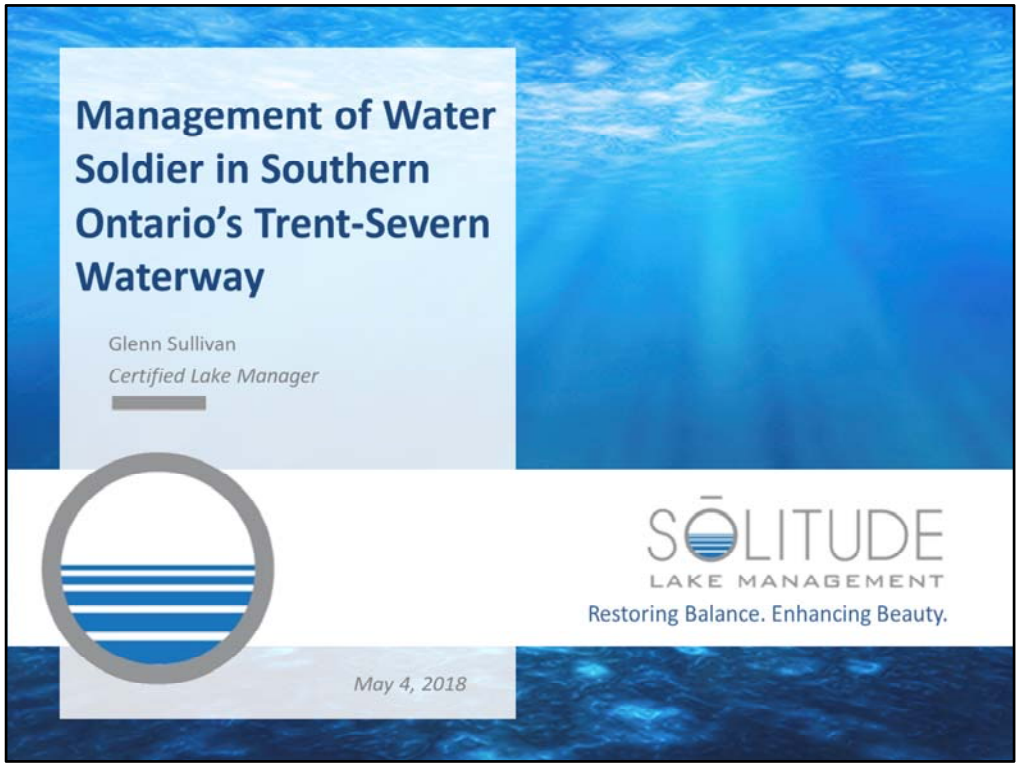
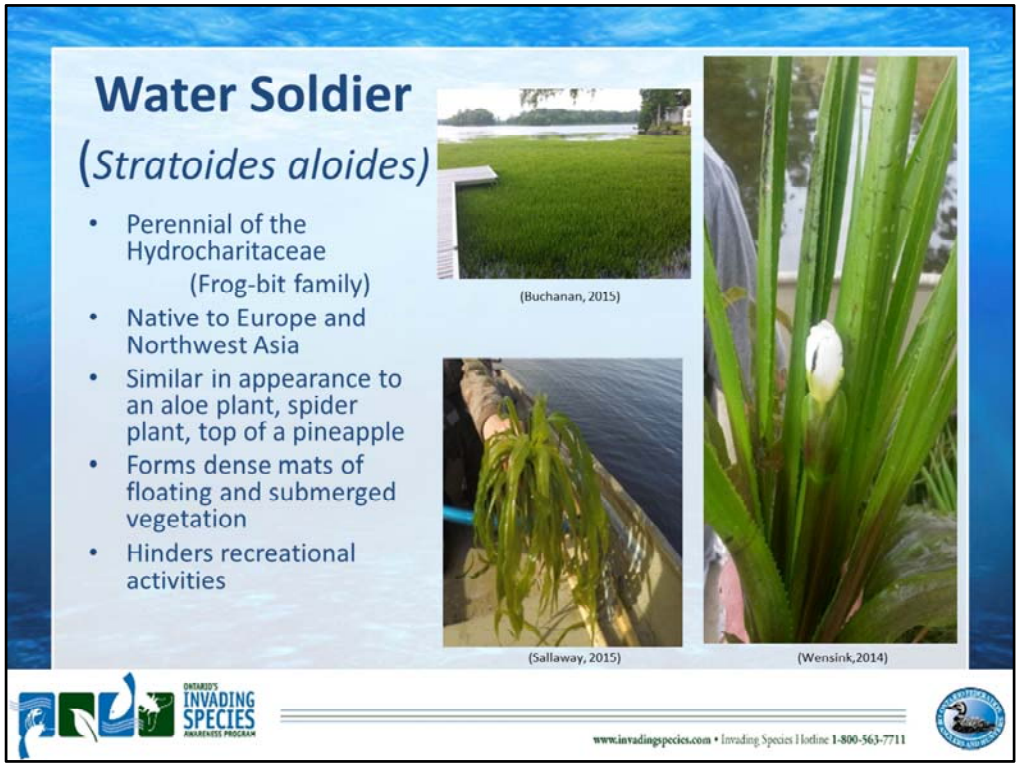

Management of Water Soldier in Southern Ontario's Trent-Severn Waterway
Glenn Sullivan
Certified Lake Manager
SOLITUDE
LAKE MANAGEMENT
Restoring Balance. Enhancing Beauty.
May 4, 2018



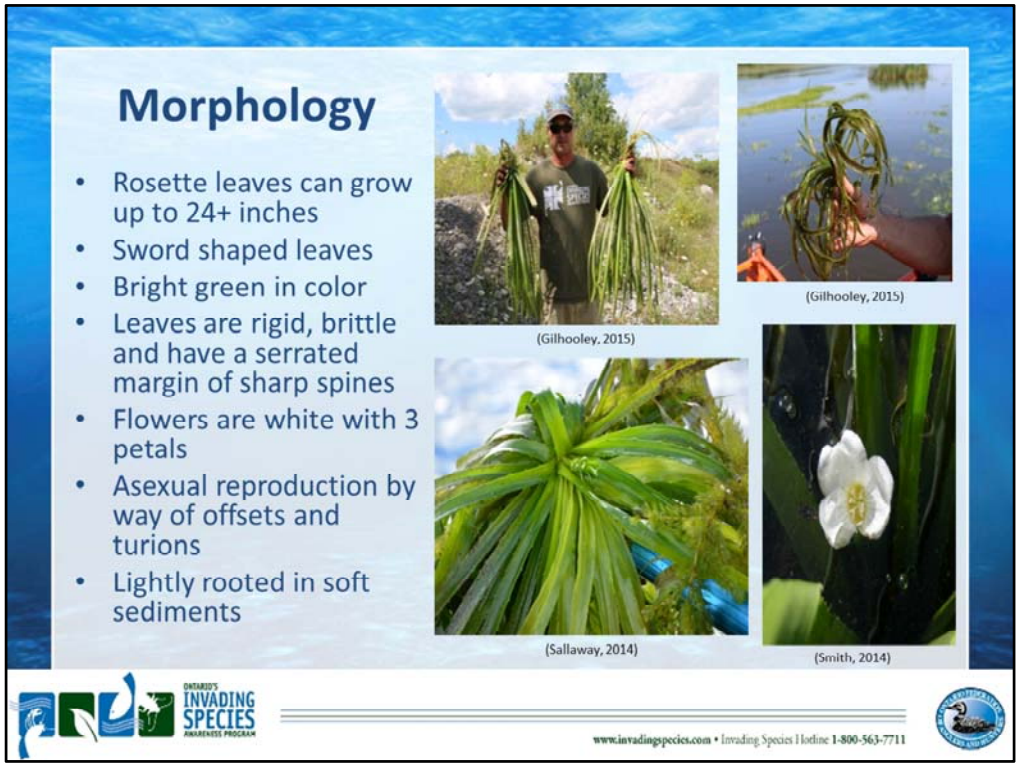
Water soldier is an invasive perennial aquatic plant that is native to Europe and northwest Asia. The only known wild population in North America was found in the Trent River in 2008, near the Hamlet of Trent River, Ontario. Water soldier is used as an ornamental plant in water gardens, which is the likely source of its introduction to the Trent River.

Why is it a problem

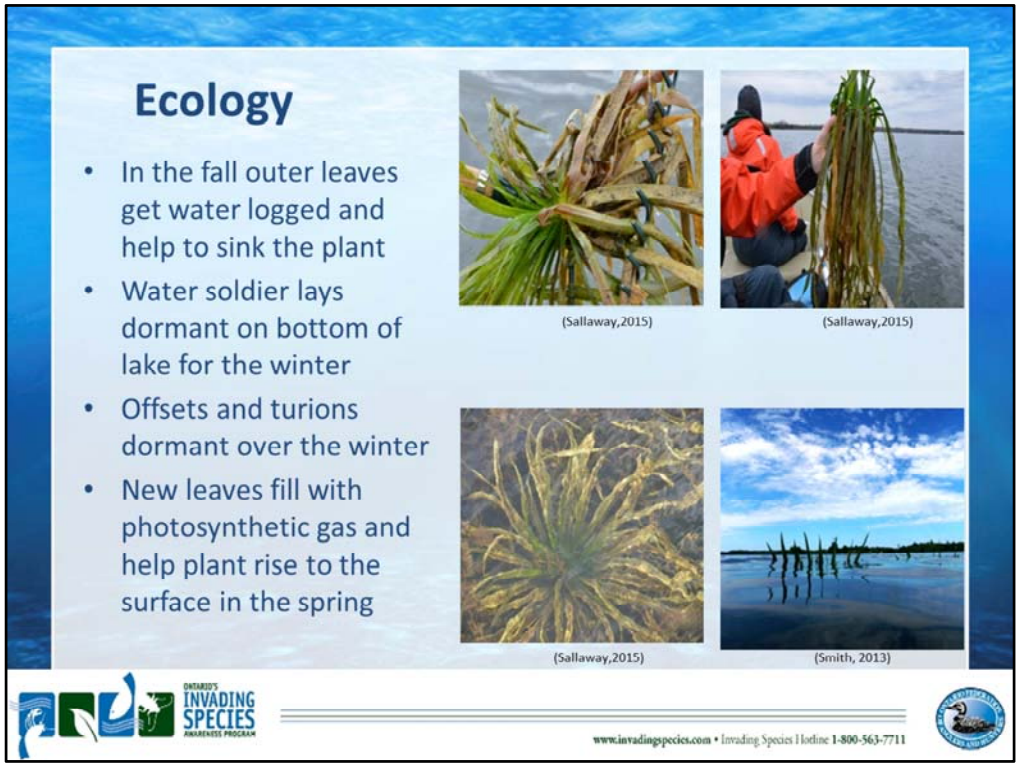
Forms dense mats of floating or submerged vegetation.
Crowds out native vegetation resulting in decreased plant biodiversity.
Has the potential to alter surrounding water chemistry, which may harm phytoplankton and other aquatic organisms.
Dense floating mats of water soldier can hinder recreational activities, such as boating, angling and swimming.
Sharp serrated leaf edges can cut swimmers and individuals who handle water soldier plants. Caution should be taken whenever handling the plant.

The typical habitat of water soldier is still or slow-flowing, meso-eutrophic water. It is not found in very shallow water, fast flowing water, or in areas where water fluctuates due to the sinking and floating behavior of the plant. The plant is lightly rooted and prefers soft muddy sediments.
Under conditions of low light the leaves do not develop enough gas in their air-canals and intercellular spaces to become emergent, and it is normal to find water soldier as a bottom-dwelling plant in water between 1 - 5 m deep, with low light conditions

Describe the pic taken the bathometry and turned into colour ramp darker deeper



Rosette leaves can grow up to 60 cm
Bright green in colour
Leaves are Sword shaped ,rigid, brittle and have a serrated margin of sharp spines
flowers are white with 3 petals
Asexual reproduction by way of offsets and turions
Lightly rooted in soft sediments (can be mobile)

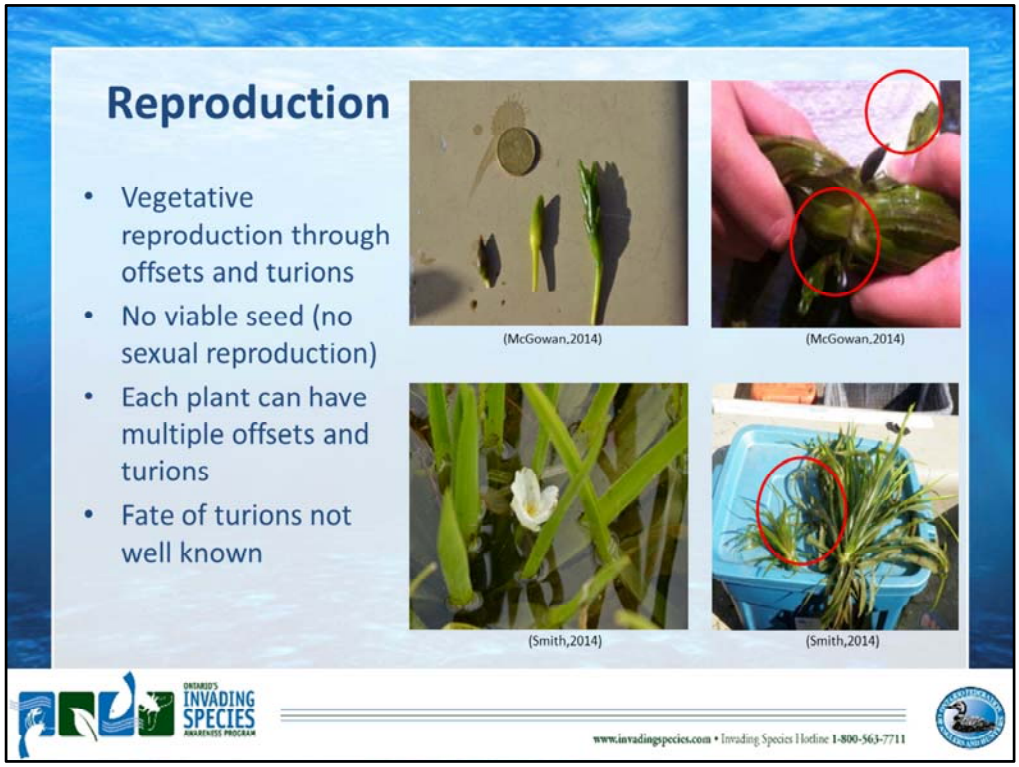


Seasonal changes in temperature result in ecological and morphological changes to the water soldier plants, water soldier becomes submerged in water in the fall, and over winters in a rootless state. You can see the outside leaves are brown, this is what helps the plants sinking behaviour. Outer leaves loose photosynthic gas this helps it to become buoyant in the summer and in the fall these leaves loose the gas and become waterlogged which helps the plant to sink.

In the winter, the leaves together with the stem perform a storage function keeping starch in their cells and this helps it to survive the winter

These rosette shoots and turions survive the winter season on the bottom of the lake under the ice

In the spring as a rootless rosette rises toward the water surface and forms new additional roots, the offsets become active, and the vegetative reproduction begins again



Water soldier relies primarily on vegetative reproduction through offsets. The offsets develop directly into open rosettes resembling small versions of the parent and become detached by late summer. Offsets that develop late in the growing season are almost bud-like and are called “turions. Turions will remain attached to the mother plant until the following spring when they detach.

Potential mechanisms for turion or offset dormancy are not clearly addressed in the literature and this information is critical in developing long-term management plans.

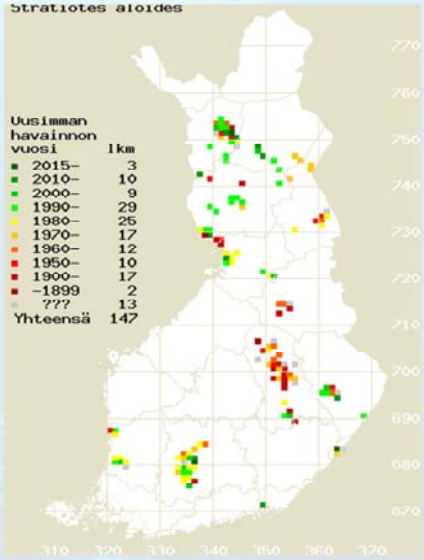
Potential pathways of introduction

- **Hitchhiking/fouling of boats**
  - Trent-Severn Waterway (TSW) connects to Great Lakes, St Lawrence River
- **Stocking/Planting/Escape from Culture**
  - Source of TSW infestation (OMNRF)
  - Available from water garden suppliers
- **Water movement**
  - Buds easily dispersed (26 miles between upstream and downstream TSW infestations)
  - 84% of propagules resprouted (Sarneel, 2013)
  - Stratoides buds increased buoyancy in Spring (Sarneel, 2013)
- **Waterfowl**?????

Water soldier in Finland

- "Arrived around 11,000 years ago"
- "The plant's vegetative spread is quite limited"
- "Necessary for Finland's rarest dragonflies, who won't lay their eggs anywhere else"

- NatureGate (www.luountoportti.com)



Water soldier in New South Wales, AUS

- "has the potential to become a serious weed of freshwater lakes, ponds in Australia"
- "can grow in depths of up to 5 meters"
- herbicide use limited to glyphosate on emergent parts of plant
- "NSW Weedwise"

Water Soldier in the UK

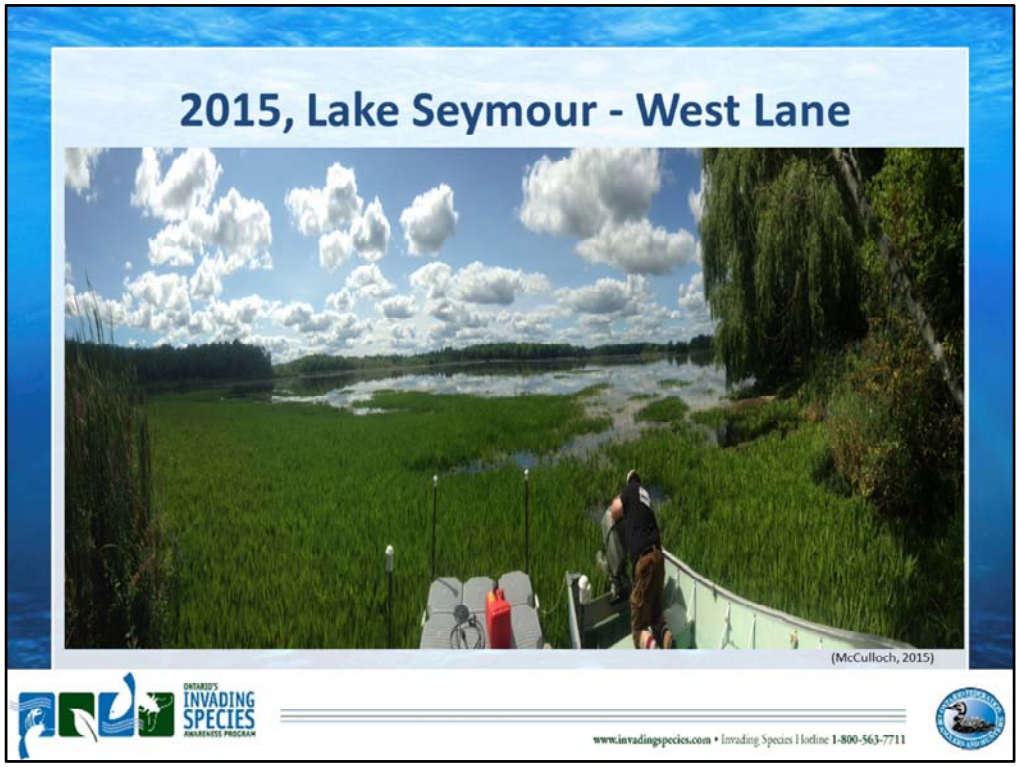
Native in England & Wales, Invasive in Ireland

North American Infestations

Trent-Severn Waterway/Lake Seymour and Black River, Ontario

This is a picture of a land owners water front in 2013, she has been keeping photos to document the spread of water soldier in front her dock.

You can see in one year that the water soldier has filled spaces in between the offshore popns and the shoreline .



As you can see, the water soldier popn has exploded along this water front in a very short period of time.

Biological control

- Experiment in 10 Dutch wetlands
- 1 year old water soldier plants
- Grazing by waterbirds measured
- Reduced biomass by 60%
- Decreased survival of *Stratoides*
- *GF (Ciska) Veen, et al. Freshwater Biology, September 2013*

Physical Control

- Hand removal effort in Trent River (*Snyder et al. 2016*)
  - Initially as effective as herbicides, but less efficient
  - Difficulties with dense stands, turbidity
- Mechanical methods not evaluated (*Snyder*)
  - Prevalence of stumps, shallow water would be prohibitive in Lake Seymour
- Benthic barrier – 3 sites in Ontario (*OISAP 2016*)
  - Plants deceased after 2 months

2015 Herbicide Control Project

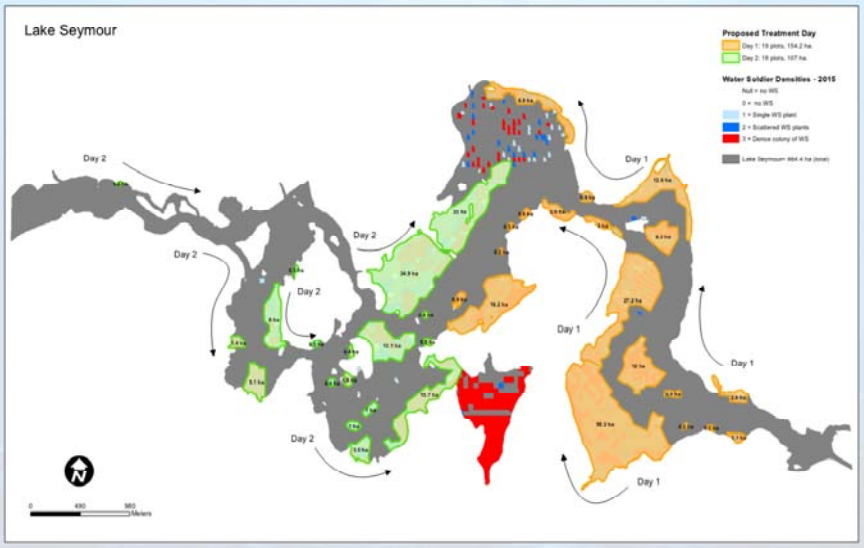
- Ontario Federation of Anglers and Hunters
- Ontario Ministry of Natural Resources and Forests
- Ontario Ministry of Environment and Climate Change
- Trent University
- University of Florida
- SOLitude Lake Management

2015 Herbicide Control Project

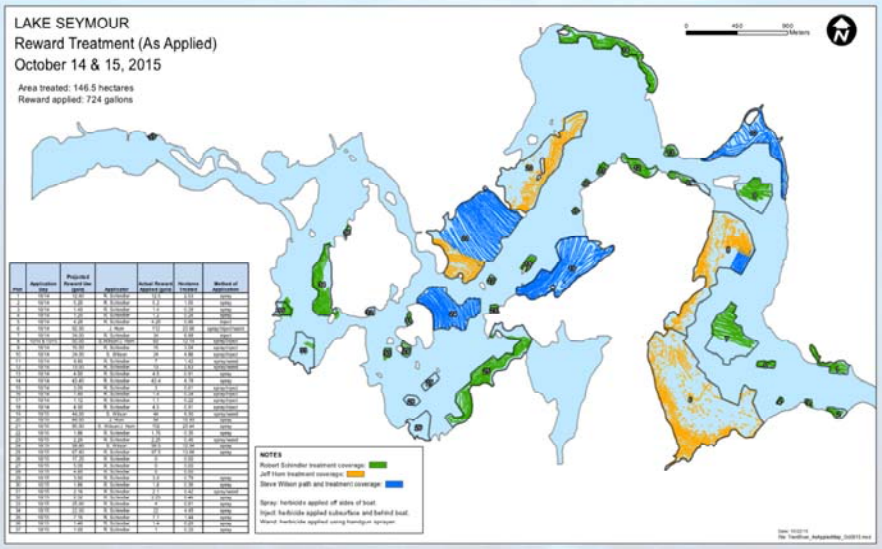
- Only one herbicide approved in CA – Reward
- OMNRF consulted with Dr. Mike Netherland (U of Florida) on rate, timing.
- Ontario applicators lacked equipment and experience (failed trial), so US firms invited to bid
- Treat after Canada Thanksgiving
  - Avoid "cottage season"
  - Avoid native plant impact
  - Treat in 48 hours!
- Thank you NAFTA

Lake Seymour Water Soldier Control

Fall 2015 Treatment Plan – Reward for 370 acres



Lake Seymour - October 2015 Treatment
Treated 360+ acres

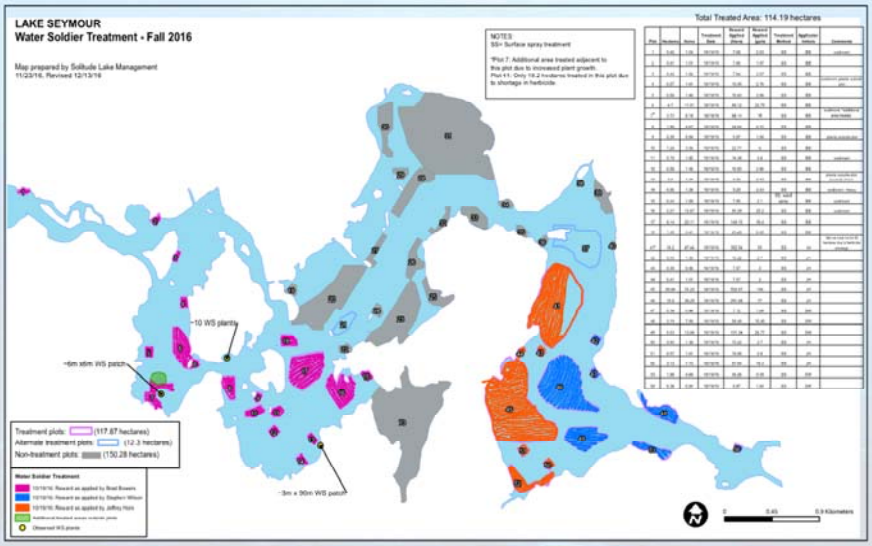



2016 Lake Seymour – West Lane
ONTARIO'S INVADING SPECIES AWARENESS PROGRAM
www.invadingspecies.com • Invading Species Hotline 1-800-563-7711

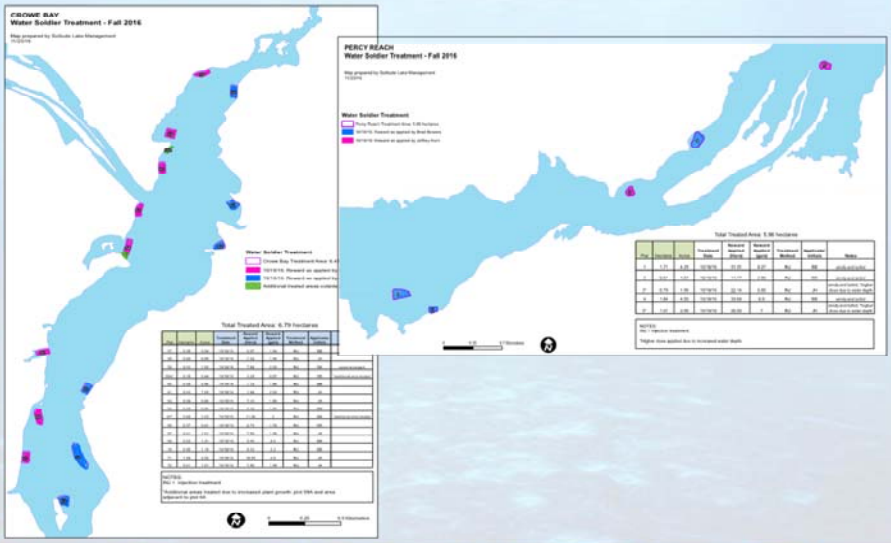
2016

South Shores – 2015 & 2016

Lake Seymour - October 2016
282 acres



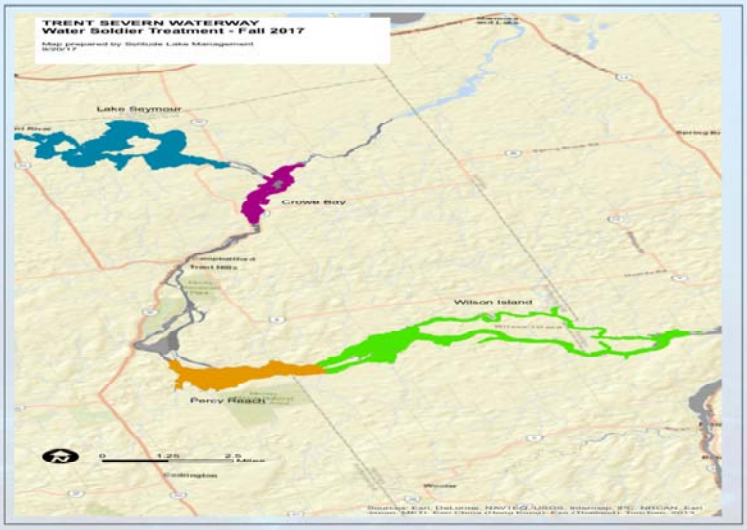
Crowe Bay & Percy Reach
October 2016 Treatment –31 acres



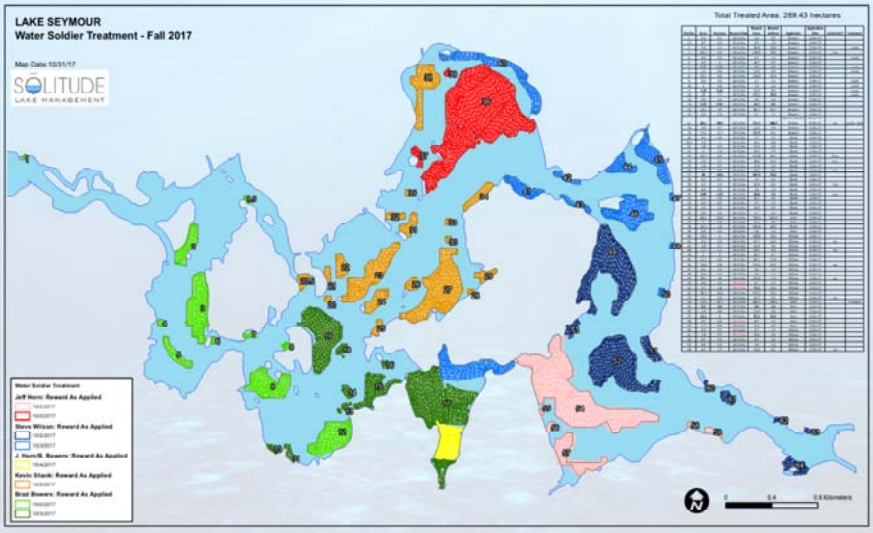
Fall 2017 Treatment

- **Timing – Two weeks earlier – Oct. 2-3**
- **Area – 2x greater area – ~700 acres (all infestations)**
- **Expansion – from 1**(2015) **to 4 zones**

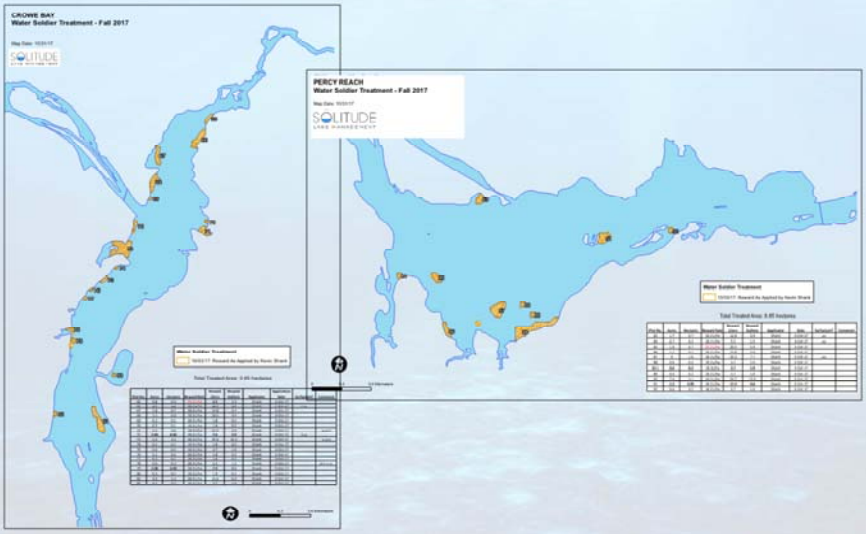
Lake Seymour and downstream areas
Fall 2017 Treatment Plan



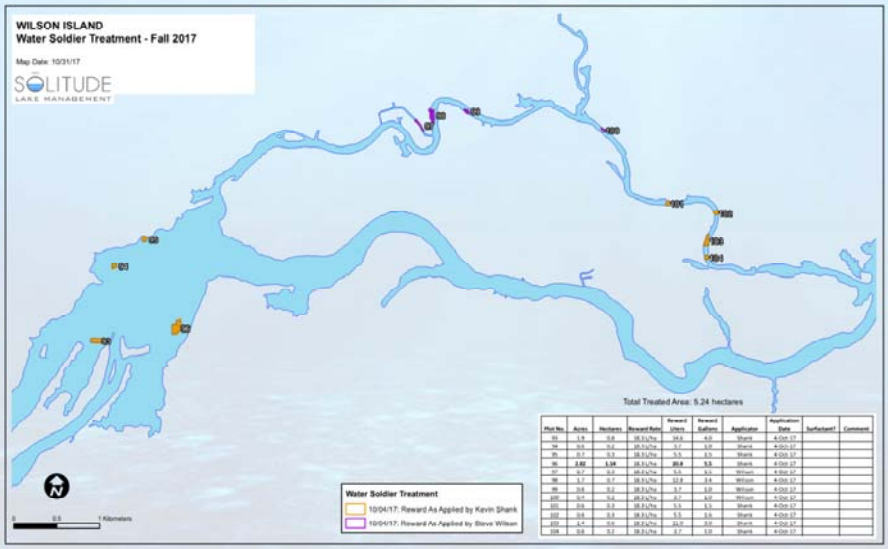
Lake Seymour - October 2017 Treatment
665 acres



Crowe Bay & Percy Reach
October 2017 Treatment – 45 acres



Wilson Island - October 2017 Treatment
13 acres



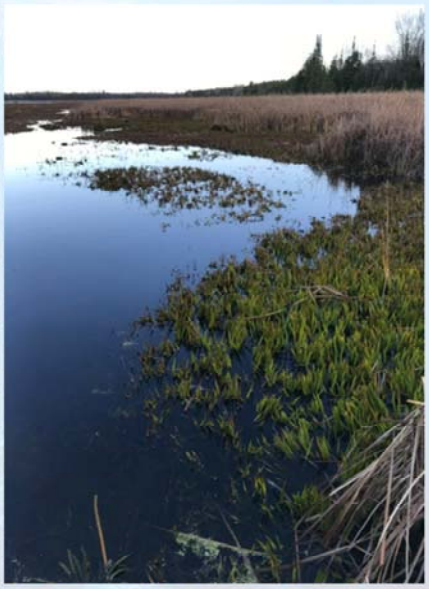
Fall 2017 Treatment Notes

- 4 airboats and 2 support boats
- Surfactant used on emergent sites
- Better timing on monitoring reduced plot location discrepancies
- WS in Puffball Bay stacked 2-3 plants deep
- Did not snow the next day (like in 2015)



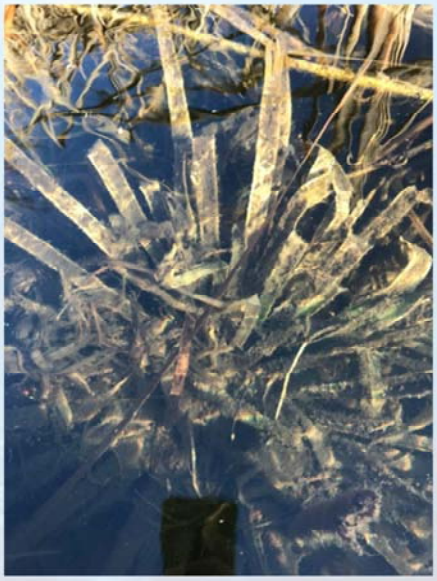
Post-treatment survey – November 3, 2017 (1MAT)

Untreated water soldier (Plot 17 south end)



Untreated water soldier (Plot 17 south end)

Treated water soldier (Plot 17 10/3, SW)



Treated water soldier (Plot 17, 10/3, BB, west side)

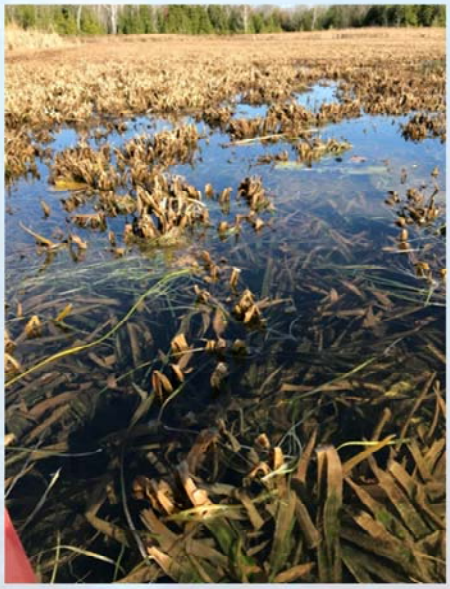
Treated water soldier (Plot 16, 10/3, BB)

Untreated/Treated water soldier (Plot 25, 10/2, KS)

Treated water soldier (Plot 23, 10/2, KS)

Treated water soldier (Plot 23, 10/2, KS)

Treated water soldier (Plot 16, 10/3, SW)



Lessons Learned

- Monitoring closer to application is valuable
- Earlier season application may:
  - reduce siltation on plants
  - Allow more rapid mortality
- Supplemental product (copper herbicide, sinking agent) may improve control on submersed plants
- Earlier Fall application isn't disruptive to recreation


Acknowledgements
Holly Simpson – Ontario Ministry of Natural Resources and Forestry
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May 4, 2018


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