2011 Milfoil Solution® Progress Report for Big Cedar Lake, Ontario

Prepared for:

Big Cedar Lake Stewardship Association

Prepared by:

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1.0 Introduction

Eurasian watermilfoil (*Myriophyllum spicatum*, hereafter referred to as milfoil) is an exotic aquatic species that tolerates a wide range of growing conditions and out-competes native vegetation. Monocultures of milfoil limit recreational use, reduce biodiversity, and can cause detrimental changes to water temperature and dissolved oxygen in severe infestations. The native North American beetle, the milfoil weevil (*Euhrychiopsis lecontei)*, has been augmented in Big Cedar Lake, Ontario, to suppress the growth of milfoil through EnviroScience's **Milfoil Solution®**.

The milfoil weevil is native to Ontario waters and Big Cedar Lake and is the natural predator of milfoil. Augmenting the indigenous weevil population to accelerate this predator/prey relationship is the goal for all **Milfoil Solution®** programs in order to establish a self-sustaining weevil population that suppresses milfoil below nuisance levels. For most of our clients, this process takes anywhere from three to five years, depending on the size of the milfoil infestation.

This insect is a specialist herbivore of milfoil and damages the plant in multiple ways. The most significant impact is caused by the weevil larva as it damages the meristem, or growing tip, and burrows through the stem. Nutrient flow in the plant is disrupted and the stem loses buoyancy and collapses in the water column. A cascading effect pulls neighboring plants lower into the water column and the rate of photosynthesis is significantly reduced in these stems. The adult weevil also feeds on the plant and will move from plant to plant as it needs fresh, healthy tips for mating, laying eggs and feeding. The life cycle of the milfoil weevil from egg to adult occurs over 20 to 30 days and is dependent on temperature. Each female has the potential to lay 2 to 4 eggs per day, and 3 to 4 generations are produced each summer depending on seasonal conditions. The last generation of the summer concentrates on moving to the shoreline to overwinter under dry leaf litter. In the spring, the weevil is known to head back to water as soon as ice-off and start reproducing when water temperatures reach approximately 15 °C.

The following is the projected Milfoil Solution® program at Big Cedar Lake as outlined in the proposal:

Year	Survey Dates	Sites Established	Weevils Stocked
2011	Initial: 9, 11, 15 September Follow-up: 18 September	S1-S5, M1, M2 5 private stocking sites	30,000 (Lake Association) 23,000 (Private Stocking)
2012	--	--	30,000
2013	--	--	20,000
2014	--	--	15,000
2015	--	--	*Survey*

2.0 Survey Methods

An initial survey is performed prior to weevil stocking and a follow-up survey is conducted six to eight weeks later. Qualitative observations include overall milfoil density and health, native plant species present, and the presence of weevils and weevil-induced damage. Quantitative measurements include milfoil density and weevil population density. Milfoil density is determined by randomly collecting stems throughout the milfoil bed using a quadrat. This sample is then converted to the number of stems per square meter (stems/m^2). Weevil population density (number of weevils per stem) is determined through lab analysis of approximately 30 stems sampled from three transect lines at each site. Weevil densities (Table 1) and milfoil densities (Table 2) were recorded for five stocking sites and two monitoring sites. Due to the random nature of sampling, these results are best viewed over multiple years as survey locations often may not exhibit a high number of weevil life stages or a stable pattern in milfoil growth.

3.0 Results and Weevil Stocking

Stocking Sites (S1-S5): A total of 30,000 weevils were stocked throughout five sites (S1-S5) as part of a lake-wide management program (see attached map). Surveys at most sites revealed a native weevil population. Milfoil density was the highest at S5 and the lowest at S2. Orange buoys were placed at each stocking site and location was recorded using a GPS unit.

- **S1** – 5,300 weevils were stocked at S1. Milfoil was moderately dense and composed about 90% of the plant community. Sample analysis from the initial survey included 2 weevil life stages and damage to 10% of the samples. The follow-up survey included 20 weevil life stages and damage to 47% of the samples. Milfoil density appeared to increase from 103.7 to 188.89 stems/m^2.

- **S2** – 5,300 weevils were stocked at this site. Milfoil was dense and composed about 75% of the plant community. Sample analysis from the initial survey included 2 weevil life stages and damage to 40% of the plants. The follow-up survey included 14 weevil life stages and damage to 67% of the plant samples. Milfoil density appeared to increase from 88.9 to 211.1 stems/m^2.

- **S3** – 6,500 weevils were stocked at S3. Milfoil was dense and composed about 75% of the plant community. Sample analysis from the initial survey included 28 weevil life stages and damage to 73% of the plants. The follow-up survey included 63 weevil life stages and damage to 70% of the plant samples. Milfoil density appeared to decrease from 244.4 to 114.8 stems/m^2.

- **S4** – 7,800 weevils were stocked at S4. Milfoil composed about 90% of the plant community. Sample analysis from the initial survey included 23 weevil life stages and damage to 80% of the plants. The follow-up survey included 8 weevil life stages and damage to 47% of the plant samples. Milfoil density appeared to increase from 251.9 to 355.6 stems/m^2.

- **S5** – 5,100 weevils were stocked at S5. Milfoil composed about 90% of the plant community. Sample analysis from the initial survey included 10 weevil life stages and damage to approximately 73% of analyzed samples. The follow-up survey included 21

weevil life stages and damage to 43% of samples. The measured density of the milfoil appeared to increase from 470.4 to 692.6 stems/m^2.

Private Stocking Sites: A total of 23,000 weevils were stocked throughout five private stocking locations. Full surveys were not contracted at the private stocking locations and plant samples were not collected for analysis, but weevil life stages and damage indicative of an indigenous weevil population were observed at all sites. Orange buoys were placed at each of the private stocking locations and location was recorded using a GPS unit.

Monitoring Sites (M1 and M2): Two monitoring sites were established to compare stocking sites to untreated conditions over the course of the program. These sites are located in the northeast portion of the lake and both contain a native weevil population.

- **M1** - Milfoil composed about 75% of the plant community at Monitoring Site 1. Sample analysis from the initial survey included 7 weevil life stages and damage was found on 80% of analyzed samples. The follow-up survey included 18 weevil life stages and damage to 63% of samples. Milfoil density appeared to decrease from 466.7 to159.2 stems/m^2, although the site still remains dense.

- **M2**- Milfoil composed about 60% of the plant community at Monitoring Site 2. Sample analysis from the initial survey included 2 weevil life stages. The follow-up survey included 29 weevil life stages and damage to 57% of the plant samples. Milfoil density appeared to slightly increase from 237.0 to 244.4 stems/m^2.

Native aquatic plant species recorded throughout Big Cedar Lake in 2011 included: Chara (*Chara* sp.), Clasping leaf pondweed (*Potamogeton perfoliatus*), Coontail (*Ceratophyllum demersum*), Eelgrass/Water Celery (*Valisneria americana*), Elodea (*Elodea canadensis*), Fern pondweed (*P. robbinsii*), Flat-stem pondweed (*P. zosteriformis*), Large leaf pondweed (*P. amplifolius*), Northern watermilfoil (*Myriophyllum sibiricum*), Sago pondweed (*P. pectinatus*), Slender naiad (*Naias flexilis*) Small pondweed (*P. pusillus*), Water stargrass (*Zosterella dubia*) White-stem pondweed (*P. praelongus*), and White water lily (*Nymphaea* spp.).

4.0 Discussion

Based on results from the 2011 initial and follow-up surveys, it appears that Big Cedar Lake contains the conditions necessary to support an augmented weevil population as part of a Milfoil Solution® program.

- Weevil population density has increased at six of seven sites from the initial (pre-weevil stocking) survey to the follow-up survey. This statistic is highly encouraging as it is often typical to find very few weevils on 30 randomly-collected stems within a large site.

- Milfoil samples from all sites exhibited indicators unique to a weevil population such as holes in the stems and extensively damaged areas where larvae have burrowed through the stems.

Weevil density increased at every site with the exception of S4, which indicates that the augmented weevil population successfully contributed to the overall population. While it appears

the weevil population at S4 did not increase, this might be attributed to the nature of random sampling. The weevil population at both monitoring sites has also appeared to increase and these measurements are best viewed over multiple years to more accurately assess how the lake-side weevil population is progressing.

Milfoil stem density increased at most sites at the time of the follow-up survey. This pattern is often typical as plant growth progresses throughout the season until plant height begins to decrease in early autumn. Observing long-term oscillations between weevil populations and milfoil density is natural and reflects the predator-prey nature of biological control. Data at some sites may not follow what is considered a "normal" pattern which is why multiple years of surveys are crucial to comprehensively assess how the milfoil and weevil populations are interacting.

The overall stem density and infestation of milfoil is expected to decrease as the augmented weevil population grows. As a biological control, the Milfoil Solution® process is most successful when introduction of the milfoil weevil occurs over multiple, successive growing seasons to ensure that the weevil population reaches high densities in the lake to maintain the milfoil to non-nuisance levels. Signs of milfoil suppression include:

- ✓ Reduction in density of the milfoil
- ✓ Maintenance of the stems below the lake surface at a non-nuisance level
- ✓ Open areas within the stocking sites

A secondary effect of the process it that native aquatic plants replace exotic milfoil as it is outcompeted and becomes a less dominant species in the plant community. Over the course of the program, areas of infestation transition into a more natural distribution of native plants, restoring a balanced lake ecology that supports a healthier fishery while improving recreational and aesthetic value. A total of fifteen native aquatic species were identified throughout the survey sites and will continue to be monitored over the course of the program to monitor positive changes in the plant community.

5.0 Recommendations

Based on results in 2011 and the measured increase in the weevil population, the first year of this stocking program is progressing as expected. The current proposal includes stocking from 2011 to 2014, with 30,000 weevils contracted in 2012. Based on this proposal, it is the recommendation of EnviroScience that 10,000 weevils are stocked at S5 and 5,000 are stocked at S1-S4 in 2012.

In addition to the contracted amount, we recommend that the association consider stocking 5,000 to 10,000 extra weevils in S5 in response to the dense, extensive infestation observed in 2011. Stocking additional weevils in this area is a more aggressive strategy that will yield results more quickly. Should a more aggressive treatment not be implemented, milfoil at this site is expected to continue to grow at the surface of this bay and severely out-compete native vegetation. Should the association wish to contract for additional weevils at S5 and other sites not stocked in 2011, a revised proposal may be developed upon request.

As part of a lake-wide strategy to manage Eurasian watermilfoil infesting Big Cedar Lake, it is key to recognize that suppressing this invasive species will be a gradual process that will

require continued support from the Big Cedar Lake Stewardship Association. As established sites are treated in subsequent years, supplementary sites outside the scope of the current stocking program may need to be addressed in 2013 to aid in preventing the spread of milfoil. Thank you for choosing our natural program to manage Eurasian watermilfoil safely and sustainably. Please contact EnviroScience for more information about our customized programs and incentives for a revised stocking proposal in 2012.

Should you have comments or questions upon reading this report, please do not hesitate to contact EnviroScience at (800) 940-4025 or at slomske@enviroscienceinc.com.

EnviroScience, Inc.
Lake Management Division
Milfoil Solution®

Table 1. Average Weevil Population Density (weevils/stem) in Big Cedar Lake

Site	Parameter measured	Initial Survey August 10, 2011	Follow-up Survey September 18, 2011
S1	Total weevils Total stems **Avg. weevils/stem**	2.00 30.00 **0.07**	20.00 30.00 **0.67**
S2	Total weevils Total stems **Avg. weevils/stem**	2.00 30.00 **0.07**	14.00 20.00 **0.70**
S3	Total weevils Total stems **Avg. weevils/stem**	28.00 30.00 **0.93**	63.00 30.00 **2.10**
S4	Total weevils Total stems **Avg. weevils/stem**	23.00 30.00 **0.77**	8.00 30.00 **0.27**
S5	Total weevils Total stems **Avg. weevils/stem**	10.0 30.00 **0.33**	21.00 30.00 **0.70**
M1	Total weevils Total stems **Avg. weevils/stem**	7.00 30.00 **0.23**	18.00 30.00 **0.60**
M2	Total weevils Total stems **Avg. weevils/stem**	2.00 30.00 **0.07**	29.00 30.00 **0.97**

Table 2. Average Density of EWM (stems/m^2) in Big Cedar Lake

Site	Initial Survey August 10, 2011	Follow-up Survey September 18, 2011
S1	103.7	188.9
S2	88.9	211.1
S3	244.4	114.8
S4	251.9	355.6
S5	470.4	692.6
M1	466.7	159.2
M2	237.0	244.4

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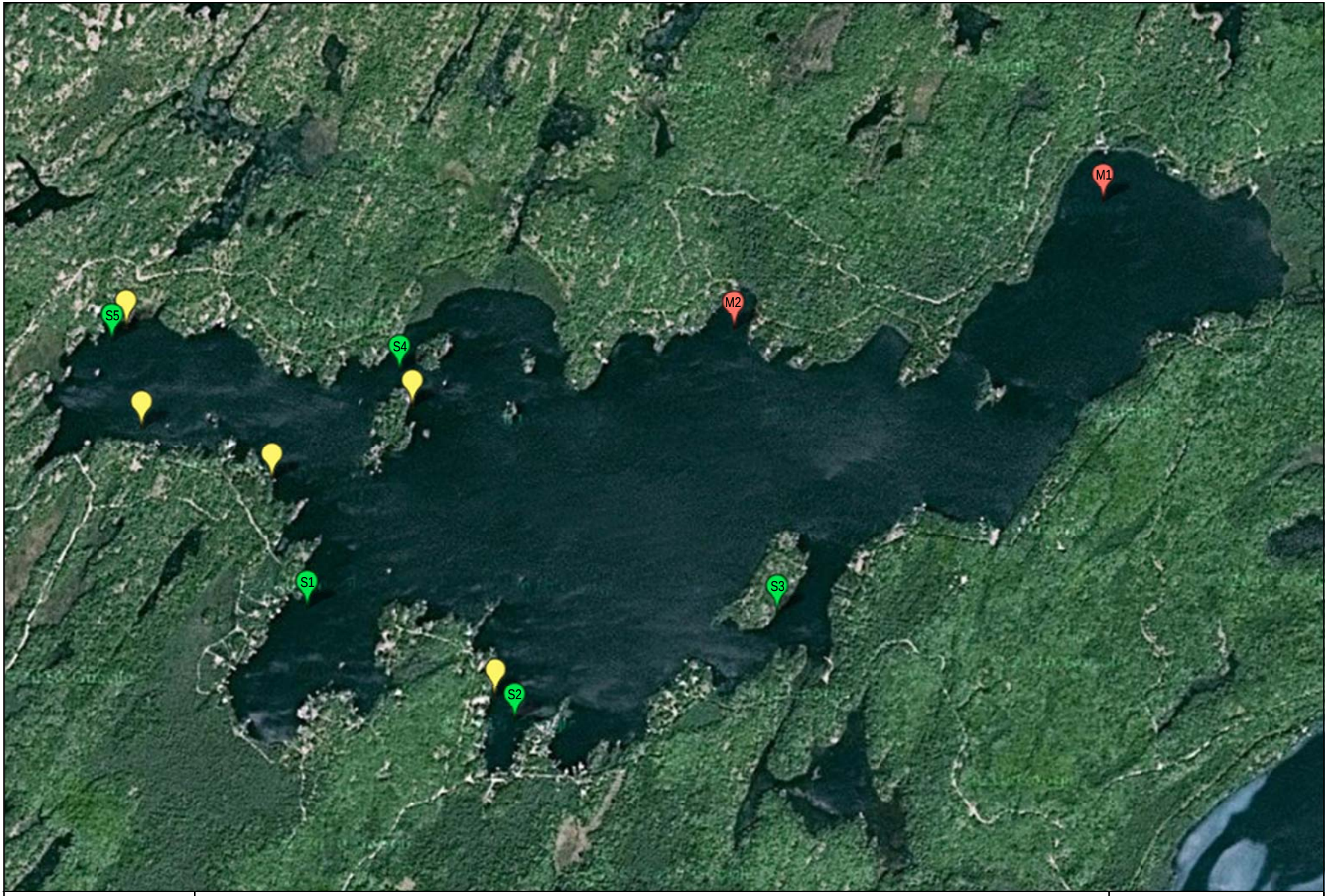

Big Cedar Lake
Peterborough County, Ontario

2011 Weevil Stocking and Survey Sites

- Stocking Sites
- Private Stocking Sites
- Monitoring Sites

200 m 600 m

1000 ft 3000 ft

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