Why Use Herbicides to Control Nuisance Aquatic Weeds?

- Aquatic herbicides provide a common, effective, and (if properly applied) safe technique to treat aquatic weeds (particularly submerged types) that have grown to such high coverage or densities as to impair recreational or ecological uses.
- Aquatic herbicides (a general class of pesticides) are typically applied to thousands of lakes, canals, and reservoirs in the U.S. annually to control and manage nuisance aquatic weeds.
- The use of herbicides to get a major plant nuisance under control is a valid element of long-term management when other means of controlling plant growth are then applied.
- Relying only on annual applications to control aquatic weeds, year-after-year is not cost-effective and is bad environmental stewardship.
- When considering chemical use you should become aware of all possible benefits, known limitations and constraints, and possible negative impacts, and should carefully evaluate the applicability and efficacy for the target lake.

How do herbicides act to destroy weeds?

- Herbicides and algaecides contain active ingredients (AI) that are toxic to target plants. They work in a number of ways – e.g., attack the photosynthesis system, inhibit respiration, block synthesis of enzymes necessary for growth, as well as other routes.
- Herbicides are typically classified as **contact** or **systemic** herbicides based on the action mode of the active ingredient.
    - Contact herbicides are toxic to plants by uptake in the immediate vicinity of application through external contact.
    - Systemic herbicides are taken up by the plant and are translocated internally throughout the plant.

What kind of plants are the affected?

- Herbicides are divided between **selective** and **broad-spectrum** categories
- Selective herbicides are effective on certain plant species but may have no effect on others.
    - Control of selectivity is normally dependent on dose and exposure duration.
    - Plant factors that influence selectivity include plant morphology, physiology and the stage of growth.
- Broad spectrum herbicides can induce impacts on a wide range (broad spectrum) of plant species. Some selection may be shown based on dose and plant features.
- Some herbicides only work on dicotyledonous plants or monocotyledonous (grasses) species.

How do we know if an herbicide is safe for use?

- Current pesticide registration procedures are very thorough and vigorous and are conducted at both federal and state levels.
- The basic premise of the pesticide regulations is that use of the herbicide will not result in unreasonable human health or environmental effects when the chemical is used according to label restrictions.
- U.S. Environmental Protection Agency (EPA) does initial research and decides if a product is effective and is safe for human and ecological uses of the water.
- After EPA approval, individual states decide if product is appropriate for their type of lakes or ponds. Massachusetts tends to be conservative about registering new pesticides.

How do you choose an effective herbicide?

- Identify those herbicides that have demonstrated success against the three major nuisance species – fanwort, variable milfoil and largeleaf pondweed.
- Based on the long-term management program identify whether a large area or limited area or work is to be treated – some herbicides come in both liquid (good for larger applications) and pelletized forms (easier to control small applications).
- Does the dose needs be kept constant for several days (so that lake flow is minimized) or whether application can occur over relatively short period (e.g., 24 hours)
- Review pertinent chemical description to identify whether the herbicide is protective of current human and ecological uses of the lake, is compatible with other treatment alternatives, and provides a cost-effective alternative for expected level of control.

Who actually applies the herbicide?

- Only MA-licensed applicators are allowed to conduct the herbicide application. All operators are trained and are required to keep with updates and refresher courses.
- The Hopkinton Conservation Commission regulates application of herbicides as part of the Wetland Protection Act since lakes are covered as "lands under water."
- Application requires a Notice of Intent (NOI) permit that sets the requirements of the application (i.e., Order of Conditions): treatment dates, delineated locations within the lake, calculation of doses, monitoring of lake conditions (water temperatures, turbidity, wind or wave action), personnel safety measures, refilling and spill prevention measures, pre- and post-treatment surveys, and posting of signs.
- Herbicide applications are well-publicized in advance (notices and signs) and will identify the day(s) of application and areas and list any restrictions on uses of the lake. Usually recreational uses are prohibited the day of application to reduce boat traffic during applications.

What happens once the herbicide is applied to the water?

- Product generally goes into three compartments:
    - taken up by target plant
    - stays dissolved in water
    - taken up in animal tissue (bioaccumulates; rare)
    - settles out and adsorb by sediment
- What happens to material in water? – some may go downstream at very dilute levels, usually starts to breakdown by photolysis (light), hydrolysis (water) or microbial breakdown. Breakdown in rapid, usually with half-lives of days to weeks.
- What happens to materials in sediment? – subject to microbial breakdown in sediments but may be slower since colder and dissolved oxygen is lower here – half lives of days to weeks; can be resuspended in shallow sediments by boats

What are potential human concerns for herbicides that have been applied to the lake?

- Concentrated herbicide stock solutions are handled only by licensed applicators who wear appropriate personal protection equipment and public should keep away from loading.
- Depending on the herbicide, restrictions on recreational use (contact or non-contact), potable water use, or other uses (e.g., irrigation, livestock watering) may be in effect; (see Exhibit below).
- General symptoms of high exposure to treated lake water vary between herbicide but can include skin or eye irritation, gastrointestinal symptom, respiratory ailments. The effective concentration for all these effects is very much higher than what is point into water.
- All EPA-registered herbicides have been researched with regard to long-term non-carcinogenic and carcinogenic properties and labels reflect safe application levels.

Table 2. Aquatic vegetation herbicide control water use restriction (number of days after treatment before use in private waters only).[1]

	Human use			Livestock	Irrigation	
Common name	**Drinking**	**Swimming**	**Fish**	**Watering**	**Turf**	**Crops**
bispyribac	0	0	0	0	30	30
carfentrazone	0 - 1[2]	0	0	0 - 1[2]	0 - 14[2]	0 - 14[2]
copper complexes[3]	0	0	0	0	0	0
diquat	1 - 3[4]	0	0	1	1 - 3[4]	5
endothall[5]	7 - 25	1	0	7 - 25	7 - 25	7 - 25
flumioxazin	0	0	0	0	0 - 3[4]	5
fluridone[6]	0	0	0	0	7 - 30	7 - 30
glyphosate[7]	0	0	0	0	0	0
imazamox	0	0	0	0	1	1[8]
imazapyr	*[9]	0	0	0	120[10]	120[10]
penoxsulam	0	0	0	0	0	*[11]
SCP[12]	0	0	0	0	0	0
triclopyr	*[13]	0	0	0	0[14]	120[15]
2,4-D	*[16]	*[16]	*[16]	*[16]	*[16]	*[16]

[1] Aquatic vegetation control can cause a period of low dissolved oxygen, which can stress and/or kill fish. It is best to treat most aquatic vegetation early in the growing season when the plant is rapidly growing. Treating small areas (e.g., ¼) of pond at a time at 10- to 14-day intervals usually will allow for decomposition without causing an oxygen depletion.
[2] Varies if 20% or more of surface area is treated.
[3] If water is for drinking, the elemental copper concentration should not exceed 1.0 ppm (i.e., 4.0 pp. copper sulfate).
[4] Depending on formulation or rate. **Read label.**
[5] Length of use restriction for endothall varies with concentration used. **Read label.**
[6] Do not apply within ¼ mile of a functioning potable water intake.
[7] Do not apply within ½ mile of a functioning potable water intake.
[8] Do not use treated water to irrigate greenhouses, nurseries or hydroponics.
[9] Greater than ½ mile from potable water intake.
[10] Or until <1.0 ppb.
[11] Do not use water from any treated site for food crop irrigation until residues are determined to be less than or equal to 1 ppb.
[12] Sodium carbonate peroxyhydrate.
[13] Minimum setback distances from potable water intakes required and laboratory tests to determine < 0.4 ppm. **Read label.**
[14] No restriction on irrigating established grasses but do not harvest hay for 14 days after application. **Read label.**
[15] Or until non-detectable concentration in immunoassay analysis.
[16] Water restrictions on 2,4-D vary with formulation, location, rate and time of year. **Read label.**

What are potential ecological concerns for herbicides that have been applied to the lake?

- Depending on whether herbicide is classified as selective or broad-spectrum, non-target aquatic plants could be adversely affected.
- Ecotoxicity testing established safe effects concentrations for parts of the food web: zooplankton, finfish, and wildlife. Herbicides are generally low concern for ecological receptors
- Ecological concern if too much area is treated due to lowered dissolved oxygen associated with the decaying vegetation.
- Need to be careful to check with Mass Natural Heritage for T&E species.