/2022	44.720434	-72.499675
109	7	2 plants	20’ apart. One in 4’ water	8/16/2022	44.717804	-72.501760
110	4	3 plants	5' diameter area	8/16/2022	44.717780	-72.501850
138	8	12 plants	10’diameter area	8/16/2022	44.717570	-72.502599
139	7	17 plants	12’ diameter area	8/16/2022	44.717621	-72.502254
140	6	1 plant		8/16/2022	44.717668	-72.502035
141	6	1 plant		8/16/2022	44.718928	-72.500507
142	1	1 plant		8/16/2022	44.721312	-72.500597
143	1.5	1 plant		8/16/2022	44.721390	-72.500812
144	10	5 plants	20 ft diameter area	8/16/2022	44.720215	-72.499813
145	10	30 plants	20 ft diameter area	8/16/2022	44.720255	-72.499747
146	4	1 plant		8/16/2022	44.720623	-72.499727
147	8	1 plant		8/16/2022	44.721280	-72.500795
148	9	3 plants	5 ft diameter area	8/16/2022	44.721206	-72.500846
149	11	3 plants	5 ft diameter area	8/16/2022	44.721139	-72.500817
150	11	1 plant		8/19/2022	44.727976	-72.496654
151	7	2 plants		8/19/2022	44.727899	-72.496992
152	8	2 plants		8/19/2022	44.727636	-72.497151
153	9	1 plant		8/19/2022	44.728188	-72.496057
154	3	3 plants		8/19/2022	44.728294	-72.495762
155	2	1 plant		8/19/2022	44.728478	-72.495663
156	0	2 plants		8/19/2022	44.728200	-72.495479
157	6	7 plants	20 ft diameter area	8/19/2022	44.727580	-72.495030
158	8	~120 plants	20 ft diameter area	8/19/2022	44.727575	-72.495008
159	11	~50 plants	In area just outside buoys	8/19/2022	44.727822	-72.495080
160	11	1 plant		8/19/2022	44.718761	-72.508243
161	11	1 plant		8/19/2022	44.718877	-72.508087
162	11	2 plants		8/19/2022	44.718823	-72.508543
163	11	4 plants	5 ft diameter area	8/19/2022	44.718759	-72.508145
164	10	1 plant		8/19/2022	44.723332	-72.499732

Appendix 2

Maps of Survey Types and EWM Occurrences



Lake Eden: Sample Locations 2022

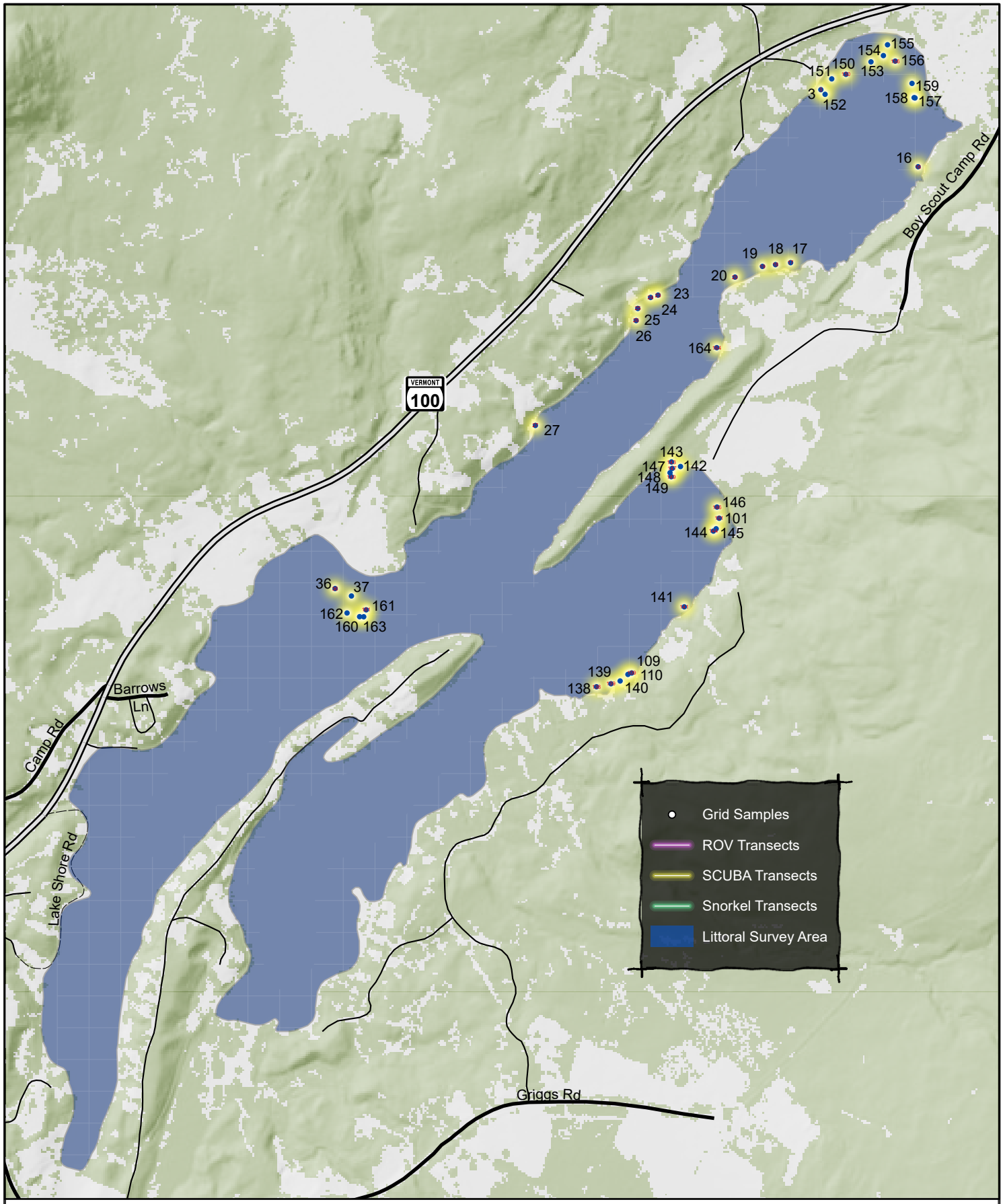
Monday, August 29, 2022 File: LakeEden:8.5x11 Report

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 105210 420 630 840 Feet

N W E S

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON,VT 05462
(802 434-7276 FAX: (802) 329-2259



Lake Eden: Eurasian Watermilfoil 2022

Monday, August 29, 2022 File: LakeEden:8.5x11 Report

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 105210 420 630 840 Feet

N W E S

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON,VT 05462
(802 434-7276 FAX: (802) 329-2259