Common aquatic nuisance species and chemicals applied to deter pond algal blooms and potential impacts on aquatic systems

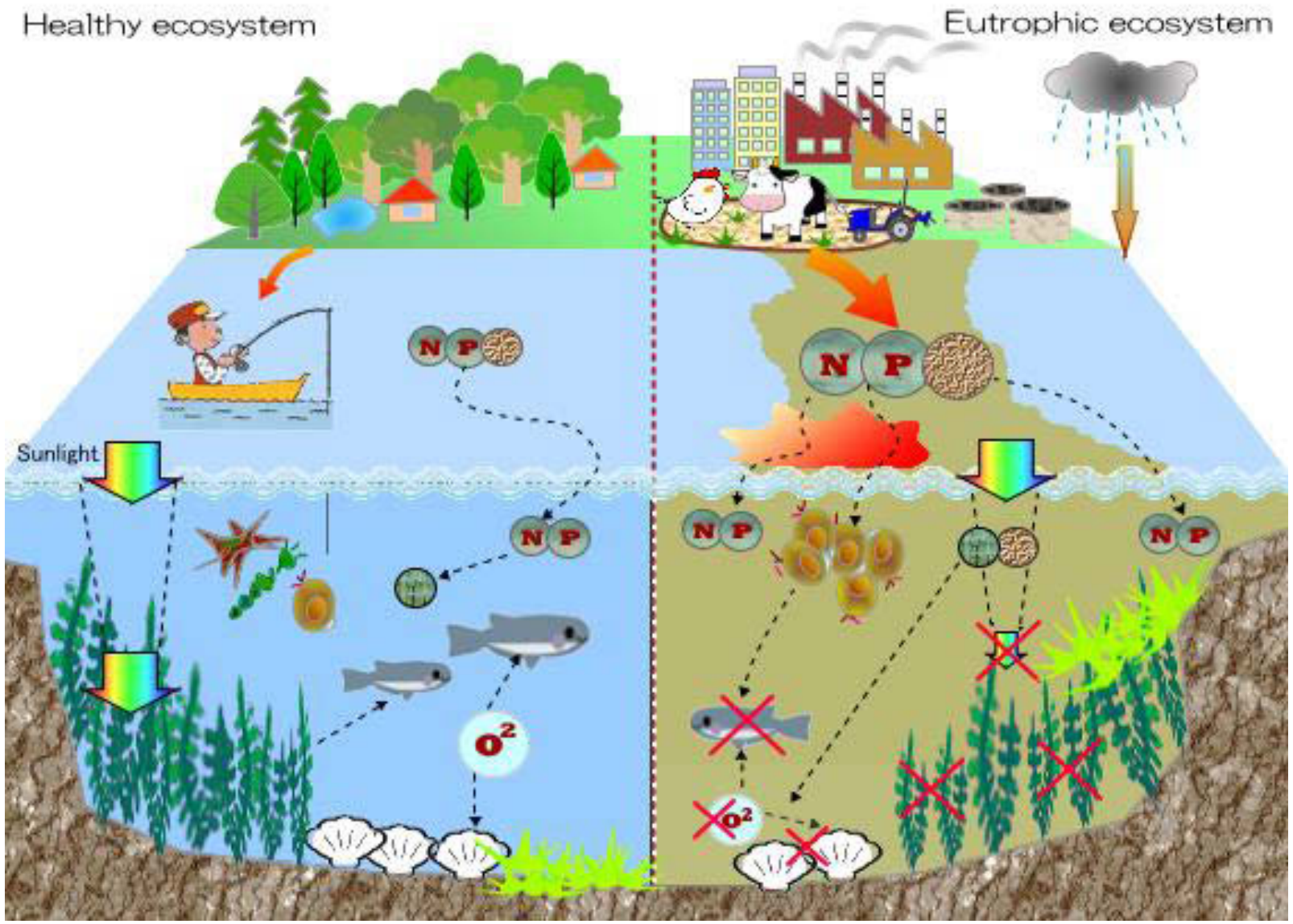
Information from:

NUISANCE AQUATIC VEGETATION MANAGEMENT GUIDEBOOK
State Of Connecticut
Department of Energy & Environmental Protection
Pesticides Management Program
http://www.ct.gov/deep/lib/deep/pesticide_certification/Supervisor/aweeds.pdf

http://www.epa.gov/pesticides/

http://www.telegraph.co.uk/earth/earthnews/8679448/Algae-explosion-in-the-hot-weather.html

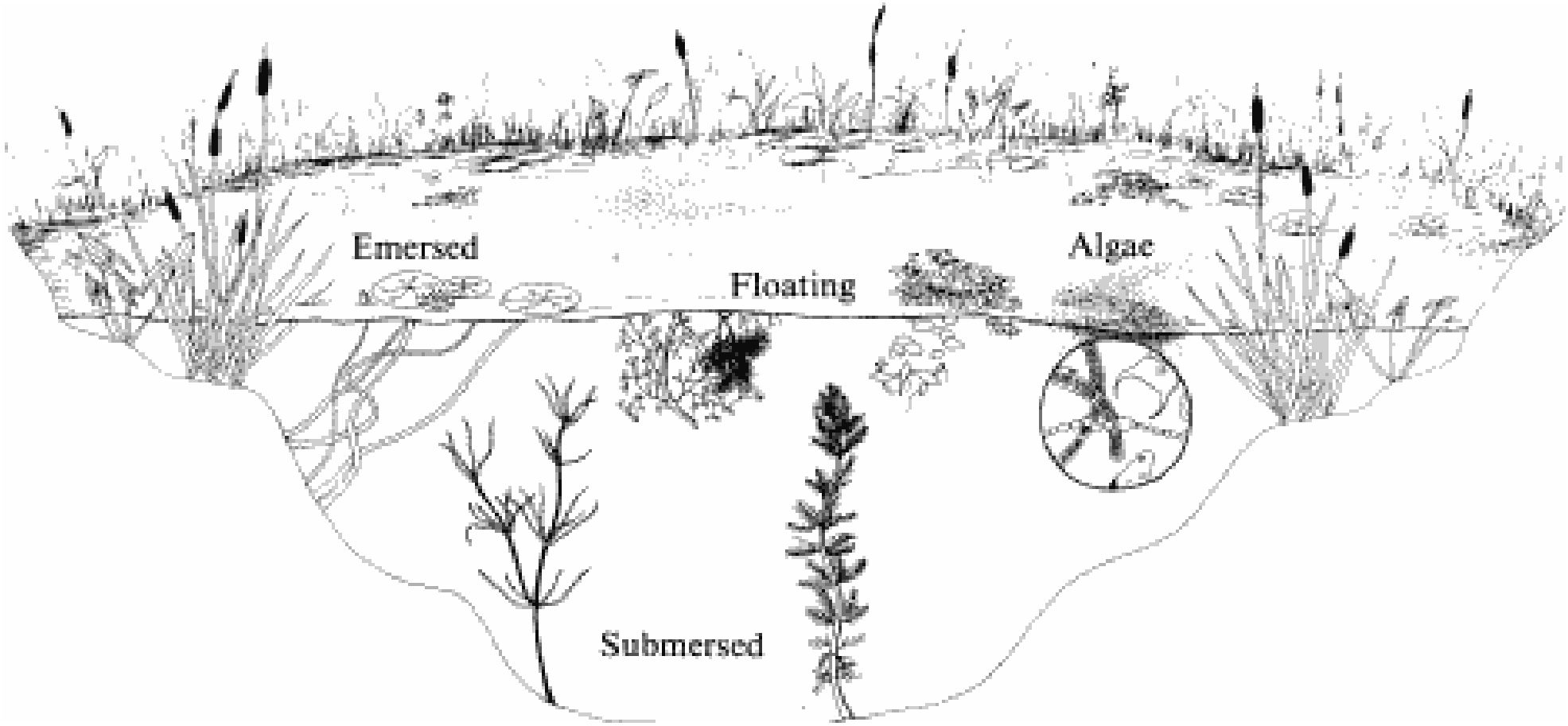
“Cultural Eutrophication”



http://www.nowpap3.go.jp/eng/case/eutrophication/img/eutrophication_fig1.jpg

- ✓Septic tank leachate
- ✓Turf and garden fertilizers
- ✓Waterfowl droppings
- ✓Domestic animal manure
- ✓Erosion
- ✓Storm Drainage

Mature Pond



http://staff.tuhsd.k12.az.us/gfoster/standard/bsuces.htm

Aquatic Plants: Algae

Unicellular Algae

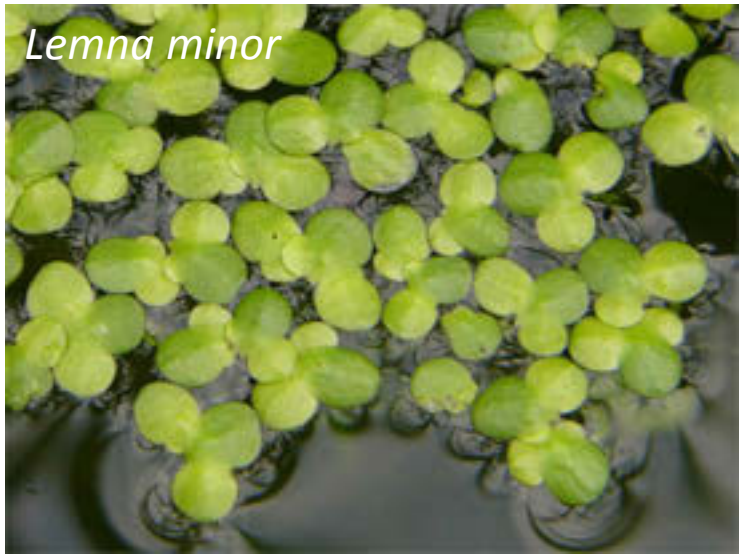
Filamentous Algae

Aquatic Plants: Stoneworts

✓ Skunky odor

✓ Usually not a nuisance. Should be treated early, become more resistant as summer progresses

Aquatic Plants: Duckweed and Watermeal (Native)

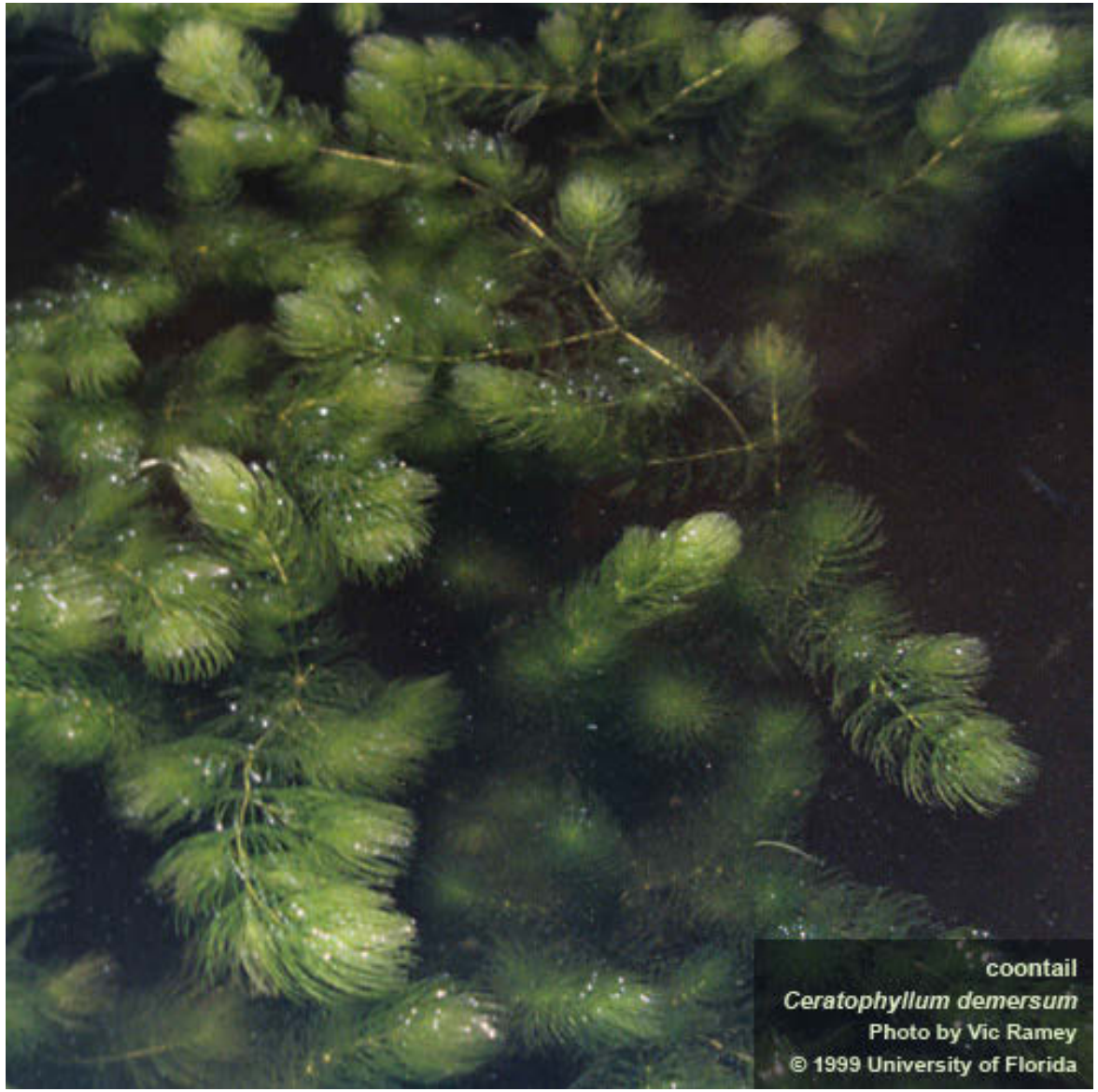


- ✓ Growth can be very dense, completely covers pond surface
- ✓ Can be difficult to control

Aquatic Plants: Water Milfoil (Invasive)

- ✓ Grows all year long, rapid growth rate
- ✓ Forms impenetrable mats, disrupts navigation and recreation
- ✓ Shades out native vegetation
- ✓ Decreases water flow
- ✓ Spreads by fragmentation, should not be cut
- ✓ Best controlled with systemic herbicides at low doses

Aquatic Plants: Coontail (Native)



- ✓ Grows completely underwater
- ✓ Spreads by fragmentation, should not be cut
- ✓ Restrict navigation and recreational use

Aquatic Plants: American Elodea

- ✓ Grows below water surface
- ✓ Forms large masses
- ✓ Spreads by fragmentation

Aquatic Plants: Pondweeds

Curlyleaf Pondweed

http://www.thewildclassroom.com/biodiversity/problemplants/species/Curlyleaf%20Pondweed.htm

American Pondweed

http://rollinsaquatic.com/common-aquatic-plants/

http://www.gooneybirdsllc.com/PondweedIdentification/PondweedIdentification.htm

Narrowleaved Pondweed

http://www.gotalgae.com/aquatic_plant_solutions.htm

Aquatic Plants: Water Chestnut (Invasive)

- ✓ Reproduce quickly
- ✓ Cover entire bodies of water
- ✓ Seed longevity
- ✓ Large populations are troublesome for boat navigation, fisheries and recreation

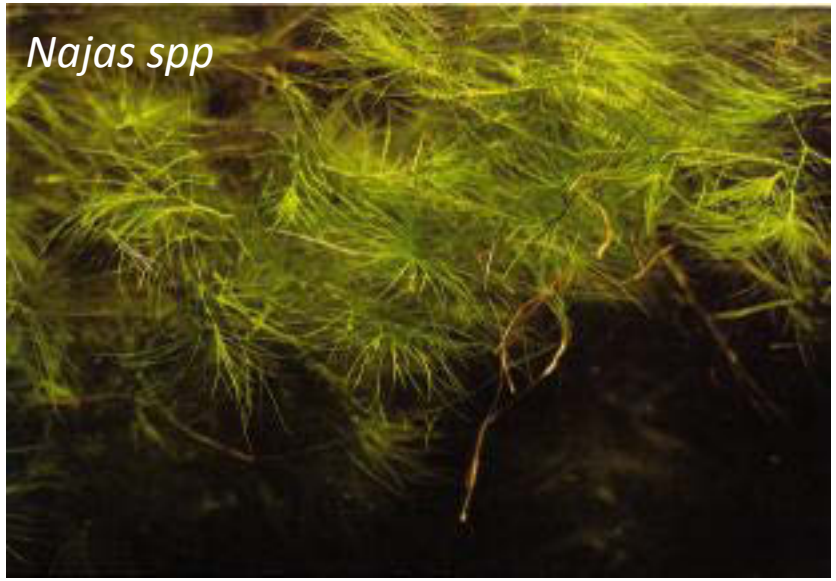
Aquatic Plants: Fanwort (Invasive)

http://www.ptccb.org.gy/agallery.html

http://www.dierengroothandel.be/bestellen/index.php?route=product/product&product_id=377

- ✓ Starting to make progress in CT lakes
- ✓ Can appear AFTER herbicide treatments for other species

Aquatic Plants: Naiad (Native)



http://warnell.forestry.uga.edu/SERVICE/LIBRARY/b0839/index.html

http://idtools.org/id/aquariumplants/Aquarium_&_Pond_Plants_of_the_World/key/Aquarium_&_Pond_Plants/Media/Html/Fact_sheets/najas.html

wric.ucdavis.edu

- ✓ Annuals
- ✓ Appear in late summer
- ✓ If appears before mid-summer, it is not naiad
- ✓ Very narrow stems and leaves
- ✓ Hard to distinguish from stoneworts or narrow leaved pondweeds

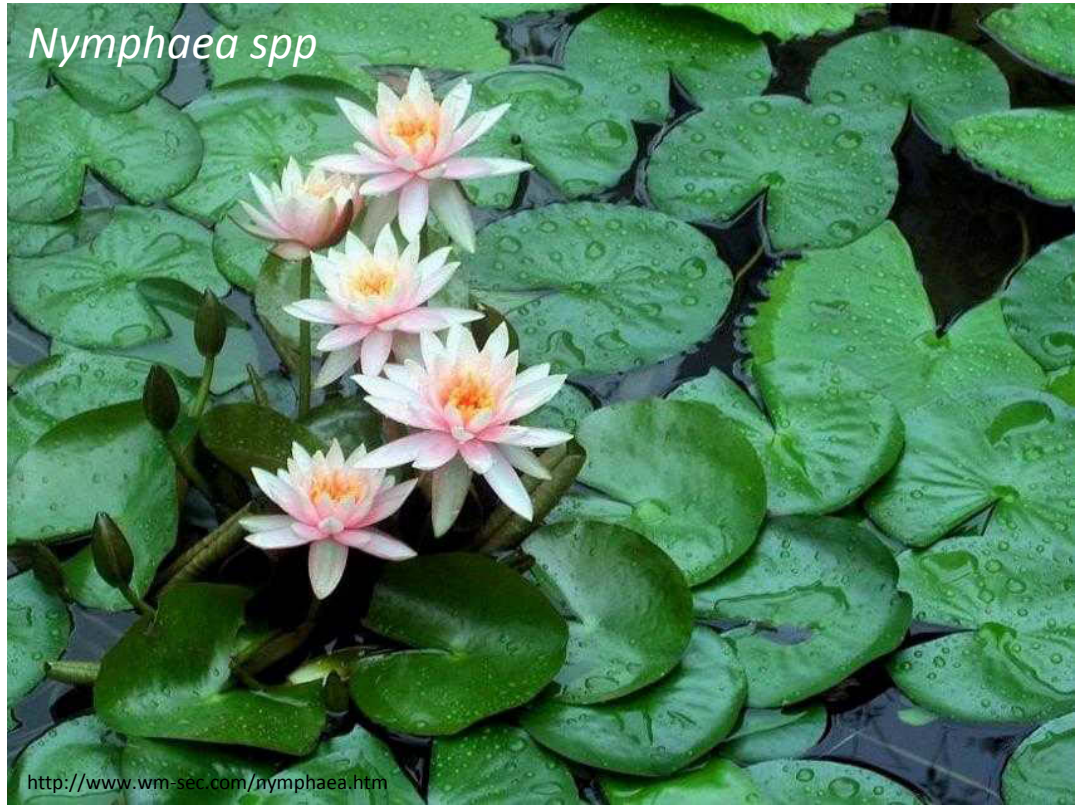
Aquatic Plants: Watershield (Native)

- ✓ Floating leafed plant
- ✓ Roots at bottom of pond
- ✓ Leaves can cover entire pond
- ✓ Inhibits growth of other plants
- ✓ Dense populations can impede small boat and restrict recreational use

Aquatic Plants: Bladderwort (Native)

- ✓ Characterized by tiny bladders on leaf segments
- ✓ Flower extends above the water (yellow or purple)
- ✓ Not a pest species, but may need limited control

Aquatic Plants: Waterlily and Spatterdock (Native)



- ✓ Large tubers rooted in the lake and large floating leaves
- ✓ Attractive, but crowd areas limiting access
- ✓ Must dig out roots, cutting will not affect future growth

Aquatic and Land Plants: Cattails (native) and Phragmites (invasive)

Cattails

Phragmites

- ✓ Grow on land and in water
- ✓ Tenacious root system
- ✓ Require systemic herbicide
- ✓ Best applied after flower spikes have formed

Algicides and Herbicides
Pro/Con and off-target effects

Algicides are a temporary cure

http://www.diywatergardening.com/algaecides-ponds-lakes-granular-and-liquid.html

http://www.clnwtr.com/images/pond_before_after.jpg

Algicides: Copper Agents General Indroduction

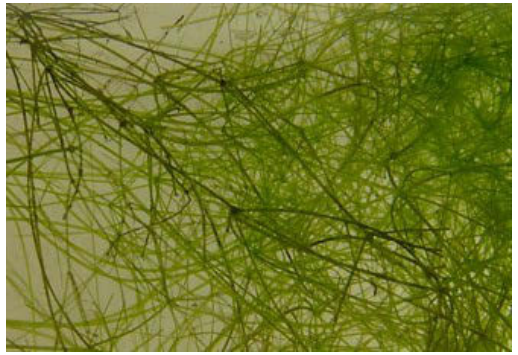
- ✓ Treats algae mainly, but some formulations can treat macrophytes
- ✓ Must consider target species, water hardness, water temperature, amount of algae, water clarity and flow
- ✓ Effect may be short lived, multiple treatments may be necessary during growing season
- ✓ Applications must be split. No more than ½ of water body can be treated at one time
- ✓ Copper is elemental, does not break down in environment
- ✓ Precipitates out of water and settles in sediment: persist and accumulates
- ✓ High concentrations are toxic to plant and animal life

Algicides: Copper Sulfate (SeClear)

Pro	Con
Enhances water quality	Within 24hr after application, precipitates to bottom as heavy metal precipitate and does not degrade
Reduces amount of phosphorus in water	Once buildup begins, sterile lake bottom develops and invertebrates are killed off
Applied as surface spray or underwater injection	Highly toxic to most aquatic species including insects and larvae, crayfish, mollusks, fish (trout and carp) and beneficial bacteria
Can be used on dense mats if broken up prior to treatment	Overall weakens the food chain, over time decline in foraging fish and poor fish growth rates
Quickly travels through water column, algae killed on day applied	Over time may increase frequency and severity of algal blooms
	Large scale die offs deplete oxygen too quickly- lethal to fish and other aquatic life (split applications)

Algicides: Copper Chelating Agents

Pro	Con	Copper TEA (Cutrine, Captain, Clearigate, K-TEA)	Copper EDA (Komeen)
Chelated copper does not precipitate out of water as quickly	May be toxic to fish in soft water (carbonate content less than 50ppm)	Granular and liquid form	Liquid form
Longer contact time with target vegetation and prevents new growth		Liquid useful for filamentous and unicellular algae	Controls algae and copper-sensitive macrophytes
Less toxic to aquatic organisms		Granular useful for *Chara* and *Nitella* (stoneworts)	



Herbicides: 2,4-D
Dimethylamine Salt (Clean Amine) and Butoxyethyl Ester (Aquakleen)

Pro	Con
Selective systemic herbicide	Application must be made before dense mats form and when weeds are actively growing
Effective within a few days to a week after treatment	It is mobile and can leach into groundwater
Granular 2,4-D on clay granules resist decomposition in water	Ester formulations more toxic to fish and invertebrates than amine formulations
Continuous concentration released	Toxic to tomatoes, peppers, grapes and newly seeded lawns
May give up to 2 years residual control on certain weed species	Not permitted for use in public water supply watershed
Very effective against water milfoil, coontails, naiads, elodea, duckweeds, lilies and bladderworts	

Herbicides: Diquat (Weedtrine, Reward)

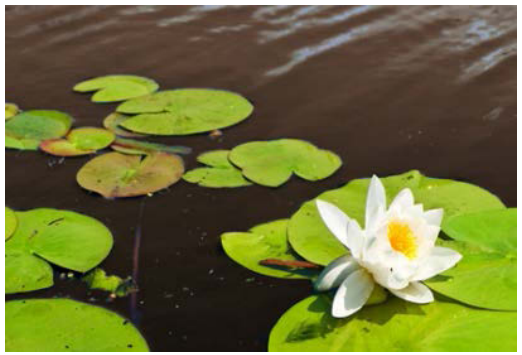
Pro	Con
Broad spectrum, controls floating-leaf and submerged macrophytes and algae	Not very effective on plants with extensive root systems
Plants die within one week	Must be applied before plant growth becomes dense
Can be sprayed onto water surface or poured into water	Decomposition depletes O_2 levels, treatments must be split by 14 days
Because of high affinity for soil particles, unlikely to leach into groundwater	Strongly binds with soil particles, not effective in muddy or silty waters
At acceptable rates, does not appear to have significant effects on most aquatic organisms	Cannot disturb bottom sediments during treatment (boating, swimming)
	Prohibited in public water supply watersheds

Herbicides: Endothall
Dipotassium Salt (Aquathol K) and Monoamine Salt (Hydrothol)

Pro	Con
Broad spectrum, particularly effective against submerged plants	Must properly ID species to avoid harm to native species important for ecosystem
Plants die within 3-5 days	Must be applied when actively growing
2 forms vary in target species	Wide margin of safety between recommended dose and toxic levels
Liquid (large areas) or granular (small or spot areas) forms available	Hydrothol is toxic to fish above 0.3ppm which is below allowed label rates
Highly mobile in soil, but is rapidly degraded limiting leaching into groundwater	Recommend no treatment with Hydrothol where fish are an important resource
At acceptable levels, no apparent short-term effects on fish or aquatic invertebrates with Aquathol	May not permitted in public water supply watershed
	Decomposition depletes O_2 levels, treatments must be split

Herbicides: Light Blocking Dye (Aquashade)

Pro	Con
Controls submerged macrophytes and algae	Does not control floating algae mats or free floating macrophytes
Effective in water sources with little to no outflow- shallow lakes where flow through time is long	May not be permitted for use in a public water supply watershed
It's just a dye, not a chemical	Not to be applied on a breezy day, you'll turn blue
No restrictions for animal/livestock drinking, irrigation, swimming or fish consumption when used at label rates	Additional applications will be needed at 1 to 4 week intervals as dyes are broken down by sunlight.



http://aquashadedye.com/

Herbicides: Glyphosate (Rodeo, Aquapro, Glypro)

Pro	Con
Broad spectrum, systemic (roots and tops) herbicide	Effective only on plants that grow above water, no effect on submerged plants. Particularly effective with cattails and yellow waterlily
Plants wilt, turn yellow and die within 2-7 days	Cannot apply if rain or wind is predicted
Binds strongly with soil particles, not expected to leach into groundwater	Must use appropriate surfactant before application to help it stick to plant surface. Not all surfactants are approved for use in aquatic environment, some are toxic
At appropriate doses, non-toxic to aquatic species and wildlife	Concentration is reduced by dispersal in water movement and binds to sediments
May be permitted in a public water supply watershed	Must take care not to contact valuable native plants

Herbicides: Fluridone (Sonar, Avast, WhiteCap)

Pro	Con
Selective systemic herbicide	Very low concentration, slow acting, takes 1-2 months
Due to long contact period, best used for larger-scale or whole-lake treatments	Should not be used where rapid dilution can occur (no spot treatments or moving water)
Strongly absorbs to clay, soils and organic matter. Does not pose a threat to groundwater	Additional “bump” treatments may be required
Low order toxicity to humans, fish and wildlife	Can have adverse effects on all submerged plants, should only be used at very low rates
	May damage or kill shoreline vegetation with roots extending into the water
	Repeated use of herbicides with same mode of action can lead to herbicide-resistant plants. Must alternate treatments

Herbicides: Flumioxazin (Clipper)

Pro	Con
Controls submerged, emergent and floating-leaf macrophytes as well as filamentous algae	Most effective when applied to young, actively growing plants in water with pH less than 8.5
Plants rapidly decompose	Should only be used in still or slow moving bodies of water
Flumioxazin has low potential for leaching and does not persist in environment	
Rapidly broken down by water and microbes into APF and THPA	APF and THPA do have a high potential to leach and may be persistent in the environment
There are no restrictions on swimming, eating fish from treated water bodies, or pet/livestock drinking water use. There is a five day restriction on irrigation.	Slightly to moderately toxic to fish Moderately to highly toxic to aquatic invertebrates Mostly non-toxic to birds, small mammals and bees Highly toxic to plants, must minimize damage to off-site vegetation

Herbicides: Review of effect beyond target species

Chemical	Invertebrate	Fish	Amphibian	Reptile	Birds
Copper Sulfate (SeClear)	Highly toxic water fleas, crustaceans, mollusks, mayflies, snails, crayfish and beneficial bacteria populations which inadvertently weakens the food chain	Toxic especially to trout and carp	Toxic even at low doses (slowed growth rates, decreased mobility and death)	Not documented	toxic at high levels, standard treatment levels-not harmful
Copper Chelating Agents (Cutrine, Captain, Clearigate, K-TEA, Komeen)	toxic at application rates	toxic to trout and bluegill in soft water			toxic at high levels, standard treatment levels-not harmful

Herbicides: Review of effect beyond target species

Chemical	Invertebrate	Fish	Amphibian	Reptile	Birds
2,4-D (Aquakleen) Ester Formation	toxic (water flea and midges) at application rates	toxic	not toxic at application rates	effect unknown	moderately to practically nontoxic
2,4-D (Aquakleen) Amine Formation	not toxic at application rates	not toxic at application rates	not toxic at application rates	effect unknown	moderately to practically nontoxic
Diquat (Weedtrine, Reward)	Amphipods and water fleas (food chain organisms) adversely effected at application rates Snails show decreased reproductive success	Walleye fish very sensitive at application rates Northern pike, bass and bluegills not effected		Some data on turtles suggests toxicity	Moderately toxic to birds

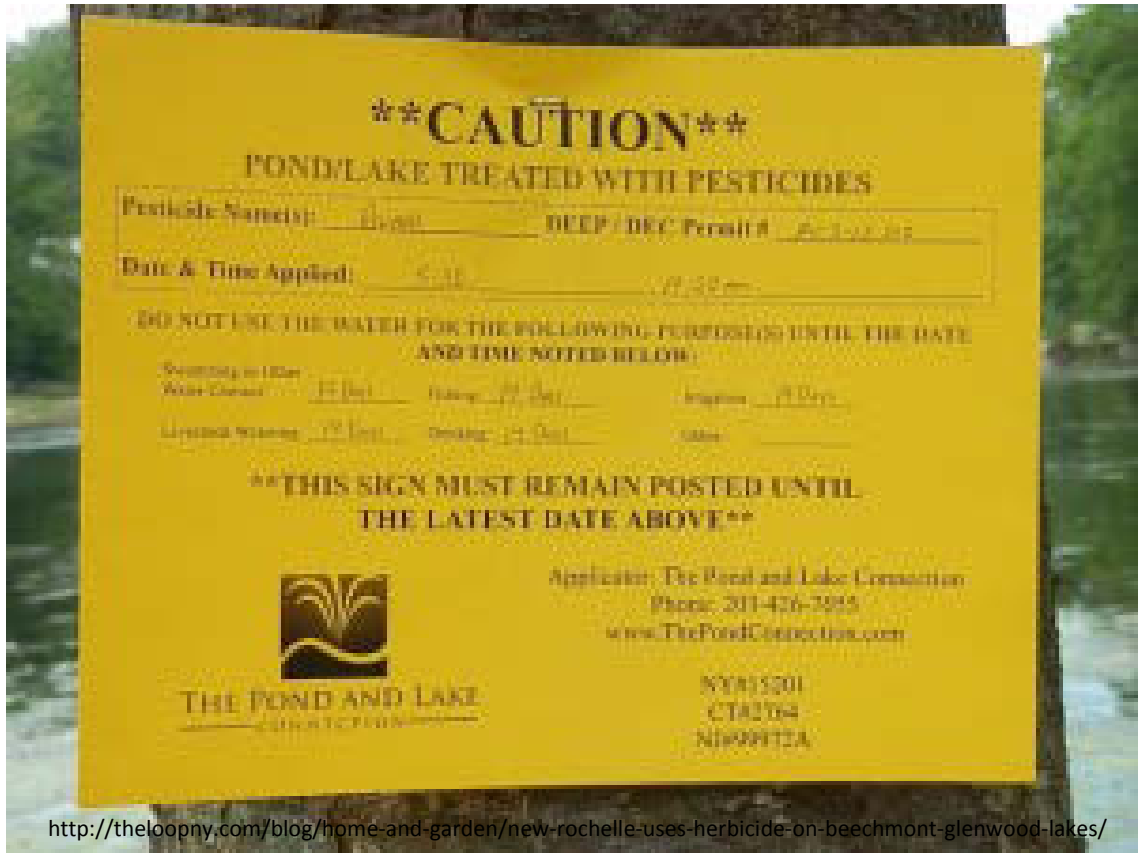
Herbicides: Review of effect beyond target species

Chemical	Invertebrate	Fish	Amphibian	Reptile	Birds
Endothall – dipotassium salt (Aquathol K)	No significant adverse effects in snails, aquatic insects and crayfish	No effects on fish tested			Low toxicity
Endothall – Monoamine salt (Hydrothol 191)	freshwater scuds demonstrate sensitivity above 0.5ppm	Toxic to fish at doses above 0.3ppm	Tadpoles demonstrate sensitivity above 0.5ppm		
Light Blocking Dye (Aquashade)	Very low	Very low			Very low

Herbicides: Review of effect beyond target species

Chemical	Invertebrate	Fish	Amphibian	Reptile	Birds
Glyphosate (Rodeo, Aquapro, Glypro)	Non-toxic on food chain organisms midge, mayfly and scuds	Carp, bluegill and trout demonstrate toxicity only at off-label high doses	Practically non-toxic to slightly toxic		Very slightly toxic
Fluridone (Sonar, Avast, WhiteCap)	increased mortality at labeled application rates in water flea and midge	No short or long term effects at application rates	effect unknown	effect unknown	Low toxicity, no acute or chronic risk
Flumioxazin (Clipper)	moderately to highly toxic	slightly to moderately toxic in bluegill and trout			Mostly non-toxic

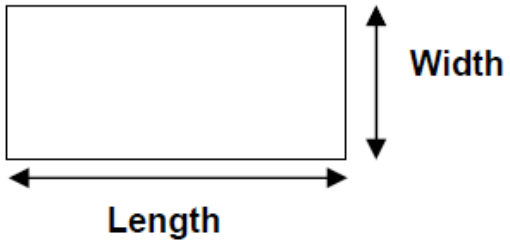
Permits- Information you'll need to make educated decisions



http://theloopny.com/blog/home-and-garden/new-rochelle-uses-herbicide-on-beechmont-glenwood-lakes/

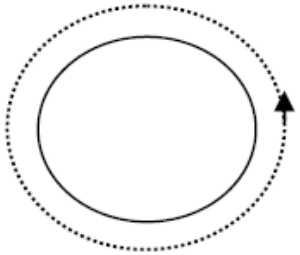
Baseline Data: Body of Water- Surface Area and Volume

Rectangular Ponds



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

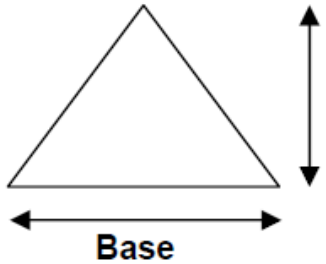
Circular Ponds



Total feet of shoreline

$$\text{Surface Acreage} = \frac{\left[\text{total ft of shoreline} \times \text{total ft of shoreline}\right]}{\text{547,400 sq. ft}}$$

Triangular Ponds



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

Baseline Data: Manufacturers Established Doses

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

** Some chemicals require split treatments with required X number of days between treatments

** Some chemicals interact and have incompatible uses

Baseline Data: Endangered and Threatened Species

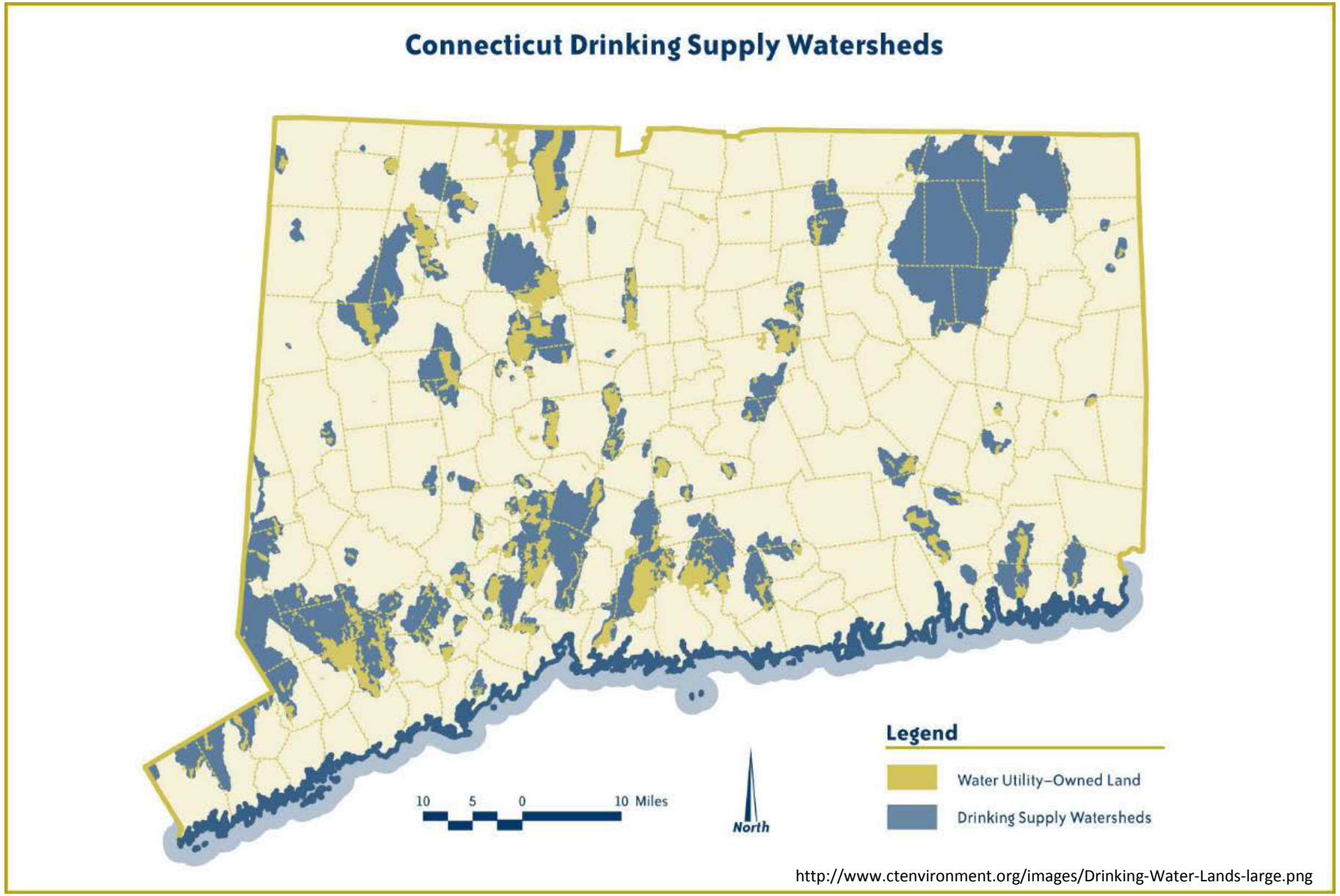
Connecticut General Statutes Section 26-303 to 26- 315
www.cga.ct.gov

CHAPTER 495
ENDANGERED SPECIES

Table of Contents

Sec. 26-303. Findings. Policy.
Sec. 26-304. Definitions.
Sec. 26-305. Program for the protection of endangered and threatened species.
Sec. 26-306. Regulations. Determination of whether any native species is endangered, threatened or of special concern. List. Essential habitats identified.
Sec. 26-307. Review.
Sec. 26-308. Treatment of species not listed as endangered or threatened as endangered or threatened species.
Sec. 26-309. State acquisition of essential habitat. Management.
Sec. 26-310. Actions by state agencies which affect endangered or threatened species or species of special concern or essential habitats of such species.
Sec. 26-311. Taking of endangered or threatened species. Construction of chapter.
Sec. 26-312. Violation. Order. Hearing.
Sec. 26-313. Disclosure.
Sec. 26-314. Natural Area Preserves Advisory Committee.
Sec. 26-315. Elephant ivory.
Sec. 26-316. Eelgrass beds.

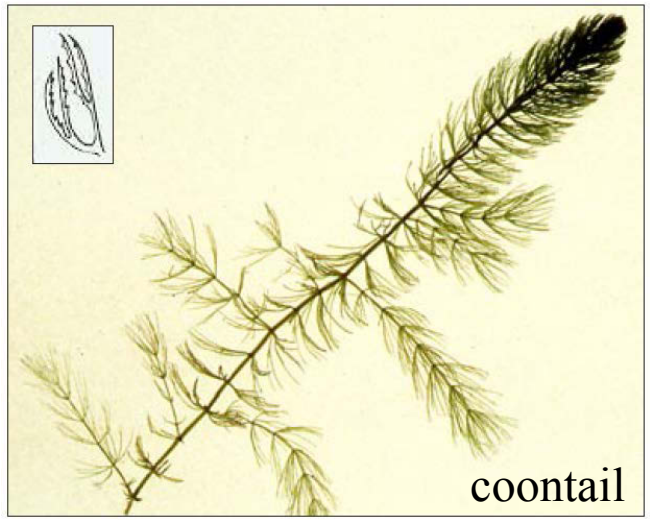
Baseline Data: Public Water Watershed



http://www.ctenvironment.org/images/Drinking-Water-Lands-large.png

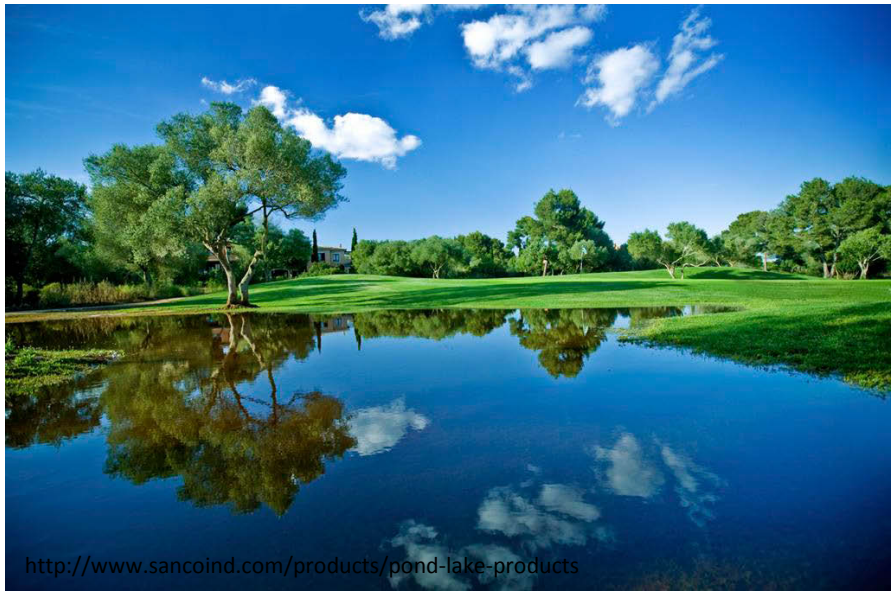
Baseline Data: Proper identification of species

(Left) Although Chara resembles flowering plants, it is an alga. (Right) Chara leaves are arranged along the stem in whorls.



https://www.extension.purdue.edu/extmedia/APM/APM_3_W.pdf

Baseline Data: General



Pond Descriptions

- Surface area, average depth, maximum depth
- Sediment type (muddy, silty)
- Submerged and floating vegetation
- Algae
- % coverage
- Drainage area, water flow
- Watershed land-use (residential, forest, etc)
- Coastal- subject to ebb/flow tides, saline/brackish water

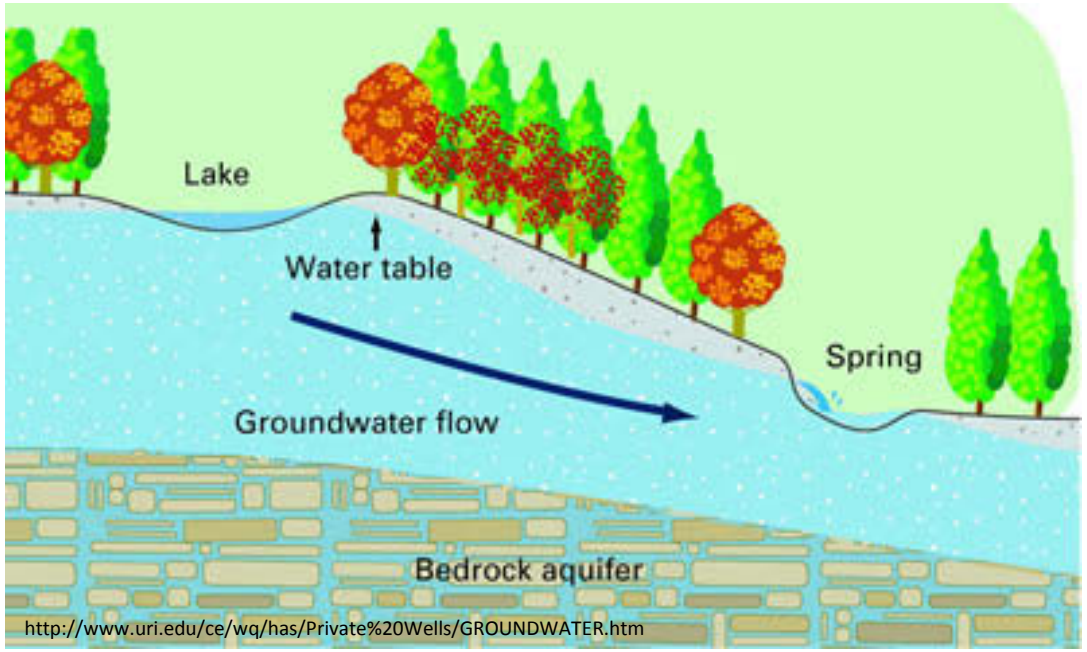
Pond Characteristics

- Biotic and abiotic wildlife habitat features
- Aquatic species
- Other associated species (mammals, birds, fish, reptiles, amphibians, etc)
- Endangered or threatened species

Baseline Data: General- Water

Site Waterbody Information

- Aquifer protection areas
- Waterbody in public water supply watershed
- Waterbody flow
- Size/acreage/depth
- Public access
- Waterbody stocked with fish by state
- Uses of waterbody (fishing, swimming, boating)
- Downstream users of water who may be affected
- Location of private drinking wells within ½ mile
- Types of fish/plants/animals



Baseline Data: General

Management Program

- Applicator and Pond management team
- Recent Treatment History
- Nuisance species
- Proposed herbicides/algicides and doses
- Spot or whole body treatments
- Treatment Notifications/Postings
- Application Methodologies
  - Boat/shoreline- Spray/injection - Droplets/drift
- Timing/Scheduling of Treatment
  - Species ID important, times of year vary
  - Rain/wind
- Water use restrictions post-treatment: drinking/irrigation/swimming/fishing
- Downstream protection/overflow block/natural buffers
- Sedimentation, erosion and downstream siltation controls
- Monitoring and inspections
  - Growth conditions, water flow characteristic changes, wildlife utilization, watershed disturbances

https://bangordailynews.com/2010/10/31/news/char-trout-restored-to-remote-pond/

Natural and Less Toxic Alternatives

Winter drawdown

Dredging excavation

Weed harvesting

Barley straw

Sterile triploid grass carp

Nutrient precipitation