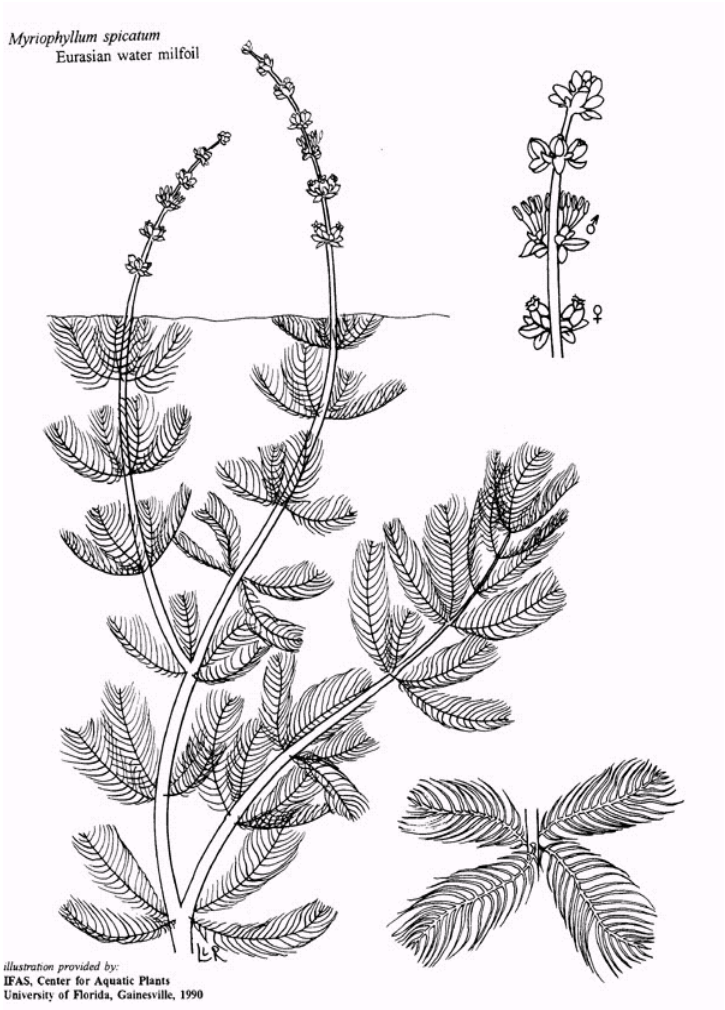

NUISANCE AQUATIC VEGETATION MANAGEMENT

A GUIDEBOOK

State Of Connecticut
Department of Energy & Environmental Protection
Pesticides Management Program
79 Elm Street
Hartford, CT 06106-5127

Robert J. Klee, Commissioner

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CT DEPARTMENT OF ENERGY & ENVIRONMENTAL PROTECTION
MANAGEMENT OF NUISANCE AQUATIC VEGETATION

INTRODUCTION

When present in small quantities, algae and other aquatic vegetation are beneficial to lakes and ponds. However, when these plants become overabundant, they can lower the recreational and aesthetic qualities in a body of water, and also alter some of the natural qualities such as fish community structure. It is hoped that this guidebook will assist the pond owner or lake property association in becoming acquainted with the problems associated with, and materials used in, the control of nuisance aquatic vegetation and algae.

SHOULD I TREAT MY POND?

Before starting to control aquatic vegetation, pond or lake owners and managers need to assess the uses of the water, and develop a realistic goal for the water body. At this point control measures should be evaluated. For example, very few ponds in Connecticut are capable of supporting trout on a long term basis. Therefore, a management plan for fly fishing in one's backyard pond may be unrealistic. Similarly, swimming in clear water with a sandy bottom can be difficult to achieve, and may require continual treatment to be possible. Ponds that attract wildlife however, are much easier to achieve.

Many chemical treatments for weeds in Connecticut ponds may be unnecessary or inadvisable. Without plant life in a pond, no fish or other animals can survive long. Publications from the Inland Fisheries Division of the Connecticut Department of Energy and Environmental Protection entitled "A Management Plan for Bass in Connecticut Waters and Recommendations for other Warm water Species" (www.ct.gov/deep/lib/deep/fishing/freshwater/bassplan.pdf) and "A Fisheries Guide to Lakes and Ponds of Connecticut" (www.ct.gov/deep/cwp/view.asp?a=2696&q=322692&deepNav_GID=1630) recommend the retention and maintenance of between 20% and 40% plant coverage in the ponds and lakes of the state. This recommendation is made to optimize the habitat, and improve the foraging and reproductive environment for warm and cold water fish.

Most ponds in Connecticut are naturally eutrophic (full of nutrients, and producing an abundance of plant material). Nutrients such as nitrates and phosphates act as plant fertilizers for algae and larger plants (macrophytes) which provide food and habitat upon which the pond's animal life depends. Warm water, plentiful nutrients, and shallow depth combine to encourage luxuriant plant growth.

Algal "blooms" in the spring and autumn are natural occurrences and in many instances clear themselves. However, problems arise when human activities add unnaturally large amounts of nutrients to a water body. Such "cultural" eutrophication results in excessive macrophyte and algal growth.

When too many nutrients are added, algae can reproduce at extremely fast rates, producing heavy persistent blooms that can shut off sunlight, killing submerged rooted plants. Algae produce oxygen during the day, but use it at night. Dense blooms can, on hot summer nights, rob the pond of enough oxygen to

kill fish. In extreme cases, algae themselves die in masses, using even more oxygen as they decompose. This decomposition is even more likely to occur after the pond has been treated with an algicide, so algicide treatments of heavy growth during hot summer periods should be avoided. If conditions require treatment, the chemical application should be split so that only 1/3 to ½ of the water body is treated at one time, with 10 to 14 days between each split treatment. (Read your product's label for specific requirements regarding split treatments.) Split treatments allow fish to move from the oxygen depleted treatment area to untreated areas where there is enough oxygen for them to survive.

In short, algal blooms are a symptom of a more basic problem of over-fertilization. Sources of nutrients commonly associated with human activities are:

- Septic tank leachate: even though household sewage may be broken down to non-infectious materials, nutrients such as nitrates and phosphates from the leaching field can enter surface or groundwater. Correction can be made by installing sanitary sewer lines or by keeping septic systems in good repair and locating them as far away as possible from any stream or pond. Installation of sanitary sewers is the only sure way to eliminate this source of nutrients. Where sanitary sewers are not feasible, direct management of aquatic plants may be the only option.

- Turf and garden fertilizers: many are highly water soluble; their use near lakes and streams should be minimized or eliminated. Natural buffer areas along watercourses can help to prevent or reduce problems associated with fertilizers and pesticides.

- Waterfowl: bird droppings are very high in nutrients and bacteria, and can add significantly to pond nutrient levels. Therefore, feeding ducks and geese should be avoided.

- Domestic animals: manure from cows or horses held in yards, barns, or stables near a watercourse can provide a source of nutrients. Dog manure should be controlled by local leash laws and removal ordinances.

- Erosion: activities that disturb the surface of the land will promote erosion, which contributes nutrients and sediments to a lake or pond. Construction sites are a particular concern. When disturbing the land near a water body, sediment control methods, such as installing silt fencing or hay bales, should be used to prevent sediment from being deposited in the water body.

- Storm water drainage: systems that drain to a water body without detention or treatment provide direct transport of pollutants that contain nutrients such as road sand, pet excrement, and organic debris. Additionally, deposition of sand and dirt conveyed to a lake or pond from roadway runoff will create shoal areas that can foster growth of nuisance aquatic plants. Storm water drainage systems should be designed not only to drain water quickly from roads, but also remove pollutants before discharging to a water body.

Once a pond is suffering from an algal bloom, treatment is sometimes attempted. Although chemical treatment has become increasingly popular, merely killing the algae is only a temporary "cure." The vegetation decomposes, consuming oxygen and returning

nutrients to the water to fertilize new blooms. Treatment may be required annually or even more frequently. It may be less expensive and more effective in the long run to reduce the flow of nutrients into the pond. In some cases, ponds will then proceed to clear themselves as excess nutrients leave via outflow in spring.

In contrast to algae, most macrophytes obtain their nutrients from the sediments on the bottom of the pond. Reducing the nutrient influx may not result in a decrease of macrophyte growth, even though algae production is reduced. Ironically, the growth of macrophytes may increase as algae are controlled, since the improvement in water clarity allows light to penetrate deeper, which in turn allows for greater macrophyte production.

Management for macrophytes should consider the quality as well as the quantity of vegetation. Native species, such as some pondweeds in the genus *Potamogeton,* tend to form clumps rather than mats, and provide fish and wildlife cover without taking over a pond. Mat forming exotic species such as Eurasian watermilfoil or curlyleaf pondweed, are more likely candidates for control, since they are much more invasive, and are more likely to completely take over a water body, forming impenetrable mats that make it difficult to use the water body.

In small ponds, physical removal of floating algal scum and macrophytes provides immediate aesthetic improvement and can lessen the amount of available plant nutrients. The vegetation can be composted away from the water. As nutrients usually tend to accumulate in bottom sediments, a small pond with a severe problem can be drained and the sediments removed. This action may, however, require a local inland wetland permit.

The DEEP Bureau of Water Management distributes a booklet on lake management in Connecticut entitled Caring for our Lakes www.ct.gov/deep/cwp/view.asp?a=2719&q=325528&deepNav_GID=1654. This publication provides information on various watershed and in-lake management methods.

In Summary:

1. Develop a plan for your water body and make sure your goals are attainable.

2. Be certain that your pond really has a severe algae or aquatic weed problem, keeping in mind that moderate levels of vegetation are beneficial. (i.e.; 20-40% vegetation coverage)

3. Investigate and eliminate controllable sources of nutrients if possible.

4. Consider non-chemical treatment procedures.

5. If chemical use is necessary, apply for an aquatic permit from DEEP.

6. After receiving an aquatic permit, follow pesticide directions for use and application procedures carefully.

CHEMICAL TREATMENT

Policy. The use of chemicals to control aquatic plants and animals in the waters of Connecticut is governed by state statute (Chapter 441, Section 22a-66z of the Connecticut General Statutes). Anyone wishing to apply a chemical to a water body to control aquatic vegetation must apply for and obtain a permit from the DEEP Pesticide Management Program. In addition, any chemical used to control an aquatic plant must be registered by the DEEP and the United

States Environmental Protection Agency (EPA). Certain products are classified for "restricted use". This means that only a certified applicator is allowed to apply the product. A list of state registered pesticides and their use classification can be found at www.ct.gov/deep/lib/deep/pesticides/restrictedpermitusepesticides.pdf.

Obtaining a Permit

The permit application and instructions may be obtained from the DEEP Pesticide Management Program and are also available on the DEEP website at www.ct.gov/deep/lib/deep/Permits_and_Licenses/Waste_Permits/aquatic_app.pdf; and www.ct.gov/deep/lib/deep/Permits_and_Licenses/Waste_Permits/aquatic_inst.pdf.

Read and follow the application instructions carefully. In order for your permit to be processed quickly, it is important that you fill out the form accurately and completely. Make sure that you calculate the size of the pond accurately, since this information is used to calculate dosage. You will need to enclose a copy of a map with the pond highlighted. Correct plant identification is important since it allows us to determine the proper chemical and dosage rate. Simply putting "weeds" is not sufficient information. Use this guidebook or obtain professional help in identifying plants. Sources of information are listed in this guidebook.

Fees: Effective October, 2009, a fee of $200.00 will be charged for each permit application. The fee is due at the time of application and is not refundable. DEEP may issue permits that are effective for up to 3 years. If the applicant requests a multi-year permit and such a permit is granted, the fee will be $200.00 for each effective year of the permit.

Endangered and Threatened Species

Certain water bodies or areas near them may contain plants or animals that are threatened or endangered (Connecticut General Statutes Section 26-303 to 26-315).

A permit for a water body that has these species may include conditions designed to protect them or the permit application may be denied. The DEEP Pesticide Management Program will not issue a permit until any issue regarding an endangered or threatened species has been resolved with the DEEP Wildlife Division.

Public Water Supply Watersheds and Wells. About 17% of the land area in Connecticut is tributary to reservoirs used for public drinking water and many people rely on groundwater for their drinking water supply. It is very important that chemicals used in a pond, lake or stream that leads into a public water supply reservoir, or that are applied in close proximity to a public water supply well, do not contaminate the drinking water supply. Therefore, the use of aquatic pesticides in these areas is highly scrutinized. See Table 3 for information on chemicals that are currently allowed for use within a public water supply watershed, and the conditions for such use, as required by the Memorandum of Agreement between DEEP and the Department of Public Health (DPH) (www.ct.gov/deep/lib/deep/pesticides/moadphpestwatersupply.pdf).

Applications proposing the use of a chemical within 200 feet of a public water supply well must be reviewed by DPH. Use of a chemical may be denied or conditions may be added to the permit to protect the well.

The DEEP Pesticide Management Program will not issue a permit until any issue regarding the protection of a public water supply has been resolved with DPH.

Local Authority. You must send a copy of your permit application to your town Inland Wetlands Agency at the time you submit your application to DEEP. Local Commissions do not have the authority to unilaterally deny a permit, but DEEP does seek their input.

Posting and Notification of Pesticide Application

State statutes and regulations require the posting of treated water bodies in certain situations. Signs must be posted at public access places when lakes with public access are treated by a government agency or commercial applicator. Signs must include information on the waiting periods before water use, and must remain posted until all such warning periods lapse. In addition, the commercial applicator or government agency must publish a newspaper notice of the impending pesticide application.

In cases where the pond is private, but has more than one owner or shoreline property owner, newspaper notice of impending treatment must be published if the pond is being treated with pesticides by a commercial applicator.

The statute and regulations governing the posting and notification requirements, along with the format for the sign, are included in Appendix I.

National Pollution Elimination System (NPDES) General Permit

If the total area to be treated in any one water body exceeds 80 acres in any calendar year, or an area of shoreline exceeding 20 miles measured linearly is to be treated in any one year, a Notice of Intent must also be submitted pursuant to the NPDES General Permit for Point Source Discharges to Waters of the State from the Application of Pesticides (www.ct.gov/deep/lib/deep/Permits_and_Licenses/Water_Discharge_General_Permits/pesticide_reg.pdf) and an Approval of Registration must be obtained from the DEEP Water Permitting and Enforcement Division. There is no additional fee for registration under the general permit.

GENERAL INSTRUCTIONS.

Information is provided in this guidebook to assist the pond owner in selecting an effective algicide or herbicide to be used at a recommended dosage rate for a particular nuisance aquatic plant. No one may apply a chemical to the waters of the state to control aquatic plants without first obtaining a permit.

Recommendations.

1. Use extreme care in handling any herbicide or algicide. Some of these materials *can cause blindness* and some *can cause death* if swallowed, splashed in the eyes or inhaled.

2. Follow the directions on the container label, and make sure you use only the amount that the permit allows. You must also adhere to all conditions included in your permit.

3. Use extreme care in the application of any herbicide or algicide. Drift of the material from the treatment area should be avoided. Some of these materials will kill farm crops, fruit trees, flowers and ornamentals as well as nuisance aquatic vegetation.

4. Never increase the dosage or concentration of the chemical used for treatment unless prior approval for such an increase has first been obtained from the Pesticide Management Program and your permit has been revised to allow such increases.

5. Dispose of used containers in such a manner that children or animals

cannot come into contact with them as some of these chemicals are toxic. Containers must be triple rinsed to be considered "clean".

6. To avoid killing fish by suffocation, some product labels require that treatments be split. In general, no more than half of the water body may be treated at one time, with a wait time of 10 to 14 days between each split. In such cases, for each treatment allowed in your permit, you must a) treat only half of the water body at one time, using half of the permitted chemical amount, and b) follow the directions on the product label regarding the amount of time you must wait between each split application.

7. Be extremely cautious about combining treatment chemicals. While some combinations such as diquat and copper increase effectiveness, others may work against each other or may be dangerous. Make sure you consult the product labels.

8. Make sure that your use of chemicals is compatible with other uses of the lake. For example, certain herbicides must not be used if the lake water is to be used for domestic purposes or irrigation. Also check to make sure that your use of chemicals is compatible with any downstream uses of the water being treated.

9. Make sure that you control enough of the water body to treat it legally. If other pond owners object to your treatment, you may be liable for trespass if you treat the water.

10. Carefully identify the type of plants that you have in your pond. The proper chemical and timing for control are important in achieving the desired results. The plant and chemical descriptions provided later in this guidebook are intended to give an indication of the proper timing and dose.

NON-CHEMICAL TREATMENTS

Winter Drawdown. Lowering the water level in the winter until the exposed bottom freezes can kill roots, vegetative parts, and susceptible seeds of certain rooted aquatic plant species. Although winter drawdowns can be relatively inexpensive to implement, unintended ecological consequences should be carefully considered before implementing a winter drawdown. The negative effects of winter drawdowns can include reductions in fish spawning and nursery habitat, reduced amphibians and invertebrate populations, loss of total aquatic habitat availability, and water quality impairments, including reduced dissolved oxygen levels. Winter drawdowns will not control certain plant species, and they have no direct control over algae levels. Drawdowns must be carefully controlled to prevent downstream flooding, damage to stream channels, fish kills, and altered well fields. In addition, the contributing watershed must be large enough to allow for refilling of the pond, and sufficient instream flows must be maintained during the refilling process.

Drawdowns may require a diversion permit from the Inland Water Resources Division (IWRD). (www.ct.gov/deep/cwp/view.asp?a=2709&q=324178&deepNav_GID=1654) In addition, section 26-138 of the Connecticut General Statutes requires that anyone draining a water body or watercourse to the point that fish and other aquatic life are endangered must provide DEEP with 48 hours notification. When issuing dam modification permits that result in drawdowns, IWRD requires that the DEEP Inland Fisheries Division (860-424-3474) also be notified. Information concerning drawdowns can

be obtained by contacting the Inland Fisheries Division at the number indicated above or at DEEP.Inland.Fisheries@ct.gov.

Dredging and Excavation. By removing the bottom sediment you can remove plant nutrients and also increase the water depth to levels where some rooted plants will not grow. This can sometimes be usefully done in conjunction with a winter drawdown. Algal blooms and increased turbidity should be expected in the short term.

Permits may be needed from the town Inland Wetlands agency, IWRD or the U.S. Army Corps of Engineers.

Weed Harvesting. Mechanical cutting and removal of aquatic plants will give immediate relief to weed-choked areas but may have to be repeated at periodic intervals. Mechanical harvesters sometimes kill many small fish by harvesting them along with the weeds.

Mechanical methods do not require a state permit (but may require a local inland wetland permit) and are advisable in many situations. Pulling, cutting or raking weeds can provide immediate easing of weed problems in small areas. For larger areas, large mechanical weed harvesters can be used. If weeds are cut, they should be brought to shore, since many species can spread via plant fragments. For this reason mechanical methods are not recommended for certain plants such as water milfoil, brazilian elodea, parrot-feather and fanwort. Cut aquatic weeds can be used for mulch or compost.

Barley Straw. Barley straw has become an increasingly popular alternative for prevention and treatment of algae growth in ponds. It is thought that rotting barley straw in a well oxygenated environment produces the anti-algal activity. One or two bales of barley straw staked near the water inlet to a pond appear to be effective in preventing algal growth in a pond of one acre or less. An approximate application rate for barley straw is 0.5 to 1.5 ounces per 10 square feet of surface water area. The placement of the barley straw is best achieved by placing the barley straw in mesh bags. The duration of effective anti-algae activity is considered to be about six months. The bag of barley straw should be removed at the end of the season to avoid inadvertent addition of nutrients to the water body. The barley straw can then be replenished.

Triploid grass carp - Sterile grass carp are herbivorous fish that can be introduced into some ponds on a restricted basis for controlling nuisance levels of aquatic vegetation. Stockings are regulated through the issuance of special importation and liberation permits. Before permits are issued, every site is visited and inspected by staff from the DEEP, Inland Fisheries Division (IFD) Habitat Conservation and Enhancement (HCE) program. Whether or not triploid grass carp are a viable option for the biological control of nuisance levels of aquatic vegetation in a particular pond depends on several factors including the type of vegetation, amount of vegetation present, and whether the pond can be "ecologically isolated" per CT State Regulations. Ecological isolation, for this purpose, refers to a lake or pond from which there is no surface water outflow or those which in the opinion of the Commissioner, are adequately screened so as to prevent fish emigration into public waters or waters of another. Grass carp prefer finer leafed, submerged and small floating vegetation. Plants with thick, fibrous, or waxy leaves and stems such as watershield and water lilies are rarely consumed and grass carp are not capable of eating unicellular algae (i.e., phytoplankton). Stocking the proper number of triploid grass carp to achieve partial control can be difficult as grass carp are preferential eaters, sometimes completely eradicating a

favored plant before consuming another type. This can lead to the unpalatable plants taking over the pond and making the vegetation problem worse. Overstocking can lead to the total eradication of aquatic plants, and also lead to increased algae levels, resulting in algal blooms. Contact Mindy M. Barnett, of the Inland Fisheries Division at (860) 295-9523 or Mindy.Barnett@ct.gov for more information on the triploid grass carp permitting program.

Fountains - Aeration from the operation of a fountain does not limit the growth of algae or aquatic vegetation. It may, however, physically move algae to the side of the pond.

Nutrient Precipitation - This is actually a chemical method, but is not considered pesticidal, since the objective is not to directly kill the offending aquatic plant. Products such as alum and Phoslock combine with phosphates in the water to form an insoluble precipitate that falls to the bottom. This makes these nutrients unavailable to algae, and often inhibits its growth.

Chemical nutrient precipitation does require an aquatic permit as described in this guidebook if the purpose for its use is to control aquatic vegetation. For further information and dosage rates and for technical assistance and publications on non-chemical methods of aquatic plant control and watershed management, contact the Bureau of Water Protection and Land Reuse at (860) 424-3020.

"Small Ponds in Connecticut - A Guide for Fish Management". The Inland Fisheries Division has published a booklet entitled "Small Ponds in Connecticut - A Guide for Fish Management". The booklet provides information on a wide range of pond management issues, including pond construction, fish management, aquatic plant control, watershed management, miscellaneous pond problems, and associated pond life. It can be ordered from the DEEP Bookstore on-line at www.ctdeepstore.com/Small-Ponds-in-Connecticut-70.htm or by calling (860) 424-3555.

AQUATIC PLANT DESCRIPTIONS

It is necessary to identify the nuisance species of aquatic plants so that an effective algicide or herbicide may be chosen. When considering aquatic plants, the two major categories are algae and vascular plants (macrophytes). Invasive vascular plants, or water weeds, are non-native plants that exhibit aggressive growth habits and can outcompete and displace native plant species, contributing to a loss of biological diversity and overall aquatic habitat degradation. Water plant identifications are often made easier by observing an intact specimen placed in a shallow pan of water. Diagrams and descriptions of algae and the more common species of nuisance water plants found in Connecticut are provided below. Native and invasive species are so indicated. For more detailed drawings and information, you may wish to study a botanical guide for aquatic plants. Your local library may have such a book.

The plant illustrations in this guidebook have been provided by the University of Florida, IFAS, Center for Aquatic Plants.

Unicellular Algae

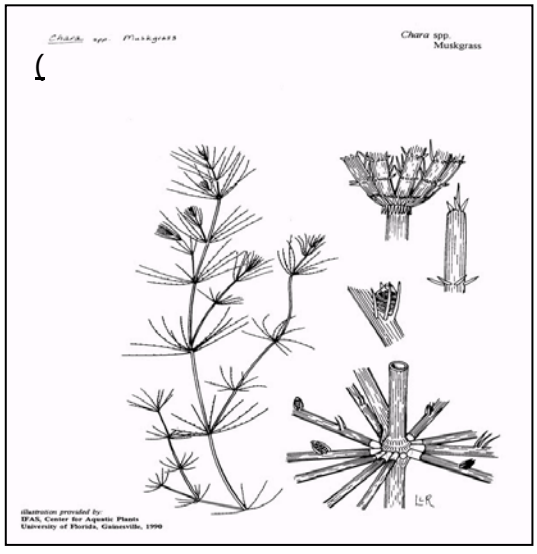
Unicellular algae include many different species of microscopic single celled plants, or colonies of single celled plants, that are suspended in the water. Millions of these plants are normally found in ponds, and are the basis for all life in the pond. When they become over abundant, they can give the water a soupy green or brown color. This condition is known as an algal bloom.

Filamentous Algae

Filamentous algae include many different species of plants that consist of visible hair-like strands. These strands may be straight, branched, or even arranged in net-like structures. They may feel slimy, woolly or cottony. These algae begin their growth on the pond bottom, but may float to the surface due to entrapped bubbles produced during photosynthesis. There are no roots, and no recognizable plant structures such as stems or leaves. Floating filamentous algae can best be treated by spraying the algicide directly onto the mat.

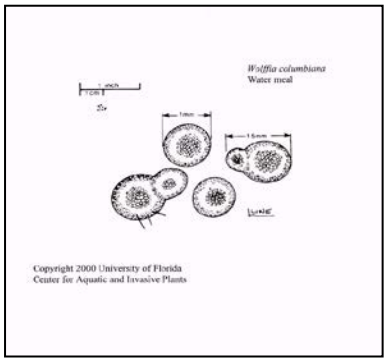
Stoneworts

(Chara spp. and Nitella spp.)
These advanced forms of algae have bristly stems and branches. Both grow on the bottom and are usually rather short. They have short, even-length branches clustered at a joint. *Chara* usually has a skunky odor, and feels rough due to encrusted carbonates. The accompanying picture is of *Chara*, but *Nitella* looks quite similar. These plants are usually not a nuisance. Treatment, if necessary, should be carried out early in the season since these plants become more resistant as the summer progresses.



Duckweed and Watermeal
(Lemna minor and Wolffia columbiana)
Native

Duckweed and Watermeal are the smallest of the flowering plants. They float on the surface of the water. Duckweed is about the size of oatmeal flakes, and is usually a light green color. It has tiny rootlets hanging down in the water. Watermeal has neither leaves nor rootlets, and appears as minute green grains floating on the water. These plants often occur together. Frequently the growth of duckweed and watermeal can be so dense as to completely cover the pond surface. Both of these plants, but especially watermeal, can be extremely difficult to control. They are best treated on a calm day, with no ripple action which washes off herbicide. The use of surfactant with the herbicide can increase its effectiveness.



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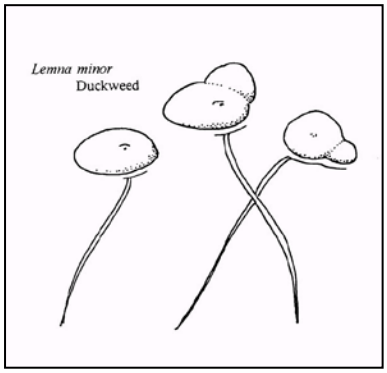
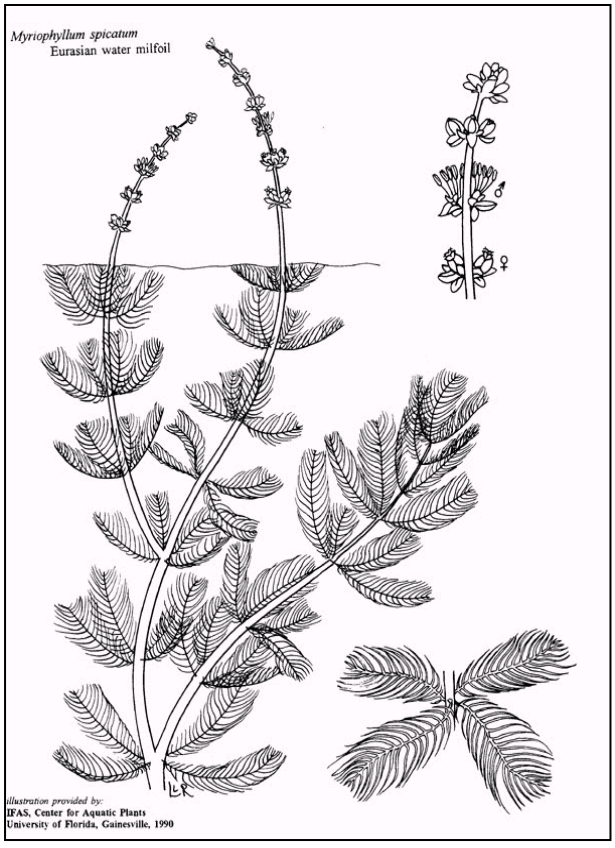


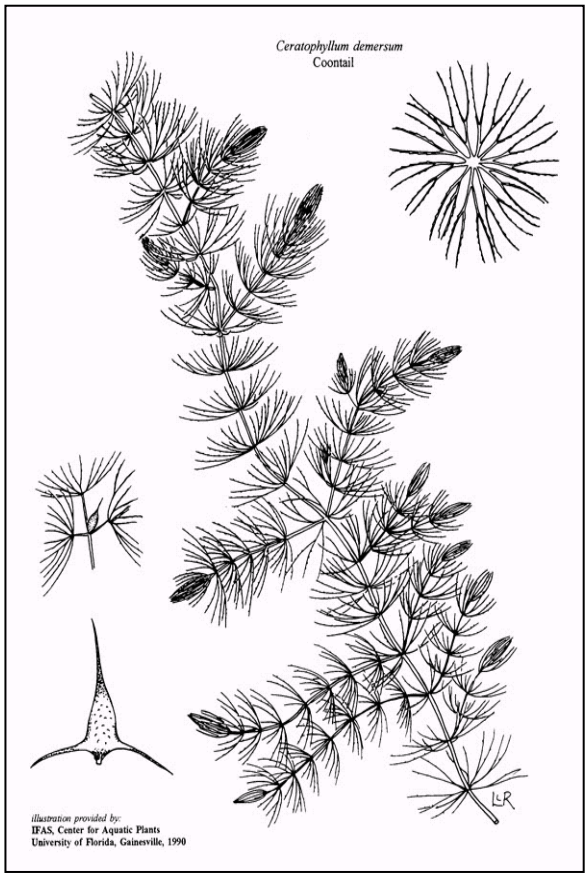


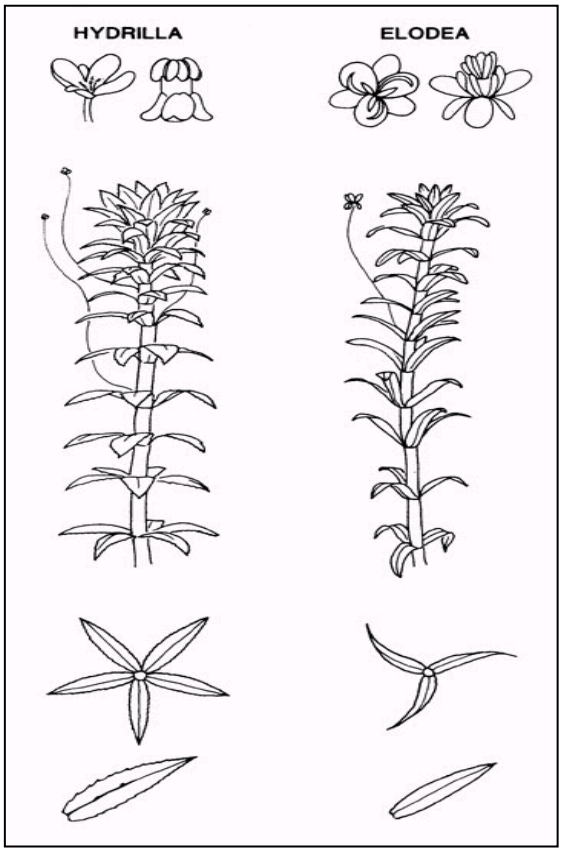
Water Milfoil
(Myriophyllum spicatum)
(Myriophyllum heterophyllum)
Invasive

There are several species of milfoil that occur in Connecticut, but Eurasian water milfoil is the most likely to be a nuisance in the western part of the state. This plant grows all year long, with the winter form creeping along the bottom. It often forms impenetrable mats. The stem is often a light reddish color and is hollow. The feather-like leaves often collapse when the plant is removed from the water. Variable leaf milfoil is likely to be found in eastern Connecticut. Milfoil can spread by fragmentation, so it should not be cut as a control measure. The most effective chemical controls are systemic herbicides applied at low dosages so the plant can absorb them and kill the roots and not just burn off the tops.

Coontail
(Ceratophyllum demersum)
Native

Coontail grows completely underwater. Stiff forked leaves growing out of a whorl are attached to a central stem and become more crowded toward the stem tip. The leaves have teeth on one side. The stems are usually green. Coontail can spread from fragmentation, so cutting should be avoided.





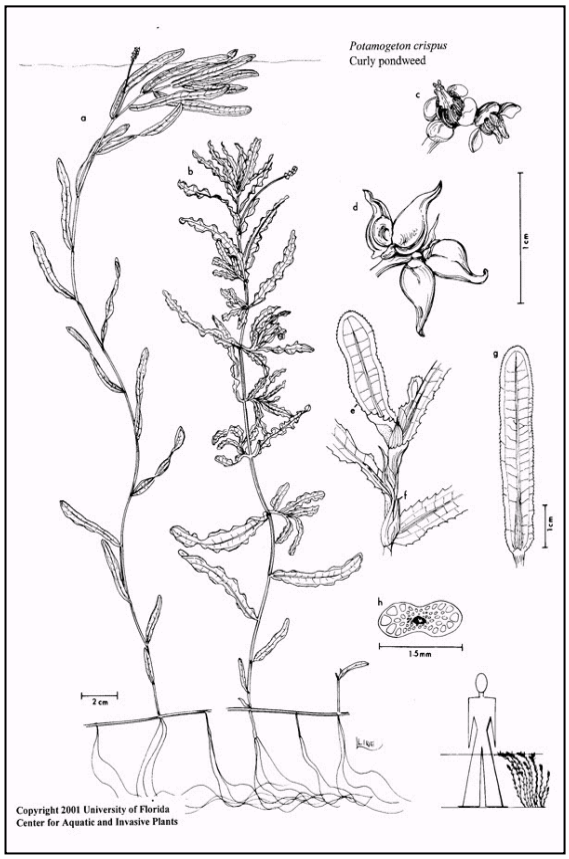
American Elodea
(Elodea canadensis)
Native

Hydrilla
(Hydrilla verticillata) Invasive

American elodea grows completely below the water surface and may form large masses near the bottom. The leaves, which are sometimes purple tinged, are bunched toward the tip of the stem and are grouped in threes at each joint. Leaves may vary in size and bunching in different ponds. This plant looks very similar to *Hydrilla*, which is a very serious pest of southern waters. *Hydrilla* has five leaves per group and the leaf margins are toothed. Anyone finding *Hydrilla* should report it to the DEEP Wildlife Division at (860) 424-3589.

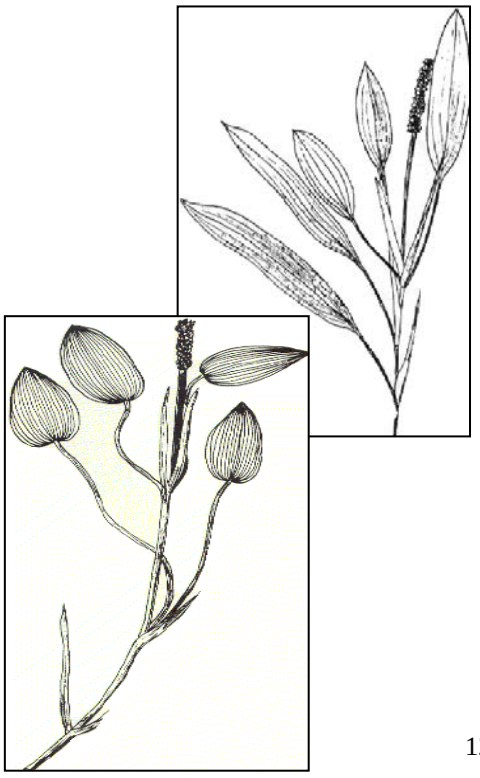
Curlyleaf Pondweed
(Potamogeton crispus)
Invasive

Curlyleaf pondweed is characterized by its curly or wavy membranous leaves which have a row of small teeth along their edges. Flowers are borne on spikes. Curlyleaf pondweed may start to grow in the fall and dies back by the following midsummer. It is a pest of the spring and early summer. Any effective control must be done early in the season.



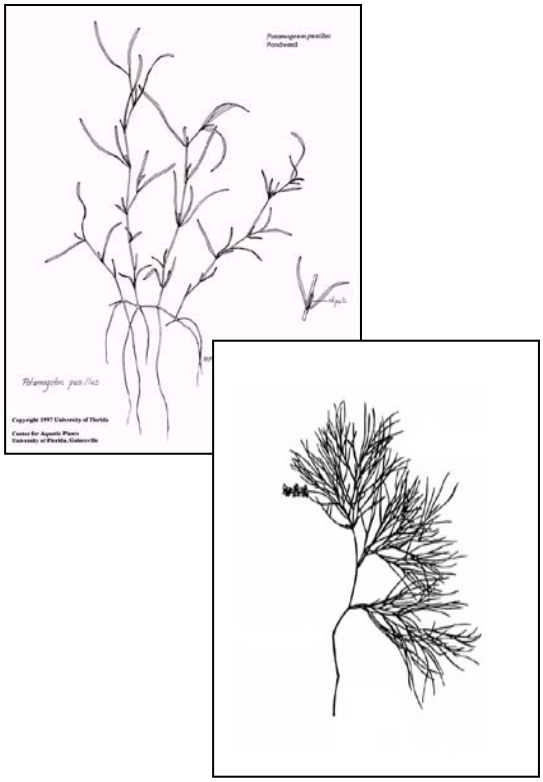
American Pondweeds
(Potamogeton spp.)
Native

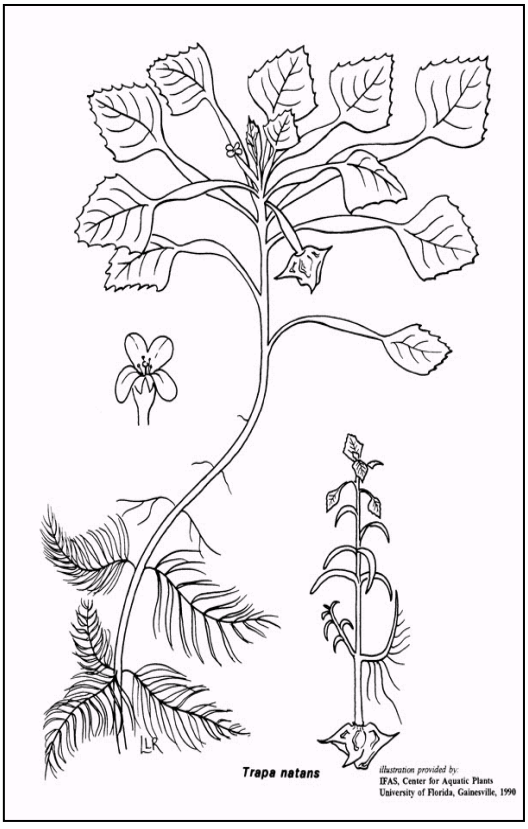
There are several species of pondweed having widely variable forms. A few of the more common ones are displayed here. Many species have floating elliptical leaves and underwater leaves of a different shape. Flowers are borne on spikes, which usually rise above the water surface. These plants are native species, and are usually not nuisances. Early season treatment for milfoil or curlyleaf pondweed will often spare these plants, since they emerge somewhat later in the season.



Narrowleaved Pondweeds
(Potamogeton spp)
Native

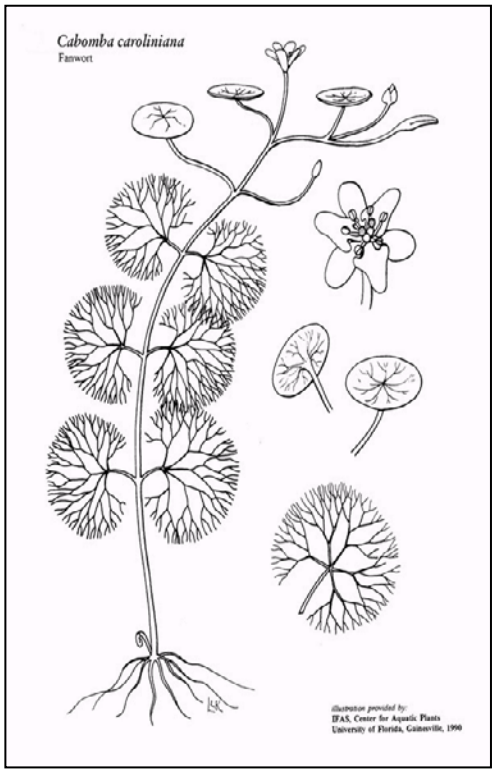
Narrowleaved pondweeds are perennials that have grass or hairlike submersed leaves that may or may not appear bushy in form depending upon species. Some species will grow along shoreline areas to depths of approximately 4 feet, where others may grow only in areas where the water is 6 to 8 feet deep.





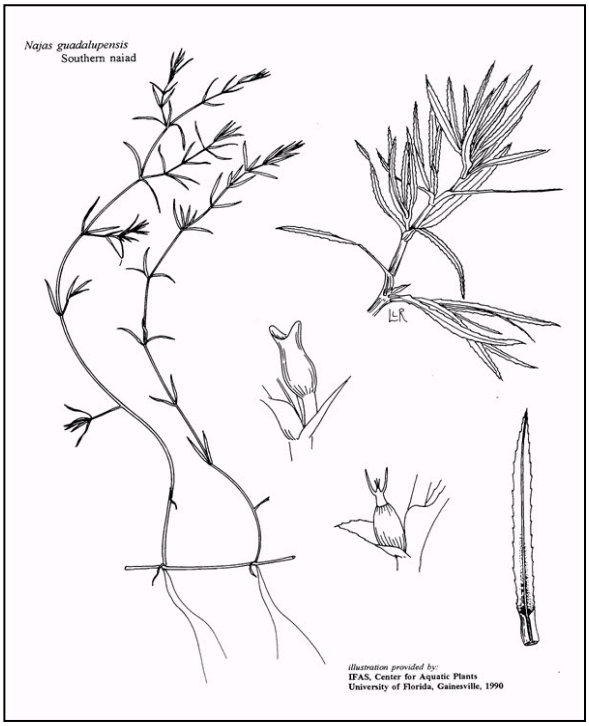
Water Chestnut
(Trapa natans)
Invasive

Each water chestnut plant has two types of leaves, submerged leaves that are feather-like and emerged leaves that float. The floating leaves are waxy, triangular in shape and form a rosette on the water surface. The plants begin to flower in mid to late July and continue into the fall when frost kills the floating rosettes. Single seeded horned fruits, or chestnuts, sink to the bottom of the water body where they may be viable for as many as 12 years. An individual seed can produce a plant with 10-15 rosettes, each of which can develop 15-20 seeds. Water chestnuts can reproduce quickly, covering entire bodies of water, negatively impacting native plants and animals and making the area unusable for recreation. Anyone finding water chestnut should report it to the DEEP Wildlife Division at (860) 424-3868.



Fanwort
(Cabomba aquatica)
Invasive

Fanwort is a non-native species which occasionally appears after herbicide treatments targeting other plants. Fanwort is a multi-branched, submerged perennial plant with a few small, elongated floating leaves. The submerged leaves are arranged opposite from each other along the stem and are finely divided with a "fan-shape". The plant has a small (1/2 to 3/4 inch diameter) white to pink flower which arises from the tip of the stem and stands slightly above the water surface.

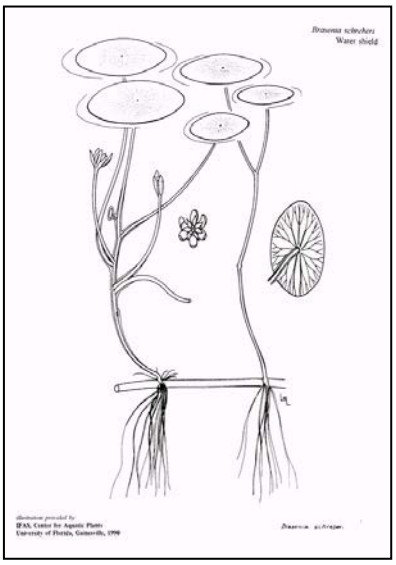


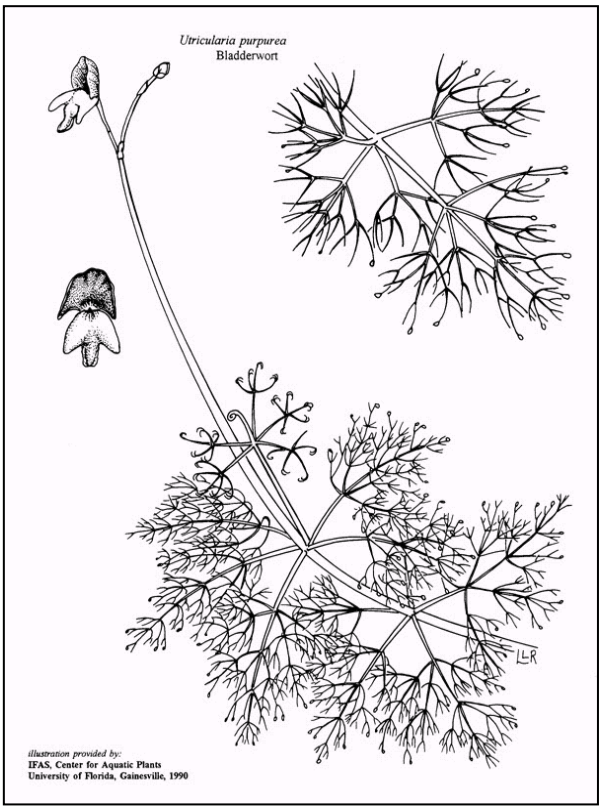
Naiad
(Najas spp.)
Native

Naiads are annual plants, reproducing from seed every year. They appear in late summer due to this characteristic. The stems and leaves are very narrow. The leaves are joined to the stems in nodes. They need to be examined carefully to distinguish them from stoneworts or narrow leaved pond weeds.

Watershield
(Brasenia schreberi)
Native

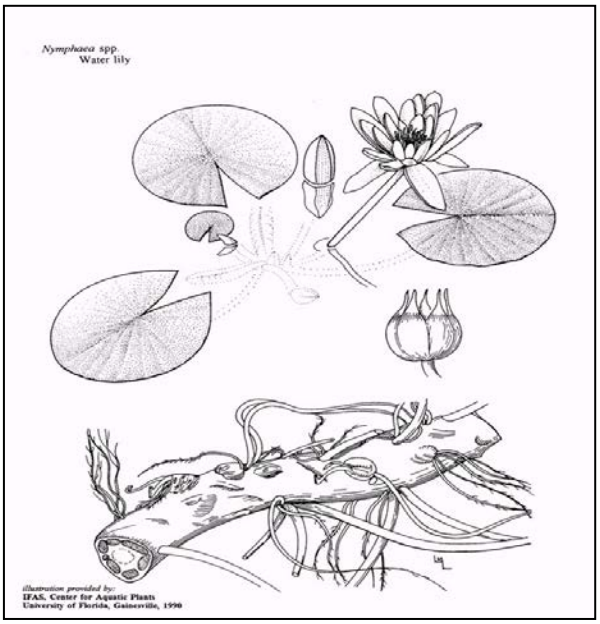
Watershield is a floating leafed plant whose roots are in the bottom of the pond. The stems and undersides of the leaves are coated with a jelly-like material. The stem attaches to the middle of the oval leaf, with no slit in the side.

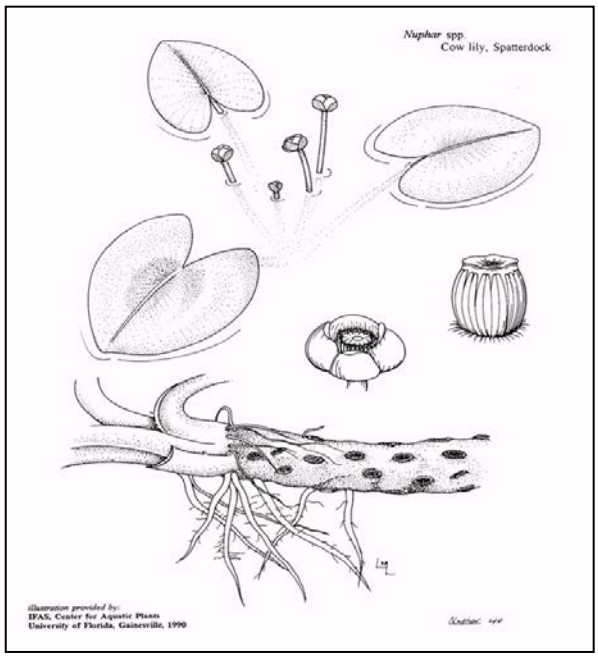




Bladderwort
(Utricularia spp.)
Native

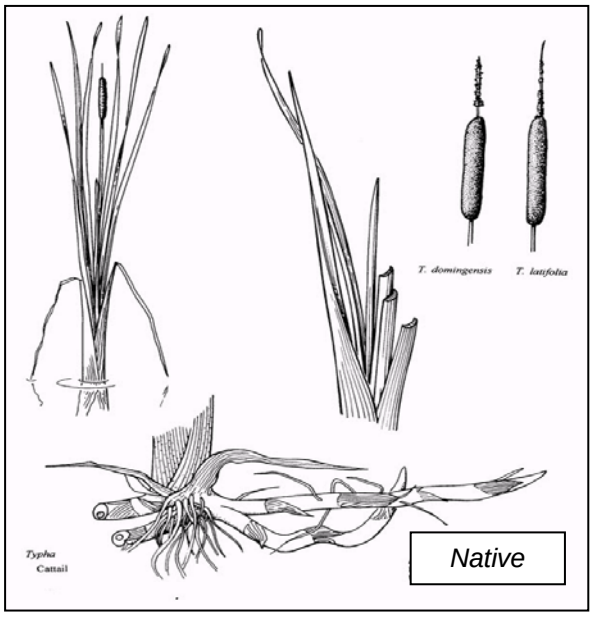
Bladderwort is characterized by the tiny bladders located on some of the underwater sections of the leaf segments. The leaves are thin, and divided many times. The flower extends above the water and is usually yellow or purple, and is present from July through August. Bladderwort is not often a pest species, but sometimes requires limited control.

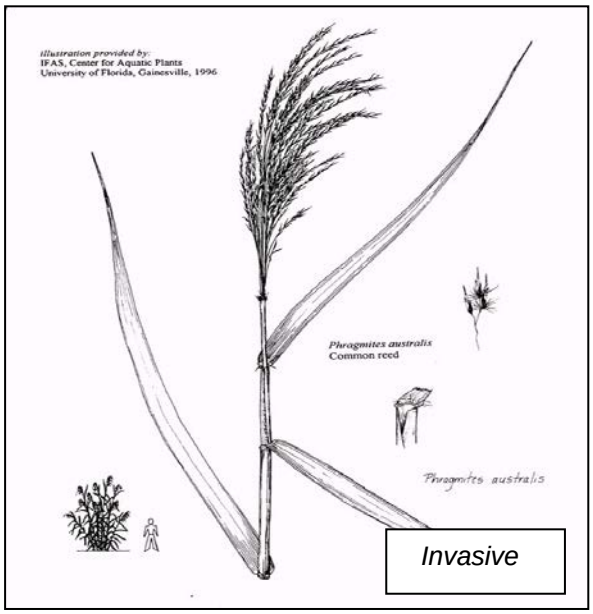




Waterlily and Spatterdock
(Nymphaea spp . and Nuphar spp.)
Native

Spatterdock (sometimes called yellow waterlily) and waterlilies have large tubers well rooted in the lake or pond bottom and large floating leaves. They are often attractive and desirable plants, but can crowd coves and other areas making access very difficult. Mechanical control should involve digging out the roots, since simple cutting of the stems will not have an effect on the future growth of the plant.





Cattails and Phragmites
(Typha and Phragmites australis)

Cattails and Phragmites are plants that can grow both in water and on land. They have tenacious root systems, and need a systemic herbicide for effective chemical treatment. Such treatment is more effective after the flower spikes have formed. Mechanical treatment should not neglect the root system if more than temporary control is desired.

ALGICIDE AND HERBICIDE DESCRIPTIONS

The following is a brief discussion of some of the commonly used aquatic herbicides and algicides presently on the market and registered by the Department of Energy and Environmental Protection. It is not a complete list of all chemicals that can be used. Aquatic herbicides and algicides may be obtained with a Connecticut DEEP issued aquatic permit from a distributor of chemicals and agricultural supplies.

Remember: A permit from the Pesticide Management Program is required before any of the following chemicals can be legally purchased and introduced into any waters of the state. In addition, some of these products are classified for restricted use, which means that only a certified applicator is allowed to apply them.

ALGICIDES

Copper is a contact algicide and is available in both liquid and solid forms. Copper products are primarily used to treat algae but certain formulations will control macrophytes as well. Copper works by interfering with enzyme production. Treatment results for algae can be seen within hours while the effects of treatment on macrophytes can be seen in approximately one to two weeks. Determining the correct copper formulation and calculating the proper dosage are key factors in determining how effective a copper treatment will be. Anyone using copper needs to consider target species, water hardness, water temperature, amount of algae/plants present, as well as water clarity and flow. The effects of copper may be short-lived and multiple treatments may be necessary during the growing season. Since copper works so quickly, the decomposition of dead vegetation can deplete oxygen levels in the water which can be lethal to fish and other aquatic life. Therefore, treatments must be split so that no more than ½ of the water body is treated at one time with at least 10 to 14 days between each split.

Since copper is an element, it does not break down in the environment like other herbicides. Copper precipitates out of the water and settles in the sediment where it persists indefinitely and accumulates over time. The buildup of copper in sediments is a serious concern because high concentrations of copper are toxic to both plant and animal life.

Copper compounds may be permitted for use in public water supply watersheds provided the total dissolved copper concentration does not exceed 1.3 ppm at the time of application.

There are two types of copper products: copper sulfate and chelated copper.

Copper Sulfate is marketed in crystalline form or in liquid form (SeClear). Within approximately 24 hours after application, much of the dissolved copper will combine with available carbonates in the water and precipitate to the bottom. Therefore, copper sulfate provides poor control in hard waters, except when applied at very high concentrations.

Copper sulfate is highly toxic to most aquatic species including insects, mollusks and fish. In soft waters, some species of fish may be killed with applications greater than 0.25 parts per million. Trout and carp are very susceptible to copper sulfate and if these fish are present, it should be used only with extreme care.

When applying crystalline copper sulfate to control filamentous algae, the crystals should be first dissolved in water. The solution may then be sprayed directly on algae mats. Copper sulfate treatment of unicellular algae is usually carried out by dragging a burlap bag containing the crystals through the water. Since copper sulfate is highly corrosive, the inside of any metal container holding a copper sulfate solution should be painted, enameled or copper lined. Anyone applying copper sulfate should be aware that it can cause irreversible eye damage and may be fatal of swallowed. Label requirements regarding personal protection should be strictly followed.

The use of SeClear provides the added benefit of enhancing water quality and algae control by reducing the amount of phosphorus in the water. SeClear can be applied as a surface spray or by underwater injection. For dense floating algal mats, the mats should be broken up prior to treatment or a high pressure surface spray application should be used.

Chelated copper products differ from copper sulfate in that the copper is combined with other compounds. Chelated copper does not precipitate out of the water as quickly as copper sulfate, providing a longer contact time with the targeted vegetation. In addition, while many chelated copper products are toxic to invertebrates and can kill fish, especially in soft waters with a carbonate content of less than 50 parts per million, they are much less toxic than copper sulfate to aquatic organisms.

In chelated copper products, copper can be found combined with either triethanolamine (TEA) or ethylenediamine (EDA).

Copper TEA (Cutrine, Captain, Clearigate, K-TEA) is available in both granular and liquid form and is widely used to control algae. Liquid Copper TEA is best for filamentous and unicellular algae and should be diluted with enough water to ensure even distribution with the type of spray equipment being used. The diluted solution should be sprayed directly on filamentous algal mats. Granular Copper TEA is best for Chara and Nitella control. The granules should be spread directly over the nuisance vegetation.

Copper EDA (Komeen) is available in liquid form and is effective in controlling algae and macrophytes that are sensitive to copper. Komeen may be applied as a surface spray by sprayer or spray boat, or as a subsurface application using weighted hoses. Depending on the targeted species and site conditions, the product may need to be diluted and applied in combination with a surfactant.

Hydrogen Dioxide (GreenClean, PAK 27, Phycomycin) is a contact algicide that is available in granular or liquid form. The active ingredient in the granular formulation is sodium carbonate peroxyhydrate which generates hydrogen dioxide upon contact with water. It selectively controls blue-green algae at lower application rates and controls many types of algae at higher rates. It is not effective on the macroalgaes, *Chara* or *Nitella,* or on any macrophytes.

Treatments should be done early when algal growth first appears. Hydrogen dioxide works by disrupting cell walls and membranes and bubbling, bleaching and/or discoloration of the algae should be evident soon after application.

The liquid form can sprayed on the water surface from the shore or from a properly equipped boat. For subsurface applications, the products can be injected into the water via a piping

system. The granular form can be applied to the surface of the water using a mechanical spreader or by hand. For subsurface applications, granules can be placed in a burlap bag and dragged through the water using a boat or they can be dissolved in water and injected into the water body using a piping system.

Following application, hydrogen dioxide breaks down into water and oxygen. Therefore, there is no accumulation of the chemical in the water body or generation of harmful break down products.

Concentrated products containing hydrogen dioxide or sodium carbonate peroxyhydrate are toxic to birds and fish and are highly toxic to bees and other insects. However, since hydrogen dioxide rapidly breaks down into water and oxygen following application, it presents no toxicity concerns in the water body. Therefore, it provides an alternative treatment option when the presence of an endangered or threatened species does not allow the use of copper.

Hydrogen dioxide and sodium carbonate peroxyhydrate are highly corrosive and are strong oxidizing agents. They should not be brought into contact with other pesticides, cleaners or oxidative agents such as bleach. Anyone applying these chemicals should be aware that they can cause irreversible eye damage and may be fatal if swallowed or absorbed through the skin. Label requirements regarding personal protection should be strictly followed.

Hydrogen dioxide may be permitted for use in a public water supply watershed without restriction.

HERBICIDES

2, 4-D is available in both liquid and granular forms. It is a selective, systemic herbicide that affects cell growth and division primarily in broad-leaf plants. There are two types of 2,4-D used as aquatic herbicides: dimethyl amine salt (Clean Amine, Amine 4, DMA 4) and butoxyethyl ester (Aqua-Kleen, Navigate).

Once applied, 2,4-D is absorbed into the plant and moves to the reproducing sections of the roots, stems, and leaves. This causes uncontrolled, unsustainable growth (characterized by stem curl-over and leaf withering) within a few days to a week following treatment. Plant death can take up to 4 to 6 weeks. Treatments should be made when plants are young and actively growing, normally from the spring to early summer. Applications should be made before dense mats form.

In Connecticut, the granular form is more available and more widely used than the liquid form. Granular 2,4-D is impregnated on clay granules that resist decomposition in water. When applied, the granules sink to the pond bottom, where the slow release of 2,4-D maintains a continuous concentration of herbicide in the immediate vicinity of plant roots and leaves. Granular 2, 4-D may give up to two years residual control on certain species.

Plants are difficult to control with 2,4-D in water bodies that are spring fed. Best results are obtained when granular 2, 4-D is spread evenly over weed beds. Spreading of the granules may be facilitated by the use of a hand-operated spreader, such as a Cyclone Seeder.

Liquid 2,4-D must be mixed only with water to obtain adequate coverage and can be applied as a broadcast spray. Depending on site conditions, use of an adjuvant may be required.

The half-life of 2,4-D ranges from 13 to 40 days depending on water conditions. After treatment, the concentration of 2,4-D in the water is reduced primarily through microbial activity, off-site movement by water, or adsorption to small particles in silty water. It is mobile in the environment and leaching into groundwater can be a concern.

Toxicity of aquatic 2,4-D products vary depending on whether the formulation is the amine or the ester. Ester formulations have been found to be more toxic than the amine formulations. The ester formulation is toxic to fish and some invertebrates at application rates while the amine formulation is not.

2,4-D is very toxic to certain plants such as tomatoes, peppers, and grapes, as well as newly seeded lawns. Therefore, unless treated water is being used to irrigate crop or noncrop areas that are labeled for direct treatment with 2,4-D, treated water may not be used for irrigation purposes for at least 7 days following treatment or until the 2,4-D concentration in the treated water is 100 ppb or less.

2,4-D is corrosive and causes irreversible eye damage. Anyone applying this herbicide should strictly follow all label requirements regarding personal protection

2, 4-D may not be permitted for use in a public water supply watershed.

Diquat (Weedtrine D, Reward) is available in liquid form and is used to control certain floating-leaf and submerged aquatic macrophytes and algae. It is a broad spectrum, contact herbicide that works by disrupting cell membranes and interfering with photosynthesis. Following treatment, plants will die within a week. Because the decomposition of dead vegetation can deplete oxygen levels in the water which can be lethal to fish and other aquatic life, treatments must be split so that no more than ½ of the water body is treated at one time with at least 14 days between each split.

Diquat should be applied before plant growth becomes dense and when plants are actively growing. Application of this herbicide can be made by spraying it onto the water surface or by pouring into the water.

Diquat is strongly attracted to, and binds with, soil particles. Therefore, since diquat only works when it makes direct contact with a plant, it will not be effective in lakes or ponds with muddy water or where plants are covered with silt. Care must be taken to avoid disturbing bottom sediments during treatment, as may occur when using an outboard motor.

Diquat is not degraded by microbes. When applied to a water body, diquat binds with organic matter, and remains bound for a long time. It degrades very slowly and accumulates in the sediment, but it is biologically unavailable. Diquat is usually detectable in the water column for less than a day to approximately 35 days after treatment. Diquat will remain in the water column longer when treating a water body with sandy soils due to low organic matter and clay content. Because of its very high affinity to bind to soil particles, it is not likely that diquat will leach into groundwater.

At application rates, diquat does not have any apparent significant effects on most aquatic organisms.

Diquat causes severe skin and eye irritation and is toxic or fatal if absorbed through the skin, inhaled or swallowed. Anyone applying this herbicide should strictly follow all label requirements regarding personal protection

Products that contain greater than 18% of diquat (such as Reward) are classified

for restricted use and only a licensed applicator may use them. However. other products, such as Weedtrine D, are available with lower concentrations of diquat and may be used by an unlicensed applicator (with a permit). The application rate must be altered to account for the lower concentration.

Diquat may not be permitted for use in a public water supply watershed.

Endothall is available in both liquid and granular forms. It is a broad spectrum, contact herbicide that prevents certain plants from making essential proteins. Factors such as density and size of the plants present, water movement, and water temperature determine how quickly endothall works. Under favorable conditions, plants begin to weaken and die within three to five days after application.

Two types of endothall are available for aquatic use: dipotassium salt (Aquathol K) and monoamine salt (Hydrothol 191). These products vary somewhat in the target species they control (Hydrothol can also be used to control certain algae), so it is important to always check the product label for the list of species that may be affected.

Endothall is particularly effective against submerged plants. It is important to carefully identify plants and apply endothall products to avoid unintended harm to valuable native species. For effective control, endothall should be applied when plants are actively growing. The choice of liquid or granular formulations depends on the size of the area requiring treatment. Granular is more suited to small areas or spot treatments, while liquid is more suitable for large areas. When using Hydrothol 191 to control algae, the liquid form is preferable for treating unicellular and filamentous algae.

Liquid endothall products can be sprayed on the water or injected below the water surface. It may be applied as a concentrate or diluted with water depending on the equipment used. Granular endothall products must be spread as evenly as possible in the area to be treated.

Endothall is broken down by microorganisms into carbon, hydrogen, and oxygen. Its half-life in water averages from five to ten days and it disappears in soil from 7 to 21 days. While endothall is highly mobile in soil, its rapid degradation limits the extent of leaching into groundwater.

At label rates, the dipotassium salts (Aquathol K) do not have any apparent short-term effects on fish and have no significant adverse effects on aquatic invertebrates. There is reportedly a wide margin of safety between the recommended dosage for controlling plants and the concentrations that are toxic to fish and fish food organisms. In contrast to the low toxicity of the dipotassium salt formulations, the monoamine salts (Hydrothol 191) are toxic to fish at dosages above 0.3 parts per million (ppm), which is well below allowed label rates. In particular, the liquid formulation will readily kill fish present in a treatment site. Because of the extreme toxicity of the monoamine salt, product labels recommend no treatment with Hydrothol 191 where fish are an important resource. In addition, aquatic invertebrates and wildlife can also be adversely affected by Hydrothol 191 depending upon the concentration used and duration of exposure.

Endothall is corrosive and causes burns and irreversible eye damage. It may be fatal if swallowed or absorbed though the skin. Anyone applying this herbicide should strictly follow all label requirements regarding personal protection. Liquid formulations are

classified for restricted use and only a certified applicator may use them.

Endothall may not be permitted for use in a public water supply watershed.

Light Blocking Dye (Aquashade) is a light opaque dye that is available in liquid form. It controls submerged macrophytes and algae by reducing light penetration into the water column, thereby interfering with photosynthesis. It does not control floating algae mats, or free floating and emergent macrophytes. It is most effective in water bodies that have little to no outflow and should be applied early in the season before weed growth has started.

Aquashade can be applied by pouring it directly into the water body. Non-target shoreline plants may suffer contact burn if they come into direct contact with the product.

Light blocking dye may not be permitted for use in a public water supply watershed.

Glyphosate (Rodeo, Aquapro, Glypro) is available in liquid form. It is a broad spectrum, systemic herbicide that moves throughout the plant tissue and works by inhibiting an important enzyme needed for multiple plant processes, including growth. Glyphosate is effective only on plants that grow above the water. It will not be effective on plants that are submerged or have most of their foliage under water, nor will it control regrowth from seed.

Glyphosate should be applied to plants that are actively growing and after flowers have formed, usually around midsummer. Following treatment, plants will gradually wilt, appear yellow, and die in approximately 2 to 7 days. Occasionally, effects are not seen on the plant the year it is applied, but the plants do not appear the next season. Application should be avoided when heavy rain is predicted within 6 hours, because the herbicide may wash off the plants.

Glyphosate may be applied as a broadcast spray. This application method is effective for most species, such as Phragmites in large stands. In very small stands, an alternative method of glyphosate application is to wipe the entire plant (wearing personal protective equipment) with a wet rag or using a wick type applicator. Sometimes in very small stands of Phragmites, one can brush cut the Phragmites down and use an eye dropper to place glyphosate into the interior of the cut stem. The herbicide will travel from the cut stem down into the roots and kill the remaining portion of the plant.

When using glyphosate, an appropriate surfactant must be mixed with the product before application to ensure that the glyphosate “sticks” to the plant surfaces, increasing the rate of absorption.

In water, the concentration of glyphosate is reduced through dispersal by water movement, binding to sediments, and break-down by microorganisms. Its half-life is between 3 days and 19 weeks depending on water conditions. Glyphosate bonds strongly with soil particles. Therefore, it is not expected to leach into groundwater.

At dosage rates, glyphosate is rated as practically non-toxic to aquatic species and wildlife. However, care must be used when applying glyphosate to prevent injury or death to desirable plants. To avoid drift, application is not recommended when winds exceed 5 mph. In addition, excessive speed or pressure during application may allow spray to drift which must be avoided.

Glyphosate may be permitted for use in a public water supply watershed subject to certain conditions.

Fluridone (Sonar, Avast, WhiteCap) is available in both liquid and granular forms. It is a selective, systemic herbicide that stops a plant from making a protective pigment that keeps chlorophyll from breaking down in sunlight. Treated plants will turn white or pink at the growing tips approximately a week after treatment and will die in one to two months after treatment. It is only effective if plants are growing at the time of treatment and works best if applied early in the season. Fluridone is used at very low concentrations, and is slow acting, requiring a very long contact time (45 – 90 days). Because of this long contact period, fluridone is best used for larger-scale or whole-lake treatments and should not be used where rapid dilution can occur such as spot treatments or moving water. (Under certain circumstances, fluridone may be used for spot treatment, however, higher application rates and multiple applications would be required and the treatment area should be at least 5 acres in size.)

Liquid fluridone may be applied as a spray or applied using weighted hoses. Fluridone pellets must be evenly spread across the treatment area as a broadcast application.

The half-life of fluridone ranges from 4 to 97 days depending on water conditions. After treatment, the fluridone concentration in the water is reduced through dilution due to water movement, uptake by plants, adsorption to the sediments, and break down from light and microbial action. Therefore, following the initial treatment, additional "bump" treatments may be needed to maintain an effective concentration for the required contact time. However, for water bodies 10 acres in size or smaller, the sum of all applications must not exceed a total of 90 ppb during an annual growth cycle and for water bodies greater than 10 acres in size, the sum of all applications must not exceed a total of 150 ppb during an annual growth cycle.

Fluridone residues in sediments reach a maximum in one to four weeks after treatment and decline in four months to a year depending on environmental conditions. Fluridone strongly adsorbs to clay and soils with high organic matter, and does not pose a threat to groundwater.

Fluridone has a very low order of toxicity to humans, fish and wildlife. However, it may have adverse effects on all submerged plants and should be used at very low rates (less than 8 ppb) if selectivity is desired. In addition, it may damage or kill shoreline vegetation that has roots extending into the water.

Repeated use of herbicides with the same mode of action can lead to herbicide-resistant plants. Such resistance has been observed in plants that have been repeatedly treated with fluridone. Therefore, in order to prevent fluridone resistance, alternate treatments with herbicides that have a different mode of action and use non-herbicide methods of control when possible.

Fluridone may be permitted for use in a public water supply watershed subject to certain conditions.

Flumioxazin (Clipper) is available in a soluble granular form and is for control of selected submerged, emergent and floating-leaf macrophytes as well as certain filamentous algae. It is a broad spectrum contact herbicide that interferes with a plant's ability to produce chlorophyll. Treated plants will respond quickly to treatment and rapidly decompose. Flumioxazin is most effective when applied to young, actively growing plants in water with a pH of less than 8.5. It should be used only in still or slow moving bodies of water.

Prior to use, Clipper must be mixed with water. For surface applications, it must be mixed with an appropriate adjuvant and applied using a sprayer equipped with a nozzle designed to deliver the desired spray pressure and volume. For subsurface applications, Clipper must be applied using subsurface trailing hoses.

Flumioxazin is broken down rapidly by water and microbes. The half-life depends on the pH of the water. In low pH water the half-life is four to five days; in high pH water the half-life is a day or less.

When flumioxazin degrades, it breaks down into two compounds known as APF and THPA. While flumioxazin has a low potential for leaching and does not persist in the environment, APF and THPA do have a higher potential to leach through soil and may be persistent in the environment. However, these breakdown products do not pose a significant risk to groundwater resources.

Flumioxazin is slightly to moderately toxic to fish, moderately to highly toxic to aquatic invertebrates, and practically non-toxic to birds, small mammals and bees. It is highly toxic to plants and should be used in strict conformance with label requirements to minimize damage to off-site vegetation.

Imazamox (Clearcast) is available in both liquid and granular forms and is used to control submerged, emergent and floating leaf plants. It is a selective, systemic herbicide that moves throughout plant tissue and prevents the plant from producing a necessary enzyme, known as ALS, which is not found in animals. Susceptible plants will stop growing soon after treatment, with plant death and decomposition occurring over several weeks. When used as a post-emergence herbicide, imazamox should be applied to plants that are actively growing. It can also be used during drawdown as a pre-emergent herbicide to prevent plant regrowth.

Liquid Clearcast can be applied to the surface of the water using a sprayer or injected below the water surface. When treating emergent or floating plants, Clearcast must be used with a spray adjuvant.

The half-life for imazamox in water ranges from 4 to 49 days with an average of 17 days. Imazamox does not break down in deep, poorly-oxygenated water where there is no light. Under these conditions, imazamox will tend to bind to sediment rather than breaking down, with a half-life of approximately 2 years. Once bound to soil, leaching to groundwater is believed to be very limited.

The breakdown products of imazamox are nicotinic acid and di- and tricarboxylic acids. These breakdown products are not herbicidal nor is there any evidence that they pose a risk to aquatic organisms or human health.

Since Imazamox is a relatively new herbicide that has not been extensively field tested, there is some uncertainty regarding the sensitivity of non-target plant species. It is practically non-toxic to fish and aquatic invertebrates. Studies indicate that it is toxic to birds only at dosages that exceed approved application rates. However, honeybees are affected at application rates so it should be used in strict conformance with label requirements regarding drift management to minimize any negative impacts.

Repeated use of herbicides with the same mode of action can lead to herbicide-resistant plants. Plants that are resistant to ALS inhibitors such as imazamox, have appeared at a higher rate than plants resistant to other types of herbicides. In order to prevent herbicide resistance, avoid using the

same type of herbicide year after year, and when possible, use non-herbicide methods of control when possible.

Imazapyr (Habitat, Polaris) is available in liquid form for use in controlling emergent and floating-leaf plants. Imazapyr has little to no activity on submerged vegetation. It is a broad spectrum, systemic herbicide that moves throughout plant tissue and prevents plants from producing a necessary enzyme, acetolactate synthase (ALS), which is not found in animals. Susceptible plants will stop growing soon after treatment and become reddish at the tips of the plant. Plant death and decomposition will occur gradually over several weeks to months. Imazapyr should be applied to plants that are actively growing. If applied to mature plants, a higher concentration of herbicide and a longer contact time will be required. The decomposition of dead plants can deplete oxygen levels in the water which can be lethal to fish and other aquatic life. Therefore, treatments must be split so that no more than ½ of the water body is treated at one time with at least 10 to 14 days between each split.

When applying Habitat or Polaris, a spray adjuvant must be used. These products must be applied using surface application equipment and mixed in a minimum of 2 gallons of water per acre.

Imazapyr is broken down in the water by light and has a half-life ranging from three to five days. It doesn't bind to sediments, so leaching through soil into groundwater is likely.

The breakdown products of imazapyr are: pyridine hydroxy-dicarboxylic acid, pyridine dicarboxylic acid (quinolinic acid), and nicotinic acid. These degradates persist in water for approximately the same amount of time as imazapyr.

Imazapyr is practically non-toxic to fish, invertebrates, birds and mammals.

Repeated use of herbicides with the same mode of action can lead to herbicide-resistant plants. Plants that are resistant to ALS inhibitors such as imazapyr, have appeared at a higher rate than plants resistant to other types of herbicides. In order to prevent herbicide resistance, avoid using the same type of herbicide year after year, and use non-herbicide methods of control when possible.

Penoxsulam (Galleon) is available in liquid form and is used for control of submerged, emergent and floating-leaf vegetation. It is a selective systemic herbicide that moves throughout plant tissue and prevents plants from producing a necessary enzyme, acetolactate synthase (ALS), which is not found in animals. Susceptible plants will stop growing soon after treatment and become reddish at the tips of the plant. Plant death and decomposition will occur gradually over several weeks to months. Penoxsulam should be applied to plants that are actively growing. Mature plants require a higher concentration of herbicide and a longer contact time. It must remain in contact with plants for 60 to 120 days to achieve effective control. Additional "bump" treatments may be needed to maintain an effective herbicide concentration for the required contact time. However, the sum of all applications cannot exceed 150 ppb per annual growth cycle. Because of this long contact period, penoxsulam is likely to be used for larger-scale or whole-lake treatments and should not be used where rapid dilution can occur such as spot treatments or moving water.

Galleon can be applied to the surface of the water using a sprayer or injected below the water surface. When treating emergent or floating plants, it must be diluted in water and used with a spray adjuvant.

Penoxsulam is broken down in the water by light and microbes and has a half-life ranging from 12 to 38 days. As penoxsulam breaks down, twelve degradation products are created. Six of these are more persistent in the environment than penoxsulam itself. Penoxsulam doesn't bind to sediments, so leaching through soil into groundwater is likely. Three of the more persistent breakdown products are also mobile through soil.

Penoxsulam is practically not toxic to fish birds and mollusks and demonstrates low toxicity to mammals invertebrates and bees.

Repeated use of herbicides with the same mode of action can lead to herbicide-resistant plants. Plants that are resistant to ALS inhibitors such as penoxsulam, have appeared at a higher rate than plants resistant to other types of herbicides. In order to prevent herbicide resistance, avoid using the same type of herbicide year after year, and use non-herbicide methods of control when possible.

Triclopyr (Renovate) is available in both liquid and granular form for use in controlling submerged, emergent and floating-leaf plants. There is also a granular formulation that contains triclopyr plus 2,4-D (Renovate Max G). Triclopyr is a selective, systemic herbicide that moves throughout plant tissue and works by interfering with cell growth and division. Following treatment, plant growth will be abnormal and twisted, and plants will die within two to three weeks after application, decomposing over several weeks. Triclopyr should be applied to plants that are actively growing and should only be used in still or slow moving bodies of water. If there is water movement at a treated site, higher concentrations or a repeated application may be required. The decomposition of dead plants can deplete oxygen levels in the water which can be lethal to fish and other aquatic life. Therefore, when using liquid Renovate, treatments must be split so that no more than ½ of the water body is treated at one time with at least 10 to 14 days between each split.

When treating emergent or floating vegetation, liquid Renovate must be mixed with water and a non-ionic surfactant and applied using a spray boom, handgun or other suitable equipment mounted on a boat or vehicle. For subsurface applications, it can be applied directly into the water using a boat-mounted distribution system. When treating plants that are 6 ft below the water surface, trailing hoses should be used along with an aquatic approved sinking agent.

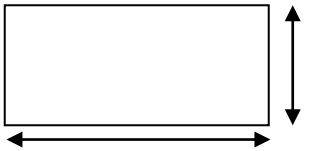
Triclopyr is broken down rapidly by light and microbes and has a half-life of about 1 to 10 days. The initial breakdown products of triclopyr are TCP (3,5,6-trichloro-2-pyridinol) and TMP (3,5,6-trichloro-2-methoxypridine). The half-lives for TCP and TMP are similar to those of triclopyr. Triclopyr doesn't bind to soil, and limited leaching of triclopyr and its breakdown products may occur. However, it is not likely to be mobile enough to contaminate groundwater.

The aquatic formulation of triclopyr is practically non-toxic to fish, invertebrates, birds and bees. TCP and TMP appear to be slightly more toxic to aquatic organisms than triclopyr; however the peak concentration of these breakdown products is very low following treatment, so they should not pose a threat to aquatic organisms.

DETERMINATION OF SURFACE AREA AND VOLUME

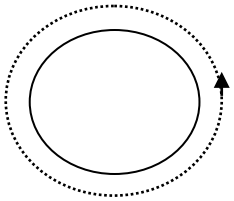
It is very important to accurately calculate the surface area and volume of the water body to be treated to ensure that the proper amount of herbicide or algicide is used. Many water bodies approximate geometric shapes, and their surface area can be calculated using the formulas provided below. If a water body has an irregular shape, divide it into sections that best approximate these geometric shapes, calculate the surface area of each individual section, and then add these surface areas together to determine the total surface area of the water body. The units of measurement that are most often used, and upon which label dosage tables are based, are acres for surface area and acre-feet for volume. An acre is 43,560 square feet and is approximated by a square of 209 by 209 feet. An acre-foot is simply the volume of water in an acre that is one foot deep.

Rectangular Ponds



$$\text{Surface Acreage} = \frac{\text{width in ft} \times \text{length in ft}}{43{,}560 \text{ sq. feet}}$$

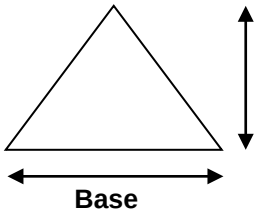
Circular Ponds



Total feet of shoreline

$$\text{Surface Acreage} = \frac{(\text{total ft of shoreline}) \times (\text{total ft of shoreline})}{547{,}400 \text{ sq. ft}}$$

Triangular Ponds



$$\text{Surface Acreage} = \frac{\text{base in ft} \times \text{height in ft}}{87{,}120 \text{ sq. ft}}$$

The volume of a water body can be calculated (in acre feet) by multiplying the surface area (in acres) by the average depth (in feet). Average depth can be calculated by averaging several depth soundings of the water body. Alternatively, an estimate for water bodies with uniformly rounded basins is one half of the maximum depth.

Table 1. Formulated Product Dosages

Listed below are the dosages established by the manufacturers of algicides and herbicides used for effective control of the aquatic plants described in this guidebook. You must carefully consider the conditions specific to your water body when determining the amount of product you should use.

Note: This information is subject to change. Pesticide products and labels may change and new products and labels are frequently introduced. Before using any pesticide product, the specific product label should be consulted to determine the exact dosage rates. Labels contain the legal requirements for pesticide product use.

Unicellular Algae	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Copper EDA - Ethylenediamine (Komeen)	0.68 - 3.3 gal. per acre foot
Copper TEA - Ethanolamine Captain Clearigate Cutrine K-Tea	 0.6 - 3.0 gal. per acre foot 0.9 - 4.4 gal. per acre foot 0.6 - 1.8 gal. per acre foot 0.7 - 3.4 gal. per acre foot
Copper EDA/TEA (Nautique)	1.5 - 3.0 gal. per acre foot
Copper Sulfate Copper Sulfate SeClear	 0.7 - 2.8 lb. per acre foot 1.0 – 6.5 gal per acre foot
Endothall - Mono(N,N-dimethylalkylamine) salt–Granular (Hydrothol)	3 - 162 lb. per acre foot
Endothall - Mono(N,N-dimethylalkylamine) salt–Liquid (Hydrothol)	0.6 - 36 pt. per acre foot
Light blocking dye (Aquashade)	20 - 80 oz. per acre foot
Hydrogen Dioxide – Liquid (GreenClean)	1.2 - 30 gal. per acre foot
Sodium Carbonate Peroxyhydrate (Hydrogen Dioxide) – Granular (GreenClean Pro)	2 - 100 lb. per acre foot

Filamentous Algae	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Copper EDA - Ethylenediamine (Komeen)	0.68 - 3.3 gal. per acre foot
Copper TEA - Ethanolamine Captain Clearigate Cutrine – Liquid Cutrine - Granular K-Tea	 0.6 - 3.0 gal. per acre foot 1.8 - 5.3 gal. per acre foot 0.6 - 2.4 gal. per acre foot 20 - 60 lb. per surface acre 0.7 - 3.4 gal. per acre foot
Copper EDA/TEA (Nautique)	1.5 - 3.0 gal. per acre foot
Copper Sulfate Copper Sulfate SeClear	 0.7 - 2.8 lb. per acre foot 1.0 – 6.5 gal per acre foot
Diquat (Reward)	0.25 - 0.5 gal. per acre foot
Endothall - Mono(N,N-dimethylalkylamine) salt–Granular (Hydrothol)	3 - 162 lb. per acre foot
Endothall - Mono(N,N-dimethylalkylamine) salt–Liquid (Hydrothol)	0.6 - 36 pt. per acre foot
Flumioxazin	6 - 12 oz. per surface acre
Light blocking dye (Aquashade)	20 - 80 oz. per acre foot
Hydrogen Dioxide – Liquid (GreenClean)	1.2 - 30 gal. per acre foot
Sodium Carbonate Peroxyhydrate (Hydrogen Dioxide) – Granular (GreenClean Pro)	2 - 100 lb. per acre foot

COPPER SULFATE DOSE TABLE: (Maximum Rates)		
Trout or Triploid Grass Carp Present	0.25 ppm	0.7 lb. per acre foot
Warm water fish (Bass, sunfish, perch) present	0.5 ppm	1.4 lb. per acre foot
No fish present	1.0 ppm	2.8 lb. per acre foot

Stoneworts *(Chara, Nitella)*	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Copper TEA - Ethanolamine Captain Clearigate Cutrine - Liquid Cutrine - Granular K-Tea	 1.2 - 3.0 gal. per acre foot 3.6 - 7.1 gal. per acre foot 1.2 - 3.0 gal. per acre foot 30 - 90 lb. per surface acre 1.7 - 3.4 gal. per acre foot

Duckweed and Watermeal	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Diquat (Reward)	1 - 2 gal. per surface acre
Diquat (Weedtrine D)	5 gal. per surface acre
Flumioxazin (Clipper)	1.1 - 2.1 lb. per acre foot or 6 - 12 oz per surface acre
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone - Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
Penoxsulam (Galleon)	2 - 5.6 fl. oz. per surface acre; or 1.7 - 26.1 fl. oz. per acre foot

Water Milfoil	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
2, 4-D – Butoxyethyl Ester (Aqua-Kleen, Navigate)	28.4 - 56.8 lb. per acre foot
Diquat (Weedtrine D)	5 - 10 gal. per surface acre
Diquat (Reward)	0.25 - 0.5 gal. per acre foot
Endothall - Dipotassium salt - Liquid (Aquathol K)	1.3 - 3.2 gal. per acre foot
Endothall - Dipotassium salt - Granular (Aquathol Super K)	8.8 - 22 lb. per acre foot
Flumioxazin (Clipper)	1.1 - 2.1 lb. per acre foot
* Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
* Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
* Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lbs. per acre foot
Imazamox (Clearcast)	Eurasian: 17 - 173 fl. oz. per acre foot Variable-leaf: 64 - 128 fl. oz. per surface acre; or 17 - 173 fl. oz. per acre foot
Penoxsulam (Galleon)	1.7 - 26.1 fl. oz. per acre foot
Triclopyr - Granular (Renovate)	14 - 67 lb. per acre foot
Triclopyr - Liquid (Renovate)	0.7 - 2.3 gal. per acre foot
Triclopyr/2,4-D – dimethylamine salt (Renovate Max G)	4.7 - 93.7 lb. per acre foot

* Variable leaf milfoil is not controlled by fluridone

Coontail	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
2, 4-D – Butoxyethyl Ester (Aqua-Kleen, Navigate)	28.4 - 56.8 lbs. per acre foot
Copper EDA - Ethylenediamine (Komeen)	1.7 - 3.3 gal. per acre foot
Copper EDA/TEA – Ethylenediamine/ Ethanolamine (Nautique)	1.5 - 3.0 gal. per acre foot
Endothall - Dipotassium salt - Liquid (Aquathol K)	1.3 - 3.2 gal. per acre foot
Endothall - Dipotassium salt - Granular (Aquathol Super K)	8.8 - 22 lb. per acre foot
Diquat (Reward)	0.25 - 0.5 gal. per acre foot
Diquat (Weedtrine D)	5 - 10 gal. per surface acre
Endothall - Dipotassium salt - Liquid (Aquathol K)	1.3 - 3.2 gal. per acre foot
Endothall - Dipotassium salt - Granular (Aquathol Super K)	8.8 - 22 lb. per acre foot
Flumioxazin (Clipper)	1.1 - 2.1 lb. per acre foot
Fluridone - Liquid (Sonar AS, Avast, WhiteCap))	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lb. per acre foot
Imazamox (Clearcast)	69 - 173 fl. oz. per acre foot

American Elodea	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Copper EDA - Ethylenediamine (Komeen)	1.7 - 3.3 gal. per acre foot
Copper EDA/TEA - Ethylenediamine/ Ethanolamine (Nautique)	1.5 - 3.0 gal. per acre foot
Diquat (Reward)	0.25 - 0.50 gal. per acre foot
Diquat (Weedtrine D)	10 gal. per surface acre
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lb. per acre foot

Curlyleaf Pondweed	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Copper EDA/TEA - Ethylenediamine/ Ethanolamine (Nautique)	1.5 - 3.0 gal. per acre foot
Diquat (Reward)	0.25 - 0.50 gal. per acre foot
Diquat (Weedtrine D)	10 gal. per surface acre
Endothall - Dipotassium salt - Liquid (Aquathol K)	0.45 - 3.2 gal. per acre foot
Endothall - Dipotassium salt - Granular (Aquathol Super K)	3.3 - 22 lb. per acre foot
Flumioxazin (Clipper)	1.1 - 2.1 lb. per acre foot
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lbs. per acre foot
Imazamox (Clearcast)	17 - 69 fl. oz. per acre foot

Floating Leaf Pondweeds *(Potamogeton spp.)*	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Copper EDA - Ethylenediamine (Komeen)	2.5 - 3.3 gal. per acre foot
Copper EDA/TEA - Ethylenediamine/ Ethanolamine (Nautique)	1.5 - 3.0 gal. per acre foot
Endothall - Dipotassium salt - Liquid (Aquathol K)	0.45 - 3.2 gal. per acre foot
Endothall - Dipotassium salt - Granular (Aquathol Super K)	3.3 - 22 lb. per acre foot
Diquat (Reward)	0.25 - 0.50 gal. per acre foot
Diquat (Weedtrine D)	10 gal. per surface acre
Endothall - Dipotassium salt - Liquid (Aquathol K)	0.45 - 3.2 gal. per acre foot
Endothall - Dipotassium salt - Granular (Aquathol Super K)	3.3 - 22 lb. per acre foot
Flumioxazin (Clipper)	1.1 - 2.1 lb. per acre foot
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lb. per acre foot
Imazamox (Clearcast)	35 - 104 fl. oz. per acre foot
Penoxsulam (Galleon)	1.7 - 26.1 fl. oz. per acre foot

Fanwort	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Flumioxazin (Clipper)	1.1 - 2.1 lb. per acre foot
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lb. per acre foot
Penoxsulam (Galleon)	1.7 - 26.1 fl. oz. per acre foot

Naiad	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Copper EDA - Ethylenediamine (Komeen)	1.7 - 3.3 gal. per acre foot
Copper EDA/TEA - Ethylenediamine/ Ethanolamine (Nautique)	1.5 - 3.0 gal. per acre foot
Diquat (Reward)	0.25 - 0.50 gal. per acre foot
Diquat (Weedtrine D)	5 gal. per surface acre
Endothall - Dipotassium salt - Liquid (Aquathol K)	1.3 - 3.2 gal. per acre foot
Endothall - Dipotassium salt - Granular (Aquathol Super K)	8.8 - 22 lb. per acre foot
Flumioxazin (Clipper)	1.1 - 2.1 lb. per acre foot
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lb. per acre foot
Imazamox (Clearcast)	69 - 173 fl. oz. per acre foot
Light blocking dye	0.25 gal. per acre foot
Penoxsulam (Galleon)	1.7 - 26.1 fl. oz. per acre foot

Spatterdock, Water Lily and Watershield	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
2, 4-D – Butoxyethyl Ester (Aqua-Kleen, Navigate)	21 lb. per surface acre
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. per acre foot
Glyphosate (Rodeo, Glypro, AquaPro)	Up to 7.5 pt. per surface acre
Imazamox (Clearcast)	69 - 173 fl. oz. per acre foot
Imazapyr (Habitat, Polaris)	2 - 4 pints per surface acre
Triclopyr – Granular (Renovate)	27 - 67 lb. per acre foot
Triclopyr – Liquid (Renovate)	2 - 8 qt. per surface acre

Bladderwort	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Diquat (Reward)	0.25 - 0.50 gal. per acre foot
Diquat (Weedtrine D)	5 - 10 gal. per surface acre
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gals. per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lbs. per acre foot
Imazamox (Clearcast)	35 - 104 fl. oz. per acre foot
Triclopyr/2,4-D – dimethylamine salt (Renovate Max G)	4.7 - 93.7 lb. per acre foot

Hydrilla	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Copper EDA - Ethylenediamine (Komeen)	2.5 - 3.3 gal. per acre foot
Copper EDA/TEA - Ethylenediamine/ Ethanolamine (Nautique)	1.5 – 3.0 gal. per acre foot
Copper Sulfate Copper Sulfate SeClear	 0.7 - 2.8 lb. per acre foot 1.0 – 6.5 gal per acre foot
Endothall - Dipotassium salt - Liquid (Aquathol K)	0.6 - 3.2 gal. per acre foot
Endothall - Dipotassium salt - Granular (Aquathol Super K)	4.4 - 22 lb. per acre foot
Flumioxazin (Clipper)	1.1 - 2.1 lb. per acre foot
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gals. per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lbs. per acre foot
Penoxsulam (Galleon)	1.7 - 26.1 fl. oz. per acre foot
Diquat (Reward)	0.25 - 0.50 gal. per acre foot

Water Chestnut	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
2,4-D – dimehtylamine salt (CleanAmine, Amine 4, DMA 4)	1.42 - 2.84 gal.per acre foot; 2 - 4 qt. per surface acre
2, 4-D – Butoxyethyl Ester (Aqua-Kleen, Navigate)	28.4 - 56.8 lb. per acre foot
Imazapyr (Habitat, Polaris)	4 - 6 pt. per surface acre

Cattails	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Diquat (Reward)	2 gal. per surface acre
Diquat (Weedtrine D)	5 gal. per surface acre
Fluridone - Liquid (Sonar AS, Avast, WhiteCap)	0.03 - 0.24 qt. per acre foot
Fluridone – Liquid (Sonar Genesis)	0.05 - 0.48 gal. Per acre foot
Fluridone - Pellet (Sonar One, Sonar Q)	0.9 - 5 lbs. per acre foot
Glyphosate (Rodeo, Glypro, AquaPro)	4.5 - 6.0 pt. per surface acre
Imazamox (Clearcast)	32 - 64 fl. oz. per surface acre; or 69 - 173 fl.oz. per acre foot
Imazapyr (Habitat, Polaris)	2 - 4 pt. per surface acre

Phragmites	
CHEMICAL/TRADE NAME	FORMULATED PRODUCT DOSAGE
Glyphosate (Rodeo, Glypro, AquaPro)	4 - 6 pt. per surface acre
Imazamox (Clearcast)	96 - 128 fl. oz. per surface acre
Imazapyr (Habitat, Polaris)	4 - 6 pt. per surface acre
Triclopyr – Liquid (Renovate)	3 - 8 qt. per surface acre

Table 2. Water Use Restrictions

Water Use Restrictions After Treating a Lake or Pond with an Herbicide or Algicide as Established by the Product Label[1]

CHEMICAL	DRINKING	IRRIGATION	SWIMMING	FISHING
2,4,-D: Dimethylamine salt	Wait at least 7 days following treatment if product was applied within 600 ft. of an intake or show concentration at intake is 70 ppb or less using an approved assay	Refer to label	*	*
2, 4-D: Butoxyethylamine Ester	Wait at least 7 days following treatment if product was applied within 600 ft. of an intake or show concentration at intake is 70 ppb or less using an approved assay	Refer to label	Wait 24 hours	*
Copper Sulfate	*	*	*	*
Copper TEA	*	*	*	*
Diquat	Depending on amount of product applied, wait 1 to 3 days.	Wait at least 1-3 days for turf & landscape ornamentals depending on application rate Wait at least 5 days for food crops and production ornamentals	*	*
Endothall: (Mono (N,N-dimethylalkylamine) salt and Dipotassium salt)	No application may be made within 600 ft. of an intake and concentration cannot exceed 0.1 ppm at time of consumption	Wait at least 7 before use on annual nursery or greenhouse crops and newly seeded or transplanted crops, ornamentals or turf	*	*
Flumioxazin	*	Wait at least 5 days	*	*
Fluridone	*	Refer to label	*	*
Glyphosate	Do not apply within ½ mile upstream of intake or, for applications within and around ½ mile of intake, turn off intake for at least 48	*	*	*

Water Use Restrictions After Treating a Lake or Pond with an Herbicide or Algicide as Established by the Product Label[1]

CHEMICAL	DRINKING	IRRIGATION	SWIMMING	FISHING
	hours after application unless the glyphosate concentrations in the intake water is below 0.7 ppm.			
Imazamox	Wait until concentration is less than 50 ppb.	Refer to label	*	*
Imazapyr	Do not apply directly to water within ½ mile upstream of intake or, for applications within and around ½ mile of intake, turn off intake for at least 48 hours after application.	Wait at least 120 days or begin use when concentration is 1 ppb or less.	*	*
Light Blocking Dye	Chemical cannot be applied to water used for human consumption	Wait at least 1 hour	Wait at least 1 hour	*
Penoxsulam	*	Refer to label	*	*
Sodium Carbonate Peroxyhydrate (Hydrogen Dioxide)	*	*	*	*
Triclopyr	Wait until concentration is 400 ppb or less.	No restriction on use for established grasses. Otherwise, wait at least 120 days or begin use when concentration is 1 ppb or less	*	*

[1] See Table 3 for additional restrictions for public water supplies per the Memorandum of Agreement between DEEP and the Department of Public Health dated November 15, 2012. See product label for complete requirements regarding water use restrictions.

* If no label restriction is noted, then the lake or pond can legally be used for the specific purpose as soon as the chemicals have dispersed. Caution, however, may indicate waiting at least one day before using the lake or pond.

Table 3. Chemical Use Allowed in Public Water Supply Watersheds

Active Ingredient	Trade Names	Watershed Use
2,4-D; Dimethylamine salt	Amine 4, DMA 4, CleanAmine, Renovate Max G	NO
2,4-D; Butoxyethyl Ester	Aqua-Kleen, Navigate	NO
Acid Blue 9 Acid Yellow 23	Aquashade	NO
Copper Sulfate	Copper Sulfate, SeClear	Yes, provided copper concentrations do not exceed 1.3 ppm
Copper EDA (Ethylenediamine)	Komeen	Yes, provided copper concentrations do not exceed 1.3 ppm
Copper TEA (Ethanolamine)	Cutrine, K-Tea, Captain, Clearigate	Yes, provided copper concentrations do not exceed 1.3 ppm
Copper EDA/TEA	Nautique	Yes, provided copper concentrations do not exceed 1.3 ppm
Diquat	Reward, Weedtrine D, Redwing	NO
Endothall; Mono(N,N-dimethylalkylamine) salt	Hydrothol 191	NO
Endothall; Dipotassium salt	Aquathol K	NO
Flumioxazin	Clipper	Possibly. Use requires DPH review and approval. Permit may include additional conditions.
Fluridone	Sonar, Avast, WhiteCap	Yes, provided the product is not applied within ¼ mile of the intake
Glyphosate	AquaPro, Rodeo, Glypro, Touchdown Pro	Yes, provided the product is not applied within ½ mile upstream of a public water supply reservoir and a sample is collected for analysis following treatment.
Imazamox	Clearcast	Yes, with no additional restrictions imposed beyond that required by the product label.
Imazapyr	Habitat. Polaris	Yes, provided the product is not applied within ½ mile upstream of a public water supply reservoir.
Penoxsulam	Galleon	NO
Sodium Carbonate Peroxyhydrate (Hydrogen Dioxide)	GreenClean, Phycomycin	Yes, with no additional restrictions imposed beyond that required by the product label.
Triclopyr	Renovate	Possibly. Use requires DPH review and approval. Permit may include additional conditions.

Sources of Additional Information

Connecticut Department of Energy and Environmental Protection

http://www.dep.state.ct.us/pao/download.htm#Waste
(For: Aquatic permit application form, instructions and related materials)

Inland Fisheries Division – Hartford 860-424-3474
(For: Fish problems, identification of aquatic weeds, grass carp information)

Regional DEEP Fisheries Biologists
Eastern District – Marlborough 860-295-9523
Western District – Harwinton 860-485-0226
(For: Fish kills, other fisheries problems)

Bureau of Water Protection and Land Reuse
Lakes Management Program 860-424-3020
(For: Water quality surveys, non-chemical control, watershed management, weed identification and lake restoration grants)

Inland Water Resources Division 860-424-3706
(For: Maintenance, inspection or repair of a dam, 860-424-3019
dredging or drawdown of a pond or lake, and state regulatory requirements for work in wetlands and watercourses, including ponds, lakes or flowing waters)

Pesticides Management Program 860-424-3369
(For: Aquatic herbicide permits, commercial applicators and rates of herbicide application)

Natural Resource Conservation Service, USDA – Windsor 860-688-7725
(For: Construction of ponds and erosion control)

U.S. Army Corps of Engineers - Concord, MA 978-318-8338
(For: Federal regulatory requirements for work in waterways or wetlands, including ponds, lakes or other waters)

University of Florida - Center for Aquatic & Invasive Plants
http://plants.ifas.ufl.edu

Texas Agricultural Extension Service
http://wildlife.tamu.edu/aquaplant

Local Inland Wetland Commission
(For: Any modification or treatment of water within your town)

Appendix I: Connecticut General Statutes and Regulations Governing Posting and Notification

Connecticut General Statutes

22a-66a(h) Any pesticide application business or department, agency or institution of the state or municipality prior to making a pesticide application in any lake or pond with any public access owned by the state or municipality shall cause to be published notice of the application in a newspaper of general circulation in each municipality in which the lake or pond is located and shall post a sign notifying the public of the application at each place of public access. Such sign shall comply with regulations adopted by the commissioner pursuant to subsection (g) of this section. Any pesticide application business prior to making a pesticide application on any private lake or pond with more than one owner of shoreline property shall cause to be published notice of such application in a newspaper of general circulation in each municipality in which the lake or pond is located.

REGULATIONS OF CONNECTICUT STATE AGENCIES

(e) Notice of pesticide applications to lakes and ponds.

(1) In accordance with subsection (h) of section 22a-66a of the Connecticut General Statutes, any pesticide application business or department, agency or institution of the state or a municipality, prior to making a pesticide application in any lake or pond with any public access owned by the state or a municipality shall give newspaper notice to the public in accordance with subsection (h) of section 22a-66a of the Connecticut General Statutes, and shall post a sign in a conspicuous location at each place of public access owned by the state or a municipality.
(2) The bottom of each sign shall be posted a minimum of forty inches above the ground and the top no higher than sixty inches above the ground.
(3) No person shall remove or render difficult to read, in whole or in part, any information which is required by this subsection until the end of the longest waiting period specified in subdivision (4)(C)(v) of this subsection.
(4) Each sign required by subsection (h) of section 22a-66a of the Connecticut General Statutes shall conform to the following requirements:
(A) The sign shall be a minimum of eight and one half inches high by eleven inches wide;
(B) The sign shall be of a rigid material substantial enough to be easily read for at least the longest waiting period specified in subdivision (4)(C)(v) of this subsection;
(C) The sign shall contain the following information in black lettering on a bright yellow background in the format specified in Appendix B of this section:
(i) "**CAUTION**" in bold print of at least thirty-six point type, followed by, "**LAKE TREATED WITH PESTICIDES**" in bold print of at least twentyfour point type;
(ii) "**Pesticide name(s)**: (the common name of each pesticide applied)" in bold print of at least twenty point type;
(iii) "**Date/time**: (date and time each pesticide was applied)" in bold print of at least twenty point type;
(iv) "**Applicator**: (the name and telephone number of the pesticide application business or other person that applied the pesticide)" in bold print of at least twenty point type;
(v) The statement, "Do not use the water for the following purpose(s) until the date and time noted below:" in at least eighteen point type, followed by the dates and times that swimming and other water-contact activities, drinking, fishing, irrigation, livestock watering

and other uses specified on the pesticide label or pesticide use permit may be resumed, according to the label and permit, whichever is more stringent. If the label and permit are silent as to when a certain activity may be resumed, the words "No Restriction" shall be used for that activity. Nothing in this clause shall prohibit a pesticide application business, department, agency or institution from placing more stringent water use restrictions on the notice than are required by the label and permit; and

(vi) The statement, "**This sign must remain posted until the latest date above**" in bold print of at least twenty-four point type; and

(D) Except for the date and time of the pesticide application, the name and telephone number of the pesticide application business or other person that applied the pesticide, and the end of each waiting period, the information required on the sign shall be professionally printed. The remaining information may be handwritten, provided it is in permanent ink and in a print that is easy to read.

(5) (A) Any notice of pesticide application required to be published pursuant to subsection (h) of section 22a-66a of the Connecticut General Statutes regarding pesticide application to a lake or pond with any public access owned by the state or a municipality and pesticide applications to any private lake or pond with more than one owner of shoreline property, or required to be published or posted pursuant to subsection (j) of section 22a-66a of the Connecticut General Statutes regarding mosquito control, shall include but not be limited to the following information:

(i) the common name of each pesticide to be applied;

(ii) the location of the pesticide application;

(iii) the purpose of the pesticide application;

(iv) the estimated date of the pesticide application, and the statement, "Information on the specific date of application may be obtained from the person named below.";

(v) the name, address and telephone number of a contact person affiliated with the pesticide application business or department, agency or institution of the state or municipality making the pesticide application; and

(vi) the statement, "Do not use the water for the following purpose(s) until the date and time noted below:" followed by the dates and times that swimming and other water contact activities, drinking, fishing, irrigation, livestock watering and other uses specified on the pesticide label or pesticide use permit may be resumed, according to the label and permit, whichever is more stringent. If the label and permit are silent as to when a certain activity may be resumed, the words "No Restriction" shall be used for that activity. Nothing in this clause shall prohibit a pesticide application business, department, agency or institution from placing more stringent water use restrictions in the notice than are required by the label and permit.

(B) A pesticide application business or department, agency or institution of the state or a municipality shall not apply such pesticide prior to the estimated date of application specified in a published notice. If the actual date of pesticide application will exceed the estimated date of application by more than three calendar days, the pesticide application business or department, agency or institution of the state or municipality shall republish the notice.

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(Effective March 4, 2013)

CAUTION

LAKE TREATED WITH PESTICIDES

PESTICIDE NAME(S): **DATE/TIME:**

APPLICATOR: **PHONE:**

Do not use the water for the following purpose(s) until the date and time noted below:

Swimming or other Water contact: Fishing: Irrigation:

Drinking: Livestock watering: Other:

This Sign must remain posted until the latest date above

Appendix II
Registered Commercial Pesticide Application Businesses
Aquatic Category

ALL HABITAT SERVICES, LLC
PO BOX 231
BRANFORD, CT 06405
PHONE: (203) 245-1212

ALLIED BIOLOGICAL INC OF NEW JERSEY
580 ROCKPORT ROAD
HACKETTSTOWN, NJ 07840
PHONE: (908) 850-0303

BCI INC DBA BUTLER COMPANY
848 MARSHALL PHELPS RD.
WINDSOR, CT 06095
PHONE: (860) 688-8024

CONNECTICUT POND SERVICES
PO BOX 320178
FAIRFIELD, CT 06825
PHONE: (203) 452-1481

DIVERSIFIED PEST MANAGEMENT, INC.
231 WEST MAIN ST.
CHESTER, CT 06412
PHONE: (860) 526-2277

INNOVATIVE MOSQUITO MANAGEMENT
P.O. BOX 1304
MADISON, CT 06443
PHONE: (203) 245-7015

JIM MARTURANO
25 WOODBINE CT
BERLIN, CT 06037
PHONE: (860) 777-6771

LAWNS BY MARCUS HILDITCH, LLC
55 NORTH WOOD ROAD
STORRS, CT 06268
PHONE: (860) 477-0387

LIFE-LAKES, INC.
19 SANDY PINES BLVD.
HOPEWELL JUNCTION, NY 12533
PHONE: (845) 227-8805

NON-TOX INC
26 HIGHLAND PARK RD.
NORTH HAVEN, CT 06473
PHONE: (203) 234-7207

NORTHEAST AQUATIC (NORTHEAST TREE, POND & TURF SERVICE, INC.)
4 OLD MILL ROAD
NEW MILFORD, CT 06776
PHONE: (860) 354-3319

SOLITUDE LAKE MANAGEMENT
590 LAKE STREET
SHREWSBURY, MA 01545
PHONE: (508) 885-0101

THE POND AND LAKE CONNECTION
1112 FEDERAL ROAD
BROOKFIELD, CT 06804
PHONE: (203) 885-0184

TOM DONAGHER & SONS
79 WILLARD AVENUE
NEWINGTON, CT 06111
PHONE: (860) 233-2815

WEEDS, INC.
250 BODLEY RD.
ASTON, PA 19014-1412
PHONE: (610) 358-9430

THIS LIST IS PROVIDED FOR THE CONVENIENCE OF THE PUBLIC AND DOES NOT IMPLY AN ENDORSEMENT OF ANY OF THE FIRMS LISTED ABOVE. THIS LIST CAN CHANGE AT ANY TIME AND IS ONLY ACCURATE AS OF THE REVISION DATE INDICATED BELOW.

The Connecticut Department of Energy and Environmental Protection is an Affirmative Action/Equal Opportunity Employer that is committed to requirements of the Americans with Disabilities Act. Any person with a disability who may need information in an alternative format may contact the agency's ADA Coordinator at 860-424-3194, or at deep.hrmed@ct.gov. Any person with limited proficiency in English, who may need information in another language, may contact the agency's Title VI Coordinator at (860) 4234-3035, or at deep.aaoffice@ct.gov. Any person with a hearing impairment may call the State of Connecticut relay number - 711. Discrimination complaints may be filed with DEEP's Title VI Coordinator. Requests for accommodations must be made at least two weeks prior to any agency hearing, program or event.