



Mississippi Valley Conservation

*State of the Lake
Environment Report
December 2004*

Ardoch Lake



Ardoch Lake

Ardoch Lake, also known locally as Green Lake, is located in the Township of North Frontenac. Ardoch Lake is at an elevation of 282 metres above sea level. The lake perimeter is 5.5 kilometres and the deepest point is 17.4 metres. Ardoch Lake supports a warm water fishery. In particular walleye, northern pike and smallmouth bass. As of 2004, there were 10 cottages and 6 camp sites on the lake.



Limited water quality data is available for Ardoch Lake. Records indicate that shoreline property owners have not yet formed a Lake Association or participated in water quality testing available through the Ministry of Environment's Self Help Program or the Lake Partner Program. However, Ardoch Lake was monitored by the Ministry of Environment in 1976 and 1980 under the Recreational Lakes Program. Comprehensive testing in 1999 and 2004 through Mississippi Valley Conservation's (MVC) *Watershed Watch Program*, provides for a comparison between water quality conditions as they exist now, to results obtained twenty-eight years ago.

In general, the water quality in Ardoch Lake is very good. There is one sampling station on the lake at the deepest point as indicated on the bathymetric map included in this report. Samples were obtained three times at this location in 2004. You will find graphs which follow, that water clarity, as measured by Secchi Disk readings, were observed as excellent. The average for 2004 is 6.2 metres, thus indicating that Ardoch Lake is an unenriched (few nutrients) or oligotrophic lake, compared to 5 years ago, when the average was 4.1 metres.

Directly related to water clarity is the amount of nutrients, in particular phosphorus, entering the lake. The Provincial Objective for phosphorus levels in warm water lakes is 20 micrograms per litre (ug/L). In 2004, the mean for the euphotic zone (depth at which sunlight can penetrate or two times the secchi disk depth) was $2.7 ug/L$. The mean for the samples taken one metre off the bottom was $10.3 ug/L$, both readings are well below the Provincial Objective. Five years ago, the average phosphorus level was $10.0 ug/L$ in the euphotic zone and $76.7 ug/L$ one metre off the bottom of the lake, Ardoch Lake has greatly improved its average phosphorus levels in both the euphotic zone and one metre off the bottom.

Chlorophyll a is a measure of the algal density in the lake. The average chlorophyll a density for the sampling station was $1.03 ug/L$. Thus, indicating a low algal density for Ardoch Lake in 2004. In 1999, chlorophyll a levels were slightly lower at $0.79 ug/L$. Therefore, indicating that Ardoch Lake is an unenriched (few nutrients) or oligotrophic lake.

Plants and animals are a direct reflection of their environment. The most critical time of year for conducting dissolved oxygen and temperature profiles is after August 31. Profiles are generally conducted at this time of year and at the deepest point in the lake. Aquatic vegetation and algae that has grown over the summer, has died off and settled on the bottom, using the available oxygen necessary to sustain aquatic life in the lower portion of the lake or the hypolimnion.

The dissolved oxygen and temperature data, measured at the deepest point in the main basin, indicate oxygen concentrations in the deep water portion are reduced by late-summer. Warm water fish species, such as walleye and smallmouth bass, are squeezed into the upper 8 metres of the lake by September.

Ardoch Lake was also tested for invasive species in 2004, in particular, for zebra mussels and spiny water flea, in partnership with the Ontario Federation of Anglers and Hunters (OFAH). Ardoch Lake tested negative for both, zebra mussel veligers (larvae) and spiny water flea present. Residents and property owners need to ensure that all access points to the lake have posted signs indicating the precautions they can take to avoid the spread of invasive species from other lakes into Ardoch Lake. Another recommendation is for residents to begin participation in the invasive species monitoring program through MVC.



Residents and users of Ardoch Lake cannot afford to be complacent. Every effort should be made to reduce nutrient loading into the lake from land use activities. Human sources of phosphorus include leachate from sewage disposal systems, erosion from the clearing of shorelines and the use of lawn fertilizers. The first step to achieve this is to form a Lake Association. It is recommended that a Lake Steward be appointed to undertake ongoing water quality testing and to join the Mississippi Valley Lake Stewardship Network. Monitoring over time is essential to determine long term trends and changes. Resources and information are readily available through the *Watershed Watch Program*. There are helpful tips throughout this report to help reduce your impact on Ardoch Lake. Additional water quality data, current and historic, is available for Ardoch Lake and many other lakes in the Mississippi Valley watershed. Contact MVC for more information on how you can become a good lake steward for your lake.

FIVE EASY STEPS TO IMPROVE WATER QUALITY



1. Build at least 30 metres away from the shoreline.
2. Keep your lot well treed and preserve or replant native vegetation along the shoreline.
3. Pump out your septic tank every three to five years.
4. Reduce water use and use phosphate free soaps and detergents.
5. Keep the size of your lawn to a minimum; do not use fertilizers, herbicides or pesticides.

LOW PHOSPHORUS LIFESTYLE	Amount of Phosphorus (grams)	HIGH PHOSPHORUS LIFESTYLE	Amount of Phosphorus (grams)
Human waste	535	Human waste	535
No dishwasher	0	Dishwasher using powdered detergent once per day	650
No fertilizer	0	Lawn fertilized once/year	1960
Trees not cut down	20	Lot cleared of trees	30
Uses phosphate-free products	20	Uses products with phosphate	180
TOTAL	575 grams	TOTAL	3355 grams

How Does Ardoch Lake Measure Up?

1976 – 2004 Water Quality Results

Sample Year [Various Stations]	Secchi Disk Depth [Metres]	Total Phosphorus Euphotic Zone [Micrograms/Litre]	Total Phosphorus 1 Metre off Bottom [Micrograms/Litre]	Chlorophyll <i>a</i> Composite [Micrograms/Litre]
**1976 Mean	7.4	16.0		2.70
**1980 Mean	4.6	12.4	126.0	2.21
1999 Mean	4.1	10.0	76.7	0.79
*2004 Mean	6.2	2.7	10.3	1.03
n	4	4	3	4
Minimum	4.1	2.7	10.3	0.79
Maximum	7.4	16.0	126.0	2.70
Mean	5.6	10.3	71.0	1.70
Standard Deviation	1.50409164	5.633313856	58.04454582	0.919397448

*Mean based on less than 6 measurements **Includes Recreational Lakes Program Data
Chlorophyll *a* data prior to 1985 has been adjusted to reflect new lab procedures
in filtering resulting in an increase in chl.*a* concentrations by 35%

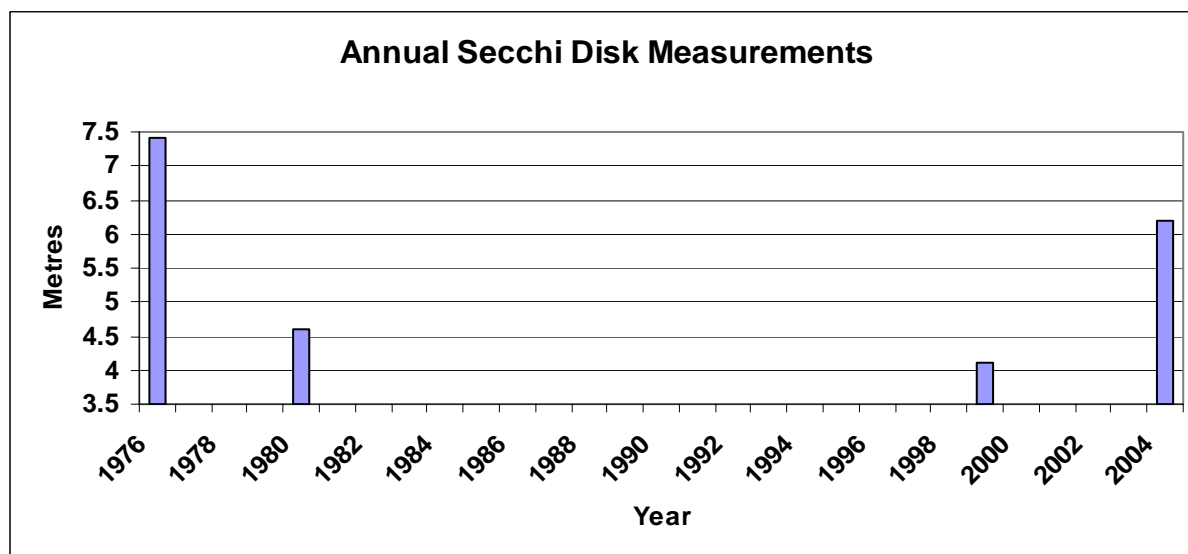
Interpreting Secchi Disc Readings:

A Secchi disk is a black and white coloured disk used to determine water clarity. The disk is lowered into the water. The point, at which you can no longer distinguish the black and white, is called the Secchi depth.



The higher the Secchi Disk measurement the clearer your lake is.

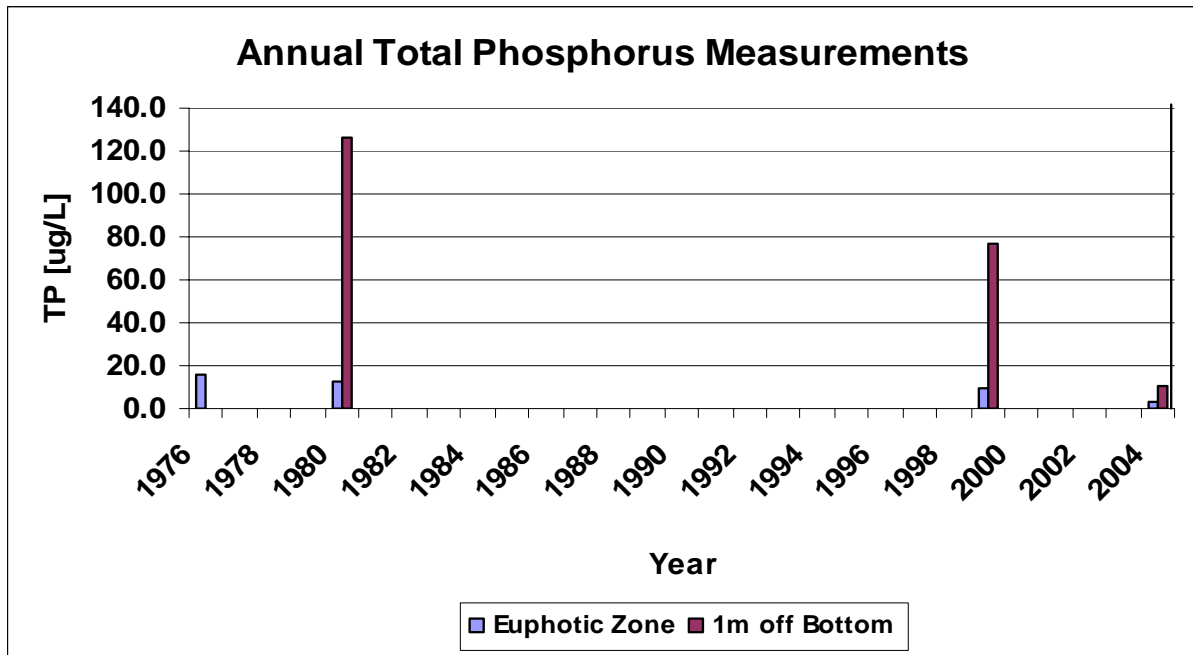
INTERPRETING YOUR SECCHI DISC RESULTS	
Secchi Reading	Lake Nutrient Status
Over 5 metres	Oligotrophic - unenriched, few nutrients
3.0 to 4.9 metres	Mesotrophic – moderately enriched, some nutrients
Less than 2.9 metres	Eutrophic – enriched, higher levels of nutrients



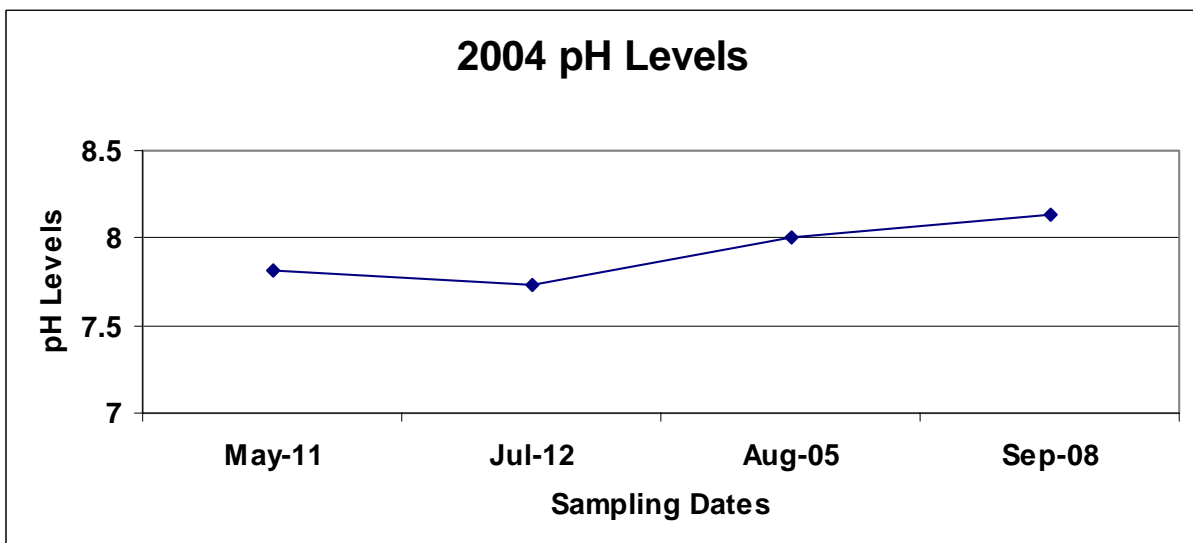
Interpreting Total Phosphorus Results:

Phosphorus is the nutrient that controls the growth of algae in most Ontario lakes. For this reason any increase in phosphorus in the lake will increase the quantity of algae that can grow. High levels of phosphorus can lead to algal blooms and in some cases affect the habitat of cold water fish such as lake trout. A general guideline exists to characterize your lake based on the total phosphorus that is measured.

INTERPRETING YOUR TOTAL PHOSPHORUS RESULTS	
Total Phosphorus	Lake Nutrient Status
10 ug/L or less	Oligotrophic - unenriched, few nutrients
11 to 20 ug/L	Mesotrophic – moderately enriched, some nutrients
21 ug/L or more	Eutrophic – enriched, higher levels of nutrients



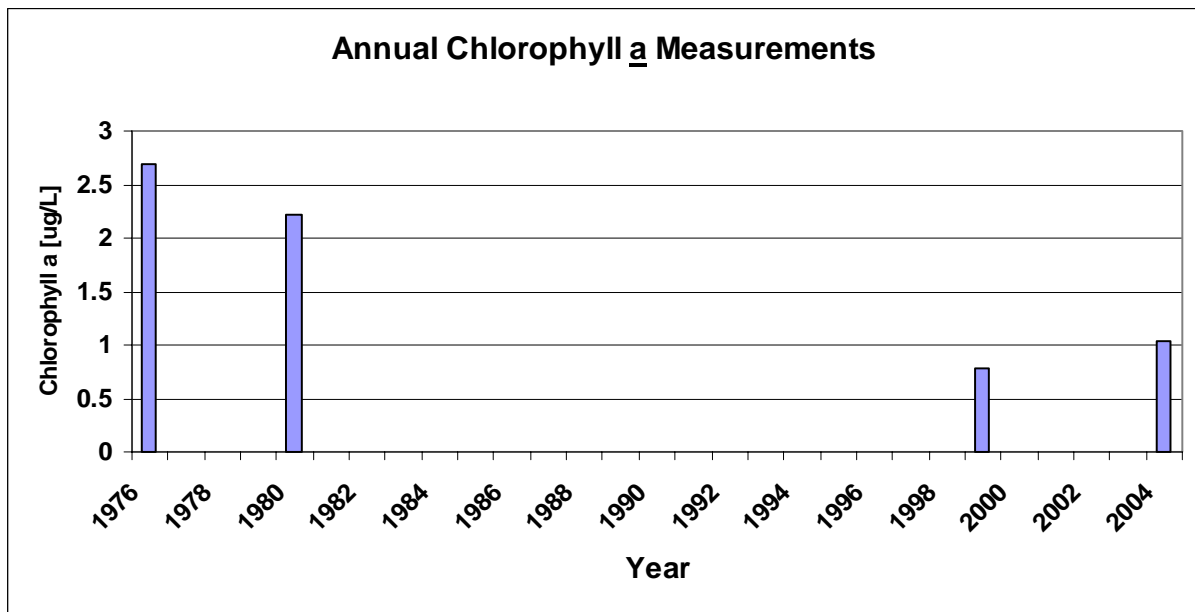
Evaluating your pH Results: Lakes with pH levels at 7.3 or higher are vulnerable to zebra mussels invasive.



Evaluating your Chlorophyll a Results:

The lower the chlorophyll a density in your lake, the clearer your lake is. Chlorophyll a is directly affected by the amount of total phosphorus in your lake. The more phosphorus there is in the water, the more algal growth will occur.

INTERPRETING YOUR CHLOROPHYLL <u>A</u> RESULTS	
Chlorophyll <u>a</u> Reading	Lake Nutrient Status
Up to 2 ug/L - low algal density	Oligotrophic - unenriched, few nutrients
2-4 ug/L - moderate algal density	Mesotrophic - moderately enriched, some nutrients
More than 4 ug/L- high algal density	Eutrophic - enriched, higher levels of nutrients



How to protect or restore a shoreline depends on the conditions of the site and the energy and resources of the owner.

There are four main strategies to choose from:

① PRESERVATION

When purchasing a lakefront property, a natural shoreline is retained and access to the lake is designed to avoid shoreline damage.

② NATURALIZATION

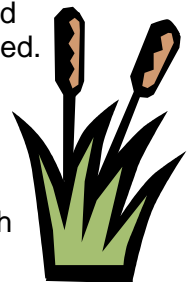
Degraded shorelines are left alone to return to their natural state.

③ ENHANCEMENT

Native species are planted and non-native species are removed.

④ RESTORATION

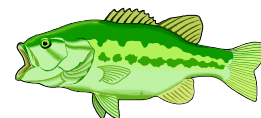
Cleared areas are planted with native species.



ARDOCH LAKE – Main Basin

DISSOLVED OXYGEN/TEMPERATURE PROFILES

MOE Rec. Lks. Station 18-3430-702-01 MVC Station # 04-21



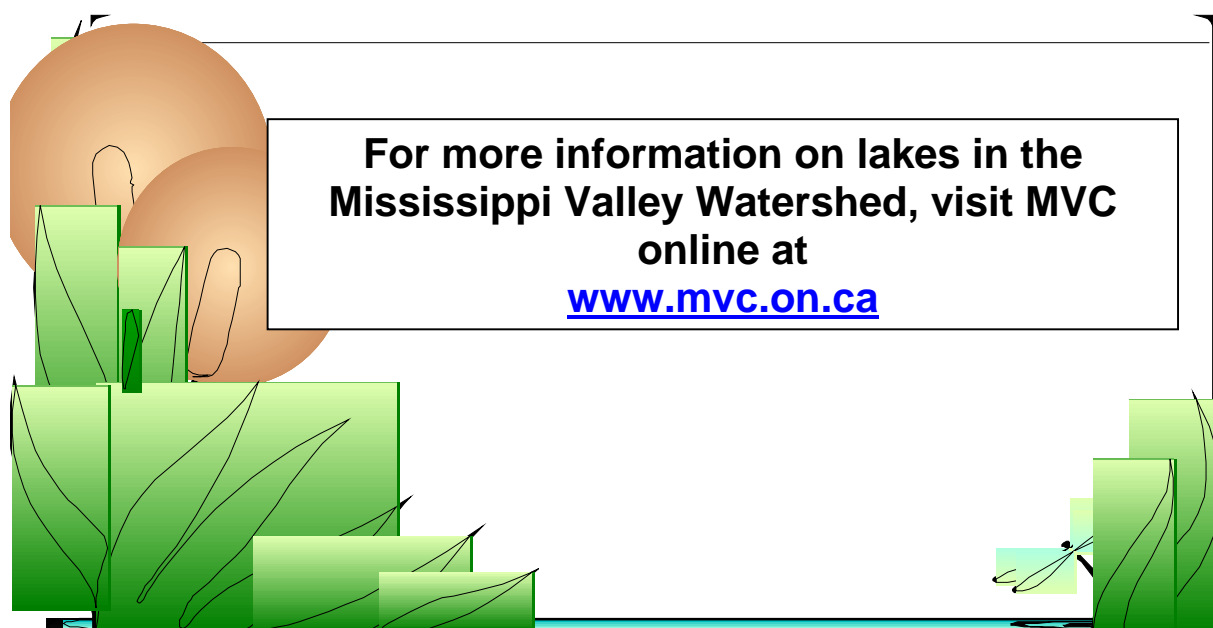
Date: May 11, 2004

Depth: 13.0 Metres

Euphotic Zone (Penetration of Light) = 13.0 Metres

Depth [Metres]	Temperature [Degrees Celsius]	Dissolved Oxygen [Milligrams/Litre]	Percent % Saturation	Thermal Stratification
0.1	15.4	7.9	76	Epilimnion
1.0	13.8	8.3	77	Metalimnion or Thermocline
2.0	12.8	8.4	76	
3.0	11.7	8.7	77	
4.0	11.5	8.5	74	Hypolimnion
5.0	11.0	8.6	75	
6.0	10.8	8.5	73	
7.0	10.4	8.2	71	
8.0	8.7	6.7	56	
9.0	8.3	5.9	48	
10.0	7.9	5.7	46	
11.0	7.5	3.6	29	Bottom
12.0	7.3	3.1	24	
13.0				

 Warm Water Fisheries Habitat (Bass, Walleye, Pike, Perch) = DO > 4 mg/L at < 25°C



ARDOCH LAKE – Main Basin Continued...

Date: July 12, 2004

Depth: 14.0 Metres

Euphotic Zone (Penetration of Light) = 10.0 Metres

Depth [Metres]	Temperature [Degrees Celsius]	Dissolved Oxygen [Milligrams/Litre]	Percent % Saturation	Thermal Stratification
0.1	23.9	7.9	89	Epilimnion
1.0	23.8	8.0	90	
2.0	23.6	8.1	91	
3.0	23.5	8.1	91	
4.0	22.0	8.2	90	
5.0	21.2	8.2	88	
6.0	17.7	9.5	96	Metalimnion or Thermocline
7.0	15.1	10.5	100	
8.0	12.2	9.5	85	
9.0	10.6	6.7	57	Hypolimnion
10.0	10.0	4.5	39	
11.0	9.3	1.6	13	
12.0	8.9	0.4	3	
13.0	8.4	0.2	2	Bottom
14.0				

 Warm Water Fisheries Habitat (Bass, Walleye, Pike, Perch) = DO > 4 mg/L at < 25°C

Date: September 8, 2004

Depth: 13.0 Metres

Euphotic Zone (Penetration of Light) = 9.2 Metres

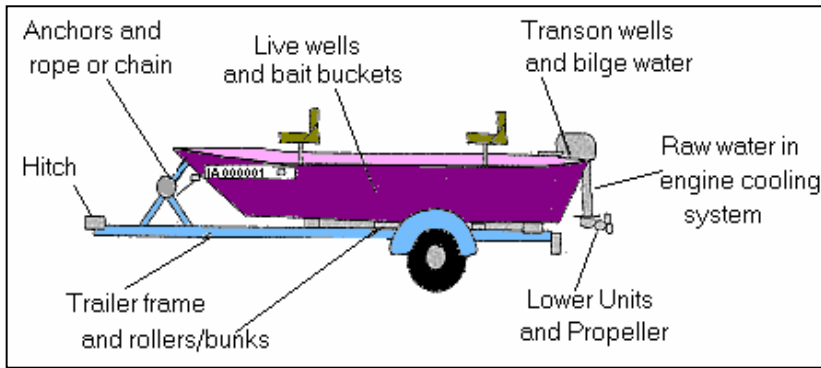
Depth [Metres]	Temperature [Degrees Celsius]	Dissolved Oxygen [Milligrams/Litre]	Percent % Saturation	Thermal Stratification
0.1	20.4	8.7	92	Epilimnion
1.0	20.4	8.7	92	
2.0	20.4	8.7	92	
3.0	20.4	8.7	92	
4.0	20.4	8.7	92	
5.0	20.4	8.6	91	
6.0	20.3	8.6	91	
7.0	20.3	8.6	91	Metalimnion or Thermocline
8.0	15.5	9.0	87	
9.0	11.8	3.4	30	
10.0	10.8	1.1	9	Hypolimnion Bottom
11.0	10.2	0.5	4	
12.0	9.5	0.3	3	
13.0				

 Warm Water Fisheries Habitat (Bass, Walleye, Pike, Perch) = DO > 4 mg/L at < 25°C



MVC and OFAH need your help to Stop the Invasion!

Check & clean your boat every time you change water bodies



Working with Lake Associations, we hope to improve signage at public launching areas to identify lakes where zebra mussels and spiny water fleas are already present. We hope to focus on an ambitious educational campaign to help reduce their spread to lakes where they are not yet present.

For more information call MVC at (613)259-2421, the Invading Species Hotline 1-800-563-7711.



The Watershed Watch program was made possible thanks to the generous support of the Ministry of Environment, Lake Associations, area Stewardship Councils, the Lake Stewardship Network and concerned citizens

For more information regarding Watershed Watch or for advice on how you can help protect or enhance your lake environment, contact Melissa Dakers, Water Quality Technician, Mississippi Valley Conservation at (613) 259-2421 or mdakers@mvc.on.ca

