New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Robert F. Flacke
Commissioner

Identifying Number P-S07

SEQR
NOTICE OF COMPLETION OF FINAL E.I.S.

Date: May 1, 1981

This notice is issued pursuant to Part 617 of the implementing regulations pertaining to Article 8 (State Environmental Quality Review) of the Environmental Conservation Law.

The Department of Environmental Conservation, as lead agency, has completed a final Environmental Impact Statement (EIS) on the proposed action described below.

DESCRIPTION OF THE ACTION:

This document is titled "Aquatic Vegetation Control Program". DEC administers this program which is mandated under state law and requires anyone proposing to apply a chemical to water for the purpose of controlling aquatic vegetation to obtain a permit from the department. Proposed treatments are reviewed and permits are granted with such conditions and restrictions imposed as are required to insure the protection of the environment.

LOCATION:

Statewide

POTENTIAL ENVIRONMENTAL IMPACTS:

Negative environmental impacts include restrictions of water use, reduction in food supply, habitat for fish, aquatic mammals, birds, and other aquatic organisms, reduction of disolved oxygen in water, no increase of nutrients from decaying vegetation, and possible fish kills.

Positive environmental impacts include increased recreational use of waters of the state, may improve water quality, indirect control of mosquito-borne diseases thru control of aquatic weeds and may cause a temporary increase in harvest of fisheries resource.

COPIES OF THE FINAL EIS MAY BE OBTAINED FROM:

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COPIES OF THIS NOTICE SENT TO:

Environmental Notice Bulletin (Room 608)
Division of Regulatory Affairs (Room 514)
Office of Fiscal Management (Room 630)
Robert McManus (Room 602)
Appropriate Regional Director(s)
NYS Department of Health
NYS Department of Agriculture and Markets
NYS College of Agriculture and Life Sciences
State Clearinghouse (address: Division of Budget, State Capitol, Albany, New York 12224)
Appropriate Regional Clearinghouse(s)
Chief Executive Officer of the political subdivision in which the action will be principally located
All persons who have requested copies of draft EIS

F - I - N - A - L

PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

ON

AQUATIC VEGETATION CONTROL PROGRAM

OF THE

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF LANDS AND FORESTS

Required Under: State Environmental Quality Review Act of 1975 (SEQR)

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Availability of Documents not Submitted with Statement:

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SUMMARY

This document is a Programmatic Environmental Impact Statement to cover the aquatic vegetation control program in all waters of New York State. The Department of Environmental Conservation, Bureau of Pesticides, has statutory authority to issue permits and otherwise administer this program in the State of New York. The aquatic vegetation control permit program provides a rational basis for the introduction of pesticides into the waters of New York State in a consistent, environmentally sound manner in order to protect the health and safety of the people using the water, populations of organisms that inhabit or use the water body, and the environment.

The specific regulated activity in the aquatic vegetation control program is:

1. Application of pesticides to control aquatic vegetation in the waters of New York State.

Specific activities involved in regulating the control program are:

1. Review of applications from residents and applicators proposing treatment.

2. Issuance of permits specifying rates of application and any necessary restrictions.

3. Random monitoring of pesticide applications to insure adherence to permit requirements and the pesticide laws.

Beneficial Impacts:

1. Increase recreational use of New York State waters thus stimulating local economics and/or improving aesthetic appearance of waters.
2. May improve water quality.
3. Indirect control of mosquito-borne diseases thru control of aquatic weeds.
4. May cause a temporary increase in harvest of fisheries resource.

Adverse Impacts:

1. Restrictions of water use.

2. Reduction in food supply and habitat for fish and other aquatic organisms which could result in lower fish populations.

3. Possible buildup of copper in bottom sediments of ponds.

4. Due to the decay of large amounts of vegetation all at one time, there is a temporary increase in the biological oxygen demand (BOD). In extreme instances, this can result in a sufficient reduction of dissolved oxygen to be adverse to aquatic life.

5. The decay of treated vegetation will add nutrients to the water which may, in turn, foster the growth of new vegetation. This may result, on a short-term basis, in a profuse algae bloom, and on a long-term basis, monotypic stands of fast-growing species which are usually more of a nuisance than mixed vegetation stands.

6. Reduction in food supplies for aquatic mammals and birds.

7. Removal of aquatic vegetation used for escape cover and nesting.

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I. INTRODUCTION

This statement reviews aquatic vegetation control in waters of New York State. The statement endeavors to include all aspects of the program and deals with the impacts of the pesticides on aquatic vegetation, effects on non-target organisms, and the economic impact. It is not within the scope of this EIS to give an indepth discussion of human toxicity of the individual chemicals. This aspect is covered by the individual reviews conducted prior to product registration. These reviews are conducted by the Environmental Protection Agency and New York State registration programs.

The department's enforcement program is referenced along with numerous studies involving aquatic vegetation control. The statement deals with the statewide program as a whole rather than detailing specific regional programs in an attempt to provide an overall view of both adverse and beneficial impacts.

The program deals strictly with the control or elimination of aquatic vegetation. This department is involved either by statute or regulation. Section 15-0313 of the Environmental Conservation Law authorizes the department to "adopt and enforce rules and regulations governing the use of chemicals in water for the control and elimination of aquatic vegetation, for the control or extermination of undesirable fish, or for the control or extermination of aquatic insects . . ."(11) The law also provides for the issuance of a permit and for the limitations on the kinds and quantities of chemicals used. Part 327 of 6NYCRR contains regulations which implement this section and are found as Appendix 1.

II. DESCRIPTION OF THE ACTION

An aquatic vegetation control permit program is in effect in New York State. The purpose is to provide the public with regulated control of nuisance aquatic vegetation so as to assure aquatic vegetation control in an environmentally acceptable manner and assure protection of human water uses where humans may be exposed to aquatic vegetation control chemicals.

Overabundant aquatic vegetation is aesthetically unpleasing to some, may interfere with effective and proper harvest of the fishery resources, and may interfere with other recreational activities. In addition, weed beds offer a favorable environment for mosquito production.(4) Mosquito-borne diseases in general, and malaria and encephalitis in particular, probably offer the most important examples of indirect relationships between weeds and public health problems.(13) A need, therefore, exists for proper aquatic plant management to insure that the environment and man's interests are mutually protected.(12)

An increasing number of complaints concerning excessive growth of aquatic plants in New York State waters reflects the extent of nutrient enrichment of the lake and pond water called eutrophication.(1) Excessive nutrient input could come from specific sources such as septic tank leachate, farm feed lots, lawn fertilizers, household detergents, or non-point sources such as sedimentation, nitrate input from rainfall, agricultural fertilizers, or animal and bird wastes.(3)

Nuisance aquatic vegetation can be divided into two general categories - algae and rooted aquatics, based on differences in biological structures and processes.[12] The following is a list of algae and rooted aquatic vegetation: [8][15][17]

ALGAE

1. Planktonic algae

   Planktonic algae are minute, free-floating plants that color water green or brown or even dark red. When planktonic algae are overabundant, they are referred to as a bloom and often make water appear like pea soup. Common examples are: Anacystis, Anabaena, Oscillataria, and Aphanizomenon.

2. Filamentous algae

   Filamentous algae consist of long strands, filaments, or nets of plant material that often form floating mats. Sometimes this type of algae is referred to as pond scum. Common examples are: Spirogrya, Cladophora, Pithophora, and Hydrodictyon.

3. Muskgrass or stonewart algae

   Muskgrass or stonewart algae have the appearance of flowering plants with a stem and with whorls of leaves or branches. Two common muskgrass or stonewart algae are: A. Chara spp.; and B. Nitella spp.

ROOTED AQUATIC VEGETATION

Rooted aquatic vegetation is divided into three groups: submergent, emergent, and floating aquatic plants.

1. Submergents

Submergents, aquatic plants which usually are rooted on the bottom, have stems and leaves that seldom appear above the water surface. The following is a list of the most common submergent plants by common and scientific name:

COMMON NAME	SCIENTIFIC NAME
Bladderwort	*Utricularia* spp.
Common elodea	*Elodea canadensis*
Coontail	*Ceratophyllum demersum*
Fanwort	*Cabomba caroliniana*
Horned pondweed	*Zannichellia palustris*
Naiad	*Najas* spp.
Pond weeds	*Potamogeton* spp.
Watercress	*Nasturtium* spp.
Watermilfoil	*Myriophyllum* spp.
Water buttercup	*Ranunculus* spp.
Water - stargrass	*Heteranthera* spp.
Wild celery	*Vallisneria americana*

2. Emergents

Emergents are aquatic plants with roots in soil and with stem and leaves that emerge above the water surface. Plants generally grow in shallow waters or margins of the ponds or lakes. The following is a list of these aquatic plants giving their common and scientific names:

COMMON NAME	SCIENTIFIC NAME
Arrowhead	Sagittaria, spp.
Arrowarum	Peltandra, spp.
Bulrush	Scirpus, spp.
Burreed	Sparganium spp.
Cattail	Typha spp.
Pennywort	Hydrocotyle umbellata
Pickerelweed	Pontederia cordata
Rush	Juncus spp.
Sedge	Carex spp.
Spikerush	Eleocharis spp.
Water Smartweed	Polygonum amphibium

3) Floaters

Floaters are aquatic plants whose visible parts float and may move about on the surface. Attached floaters such as waterlily have stems and their roots are anchored in the bottom mud. Free floaters such as duckweed lack root anchorage. Their roots dangle in the water. The following is a list of these aquatic plants giving their common names and scientific names:

COMMON NAME	SCIENTIFIC NAME
Duckweed	Lemna spp., Wolffia, Spirodola
Lotus	Nelumbo lutea
Spatterdock	Nuphar luteum
Water chestnut	Trapa natans
Water primrose	Jussiaea repens
Watershield	Brasenia schreberi
White waterlily	Nymphaea odorata

AQUATIC VEGETATION APPLICATION PROCEDURES AND REQUIREMENTS

Instructions for the preparation and submission of an application for a permit to use chemicals for the control or elimination of aquatic vegetation are available from the Department of Environmental Conservation.

A complete application for a chemical use permit consists of:

1. A properly completed DEC Form #44-19-5 - Appendix 2. Application for a Permit for the Use of Chemicals for the Control of Aquatic Vegetation.

2. Maps such as the U.S. Geological Survey Quadrangle or lake charts showing the geographic location of the water or portion to be treated.

3. An expanded scale drawing (on 8 1/2" x 11" paper) showing in detail the following features of the treatment areas: (if necessary, more than one such drawing may be submitted).
    a. outline of areas to be treated,
    b. outline of weed beds (if area to be treated is 5 acres or less of a large body of water, show the weed areas within 200 feet of areas to be treated),
    c. length of shoreline in the treatment area (in feet),
    d. width outward from shore (in feet),
    e. depth sounding and their location (sufficient to calculate the volume of water to be treated),
    f. inlet and outlet streams and structures,
    g. names and locations of riparian and other known users that may be affected by treatment of this water, and

h. names and locations of public and private water supply intakes, cattle watering areas, and bathing areas in the vicinity of the treatment areas and outlet waters.

Map requirements are waived by Regional Permit Administrators for projects which are identical repeats of a previous year's treatment.

AQUATIC VEGETATION APPLICATION REVIEW:

Upon receipt of a complete aquatic vegetation control permit application, the regional pesticide inspectors or regional permit administrators distribute copies to the regional fish and wildlife review coordinator, the Albany office Bureau of Pesticides, the Bureau of Environmental Protection, and the New York State Health Department. All of the above-mentioned bureaus and departments then review the application. Upon completion of the review, any one or all of the reviewers can approve or deny the application. If the treatment is approved, the region or central office will issue a permit to the applicant. If there is a denial, information justifying the refusal must be sent to the Bureau of Pesticides in Albany. After review by that office, the region or central office will then notify the applicant of the refusal. This procedure in itself is a mini environmental impact review.

PERMIT PROCEDURES AND REQUIREMENTS

This year (1980), the department has issued approximately 200 aquatic vegetation control permits. Title 6NYCRR, Part 327, Section 327.1, states "No person, individual, public or private corporation, political subdivision, government agency, industry, co-partnership, association, firm, trust or estate, or any other legal entity whatsoever, shall use chemicals for the control or elimination of aquatic vegetation in any waters of the state without having applied for and obtained a written permit to do so from a designated permit-issuing official, except as specified in subdivision (C)". The permits issued by the department for this program specify:

1. Issuance is based on statements, agreements, and restrictions made or accepted by the applicant in his application
2. The authorized date of treatment
3. The permissable concentration of chemical, the maximum dosage to be applied to the treatment area, and the methods of application to be used
4. Any restrictions imposed on the use of waters during and following the application and the duration of these restrictions
5. Any special restrictions made by the permit-issuing official to implement the stated intent
6. That the application of chemicals shall be deemed to be in violation of the provisions of the Environmental Conservation Law and of Article 12 of the Public Health Law, if the applicant fails to comply with the permit terms
7. The applicant is also required to notify the regional pesticide inspector at least (7) days prior to the treatment. This enables the department enforcement officers to randomly monitor chemical treatments.

EXCEPTIONS:

1. The use of copper sulfate for the purpose of algae control by a duly constituted water supply agency in its supply waters does not require a permit.
2. Permits are not required for the use of chemicals in ponds or lakes having no outlet to other waters and which lie wholly within the boundaries of lands privately owned or leased by the individual making or authorizing such treatment.

These provisions are part of the permit system and are enforced by the Department of Environmental Conservation, which is the issuing agent.

PESTICIDE CHEMICAL CONTROL:

Chemical treatment offers a temporary solution to many difficult aquatic vegetation problems. To be effective, the timing and duration of a control method should be correlated with the germination period and/or vegetative stage of the plant. Great care should be exercised when the application of chemical pesticides is required.

The application of chemicals must be made by a certified pesticide applicator classified in either the private or commercial aquatic vegetation category. The department prescribes what chemical pesticides may be applied to the waters under stipulated conditions. See attached sample labels of pesticides approved for aquatic use (Appendix 3).

Also find enclosed department memorandum of dosage rates of hercidides permissable in water. These dosage rates may be more restrictive than the label recommendations (Appendix 4). The method for application of each specific pesticide can be found on the respective labels.

There are advantages as well as disadvantages to chemical control:[14]

1. Advantages
    a. Longer lasting control than mechanical methods. (See section on alternatives.)
    b. Involves less physical labor and time
    c. Often less expensive than alternative methods
    d. Quickly applied in any water depth
    e. The aquatic vegetation disappears shortly after application
    f. No aquatic vegetation disposal problem
    g. The person applying the pesticides must be a New York State certified private or commercial applicator in Category 5A - Aquatic Vegetation. Private and commercial applicators must demonstrate a practical knowledge of a wide variety of pests; their identification, life cycles, control methods, and chemical formulations that do not endanger humans or the environment. In addition, New York State law requires all commercial pesticide applicators be certified to use all pesticides. In order to obtain certification, the commercial applicator must be tested on these standards of competency:

1. Label and labeling
2. Safety
3. Environmental effects
4. Pests
5. Pesticides
6. Equipment
7. Application techniques
8. Pertinent state and federal laws and regulations

Additionally, the commercial applicator will be tested on problems and situations appropriate to his category (in this case Aquatic Vegetation - 5A).[14] This training and the certification process creates an awareness within the applicator such that proper treatment is more likely.

2. Disadvantages
   a. No guarantee it will work in any situation
   b. No long-lasting effect to the next season
   c. There is danger of killing too much weed material at one time and producing an oxygen deficiency for fish and other organisms as the weed mass decays
   d. There is a restricted water use period after each application of chemical. Water use restrictions can be found in 6NYCRR, Part 327, Sections 327.6 and 327.7

e. Pesticides do not solve the problem of fertility in the water. The nutrients of the dead plants are still in the lakes and ponds

f. Possible build-up of copper in bottom sediments of ponds

g. Reduction in cover for fish and aquatic invertebrates with potential reduction in biomass of fish available to the angler. Initial angling success may be enhanced

h. Reduction in food supplies for aquatic mammals and birds

PESTICIDE DEFINITIONS:

1. LD_{50} is an abbreviation for median lethal dose. The notation indicates the amount of toxicant that effects a 50% kill of the animal being tested. It is expressed in weight of the chemical per unit of body weight (mg/kg). LD_{50} is used to measure the acute oral and dermal toxicity of a chemical. The lower the LD_{50}, the more poisonous the chemical.

2. LC_{50} is an abbreviation denoting median lethal concentration. LC_{50} is often used to measure the toxicity of a chemical present in air or water. It is often expressed in parts per million or mg/l. The lower the LC_{50} value, the more hazardous the chemical.

3. Pesticide categories:

   Category 1 - HIGHLY TOXIC; signal word on the label - DANGER; skull and cross bones; poison

   Category 2 - MODERATELY TOXIC; signal word on the label - WARNING

   Category 3 - SLIGHTLY TOXIC; signal word on the label - CAUTION

   Category 4 - RELATIVELY NON-TOXIC; signal word on the label - none

Attached information, obtained from the Northeastern Regional Pesticide Coordinators' Pesticide Information Manual, depicts categories of toxicity (Appendix 5).

4. RPAR - A regulatory procedure adopted by the U.S. Environmental Protection Agency. Rebuttable Presumption Against Registration (RPAR) establishes risk criteria for all pesticides. If a compound exceeds risk criteria, it is presumed unsuitable for registration unless presumptions are rebutted.
5. NLE - No lethal effect
6. EC_{50} - Effect concentration to 50% of test organisms, usually immobilization
7. LCLo - Lowest recorded lethal concentration
8. MATC - Maximum acceptable toxicant concentration safe
9. NTE - No toxic effect (may be same as NLE)
10. TL_{50} - Tolerance limit of 50% of test organisms, essentially same as an LC_{50}, but means survival instead of mortality.

III. ENVIRONMENTAL SETTINGS

The environmental setting for this program includes all water bodies of New York State.

IV. IMPORTANT ENVIRONMENTAL IMPACTS

A. Economic Impacts:

Good fishing and boating waters and swimming areas is a prime attraction to residents, tourists, and visitors in New York State. These recreational activities bring considerable income into our state. Shoreline waters near residences, hotels, motels, and cottages can become unsightly and uninviting due to excessive weed and algae growth.

To be acceptable to the public and the regulatory authorities, waters must conform to three general conditions:(10)

1. They must be aesthetically enjoyable, free from floating or suspended substances, objectionable color, and foul odors.(10)
2. They must contain no substances that are toxic upon ingestion or irritating to the skin of human beings.(10)
3. They must be reasonably free from pathogenic organisms.(10)

The above conditions relate to water use for swimming. However, the water quality conditions for boating, fishing, and general aesthetic enjoyment may not be as rigid as those for swimming; nor are they inclusive for other uses.(10)

New York State receives a sizable income from water-related recreational activities. This income source may be reduced where heavy growth of weeds and algae are present. It is difficult to substantiate this reduction without a comprehensive economic study. However, the total losses due to excessive

aquatic vegetation in the United States was estimated at approximately 50 million dollars annually from 1951 to 1960. These losses probably have increased and will increase each year as the need for recreational waters becomes critical.(13)

In addition to the economic impacts above, potential copper accumulation in sediments of ponds and lakes should mandate a comprehensive statewide study. This study would depend upon the necessary funds and staffing needed to conduct this program. At present, the cost of analyzing copper and dry solids is $80.23 per sample. If multiple samples are analyzed, the cost is reduced to approximately $75/sample. Estimated costs of this study would be approximately $61,125. Please refer to Appendix 8 for a description of this proposed study and itemized costs.

B. Human, Fish, and Wildlife Impacts (Plus Other Pertinent Data)

The impacts of aquatic vegetation control chemicals upon humans, fish, and wildlife may be diverse and in many instances are not well documented. What is presented here is a scenario of possible impacts based on the data available and knowledge of the habitat and food preferences of fish or wildlife that may be affected. In addition, general notes on human impacts experienced through ingestion or skin contact of these pesticides are included.

For mammals and man, use of toxicity data for rats and rabbits is thought to be representative of impacts on man, due to the similarity of metabolic functions; however, rats and rabbits may not always be good indicators for the universe of North American mammals. The mammalian data is not readily indicative of impacts on birds, thus special avian testing is required. For all aquatic vegetation control chemicals, except aqualin and the endothalls, toxicity to mammals is generally moderate to low. At recommended usage concentrations and normal water exposures, there should be no acute toxicity symptoms, provided label usage restrictions are adhered to (See table 1). Label restriction or state regulation adherence should also prevent chronic effects, since the regulations are designed to prevent general exposure to non-degraded or active residues of the pesticide used.

For mammals such as muskrats, elimination of aquatic vegetation via use of pesticides also reduces or eliminates a prime food supply.

Relative to livestock, pesticide residues may accumulate in the flesh or be transmitted to the milk of dairy animals, thereby making them unacceptable for human consumption. Specific U.S. Food and Drug Administration actionable levels or temporary tolerance levels are given in Table 2. Residue levels for poultry and eggs are also included since similar problems could occur. Compliance with label or New York restrictions on water usage should prevent excessive residue accumulation in livestock or dairy products. Other effects include tainting the flavor of animal flesh by 2,4-D, thus reducing its acceptability for consumption (label note).

The lack of data on avian species, particularly waterfowl, is quite evident. Man's desire to reduce aquatic vegetation to facilitate boating or swimming may have a double impact on birds, i.e., exposure to pesticide residues and reduction in available habitat and food supply. The limited toxicity data available indicates generally low to moderate toxicity to birds; however, where data is available, it is limited to other than waterfowl. For certain pesticides, waterfowl have been shown to be much more sensitive than other bird species, thus it would be prudent for the scientific community to develop toxicity data addressing waterfowl specifically. Relative to habitat and food supply destruction, waterfowl graze on aquatic vegetation and use the vegetation for nest materials as well as cover. Vegetation removal eliminates the habitat and food supply, thereby reducing or eliminating waterfowl in the affected area. It should be noted that in waters with heavy human usage prior to aquatic vegetation control, waterfowl may not be present due to the human disturbances already existing.

Fisheries may be impacted by direct exposure to the pesticide, removal of habitat, reduction in food supply, and increased susceptibility to angling or predation. Several of the aquatic vegetation control chemicals may be classified as being of moderate to high toxicity to aquatic life (see specific chemical characterizations later) and aqualin is considered extremely toxic. Copper treatments may be of high to extreme toxicity, especially in waters of low alkalinity. Measures of safety are provided by a combination of application at concentrations below toxicity thresholds, rapid dilution in the water column, and avoidance reactions by aquatic life.

Aquatic vegetation provides a major portion of the shelter available to a variety of fish species and associated food organisms. It may become a limiting factor in species abundance in a given water body dependent on plant abundance. Where overabundant, the plant life causes wide fluctuations in dissolved oxygen supply which may impede reproduction or growth of fish and, further, may discourage fishing and other uses. When vegetation is present in insufficient quantity, certain desired fish species may be present in low quantities.

While this latter scenario would be considered an ideal by swimmers and boaters, it is not desired by most fisherman. A blend of the two extremes is most desirable; however, this may indicate a need for lake management, planning, and implementation, especially where vegetation may be excessive.

It must be remembered that vegetation provides a major component of the biological carrying capacity of a lake, thus any reduction in vegetation may reduce the quantity and quality of fish or other aquatic life inhabiting the water. Where desirable stands of aquatic vegetation are removed by chemical control, the aquatic life will experience a loss of shelter which enhances the loss of young fish and the invertebrate forage base to predators, causes a shift in species distribution, increases the competition for limited food supplies in areas where vegetation remains, and may cause a temporary increase in angler harvest due to limited habitat and food supplies. The end result is a reduction in the fish population and a loss of recreational opportunity.

The following section provides a brief review of toxicity data and other pertinent facts for specific aquatic vegetation control chemicals that are presently being used, or have been used in the recent past, within New York State. Within each compound's characterization, data on chemical synonyms, chemical name, chemical usages, New York State aquatic vegetation control usage recommendation, producers of the product, chemical properties, the precautionary label work, and affects on humans, fish, and wildlife are presented. The sections on impacts on living resources are often limited by a lack of data; therefore, definitive statements are not always possible. These sections are meant to present basic data and concerns about the particular chemical addressed; however, they are not meant to be, and they are not exhaustive reviews.

Table 1: Label or New York State restrictions preventing specified water usages after aquatic vegetation control chemical application.

Chemical	Usage Restriction and Its Duration				
	Drinking	Swimming	Fishing	Irrigation	Livestock Watering
Algimycin PLL-C	--	--	--	--	--
Aqualin	No longer permitted for aquatic vegetation control				
Copper Sulfate	--	24 hrs.	--	--	24 hrs.
Cutrine	--	--	--	--	--
2,4-D	24 hrs.	24 hrs.	24 hrs.	+	24 hrs.
Dalapon	No longer permitted for aquatic vegetation control				
Dichlobenil	No use*	--	90 days	No use*	No use*
Diquat	14 days	14 days	14 days	14 days	
Endothalls	7-25 days**	24 hrs.	3 days	--	7-25 days**
Fenac	No longer used in New York State, but is registered for use				
Malachite	--	--	--	--	--
Silvex	No permitted usage at present time				
Simazine	12 months	--	--	12 months	12 months

\+ Until no phytotoxicity
* No use means do not use chemical where this usage occurs.
** Dependent on concentration used in waters.

Table 2: U.S. Food and Drug Administration levels or temporary tolerances for certain aquatic vegetation control chemical residues in livestock, dairy products, poultry, and eggs.*

Residue level in ug/g on Fat Basis

Chemical	Livestock	Milk/Cheese	Poultry	Eggs
2,4-D	0.2	0.1	0.05	0.05
Dalapon	0.2	0.1	3.0	0.3
Silvex	0.1	0.05	--	--
Simazine	0.02	0.02	0.02	0.02

* Fish flesh actionable levels exist for 2,4-D and simazine only, i.e. 1.0 and 12.0 ug/g in the edible flesh, respectively. A shellfish actionable level exists for 2,4-D at 1.0 ug/g. Pending actionable levels exist for dichlobenil in fish at 5.0 ug/g.

AQUALIN

Synonyms: Acrolein, acrylaldehyde

Chemical name: 2-propenal

Usages: Intermediate for synthetic glycerol, polyurethane and polyester resins, methionine and pharmaceuticals; herbicide; teargas.

NYS Recommendation: Do not use product for aquatic vegetation control since the product is toxic to fish at concentrations recommended for aquatic vegetation control.

Producer: Shell Chemical Company; however, production has been discontinued.

Chemical Properties: Liquid; specific gravity 0.84; flammable; volatile; highly reactive especially with alkaline materials and strong acids.

Signal Word: Danger

Human Toxicity: Extremely toxic when administered orally (lowest lethal dose reported is 5 mg/kg); toxicity comparable to the human toxicity of the insecticide endrin.[1] Toxic by inhalation; TLV = 0.1 ppm in air.

Mammalian Toxicity: High toxicity is characteristic[1], as outlined below. Highly lachrymatory; may cause skin burns if not removed immediately.

Species	Administration	Effect	Concentration
Rat	oral	LD_{50}	46 mg/kg
Rat	inhalation	LCLO(4hrs)	8 ppm
Rat	subcutaneous	LD_{50}	50 mg/kg
Mouse	oral	LD_{50}	40 mg/kg
Rabbit	oral	LD_{50}	7 mg/kg

Avian Toxicity: Not known.

Aquatic Toxicity: Extremely toxic to fish; representative data given below for freshwater aquatic life occurring in New York State.

Species	Effect	Concentration	Reference
Brown Trout	24 hr LC_{50}	0.046 mg/l	2
	24 hr LC_{50}	0.065 mg/l	6
Rainbow Trout	Avoidance	0.1 mg/l	3
Largemouth bass	24 hr LC_{50}	0.183 mg/l	4
	96 hr LC_{50}	0.16 mg/l	4
Bluegill	24 hr LC_{50}	0.079 mg/l	2
	24 hr LC_{50}	0.14 mg/l	4
	96 hr LC_{50}	0.10 mg/l	4
Fathead minnow	24 hr LC_{50}	0.15 mg/l	4
	48 hr LC_{50}	0.115 mg/l	4
	Incipient LC_{50}	0.084 mg/l	7
	MATC (safe)	0.0114 mg/l	7
Goldfish	24 hr LC_{50}	2.0 mg/l	5
Bowfin	24 hr LC_{50}	0.062 mg/l	4
Chinook salmon	24 hr LC_{50}	0.08 mg/l	6
Coho salmon	96 hr LC_{50}	0.068 mg/l	8
Invertebrates:			
Daphnia magna	Incipient LC_{50}	0.057 mg/l	7
	MATC (safe)	0.0169 mg/l	7

No accumulation or persistence data is available.

DIQUAT

Synonyms: Aquacide, diquat dibromide, Reglon, Reglone, Reglox, Weed-trine-D

Chemical Name: 1,1 ethylene -2-2- bipyridylium ion; or 6,7-dihydrodipyrido [1,2-a: 2', 1'-c] pyradiium ion (chemical abstracts usage) present in formulations as the dibromide monohydrate salt.

Usages: Contact herbicide and plant growth regulator.

NYS Recommendations: Use one gallon of product (2 pounds a.i./gal) per surface acre unless attached aquatic vegetative growth is extremely heavy or resistant species are to be controlled, in which event up to 2 gallons per surface acre may be permitted. Do not apply where waters are turbid.

Producer: Chevron Chemical Company, Ortho Agricultural Chemicals Division

Chemical Properties: Solid; completely soluble in water; stable; specific gravity 1.22 to 1.27; photodegrades readily; non volatile; only available as aqueous solution.

Signal Word: Caution.

Human Toxicity: High oral toxicity; lowest lethal oral dose reported is 50 mg/kg.[1]

Mammalian Toxicity: Moderate toxicity as outlined below.[1,9]

Species	Administration	Effect	Concentration
Rat	oral	LD_{50}	231 mg/kg
Rat	subcutaneous	LD_{50}	20 mg/kg
Mouse	oral	LD_{50}	233 mg/kg
Dog	oral	LD_{50}	187 mg/kg
Rabbit	oral	LD_{50}	188 mg/kg
Rabbit	dermal	LD_{50}	400 mg/kg
Guinea pig	oral	LD_{50}	187 mg/kg

No inhalation hazard (except for spray); eye and skin irritant; may produce cataracts with prolonged ingestion; poisoning symptoms include general malaise, diarrhea, vomiting; may produce kidney and liver damage.

Avian Toxicity: Moderate to low toxicity; oral LD_{50} for mallards 3-4 months old is 564 mg/kg;[17] produces ataxia, wing drop and shivers, immobility; survivors have long recovery period.

Aquatic Toxicity: Toxicity is quite variable; but it appears that in general, diquat can be considered moderately toxic to fish and aquatic invertebrates.

Recommended usage concentrations should not produce lethal conditions for fish. Toxicity data for freshwater aquatic organisms occurring in New York State are reported below.

Species	Effect	Concentration	Reference
Rainbow trout	96 hr NLE	5.0 mg/l	18
	96 hr LC_{50}	11.2 mg/l	19
	NLE, no avoidance	10.0 mg/l	3
Brown trout	96 hr LC_{50}	20.4 mg/l	20
Chinook salmon	48 hr LC_{50}	10.0 mg/l	3
	48 hr LC_{50}	28.5 mg/l	6
Coho salmon	96 hr LC_{50}	30.0 mg/l	8
Smallmouth bass	No toxic effect (NTE)	0.5 mg/l	8
	96 hr LC_{50}	2.5 mg/l	8
	24 hr LC_{50} (fry)	2.5 mg/l	8
Largemouth bass	96 hr NTE (fry)	1.0 mg/l	8
	96 hr LC_{50}	2.1 mg/l	19
Walleye	96 hr LC_{50}	2.1 mg/l	19

Discussion:

Bimber, et al[22] showed that two-year old perch from Chautauqua Lake gave evidence of a significant level of respiratory stress when exposed

to as little as 1 mg/l of diquat for 24 hours or more. To produce this concentration in a lake or pond would require 1.4 gallons of diquat per acre foot of water. The usual limit of one gallon per surface acre generally assures that concentrations will not exceed the 0.5 mg/l no toxic effect (NTE) level except prior to complete mixing, which should be less than 24 hours in all cases. In those rare instances where as much as two gallons per surface acre are permitted, the average depth would have to be only 1.43 ft. in order to result in a concentration of 1 mg/l after complete mixing. It is very unlikely that such a shallow body of water would be encountered; but if it were, only the lower dosage should be approved.

At the commonly permitted dosage of one gallon per surface acre, and assuming an average depth of three feet in the treatment area, the concentration of active ingredient (cation) when completely mixed in the water column would be 0.25 mg/l, or only half of the lowest NTE level noted. It appears that a level this low would have no direct affect on fish or wildlife.

Diquat is not known to bioaccumulate and is usually non-detectable in water within 21 days.(50)

2,4-D

Synonyms: Aqua-Kleen, Weed-Rhap, and many others.

Chemical Name: 2,4-dichlorophenoxyacetic acid (many formulations as salts or esters).

Usages: Selective herbicide and defoliant.

NYS Recommendation: Official regulations permit the use of "Low-volatile" esters, salts, and amines of 2,4-D for emergent vegetation. Dosage is limited to four pounds active ingredient per acre. Special local needs may require use of dosages of 2,4-D up to eight pounds active ingredient per acre, particularly for control of water chestnut. The use of pellets for subsurface application requires special authorization. Restricted water use for 24 hours after treatment.

Producer: Many different producers world-wide. The Dow Chemical Company is a major producer in the United States.

Chemical Properties: The free acid is a white powder, odorless when pure; only slightly soluble in water and petroleum distillate; soluble in alcohols; stable at its melting point of 140°C. The acid is not often used by itself, but usually as an amine, a salt, or an ester. Persistence is generally 1-4 weeks in warm, moist soil. Slight photodecomposition.

Signal Word: Caution

Human Toxicity: Oral LD_{50} = 30 mg/kg, considered moderately toxic; irritant. Waters used for drinking shall not contain 2,4-D concentrations greater than 0.1 mg/l (10 NYCRR, Part5); whereas, groundwater concentrations of 2,4-D shall not exceed 4.4 ug/l (6NYCRR, Part 703).

Mammalian Toxicity: Not considered harmful to wild mammals under existing use dosages. The acute oral LD_{50} of the various formulations falls in the range of 300-1000 mg/kg for rats, guinea pigs, and rabbits.(9) A diet of 1250 ppm fed to rats for two years had no effect (higher doses not tested).(9) The range of acute oral LD_{50} for mule deer was 400-800 mg/kg of body weight.(17)

Avian Toxicity: Generally low toxicity to birds with a range of 340-2000 mg/kg as the acute oral LD_{50} for mallards, pheasants, coturnix, and pigeons.[17]

Aquatic Toxicity: The various formulations have widely divergent toxicities to fish. The dimethylamine salt (DMA-2, 4-D) caused no mortality to yearling coho salmon at a concentration of 200 mg/l when exposed 144 hours.[8] Certain esters of 2,4-D are toxic to certain fish species at 1 mg/l;[8] particularly toxic are the propyleneglycol butyl ether (PGBE) esters, butoxyethanol (BE) ester, and butyl esters. The isooctyl ester is reported to be the least toxic of the ester formulations.[8] Only the toxicity of the 2,4-D ester formulations have been considered here since the ester formulations are those currently being permitted for aquatic vegetation control in New York State.

Discussion:

Although new regulations have not been adopted to standardize their use in New York, it has been the regular practice since about 1975 to permit the use of granular formulations containing various esters of

2,4-D, primarily for the control of Eurasian watermilfoil, coontail, and water lillies. These permits should only be issued for use in marginal areas of large lakes where there is considerable untreated water for dissipation and dilution of the chemical. The 2,4-D esters should generally not be permitted for the entire treatment of sheltered bays, ponds, or lakes since the total amount of chemical once released could theoretically reach lethal levels in water averaging 11 feet in depth or less. The granules sink to the bottom and provide a timed release of the active ingredient by the dissolution of the clay in the granules. The chemical is released over a period of hours to days, depending on the manufacturer.

Most of these granular formulations are permitted at a dosage of 100 lbs/surface acre and they contain 20% acid equivalent of 2,4-D, which results in 29-30% active ingredient (ester of 2,4-D). If this amount of chemical were applied as a liquid to water averaging three feet deep, it would result in a concentration of 3.7 mg/l, which would be lethal to nearly all fish and aquatic life. However, since the chemical is released gradually at the bottom (or lodged in the vegetation),

it has time to dissipate and be absorbed by plants and sediments and also to be dispersed by currents (when the wind is blowing, bottom currents are usually generated in shallow water). Thus the concentration of active ingredient in the water supposedly never reaches concentrations lethal to fish. There is the potential that very small fry living in the treated vegetation may be killed, since fry are more susceptible to the chemical than are adults and would be less able to leave the treated area. Also, these fry are very vulnerable to predation once the vegetation is killed. 2,4-D does not accumulate in fish.[40]. However, it may persist in water for up to four weeks.[50]

COPPER SULFATE

Synonyms: bluestone, blue vitriol, blue copperas, chalcanthite.

Chemical Name: Cupric sulfate pentahydrate ($C_uSO4.5H2O$)

Usages: Algicide; pesticide; feed additive; soil additive; wood preservative; medicine; many industrial applications.

NYS Recommendation: For algae control use not to exceed 0.3 ppm $CuSO_45H_2O$ in the upper six feet of depth in ponds or lakes with over two acres of surface area. Not to exceed 0.3 ppm $CuSO_45H_2O$ in the total volume of ponds with two acres or less of surface area. The above is based on waters with average alkalinity of 100 ppm or greater. In softer waters, reduced dosage will be required. No broadcasting of crystals or snow is permitted. Must be applied as a liquid or dissolved by dragging in a bag behind a boat. Repeat treatments permitted at two-week intervals. Water use is restricted for 24 hours following treatment.

The water quality standard for copper in raw drinking water is less than 0.2 mg/l (10 NYCRR, Part 170); in

groundwater, 1.0 mg/l (6NYCRR, Part 703); and in fresh surface waters with an alkalinity of 80 mg/l or more, less than 0.2 mg/l (6NYCRR, Part 701). Fresh surface waters with alkalinity less than 80 mg/l may have more stringent limits applied.

Producers: Phelps Dodge Refining Corp.; CP Chemicals Inc.; Cities Service Co.; Industrial Chemicals Marketing Dept.

Chemical Properties: blue solid; highly soluble in water; available also in "snow" form which speeds the rate of dissolution; specific gravity 2.284; corrosive to galvanized coating on steel.

Signal Word: Caution

Human Toxicity: Fatalities have been reported following the ingestion of 10 gm of copper sulfate. Chronic poisoning does not occur. The pathologic findings in such deaths include hemorrhage, gastroenteritis, kidney and liver damage.(23)

Copper is considered an essential element for the growth of living organisms but only in trace amounts. When water contains copper in concentrations high

enough to be dangerous to humans, it gives it a disagreeable taste. Doses of from 60 to 100 mg taken orally cause symptoms of gastroenteritis and nausea. Many authorities believe that only doses over 100 mg of copper are likely to injure humans.[24]

Mammalian Toxicity: It is generally understood that copper is an essential ingredient in animal nutrition, being an active agent in the synthesis of hemoglobin in the red blood corpuscles. Copper deficiencies cause anemia in domestic animals, so copper sulfate in small quantities is generally added to the feed.

Rats fed 2-4 mg per day of copper were unaffected, while doses of 6-9 mg per day were harmful. Doses amounting to over 1 mg/kg of body weight for five days are injurious to growth. Sheep have exhibited variable susceptibility to copper. In one test, all sheep died when fed a quantity of 2 mg/day of copper although one of the animals survived for 128 days while the first death occurred at 9 days. In another test, one sheep was killed in six months by a daily dose of 0.5 mg copper sulfate while another sheep was not poisoned by one gram per day for four years.[24]

Avian Toxicity: The only reference on avian toxicity[24] stated that 2500 mg/l of copper sulfate in water was harmful to turkeys although as little as 630 mg/l in the water sometimes caused the turkeys to stop drinking it entirely. Bordeau mixture (12.75% copper), when fed to three-month old mallards and pheasants at a dose of 2,000 mg/kg of body weight, caused only mild symptoms for one day after treatment.[17]

Aquatic Toxicity: The toxicity of copper sulfate to fish is extremely variable because there are so many different factors which influence its toxicity, both physical and chemical. The actual toxic part of the chemical in aqueous solution is the bivalent cupric ion (Cu^{2+}). These cupric ions may be complexed by organic and inorganic substances in water, thus changing its toxicity. The alkalinity and pH of the water have a strong influence on toxicity; when both are high, insoluble precipitates form which remove cupric ions from solution. Even when in solution, certain copper compounds or complexes produce very few free cupric ions, which is the true toxic component. Factors which influence toxicity besides the species and age of the fish include: dissolved oxygen, carbon

dioxide, temperature, amount of organic matter present, hardness, total alkalinity, and pH. Any water high in alkalinity, pH, and organic substances will have low cupric ion concentrations.[37] Unfortunately, many of the reports on copper toxicity ignore water characteristics and their effects on copper complexation. Thus, results are often reported as the calculated copper concentration rather than the actual measured cupric ion concentration. The following toxicities have been reported:

Species	Size	Alkalinity	Test	Cu mg/l	Reference
Rainbow trout	Yearling	250	48h TL_{50}	0.27	(25)
Atlantic salmon	3 years	4	96h LC_{50}	0.125	(26)
Coho salmon	Yearling	78	72h LC_{50}	0.19	(27)
Coho salmon	Yearling	74	96h LC_{50}	0.067	(28)
Channel catfish	8.8 gm	low	24h TL_{50}	2.6	(29)
Channel catfish	5.0 gm	255	14d TL_{50}	1.2	(37)
Fathead minnow	20-69 mm	90	96h TL_{50}	0.69	(30)
Fathead minnow	Adults	30	96h TL_{50}	0.08	(31)
Bluegill	35 gm	43	96h TL_{50}	1.10	(32)
Bluegill	1-9 gm	4	96h TL_{50}	0.74	(33)
Bluegill	0.5 gm	255	14d TL_{50}	2.50	(37)
Golden Shiner	2.5 gm	low	24h TL_{50}	0.27	(29)

Copper also causes morphological and pathological changes in fish. Gills, livers, and kidneys of bluegills exposed to copper contained higher levels of copper than the same organs of control although brain, spleen, gonads, and muscle tissue were the same as controls.(32) Studies of the winter flounder exposed to copper showed gross morphological changes in the gills, fatty metamorphosis of the liver, and necrosis of the kidney.(34) Changes in the blood have also been recorded. After six days exposure, the blood of the brown bullhead showed glucose and hematocrit increases. After 30 days, the chloride and protein decreased.(35)

Four species of invertebrates in the genus Daphnia were exposed to various concentrations of copper sulfate in laboratory bioassays. The acute 72 hr LC_{50} values ranged from 54.0 to 86.5 ug/l of copper.(36) The pH of the test water varied between 8.2 and 9.5, which would have tended to reduce the cupric ion concentration of the test solutions. This may account for the variability of results in different repetitions of the tests at different seasons of the year.

Discussion:

The New York State dosage limit of 0.3 ppm of copper sulfate in water for algae control is the equivalent of 0.076 mg/l of elemental copper (cupric ion). The toxicity levels for fish listed under "Aquatic Toxicity" are the lowest found for each species; all except coho salmon are higher than the allowed concentration. It must also be recognized that many of the tests were done in waters with low alkalinity, which is not typical of New York waters being treated for algae control. Our regulation (Section 327.6, 6NYCRR) states that the dosage of 0.3 ppm $CuSO_4.5H_2O$ is based on water of average alkalinity for the state of 100 ppm or over and that in softer water a reduced dosage may be required.

In waters inhabited by trout or salmon, permission to use copper sulfate is generally denied or only half the usual dosage is permitted. In waters where permitted, the natural alkalinity and pH of the waters reduces the amount of soluble copper very rapidly. Richey and Roseboom[37] showed that in water of high alkalinity and high pH the amount of soluble copper in the test water ranged from 14 to 25 percent of the total copper added as copper sulfate.

The greatest reduction in soluble copper occurred at the highest dosages so the alkaline waters have a natural detoxification mechanism that reduces copper toxicity quite rapidly.

Nearly all of the copper added to lakes or ponds ends up in the bottom sediments. When waters are treated repeatedly over a long period of years, the accumulation of copper in these sediments can reach levels that are toxic to benthic organisms as well as to rooted plants. This could be due to a lower pH in the sediment than in the water, which would tend to increase solubility and release cupric ions. The acidification of lakes by acid rain could promote the release of some of the stored copper in bottom sediments. It may be advisable to require chemical analysis of both waters and sediments before the issuance of permits to use copper sulfate. Such a requirement would probably discourage some users from getting a permit and could lead to an increase in illegal treatments.

For copper, an application factor of 0.1 is appropriate for determining the maximum acceptable toxicant concentration (MATC) from the LC_{50} of the most sensitive species. In this case, the

invertebrate (Daphnia) is the most sensitive of the ones tested in alkaline waters with a minimum acute 72 hour LC_{50} of 54 ug/l. Since Daphnia and many other species of invertebrates occur in nearly all waters and constitute an important segment of the aquatic food chain which should be protected, it is reasonable to use this organism as the one for establishment of the MATC. Using an application factor of 0.1, the MATC would be 5.4 ug/l compared to 75 ug/l currently being permitted. Populations of Daphnia may begin recovery within ten days, but the impact of reduced food supply upon certain fishes is undetermined. It appears from this analysis that the continued issuance of permits for the use of copper sulfate for algae control must be seriously questioned.

Other chemicals containing copper which are registered for use in New York (Cutrine Plus, Mariner M) have been permitted in the past at the same rate of dosage as has been permitted when using copper sulfate since the cupric ion is the same toxic ingredient. If copper sulfate should be discontinued, these other copper compounds would also need to be critically reviewed.

There is attached a copy of a copper standard recommendation which was prepared and submitted for consideration in the 1979 hearings on new water quality standards. The recommendation in that review is very similar to this one (Appendix 7).

ALGIMYCIN PLL-C

Synonyms: None

Chemical Name: Citrate and gluconate chelates of copper

Usage: Algicide

NYS Recommendation: In waters with no outlet use in accordance with label directions and restrictions. Elsewhere, apply for a New York State permit. Dosage up to .075 ppm copper may be permitted.

Producer: Great Lakes Biochemical Company, Inc.

Chemical Properties: The chelated form of copper promotes solubility of copper over a wide range of pH and hardness.

Signal Word: Caution

Human Toxicity: Toxicity is expected to be similar to that for metallic copper.

Mammalian Toxicity: See Appendix 7

Avian Toxicity: No data available

Aquatic Toxicity: See Appendix 7

DICHLOBENIL

Synonyms: Casoran; Fydulan; Fydulex; Cyclanit

Chemical Name: 2,6-dichlorobenzonitrile

Usage: Herbicide and plant growth inhibitor

NYS Recommendation: Use according to label instructions and limitations in waters with no outlet. However, dichlobenil is rarely requested in New York State for an aquatic vegetation control permit.

Producer: Thompson-Hayward Chemical Company

Chemical Properties: White solid; soluble in water to 25 ppm; soluble in most organic solvents.

Signal Word: Caution

Human Toxicity: Not known.

Mammalian Toxicity: Generally considered of low toxicity with oral LD_{50} values to rats, mice, and guinea pigs of 2710, 2056, and 681 mg/kg, respectively.[1] Chronic toxicity was displayed at concentrations above 20 ppm in rats.[9]

Avian Toxicity: Low to moderate toxicity is characteristic with oral LD_{50} values to mallards and pheasants of $\searrow$ 2000 and 1189 mg/kg, respectively. Birds displayed ataxia, fluffed feathers, and necks pulled at levels as low as 500 mg/kg. At higher doses, birds tended to stand in place with eyes closed. Mortality normally occurred 10-16 days after single oral administration. (17)

Aquatic Toxicity: The data available for fish is very limited and indicated moderate toxicity. Bluegill, pumkinseed, and largemouth bass all displayed LC_{50} values in the 10-20 ppm range.(9) Aquatic invertebrates have shown similar sensitivity with 48-hour LC_{50} values ranging from 7.8 and 10 mg/l for Cypridopsis vidua and Daphnia magna to 34 mg/l for Asellus brevicauda, a typically resistant species.(38) Dichlobenil has caused loss of pigmentation in corixid bugs at normal aquatic use concentrations.(39) Dichlobenil accumulates in fish flesh to a concentration 55 times that in water.(40) Residues in water and sediment reportedly persist at least 64 days.(50) There is a label precaution against consumption of fish from treated water for 90 days after use.

ENDOTHALL

Synonyms: Aquathol; Hydout; Hydrothal-47; Hydrothal-191; Des-I-Cate; Accelerate; Ripenthal; Tri-Endothal; Aquathol K; Herbicide 273.

Chemical Name: 7-oxabicycle (2.2.1) heptane-2,3-dicarboxylic acid; normally the sodium, potassium, or amine salts are used for aquatic vegetation control.

Usages: Herbicide; defoliant; dessicant.

NYS Recommendation: Use according to label instructions and restrictions in waters with no outlet. Use of the alkylamine derivatives of endothall is discouraged due to its high toxicity to aquatic life. State permit is required in waters having an outlet.

Producer: Pennwalt Corporation

Chemical Properties: White crystalline solid; odorless; density 1.431; stable in acids; does not photodegrade; soluble in water and methanol.

Signal Word: Danger

Human Toxicity: Endothal and its salts are highly toxic to man; the lowest lethal dose reported is 5 mg/kg of the disodium salt.[1] Ingestion may cause vomiting and diarrhea. The chemical may be very irritating to skin, eyes, and mucous membranes.[9]

Mammalian Toxicity: Toxicity varies based on the salt or parent compound used. Acute toxicity data (presented below) indicates high toxicity.

Chemical Form	Organism	Exposure	Effect	Concentration (mg/kg)
Acid	rat	oral	LD_{50}	38
Amine salt	rat	oral	LD_{50}	206
Disodium salt	rat	oral	LD_{50}	51
	rat	skin	LD_{50}	750
	rabbit	skin	LD_{50}	100
	guinea pig	oral	LD_{50}	250

Avian Toxicity: Not known.

Aquatic Toxicity: The two amine salts (see Table 3) of endothall are highly toxic to aquatic animal life; whereas, sodium and potassium salts are of moderate to low toxicity. For this reason, the amine salts should be avoided where fish are present or are an important resource of the water to be treated. Endothall also appears to be

somewhat more toxic in hard water than in soft waters, but the tendency is not consistent. Endothall does not accumulate in fish flesh.[40] However, the chemical may persist in the water for 2.5 to 36 days, depending on environmental conditions in the particular water body.[48]

Table 3: Toxicity of endothalls to fish and other aquatic life

Endothall Formulation	Species	Effect	Concentration (ug/l)	Reference
Dipotassium salt	Rainbow Trout	No Avoidance	10	3
	Bluegill	96 hr LC_{50}, soft water	140	44
		96 hr LC_{50}, hard water	102	44
	Gammarus lacustris	96 hr LC_{50}	100	43
Disodium salt	Bluegill	96 hr LC_{50}	125-150	45
		96 hr LC_{50}	280	46
		12 day no toxic effect	25	10
		72 hr no toxic effect	50	47
	Largemouth Bass	72 hr no toxic effect	10	47
		96 hr LC_{50}	200	13
		96 hr LC_{50}	120-125	45
	Smallmouth Bass	12 day no toxic effect	10-25	10
	Channel Catfish	72 hr no toxic effect	100	47
	Brown bullhead	96 hr LC_{50}	170-175	45
	Black bullhead	96 hr LC_{50}	180-185	45
	Fathead minnow	96 hr LC_{50}, soft water	320	13
		96 hr LC_{50}, hard water	610	13
	Bluntnose minnow	96 hr LC_{50}	105	45

Table 3 - Endothall continued

Endothall Formulation	Species	Effect	Concentration (ug/l)	Reference
	Lake Chubsucker	12 day no toxic effect	25	10
	Redfin shiner	96 hr LC_{50}	105	45
	Red shiner	96 hr LC_{50}	95	45
Mono (N,N-dimethyl-alkylamine) salt	Rainbow trout	48 hr LC_{50}	1.5	12
	Bluegill	48 hr LC_{50}	0.8	11
	Bluegill	48 hr LC_{50}, soft water	1.18	44
		48 hr LC_{50}, hard water	0.96	44
	Gammarus lacustris	96 hr LC_{50}	0.5	43
	Gammarus fasciatus	96 hr LC_{50}	0.48	38
	Bluegill	48 hr LC_{50}, soft water	0.70	44
		48 hr LC_{50}, hard water	0.83	44
	Gammarus fasciatus	96 hr LC_{50}	0.51	38
	Gammarus fasciatus	96 hr LC_{50}	0.48	38
Di (N,N-dimethyl-alkylamine) salt	Bluegill	48 hr LC_{50}	0.3	11
		72 hr no toxic effect	0.75	47
	Largemouth Bass	72 hr no toxic effect	0.075	47
	Channel Catfish	72 hr no toxic effect	0.2	47

FENAC

Synonyms: fenavar; fenamine; tri-fene; chlorfenac; TCPA

Chemical Name: (2,3,6-trichlorophenyl) acetic acid

Usages: Herbicide

NYS Recommendation: Use according to label recommendations in waters with no outlet or apply for permit if there is an outlet. Use of fenac for aquatic vegetation control is not known in New York State.

Producer: Union Carbide Agricultural Products, Co., Inc.; Amchem Products Inc.

Chemical Properties: White crystalline powder; odorless; nearly insoluble in water

Signal Word: Caution

Human Toxicity: Not Known

Mammalian Toxicity: Low toxicity to rats with oral dose producing an LD_{50} of 1780 mg/kg.[9]

Avian Toxicity: Not known.

Aquatic Toxicity: Only one toxicity value was found for fish, i.e. bluegill with a 48 hour LC_{50} of 19.0 mg/l.[38] Toxicity values for aquatic invertebrates are more common.

Species	Effect	Concentration	Reference
Daphnia pulex	48 hr EC_{50}	4.5 mg/l	15
Gammarus lacustris	96 hr LC_{50}	12.0 mg/l	43
Pteronarcys californica	96 hr LC_{50}	55-60 mg/l	16
Simocephalus serrulatus	48 hr EC_{50}	6.6 mg/l	15

Accumulation in fish flesh and persistence in water are not known. Persistence in soils is 1 to 2 years.[9]

MALACHITE

Synonyms:	basic copper carbonate; cupric carbonate
Chemical Name:	copper carbonate hydroxide
Usages:	Algicide; fungicide; feed additive for ruminants; pyrotechnics; pigment for paints and varnishes.
NYS Recommendation:	Not recommended because of the excessive deposition of copper into bottom sediments at recommended treatment rates.
Producer:	Cities Service Company, Industrial Chemicals Division
Chemical Properties:	Green to blue amorphous powder or dark green monocyclic crystals; practically insoluble in water, soluble in dilute acids and ammonia;
Signal Word:	Warning
Human Toxicity:	No data was found for malachite specifically. Toxicity is expected to be similar to that for metallic copper. Malachite is moderately irritating upon skin contact.

Mammalian Toxicity: Oral LD_{50} for the rabbit is 159 mg/kg[1] while 420 mg/kg is the LD_{50} for goats.[44]

Avian Toxicity: Low acute toxicity to birds is displayed with oral LDLo values for mallards and pigeons being 900 and 1000 mg/kg, respectively.

Aquatic Toxicity: Toxicity is expected to be similar to that of ionic copper. See copper sulfate and Appendix 7 for further discussion of copper toxicity.

SILVEX

Synonyms: 2,4,5-TP; Aqua-Vex; fenoprop; Kuron; weed one

Chemical Name: 2-(2,4,5-trichlorophenoxy) propionic acid

Usages: Herbicide and plant growth regulators

NYS Recommendation: No permitted usage. Silvex usage was permitted through 1978 and until EPA rescinded all permitted aquatic uses during RPAR proceedings. The EPA emergency suspension order was issued February 28, 1979.

Producer: Dow Chemical Company; Thompson-Hayward Chemical Company; Amchem Products. Inc.

Chemical Properties: White solid; soluble in water to 140 ppm; low volatility; density 1.640.

Signal Word: Caution

Human Toxicity: Lowest oral lethal dose is reported as 500 mg/kg.[1] Silvex containing the TCDD impurity was teratogenic. However, carcinogenicity and mutagenicity were not displayed. Drinking water interim standard for silvex in finished water is 0.01 mg/l.[41] Surface waters used for drinking shall not contain silvex in concentrations greater than 0.01 mg/l (10NYCRR, Part 5) while groundwaters shall not contain silvex at concentrations greater than 0.26 ug/l (6NYCRR, Part 703).

Mammalian Toxicity: Oral LD_{50} values for the rat is 650 mg/kg which indicates low toxicity.

Avian Toxicity: Low toxicity to mallard young with LD_{50} of $\searrow$ 2000 mg/kg. Poisoned birds displayed ataxia, wings crossed high over back, tail pointed abnormally high or low, walking high on toes, minor tremors. Symptoms produced at concentrations as low as 500 mg/kg and persisted as long as four days.[17]

Aquatic Toxicity: Limited toxicity data indicates silvex toxicity varies with the ester used and species tested. Typical toxicity data are found below.[38]

Species	Effect	Concentration of Ester mg/l BE*	PGBE*
Bluegill	48 hr LC_{50}	70	0.90
Daphnia magna	48 hr LC_{50}	2.1	0.10
Gammarus fasciatus	48 hr LC_{50}	0.74	2.6
Gammarus fasciatus	96 hr EC_{50}	0.25	0.84
Asellus brevicaudus	48 hr LC_{50}	40	2.2
Orconectes nais	48 hr LC_{50}	60	$\searrow$100

*BE = butoxy ethanol ester
PGBE = propylene glycol butyl ether ester

Predicted bioaccumulation rates based on water solubility and octanol - water partition coefficients range from 38 to 170, respectively.[42]
Silvex is known to persist in water for up to five months.[50]

SIMAZINE

Synonyms: Aquazine; G-27692; Gesatop; Primatol S; Princep; Simanex; Geigy 27,692; Herbex

Chemical Name: 2-chloro-4,6-bis(ethylamino)-s-triazine

Usages: Selective herbicide

NYS Recommendation: Use only in impoundments with no outlet and wholly owned by the applicant. Do not use treated water for human consumption or for irrigation, crop spraying, or for livestock watering within 12 months of treatment.

Producer: CIBA-Geigy Corporation, Agricultural Chemical Division

Chemical Properties: White crystals; solubility in water is 3.5 mg/l at 20°C; soluble in chloroform to 900 mg/l; photodecomposition slight in field conditions.

Signal Word: Caution

Human Toxicity: Estimated lowest lethal dose is 500 mg/kg.[1] Contact with skin produces little, if any, irritation. Groundwaters shall not contain simazine concentrations greater than 75.25 ug/l (6NYCRR, Part 703).

Mammalian Toxicity: Very low acute toxicity to rats, mice, and rabbits with oral LD_{50} values of 5000 to $>$ 5000 mg/kg.[41] No chronic effects when rats fed 100 ppm for two years.

Avian Toxicity: Very low acute toxicity with LD_{50} values $>$ 5000 mg/kg for chickens and pigeons.[41]

Aquatic Toxicity: Limited data available provide a mixed picture of toxicity. Bluegill, Gammarsus fasciatus, Asellus brevicaudus, Orconectes nais, and Palaemonetes kadiakensis all showed 48 hour LC_{50} values greater than 100 mg/l. However, Gammarus lacustris had a 96 hour LC_{50} value of 13.0 mg/l[43] and Daphnia magna and Cypridopsis vidua had a 48 hour LC_{50} values of 1.0 and 3.2 mg/l, respectively. Simazine does not accumulate in fish flesh (BCF = 1; 42). However, residues in fish flesh persist for long periods of time.[41] Residues of simazine (applied at recommended concentrations) have been shown to be present in water and invertebrates over one year after application to small ponds.[48] The use of simazine for aquatic vegetation control is discouraged.

V. UNAVOIDABLE ADVERSE IMPACTS

The use of certain chemicals at prescribed dosages will cause temporary curtailment of certain usages of treated water. The restricted usages and recommended durations of restriction for each chemical are listed below.

1. Restrictions on water usage for specific chemicals follow:

   A. Copper Sulfate:

   "Bathing and livestock watering shall be prohibited for at least 24 hours following a treatment."

   B. Diquat:

   "Treated waters shall not be used for irrigation, bathing, fishing, or by man or animals for drinking or food processing for a period of 14 days after treatment."

   C. Low-Volatile Esters, Salts, and Amines of 2,4-D:

   "Use of waters for irrigation shall be prohibited for a period sufficient to permit the decay of the phytotoxicity. The treated waters and those waters affected by the treatment shall not be used for other purposes during the treatment and for at least 24 hours thereafter."

   These restrictions can be found in N.Y.S. Regulations 6NYCRR, Part 327, Section 327.6 (Appendix 1).

D. Aquazine:

Use only in ponds or lakes which will have little or no outflow after treatment. Water from treated ponds may not be used for irrigation or spraying of agricultural crops, lawns, or ornamental plantings or for watering cattle, goats, hogs, horses, poultry, or sheep, or for human consumption until 12 months following treatment. Treated ponds may be used for swimming and fish taken from the treated ponds may be used for human consumption.(9)

For all other aquatic pesticides involved, please check the respective labels for water restrictions (Appendix 3).

2. Reduction in food supply and habitat for fish and other aquatic organisms which could result in lower fish populations.

3. Possible build-up of copper in the bottom sediments of lakes and ponds through repeated use (Apendix 6).

4. Due to the decay of large amounts of vegetation all at one time, there is a temporary increase in the biological oxygen demand (BOD). In extreme instances, this can result in reduction of dissolved oxygen sufficient to be adverse to aquatic life.

5. The decay of treated vegetation will add nutrients to the water which may, in turn, foster the growth of new vegetation. This may result in a profuse algae bloom on a short-term basis and, on a long-term basis, monotypic stands of fast-growing species which are usually more of a nuisance than mixed vegetation stands.

6. Reduction in food supplies for aquatic mammals and birds.

7. Removal of aquatic vegetation used for escape cover and nesting.

8. Removal of the protective cover used by small fish exposes them to increased predation and constitutes a loss of suitable "nursery" habitat.

VI. ALTERNATIVES TO THE PROPOSED ACTION

1. No vegetation control at all, which may result in economic loss to the state. This may also reduce water qualty, hinder desired human usages, and may present health hazards.

2. No Regulatory Control - Accidental Misuse. The no-permit alternative which would abolish the present system and provide no control over the elimination of aquatic vegetation is not possible under the Environmental Conservation Law. Article 15-0313 authorizes and mandates the department "to adopt and enforce rules and regulations governing the use of chemicals in water for the control and elimination of aquatic vegetation".

3. Mechanical harvesting (no aquatic permit required, but a freshwater wetlands permit could be required) which involves the cutting and removal of aquatic weeds by mechanical means.

Mechanical harvesting, moreover, adds no foreign substances to the water. It gives the option of utilizing the harvested plant material for nutritional or other purposes. While the quantity of nutrients removed from the water may be relatively small as compared to supply, it is at least a positive step and would become relatively more significant a nutrient inflow as decreased through improved watershed management.

Further, the removal of plant material after cutting eliminates the danger of oxygen depletion in the water, which may occur during plant decomposition.(1) It was demonstrated that large quantities of plant material may be utilized by spreading on agricultural land or lawn. They also indicated that chopped vegetation was good for mulching, compost, and soil conditioning with a fertilizer value slightly better than cow manure.(22)

Harvesting of rooted aquatic vegetation also has its drawbacks:

a. High cost of equipment, maintenance, and repair
b. Harvesting machines cannot be used in extremely shallow water
c. Launch areas must be available

d. Harvesting could aid the spread of plant problems since cut plants may drift to unaffected areas and take root

e. Short-term control, requiring several cuttings per season to keep vegetation at an acceptable level (4'-6' below the water surface)

f. Removal and disposition of the plant fragments is bulky, thus trucking and disposal could be very costly

The harvesting of algae appears presently to be economically infeasible primarily due to high energy costs to remove the microscopic plants from the water.(12)(8)

4. Shading (no aquatic permit required) - Shading water with black plastic sheeting has been effective in reducing certain submergent weeds and of limited control value for emergent weeds on small areas. Problems with wave action and currents limit the usefulness of a floating plastic shade.(12) In addition, this method is very labor intensive.

5. Drawdown (no permit required) or the periodic lowering of water levels to expose the bottom is an effective tool for controlling some aquatic weed species. Drying out of underwater weeds and compaction of bottom mud results. Encroachment by emergent shoreline plants, seed survival, and destruction of fish habitat can present a problem.

6. Biological control of aquatic vegetation is presently the least understood and utilized management technique. Biological methods may employ the use of insects, snails, fish, and mammals.[15] The introduction of these and other organisms obtain control by: competing with, preying upon, inhibiting the growth of, causing disease in, or parasitizing an aquatic plant species which has created a problem.[12] In southern states where these controls have been tested and applied, results seem promising. At the present time, the developed techniques are not applicable here or are still experimental.[15]

7. Dredging (no aquatic permit required)

(Permits for dredging would be required in any navigable waters through the U.S. Army Corps of Engineers. In addition, a protection of waters permit and possibly a wetlands permit would be required from New York State.) Dredging has the benefit of reducing existing aquatic weeds. Deepening the lake bottom below the depth of light penetration causes germination and growth of aquatic weeds to be reduced. The disadvantages include the high cost of the dredge, a temporary increase in silt suspended in the water, sediment disposal, and trucking the spoils. As a result, dredging is very costly.[12] Dredging has an additional problem of removing spawning, hiding, and fry/larvae development areas through loss of littoral zone habitat.

8. Nutrient inactivation

Nutrient inactivation is the application of a chemical, usually a metal ion, to a lake that binds with and immobilizes nutrients necessary for plant growth. Once immobilized, the nutrients settle to the bottom. This technique is expensive and may adversely affect the lake biology by covering the bottom sediments and fish food animals with settling material.(12)

9. Water Shed Management Techniques to Control Nutrient Input

Watershed management techniques can be either structural or non-structural, are preventative in nature, and generally address land-use practices. Structural land use practices include techniques which reduce soil erosion and subsequent nutrient loading of lakes (or ponds). These techniques include the employment of catch basins, building detention ponds, controlling new construction, and construction practices. Non-structural management techniques include regulations for managing septic systems, managing the fertilization of cropland, managing manure, and zoning critical areas around lakes (or ponds) and their tributaries for shoreland protection program.(21)

10. Aquascreeen (No Aquatic Permit Required)

Aquascreen is a new technique developed to control aquatic weeds. The closely woven, fiberglass-coated fabric is heavier than water and is applied directly over rooted aquatic plants. Aquascreen applications work by compressing weed communities into a stressed configuration and by screening

out sunlight. These two factors cause the weed bed to start decomposing. The gases given off by decomposition escape through the tiny mesh of the screening. Testing has proven that compressed aquatic weeds decomposed within 21 to 40 days.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

1. Short-term affects: Restricted water use of the lakes and ponds where chemicals have been applied

2. Long-term affects: Copper-containing algicides that are put in the water may go into the bottom sediments and stay there indefinitely. This could cause environmental damage in lakes and ponds (Appendix 6).

VIII. MITIGATION MEASURES

A. Place all aquatic vegetation control pesticides on the New York State restricted pesticide list. Existing state law requires that the person applying the pesticide must be certified as a private or commercial applicator in Category 5A (Aquatic Vegetation) and the applicant must have an approved aquatic vegetation control permit. At present, no permit is required to purchase the aquatic vegetation control chemicals. If they were placed on the restricted list, only certified persticide applicators would be permitted to purchase aquatic pesticides.

B. A reduced dosage rate or frequency of application may be specified in the permits that is less than the label recommendations. A reduced rate and/or frequency may control the weed or algae but will not eradicate it. These actions will place less of the chemical in the aquatic environment, thereby reducing its toxicity to non-target organisms. Refer to Appendix 4 for these reduced rates and treatment requirements.

C. Monitoring - Random inspections are made before, during, and after pesticide application. This is to insure that all permit conditions are being adhered to.

D. In circumstances where permit applicants have applied for use of copper sulfate for twenty years or more, the applicant should have bottom sediment and water samples of the treated areas analyzed. These analytical reports should be submitted to the DEC. The DEC's responsibility would then be to establish acceptable copper thresholds in bottom sediments and analyze the reports submitted to see that they conform to acceptable levels.
If copper thresholds are exceeded, the permit should not be issued. These thresholds should relate to, but not be limited to, human water uses, potability of water, and fish and wildlife uses.

E. This programmatic EIS does not include applications of copper sulfate where municipal water supplies are involved; or for chemical control of aquatic vegetation in ponds or lakes having no outlet. These exceptions are found

in the rules and regulations 6NYCRR 327.1(c) (Appendix 1). Those persons or agencies included in the above-mentioned exceptions should prepare a programmatic EIS using this document as a reference.

IX. GROWTH INDUCING ASPECTS

An effective aquatic vegetation control program will have a tendency to increase the use of waters in New York State for recreation and may also improve water quality. Improved water quality and recreational use may stimulate the state's economy and should be considered more of a benefit than a detriment. There is no indication that an effective program would increase permanent year-round growth.

X. ENERGY USE AND CONSERVATION EFFECTS

The only expenditure of energy when dealing with aquatic vegetation control is found in the production of aquatic pesticides and their application. Both of these areas appear to be insignificant in total consideration.

Conservation effects are seen with residents and tourists having to travel shorter distances to find acceptable aquatic recreational areas.

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Appendices
Aquatic Vegetation EIS

1. Circular 866: Part 327 - Rules and Regulations Relating to the Use of Chemicals for the Control or Elimination of Aquatic Vegetation

2. Application for Permit to Use Chemicals for the Control of Aquatic Vegetation

3. Pesticide Labels

4. Memorandum: To - Regional Fisheries Managers; From - Bureau of Environmental Protection; Subject - Dosages of Herbicides Permissible in Water

5. Chart: Federal Insecticide Fungicide and Rodenticide Act - Categories of Toxicity

6. A Special Message from the Division of Fish and Wildlife to Persons who Apply Chemicals Containing Copper to Lakes or Ponds

7. Manuscript entitled "Copper"

8. Manuscript entitled "Comprehensive Copper Study"

9. List of Publications Available for Review

10. Letters of Comment to Draft EIS and Responses

A.2.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
BUREAU OF PESTICIDES – ALBANY, NEW YORK 12233

APPLICATION FOR PERMIT TO USE CHEMICALS FOR THE CONTROL OF AQUATIC VEGETATION

Appendix 2

SEE INSTRUCTIONS ON REVERSE SIDE

1. NAME OF APPLICANT

STREET ADDRESS

POST OFFICE | STATE | ZIP CODE

2. ☐ Riparian Owner(s) ☐ Lessee(s) ☐ Association of above persons

3. NAME OF WATER

COUNTY | TOWNSHIP

ARE THEY WHOLLY CONTAINED ON APPLICANT'S PROPERTY? ☐ Yes ☐ No

4. TOTAL ACREAGE OF WATER

5. NUMBER OF AREAS TO BE TREATED

6. TOTAL ACREAGE TO BE TREATED

7. CHEMICAL REQUESTED | TOTAL AMOUNT | CONCENTRATION OF ACTIVE INGREDIENT | RATE OF APPL. | PROPOSED DATE OF TREATM

8. CHEMICAL PRODUCT OR TRADE NAME AND EPA REGISTRATION NO.

9. TYPE OF VEGETATION: ☐ Emergent ☐ Submergent ☐ Algae (Species) _____

10. METHOD OF CHEMICAL APPLICATION

11. NEW YORK STATE CERTIFICATION I.D. NO.

Category | Sub-category

12. IF TREATMENT INVOLVES THE USE OF AIRCRAFT, ANSWER THE FOLLOWING:

Does aircraft have:

a. a leakproof distribution system? ☐ Yes ☐ No
b. a positive shutoff to prevent dribble? ☐ Yes ☐ No
c. positive pump pressure to apply chemical at the prescribed rate? ☐ Yes ☐ No
d. is there adequate insurance on the craft to reimburse individuals or property owners against losses? ☐ Yes ☐ No
e. does the aircraft comply with pertinent Civil Air Board Regulations, includin licensing, and those of the State of New York? ☐ Yes ☐ No

13. IS THERE AN OUTLET TO THE WATER? ☐ Yes ☐ No | ESTIMATED FLOW DURING AND AFTER TREATMENT (in cfs)

14. CAN APPLICANT CONTROL WATER LEVELS AFTER TREATMENT? ☐ Yes ☐ No
If "Yes", how?

15. FISH PRESENT: ☐ Warm Water ☐ Trout
ARE THEY STOCKED BY THE STATE? ☐ Yes ☐ No

16. IS THE WATER USED AS, OR CLOSELY TRIBUTARY TO A WATER SUPPLY? ☐ Yes ☐ No
TYPE: ☐ Private ☐ Public

17. NAME OF APPLICATOR

18. Have all other riparian users, in the vicinity of the treated area and along the outlet stream, who may be required to restrict their usages as a result of the treatment:

Approved your plans? ☐ Yes ☐ No
Agreed to restrictions? ☐ Yes ☐ No

STREET ADDRESS

POST OFFICE | STATE | ZIP

19. IF REQUIRED:

Are you prepared to post the shoreline of the area to be treated with suitable warning signs? ☐ Yes ☐ No

Will you mark or buoy the areas to be treated previous to the treatment? ☐ Yes ☐ No

BUSINESS REGISTRATION NO.

20. The applicant guarantees that he will employ the listed chemicals in conformance with all the conditions of the permit. In addition, the applicant certifies the truth of the above statements and agrees to accept the following conditions as a prerequisite to the issuance of a permit: that the issuance of the permit is based on the accuracy of all statements presented by the applicant; that damage resulting from the inaccuracy of any computations, improper application of the chemical, or legal responsibility for the representations made in obtaining approvals or releases, or failure to obtain approvals or releases from the riparian users likely to be affected is the sole responsibility of the applicant.

I hereby affirm under penalty of perjury that information provided on this form is true to the best of my knowledge and belief. False statements made herein are punishable as a Class A misdemeanor pursuant to Section 210.45 of the Penal Law.

APPLICANT'S SIGNATURE | TITLE | Phone

MAILING ADDRESS | Date

44-19-5 (1/79)
Obsoletes prior versions

SUBMIT 45 DAYS PRIOR TO TREATMENT

INSTRUCTIONS AND INFORMATION

1. A permit for the use of chemicals for control and elimination of aquatic vegetation must be obtained in accordance with the Rules and Regulations of the State of New York, adopted pursuant to Article 15, Title 3 of the Environmental Conservation Law.

   Exceptions:
   (a) Use of copper sulphate for algae control by a duly constituted water supply agency in its water supply waters, or,
   (b) Treatment of waters which have no outlet to other waters and which lie wholly within boundaries of lands privately owned or leased by the individual making or authorizing such treatment.

2. To apply chemicals to water the applicator, if he is a riparian owner, lessee, or a member of an association of such persons etc. must be certified as a pesticide applicator to use such pesticides. List the applicator's certification I.D. number and category(s) on the application. If the treatment is to be made by other than the applicant, fill out item 17 on this application. Details about certification may be be obtained from any local county cooperative extension agent and any regional or unit office of the Dept. of Environmental Conservation.

3. Applications should be filled out completely. Failure to do so will delay the issuance of a permit.

4. In addition to the completed form, the applicant shall provide, in triplicate, the following maps or scale drawings. (One will be returned to the applicant and made part of the permit, the other will be retained by the issuing office).
   (a) Maps such as the U. S. Geological Survey Quadrangle or Lake Chart showing the geographic location of the water or portion to be treated.
   (b) In addition, an expanded scale drawing on 8½ by 11 inch paper showing in detail the following features of the treatment areas: (if necessary, more than 1 such drawing may be submitted).
      1. Outline of areas to be treated.
      2. Outline of weed beds – (If area to be treated is 5 acres or less of a large body of water, just show the weed areas within 200 feet of area to be treated.)
      3. Length of shoreline in the treatment area (in feet).
      4. Width outward from shore (in feet).
      5. Depth soundings and their location (sufficient to calculate the volume of water to be treated).
      6. Inlet and outlet streams and structures.
      7. Names and locations of riparian and other known users that may be affected by treatment of this water.
      8. Names and locations of public and private water supply intakes, cattle watering areas, and bathing areas in the vicinity of the treatment areas and on the outlet waters.

Both needed

5. (a) **Public Watersupply Waters:** Application that involve public water supply will be referred to the State Department of Health for approval before a permit will be issued.
   (b) **State-stocked trout waters:** Applications involving such waters will be rejected if the proposed control is deemed to adversely affect trout habitat in the water.
6. Applications should be fully completed and returned to the Pesticide Inspector, listed below, covering the county where the control is being applied.

PESTICIDE INSPECTOR

Counties	Regional Address
Nassau, Suffolk	Bldg. #40 - SUNY Stony Brook, N. Y. 11790 516-751-7900, Ext. 216
Bronx, Kings, Queens, Richmond, New York	2 World Trade Center 61st Floor New York, N. Y. 10047 212-488-6146
Dutchess, Orange, Sullivan, Westchester, Putnam, Rockland, Ulster	Farm & Home Center Millbrook, N. Y. 12545 914-677-8268
Albany, Columbia, Delaware, Greene, Montgomery, Otsego, Rensselaer, Schenectady, Schoharie	Room #209 50 Wolf Road Albany, N. Y. 12233 518-457-7111
Clinton, Essex, Franklin, Hamilton, Fulton, Saratoga, Warren, Washington	Hudson Street Warrensburg, N. Y. 12885 518-623-3671, Ext. 58
Herkimer, Jefferson, Lewis, Oneida, St. Lawrence	317 Washington Street Watertown, N. Y. 13601 315-782-0100, Ext. 306
Broome, Cayuga, Chenango, Cortland, Madison, Onondaga, Oswego, Tioga, Tompkins	P. O. Box 1169, Fisher Ave. Cortland, N. Y. 13045 607-753-3095
Chemung, Genesee, Livingston, Monroe, Ontario, Orleans, Seneca, Schuyler, Steuben, Yates	P. O. Box 57 Avon, N. Y. 14414 716-226-2466
Allegany, Cattaraugus, Chautauqua, Niagara, Erie, Wyoming	584 Delaware Avenue Buffalo, N. Y. 14202 716-842-5825

N.Y.S.D.E.C., Region #3
21 So. Putt Corners Road
New Paltz, N. Y. 12561

Appendix 3

PESTICIDE LABELS

PHELPS DODGE COPPER SULFATE

100 LBS. NET WEIGHT

PHELPS DODGE COPPER SULFATE

PHELPS DODGE REFINING CORPORATION
TRIANGLE BRAND
COPPER SULFATE
NEW YORK N.Y.

CAUTION

KEEP OUT OF REACH OF CHILDREN
HARMFUL IF TAKEN INTERNALLY

NOT FOR MEDICINAL USE

EPA REGISTRATION NO. 1278-5

ACTIVE INGREDIENT	(Copper Sulfate)	NOT LESS THAN 99.00%
INERT INGREDIENTS		NOT MORE THAN 1.00%
		100.00%

COPPER AS METALLIC NOT LESS THAN 25.20%

MANUFACTURED BY

Phelps Dodge Refining Corporation New York, N.Y. 10022

MADE IN THE UNITED STATES OF AMERICA

GENERAL USES FOR COPPER SULFATE

Agricultural

An ingredient in Bordeaux Mixture sprays or dusts for use as a fungicide to control plant diseases. An ingredient in fertilizers to correct copper deficiency in soils.

Important dietary supplement in mixed feeds for beneficial animals.

(Consult State Agricultural Experiment Station or State Extension Service Specialists for recommended dosage and formula.)

Industrial

CHEMICAL INDUSTRY
A raw material in the production of reagent and other chemicals and compounds.

DYESTUFFS
Effective as a color stabilizer in various dyes.

PIGMENT MANUFACTURE
Ingredient in production of blue and green pigments.

STEEL INDUSTRY
In baths for pickling and wire plating.

MINING
A flotation reagent in refining lead, zinc and uranium ores.

PLATING
In copper plating baths.

Public Health-Water and Sewage Treatment

WATER TREATMENT
Destroys algae safely, eliminates tastes and odors in water supplies and purifies water.

SEWER TREATMENT
Eliminates roots and fungus growths in sewers and storm drains.

Wood Treatment

In combination with certain other chemicals, an excellent preservative for wooden fence posts, in treatment of lumber, wallboards, paper and textiles to protect against mildew and other fungus growths.

AGWAY

COPPER SULFATE

FOR THE CONTROL OF ALGAL POND SCUM AND ALGAL WATER BLOOM IN FARM PONDS.

ACTIVE INGREDIENT:	
Copper sulphate pentahydrate	99%
INERT INGREDIENTS:	1%
	100%

Copper as metallic — 25.2%

CAUTION: KEEP OUT OF REACH OF CHILDREN

See additional cautions and warnings elsewhere on label.

WARRANTY: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purpose stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of merchantability or fitness for a particular purpose, express or implied, extends to the use of this product contrary to label instructions or under abnormal conditions, or under conditons not reasonably foreseeable to seller, and buyer assumes the risk of any such use. Any damages arising from a branch of this warranty shall be limited to direct damages, and shall not include consequential commercial damages such as loss of profits or values, etc.

NET WEIGHT FIVE POUNDS

COPPER SULFATE

CAUTION: Harmful if swallowed. Wash hands thoroughly after using and before eating or smoking.

DO NOT USE IN TROUT PONDS. Many states require a permit prior to treatment of pond with this material. The user should consult proper authorities as to any restrictions.

Do not use water for any purpose for 7 days after treatment.

Solutions of copper sulfate pentahydrate displaces galvanized coating on steel containers. Use painted, enameled or copper coated containers for handling, mixing and spraying solutions.

Do not reuse empty container. Destroy by burying with wastes or burning.

DIRECTIONS

READ THESE ENTIRE DIRECTIONS AND WARRANTY OF SALE. USE STRICTLY IN ACCORDANCE WITH LABEL CAUTIONS, WARNINGS AND RESTRICTIONS.

TIMING Apply when the algae first appear, usually in early summer after the water temperature is 60°F or above. If filamentous algae is abundant apply during an afternoon following a sunny morning — since then a large amount of the algal mat is likely to be floating on the surface.

If the pond has a water supply that can be controlled, the water should be shut off or diverted before beginning to treat each section. About 3-4 days after treatment, or when the plants have started to die, the water may be turned on again.

In regions where ponds freeze in winter, algae should be controlled 6-8 weeks before the time ice formation is expected to prevent the occurrence of masses of decaying algae under an ice cover.

AMOUNT TO USE Use 2¾ - 5½ lbs. per acre-foot of water (325,850 gallons) equivalent to 1-2 ppm of copper sulfate pentahydrate, depending upon the hardness of the water and density of algal growth.

Use the higher rate only for hard water and dense growth of algae.

Repeat treatments as necessary.

Pond Volume		Concentrate of copper sulfate pentahydrate desired	
Acre-feet	Gallons	1 ppm	2 ppm
1.0	325,850	2¾ Lbs.	5½ Lbs.

It is important to determine the pond volume in acre feet. Don't guess — the formula follows —

$$\text{Rectangular ponds} = \frac{\text{length (ft.)} \times \text{width (ft.)}}{43{,}560} \times \text{Average depth of water}$$

$$\text{Round ponds} = \frac{\text{(Total ft. of shoreline)} \times \text{(total ft. of shoreline)}}{547{,}390} \times \text{Avg. depth of water.}$$

If the above method can't be used, a Soil Conservation Service Technician, County Agricultural Agent or civil engineer should be consulted.

METHOD Dissolve the required quantity of copper sulfate pentahydrate in an amount of water needed for uniform spraying. Spray over the surface of the water, particularly above areas of algal growth.

If the algae cover more than one-third of the total pond area, treat the pond in sections and allow enough time between the treatment of each section for the algae to decompose and to disappear below the surface. A week or more may be required to produce this amount of decomposition. Sectional treatments help to prevent loss of fish.

FISH SAFETY Treatment of algae can result in oxygen loss from decomposition of dead algae. This loss can cause fish suffocation. Therefore, if algae are visible, treat no more than ⅓ to ½ of the total pond at one time and wait 10 to 14 days between treatments. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas.

Note: Trout and other species of fish may be killed at application rates recommended on this label. However, fish toxicity generally decreases when the hardness of the water increases. Consult your State Fish and Game Agency before applying this product to public waters.

EPA Reg. No. 8590-405

STOP

DO NOT INHALE
DO NOT GET ON SKIN

WARNING: May be fatal if swallowed, inhaled or absorbed through skin. Skin contact will cause severe irritation. Do not get material on skin, eyes or clothing. Contact with skin may increase danger of absorption. Symptoms of injury may be delayed. In case of skin contact, wash immediately with water, remove clothing and wash skin whole necessary. For eyes, wash thoroughly with water and get medical attention. Wear face shield, rubber gloves and rubber apron when handling concentrate. Do not breathe spray mist in order to avoid local throat and respiratory tract irritation. When spraying or when contacting sprayed vegetation wet with spray, dew or rain, wear waterproof footwear and clothing.

Note to Physicians: Emergency Information - call (415) 233-3732.

Do not contaminate feed, foodstuffs or drinking water. Do not store or transport near feed or food. Do not apply under conditions involving possible drift to food, forage or other plantings that might be damaged or the crops thereof rendered unfit for sale, use or consumption. When container is empty, immediately wash thoroughly and destroy. Navy rinse.

WARNING: Do not feed forage from treated crops to livestock. Keep livestock out of treated fields and crop areas. Rinse all spray equipment thoroughly with water after use. AVOID SPRAY DRIFT to crops which may be damaged during application.

NOTE: Do not use treated water for animal consumption, swimming, spraying or irrigation within 10 days after treatment. Do not use treated water for drinking purposes until 14 days after treatment. Treatment of dense weed areas can result in oxygen loss from decomposition of dead weeds. This loss can cause fish suffocation. Therefore treat only ¼ to ½ of the dense weed areas at a time and wait 10-14 days between treatments. DO NOT APPLY TO MUDDY WATER. Avoid coagitating muddy water during application. Do not apply under conditions of high wind and wave action. Do not apply where plants are covered with mud deposits. Consult State Fish and Game Agencies before applying this product to public waters.

CONDITIONS OF SALE: 1. Chevron Chemical Company (Chevron) warrants that this material conforms to the chemical description on the label and is reasonably fit for the purposes directed hereon. Chevron neither makes nor authorizes any agent or representative to make any other warranty of FITNESS or of MERCHANTABILITY, guarantee or representation, express or implied, concerning this material.

2. Critical and unforeseeable factors beyond Chevron's control prevent it from eliminating all risks in connection with the use of chemicals. Such risks include, but are not limited to, damage to plants and crops to which the material is applied, lack of complete control, and damage caused by drift to other plants or crops. Such risks occur even though the product is reasonably fit for the uses stated herein and even though label directions are followed. Buyer and User acknowledge and assume all risks and liability (except those assumed by Chevron, under 1 above) resulting from handling, storage, and use of this material.

Chevron

ORTHO

Diquat Water Weed Killer

Also Harvest Aid Chemical

Active Ingredient	By Wt.
Diquat dibromide (6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinediium dibromide)	35.3%
Inert Ingredients	64.7%

Contains 2 lbs. diquat cation per gallon as 3.73 lbs. salt per gallon.

U.S. Pat. No. 2,823,967

WARNING: KEEP OUT OF REACH OF CHILD

See back panel for additional warnings.

NET CONTENTS 1 GALLON LIQUI

HEN.

D

STORE AT TEMPERATURES ABOVE 32° F.
READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH WARNINGS AND DIRECTIONS, AND WITH APPLICABLE STATE AND FEDERAL REGULATIONS.
KEEP PESTICIDE IN ORIGINAL CONTAINER. DO NOT PUT CONCENTRATE OR DILUTE INTO FOOD OR DRINK CONTAINERS.

ORTHO Diquat Water Weed Killer is a nonvolatile herbicidal chemical for use in the desiccation of certain plants in preharvest application in order to facilitate both mechanical and hand harvesting. It is also recommended for use as a general weed killer and as an aquatic weed killer. Absorption and herbicidal action is usually quite rapid with effects visible in a few days. Do not use on lawns.

NONCROP OR NONPLANTED AREAS: To Kill Above Ground Weed Growth Around Buildings and Other Installations, Gardens, Walkways, Patios, Beneath Greenhouse Benches, Fence Lines, Golf Courses, Pathways and Driveways for Control of Undesirable Broadleaved and Grassy Weeds – 1 qt. plus 4 oz. ORTHO X-77® Spreader (non-ionic) per 60 gals. water (4 teaspoonfuls ORTHO Diquat Water Weed Killer plus ½ teaspoonful ORTHO X-77® Spreader (non-ionic) to 1 gal. water). Apply for full coverage and thorough weed contact. Apply to young weeds since control decreases as weeds mature. Retreatment may be necessary to control grasses and established weeds. Avoid spray contact with foliage of food crops or ornamental plants.

ALFALFA, CLOVER, GRAIN SORGHUM, SOYBEANS (Seed Crops Only): 1½ to 2 pts. per acre. On thin Stands of Seed Alfalfa - 1 pt. per acre. **VETCH (Seed Crops Only):** 1 pt. per acre. Preharvest Desiccation of Foliage of listed Crops: Use specified dosage in 15 to 30 gals. water by ground spray application and 5 to 10 gals. water by air. On Alfalfa, Clover and Vetch, desiccation is complete in 3 to 10 days. On Grain Sorghum, apply within 1 to 2 weeks of harvest and when seeds have not more than 30% moisture. On Soybeans, apply 1 week before harvest. Do not graze treated areas or feed treated forage to livestock. Do not use seed from treated plants for food, feed or oil purposes.

SUGARCANE (HAWAII ONLY): To Prevent Flowering (tasseling) of Cane – 1 pt. ORTHO Diquat Water Weed Killer plus 1 oz. ORTHO X-77® Spreader (non-ionic) per acre. Apply during flower initiation period, first 3 weeks of September. Apply by aircraft in 7 to 10 gals. water per acre. Some leaf burn will occur following this treatment. Do not apply within 5 months of harvest.

SUGARCANE (FLORIDA AND PUERTO RICO ONLY): To Prevent Flowering (tasseling) of Cane – 1 pt. ORTHO Diquat Water Weed Killer plus 1oz. ORTHO X-77® Spreader (non-ionic) per acre. Apply during flower initiation period. Apply by aircraft in 3 to 10 gals. of water per acre. Some leaf burn will occur following this treatment. Do not apply within 3 months of harvest.

Manufactured by
Chevron Chemical Company
Ortho Division/San Francisco CA 94119 Richmond CA 94804
Form 6668-12 Product 1000.2

EPA Est. 239-MO-1
EPA Reg. No. 239-1663-AA

AQUATIC USE DIRECTIONS

WEED SPECIES	GALS./SURFACE ACRE
SUBMERSED WEEDS (Infesting Still Ponds, Lakes, Ditches, Laterals, Waterways or Portions Thereof)	
Bladderwort (Utricularia spp.)	[illegible]
Coontail (Ceratophyllum demersum)	
Elodea (Elodea spp.)	
Naiad (Najas spp.)	
Pondweeds (Potamogeton spp.)	
(Except P. robbinsii, also Richardson Pondweed (P. richardsonii) in Minnesota)	
Watermilfoil (Myriophyllum spp.)	[illegible]

APPLICATION: In early season where submersed weed growth has not reached the surface apply ORTHO Diquat Water Weed Killer by pouring directly from the container into the water while moving slowly over the water surface in a boat. Distribute evenly over infested areas in strips 40 feet apart. In mixed weed populations, use the high rate of application as indicated by weeds present.

In late season or where submersed weed growth has reached the water surface throughout the area to be treated, apply ORTHO Diquat Water Weed Killer by pouring as above or injecting a diluted (10 - 20 to 1) solution below the water surface in strips no more than 20 feet apart. Use the high rate of application as indicated by the weeds present.

Where algae are present along with the submersed weeds, pre-treatment with Copper Sulphate at recommended rates is advised for best results with ORTHO Diquat Water Weed Killer.

FLOATING WEEDS	
Pennywort (Hydrocotyle umbellata)	[illegible]
Salvinia (Salvinia rotundifolia)	[illegible]
Waterhyacinth (Eichhornia crassipes)	[illegible]
Waterlettuce (Pistia stratiotes)	[illegible]

APPLICATION: 150 to 200 gals. of water plus 1 pt. ORTHO X-77® Spreader (non-ionic) should be applied as an overall spray for control of the above weeds. For boiled application to Waterlettuce, use 7.5 gals. of water per acre plus 1 pt. ORTHO X-77® Spreader (non-ionic) per 100 gals. spray solution. The high rates of ORTHO Diquat Water Weed Killer should be used for late season application.

Duckweed (Lemna spp.)	[illegible]

APPLICATION: For control, apply ORTHO Diquat Water Weed Killer as an overall spray in 50 to 150 gals. of water per acre. Care should be taken to thoroughly cover all plants on water and on damp marginal areas. Reinfestation of duckweed occurs readily from untreated areas. Retreatment with ORTHO Diquat Water Weed Killer may be necessary to obtain season-long control.

WEED SPECIES	GALS./100 GALS. WATER
MARGINAL WEEDS (Infesting the Edges and Other Portions of Ponds, Lakes, Ditches, Laterals, Canals and Waterways.)	
Cattails (Typha spp.)	[illegible]

APPLICATION: For top kill, apply ORTHO Diquat Water Weed Killer in 100 gals. water plus 1 pt. ORTHO X-77® Spreader (non-ionic) for full coverage and thorough weed contact. Repeat treatment as necessary to control regrowth. For best results apply before flowering.

ALGAE: ORTHO Diquat Water Weed Killer will control certain filamentous algae, Spirogyra spp. and Pithophora spp. Apply 0.5 to 1.5 p.p.m. of ORTHO Diquat Water Weed Killer for control. Application methods as for submersed weeds.

Formula for Parts Per Million (PPM) Recommendations

Gals. to use = p.p.m. recommended x acreage of water x average depth of water x [illegible]

For example – ½ p.p.m. recommendations, two acre pond, 4 feet average depth, ½ x 2 x 4 x 1.4 = [illegible] gals. required

® X-77 Registered Trade Mark of KALO Laboratories, Inc.

NATIONAL CHEMSEARCH

WATROL

4/1/75

HERBICIDE

Kills Aquatic Weeds, May Be Used as A Chemical Edger

ACTIVE INGREDIENTS:

*Diquat Dibromide (6,7-dihydrodipyrido (1,2-a:2'1'c) Pyrazinedilum dibromide	1.85%
INERT INGREDIENTS:	98.15%

*Equivalent to .08 lb. Diquat cation or .156 lbs. Diquat Salt per Gallon.

Read entire label. Use strictly in accordance with cautions, warnings and directions, and with applicable state and federal regulations.

CAUTION:

KEEP OUT OF REACH OF CHILDREN

(See additional cautions on right panel)

EPA Reg. No. 1769—174—AA

NET CONTENTS: _____

NATIONAL CHEMSEARCH [illegible] IRVING, TEXAS 75062
Eastern Plant Steele Co., Monmouth Junction, N.J. Western Plant 3312 Arden Rd., Sunnyvale, Calif.
NATIONAL CHEMSEARCH div. of USAchem Inc.
DALLAS · ST. LOUIS · MACUNGIE · BEVERLY HILLS PRINTED IN U.S.A.

DIRECTIONS

Submerged Weeds — Apply at the rate of 48 gallons per surface acre or 140 ounces per 1000 square feet to control Bladder Wort, Coontail, Elodea, Naiad, Pondweeds and Watermilfoil. In early season and before the submerged weed growth has reached the surface, apply WATROL undiluted into the water while moving slowly over the surface in a boat. Distribute uniformly over infested areas in strips 40 feet apart.

In late season or where weed growth has reached the water surface, apply WATROL as above or injecting below the water surface in strips 20 feet apart or less.

For Floating Weeds — To control Pennywort, Salvinia, Waterhyacinth and Waterlettuce, apply at the rate of 12-18 gallons per surface acre or 35 fl. oz. — 53 fl. oz. per 1000 square feet. Mix 12-18 gallons of WATROL with 140-185 gallons of water and spray uniformly over the surface of one acre of the water. For small areas, mix 35-53 fl. oz. with 3¼ to 4¼ gallons of water and spray uniformly onto 1000 square feet of surface areas.

For Duckweed — Dilute 24 gallons of WATROL with 30-130 gallons of water and apply as an overall spray to the acre. Thoroughly cover all plants on water and on damp marginal areas. Retreat when necessary as reinfestation of duckweed occurs readily from untreated areas.

For Marginal Weeds infesting the edges and other portion of ponds, lakes, ditches, laterals, canals, waterways and for Cattails — Mix 2½ gallons per 80 gallons of water. Thoroughly wet the plants. Retreat when necessary for best results apply before flowering.

As a Chemical Edger — Dilute 2½ gallons of WATROL with 20 gallons of water. Spray thoroughly along fence rows, sidewalks, under shrubs and trees. WATROL kills only by leaf absorption and is harmless to bark and woody stems of plants. Do not allow spray to contact the leafy structure of desirable shrubs, ornamentals or trees. For best results, treat while plants are young and growing vigorously. Repeat treatment when necessary.

To clean dormant Bermuda, St. Augustine, Centipede or Zoysia fairways of the early stages of undesirable cool weather emergent weeds and grasses such as Poa Annua and chickweed, dilute 1 gallon of WATROL with 20 gallons of water and apply 2.5 to 5 gallons of diluted spray per 1000 square feet. Thoroughly cover all plants as WATROL kills by contact only.

NOTE: Green desirable grasses can be damaged.

FOR INDUSTRIAL OR INSTITUTIONAL USE ONLY

CAUTION: KEEP OUT OF REACH OF CHILDREN. DO NOT INHALE. DO NOT GET ON SKIN. DO NOT TAKE INTERNALLY.

May be fatal if swallowed, inhaled or absorbed through skin. Prolonged skin contact will cause severe irritation. Do not get WATROL on skin, eyes or clothing. Repeated contact with skin may increase danger of absorption. Symptoms of injury may be delayed. In case of skin contact, wash immediately with water; remove clothing and wash skin where necessary. For eyes, wash thoroughly with water and get medical attention. Wear face shield, rubber gloves and rubber apron when handling concentrate. Do not breathe spray mist in order to avoid nasal, throat and respiratory tract irritation. When spraying or when contacting sprayed vegetation wet with spray, dew or rain, wear waterproof footwear and clothing. Do not contaminate feed, foodstuffs or drinking water. Do not store or transport with feed or food. Do not apply under conditions involving possible drift to food, forage or other plantings that might be damaged or the crops thereof rendered unfit for sale, use or consumption.

CAUTION: Keep livestock out of treated fields and crop areas. Rinse all spray equipment thoroughly with water after use. AVOID SPRAY DRIFT to crops which may be damaged during application.

NOTE: Do not use treated water for human or animal consumption, swimming, spraying or irrigation within 14 days after treatment. Treatment of dense weed areas can result in oxygen loss from decomposition of dead weeds. This can cause fish suffocation. Therefore, treat only ⅓ to ½ of the dense weed areas at a time and wait 10-14 days between treatments. DO NOT APPLY TO MUDDY WATER. Avoid treating muddy water during application. Do not apply under conditions of high wind or wave action. Do not apply where plants are covered with mud deposits. Consult your State Fish and Game Agencies before applying this product to public waters.

DO NOT REUSE EMPTY CONTAINERS. WASH OUT AND DESTROY IN A SAFE PLACE OR RETURN TO A DRUM RECONDITIONER.

EPA Est. No. 4140

CA-1	IN-1	NJ-1	PR-1	TX-1

9-74

UNCONDITIONALLY GUARANTEED
WHEN USED AS DIRECTED

AQUATIC WEED CONTROL

AQUATIC USE DIRECTIONS: AQUATIC WEEDS (Infesting Still Ponds, Lakes, Ditches, Laterals, Canals.)

Water Treatments	Gals./Surface Acre	PPM**
*Algae		
(Spirogyra and Pithophora spp.)	20 to 40 gal.	½ to 1½
Bladderwort (Utricularia spp.)	20 to 40 gal.	½ to ½
Coontail		
(Ceratophyllum demersum)	40 gal.	1½ to 2½

Water Treatments	Gals./Surface Acre	PPM**
Elodea (Elodea spp.)	40 gal.	1½ to 2½
Najad (Najas spp.)	20 gal.	½
*Pondweed (Potamogeto spp.)	40 gal.	½
Watermilfoil (Myriophyllum spp.)	20 to 40 gal.	½ to ½

WATER TREATMENTS: Make application from a boat or other suitable craft either by injecting this product below the water surface, or by pouring it directly from the container into the water while moving slowly over the water surface. *Repeat application may be necessary under conditions of heavy infestations or where reinfestation may readily occur from seed, fragmentation or escapes.
** This product ration by weight. (See dilution chart).

CAUTION: Treatment of aquatic weeds can result in oxygen loss from decomposition of dead weeds. This loss can cause fish suffocation. Therefore, to minimize this hazard treat 1/3 to 1/2 of the water area in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Consult your State Fish and Game Agency before applying this product to public waters. Apply this product only as specified on this label. (Do not apply to muddy water).

DILUTION CHART

Depth of Water (Ft.)	Gallons Cation (By Wt.) to Use per Acre at Indicated PPM				
	½ ppm	½ ppm	1 ppm	1½ ppm	2½ ppm
1	7 gal.	14 gal.	28 gal.	42 gal.	70 gal.
2	14 gal.	28 gal.	56 gal.	84 gal.	140 gal.
3	21 gal.	42 gal.	84 gal.	126 gal.	210 gal.
4	28 gal.	56 gal.	112 gal.	168 gal.	280 gal.
5	35 gal.	70 gal.	140 gal.	210 gal.	350 gal.

FOLIAGE SPRAY TREATMENTS—AMOUNT/ACRE

(Salvinia rotundifolia)	10 to 15 gal.
Waterlettuce (Pistia stratiotes)	10 to 15 gal.
Water hyacinth (Eichhornia crassipes)	10 to 15 gal.
DUCKWEED (Lemna spp)	20 gal.

FOLIAGE SPRAY TREATMENTS should be applied in sufficient water (150-200 gals. per acre) to thoroughly wet foliage. As the season progresses and vegetation increases in mass, the higher dosages indicated should be used and more uniform distribution is necessary. Local conditions may affect the use of this chemical. Consult Agricultural Experiment Station or Extension Service Weed Specialist for specific recommendations to dosage and time of application, and for control of other weeds. Check with state authorities for necessary permits.

CAUTION: Harmful if swallowed. Avoid contact with skin, eyes and clothing. Concentrate may cause skin damage. Use waterproof gloves and face shield or goggles, when handling concentrate. Avoid breathing spray mist. In case of contact, immediately remove clothing and wash thoroughly and get medical attention. For eyes, wash thoroughly with water. Do not store with or near feed and foodstuffs or drinking water.

During application avoid drift to adjacent food and forage plantings that might be damaged or the crops thereof rendered unfit for sale, use or consumption. Do not use treated water for human or animal consumption, swimming, spraying of overhead and furrow irrigation within 10 days after treatment. Do not apply to muddy water and do not agitate water excessively with outboard motor or injection equipment during application.

Wash sprayer immediately after application with detergent and water, then rinse with clean water.

Do not reuse empty drum. Return to drum reconditioner or destroy by perforating or crushing and burying in a safe place away from water supplies.

SHARE

AQUATIC WEED CONTROL

A CONTACT, NON-SELECTIVE VEGETATION CONTROL OF AQUATIC WEEDS

ACTIVE INGREDIENTS:

Diquat dibromide (6, 7-Dihydrodipyrido
(1, 2-a: 2', 1'-c) pyrazinediium dibromide) .....
INERT INGREDIENTS .....

Contains 0.083 Diquat Cation per gal. as 0.165 lbs. Salt per gal.
This product is a herbicidal chemical, when used as directed, will kill most all for
plant growth without damage to the soil. Absorption and herbicidal action is usually
rapid with effects visible in a few days. This product is inactivated on contact with s

CAUTION!

KEEP OUT OF REACH OF CHILDREN

Read entire label. Use strictly in accordance with label cautions, warnings and directions and in conformity with Federal and State Regulations. Wash and destroy container when empty. Never re use.

NET CONTENTS:

EPA REG. NO. 11547
EPA EST. NO. 11547

CUTRINE-PLUS

Patent Pending
EPA Registration
Number 8959-10

ALGAECIDE

FOR USE IN POTABLE WATER RESERVOIRS; FARM, FISH & FIRE PONDS, LAKES AND FISH HATCHERIES

ACTIVE INGREDIENTS	
Copper as elemental*	9.0%
INERT INGREDIENTS	91.0%
TOTAL	100.0%

CUTRINE-PLUS contains 0.909 lbs. of elemental copper per gallon.
*From Copper Triethanolamine complex.

CAUTION
KEEP OUT OF REACH OF CHILDREN

See other cautions on side panel

NET CONTENTS — ONE GALLON

GENERAL INFORMATION

CUTRINE-PLUS, under field conditions, has shown to be effective in controlling a broad range of algae. Especially effective results have been obtained against Chara, Spirogyra, Cladophora, Vaucheria, Ulothrix, Microcystis and Oscillatoria. The Triethanolamines in CUTRINE-PLUS prevents the precipitation of the copper with carbonates or bicarbonates in the water.

CUTRINE-PLUS IS USED:

INDIVIDUAL . . .
POTABLE WATER RESERVOIRS, FISH PONDS, LAKES

AGRICULTURAL . . .
FARM PONDS

INDUSTRIAL . . .
FISH HATCHERIES; FIRE PONDS

Where used in public waters, some states may require permits; check with appropriate agencies.

FISH CAUTION: CUTRINE-PLUS may be toxic to trout and other species of fish. Fish-toxicity is dependent upon the hardness of water. Do not use CUTRINE-PLUS in water containing trout if the carbonate hardness of water does not exceed 50 ppm.

HOW TO APPLY

Apply as a surface spray using the amounts of CUTRINE-PLUS shown in dilution chart.

Before applying the concentrated liquid CUTRINE-PLUS, dilute with at least nine parts of water. Use hand or power sprayer for best distribution of the diluted CUTRINE-PLUS solution. Break up floating algae mats before spraying.

Apply when algae growths first become visible and when temperature is above 60 degrees F. Treat shoreline areas first so fish will not be trapped in shallow inlets. The most effective algae control is obtained under calm and sunny conditions.

Dosage rates for application of CUTRINE-PLUS are given in gallons per acre foot of water.

Free floating algae such as Microcystis, Oscillatoria, Anacystis, Aphanizomenon are controlled with 0.6 gallon of CUTRINE-PLUS per acre foot of water. Chara requires 1.2 gallons of CUTRINE-PLUS per acre foot of water.

To avoid suffocation of fish due to lack of oxygen caused by the decaying vegetation, never treat more than 1/3 to 1/2 of the lake or pond at a time. Allow sufficient time between treatments for oxygen levels to recover (usually 1-2 weeks).

Repeat applications may be necessary under certain conditions of algae infestation. If a week or two following treatment algae are still present in large quantities, treat again.

DILUTION CHART

Average Water Depth	Gallons of CUTRINE-PLUS to use per Acre	
	3.2ppm Cu/Algae	6.4ppm Cu/Chara
1 Foot	0.6	1.2
2 Feet	1.2	2.4
3 Feet	1.8	3.6

DILUTE the above volumes of CUTRINE-PLUS at least 9 to 1 with water before spraying onto water surface.

All application rates are based on static or minimum flow situations.

NOTE:

Areas treated with CUTRINE-PLUS may be used for swimming or fishing immediately after treatment. Water from treated lakes or ponds may be used to irrigate turf, fairways, putting greens and ornamental plants.

CAUTION

Keep out of the reach of children. CUTRINE-PLUS may cause skin damage. Do not get on skin, eyes or clothing. In case of contact, wash thoroughly. For eyes, wash thoroughly and get medical attention. May be harmful if swallowed. If swallowed, call a doctor.

Do not reuse empty container. Destroy it by perforating or crushing. Bury or discard in a safe place.

Wash spray equipment after each application.

NOTICE

Neither the manufacturer nor the seller makes any warranty expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use of this material when such use is contrary to label instructions. Read and follow the label directions carefully.

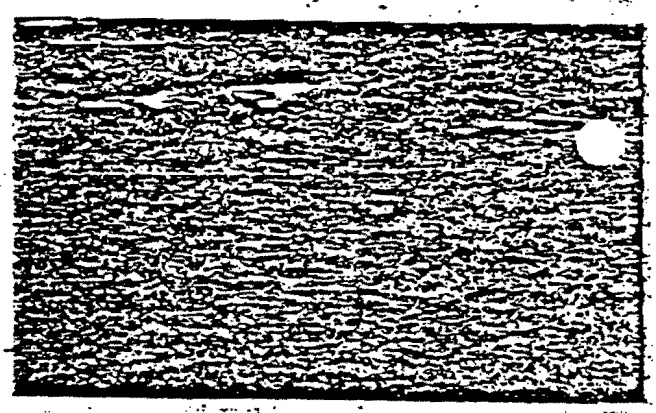
Manufactured and Sold By
APPLIED BIOCHEMISTS, INC.
MEQUON, WISCONSIN 53092

CUTRINE-PLUS

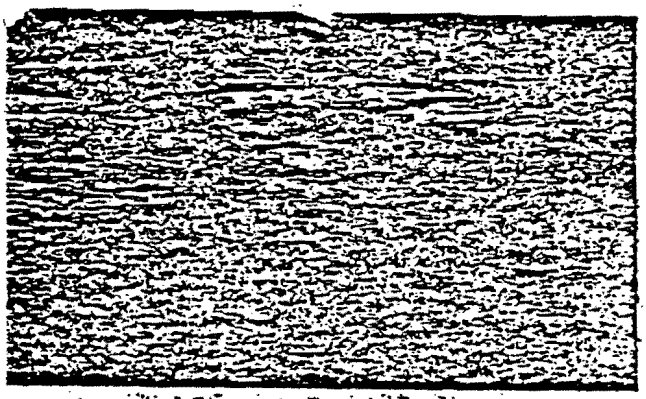
NEW, IMPROVED
ALGAECIDE

FOR USE IN
POTABLE WATER RESERVOIRS;
FARM, FISH & FIRE PONDS,
LAKES AND FISH HATCHERIES

- Contains no sulfates
- Increased stability
- Less chemical needed per treatment, thus less cost per acre
- Less corrosive

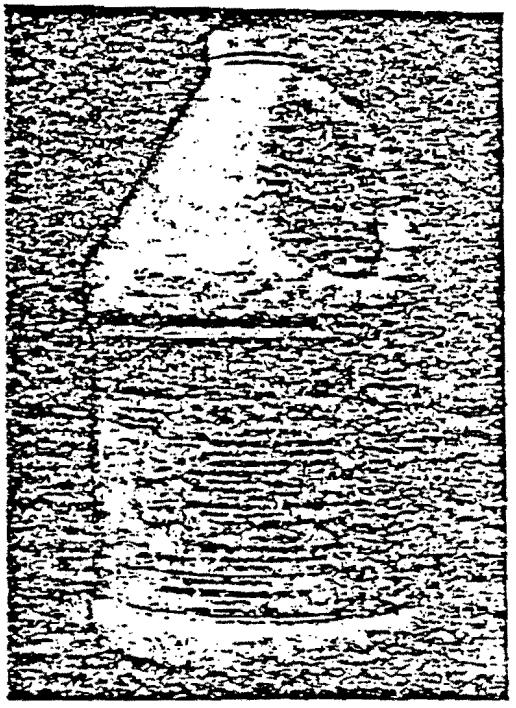


Before Treatment



6 Hours After Treatment

To control Chara, Nitella and to check filamentous algae as it begins growth on the bottom
USE
CUTRINE-PLUS GRANULAR



APPLIED BIOCHEMISTS, Inc.
P.O. Box 25
MEQUON, WISCONSIN 53092

THE NATION'S
NO. 1 ALGAECIDE!

50 LBS.
NET CONTENTS

LOT NUMBER:

Mariner
BRAND

AQUATIC HERBICIDE
SYSTEM

M

U. S. PATENT 3,634,061
NEW BUSINESS VENTURES DIVISION, 3M COMPANY, ST. PAUL, MINNESOTA 55101

MADE IN U.S.A.

ACTIVE INGREDIENT	
Copper*	55.8%
INERT INGREDIENTS	44.2%
TOTAL	100.0%

*From Malachite [dicopper (II) dihydroxide carbonate]

DANGER: KEEP OUT OF REACH OF CHILDREN

SEE BACK PANEL FOR PRECAUTIONARY INFORMATION AND DIRECTIONS FOR USE.

EPA REGISTRATION NO. 10350-1

NOTE: Our recommendations for use of this product are based upon tests believed to be reliable. Since aquatic field conditions vary widely, the user must determine the suitability of this product for his particular application. 3M Company makes no representation or warranty expressed or implied with respect to the use of this product other than the statements on the label.

GENERAL INFORMATION

MEPINER Brand Aquatic Herbicide System M is an insoluble wettable powder which is very effective in controlling chara and many species of filamentous algae. The product is applied to infested areas as an aqueous suspension. Uniform coverage is important because the particles of the product must come in direct contact with all the vegetation to be controlled. It is recommended that treated waters be calm at time of treatment and be left undisturbed for 48 hours following treatment.

DIRECTIONS FOR USE

This product is intended for the control of chara and filamentous algae in non-moving water in lakes, ponds and stagnant canals and waterways. The directions and dosage rates provided on this label are meant as a general guide only. The population and distribution of all algae species, water currents, water temperature, chemical characteristics of the water, and the size and depth of the area to be treated should be determined prior to treatment. The product is more effective when the water temperature is above 65 .

DOSAGE RATES. Under most circumstances, chara may be controlled at dosage rates in the range 15-25 pounds of product per acre. Dosage rates should be at the high end of the range if (a) treatments are made near the end of the growing season in northern states, (b) if the plants are encrusted with marl, or (c) if a very narrow marginal treatment is being made (less than ~ 30 ft at in width). Filamentous algae may usually be [illegible] dosage rates of 15 pounds of product [illegible] dosage rates are generally independent of [illegible]

METHOD OF APPLICATION. It is essential that this product be applied evenly over the surface of the treated area. Do not rely on diffusion of the product in the water for uniform coverage. The product should be sprayed as an aqueous suspension which consists of at least 10 gallons of water for each pound of product. The suspension may be prepared either by mixing the product and water in the indicated proportion in a spray tank, or by preparing an aqueous concentrate consisting of 1-2 pounds of product per gallon of water and diluting the concentrate with water as it is pumped out of the spray tank. Aqueous suspensions of the product require periodic agitation to prevent settling. The treated areas should not be disturbed by boat activity or other interference for at least 48 hours.

NOTE

Consult your State Fish and Game Agency before applying this product. Apply this product only as specified on this label. Obtain appropriate federal, state, or local government approvals where required. Treated areas must be left undisturbed for forty-eight hours following treatment to obtain best results. This restriction includes boating and swimming. There are no restrictions on water use or fishing following the forty-eight hour waiting period. Treat only ⅓ to ½ of the water area in a single operation. Decaying vegetation depletes the oxygen content of water and will result in fish kills if an extensive area is treated at one time.

Avoid contact of Aquatic Herbicide System M with desirable plants as injury to these plants may result. Wash out and clean equipment thoroughly with water immediately following use of this product. Do not allow product to dry inside equipment.

Do not store this material where it might contaminate food, feed, or seeds. Keep out of reach of children, pets, and livestock. Reseal tightly partially used containers. Do not reuse empty container. Destroy it by burying with waste or burning. Stay away from smoke or fumes.

DANGER- CAUSES EYE DAMAGE AND IRRITATES RESPIRATORY SYSTEM. AVOID BREATHING DUST OR SPRAY MIST. HARMFUL IF SWALLOWED.

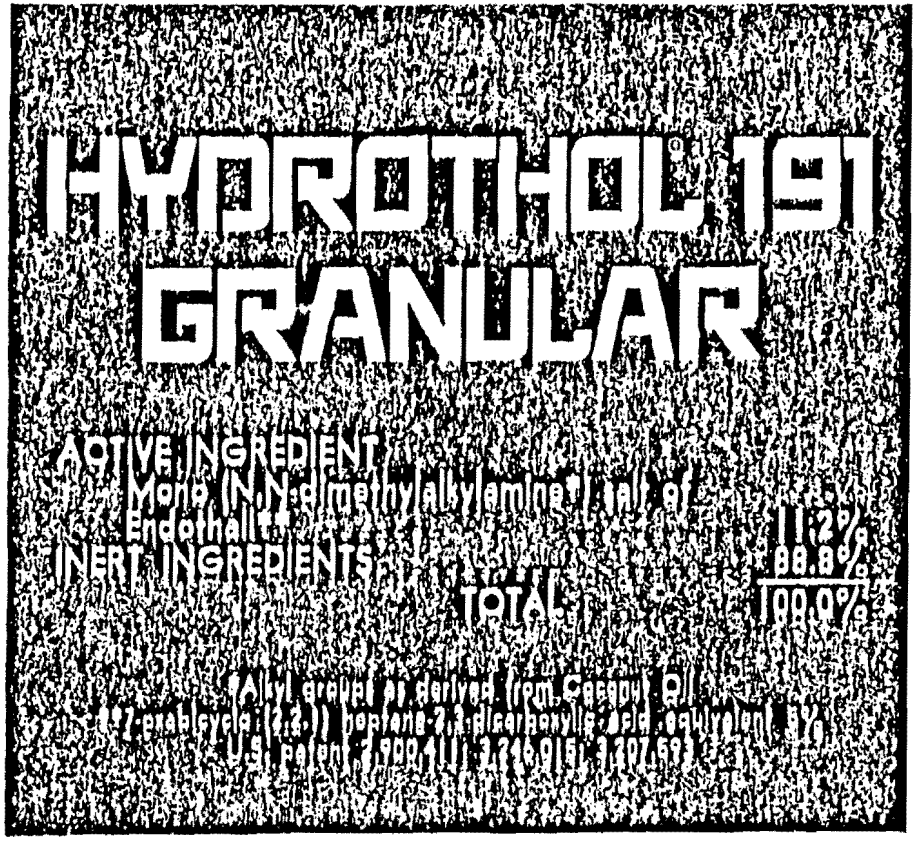
Protect eyes when mixing and applying. Wear respiratory protective equipment when mixing System M with water. In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical advice. Bathe and change clothing daily while using.

Plant Care Systems 3M COMPANY

3M CENTER • SAINT PAUL, MINNESOTA 55101

PENNWALT

HYDROTHOL® 191 GRANULAR



WARNING

KEEP OUT OF REACH OF CHILDREN

SEE SPECIFIC WARNING AND CAUTION STATEMENTS ON SIDE PANEL

EPA REGISTRATION NO. 4581-172

EPA ESTABLISHMENT NO. 270-CA-1

50 Lbs. Net Weight

AGCHEM DIVISION—PENNWALT CORPORATION

FRESNO, CA — PRATTVILLE, AL — PHILADELPHIA, PA

COLUMBUS, OH. — BRYAN, TX

GENERAL INFORMATION

HYDROTHOL 191 Granular is a highly effective algaecide and aquatic weed killer for use in irrigation and drainage canals, lakes and ponds to control the following weeds and algae: Hydrilla, Elodea, Coontail, Potamogeton, Milfoil, sp., Zannichellia, Vallisneria, Cladophora, Spirogyra, Pithophora and Chara when weeds are actively growing. Dosage rates indicated are measured in "Parts per Million" (ppm). 1 ppm as a dosage rate means that there would be 1 part endothall (acid) in 1,000,000 parts of water.

IRRIGATION and DRAINAGE CANALS

HEAVY INFESTATIONS—Evenly spread 160 to 270 lbs. HYDROTHOL 191 Granular per acre foot of water (3 to 5 ppm) with suitable aerial or ground equipment.

MODERATE OR LIGHT INFESTATIONS—Use 55 to 110 lbs. per acre foot HYDROTHOL 191 Granular (1 to 2 ppm) applied evenly.

Pounds of HYDROTHOL 191 Granular required per mile of canal or ditch 1 ft. deep

	WIDTH OF CANAL, DITCH or SWATH				
ppm	10	15	20	30	40
0.5	33	49	65	95	130
1.0	65	98	130	190	260
2.0	130	195	260	380	520
3.0	195	294	390	570	780
4.0	260	392	520	760	1040
5.0	375	490	650	950	1300

Note: 5.5 lbs. per acre foot equals 0.1 ppm of Endothall (acid).

Do not use treated waters for irrigation of crops.

LAKES and PONDS

ALGAE CONTROL—Cladophora, Pithophora, Spirogyra, and Chara can be controlled by even applications of 3 lbs. to 11 lbs. HYDROTHOL 191 Granular per acre foot (0.05 to 0.2 ppm) applied by suitable air or water equipment. HYDROTHOL 191 Granular is especially effective on bottom growth control. Pithophora may require 0.2 ppm or higher. Dosages may be increased to 27.52 lbs. of HYDROTHOL 191 Granular (.5 to 1.5 ppm) where greater longevity of control is desired and for marginal treatments. For floating mats HYDROTHOL 191 Granular should be scattered as evenly as possible over the mat. Repeat treatments when algal growth reappears.

SUBMERGED AQUATICS—Due to the toxicity to fish, the use of HYDROTHOL 191 Granular for submerged aquatics is suggested only by commercial applicators on a marginal or sectional treatment basis. Use 27 to 136 lbs. HYDROTHOL 191 Granular per acre foot (0.5 to 2.5 ppm) scattered evenly as possible. Use dosages over 1 ppm on narrow margins or in areas where some fish kill is not objectionable.

Do not treat more than 1/10 of the lake or pond at one time with doses in excess of 1 ppm.

Approximate pounds of HYDROTHOL 191 Granular for one acre* treatment at various depths and ppm concentrations

Depth	PPM Concentrations						
	.05 ppm	0.1 ppm	0.2 ppm	0.5 ppm	1.0 ppm	1.5 ppm	2.5 ppm
1 ft.	3	5	11	27	54	82	136
2 ft.	5	11	22	54	109	163	272
4 ft.	11	22	44	109	217	326	544
6 ft.	16	33	65	163	326	489	815

*One acre equals approximately 208' x 208'

CAUTION

Fish will be killed by dosages in excess of 0.3 ppm. Do not use where fish are important resources. Avoid contact with or drift to desirable plants or crops as injury may occur. Do not store this material where it may contaminate seeds, feed or foodstuffs. Clean out applicator after each operation. Do not use fish from treated water for food or feed within three days after treatment.

Do not use treated water for watering livestock or domestic purposes within the following periods:
Up to 0.3 ppm—7 days after application. Up to 3.0 ppm—14 days after application. Up to 5.0 ppm—25 days after application.

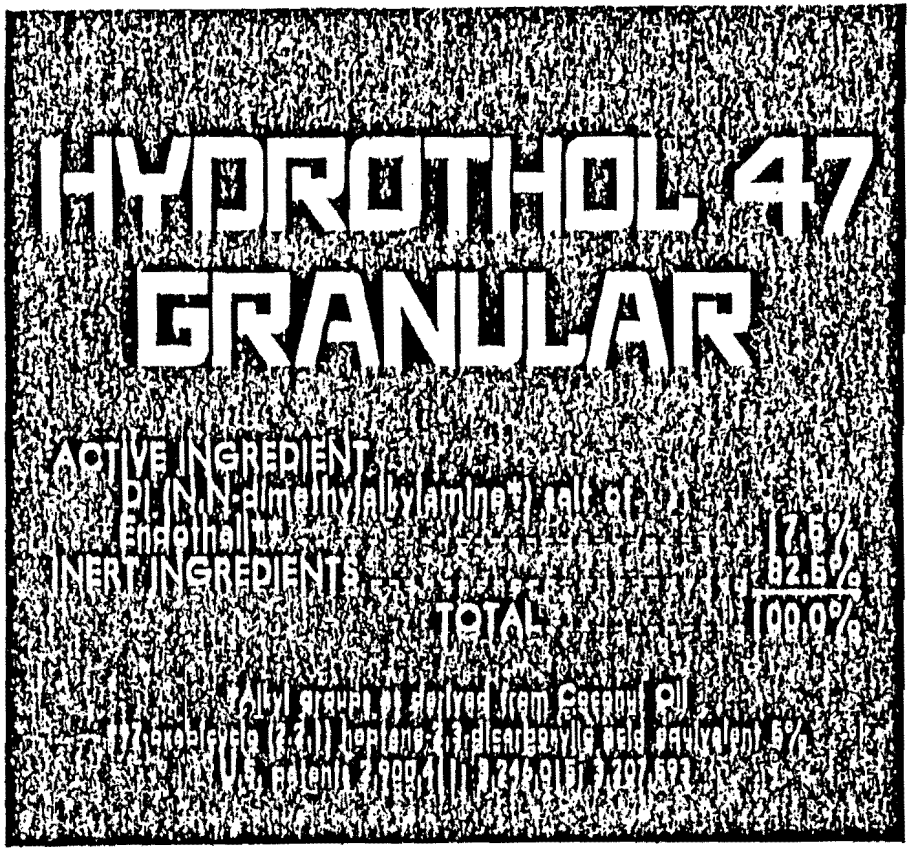
Necessary approval and/or permits should be obtained in states where required. Consult state water or conservation authorities before applying to public waters or to ponds, canals or streams which flow into public waters.

WARNING

May be fatal if swallowed. Irritating to skin, nose, eyes, and throat. May be absorbed through skin. Do not get in eyes, on skin, or on clothing. In case of skin contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes get medical attention. If swallowed, give cold milk or cold water. Call a DOCTOR immediately. Bathe and change clothing at least daily while using. Do not reuse containers. Destroy when empty.

PENNWALT

HYDROTHOL 47 GRANULAR



WARNING

KEEP OUT OF REACH OF CHILDREN

SEE SPECIFIC WARNING AND CAUTION STATEMENTS ON SIDE PANEL

USDA Registration No. 4581-175

50 Lbs. Net Weight

AGCHEM DIVISION—PENNWALT CORPORATION

TACOMA, WASHINGTON PHILADELPHIA, PA.

OAK BROOK, ILL. BRYAN, TEXAS FRESNO, CALIF. MONTGOMERY, ALA.

GENERAL INFORMATION

HYDROTHOL 47 Granular is a highly effective algaecide and aquatic weed killer for use in irrigation and drainage canals, lakes and ponds to control the following weeds and algae: Najas, Elodea, Coontail, Potamogeton, Milfoil, sp., Zannichellia, Vallisneria, Cladophora, Spirogyra, Pithophora and Chara when weeds are actively growing. Dosage rates indicated are measured in "Parts per Million" (ppm). 1 ppm as a dosage rate means that there would be 1 part endothall (acid) in 1,000,000 parts of water.

IRRIGATION and DRAINAGE CANALS

HEAVY INFESTATIONS—Evenly spread 160 to 270 lbs. Hydrothol 47 Granular per acre foot of water (3 to 5 ppm) with suitable aerial or ground equipment.

MODERATE or LIGHT INFESTATIONS—Use 55 to 110 lbs. per acre foot Hydrothol 47 Granular (1 to 2 ppm) applied evenly.

Pounds of Hydrothol 47 Granular required per mile of canal or swath 1 ft. deep

	WIDTH OF CANAL, DITCH or SWATH				
ppm	10	15	20	30	40
0.5	33	49	65	95	130
1.0	65	98	130	190	260
2.0	130	195	260	380	520
3.0	195	294	390	570	780
4.0	260	392	520	760	1040
5.0	325	490	650	950	1300

Note: 5.5 lbs. per acre foot equals 0.1 ppm of Endothall (acid)

Do not use treated water for irrigation of crops.

LAKES and PONDS

ALGAE CONTROL—Cladophora, Pithophora, Spirogyra, and Chara can be controlled by even applications of 3 lbs. to 11 lbs. Hydrothol 47 Granular per acre foot (0.05 to 0.2 ppm) applied by suitable air or water equipment. Hydrothol 47 Granular is especially effective on bottom growth control. Pithophora may require 0.2 ppm or higher. Dosages may be increased to 27-82 lbs. of Hydrothol 47 Granular (.5 to 1.5 ppm) where greater longevity of controls is desired and for marginal treatments. For floating mats Hydrothol 47 Granular should be scattered as evenly as possible over the mat. Repeat treatment when algal growth reappears.

SUBMERGED AQUATICS—Due to the toxicity to fish, the use of Hydrothol 47 Granular for submerged aquatics is suggested only by commercial applicators on a marginal or sectional treatment basis. Use 27 to 136 lbs. Hydrothol 47 Granular per acre ft. (0.5 to 2½ ppm) scattered evenly as possible. Use dosage over 1 ppm on narrow margins or in areas where some fish kill is not objectionable.

Do not treat more than 1/10 of the lake or pond at one time with doses in excess of 1 ppm.

Approximate pounds of Hydrothol 47 for one acre* treatment at various depths and PPM concentrations

Depth	PPM Concentrations						
	.05 ppm	0.1 ppm	0.2 ppm	0.5 ppm	1.0 ppm	1.5 ppm	2.5 ppm
1 ft.	3	5	11	27	54	82	136
2 ft.	5	11	22	54	109	163	272
4 ft.	11	22	44	109	217	326	544
6 ft.	16	33	65	163	326	489	815

*One acre equals approximately 208' x 208'

CAUTION

Fish will be killed by dosages in excess of 0.3 ppm. Do not use where fish are important resources. Avoid contact with or drift to desirable plants or crops as injury may occur. Do not store this material where it may contaminate seeds, feeds or foodstuffs. Clean out applicator after each operation. Do not use fish from treated water for food or feed within three days after treatment.

Do not use treated water for watering livestock or domestic purposes within the following periods:

Up to 0.3 ppm—7 days after application. Up to 3.0 ppm—14 days after application. Up to 5.0 ppm—25 days after application.

Necessary approval and/or permits should be obtained in States where required. Consult state water or conservation authorities before applying to public waters or to ponds, canals or streams which flow into public waters.

WARNING

May be fatal if swallowed. Irritating to skin, nose, eyes, and throat. May be absorbed through skin. Do not get in eyes, on skin, or on clothing. In case of skin contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes get medical attention. If swallowed, give cold milk or cold water. Call a doctor immediately. Bathe and change clothing at least daily while using. Burn or bury containers; never re-use. Stay out of smoke or fumes.

NOTICE

Pennwalt Corporation warrants that this material conforms to the chemical description on the label and is reasonably fit for the purposes referred to in the Directions for Use, subject to the risks referred to therein. Pennwalt Corporation makes no other express or implied warranty including any other express or implied warranty of FITNESS or of MERCHANTABILITY, and no agent of Pennwalt Corporation is authorized to do so except in writing, with a specific reference to this warranty. Any damages arising from a breach of this warranty shall be limited to direct damages, and shall not include consequential damages or loss of profits or values.

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GENERAL INFORMATION

Aquathol K is a liquid concentrate soluble in water which is effective against a broad range of aquatic plants with a margin of safety to fish.

Dosage rates indicated for the application of Aquathol K are measured in "Parts Per Million" (ppm) of dipotassium endothall. Only ½ to 5 ppm are generally required for aquatic weed control, whereas some fish species are tolerant to approximately 100 ppm or over.

AQUATIC WEEDS CONTROLLED AND DOSAGE RATE CHART

Aquathol K is recommended for the control of the following aquatic weeds in ponds and lakes at the rates indicated. Since the active ingredient is water soluble and tends to diffuse from the area treated, select the dosage rate applicable to the area to be treated. Use the lower rate in each range of rates when the growth is young and growing and/or where the weed stand is not heavy. Marginal treatments of large bodies of water require higher rates as indicated.

Common Name	Latin Name	Entire Pond Or Large Area Treatment	Spot Or Lake Margin Treatment
Bass Weed	Potamogeton amplifolius	2-3 ppm	3-4 ppm
Bur Reed	Sparganium spp.	3-4 ppm	4-5 ppm
Coontail	Ceratophyllum spp.	1-2 ppm	2-3 ppm
Milfoil	Myriophyllum spp.	2-3 ppm	3-4 ppm
Pondweed			
Bushy	Najas spp.	.5-1.5 ppm	2-3 ppm
Curly Leaf	Potamogeton crispus	.5-1.5 ppm	2-3 ppm
Flat Stem	Potamogeton zosteriformis	2-3 ppm	3-4 ppm
Floating Leaf	Potamogeton natans	1-2 ppm	2-3 ppm
Horned	Zannichellia spp.	1-2 ppm	2-3 ppm
Sago	Potamogeton pectinatus	1-2 ppm	2-3 ppm
_____	Potamogeton americanus	2-3 ppm	3-4 ppm
_____	Potamogeton diversifolius	1-2 ppm	2-3 ppm
_____	Potamogeton filiformis	2-3 ppm	3-4 ppm
_____	Potamogeton pusillus	1-2 ppm	2-3 ppm
Water Star Grass	Heteranthera spp.	2-3 ppm	3-4 ppm

RATE OF APPLICATION

The following chart indicates the total quantity of material to be applied

APPROXIMATE GALLONS OF AQUATHOL K FOR ONE ACRE* TREATMENT

	DOSAGE IN GALLONS FOR VARIOUS CONCENTRATIONS IN PPM						
DEPTH	0.5 ppm	1.0 ppm	1.5 ppm	2.0 ppm	3.0 ppm	4.0 ppm	6.0 ppm
1 ft.	.3	.6	1.0	1.3	1.9	2.6	3.2
2 ft.	.6	1.3	1.9	2.6	3.8	5.1	6.4
4 ft.	1.3	2.6	3.8	5.1	7.7	10.2	12.8
6 ft.	1.9	3.8	5.8	7.6	11.5	15.3	19.2

*One acre equals approximately 208' x 208'

Reprinted

PENNWALT

AQUATHOL® K

Contains 4 lbs. per gallon (4.23 lbs. Dipotassium Endothall)

(Equivalent to 3.0 lbs. Endothall Acid)

ACTIVE INGREDIENT

INERT INGREDIENTS

TOTAL

WARNING

KEEP OUT OF REACH OF CHILDREN

See Specific Warning and Caution Statements on Side Panel

USDA Registration No. 4581-204

NET CONTENTS..... ..U.S. GAL.

AGCHEM-DECCO DIVISION—PENNWALT CORPORATION

TACOMA, WASHINGTON MONROVIA, CA. PHILADELPHIA, PA.

OAK BROOK, ILL. BRYAN, TEXAS FRESNO, CALIF. MONTGOMERY, ALA.

PENNWALT

AQUATHOL K

Contains per gallon 4.2[illegible] lbs. Dipotassium Endothall (equivalent to 3.0 lbs. Endothall Acid)

ACTIVE INGREDIENT:

Dipotassium Salt of Endothall .... [illegible]%

INERT INGREDIENTS 59.7%

TOTAL 100.0%

[illegible]

WARNING

KEEP OUT OF REACH OF CHILDREN

See Specific Warning and Caution Statements on Side Panel

USDA Registration No. 4581-204

NET CONTENTS ............U.S. GAL.

AGCHEM-DECCO DIVISION—PENNWALT CORPORATION

TACOMA, WASHINGTON   MONROVIA, CA.   PHILADELPHIA, PA.

OAK BROOK, ILL.   BRYAN, TEXAS   FRESNO, CALIF.   MONTGOMERY, ALA.

HOW TO APPLY

Aquathol K is a contact killer; consequently, do not apply before weeds are present. Application as early as possible after weeds are present is recommended to permit use of lower application rates. However, for best results water temperature should be at 65°F. or above. If an entire pond is treated at one time, or if the dissolved oxygen level is low at time of application, decay of weeds may remove enough oxygen from the water, causing fish to suffocate. Water containing very heavy vegetation should be treated in sections to prevent suffocation of fish. Sections should be treated 5-7 days apart. Carefully measure size and depth of area to be treated and determine amount of Aquathol K to apply from chart. For best results apply on a calm day when there is little wave action.

Aquathol K should be sprayed on the water or injected below the water surface and should be distributed as evenly as possible. It may be applied as it comes from the container or diluted with water depending on the equipment. Some dilution will give better distribution.

In instances where the nuisance to be controlled is an exposed surface problem (i.e., some of the broadleaved pond weeds) it is important to get good contact coverage utilizing the highest concentration (least water dilution) compatible with the type of equipment used so that even distribution is achieved.

CAUTION

Avoid contact with or drift to other crops or plants as injury may result. Wash out spray equipment with water after each operation. Do not store this material where it might contaminate seeds, feed or foodstuffs. Do not use treated water for irrigation or for agricultural sprays on food crops or for domestic purposes within 7 days of treatment. Treated water can be used for sprinkling bent grass immediately. Do not use fish from treated water for food or feed within 3 days of treatment. Necessary approval and/or permits should be obtained in states where required.

Note: Areas treated with Aquathol K may be used for swimming twenty four hours after treatment.

WARNING

MAY BE FATAL IF SWALLOWED. IRRITATING TO SKIN, NOSE, EYES AND THROAT. May be absorbed through skin. Do not get in eyes, on skin or on clothing. Avoid breathing spray mist. Bathe and change clothing at least daily while using. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes get medical attention. If swallowed, give cold milk or cold water. Call a doctor immediately.

DESTROY CONTAINER WHEN EMPTY

Flush out thoroughly with water in some location where flush water can be run off harmlessly so as not to contaminate land, feed, or water sources. Then punch container full of holes or crush so that it cannot be used again for any purpose. Take to city dump or other location where no attempt will be made to salvage for any use whatsoever.

NOTICE

Pennwalt Corporation warrants that this material conforms to the chemical description on the label and is reasonably fit for the purposes referred to in the Directions for Use, subject to the risks referred to therein. Pennwalt Corporation makes no other express or implied warranty, including any other express or implied warranty of FITNESS or of MERCHANTABILITY, and no agent of Pennwalt Corporation is authorized to do so except in writing with a specific reference to this warranty. Any damages arising from a breach of this warranty shall be limited to direct damages, and shall not include consequential damages such as loss of profits or values.

MADE IN U.S.A.   [illegible]   PRINTED IN U.S.A.

GENERAL INFORMATION

AQUATHOL GRANULAR is a granular aquatic herbicide which under field tests conditions has shown to be effective against a broad range of aquatic plants with a margin of safety to fish. Dosage rates indicated for the application of AQUATHOL GRANULAR are measured in "Parts Per Million" (ppm). 1 ppm as a dosage rate means that there would be 1 part of AQUATHOL GRANULAR's active ingredient in 1,000,000 parts of water. Only ½ to 5 ppm are generally required for aquatic weed control, whereas some fish species are tolerant to approximately 100 ppm or over.

HOW TO DETERMINE DOSAGE RATE (Active Ingredient)

AQUATHOL GRANULAR is recommended for the control of the following aquatic weeds at the rates indicated. Since AQUATHOL GRANULAR's active ingredient is water soluble and tends to diffuse from the area treated, select the dosage rate applicable to the area to be treated. Use the lower rate in each range of rates when the growth is young and growing and/or where the weed stand is not heavy. Marginal treatments of large bodies of water require highest rates as indicated.

WEEDS CONTROLLED AND AQUATHOL GRANULAR DOSAGE RATE CHART

Common Name	Latin Name	Entire Pond Or Large Area Treatment	Spot Or Late Margin Treatment
Bass Weed	Potamogeton amplifolius	2-3 ppm	3-4 ppm
Bur Reed	Sparganium spp.	3-4 ppm	4-5 ppm
Coontail	Ceratophyllum spp.	1-2 ppm	2-3 ppm
Milfoil	Myriophyllum spp.	2-3 ppm	3-4 ppm
Pondweed			
Bushy	Najas spp.	.5-1.5 ppm	2-3 ppm
Curly Leaf	Potamogeton crispus	.5-1.5 ppm	2-3 ppm
Flat-Stem	Potamogeton zosteriformis	2-3 ppm	3-4 ppm
Floating Leaf	Potamogeton natans	1-2 ppm	2-3 ppm
Horned	Zannichellia spp.	1-2 ppm	2-3 ppm
Sago	Potamogeton pectinatus	1-2 ppm	2-3 ppm
_____	Potamogeton nodosus	2-3 ppm	3-4 ppm
_____	Potamogeton diversifolius	1-2 ppm	2-3 ppm
_____	Potamogeton filiformis	2-3 ppm	3-4 ppm
_____	Potamogeton pusillus	1-2 ppm	2-3 ppm
Water Star Grass	Heteranthera spp.	2-3 ppm	3-4 ppm

HOW TO DETERMINE QUANTITY TO BE APPLIED

The following charts indicate the total quantity of material to be applied for certain size areas.

APPROXIMATE POUNDS of AQUATHOL GRANULAR for ONE ACRE* TREATMENT

DOSAGE IN POUNDS FOR VARIOUS CONCENTRATIONS IN PPM

DEPTH	0.5 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm	3.0 ppm	4.0 ppm	5.0 ppm
1 Ft. Deep	13 lbs.	27 lbs.	40 lbs.	54 lbs.	67 lbs.	81 lbs.	108 lbs.	135 lbs.
2 Ft. Deep	27 lbs.	54 lbs.	81 lbs.	108 lbs.	134 lbs.	161 lbs.	215 lbs.	269 lbs.
3 Ft. Deep	40 lbs.	81 lbs.	121 lbs.	161 lbs.	202 lbs.	242 lbs.	323 lbs.	403 lbs.
4 Ft. Deep	54 lbs.	108 lbs.	161 lbs.	215 lbs.	269 lbs.	323 lbs.	430 lbs.	538 lbs.
5 Ft. Deep	67 lbs.	136 lbs.	202 lbs.	269 lbs.	336 lbs.	403 lbs.	538 lbs.	673 lbs.
6 Ft. Deep	81 lbs.	161 lbs.	242 lbs.	323 lbs.	403 lbs.	484 lbs.	646 lbs.	807 lbs.

FOR 1000 SQUARE FEET TREATMENT

DOSAGE IN POUNDS FOR VARIOUS CONCENTRATIONS IN PPM

DEPTH	0.5 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm	3.0 ppm	4.0 ppm	5.0 ppm
1 Ft. Deep	.3 lbs.	.6 lbs.	.9 lbs.	1.2 lbs.	1.5 lbs.	1.9 lbs.	2.5 lbs.	3.1 lbs.
2 Ft. Deep	.6 lbs.	1.2 lbs.	1.9 lbs.	2.5 lbs	3.1 lbs.	3.7 lbs.	4.9 lbs.	6.2 lbs.
3 Ft. Deep	.9 lbs.	1.9 lbs.	2.8 lbs.	3.7 lbs.	4.6 lbs.	5.6 lbs.	7.4 lbs.	9.3 lbs.
4 Ft. Deep	1.2 lbs.	2.5 lbs.	3.7 lbs.	4.9 lbs.	6.2 lbs.	7.4 lbs.	9.9 lbs.	12.4 lbs.
5 Ft. Deep	1.5 lbs.	3.1 lbs.	4.6 lbs.	6.2 lbs.	7.7 lbs.	9.3 lbs.	12.4 lbs.	15.4 lbs.
6 Ft. Deep	1.9 lbs.	3.7 lbs.	5.6 lbs.	7.4 lbs.	9.3 lbs.	11.1 lbs.	14.8 lbs.	18.5 lbs.

*One acre equals approximately 208' x 208'

Where the area to be treated is greater than those listed in the charts proceed as follows:

a. Compute the approximate surface acreage
b. Compute the average depth
c. Multiply a. by b. to determine the total number of acre/feet
d. Multiply the pounds required of the 1 foot depth under the rate to be used

PENNWALT

AQUATHOL GRANULAR

A QUICK EFFECTIVE AQUATIC WEED KILLER FOR PONDS AND LAKES

GIVING 1 PPM TO A DEPTH OF 1 FOOT
NET CONTENTS 50 LBS. (22.7 KG)
TOTAL ACTIVE INGREDIENT 10%

WARNING

KEEP OUT OF REACH OF CHILDREN

SEE SPECIFIC WARNING AND CAUTION STATEMENTS ON SIDE PANEL

USDA Registration No. 4581-201

50 Lb. Net Weight

AGCHEM-DECCO DIVISION—PENNWALT CORPORATION

TACOMA, WA. PHILADELPHIA, PA. MONROVIA, CA.

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PENNWALT

AQUATHOL GRANULAR

A QUICK, EFFECTIVE AQUATIC WEED KILLER FOR PONDS AND LAKES

ACTIVE INGREDIENT:
DIPOTASSIUM SALT OF ENDOTHALL ACID 5%
INERT INGREDIENTS 95%
TOTAL 100%

WARNING

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SEE SPECIFIC WARNING AND CAUTION STATEMENTS ON SIDE PANEL

USDA Registration No. 4581-201

50 Lb. Net Weight

AGCHEM-DECCO DIVISION—PENNWALT CORPORATION

HOW TO APPLY

AQUATHOL GRANULAR is a contact killer; consequently, do not apply before weeds are present. Application as early as possible after weeds are present is recommended to permit use of lower application rates. However, for best results water temperature should be at a minimum of 65°F. If an entire pond is treated at one time, or if the dissolved oxygen level is low at time of application, decay of weeds may remove enough oxygen from the water causing fish to suffocate. Water containing very heavy vegetation should be treated in sections to prevent suffocation of fish. Sections should be treated 5-7 days apart. Carefully measure size and depth of area to be treated and determine proper amount of AQUATHOL GRANULAR to apply from chart. For best results apply on a calm day when there is little wave action.

Scatter AQUATHOL GRANULAR as evenly as possible over treated areas. A cyclone seeder is useful for this purpose.

In instances where the nuisance to be controlled is an exposed surface problem (i.e., some of the broadleaved pond weeds) it is important to get good contact coverage of the problem.

CAUTION

Avoid contact with or drift to other crops or plants as injury may result.

Thoroughly clean application equipment immediately after use.

Do not store this material where it might contaminate seeds, feed or foodstuffs.

Do not use treated water for irrigation or for agricultural sprays on food crops or for domestic purposes within 7 days of treatment.

Do not use fish from treated water for food or feed within 3 days of treatment.

For best results treat areas of one acre or more and/or margins of at least 100 feet in large bodies of water.

Necessary approval and/or permits should be obtained in states where required.

NOTE: Areas treated with AQUATHOL GRANULAR may be used for swimming 24 hours after treatment.

WARNING

MAY BE FATAL IF SWALLOWED.
IRRITATING TO SKIN, NOSE, EYES AND THROAT.
MAY BE ABSORBED THROUGH SKIN.
AVOID INHALATION OF DUST OR GRANULAR PARTICLES.

Do not get in eyes, on skin, or on clothing. Bathe and change clothing at least daily while using. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes get medical attention. If swallowed, give cold milk or cold water. Call a doctor immediately.

Burn or bury containers, stay out of smoke; never re-use.

NOTICE

Pennwalt Corporation warrants that this material conforms to the chemical description on the label and is reasonably fit for the purposes referred to in the Directions for Use, subject to the risks referred to therein. Pennwalt Corporation makes no other express or implied warranty, including any other express or implied warranty of FITNESS or of MERCHANTABILITY, and no agent of Pennwalt Corporation is authorized to do so except in writing, with a specific reference to this warranty. Any damages arising from a breach of this warranty shall be limited to direct damages, and shall not include consequential commercial damages such as loss of profits

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3 Ft. Deep	.9 lbs.	1.9 lbs.	2.8 lbs.	3.7 lbs.	4.6 lbs.	5.6 lbs.	7.4 lbs.	9.3 lbs.
4 Ft. Deep	1.2 lbs.	2.5 lbs.	3.7 lbs.	4.9 lbs.	6.2 lbs.	7.4 lbs.	9.9 lbs.	12.4 lbs.
5 Ft. Deep	1.5 lbs.	3.1 lbs.	4.6 lbs.	6.2 lbs.	7.7 lbs.	9.3 lbs.	12.4 lbs.	15.4 lbs.
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PENNWALT

AQUATHOL GRANULAR

A QUICK EFFECTIVE AQUATIC WEEDKILLER FOR PONDS AND LAKES

GIVING CONTROL OF THESE AND OTHER SUSCEPTIBLE AQUATIC WEEDS

WARNING

KEEP OUT OF REACH OF CHILDREN

SEE SPECIFIC WARNING AND CAUTION STATEMENTS ON SIDE PANEL

USDA Registration No. 4581-201

50 Lb. Net Weight

AGCHEM-DECCO DIVISION—PENNWALT CORPORATION

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CASORON® G-1

DICHLOBENIL WEED AND GRASS KILLER

8/16

NET CONTENTS

CAUTION: KEEP OUT OF THE REACH OF CHILDREN

ACTIVE INGREDIENT:	
Dichlobenil*	10.0 %
INERT INGREDIENTS	90.0 %
	100.0 %

*2,6-dichlorobenzonitrile

AQUATIC WEED KILLER AND NON-SELECTIVE HERBICIDE FOR CONTROL OF WEEDS (BROADLEAF AND GRASSY) IN INDUSTRIAL AND NON-CROP AREAS.

CASORON is a Research Discovery of N. V. PHILIPS-DUPHAR
U. S. Patent No. 3,027,248

NOTICE

Seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions.

BEFORE USE READ DIRECTIONS, CAUTION AND NOTICE STATEMENTS CAREFULLY.

AQUATIC WEED CONTROL

CASORON G-10 is recommended for the control of submerged aquatic weeds in non-flowing water, such as ponds, reservoirs and lakes. CASORON G-10 applied before weed growth begins will give season long control of several species of weeds including the following.

Elodea	Naiads	Chara
Northern watermilfoil	Coontail	Pondweeds (Potamogeton spp.)

DIRECTIONS

Apply CASORON G-10 during early spring either to exposed ponds bottoms or through the water. CASORON is active through the soil rather than through the water, therefore uniform distribution of the granules over the entire area to be treated is essential. It is particularly suited for use as a partial pond treatment around boat docks and swimming areas.

Treatment of Exposed Bottoms and Shorelines: Apply CASORON G-10 at a rate of 70 to 100 pounds per acre. Complete and uniform coverage of the area, whether it be applied to the soil or into the water is necessary for control. Use the lower rate if the soil is wet at the time of application, or if the water is less than 1 foot deep. In the case of treatment after drawdown, the pond should be refilled promptly.

Treatment Through Water: Distribute CASORON G-10 uniformly over the surface of the water using a rate of 100 to 150 pounds per acre of surface area. The lower rate should be used in shallow water less than 2 feet deep, the higher rate in deep water over 5 to 6 feet. Application should be made during periods of calm when wave action is at a minimum. Use of a non-motorized boat is recommended to avoid excessive water turbulance.

CASORON G-10 should be spread using an applicator such as the CASORON SPREADER. If areas to be treated are small, satisfactory application can be made by hand, throwing the granules with a small scoop. CASORON G-10 is designed to sink rapidly in water.

PRECAUTIONS: Do not apply to water which will be used for crop irrigation, for livestock water or for human consumption. Do not use fish from treated water for food or feed for a period of 90 days after application. Do not use in commercial fish or shellfish water. Consult your State Fish Game Department before applying CASORON G-10 to public waters.

DIRECTIONS
NON-SELECTIVE WEED CONTROL

CASORON G-10 is recommended for industrial weed control. Annual and perennial broadleaf and grass weeds listed below are controlled in a wide range of non-cultivated situations. When applied as directed this product will give non-selective weed control for an extended period of time. Length of residual action is dependent upon rain-fall, soil type and season of application.

CASORON G-10 is a free-flowing granule, non-flammable and easy to use. Best results are obtained by distributing uniformly over the soil surface by hand operated or tractor mounted granule applicator.

CASORON G-10 is recommended for control of certain perennial weeds such as:

Artemisa	Fescue	Sheep Sorrel
Bindweed	Leafy Spurge	Timothy
Canada Thistle	Orchardgrass	Wild Artichoke
Curly Dock	Quackgrass	Wild Aster
Falsedandelion (Catsear)	Russian Knapweed	Wild Carrot
		Yellow Rocket

CASORON G-10 is recommended for control of annual grassy and broadleaved weeds and certain perennial weeds such as:

Annual Bluegrass	Foxtail	Purslane
Bluegrass	Giselda	Ragweed
Bull Thistle	Groundsel	Red Deadnettle
Camphorweed	Henbit	Redroot Pigweed
Carpetweed	Horsetail	Rosarypea
Chickweed	Jerusalemoak	Russian Thistle
Citron Melon	Goosefoot	Shepherdscourse
Coffeeweed	Knotweed	Smartweed
Crabgrass	Lambsquarters	Spanishneedles
Cudweed	Maypops	Sowgrass
Dandelion	Milkweed Vine (Morrenia odorata)	Teaweed
Dogfennel	Miners lettuce	Texas Panicum (Hurrangrass)
Evening-primrose	Natalgrass	Wild Barley
Fiddleneck	Old Witchgrass	Wild Mustard
Florida Pursiane (Pusley)	Peppergrass	Wild Radish
	Pineappleweed	Yellow Woodsorrel
	Plantain	

For annual weed control CASORON G-10 should be applied prior to germination or when new plants are very small. For perennial weeds, make application during coldest weather when plants are fully dormant, or in the winter rosette stage.

KANSAS CITY, KANSAS 66110

EPA Reg. No. 148-725

10/72

CASORON® G-10

DICHLOBENIL WEED AND GRASS KILLER

3/16

50 POUNDS

CAUTION: KEEP OUT OF THE REACH OF CHILDREN

ACTIVE INGREDIENT:	
Dichlobenil*	10.0 %
INERT INGREDIENTS	90.0 %
*2,6-dichlorobenzonitrile	100.0 %

AQUATIC WEED KILLER AND NON-SELECTIVE HERBICIDE FOR CONTROL OF WEEDS (BROADLEAF AND GRASSY) IN INDUSTRIAL AND NON-CROP AREAS.

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Bindweed	Leafy Spurge	Timothy
Canada Thistle	Orchardgrass	Wild Artichoke
Curly Dock	Quackgrass	Wild Aster
Falsedandelion (Catsear)	Russian Knapweed	Wild Carrot
		Yellow Rocket

CASORON G-10 is recommended for control of annual grassy and broadleaved weeds and certain perennial weeds such as:

Annual Bluegrass	Foxtail	Purslane
Bluegrass	Giselia	Ragweed
Bull Thistle	Groundsel	Red Deadnettle
Camphorweed	Henbit	Redroot Pigweed
Carpetweed	Horsetail	Rosarypea
Chickweed	Jerusalemoak	Russian Thistle
Citron Melon	Goosefoot	Shepherdspurse
Coffeeweed	Knotweed	Smartweed
Crabgrass	Lambsquarters	Spanishneedles
Cudweed	Mayweed	Sowge
Dandelion	Milkweed Vine (Morrenia odorata)	Teaweed
Dogfennel		Texas Panicum (Hurrangrass)
Evening-primrose	Miners lettuce	Wild Barley
	Natalgrass	Wild Mustard
Fiddleneck	Old Witchgrass	Wild Radish
Florida Purslane (Pusley)	Peppergrass	Yellow Woodsorrel
	Pineappleweed	
	Plantain	

For annual weed control CASORON G-10 should be applied prior to germination or when new plants are very small. For perennial weeds, make application during coldest weather when plants are fully dormant, or in the winter rosette stage.

The weeds listed above can be controlled in industrial and non-crop areas such as:

Electric substations
Equipment sales and storage areas
Lumber yards
Around/above ground pipes and tanks
Non-surfaced roadways
Railroad and highway right-of-way
Petroleum installations
Around buildings
Along fence rows
Farm fuel storage tanks and out buildings

For non-selective weed control CASORON G-10 should be applied at the rate of 120 to 200 pounds per acre (2 3/4 to 4½ pounds per thousand square feet, 4½ to 7½ ounces per 100 square feet or 3/4 to 1¼ pounds per square rod). The lower rates may be used if the weed infestation is primarily annuals. For perennial weeds and in dry soil areas the higher rates should be used. Dead weeds from previous seasons growth do not need to be removed and soil should not be cultivated prior to application.

CASORON G-10 should be applied during the season of lowest temperatures. Apply November 1 to March 1 in most areas or until April 1 in the northern tier of states. Do not apply if air temperatures are expected to rise above 70°F within the following week. In areas of limited rainfall, apply just prior to or during rainy season. For prompt and effective results rainfall or other precipitation should occur within a few days of application. Do not seed or transplant into treated area for 24 months.

PRECAUTIONS

This product is not selective in action and may destroy all types of vegetation. The treated area may be totally or partially non-productive for one or more years. Apply only to areas where complete plant control is desired. Do not apply to areas on slope above lawns or susceptible crops as run-off water from treated area could cause injury. Do not graze livestock in treated areas. Store in a tightly closed container in a dry place.

OTHER USES

UNDER ASPHALT: For general weed control under asphalt (in areas such as roadways, parking lots, recreational areas), after final grade is achieved, apply 100 to 120 lbs. per acre. (2.3 to 2.8 lbs. per 1,000 sq. ft.) Treated area should be covered with asphalt as soon as possible. For re-surfacing work, existing weeds should be sprayed with a contact herbicide prior to CASORON G-10 application.

CAUTION

HARMFUL IF SWALLOWED. Do not breathe dust. Do not allow contact with eyes or on skin. Use with caution. Avoid contamination of feed and foodstuffs. Keep out of reach of children. Do not store with propagative structures such as seed, bulbs, tubers, nursery stock, etc., or with feed or food products. Do not reuse containers. Destroy when empty.

KANSAS CITY, KANSAS 66118

EPA Reg. No. 148-726 10/72

TRANSVAAL

WEED-RHAP®

LV-4D

HERBICIDE

2,4-D LOW VOLATILE

4 LBS. OF 2,4-D ACID EQUIVALENT PER GALLON

WHERE TO USE

Weed-Rhap® Low Volatile 4D is used to control broad-leaved weeds in cereal grains, corn, sorghums, woody and brush in rangeland, pastures, rights of way, similar non-crop areas; and for aquatic weed control.

PLANTS CONTROLLED

Weed-Rhap Low Volatile 4D will kill or control the following as well as many other noxious plants susceptible to 2,4-D:

[illegible]

DIRECTIONS FOR USE

Add the recommended amount of product to about one-half the volume of water to be used in spraying. Mix well, then add remaining water and mix until spray mixture is uniform.

Best results are obtained when applications are made while the plants are well leafed and actively growing.

On Fall-Planted Wheat, Oats, and Barley—Use ½ to ¾ pint of product in 5 to 10 gallons of water to cover one acre. Apply in early spring when weeds are small and before the crop has reached the boot stage.

[illegible]

ACTIVE INGREDIENT:

2-Ethylhexyl Ester of 2,4-Dichlorophenoxyacetic Acid ... 69 %

INERT INGREDIENTS: ... 31 %

TOTAL ... 100 %

MADE BY

TRANSVAAL, INC.

JACKSONVILLE, ARKANSAS

72076

NET CONTENTS ... GAL.

EPA REGISTRATION NO. [illegible]

WARNING

DO NOT apply this product to susceptible broad-leaved plants that are desirable such as cotton, soybeans, tomatoes, grapes, clover, ornamentals. Excessive amounts of this product in the soil may temporarily inhibit seed germination and all plant growth.

Minute quantities may cause severe injury by drift or vaporization. Avoid drift of spray and use a coarse spray which is less likely to drift. Although this product contains an ester of low volatility, use it with caution where the spreading of vapors can damage nearby susceptible plants.

DO NOT contaminate water in irrigation ditches or water used for domestic purposes.

Users should note that herbicide treatment of public waters requires a permit from appropriate state agencies in most states. Your State Conservation Department or Game and Fish Commission will aid you in securing a permit if required in your state.

DO NOT store this product near fertilizers, seeds, insecticides, or fungicides. DO NOT contaminate food or foodstuffs.

DO NOT use spray equipment contaminated with this product for any other purpose. DO NOT apply insecticides, fungicides, or other agricultural products unless the equipment has been cleaned very carefully with a suitable chemical cleaner.

If stored below freezing, it may be necessary to warm to 40°F and agitate before using. This does not affect the efficiency of the product.

DO NOT reuse empty containers. Destroy by burying in an isolated place away from water supplies.

CAUTION

This product may cause skin irritation. Avoid inhaling spray mist. Harmful if swallowed. Avoid contact with the eyes, skin, or clothing. Flush eyes with clean water and get prompt medical attention.

NONWARRANTY

Transvaal warrants that this herbicide conforms to the chemical description on its label. When used in accordance with label directions under normal conditions, this herbicide is reasonably fit for its intended purpose. Since timing, method of application, weather, plant and soil conditions, mixture with other chemicals, and other factors affecting the use of this product are beyond our control, no warranty is given concerning the use of this product contrary to label directions or under conditions which are abnormal or not reasonably foreseeable. The user assumes all risk of any such use.

SPECIMEN LABEL

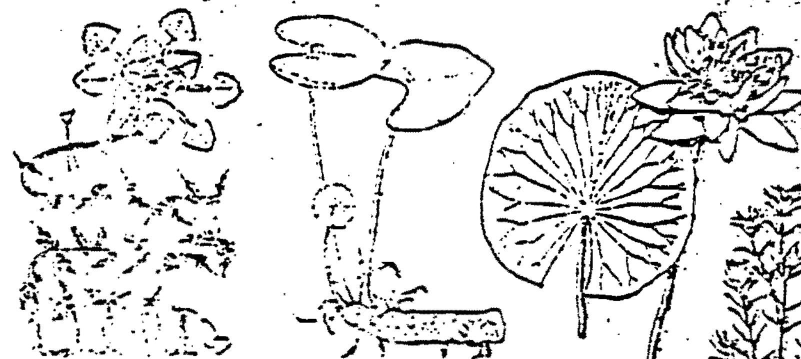
CAUTION: KEEP OUT OF REACH OF CHILDREN

READ SIDE PANELS FOR ADDITIONAL HANDLING PRECAUTIONS

Net Weight 50 Pounds

AQUA-KLEEN® 20

THE GRANULAR 2,4-D WEED KILLER FOR CONTROLLING WATER WEEDS

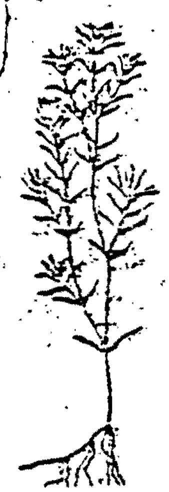


WATER CHESTNUT

YELLOW WATERLILY OR SPATTERDOCK

WHITE WATERLILY

WATER STARGRASS



WATER NAIAD

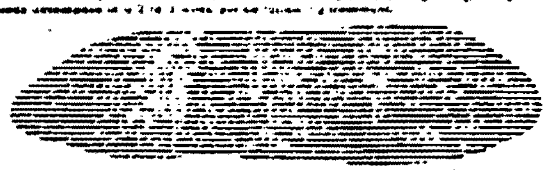
GENERAL INFORMATION

AQUA-KLEEN 20 contains 20% by weight of 2,4-D acid equivalent, as the [illegible]

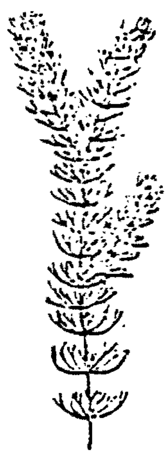
OXYGEN RATIO

[illegible]

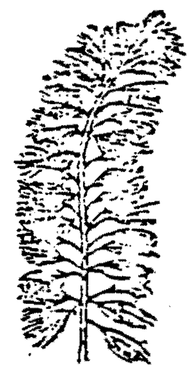
[illegible]



Buffer lanes should be 50 to 100 feet wide. Treated lanes should be as wide as the buffer strips.



COONTAIL



WATER MILFOIL

PERMIT TO USE CHEMICALS IN WATER

In many states, permits are required to control weeds by chemical means in public waters. If permits are required, they may be obtained from the Chief, Fish Division, State Department of Conservation, or the State Department of Public Health.

CAUTION: Keep out of the reach of children. See other Cautions on back panel.

ACTIVE INGREDIENTS:

*2,4-Dichlorophenoxyacetic Acid, Butoxyethanol Ester 29.0%

INERT INGREDIENTS: 71.0%

*2,4-Dichlorophenoxyacetic Acid equivalent 20% by weight

AMCHEM [illegible]

41929

	AQUA-KLEEN 20	
	Pounds per acre	Pounds per 2000 sq. ft.
Susceptible weeds 100		5
Water milfoil (Myriophyllum spp.)		
Water stargrass (Heteranthera dubia)		
Slightly to moderately resistant weeds 150-200		7½-10
Bladderwort (Utricularia spp.)		
Water naiad (Najas spp.)		
White water lily (Nymphaea spp.)		
Yellow water lily or spatterdock* (Nuphar spp.)		
Water shield (Brasenia spp.)		
Water chestnut (Trapa natans)		
Coontail* (Ceratophyllum demersum)		

* Repeat treatments may be needed

This product is designed to control the weeds listed on the label. Control of other weeds may not be satisfactory.

Generally, weeds are difficult to control in lakes where water replacement comes from bottom springs.

Water pH

Lake water that is extremely acid or alkaline may influence the effectiveness of AQUA-KLEEN 20. A pH on the acid side (pH 6.0 or below) generally favors the action of the chemical while a pH on the alkaline side (pH 8.0 or above) may reduce the action. If regrowth occurs within a period of 6 to 8 weeks, a second application may be needed.

CAUTION

Avoid contact with skin, eyes, or clothing. Do not store near fertilizers, seeds, insecticides or fungicides. Do not use in a greenhouse. Clean spreader equipment thoroughly before using it for any other purpose. Vapors from this product may injure susceptible plants in the immediate vicinity.

Do not apply to waters used for irrigation, agricultural sprays, watering dairy animals, or domestic water supplies.

If treated water must be used for irrigation, wait a minimum of three weeks after treatment before irrigation. At the end of this period, test a sample of treated water on several plants susceptible to 2,4-D (tomatoes, beans, legumes, cotton). If no 2,4-D symptoms appear within one week, the water can probably be used safely.

Do not reuse empty bag. Destroy by burying in a safe place. Do not burn.

Do not use this product for purposes other than those recommended on the label.

WARRANTY

Amchem warrants that composition of this product conforms to the chemical description given in the ingredient statement and the product is suited for the purposes described when used according to directions. Because of the broad range of conditions which may be encountered with the use of this product, it is impossible to eliminate all risks, even though label directions are followed. Amchem therefore makes no other express or implied warranty, and no agent of Amchem is authorized to do so. Buyer agrees in purchasing this product to assume the risks and in the event of damages arising from a breach of the warranty to accept refund of the purchase price of the product as full discharge of Amchem's liability.

U.S.D.A. Reg. No. 264-109

PRODUCT NO.
2650

RHODIA 2,4-D GRAN 20

NET CONTENTS
50 POUNDS

A LOW VOLATILE 2,4-D WEED KILLER

Contents Licensed Under U. S. Patent No. 2,792,295

For preemergence use on corn for the control of broadleaf weeds and certain seedling grasses.
Also for use in lakes and ponds for the control of certain aquatic weeds.

ACTIVE INGREDIENT:	
Isooctyl ester of 2,4-dichlorophenoxyacetic acid*	30.15%
INERT INGREDIENT	69.85%

*Equivalent to 20% 2,4 dichlorophenoxyacetic acid.

U. S. Pat. Nos. 2,390,941 2,396,513 2,453,983 2,472,347

CAUTION: Keep Out of Reach of Children

CAUTION: Harmful if swallowed. Avoid contact with skin, eyes, or clothing. Do not take internally. In case of contact, flush eyes with plenty of water; wash skin with soap and water. Avoid inhalation.

Avoid possible drift to susceptible plants as this product may injure cotton, tobacco, blackeyed peas, beans, tomatoes, melons, other vegetables, grapes, fruit trees, and some ornamentals. It is difficult to completely remove traces of 2,4-D from equipment, therefore do not use such equipment for purposes where even trace amounts of this chemical may cause injury to susceptible crops. Do not reuse shipping containers. Destroy by burying. Avoid contamination of water intended for irrigation and domestic use. Do not transport with or store near seeds, fertilizers, insecticides, or fungicides. Vapors from this product may injure susceptible plants in the vicinity.

SELECTIVE WEEDING IN FIELD CORN

2,4-D is a recognized method of killing weeds in corn. Research at Iowa State College of Agriculture and elsewhere has shown that preemergence applications of 2,4-D in granular form give just as good results as preemergence 2,4-D sprays in controlling susceptible broadleaf weeds as well as keeping down the seedlings of grassy weeds. Between the row cultivation is thus made easy and the number of such cultivations reduced.

CONTROLS THESE WEEDS IN CORN

Smartweed	Wild Mustard	Ragweed	Dandelions	Chicory
Sunflower	Pigweed	Wild Radish	Plantains	Yellow Star Thistle
Morningglory	Tarweed	Pennywarts	Healall	and many others

SUPPRESSES THE GROWTH OF THESE WEEDS

Crabgrass Giant Foxtail Barnyard Grass Pigeon Grass (small foxtail)

RATE OF APPLICATION: (Do not exceed the following rates) **Band Application**—On 36 inch rows apply 3¼ to 3½ pounds per acre on a 12 to 14 inch band. **Broadcast Application**—Apply 10 pounds per acre.

HOW APPLIED: May be applied broadcast with grass seeder or in band application behind the seed planter. Special attachments for this are available from a number of corn seed drill manufacturers. These place the granules in a 12 or 14 inch band across the top of the row. Use a press wheel and do not work into soil.

WHEN APPLIED: Rhodia 2,4-D Gran 20 should be applied preferably as a preemergence treatment at corn planting time. It may, however, also be applied just before corn emerges through the soil. It has very little effect on established broadleaf weeds over 6 inches tall, and none at all on grassy weeds once they have germinated.

SPECIAL CAUTION: Plant corn at least 2 inches deep when using preemergence 2,4-D applications. 2,4-D should not be used on sandy or light soils or damage to the crop may result. In other areas State Agricultural authorities should be consulted before using.

Do Not Store with Foodstuffs

WEED CONTROL IN PONDS AND LAKES

Rhodia 2,4-D Gran 20 is recommended for control of certain specified water weeds listed below. Best results with 2,4-D are likely to be obtained where water conditions are acid and there is no flow and little or no water movement. In ponds and lakes with excessive movement, it may be possible to draw down the water for a few days just before and after treatment.

RATE OF APPLICATION (100 pounds per acre is equivalent to 1 pound per 430 square feet)

WEEDS	RATE PER ACRE	WEEDS	RATE PER ACRE
Arrowhead (*Sagittaria spp.*)	200 lbs.	Waterweed (*Elodea or Anacharis*)	200 lbs
Bladderwort (*Utricularia spp.*)	100-150 lbs	Waterchestnut (*Trapa natans*)	100 lbs
Bulrush (*Scirpus spp.*)	200 lbs	Watermilfoil (*Myriophyllum spp.*)	100-150 lbs
Coontail or Hornwort (*Ceratophyllum demersum*)	200 lbs	Water Smartweed (*Polygonum spp.*)	200 lbs
Creeping Waterprimrose (*Jussiaea repens*)	200 lbs	White Waterlily (*Nymphaea spp.*)	150 lbs
Pickerelweed (*Pontederia spp.*)	200 lbs	Naiad (*Najas flexilis*)	200 lbs
Spatterdock, Cow Lily, Yellow Water Lily (*Nuphar spp.*)	150 lbs	Pondweeds (*Potamogeton spp.*)*	200 lbs
Burreed (*Sparganium spp.*)	200 lbs	Watershield (*Brasenia spp.*)	150-200 lbs

*Check with state weed control services as results depend much on species and environment.

HOW TO APPLY: Broadcast and spread evenly over the water surface either by hand or with a rotary type seeder or spreader.

TIME OF APPLICATION: Early spring when aquatic growth is most active gives best results. The time required for maximum plant kill may extend from 4 to 6 weeks, depending on water temperature and other factors.

SPECIAL PRECAUTIONS: Always check with State Agricultural Experiment Station or Extension Service specialists so as to comply with existing regulations reference the introduction of chemicals into water for aquatic weed control, and also to check on local variations of rates required. If a pond or lake is very weedy and the entire area requires treatment, do only one half at a time and wait until weeds are dead and well rotted before treating the other half. This avoids excessive weed decomposition which would reduce oxygen levels in the water to a point harmful to fish life. Do not allow chemical to be applied to adjacent desirable shoreline vegetation. Observe other handling and storage precautions listed elsewhere on label. Do not use treated waters for domestic or irrigation purposes, or for making up spray to be applied to crops and desirable plants.

2,4-D may cause off flavor in fish for some days after application, therefore, apply early before fishing season begins.

Consult your State Fish and Game Agency before applying this product.

Local conditions may affect the use of this chemical. Consult State Agricultural Extension or Experiment Station weed specialists for specific recommendations for local weed problems and for information on possible lower dosages.

Follow directions carefully. Timing and method of application, weather and crop conditions, mixtures with other chemicals not specifically recommended, and other influencing factors in the use of this product are beyond the control of the seller. Buyer assumes all risks of use, storage, or handling of this material not in strict accordance with directions given herewith.

LOT No.

EPA Reg. No. 359-380
EPA Est. 359-MO-1
EPA Est. 359-OA-1

PI-1074

Manufactured by
RHODIA INC.
AGRICULTURAL DIVISION
SOMERSET, NEW JERSEY

Rhodia

VERTAC.

SILVI-RHAP®

LV-4TP

HERBICIDE

WHERE TO USE

[illegible]

PLANTS CONTROLLED

Woody Growth	[illegible]	[illegible]
Aquatic Weeds	[illegible]	[illegible]
Broad-leaved Weeds	[illegible]	[illegible]

DIRECTIONS FOR USE

[illegible]

Woody Growth in Noncrop Areas

[illegible]

Aquatic Weeds

[illegible]

Weeds in Turf

[illegible]

Weeds in Rice

[illegible]

Sugar Cane in Louisiana

[illegible]

2,4,5-TP LOW VOLATILE

4 LBS. OF SILVEX EQUIVALENT PER GALLON

ACTIVE INGREDIENTS:	
Isooctyl Ester of Silvex*	65.2%
INERT INGREDIENTS:	34.8%
TOTAL	100.0%

*[illegible]

MANUFACTURED FOR
VERTAC, INC.
MEMPHIS, TENNESSEE 38137

EPA REG. NO. 39511-47

CAUTION

This product may cause skin irritation. Avoid inhaling spray mist. Harmful if swallowed. Avoid contact with the eyes, skin, or clothing. Flush eyes with clean water and get prompt medical attention.

WARNING

DO NOT apply this product to susceptible broadleaved plants that are desirable such as cotton, soybeans, tomatoes, grapes, flowers or ornamentals. [illegible]

[illegible]

DO NOT contaminate water in lakes, ponds, irrigation ditches, drainage ditch banks or water used for domestic purposes.

DO NOT contaminate water by cleaning of equipment or disposal of wastes. Apply this product only as specified on this label.

[illegible]

DO NOT store this product near fertilizers, seeds, insecticides, or fungicides. DO NOT contaminate food or foodstuffs.

DO NOT use spray equipment contaminated with this product for any other purpose. [illegible]

If stored below freezing, it may be necessary to warm to 40°F, and agitate before using. This does not affect the efficiency of the product.

DO NOT reuse empty container. Destroy by burying in a safe place away from water supplies.

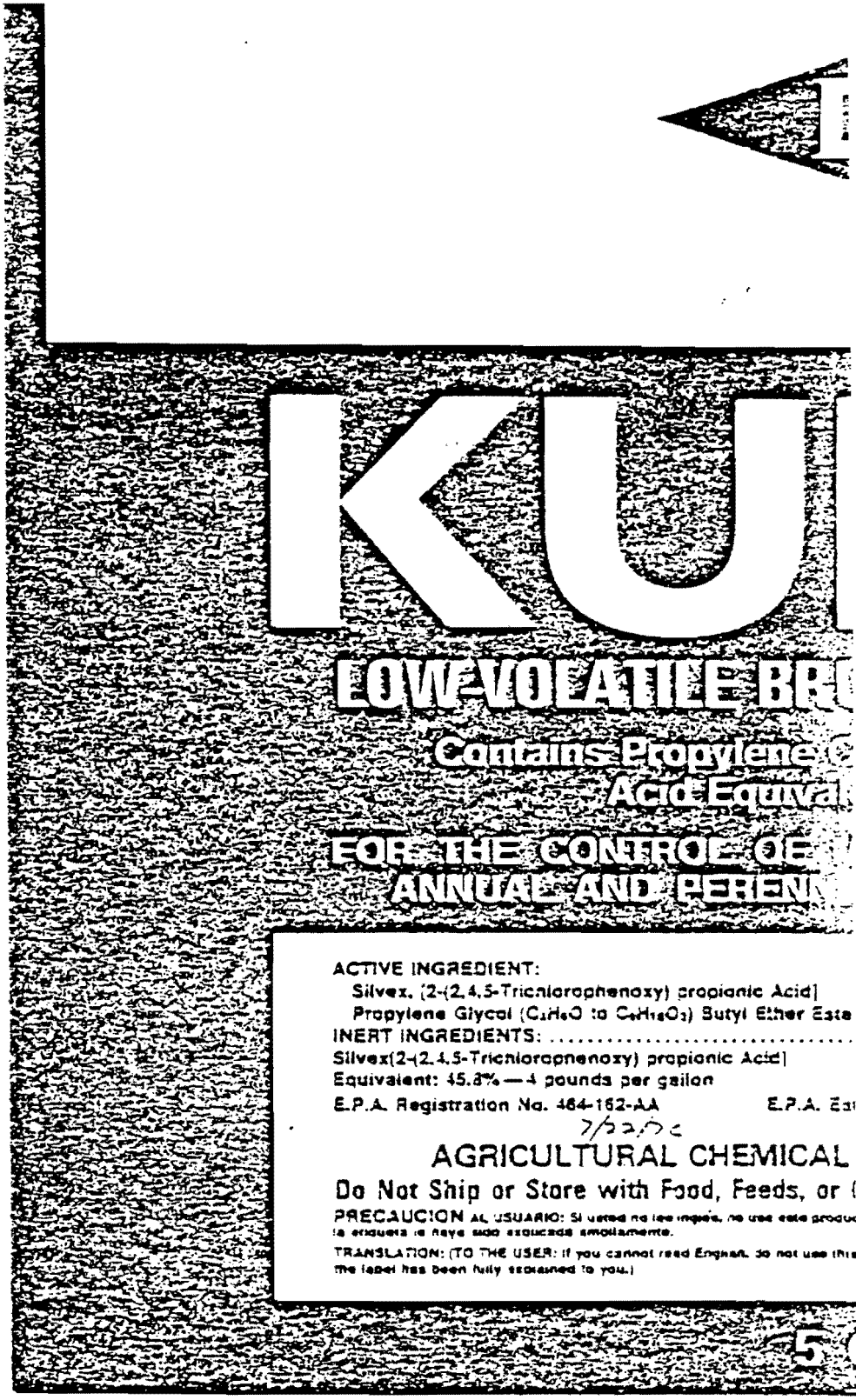
NONWARRANTY

[illegible]

NET CONTENTS: GAL.

C-8 [illegible] PRINTED IN U.S.A.

CAUTION KEEP OUT OF REACH OF CHILDREN
READ SIDE PANELS FOR ADDITIONAL HANDLING PRECAUTIONS



86-1092 PRINTED IN U.S.A. IN DECEMBER, 1974

REPLACES SPECIMEN LABEL 86-1092 PRINTED IN SEPTEMBER

REVISIONS INCLUDE: (1) EPA ESTABLISHMENT NUMBER ADD
(2) AGRICULTURAL CHEMICAL STATEMENT ADDED

SPECIMEN LABEL
REDUCED TO 72%

RON

H AND WEED HERBICIDE

oB Butyl Ether Esters of Silve
pounds per gallon

Y WOODY PLANTS HERBACEOUS
WEEDS AND AQUATIC WEEDS

CAUTION

KEEP OUT OF REACH OF CHILDREN
HARMFUL IF SWALLOWED
MAY CAUSE SKIN IRRITATION
Avoid Contact with Eyes, Skin
and Clothing

E/189 E

973

DOW

KURON

LOW-VC
AND WI

Contains Propylene Glycol Butyl Ether Esters of Silvex   Acid Equivalent: 4

USES

KURON herbicide is recommended for control of many species of woody, herbaceous and aquatic plants growing on industrial sites: in forests; on rights-of-ways such as communication lines, electrical power lines, pipelines, highways and railroads; along drainage ditch banks, fuel breaks and fence rows; on golf courses, parks and athletic fields; in ponds and similar aquatic areas; in farmyards, pastures and rangeland; and in rice and sugarcane. Use only as recommended on this label.

KURON herbicide will control most unwanted (1) woody plants, such as alder, bramble, [illegible], dogwood, honeysuckle, locust, maple, mesquite, oak, persimmon, poison ivy, poison oak, [illegible] cactus, sassafras, salmonberry, salt cedar, wild rose, willow, yucca; (2) broadleaf weeds such as [illegible], blackmedic, [illegible], burdock, buttercup, croton, chickweed, [illegible], dandelion, dogfennel, groundcherry, [illegible], lupine, [illegible], plantain, ragweed, spurge; (3) aquatic weeds, both emergent and submergent species, such as arrowhead, bladderwort, [illegible], pickerelweed, waterlily, watermilfoil and waterweed. Many other species in each category also can be controlled.

DIRECTIONS

Foliage sprays should be applied when brush or weeds are actively growing. Application under drought conditions may give poor results. Use low spray pressure to minimize spray drift. Do not apply KURON where spray drift may contact nearby susceptible crops or other desirable plants. Read and follow all Use Precautions given on this label. NOTE: Consult your Agricultural Experiment Station or Extension Service weed specialists for advice concerning special local use conditions.

PREPARING THE SPRAY

KURON herbicide in water or oil-water sprays forms an emulsion. Separation may occur unless the spray mixture is continually agitated. Mechanical agitation is recommended. When mixed only with oil a solution is formed and further agitation is not needed. NOTE: Where oil is recommended, use diesel oil, No. 1 or No. 2 fuel oil or kerosene.

Oil Sprays: Add KURON to the required amount of oil in the spray tank or mixing tank and mix thoroughly. Do not let any water or oil-water mixture get into the KURON or into the mixture, since this may cause formation of a thick gel.

Water Sprays: Fill the spray tank about half full with water. Then, with agitator running, slowly add the required amount of KURON and finally complete filling the tank with water. Continue agitation while spraying.

Oil-Water Spray Mixtures: With vigorous agitation, 1 gallon of KURON will emulsify up to 10 gallons of oil in 100 gallons of spray mixture. Preferred mixing procedure: Premix the KURON and oil in a separate container. Start filling the spray tank with water. After the tank is about ½ full, slowly add the required quantity of the KURON-oil premix with agitator running and complete filling the tank with water. Alternate procedure: Start filling the spray tank with water. After it is about ½ full, add the required quantity of KURON with agitator running. Then add the oil and complete filling the tank. Vigorous agitation in the spray tank is required to make a good emulsion. NOTE: Agitation in the spray tank should be continued during spraying.

USES IN INDUSTRIAL AND NON-CROPLAND AREAS

RIGHT-OF-WAYS AND FOREST SITE PREPARATION: With ground application on mixed brush, use 3 to 4 quarts of KURON in 100 gallons of water and apply as a full-coverage spray when foliage is well developed and plants are growing actively. This usually requires 100 to 400 gallons of spray per acre depending on height and density of the brush. With aerial application on mixed brush, use 2 to 4 gallons of KURON in 10 to 30 gallons of water per acre and provide uniform spray coverage of target areas. Aircraft should be equipped and operated to minimize spray drift. With either air or ground application apply only when there is little or no wind and when there is no hazard from spray drift.

As long as there is ample soil moisture and brush is growing well, spraying can be effective throughout the growing season up to 3 weeks before normal fall frost. Spraying during hot dry weather or after the foliage loses its normal green color may result in poor control. Under dry conditions the inclusion of added oil (up to 10% of spray volume) may increase overall effectiveness. Avoid drift of spray from area being treated. To lessen spray drift when using a spray gun, use only enough pressure to obtain coverage, usually 40 to 50 psi at the gun. Brush taller than 6 to 8 feet can be sprayed successfully but in many cases treatment of basal bark, dormant stems or stumps as described on this label may be preferred.

On right-of-ways and industrial sites only, KURON can be used in a tank mix with TORDON 101 Mixture to obtain improved control of hard-to-control species and other species not adequately controlled by silvex alone. Avoid drift of spray from area being treated. With ground equipment use 3 quarts of KURON plus 1 gallon of TORDON 101 Mixture in 100 gallons of water and apply as a full coverage spray, usually requiring 100 to 400 gallons per acre. With aerial application use 1½ gallons of KURON plus 2 to 3 gallons of TORDON 101 Mixture per acre by diluting with water to a total spray volume of 10 to 30 gallons per acre. Application should be made only with a helicopter mounted Microfoil applicator or an equipment system providing equivalent drift control. Keep the spray mixture agitated to prevent separation. Do not use oil in sprays containing TORDON 101 Mixture.

FOREST CONIFER RELEASE: Oil Spray: Apply 2 to 3 quarts of KURON in about 10 gallons of oil per acre by aircraft or ground equipment to control undesired hardwoods in dormant Douglas fir, true fir, hemlock and spruce. Rates higher than 3 quarts may cause conifer injury. Do not use oil spray on pines (see water spray recommendation below). Apply before conifer bud break during late dormancy, usually February and March in the northwest. Application of this spray after conifer bud break can injure the conifers.

Water Spray: Apply 2 to 3 quarts of KURON in 10 to 15 gallons of water per acre to control hardwood species in conifers including pines. Apply during the summer after the conifers cease spring growth and have "hardened off". Rates higher than 3 quarts may cause conifer injury.

Consult your State, Regional or Extension Forester for recommendations to fit local conditions.

BASAL BARK AND STUMP TREATMENT: Brush and ... the basal 12 to 20 inches of stems and trunks. For ... taining 2 to 4 gallons of KURON in 100 gallons ... the ground and the freshly cut stumps sprayed ... control. All exposed bark down to the ground ... soaked. In either treatment, apply as a low-pressure ... equipment and at any time of year except when ... ground line.

POWERED KNAPSACK BASAL TREATMENT: Mix ... 100 gallons of spray solution. Apply with a port... stems. Total coverage of stems and root collars ... at ¼ to ⅓ throttle for best spray delivery and be... ment for maximum drift control and do not ...

MODIFIED BASAL OR DORMANT CANE TREATM... of KURON in 100 gallons of oil and thoroughly ... lower ⅓ to ¾ of the top portions of the brush. U... persimmon, sassafras and sumac, also spray ... readily visible are treated. Spray any time after ... has fallen. Brush of average density and 4 to 6 ... of spray per acre for proper coverage.

SPOT TREATMENT: To treat small brush clumps ... of KURON in 25 gallons of water and spray to ... regrowth occurs.

LAWNS, GOLF COURSES, ATHLETIC FIELDS AND ... leaf weed control, use 1½ quarts of KURON in ... areas use 3 tablespoons in 2 gallons of water. ... injury to the grass. A second treatment may be ... as mouse-ear chickweed, yarrow and ground ivy ... following treatment. With spring application ... reseed in the spring. Do not apply to ... Augustine, carpet and centipede; to dichondra ... established; or to golf greens.

AQUATIC WEED ...

Submergent Weeds in Still Water Such as Pond... wort, bladderwort and waterweed, use 3 quarts ... in early summer when water is above 60°F and ... form distribution over the water surface is neces... diluting the KURON with water to provide enough ... tion. Also, special proportioning equipment ... water. A pond with a slight current can be treated ... will be no overflow for at least 3 days following ...

Emergent Weeds: Use 1 gallon of KURON in ... growing plants when foliage above water is well ... spray per acre of treated area. Species such as ... arrowhead can be controlled. For free floating ... foliage very thoroughly as soon as plants reach ... the treatment if regrowth reaches 4 inches above ... cation is required for effective control.

Special Precautions: Apply only in accordance ... laws governing chemical treatment of bodies ...

To avoid injury, do not use KURON where pond ... rice production), for agricultural sprays, for domes... Do not apply to water containing valuable fish ... may occur in shallow areas if application is not ... fresh water. Treatment of aquatic weeds can res... dead weeds. This loss can cause fish suffocation ... area in a single operation and wait 10 to 14 da... that treatment be applied to pond edges or ... trapped in shallow pockets or inlets. If desirable ... vegetation along the shorelines of ponds and ... water levels are low.

Do not apply algacides such as copper sulfate for ... since they may interfere with the action of the KU...

USES IN PASTURE AN...

For general broadleaf weed control, use 1½ to ... water to provide uniform spray coverage, usual... equipment and 5 to 10 gallons per acre by aircr... young and growing actively when treated. For ... control of yucca and sand shinnery oak, use 1½ ... plus water to make 4 gallons of spray per acre ... developed and plants are growing well. Usually ... sufficient but applications in succeeding years ... apply by ground equipment using 2 quarts per ... of oil. For post and black-jack oaks, apply by ... of diesel oil and 2½ to 3½ gallons of water ... application on well developed foliage, usually ... bentgrass, newly seeded areas, or after seeding ... not use on pastures underseeded to clover, alfa... to silvex. NOTE: DO NOT GRAZE DAIRY ANIMA... AFTER APPLICATION. DO NOT GRAZE MEAT ANI... PRIOR TO SLAUGHTER. DO NOT CUT GRASS FO... MENT.

THE DOW CHEMI...

SPECIMEN LABEL
(BACK)
REDUCED TO 77%

...TILE BRUSH
...) HERBICIDE

...nds per gallon

[illegible]

...GRASS TURF AREAS: [illegible]

[illegible]

...NGELAND

[illegible] ...TREATED AREAS WITHIN 7 DAYS ...ON TREATED AREAS FOR 14 DAYS ...DURING THE SEASON OF TREAT-

SPOT TREATMENT: [illegible] KURON [illegible]

USES IN CROPLAND

WEED CONTROL IN RICE: [illegible] KURON per acre. [illegible]

WEED CONTROL IN SUGARCANE

FLORIDA

Postemergence: Apply 1 to 1½ quarts of KURON in 20 to 40 gallons of water per acre as broadcast spray to control broadleaf weeds. [illegible] NOTE: Do not apply after the cane is 2½ feet tall.

LOUISIANA

Preemergence: Apply 1 quart of KURON per acre [illegible] DOWPON® [illegible] this product.

Postemergence: To control [illegible] KURON per acre [illegible] NOTE: [illegible]

HAWAII

Preemergence: Apply 4 to 5 quarts of KURON per acre [illegible]

Postemergence: [illegible] KURON [illegible] DOWPON [illegible] KURON to any one crop.

USE PRECAUTIONS

Do not apply KURON directly to, or otherwise permit it to come into contact with cotton, [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] KURON [illegible]

[illegible]

[illegible]

CAUTION

KEEP OUT OF REACH OF CHILDREN
HARMFUL IF SWALLOWED
MAY CAUSE SKIN IRRITATION
Avoid Contact with Eyes, Skin and Clothing

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

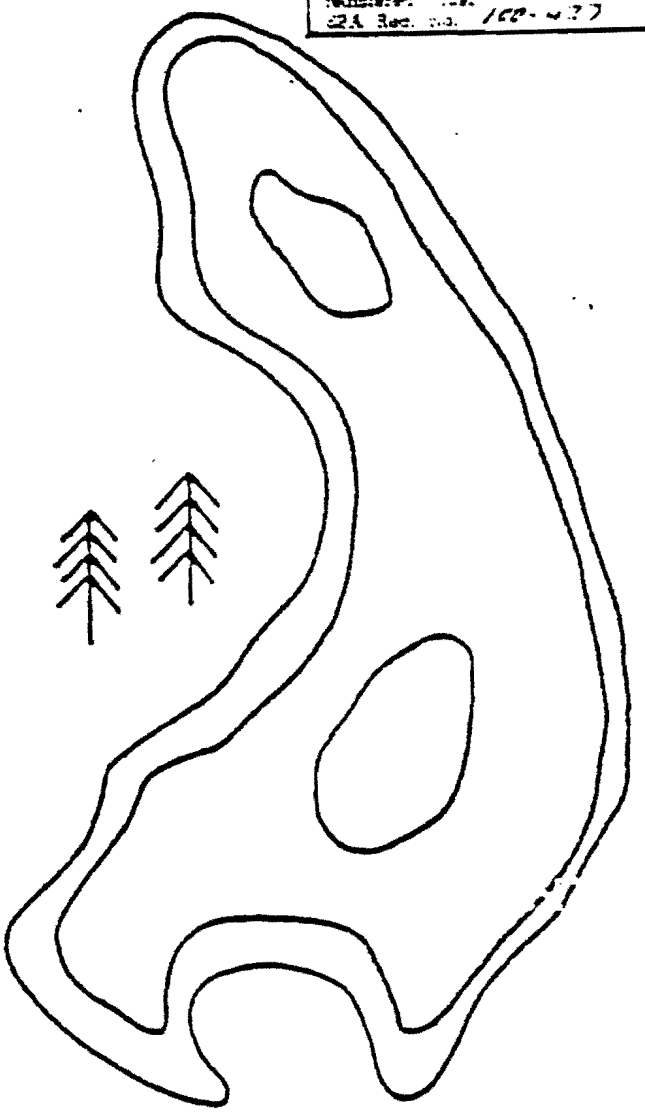
N974

...AL COMPANY

Aquazine®

algicide

For control of algae and certain pond weeds



Active Ingredient:
Simazine: 2-chloro-4, 6-bis (ethylamino)-s-triazine 80%
Inert Ingredients: 20%
Total: 100%

EPA Reg. No. 100-437

8/29/78

Caution:

Keep out of reach of children.
See additional caution statements on panel at left.

See directions for use on panel at right.

Five Pounds

Net Weight

CIBA–GEIGY

1. Broad spectrum algae control
2. Usually season-long control.
3. May be used in ponds containing fish.
4. No special equipment needed to apply.

DIRECTIONS FOR USE AND CONDITIONS OF SALE AND WARRANTY

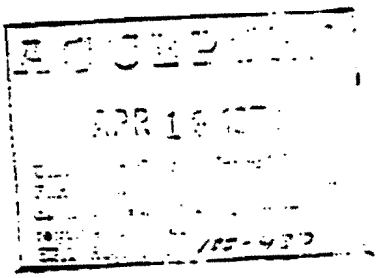
IMPORTANT: Read the entire Directions for Use and the Conditions of Sale and Warranty before using this product.

Conditions of Sale and Warranty

The Directions for Use of this product reflect the opinion of experts based on field use and tests. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness, or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application all of which are beyond the control of CIBA-GEIGY or the Seller. All such risks shall be assumed by the Buyer.

CIBA-GEIGY warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes referred to in the Directions for Use subject to the inherent risks referred to above. CIBA-GEIGY makes no other express or implied warranty of Fitness or Merchantability or any other express or implied warranty. In no case shall CIBA-GEIGY or the Seller be liable for consequential, special, or indirect damages resulting from the use or handling of this product. CIBA-GEIGY and the Seller offer this product, and the Buyer and user accept it, subject to the foregoing Conditions of Sale and Warranty, which may be varied only by agreement in writing signed by a duly authorized representative of CIBA-GEIGY.

1. Broad spectrum algae control.
2. Usually season-long control.
3. May be used in ponds containing fish.
4. No special equipment needed to apply.



Directions for Use

Aquazine may be used in ponds for control of several submerged and floating aquatic weeds and algae. Control of weeds is usually season-long. Algae may be controlled for one to three months or may require retreatment later in the season. Aquazine may be used in ponds containing fish. Use only in ponds which will have little or no outflow after treatment. Do not use Aquazine as a spot treatment.

When to Apply

Treat ponds after seasonal flow has ceased early in the weed and algae growth period. Treat when 5-10% of the pond surface is covered with scum (algae mats) or floating weeds, and/or while submerged aquatic weeds are actively growing and before they reach the surface of the water. As a general rule, ponds in northern areas may be treated between May 1 and June 15. In southern areas, where water warms up and weed growth is earlier, ponds may be treated between April 1 and May 15.

High water temperatures cause more rapid natural decay of dead weeds and algae which can cause fish distress; therefore, apply Aquazine before water temperatures exceed 75°F.

Do not treat ponds having an extremely heavy infestation of weeds and algae such as occurs in mid and late summer, since rapid decomposition of heavy growth greatly reduces the oxygen content of the water which can cause fish distress and/or death.

Dosage Rates

The appropriate rate of Aquazine depends on the types of algae and submerged weeds present and the extent of the infestation. Rates are given in terms of lbs. of Aquazine per acre foot of water. Determine the number of acre feet of water in a pond by multiplying the surface acres by the average depth in feet. Use the following guidelines to determine the dosage per acre foot of water.

Algae Control

Most unicellular algae (algae which impart a green, yellow, red or brown turbid color to the water) and many floating mat (pond scum) algae may be controlled with 1.7 to 3.4 lbs. of Aquazine per acre foot of water. If the algae infestation is light, use 1.7 lbs. If infestation is moderate, use 2.5 to 3.4 lbs. of Aquazine per acre foot.

Cladophora, Chara and water net algae require 4.25 lbs. of Aquazine per acre foot of water. Most other algae which form on the bottom soil (benthic) or which produce underwater plumes that later break loose and float on the surface, also require 4.25 lbs. per acre foot.

Algae control should be noted within 7 days after application.

Due to uncontrollable factors such as infestation with later germinating algal species, some ponds may require retreatment in mid or late summer. If retreatment becomes necessary, apply at the first signs that algae (mats or moss) is building up. Do not treat in the fall or just before freezing is expected, since water oxygen levels may be lowered during ice cover.

Submerged Weed Control

Submerged weeds, including pond weeds (*Potamogeton* spp.), naiad (*Najas* spp.), watermilfoil (*Myriophyllum* spp.), and coontail (*Ceratophyllum* spp.) may be controlled with 3.4–6.8 lbs. of Aquazine per acre foot of water. Use 3.4 lbs. for light infestations and 5.1 to 6.8 lbs. per acre foot of water for moderate infestations. For control of tanwort (*Cadomba* spp.) use 8.5 lbs. of Aquazine per acre foot.

Control of submerged weeds, except coontail, occurs in 4-6 weeks. Coontail control may require 10 weeks.

Floating Weed Control

Floating weeds, including duckweed (*Lemna* spp.) and watermeal (*Wolffia* spp.) may be controlled with 3.4–6.8 lbs. of Aquazine per acre foot of water. Within this range use lower rates for light infestations and higher rates for heavy infestations.

Where watermeal occurs alone or with other weeds, control is most effective with a split application. Apply one-half the recommended rate initially followed in 3–4 weeks with a repeat application if control is not satisfactory.

Control of duckweed occurs in 1-3 weeks, and watermeal in 5-9 weeks.

How to Apply

After determining the amount of Aquazine required to treat the entire pond, mix convenient portions such as 5 or 10 lbs. with some water in a pail or bucket to form a thin paste or slurry. Toss the paste or slurry into the pond from the shoreline. Repeat this operation at several different locations around the pond edges until the required amount has been applied. It is not necessary to use spray equipment or evenly distribute Aquazine over the surface since it will dissolve in the pond water and evenly distribute itself throughout the entire pond. Care should be taken not to spill the paste or slurry on the grass or vegetation on the pond banks as injury to such vegetation will occur.

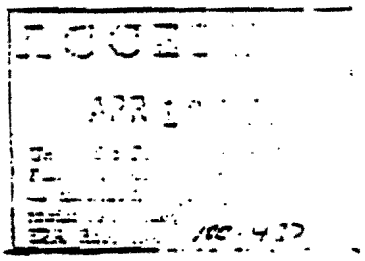
Use of Fish and Water

(1) Fish taken from treated ponds may be used for human consumption.

(2) Treated ponds may be used for swimming.

(3) Water from treated ponds may not be used for irrigation or spraying of agricultural crops, lawns, or ornamental plantings, or for watering cattle, goats, hogs, horses, poultry, or sheep or for human consumption until 12 months following treatment.

Precaution: Do not treat ponds which have bordering trees with roots visibly extended into the water, since injury to these trees may occur. Usually, trees 30 feet or more from the pond's edge will not be injured.



1. Broad spectrum algae control.
2. Usually season-long control.
3. May be used in ponds containing fish.
4. No special equipment needed to apply.

Caution

Keep out of reach of children.
Harmful if swallowed. Avoid inhalation of dust. Avoid contamination of food and feed.
Do not contaminate domestic or irrigation water supplies. Do not contaminate water by cleaning of equipment or disposal of wastes. Apply this product only as specified on this label.
Do not reuse container. Destroy when empty.
Store in a dry place.
Aquazine® trademark of CIBA-GEIGY for simazine

Agricultural Division
CIBA-GEIGY Corporation
Greensboro, North Carolina 27409
CGA 47L1S C48

FENAC™ Industrial Herbicide

Controls puncture vine, Russian thistle bindweed, leafy spurge, other broadleaf weeds and grasses on roadsides, fencerows, drainage ditchbanks and industrial areas.

CAUTION: Keep out of the reach of children. See other cautions.

ACTIVE INGREDIENTS:
*2, 3, 6-Trichlorophenylacetic acid sodium salt 17.1%

INERT INGREDIENTS: 82.9%

*2, 3, 6-Trichlorophenylacetic acid equivalent 15.7% by weight or 1½ pounds per gallon.

GENERAL INFORMATION

Aquatic Weed Control (non-irrigation uses)
FENAC can be used for the control of submerged aquatic weeds in lakes, drainage ditches, farm ponds and reservoirs not used for irrigation purposes. Specifically for boat docks, swimming areas and shore lines. Do not use treated water for domestic purposes or livestock drinking.

Apply FENAC to the exposed lake, ditch or pond bottom following drawdown or draining. Complete drawdown is not necessary. Expose only the area to be treated.

In low rainfall areas, make applications shortly after fall drawdown to allow maximum fixation time. Lakes which refill gradually and are not subject to severe flooding may be treated in fall or spring. Keep water drawn down for a minimum of three weeks following treatment. Once fixed, FENAC will remain in the area of application and control many submerged weeds as they sprout.

Prior removal of debris and excess vegetation will make application easier. In a few weeks following drawdown, aquatic plant material normally dries and disintegrates, exposing the soil bottom.

Apply 10 to 13 gallons of FENAC per acre in 50 to 100 gallons of water. Use the higher rate in areas of very dense weed infestations or in areas with a history of heavy weed growth.

Among the Weeds Controlled are:

American pondweed	*poramogeton nodosus*
leafy pondweed	*Potamogeton foliosus*
sago pondweed	*Potamogeton pectinatus*
waterthread pondweed	*Potamogeton diversifolius*
American elodea pondweed	*Elodea canadensis*
southern naiad	*Najas guadaluoensis*
waterstargrass	*Heteranthera dubia*
coontail	*Ceratophyllum demersum*
milfoil sp.	*Myriophyllum spp.*
slender spikerush	*Eleocharis acicularis*

DIRECTIONS

WEED CONTROL ON HIGHWAYS, DITCHBANKS, FENCEROWS, INDUSTRIAL AREAS

Puncture Vine:
In moderate rainfall areas (20 to 30 inches per year), treat during late winter to early spring before puncture vine emerges.

In low rainfall areas (4 inches or less per year), treat during fall or early winter, just before rains cause puncture vine to sprout.

Russian thistle:
Other seedling weeds such as plantain, kochia, turkey mullein, pigweed, and lambsquarters.

In areas with seasonal rainfall, treat in late fall or early winter, just before rains cause weeds to germinate.

In other areas, treat in the spring before weeds germinate. Apply 3 to 4 gallons of FENAC per acre in enough water for good distribution (25 to 100 gallons per acre). Use the higher rate for longer residual control, or where rain is distributed throughout the year.

Field Bindweed:
leafy spurge, Russian knapweed, Canada thistle:
In moderate rainfall areas, apply FENAC any time during the growing season. Rainfall after application is important for leaching the chemical into the root zone of perennial weeds. Therefore, treat prior to the rainy season, usually early spring or fall. Treat an extra 10 feet around patches of deep-rooted perennial weeds to make sure all roots are affected.

Amounts to Use			
	Area Surveyed	FENAC	Water
Spot treatments	1 square rod	½ pint	1 gallon
	3 square rods	1½ pints	3 gallons
	¼ acre	3 gallons	40 gallons
Large treatments	1 acre	12 gallons	50-100 gallons

Use enough water to thoroughly wet weed foliage and soil around weeds. If top growth of weeds is so heavy that FENAC will not reach the soil, burning or mowing top growth before treatment is suggested. Where practical, discing the material into the soil after application improves weed control.

Annual grasses, annual and some perennial broadleaf weeds: Apply 10 gallons of FENAC per acre in a minimum of 50 gallons of water. For seasonal control of annual weeds, treat in early spring before weed growth begins. Do not apply to frozen ground. For perennial broadleaf weeds, apply in spring or fall when rainfall after application will help leach the chemical into the root zone of these weeds.

Annuals: foxtail, crabgrass, barnyard grass, smartweed, lambsquarter, pigweed, ragweed.

Perennials: bur ragweed, indian rush pea, Texas blueweed, mouse-ear poverty weed, alkali sida, chickweed, plantain, dandelion, bounding bet.

IMPORTANT

Do not apply FENAC to frozen soil or soil subject to the rapid washing the follows a winter thaw or heavy rain. FENAC will not work properly when applied to moving water in draining streams, or to bottom mud saturated with seepage water.

In Western and Southern lakes or ditches not subject to freezing, apply FENAC before winter rains.

In ditches or lake bottoms where soils can freeze and remain frozen for long periods of time, apply FENAC in the fall before freeze-up.

CAUTION

Harmful if swallowed. Avoid contact with skin, eyes or clothing. Do not take internally.

Do not use the same sprayer for other purposes. Do not store near fertilizers, seeds, insecticides or fungicides or use in a greenhouse.

Avoid spray drift. Tests have shown that very small amounts of this material can injure many broadleaf plants such as tobacco, soybeans, cotton, most vegetables, and ornamentals. Coarse sprays are less likely to drift.

Do not contaminate water used for irrigation or domestic purposes. Consult your State Fish and Game Agency before applying this product.

IMPORTANT: Application as directed will result in the loss of soil productivity for at least one year and possibly longer, depending on soil type and rainfall. Do not allow material to drift or wash onto fields growing susceptible crops, especially soybeans and tomatoes, during the same season.

Do not reuse container. Destroy when empty.

Do not use this product for other purposes other than those recommended on this label.

WARRANTY

Amchem warrants that composition of this product conforms to the chemical description given in the ingredient statement and the product is suited for the purposes described when used according to directions. Because of the broad range of conditions which may be encountered with the use of this product, it is impossible to eliminate all risks, even though label directions are followed. Amchem therefore makes no other express or implied warranty, and no agent of Amchem is authorized to do so. Buyer agrees in purchasing the product to assume the risks and in the event of damages arising from a breach of the warranty to accept refund of the purchase price of the product as full discharge of Amchem's liability.

AMCHEM PRODUCTS, INC.
First Name in Herbicide Research
AMBLER, Pa. Clinton, Iowa St. Joseph, Mo. Fremont, Calif.

EPA Reg. No. 64-13929
EPA Est. 264-PA-1
Form No. 3720-SM-10/74 MP
Printed in U.S.A.

GENERAL INFORMATION

Hydrothol 47 is a liquid concentrate soluble in water and is a highly effective algaecide for use in lakes and ponds to control the following algae: Cladophora, Pithophora, Spirogyra and Chara when the algae are actively growing. Dosage rates indicated are measured in "Parts per Million" (ppm). 1 ppm as a dosage rate means that there would be 1 part endothall (acid) in 1,000,000 parts of water.

LAKES AND PONDS

ALGAE CONTROL: Cladophora, Pithophora, Spirogyra and Chara can be controlled with applications of ¾ to 3 pints per acre foot (0.05 to 0.2 ppm) applied as a uniform surface spray or injected under water surface. Pithophora may require 0.2 ppm or higher. Dosages may be increased to ½ to 1½ gals. (0.3 to 0.8 ppm) where greater longevity of control is desired and for marginal treatments. Repeat treatments when algal growth reappears.

APPROXIMATE QUANTITY OF HYDROTHOL 47 FOR ONE ACRE* TREATMENT

	Dosage for various concentrations in ppm				
Depth	0.1	0.2	0.3	0.5	0.8
1 ft.	1.5 pts	2.9 pts	.5 gal	.9 gal	1.5 gal
4 ft.	5.8 pts	11.6 pts	2.2 gal	3.6 gal	5.8 gal

*one acre equals approximately 208' x 209'

PENNWALT

WARNING

KEEP OUT OF REACH OF CHILDREN

MAY BE FATAL IF SWALLOWED, IRRITATING TO SKIN, NOSE, EYES, AND THROAT
MAY BE ABSORBED THROUGH SKIN.

Do not get in eyes, on skin, or on clothing. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes get medical attention. If swallowed give cold milk or cold water. Call a doctor immediately. Bathe and change clothing at least daily while using.

USDA Registration No. 4581-173

NET CONTENTS _____ U.S. GAL.

SOLD BY

AGCHEM-DECCO DIVISION—PENNWALT CORPORATION

TACOMA, WASH. MONROVIA, CA. PHILADELPHIA, PA.
OAK BROOK, ILL. BRYAN, TEXAS FRESNO, CALIF. MONTGOMERY, ALA.

CAUTION

Fish will be killed with dosages in excess of 0.3 ppm. Avoid contact with or drift to desirable plants or crops as injury may occur. Do not store this material where it may contaminate seeds, feeds, or foodstuffs. Wash spray equipment out after each operation. Do not use fish from treated water for food or feed within three days after treatment. Do not use treated water for irrigation or agricultural sprays on food crops, for watering livestock or for domestic purposes within the following periods: Up to 0.3 ppm, 7 days after application; Up to 3.0 ppm, 14 days after application.

Necessary approval and/or permits should be obtained in States where required. Do not use where fish are an important resource, consult state water or conservation authorities before applying to public waters or to ponds or streams which flow into public waters.

Burn or bury containers. Stay out of smoke; never re-use.

NOTICE

Pennwalt Corporation warrants that this material conforms to the chemical description on the label and is reasonably fit for the purposes referred to in the Directions for Use, subject to the risks referred to therein. Pennwalt Corporation makes no other express or implied warranty, including any other express or implied warranty of FITNESS or of MERCHANTABILITY, and no agent of Pennwalt Corporation is authorized to do so except in writing, with a specific reference to this warranty. Any damages arising from a breach of this warranty shall be limited to direct damages, and shall not include consequential commercial damages such as loss of profits or values.

MADE IN U.S.A. 2 FLUID OUNCES PRINTED IN U.S.A.

GENERAL INFORMATION

AQUATHOL PLUS is an especially formulated product useful in the control of a broad range of aquatic plants, both submerged and emerged. This product offers a margin of safety to fish when used at recommended dosages. Only 1 to 6 ppm total active ingredient is normally required for control of most aquatic weeds. Use as a contact killer only after weeds are present.

HOW TO USE

AQUATHOL PLUS is recommended for the control of the following weeds in recreational lakes and ponds. Since the active ingredients of AQUATHOL PLUS are water soluble, marginal treatments of large bodies of water less than one acre should preferably be made with the granular formulation of AQUATHOL PLUS.

Apply AQUATHOL PLUS at the recommended rates as an even surface spray where floating weeds are the problem. Where submerged weeds are prevalent, the material may be injected below the surface or sprayed, depending on the problem.

Dosage rates indicated for the application of AQUATHOL PLUS are measured in "Parts Per Million" [ppm]. 1 ppm as a dosage rate means that there would be 1 part of AQUATHOL PLUS' active ingredient in 1,000,000 parts of water.

WEEDS CONTROLLED DOSAGE CHART

COMMON NAME	LATIN NAME	Table Feed or Large Area Treatment
SUBMERGED		
Bass Weed	Potamogeton amplifolius	3 ppm
Coontail	Ceratophyllum spp.	3 ppm
Fanwort	Cabomba spp.	3 ppm
Milfoil	Myriophyllum spp.	3 ppm
Pondweed		
Bushy	Najas spp.	3 ppm
Curly Leaf	Potamogeton crispus	1.5 ppm
Flat Stem	Potamogeton zosteriformis	3 ppm
Floating Leaf	Potamogeton natans	3 ppm
Horned	Zannichellia spp.	3 ppm
Sago	Potamogeton pectinatus	3 ppm
	Potamogeton nodosus	3 ppm
	Potamogeton diversifolius	3 ppm
	Potamogeton foliosus	3 ppm
	Potamogeton pusillus	3 ppm
Water Cress	Nasturtium spp.	3 ppm
Water Star Grass	Heteranthera spp.	3 ppm
Watermilfoil*	Elodea spp.	3 ppm
EMERGENT AND FREE-FLOATING		
Arrowhead	Sagittaria spp.	3 ppm
Bur Reed	Sparganium spp.	3 ppm
Lotus	Nelumbo spp.	3 ppm
Spike Rush	Eleocharis spp.	3 ppm
Water Hyacinth	Eichhornia spp.	3 ppm
Water Lily**	Nuphar spp. (Spatterdock, Cow Lily)	3 ppm
Water Primrose	Jussiaea spp.	3 ppm

*Not every species at 3 under some conditions 3 ppm may be required
**See application section 1 at the recommended rate 30 days apart

For control of weeds using lake margins use 4-6 ppm.

HOW TO DETERMINE QUANTITY TO BE APPLIED

The following table is for the total quantity of material to be applied for the control of

PENNWALT

AQUATHOL PLUS

FOR AQUATIC WEED CONTROL

ACTIVE INGREDIENTS:

INERT INGREDIENTS:

TOTAL

WARNING

KEEP OUT OF REACH OF CHILDREN

See specific warning and caution statements on side panel

USDA Registration No. 4581-183

Net Contents U. S. Gallons

(OPTIONAL)

AGRICULTURAL CHEMICALS DIVISION — PENNWALT CORPORATION

Appendix 4

New York State Department of Environmental Conservation

MEMORANDUM

TO: Regional Fisheries Managers
FROM: Bureau of Environmental Protection
SUBJECT: Dosages of Herbicides Permissible in Water

DATE: May 19, 1980

The Division of Fish and Wildlife has a working agreement with the Bureau of Pesticides that provides for review and recommendations on all applications for permits to use chemicals in water for the control of aquatic vegetation. Reviews are done at the Regional Office on all applications. First time and amended applications are also reviewed by central office of the Bureau of Environmental Protection.

It is the intention of this memorandum to provide guidance to all regional Fish and Wildlife personnel who review these applications so they may be aware of the chemicals which are generally approved for use and the allowable dosages for each chemical. General conditions for waters open to the public are also provided. The pesticide inspector in each region should have available copies of the labels for each pesticide formulation as registered with EPA and the Bureau of Pesticides. Always consult the label to determine the amount of active ingredient in the chemical proposed for use.

The standard dosages of herbicides which may be permitted in fresh water for control of aquatic vegetation is as follows:

Copper sulfate ($CuSO_4 \cdot 5H_2O$) For control of algae 0.3 ppm in the upper six feet of lakes or ponds. (0.815 pounds per acre foot of water). Solid forms are not to be spread directly into water. Solid forms must be dissolved either by dragging bags behind a boat or by stirring in water containers prior to spraying. Best control of floating mats of filamentous algae is by spraying a solution of copper sulfate on the surface at whatever dosage would produce 0.3 ppm when dissipated to the bottom or six feet deep, whichever is less. If water is inhabited by trout or has less than 50 ppm of carbonate hardness, then only half the above dosage should be permitted when the entire body of water is to be treated. Water supply reservoirs may be treated without a permit. A two week separation period is required between a copper sulfate treatment and use of any other chemical. Repeat treatments are permitted at not less than 2 week intervals. Users of copper based products should be warned that all of the copper they put in the water will be deposited in the bottom sediments and will accumulate there and may eventually cause problems by poisoning anything living in these bottom sediments.

Cutrine, Cutrine Plus and other copper compounds are permitted in place of copper sulfate provided the dosage of elemental copper does not exceed the amount in 0.3 ppm copper sulfate. This is 0.076 ppm elemental copper or 0.2 pound per acre foot. Cutrine has 0.76 lb copper per gallon so 0.27 gallon per acre foot is permitted in the upper 6 feet of depth. For Cutrine Plus which has 0.909 lb copper per gallon the dosage allowed is 0.23 gallon per acre foot. In both

cases this is less than the dosages recommended on the labels. All other requirements are the same as for copper sulfate. Cutrine Plus Granular is registered by EPA and New York but has never been permitted because the recommended dosage of .4 ppm of elemental copper is 5 times the copper concentration we normally allow. It might be permitted to control algae in swimming areas if no fish are present.

Diquat is the most frequently used herbicide for rooted aquatic vegetation such as pondweeds, elodea, coontail and bladderwort and for floating duckweeds. The standard dosage is one gallon per surface acre regardless of depth. In small localized situations a maximum of 2 gallons per surface acre has been approved, particularly where the applicant identified the species of plant involved and has found the 1 gallon per acre dosage to be inadequate. Never authorize in turbid water or where plants have muddy covering on leaves since the solids prevent absorption by the plants. Diquat should never be permitted together with copper products. There must be a two week separation period between their usage.

2,4-D Granular formulations of various esters, most of which are equivalent to 20% 2,4-D acid should be used in early season during active plant growth to control coontail, watermilfoil water stargrass, water lillies, watershield and water chestnut. Standard dosage is 20 lb of acid equivalent per acre although water lillies, watershield, coontail and water chestnut often require higher dosages. The maximum dosage allowed is 40 pounds of acid equivalent per acre. Cannot be used where domestic water supplies will be affected. Liquid formulations are available but are seldom requested for use any more because they are not allowed at as high dosages as the granular which is a slow release method and more effective. Liquid formulations can be used as a foliage spray on floating leaved or emergent vegetation at dosages specified on the labels (usually not over 8 lb acid equivalent per acre).

Endothall There are several formulations of this acid which are particularly useful in controlling specific aquatic vegetation problems which may be permitted.

Aquathol "K" uses the dipotassium salt of endothall in liquid form as its active ingredient and is especially effective for control of Najas spp, Potamogeton crispus, Ceratophyllum spp, and Zannichellia palustris. Aquathol Granular is the same chemical in granular form and provides a slow release of the active ingredient at the lake or pond bottom thus having less impact on the entire water column. Dosage should not exceed 3 ppm of active ingredient for entire pond or lake treatments or 4 ppm for spot or marginal treatments. Hydrothal 47 (Liquid) and Hydrothal 191 (Granular) contain dimethylalkylamine salts of endothall (acid). These chemicals can cause fish kills at dosages slightly above 0.3 ppm acid equivalent. They may be permitted for control of filamentous algae and Chara in localized sites such as swimming areas and drainage ditches at dosages up to 0.2 ppm acid equivalent if fish are present. If no fish are present the higher dosages up to 0.8 ppm may be allowed to provide longer lasting control. The lower dosage where fish are present may have to be repeated several times in a season when algal growth reappears.

Simazine (Trade name Aquazine) is a broad spectrum herbicide which controls planktonic and filamentous algae, Chara, Myriophyllum, Najas and Potamogeton. It is relatively non-toxic to fish and zooplankton but its persistence for as

much as two months makes its large scale use unacceptable. It is therefore registered for use only in ponds where little or no outflow occurs during the entire summer season. Because of its broad spectrum effect it may limit primary productivity in a pond and thus reduce fish growth rates. Authorize only in private ponds with no summer outflow. Maximum allowable dosage is 6.8 lbs. per acre foot of water.

2,4,5-TP (Silvex) No herbicides containing this active ingredient may be authorized due to its dioxin contaminants.

General Conditions in waters open to the public

Waters open to the public include all of the larger lakes in the state where the bottom of the lake is state owned up to mean low water line. These include the Great Lakes (Erie, Ontario), Chautauqua Lake, Lake Champlain, Lake George, Oneida Lake and the Finger Lakes (except Hemlock). Other lakes where the ownership of the bottom may be uncertain are considered open to the public whenever there is any publicly owned land touching the shoreline of the lake and such lands are not posted or regulated against general public access. In all such waters open to the public the following conditions apply to any permits for use of chemicals in water to control aquatic vegetation:

a. Treatment for rooted aquatics (vascular plants) may not be done more than 200 feet from shore or in water over six feet deep except to open boat channels not over 100 ft wide out to open water. Such boat channels should be no closer than 0.25 mile apart.

b. Undeveloped shorelines may not be treated.

c. Shorelines adjacent to publicly owned lands may be treated only with concurrance of the agency having jurisdiction of such lands.

d. Other than for algae control, only one chemical herbicide may be used in any treatment area per year and repeat treatments with the same or another chemical in the same year are prohibited. (This rule is generally followed in private lakes also but might have to be relaxed if the private owner is adamant and the label allows it)

e. Any treatment which would result in demonstrable harm to fisheries resources may be denied or limited as the situation warrants.

APPENDIX 5

FEDERAL INSECTICIDE, FUNGICIDE, & RODENTICIDE ACT - CATEGORIES OF TOXICITY

		ROUTE OF ADMINISTRATION			
		LD_{50}			LC_{50}
Category	Signal Word on the Label	Oral (mg/kg)[1]	Probable Oral Dose for a 150 lb. Man	Dermal (mg/kg)[1] 24 hr. Exposure	Inhalation (ug/l)[2]
I (HIGHLY TOXIC)	DANGER - skull and crossbones -	0 to 50	a few drops to a teaspoonful	0 to 200	0 to 200 0 thru 0.2 mg/l
II (MODERATELY TOXIC)	WARNING	over 50 to 500	over one teaspoonful to one ounce	over 200 to 2,000	over 200 to 2,000 (0.2 thru 2 mg/l
III (SLIGHTLY TOXIC)	CAUTION	over 500 to 5,000	over one ounce to one pint or one pound	over 2,000 to 20,000	2,000 to 20,000 2 thru 20 mg/l
VI (RELATIVELY NONTOXIC)	none*	over 5,000	over one pint or one pound	over 20,000	over 20,000 (greater than 20 mg/l

NOTE: *None required based on acute toxicity; however, nature of product and use pattern may require appropriate precautionary statements.

LD_{50} - the dose level which will kill 50% of the test animals. Minimum of 14 days observation. Animals fasted for oral studies.

LC_{50} - the air concentration which will kill 50% of test animals exposed for a period of 1 hour. Minimum of 14 days observation. Vapor or gas may be expressed in ppm.

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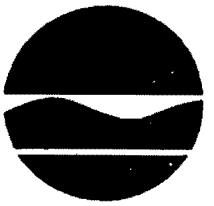
[1]Equivalents: 1000 milligrams (mg) = 1 gram (g); 28.3 grams = 1 ounce; 1 kilogram (kg) = 2.2 pounds (lb)

[2]Equivalents: 1 liter (l) = 1.06 quarts; 1000 micrograms (ug) = 1 milligram (mg)

This information obtained from the Northeastern Regional Pesticide Coordinators' Pesticide Information Manual.

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233



Robert F. Flacke
Commissioner

Appendix 6

A SPECIAL MESSAGE FROM THE DIVISION OF FISH AND WILDLIFE

TO: PERSONS WHO APPLY CHEMICALS CONTAINING COPPER TO LAKES OR PONDS

Every package of cigarettes bears a warning that smoking may be dangerous to ones health. Every container of copper sulfate or other copper-containing algicide should bear a conspicuous warning that its contents may be dangerous to the health of the waters where used.

New York State law requires the Department of Environmental Conservation to issue permits for the use of chemicals in water to control aquatic vegetation. These permits cannot be legally denied in privately owned waters. Only the dosage of authorized chemicals may be restricted to assure safety to aquatic life at the time of treatment.

However, we feel it is our obligation to warn permittees that all of the copper which is put into a body of water goes into the bottom sediments and stays there indefinitely (unless dredged out). The use of copper algicides year after year thus results in a continuous accumulation of copper in the bottom sediments (mud). Copper is a toxic substance when present at excessive concentrations just as common salt (sodium chloride) is toxic in large doses (there are no fish in the Great Salt Lake of Utah!).

Repeated use of copper-containing algicides can cause serious environmental damage in lakes or ponds. Bottom dwelling organisms which are one source of fish food can be completely eliminated and certain desirable rooted aquatic plants may be unable to grow. Some people may consider it an advantage to have a sterile lake bottom. However, we have heard of some lake owners in Wisconsin who have spent large sums of money to have the copper dredged out of their lake beds after the lakes became unproductive due to copper poisoning.

We do not have the ability to test lake bottoms to warn of impending toxic conditions. We can only warn you that continued use of copper-containing chemicals in any body of water can severely impair the future ability of that water body to support normal living communities of plants and animals.

Appendix 7

Copper

Recommendation: 0.005 mg/l. as total copper for the protection of fish and aquatic life.

Existing criterion: Not greater than 0.2 milligrams per liter expressed as Cu in waters having an alkalinity of 80 milligrams per liter or above.

Copper when dispersed to water, is distributed in several forms, most commonly including metallic copper, copper sulfate, copper chloride, copper nitrate and copper oxide. Metallic copper is insoluble in water, while copper oxide is only slightly soluble and the remaining salts are highly soluble in water.

The uses for copper and its salts are very diverse. Metallic copper is used extensively in the electroplating and electrical industries, and for cooking utensils, pipes, roofing, currency and other uses where corrosion resistance or conductivity are important. Copper salts are used in textile processes, insecticides, fungicides, algicides and other industrial purposes.

Copper salts generally occur in natural waters in trace quantities, usually less than 0.020 mg/l. (McIntosh, 1976). Thus the presence of elevated quantities of copper usually indicate human influence or pollution. Copper in small quantities is considered an essential element for life, particularly in the formation of hemoglobin in animals and for growth of plants. However, small increases in copper content of water may quickly make the water unsuitable for life.

There has been insufficient work accomplished in defining clearly the toxic agent of a copper compound, i.e., total vs ionic copper, and its relationship to

parameters affecting its availability in water. Therefore, all concentrations given below will be as total copper unless otherwise specified.

McIntosh (1975) demonstrated the rapidity with which copper is complexed in moderately hard water. Upon addition of 3 mg/l. copper sulfate, the copper concentration declined within one day of addition to levels approximating 0.5 mg/l. and subsequently gradually declined to background concentrations in 6 to 8 weeks. The copper became accumulated primarily in plant tissue and the sediments. Stiff (1971) observed that 43 to 77 percent of copper in natural waters was adsorbed to suspended particulate matter greater than 0.45 um in size. In model water systems, the soluble copper was present predominantly as copper carbonates (approximately 96.7%) with the remainder as ionic copper when amino acids, cyanide or humic complexes were absent. However, in the presense of these latter substances, copper became strongly complexed with these substances to varying degrees rather than forming copper carbonates (Stiff, 1971).

Copper concentrations in water that are detrimental to humans are unlikely to be consumed due to their disagreeable taste (McKee and Wolf, 1963). Copper concentrations detrimental to livestock and most terrestrial wildlife exceed those detrimental to man and rarely occur in nature, therefore, there is little concern for copper poisoning from aqueous sources (Rudd and Genelly, 1956; Tucker and Crabtree, 1970).

Toxicity of copper and its salts (in the absence of suspended matter, amino acids, cyanide and humic complexes) to aquatic life has been widely studied. First literature recognition of the toxic effects to fish may have been that of Titcomb in 1914. Prior to that time, it algicidal (Moore and Kellerman, 1905) and bactericidal (Kellerman and Bethwith, 1906) properties had been well documented.

Lethal effects of copper in fish are caused by chelation of copper with mucousal proteins of the skin, mouth and gills (Holland, et al., 1960; Lloyd, 1961; Trama, 1954) at concentrations of copper as low as 0.03 mg/l. The responses are typical of respiratory distress or hypoxia. The fish rise to the surface of the water, increase respiration rate, dart about with jaws agape, respond less to external stimuli, finally losing equilibrium, and becoming immobile before dying.

Acute toxicity of copper to fish and other aquatic life varies widely. The concentration of copper affecting an organism varies with the same factors that affect availability of copper in water given above. Pagenkopf et al. (1974) determined that the primary toxic agent is the cupric ion and the principal factor controlling its toxicity is alkalinity. Therefore, a given concentration of copper in water of low hardness or alkalinity (less than 80 mg/l. as $CaCO_3$) and low dissolved oxygen content (less than 4.0 mg/l.) will be more toxic than if the same concentration were present in hard or more alkaline waters with higher dissolved oxygen content. The wide variation in acute toxicity is evident in Table I which presents reported toxicity findings of numerous authors. Members of the family Centrarchidae appear to be relatively insensitive to elevated copper levels (96-hour median tolerance concentrations ranging from 0.2 to 10.2 mg/l. for bluegills) (TLm) when compared with the more sensitive Salmonidae, and brown bullheads, goldfish and striped bass (96-hour TLm range from 0.04 to 0.5 mg/l.). Among the invertebrates, the various species of water flea Daphnia sp., the isopod Gammarus pseudolimnaeus and the snail Physa integra appear to be as sensitive to copper as Salmonids.

Sublethal effects (See Table 2) of copper to fish include cessation of feeding at 0.009 to 0.10 mg/l. in brook trout and rainbow trout, respectively (Drummond et al., 1973; Lett et al., 1976), increased cough response at 0.006 to

0.015 mg/l. in brook trout (McKim and Benoit, 1971; Drummond et al., 1973) and increased locomotor activity at 0.012 to 0.015 mg/l. copper (Drummond et al., 1973). This latter response manifiests itself in two extremes, i.e., avoidance and attraction. Avoidance was demonstrated with Atlantic salmon in both field and laboratory situations at copper concentrations of 0.0023 to 0.0043 mg/l. (Sprague, 1964a; Sprague, 1964b; Sprague and Ramsey, 1965; Sprague, et al., 1965) which may have been aggravated by the presence of zinc. This avoidance prevented reproduction due to failure of the salmon to reach their spawning beds. Attraction of goldfish was shown in a shallow copper gradient (0.011 to 0.017 mg/l.) (Kleerekoper, 1973; Kleerekoper et al., 1972).

Reproduction of fathead minnows was reduced at copper concentrations of 10.6 to 18.4 ug/l. in soft water (31 mg/l. as $CaCO_3$) (Mount and Stephan, 1969) and 14.5 to 33 ug/l. in hard water (200 mg/l. as $CaCO_3$) (Mount, 1968). Growth of fathead minnows was affected by copper concentrations greater than 10.6 ug/l. in soft water (Mount and Stephan, 1969) and greater than 14.5 ug/l. (Mount and Stephan, 1968) or 32.0 ug/l. (Eaton, 1973) in hard water (200 mg/l.). Similarly, growth of brook trout was reduced by 32.5 ug/l. copper in soft water (45 mg/l.) (McKim and Benoit, 1971) and rainbow trout growth was reduced by 75 ug/l copper in very hard water (365 mg/l.) (Lett et al., 1976). Some acclimation to copper at experimental concentrations was noted by Lett et al., (1976).

Accumulation of copper in fish exposed to lethal concentrations occurred primarily on the gills and in the liver (Benoit, 1975, and Brungs et al., 1973). Fish did not accumulate increasing amounts of copper with increasing age (Tong et al., 1974) nor at sub-effect levels (McKim and Benoit, 1974) but short term exposures did cause temporary (up to 79 days duration) increases in copper content of green sunfish (Lepomis cyanellus) in experimental ponds receiving

copper sulfate treatment (McIntosh, 1975). Lin et al. (1972) stated that there was no apparent relationship between length of copper exposure or concentration of copper to the copper residues detected in fish, however, fish exposed to copper generally had increased concentrations in the flesh.

Copper at concentrations of 0.006 and 0.014 mg/l. lowered the resistance of the European eel (Anquilla anguilla) and coho salmon, respectively, to the bacteria Vibrio anguillarum (Rodsaether et al., 1977; Stevens, 1977).

The maximum acceptable toxicant concentrations (MATC) and application factors for copper are in close agreement (summarized below) considering the inherent biological variability and that total copper was used for calculations rather than dissolved copper.

		MATC (mg/l.)		Application Factor		
Species	Type of water	Safe	Unsafe	Safe	Unsafe	Reference
Fathead minnow	Hard	0.015	0.033	0.03	0.07	Mount, 1968
Fathead minnow	Hard	0.024	0.037		0.07	Pickering et al., 1977
Fathead minnow	Soft	0.011	0.018	0.14	0.24	Mount & Stephan, 1969
Fathead minnow	Variable	0.066	0.12	0.04	0.07	Brungs et al., 1976
Brook trout	Soft	0.010	0.017	0.10	0.17	McKim & Benoit, 1971
Bluegill	Soft	0.021	0.040	0.02	0.04	Benoit, 1975

Similar effect - no effect concentrations are summarized on the following page and are consistent with MATC values noted above.

Effect - No effect (mg/l.)

Species	Type of Water	Safe	Unsafe	Reference
Brown bullhead	Hard	0.011	0.016	Christensen et al. 1972
Coho salmon	Soft	0.010	0.014	Stevens, 1977
Daphnia magna	Hard	0.040	0.060	Winner & Farrell, 1976
Daphnia ambigua				
Daphnia pulex	Hard	0.020	0.040	Winner & Farrell, 1976
Daphnia parvula				
Gammarus pseudolimnaeus				
Campeloma decisum	Soft	0.008	0.015	Arthur & Leonard, 1970
Physa integra				

Copper is commonly found in association with other heavy metals particularly zinc or cadmium. Synergistic reactions between copper and zinc causing avoidance reactions by Atlantic salmon have been noted previously. Eaton (1973) found that fathead minnow spawning success and egg production were reduced by copper concentrations between 5.3 and 6.7 ug/l when low concentrations of added cadmium and zinc were present. The cadmium and zinc concentrations were 3.9 and 27.3 ug/l., respectively, when no effect was observed and 7.1 and 42.3 ug/l., respectively, when reproduction was affected. Test waters had average hardness and alkalinity of 207 and 154 mg/l., respectively, expressed as $CaCO_3$. Each concentration of the heavy metals could be reasonably expected below industrial areas thus influencing the reproductive and growth capability of sensitive fishes.

Soluble copper compounds are the most widely used chemicals for the control of algae in impounded waters. The prevalent algal problems occur in waters supporting warm water fisheries. They are also the waters with the greatest nutrient content which supports algal growth. Copper at concentrations between 0.05 and 1.0 mg/l. will kill most species of green and blue-green algae. These concentrations are sufficient to kill fish if they are exposed for a sufficient period of time to copper, therefore, control of algae with copper must be dealt with cautiously. It should be noted that the greatest mass of algae will be located within the first 1 to 2 meters of the water surface. The Department of Environmental Conservation issues permits for algae control to private citizens with certain conditions attached. These conditions recognize the distributional pattern of algae in the water column and permit a copper concentration of 0.076 mg/l. in waters with an alkalinity of 80 mg/l. or more (0.025 mg/l. in waters with less than 80 mg/l. alkalinity) over the first 1 to 2 meters of the water column thereby temporarily controlling the majority of algae present. Fish within the treatment zone are temporarily repelled; however, due to the hardness

and alkalinity of the water, the copper is quickly complexed and precipitates to be incorporated in the sediments or is taken up by the algae.

The fresh waters of New York State generally have an alkalinity of 150 mg/l. or less and hardness of 200 mg/l. or less expressed as calcium carbonate. Therefore, experimental results presented above are applicable to most New York State fresh waters. Based upon MATC values, the synergistic effects of copper with other metals, and reduced disease resistance, a total copper concentration of 0.005 mg/l. is recommended.

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Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	Concentration (mg/l)	Duration	Bioassay Type*	Effect**	Reference
Fishes:						
Salmonidae:						
Salmo salar	Atlantic salmon	0.05	-	Field	Incipient lethal concentration	Sprague (1965)
Salmo salar	Atlantic salmon	0.032	-	S	Incipient lethal level soft water; 17°C	Sprague & Ramsey(1965)
Salmo salar	Atlantic salmon	0.125	96 hours	S	TLm; HD=8-10; pH=6.5-6.7; 18-21°C	Wilson (1972)
Salmo salar	Atlantic salmon	0.48	-	F	Incipient lethal level; hard water; pH=7.1-7.5; 15°C; juveniks	Sprague (1964a)
Salmo salar	Atlantic salmon	0.04-0.06	21 days	-	Little mortality; 15°C	Grande (1967)
Salmo gairdneri	Rainbow trout	0.8	48 hours	Field	TLm	Herbert et al.(1965)
Salmo gairdneri	Rainbow trout	0.4-0.5	48 hours	S	TLm; dependent on dissolved oxygen & hardness	Brown (1968)
Salmo gairdneri	Rainbow trout	0.4-0.6	21 days	S	Little mortality; 15°C	Brown & Dalton(1970)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC= Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD=Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	(mg/l) Concentration	Duration	Bioassay Type*	Effect**	Reference
Salmo gairdneri	Rainbow trout	0.75	48 hours	S	TLm; 15.3-18.4°C	Brown & Dalton(1970)
Salmo gairdneri	Rainbow trout	5.0	11 hours	S	Death or distress; 12.8°C	Applegate et al.(1957)
Salmo gairdneri	Rainbow trout	0.15	48 hours	S	TLm; 13°C	Cope (1966)
Salmo gairdneri	Rainbow trout	0.242	48 hours	F	LC 50; HD=350-375; pH=8.0-8.3	Cope (1966)
Salmo gairdneri	Rainbow trout	0.094	10 days	F	Threshold LC 50, HD= 350-375; pH=8.0-8.3	Fogels & Sprague(1977)
Salmo gairdneri	Rainbow trout	0.070	48 hours	Field	TLm; HD=21-26; pH= 5.5-6.4	Calamari & Marchetti (1975)
Salmo trutta	Brown trout	0.04-0.06	21 days	S	Little mortality; 15°C	Grande (1967)
Salmo trutta	Brown trout	2.5	12.5 hours	Field	Partial kill, 248 ppm alkalinity	Warrick et al.(1948)
Salvelinus fontinalis	Brook trout	0.1	96 hours	F	TLm; 14 month-old fish	Mckim & Benoit(1971)
Oncorhynchus tshawytscha	Chinook salmon	0.04	-	F	Acutely toxic to fry	Hazel & Meith(1970)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC= Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD-Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	Concentration (mg/l)	Duration	Bioassay Type*	Effect**	Reference
Oncorhynchus kisutch	Coho salmon	0.19-0.48	96 hours	U	TLm	Holland et al.(1960)
Oncorhynchus kisutch	Coho salmon	0.074	96 hours	S	TLm, yearlings; 10-12°C; HD=89-99	Lorz (1976)
Oncorhynchus kisutch	Coho salmon	0.060	96 hours	S	TLm, smolts; 10-12°C; HD=89-99	Lorz (1976)
Cyprinidae:						
Pimephales promelas	Fathead minnow	0.43	96 hours	F	TLm; hard water	Mount (1968)
Pimephales promelas	Fathead minnow	0.75	96 hours	F	TLm, HD=31; pH=6.9-7.2; Alk=30-31	Mount & Stephan (1969)
Pimephales promelas	Fathead minnow	0.84	96 hours	S	TLm, HD=31; pH=6.9-7.2; Alk=30-31	Mount & Stephan (1969)
Pimephales promelas	Fathead minnow	0.18	96 hours	S	TLm	Maloney & Palmer(1956)
Pimephales promelas	Fathead minnow	1.4	96 hours	S	TLm; hard water	Tarzwell & Henderson (1960)
Pimephales promelas	Fathead minnow	0.05	96 hours	S	TLm; soft water	Tarzwell & Henderson (1960)
Pimephales promelas	Fathead minnow	0.60-0.98	96 hours	S	TL 50, dissolved copper moderately soft & hard water.	Brungs et al.(1976)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC= Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD=Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	(mg/l) Concentration	Duration	Bioassay Type*	Effect**	Reference
Notimegonus crysoleucus	Golden shiner	1.0	-	Field	Not killed	Eipper (1959)
Notimegonus crysoleucus	Golden shiner	5.0	46 hours	F	Total mortality	Lewis & Lewis(1971)
Carassius auratus	Goldfish	0.094	24 hours	S	TLm; soft water; 25°C	Pickering & Henderson (1964)
Carassius auratus	Goldfish	0.036	96 hours	S	TLM; soft water; 25°C	Pickering & Henderson (1964)
Cyprinus carpio	Carp	2.1	24 hours	S	TLm; pH=7.8, 17°C; D.O.=6.5	Rehwoldt et al.(1971)
Cyprinus carpio	Carp	0.81	96 hours	S	TLm; pH=7.8; 17°C; D.O.=6.5	Rehwoldt et al.(1971)
Centrarchidae:						
Lepomis macrochirus	Bluegill	1.25	96 hours	S	TLm; 18°C; soft water	Patrick et al.(1968)
Lepomis macrochirus	Bluegill	1.10	96 hours	F	TL 50, HD=45; pH=7-8	Benoit (1975)
Lepomis macrochirus	Bluegill	0.74	96 hours	S	TLm; pH 5.3, HD=45-47	Trama (1954)
Lepomis macrochirus	Bluegill	1.25	96 hours	S	TLm, 18°C, soft water	Cairns & Scheier(1968)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC= Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD=Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	(mg/l) Concentration	Duration	Bioassay Type*	Effect**	Reference
Lepomis macrochirus	Bluegill	0.46	30 days	U	TLm, soft water	Surbes (1965)
Lepomis macrochirus	Bluegill	10.0	96 hours	S	TLm, hard water	Tarzwell & Henderson (1960)
Lepomis macrochirus	Bluegill	0.2	96 hours	S	TLm, soft water	Tarzwell & Henderson (1960)
Lepomis macrochirus	Bluegill	10.2	96 hours	S	TLm; hard water; 25°C	Pickering & Henderson (1964)
Lepomis macrochirus	Bluegill	0.66	96 hours	S	TLm; soft water; 25°C	Pickering & Henderson (1964)
Lepomis macrochirus	Bluegill	2.80	48 hours	S	TLm; 24°C	Cope (1966)
Lepomis macrochirus	Bluegill	0.86	24 hours	S	TLm, soft water, 25°C	Pickering & Henderson (1964)
Lepomis macrochirus	Bluegill	10.7	24 hours	S	TLm, hard water, 25°C	Pickering & Henderson (1964)
Lepomis macrochirus	Bluegill	3.8	24 hours	S	TLm; 17°C; pH-7.8; D.O.=6.5	Rehwoldt et al.(1971)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC= Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD=Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	(mg/l) Concentration	Duration	Bioassay Type*	Effect**	Reference
Lepomis macrochirus	Bluegill	2.4	96 hours	S	TLm; 17°C; pH=7.8; D.O.=6.5	Rehwoldt et al.(1971)
Micropterus salmoides	Largemouth bass	1.0	-	Field	Not killed	Eippes (1959)
Ictaluridae:						
Ictalurus punctatus	Channel catfish	2.5	94 hours	F	Not lethal, 19-24°C	Lewis & Lewis (1971)
Ictalurus nebulosus	Brown bullhead	0.17-0.19	96 hours	F	TL 50, 7 month-old fish, HD=200, 23°C, pH=7.2-8.2	Brungs et al.(1973)
Percichthyidae:						
Morone americana	White perch	11.8	24 hours	S	TLm; 17°C; pH=7.8; D.O.= 6.5	Rehwoldt et al.(1971)
Morone americana	White perch	6.2	96 hours	S	TLm; 17°C; pH=7.8; D.O.=6.5	Rehwoldt et al (1971)
Morone saxatilus	Striped bass	0.4	24 hours	F	TLm; fingerlings; 21.1C	Hughes (1971)
Morone saxatilus	Striped bass	0.25	48 hours	F	TLm; fingerlings; 21.1C	Hughes (1971)
Morone saxatilus	Striped bass	0.15	72+ hours	F	TLm; fingerlings; 21.1C	Hughes (1971)
Morone saxatilus	Striped bass	0.75	24 hr.	F	TLm; larvae; 21.1°C	Hughes (1971)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC= Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD=Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	(mg/l) Concentration	Duration	Bioassay Type*	Effect**	Reference
Morone saxatilus	Striped bass,	0.25	48 & 72 hr.	F	TLm; larvae; 21.1°C	Hughes (1971)
Morone saxatilus	Striped bass	0.1	96 hours	F	TLm; larvae; 21.1°C	Hughes (1971)
Morone saxatilus	Striped bass	8.3	24 hours	S	TLm; 17°C; pH=7.8 D.O.=6.5	Rehwoldt et al.(1971)
Morone saxatilus	Striped bass	4.3	96 hours	S	TLm; 17°C; pH=7.8; D.O.=6.5	Rehwoldt et al.(1971)
Invertebrates:						
Acroneuria lycorias	Stone fly	8.3	96 hours	S	TLm; 18°C; pH=7.25 H.D.=44; D.O.=9.2	Warnick & Bell (1969)
Ephemerella subvaria	May fly	0.32	48 hours	S	TLm, 18°C; pH=7.25 H.D.=44; D.O.=9.2	Warnick & Bell (1969)
Hydropsyche betteni	Caddisfly	32.0	14 days	S	LC 50; 18°C; pH=7.25; H.D.=44; D.O.=9.2	Warnick & Bell (1969)
Crustacea:						
Gammarus pseudolimnaeus	Amphipod	0.020	96 hours	F	TLm; 15°C; soft water	Arthur & Leonard(1970)
Gammarus lacustris	Amphipod	1.5	96 hours	S	TLm, 15°C	Nebeker & Gaufin(1964)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC= Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD=Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	(mg/l) Concentration	Duration	Bioassay Type*	Effect**	Reference
Daphnia magna	Water flea	0.044	48 hours	S	LC 50, H.D.=44-53; pH=7.4-8.2	Biesinger & Christensen(1972)
Daphnia magna	Water flea	0.013	64 hours	S	Apparent threshold toxicity for 50% of animals	Anderson (1950)
Daphnia magna	Water flea	0.0865	72 hours	S	LC 50, H.D.=130-160; pH=8.2-9.5; D.O.=8.7-11.4; 20°C	Winner & Farrell(1976)
Daphnia magna	Water flea	0.08	-	S	Threshold concentration no immobilization; Copper as $CuCl_2$; 25°C	Anderson (1944)
Daphnia magna	Water flea	0.10	-	S	Threshold concentration no immobilization; Copper as $CuSO_4$; 25°C	Anderson (1944)
Daphnia magna	Water flea	0.027	64 hours	S	Threshold Concentration; immoblization; copper as $CuCl_2$; 25°C	Anderson (1948)
Daphnia pulex	Water flea	0.086	72 hours	S	LC 50; H.D.=130-160; pH=8.2-9.5; D.O.=8.7-11.4; 20°C	Winner & Farrell (1976)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC=Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD=Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 1: Acute toxicity of copper and copper compounds to fish and aquatic invertebrates

Scientific name	Descriptive name	(mg/l) Concentration	Duration	Bioassay Type*	Effect**	Reference
Daphnia parvula	Water flea	0.072	72 hours	S	LC 50, H.D.=130-160; pH=8.2-9.5, D.O.=8.7-11.4; 20°C	Winner & Farrell(1976)
Daphnia ambigua	Water flea	0.0677	72 hours	S	LC 50 H.D.=130-160; pH=8.2-9.5, D.O.=8.7-11.4; 20°C	Winner & Farrell(1976)
Gyraulus circumstriatus	Snail	0.425	96 hours	-	TLm; hard water	Wurtz & Bridges(1961)
Physa integra	Snail	0.039	96 hours	F	TLm; 15°C; soft water	Arthur & Leonard(1970)
Physa heterostropha	Snail	0.27	48, 72 & 96 hours	F	TLm; hard water	Wurtz & Bridges(1961)
Campeloma decisum	Snail	1.7	96 hours	-	GLm; 15°C; soft water	Arthur & Leonard(1970)

* Bioassay Type: S=static; F=Flow-through; Field=Field study; U=Unknown

** Effects & remarks: TLm=median tolerance limit; LC=lethal concentration to a given percentage of individuals; MATC= Maximum acceptable toxicant concentration; TL=Tolerance limit to a given percentage of individuals; HD=Hardness as mg/l. $CaCO_3$; DO=Dissolved oxygen in mg/l.

Table 2: Chronic effects of copper and copper compounds to fish and aquatic invertebrates.

Scientific name	Descriptive name	Concentration (mg/l)	Duration	Bioassay* Type	Effect**	Reference
Salmonidae						
Salvelinus fontinalis	Brook trout	> 0.009	24 hours	F	Reduced or no feeding	Drummond et al.(1973)
Salvelinus fontinalis	Brook trout	> 0.009	24 hours	F	Increased cough response	Drummond et al.(1973)
Salvelinus fontinalis	Brook trout	> 0.012	7 days	F	Increased locomotor activity for 3 days	Drummond et al.(1973)
Salvelinus fontinalis	Brook trout	> 0.015	7 days	F	Increased locomotor activity for test period. All results above at: pH=7.54-7.75; HD=44-46; 8.5°C	Drummond et al.(1973)
Salvelinus fontinalis	Brook trout	0.0325	8 months	F	Reduced survival yearlings.	McKim & Benoit(1971)
Salvelinus fontinalis	Brook trout	0.0325	8 months	F	Reduced growth of surviving yearlings	McKim & Benoit(1971)
Salvelinus fontinalis	Brook trout	0.0325	-	F	Reduced egg hatchability	McKim & Benoit(1971)
Salvelinus fontinalis	Brook trout	0.0325	3 months	F	Alevins experience 24% mortality	McKim & Benoit(1971)
Salvelinus fontinalis	Brook trout	0.0325	4 months	F	Alevins experience total mortality	McKim & Benoit(1971)

* Bioassay Type; s=static; F=Flow-through

** Effect comments: HD-Hardness as mg/l $CaCO_3$; Alk. Alkalinity as mg/l $CaCO_3$; DO Dissolved oxygen in mg/l; MATC Maximum acceptable toxicant concentration.

Table 2: Chronic effects of copper and copper compounds to fish and aquatic invertebrates.

Scientific name	Descriptive name	Concentration (mg/l)	Duration	Bioassay* Type	Effect**	Reference
Salvelinus fontinalis	Brook trout	0.0095-0.0174	22 months	F	MATC, all results above at pH-7.5; HD=45, Alk=38.5-44.0 natural water temp.	McKim & Benoit(1971)
Salvelinus fontinalis	Brook trout	0.0094	-	F	Maximum no effect concentration for yearling thru spawning to 3 month-old juveniles. pH=6.9-8.8, HD=40-46, Alk=39.5-48.0 Natural water temp.	McKim & Benoit (1974)
Salmo gairdneri	Rainbow trout	$\geq$ 0.075	40 days	F	Reduced growth	Lett et al.(1976)
Salmo gairdneri	Rainbow trout	0.10-0.30	40 days	F	Cessation of feeding initially but returned to near normal feeding by end of experiment, tests at HD=365, 10^{o}C	Lett et al.(1976)
Salmo gairdneri	Rainbow trout	0.1	30 minutes	S	Increased time to hatching	Shaw & Brown(1971)
Salmo salar	Atlantic salmon	0.0043	-	S	Avoidance reaction	Sprague & Ramsey(1965)
Salmo salar	Atlantic salmon	0.0023	-	F	Avoidance threshold; juveniles	Sprague(1946b)

* Bioassay Type: s=static; F=Flow-through

** Effect comments: HD=Hardness as mg/l $CaCO_3$; Alk.=Alkalinity as mg/l $CaCO_3$; DO=Dissolved oxygen in mg/l; MATC= Maximum acceptable toxicant concentration.

Table 2: Chronic effects of copper and copper compounds to fish and aquatic invertebrates.

Scientific name	Descriptive name	Concentration (mg/l)	Duration	Bioassay* Type	Effect**	Reference
Cyprinidae:						
Pimephales promelas	Fathead minnow	0.0184	327 days	F	50% mortality	Mount & Stephan(1969)
Pimephales promelas	Fathead minnow	>0.0106	327 days	F	Reduced growth	Mount & Stephan(1969)
Pimephales promelas	Fathead minnow	>0.0106	-	F	Reduced egg hatchability	Mount & Stephan(1969)
Pimephales promelas	Fathead minnow	0.0184	327 days	F	No spawning occurred	Mount & Stephan(1969)
Pimephales promelas	Fathead minnow	0.0106-0.0184	-	F	MATC, tests at HD=31, pH=6.9-7.2, DO=6.9-7.9, Alk=30-31	Mount & Stephan(1969)
Pimephales promelas	Fathead minnow	0.0145-0.033	-	F	MATC; HD=200	Mount (1968)
Pimephales promelas	Fathead minnow	0.0053-0.032	12.5 mon.	F	Reduced growth at 45 days-old but roughly equal length compared to control at termination.	Eaton (1973)
Pimephales promelas	Fathead minnow	0.032	12.5 mon.	F	Reduced weight of fish.	Eaton (1973)
Pimephales promelas	Fathead minnow	0.032	12.5 mon.	F	Sexual development inhibited-effect enhanced by presence of zinc. Tests at HD=191-224, pH=7.35-7.90; DO=3.8-8.7, Alk=136-180.	Eaton (1973)

* Bioassay Type: s=static; F=Flow-through

** Effect comments: HD=Hardness as mg/l $CaCO_3$; Alk.=Alkalinity as mg/l $CaCO_3$; DO=Dissolved oxygen in mg/l; MATC= Maximum acceptable toxicant concentration.

Table 2: Chronic effects of copper and copper compounds to fish and aquatic invertebrates.

Scientific name	Descriptive name	Concentration (mg/l)	Duration	Bioassay* Type	Effect**	Reference
Pimephales promelas	Fathead minnow	0.18	9 months	F	Spawning totally inhibited	Brungs et al.(1976)
Pimephales promelas	Fathead minnow	≥ 0.12	9 months	F	Spawning reduced	Brungs et al.(1976)
Pimephales promelas	Fathead minnow	0.18	9 months	F	Some mortality due to copper tests at HD=148-340; pH=7.6-8.6; DO=5.0-12.4; Alk=76-244.	Brungs et al.(1976)
Carassius auratus	Goldfish	0.011-0.017	-	F	Attraction is shallow copper gradient	Kleerekiper(1973)
Centrarchidae:						
Lepomis macrochirus	Bluegill	0.162	22 months	F	Adult survival reduced, growth retarded, spawning inhibited	Benoit (1975)
Lepomis macrochirus	Bluegill	> 0.040	90 days	F	Larval survival reduced	Benoit (1975)
Lepomis macrochirus	Bluegill	> 0.077	90 days	F	Larval growth reduced	Benoit (1975)
Lepomis macrochirus	Bluegill	0.021-0.040	22 months	F	MATC, tests at HD=44-50, pH=7.0-8.0, DO=4-10, Alk=40-49	Benoit (1975)

* Bioassay Type: s=static; F=Flow-through
** Effect comments: HD=Hardness as mg/l $CaCO_3$; Alk.=Alkalinity as mg/l $CaCO_3$; DO=Dissolved oxygen in mg/l; MATC= Maximum acceptable toxicant concentration.

Table 2: Chronic effects of copper and copper compounds to fish and aquatic invertebrates.

Scientific name	Descriptive name	Concentration (mg/l)	Duration	Bioassay* Type	Effect**	Reference
Ictaluridae:						
Ictalurus nebulosus	Brown bullhead	0.011-0.016	30 days	F	Maximum no effect concentration on blood chemistry between limits given.	Christensen et al.(1972)
Invertebrates:						
Daphnia magna	Water flea	0.022	21 days	S	16% reproductive impairment	Biesinger & christensen(1972)
Daphnia magna	Water flea	0.035	21 days	S	50% reproductive impairment	Biesinger & Christensen (1972)
Daphnia magna	Water flea	0.080	-	S	Increased brood size but reduced survival	Winner & Farrell(1976)
Daphnia pulex	Water flea	0.080	-	S	Reduced brood size	Winner & Farrell(1976)
Daphnia parvula	Water flea	$\geq$0.060	-	S	Reduced brood size	Winner & Farrell(1976)
Daphnia ambigua	Water flea	$\geq$0.040	-	S	Reduced brood size	Winner & Farrell(1976)
Gammarus pseudolimnaeus	Amphipod	>0.0046	15 weeks	F	Growth to adult stage inhibited	Arthur & Leonard(1970)
Gammarus pseudolimnaeus	Amphipod	0.008-0.0148	6 weeks	F	No effect level	Arthur & Leonard(1970)

* Bioassay Type: s=static; F=Flow-through

** Effect comments: HD Hardness as mg/l $CaCO_3$; Alk. Alkalinity as mg/l $CaCO_3$; DO Dissolved oxygen in mg/l; MATC Maximum acceptable toxicant concentration.

Table 2: Chronic effects of copper and copper compounds to fish and aquatic invertebrates.

Scientific name	Descriptive name	Concentration (mg/l)	Duration	Bioassay* Type	Effect**	Reference
Physa integra	Snail	0.008-0.0148	6 weeks	F	No effect level	Arthur & Leonard(1970)
Compeloma dicisum	Snail	0.008-0.0148	6 weeks	F	No effect level	Arthur & Leonard(1970)
Tubifex tubifex	Tubifieid worm	0.06	6 hours	S	Depression of respiration at 20°C	Popovic & Popovic(1977
Orconectes rusticus	Crayfish	≥0.015	-	F	Growth reduced	Hubschman(1967)

* Bioassay Type: s=static; F=Flow-through
** Effect comments: HD=Hardness as mg/l $CaCO_3$; Alk.=Alkalinity as mg/l $CaCO_3$; DO=Dissolved oxygen in mg/l; MATC= Maximum acceptable toxicant concentration.

APPENDIX 8

COMPREHENSIVE COPPER STUDY

PROJECT: Impact of copper treatments on lake systems

OBJECTIVES:

1. To determine the history of copper usage for algae control on specific lakes of New York State.
2. To determine the impact of copper applications to lakes for algae control upon benthic macroinvertebrate communities.
3. To determine the relative accumulation rate of copper in lake sediments where algae control with copper is practiced.
4. To determine the potential number of lakes with impaired benthic communities as a result of copper applications.

SPECIAL NOTES:

1. Copper in water solution for extended periods of time have been shown to impair reproduction and growth of fish and certain invertebrates at concentrations considerably less than those used for algae control.
2. Water quality limits for the protection of aqutic life at levels approximating 0.005 mg/l have been proposed.
3. Copper treatments of impounded waters occur annually with treatments being made as frequently as once every two weeks during periods of heavy water usage.

4. Copper usage requiring permits from the department were as follows for the years 1976 through the present time (9/4/80):

1977	71 waters
1978	68 waters
1979	56 waters
1980	76 waters

Waters supply impoundments and ponds with no outlet which use copper for algae control are not required to obtain a permit from the department.

IMPLEMENTATION:

The project is to be implemented in three stages as follows:

1. Determine history of copper usage on all waters in New York State where copper has been used for algae control.
2. Select, sample, and analyze sediments of approximately 55 treated waters and 50 control waters of comparable sediment charcters. It is desirable to select five treated waters within each treatment class, i.e. treatment classes being waters receiving treatments for 1,2,4,8,12,14,16,18, and 20 years. An additional treatment class for waters receiving treatments for over 20 years may have as many as ten waters. Replicated chemical analysis is required.
3. Based upon the above findings in stages 1 and 2, 20 waters (5 control and 15 treatment waters) should be selected for macroinvertebrate sampling, sediment sieve analysi,s and limited water chemistry analysis. Samples of macroinvertebrates and sediments are in replicate.

More specific detail will be developed based on the physiography of the waters being sampled and subsequent results of sediment copper analysis.

BUDGET SUMMARY

Activity	# of Samples	Man Days Sample	$/sample or $/man day	Total
Part I				
Sediment collection for copper analyses	105	0.5	100	$ 5,250
Copper analyses	265	----	75	19,875
Data analyses etc.	30	----	80	2,400
Subtotal				$27,525
Part II				
Macroinvertebrate collections	20	1.5	100	$ 3,000
Macroinvertebrate analysis	20	15.0	80	24,000
Sediment sieve analysis	40	----	50	2,000
Sediment collection	40	0.3	100	600
Water collection and on-site analysis	20	0.2	100	400
Data analysis	45	----	80	3,600
Subtotal				$33,600
TOTAL PROGRAM COST ESTIMATE				$61,125

Copper Analysis of Lake Sediments

Collection of samples and shipping:

1/2 man-day/water body x $100/man-day x 105 water bodies = $5,250

Chemical analysis (copper in sediments only):

50 control water bodies x 2 samples/water body x $75/sample = $7,500

55 treated water bodies x 3 samples/water body x $75/sample (copper treated 1,2,4,8,12,14,16,18,20 and 720 years with 5 waters per trreatment period except 10 waters for treatment period 20 years) = $12,375

Data analysis, report preparation, project coordination

30 days x $80/day = $ 2,400

Subtotal $27,525

This estimate excludes any work which would correlate copper concentrations in sediments with damage, if any, to biotic communities within the water body. Such estimates must of necessity include macroinvertebrate work, additional chemical analyses for parameters other than copper, and sediment analyses.

Macroinvertebrate Rate Collection and Analysis

Collections:

Macroinvertebrate collections:

20 waters (5 control, 15 treated waters) x 1.5 man-days/water x $100/man-day = $3,000

Sediment collections (in conjunction with macroinvertebrate collections) for sieve analysis:

20 waters x 0.3 man-days/water x $100/man-day = $ 600

Watercollection and on-site chemical analysis:

20 waters x 0.2 man-days/water x $100/man-day = $ 400

Analysis:

Macroinvertebrate indentification and data compilation:

20 waters x 15 man-days/water x $80/man-day = $24,000

Sieve analysis:

20 waters x 2 samples/water x $50/analysis = $ 2,000

Data interpretation, report preparation, and project coordination with data from copper analysis of sediment:

45 days x $80/day = $ 3,600

Without data from copper analysis of sediment:

40 days x $80/day $ 3,200

Subtotal $33,200/33,600

Total Costs:	w/copper	w/o copper
Copper/sediment analysis	$27,525	---
Macroinvertebrate analysis	33,600	$33,200
TOTAL*	$61,125	$33,200

* These totals exclude any increase in costs due to inflation. We have been advised that analytical costs are to be increased within the near future.

APPENDIX 9

List of Publications Available for Review

1. Aquatic Plant Herbicides - 1977; Pennsylvania State University

2. Aquatic Plants, Management and Control; Special Circular #222; Natural Resource Series; Penssylvania State University

3. Aquatic Plant Control Program; Technical Report #1; Controlled-release Herbicides; National Technical Information Service; U.S. Dept. of Commerce

4. Aquatic Plant Control Program; Technical Report #5; Aquatic-use Pattern for Silvex; National Technical Information Service; U.S. Dept. of Commerce

5. Aquatic Plant Management and Control by John H. Perverly; An Extension Publication of the New York State College of Agriculture and Life Sciences

6. Washington Pest Control Handbook; Washington State University; Washington State Dept. of Agriculture

7. Principles of Plant and Animal Pest Control; Volume 2, Weed Control National Academy of Sciences

8. Aquatic Plants and Their Control; Cayuga County Water Resources and Environmental Control Agency

9. Water Quality Criteria; California State Water Resources Control Board

10. Managing Ponds for Recreation and Esthetics

11. Aquatic Weeds - Their Identification and Method of Control; State of Illinois, Department of Conservation

12. Pesticide Information Manual; Northeastern Regional Pesticide Coordinators

13. Control of Aquatic Vegetation in New York State by Jan Adamec, Cornell U.

14. 20 Ways to Improve Surface and Waste Water

15. How to Identify and Control Water Weeds and Algae, A Guide to Water Management

Appendix 10

Letters of Comment to Draft EIS and Responses

ALLIED BIOLOGICAL CONTROL CORPORATION

March 23, 1981

Raymond J. Malkiewicz
Acting Director
Bureau of Pesticides
50 Wolf Road
Albany, New York 12233

Re: Draft Programmatic EIS Aquatic Vegetation Control Program

Dear Mr. Malkiewicz:

I have reviewed the above referenced document and in general found it to be generally objective. I do however feel a number of statements in the document are incorrect or misleading, including the following:

(1) Page 21 - Statement

Use one gallon of product (Diquat) per surface acre unless attached aquatic vegetation growth is extremely heavy, in which event up to two gallons per surface acre may be permitted.

Comment

The most important factor in selecting the proper rate of Diquat is the target weed species, not plant densities. As an example, very heavy stands of *Potamogeton crispus* can be easily controlled with one gallon/surface acre, however, two gallons/acre are required for many other *Potamogeton*. The same applies for *Najas flexilis* versus *Najas guadalupensis*.
The statement in the EIS or the regulation from which it is derived demonstrates a lack of understanding of the mode of action of this herbicide.

(2) Page 37 - Statement

"The following chemicals have little use in New York and no data is available for them".

Comment

Included in the list following this statement is Endothal and Aquazine. There is available, from the basic manufacturer, and a variety of other sources, volumes of recent data on both of these products. Both of these materials have widespread usage throughout the Northeast and certainly in New York.

Endothal is the most cost effective herbicide for control of most *Potamogetons* and certain other species as well. Aquazine is a very usefull algicide/herbicide however NYDEC policy restricts it's usage to ponds. In view of NYDEC's concern over prolonged usage of copper sulfate as an algicide, the Department should become more familar with the usage of Aquazine as a very effective algicide in certain situations.

(3) Page 30 - Statement

"Bathing and livestock watering shall be prohibited for at least 24 hours following a treatment".

Comment

This is not an unavoidable adverse impact but rather a questionable restriction imposed by the NYDEC. The federal label contains no such restrictions. Copper sulfate is routinely used in potable water reservoirs and possibly delivered to consumers within 24 hours for direct consumption. The National Secondary Drinking Water Regulations list the maximum contaminant level for copper at 1.0 mg/l which is considerably higher than the .3 mg/l permitted by NYDEC for lake treatments.

(4) Statement

Diquat - Treated waters shall not be used for irrigation, bathing, fishing or by man or animals for drinking or food processing for a period of 14 days after treatment.

Comment

This is not an unavoidable adverse impact since this restriction was partially imposed by NYDEC. The federal label requires 14 days for human consumption, 10 days for animal consumption, swimming, spraying or irrigation. There is no restriction on fishing or consumption of fish. I am not aware of use restrictions similar to NYDEC that have been imposed by any other state.

(5) Page 43 - Statement

B. A reduced dosage rate may be specified in the permits that is less than the label recommendations. A reduced rate may control the weed or algae but will not eradicate it. This sublethal rate will place less of the chemical in the aquatic environment; thereby reducing its toxicity to non-target organisms.

Comment

In some situations label recommendations as to rates are in excess of what is necessary to achieve control, however in many cases the label recommendations provides for a rate that will result in control without excessive dosages. In many cases, to reduce the rate will likely result in no control and a need for another application at a higher rate hereby exposing the aquatic environment to additional materials rather than less. Furthermore, the available herbicides do not provide for eradication but rather seasonal control. The statement appears to be a valid approach but is based on a limited understanding of the materials under discussion.

(6) In addition to the above comments, the document appears to be unduly concerned with the fisheries management aspect of lake management and aquatic vegetation control. While this is an important consideration, the NYDEC regualtions and policy decisions should consider other equally important concerns including impairment of aesthetic and recreational values as well.

Appendix 4 (Memorandum of May 19, 1980) also is based to a large degree on the management of a fisheries resource and statements in that document which somehow become NYDEC policy impose further constraints on the effectiveness of aquatic vegetation management programs carried out in New York State.

It is my recommendation that policies affecting the use of aquatic control programs should also have the benefit and views of other disciplines concerned with lake management.

Sincerely,

ALLIED BIOLOGICAL CONTROL CORPORATION

Charles E. Gilbert
Vice President
New Jersey Regional Operations

Aquatic EIS
Response to Allied Biological Control Corporation's Comments

1. Added to Final EIS.

2. Pesticide data included in final EIS as well as New York State recommendations.

3. Title 6, Part 327.6(7) of the Environmental Conservation Law states that bathing and livestock watering shall be prohibited for at least 24 hours following a treatment.

4. Title 6, Part 327.6(b)(7) of the Environmental Conservation Law states that treated waters shall not be used for irrigation, bathing, fishing, or by man or animals for drinking or food processing for a period of 14 days after treatment with diquat. This is an adverse impact, as the water cannot be used for 14 days after treatment.

5. The second mitigation measure introduces the possibility of reduced dosages of pesticides where individual circumstances may warrant or where department rules and regulations or policy dictate reduced dosages.

6. Answered under Important Environmental Impacts.

CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
2358 MUNICIPAL BUILDING, NEW YORK, N.Y. 10007 (212) 566 4124

FRANCIS X. McARDLE, Commissioner

March 26, 1981

Mr. Raymond J. Malkiewiez
Director
Bureau of Pesticides
50 Wolf Road
Albany, N.Y. 12233

Re: PEIS - Aquatic Vegetation Control

Dear Mr. Malkiewiez:

This department has completed its review of the draft programmatic EIS for aquatic vegetation control and wishes to offer the following comments:

1. Possible build-up of copper in bottom sediments (Summary page ii, pages 10, 16, 39, 42, 43):

   While it may be true that copper sulfate can ultimately be deposited in bottom sediments, it does not appear that there will be any adverse impacts.

   When used as an algicide or herbicide, copper sulfate accumulates only to the extent necessary for plant destruction, but this accumulation does not lead to biomagnification because of the homeostatic systems in the food chain. Studies performed by Kneip and Laurer (1973) and Hutchinson etal (1976) indicate that in ecosystems subjected to copper sulfate "biomagification through the food chain does not appear to occur".

   Since it is a fact that a large variety of aquatic organisms, including fish, are able to thrive in systems treated with copper sulfate, and especially in a carefully controlled water supply, we do not feel that this should be listed as an adverse impact.

(2.) 2. Algae (page 2)

Planktonic algae are miscroscopic plants that can color water only when found in an overabundance.

(3.) 3. Aquatic Vegetation Application Review (page 6):

Prior to DEC assumption of this responsibility, this department reviewed applications for approval. As also stated in the Integrated Pest Management Program, we request inclusion in this review process for applications relating to the NYC watersheds. Because of the very nature and size of these properties and our commitment to insure a supply of potable water we feel quite strongly that we have a need to know beforehand what is proposed that could influence our operations.

(4) 4. Exceptions (page 7):

Cognizance must be made of the interrelation between ground and surface waters. Wholly enclosed water bodies must somehow discharge and it is probably through exfiltration to an aquifer. The infiltration process may not cleanse these waters of all pesticides before reaching an aquifer which could be tributary to a water supply. This exception should be carefully reviewed especially in light of the findings in Nassau and Suffolk counties.

(5) 5. Important Environmental Impacts (page 15):

The prime impact is - the assurance of introduction of toxic and hazardous materials in a consistent, environmentally sound manner to protect the health and safety of the residents of New York State.

Swimming, fishing and boating are secondary to our concerns that the populus not be haphazardly exposed to potential risks. This should be emphasized before the economic impact of recreational activities as it is the prime mission of the State and City to insure environmental health and safety.

(6) 6. Environmental Impacts (page 16):

The merit of a statewide study on the potential copper accumulation in sediments is questionable in light of the information available (see comment 1). Numerous studies have been and are being made of nutrient introductions, algal blooms, etc. all of which point to control of these elements. Should measures be taken (via SPDES, etal) the need for chemical treatment would

be cut significantly. To best illustrate this point, we refer to the Great Lakes Basin and the International Joint Commission who have proposed effluent limitations for phosphous (a limiting nutrient). Establishment of pollutant budgets and effluent limitations will effectively control nutrient enrichment of ecqsystems.

(7.) 7. Human, Fish and Wildlife Impacts (pages 17-37):

Rather than attempt to list chemical agents, it is recommended that the Herbicide Handbook (4th Ed.-1979) be set as the standard reference guide. If this is not satisfactory, we would request that human toxicity be emphasized over aquatic toxicity. While preservation of fish is commendable, we do not feel that it should be given emphasis over mankind. If human toxicity is not known, this fact should be noted in capital letters.

(8.) 8. Alternatives (pages 40-42):

We recommend addition of an alternative for nutrient controls as outlined in our comment #6. The issue of nutrient controls was the subject of a grant request from DEC's Division of Water to analyze phosphous control. Elimination at the source would be an appropriate alternative and might prove most cost-effective.

(9) 9. Mitagation (pages 43-44):

D- As previously stated, if the impact of copper accumulation is negligible, what is the justification for requiring costly bottom sample analyses?

E- We again question the cost justification. If all evidence points to the homeostatic control of copper sulfate within aquatic, mammalian, and human beings, preparation of such a document serves no purpose. Copper sulfate is used medically as an emetic at dose levels of 250 milligrams which is 8000 times greater than our residual and 250 times greater than the State and Federal standards.

New York City, in conjunction with DEC, is proposing a watershed management control program to EPA, a part of which will address introduction of nutrients and possibly establish effluent limitations. In the course of that study an EAS will be prepared. At this time we therefore do not feel that an EIS is appropriate.

(10) 10. Growth Aspects (page 44):

Improvement of water quality enhancing the health and well-being of the citizens of New York should be emphasized over recreation. The entire thrust of 208 and 201 were to improve water quality and stimulate industry, etal. Conjunctive programs further protecting and enhancing the environment would also help stimulate population shifts.

(11) 11. Bibliography A and B:

There appear to be no references to copper sulfate as used in a domestic water supply. Most of the references have specific spheres of influence such as alkalinity, etc. and were not run in carefully controlled drinking water situations.

Should you have any questions concerning these comments, please contact me at (212) 566-2734.

Yours truly,

A Cole

Andrew Cole
Director
Water Quality Planning & Policy

cc: Conway/O'Connell
Scheader
Mekenian
Popper

AC:sv

Aquatic EIS

Response to City of New York Dept. of Environmental Protection's Comments

1. Very little is known about the fate and distribution of heavy metals in aquatic ecosystems, but it is probable that a considerable proportion of the elements which reach the surface water are eventually deposited in the sediments (See page 16). A building of copper in the sediment in Lakes Monrona, Waubesa, and Kegonsa in Wisconsin has been related to the copper sulfate treatment of these lakes. ("Concentration of Heavy Metals in Sediment Cores from Selected Wisconsin Lakes"; I.K. Iskander & D.R. Keeney; 1974; Environmental Science and Technology; 8,2. 165-170) The authors consider this a possible adverse impact. See Appendices 6 and 8.

2. Author agrees. Refer to page 3, Algae.

3. This EIS deals with existing policies and procedures, but the New York State Health Department does review the applications for potable water.

4. Current policy indicated by the rules and regulations include these exceptions. See additional comments under Mitigation Measures, Part E.

5. Added to Final EIS in Summary section. Author agrees; the aquatic vegetation control permit program provides a rational basis for the introduction of herbicides into the waters of New York State in a consistent, environmentally sound manner in order to protect the health and safety of the people using the water, populations of organisms that inhabit or use the water body, and the environment.

6. Information included in Final EIS.

7. Most of the chemical agents listed are those that come under jurisdiction of the permit system as they are registered for use in New York State. The Herbicide Handbook is listed in the bibliography. It is not within the scope of this EIS to give an in-depth discussion of human toxicity effects. This aspect is covered in the registration process and meets current standards acceptable to both EPA and New York State. Further, it is DEC's mandate to protect the natural resources as well as mankind.

8. Watershed management to control nutrients has been added to the Final EIS in the section Alternatives to Proposed Actions.

9. Information included in Final EIS.

10. Corrected in Final EIS. Author agrees; the items listed under growth-inducing aspects are not in order of priority.

11. The program as administered has no control over copper sulfate application to public water supplies. Additional information has been added to pages 35-44 stating existing New York State water quality standards for copper.

STATE OF NEW YORK
DEPARTMENT OF HEALTH OFFICE OF PUBLIC HEALTH
TOWER BUILDING • THE GOVERNOR NELSON A. ROCKEFELLER EMPIRE STATE PLAZA • ALBANY, N.Y. 12237

DAVID AXELROD, M.D.
Commissioner

GLENN E. HAUGHIE, M.D.
Director

DIVISION OF ENVIRONMENTAL HEALTH
LEO J. HETLING, P.E., PH.D.
Director

March 31, 1981

Raymond J. Malkiewicz, Acting Director
Bureau of Pesticides
50 Wolf Road
Albany, New York 12233

Dear Mr. Malkiewicz:

The Draft Programmatic Environmental Impact Statement on Aquatic Vegetation Control written by the Department of Environmental Conservation has been reviewed. Comments and suggestions are attached. We would also like to discuss with you the possibility of distributing permit application data to local health departments so that they would be aware of any potential for contamination of private water supplies.

Sincerely,

Leo J. Hetling /cms

Leo J. Hetling, P.E., Ph.D.
Director

LJH/pab

Attachment

Aquatic EIS
Response to NYS Department of Health's Comments

1. It is not the intent of this EIS to be an indepth study of the chemicals used in aquatic vegetation control. These pesticides are thoroughly reviewed in the Environmental Protection Agency and the state registration programs. This document will only supply enough toxilogical data to explain the basic properties of the chemicals and their effects on various organisms.

2. Correction made in final EIS.

3. Author feels that this is an excellent comment and will submit to Bureau of Pesticides for review. At present, based on existing rules and regulations, exception #2 is stated correctly.

4. a. Simazine (also called Aquazine) for aquatic weed control has little use in New York State. Restrictions for its use can be found on Page 63, Section D. In addition, Aquazine has a slight degradation after 21 days according to Reese, et al. and according to the 1979 Herbicide Handbook. The average half life is 30 days. Additional information about Simazine has been added to the Final EIS.

   b. During the permit application review, the Bureau of Public Water Supply of the NYS Department of Health, reviews the application for this particular problem. If potential contamination was a problem, they would not approve the application for permit. Existing New York State groundwater and surface water standards have been added to the Final EIS where they exist for the particular chemical in question.

   c. This information has been added to page ii, Adverse Impacts.

5. a. This is a list of aquatic pesticides used both in the past and present.

   b. Additional information has been added to the Final EIS in the Important Environmental Impacts section.

6. a. On page 1 of this impact statement, it states that "It is not within the scope of this EIS to give an indepth discussion of human toxicity of the individual chemicals." Please refer to the answer to question #1. The drinking water standards have been included.

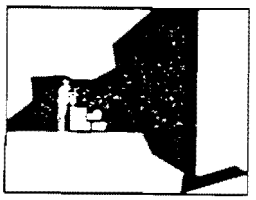
   b. Persistence information has been added to the Final EIS where it was available.

   c. Dalapon is no longer used for aquatic weed control and has been taken out of this Final EIS.

   d. The chemical reviews have been added to the Final EIS where information was available.

7. Author agrees and this is mentioned in the first paragraph under Part VIII, A.

Southern Tier Central
Regional Planning &
Development Board



53½ Bridge Street
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607/962-3021; 607/962-5092

William D. Hess
Executive Director

March 24, 1981

Mr. Raymond J. Malkiewicz
Acting Director
Bureau of Pesticides
50 Wolf Road
Albany, New York 12233

Dear Mr. Malkiewicz:

Enclosed please find copies of our staff comments on the draft programmatic environmental impact statement on DEC's aquatic vegetation control program.

Thank you for this opportunity to review the EIS.

Sincerely,

Jennifer Green Fais
Senior Environmental Planner

JGF/fmb
Encl.

CC: C. Lu
Physical Resources Advisory
Committee, Voting members

File: 05.2
42.42J

Comments and Suggestions
on Draft Programmatic Environmental Impact Statement
on Aquatic Vegetation Control

Page 1 Introduction

(1) Some of the herbicides cited in the Programmatic Environmental Impact Statement were reviewed and registered prior to FIFRA, and the types and quality of toxicity data required by EPA have changed considerably. In the case of 2,4-D, for example, EPA has recently issued a "marker" requiring manufacturers to submit additional toxicity data. Human or animal toxicity data should at least be considered within the scope of this PEIS since such information (acute and chronic toxicity data, ADI's, drinking water guidelines or standards) will aid applicants and other interested persons in selecting the herbicide most appropriate for their situation. While a compilation of toxicity data may initially require a considerable amount of time and effort, only updates would be needed in future years. If another mechanism besides the EIS would accomplish this purpose more effectively, that mechanism should be discussed.

Page 4 Rooted Aquatic Vegetation

(2) The names of representative floating aquatic plants were not provided.

(3) Page 7 Exceptions

Under exception #2, some ponds or lakes having no outlet to other waters and lying wholly within the boundaries of lands privately owned or leased may be used for campgrounds or other types of recreational areas which are open to the public. Requiring permits in these situations may provide better protection for the public.

(4) Pages 9-10 Disadvantages

A. Some of the herbicides besides copper may accumulate in the bottom sediment of ponds after repeated use. In the case of Simazine, a Missouri pond study (Bull. Environ. Contam. Toxicol. 16(1):1-8, 1976) reported that following the second year of treatment with Simazine, residues in mud and water were two to eight times higher than after the first year's application. Information on persistence and bio-accumulation would be appropriate.

B. Potential contamination of nearby public and private water supplies (surface or groundwater) should be addressed.

C. Possible effects of human exposure through swimming and other accidental or deliberate uses of treated waters after the application of various herbicides are not addressed.

(5) Pages 11-14 Pesticides and Precautionary Notices

A. Is the list of aquatic vegetation control pesticides a complete listing of those available in New York State or is it a listing of the most commonly used pesticides? This should be clarified.

B. Although the pesticide Malachite may be exempt from residue tolerances, basic toxicity information is available and its inclusion would help

the reader to compare the acute toxicities of the listed pesticides. Some data may be found in the NIOSH Registry of Toxic Effects of Chemical Substances, 1979. 1978

Some mention should be made of the current review of 2,4-D being undertaken by the U.S. Environmental Protection Agency.

Pages 17-37 Human, Fish and Wildlife Impacts

6. A. In general, more information is needed on possible human impacts. Pertinent data is available from original research articles and from toxicity reviews by EPA, WHO, NAS, and/or other qualified agencies.

Part 5 drinking water standards for the herbicides 2,4-D and 2,4,5-TP (Silvex) should be included.

B. More information is also needed on the potential for persistence and bioaccumulation of these pesticides, particularly for Dalapon, Aqualin, Diquat, and 2,4-D. The long-term persistence of copper in the aquatic environment is reviewed comprehensively, and similar discussions for the other pesticides should be included. The potential of these pesticides to persist in aquatic sediments is particularly important because of possible adverse impacts on the aquatic food chain. The persistence in water should be addressed because of possible contamination of public and private water supplies.

C. Some mention of the recommended application rate for Dalapon (pages 17-19 would be helpful).

D. Although the chemicals listed on page 37 may not be used extensively in New York, relevant information exists for at least some of them (e.g. Silvex, Aquazine). Why were these chemicals not reviewed when Aqualin, which is not recommended for use in New York State, is reviewed fairly extensively (pages 19-20)?

For purposes of comparison, information on all aquatic herbicides would be useful.

7. Page 43 Mitigating Measures

Aquatic vegetation control chemicals may be purchased by the general public. We strongly urge that these chemicals be available only to certified pesticide applicators.

COMMENTS ON THE

DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT ON DEC's

AQUATIC VEGETATION CONTROL PROGRAM

In general, I assume that approving specific chemicals for use, determining application rates and amounts, establishing water use restrictions, etc. are a part of a thorough testing and review procedure and that any questions regarding the scientific accuracy of toxicity levels, etc. would be considered as part of that procedure. This EIS concerns the relative merits of using chemicals taking into account a wide range of impacts and alternatives.

(1) P. 1. I'm not sure why the EIS states "it is not within the scope of this EIS to discuss human toxicity effects of the individual chemicals" since much of the report addresses that subject and since humans certainly qualify as non-target organisms.

(2) P. 7. When will DEC consider the effects of chemicals on groundwater whether or not chemicals are applied in privately owned "ponds or lakes having no outlet"?

(3) P. 8. Are you assuming that all certified pesticide applicators use the chemicals correctly so that there is no risk of spillage or misuse? What does the record show?

(4) P. 8. Costs of disposing of pesticides and other toxic wastes are skyrocketing to match the actual cost of safe transportation and disposal. This aspect may make less lethal methods of weed control, which are briefly discussed in the section on alternatives, more economically competitive. The economics of this "quick, cheap" method should be reevaluated. Also, if "no long-lasting effect to the next season" is listed as a disadvantage, how cost effective are chemicals?

(5) P. 8. I seriously question "(f) no aquatic vegetation disposal problem". The poisoned, decaying matter is still in the water body, which you point out on page 10(e).

(6) P.10. Effects on non-target organisms are referred to obliquely - "possible build up of copper in bottom sediments" (what does this mean to the life of the water body?) and "restricted water use period" (what general adverse impacts can we expect?).

(7) There is no specific sentence addressing the effects of aquatic pesticides on the ecology of the water body. I am hoping that this was only an oversight since a major concern of DEC is to protect the entire fabric of the environment, not just sport fish and game animals. There is also no discussion of the persistence of the chemicals or of the effects of the chemicals working synergistically. This additional "disadvantages" make that column a bit more sobering.

8. P.11-14. Why can't this information be incorporated into P.17-37? Why don't these two sections describe the same list of chemicals?

9. P.16. I'm surprised that this EIS does not discuss the merits of preventing nutrient enrichment of our lakes and ponds which lead to weed growth and the annual loss of $50 million. Again, I'm assuming that DEC has just overlooked such an obvious option; however, it should be fully discussed in the alternatives.

P.16. The fact that DEC is calling for a study on copper accumulation in sediment should make DEC more sensitive than ever to the unexpected impacts of all types of aquatic pesticides. Hopefully, DEC will be monitoring long term effects of these chemicals so that problems can be anticipated and dealt with effectively.

10. P.17-37. The chemicals' persistence in the environment should be discussed.

11. P.39. 2. Again, effects on the lake's ecology should be emphasized rather than noting temporary (thus, supposedly, minor) impacts on the rest of the lake's inhabitants. There is no real discussion of conflicting uses for the lake: fish need plantlife for food and habitat while boaters and swimmers would like as few weeds as possible.

12. P.40. Harvesting. No positive aspects to this method are listed which is not a fair assessment of the option. Equipment can be shared, long range toxic hazards are avoided and alternatives can be devised for disposal of the weeds.

13. P.41. 5. As in the gypsy moth and tent caterpillar control programs, DEC seems to feel that writing off biological controls as an experimental or untested alternative satisfies their obligation to consider them. Indeed, DEC should be cautious with new ideas, but this does not free the Department from its responsibility to pursue the least environmentally damaging alternatives possible.

14. P.42. 9. A thorough discussion of preventing nutrient intrusion into lakes should be discussed here.

15. P.42.
VII 1. What are the economic impacts of restricted water use on farmers, public water supplies, industries, bathers? Why doesn't this discussion appear in the economic impacts section, too?

16 P.42. There should be a discussion of the abundance/scarcity of the compounds used to manufacture pesticides. Are they petroleum based? Do they use scarce natural elements? How are pesticide containers/residues/processing by products disposed of? Shouldn't these concerns be discussed as an irreversible commitment of resources? These comments could also be addressed on page 44 under energy use.

Aquatic EIS
Response to Southern Tier's Comments

1. Refer to Snyder Answer #1.

2. When and if the law is changed.

3. No. We are not assuming that all certified pesticide applicators are using the chemical correctly. The training and certification process creates an awareness within the applicator; therefore, proper treatment is more likely.

4. The cost of manufacturing and operating other equipment is also skyrocketing. Economic studies involving the alternatives should be carried out.

5. There is no vegetative disposal problem with chemical control. The decaying matter is not removed, as is required in mechanical harvesting. Failure to remove mechanically-harvested vegetation would encourage more growth.

6. At present, we are aware that there may be a possible buildup of copper in bottom sediments (Appendix 6). The proposed study described in Appendix 8 would answer the questions.

7. Additional information has been added to the Final EIS where available.

8. Corrected in Final EIS.

9. Excessive nutrient input is mentioned on Page 2 and nutrient inactivation is discussed on Page 68 as an alternative to the proposed action. In addition, watershed management techniques of nutrient input have also been added to the Final EIS.

10. Persistence information has been added to the Final EIS where known.

11. Information included in Final EIS on Page 63.

12. Refer to Snyder answer #4. Additional information has also been added to Final EIS.

13. Biological controls are discussed on page 41.

14. Included in Final EIS under Alternatives to Proposed Action.

15. This would be difficult to substantiate without a comprehensive economic survey.

16. There would be no irreversible committment of resources in the issuance of a permit to initiate the program. This is the initial step in a water management program which in itself is reversible.

TOWN OF YORKTOWN
DEPARTMENT OF PARKS AND RECREATION
176 Granite Springs Road
Yorktown Heights, New York 10598

BRIAN J. SLAVIN
Superintendent

Tel. 914-245-4650

WILLIAM G. KEATING
Recreation Supervisor

March 12, 1981

Mr. Raymond J. Malkiewicz, Acting Director
Bureau of Pesticides
N.Y.S. Department of Environmental Conservation
50 Wolf Rd.
Albany, N.Y. 12233

Dear Mr. Malkiewicz:

I have reviewed the draft of the Programmatic Environmental Impact Statement on the Aquatic Vegetation Control Program of the Department of Environmental Conservation and have the following comments:

(1) Under Rooted Aquatic Vegetation (page 3). It was stated that this would be divided into three groups: submerged, emergent, and floating acquatic plants. The third (floating acquatic plants) was not discussed.

(2) Under Acquatic Vegetation Application Procedures and Requirements (page 5) Subdivision 3g. I do not believe that names and locations of riparian and other known users are required as a part of the application. However, the application does stipulate that these people must be contacted.

(3) There are two pages 21-22 in the document I received. A minor consideration or comment.

All in all, I feel that the statement was very well done. Please forward a copy of the final statement to me at the above address. It should help us at the local level a great deal.

Sincerely,

William G. Keating

William G. Keating
Recreation Supervisor

WGK:ly

Aquatic EIS
Response to Yorktown's Comments

1. Author concurs. Typing error from original document. See Final EIS for correction.

2. The names and location of all known riparian owners and users are required on the back of form #44-19-5 - Application for Permit to Use Chemicals for the Control of Aquatic Vegetation. The instructions clearly state (under Number 4B-7): An expanded sale drawing showing names and location of riparian and other known users that may be affected by treatment of this water.