Project Title:

USE OF THE REGISTERED AQUATIC HERBICIDE FLURIDONE (SONAR®) AND THE USE OF THE REGISTERED AQUATIC HERBICIDE GLYPHOSATE (RODEO® AND ACCORD®) IN THE STATE OF NEW YORK

FINAL GENERIC ENVIRONMENTAL IMPACT STATEMENT

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EXECUTIVE SUMMARY

This Generic Environmental Impact Statement (GEIS) has been prepared on behalf of DowElanco and Monsanto, for the use of their respective aquatic herbicides, fluridone (Sonar®) and glyphosate (Rodeo®/Accord®)[1]. This document was prepared for the New York State Department of Environmental Conservation (NYSDEC) as a supplement to the Final Programmatic Environmental Impact Statement on Aquatic Vegetation Control. It is the purpose of this GEIS to objectively evaluate documented evidence regarding the use of these aquatic herbicides in the control of nuisance aquatic weeds in waters of the State of New York.

This GEIS is prepared in accordance with 6 NYCRR Part 617, the New York State Environmental Quality Review Act (SEQR). The purpose of SEQR is to incorporate the consideration of environmental factors into the existing planning, review and decision-making processes of State, regional and local government agencies at the earliest possible time. An action is subject to review by NYSDEC under SEQR if any state or local agency has the authority to issue a permit or other type of approval over that action.

In the case of the DowElanco and Monsanto, NYSDEC has issued a Positive Declaration (as defined in § 617.10(b)) stating that any permits developed for the potential use of the products Sonar® and Rodeo®/Accord® herbicides in the State of New York warrant a review under the SEQR process. As described in Section 1.2 of this GEIS, the Applicants (DowElanco and Monsanto) have chosen to prepare this document as described in § 617.15 to facilitate the development of individual permits for potential users of their products. Section 617.15 (a)(4) allows for the development of a GEIS to assess the potential environmental effects of an entire program or plan having wide application.

The U.S. Environmental Protection Agency (USEPA) approved the label for Sonar® on March 31, 1986. The USEPA registration number for Sonar® A.S. is 62719-124. The USEPA registration number for Sonar® SRP is 62719-123. DowElanco received New York State registration approval for Sonar® SRP on February 9, 1993. DowElanco applied for, and was granted, a Special Local Needs (SLN) registration for Sonar® A.S. for the control of Eurasian watermilfoil (Myriophyllum spicatum L.), at application rates of 50 ppb or less in freshwater ponds, lakes, and reservoirs. The SLN registration was received by DowElanco on February 9, 1993. The SLN registration number is SLN NY-930001.

The Accord® herbicide received Federal registration on December 5, 1978 (USEPA Reg. No. 524-326-AA), with New York State registration granted shortly thereafter. The Rodeo® herbicide received Federal registration on June 14, 1982 (USEPA Reg. No. 524-343). Registration approval was granted in New York State shortly thereafter.

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[1]The rights of the trademarked product Sonar®, have been purchased by the SePRO Corporation of Carmel, Indiana. The Department of Environmental Conservation has received an application to change just the name on the labels of Sonar® A.S. and Sonar® SRP. The revised labels will be identical with DowElanco's name replaced by SePRO. The decision is pending.

The proposed action is the use of the aquatic herbicides Sonar® and Rodeo/Accord for the control of nuisance aquatic vegetation in waterbodies located in the State of New York. The use of the products can be an important component of a comprehensive management approach to limiting the production and spread of certain aquatic macrophytes. These macrophytes are often undesirable, opportunistic introduced species. These species can become a nuisance as a result of the production of excessive biomass or because of the growth habits or physical architecture of the plant. The production of these plant species can reduce the recreational use of a waterbody by interfering with swimming, boating, or fishing. They may also clog intake screens and turbines, impart an unpleasant taste to the water, reduce the presence of native aquatic species, and modify the aquatic habitat for indigenous organisms.

Because of its mat forming characteristics, excessive growth of Eurasian watermilfoil (a primary target species for Sonar®) may also present a safety hazard to the recreational use of a waterbody. The mats may conceal rocks, logs and other obstructions that could damage moving boats or injure skiers. Additionally, the mats may entangle swimmers, potentially resulting in drownings. Drownings as a result of entanglement in Eurasian watermilfoil mats have been documented in New York and Michigan.

Sonar® is a systemic aquatic herbicide produced by DowElanco. Sonar® works by interrupting the photosynthetic abilities of the target plants. Specifically, Sonar® inhibits the formation of the accessory pigment carotene within the target plants. In the absence of carotene, chlorophyll is rapidly degraded by sunlight, thereby preventing the formation of carbohydrates necessary to sustain the plant.

The active ingredient in Sonar® is fluridone (1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4[1H]-pyridinone). The U.S. Environmental Protection Agency (USEPA) Shaughnessy code for fluridone is 112900-6. Sonar® is packaged in two formulations: Sonar® SRP and Sonar® A.S. Sonar® SRP is a pelleted formulation containing 5% fluridone. Sonar® SRP is generally applied via broadcast spreading. Sonar® A.S. is a liquid formulation that is mixed with water prior to application. Sonar® A.S. is generally applied via broadcast surface spraying or through the use of underwater hoses.

For both Sonar® formulations, the critical feature with regard to aquatic macrophyte control is obtaining an adequate concentration of the product in the treated area for a sufficient time period to produce the effect. Under optimum conditions the desired level of target aquatic macrophyte control is achieved 30 - 90 days after the use of Sonar®. Sonar® is absorbed from water by plant shoots and from the hydrosoil by the roots of aquatic vascular plants.

The Milfoil Study Committee of the Vermont Department of Environmental Conservation (VDEC) reported that the VDEC has been attempting to control the spread of Eurasian watermilfoil through non-chemical means since 1978. The primary means have been mechanical harvesters and bottom barriers. Despite the attempts, the Committee has noted that Eurasian watermilfoil has continued to spread within infected lakes and to uninfested lakes. The Study Committee recommended to the VDEC in 1993 that they use aquatic herbicides on a site-specific basis for the control of introduced, exotic vascular aquatic plant species in Vermont. The Committee does not recommend the use of Diquat or Endothall because their use would not meet the statutory requirement of pesticide minimization in a long-range management plan and they do not recommend the use of 2,4-D because of the uncertainty about potential human health effects.

The Rodeo® and Accord® herbicides are the aquatic versions of the broad spectrum, systemic herbicide Roundup. The active herbicidal ingredient in Rodeo® and Accord® herbicides is glyphosate (N-phosphonomethylglycine), formulated as its isopropylamine salt. Glyphosate is a white, odorless solid which readily dissolves in water. It is not soluble in organic solvents. Rodeo/Accord are concentrated aqueous formulations which contain 53.8% and 41.5% glyphosate in the form of isopropylamine salt, respectively. The remaining component of Rodeo/Accord is water. Rodeo/Accord herbicides do not contain any added surfactants.

The primary herbicidal mode of action for the Rodeo®/Accord® herbicides is the blockage of the synthesis of aromatic amino acids. Additionally, Rodeo/Accord blocks the metabolism of phenolic compounds by disrupting the plant's shikimic acid metabolic pathway. Glyphosate is the only herbicide known to disrupt this particular enzymatic pathway. This type of disruption results in the plant's inability to synthesize protein and consequently new plant tissue.

The effectiveness of the herbicides Rodeo® and Accord® depends, in part, upon the adsorption of these herbicides to the foliage of actively growing plants. Shortly after contact with foliage these herbicides penetrate the cuticle of the plant where they begin a cell by cell migration to the phloem (i.e., plant transport mechanism). The addition of a surfactant during the application process, as recommended by the manufacturer, aids in this absorption process. Once in the phloem, Rodeo® and Accord® herbicides are transported throughout the plant, including the roots, where their herbicidal activities take place. Visible effects (i.e, wilting and yellowing) of this herbicidal action generally occur within 7 days but may require up to 30 days in some woody plants. Because glyphosate is not selective, the herbicides are effective against most species of deep rooted perennials, annual and biannual grasses, sedges, rushes and broad-leaf weeds, and woody plants.

It is the aim of this document to evaluate the role of Sonar® and Rodeo®/Accord® herbicides in the management of aquatic nuisance vegetation and the potential for impacts from that use. This Generic Environmental Impact Statement evaluates Sonar® and the Rodeo®/Accord® herbicides with respect to the following issues:

- Environmental Setting
- General Description of Sonar® and Rodeo®/Accord® Herbicides and Their Active Ingredients
- Significant Environmental Impacts
- Potential Public Health Impacts
- Mitigation Measures

- Unavoidable Environmental Impacts

- Alternatives

This Final Generic Environmental Impact Statement (FGEIS) consists of:

- The text of the FGEIS as amended from the Draft Generic Environmental Impact Statement (DGEIS), based on comments received by the Department;

- The Written Comments received on or before the close of the public comment period on June 6, 1994 and the responses to those comments are contained in Appendix G to this document;

- The Hearing Comments as received at the May 4, 1994 Hearing in Lake George; the May 5, 1994 Hearing in Poughkeepsie; and the May 11, 1994 Hearing in Rochester and the responses to those comments are contained in Appendix H to this document.

The DGEIS was accepted as complete on April 6, 1994 and available for public comment for 60 days until June 6, 1994. There were 3 public hearings held as follows:

- May 4, 1994 at 7:00 pm in the Lake George Town Center on Old Post Road in the Village of Lake George;

- May 5, 1994 at 7:00 pm in the Best Western Inn and Conference Center at 679 South Road (Route 9) in the City of Poughkeepsie; and

- May 11, 1994 at 7:00 pm in the Marriot Thruway at 5257 West Henrietta Road in the City of Rochester.

1.0 INTRODUCTION

1.1 PURPOSE OF THE GENERIC ENVIRONMENTAL IMPACT STATEMENT (GEIS)

DowElanco and Monsanto (the Applicants) are submitting this Generic Environmental Impact Statement (GEIS) to the New York State Department of Environmental Conservation (NYSDEC) for their respective aquatic herbicides fluridone (Sonar®) and glyphosate (Rodeo®/Accord® herbicides)[2]. It is the purpose of this GEIS to objectively evaluate the scientifically documented evidence regarding all aspects of the use of these aquatic herbicides for the control of nuisance aquatic weeds in waters of the State of New York. This document is a supplement to the Final Programmatic Environmental Impact Statement on Aquatic Vegetation Control (NYSDEC, 1981a) and it is intended to present a general description of the potential positive and negative impacts from the use of these materials.

1.2 OBJECTIVE OF THE GEIS

This document is intended to provide potential users with a general understanding of the various results that might be associated with the use of Sonar® and the Rodeo®/Accord® herbicides in the waters of the State of New York. By developing this GEIS, the Applicants will provide the information necessary for individual potential applicators to easily develop the necessary permit applications. However, the approach taken through the development of this GEIS is not intended to prevent any applicant from preparing a site specific supplement to the Final Programmatic Environmental Impact Statement on Aquatic Vegetation Control (NYSDEC, 1981a) in the development of a permit for the use of fluridone (Sonar®) or glyphosate (Rodeo®/Accord® herbicides) in surface waters of New York State.

1.3 REGULATORY FRAMEWORK

This GEIS is prepared in accordance with 6 NYCRR Part 617, the New York State Environmental Quality Review Act (SEQR). The purpose of SEQR is to incorporate the consideration of environmental factors into the existing planning, review and decision-making processes of State, regional and local government agencies at the earliest possible time. An action is subject to review by the NYSDEC under SEQR if any state or local agency has the authority to issue a permit or other type of approval over that action.

In the case of the Applicants, NYSDEC has issued a Positive Declaration (as defined in § 617.10(b)) stating that any permits developed for the potential use of the products Sonar® and Rodeo®/Accord® herbicides in the State of New York warrant a review under the SEQR process. As described in Section 1.2 of this GEIS, the Applicants have chosen to prepare this document

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[2]The rights of the trademarked product Sonar®, have been purchased by the SePRO Corporation of Carmel, Indiana. The Department of Environmental Conservation has received an application to change just the name on the labels of Sonar® A.S. and Sonar® SRP. The revised labels will be identical with DowElanco's name replaced by SePRO. The decision is pending.

as described in § 617.15 to facilitate the development of individual permits for potential users of the products. Section 617.15 (a)(4) allows for the development of a GEIS to assess the potential environmental effects of an entire program or plan having wide application.

The regulations concerning the use of pesticides in NYS are defined in 6 NYCRR Part 325 through 327. The regulations addressing the use of pesticides in wetlands are defined in 6 NYCRR Part 663 and within the Adirondack Park, 9 NYCRR Part 578.

The USEPA issued an Experimental Use Permit (No. 1471-EUP-67) for Sonar® in 1981. The USEPA approved the label for Sonar® on March 31, 1986. The USEPA registration number for Sonar® A.S. is 62719-124. The USEPA registration number for Sonar® SRP is 62719-123. DowElanco received New York State registration approval for Sonar® SRP on February 9, 1993. DowElanco applied for, and was granted, a Special Local Needs (SLN) registration for Sonar® A.S. for the control of Eurasian watermilfoil (Myriophyllum spicatum L.), at application rates of 50 ppb or less in freshwater ponds, lakes, and reservoirs. The SLN registration was received by DowElanco on February 9, 1993. The SLN registration number is SLN NY-930001. Pursuant to the registration conditions described in 6 NYCRR Part 326, fluridone may only be used as follows:

1. Application of aqueous suspension formulations are permitted in water of the State at application rates not to exceed 50 ppb of the active ingredient fluridone.

2. Application of pellet formulations are not permitted in waters less than two feet deep.

3. Swimming is not allowed in treated areas for a period of 24 hours following the application.

Sonar® is registered for use without restrictions in all states bordering New York State. Sonar® is not registered in Canada. The approved labels and Material Safety Data Sheets (MSDSs) for Sonar® SRP and Sonar® A.S. are presented in Appendix A.

The Accord® herbicide received Federal registration on December 5, 1978 (USEPA Reg. No. 524-326-AA), with New York State registration granted shortly thereafter. The Rodeo® herbicide received Federal registration on June 14, 1982 (USEPA Reg. No. 524-343). Registration approval was granted in New York State shortly thereafter. The approved labels for both the Accord® and Rodeo® herbicides are listed in Appendix B. The MSDS for glyphosate is included as part of Appendix D.

1.4 IDENTIFICATION AND JURISDICTION OF THE INVOLVED AGENCIES

The following agencies have been identified as involved agencies for purposes of the development of this GEIS:

a. New York State Department of Environmental Conservation (NYSDEC) - Responsible for implementation of the laws and regulations pertaining to the management of environmental resources for the State of New York.

b. New York State Department of Health (DOH) - Responsible for potential public health issues associated with the use of the Products.

c. New York State Office of General Services (OGS) - Responsible for the management of property owned by the State of New York. As pertaining to this project, they are responsible for the management of the lakes and/or lake bottoms owned by the State of New York.

d. Adirondack Park Agency (APA) - responsible for implementation of the Adirondack Park Land Use and Development Plan (as described by the Adirondack Park Agency Act).

e. New York State Department of State (DOS) - Responsible for the administration of the Coastal Zone Program.

By agreement of the involved agencies, NYSDEC has been designated as the lead agency for this GEIS.

2.0 DESCRIPTION OF THE PROPOSED ACTION - USE OF SONAR®

The proposed action is the use of the aquatic herbicide Sonar® for the control of nuisance aquatic vegetation in waterbodies located in the State of New York. The use of Sonar® can be an important component of a comprehensive management approach to limit the spread of certain aquatic macrophytes. These macrophytes can be undesirable in certain circumstances. They may be introduced species, which because of the lack of controlling ecological factors, reach a nuisance stage in terms of extreme numbers or biomass. Such exponential growth can reduce the recreational use of a waterbody by interfering with swimming, boating, or fishing. They may also clog intake screens and turbines, impart an unpleasant taste to the water, and reduce the presence of native aquatic species (Madsen et al., 1991a). Vermont Department of Environmental Conservation notes that nuisance vegetation may modify the aquatic habitat for indigenous organisms (VDEC, 1993).

Because of its mat forming characteristics, excessive growth of Eurasian watermilfoil (a primary target species for Sonar®) may also present a safety hazard to the recreational use of a waterbody. The mats may cover rocks, logs, and other obstructions that could damage moving boats or injure water skiers. Additionally, the mats may entangle swimmers, potentially resulting in drownings. Drownings as a result of entanglement in Eurasian watermilfoil mats have been documented in New York (Long et al., 1987) and Michigan (COLAM, 1992).

2.1 GENERAL DESCRIPTION OF THE AQUATIC HERBICIDE FLURIDONE (SONAR®)

Sonar® is a systemic aquatic herbicide produced by DowElanco. Sonar® works by interrupting the photosynthetic abilities of the target plants. Specifically, Sonar® inhibits the formation of the accessory pigment carotene within the target plants. In the absence of carotene, chlorophyll is rapidly degraded by sunlight, thereby preventing the formation of carbohydrates necessary to sustain the plant.

The active ingredient in Sonar® is fluridone (1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4[1H]-pyridinone). The U.S. Environmental Protection Agency (USEPA) Shaughnessy code for fluridone is 112900-6. Fluridone was registered with the USEPA in 1986 and with the NYSDEC in 1993. Sonar® is packaged in two formulations: Sonar® SRP (Slow Release Pellets) and Sonar® A.S (Aqueous Suspension). Sonar® SRP is a pelleted formulation containing 5% fluridone. Sonar® SRP is generally applied via broadcast spreading. Sonar® A.S. is a liquid formulation that is mixed with water prior to application. Sonar® A.S. is generally applied via broadcast surface spraying or through the use of underwater application equipment.

For both formulations, the critical feature with regards to aquatic macrophyte control is obtaining an adequate concentration of the product in the treated area for a sufficient time period to produce the effect. Under optimum conditions, as noted on the approved label, the desired level of target aquatic macrophyte control is achieved 30 - 90 days after the application of

Sonar®. Sonar® is absorbed from water by plant shoots and from the hydrosoil by the roots of aquatic vascular plants.

2.1.1 Purpose of the Product

As a systemic aquatic herbicide, Sonar® is designed to control broad-leaved submerged aquatic macrophyte species. This includes nuisance species such as Eurasian watermilfoil and curlyleaf pondweed, as well as native pondweeds. As opposed to a non-selective contact herbicide which will kill any plant material that it comes in contact with, Sonar® is intended for a select group of target species, which are listed on the registered labels. Several plant species that perform valuable functions in the aquatic environment, mainly floating and emergent species such as algae, bulrush, pickerel weed, cattails and waterlilies, are either not impacted, marginally impacted, or are impacted in a positive manner by the use of Sonar® at the labeled application rates. It is noted that the target species for Sonar® also perform valued functions, though the level of function can be dependent on the density of the target species.

The product's manufacturer, supported by various researchers, believes that the selectivity of Sonar® to the intended group of broad-leaved submergent aquatic macrophytes can be focused based on the application rates. Those species such as Eurasian watermilfoil and curlyleaf pondweed which are highly sensitive to fluridone, can be treated at sufficiently low rates that those species which are not quite as sensitive will only be moderately impacted. However, it is understood that the higher the application rate, the broader the impacts become within that category of macrophytes which are considered as potential targets or are sensitive to fluridone.

It is for these reasons, that the authors believe that the use of the term "selective" is appropriate for a discussion of Sonar®. The authors have attempted to objectively present all available information with regard to questions of selectivity and varying responses based on observed application rates, which again, is the purpose of this document. This includes information on the observed rapid reestablishment of native plant communities within a growing season of Sonar® application. Kenaga (1993) states in his document that often there are other factors related to impacts to native aquatic plant communities which are not associated with the use of Sonar®. Of particular note is that the intended opportunistic target species may so dominate the plant community that the remaining non-target community is reduced and very poor. This is where the rapid reestablishment of the non-target community that is documented in other studies (and is discussed in the GEIS) would be of importance.

2.1.2 Need for the Product

Sonar® is an aquatic herbicide which is intended for the selective control of nuisance aquatic macrophytes. Sonar® is especially effective in controlling or removing Eurasian watermilfoil and curlyleaf pondweed. Eurasian watermilfoil is an exotic, invasive aquatic macrophyte that can significantly affect the littoral characteristics of a freshwater pond or lake (Pullman, 1993 and VDEC, 1993). VDEC (1993) reports that in Vermont the number of confirmed lake infestations by Eurasian watermilfoil has grown exponentially, from fewer than 5 in 1962, to more than 35 lakes in 1992. Eighty-five percent of that growth has occurred since 1982 and has occurred despite the efforts of non-chemical control methods. Coalition of Lakes Against Milfoil (COLAM, 1992) notes that 10 counties in the State of New York had reported occurrences of Eurasian watermilfoil in 1980. They report that by 1992, that number had grown to 35 counties. In its 1993 Annual Report on the Aquatic Plant Identification Program, the Rensselaer Fresh Water Institute notes that 38 counties had documented populations of Eurasian watermilfoil in 1993 (Eichler and Bombard, 1994). As a result of the documented expansion in the occurrences of Eurasian watermilfoil throughout the State of New York, the need for environmentally sound, effective methods for control of this nuisance species is evident. Westerdahl and Hall (1987) note that Eurasian watermilfoil is extremely susceptible to fluridone (the active ingredient in Sonar®).

Curlyleaf pondweed is also an exotic species that has spread throughout the United States (NYSDEC, 1990). Pullman (1992) notes that the curlyleaf pondweed will thrive in most plant productive lakes and that it can be a severe nuisance during the early part of the peak recreational use period in lakes in the northern United States. Pullman (1992) reports that Sonar® was used selectively for the control of curlyleaf pondweed in lakes in Michigan.

2.1.3 Benefits of the Product

The use of Sonar® will allow for a comprehensive approach to the control and management of target aquatic macrophyte species. It allows for the selective control of target macrophyte species and for the restoration of native plant communities. Through the use of Eurasian watermilfoil management techniques, which include an aquatic herbicide such as Sonar®, the negative attributes of the growth of this nuisance weed can be reversed. Pullman (1993) reports that the use of Sonar® in lakes in Michigan has resulted in the removal of Eurasian watermilfoil and allowed for the restoration of the native plant community. At concentrations above 8 ppb, Sonar® has never failed to control the growth of both Eurasian watermilfoil and curlyleaf pondweed.

Based on an economic study conducted in the Okanagan Valley region of British Columbia, the British Columbia Ministry of Environment, Lands and Parks (BCMELP, 1991) noted that the failure to control Eurasian watermilfoil results in economic impacts to the area surrounding the affected waterbody. Their study was conducted in an area containing seven mainstream lakes and one upper elevation lake, of which 1000 hectares of shoreline were reported to be infested with Eurasian watermilfoil. They estimated losses in several economic areas; including transportation, the restaurant industry, the accommodation sector, and the shopping sector. BCMELP (1991) projected that a no-action alternative to managing for Eurasian watermilfoil would result in a revenue loss of $85 million dollars in 1990 to the region (or 26.5% of 1989 revenues). BCMELP (1991) also predicted a loss of 1700 employment positions in the tourist industry and a loss in real estate values of $360 million in the region. However, the British Columbia Ministry of Environment, Lands and Parks has not verified these projected economic losses. The use of Sonar® as a management approach would help alleviate those concerns.

The use of Sonar®, as per the NYS registered labels, would allow for the alleviation of safety concerns brought about by the infestation of a lake by Eurasian watermilfoil. Eurasian watermilfoil can reach a stage where thick mats will form at the waters surface. Under these conditions, rocks, logs, and other obstructions will be concealed. These objects would damage moving boats or injure skiers attempting to pass through the matted areas. Sonar® could be used to remove the Eurasian watermilfoil, and allow for the safe recreational use of the lake.

Sonar® can be a selective means of managing nuisance aquatic vegetation. The benefit of its use is the selective removal of those exotic aquatic macrophytes considered to be a nuisance to the use, function and value of a lake, while allowing for the reestablishment of more valuable native plant species.

2.1.4 History of Product Use

The USEPA issued an Experimental Use Permit (No. 1471-EUP-67) for Sonar® in 1981. The USEPA approved the label for Sonar® on March 31, 1986. There were no use restrictions included for treated ponds (waterbodies 10 acres or less in size). For treated lakes and reservoirs, the only restriction was the prohibition on the use of Sonar® within 1/4 mile (1320 feet) of any potable water intake. There were no restrictions on uses of treated water. Sonar® and its active ingredient, fluridone, are registered only for aquatic uses. Specifically, it is registered for the management of aquatic vegetation in freshwater ponds, lakes, reservoirs, drainage canals and irrigation canals. The Sonar® SRP formulation is also registered for application to rivers. The USEPA registration number for Sonar® A.S. is 62719-124. The USEPA registration number for Sonar® SRP is 62719-123. DowElanco received New York State registration approval for Sonar® SRP on February 9, 1993. DowElanco applied for, and was granted, a Special Local Needs (SLN) registration for Sonar® A.S. for the control of Eurasian watermilfoil (Myriophyllum spicatum L.), at application rates of 50 ppb or less in freshwater ponds, lakes, and reservoirs. The SLN registration was received by DowElanco on February 9, 1993. The SLN registration number is SLN NY-930001.

Pursuant to the registration conditions described in 6 NYCRR Part 326, fluridone may only be used as follows:

1. Application of aqueous suspension formulations are permitted in water of the State at application rates not to exceed 50 ppb of the active ingredient fluridone.

2. Application of pellet formulations are not permitted in waters less than two feet deep.

3. Swimming is not allowed in treated areas for a period of 24 hours following the application.

Sonar® herbicides have been used primarily for the control of submersed nuisance aquatic plants, primarily hydrilla (Hydrilla verticillata) in the southern states, and Eurasian watermilfoil in the northern United States (U.S.). Curlyleaf pondweed (Potamogeton crispus) is also frequently a target species of aquatic plant management programs. Applications have provided successful management of target species, with control lasting from one to several seasons after treatment.

Lack of satisfactory control within treated areas is generally evident only where moderate to rapid rates of water exchange cause rapid dilution of fluridone treated water, resulting in too little contact time with target plants for adequate herbicide uptake. This situation may occur at water inlets into otherwise quiescent waterbodies.

Experience during the years since registration has shown that the use of Sonar® A.S. in treating water at concentrations that are lower than those listed on the Federal label can provide excellent control of Eurasian watermilfoil (Pullman, 1992). This is especially true in situations where treatments can be applied to whole water bodies and there is limited opportunity for dilution with untreated water. The low use rate experience made possible a 24(c) Special Local Need registration of Sonar® A.S. in NYS for control of Eurasian watermilfoil using reduced treatment rates.

Sonar® applications for control of Eurasian watermilfoil in northern states have been made most frequently in Michigan. Applications have also been made in Indiana, Illinois, Minnesota, New Jersey and Washington. As indicated, these treatments have provided excellent control of target plants. Reduced Sonar® rates, early season treatments, and uniform product applications over the area to be treated have removed nuisance growths of Eurasian watermilfoil, while minimizing the herbicide impacts on non-target species, including other aquatic plants listed on the Sonar® labels as species controlled.

2.1.4.1 Registration Status in States and Canadian Provinces That Are Neighboring New York State.

Sonar® is registered, without any use restrictions, in Pennsylvania, New Jersey, Connecticut, Massachusetts, and Vermont. Furthermore, there are no restrictions on the use of Sonar® herbicides in any other state in which it is registered. Sonar® herbicides are not registered for use in Canada. No registration actions have been submitted to Canada.

2.2 GENERAL LOCATION OF THE PROPOSED ACTION

For the purposes of this portion of the GEIS, the general location for the proposed action is in the surface waters of the State of New York. The proposed action is the use of the aquatic herbicide Sonar® for the control of certain nuisance aquatic macrophytes. A specific description of the actual body of water in which Sonar® is intended for use would be included in the individual permit applications. Sonar® A.S. is registered in New York for use in freshwater lakes, ponds, and reservoirs. Sonar® SRP is registered for use in freshwater lakes, ponds, reservoirs, drainage canals, irrigation canals, and rivers. Under Article 24 of the Environmental Conservation Law, some ponded water may be described as wetlands.

NYSDEC (1987) reports that over 7500 lakes, ponds, and reservoirs can be found in the State of New York. While NYSDEC (1990) states that there are no scientific terms for the three types of waterbodies, it notes that ponds are generally small, shallow waterbodies with little or no wave action, that usually exhibit uniform temperature distributions. Lakes are generally large and deep water bodies that exhibit periodic thermal stratification and may have rocky, wave-impacted shorelines due to exposure to prevailing winds. Water in the lake is contributed from the surrounding land which is termed the water basin. Water can be contributed to the lake through streams, rivers, groundwater, or general surface runoff. Reservoirs are man-made lakes. For purposes of label interpretation, Sonar® labels define a pond as a body of water 10 acres or less in size. A lake or reservoir is defined as greater than 10 acres in size.

2.3 POTENTIAL AQUATIC MACROPHYTE TARGET SPECIES

This GEIS is a supplement to the NYS Environmental Impact Statement, dated May 1, 1981 (NYSDEC, 1981a). Based on the registered label for Sonar® SRP, the aquatic macrophyte species listed in this section are considered to be potential target species for this product. However, not all of the aquatic macrophyte species described on the product labels are found in the State of New York. The detailed discussions of the target species are limited to those species indigenous to New York State. With respect to Sonar® A.S., it should be noted that this product is registered in NYS only for the treatment of Eurasian watermilfoil. However, at the registered application rate for Sonar® A.S., the plants in the following sections would be expected to be either affected, or not affected, depending on the species sensitivity to fluridone.

2.3.1 Eurasian Watermilfoil (Myriophyllum spicatum L.)

A primary target species for Sonar® in New York State is Eurasian watermilfoil (Myriophyllum spicatum L.). Eurasian watermilfoil is an aquatic plant found in the taxonomic family Haloragaceae. It is a rooted, vascular submergent macrophyte with long stems and feathery perennial leaves. Plants form no specialized overwintering vegetative structures such as turions. The leaves are generally attached along the entire stem in whorls of four and can be in excess of 35 mm in length. Each leaf is composed of 7 to 18 pairs of leaflets (Pullman, 1993). The leaflets are mostly straight and of equal length. The inflorescence is terminal and extends above the water surface. Upper flowers are generally staminate. Lower flowers are generally pistillate (Britton and Brown, 1970b). Eurasian watermilfoil is an invasive, opportunistic exotic plant that is native to Europe, Asia, and North Africa (Pullman, 1993 and Long et al., 1987). Hotchkiss (1972) reports that Eurasian watermilfoil is distributed across the northern tier of the United States, from California to Vermont.

2.3.2 Other Potential Aquatic Macrophyte Target Species

The following species are listed on the federally registered labels for Sonar® A.S. and Sonar® SRP as potential species targeted for control. These species are consistent with those species listed on the New York registered label for Sonar® SRP. Sonar® A.S. is only registered in the State of New York for the management of Eurasian watermilfoil. The selection of A.S. versus SRP is further addressed in Section 4.2 and 4.5. Only those potential target species actually occurring in New York State are discussed in this section. Species listed in Table 2-1 are found on the New York registered Sonar® SRP label, but do not occur in New York State.

TABLE 2-1

AQUATIC MACROPHYTES LISTED ON THE REGISTERED LABELS FOR SONAR® BUT NOT FOUND IN THE STATE OF NEW YORK

Alligatorweed (Alternanthera philoxeroides)
Giant Cutgrass (Zizaniopsis miliacea)
Hydrilla (Hydrilla verticillata)

The following potential target species are noted as being either controlled or partially controlled, consistent with the Sonar® SRP label. The controlled notation indicates that the plant species would be removed from the treatment area by the use of fluridone at the application rate labeled for Sonar® SRP in NYS. The partially controlled notation indicates that at the 50 ppb maximum application rate for Sonar® A.S. and at the maximum label application rate for Sonar® SRP in NYS, some herbicidal effects or growth suppression would be observed on the plant. The level of herbicidal effects, however, would not be such that the species would be removed from the waterbody and a claim for commercial control of the macrophyte could be maintained. Plant distributions in this section are based on Hotchkiss (1972), Mitchell (1986), Magee (1981), Tiner (1987) and ACOE (1977).

Submerged, Floating-leaved, and Floating Plants:

American Lotus (Nelumbo lutea) [Partially Controlled]

The American lotus or yellow lotus is found in the taxonomic family Nymphaeaceae. This plant is listed as a rare native plant species in NYS. The lotus is characterized by grayish-green leaves which are as much as 2 feet across and float or stand above the water.

Bladderwort (Ultricularia spp.) [Controlled]

Bladderworts are found in the taxonomic family Lentibulariaceae. Magee (1981) reports that bladderworts are generally found in ponds, shallow lakes and sluggish streams, up to 1.2 meters in depth. Bladderworts are long, slender, free-floating plants with finely forked leaves, bearing small air bladders in the forks of the divisions. When treated at low Sonar® rates for control of Eurasian watermilfoil, bladderwort species will increase in area covered after the treatment (Pullman, 1993).

Common Coontail (Ceratophyllum demersum) [Controlled]

Coontail, or hornwort, is found in the taxonomic family Ceratophyllaceae. NYSDEC (1990) reports that coontail is a free-floating perennial which lacks roots. The stems are generally slender, and hollow and can grow up to 50 cm in length. Leaves are submersed and whorled in groups of 5 to 12 and are abundantly located near the stem tip. The primary method for coontail reproduction is through fragmentation. When treated at low Sonar® rates used for watermilfoil, coontail displays temporary herbicidal symptoms (Pullman, 1993).

Common Elodea (Elodea canadensis) [Controlled]

Common elodea, or ditch-moss, is found in the taxonomic family Hydrocharitaceae. NYSDEC (1990) notes that common elodea is a submersed perennial, with thin, branched green stems. It often forms large masses near the bottom. Leaves are arranged in whorls of three or are opposite. Leaves are generally 10 to 13 mm long and 3 to 5 mm wide. Elodea is considered to be an aquatic nuisance species (Nichols and Shaw, 1986). Elodea grows on a wide variety of sediments, though it grows best on fine sediments where organic matter ranges from 10% to 25%. Elodea overwinters as an entire plant under the ice and grows quickly in the spring from the dormant stem apices. As with Eurasian watermilfoil, elodea spreads primarily through the disposal of stem fragments. Elodea is considered to be an important substrate for invertebrates. It is not considered to be important for invertebrates as a food source or as a place to lay eggs. Elodea has been noted to inhibit the growth of phytoplankton in a waterbody (Nichols and Shaw, 1986).

Egeria, Brazilian Elodea (Egeria densa) Controlled

Egeria is found in the taxonomic family Hydrocharitaceae. This plant is an exotic species that is listed in NYS as a rare, escaped plant species.

Fanwort (Cabomba caroliniana) Controlled

Fanwort is an exotic introduced species introduced to NYS. It is found in the taxonomic family Nymphaeaceae. It is a submersed, floating perennial herb that is often rooted. The stems are slender and the leaves are opposite and whorled. Flowers appear above the upper leaves and are usually white or pink.

Naiad (Najas spp.) Controlled

Plants in this family, Najadaceae, are distributed from Newfoundland and Quebec to Minnesota, and south to Florida. They are generally found in shallow, quiet waters of ponds, lakes, pools, and sluggish streams. Magee (1981) notes that these plants are slender, with many-branched stems up to 1 meter long. The leaves are opposite, slender and thread-like. Flowers are small and inconspicuous. Naiad (Najas quadalupensis var. olivacea) and holly-leaved naiad or marine naiad (Najas marina), are listed as rare native plants in NYS.

Parrotfeather (Myriophyllum brasiliense) Partially Controlled

Hotchkiss (1972) notes that parrotfeather is a common aquarium plant that is originally from South America. Parrotfeather is found in inland freshwater marshes and ponds.

Pondweed (Potamogeton spp.) Controlled

The pondweed family, Potamogetonaceae, is distributed from Newfoundland and Quebec to southern Alaska, south from Florida to California. Pondweeds are generally found in still waters of ponds, lakes to moderately moving streams and rivers. Magee (1981) reports that pondweeds have slender, flexible, underwater stems bearing variable leaves in two vertical rows and opposite, elliptic floating leaves. Flowers are borne on spikes above the water surface. One species of pondweed (Ogdens's pondweed, Potamogeton ogdenii) is listed as an endangered native species in NYS. Hill's pondweed (P. hillii) is listed as a threatened native plant species in NYS. Pondweed (P. confervoides), northern pondweed (P. alpinus) and sheathed pondweed (P. filiformis var. occidentalis) are listed as rare native plant species in NYS.

Curlyleaf pondweed (Potamogeton crispus) is an exotic species that is considered to be a nuisance aquatic weed. Nichols and Shaw (1986) note that curlyleaf pondweed is native to Eurasia. It overwinters under the ice and its primary mode of spread is through the dispersal of dormant apices or turions. It prefers a water depth of one to three meters and a fine sediment texture with 10% to 25% organic content. It will survive in highly eutrophic conditions. Curlyleaf pondweed will form dense surface mats, which disrupt native plant communities.

Spatterdock (Nuphar sp.) Partially Controlled

Spatterdock (Family Nymphaeaceae) is found in inland and coastal fresh water marshes, ponds, lakes, pools, and the borders of slowly moving streams. Leaves vary greatly in size, but are generally large and lance-like in shape. In the form of the species indigenous to the northeastern United States, the leaves generally float on the surface of the water (Hotchkiss, 1972). Low Sonar® application rates used for treatment of Eurasian watermilfoil do not control spatterdock, but may produce temporary herbicidal effects.

Waterlily (Nymphaea spp.) Partially Controlled

Waterlilies (Family Nymphaeaceae) are aquatic herbs with thick cylindric, horizontal rootstocks. The leaves are generally large and cordate. Flowers are showy (Britton and Brown, 1970b). Waterlilies are found in slow, standing water in ponds, lakes or slowly moving streams. The three species of waterlily commonly found in New York State include Nymphaea odorata, N. tuberosa, and N. alba. Low Sonar® application rates used for treatment of Eurasian watermilfoil do not control waterlily, but may produce temporary herbicidal effects (Pullman, 1993).

Watermilfoil (Myriophyllum spp.) Controlled

Native species of Myriophyllum (Family Haloragaceae) are submersed, stout-stemmed perennials (Fairbrothers and Moul, 1965). There are generally 5 to 13 pairs of leaflets per leaf with each leaf approximately 4 cm long. Flowers are small and inconspicuous and occur in the axils of the upper leaves. Watermilfoil is found in ponds, lakes, sluggish streams, and shorelines. Eurasian watermilfoil (Myriophyllum spicatum L.) is considered to be an exotic nuisance weed (Nichols and Shaw, 1986). Water milfoil (Myriophyllum alterniflorum) is listed as a rare native plant species in NYS.

Waterprimrose (Ludwigia spp.) Partially Controlled

Waterprimroses are found in the evening-primose family (Onagraceae). Plants in the genus Ludwigia are perennial or annual herbs, with alternate, usually entire leaves. They are generally found in freshwater marshes (Britton and Brown, 1970b). Ludwigia (Ludwigia sphaerocarpa) is listed as a rare plant species in NYS. Low Sonar® application rates used for treatment of Eurasian watermilfoil will only produce temporary herbicidal effects in waterprimrose.

Waterpurslane (Ludwigia palustris) Partially Controlled

Waterpurslane, or false loosestrife (Family Onagraceae), is found along streams or springy areas. It can be found partly or wholly submerged in shallow water or sprawling over mud (Magee, 1981). It is a plant with a prostrate stem, with rooting occurring at the lower and middle nodes. Waterpurslane will often form mats. The leaves of the species are opposite and entire. The flowers of the species are small and found in the leaf axils. Low Sonar® application rates used for the treatment of Eurasian watermilfoil will only produce temporary herbicidal effects in waterpurslane.

Watershield (Brasenia schreberi) Partially Controlled

Watershield (Family Cabombaceae) is found in ponds, lakes, pools, and margins of slowly moving streams. It is found in water up to 1.2 meters in depth. The plant has floating leaves and flowers attached to flexible underwater petioles which are connected to thick rhizomes embedded horizontally in the mud. The leaves are large; growing up to 25 cm. The flowers are pinkish, with dark red centers. Low application rates used for the treatment of Eurasian watermilfoil will only produce temporary herbicidal effects in watershield.

Emergent and Marginal Plants:

Reed Canarygrass (Phalaris arundinaceae)

Reed canarygrass (Family Poaceae) is a grass that grows up to 2 meters in height. It is primarily found in marshes, wet meadows, and in ditches (Magee, 1981). Reed canarygrass normally grows in dense colonies. The leaf blades are long (up to 3.6 meters) and flowers are borne in a narrow, dense panicle. Reed carnarygrass is not controlled by Sonar® at low Eurasian watermilfoil treatment rates.

Smartweed, Pennsylvania (Polygonum pensylvanicum)

The forms of species within this genus (Family Polygonaceae) are highly variable. Leaves are generally lance-like. The flowers are rose-pink or white. Pennsylvania smartweed is found in damp soil, roadsides, or fields (Peterson and McKenney, 1968).

Smartweed is not controlled by Sonar® at the low concentrations used to treat Eurasian watermilfoil.

Smartweed, swamp (Polygonum coccineum)

The forms of species within this genus are highly variable. This species has an erect form in the terrestrial environment and an aquatic form with floating leaves. Leaves are lance-like. Flowers are showy and pink. Swamp smartweed is found in swamps and in shallow water, and along the borders of ditches (Peterson and McKenney, 1968). Smartweed is not controlled by Sonar® at the low concentrations used to treat Eurasian watermilfoil.

Spikerush (Eleocharis spp.)

Spikerushes (Family Cyperaceae) are annual or perennial sedges. Spikerushes are found in shallow water, marshes, and in wet soil. The culms of each plant are generally simple. The leaves are generally reduced to sheaths; very rarely the lowest leaf is blade-bearing. Flowers are borne in spikes. There are approximately 120 species of spikerushes distributed in North America (Britton and Brown, 1970a). Some of the spikerush species indigenous to New York State include the creeping spikerush (Eleocharis fallax), blunt spikerush (Eleocharis obtusa), and dwarf spikerush (Eleocharis parvula). Engelmann spikerush (E. engelmannii) is listed as an endangered native plant species in NYS. Knotted spikerush (E. equisetoides), angled spikerush (E. quadrangulata), three-ribbed spikerush (E. tricostata), and long-tubercled spikerush (E. tuberculosa) are listed as threatened native plant species in NYS. Creeping spikerush, salt-marsh spikerush (E. halophila), and blunt spikerush are listed as rare native plant species in NYS. Spikerush is not controlled by Sonar® at the low concentrations used to treat Eurasian watermilfoil.

3.0 ENVIRONMENTAL SETTING - SONAR®

This section describes the environmental setting in which the proposed action, the use of the aquatic herbicide Sonar®, is projected to occur. While this section presents the available data in as detailed an extent as is required, the information is generic for the State of New York.

3.1 GENERAL DESCRIPTION OF NEW YORK STATE AQUATIC ECOSYSTEMS

The aquatic ecosystems of New York State generally fall into four basic categories. These include standing freshwater systems (lakes, ponds, and reservoirs), flowing freshwater systems (rivers and streams), brackish systems (tidal estuaries), and saline coastal systems.

It is calculated that New York State has over 3.5 million acres covered by some type of surface water system (NYSDEC, 1967). That includes over 7500 lakes (NYSDEC, 1987), of which over 1500 are found in the Adirondack Mountains (NYSDEC, 1967). The Adirondack Mountains also contain over 16,700 miles of significant fishing streams. The state's largest lakes are Lake George, Lake Chautauqua, Oneida Lake, and the major Finger Lakes; Canadaigua, Keuka, Seneca, Cayuga, and Skaneateles (NYSDEC, 1967).

The specific characteristics of each aquatic system are partially determined by its physiographic setting within the state. Changes in the characteristics of each aquatic system will lead to changes in the endemic biota associated with that waterbody. Generally, waterbodies within New York State can be defined geographically by region and drainage basin location. Aquatic ecosystems in the eastern region, which includes the St. Lawrence/Lake Champlain/Black River basin, the Hudson-Mohawk basin, the Delaware basin, and Long Island are defined by either the Adirondack/Catskill mountain areas to the north or the New York Bight tidal estuarine area to the south. Aquatic ecosystems in the central region, which includes the Oswego-Ontario basin and the Susquehanna, are defined by areas of low relief with large areas of marshes to the north and broad, steeply sided valleys with limited natural storage capacity in the south. Aquatic ecosystems in the western region, which includes the Lake Ontario basin, the Erie-Niagara basin, the Genesee basin, and the Allegheny basin, are defined by the glaciated geology of that region (NYSDEC, 1967).

Waters in each of these basins are influenced by the composition of the geological formations found within the region. For example, waters in the Adirondack mountains and the Catskill mountains can be influenced by formations with little buffering capacity. In some lakes, this results in waters with pH values of less than 5 (NYSDEC, 1981b; ALSC, 1989). Surface water systems in the Erie-Niagara basin in western New York State are characterized by high levels of dissolved solids (140 to 240 ppm) and hard water (100 to 200 ppm, expressed as $CaCO_3$). Surface water in the Delaware River basin are characterized by low dissolved solid levels (averaging 37 ppm) and an average hardness of approximately 37 ppm. The dominant ions are silica, calcium, bicarbonate and sulfate (Archer and Shaughnessy, 1963). The dissolved solid concentrations in surface waters in the Champlain-Upper Hudson basin rarely exceed 500 ppm

(Giese and Hobba, 1970). In surface waters of the Western Oswego River basin, dissolved solid concentrations range from 50 to 300 ppm (Crain, 1975).

3.2 GENERAL CHARACTERIZATION OF AQUATIC PLANT COMMUNITIES IN NEW YORK STATE WATERBODIES

Aquatic plants are often the dominant biotic factors in pond settings and are important ecological features of larger waterbodies such as lakes and reservoirs.

The characteristics of plant communities in aquatic settings are determined by the type of waterbody in which the community is located. New York State, with its over 7500 lakes, contains an extensive array of freshwater systems. This diversity is further increased by the inclusion of streams, rivers, and other bodies of flowing water. Waterbodies vary in terms of color, pH, temperature, silt loading, bottom substrate, depth, rate of flow if it is a moving body, and watershed area. Each of these characteristics will affect, to some extent, the type and distribution of the plant communities in that waterbody. NYSDEC (1990) notes that the bottom morphology (shape) of a lake is a key factor is determining the type and extent of plant communities that are present. The chemical quality of the water is another factor that influences the distribution of plant species within a waterbody. Soft water lakes with a total alkalinity of up to 40 ppm and a pH of between 6.8 and 7.4 will often have sparse amounts of vegetation. Hard water lakes with a total alkalinity from 40 ppm to 200 ppm and a pH between 8.0 and 8.8 will have dense growths of emergent species that can extend into deeper water (Fairbrothers and Moul, 1965). Sculthorpe (1967) notes that the distribution of species within a waterbody is determined by the bottom substrate, light intensity (which is a function of depth and water clarity), and turbulence (currents or wave action).

Freshwater ecosystems include lentic ecosystems represented by standing waterbodies, such as lakes and ponds, and lotic ecosystems, which are represented by running water habitats. Lentic systems can be further subdivided in littoral, profundal, and benthic zones. The littoral zone is that portion of the waterbody in which the sunlight reaches to the bottom. This area is occupied by vascular, rooted plant communities. Beyond the littoral zone is the open water area, or limnetic zone, which extends to the depth of light penetration. This point of light penetration is called the compensation depth. This is the depth where approximately 1% of the light incident on the water surface still remains. As a result of this decreased light, photosynthesis does not balance respiration in plants. Therefore, the light is not sufficient to support plant life. The strata below the compensation depth is called the profundal zone. The bottom of the waterbody, which is common to both the littoral zone and the profundal zone, is the benthic zone (Smith, 1980).

Lentic systems can be categorized based on ecological successional characteristics of the waterbody (Smith, 1980; NYSDEC, 1990; and Pullman, 1992). Succession is the ecological process by which one community is gradually replaced by a series of communities; tending to progress to a terminal community. In aquatic settings, the initial stage of succession is characterized by a lack of biota. Over a period of time, pioneering species colonize the waterbody. As the water and bottom substrates change as a result of movement of organic and inorganic sediments and nutrients into the waterbody, the organisms present change from those intolerant of higher organic material levels, to species that are more tolerant of the changes. Eventually, the waterbody can shift from a deep, sterile pool, to a shallow temporary pond, to an emergent marsh to eventually a terrestrial meadow. For additional information on lentic systems typical of NYS lakes, see Diet For a Small Lake (NYSDEC, 1990).

In lotic systems the distribution of plant communities is dictated by the velocity of the water flow and the nature of the bottom substrate. In fast moving waters, the system is usually divided into riffle and pool habitats. Riffles, which are areas of fast water, are centers of high biological productivity. However, the speed at which the water flows in these areas usually will not allow for rooted macrophytes to become established. Rooted vascular plant are more characteristic of pool habitats, which are interspersed with the riffle zones. In pools, the softer bottom substrate and the slower current velocities allow for the establishment of rooted plants. This is also the case for slower moving streams and rivers. In larger rivers, as with lakes, ponds, and reservoirs, depth becomes a determining factor for the distribution of plant communities (Smith, 1980).

Functionally, aquatic plants play important roles in the aquatic ecosystem. Aquatic macrophytes provide food and shelter for both vertebrate and invertebrate organisms and as spawning habitat for fish (Keast, 1984; Gotceitas and Colgan, 1987; Schramm and Jirka, 1989; Hacker and Steneck, 1990; and Kershner and Lodge, 1990). The ability of the community to fill these functions, its value per se, is often a function of the species, density, and distribution of the members of that plant community. Daubenmire (1968) notes that plants in the genera Potamogeton and Scirpus are a favored food source for North American waterfowl, whereas muskrats (Ondatra zibethica) favor plants in the genera Carex, Sagittaria, and Typha. Brown et al. (1988) reported that vertically heterogeneous stands of aquatic macrophytes tended to contain more invertebrates than a community dominated by a single taxon. Therefore, opportunistic, rapid-growing species such as Eurasian watermilfoil, purple loosestrife, phragmites, and cattails, which develop dense monotypic stands in mature communities, would not be expected to offer the quality or diversity of habitat in such circumstances as more diverse communities would. Dionne and Folt (1991) note that high plant densities can interfere with the foraging ability and efficiency of piscivorous and insectivorous fish. Dense plant stands can directly or indirectly disrupt the utilization of macrophyte beds by fish and macroinvertebrates by affecting light penetration, temperature regimes, and water chemistry (Lillie and Budd, 1992).

Aquatic vegetation performs four basic functions in waterbodies (Fairbrothers and Moul, 1965). These functions include: 1) modification of the dissolved gas content of the surrounding water; 2) provision of nutrient material suitable for food and the introduction of inorganic nutrients into the food cycle; 3) modification of the physical environment; and 4) the protection and provision of habitat for other organisms. In general, aquatic plants fulfill the preceding functions in the aquatic ecosystem. However, the extent to which those functions are fulfilled will depend on the location of the plant community (i.e. emergent community versus a deepwater community). The following sections more specifically address the type of plant community most likely to be involved in the use of Sonar® in New York State waterbodies. Furthermore, the roles that the individual species may play in that community are also described.

3.2.1 Submerged, Deepwater and Floating Plant Communities

Submerged plants are generally relegated to the littoral zone and include such genera as Potamogeton and Myriophyllum. Many of these macrophytes are rooted plants which complete the majority of their life cycle below the water surface, with only the reproductive structures extending above the water surface. Exceptions to this include plants in the genera Ceratophyllum and Utricularia. These plants do not have true roots, but are considered to be submerged plants found in the littoral zone (NYSDEC, 1990). Lemna and other free-floating species are generally found over the littoral zone and deeper water.

In ponded waters, generally a greater variety of plant genera is available to fulfill the necessary functions provided by the plant communities (Daubenmire, 1968). This occurs because of the small size of the ponds, which results in a reduction in the influence of wave action. Plant communities in large lakes can be influenced by wind driven waves which will restrict the distribution of plants in exposed areas. The functions described by Daubenmire include habitat for fish and invertebrates, food for waterfowl, and nesting or hiding areas for fish and other vertebrates, such as amphibians. Plants in the genera Ceratophyllum, Chara, Elodea, Najas, and Potamogeton are the most common native species to fulfill these functions. These macrophyte species are generally the first macrophytes to advance over the bottom and will usually dominate the plant community which occupies that portion of the littoral zone at the pond margin to a depth of 7 meters.

In ponds, Daubenmire (1968) reports that floating plants, such as Lemna, are not affected by the depth of water with regards to distribution. The surface of a pond is a homogenous habitat for these plants, which will occur uniformly. Floating plants can be pushed by the wind from one area to another. Floating-leaved hydrophytes are common in shallow water habitats. These plants, such as the species Brasenia schreberi, Nuphar lutea, and Nymphaea odorata, are limited to shallow water because they must produce a petiole of sufficient length to connect the root stock to the floating leaf.

Aquatic plant communities are commonly arranged by species along depth contours. These communities are comprised of either heterogeneous mixtures of species, or as is sometimes the case, they are comprised of monotypic stands of a single opportunistic macrophyte. The species diversity or richness of a plant community depends on sediment type, disturbance, and vegetation management efforts. The characteristics of the communities will change with increasing depth as more shade tolerant species become dominant. Mosses, charophytes, several vascular species, and blue-green algae (Cyanobacteria) are the common constituents of the near-profundal zone. Open architecture species such as members of the genera Potamogeton are found in shallower, better lighted zones. Emergent species will typically dominate the shallowest water, but are usually accompanied by other vascular species.

Aquatic plants serve as food sources for a variety of organisms, including fish, waterfowl, turtles (snapping, Chelydra serpentina and painted, Chrysemys picta), and moose (Alces alces). Herbivores will consume fruits, tubers, leaves, winter buds and occasionally, the whole plant. Many species in the genera Potamogeton and Najas are considered to be valuable sources of food items. Plants in the genera Myriophyllum, Nymphaea, and Ceratophyllum are considered to be poor sources of food items (Fairbrothers and Moul, 1965). Nichols and Shaw (1986) note that Eurasian watermilfoil (Myriophyllum spicatum) is a poor source of food for waterfowl.

Submerged plants play an important role in supporting fish populations. Submerged plants provide food and shelter for fish and their young. Submerged plants serve as the substrate for the invertebrates that support fish populations. Smith et al. (1991) state that the production of forage fish and invertebrates generally increases in proportion to the submersed plant biomass. However, they conclude that populations of piscivorous fish tend to peak in water with intermediate levels of plant biomass. This is a function of the ability of the piscivorous fish, such as largemouth bass (Micropterus salmoides) to see their prey.

Submerged macrophyte stems and leaves may act as a substrate for a variety of microscopic organisms, called aufwuchs. Aufwuchs include bacteria, fungi, diatoms, protozoans, thread worms, rotifers and small invertebrates. The architecture of a particular plant species will also determine its suitability as a place for egg deposition for fish and amphibians. Additionally, the young of many fish species and some tadpoles will seek shelter in plant structures to evade predators.

Pullman (1992) notes that the architectural attributes of a particular plant species are a critical feature in the ability of that plant to function in support of fish populations. Those vertical plants with open architecture (some Potamogetons, Elodea, Cabomba, and a native species of Myriophyllum) provide more suitable habitat for fish than those plant species that form dense vertical mats or mats at the surface such as are formed by (Myriophyllum spicatum), and some Potamogetons (including Potamogeton crispus). Matted Eurasian watermilfoil plants have few leaves along their stems. The leaves are shaded and replaced by a dense leaf cover at the water's surface. The collection of vertical stems has limited habitat value. Madsen et al. (1991) supports this by noting that most native species are recumbent or have short stems and do not approach the water surface and therefore tend to support greater fish populations than mat forming macrophyte species. Variable height and leaf architecture will yield more diverse habitats.

Pullman (1992) concludes that, in general, most native aquatic plant species do not reach nuisance levels. It is generally the exotic, introduced species that reach nuisance proportions based on numbers or biomass and are considered to be weeds.

3.3 DISTRIBUTION AND ECOLOGY OF PRIMARY POTENTIAL AQUATIC MACROPHYTE TARGET SPECIES

As mentioned in Section 2.0, the proposed action is the use of the aquatic herbicide Sonar® for the control of nuisance aquatic vegetation located in the State of New York. NYSDEC (1981) defines nuisance vegetation as overabundant vegetation that may be aesthetically unpleasing, may interfere with effective and proper harvest of fishery resources, and may interfere with other recreational activities. Pieterse (1990) defines nuisance aquatic vegetation as an aquatic weed or "an aquatic plant which, when growing in abundance, is not desired by the manager of it place of occurrence". In some circumstances, the aquatic species of concern is an exotic or introduced species. Such a species is not indigenous to the area and was introduced either accidentally or on purpose. This is not to say that exotic aquatic macrophytes do not, in some circumstances, fulfill all of the benefits and functions of native species. This is discussed more thoroughly in Section 9.0. A plant species, whether native or exotic, becomes a nuisance when the population reaches some level of overabundance such that a problem with the waterbody is evident. However, because an aquatic species is an exotic or introduced species, it generally has the potential for a more rapid population growth for the following reasons.

Suter (1993) maintains that many of the severe man-caused effects brought upon natural biotic systems are caused by the introduction of exotic species. Introduced species are generally opportunistic in nature and are usually able to out-compete native species. Thus, they have can significantly alter the character of native plant communities or the ecosystems. Exotic species are considered pioneer species. Pioneer species are those organisms that possess a reproductive strategy that emphasizes efficient dispersal of propagules, rapid spread and growth rate, and sometimes high rates of biomass production emphasized by high productivity and rapid growth. These plants are able to occupy a wide diversity of habitats (Smith, 1980).

Invasive, exotic species have successfully extended their distribution through both natural and anthropogenic means on a world-wide basis. Nichols and Shaw (1986) and Wade (1990) note that an invasive aquatic macrophyte has the potential to infest a waterbody, then spread to the maximum extent of the available habitat. Following the initial invasion period, the production of the invasive species can attain a degree of stability and habitat equilibrium. Subsequently, the population of the invasive will fluctuate in response to the temporal and spatial dynamics of the aquatic environment (Nichols and Shaw, 1986; Wade, 1990). Usually, the equilibrium condition for the production of species such as Eurasian watermilfoil and curlyleaf pondweed is considered to be deleterious for most recreational and utilitarian uses as well as a disruptive influence on the production of native plants and animals.

Some exotic species do serve as target species for Sonar®. This is particularly true of Eurasian watermilfoil, curlyleaf pondweed and cabomba (See Section 2.3). However, other exotic species which have substantial populations in NYS are not considered to be target species. That includes waterchestnut (Trapa natans). The following sections describe the general distribution and ecology of the primary target macrophyte for Sonar®.

3.3.1 Eurasian Watermilfoil (Myriophyllum spicatum L.)

Eurasian Watermilfoil is an introduced exotic that is thought to be native to Eurasia and North Africa (Couch and Nelson, 1985). It is currently believed to have been introduced into the Chesapeake Bay region in the mid-1940s. Since then, it has spread across the St. Lawrence system, the Great Lakes region, and into British Columbia and Washington State (Aiken et al., 1979). It is found throughout the Tennessee Valley system and from Florida to Texas (Giesy and Tessier, 1979). As of 1992, COLAM (1992) reports that Eurasian watermilfoil had been identified in lakes in 35 of New York State's 62 counties. In its 1993 Annual Report on the Aquatic Plant Identification Program, the Rensselaer Fresh Water Institute notes that 38 counties had documented populations of Eurasian watermilfoil in 1993 (Eichler and Bombard, 1994). VDEC (1993) reports that over 35 lakes in Vermont have been infested with Eurasian watermilfoil as of 1992. That is up from approximately 5 lakes in 1982. Pullman (1993) reports that Eurasian watermilfoil had been identified in lakes in all 83 counties in Michigan by 1978.

Eurasian watermilfoil is a tolerant species that has been shown to grow well in a variety of aquatic habitats. Couch and Nelson (1985) note that the plant will thrive in all types of nutrient conditions (oligotrophic to eutrophic), both hard and soft water and under both brackish and freshwater conditions. The plant appears to grow best in fine, nutrient-rich sediments that do not contain more than 20% organic matter and requires a minimum light intensity of 1% to 2% of the available light (Smith and Barko, 1990). Kimbel (1982) reports that the colonization success of Eurasian watermilfoil in terms of growth and mortality is best in late summer months in shallow water on rich organic sediments. Eurasian watermilfoil's maximum growth rate occurs at temperatures ranging from 30 to 35^0 C (Smith and Barko, 1990). The plant utilizes both sediments and the surrounding surface water as sources of nitrogen and phosphorus (Smith and Barko, 1990). Barko and Smart (1980) indicate that uptake by the roots is the primary means of obtaining phosphorus.

Eurasian watermilfoil grows in waters at depths of 0 to 10 meters (typically between 1 to 5 meters in depth). Eurasian watermilfoil will commonly grow as an emergent in circumstances where the water level of the lake slowly recedes (Aiken et al., 1979). Smith and Barko (1990) suggest that light intensity determines much of the distribution and morphology of Eurasian watermilfoil. While it grows in waterbodies with wide ranges in water clarity, in turbid waters growth is generally concentrated in the shallow areas (Titus and Adams, 1979). In relatively clear waters, Eurasian watermilfoil grows at much deeper depths and may not reach the water surface.

Pearsall (1920) considers Eurasian watermilfoil to be a deep water plant species, which he defines as a plant growing at a depth where light intensity is less than 15% of full sunlight. The common growth pattern for Eurasian watermilfoil is for the plant to initially colonize deeper waters, where it will generate a large quantity of biomass which extends to the surface (Coffey and McNabb, 1974). As the Eurasian watermilfoil reaches toward the surface, the lower leaves of the plant will be shaded out and will slough off. This creates a dense organic bed beneath dense beds of Eurasian watermilfoil and is part of the process that recycles nutrients back into the water column. The leaves and stems of Eurasian watermilfoil will concentrate at the surface of the waterbody, forming a thick canopy or mat which extends into shallower waters when the plant reaches sufficient densities.

Madsen et al. (1991a), in work done in Lake George, New York, noted that growth characteristics are facilitated by a high photosynthetic rate and a high light compensation point.

Because of its high photosynthetic rate and correspondingly increased metabolic activity and productivity, the plant is able to grow at a significantly higher rate than that exhibited by native species such as Potamogeton spp. and Elodea canadensis. Additionally, with its high light tolerance, Eurasian watermilfoil will tend to grow closer to the waters surface than the native species that occur in low to medium light intensity regions of the littoral zone. This pattern allows for successful replacement or disruption of native vegetative communities. Madsen et al. (1991b) reported that dense growth of Eurasian watermilfoil in a bay in Lake George had significantly reduced the number of native species present.

Eurasian watermilfoil will overwinter with much of its green biomass intact. Because of its adaption to grow at lower temperatures than many native aquatic species, Eurasian watermilfoil is capable of tremendous growth at the very beginning of the growing season. The early timing of growth, in conjunction with its great ability to produce large quantities of biomass, further gives Eurasian watermilfoil a competitive advantage over most native aquatic macrophytes (Pullman, 1992). Smith and Barko (1990) report that the characteristic annual pattern of growth is for the spring shoots to begin growing rapidly as soon as the water temperature approaches 15° C. Pullman (1993) notes that this growth generally occurs before most native aquatic macrophytes become active. However, Boylen and Sheldon (1976) state that some native aquatic macrophytes, including Potamogeton robbinsii and P. amplifolius, will remain metabolically active at temperatures as low as 2° C.

As the shoots grow, the lower leaves slough off as a result of shading. As the shoots approach the surface, they branch extensively and form the characteristic canopy (mat) discussed earlier in this section. Biomass peaks at flowering in early July, and then declines. If the population flowers early, a second biomass peak and subsequent flowering may be attained. It is common for Eurasian watermilfoil to adopt a stoloniferous habit in the autumn, growing prostrate over the surface of the lake sediment. This may also assist Eurasian watermilfoil in the displacement of competing native species through the acquisition of space when most native species are dormant. Variations in this growth pattern can occur as a result of differences in climate, water clarity and rooting depth.

Dispersal of Eurasian watermilfoil is primarily through the spread of vegetative fragments. Seed production has been reported, but is considered a minor contributor to the plant spread (Hartleb et al., 1993). Pullman (1993) notes that there is much circumstantial evidence indicating that Eurasian watermilfoil does not form a viable seed bank in infested lakes. Eurasian watermilfoil has a tremendous capacity for the formation of vegetative fragments. A viable plant can regenerate from a single node carried on a fragment released in the water. Fragmentation can occur from boating or skiing impacts, as well as from mechanical harvesting operations. Additionally, Madsen et al. (1988a) reports that autofragmentation (self-fragmentation) is common after peak seasonal biomass is attained. Often fragments released through autofragmentation bear adventitious roots. Madsen et al. (1988a) also noted that fragments are very durable, and resistent to extensive environmental stress.

Pullman (1993) concluded that Eurasian watermilfoil is supportive of fish populations during its initial expansion stages in a waterbody. However, he goes on to note that once Eurasian watermilfoil begins to dominate the plant community and form its characteristic dense mats, the lack of plant species diversity and associated water quality impacts will reduce the quality of the habitat for fish. Nichols and Shaw (1986) reported that Eurasian watermilfoil provides beneficial cover for fish, unless the cover is so dense that stunting of fish growth from overcrowding results. Eurasian watermilfoil has been shown to provide a better habitat for fish (Kilgore et al., 1989) and invertebrates (Pardue and Webb, 1985) than open water. However, Dvorek and Best (1982) found that Eurasian watermilfoil had the poorest invertebrate fauna populations out of 8 aquatic macrophyte species that were examined. Keast (1984) noted that fish abundance was 3 to 4 times greater in mixed native plant communities than in a plant community dominated by Eurasian watermilfoil. Nichols and Shaw (1986) noted that Eurasian watermilfoil is poor food for muskrats and moose and fair food for ducks, which will eat its fruit.

Eurasian watermilfoil is an opportunistic species, that is commonly found growing in areas that are not highly disturbed (Pullman, 1992). However, Pullman goes on to report that Eurasian watermilfoil appears to significantly increase in numbers and in biomass in areas of disturbance. This is reflective of the high productivity rate of the species and its resulting ability to outgrow native plant species. Eurasian watermilfoil is an aggressive colonizer and is able to displace native submergent plant species in as little as 2 to 3 years (Aiken et al., 1979). Nichols and Shaw (1986) summarized that Eurasian watermilfoil has various physiological adaptations that allow the plant to rapidly propagate by vegetative means, an opportunistic nature for absorbing nutrients, a life cycle that favors cool weather and mechanisms that enhance photosynthetic activity.

Once it has formed dense stands, Eurasian watermilfoil interferes with, or prevents, recreational activities in a lake. Pullman (1993) notes that mats may constitute a safety hazard because they are not penetrable by boats and may hide submerged objects that could be struck by moving boats. He also notes that people can be placed at risk if they swim in dense areas of Eurasian watermilfoil due to the potential for entanglement.

3.4 DISTRIBUTION AND ECOLOGY OF OTHER POTENTIAL AQUATIC MACROPHYTE TARGET SPECIES OF SONAR®

In addition to the primary potential aquatic macrophyte target species discussed in Section 3.3, Sonar® is intended for use to potentially control other aquatic macrophyte species. While the opportunistic ecological behavior of Eurasian watermilfoil will lead to extensive growth and large quantities of biomass, under certain conditions, the following species may also reach a nuisance level. They include both introduced and native species.

Table 3-1 discusses the submerged, floating-leaved and floating macrophyte species that are potential targets for control by Sonar®. The sources of information for Table 3-1 include NYSDEC (1990), Fairbrothers and Moul (1965), Magee (1981), Hotchkiss (1972), and Martin et al (1951). These species are found throughout New York State, though the actual presence and distribution in a waterbody are dependent on the physical characteristics of that waterbody.

TABLE 3-1

DISTRIBUTION AND ECOLOGY OF POTENTIAL SUBMERGED, FLOATING-LEAVED AND FLOATING TARGET MACROPHYTE SPECIES

American Lotus (Nelumbo lutea)

Found in ponds and quiet streams; is at the northern edge of its geographic distribution in NYS

Bladderwort (Ultricularia spp.)

Found in ponds, lakes and sluggish streams throughout New York State (NYS); is considered of little food value to birds and mammals, but is a provider of cover for fish

Common Coontail (Ceratophyllum demersum)

Found in shallow ponds and slow streams throughout NYS; provides good shelter for young fish and supports insects that are eaten by fish; its fruits are eaten by waterfowl

Common Elodea (Elodea canadensis)

Found in ponds, lakes and sluggish streams throughout NYS; provides shelter for fish; used as food by waterfowl

Egeria, Brazilian Elodea (Egeria densa)

Found in ponds, lakes and sluggish streams; is a rare and exotic species in NYS; is considered to have escaped into the natural environment

Fanwort (Cabomba caroliniana)

Found in ponds and quiet streams in southern regions of NYS; provides cover and food for fish; not an important food for waterfowl or mammals

Naiad (Najas spp.)

Grows in shallow ponds, lakes and sluggish streams throughout NYS; all parts of these plants are eaten by waterfowl

TABLE 3-1 (CONTINUED)

DISTRIBUTION AND ECOLOGY OF POTENTIAL SUBMERGED, FLOATING-LEAVED AND FLOATING TARGET MACROPHYTE SPECIES

Parrotfeather (Myriophyllum brasiliense)

> Grows in shallow ponds, lakes and sluggish streams throughout most of NYS; poor food source; good shelter for invertebrates and fish

Pondweed (Potamogeton spp.)

> Found in sluggish streams, lakes and ponds throughout NYS; all portions of the plant are eaten by birds and muskrats

Watermilfoil (Myriophyllum spp.)

> Native watermilfoil species are found in ponds, lakes and sluggish streams throughout NYS; is considered a low-grade duck food; is considered to be good habitat and shelter for fish and macroinvertebrates

Spatterdock (Nuphar luteum)

> Found in sluggish streams, ponds, small lakes and swamps throughout NYS; low wildlife food value

Waterhyacinth (Eichornia crassipes)

> Rare and introduced in NYS; found in ponds, lakes and sluggish streams

Waterlily (Nymphaea spp.)

> Found in shallow ponds, lakes and swamps throughout NYS; seed and rootstocks are eaten by ducks and marshbirds, beaver and moose eat the foliage, invertebrates utilize the undersides of leaves as shelter

Waterprimrose (Ludwigia spp., including waterpurslane (Ludwigia palustris)

> Found in streams and springy areas throughout NYS; serves as a food source for birds and grazing mammals

TABLE 3-1 (CONTINUED)

DISTRIBUTION AND ECOLOGY OF POTENTIAL SUBMERGED, FLOATING-LEAVED AND FLOATING TARGET MACROPHYTE SPECIES

Watershield (Brasenia schreberi)

Grows in ponds, lakes, and along margins of sluggish streams; plants provide shade and shelter for certain fish; fruits are eaten by various species of ducks

3.5 ROLE OF POTENTIAL AQUATIC MACROPHYTE TARGET SPECIES IN PLANT COMMUNITIES WITHIN NEW YORK STATE WATERBODIES

As discussed in Section 3.2, aquatic macrophytes fulfill valuable functions in the aquatic environment. They assist in oxygenation of the water, recycling of nutrients, and provide nesting and shelter areas for fish, amphibians, birds and mammals. Aquatic macrophytes serve in the stabilization of banks along watercourses and are a food source for a variety of organisms, including both invertebrates and vertebrates. The ability of a particular macrophyte to perform these functions and the quality of that function often depend on the characteristics of the entire aquatic community. Heterogeneous stands of plant species generally offer more of these functions than a monotypic stand (dominated by a single species). Heterogeneous stands have a greater vertical distribution of niches, which aquatic organisms that are dependent on the vegetation may fill. Additionally, the horizontal distribution of the aquatic plant communities will affect the functions and values that the individual species may offer. Patchy communities, with a variety of vegetative species spread over the available substrate, tend to offer a greater variety in habitats than a community dominated by a single species that completely covers the substrate. However, if that single species community is localized and is the only available habitat in a large aquatic setting, then at least some of the functions generally offered by aquatic vegetation would be offered. This circumstance may be evaluated in a lake management plan that would determine the goals and objectives of the vegetation management needs for that waterbody. Restoration of a mixed community of desirable plant species is likely to require initial removal of a monotypic plant stand.

3.5.1 Submerged, Floating-leaved, and Floating Plant Communities

Lillie and Budd (1992) provide a definitive evaluation of the quality of habitat offered by Eurasian watermilfoil. In their study, conducted on a lake in Wisconsin, Lillie and Budd utilized an index of plant habitat quality and quantity to describe the following: 1) horizontal visibility within macrophyte beds; 2) the amount of shading afforded by the surface canopy; 3) the amount of available habitat for macroinvertebrate attachment; 4) the relative amount of protection afforded fish by the plants; and 5) the degree of crowding or compaction among plants. The results of their study indicated that the edges of Eurasian watermilfoil beds potentially provide more available habitat for macroinvertebrates and fish than interior portions. This conclusion was based on their observation that habitat space was more optimal at the edges, than in the center of the beds where stem crowding and self-defoliation resulted in a lack of vertical architecture due to the formation of surface mats. They noted that as Eurasian watermilfoil densities increase from sparse to dense, habitat value for prey species increased. However, as the vegetative density increased in Eurasian watermilfoil stands, a reduction in habitat for macroinvertebrates reduced the habitat quality for small fish. Habitat value for predator fish species initially increased as Eurasian milfoil first colonized areas, but, then decreased as plant crowding impacted the ability of the predators to access their prey.

The work by Lillie and Budd (1992) suggests that in relatively new or small Eurasian watermilfoil beds or in heterogenous communities where watermilfoil is a component, habitat functions and values of this plant are consistent with native plant species. However, it must be recognized that areas occupied by small, new or partial Eurasian watermilfoil stands may become dominated by this species within one or two seasons (Lillie and Budd, 1992).

In work conducted by Keast (1984) in a lake in Ontario, Canada, Eurasian watermilfoil significantly modified the habitat available to fish and macroinvertebrates. Keast noted that since the advent of Eurasian watermilfoil in his study area, significantly fewer bluegill (Lepomis macrochirus) were observed, but greater numbers of black crappie (Pomoxis nigromaculatus) and golden shiner (Notemigonus crysoleucus) were seen. He reported 3 to 4 times as many fish feeding in native plant beds as in the Eurasian watermilfoil beds.

The most critical impact Keast (1984) noted was to prey organisms. Keast reported that significantly fewer macroinvertebrates were seen in the watermilfoil beds than in a native plant community composed of Potamogeton and Vallisneria. He found 3 to 7 times greater abundance of 5 invertebrate taxa in the native plant communities and noted that foliage of the native plants supported twice as many invertebrates per square meter. Keast observed twice as many insect emergences in the native plant community as in the Eurasian watermilfoil beds.

Other recent studies have documented the impacts to the aquatic environment by the invasion of Eurasian watermilfoil. Madsen et al. (1991) noted a sharp decline in the number of native species per square meter in a bay in Lake George, New York. The decline was due to the suppression of native species by Eurasian watermilfoil. The decline was from 5.5 species per square meter to 2.2 species per square meter over a 2-year period.

Honnel et al. (1992) noted that in ponds containing Eurasian watermilfoil, dissolved oxygen levels were significantly lower than dissolved oxygen levels in ponds dominated by native plants. Additionally, they note that pH levels were higher in Eurasian watermilfoil than in native plant dominated ponds.

3.6 GENERAL CHARACTERIZATION OF AQUATIC VEGETATION MANAGEMENT OBJECTIVES FOR THE USE OF SONAR®

Aquatic vegetation management becomes necessary when the populations or biomass of aquatic macrophytes in a waterbody become so great that they impact some function or use of that waterbody. This is equally true for introduced exotic plant species, such as Eurasian watermilfoil, which displace native species that may possess greater ecological value. Those deleterious effects could include reduction in fish populations or quality of the fishery, angler success or waterfowl use, restrictions in boating or swimming, and clogging of intake pipes. Additionally, the scenic beauty on the lake, and value of lakeside property will be significantly reduced as a result of the uncontrolled spread of an invasive species.

The primary management objective for the use of Sonar® is the control of overabundant submerged aquatic weeds, particularly Eurasian watermilfoil and curlyleaf pondweed. How Sonar® is to be used within the waterbody will depend on the aquatic plant management objectives for the individual waterbody. It is important that these objectives be identified by the lake association or organization governing the use of a waterbody. Factors which may need to be considered in developing the objectives include the size of the lake or waterbody and whether the waterbody is to be used for potable water, swimming, boating, and fish or waterfowl management. Improvement or maintenance of aesthetic, scenic, and property values may also require aquatic plant management. Additionally, information on the development of lake management objectives can be found in Chapter 5 of Diet For a Small Lake (NYSDEC, 1990).

4.0 GENERAL DESCRIPTION OF SONAR® AND ITS ACTIVE INGREDIENT FLURIDONE

4.1 GENERAL DESCRIPTION OF SONAR® A.S. AND SRP FORMULATIONS

Sonar® is a systemic aquatic herbicide used in the management of aquatic macrophytes in freshwater ponds, lakes, reservoirs, drainage canals, irrigation canals, and rivers. The active ingredient of Sonar® is fluridone. Two formulations of Sonar® are registered in New York State. Sonar® A.S. (Aqueous Suspension) is a liquid formulation containing 41.7% fluridone and 58.3% inert ingredients. Sonar® SRP (Slow Release Pellets) is a dry material containing 5.0% fluridone and 95.0% inert ingredients.

4.1.1 Active Ingredients

The active ingredient in Sonar® is fluridone (1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4[1H]-pyridinone). Technical fluridone is an off-white to tan, odorless crystalline solid. It melts at between 151 to 154° C. The vapor pressure of fluridone is less than 1×10^{-7} mm Hg at 25°C. Fluridone is stable to hydrolysis at a pH of 3, 6 and 9. The partition coefficient (log K_{ow}) for fluridone in n-octanol/water is 1.87. Fluridone is not corrosive.

4.1.2 Inert Ingredients

The primary inert ingredient in Sonar® A.S. is water. Other inert ingredients are added to serve as wetters and dispersants in the formulation and to prevent freezing during storage. Sonar® A.S. and Sonar® SRP do not contain any inert ingredient listed on the USEPA List 1 - Inerts of Potential Toxicological Concern or List 2 - Potentially Toxic Inerts/High Priority for Testing. The primary inert ingredient in Sonar® SRP is clay. Small amounts of a binder are added to maintain the integrity of the pelleted formulation.

4.1.3 Product Contaminants

There are no toxicological concerns associated with product impurities in Sonar® herbicides as formulated.

4.2 SELECTION OF SONAR® SRP VERSUS SONAR® A.S.

The selection of Sonar® SRP versus Sonar® A.S. should be based on the management objectives of the aquatic macrophyte control program for the particular waterbody. The permit restrictions for the products should also be considered, noting that Sonar® A.S. is only registered for the management of Eurasian watermilfoil. The selection of one formulation or the other is related to maintaining an appropriate concentration of fluridone for a sufficient amount of time to allow for uptake by the target macrophyte. Generally, Sonar® SRP is more appropriate for moving water because it releases fluridone over a longer period of time than the A.S. formulation. This will allow for a longer exposure time than the liquid formulation which would tend to be more rapidly diluted by untreated water.

Sonar® SRP is most effective when applied while the target submerged plants are low growing in the water column and where bottom sediments are sands or other firm substrates. Sonar® A.S. is most effective where target submerged plants have grown to near the water surface. Sonar® A.S. performs well when applied over soft muck or organic sediments.

4.3 DESCRIPTION OF USE

Sonar® is used as a systemic herbicide for the control of unwanted aquatic macrophytes in lakes, ponds, reservoirs, slow moving rivers, drainage canals, and irrigation canals. Sonar® A.S. can be applied through surface application, subsurface application, or by bottom application just above the hydrosoil. Sonar® SRP is applied through any type of broadcast applicator.

4.4 MODE OF ACTION/EFFICACY

Sonar® is a systemic herbicide that is absorbed from the water column by plant shoots and from the hydrosoil by roots. The active ingredient in Sonar®, fluridone, inhibits the biosynthesis of carotenoid pigments within susceptible plants. Carotenoid pigments protects the photosynthetic pigment chlorophyll from photodegradation. Without the carotenoid pigments, chlorophyll is photodegraded and the plant is unable to carry on photosynthesis. Photosynthesis is required by the plant to produce carbohydrates necessary for metabolism (Elanco, 1981 and USEPA, 1986a). Specifically, the application of fluridone results in the accumulation of the colorless carotenes, phytoene and phytofluene, and lack of formation of the colored carotenoid, ß-carotene. In the absence of ß-carotene, chlorophyll is destroyed and the chloroplasts are disrupted in the sunlight causing cellular bleeding (Bartels and Watson, 1978 and Kowalczyk-Schröder and Sandmann, 1992).

Sonar®, and its active ingredient fluridone, have been shown to effectively control susceptible aquatic macrophytes. Eurasian watermilfoil and curlyleaf pondweed have been shown to be highly sensitive to fluridone. Pullman (1993) reported the removal of Eurasian watermilfoil and curly leaf pondweed and the restoration of the native plant community following the treatment of a lake in Michigan with Sonar® at a rate of 13.6 ppb. Pullman (1993) cited more than two dozen other lake treatments in Michigan using application rates of between 8 ppb to 29 ppb to successfully control Eurasian watermilfoil and curly leaf pondweed.

Sonar® is a slow-acting herbicide that requires an extended period of contact with the target macrophytes for the herbicidal effects to be induced. Netherland and Getsinger (1992) note that control of Eurasian watermilfoil with fluridone may take several weeks. DowElanco (1990) stated that it generally takes 30 to 90 days for Eurasian watermilfoil to drop out of the water column after treatment.

4.5 APPLICATION CONSIDERATIONS THAT MAXIMIZE THE SELECTIVITY OF SONAR®

Application considerations should include those conditions described in 6 NYCRR Part 326. Under those considerations, fluridone may only be used as follows:

1. Application of aqueous suspension formulations are permitted in water of the State at application rates not to exceed 50 ppb of the active ingredient fluridone.

2. Application of pellet formulations are not permitted in waters less than two feet deep.

3. Swimming is not allowed in treated areas for a period of 24 hours following the application.

SONAR cannot be used with 1320 feet of any functioning potable water intake and users must comply with all other federal and state approved label requirements. Further, it must be noted that Sonar® A.S. is only permitted for the treatment of Eurasian watermilfoil. The following factors should be considered in the application of Sonar® to ensure maximum selectivity of the product.

4.5.1 Time of Application

It is recommended that Sonar® be applied as early in the growing season as possible. Eurasian watermilfoil initiates productivity and metabolic activity at an earlier time than native plants (Smith and Barko, 1990). They report that the characteristic annual pattern of growth is for the spring shoots to begin growing rapidly as soon as the water temperature approaches 15° C. Pullman (1993) notes that this growth generally occurs before most native aquatic macrophytes become active. However, Boylen and Sheldon (1976) state that some native aquatic macrophytes, including Potamogeton robbinsii and P. amplifolius, will remain metabolically active at temperatures as low as 2° C. As a result of those growth characteristics, an early season application is recommended.

Utilizing an early growing season application would allow for the treatment of Eurasian watermilfoil while the remaining plant community is still dormant. Additionally, such applications would occur while the water is sufficiently cold to prevent recreational use (Pullman, 1994). Based on observations made in Michigan, Pullman (1993) noted that several broadleaf pondweeds may be moderately to highly susceptible to fluridone at application rates of 15 to 20 ppb, if the application occurs as these plants begin to grow. Though again, the spring growth of these species occurs after initiation of the growth of Eurasian watermilfoil.

4.5.2 Rate of Application

The registered application rates are described on the labels attached as Appendix A. Application rates for individual treatments may be varied to reflect the potential for water exchange in the treated area and for the susceptibility of target plants. Where treatments are being applied on a whole lake basis, with minimal opportunity for dilution by untreated water, application of Sonar® A.S. at low fluridone concentrations of 10 to 12 ppb has provided control of Eurasian watermilfoil. Higher rates may be required where applications are made to portions of a water body and where water movement will cause dilution with untreated water. Such conditions would be based on the characteristics of an individual site.

It is the objective of this GEIS, under the SEQR process, to objectively present all pertinent facts associated with the potential use of these products as currently registered in the State of New York. The information that has been presented in the GEIS is a compilation of facts that have been shown in various studies. While it is true that lower applications rates may be efficacious, this is usually in entire waterbodies where the concentrations can be maintained for a sufficient period of time. In larger waterbodies where partial area control may be attempted, a higher concentration (but not exceeding the registered application concentration) would be required to compensate for dilution from untreated waters. It is for this reason that the NYS registered labels for Sonar® SRP and A.S. give the user a range of application rates such that a variety of site circumstances can be addressed.

4.5.3 Method of Application

The method of application should be chosen based on the formulation of Sonar® to be used, which is a function of the management objectives of the control program. Sonar® A.S. can be applied through surface application, subsurface application, or by bottom application just above the hydrosoil, if plant development permits. Sonar® SRP is applied through any type of broadcast applicator. Sonar® should be applied as evenly as possible over nuisance plant zones. However, certain lake basin morphometries may require that the material be applied uniformly over the entire lake. This should be done to enhance the selectivity of the Sonar® application.

4.5.4 Species Susceptibility

The potential target macrophytes discussed in Section 2.0 are susceptible to Sonar®. Susceptibility is related to the concentration of Sonar® applied to the system. Table 4-1 lists the species considered to be susceptible to Sonar®.

4.5.5 Dilution Effects

As previously noted, the important factor regarding the efficacy of Sonar® is the ability to keep a sufficient concentration of fluridone in contact with the plant for a sufficient time to allow for uptake by the target macrophyte. To prevent the dilution of the herbicide from reducing efficacy, several recommendations may be made. Ponds should be treated at one time. If lakes or reservoirs are being treated, it is recommended that treated areas be greater than 5 acres. To obtain effective plant control, spot treatments should not be applied to small (less than 5 acre) areas in large water bodies, such as when narrow boat lanes or dock areas are being treated. Application periods should be chosen when heavy rainfall is not expected. Where possible, the

TABLE 4-1

SPECIES CONSIDERED SUSCEPTIBLE TO SONAR*

American Lotus (Nelumbo lutea)
Bladderwort (Ultricularia spp.)
Common Coontail (Ceratophyllum demersum)
Common Elodea (Elodea canadensis)
Egeria, Brazilian Elodea (Egeria densa)
Fanwort (Cabomba caroliniana)
Naiad (Najas spp.)
Parrotfeather (Myriophyllum brasiliense)
Pondweed (Potamogeton spp.)
Watermilfoil (Myriophyllum spp., including Eurasian watermilfoil, M. spicatum)
Spatterdock (Nuphar luteum)
Waterhyacinth (Eichornia crassipes)
Waterlily (Nymphaea spp.)
Waterprimrose (Ludwigia spp., including waterpurslane (Ludwigia palustris)
Watershield (Brasenia schreberi)

Sources: Payne, 1992, Pullman, 1993 and the NYS approved labels for Sonar* SRP and Sonar* A.S.

efficacy may be improved by restricting the flow of water. Whole lake applications provide the greatest opportunity for the long-term restoration of native plant communities.

4.6 FLURIDONE PRODUCT SOLUBILITY

Fluridone is slightly soluble in organic solvents such as methanol, diethyl ether, ethylacetate, chloroform, and hexane. Fluridone has a water solubility of 12 ppm, which is considered to be medium solubility. The solubility of fluridone in water is greater than the 0.05 ppm use rate on the NYS SLN label for Sonar® A.S.

4.7 SURFACTANTS

Surfactants are not used with Sonar® products when used as labeled in New York.

4.8 FATE OF FLURIDONE AND ITS PRIMARY METABOLITE IN THE AQUATIC ENVIRONMENT

Various studies have indicated that photolysis is the primary degradation mechanism for fluridone in aquatic ecosystems (Saunders and Mosier, 1983 and Muir and Grift, 1982). Microbial degradation of fluridone is documented to occur in laboratories (Mossler et al., 1991); however, photolysis generally occurs much more quickly (Muir and Grift, 1982). West and Parka (1981) also reported that the photolytic action occurs rapidly and is not influenced by the type of dispersal mechanism used to introduce Sonar®. Variables which may affect the rate of photolysis are those variables associated with sunlight penetration of the water column and sunlight intensity. They include geographic location, date of application, water depth, turbidity, weather, and weed cover (West et al., 1983).

West et al. (1983) identified 1-methyl-3-(4-hydroxyphenyl)-5-[3-(trifluoromethyl)phenyl]-4[1H]-pyridinone as the primary metabolite in fish. The same metabolite was identified as a minor metabolite in water and hydrosoil by Muir and Grift (1982). West et al. (1983) also identified 1,4-dihydro-1-methyl-4-oxo-5-[3-(trifluoromethyl)phenyl]-3-pyridinone as the major hydrosoil metabolite in hydrosoil studies conducted in laboratory settings. They note that the laboratory hydrosoil metabolite has not been identified in the hydrosoil of small ponds under natural conditions. Saunders and Mosier (1983) identified benzaldehyde, 3-(trifluoromethyl)-benzaldehyde, benzoic acid, and 3-(trifluoromethyl)-benzoic acid as photolytic breakdown products of fluridone added to a methanol/water solution in the laboratory.

Saunders and Mosier (1983) also identified N-methylformamide (NMF) as a photolytic breakdown product of fluridone which was added to a methanol/water solution in the laboratory. NMF has been shown to be teratogenic in rabbits at high doses and can penetrate human skin (Gaines, 1989). Early investigators were concerned with the possibility of NMF being produced by the breakdown of fluridone in the natural environment. However, NMF has never been identified under natural conditions (Gaines, 1989 and Osborne et al., 1989). Dechoretz (1991) did not identify NMF in water samples collected from ponds in California treated with aqueous suspension and pelleted formulations of Sonar®. West et al. (1990) did not identify NMF in water or hydrosoil samples collected from two ponds in Florida treated with Sonar® A.S. and Sonar® SRP at application rates of 0.15 ppm. In three ponds in Massachusetts, Smith et al. (1991) applied Sonar® A.S. and Sonar® SRP at a concentration rate of 0.15 ppm. Analysis of water samples collected from the ponds did not detect for NMF. Osborne et al. did not find NMF in water samples from ponds treated with up to 446 ppb fluridone.

4.8.1 Water (Aerobic and Anaerobic)

USEPA (1986a) reports that, under anaerobic conditions, fluridone has a half-life of 9 months and under aerobic conditions has an average half-life of 20 days. In field trials in ponds and lakes, using pelleted and aqueous Sonar® formulations, West et al. (1983) reported that the average maximum concentration for fluridone occurred 1 day after treatment in ponds (0.0871 ppm) and lakes (0.026 ppm). Observed concentrations are, of course, dependent on use rate. Ponds, which were 1.2 hectares and smaller, were located throughout the U.S., including New York State. Treatment in this study was on a whole pond basis. Lakes were larger than 1.2 hectares and were located in Florida and Panama. Areas of 0.8 to 4.0 hectares were treated in lakes. West et al. (1983) reported the maximum average concentrations of fluridone in water after treatment using a pelleted formulation of Sonar® (Sonar® 5P), occurred 2 weeks after treatment in ponds (0.025 ppm) and 1 day after treatment in lakes (0.022 ppm). The delay in reaching the maximum concentration in the pelleted formulation is due to the time involved in the breakdown of the clay pellet and the subsequent release of fluridone. West et al. (1983) noted that the average fluridone concentrations in the water from the pelleted formulation were similar or less than the average fluridone concentrations in the water from the aqueous formulation. Additionally, their results indicated that, once the maximum fluridone concentrations were reached, the dissipation rates between the two formulations were similar.

Langeland and Warner (1986) supported the work conducted by West et al. (1983). In the study conducted by Langeland and Warner, two ponds in North Carolina were treated with 2.27 kg ai/ha and 1.14 kg ai/ha of Sonar® A.S., respectively. One additional pond in Virginia was treated with Sonar® 5P, a pelleted formulation similar to Sonar® SRP. Their results indicated that between 64 and 69 days were required to reach no detectable levels of fluridone in the Sonar® A.S. treated ponds. In the Sonar® 5P treated lake, the maximum fluridone concentration (44.4 ppb) was reached 17 days after treatment, reflecting a time lag necessary for the fluridone to dissociate from the pellet formulation. Concentrations then decreased until 51 days after treatment, when a small increase in the fluridone concentration (from 20.9 to 28.9 ppb) in water was observed. Langeland and Warner speculated that this was the result of the release of fluridone back into the water from stressed vegetation.

West et el. (1983) reported that the half-life for fluridone in pond water treated with Sonar® A.S. ranged from 5 to 60 days. They were unable to calculate a half-life figure for the pelleted formulation of Sonar®. This was because fluridone was degrading at the same time it was being released from the pelleted formulation, resulting in a steady state concentration. Muir et al. (1980) reported a half-life for fluridone in water at a treatment level of 0.70 ppm of 4 days.

4.8.2 Sediment

Fluridone will adhere to sediment particles and organic material within the sediment. Elanco (1981) reported that fluridone will gradually desorb from the hydrosoil into the water column where it will photodegrade. Malik and Drennan (1990) noted that pH can be a controlling factor in adsorption, with the strength of adsorption increasing with lower pH levels. USEPA (1986a) notes that the half-life of fluridone in the hydrosoil is 90 days. West et al. (1979) reported a sediment maximum residue concentration equivalent to 16% of the fluridone theoretically applied to a pond in New York State. The application rate was 2.7 kg/ha of an aqueous fluridone formulation. That residue concentration decreased to 3% of the applied amount after 112 days. West et al. (1983) calculated a half-life of 3 months for fluridone in the hydrosoil of ponds. Additionally, they noted in 20 field trials that the laboratory hydrosoil metabolite does not form under natural conditions. West et al. (1983) also reported that studies on sediment-water systems indicated that fluridone tends to establish an equilibrium concentration between the water and sediment. Removal of fluridone from the water through photolysis results in the desorption of fluridone from the sediment into the water column to maintain the equilibrium.

4.8.3 Plants

Muir et al. (1980), using exaggerated application rates, reported a maximum residue concentration of 63.71 ppb of fluridone in duckweed (Lemna minor) following exposure to 5.0 ppm of fluridone in water. West et al. (1979) reported a maximum fluridone residue concentration of 3.98 ppm in Elodea canadensis, 7 days after treatment with an aqueous solution of fluridone that resulted in a water column concentration of 0.30 ppm at the time of application.

There is no information available on studies of herbivorous animals that consume aquatic vegetation containing fluridone residues. However, based on the low bioaccumulation rates reported in plants and the high levels of fluridone necessary to produce a toxic response in mammals and birds, it is not expected that herbivorous animals would be impacted by the use of fluridone at the registered application rates.

4.8.4 Fish

Based on all available fluridone residue data, USEPA has established a tolerance level of 0.5 ppm as adequate to protect human health from consumption of fish and crayfish (40 CFR and 180.420). The tolerance expressions assume an application at the maximum rates listed on the Federal Sonar® labels. West et al. (1983) reported that the maximum residue in the edible tissue of fish (the filet) occurred 1 day after treatment using Sonar® A.S. (reported 0.132 ppm), 14 days after treatment (reported 0.528 ppm) in inedible tissue (the viscera) and 14 days after treatment in whole fish (reported 0.399 ppm). They also reported a maximum residue level in the edible tissue of fish occurred 1 day after treatment using a pelleted formulation of Sonar® (reported 0.067 ppm), 28 days after treatment in inedible tissue (reported 0.268 ppm) and 28 days after treatment in whole fish (reported 0.185 ppm).

Muir et al. (1980) observed a maximum concentration of 0.17 ppb of fluridone in fathead minnows (Pimephales promelas) following exposure to 0.070 ppb of fluridone in water. Additionally, they noted that the maximum concentration was detected 9.6 days after treatment. In ponds treated at an application rate of 0.1 ppm, Arnold (1979) noted fluridone concentration residues of 0.054 ppm in green sunfish (Lepomis cyanellus) one day after application; concentration residues in pumpkinseed sunfish (Lepomis gibbosus) of 0.023 ppm and in largemouth bass (Micropterus salmoides) of 0.010 ppm 7 days after application; concentration residues in black bullhead (Ictalurus melas) of 0.010 ppm 14 days after application; and no detectable concentration residues in pumpkinseed sunfish and largemouth bass after 27 days after application.

The consensus of the scientific literature is that fluridone concentrations in fish generally reflect the concentrations in water. As the residues are removed from the water column, they clear from fish tissues. In their work, West et al. (1983) observed that concentrations of fluridone in fish were at non-detectable levels following dissipation of the material from the water column. This supported the observations made by Muir et al. (1980).

There is no information available on studies of fish-eating mammals or birds that consume fish containing fluridone residues. However, based on the low bioaccumulation rates reported in fish and the high levels of fluridone necessary to produce a toxic response in mammals and birds, it is not expected that piscivorous animals would be impacted by the use of fluridone at the registered application rates.

4.8.5 Mammals

Absorption/excretion studies in rats indicate that a single oral dose of fluridone is rapidly absorbed and extensively metabolized and primarily excreted in the feces. Arnold (1979) noted that the fluridone dose was excreted within 72 hours. More than 80% was excreted in the feces and a trace was excreted in the urine.

4.8.6 Bioaccumulation/Biomagnification

USEPA (1986a) states that fluridone has a low potential for accumulation in fish. West et al. (1983) identified a total average bioconcentration factors for total fluridone residues of 1.33 for edible tissue, 7.38 for inedible tissue, and 6.08 for whole body. These data were obtained from 175 fish samples collected from across the country, including New York State. Muir et al. (1980) reported bioconcentration factors of up to 85 in duckweed following exposure to 5.0 ppm of fluridone in water. West et al. (1979) reported bioconcentration factors ranging from 0 to 15.5 in vascular plants following exposure to 0.10 ppm of fluridone in water. These peak values of fluridone residues were followed by a decline in concentrations as fluridone dissipated from the water column. No circumstance was identified in the scientific literature where fluridone irreversibly accumulated in biological tissues and remained after the dissipation of fluridone from the water column.

4.9 FLURIDONE RESIDUE TOLERANCES

The following residue tolerances have been established in accordance with applicable federal regulations.

4.9.1 Water

The USEPA designated an acceptable residue level for fluridone in potable water of 0.15 ppm. This concentration is based on the maximum application rate for fluridone as registered under FIFRA (USEPA, 1986a). NYS DOH has established an acceptable level of 0.05 ppm for unspecified organic compounds in drinking water that applies to fluridone residues.

4.9.2 Fish/Shellfish

The USEPA has designated a tolerance of 0.5 ppm for residues of fluridone and its primary metabolite (metabolite II) in fish (USEPA, 1986) and crayfish (40 CFR § 180.420).

4.9.3 Crops/Agricultural Products

USEPA (1986) and 40 CFR § 180.420 have designated the following residue tolerances for crops irrigated with water containing fluridone residue concentrations of 0.15 ppm:

Commodities	Parts per million
Avocados	0.10
Citrus	0.10
Cottonseed	0.10
Cucurbits	0.10
Forage grasses	0.15
Forage legumes	0.15
Fruiting vegetables	0.10
Grain crops	0.10
Hops	0.10
Leafy vegetables	0.10
Nuts	0.10
Pome fruit	0.10
Root crops, vegetables	0.10
Seed and pod vegetables	0.10
Small fruit	0.10
Stone fruit	0.10

Additionally, residue tolerances have been established for the following raw agricultural commodities by USEPA (1986a) and 40 CFR § 180.420:

Commodities	Parts per million
Cattle, fat	0.05
Cattle, kidney	0.10
Cattle, liver	0.10
Cattle, meat (except liver and kidney)	0.05
Cattle, mbyp	0.05
Eggs	0.05
Goats, fat	0.05
Goats, kidney	0.10
Goats, liver	0.10
Goats, meat (except liver and kidney)	0.05
Goats, mbyp	0.05
Hogs, fat	0.05
Hogs, kidney	0.10
Hogs, liver	0.10
Hogs, meat (except liver and kidney)	0.05
Hogs, mbyp	0.05
Horses, fat	0.05
Horses, kidney	0.10
Horses, liver	0.10
Horses, meat (except liver and kidney)	0.05
Horses, mbyp	0.05
Milk	0.05
Poultry, fat	0.05
Poultry, kidney	0.10
Poultry, liver	0.10
Poultry, meat (except liver and kidney)	0.05
Poultry, mbyp	0.05
Sheep, fat	0.05
Sheep, kidney	0.10
Sheep, liver	0.10
Sheep, meat (except liver and kidney)	0.05
Sheep, mbyp	0.05

5.0 SIGNIFICANT ENVIRONMENTAL IMPACTS ASSOCIATED WITH SONAR®

As a manufactured chemical that is released into the environment, Sonar® has been extensively evaluated for non-desired impacts in aquatic ecosystems. Much of this testing and evaluation has been reviewed as a facet of the NYS registration process, which resulted in the registration of Sonar ® SRP in NYS, limiting its application to waters greater than two feet in depth. The registration process also resulted in the issuance of a Special Local Need (SLN) registration limiting the use of Sonar® A.S. to reduced application rates (50 ppb or less) for the control of Eurasian watermilfoil (Myriophyllum spicatum L.). However, as supported by extensive toxicological tests conducted during the product development and FIFRA registration process, no adverse impacts have been identified which are expected to result from the presence of fluridone at or below the NYS unspecified organic compound concentration level of 50 ppb.

The EPA has designated an acceptable residue level for fluridone in potable water at 0.15 ppm (150 ppb) (USEPA, 1986a). Independent studies have reported that fluridone has a very low level of toxicity to zooplankton, benthic macroinvertebrates, fish, and wildlife (Parka et al., 1978; McCowen et al., 1979; Arnold, 1979, and Grant et al., 1979). Arnold (1979) reported that fluridone is a safe, slow-acting herbicide that provides control of selected aquatic macrophytes, without impacting phytoplankton, zooplankton, benthic organisms or fish. Hamelink et al. (1986) concluded that fluridone is not expected to have adverse effects on the assortment of fish and invertebrates utilized in their study or on similar nontarget aquatic organisms. Furthermore, the potential for impacts can be reduced through the application considerations to maximize target selectivity as discussed in Section 4.5 and consideration of mitigation measures as discussed in Section 7.0. The following section discusses the potential impacts from the use of Sonar® in the water of NYS.

5.1 DIRECT AND INDIRECT IMPACTS TO NON-TARGET SPECIES

Sonar® is formulated as a selective aquatic herbicide for use in the management of unwanted aquatic macrophytes. As a chemical introduced into the environment, Sonar® has been evaluated during the registration process to determine potential adverse effects to non-target species. Direct impacts evaluated include toxicity, chronic changes in behavior or physiology, genetic defects or changes in breeding success or breeding rates for many test organisms. Indirect effects resulting from aquatic plant management may include changes in population size, changes in community structure or changes in ecosystem function. Both direct and indirect impacts can be evaluated at all stages of the life cycle of the non-target organism; though generally, the most sensitive stage of the organism (the young) is the period during which the organism is at greatest risk.

It should be noted that indirect impacts are often positive. For example, by controlling an exotic weed with Sonar®, the lake manager can facilitate the restoration of the native plant community. These desired changes in the community structure could be construed as an "impact". The connotation of negative must be examined in light of the management objectives for the use of the product in the waterbody. Additionally, the balance of potential impacts must be considered in relation to the potential impacts from the presence of an exotic nuisance weed in an aquatic environment. The prevention of long-term impacts caused by unwanted aquatic plants may offset a potential short-term impact of the management program. Again, this issue should be evaluated for the waterbody of concern.

The direct toxicity of fluridone-based herbicides has been assessed using laboratory toxicity tests. The results of tests referenced in this section will be characterized according to the risk phases established by Christenson (1976) as follows:

EC or LC_{50}	Classification
< 1 mg/l	Highly Toxic
1 - 10 mg/l	Moderately Toxic
10 - 100 mg/l	Slightly Toxic
100 - 1,000 mg/l	Practically Non-toxic
> 1,000 mg/l	Insignificant Hazard

Note: EC = Effective Concentration
LC_{50} = Concentration Considered to be Lethal to 50% of the Test Population

The following results should be considered in comparison to the 0.05 ppm concentration of fluridone allowed under the NYS drinking water concentration limit for all chemical compounds not specifically identified in the standards in waterbodies of NYS.

5.1.1 Macrophytes and Aquatic Plant Communities

Impacts to non-target macrophytes will be dependent on the sensitivity of that macrophyte to Sonar® at the application rate utilized (less than 50 ppb or 0.05 ppm), time of year of application, and use rate. Table 5-1 and Section 4.5.4 discuss those aquatic plants considered to be sensitive to Sonar® and fluridone. The loss of non-target plants within the aquatic plant community could alter the quality of functions that the vegetative community serves in the aquatic ecosystem. Loss of certain species from the community could alter the available habitat for fish species. The thinning of the macrophyte community could reduce the amount of refuge available to prey species and enhance the success of predators such as smallmouth bass. Such changes could benefit the fishery by altering the size distribution of the fishery (Andrews, 1989).

Lillie and Budd (1992) and Pullman (1993) suggest that in plant communities where Eurasian watermilfoil is in its pioneer stage of invasion or in heterogenous communities where watermilfoil is a component, habitat functions and values of this plant are considered to be comparable with native plant species. Therefore, the control of Eurasian watermilfoil in such communities could positively or negatively impact the associated fish community by temporarily reducing needed cover, shelter and food sources. However, it should be recognized that, once established, Eurasian watermilfoil is opportunistic and aggressive and demonstrates an ability

TABLE 5-1

SENSITIVITY OF SUBMERGED AND FLOATING MACROPHYTE SPECIES TO SONAR® APPLIED IN MICHIGAN LAKES

The sensitivity of common macrophyte species to Sonar when applied as whole lake treatments at rates used for the selective control of Eurasian watermilfoil and curly leaf pondweed during the year of application and the year following application.

Common Name	Scientific Name	Response During Year of Application [1]	Response Following Year of Application [1]
Watershield	*Brasenia schreberi*	4	2
Fanwort	*Cabomba caroliniana*	5	?
Coontail	*Ceratophyllum demersum*	4-5	2
Charoid Algae	*Chara* spp. & *Nitella* spp.	1	2
Elodea	*Elodea canadensis*	5	5
Water Stargrass	*Heteranthera dubia*	1	1
Northern Watermilfoil	*Myriophyllum sibiricum*	5	3
Eurasian Watermilfoil	*Myriophyllum spicatum*	5	0
Watermilfoil	*Myriophyllum verticillatum*	3	3
Naiad	*Najas* spp.	4	2
Spatterdock	*Nuphar* spp.	4	2
Waterlily	*Nymphaea* spp.	4	2
Broad Leaf Pondweed	*Potamogeton amplifolius*	3-4	2
Curlyleaf Pondweed	*Potamogeton crispus*	5	1-5
Illinois Pondweed	*Potamogeton illinoenis*	3-4	2
Sago Pondweed	*Potamogeton pectinatus*	4	1
Robin's Pondweed	*Potamogeton robbinsii*	1	3
Bladderwort	*Utricularia* spp.	1	3
Wild Celery	*Valliseria americana*	2-5	3

[1]: The range of responses is related to the timing of the Sonar application.

TABLE 5-1 (CONTINUED)

Response During Year of Application:

1 = Production or Total Distribution Increased
2 = Production or Total Distribution Slightly Increased
3 = No Impact on Plant Production or Distribution
4 = Production or Total Distribution Slightly Decreased
5 = Production or Total Distribution Drastically Decreased

Response Following Year of Application:

0 = Production Virtually Eradicated by Previous Year Application
1 = Production or total Distribution Increased
2 = Production or Total Distribution Slightly Increased
3 = No Impact on Plant Production or Distribution
(Production and Distribution Presumed to be Similar to Time of Pre-Milfoil Invasion)
4 = Production or Total Distribution Slightly Decreased
5 = Production or Total Distribution Drastically Decreased

Source: D. Pullman, Personal Communication, 1993 to grow faster than and displace native plants (Pullman, 1993; Madsen et al., 1991b). The value of the fishery will then be degraded by loss of plant diversity resulting from excessive Eurasian watermilfoil growth.

Sonar® controls all species listed on the label at the federal label application rate of 150 ppb. The label also lists species that may be partially controlled or are not controlled at these rates. Andrews (1989) notes that at low concentrations, Sonar® is highly selective to Eurasian watermilfoil and curly leaf pondweed. In a series of lake treatments in Michigan in 1992 at Sonar® application rates ranging from 8 to 29 ppb, Eurasian watermilfoil and curlyleaf pondweed were completely removed from the aquatic plant communities (Pullman, 1993). Non-target impacts included temporary herbicidal symptoms in water lilies (Nymphaea spp. and Nuphar spp.) and coontail (Ceratophyllum demersum). Pullman (1993) did report that elodea (Elodea canadensis) is susceptible to Sonar® and was usually removed from the plant communities in the treated lakes. He did observe that some native broadleaf pondweeds (Potamogeton spp.) appeared to be moderately to highly susceptible to Sonar® at application rates of 15 to 20 ppb, if the application occurred in the latter part of April and the early part of May. However, Pullman noted that native flora reestablished itself within a year of application. The production of Chara increased dramatically in nearly all lakes during the season of application. Water stargrass (Heteranthera dubia) and bladderwort (Utricularia spp.) also increased in area cover during the season of application.

In another lake treatment in Michigan, Pullman (1990) reported that at a Sonar® application rate of 0.014 ppm. Eurasian watermilfoil and curly leaf pondweed were removed from the water column in 4 to 6 weeks. In that treatment, water lilies exhibited some Sonar® induced chlorosis. Coontail was heavily impacted by the treatment, but persisted until the end of the growing season. Illinois pondweed (Potamogeton illinoensis) and water stargrass (Heteranthera dubia) were not affected by the Sonar® application and succeeded in expanding their distribution into areas previously colonized by the exotic aquatic macrophytes.

In a review of 21 lake treatments in Michigan in 1992, Kenaga (1992) noted that Sonar® effectively removed Eurasian watermilfoil and curlyleaf pondweed at concentrations as low as 8 ppb, where water exchange was minimal. The lakes ranged in size from two to 600 surface acres. In many of these lakes, non-target species had been limited by almost monoculture populations of nuisance exotic macrophytes. Kenaga (1992) went on to report that Sonar® was moderately effective at controlling southern naiad (Najas guadalupensis) and coontail (Ceratophyllum demersum) at 20 ppb, but relatively ineffective at controlling fanwort (Cabomba sp.).

In his 1992 preliminary draft report, Kenaga also noted that Sonar® effectively removed non-target species from the treated lakes at concentrations above 12 ppb. He reported that after twelve to sixteen weeks, from 20 to 100% of the native plant community had been removed in the 21 lakes. However, he also noted that the study had not been of sufficient duration to evaluate the longer term control effectiveness of Sonar®, and even stated that pondweed regrowth was observed in two lakes at the end of the study. He also stated that several factors contributing to the low amounts of remaining cover could vary from lake to lake and could include:

a. A lack of accurate knowledge of the lakes depth resulted in treatment with a higher concentration of Sonar® then planned.

b. Succeeding yearly treatments.

c. Poor initial non-target plant communities. Monotypic stands of Eurasian watermilfoil or curlyleaf pondweed will result in very low populations of native plants. Kenaga noted that in 11 lakes in which the submersed native plant community was reduced in cover by 90 to 100% after 14 to 16 weeks, the initial native plant community was sparse to very sparse in terms of species diversity and density prior to treatment.

As previously discussed, Pullman (1993) stated that regrowth of the native plant community nearly always returned within a year of application. This is further supported in Pullman (1994).

Kenaga (1992) also reported that the primary emergent vegetation effected by Sonar® were water lilies and cattails. Impacts to these species were primarily chlorosis and damage to plant foliage. However, even with damage or lost leaves, most water lilies were still observed to flower, indicating the continuing viability of the plant. Kenaga did note that emergent vegetation in lakes treated early in the season or in the 8 to 10 ppb range, experienced the least damage.

In an experimental lake treatment in Florida using both Sonar® A.S. and Sonar® SRP, hydrilla (Hydrilla verticillata) and Illinois pondweed (Potamogeton illinoensis) were the only two submerged aquatic macrophytes significantly impacted by the application. Coontail (Ceratophyllum demersum), southern naiad (Najas guadalupensis), bladderwort (Ultricularia spp.) and eelgrass (Vallisneria americana) were unaffected by the Sonar® application.

Fluridone has the potential to impact terrestrial plants through the use of water containing fluridone for irrigation purposes. Recommended time frames for delaying use of treated water for irrigation are summarized on the Sonar labels.

5.1.2 Algal and Planktonic Species

Sonar® is not considered to be effective as an algicide (product label). Pullman (1993) reported that Chara rapidly spreads in the littoral zone of Michigan lakes following Sonar® use for removal of Eurasian watermilfoil or curlyleaf pondweed. Filamentous algae and Nitella increased in Lake Sompson, Florida, following treatment with Sonar® (Hinkle, 1985). Parka et al. (1978) noted that fluridone did not appear to adversely affect desirable phytoplankton at treatment concentrations of 0.3 and 0.1 ppm. They did report some temporary reductions in less desirable blue-green phytoplankton species such as Anabaena and Anacystis. Similarly, Kammarianos et al. (1989) reported the elimination of bloom causing blue-green algae

(Cyanophyceae) following the treatment of a Greek pond with Sonar® A.S., which resulted in a water concentration of 0.042 ppm of fluridone. However, diatoms and other phytoplankton species (Diatomaceae, Chlorophyceae, Dinophyceae and Englenineae) increased after Sonar® use. The authors concluded that no detrimental effects were apparent. Struve et al. (1991) reported no sufficient reduction in phytoplankton densities when two ponds in Alabama were consistently exposed to a fluridone concentration of 0.125 ppm. Fluridone as an aqueous solution, when applied at the exaggerated rate of 1.0 ppm resulted in the reduction of zooplankton species, while an application rate of 0.3 ppm did not produce any effects in the zooplankton community (Arnold, 1979). In the 1.0 ppm treated pond, zooplankton populations returned to pretreatment levels within 43 days. Arnold reported similar trends in the phytoplankton population.

Kenaga (1992) reported that Chara expanded almost exponentially following the removal of submersed macrophytes in most lakes that he surveyed in Michigan. He also noted a perceived improvement in water clarity. While not scientifically documented, Kenaga reported that the possible reason for the improvement in water clarity was the increased growth in Chara.

5.1.3 Fish, Shellfish and Aquatic Macroinvertebrates

USEPA (1986a) summarizes the data developed from exposure of aquatic organisms in standard static water LC_{50} toxicity tests. Following exposure of Daphnia magna for 48 hours, the concentration of fluridone calculated to produce an acute response in 50% of the test population was 6.3 ppm. Following exposure of rainbow trout (Salmo gairdneri) and bluegill (Lepomis macrochirus) for 96 hours, the concentration of fluridone calculated to produce a lethal response in 50% of the test population was 11.7 ppm and 12 ppm, respectively.

USEPA (1986a) also lists a Maximum Acceptable Toxicant Concentration (MATC) of greater than 0.48 ppm, but less than 0.96 ppm, for exposure of fathead minnow fry (Pimephales promelas) to fluridone, indicating that no treatment related effects on fathead minnow reproductive measures were observed at or below 0.48 ppm. Struve et al. (1991) observed that fish abundance and community structure remained unchanged in ponds exposed to a fluridone concentration level of 0.125 ppm.

Parka et al. (1978) reported that at the exaggerated rate of 1.0 ppm of fluridone in water, the total numbers of benthic organisms were significantly reduced when compared to a control population. They also noted that 0.3 ppm of fluridone in water did not significantly reduce total numbers of benthic organisms. Fluridone as an aqueous solution, when applied at the rate of 1.0 ppm resulted in the reduction of populations of the amphipod Hyalella azteca, while an application rate of 0.3 ppm did not result in the reduction of amphipod populations (Arnold, 1979). Naqvi and Hawkins (1989) reported Sonar® LC_{50} values of 12.0 ppm, 8.0 ppm, 13.0 ppm and 13.0 ppm for the microcrustaceans Diaptomus sp., Eucyclops sp., Alonella sp., and Cypria sp., respectively.

Hamelink et al. (1986) conducted extensive acute and chronic toxicity tests on numerous fish and invertebrate organisms. For invertebrates, they noted an average 48-hour or 96-hour LC_{50} or EC_{50} (depending on the organisms) fluridone concentration of 4.3 ± 3.7 ppm. The representative invertebrates used in the study included amphipods (Gammarus pseudolimnaeus), midges (Chironomus pulmosus), daphnids (Daphnia magna), crayfish (Orconectes immunis), blue crabs (Callinectes sapidus), eastern oysters (Crassostrea virginica), and pink shrimp (Penaeus duorarum). For fish, they noted an average 96-hour LC_{50} fluridone concentration of 10.4 ± 3.9 ppm. The representative fish used in their study included rainbow trout (Salmo gairdneri), fathead minnows (Pimephales promelas), channel catfish (Ictalurus punctatus), bluegills (Lepomis macrochirus), and sheepshead minnows (Cyprinodon variegatus).

In the chronic toxicity tests conducted by Hamelink et al. (1986), no effects were observed in daphnids, amphipods, and midge larvae at fluridone concentrations of 0.2, 0.6, and 0.6 ppm, respectively. They reported that channel catfish fry exposed to fluridone concentrations of 0.5 ppm were not significantly affected. Catfish fry growth was reported as reduced at fluridone concentrations of 1.0 ppm. They also reported that chronic exposure of fathead minnows to mean concentrations of 0.48 ppm did not produce adverse effects. Results from Hamelink et al. (1986) indicated that fluridone concentrations of 0.95 and 1.9 ppm resulted in reduced survival of fathead minnow within 30 days after hatching.

5.1.4 Avian Species

USEPA (1986a) notes that acute toxic effects were not observed in bobwhite quail (Colinus virginianus) following the oral administration of a dose concentration of 2000 mg/kg of fluridone. USEPA considers this to be a slightly toxic response. Avian 8-day dietary studies for the bobwhite quail and the mallard ducks (Anas platyrhynchos) resulted in no mortality at 5000 ppm fluridone in the bird's food ration. (USEPA, 1986). USEPA further reported that no reproductive impairments in bobwhite quail or mallard ducks were observed following dietary exposure of up to 1000 ppm.

5.1.5 Mammals

Metabolism and distribution tests have shown that fluridone is absorbed and excreted in the feces within 72 hours of oral administration within rats. Acute toxicity studies have shown that the LD_{50} for a rat (Rattus norvegicus) exposed through the oral pathway to technical grade fluridone is greater than 10,000 ppm. Ingestion of Sonar® A.S. by rats resulted in no mortality when administered at 0.5 ml/kg. The LD_{50} for a mouse (Mus musculus) exposed through the oral pathway to technical grade fluridone is greater than 10,000 ppm. The LD_{50} for a cat (Felis domesticus) exposed through the oral pathway to technical grade fluridone is greater than 250 ppm. The LD_{50} for a dog (Canis familiaris) exposed through the oral pathway to technical grade fluridone is greater than 500 ppm (Elanco, 1981).

In 90-day subchronic feeding studies, no treatment-related effects were noted in rats at dietary doses of 330 ppm fluridone or in mice at dietary doses of 62 ppm fluridone. No toxic effects were observed in dogs at dietary doses of fluridone of 200 mg/kg/day. In one-year feeding studies, a dietary level of fluridone of 200 ppm did not produce toxic effects in rats and a 100 ppm dietary level did not produce toxic effects in mice. The administration of 150 mg/kg/day of fluridone to dogs for one year did not produce toxicological effects. Two-year feeding studies resulted in no evidence of carcinogenicity. In reproductive studies, fluridone was not teratogenic to rats at 200 mg/kg/day or rabbits at 750 mg/kg/day when administered during the organogenesis phase of gestation. Three successive generations of rats maintained on diets containing 2000 ppm of fluridone showed no impairment of fertility, liveborn litter size, gestation length or survival, progeny survival, or sex distribution (Elanco, 1981). Table 5-2 summarizes the NOEL's identified in toxicological tests conducted on fluridone. NOEL (No Observed Effect Level) is the highest dose tested which did not produce effect in the test group. For relative comparison of toxicity values, a listing of the toxicity of some common chemicals follows in Table 5-3.

5.1.6 Reptiles and Amphibians

Toxicity tests have not been conducted on any reptile or amphibian species, nor have they been required under the FIFRA process. Qualitative observations made by Arnold (1979) in field tests of fluridone in an aqueous solution at application rates of up to 1.0 ppm noted that frogs (Rana spp.), watersnakes (Nerodia spp.), and softshell turtles (Trionyx spp.) were not obviously impacted by the herbicidal application.

5.1.7 Federal and State Listed Rare, Threatened, and Endangered Species

Endangered species are those organisms faced with extinction in all or much of their distribution. Threatened species are those organisms that seem likely to become endangered. Rare species are those organisms which have widely scattered populations or are few in number. These organisms are rare for a variety of reasons, including changes in habitat (both natural and man-made), at the extent of its geographical range and predation pressure. Federal identified species are listed under the 50 CFR § 17.11 and § 17.12. State listed species are identified in NYCRR § 193.3.

Acute aquatic toxicity values and MATC's suggest that potential hazards to aquatic organisms would only be seen at concentrations higher than labeled application rates. This is particularly true in New York, where the maximum label rate for use of Sonar® A.S. is 0.05 ppm in treated water. It should also be noted that Sonar® labeling states that "to avoid impact on threatened or endangered aquatic plant or animal species, users must consult their State & Game Agency or the U.S. Fish and Wildlife Service before making applications". Identification of any rare, threatened or endangered species should be made as part of a permit application. A complete listing of threatened and endangered plant species in NYS is presented in Appendix C.

5.1.8 Biodiversity Sites

Information on the known location of rare species and significant natural communities can by obtained from the NYS Natural Heritage Program, which maintains a database on those resources. A determination of whether the proposed location of a Sonar® application would occur in one of these areas may be made through the Natural Heritage Program as part of the evaluation of a permit application.

TABLE 5-2

SUMMARY OF NOEL'S IDENTIFIED IN TOXICOLOGICAL RESEARCH CONDUCTED ON FLURIDONE

FLURIDONE STUDIES	NOEL RESULTS
90-day feeding study	53 mg/kg/day in the diet
90-day mouse feeding study	9.3 mg/kg/day in the diet
90-day dog feeding study	200 mg/kg/day administered orally
1-year rat feeding study	9.4 mg/kg/day in the diet
1-year mouse feeding study	11.4 mg/kg/day in the diet
1-year dog feeding study	150 mg/kg/day
2-year rat chronic feeding/oncogenicity studies	8.5 mg/kg/day in the diet No evidence of carcinogenicity at any feeding level
2-year mouse chronic feeding/oncogenicity studies	11.6 mg/kg/day in the diet No evidence of carcinogenicity at any feeding level
Modified Ames test	Negative at level of compound solubility
Unscheduled DNA repair synthesis assay	Negative in cultured rat hepatocytes at 1 micromole/ml
Sister chromatid exchange assay	Negative at an intraperitoneal dose of 500 mg/kg in Chinese hamster bone marrow
Dominant lethal test in male rats	Negative at an oral dose of 2,000 mg/kg
Rat teratology study	200 mg/kg/day
Rabbit teratology study	750 mg/kg/day
3-generation rat reproduction study	121 mg/kg/day in the diet

Notes: NOEL = No Observed Effect Level
mg/kg/day = milligram/kilogram/day
mg/kg = milligram/kilogram
micromole/ml = micromole/milliliter

Source: NYSDOH, 1986

TABLE 5-3

APPROXIMATE TOXICITY VALUES FOR OTHER COMMON CHEMICALS RELATIVE TO SONAR*

COMPOUND	LD50
Table Salt	3,000 mg/kg
Vitamin A	2,000 mg/kg
Aspirin	1,000 mg/kg
Technical Grade Fluridone	250 mg/kg*
Caffeine	164 mg/kg
Nicotine	53 mg/kg

* For exposure to cats via the oral pathway

5.2 POTENTIAL FOR IMPACT FROM THE ACCUMULATION/DEGRADATION OF TREATED PLANT BIOMASS ON WATER QUALITY

The rapid defoliation of aquatic plants in the water column can negatively impact Dissolved Oxygen (DO) levels in the waterbody as a result of the biological degradation of the organic material. This can impact the fish populations in the surrounding area. It is not expected that this event would occur following the use of Sonar®. Sonar® is a slow acting systemic herbicide which can take 30 to 60 days to produce its herbicidal effects in the target population. This results in a slow addition of organic material into the water column. Various researchers (Parka et al., 1978 and Struve et al., 1991) reported that Sonar® applications of up to 0.125 ppm have not resulted in significant decreases in DO content. In field tests conducted by Arnold (1979), fluridone in an aqueous solution at application rates of up to 1.0 ppm did not change water quality parameters as measured by DO, pH, Biological Oxygen Demand (BOD), color, dissolved solids, hardness, nitrate, specific conductance, total phosphates, and turbidity. Osborne et al. (1989) and West et al. (1990) also did not identify any changes in DO levels following application of Sonar®.

As discussed in Section 4.8.1, several authors (West et al., 1979 and Langeland and Warner, 1986) reported that low concentrations of fluridone are released back into the water system as the plant material degrades. Langeland and Warner (1986) noted an increase from 20.9 ppb to 28.9 ppb at day 51 of their degradation trial at a pond in Virginia. However, this increase is not to a level considered to be detrimental to fish population and is taken into account with regards to the overall degradation profile of fluridone which is discussed in Section 4.0. As such, the rerelease of fluridone into the water column from decaying plant material is not considered to be a potential for ecological concern.

5.3 IMPACT OF RESIDENCE TIME OF SONAR® IN THE WATER COLUMN

As discussed in the previous sections, Sonar® is a slow acting systemic herbicide that degrades with an average half-life of approximately 20 days in the water column. The chemical is designed to remain in the water column long enough to produce its effects and the application concentrations of fluridone are below those considered to be toxic to most aquatic organisms. Therefore, it is not anticipated that the residence time in the water column would alter the projected impacts that have been discussed.

5.4 RECOLONIZATION OF NON-TARGET PLANTS AFTER CONTROL OF TARGET PLANTS IS ACHIEVED

It is expected that following the reduction of coverage of nuisance macrophytes such as Eurasian watermilfoil and curlyleaf pondweed which are sensitive to low-level application rates of Sonar®, that the more tolerant native aquatic macrophyte species would expand into the vacated niches. Pullman (1993) supports that assumption based on observations of Sonar® application in lakes in Michigan. Certain species such as water stargrass, Chara, Nitella, bladderwort, and Illinois pondweed may actually expand enough to become a nuisance the year after Sonar® application. Kenaga (1992) reported exponential growth in Chara in most of the 21 lakes he surveyed in

Michigan that were treated with Sonar®. Dechoretz (1991) reported that regrowth by pondweeds, coontail and other native plants occurred generally within six to eight months following treatment of ponds in California with Sonar® A.S. and Sonar® SRP at the labeled application rates (0.15 ppm).

5.5 IMPACTS ON COASTAL RESOURCES

As noted in Section 5.1.3, the use of Sonar® herbicides at the recommended application rates is not likely to result in any adverse toxicological effects to marine species. The likelihood of any effects is also reduced by the probability of heavy dilution of any herbicide reaching the water column due to wave, current, and tidal activity.

If the use of Sonar® herbicides is proposed to be located within the NYS Coastal Zone and is determined to require federal licensing, permitting, or approval, or involves federal funding, then the action would be subject to the NYS Coastal Zone Management Program (19 NYCRR Section 600). This determination would be required during the preparation of an individual permit application. It should be noted that the label for Sonar® SRP states that it should not be applied in tidewater/brackish water and the SLN label for Sonar® A.S. allows its use only in freshwater ponds, lakes, and reservoirs.

6.0 POTENTIAL PUBLIC HEALTH IMPACTS OF SONAR®

6.1 BRIEF OVERVIEW OF FLURIDONE TOXICITY

USEPA (1986a) has reported that technical grade fluridone, as used in manufacturing, is in Category IV for acute oral effects in the rat and is moderately toxic through acute inhalation exposure. Eye irritation for technical fluridone potential has been demonstrated as moderate to severe (Category III and Category II). Both the aqueous suspension and pellet formulations are in Category III for oral, dermal, skin, and eye irritation effects. Consequently, Sonar® A.S. and Sonar® SRP labels bear a "Caution" signal word.

Metabolism and distribution tests have shown that fluridone is absorbed and excreted in the feces within 72 hours of oral administration to rats. Acute toxicity studies have shown that the LD_{50} for a rat (Rattus norvegicus) exposed through the oral pathway to technical grade fluridone is greater than 10,000 mg/kg. Administration of Sonar® 4 A.S. to rats at 0.5 ml/kg did not provoke a lethal response. The LD_{50} for mice (Mus musculus) exposed through the oral pathway to technical grade fluridone was greater than 10,000 mg/kg. The LD_{50} for cats (Felis domesticus) exposed through the oral pathway to technical grade fluridone was greater than 250 mg/kg. The LD_{50} for dogs (Canis familiaris) exposed through the oral pathway to technical grade fluridone was greater than 500 mg/kg (Elanco, 1981).

In 90-day subchronic feeding studies, no treatment-related effects were noted in rats at dietary doses of 330 mg/kg or in mice at dietary doses of fluridone of 62 mg/kg. No toxic effects were observed in dogs at dietary doses of fluridone of 200 mg/kg/day. In chronic toxicity studies, dietary levels of fluridone of 200 mg/kg did not produce toxicological or carcinogenic effects for either a one or two year test period. In reproductive studies, fluridone was not teratogenic to rats at 200 mg/kg/day or rabbits at 750 mg/kg/day when administered during the organogenesis phase of gestation. Three successive generation of rats maintained on diets containing 2000 mg/kg of fluridone showed no impairment of fertility, liveborn litter size, gestation length or survival, progeny survival, or sex distribution (Elanco, 1981).

6.2 NYS DRINKING WATER STANDARD

The drinking water standard established in New York State for any organic chemical contaminant not specifically identified in the standards is either 5 ppb or 50 ppb, depending on the chemical structure. Based on its chemical structure, the drinking water standard for fluridone is 50 ppb. Pursuant to the SLN, application of Sonar® A.S. is limited to application rates of 50 ppb. The release of fluridone from the pellet formulation (Sonar® SRP) will not result in fluridone concentrations exceeding 50 ppb at the labeled application rate. No adverse health effects have been identified at fluridone concentrations of 50 ppb or less. Kim (1992) states that at the 50 ppb application rate, no restrictions are necessary on the use of Sonar® A.S. in water bodies that serve as sources of potable water, beyond not allowing swimming for 24 hours and those restrictions on the federal label. Kim does recommend for Sonar® SRP that application should be prohibited in waters less than 2 feet deep. USEPA (1986a) has designated an acceptable residue level for fluridone in potable water at 0.15 ppm (150 ppb). Sonar® cannot be applied within one-fourth mile (1320 feet) from any functioning potable water intake.

7.0 MITIGATION MEASURES TO MINIMIZE ENVIRONMENTAL AND HEALTH IMPACTS FROM SONAR®

Mitigation measures describe guidelines to mitigate or lessen the potential for impacts from the use of Sonar® in the waters of NYS. While no impacts to humans are expected from the use of Sonar® in the waters of NYS, there is the potential for some ecological effects. The mitigation measures described in this section will reduce, or mitigate that potential for ecological effects, without reducing the efficacy of the product.

7.1 USE CONTROLS

When the aquatic plant management objective is to control Eurasian watermilfoil, while minimizing impacts to other aquatic macrophytes, Sonar® may be used early in the season. As was discussed in Section 3.5.1, Eurasian watermilfoil is essentially evergreen and begins to grow rapidly at the beginning of the growing season. This enables this plant to develop significant biomass before native macrophyte species begin growing (Smith and Barko, 1990). The use of Sonar® early in the growing season would target Eurasian watermilfoil, while minimizing the impact on other aquatic vegetation.

For removal of Eurasian watermilfoil with minimal impact on other species, it is suggested that Sonar® products be uniformly applied across the entire area to be treated. Applicators should follow an application pattern that minimizes concentration of the product in local areas. When making lake-wide treatments it is recommended that application rates, calculated as ppb of fluridone, be based only on the water volume in which mixing is expected to occur. Calculations should be based on water volume in the epilimnion above any deep water areas below the metalimnion or thermocline.

7.2 LABEL INSTRUCTIONS

The USEPA approved label for Sonar® SRP and the NYSDEC Special Local Need supplemental label for Sonar® A.S. list several general use precautions for the two products. The sale of Sonar® A.S. solely under the USEPA approved label is not permitted in NYS. The use is only allowed in conjunction with the SLN label. The SLN label for Sonar® A.S. specifies the use of this product for Eurasian watermilfoil only. Label use precautions and directions include the following:

1) Before applying the product, notification of and approval of the NYS Department of Environmental Conservation is required, either by an aquatic permit issued pursuant to ECL Section 15.0313(4) or issue of purchase permits for such use.

2) In lakes and reservoirs, do not apply Sonar® A.S. within one-fourth mile (1320 feet) of any functioning potable water intake. Existing potable water intakes which have been disconnected and are no longer in use, such

as those replaced by connections to potable water wells or a municipal water system, are not considered to be functioning potable water intakes.

3) Irrigation with Sonar® treated water may result in injury to the irrigated vegetation.

4) Follow use directions carefully so as to minimize adverse effects on nontarget organisms. In order to avoid impact on threatened or endangered aquatic plant or animal species, users must consult their State Fish and Game Agency or the U.S. Fish and Wildlife Service before making applications.

5) Do not apply in tidewater/brackish water.

6) Lowest rates should be used in shallow areas where the water depth is considerably less than the average depth of the entire treatment site, for example, shallow shoreline areas.

7.3 RELATIONSHIP TO THE NYS DRINKING WATER STANDARD

The drinking water standard established in New York State for all chemical compounds not specifically identified in the standards is 50 ppb. No adverse health effects have been identified at fluridone concentrations of 50 ppb or less. Kim (1992) states that at the 50 ppb application rate, no restrictions are necessary on the use of Sonar® AS in water bodies that serve as sources of potable water. As discussed in Section 4.4, Sonar® is effective as a selective systemic herbicide at the application rate of 50 ppb or less.

7.4 RULEMAKING DECISIONS

As of April 7, 1993, all pesticides labeled for use in aquatic settings were classified as restricted use products by regulation of the New York State Department of Environmental Conservation. Under this regulation, 6 NYCRR Parts 325 and 326, the use of aquatic pesticides, including Sonar® A.S. and Sonar® SRP, is limited to persons privately certified, commercially certified in Category 5, or possessing a purchase permit for the specific application that is proposed. Additionally, only those persons who are certified applicators, commercial permit holders, or have a purchase permit may purchase aquatic use pesticides.

With respect to fluridone, the regulations place the following restrictions on its use:

1. Aqueous suspension formulations may be applied at application rates not to exceed 50 ppb.

2. Pellet formulations may be applied to water two feet or greater in depth.

3. Swimming is not allowed in treated waters for 24 hours following application.

The effect of these rules will be to reduce the potential for risks to public health and the environment.

Under Part 327, a site specific permit will be required for the use of Sonar® in the waters of NYS, unless the waterbody is a privately-owned, no-outlet pond. The permit is issued through the NYSDEC. Potential permit applicants are cautioned to utilize the most recent product label for the development of their permit application. The applicants for the permit are required to be a riparian owner, or a lessee of a riparian owner, or an association of such persons. The applicant is required to submit the permit on a form provided by the NYSDEC. The information required for the application includes:

1. A scale drawing or map, including depth soundings adequate to determine: the size and depth of the treatment area; the concentration of the chemical within the area and the conformity to the limitations set forth in the regulations; the location and type of submerged and emergent weed beds; the location of water users relative to the area and along the outlet; and any further information required by the permit-issuing official.

2. Applications that involve public water supply waters or their tributaries will be referred to the State DOH for approval before the permit is issued.

3. The applicant must certify: that the listed chemical will be employed in conformance with all conditions specified in the permit issued; that the applicant obtained agreements to the treatment from water users whose use may be restricted as set forth in the application; that the applicant agrees that the issuance of the permit is be based on the assumed accuracy of all statements presented by him; that the applicant is legally responsible for damages resulting from the application of the chemical, or from the inaccuracy of any computations or from improper application of the chemical; and that the applicant assumes full legal responsibility for the accuracy of all representations made in obtaining approvals or releases, and for any failure to obtain approval or releases from the persons likely to be adversely affected.

A full copy of the Part 327 regulation is contained in Appendix E to this GEIS.

The use of SONAR within any jurisdictional wetland in the Adirondack Park is a regulated activity requiring a wetland permit from the APA pursuant to 9 NYCRR Part 578. The Agency's permit application requests information similar to that required by the NYSDEC, however additional details on the identification of all plant species including rare or endangered and their relative density within the treatment area will be necessary.

7.5 SPILL CONTROL

Care should be taken to use Sonar® properly and in accordance with the approved labels. Any leaks or spills should be promptly addressed. Liquid spills on an impervious surface should be cleaned up using absorbent materials and disposed of as waste. Liquid spills on soil may be handled by removal of the affected soil, and disposal at an approved waste disposal facility. Leaking containers should be separated from non-leaking containers and either the container or its contents emptied into another container. Spills of granular material should be promptly picked up, placed in a container and used according to label directions or disposed of in a proper manner at an approved waste disposal facility.

7.6 OTHER MITIGATION CONSIDERATIONS

In addition to the above mentioned activities, the following measures may be considered to further reduce, or mitigate any potential for environmental effects, without reducing the efficacy of the product.

7.6.1 Timing of Application

The potential for non-target impacts may be mitigated by the selection of an optimum time for application. It is recommended that Sonar® be applied as early in the growing season as possible. Eurasian watermilfoil initiates productivity and metabolic activity at an earlier time than native plants (Smith and Barko, 1990). As a result of those growth characteristics, an early season application is recommended. This would allow for treatment of Eurasian watermilfoil while the remaining plant community is still dormant. Based on observations made in Michigan, Pullman (1993) noted that several broadleaf pondweeds may be moderately to highly susceptible to fluridone at application rates of 15 to 20 ppb, if the application occurs as these plants begin to grow.

Additionally, early season application would be conducted while the water is relatively cold. Dissolved Oxygen levels during that time of the year are generally high, thereby mitigating any possibility of impacts to fisheries. Also, recreational use of water during that time frame would be limited (Pullman, 1994).

7.6.2 Application Techniques

The choice of Sonar® SRP or Sonar® A.S. could serve as a means of mitigating the potential for impacts to non-target macrophytes. The selection of Sonar® SRP versus Sonar® A.S. should be based on the management objectives of the aquatic macrophyte control program for the particular waterbody. The selection of one formulation or the other is related to maintaining an appropriate concentration of fluridone for a sufficient amount of time to allow for uptake by the target macrophyte. Generally, Sonar® SRP is more appropriate for moving water because it releases fluridone over a longer period of time than the A.S. formulation. This will allow for a longer exposure time than the liquid formulation which would tend to be more rapidly diluted by untreated water.

Sonar® SRP is recommended when applied while the target submerged plants are low growing in the water column and where bottom sediments are sands or other firm substrates. Sonar® A.S.

is recommended where target submerged plants have grown to near the water surface. Sonar® A.S. performs well when applied over soft muck or organic sediments.

8.0 UNAVOIDABLE ENVIRONMENTAL IMPACTS IF USE OF SONAR® IS IMPLEMENTED

As detailed in Section 6.0, the use of Sonar has been evaluated during federal and New York State registration process and in this GEIS for various impacts to non-target organisms in the aquatic setting. There are several unavoidable impacts that will occur when Sonar® is used in the waters of NYS to manage unwanted aquatic macrophytes such as Eurasian watermilfoil. It is important to note that the mitigation approaches described in Section 7.0 will lessen the magnitude and extent of those impacts. Those impacts are:

1. Impact to Habitat

   When Sonar® is introduced into a waterbody, it will result in the death of the target macrophytes. Once these target macrophytes have dropped out of the water column, there will be a period of time before the native non-target macrophytes reestablish themselves in the vacant niches. While the non-target species will reestablish themselves as detailed in Section 5.4, the process is not immediate. During that period of time, the aquatic macrophyte community will be reduced in size.

2. Impacts to Non-target Species

   A review of the literature indicates that there are native macrophytes which would be impacted to some extent by the use of fluridone in a waterbody. This has been detailed in Section 5.1.1. However, the literature indicates that a plant community composed of native plant species will become reestablished during the season following Sonar® use.

3. Possible Reinfestation

   In areas of significant water flow, such as lake inlets, Eurasian watermilfoil and other target plants may not be sufficiently controlled due to the dilution of applied Sonar® with untreated water. The reinfestation of Eurasian watermilfoil may occur via the dispersal means described in Section 3.3.1. This may necessitate the utilization of alternative means of controlling Eurasian watermilfoil in those areas of rapid water movement.

9.0 ALTERNATIVES TO SONAR®

This section details the various alternatives to the proposed action. The other alternatives include the no-action alternative to the use of Sonar® (which entails the lack of any aquatic macrophyte control measure, except as specified), chemical alternatives to Sonar®, mechanical alternatives to Sonar®, biological alternatives to Sonar®, and various other options. The no-action alternative does not preclude the ability of an applicant to apply for a permit for the use of those products described in the Final Programmatic Environmental Impact Statement on Aquatic Vegetation Control (NYSDEC, 1981a). Each of the possible alternatives will be evaluated from the standpoint of efficacy, positive and negative environmental impacts, and relative costs. The choice of a particular alternative over the proposed use of Sonar® should be based on the management objectives for the waterbody and the specific characteristics of the problem.

9.1 NO-ACTION ALTERNATIVE

In the no-action alternative, aquatic macrophyte control measures which could be utilized in the waterbodies of potential concern would be those chemical and mechanical means identified in the Final Programmatic Environmental Impact Statement on Aquatic Vegetation Control (NYSDEC, 1981a). Under the no-action alternative, the use of Sonar® is not considered for the control of the growth and spread of the target macrophytes in the waterbodies of concern. In this scenario, the only controlling measures, other than natural fluctuations in the plant populations, would be those activities presently permitted in NYS waterbodies. Without any controlling measures, the spread of invasive weeds such as Eurasian watermilfoil could result in significant modifications of the native aquatic habitat of a particular waterbody. Uncontrolled invasive macrophytes produce seeds and/or other reproductive parts that can be spread to other aquatic sites.

As discussed in Section 3.3.1, a large number of researchers have documented the negative impact of the introduction of Eurasian watermilfoil in a waterbody (Aiken et al., 1979; Lonsdale and Watkinson, 1983; Keast, 1984; Nichols and Shaw, 1986; and Smith and Barko, 1990). Madsen et al. (1991a) documented the decline of native macrophytes in a New York lake as a result of the invasion of Eurasian watermilfoil. Without any controlling measures, Eurasian watermilfoil can potentially modify the native plant community in a significant manner. Eurasian watermilfoil, once it has begun to form its characteristic canopy, will displace non-canopy forming native species. The result of the typical growth pattern of Eurasian watermilfoil is to form dense monotypic stands.

Pullman (1993) concluded that Eurasian watermilfoil is supportive of fish populations during its initial expansion stages in a waterbody. However, he goes on to note that once Eurasian watermilfoil begins to dominate the plant community and form its characteristic dense mats, the lack of plant species diversity and associated water quality impacts will reduce the quality of the habitat for fish. Nichols and Shaw (1986) reported that Eurasian watermilfoil provides beneficial cover for fish, unless the cover is so dense that stunting of fish growth from overcrowding results. Eurasian watermilfoil has been shown to provide a better habitat for fish (Kilgore et al.,

1989) and invertebrates (Pardue and Webb, 1985) than open water. However, Dvorek and Best (1982) found that Eurasian watermilfoil had the poorest invertebrate fauna populations out of 8 aquatic macrophyte species that were examined. Keast (1984) noted that fish abundance was 3 to 4 times greater in mixed native plant communities than in a plant community dominated by Eurasian watermilfoil. Nichols and Shaw (1986) noted that Eurasian watermilfoil is poor food for muskrats and moose and fair food for ducks, which will eat its fruit.

Eurasian watermilfoil also impacts the recreational use of a waterbody by interfering with swimming and boating, by reducing the quality of sport fisheries, and by reducing the aesthetic appeal of waterbodies (Newroth, 1985). Because of its mat forming characteristics, excessive growth of Eurasian watermilfoil (a primary target species for Sonar®) may present a safety hazard to the recreational use of a waterbody. The mats may cover rocks, logs, and other obstructions that could damage moving boats or injure water skiers. Additionally, the mats may entangle swimmers, potentially resulting in drownings. Drownings as a result of entanglement in Eurasian watermilfoil mats have been documented in New York (Long et al., 1987). NYSDEC (1981) notes that the lack of vegetation control may result in economic loss to the state and may reduce water quality, hinder desired human usages, and present health hazards.

Keast (1984) noted that fish populations and their invertebrate prey species are reduced in dense mats of Eurasian watermilfoil. Excessive Eurasian watermilfoil growth will result in clogged industrial, potable and power generation intakes, lowered dissolved oxygen concentrations, and increased populations of permanent pool mosquitoes (Bates et al., 1985). Additionally, the failure to control an invasive species such as Eurasian watermilfoil can jeopardize uninfested lakes by increasing the likelihood of the spread of the plant (VDEC, 1993).

Under the no-action alternative, there is the potential for subsequent declines in Eurasian watermilfoil following the invasion of a particular waterbody by the plant. Smith and Barko (1990) note that the population growth patterns of Eurasian watermilfoil in many waterbodies often vary to a great extent over time and from location to location. A variety of hypotheses have been presented to explain these population declines. They include nutrient depletion, shading by phytoplankton, attack by parasites, climatic fluctuations, and long-term effects of aquatic weed control (Carpenter, 1980). Smith and Barko (1990) note that declines have been documented in Wisconsin, British Columbia, and the Chesapeake Bay area. Painter and McCabe (1988) reported the decline and disappearance of Eurasian watermilfoil from several lakes in Ontario, Canada. No reason was confirmed for the disappearance, though circumstantial evidence indicated insect herbivory as the cause.

Carpenter (1980) reports that the period of peak abundance in these locations has ranged from approximately 5 to 10 years, with 10 years seen as the typical time frame. However, fluctuations in Eurasian watermilfoil populations are not generally predictive. In some areas, population fluctuations have been limited to seasonal changes or have not been observed (Grace and Wetzel, 1978; Madsen et al., 1988a; Kimbel, 1982; Nichols and Shaw, 1986; and Madsen et al., 1991b). Pullman (1992) noted declines in several Michigan lakes; though the declines were generally short-lived and populations soon returned to pre-decline levels. FOLA (1994) noted that the decline of Eurasian watermilfoil populations in Cayuga Lake appeared to be associated with the spread of the European aquatic moth larva (Acentria nivea). As detailed in Section 3.3.1, the number of lakes throughout the northeastern United States in which Eurasian watermilfoil infestation has been observed is increasing.

Some research has shown that the failure to manage Eurasian watermilfoil in a waterbody can have financial impacts to the recreational use of the waterbody. In a socio-economic research study in an area of 8 lakes infested with Eurasian watermilfoil, BCMELP (1991) estimated a loss in several economic areas, including transportation, the restaurant industry, the accommodation sector, and the shopping sector. They projected that a no-action alternative to managing for Eurasian watermilfoil would result in a loss in revenues in 1990 of $85 million in the Okanagan Valley region of British Columbia, Canada (or 26.5% of 1989 revenues). They also predicted a loss of 1700 employment positions in the tourist industry and a loss in real estate values of $360 million in the region. However, these figures have not been verified by the British Columbia Ministry of Environment, Lands and Parks.

9.2 CHEMICAL ALTERNATIVES

NYSDEC (1981) presented an evaluation of various chemical alternatives to Sonar®. Generally, chemical herbicides are divided into two broad categories. Those categories include contact herbicides and systemic herbicides. Contact herbicides remove that part of the plant that they come in contact with. Plant regrowth typically occurs within a few weeks or months. Systemic herbicides are absorbed by the plant and translocated to the lower stem and root system, which results in longer term plant control. Because of the systemic nature of Sonar®, another submersible systemic herbicide would be its most logical chemical alternative.

NYSDEC (1990) notes that aquatic herbicides are chemicals used primarily to manage specifically-targeted aquatic macrophyte species. Herbicides are applied in either a liquid or granular form. Herbicides can be successfully used in most lakes. In those lakes which serve as a potable water supply; however, certain use restrictions may be in place for the herbicides. NYSDEC (1990) lists endothall, diquat, and 2,4-D as the most commonly used aquatic herbicides in NYS. The average cost of most aquatic herbicides ranges between $200 - $400 per treated acre (NYSDEC, 1990). The cost per acre to apply Sonar® varies greatly depending on the application rate and the depth of water. In general, the cost may range between $40 - $160 per treated acre.

9.2.1 Endothall

Endothall was reviewed by the NYSDEC (1981). Endothall compounds are contact herbicides, which are primarily used for the control of most pondweeds and coontail. Endothall is not effective for floating or emergent species. The active ingredient in endothall is 7-oxabicyclo [2.2.1]heptane-2,3-dicarboxylic acid. The dipotassium salt of endothall is sold under the trade name Aquathol® K, as an aquatic herbicide. The mono(N,N-dimethylalkylamine) salt of endothall is sold under the trade name Hydrothol® 191, as an aquatic algicide and herbicide.

Pullman (1993) notes that the dipotassium salt of endothall will control Eurasian watermilfoil. However, he goes on to note that selective control is not possible because the application rates necessary to control Eurasian watermilfoil are lethal to many native plant species. WSDOE (1992) reports that endothall may have significant adverse impacts on non-target aquatic plants. A treatment concentration of 500 ppb for 72 hours was shown by Netherland et al. (1991) as being an optimum concentration to result in a complete removal of Eurasian watermilfoil in the water column and a shoot biomass reduction of greater than 98% when compared to reference locations.

NYSDEC (1981) notes that endothall is highly toxic to humans. WSDOE lists the acute toxicity of dipotassium or disodium endothall as ranging from 95 ppm for redfin shiners (Notropis umbratilis) to 710 ppm for striped bass (Morone saxatilis) fingerlings. Elf Atochem (1992) reports a tolerance level in water for fish of 60 to 100 ppm of dipotassium or disodium endothall. Toxicity values are significantly lower for the amine formulation of endothall. Endothall is rapidly taken up and produces quick results. This can lead to depleted oxygen levels in the water due to the sudden contribution of decaying plant biomass to the water column. Endothall is neither bioaccumulated nor persistent in the aquatic environment.

Vermont Department of Environmental Conservation (VDEC, 1993) notes that the advantage of endothall is that it is a fast acting herbicide. They also report that the disadvantages include: 1) the potential need for water use restrictions; 2) the potential need for an alternate water supply for a period of time; 3) the fact that endothall does not kill the roots, only the leaves and stems it comes in contact with; 4) the fact that control is short-termed; and 5) the fact that endothall is not selective for Eurasian watermilfoil.

9.2.2 Diquat

Diquat was reviewed by NYSDEC (1981). Diquat dibromide (6,7-dihydrodipyrido (1,2-a:2',1'-c)pyrazinediium dibromide) is a contact herbicide that can be selective for Eurasian watermilfoil. Diquat is sold under the tradename Reward®. It is used to control several submergent, floating, and emergent macrophytes at one to two gallons per acre. It is a broad spectrum contact herbicide with only local plant translocation. It is absorbed through the cuticle and works by interfering with photosynthetic activity within the plant. As a contact herbicide, it is taken up quickly and produces rapid results. This can result in decreased oxygen levels due to the sudden addition of decaying plant biomass to the water column. Pullman (1993) notes that at an application rate of 1 gallon per acre of treatment area, Eurasian watermilfoil will drop out of the water column in 10 days to two weeks, with little impact to aquatic plants native to Michigan. However, Eurasian watermilfoil will rapidly recover from a diquat application. NYSDEC (1981) considers diquat to have moderate toxicity to fish and invertebrates, moderate toxicity to test mammals, high oral toxicity to humans, and moderate to low toxicity to birds.

VDEC (1993) notes that the advantage of diquat is that it is a fast acting herbicide. They also report that the disadvantages include: 1) the potential need for water use restrictions; 2) the potential need for an alternate water supply for a period of time; 3) the fact that diquat does not kill the roots, only the leaves and stems it comes in contact with; 4) that fact that control is short-termed; and 5) the fact that diquat is not selective for Eurasian watermilfoil and water stargrass.

9.2.3 2,4-D

The aquatic herbicide 2,4-D was reviewed by NYSDEC (1981). The active ingredient is a granular formulation of 2,4-dichlorophenoxyacetic acid, butoxyethyl ester. 2,4-D is sold under the tradename Aqua-Kleen®. It is considered to be quite selective for Eurasian watermilfoil. It is a systemic herbicide which kills by inhibiting cellular division, though at low concentrations it may stimulate growth (VDEC, 1993). It is used to control several floating and submerged species, including Eurasian watermilfoil (NYSDEC, 1990). Pullman (1993) reports that when 2,4-D is applied at label-recommended rates, little or no impact to non-target species is observed. NYSDEC (1981) considers 2,4-D to have moderate toxicity to humans, low toxicity to test mammals, low toxicity to birds and varying toxicities to fish. VDEC (1993) reports that a concern has been raised by the USEPA's Office of Pesticide Programs concerning the potential carcinogenicity of 2,4-D, which is being evaluated by that office.

9.3 NON-CHEMICAL ALTERNATIVES

Non-chemical alternatives to Sonar® were evaluated with respect to their effectiveness, their advantages, and their disadvantages. These alternatives could be more suitable for small areas of milfoil or other target aquatic macrophytes (less than five acres for partial treatment) and areas having significant water movement. Generally, the non-chemical alternatives to Sonar® can be divided into mechanical alternatives, biological alternatives, and water level manipulation (drawdowns).

It is important to note that the Vermont Department of Environmental Conservation (VDEC) has been attempting to control the spread of Eurasian watermilfoil through non-chemical means since 1978. The primary mean have been mechanical harvesters and bottom barriers. Despite the attempts at controlling the spread of Eurasian watermilfoil, this aquatic macrophyte has continued to spread within infected lakes where controls have been attempted and to uninfested lakes which had not been targeted for milfoil control measures (VDEC, 1993). The Milfoil Study Committee of the VDEC recommended the use of aquatic herbicides on a site specific basis for the control of introduced, exotic vascular aquatic plant species (VDEC, 1993). The Committee does not recommend the use of Diquat or Endothall because their use would not meet the statutory requirement of pesticide minimization in a long-range management plan and they do not recommend the use of 2,4-D because of the uncertainty about potential human health effects.

9.3.1 Mechanical Alternatives

9.3.1.1 Aquatic Weed Harvesters

Harvesters are floating machinery that use a series of blades to cut the aquatic weeds at a point just above the hydrosoil of the water body, depending on depth. Harvesters are effective at removing aquatic vegetation. Madsen et al. (1988b) noted harvesting efficiencies of 79% of Potamogeton pectinatus. Engel (1990) noted that the effectiveness of harvesting is dependent on the time of year it is conducted. In his evaluation, a native macrophyte community harvested in June took a few weeks to reach pre-harvesting biomass. A native macrophyte community harvested in July took until the following spring to reach pre-harvest biomass. In his four year study, Painter (1988) reported that harvesting of a plot in Buckhorn Lake in Ontario in June and September resulted in reduction of Eurasian watermilfoil biomass, shoot weight, and plant density. However, plant height continued to reach the water's surface in the fourth year of the study. Perkins and Sytsma (1987) noted that a single harvest of Eurasian watermilfoil in July produced only a short reduction in the standing crop biomass. A twin harvest program provided an additional 36% reduction in the standing crop biomass. However, in their investigation, Perkins and Sytsma (1987) did not see a long-term reduction in the standing crop as a result of harvesting.

Harvesters have several advantages in that their use results in an immediate reduction in the plant material in the water column. Mechanical harvesters can be used in a limited, confined area and their use generally does not require any type of water use restriction. Another advantage is that they remove the plant biomass from the water. VDEC (1993) notes that the advantages to mechanical harvesting include: 1) mechanical harvesting may be used on a large scale; 2) the method immediately creates open water areas; 3) the fact that the lower part of the plant remains intact to provide some habitat; and, 4) the fact that there is no interference with water supplies or water use.

There are several disadvantages to mechanical harvesting. Because harvesting does not remove the plant roots, regrowth will occur. Generally, the maximum depth that the harvesters blades can reach is approximately six feet. For aquatic species such as Eurasian watermilfoil growing in excess of six feet of water, a substantial amount of biomass will be uncut. For fast growing species such as Eurasian watermilfoil, regrowth may occur in as little as one month, thereby requiring several harvests during the growing season. Pullman (1993) noted that repeated harvesting during a single growing season has been shown to reduce Eurasian watermilfoil populations. However, because mechanical harvesting is a broad spectrum process, the native plant communities will be as significantly impacted as the target species. The loss of the native plant community can result in the loss of valuable fish and wildlife habitat. Engel (1990) noted that the major ecological impacts of harvesting were changes in the macrophyte community structure and impacts to fish and their invertebrate prey.

Another disadvantage is the production of plant fragments. While harvesters remove most of the cut vegetation from the water column, they are not completely successful. Some plant fragments will be dispersed through the actions of the harvester. For plants such as Eurasian watermilfoil, which spread primarily through the dispersion of plant fragments, this may result in increased aerial coverage of the aquatic weed. Mechanical harvesting will also directly impact fish populations in the treatment area. WSDOE (1992) notes that harvesting can kill up to 25% of small fish in a given treatment area.

Other disadvantages include: 1) the need to have the plants within close proximity of the water surface to facilitate the most efficacious removal; 2) the fact that operating depths are generally limited to five to six feet, with an inability to harvest in shallow water; 3) the need for a disposal site for the harvested plants; 4) the inability to harvest around boats or inside docks; 5) the need for a ramp to launch the harvester; 6) the need for good weather and light winds; and 7) costs that are generally greater than herbicidal control. Harvesters cost between $50,000 and $120,000 per machine and from $200 to $600 per acre to operate for each harvest pass (NYSDEC, 1990 and VDEC, 1993).

9.3.1.2 Benthic Barriers

Benthic barriers are any compound, fabric, or physical structure that can be placed between the sediment and the water column to block sunlight and prevent the photosynthetic activities of the targeted plants. Benthic barriers may drastically alter lake plant and fish communities if used on more than a spot basis. Perkins et al. (1980) have shown that benthic barriers are an effective means of treating Eurasian watermilfoil. Eichler et al. (1993) noted that following removal of the benthic barriers, the first species to recolonize the treated areas were native species that overwintered as seeds or turions. In their investigation, Eurasian watermilfoil recolonized 71% of all sites within two years of removal of the barriers, though it was not the dominant species in the community.

The advantages of benthic barriers include multi-year control after initial installation. WSDOE (1992) notes that the effectiveness may range from 1 to 2 years up to 10 years. Benthic barriers can be used in confined areas around docks or in swimming areas. They are generally easy to install and durable, though they can be difficult to install if the water is not shallow. VDEC (1993) notes that the advantages to bottom barriers include: 1) long-term control if properly installed; 2) the method provides immediate control throughout the entire water column; 3) the use in areas not accessible to other mechanical means; and 4) the fact that there is no interference with water supplies or water use if properly installed.

The disadvantages include the high cost of initial installation. NYSDEC (1990) noted that benthic barriers can cost between $2,000 and $8,000 per acre, depending on the choice of fabric. VDEC (1993) considers this technique as not feasible on a large scale because of cost. Benthic barriers often require maintenance on a yearly basis and will require a relatively smooth lake or pond basin substrate. Additionally, benthic barriers may interfere with fish spawning and may significantly impact the benthic invertebrate community (NYSDEC, 1990 and WSDOE, 1992). Bartodziej (1992) noted that the use of benthic barriers in a lake in Florida resulted in significant adverse impacts to the benthic community under the barriers. Further, benthic barriers are not selective within the treatment area.

9.3.1.3 Hand Cutting

Hand cutting or pulling consists of the use of battery operated, knife blade or rake-type implements to cut the target plants. These methods are adequate for control of aquatic weeds inside decks and around boats, along shoreline property and inside swimming areas. This weed management technique is labor intensive, but does not require substantial skill, equipment, or expense (WSDOE, 1992). Bove (1992) utilized this technique in a lake in Vermont and considered the method effective in areas of low Eurasian watermilfoil densities.

VDEC (1993) considers the advantages of this technique to include: 1) the selective use in areas of greatest Eurasian watermilfoil density; 2) the potential for use by volunteers to keep costs down; 3) the method can be utilized in rocky and confined areas; 4) the fact that long-term control may be achieved if roots are removed, though fragments from other plants may move back into the treated area if a whole lake treatment program is not taken; and 5) there is no interference with water supplies or water use. Bove (1992) suggests that volunteers become more difficult to obtain over the course of a long management program, thereby placing a potential labor restraint on this method.

The disadvantages of this alternative include the non-discriminate nature of the method, depending on the type of hand removal. This disadvantage is usually mitigated by the small area of impact. Additional disadvantages include: 1) the fact that plant fragments may be generated which act to spread the target species; 2) the method may result in a short-termed sediment disturbance which would reduce water quality; 3) the fact that a smooth bottom is generally needed; and 4) the fact that the method is too slow and labor intensive to use on a large scale.

9.3.1.4 Rototilling or Rotovating

Rototilling is the use of a hydraulically operated rotovator head from a floating platform that removes the plant roots from the hydrosoil. This method is an effective means of controlling aquatic vegetation (Pullman, 1993). The advantages of this method include the ability to work to a maximum depth of 17 feet. Rototilling allows for seasonal to multiseasonal control of aquatic vegetation, depending on species. Generally, there are no water use restrictions with this method of weed control. It can be performed in a limited area and rototilling can occur over rocks and stumps.

There are several disadvantages to this method. As with mechanical harvesting, this method is broad spectrum and can facilitate the spread of the weed through the generation of plant fragments. Also, because this method occurs in the hydrosoil, a significant sediment load can be generated in the water column which could smother fish eggs and fry. Invertebrate habitat in the benthic area will be destroyed, which could impact the fish and wildlife species dependent on those organisms. This could result in changes in the aquatic ecosystem. Additionally, faster growing invasive species, such as Eurasian watermilfoil, may repopulate the area to the exclusion of slower growing native species (Smith and Barko, 1990; NYSDEC, 1990; and Pullman, 1993). NYSDEC (1990) and VDEC (1993) note that the capital costs for rototilling range from $50,000 to $120,000, with an operating cost of $100 to $1200 per acre.

9.3.1.5 Diver-Operated Suction Dredging

This technique consists of the use of suction dredging equipment by scuba-equipped divers to strategically remove the target species. WSDOE (1992) noted that this technique is practical for clearing individual objects such as dock areas or pilings and can result in up to 90% removal of the desired species. It can be a selective method for either an area or a species (NYSDEC, 1990 and WSDOE, 1992). Eichler et al. (1991) reported that suction dredging did not eliminate milfoil populations in a single season of harvesting, but was an effective means of managing Eurasian watermilfoil. Bove (1992) noted that diver-operated suction harvesting was used in a lake in Vermont with only limited success. She noted that it was an effective technique in areas of moderate densities of growth. However, it was not effective in dense growth areas as the root systems were difficult to extract from the associated sediments and excessive fragmentation of the milfoil was created. Bove also noted that effectiveness varies with bottom sediments type, with rockier sediments being more difficult to remove the plants from than silty sediments.

VDEC (1993) noted that the advantages to this technique include: 1) the removal of roots; 2) the fact that there is no limitation in water depth to operate; 3) the fact that this method can be selective for Eurasian watermilfoil; 4) the fact that this method can work in areas with underwater obstructions; 5) that control is possible for up to two years; and, 6) the fact that there is no interference with water supplies or water use.

The disadvantages to this method include an increase in turbidity and re-suspension of any contaminants bound in the sediment, decreased water clarity, and a possibility of algal blooms as a result of an increased nutrient load in the water column. Suction dredging will destroy benthic invertebrate habitat, though the effect is generally limited to a small area because of the limited nature of the method. VDEC (1993) noted that the disadvantages to this method include: 1) the creation of plant fragments; 2) the necessity for plant disposal; 3) the need for constant machine maintenance; 4) the method is slow and labor intensive; 5) the method is generally applicable for small scale use only; 6) the method disturbs organisms in the benthic zone of a waterbody; 7) the method may result in short-term siltation which would smother fish eggs and fry; and, 8) this method is potentially hazardous to employees due to the necessity for scuba equipment. NYSDEC (1990) estimates that the capital cost of the dredge equipment is about $15,000 to $20,000, with an operating cost of approximately $1,000 to $25,000 per acre.

9.3.2 Biological Alternatives

Biological methodologies consist of the use of introduced biota to control the targeted aquatic macrophytes. This alternative poses all of the potential problems of the invasive exotic aquatic macrophytes in that once they are released, the biota cannot be controlled. Of the three types of biological alternatives, the use of grass carp (Ctenopharynogodon idella) is not permitted in NYS and the use of insects and plant pathogens are still under study.

To underscore the problems inherent to biological controls, the following is quoted from NYSDEC (1990), Page 6-45:

> "Biological control methods, however, are not well understood. They are relatively new, have not been studied often in the field, and have not been applied to a wide variety of lake conditions. The most significant reason for the lack of understanding about biological controls, however, is in the nature of biological manipulation. Ecosystems are

at once dynamic and extremely fragile; a change in one component in the ecosystem can have dramatic effects in other components within the ecosystem. Unlike physical control methods, and to a lesser extent, chemical techniques, the results from biological manipulation studies either in theory or in the laboratory cannot be easily reproduced in the field, in actual lakes."

9.3.2.1 Grass Carp

Grass carp are an exotic herbivorous fish that can consume from 20 to 100% of their body weight in vegetation on a daily basis. Generally, only sterile carp are released into waters for vegetation control. NYSDEC (1990) considers that the disadvantages of grass carp use for vegetation control far outweigh their advantages. Unless adequately controlled, fish can escape from the stocked water and move into other waters, where they could impact plant communities in an unwanted fashion. NYSDEC (1990) noted that the most significant disadvantage to the use of grass carp is the potential to completely eradicate aquatic vegetation within a waterbody. This is further exacerbated by the fact that carp will not choose target plants such as Eurasian watermilfoil as their primary diet, instead choosing more native species, such as the pondweeds (NYSDEC, 1990, and Pine and Anderson, 1991). The total removal of the plant community can have extreme consequences to the aquatic ecosystem, significantly affecting native fish, wildlife, vertebrate and invertebrate populations (NYSDEC, 1990). Additionally, parasites have been identified as carried by grass carp. Costs for the use of grass carp range from approximately $50 to $100 per acre.

9.3.2.2 Insects

Various insects have been shown to be effective in controlling aquatic nuisance macrophytes. Generally, these organisms have certain life stages which feed on selected portions of the targeted plants. The larvae of a midge, Cricotopus myriophylli, has been shown to produce significant impacts to Eurasian watermilfoil (Kangasniemi, 1993). Macrae et al. (1990) noted that trials indicated that the larvae are very host-specific to Eurasian watermilfoil. However, more information is needed regarding the extent and specificity of the control. Macrae et al. (1990) noted that the midge only feeds on that portion of the plant extending above the surface of the water, leaving the underwater portion intact. As a controlling agent then, this alternative would not address the issue of Eurasian watermilfoil in a waterbody. NYSDEC (1990) noted that most of the successful applications of insects as a controlling agent have occurred in the southern United States. NYSDEC (1990) goes on to note that insects have been used effectively in conjunction with short-term control programs such as herbicidal or mechanical treatment, to produce long-term control. There is no indication as to the projected cost of this alternative.

9.3.2.3 Pathogens

Pathogens are biological agents that produce disease and death in the targeted organism. Pullman (1993) noted that a fungal pathogen, Mycoleptodiscus terrestris, has been shown to be a possible biological agent for the control and management of Eurasian watermilfoil. Much of the research has been conducted through the U.S. Army Corps of Engineers Waterways

Experiment Station in Vicksburg, Mississippi. This technique is currently a research project and pathogens are not available for use on Eurasian watermilfoil or other submersed northern species. There is no indication of the potential cost for this alternative.

9.3.3 Water Manipulation - Drawdown

Drawdowns or water level control is an activity in which the level of the lake is lowered to expose aquatic vegetation in shallow nearshore areas to the elements with the aim to eradicate it. Drawdowns are usually limited to those lakes or ponds which have a dam structure or similar mechanism for controlling the level of water. NYSDEC (1990) noted that the only beneficial time for a drawdown is in winter. NYSDEC (1990) goes on to note that for a drawdown to have a significant effect, the water level must be lowered at least three feet, the plants must be exposed for at least four weeks, and the bottom sediments must be frozen to a depth of at least four inches. Article 15, Title 8 of the Environmental Conservation Law presents the regulations associated with the volume, timing, and rate of change of reservoir releases.

Jenkins (1989) noted that a drawdown conducted at Lake Bomoseen in Vermont resulted in a 60% reduction of cover by aquatic species and a 99% reduction in cover by floating aquatic species. Local diversity was reduced by 44%. However, the abundance of a legally protected species was reduced by 86% and a rare species proposed for legal protection was completely removed from the lake. Additionally, he reported that the drawdown damaged the lake bottom, producing nutrient releases. VDEC (1990) noted that Eurasian watermilfoil was reduced in exposed areas of Lake Bomoseen; however, because it was not impacted in the deeper sections of the lake, recolonization of the shallower sections was expected.

VDEC (1993) considers the advantage of this technique to be the low operational cost and the potential for longer-term control than with other methods, though this would only be the situation if the whole benthic zone was exposed. Impacts to aquatic macrophytes from drawdowns are mixed, depending on species. Drawdowns have been shown to affect fanwort, coontail, most species of milfoil, most species of yellow waterlilies, and bladderwort. Drawdowns have been shown to have little effect on Chara spp., elodea, cattails, and tapegrass (Vallisneria americana). Drawdowns have been shown to increase the populations of most species of pondweeds (NYSDEC, 1990).

Disadvantages include the possible depletion of oxygen in the remaining water, if the lake is shallow and there is a high oxygen demand in the sediments and stream inflow. This could possibly result in fish kills. A nutrient release could result upon restoring the original water levels, which can produce algal blooms. Other macrophyte species may emerge as a result of the drawdown. Increased turbidity and resuspension of sediments may occur (NYSDEC, 1990). VDEC (1993) lists the disadvantages of this technique as being: 1) the potential for significant impact to non-target plants, invertebrates, fish and wildlife; 2) the potential for impacts to water intakes and shallow wells; and, 3) method effectiveness and lake refill depends on the weather.

9.4 INTEGRATED PEST MANAGEMENT

The optimal method of addressing aquatic macrophyte concerns is in a coordinated effort that brings the most effective and environmentally sound techniques to bear on the problem. An integrated approach would be based on the use of all techniques, depending on the characteristics of the specific problem in a waterbody. An integrated approach, however, would not only be based on a variety of techniques to address the immediate issue of excessive aquatic macrophyte growth, but also the inherent causes of the problem. Such an approach would include measures to reduce artificially stimulated lake eutrophication that exacerbates nuisance weed growth. Such activities would include measures such as management and control of nutrient loading, reduction of wastewater flow and reduction of sedimentation on a lake watershed basis. However, such techniques can be expensive and slow to implement. Integrated pest management is an ideal goal of lake management, but is not always a practical solution. A detailed discussion of Integrated Pest Management is presented in Diet For a Small Lake (NYSDEC, 1990).

9.5 ALTERNATIVES ANALYSIS

As discussed throughout Sections 2.0 and 3.0 of this GEIS, the uncontrolled growth of aquatic macrophytes in surface waterbodies can substantially impact the ecological characteristics of that waterbody. Desired water uses such as recreational uses may also be prevented or made hazardous by unwanted plant growth. This is particularly true for exotic species such as Eurasian watermilfoil and curlyleaf pondweed, which are capable of exponential growth. It is the responsibility of the lake manager or lake association to decide upon a course of action that not only effectively controls the macrophyte of concern, but also is ecologically sound. The use of the aquatic herbicide Sonar® is one of the alternatives that is available for the control of aquatic macrophytes. This section describes a general approach to deciding upon the use of Sonar® with respect to the other alternatives described in Section 9.

It is the responsibility of the lake manager or lake association to monitor their lakes or ponds with respect to its plant populations, including the growth and distribution of exotic and indigenous macrophytes. Through these monitoring efforts, the infestation of the waterbody by exotic macrophytes or the excessive growth of macrophytes would be noted. Any subsequent decisions regarding macrophyte management approaches must consider all permit requirements, including those specified in Part 327 as described in Section 7.4.

To document the infestation, particularly in advance of a Part 327 permit application, information on the nature and extent of the infestation would be required. That information would include the nature and areal coverage of the infestation, the areal size of the waterbody, the location of the infestation with respect to the waterbody, the depth of the water column, the recreational uses of the waterbody, the location and distances of potable water intakes with respect to the potential treatment zone, other macrophyte species which may be present, and the presence and distribution of any rare species. Information on sediment types and water movements should also be gathered. Other important considerations would be the lake management objectives and any criteria under the NYS Freshwater Wetlands Act.

Much of this information is available directly off of maps and diagrams produced by the NYSDEC. The nature of the macrophytes in and surrounding the infestation area can be determined through either direct visual observation (non-harvesting methods) or by clipping samples of the littoral vegetation for identification (harvesting methods). Community characteristics such as horizontal and vertical zonation, plus frequency and dominance can be determined by the collection of a number of samples in relationship to the area of concern. The depth of the water column can either be determined through electronic means (sonar) or through mechanical means (drop-lines and staff gauges).

As noted in Section 3.0, small quantities of Eurasian watermilfoil and curlyleaf pondweed in the early stages of infestation may offer many of the functions and values of native aquatic macrophytes. In this instance, the no-action alternative may be an appropriate management strategy. The lake manager or lake association would monitor the growth patterns of the areas of infestation under such a strategy. If the infestation is highly localized, the lake manager or lake association may chose a technique such as hand pulling, benthic barriers, or suction dredging as a control option. If the decision by the lake manager or lake association is that the quantity of macrophytes in the waterbody of concern is posing an ecological, recreational, or safety impact to the use of the waterbody, an appropriate management approach may be chosen using the following guidelines.

In ponds less than five acres in size where the entire waterbody is substantially dominated by macrophytes targeted for control, Sonar® would be an effective control method, particularly with respect to Eurasian watermilfoil and curlyleaf pondweed. In comparison to the other possible herbicides, neither Endothall nor Diquat are selective for Eurasian watermilfoil. 2,4-D is selective for Eurasian watermilfoil, but has greater water use restrictions than fluridone. Other herbicides may not be selective to control only targeted species. With respect to mechanical alternatives, Sonar® would produce longer lasting results with less environmental damage than mechanical harvesting, benthic barriers or dredging. Drawdown also is not a preferred option as it is not always a choice with a particular waterbody and the drawdown may not be able to effect the deeper parts of the pond. The potential ecological impacts from drawdowns include the possible depletion of oxygen in the remaining water, which could result in fish kills, and nutrient releases, which could produce algal blooms and increase the spread of other macrophyte species. Increased turbidity and resuspension of sediments may occur (NYSDEC, 1990). Other disadvantages are listed in Section 9.3.3.

Within a larger lakes, if the area to be treated is less than 5 acres in size, a contact herbicide such as Endothall or Diquat may be an appropriate control method. A systemic herbicide such as 2,4-D may also prove effective, if water use restriction can be met. The Sonar® label states that treating areas less than five acres in size may not produce satisfactory results due to dilution by untreated water. Mechanical alternatives such as benthic barriers or raking would also be possible treatment choices, and would be more cost effective than harvesting.

Where the area to be treated is greater than five acres, Sonar® would be an appropriate alternative. In comparison to the other possible herbicides, Endothall and Diquat are non-selective for Eurasian watermilfoil and do not provide long-term control of Eurasian watermilfoil. 2,4-D is selective for Eurasian watermilfoil, but has stricter water use restrictions than fluridone. With respect to mechanical alternatives, Sonar® would produce longer lasting results, with less environmental damage, than mechanical harvesting. VDEC (1993) notes that there are significant environmental impacts associated with the use of mechanical alternatives. Drawdown often is not a choice with a particular waterbody and the drawdown may not be able to effect the deeper parts of the lake. The potential ecological impacts from drawdowns include: possible depletion of oxygen in the remaining water that could result in fish kills; and nutrient releases which could produce algal blooms and increase the spread of other macrophyte species. Increased turbidity and resuspension of sediments may occur (NYSDEC, 1990). Other disadvantages are listed in Section 9.3.3.

As discussed in Section 9.3.2, biological alternatives in NYS are either not permitted or are still in the testing phase. At present, biological alternatives are not developed for use.

10.0 DESCRIPTION OF THE PROPOSED ACTION - USE OF RODEO®/ACCORD® HERBICIDES

The proposed action is the use of the aquatic herbicides Rodeo®/Accord® for the control of nuisance aquatic vegetation in waterbodies located in the State of New York. The use of Rodeo®/Accord® can be an important component of a comprehensive management approach to limiting the spread of certain aquatic macrophytes. These macrophytes can be undesirable in certain circumstances. These species may be introduced macrophytes, which because of the lack of controlling ecological factors, can reach a nuisance stage in terms of extreme numbers or biomass. They may produce severe ecological impacts through the reduction of native aquatic species (Madsen et al., 1991b), and the modification of the aquatic habitat utilized by indigenous organisms (VDEC, 1993).

10.1 GENERAL DESCRIPTION OF THE AQUATIC HERBICIDE GLYPHOSATE (RODEO® AND ACCORD® HERBICIDES)

Rodeo® and Accord® herbicides are the aquatic versions of the broad-spectrum, systemic herbicide Roundup®. The primary herbicidal mode of action for Rodeo®/Accord® herbicides is to block the synthesis of aromatic amino acids and the metabolism of phenolic compounds by disrupting the plant's shikimic acid metabolic pathway. Glyphosate, the active ingredient of Rodeo® and Accord® herbicides, is the only herbicide known to disrupt this particular enzymatic pathway. This type of disruption results in the plant's inability to synthesize protein and consequently, the inability to produce new plant tissue (Cole, 1985). Secondary effects of these herbicides are upon photosynthesis, respiration, and the synthesis of nucleic acids. This is carried out through a complex series of interactions with enzymes which control the synthesis of such important molecules as chlorophyll. These interactions result in decreases in the rate of photosynthesis and increases in the rate of respiration. Changes at the cellular level include the formation of granular bodies; the deterioration of oil bodies, the endoplasmic reticulum and ribosomes; and vacuolation of the cytoplasm (Smith, 1992). The ultimate result of these physiological disturbances is the death of the plant.

The active herbicidal ingredient in the Rodeo® and Accord® herbicides is glyphosate (N-phosphonomethylglycine), formulated as its isopropylamine salt. Glyphosate is a white, odorless solid which readily dissolves in water, but is not soluble in organic solvents. Rodeo/Accord are concentrated aqueous formulations which contain, respectively, 53.8% and 41.5% glyphosate in the form of isopropylamine salt. The remaining component of Rodeo/Accord is the inert ingredient water. Rodeo/Accord do not contain any added surfactants, and differ from their terrestrial counterpart, Roundup®, which contains a surfactant (polyoxyethyleneamine or POEA) as an inert ingredient.

The effectiveness of Rodeo® and Accord® herbicides depends, in part, upon the adsorption of these herbicides to the foliage of actively growing plants. Shortly after contact with foliage these herbicides penetrate the cuticle of the plant where they begin a cell by cell migration to the phloem (i.e., plant transport mechanism). The addition of a surfactant, as recommended by the manufacturer, aids in this absorption process. Once in the phloem, Rodeo® and Accord® herbicides are transported throughout the plant, including the roots, where their herbicidal activities take place. Visible effects (i.e, wilting and yellowing) of this herbicidal action generally occur within 7 days but may require up to 30 days in some woody plants. Because glyphosate is not selective, the herbicides are effective against most species of deep rooted perennials, annual and biannual grasses, sedges, rushes and broad-leaf weeds, and woody plants. Rodeo® and Accord® herbicides do not have residual herbicidal activity in the soil. Desirable plant species can revegetate a site after undesirable plant species are controlled.

10.1.1 Purpose of the Products

Rodeo® and Accord® herbicides are broad-spectrum, post-emergent aquatic herbicides which are intended for the management and control of invasive and nuisance macrophytes. The Rodeo® herbicide is labelled for use on emergent and floating aquatic plant species as well as a variety of noncrop terrestrial plant species. The Accord® herbicide is labelled for use on forestry and utility sites, including those containing wetlands and open water sites. Both Rodeo® and Accord® herbicides are intended to provide an effective and economical method for the management and control of nuisance emergent weeds in freshwater ponds, lakes, reservoirs, drainage canals, irrigation canals, and rivers, as well as saline and brackish estuaries, backwaters and impoundments. Accord is used for general vegetation management in utility right of way sites and in forestry management. These sites include areas where wetlands and surface waters exist. Rodeo is used for broad spectrum vegetation management in aquatic, wetlands, and non-crop terrestrial sites, though its primary use is in the control of cattails (Typha spp,), phragmites (Phragmites spp.), and purple loosestrife (Lythrum salicaria) in NYS. Rodeo and Accord are not effective against submerged vegetation.

10.1.2 Need for the Products

The invasion of undesirable emergent macrophytes such as cattail, phragmites, and purple loosestrife has been progressing at an astonishing rate over the past several decades. Due to their ability to invade disturbed areas (disturbed primarily by anthropogenic activities) they have been able to infiltrate most regions of North America. Once these species gain a foothold in disturbed or stressed areas, their high rates of proliferation and their ability to out-compete indigenous species have allowed them to spread into the more natural undisturbed aquatic environments. Although these species do provide some limited value as habitat and forage for some animal species, once the invaded aquatic ecosystem becomes monotypic in its vegetative cover, there is a sharp decline in the diversity of wildlife. In addition to degrading the ecological value of aquatic ecosystems, these weeds also become a nuisance for recreation, irrigation, navigation, and stormwater management.

Management and control of cattails, phragmites, and purple loosestrife has taken several forms over the years including burning, cutting and dredging; however, all of these techniques have proven to be short-term and expensive. Several of these practices have proven to be deleterious to the environment as well. The use of glyphosate in the form of Rodeo® and Accord® herbicides has proven to be a very successful, long-term, economical means of controlling these nuisance macrophytes in many parts of the country and the world, and they have done so without the adverse environmental effects attributed to some of the alternative methods of control.

10.1.3 Benefits of the Products

The use of Rodeo® and Accord® herbicides will allow for a comprehensive approach to the control and management of nuisance emergent aquatic macrophyte species. These products allow for the long term control of target macrophytes because of their ability to destroy the rootstock of the plants it is attacking, making it impossible for them to grow the following season. The lack of destruction of plant rootstocks is the primary reason alternative control measures fail. The control of these invasive weeds allows for the reemergence of indigenous aquatic macrophytes, thereby, restoring ecological diversity.

10.1.4 History of Product Use

Following is the history of Accord® and Rodeo® herbicides federal and state registrations. Accord® herbicide received Federal registration on December 5, 1978 (USEPA Reg. No. 524-326-AA), with New York State registration granted shortly thereafter. Rodeo® herbicide received Federal registration on June 14, 1982 (USEPA Reg. No. 524-343). Registration approval was granted in New York State shortly thereafter. An identical Rodeo® herbicide formulation, Roundup® NS, is registered in all Canadian provinces. An identical Accord® herbicide formula registration has not been sought in Canada. Vision, the Canadian equivalent of Roundup®, is used in Canada for many of the U.S. Accord® herbicide uses.

10.1.4.1 Registration Status in States and Canadian Provinces That Are Neighboring New York State.

Rodeo® and Accord® herbicides are registered in Pennsylvania, New Jersey, Connecticut, Massachusetts, and Vermont. Roundup® NS is the identical Rodeo® herbicide formulation registered in all Canadian provinces. Vision, the Canadian equivalent of Roundup®, is used for many of the U.S. labelled Accord® herbicide uses.

10.2 GENERAL LOCATION OF THE PROPOSED ACTION

For the purposes of this GEIS, the general location for the proposed action, which is the use of the aquatic herbicide Rodeo®/Accord®, is in the waters of the State of New York. A specific description of the actual body of water in which the products are intended for use would be included in the development of permit applications. Rodeo®/Accord® herbicides are generally intended for use on emergent vegetation in freshwater lakes, ponds, reservoirs, canals, rivers, estuaries, seeps, irrigation and drainage ditches, wastewater treatment facilities, and wildlife habitat restoration and management areas. Under Article 24 of the Environmental Conservation Law, some ponded water may be described as wetlands.

NYSDEC (1987) reports that over 7500 lakes, ponds, and reservoirs can be found in the State of New York. While NYSDEC (1990) states that there are no scientific terms for the three types of waterbodies, it notes that ponds are generally small, shallow water bodies with little or no wave action, that usually exhibit uniform temperature distributions. Lakes are large and deep water bodies that exhibit periodic thermal stratification and may have rocky, wave-impacted shorelines due to exposure to prevailing winds. Water in the lake is contributed from the surrounding land which is termed the water basin. Water can be contributed to the lake through streams, rivers, groundwater or general surface runoff. Reservoirs are man-made lakes.

10.3 POTENTIAL AQUATIC MACROPHYTE TARGET SPECIES

This GEIS is a supplement to the NYS Environmental Impact Statement dated May 1, 1981 (NYSDEC, 1981). Based on the registered labels for Rodeo and Accord, the aquatic macrophyte species listed in this section are considered as potential target species. However, not all of the aquatic macrophyte species described on the product labels are found in the State of New York. More detailed discussions of the plants are limited to those species indigenous to New York State.

10.3.1 Phragmites (Phragmites spp.)

One of the primary target species for Rodeo®/Accord® herbicides products is phragmites. Phragmites is most commonly listed as Phragmites communis Trin.; though Clayton (1968) suggests that the correct nomenclature for this species is Phragmites australis (Cav.) Trin. ex Steudel. Phragmites, or common reed, are an invasive species which is found throughout southern Canada and the United States. Magee (1981) notes that phragmites is a tall grass, usually 2 to 4 meters in height, which grows in colonies. Leaf blades are up to 61 cm long and up to 5 cm wide. The inflorescence is a dense panicle up to 30 cm in length. Flowering occurs between August and September. The plant is supported by vertical and horizontal rhizomes which can be 3.5 to 4 feet thick in mature stands.

10.3.2 Purple Loosestrife (Lythrum salicaria)

Another primary target species for Rodeo®/Accord® herbicides products is purple loosestrife (Lythrum salicaria). Purple loosestrife is a stout, erect perennial herb with a strongly developed taproot (Bender, 1988). Bender (1988) goes on to report that purple loosestrife is native to Eurasia and was first reported from the northeastern coast of North America in 1814. It is distributed nationwide. Purple loosestrife occurs in marshes, wet meadows, floodplains, and along the margins of lakes and ponds. Magee (1981) describes purple loosestrife as an aggressive weed which grows up to 1.5 meters tall, forming large, dense colonies. Leaves are lanceolate, opposite or whorled. The flowers are small and purplish-pink. Flowers are contained in long, terminal spikes. Flowering occurs during July and August.

10.3.3 Cattail (Typha spp.)

The final primary target species for Rodeo®/Accord® herbicides products are plants in the genus Typha. Motivans and Apfelbaum (1989) note that these plants, commonly called cattails, are erect, perennial freshwater aquatic herbs which can grow to a height of 2 meters or more. The most common species in this genus are T. latifolia and T. angustifolia. Hybrids are known to occur. Cattails, which are native to North America, are distributed throughout southern Canada, most of the United States and northern Mexico. Cattails are found in freshwater marshes, shallow water, and the borders of ponds and rivers. Cattails generally form dense colonies. The plant stem arises from a thick, extensively creeping rhizome. Basal leaves are long, sword-like and flattened. The flowers are inconspicuous. The male flowers form a yellowish spike up to 13 cm long. The female flowers form a spike up to 20 cm long. Flowering occurs during May and June.

10.3.4 Other Potential Aquatic Macrophyte Target Species

While the preceding three macrophytes are expected to be the most frequent target species for Rodeo or Accord, the following species are listed on the registered labels for Rodeo/Accord as potential targets for control. However, only those species actually found in New York State are discussed. Additionally, because the focus of this GEIS is on aquatic application, only aquatic oriented species are discussed. Marginal species include species commonly listed as wetland species found in shrub and forested wetland covertypes and in that are found in areas subject to flooding and which have free interchange with open water. That includes species described in the National List of Plant Species That Occur in Wetlands: 1988 for New York (Reed, 1988) that have the wetlands indicator of FAC (34% - 66% frequency of being found in a wetlands) or greater, including Facultative Wet (FACW) and Obligate (OBL) species. Species listed in Table 10-1 are found on the labels for Rodeo/Accord, but do not occur in New York State. Species listed in Table 10-2, found at the end of this section, are listed on the labels of the products, but are not aquatic species. Plant distributions were based on Hotchkiss (1972), Mitchell (1986), Magee (1981), Tiner (1987) and ACOE (1977). Because it is a broad-spectrum herbicide, the Rodeo®/Accord® herbicides would produce full control of all species.

Submerged, Floating-leaved, and Floating Plants:

Waterhyacinth (Eichornia crassipes)

> Found in the taxonomic family Pontederiaceae, waterhyacinth is listed as a rare, introduced species in NYS. In its native environment, it is usually found floating, often in dense colonies with leaves and flowers reaching above the water. Leaf blades are 2 to 4 inches across.

Emergent and Marginal Plants:

Alder (Alnus spp.)

> The alder genus (Family Betulaceae) contains about 30 species worldwide. Alders are generally found in moist, cool areas from sea level to 2408 meters. They often grow along the banks of streams, rivers, ponds, and marshes, where they form dense thickets. Elias (1989) notes that alders are of limited value to wildlife. Their more critical function is in erosion control and in vegetation reestablishment in burned over areas.

TABLE 10-1

AQUATIC MACROPHYTES LISTED ON THE REGISTERED LABELS OF THE HERBICIDES RODEO®/ACCORD® BUT NOT FOUND IN THE STATE OF NEW YORK

Salt cedar (Tamarix spp.)
Water-lettuce (Pistia stratiotes)

Alders are large shrubs to small trees, rarely growing to 20 meters in height. The leaves are simple and deciduous. Flowers are reduced in size and are borne on catkins. Two of the more common species in the northeast include European alder (Alnus glutinosa) and speckled alder (Alnus rugosa).

Ash (Fraxinus spp.)

Members of this genus (Family Oleaceae) are trees or shrubs. Ashes grow in a variety of sites, but are generally found in lowland areas (Elias, 1989). Leaves are usually deciduous, pinnately compound, composed of from 1 to 11 leaflets. Two of the more important ash species of the northeastern United States include green ash (Fraxinus pennsylvanica) and the white ash (Fraxinus americana).

Barnyardgrass (Echinochloa crus-galli)

Magee (1981) describes barnyardgrass (Family Poaceae) as a plant species up to 1.5 meters in height, that grows solitary or in groups. The plant grows from a fibrous rooted base. Flowers are terminal and the leaf blades are long, and fairly wide. Barnyardgrass is found in marshes and ditches and in waste places.

Birch (Betula spp.)

There are 15 species of trees and shrubs in this genus (Family Betulaceae) in the United States. They occur from sea level to elevations up to 1200 meters. Birches are generally found in sandy soils in cool areas, particularly along cold lakes and streams (Elias, 1989). Most birches are medium-sized trees that have been known to reach 30 meters in height. The leaves are simple and deciduous, usually with a double row of serrations along the leaf margin. The flowers are borne on catkins. Some of the common birches of New York include the river birch (Betula nigra), paper birch (Betula papyrifera), yellow birch (Betula alleghaniensis), and gray birch (Betula populifolia). The tundra dwarf birch (B. glandulosa) and dwarf white birch (B. minor) are listed as endangered native plant species in NYS. The swamp birch (B. pumila) is listed as a rare native plant species in NYS.

Cordgrass (Spartina spp.)

Britton and Brown (1970a) note that species in this genus (Family Poaceae) are perennial grasses, which originate from long, horizontal rootstocks. They have flat or involute leaves. The flowers are borne on spreading or erect alternate spikes. Most species of Spartina indigenous to New York State are found in salt and brackish marshes. Some of the species include smooth cordgrass (Spartina alterniflora), big cordgrass (Spartina cynosuroides), and saltmeadow cordgrass (Spartina patens).

Dogwood (Cornus spp.)

There are 7 species of trees and 6 species of shrubs in this genus (Family Cornaceae) in the United States. They are generally common to open woods and along streams (Elias, 1989). Dogwoods grow best in fertile soils. Leaves are generally simple and opposite and always deciduous. The veins of the leaves characteristically curve toward the tip of the leaf. The flowers grow in cluster along the side or at the tips of branchlets. Dogwood species found in the State of New York include the flowering dogwood (Cornus florida), silky dogwood (Cornus amomum), and red-osier dogwood (Cornus stolonifera). The flowering dogwood is listed as an exploitably vulnerable native plant species in NYS.

Elder (Sambucus spp.)

Elders are a small genus (Family Caprifoliaceae), comprised of 7 species of trees and shrubs in North America (Elias, 1989). Plants in this genus are woody, with stout, but soft, pithy branches. They have large, opposite compound leaves that are deciduous to almost evergreen. Flowers are contained in round to flat-topped clusters. The two elder species in New York include American elder (Sambucus canadensis) and European red elder (Sambucus racemosa).

Elm (Ulmus spp.)

There are 6 species of elm (Family Ulmaceae) are native to North America. Distribution is primarily limited to the eastern portion of the continent (Elias, 1989). Elms are small to large trees, with deeply furrowed bark and slender branches. The leaves are alternate, simple and deciduous. Leaves are either single or doubly serrate. Flowers are inconspicuous. Elm species native to New York include American elm (Ulmus american), slippery elm (Ulmus rubra), and rock elm (Ulmus thomasii).

Flatsedge, Chufa (Cyperus esculentus)

Duncan and Duncan (1987) notes that Chufa flatsedge, or yellow nutgrass, is found in the sedge family, Cyperaceae. Yellow nutgrass is a perennial plant, which grows up to 70 cm in height. It has slender rhizomes that bear hard tubers. Leaves are mostly basal. Flowers are borne on a spike. Yellow nutgrass is a ubiquitous species that is found in a variety of marsh or upland settings.

Fleabane (Erigeron spp.)

Britton and Brown (1970c) describe fleabanes (Family Asteraceae) as branching herbs, which have either alternate or basal leaves. Flowers are both tubular and radiate. Most fleabanes are found in upland settings, though hyssopleaf fleabane (Erigeron hyssopifolius) can be found in freshwater marshes.

Foxtail (Setaria spp.)

Britton and Brown (1970b) describe foxtails (Family Poaceae) as being mostly annual grasses with erect culms, flat leaf blades, and an inflorescence in spike-like panicles. Some of the foxtail species indigenous to New York State include yellow foxtail (Setaria glauca) and bur bristlegrass (Setaria verticillata).

Foxtail, Carolina (Alopecurus carolinianus)

Carolina foxtail is found in the taxonomic family Poaceae. It is listed as a rare, introduced species in NYS. It is described as a grass up to 2 feet tall, with smooth, long leaves.

Hemlock, Poison (Conium maculatum)

Poison hemlock, or snakeweed, is a tall, biennial, glabrous herb (Britton and Brown, 1970b), found in the taxonomic family Apiaceae. It grows in height from 0.6 to 1.5 meters. It has spotted stems, pinnately compound leaves and small white flowers. It is generally found in disturbed areas.

Honeysuckle (Lonicera spp.)

Petrides (1986) reports that honeysuckles (Family Caprifoliaceae) are climbing vines or free-standing, erect shrubs with opposite leaves. The vines ascend by twining stems without the benefit of secondary aids such as tendrils, aerial rootlets or clasping leafstalks. Stem piths of all honeysuckles are hollow. Leaves are opposite and deciduous. Flowers are tubular. Some of the honeysuckles indigenous to New York State include the Japanese honeysuckle (Lonicera japonica), swampfly honeysuckle (Lonicera oblongifolia), and hairy honeysuckle (Lonicera hirsuta)

Hornbeam, American (Carpinus caroliniana)

The American hornbeam (Family Betulaceae) is distributed from Nova Scotia to Minnesota, south to Florida and Texas. Magee (1981) notes that the American hornbeam is a large shrub or low spreading tree that is found along stream borders, low wet woods or along the borders of swamps. The leaves are up to 10 cm long and 5 cm wide. Flowers are inconspicuously arranged in spikes.

Lettuce, prickly (Lactuca serriola)

The prickly lettuce (Family Asteraceae) is a leafy-stemmed annual or biennial that grows up to 2.5 meters in height (Duncan and Duncan, 1987). The species has leaves prickly on the midrib below. Prickly lettuce is found in old fields, disturbed areas and thin woods.

Maple, red (Acer rubrum)

Red maple (Family Aceraceae) is a medium-sized tree that grows to 12 to 15 meters in height. It can have a trunk diameter of 0.6 to 1 meter. Red maples have slender twigs and opposite palmately lobed leaves. Red maples are found in habitats ranging from wet bottomlands and floodplains, to dry uplands.

Milkweed (Asclepias spp.)

Milkweeds (Family Asclepiadaceae) are perennial erect or decumbent herbs, with usually opposite leaves (Britton and Brown, 1970). Flowers are middle-sized or small, being borne in terminal or axillary umbels. Milkweeds are distributed through a variety of habitats, from swamps to upland fields. Some of the milkweed species indigenous to New York include swamp milkweed (Ascelpias incarnata) and red milkweed (Ascelpias rubra). Purple milkweed (A. purpurascens) and white milkweed (A. variegata) are listed as threatened native plant species in NYS. Orange milkweed (A. tuberosus) is listed as an exploitably vulnerable native plant species in NYS. Green milkweed (A. viridiflora) is listed as a rare native plant species in NYS.

Monkey-flower, Common (Mimulus guttatus)

Monkey-flowers (Family Scrophalariaceae) are erect or decumbent herbs, with opposite, mostly dentate leaves (Britton and Brown, 1970c). Flowers are showy. This species is a perennial that is supported by stolons. The stem is rather stout. The common monkey-flower was introduced in New York State from California and is found in wet meadows.

Nutgrass (Cyperus rotundus)

Nutgrass is a perennial sedge (Family Cyperaceae) that is supported by scaly tuber-bearing rootstocks. The culm is rather stout and may grow from 0.6 to 6 meters in height. The habitat for the species is variable (Britton and Brown, 1970a).

Oak, pin (Quercus palustris)

The pin oak (Family Fagaceae) is found along streams, in river bottoms, in wooded swamps, and in low wet woods (Magee, 1981). The pin oak is a tree that grows up to 18 meters in height. The lower branches are generally short and descending, while the middle and upper branches are horizontal to ascending. Leaves are alternate and simple, but deeply lobed. The flowers are inconspicuous.

Panicum (Panicum spp.)

Species found within this genus (Family Poaçeae) are annual or perennial grasses which are found in various habitats and have various foliages and inflorescences (Britton and Brown, 1970a). Some of the Panicum species indigenous to New York State include

Gattinger panic (Panicum gattingeri), witchgrass (Panicum capillare), and redtop panicum (Panicum rigidulum). Panic grass (P. flexile) is listed as a threatened native plant species in NYS.

Poison Ivy (Rhus radicans)

Poison ivy (Family Anacardiaceae) grows as an erect shrub, a trailing vine or a climber. Leaves are three-parted, long-stalked and alternate (Petroides, 1986). Flowers are small and yellowish. Berries are white. Poison ivy is found in an assortment of habitats.

Poplar (Populus spp.)

Poplars (Family Salicaceae) are fast-growing, short-lived trees. Thirteen species are native to North America (Elias, 1989). Poplars include three groups of trees, the aspens, the cottonwoods, and the balsam poplars. Leaves are generally alternate and unlobed. Male and female flowers are borne separately in catkins. Poplars indigenous to New York State include the balsam poplar (Populus balsamifera), eastern cottonwood (Populus deltoides), and quaking aspen (Populus tremuloides).

Saltbush, sea myrtle (Baccharis halimifolia)

Also known as the groundsel-tree, this species is found in the taxonomic family Asteraceae. It is a shrub with green angled twigs. The leaves of the lower portions of the plant have large and often deep teeth, those of the upper portions often lack teeth. The flowering structures are white in autumn.

Smartweed, Pennsylvania (Polygonum pennsylvanicum)

Smartweeds (Family polygonaceae) are highly variable in characteristics. Leaves are lance-like. The flowers are rose-pink or white. Pennsylvania smartweed is found in damp soil, roadsides or fields (Peterson and McKenney, 1968).

Smartweed, swamp (Polygonum coccineum)

Smartweeds (Family polygonaceae) are highly variable in characteristics. This species has an erect form in the terrestrial environment and an aquatic form with floating leaves. Leaves are lance-like. Flowers are showy and pink. Swamp smartweed is found in swamps and in shallow water, and along the borders of ditches (Peterson and McKenney, 1968).

Spikerush (Eleocharis spp.)

Spikerushes (Family Cyperaceae) are annual or perennial sedges. Spikerushes are found in shallow water, marshes, and in wet soil. The culms of each plant are generally simple. The leaves are generally reduced to sheaths or with lowest leaf very rarely blade-bearing. Flowers are borne in spikes. There are approximately 120 species of spikerushes distributed in North America (Britton and Brown, 1970). Some of the spikerush species indigenous to New York State include the creeping spikerush (Eleocharis fallax), blunt spikerush (Eleocharis obtusa), and dwarf spikerush (Eleocharis parvula). Engelmann spikerush (E. engelmannii) is listed as an endangered native plant species in NYS. Knotted spikerush (E. equisetoides), angled spikerush (E. quadrangulata), three-ribbed spikerush (E. tricostata), and long-tubercled spikerush (E. tuberculosa) are listed as threatened native plant species in NYS. Creeping spikerush, salt-marsh spikerush (E. halophila), and blunt spikerush are listed as rare native plant species in NYS.

Sumac, poison (Rhus vernix)

Poison sumac (Family Anacardiaceae) is a shrub or small tree that is generally found in low, wet grounds or swamps (Magee, 1981). It is generally 1.5 to 6 meters in height. The leaves on the poison sumac are alternate and pinnately compound with oval leaflets. Its flowers are small and greenish.

Sycamore (Platanus occidentalis)

The sycamore (Family Platanaceae) is found in rich, moist bottomlands and along river banks. Sycamores are tall trees, growing up to 45 meters in height, with a trunk diameter of up to 3 meters. The trunk is usually long, but often divides low into several long, massive, spreading branches. Leaves are alternate, broadly ovate, with three to five main, pointed lobes (Magee, 1981).

Tules, common (Scirpus acutus)

Common tules, or hard-stemmed bulrush (Family Cyperaceae), is found along the margins of inland and coastal fresh and brackish ponds, or in freshwater or brackish marshes. Culms of the hard-stemmed bulrush grow between 1.5 and 3 meters in height. Flowers are borne on spikes (Hotchkiss, 1972).

Willow (Salix spp.)

There are approximately 80 species of willow (Family Salicaceae) in North America (Elias, 1989). Leaves of these plants are deciduous or evergreen, simple, alternate, usually lance-shape and either entire or serrate along the leaf margins. The flowers are borne on catkins. Some of the willows indigenous to New York State include black willow (Salix nigra), hoary willow (Salix candida), and weeping willow (Salix babylonica). The dwarf willow (S. herbacea) is listed as an endangered native plant species in NYS. The sand dune willow (S. cordata) and the bearberry (S. uva-ursi) are listed as threatened native plant species in NYS.

TABLE 10-2

SPECIES LISTED ON THE REGISTERED LABELS OF THE HERBICIDES RODEO®/ACCORD® BUT NOT CONSIDERED AS AQUATIC MACROPHYTES

Alfalfa (Medicago sativa)
Anise/Fennel (Foeniculum vulgare)
Artichoke, Jerusalem (Helianthus tuberosus)
Aspen, quaking (Populus tremuloides)
Bahiagrass (Paspalum notatum)
Balsamapple (Momordica charantia)
Barley (Hordeum vulgare)
Barley, little (Hordeum pusillum)
Bassia, fivehook (Bassia hyssopifolia)
Bearmat (Chamaebatia foliolosa)
Bermudagrass (Cynodon dactylon)
Bindweed, field (Convolvulus arvensis)
Blackberry (Rubus spp.)
Bluegrass, annual (Poa annua)
Bluegrass, bulbous (Poa bulbosa)
Bluegrass, Kentucky (Poa pratensis)
Blueweed, Texas (Helianthus ciliaris)
Bracken (Pteridium spp.)
Brackenfern (Pteridium aquilinum)
Brome (Bromus spp.)
Bromegrass, smooth (Bromus inermis)
Broom, French (Cytisus monspessulansu)
Broom, Scotch (Cytisus scoparius)
Broomsedge (Andropogen spp.)
Buckwheat, California (Eriogonum fasciculatum)
Buttercup (Ranunculus spp.)
Cascara (Rhamnus purshiana)
Catsclaw (Acacia greggi)
Ceanothus (Ceanothus spp.)
Chamise (Adenostoma fasciculatum)
Cheat (Bromus secalinus)
Cherry, bitter (Prunus emarginata)
Cherry, black (Prunus serotina)
Cherry, pin (Prunus pensylvanica)
Chervil (Chaerophyllum tainturieri)
Chickweed, mousear (Cerastium vulgatum)
Cleavers (Galium aparine)
Clover, crimson (Trifolium incarnatum)

TABLE 10-2 (CONTINUED)

SPECIES LISTED ON THE REGISTERED LABELS OF THE HERBICIDES RODEO®/ACCORD® BUT NOT CONSIDERED AS AQUATIC MACROPHYTES

Clover, large hop (Trifolium campestre)
Clover, red (Trifolium pratense)
Clover, white (Trifolium repens)
Cocklebur (Xanthium strumarium)
Cogongrass (Imperata clylindrica)
Corn, volunteer (Zea mays)
Coyote brush (Baccharis consangiunea)
Crabgrass (Digitaria spp.)
Creeper, Virginia (Parthenocissus quinquefolia)
Dallisgrass (Paspalum dilatatum)
Dandelion (Taraxacum officinale)
Dewberry (Rubus trivialis)
Dock, Curly (Rumex crispus)
Dogbane, hemp (Apocynum cannabinum)
Dwarfdandelion (Krigia cespitosa)
Eucalyptus (Eucalyptus spp.)
Eucalyptus, bluegum (Eucalyptus glotulus)
Falseflax, smallseed (Camelina microcarpa)
Fescue (Festuca spp.)
Fescue, tall (Festuca arundinacea)
Fiddleneck (Amsinckia spp.)
Flaxleaf fleabane (Conyza bonariensis)
Geranium, Carolina (Geranium carolinianum)
Groundsel, Common (Senecia vulgaris)
Guineagrass (Panicum maximum)
Hasardia (Haplopappus squamosus)
Hawthorn (Crataegus spp.)
Hazel (Corylus spp.)
Henbit (Lamium amplexicaule)
Hickory (Carya spp.)
Holly, Florida (Schinus terebinthifolius)
Horsenettle (Solanum carolinense)
Horseradish (Armoracia rusticana)
Horseweed/Harestail (Conyza canadensis)
Ice Plant (Mesembryanthemum crystallinum)
Johnsongrass (Sorghum halepense)
Kikuyugrass (Pennisetum clandestinum)

TABLE 10-2 (CONTINUED)

SPECIES LISTED ON THE REGISTERED LABELS OF THE HERBICIDES RODEO®/ACCORD® BUT NOT CONSIDERED AS AQUATIC MACROPHYTES

Knapweed (Centaurea repens)
Kochia (Kochia scoparia)
Kudzu (Pueraria lobata)
Lambsquarters, common (Chenopodium album)
Lantana (Lantana camara)
Lespediza, common (Lespediza striata)
Lespediza, serices (Lespediza cuneata)
Locust, black (Robinia pseudoacacia)
Madrone (Arbutus menziesii)
Maidencane (Panicum hematomon)
Manzanita (Arctostaphylos spp.)
Maple, sugar (Acer saccharum)
Maple, vine (Acer circinatum)
Morningglory (Ipomoea spp.)
Muhly, wirestem (Muhlenbergia frondosa)
Mullein, common (Verbascum thapsus)
Mustard, blue (Chorispora tenella)
Mustard, tansy (Descurainia pinnata)
Mustard, tumble (Sisymbrium altissimum)
Mustard, wild (Sinapis arvensis)
Napiergrass (Pennisetum purpureum)
Nightshade, silverleaf (Solanum elaeagnifolium)
Oak, black (Quercus velutina)
Oak, post (Quercus stellata)
Oak, red (Quercus rubra)
Oak, southern red (Quercus falcata)
Oak, white (Quercus alba)
Oats, wild (Avena fatua)
Orchardgrass (Dactylis glomerata)
Pampasgrass (Cortaderia jubata)
Paragrass (Brachiaria mutica)
Pennycress, field (Thlaspi arvense)
Persimmon (Diospyros spp.)
Pigweed, redroot (Amaranthus retroflexus)
Pigweed, smooth (Amaranthus hybridus)
Poison Oak (Rhus toxicodendron)
Poplar, yellow (Liriodendron tulipifera)
Quackgrass (Agropyron repens)

TABLE 10-2 (CONTINUED)

SPECIES LISTED ON THE REGISTERED LABELS OF THE HERBICIDES RODEO®/ACCORD® BUT NOT CONSIDERED AS AQUATIC MACROPHYTES

Ragweed, common (Ambrosia artemisiifolia)
Ragweed, giant (Ambrosia trifida)
Redbud (Cercis canadensis)
Reed, Giant (Arundo donax)
Rocket, London (Sisymbrium irio)
Rose, multiflora (Rosa multiflora)
Rye (Secale cereale)
Ryegrass, Italian (Lolium multiflorum)
Ryegrass, perennial (Lolium perenne)
Russian-olive (Elaeagnus angustifolia)
Sage, black (Salvia mellifera)
Sagebrush, California (Artemisia californica)
Sandbur, field (Cenchrus spp.)
Salmonberry (Rubus spectabilis)
Sassafras (Sassafras aibidum)
Shattercane (Sorghum bicolor)
Shepherdspurse (Capsella bursa-pastoris)
Signalgrass, broadleaf (Brachiaria platyphylla)
Sourwood (Oxydendrum arboreum)
Southern Watergrass (Hydrochloa caroliniensis)
Sowthistle, annual (Sonchus oleraceus)
Spanishneedles (Bidens bipinnata)
Speedwell, corn (Veronica arvensis)
Spurry, umbrella (Holosteum umbellatum)
Starthistle, yellow (Centaurea solstitialis)
Stinkgrass (Eragrostis cilianensis)
Sumac, smooth (Rhus glabra)
Sumac, winged (Rhus copallina)
Sunflower (Helianthus annuus)
Sweet gum (Liquidambar styraciflua)
Sweet potato, wild (Ipomoea pandurata)
Swordfern (Polystichum munitum)
Tallowtree, Chinese (Sapium sebiferum)
Tan Oak (Lithocarpus densiflorus)
Thimbleberry (Rubus parviflorus)
Thistle, artichoke (Cynara cardunculus)
Thistle, Canada (Cirsium arvense)
Thistle, Russian (Salsola kali)

TABLE 10-2 (CONTINUED)

SPECIES LISTED ON THE REGISTERED LABELS OF THE HERBICIDES RODEO®/ACCORD® BUT NOT CONSIDERED AS AQUATIC MACROPHYTES

Timothy (Phleum pratense)
Tobacco, tree (Nicotiana glauca)
Torpedograss (Panicum repens)
Trumpetcreeper (Campsis radicans
Vaseygrass (Paspalum urvillei)
Velvetgrass (Holcus spp.)
Velvetleaf (Abutilon theophrasti)
Waxmyrtle, southern (Myrica cerifera)
Wheat (Triticum aestivum)
Wheatgrass, western (Agropyron smithii)
Witchgrass (Panicum capillare)

11.0 ENVIRONMENTAL SETTING - THE RODEO®/ACCORD® HERBICIDES

This section describes the environmental setting in which the proposed action, the use of the aquatic herbicides Rodeo/Accord, is projected to occur. While this section presents the available data in as detailed an extent as is required, the information is generic for the State of New York.

11.1 GENERAL DESCRIPTION OF NEW YORK STATE AQUATIC ECOSYSTEMS

The aquatic ecosystems of New York State generally fall into four basic categories. These include standing freshwater systems (lakes, ponds, and reservoirs), flowing freshwater systems (rivers and streams), brackish systems (tidal estuaries), and saline coastal systems.

It is calculated that New York State has over 3.5 million acres covered by some type of surface water system (NYSDEC, 1967). That includes over 7500 lakes (NYSDEC, 1987), of which over 1500 are found in the Adirondack Mountains (NYSDEC, 1967). The Adirondack Mountains also contain over 16,700 miles of significant fishing streams. The state's largest lakes are Lake George, Lake Chautauqua, Oneida Lake, and the major Finger Lakes; Canadaigua, Keuka, Seneca, Cayuga, and Skaneateles (NYSDEC, 1967).

The specific characteristics of each aquatic system are partially determined by its physiographic setting within the state. Changes in the characteristics of each aquatic system will lead to changes in the endemic biota associated with that waterbody. Generally, waterbodies within New York State can be defined geographically by region and drainage basin location. Aquatic ecosystems in the eastern region, which includes the St. Lawrence/Lake Champlain/Black River basin, the Hudson-Mohawk basin, the Delaware basin, and Long Island are defined by either the Adirondack/Catskill mountain areas to the north or the New York Bight tidal estuarine area to the south. Aquatic ecosystems in the central region, which includes the Oswego-Ontario basin and the Susquehanna, are defined by areas of low relief with large areas of marshes to the north and broad, steeply sided valleys with limited natural storage capacity in the south. Aquatic ecosystems in the western region, which includes the Lake Ontario basin, the Erie-Niagara basin, the Genesee basin, and the Allegheny basin, are defined by the glaciated geology of that region (NYSDEC, 1967).

Waters in each of these basins are influenced by the composition of the geological formations found within the region. For example, waters in the Adirondack mountains and the Catskill mountains are influenced by formations with little buffering capacity. This results in acid rain effects in waters from these regions (NYSDEC, 1981b). Surface water systems in the Erie-Niagara basin in western New York State are characterized by high levels of dissolved solids (140 to 240 ppm) and hard water (100 to 200 ppm, expressed as $CaCO_3$). Surface water in the Delaware River basin are characterized by low dissolved solid levels (averaging 37 ppm) and an average hardness of approximately 37 ppm. The dominant ions are silica, calcium, bicarbonate, and sulfate (Archer and Shaughnessy, 1963). The dissolved solid concentrations in surface waters in the Champlain-Upper Hudson basin rarely exceed 500 ppm (Giese and

Hobba, 1970). In surface waters of the Western Oswego River basin, dissolved solid concentrations range from 50 to 300 ppm (Crain, 1975).

11.2 GENERAL CHARACTERIZATION OF AQUATIC PLANT COMMUNITIES IN NEW YORK STATE WATERBODIES

Aquatic plants are often the dominant biotic factors in pond settings and are important ecological features of larger waterbodies such as lakes and reservoirs.

The characteristics of plant communities in aquatic settings are determined by the type of waterbody in which the community is located. New York State, with its over 7500 lakes, contains an extensive array of freshwater systems. This diversity is further increased by the inclusion of streams, rivers, and other bodies of flowing water. Waterbodies vary in terms of color, pH, temperature, silt loading, bottom substrate, depth, rate of flow if it is a moving body, and watershed area. Each of these characteristics will affect, to some extent, the type and distribution of the plant communities in that waterbody. NYSDEC (1990) notes that the bottom morphology (shape) of a lake is a key factor is determining the type and extent of plant communities that are present. The chemical quality of the water is another factor that influences the distribution of plant species within a waterbody. Soft water lakes with a total alkalinity of up to 40 ppm and a pH of between 6.8 and 7.4 will often have sparse amounts of vegetation. Hard water lakes with a total alkalinity from 40 ppm to 200 ppm and a pH between 8.0 and 8.8 will have dense growths of emergent species that can extent into deeper water (Fairbrothers and Moul, 1965). Sculthorpe (1967) notes that the distribution of species within a waterbody is determined by the bottom substrate, light intensity (which is a function of depth and water clarity), and turbulence (currents or wave action).

Freshwater ecosystems include lentic ecosystems represented by standing waterbodies, such as lakes and ponds, and lotic ecosystems, which are represented by running water habitats. Lentic systems can be further subdivided in littoral, profundal, and benthic zones. The littoral zone is that portion of the waterbody in which the sunlight reaches to the bottom. This area is occupied by vascular, rooted plant communities. Beyond the littoral zone is the open water area, or limnetic zone, which extends to the depth of light penetration. This point of light penetration is called the compensation depth. This is the depth where approximately 1% of the light incident on the water surface still remains. As a result of this decreased light, photosynthesis does not balance respiration in plants. Therefore, the light is not sufficient to support plant life. The strata below the compensation depth is called the profundal zone. The bottom of the waterbody, which is common to both the littoral zone and the profundal zone, is the benthic zone (Smith, 1980).

Lentic systems can be categorized based on ecological successional characteristics of the waterbody (Smith, 1980; NYSDEC, 1990; and Pullman, 1992). Succession is the ecological process by which one community is gradually replaced by a series of communities; tending to progress to a terminal community. In aquatic settings, the initial stage of succession is characterized by a lack of biota. Over a period of time, pioneering species colonize the waterbody. As the water and bottom substrates change as a result of movement of organic and inorganic sediments and nutrients into the waterbody, the organisms present change from those intolerant of higher organic material levels, to species that are more tolerant of the changes. Eventually, the waterbody can shift from a deep, sterile pool, to a shallow temporary pond, to an emergent marsh to eventually a terrestrial meadow.

In lotic systems the distribution of plant communities is dictated by the velocity of the water flow and the nature of the bottom substrate. In fast moving waters, the system is usually divided into riffle and pool habitats. Riffles, which are areas of fast water, are centers of high biological productivity. However, the speed at which the water flows in these areas usually will not allow for rooted macrophytes to become established. Rooted vascular plant are more characteristic of pool habitats, which are interspersed with the riffle zones. In pools, the softer bottom substrate and the slower current velocities allow for the establishment of rooted plants. This is also the case for slower moving streams and rivers. In larger rivers, as with lakes, ponds, and reservoirs, depth becomes a determining factor for the distribution of plant communities (Smith, 1980).

Functionally, aquatic plants play important roles in the aquatic ecosystem. Aquatic macrophytes provide food and shelter for both vertebrate and invertebrate organisms and as spawning habitat for fish (Keast, 1984; Gotceitas and Colgan, 1987; Schramm and Jirka, 1989; Hacker and Steneck, 1990; and Kershner and Lodge, 1990). The ability of the community to fill these functions, its value per se, is often a function of the species, density, and distribution of the members of that plant community. Daubenmire (1968) notes that plants in the genera Potamogeton and Scirpus are a favored food source for North American waterfowl, whereas muskrats (Ondatra zibethica) favor plants in the genera Carex, Sagittaria, and Typha. Brown et al. (1988) reported that vertically heterogeneous stands of aquatic macrophytes tended to contain more invertebrates than a community dominated by a single taxon. Therefore, opportunistic, rapid-growing species such as Eurasian watermilfoil, purple loosestrife, phragmites and cattails, which develop dense monotypic stands in mature communities, would not be expected to offer the quality or diversity of habitat in such circumstances as more diverse communities would. Dionne and Folt (1991) note that high plant densities can interfere with the foraging ability and efficiency of piscivorous and insectivorous fish. Dense plant stands can directly or indirectly disrupt the utilization of macrophyte beds by fish and macroinvertebrates by affecting light penetration, temperature regimes, and water chemistry (Lillie and Budd, 1992).

Aquatic vegetation performs four basic functions in waterbodies (Fairbrothers and Moul, 1965). These functions include: 1) modification of the dissolved gas content of the surrounding water; 2) provision of nutrient material suitable for food and the introduction of inorganic nutrients into the food cycle; 3) modification of the physical environment; and, 4) the protection and provision of habitat for other organisms. In general, aquatic plants fulfill the preceding functions in the aquatic ecosystem. However, the extent to which those functions are fulfilled will depend on the location of the plant community (i.e. emergent community versus a deepwater community). The following section more specifically address the type of plant community most likely to be involved in the use of the Rodeo®/Accord® herbicides in New York State waterbodies. Furthermore, the roles that the individual species may also play in that community are described.

11.2.1 Emergent and Marginal Plant Communities

Emergent plant communities are generally found in the littoral zone in close proximity to the shore. These aquatic areas are generally shallow and allow for the plant to remain rooted underwater. However, the majority of the plant body extends above the water surface. In water less than 1 meter deep, those emergent plants that are rooted in the hydrosoil, but extend above the water surface may become dominant (Daubenmire, 1968). These include the representative genera Carex, Eleocharis, Phragmites, Sagittaria, and Typha. These plants, when growing under conditions that maximize productivity, may develop tightly interlocking mats that extend out from the moist soil margin of the pond to the center.

Stems and leaves, both underwater and above the water surface, of the plants in the emergent and marginal plant communities play a variety of functions in these ecosystems. The underwater portions may serve as a substrate for aufwuchs. The underwater portions of plants growing in these communities may serve as places for egg deposition for fish and amphibians. The above water portions may serve as nesting areas for birds such as the red-winged blackbirds (Agelaius phoeniceus) and the marsh wren (Cistothorus palustris). The young of many fish species and some tadpoles will seek shelter in the underwater portions of these communities to evade predators. Nesting and shelter areas will be provided by the above water portions of these plants for a variety of rodents, birds and amphibians. These plants serve as food sources for a variety of consumers, including fish, waterfowl, reptiles and mammals (white-tailed deer, Odocoileus virginianus, and meadow jumping mouse, Zupus hudsonius). Herbivores will consume fruits, tubers, leaves, winter buds, and occasionally, the whole plant. Plants in the genera Sagittaria and Scirpus are considered good sources of food. Plants in the genera Phragmites and Typha are considered poor food producers (Fairbrothers and Moul, 1965).

11.3 DISTRIBUTION AND ECOLOGY OF PRIMARY POTENTIAL AQUATIC MACROPHYTE TARGET SPECIES

As mentioned in Section 10.0, the proposed action is the use of the aquatic herbicides Rodeo/Accord for the control of certain nuisance aquatic vegetation located in the State of New York. NYSDEC (1981) defines nuisance vegetation as overabundant vegetation that may be aesthetically unpleasing, may interfere with effective and proper harvest of fishery resources, and may interfere with other recreational activities. Pieterse (1990) defines nuisance aquatic vegetation as an aquatic weed or "an aquatic plant which, when growing in abundance, is not desired by the manager of it place of occurrence". In some circumstances, the aquatic species of concern is an exotic or introduced species. Such a species is not indigenous to the area and was introduced either accidentally or on purpose. This is not to say that exotic aquatic macrophytes do not, in some circumstances, fulfill all of the benefits and functions of native species. This is discussed more thoroughly in Section 17.0. A plant species, whether native or exotic, becomes a nuisance when the population reaches some level of overabundance such that a problem with the waterbody is evident. However, because an aquatic species is an exotic or introduced species, it generally has the potential for a more rapid population growth for the following reasons.

Suter (1993) maintains that many of the severe man-caused effects brought upon natural biotic systems are caused by the introduction of exotic species. Introduced species are generally opportunistic in nature and are usually able to out-compete native species. Thus, they have can significantly alter the character of native plant communities or the ecosystems. Exotic species are considered pioneer species. Pioneer species are those organisms that possess a reproductive strategy that emphasizes efficient dispersal of propagules, rapid spread and growth rate, and sometimes high rates of biomass production emphasized by high productivity and rapid growth. These plants are able to occupy a wide diversity of habitats (Smith, 1980).

Invasive, exotic species have successfully extended their distribution through both natural and anthropogenic means on a world-wide basis. Nichols and Shaw (1986) and Wade (1990) note that an invasive aquatic macrophyte has the potential to infest a waterbody, then spread to the maximum extent of the available habitat. Following the initial invasion period, the production of the invasive species can attain a degree of stability and habitat equilibrium. Subsequently, the population of the invasive will fluctuate in response to the temporal dynamics of the aquatic environment (Nichols and Shaw, 1986; Wade, 1990). Usually, the equilibrium condition for the production of species such as purple loosestrife is considered to be deleterious for most recreational and utilitarian uses as well as a disruptive influence on the production of native plants and animals.

Some exotic species do serve as target species for Rodeo/Accord. Of particular note is purple loosestrife (See Section 10.3). However, other exotic species which have substantial populations in NYS are not considered to be target species. This includes waterchestnut (Trapa natans). The following sections describe the general distribution and ecology of the primary target macrophyte for Rodeo/Accord.

11.3.1 Phragmites (Phragmites spp.)

Although commonly referred to as Phragmites communis (Trin.), the more widely accepted species name for phragmites is Phragmites australis (Cav.). This perennial reedgrass has a worldwide distribution and has become a dominant macrophyte in wetlands throughout the temperate regions of the northern and southern hemispheres. It has historically been valued as a material used in the construction of buildings (particularly for thatch roofing) and the weaving of mats and baskets (Reimer, 1976). It is still utilized in several areas of the world for these purposes (Haslam, 1989). According to the U.S. Fish and Wildlife Service, phragmites is a native species whose presence was first documented in the 1940s as being present in the Chesapeake and Delaware Canal (Jones, 1989). Since this time the phragmites population has grown and spread to such an extent to encompass about one-third of Delaware's coastal wetlands (Jones, 1985). It is also well established in every region of the United States except the inland portions of the south Atlantic and south central states (USDA, 1971).

The ecological value of phragmites differs depending upon the location and extent of the stand. Most researchers in North America describe phragmites as a nuisance weed of low ecological value because of its limited habitat and nutritional value (Jones, 1989; Roman et al. 1984; Reimer, 1976). However, many authors in Europe expound upon the ecological values of phragmites (Hartog, 1989; Ostendorp, 1988; Haslam, 1989) because of its integral role in the food web as the food source for many primary consumers, parasites, and decomposers, as well as being the structural framework for nesting, spawning, and riverbed stabilization (Hartog, 1989). Although the perceived value of phragmites may differ from place to place, most researchers agree that monotypic stands of phragmites lead to a decrease in biological diversity which in turn results in a decrease in the ecological value of the impacted waterbody.

The success of phragmites can be linked to two important factors: 1) its ability to tolerate many extremes and fluctuations in its environment and 2) a rhizome system which is able to spread both vertically and horizontally which restricts the growth of competing species. Among the environmental fluctuations which phragmites can tolerate are water level, pH, and dissolved oxygen concentrations. Known as a hydrophyte (i.e., water-loving plant), phragmites can grow well when water levels range from 1 meter below surface and 2 meters above surface, though soggy conditions are preferred over inundated conditions (Jones, 1985). Phragmites are able to tolerate fluctuations which decrease the water level to as much as 2 meters below surface (Haslam, 1970). This tolerance of water fluctuations allows phragmites to invade areas in which tidal fluctuation is mechanically manipulated.

Although preferring alkaline conditions, phragmites are tolerant of a wide pH range (Haslam 1972). This factor allows the phragmites to inhabit ecosystems which range in chemical characteristics from limestone quarries to acid bogs. In addition, phragmites are tolerant of low dissolved oxygen due to its ability to transport oxygen from the stems to the underwater rhizomes (Cizkova-Koncalova and Thompson, 1992).

The major limiting factors in the growth of phragmites are high salinity and low nutrient supply. Common to fresh and brackish water systems, phragmites can tolerate salinity concentration up to 27 ppt (parts per thousand) (Ricciuti, 1983). This allows the plant to inhabit the intertidal zones of large rivers and estuaries as well as freshwater inland areas. However, its inability to tolerate higher salinities, as well as its inability to tolerate heavy wave action, restricts its presence along open coastal shorelines.

Probably the most critical element in the success of phragmites is the availability of nutrients in the sediment or water column (Haslam, 1972). Phragmites does not do well in areas with low nutrient levels; however, it thrives under hypertrophic conditions. The frequency of monotypic stands of phragmites in areas subject to sewage effluent discharge or agricultural runoff is evidence of phragmites' ability to take advantage of heavy nutrient loading.

The phragmites plant consists of three major anatomical units: a horizontal rhizome, a vertical rhizome, and an aerial shoot. The key to the success of phragmites is primarily due to its rhizome system. The perennial rhizome system can live from 3 to 6 years. The horizontal rhizome has been known to spread from 30 to 60 feet per year (Jones, 1985), and as it spreads, vertical rhizomes sprout from its nodes. Vertical rhizomes are capable of producing other vertical rhizomes as well as horizontal rhizomes from buds which sprout from its nodes. This rhizome system can eventually form a 4-foot thick mat all of which is capable of absorbing nutrients from the surrounding media (i.e., water and sediment) for transport throughout the rest of the plant (Chuchova and Arbuzoba, 1970). This rhizome mat is important to the success of the plant because, due to its density, it inhibits the germination and growth of competing species. In addition, the mat acts as a sediment sink in tidal areas to trap sediments which insures a steady supply of nutrients.

As the vertical rhizome grows (to as much as one meter in height) it sprouts an annual aerial shoot which bears narrow tapering leaves which alternate along its length. This stem terminates in a seed producing panicle. The shoot is the source of photosynthesis for energy production and bears the flowering structures (i.e., panicle) for sexual reproduction.

Understanding the growth sequence of phragmites is critical to the proper management of this plant. The shoots arise from the vertical rhizome from June to September. The seed producing panicle which is located at the apex of the stem does not mature until late July. Pollination generally takes place in late August and early September, and seeds mature between September and October. Prior to panicle maturation, most of the plants energy (photosynthetic and storage) is earmarked for growth of the shoot and reproductive structures. It is not until late summer and early fall, after maturation of these structures, that translocation from shoot to rhizome of photosynthetically produced materials occurs for the purpose of energy storage for the following season.

Dispersal of phragmites can take place either vegetatively through the rhizome or sexually through seed production. The rhizome system can facilitate the spread of the plant by simple growth of the horizontal rhizome, nodal budding of either the vertical or horizontal rhizome, and/or vegetative growth of a new plant from fragmented pieces of rhizome. Sexual reproduction occurs within the flowering structures of the panicle resulting in the formation of thousands of seeds per shoot. These seeds are generally transported by wind; however, a small portion may also be transported by birds and other animal species (Haslam, 1972).

Although considered an invasive species, phragmites do grow in native populations in several pristine habitats. Phragmites provide habitat for several species of bird, mammal, and reptile for purposes of nesting, roosting, and cover. Among the animals known to occupy this habitat are the red-wing blackbird (Ageliaius phoeniceus), song sparrow (Melospiza melodia), muskrat (Ondatra zebethicus), and common moorhen (Gallinula chloropus). Although song sparrows have been known to eat phragmites seeds (Marks, 1986), this plant provides little nutritional value for higher trophic level species. However, it has been noted that phragmites is an important contributor to the food web via its nutritional value to invertebrates (Ostendorp, 1989).

Phragmites become detrimental to the aquatic ecosystem when it out-competes other indigenous species and forms monotypic stands. As noted in Section 10.1.2, these monotypic stands are detrimental in terms recreational, economic, and ecological values. This invasion of aquatic areas appears to be triggered by several factors, most of which are anthropogenic, including:

(1) infusion of large quantities of nutrients through the discharge of sewage or runoff of agricultural and garden fertilizers,

(2) interference in the water level and/or salinity through the use of drainage or tidal gates,

(3) disruption of the natural habitat through the construction of drainage and irrigation ditches, and

(4) the introduction of chemical pollutants.

11.3.2 Purple Loosestrife (Lythrum salicaria)

Purple loosestrife, an exotic species introduced from Eurasia in the early nineteenth century, is now common to freshwater lakes, ponds, streams, rivers, bogs, and drainage ditches throughout the United States (Stuckey, 1980). Its heaviest concentration is within the drainage basins of the St. Lawrence and Hudson Rivers and throughout the Great Lakes states. The distribution of purple loosestrife throughout the western and southern United States is scattered, and it is believed to have spread to these areas by gardening enthusiasts endeared by its bright purple flowers. The scattered distribution in the west and south was explained by Stuckey (1980) in an analysis of the distributional history of purple loosestrife. He has shown that purple loosestrife does not proliferate in a newly invaded area for at least twenty to forty years after introduction; however, no explanation for this behavior was provided.

The primary method of distribution for purple loosestrife is through seed dispersion. Once established in an aquatic system, purple loosestrife is somewhat benign in its spread until some type of disturbance occurs. When any portion of the water's edge is disturbed by drawdown, plowing, livestock trampling, or dredging, the seed stock takes advantage of the opportunity to germinate and grow. Because of its ability to produce rapidly germinating seeds in huge numbers (2.5 million per plant), purple loosestrife seedlings successfully crowd out other emergents attempting to germinate in the same area (Rawinski, 1982). This spread continues as mature plants crowd and shade out other emergents, and seeds continue to germinate and grow in any available bare area.

Although purple loosestrife seeds do not germinate when inundated, seeds remain viable for up to two years when stored in water (Rawinski, 1982). Once seedlings become established, they can tolerate flooding of up to 45 cm (Stuckey, 1980). Purple loosestrife is able to spread into deeper water through seed establishment on detrital mats at the edge of the colony. In essence, these mats of dead plant material slowly fill in the waterbody.

Unlike phragmites and cattail, purple loosestrife relies almost exclusively on seed distribution for geographic expansion. Vegetative reproduction only occurs if a portion of the root or stem is detached from the rest of the plant. The success of the seedling in establishing itself rests on its rapid rate of growth, its strongly developed taproot system, and its ability to tolerate extremes in pH and nutrient availability. The only limiting factors to seed germination and seedling success are temperature (with a critical temperature lying between 15 and 20 degrees centigrade) and shading. Once established, however, the mature seedling can withstand up to 50% shading (Shamsi and Whitehead, 1976).

As mentioned earlier, the strongly developed, perennial taproot system is the key to the success of the individual plant. Upon germination, generally in late spring or early summer, the tap root grows deeply into the soil, regardless of the soil constituents. The stem grows equally fast in the opposite direction and develops a woody exterior in the basal regions. This provides rigidity to its structure to reduce the threat of physical injury caused by wind or wave. This stem can grow from 0.5 to 2.0 meters, but unlike the taproot, it is annual. Although the stem dies-off each fall, it can persist due to its woody structure for up to two years after death. These stem remnants form a dense cover which acts to shade out other emergent plant species.

The second season of plant growth begins in late spring with a stem bud forming on the top of the rootstock. Flowering begins in early July and pollination takes place from late July into October. Pollination occurs through the actions of a large number of flying insects, particularly bees and butterflies (Balogh, 1985). Seed capsules located on the lower part of the stems begin dehiscing as the upper seed capsules are still developing. This practice insures distribution of seeds over a wide range of climatic conditions. Seed dispersion is primarily by wind (Rawinski, 1982).

Although blackbirds have been known to eat the seeds of purple loosestrife (Rawinski, 1982), it provides virtually no other value to marsh inhabitants (McCook, 1992). Due to its competitive edge, it quickly displaces other emergents that are important sources of food for many wildlife species. Once a monotypic stand of purple loosestrife has developed, the biological diversity and, therefore, ecological value of the waterbody is diminished.

11.3.3 Cattail (Typha spp.)

The genus Typha, commonly referred to as cattail due to its tail-like flowering spadix, is represented by three species and several hybrids in North America (Smith, 1967). Two of these species, T. latifolia (broad-leaved cattail) and T. domingensis (tall cattail), are native to North America; however, T. latifolia is the more common of the two with a range that covers the entire United State and southern Canada. T. domingensis is limited to the southern most portion of the United States (USDA, 1971). The third species of cattail, Typha angustifolia (narrow-leaved cattail), is thought to have been introduced into the United States from Europe sometime prior to 1836. The link between the U.S. and European versions of narrow-leaved cattail has not yet been definitively made through genetic analysis; however, most botanists believe that the link exists due to similarities in anatomical structures and ecological characteristics (Kantrud, 1992). T. angustifolia is common to the Pacific coast and the entire eastern half of the United States (to the central Dakotas), excluding the inland portions of the south central states (USDA, 1971).

As mentioned previously, it is believed that several hybrid cattails have developed in various portions of the United States. The most significant of these hybrids is Typha x glauca which is believed to be a cross between T. latifolia and T. angustifolia. This hybrid shows physical and behavioral characteristics intermediate between its presumed parents, but it is also more aggressive in dominating wetland areas than either of them (Kantrud, 1992). The regional distribution of T. x glauca closely parallels that of T. angustifolia, and it has become the dominant wetland plant in prairie pothole states of the midwest.

Most researchers in the United States regard Typha, particularly T. latifolia, as valued wetland plants which provide several benefits to the aquatic environment. T. latifolia is the only cattail species commonly found in pristine areas and easily outcompetes its cousins T. angustifolia and T. x glauca. The latter species are generally considered as invasive and are most often located within less stable aquatic systems that have been disturbed to some degree by anthropogenic activities (Fassett and Calhoun, 1952). Like purple loosestrife, cattails are generally not deleterious to the aquatic environment until there is some type of disturbance which allows for their proliferation into monotypic stands which limit the diversity of the ecosystem. Because of their tolerance to these anthropogenic effects, T. angustifolia and T. x glauca are the cattails of most concern in lake management.

The basis for the success of cattails rests within its ability to tolerate varying degrees of inundation and salinity and to expand into vacant areas through a prolific system of vegetative and sexual reproduction. While T. latifolia is restricted to freshwater and water depths of up to 63.5 cm, T. angustifolia is capable of surviving oligosaline conditions (i.e., salinities ranging from 0.5 to 5.0 ppt based on a specific conductivity of 8,000 Us/cm) and water depths of up to 1.3 meters (Steenis et al., 1958). In situations where both species inhabit the same waterbody, T. latifolia will outcompete T. angustifolia in the shallow regions of the waterbody restricting T. angustifolia to deeper water (Grace and Wetzel, 1981).

Although tolerant of periodic drought, the rhizomes of cattails will die-off if a late summer drought continues over the winter (Motivans and Apfelbaum, 1989). However, periodic drawdowns are one of the primary mechanisms for the spread of cattails into deeper water. Once established in the deeper zones of a waterbody, their high rate of transpiration (2-3 m of water/acre/year) may prevent the water level from returning to its normal depth (Zohary, 1962). This system of spread has resulted in the shore-to-shore monopolization of cattails in many ponds and small lakes.

The primary mechanism by which cattails spread is through the vegetative growth of the perennial rhizome. This rhizome is capable of spreading horizontally up to 518 cm/yr (McDonald, 1951), and it is successful in a variety of substrates including pure sand, peat, clay, or loam. Growth of the cattail begins in the early spring with the budding of a vertical shoot from a node within the submerged rhizome. This stem is enveloped by a series of two-ranked, narrow leaves that arise from the nodal area of the rhizome (Essbach et al., 1965). In late May and June this shoot terminates in a club-like flowering structure called the spadix. During this time the upper region of the spadix, containing the pollen forming stamens, matures and fragments. This fragmentation allows for the dispersal of pollen, primarily through aerial transport but with some minor additional transport by birds. This pollen attaches to the lower, stigma containing portion of the spadix to form seed producing fruits. In August and September these fruits mature, resulting in the airborne distribution of up to 700,000 seeds per spadix (Yeo, 1964).

Like phragmites, cattails expend most of their energy (both reserve energy from the rhizome and newly produced energy from the stem and leaves) on pollen and seed production. It is not until after late August that newly photosynthesized energy is translocated to the rhizome for overwinter storage. Senescence occurs in November and the entire leaf and stem structure dies back.

As mentioned previously, cattails are considered in North America to be a beneficial wetland inhabitant when displaying the benign growth characteristics typical of T. latifolia when in a pristine aquatic system. Although the fruit of cattails supplies little to no nutritional value, the rhizome is a valuable food source for muskrat, geese, and ducks (Kantrud, 1992). Stands of cattail are also valuable habitat for nesting and roosting of several bird species, particularly the red-winged blackbird, and it provides valuable cover for white-tailed deer (Oedocoileus virginianus), ring-necked pheasant (Phasianus colchicus), and fingerlings of many fish species (Kantrud, 1992).

However, when provided the opportunity, cattail, particularly T. angustifolia and T. x glauca, will spread to the point where they outcompete all other species and form a monotypic vegetative ecosystem. The primary triggering mechanism for this proliferation is disturbance of the waterbody, generally through anthropogenic activity, which changes salinity, depth, nutrient concentration or water quality. Under these circumstances, cattails are able to outcompete other aquatic macrophytes through several mechanisms including:

(1) the production of dense rhizome mats that prevent the rooting and germination of other species,

(2) the shading of the water surface to such an extent that other emergents will not survive, and

(3) the inability of other emergents to tolerate the environmental changes that have occurred.

11.4 DISTRIBUTION AND ECOLOGY OF OTHER POTENTIAL AQUATIC MACROPHYTE TARGET SPECIES OF RODEO/ACCORD

Table 11-1 discusses the emergent and marginal macrophyte species that are potential targets for control by the Rodeo/Accord. The sources of information for Table 11-1 include NYSDEC (1990), Fairbrothers and Moul (1965), Duncan and Duncan (1987), Petrides (1986), Magee (1981), Hotchkiss (1972) and Martin et al (1951). These species are also found throughout New York State. The presence and distribution of the plant species in a particular waterbody will be dependent on the physical characteristics of that waterbody.

TABLE 11-1

DISTRIBUTION AND ECOLOGY OF POTENTIAL EMERGENT AND MARGINAL TARGET MACROPHYTE SPECIES

Alder (Alnus spp.)

Found in swamps and shrub swamps, along the borders of streams, rivers, and ponds throughout New York State (NYS); generally poor in wildlife value, seeds are eaten by certain birds; dense stands can provide cover for wildlife

Ash (Fraxinus spp.)

Found in deep soils or moist woodlands, often in swamps and along floodplains and streams throughout NYS; of moderate importance to wildlife; seeds are eaten by a number of birds and mammals

Barnyardgrass (Echinochloa crus-galli)

Found in marshes, ditches, in waste places, and in cultivated fields throughout NYS; seeds are an important food source for ducks and other birds

Birch (Betula spp.)

Grows on river banks and in floodplains, in moist fertile soils, and in gravelly humus among rocks throughout NYS; has several important wildlife values; birds feed on catkins, buds and seeds; moose, deer and rabbits browse the twigs

Cordgrass (Spartina spp.)

Found in coastal and brackish marshes of NYS; has important wildlife values; seeds are eaten by certain ducks and marshbirds; rootstocks are utilized by geese and muskrat; cordgrass provides protective cover for many wildlife and avian species

Dogwood (Cornus spp.)

Found in wooded swamps, shrub swamps, low wet woods, and along watercourses throughout NYS; fruits and browse are extensively utilized by wildlife

TABLE 11-1 (CONTINUED)

DISTRIBUTION AND ECOLOGY OF
POTENTIAL EMERGENT AND MARGINAL TARGET MACROPHYTE SPECIES

Elder (Sambucus spp.)

Found in wooded swamps, shrub swamps, and along edges of marshes throughout NYS; berries are an important source of summer food for many song birds; squirrels and rodents feed on fruit and foliage

Elm (Ulmus spp.)

Found in deep rich soils, especially in floodplains and swamps and along watercourses throughout NYS; wildlife value is moderate, seed and buds are eaten by songbirds, foliage and twigs are browsed by deer; the canopy provides nesting and shelter spots for songbirds

Flatsedge, Chufa (Cyperus esculentus)

Found in mud flats, waste places and deep, sandy soils throughout NYS; tubers and seeds are eaten by a variety of birds

Fleabane (Erigeron spp.)

Found in disturbed areas throughout southern NYS

Foxtail (Setaria spp.)

Found in disturbed areas throughout NYS; has important wildlife value; seeds are eaten by a large number of birds and rodents

Foxtail, Carolina (Alopecurus carolinianus)

A rare, introduced species in NYS; found in wet meadows, marshes, pond margins, and on mud or in shallow water

Hemlock, Poison (Conium maculatum)

Found along wet shores and in shallow water, ditches, wet thickets, and swamps throughout NYS; has little wildlife value

TABLE 11-1 (CONTINUED)

DISTRIBUTION AND ECOLOGY OF
POTENTIAL EMERGENT AND MARGINAL TARGET MACROPHYTE SPECIES

Honeysuckle (Lonicera spp.)

Found in a variety of habitats throughout much of southern NYS; provides food and cover for birds and rabbits; fruits are eaten by both birds and mammals

Hornbeam, American (Carpinus caroliniana)

Found in rich, moist soils in bottom lands, swamps, and river margins throughout NYS; of secondary importance to wildlife; seeds are eaten by some birds and squirrels; its catkins and buds are utilized by some birds as food

Lettuce, prickly (Lactuca serriola)

Found in disturbed areas throughout NYS; has poor wildlife value, seeds are occasionally eaten by some wildlife species

Maple, red (Acer rubrum)

Found in wet bottomlands, floodplains, swamps, and dry uplands throughout NYS; provides important wildlife values; seeds, buds, and flowers provide food for many species of mammals and birds; twigs and foliage are eaten by deer and moose

Milkweed (Asclepias spp.)

An emergent/marginal species found in swamps and on lake shores and stream banks throughout NYS; has poor wildlife value; a few birds will eat the seeds

Monkey-flower, Common (Mimulus guttatus)

Grows along stream and lake shores throughout NYS; has little wildlife value

Nutgrass (Cyperus rotundus)

Found in waste places and roadsides throughout NYS; has little wildlife value

TABLE 11-1 (CONTINUED)

DISTRIBUTION AND ECOLOGY OF POTENTIAL EMERGENT AND MARGINAL TARGET MACROPHYTE SPECIES

Oak, pin (Quercus palustris)

Found along streams, in river bottoms, wooded swamps, and low wet woods throughout southern NYS; provide valuable wildlife functions; its acorns are eaten by birds and mammals; it provides valuable cover for birds and mammals; its twigs and leaves are utilized by birds for nesting material; its twigs and foliage are browsed by deer

Panicum (Panicum spp.)

Found in waste places and moist, low areas throughout NYS; is an important food source for ground-feeding songbirds and gamebirds; it provides cover for birds and small mammals

Poison Ivy (Rhus radicans)

Found in a variety of habitats throughout NYS; while a nuisance to man, provide valuable functions to wildlife, the berries are eaten by a large number of songbirds

Poplar (Populus spp.)

Found in rich moist bottomlands and along lakes and rivers throughout NYS; its buds and catkins are eaten by grouse; its twigs and foliage are eaten by rabbits and deer; the wood and bark is eaten by beavers

Reed Canarygrass (Philaris arundinaceae)

Found in marshes, wet meadows, and ditches throughout NYS; has low food value; some birds will consume seeds

Saltbush, sea myrtle (Baccharis halimifolia)

Found in saltmarshes and brackish and freshwater tidal areas in NYS; commonly found in the transition zones and elevated areas within the marsh itself

TABLE 11-1 (CONTINUED)

DISTRIBUTION AND ECOLOGY OF POTENTIAL EMERGENT AND MARGINAL TARGET MACROPHYTE SPECIES

Smartweed, Pennsylvania (Polygonum pensylvanicum) and smartweed, swamp (P. coccineum)

> Found in moist, alluvial soils, along water margins, and in cultivated fields throughout NYS; it can form extensive marshes; it provides cover for waterfowl; its seeds are eaten by birds and mammals

Spikerush (Eleocharis spp.)

> Grows in marshes and shallow waters throughout most of NYS; its fruits and culms are eaten by waterfowl, rabbits, and muskrats; its fruits are eaten by marshbirds and shorebirds

Sumac, poison (Rhus vernix)

> Found on low, wet grounds, and swamps throughout NYS; it does not provide a good choice of food or cover for wildlife; however, it is an important winter sustenance food for songbirds

Sycamore (Platanus occidentalis)

> Found in rich, moist bottomlands and along riverbanks in southern NYS; it has no appreciable importance to wildlife

Tules, common (Scirpus acutus)

> Found in marshes and sandy pond margins, often in shallow water throughout NYS; its seeds are eaten by waterfowl; its stems and underground portions are eaten by geese and muskrats; furnishes important nesting cover for waterfowl and songbirds; it provides important hiding cover for raccoons, otters, and muskrats

Willow (Salix spp.)

> Found bordering streams, rivers, and ponds, in floodplains and swampy woods throughout NYS; its buds and twigs are eaten by grouse; its twigs, foliage, and bark are eaten by rabbits, moose, and deer

11.5 ROLE OF POTENTIAL AQUATIC MACROPHYTE TARGET SPECIES IN PLANT COMMUNITIES WITHIN NEW YORK STATE WATERBODIES

As discussed in Section 11.2, aquatic macrophytes fill valuable functions in the aquatic environment. They assist in oxygenation of the water, recycling of nutrients, and provide nesting and shelter areas for fish, amphibians, birds, and mammals. Aquatic macrophytes serve in the stabilization of banks along watercourses and are a food source for a variety of organisms, including both invertebrates and vertebrates. The ability of a particular macrophyte to perform these functions and the quality of that function often depend on the characteristics of the entire aquatic community. Heterogeneous stands of plant species generally offer more of these functions than a monotypic stand dominated by a single species. Heterogeneous stands have a greater vertical distribution of niches, which aquatic organisms that are dependent on the vegetation may fill. Additionally, the horizontal distribution of the aquatic plant communities will affect the functions and values that the individual species may offer. Patchy communities, with a variety of vegetative species spread over the available substrate, tend to offer a greater variety in habitats than a community dominated by a single species that completely covers the substrate. However, if that single species community is localized and is the only available habitat in a large aquatic setting, then at least some of the functions generally offered by aquatic vegetation would be offered. This circumstance may be evaluated in a lake management plan that would determine the goals and objectives of the vegetation management needs for that waterbody. Restoration of a mixed community of desirable plant species is likely to require initial removal of a monotypic plant stand. The role that the target species may play in aquatic systems is discussed in the following sections.

11.5.1 Emergent and Marginal Plant Communities

As noted earlier, emergent macrophytes inhabit a critical ecological zone which consists of the transitional area between aquatic and terrestrial habitat. As such, these plants are the primary producers for many aquatic, semiaquatic, and terrestrial herbivores. With the exception of purple loosestrife, the targeted emergent species do provide some nutritional value to some wildlife species. One example is the role of the cattail rhizome as a major food source of muskrats. Under normal circumstances life cycles will become established between muskrats and cattails. As cattail populations grow, muskrats also flourish resulting in increased muskrat populations. Soon these populations increase to such an extent that over-grazing of cattails occurs. This system of overgrazing results in what is referred to as an "eat-out", the result of which is a large clearing in the waterbody which tends to benefit waterfowl populations. However, due to overgrazing, muskrat populations diminish allowing the cattail populations to reestablish (Motivans and Apfelbaum, 1989).

The life-cycle described above will continue unless an exogenous influence, such as nutrient loading, is placed on the ecosystem. Nutrient loading can result in such rapid spread of cattails that the muskrat population is unable to keep pace. The eventual result is a monotypic culture of cattail with little to no open space to lure waterfowl. According to Kantrud (1992), the preference of waterfowl (including ducks, grebes, coots, terns, and rails) to semi-open waterbodies is related to the balance of having enough cover to provide isolation, nesting, and escape, and enough open area to allow the emergence of varieties of submerged, floating, and emergent vegetation. This variety in vegetation will in turn result in a diverse population of aquatic insects, mollusks, and crustaceans (Kantrud, 1992).

Stromstad (1992) warns that a balanced approach to the control of emergents, particularly, is necessary due to their habitat value. In his paper, Stromstad notes that the cattail stands are important to the over-wintering success of white-tailed deer, pheasant and many other mammal species, and the recent increase in populations of these game species has been due to these monotypic stands of cattails. This argument can also be applied to phragmites which provides cover similar to that of cattail.

Monotypic stands of cattail, phragmites, and purple loosestrife can also result in the overpopulation of other species that are particularly well adapted to this type of habitat. Red-winged blackbirds flourish in these monotypic stands, particularly when located near an abundant food source like an agricultural field. In a recent symposium on cattail management, Linz (1992) pointed out that as much as 10% of a farmer's sunflower crop can be destroyed by blackbirds if located in close proximity to a waterbody with a monotypic stand of cattail. This overpopulation of nesting or roosting blackbirds also leads to competition with other bird populations.

11.6 GENERAL CHARACTERIZATION OF AQUATIC VEGETATION MANAGEMENT OBJECTIVES FOR THE USE OF RODEO/ACCORD

The ultimate objective for the use of Rodeo®/Accord® herbicides is the long-term (greater than two years), economical control of nuisance emergent macrophytes in an ecologically sound manner. However, the degree of control is dependent upon the characteristics of the waterbody to be managed. The treatment of irrigation and stormwater drainage ditches will differ from the treatment of most lakes, ponds, and estuaries. The ultimate goal in weed control in ditches is the complete eradication of the interfering vegetation; whereas, the management objectives for lakes, ponds, and estuaries is to balance ecological, recreational, aesthetic, and economic concerns. Because invasive emergent vegetation, such as cattail, phragmites, and purple loosestrife, has some inherent ecological and aesthetic value, the complete eradication of the species may not be desired. This is equally true when you consider recreational and navigational uses of the waterbody. The emergent vegetation need only be controlled up to the point where the above mentioned uses are optimized. On the other hand, the complete eradication of an invasive species, particularly one like the non-indigenous purple loosestrife, may be justified by the cost of some of the management programs as well as the potential adverse environmental effects concomitant with their uses. The degree of ecological impact imparted by an invasive species such as purple loosestrife and phragmites and the potential for reinfestation warrants the total control of those species.

To achieve the desired level of weed control in irrigation and drainage ditches the management plan may involve a program of spraying such that all vegetation within the area of concern is impacted at the proper dose and at the proper frequency to insure maximum destruction for the longest duration. The management plan for lakes, ponds, and estuaries will be more complex because its goals involve several variables. The design of the treatment pattern should be such that sections of the shoreline are clear for access for recreational purposes, the channel or central portion of the waterbody is clear for recreational boating and navigation, and enough shoreline and near shore area are clear for the reintroduction of native aquatic vegetation as well for the optimum use by the widest variety of animal species. All of this must be done while maintaining stands of the "nuisance" emergents to maintain ecological diversity and aesthetic quality. To achieve these goals, the management program should be carefully designed and implemented.

12.0 GENERAL DESCRIPTION OF THE RODEO® AND ACCORD® HERBICIDES AND THEIR ACTIVE INGREDIENT GLYPHOSATE

12.1 DESCRIPTION OF RODEO® AND ACCORD® HERBICIDE FORMULATIONS

Rodeo® and Accord® herbicides are broad-spectrum, systemic herbicides. Rodeo® herbicide is used in the management of nuisance aquatic emergents in ponds, streams, rivers, canals, and irrigation and drainage ditches; whereas, Accord® herbicide is utilized in the management of undesired vegetation in forestry and utility rights-of-way, including those containing wetlands and open water sites. Both herbicides are aqueous solutions containing the active ingredient glyphosate. Rodeo® herbicide contains 53.8% glyphosate and 46.2% water, and Accord® herbicide contains 41.5% glyphosate and 58.5% water. The Accord® and Rodeo® herbicides were registered in the State of New York in 1978 and 1982, respectively.

12.1.1 Active Ingredients

The active ingredient in both Rodeo® and Accord® herbicides is glyphosate (N-phosphonomethyl glycine) in the form of its isopropylamine salt. Glyphosate is a nonvolatile, white odorless solid with a melting point of 230° C, and a negligible vapor pressure. It is readily soluble in water (12 g/l at 25° C.), but it is virtually insoluble in organic solvents with an octanol/water partition coefficient (log K_{ow}) of -1.60. Although the mechanism of soil binding is not thoroughly understood, it is well established that glyphosate is rapidly and tightly absorbed to a wide variety of soils. Prolonged exposure of Rodeo/Accord to uncoated steel surfaces may result in corrosion and possible failure of the part. Refer to the most recent product label and MSDS sheets for mixing and application precautions.

12.1.2 Inert Ingredients

Water is the only inert ingredient in both Rodeo® and Accord® herbicides.

12.1.3 Product Contaminants

USEPA (1986b) has identified N-nitrosoglyphosate (NNG) as a contaminant of technical glyphosate at levels below 0.1 ppm. At this extremely low level, EPA does not require that any toxicology data be generated. However, Monsanto has performed several potential health effects assessment studies.

Based on the results of a wide range of toxicology, environmental residue, and metabolism studies, and applicator exposure studies, it is concluded that:

1. NNG has not been shown to cause significant adverse health effects;

2. The concentration of NNG in Accord and Rodeo is extremely low;

3. Exposure of applicators under normal use conditions is non-detectable;

4. Exposure to the general public is virtually non-existent; and

5. Microbial and photodegradation are both rapid and essentially complete.

In addition, in a recent glyphosate citing in the Federal Register, Vol. 58, No. 85, May 5, 1993 pages 26725-26727, USEPA wrote; "No detectable residues of N-nitrosoglyphosate, a contaminant of glyphosate, are expected to be present in the commodities for which tolerances are established." These studies provide sufficient proof that trace levels of N-nitrosoglyphosate in Accord® and Rodeo® herbicides do not present an unreasonable risk to man or the environment.

12.2 SELECTION OF RODEO VERSUS ACCORD

The Rodeo® herbicide is labelled for use in aquatic and other non-crop sites. Aquatic sites are all bodies of fresh or brackish water which may be flowing, non-flowing or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, and similar locations. Non-crop sites would include, but are not necessarily limited to, roadside applications, utility right-of-ways, railroads, and parks.

The Accord® herbicide is registered for use in forestry and utility right-of-way applications. These include terrestrial, wetlands and aquatic sites within forestry and utility right-of-way locations. The distinction between Rodeo® and Accord® herbicides is that Accord is limited to forestry and utility right-of-way applications, while Rodeo can be used on a broad range of non-crop sites.

12.3 DESCRIPTION OF USE

Rodeo® and Accord® herbicides are broad-spectrum systemic herbicides which are used for the management and control of a wide variety of perennial, annual, and biennial species of grasses, sedges, rushes, broad-leaf weeds, and woody plants. Use of Rodeo® herbicide is targeted toward control of emergent aquatic macrophytes; whereas, the use of Accord® herbicide is targeted toward control of woody brush, trees, and herbaceous weeds within forestry and utility rights-of-way, including those containing wetlands. Both products must be applied to the foliage of the plant to be effective, and broadcast spraying is the best method of application.

12.4 MODE OF ACTION/EFFICACY

Once applied to the foliage of the plant, the active ingredient of Rodeo® and Accord® herbicides, glyphosate, is absorbed through the cuticle into the plant tissue. Once through the cuticle, glyphosate is transported to the vascular tissue via a localized cell to cell migration which most likely occurs through a combination of passive diffusion and active transport of water soluble molecules. In the vascular tissue, glyphosate enters the phloem cells of the vascular tissue where it is transported to the various parts of the plant, including the roots.

Glyphosate has a large number of effects on a wide variety of physiological functions. The primary mode of herbicidal action results in the disruption of the shikimic acid pathway. This metabolic pathway is common only to plants and some microorganisms, and the mode of action by which this pathway is disrupted is unique among herbicides. By disrupting the shikimic acid pathway, the plant's cells are unable to metabolize aromatic amino acids or metabolic phenolic compounds. This results in a sharp decrease in the plants ability to synthesize proteins, eventually resulting in mortality. Other herbicidal modes of action attributable to glyphosate include the blockage of two additional enzyme pathways which result in the inability of the plant to synthesize chlorophyll and granular bodies, and the deterioration of oil bodies, the endoplasmic reticulum and ribosomes.

The effectiveness of Rodeo® and Accord® herbicides is determined by several factors including spray concentration, rate of application, type of species targeted, and growth stage of species targeted. In general, rate of application for the control of woody perennial species needs to be greater than those for annual weed species. These herbicides are most effective during the early growth stages of most annual and seedling plants. The most effective time of application for most perennial and rhizome-bearing species (e.g., cattail, phragmites, etc.) is after the plant enters the reproductive stages of growth - i.e., late August to October (Kantrud, 1992).

Both herbicides have been found to be effective on floating and emergent aquatic plants. Rodeo® and Accord® herbicides are not effective on submerged aquatic plant species because they are diluted below an effective concentration in the treated water. Their effectiveness is reduced on floating species if wave action washes the product off before it can penetrate the plant foliage.

Rodeo® and Accord® herbicides are fairly slow acting herbicides, and the rate of action is species specific. Translocation from leaves to roots has been observed to have occurred within 24 hours of application. Visible effects of the herbicidal activity can be observed as early as within 2 days in annuals and 7 days in perennials, however, this will vary according to growth stage and environmental conditions. Woody species can take as long as 30 days to show visible signs of herbicidal action. The visible effects begin as wilting and yellowing of leaves followed by browning and complete deterioration of leaf, stem, and root tissue.

12.5 APPLICATION CONSIDERATIONS THAT MAXIMIZE SELECTIVITY OF RODEO® AND ACCORD® HERBICIDES

The following factors should be considered in the application of Rodeo® and Accord® herbicides so as to allow for the maximum selectivity and effectiveness of the products.

12.5.1 Time of Application

It is recommended that Rodeo/Accord be applied on "actively growing plants." This general recommendation is given because the effectiveness may be reduced on plants under stress, i.e., that are not actively growing. As mentioned earlier, Rodeo/Accord are most effective on annual weeds during early stages of growth when the most robust growth is occurring. It should be noted that not all annuals are in early stages of growth in the spring, e.g., winter annuals. The most effective time of application for most perennials is after the reproductive stages of growth are reached. This varies considerably or certain species, i.e., some perennials bloom in the spring or summer as well. In general, the most effective time of application, is during periods of low stress (e.g., drought, disease, nutrient depletion, infestation, etc.) and maximum translocation. To determine the most effective time of application an understanding of the physiology of the targeted species is recommended; however, in general, Rodeo/Accord are effective herbicides during any stage of growth and other considerations may dictate that applications be made at time that are not "the most effective." An example would be a rare, threatened, or endangered plant species which is dormant during a target weed species non optimal spraying stage. Desirable, dormant plants would not translocate the active ingredient while the target species would, thereby providing target species control without affecting desirable species, i.e., rare, threatened or endangered species.

12.5.2 Rate of Application

The recommended application rates are described on the registered labels attached as Appendix B. These application rates vary depending upon target species and application method. The maximum rates are used for the most resistant target species or high target weed infestations.

12.5.3 Method of Application

Rodeo/Accord may be applied using broadcast sprays (ground-rig or aerial), handgun and backpack spray-to-wet, wiper, cut stem and cut stump, and tree injection techniques. For broad spectrum control over large areas, broadcast sprays are the most efficient method. Handgun and backpack sprayers may be used when the spray needs to be targeted onto certain plants/areas and away from desirable species. Backpack sprayers are especially effective in directing spray on plants to be controlled with minimal impact to non-target species. Wiper, trunk injection, and cut stump/stem are very effective methods of application without damaging non-target species. However, the more selective treatments are only practical for treating relatively small areas. For monotypic stands like phragmites and cattails, broadcast sprays may be needed. Many aquatic areas may require the broadcast spray to be applied with aerial equipment depending upon accessibility to the target weed stand.

The manufacturer also recommends adding a non-ionic surfactant to spray mixtures of Rodeo or Accord to promote the adhesion and spreading of spray droplets on the plant surface to aid penetration of the plant cuticle on the leaves. This maximizes absorption and effectiveness of the treatment.

Drift control agents and color marking dyes may also be warranted by the application method and atmospheric conditions. Consult the most recent product labels for recommendations for all types of application.

12.5.4 Species Susceptibility

The potential target macrophytes discussed in Section 2.0 are susceptible to Rodeo® and Accord® herbicides. Table 12-1 lists other species susceptible to these herbicides.

12.5.5 Dilution Effects

Dilution per se is not a significant consideration in the application of Rodeo® or Accord® herbicides because of the need for direct application to plant foliage rather than to the media in which they grow, i.e., water. When applied to the water surrounding the target species, Rodeo® and Accord® herbicides are ineffective. This ineffectiveness is due to the fact that the herbicides undergo rapid dissolution and degradation and therefore, reduction in their effective concentration.

Rodeo® and Accord® herbicides should not be applied if precipitation is expected within 6 hours of the time of application. Any type of precipitation may wash off the herbicides before they can be absorbed. The addition of a nonionic surfactant increases the adsorptive capability of the herbicides, reducing the chance that a light rainfall shortly after application will wash them off.

12.6 RODEO/ACCORD PRODUCT SOLUBILITY

Glyphosate, the active ingredient of Rodeo/Accord, is readily soluble in water (12g/L @ 25C), but is virtually insoluble in organic solvents with an octanol/water partitioning coefficient (log Kow) of -1.60. Glyphosate is rapidly and tightly adsorbed to all types of soils with organic carbon partition coefficients (Koc) of 4,871 in clay loam, 3,414 in silt loam, and 2,661 in sandy loam soils (Montgomery, 1993). Moreover, despite its high water solubility, numerous soil mobility (leaching) studies demonstrate that glyphosate will not leach on most soils; using the Heller and Turner Classification system, glyphosate would be categorized as a "Class I pesticide" that possesses no propensity for leaching (Heller, 1968).

12.7 SURFACTANT

The use of a nonionic surfactant labelled for herbicide use is recommended for Rodeo® and Accord® herbicides. Recommended concentrations range from 0.5 to 5.0% by volume, with typical application mixtures utilizing 1.5% surfactant by volume. Surfactants in general act to bind two surfaces which under normal circumstances might resist binding. In the case of Rodeo® and Accord® herbicides, the surfactant acts to reduce the surface tension of water, allowing adherence of the spray droplets to the foliage of plants. The surfactant also aids in the penetration of the plant cuticle, a waxy protective structure that prevents the movement of materials, including water and gas, into and out of the plant. By reducing the integrity of the cuticle, the herbicides can more easily be absorbed into the plant tissue (Latka, 1992). Table 12-2 is a partial listing of surfactants that have historically been used with Rodeo® and Accord® herbicides (Monsanto, 1989).

TABLE 12-1

PARTIAL LIST OF SPECIES SUSCEPTIBLE TO RODEO/ACCORD

Alder	Alnus spp.
Alligatorweed	Alternanthra philoxeroides
Ash	Fraxinus spp.
Barnyard grass	Echinoclia crus-galli
Birch	Betula spp.
Canarygrass, reed	Phalaris arundinacea
Cutgrass, giant	Zizaniopsis arundinacea
Elderberry	Sambucus spp.
Elm	Ulmus spp.
Foxtail	Setaria spp.
Honeysuckle	Lonicera spp.
Lettuce, prickly	Lactuca serriola
Lotus, American	Nelumbo lutea
Milkweed	Asclepias spp.
Monkey flower	Mimulus guttatus
Napiergrass	Pennisetum purpureum
Nutsedge, purple	Cyperus rotundus
Panicum grass	Panicum spp.
Poison ivy	Rhus radicans
Raspberry	Rubus spp.
Smartweed, Pennsylvania	Polygonum pennsylvanicum
Smartweed, swamp	Polygonum coccineum
Waterhyacinth	Eichornia crassipes
Willow	Salix spp.

TABLE 12-2

SURFACTANTS USED WITH RODEO/ACCORD

Agri-dex	Helena Chemical Company
Liqua-wet	Woodbury Chemical Company
LI-700	Loveland Industries, Inc.
Passage	Asgrow Florida Company
Pro-Spreader Activator	Target Chemical Company
R-11; Super Spread 200	Wilbur-Ellis Company
Spreader-Sticker	Southern Mill Creek Products
Valent X-77	Valent Chemical Company
Widespread	FMC Corporation

Numerous studies have been conducted by Monsanto and independent investigators on the efficacy of glyphosate with various nonionic surfactants on a wide range of Accord/Rodeo labelled species. These studies have consistently concluded that the addition of a nonionic surfactant greatly increases the efficacy of Rodeo® and Accord® herbicides. These results should not be interpreted as synergistic. Synergism is defined as "cooperative action of discrete agencies such that the total effect is greater than the sum of the two effects taken independently". This leaves the interpretation of synergistic effects from an efficacy standpoint open to interpretation. Nonionic surfactants have more of an additive effect, in that they aid in glyphosate adhering to and penetrating the outer plant tissue. They do not aid in enhancing the efficacy (synergism) from a mode of action standpoint. If they did, this could be considered an active ingredient and therefore, fall under FIFRA registration guidelines.

Henry (1992) studied the acute toxicity of Rodeo and X-77 independently and in a labelled application mixture. Using the criteria from Christenson (1976), Rodeo was practically nontoxic to all test animals, the field application mixture was practically non-toxic and X-77 was moderately toxic. Christenson's criteria are as follows:

EC or LC_{50}	Classification
< 1 mg/l	Highly Toxic
1 - 10 mg/l	Moderately Toxic
10 - 100 mg/l	Slightly Toxic
100 - 1,000 mg/l	Practically Non-toxic
> 1,000 mg/l	Insignificant Hazard

Note: EC = Effective Concentration
LC^{50} = Concentration Considered to be Lethal to 50% of the Test Population

Henry also studied the potential for synergistic effects. Additive indices were calculated to determine additive or synergistic toxicity effects. All mixtures involving Rodeo and X-77 were simply additive with the exception of the daphnid test in which the mixture was slightly less than additive (antagonism).

It is not expected that the addition of a surfactant classified as moderately toxic (Table 12-3) at the relatively low recommended concentrations would cause unacceptable toxicity. For Rodeo/X-77, the addition of the surfactant increases the toxicity of the formulation from a 96-hour LC_{50} of 1100 mg/L (Rodeo alone) to 680 mg/L (Rodeo plus X-77 surfactant) for rainbow trout (Mitchell et al., 1987). Although the addition of the surfactant increased the toxicity of the Rodeo formulation, the Rodeo/X-77 mixture is considered practically nontoxic to rainbow trout.

In summary, synergistic effects between Rodeo® and Accord® herbicides and surfactants are not believed to occur in terms of efficacy and/or toxicity. Additionally, numerous efficacy studies on a wide range of labeled species have consistently concluded that the addition of a nonionic surfactant greatly increases the efficacy of Rodeo® and Accord® herbicides. Relative efficacy studies for the numerous nonionic surfactants on the market have not been conducted for all target nuisance aquatic plant species. However, all nonionic surfactants should provide acceptable efficacy, regardless of potential toxicity.

TABLE 12-3

SURFACTANT TOXICITY STUDIES
MONSANTO

Moderately Toxic to Fish

Surfactant	96-hr LC50 (mg/l) Rainbow Trout	96-hr LC50 (mg/l) Bluegill	48-hr LC50 (mg/l) Daphnia
Activator 90	1.4	2.0	2.0
Entry II	4.2	1.3	2.0
Frigate	3.6	2.4	11.0
Induce	5.6	7.5	18.0
No Foam A	3.3	6.0	7.3
R-11	3.8	4.2	19.0
S. Spreader 200	4.2	9.3	24.0
Widespread	6.6	7.0	16.0
X-77	4.2	4.3	2.0

Slightly Toxic to Fish

Surfactant	96-hr LC50 (mg/l) Rainbow Trout	96-hr LC50 (mg/l) Bluegill	48-hr LC50 (mg/l) Daphnia
Liqua-Wet	13.0	11.0	7.2
Passage	52.0	75.0	17.0
Spreader-Sticker	36.0	35.0	48.0

Practically Non-Toxic To Fish

Surfactant	96-hr LC50 (mg/l) Rainbow Trout	96-hr LC50 (mg/l) Bluegill	48-hr LC50 (mg/l) Daphnia
Agri-Dex	>1,000	>1,000	>1,000
LI-700	130.0	210.0	170.0

12.7.1 Surfactant Toxicity to Aquatic Organisms

Monsanto conducted aquatic toxicity studies on the surfactants listed in Table 12-2, as well as a number of others not listed (Table 12-3). The aquatic organisms analyzed in these studies included rainbow trout (Salmo gairdneri), bluegill (Lepomis macrochirus), and daphnia (Daphnia spp.). The results indicated that the surfactants ranged in acute toxicity from moderately toxic at concentrations as low as 1.3 mg/l (Entry II) to practically non-toxic at concentrations as high as >1,000 mg/l (Agri-dex). These results were based on 96 hour LC_{50} for fish species and 48 hour LC_{50} for daphnids.

Several other studies were conducted by independent investigators on the toxicity of one of the more commonly utilized surfactants, Valent X-77. Henry (1992) studied the acute effects of this surfactant on daphnia, midge larvae (Chironomus spp.), scuds (Hyalella azteca), and leeches (Nephlopsis obscura). Her results indicated that Valent X-77, when applied alone, resulted in LC_{50}'s of 2, 10, 6 and 11 mg/l for these organisms, respectively. Valent X-77 was moderately toxic, and when applied at the manufacturer's recommended application rate, was not toxic to aquatic organisms. Buehl and Farber (1989) reported similar results with a 48-hour EC_{50} of 8.6 mg/l for the fourth instar of the midge larvae, and Watkins (1985) found that there was 100% mortality in bluegill when exposed to 6.0 mg/l of Valent X-77 for a 96-hour period.

12.8 FATE OF GLYPHOSATE AND AMPA (PRIMARY METABOLITE) IN THE AQUATIC ENVIRONMENT

In general, glyphosate rapidly dissipates from the environment and degrades quickly under a wide variety of environmental conditions. Glyphosate has a low potential for environmental accumulation. The following sections detail the fate of glyphosate and AMPA (the primary metabolite, or degradation product, of glyphosate) in specific environmental media.

12.8.1 Water (aerobic and anaerobic)

The environmental fate of glyphosate in water under typical field use conditions has also been extensively evaluated by both Monsanto and independent investigators. The results of these studies demonstrate that the residue levels of glyphosate and AMPA are very low and dissipate rapidly with time. In all cases studied, combined glyphosate and AMPA residue levels in aquatic systems treated with glyphosate, even at exaggerated use rates, are less than 0.5 ppm within 24 hours of application. Half-lives for the dissipation of glyphosate in environmental waters range from 1.5 to 14 days.

Glyphosate dissipation in natural waters in the absence of sediment is very slow with half-lives that range from 7 to 10 weeks. However, in the presence of sediment, under either aerobic or anaerobic conditions, glyphosate dissipation in water is very rapid with half-lives that range from 6.5 to approximately 21 days. These studies demonstrated that, in addition to microbial degradation, a major contributor to the aquatic dissipation of glyphosate is absorption to the sediment.

The environmental fate of glyphosate in irrigation water in canals following treatment with Roundup® herbicide was first studied by Kramer (Kramer, 1975) and Comes (Comes et al., 1976) in a collaborative study. In a dry ditch treatment test, two dry canals were treated with Roundup® herbicide at an application rate of 5 lb a.e./acre below the normal water line in the fall of 1972 for a distance of 0.8 km. The following spring, the water level was raised above the treated areas by use of check dams and water was sampled for glyphosate. Three sampling stations were within each treated area and two sampling stations were downstream from the treated areas. No detectable residues of either glyphosate or AMPA were found in any of the water samples collected from either canal. Soil samples collected the day before the canals were filled (158 and 172 days after treatment) contained 0.37 and 0.33 ppm glyphosate and 0.74 and 0.82 ppm AMPA. Thus, these results demonstrate that glyphosate and AMPA are not readily extracted from soil by flowing water; consistent with previous laboratory studies (Rueppel et al., 1977).

In this same study, the distribution, mobility, and dissipation of glyphosate in five soil and concrete-lined canals containing flowing water were also investigated. At four of the test sites an aqueous solution of glyphosate was metered into the canal water at a rate sufficient to achieve a concentration of 150 ppb. At one test site glyphosate was metered into the canal water at a rate sufficient to achieve a concentration of 1500 ppb. These injection rates were determined to represent 2.5 and 25 times the expected concentration of glyphosate to be found in the water following a normal ditch bank application (Frank et al., 1970). Sampling stations were located 0.3 and 1.6 km downstream from the application sites and then at various intervals throughout the remainder of the canals. For the canals containing glyphosate concentrations of approximately 150 ppb, concentrations decreased rapidly to approximately 74% of the initial concentration at the 1.6 km sampling station and then decreased more slowly as the treated body of water continued to move downstream. In the case of the canal which contained a glyphosate concentration of approximately 1500 ppb, the amount of dissipation was significantly greater. At the sampling station located 1.8 km downstream from the application zone, only 40.6% of the initial glyphosate concentration remained and at the sampling station located 10.1 km downstream only 22.4% of the initial glyphosate concentration remained. The results of this investigation demonstrate that when used to treat irrigation canal banks in which water is flowing, glyphosate will become diluted and dissipate as the treated body of water moves downstream. The maximum concentration of glyphosate expected in the water from this type of treatment is less than 0.1 ppm.

In a related study, Roundup® herbicide was applied at application rates of 4 and 8 lb a.e./acre to levees surrounding flooded rice fields, and the rice fields were monitored to determine the distribution and rate of dissipation of glyphosate in the water (Kramer, 1975). At two of the three test sites, the herbicide spray was purposely directed into the rice field to maximize the amount of glyphosate that would be expected under normal agronomic conditions. For one test site that was purposely over-sprayed, combined glyphosate and AMPA residues of 624 and 1321 ppb were found in water samples collected 1.5 ft into the field on the day of application for the 4 and 8 lb a.e./acre application rates. At the second test site which was purposely over-sprayed, combined glyphosate and AMPA residues 30 min after application were 192 and 226 ppb. These residue levels decreased rapidly to 26 and 64 ppb at one day after treatment, and were less than 10 ppb by 10 days after treatment. In the case of the test site at which the application of Roundup® herbicide was made only to the levee, glyphosate and AMPA residues were less than 10 ppb at all sampling points.

Dubelman (Dubelman and Steinmetz, 1981) and Steinmetz (Steinmetz, 1985), reported the results of a study designed to measure the maximum instantaneous glyphosate concentrations resulting from the use of Roundup® herbicide for aquatic weed control. In this study, Roundup® herbicide was directly applied at an application rate of 3.75 lb a.e./acre to flowing streams at thirteen sites in ten different states covering a wide geographical distribution. Water samples were collected 50 ft downstream from the application zone on a time basis when 25%, 50%, and 75% of the treated water was determined to pass the sampling station. At six of the thirteen test sites, the maximum instantaneous glyphosate concentrations in flowing water were less the 0.5 ppm, and ranged from a high of 0.467 ppm to less than 0.010 ppm. AMPA concentrations at these six test sites were in all cases no greater than 9 ppb. At the remaining seven test sites, the maximum instantaneous glyphosate concentrations ranged from a high of 2.31 ppm to a low of 0.614 ppm, and AMPA concentrations ranged from a high of 21 ppb to less than 5 ppb. Since the results of other studies demonstrate that glyphosate dissipates rapidly in environmental waters due to dilution, microbial degradation, and adsorption onto sediment, the concentrations of glyphosate in these latter seven sites were expected to decrease to less than 0.50 ppm within 48 hours.

In a related study, Rodeo® herbicide was applied at an application rate of 6 lb a.e/acre to water hyacinths growing in open water and in back water plots and the subsequent concentrations of glyphosate in the stream water were determined (Danhaus and Nord, 1983). Water samples were taken from sampling stations 20 ft and 300 ft downstream from the treatment plots at 0.5, 2, and 4 hours after treatment. For the open water plot, the highest glyphosate concentration (0.04 ppm) in the stream water was found at the sampling station 20 ft downstream from the application zone 0.5 hours after treatment. At 4 hours after treatment at this sampling station a glyphosate concentration of 0.03 ppm was found. No glyphosate concentrations greater than 0.01 ppm were detected at any time at the sampling station located 300 ft downstream from the application zone. In the case of the backwater test plot, the only glyphosate concentrations greater than 0.01 ppm were found 4 hours after application, and were 0.06 ppm and 0.04 ppm, respectively, for the sampling stations located 20 to 300 ft downstream from the application zone. No AMPA concentrations greater than 0.01 ppm were detected at any of the sampling events.

More recently, a study of the aquatic dissipation of glyphosate and AMPA was conducted by Monsanto according to the U.S. Environmental Protection Agency's Pesticide Assessment Guidelines, Subdivision N, Section 164-2, which provided additional data regarding the distribution and dissipation of glyphosate in aquatic systems (Horner and Kunstman, 1988). Water samples were collected from two different types of test sites which received glyphosate treatments: forestry sites and irrigation water source sites.

For the forestry sites, glyphosate, formulated as Accord® herbicide, was aerially applied at the maximum label use rate of 3.75 lb a.e./acre to three 20-acre forestry sites representative of areas of the U.S. where glyphosate is used in normal silviculture practice. Each location contained a flowing stream and at least one pond. Water samples were collected from both the flowing streams and ponds over a one-month period at each test site and analyzed for glyphosate and AMPA.

Water samples collected from ponds at all three forestry test sites showed the highest glyphosate concentrations on the day of application (1.680, 0.985, and 0.091 ppm). Glyphosate levels rapidly dissipated to less than 0.4 ppm by 1 day after treatment at all three test sites. AMPA residue levels were less than 0.04 ppm at all sampling events at all three test sites. Glyphosate and AMPA residues in flowing streams at all three test sites displayed similar trends to those in pond water, with the exception that the residue levels were lower. Maximum glyphosate residues were found on the day of application, and ranged from 1.237 to 0.035 ppm, and then declined rapidly to no greater than 0.048 ppm by 1 day after treatment. With the exception of a 10 ppb level on the day of application at the test site with the highest glyphosate concentration in the stream water, no AMPA concentrations greater than 3 ppb were found at any time at any of the sites. Similarly rapid dissipation of glyphosate in aquatic systems following glyphosate applications have been reported by Feng et al. (1990), Goldsborough and Beck (1989), and Goldsborough and Brown (1993).

In the case of the irrigation water source sites, applications of glyphosate, formulated as Rodeo® herbicide, were made at an application rate of 3.75 lb a.e./acre to sources of irrigation water at two locations. One location utilized a farm pond to which glyphosate was applied in a 3 ft-wide strip around the circumference of the pond. The second location utilized a concrete-lined irrigation canal to which glyphosate was applied as a 3 ft by 500 ft strip along both sides of the canal up stream from the irrigation water intake for the sprinkler. For each test site, water samples were then collected over approximately a two-month period and were analyzed for glyphosate and AMPA residues.

In this study, no glyphosate or AMPA residues greater than 1 ppb were found in any of the water samples from the canal irrigation source location, including the water samples collected on the day of application. Irrigation water on day of application was sampled just prior to initiation of the first irrigation event which started approximately 3 hours after glyphosate was applied to the irrigation canal. The absence of detectable levels of glyphosate in the irrigation water is attributable to the rapid down stream movement of glyphosate as well as dilution due to the mass flow of approximately 86,000 ft3 of water in the canal during this 3-hour interval.

In contrast to the canal irrigation source location, the pond irrigation water samples contained detectable levels of glyphosate and AMPA. The maximum glyphosate concentration of 21.3 ppm was found on the day of application in the area of the pond which had been treated. The level of glyphosate rapidly declined in this area to 0.46 ppm by 1 day after treatment and then declined more slowly to 0.013 ppm at 30 days after treatment. The AMPA concentration in the treated area peaked at 0.049 ppm 1 day after treatment and then declined to 0.009 ppm by 30 days after treatment. At the irrigation intake, located near the center of the pond, the maximum glyphosate concentration of 0.318 ppm was detected 1 day after treatment, and then rapidly decreased to 0.013 ppm by 30 days after treatment. Excluding the concentrations found on the day of application, due to the lack of homogeneity in the pond, the half-life for the dissipation of glyphosate in water was estimated to be 7.5 days.

12.8.2 Sediment

Chemical degradation and/or photodecomposition, are at most, very minor pathways for the dissipation of glyphosate in soil and water. However, a number of studies have conclusively demonstrated that glyphosate is rapidly and extensively degraded in soil, under both aerobic and anaerobic conditions, by indigenous soil microflora. The metabolite distribution resulting from the degradation of glyphosate in unsterilized soil is similar under both aerobic and anaerobic conditions. The principal soil metabolite is aminomethylphosphonic acid (AMPA). The maximum amount of AMPA detected ranges from 15 to 28.7% of the starting glyphosate. Several other minor metabolites are also produced. These minor metabolites include N-methylaminomethylphosphonic acid, N,N-dimethylaminomethylphosphonic acid, hydroxymethy-phosphonic acid, and two unidentified metabolites. None of these minor metabolites are normally present to an extent of greater than 1% of the applied glyphosate. No metabolic products containing an intact N-phosphonomethylglycine moiety have been detected in metabolism studies. These studies also established that the major metabolite of glyphosate degradation, AMPA, is further degraded by soil microflora, although at a slower rate than glyphosate (Goure, undated).

Half-lives for the dissipation of glyphosate in various soils under aerobic conditions range from 1.85 to 130 days, and are typically less than 25 days. It has been suggested that the decreased rate of glyphosate dissipation in certain soils is due to the microbial composition and reduced populations as well as the extent of glyphosate binding to the soil. Metabolism studies have demonstrated that 79 to 86% of the applied glyphosate is degraded to carbon dioxide during a six-month period (Goure, undated).

Glyphosate has also been shown to have no adverse effect on soil microflora. Plate count experiments on glyphosate treated and untreated soil extracts revealed no significant difference in the microbial population or type. Additionally, the rate of microbial degradation of radiolabeled sucrose was found to be unaffected by the presence or absence of glyphosate (Goure, undated).

The environmental fate of glyphosate in soil under typical field use conditions has been extensively evaluated by both Monsanto and independent investigators. The results of these studies demonstrate that glyphosate and its major metabolite, AMPA, are tightly bound to the soil, display very little, if any, potential for leaching, and dissipate with half-lives in all cases of less than one year, and typically less than 60 days. Studies have also demonstrated that glyphosate does not accumulate following multiple applications, either during the same year or over several years, and that there is little, if any, potential for off-site movement due to runoff (Monsanto, 1993, Goure, undated, Smith, 1992).

12.8.3 Plants

A listing of some residual concentration of glyphosate on or in plant materials is on Table 12-4. Glyphosate is absorbed into the plant tissue at a rate of 34% over the first 4 hours after application (Smith, 1992) followed by a gradual decrease in absorption over the next two days. However, although glyphosate is being absorbed into the plant tissue, it is not degraded while it is within the plant. Degradation of absorbed glyphosate does not occur until after death and decomposition.

12.8.4 Fish

Studies have been conducted on the residual levels of glyphosate in fish tissue, and most of those conducted have not detected any residuals at all. Latka (1992) has concluded that unlike plant tissue, residuals are not found in fish because there is no affinity between the glyphosate molecule and the typically lipophilic fish tissue. Because of the high water solubility and affinity to sediment particles, any glyphosate will pass unchanged through the mouth or gills, remaining either in solution or adsorbed to suspended particulates.

According to a study conducted by Sacher (1978), tissue samples collected from channel catfish (Ictalurus punctatus), largemouth bass (Micropterus salmoides), and rainbow trout exposed to 10 mg of glyphosate/l for 14 days contained 0.55, 0.12, and 0.11 mg of glyphosate/kg of wet weight, respectively.

Residual levels of glyphosate and its metabolites were studied by Newton et al. (1984) after the aerial treatment of a forest ecosystem with 3.3 kg/ha of glyphosate. A nearby stream was evaluated for residues within the water column and fingerling coho salmon (Oncorhynchus kisutch). The peak concentration of glyphosate residue in water was 0.27 mg/l, but sediment concentrations were higher. Coho salmon fingerlings taken from the vicinity of the water sample location were analyzed but showed no detectable concentrations of either glyphosate or AMPA.

12.8.5 Mammals

Following oral administration of glyphosate to rats, only 30% to 36% of the administered glyphosate is absorbed. Glyphosate is almost completely eliminated unchanged in the urine and feces. The frequency of administration does not appear to have any effect on the metabolic processes involved in glyphosate elimination (Smith, 1992).

12.8.6 Bioaccumulation/Biomagnification

As noted above, the chemical characteristics of glyphosate and its metabolites are such that they are not expected to bioaccumulate in animal tissue. This is due primarily to their high water solubilities and extremely low octanol/water partition coefficients (log K_{ow} = -1.60) (Montgomery, 1993). A bioconcentration of 1.0 means that there is the same concentration of a molecule in the fish tissue as there is in the surrounding water. Bioconcentration factors in

TABLE 12-4

PESTICIDE RESIDUE ON PLANTS

Vegetation	Typical Limit (mg/kg)	Upper Limit (mg/kg)
Fruits	6	28
Pods (legumes)	12	48
Forage (clover)	132	232
Leaves/leafy crops	140	500
Grass (long)	368	440
Range grass (short)	500	960

Reference: Latka, 1992

various studies range from a low of 0.1 to a high of 0.3 (Monsanto, 1990). As noted in Section 5.7.3, Sacher (1978) collected tissue samples from three fish species exposed to 10 mg/g of glyphosate for 14 days. These three species contained no more than 0.55, 0.12, and 0.11 mg/g of glyphosate, respectively. This equates to a bioconcentration factor of 0.18 (Sacher, 1978).

No residues were detected in fillet or eggs collected from rainbow trout exposed to 2.0 mg/l of glyphosate for 7 days (Folmar et al., 1979). This same study found that no detectable levels of glyphosate or its metabolites were found in midge larvae exposed to the same concentration.

12.9 GLYPHOSATE RESIDUE TOLERANCES

The following residue tolerances have been established in accordance with applicable federal regulations.

12.9.1 Water

USEPA (1992a) has established the MCL for glyphosate at 700 ug/l, based upon a Drinking Water Equivalent Level of 105 mg/l (derived from a reference dose of 3.5 mg/kg/day) (USEPA, 1992a). The MCL is the level considered protective of a person who in theory may drink water at that level of contamination every day for his/her lifetime. There have been no water use restrictions placed on surface waters treated by glyphosate. Rodeo/Accord cannot be applied within 1/2 mile upstream of a potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 mile of a potable water intake in a standing body of water such as a lake, pond or reservoir. No use or application restrictions have been placed on glyphosate with respect to potable water wells, or for terrestrial applications near potable water intakes.

12.9.2 Fish/Shellfish

The USEPA, in 40 CFR 180.368(b), has established a residue tolerance level for glyphosate and its primary metabolite, AMPA, at 0.25 and 3.0 mg/kg for fish and shellfish, respectively.

12.9.3 Crops/Agricultural Products

The USEPA, in 40 CFR 180.368(a), has established the following residue tolerance levels for glyphosate and its primary metabolite, AMPA, in agricultural commodities based upon direct application of the herbicide:

Commodities	Parts per million
Acerola	0.2
Alfalfa	200.0
Alfalfa, fresh and hay	0.2
Almonds, hulls	1.0
Artichoke, Jerusalem	0.2
Asparagus	0.5

Commodities (Cont.)	Parts per million
Atemoya	0.2
Avocados	0.2
Bahiagrass	200.0
Bananas	0.2
Beets	0.2
Beets, sugar	0.2
Bermudagrass	200.0
Bluegrass	200.0
Breadfruit	0.2
Bromegrass	200.0
Canistel	0.2
Carambola	0.2
Carrots	0.2
Cherimoya	0.2
Chickory	0.2
Citrus fruits	0.2
Clover	200.0
Cocoa beans	0.2
Coconut	0.1
Coffee beans	1.0
Cotton, forage	15.0
Cotton, hay	15.0
Cottonseed	15.0
Cranberries	0.2
Dates	0.2
Fescue	200.0
Figs	0.2
Forage grasses	0.2
Forage legumes (excl. soybean and peanut)	0.4
Fruits, small and berries	0.2
Genip	0.2
Grain crops	0.1
Grapes	0.2
Grasses, forage	0.2
Guavas	0.2
Horseradish	0.2
Jabotacaba	0.2
Jackfruit	0.2
Kiwifruit	0.2
Leafy vegetables	0.2
Longan	0.2
Lychee	0.2
Mamy sapote	0.2

Commodities (Cont.)	Parts per million
Mangoes	0.2
Nuts	0.2
Olives	0.2
Orchardgrass	200.0
Papayas	0.2
Parsnips	0.2
Passion fruit	0.2
Peanut, forage	0.5
Persimmons	0.2
Pineapple	0.1
Pistachio nuts	0.2
Pome fruits	0.2
Pomegranates	0.2
Potatoes	0.2
Radishes	0.2
Rutabagas	0.2
Ryegrass	200.0
Salsify	0.2
Sapodilla	0.2
Sapote, black	0.2
Sapote, white	0.2
Seed and pod vegetables	0.2
Seed and pod vegetables, forage	0.2
Seed and pod vegetables, hay	0.2
Soursop	0.2
Soybeans	20.0
Soybeans, forage	15.0
Soybeans, hay	15.0
Stone fruit	0.2
Sugar apple	0.2
Sweet potatoes	0.2
Tamarind	0.2
Timothy	200.0
Turnips	0.2
Vegetables, bulb	0.2
Vegetables, cucurbit	0.5
Vegetables, fruiting group	0.1
Vegetables, leafy, Brassica	0.2
Wheatgrass	200.0
Yams	0.2

The USEPA, in 40 CFR 180.368(c), has established the following residue tolerance levels for glyphosate and its primary metabolite, AMPA, in agricultural commodities based upon irrigation with water containing residues of 0.5 ppm of herbicide:

Commodities	Parts per million
Avocadoes	0.1
Citrus fruits	0.1
Cottonseed	0.1
Cucurbits	0.1
Forage grasses	0.1
Forage legumes	0.1
Grain crops	0.1
Hops	0.1
Leafy vegetables	0.1
Nuts	0.1
Pome fruits	0.1
Stone fruit	0.1
Vegetables, fruiting group	0.1
Vegetables, root crop	0.1
Vegetables, seed and pod	0.1
Wheatgrass	0.1
Yams	0.1

Additional residue tolerances have been established in 40 CFR 180.368(b) for the following agricultural commodities:

Commodities	Parts per million
Cattle, kidney	0.5
Cattle, liver	0.5
Goats, kidney	0.5
Goats, liver	0.5
Hogs, kidney	0.5
Hogs, liver	0.5
Horses, kidney	0.5
Horses, liver	0.5
Poultry, kidney	0.5
Poultry, liver	0.5
Sheep, kidney	0.5
Sheep, liver	0.5

13.0 SIGNIFICANT ENVIRONMENTAL IMPACTS ASSOCIATED WITH THE AQUATIC HERBICIDES RODEO®/ACCORD®

Rodeo and Accord are both spectrum herbicide formulations. To be effective the herbicides must be directly applied to the foliage of the target plant. Depending on the method of application and/or timing of application, the herbicides can be selective or non-selective. For example, directed spraying equipment, such as a back-pack sprayer, can be selective for only those plants sprayed, whereas a broadcast spray has the opportunity under certain conditions to be non-selective since some non-target plants may be treated.

Any time a pesticide is used to alter the environment (reduce insect populations, control weeds, etc.) there is the potential for undesirable effects on non-target species. The effects of glyphosate on non-target organisms has been extensively tested during the FIFRA registration and reregistration process. These studies support the judgement that there is no direct threat to animal when these herbicide formulations are applied at the manufacturers recommended application rates. Several independent studies have indicated that application of glyphosate herbicides were not toxic to waterfowl, mammals, fish, terrestrial, and aquatic invertebrates. The following sections discusses the potential direct and indirect impacts to nontarget organisms from the use of Rodeo® and Accord® herbicides in NYS.

The most frequently used method of assessing ecological risk or environmental impacts is to compare toxicity information with potential or actual environmental exposure. Toxicity information is typically collected in the laboratory using surrogate species and using uncertainty factors for extrapolation. Information on exposure concentration is estimated using worst case application scenarios or by collecting data in situ after application. The risk assessments are generally done for aquatic organisms and terrestrial wildlife. A tier system is used so that the extent of testing is decided by the degree of risk associated with the use of the product.

In general, Rodeo and Accord are less toxic than commercial grade glyphosate on a per weight basis. The most sensitive freshwater species is the rainbow trout with a 96-hour LC_{50} of 86 mg/l for glyphosate. The maximum environmental concentration (EC) that has been observed for glyphosate was 1.7 mg/l (Section 12.8.1). The actual exposure concentration integrated over a particular exposure time will likely be less, since glyphosate has a typical half-life of 1.5 to 14 days in water. USEPA estimates that minimal acute ecological risk occurs when the EC is less than 1/10 the LC_{50}. Since 1.7 mg/l is less than 8.6 mg/l (1/10 of 86 mg/l), then minimal acute risk to freshwater aquatic organisms is assumed.

Terrestrial ecological risk assessments are generally performed using avian species. The lowest acute LC_{50} for avian species was greater than 4,640 mg glyphosate/kg of diet, which was the no effect level. Based on a maximum application rate of 11.7 l/ha (10.4 lbs/acre) and using USEPA's method of determining the Estimated Exposure Concentrations (EEC) in wildlife foods (USEPA, 1986b), an EEC of 1,000 mg glyphosate/kg food is obtained. For avian species, USEPA estimates that minimal acute ecological risk occurs when the EEC is less than 1/5 the

LC_{50}. Although an LC_{50} was not determined, minimal risk is assumed since the no effect level (4,640 kg/kg diet) was 4.6 times the maximum EEC.

The risk that herbicides pose to non-target plants is more complicated since phytotoxic qualities are required for a successful product. Consequently, USEPA distinguishes between phytotoxic effects in the target area versus the non-target area (USEPA, 1986b). The reason for the distinction is because efficacious broad spectrum herbicides will likely cause some phytotoxic effects in species other than the species to be controlled. For example, an ecological risk assessment for a target aquatic ecosystem treated with Rodeo® would reveal that the maximum exposure concentration (1.7 mg/l) exceeds the toxicity level for the most sensitive aquatic plant (marine diatom EC50 = 0.64 mg/l). Since some undesired phytotoxicity is expected in the target area, USEPA has distinguished between acceptability of effects in the target site compared to acceptability of effects outside the treated area (non-target area). Glyphosate rapidly declines in the aquatic ecosystem through biodegradation and sorption to suspended solids and sediment. Therefore, significant effects on plants outside the target area are not likely.

13.1 DIRECT AND INDIRECT IMPACTS TO NON-TARGET SPECIES

Rodeo® herbicide is formulated as broad-spectrum herbicide for use in the management of invasive emergents in aquatic and semiaquatic environments. Accord® herbicide is formulated as a broad spectrum herbicide for use in the control of vegetation in forestry management and utility rights-of-way maintenance, particularly in situations where this control involves areas containing wetlands and open water areas. As a chemical introduced into the environment, glyphosate, the active ingredient in Rodeo® and Accord® herbicides, has the potential to produce both direct and indirect effects on non-target species. Direct effects to non-target plant species could vary depending on the herbicide rate to which the species is exposed, and the growth stage of the plant species. Direct adverse impacts to animal species is not expected for labelled applications of Rodeo/Accord. Indirect effects for plants species may include reduction in population size, changes in community structure, and potential changes in ecosystem function. Accordingly, animal species composition and distribution may also vary depending on the changes in the plant community. These changes should be considered and proper steps (i.e., native plant regeneration) should be encouraged to restore more desirable native plant habitat.

Indirect effects are not always negative, and in many cases are desired. The control of an invasive emergent weeds with glyphosate herbicides may result in the reintroduction of the native plant community. These changes in the community structure could be construed as an "impact". The connotation of negative must be examined in light of the management objectives for the use of the product in the waterbody. Additionally, a cost/benefit analysis must be conducted to compare the potential detriments caused by loss of target and non-target plant species with the potential benefits derived from the control of target species, particularly when the target species is reducing biological diversity within the aquatic or semi-aquatic ecosystem. The prevention of possible long-term ecological impacts from the introduction of the exotic may be worth the potential short-term impacts to non-target species. Again, this is an issue that should be assessed based on a evaluation of the waterbody of concern.

Measuring the direct effects a herbicide has on individual species within an ecosystem can be accomplished through a variety of acute and chronic toxicity studies; however, the secondary or indirect effects of a herbicide are less clear and require careful consideration. In order to more positively evaluate the potential for indirect impacts to non-target species, it will be necessary to perform a site assessment of the ecosystem on which Rodeo® and Accord® herbicides are to be applied. Such an assessment would describe the indigenous plant communities as well as the communities of fish and wildlife. Further, such an assessment would address whether a rare, threatened, or endangered species is present in the ecosystem, requiring even more careful consideration when developing the overall management plan, as discussed in previous sections. Such an assessment would be part of the development of an individual permit.

The direct toxicity of glyphosate based herbicides has been assessed using laboratory toxicity tests. The results of tests referenced in this section will be characterized according to the risk phases established by Christenson (1976) as follows:

EC or LC_{50}	Classification
< 1 mg/l	Highly Toxic
1 - 10 mg/l	Moderately Toxic
10 - 100 mg/l	Slightly Toxic
100 - 1,000 mg/l	Practically Non-toxic
> 1,000 mg/l	Insignificant Hazard

13.1.1 Macrophytes and Aquatic Plant Communities

Because Rodeo® and Accord® herbicides are broad-spectrum herbicides, impact to nontarget species is nearly inevitable. The mechanism necessary to prevent the widespread impacts to non-target species rests in the method of application, broadcast spraying from an aircraft being less accurate than application with a hand held sprayer. However, the need for precision will be defined by the objective and the particular ecosystem being targeted. A monotypic stand of phragmites on a large lake or estuary will require less precision than would pockets of purple loosestrife in a small pond. Likewise, application of Accord® herbicides in a utility right-of-way can be easily targeted from the air by spraying during favorable climatic conditions, nozzle selection, and the use of drift retardants to minimize impacts to bordering vegetation.

Application of Rodeo® herbicide to emergent vegetation in an aquatic setting requires less care for the protection of submerged macrophytes than it does for protection of desirable floating or emergent macrophytes. Because of the high solubility and sediment affinity of glyphosate, it is unavailable for absorption by the submerged portions of plant species; therefore, submerged vegetative species are unaffected by glyphosate (Scrivener and Carruthers, 1987). Under similar circumstances, care must be taken to avoid contact with fringe upland plants. The loss of these plants could result in increased erosion and bank instability (WSDOE, 1992).

Although Rodeo® herbicide is effective in the control of most emergents and a large number of floating weeds, there are certain floating species which are resistant. Barret (1985) reports that two species, Potamogeton natans and Nymphoides peltata, showed signs of leaf scorching after exposed to glyphosate (the form of the glyphosate solution was not indicated). New leaves, however, replaced the scorched ones and the plants recovered fully. Species of floating plants considered susceptible to glyphosate solutions are presented in Table 13-1.

Control of nuisance macrophytes with herbicides such as Rodeo® and Accord® herbicides should be part of an overall management plan to insure that the objectives of the control are met over a long period of time. If a control measure results in the eradication of a nuisance weed, such as phragmites, but is not followed up by close monitoring or mitigation, the result could be the reinvasion of the treatment area by a different undesirable invasive species, such as purple loosestrife, as early as the following growing season. The management plan is particularly important when the objective is the control of large monotypic stands of phragmites, cattails, or purple loosestrife due to the potential for simultaneous die-off. This die-off could result in oxygen depletion due to rapid decomposition of organic matter, typical of advanced eutrophication. Oxygen depletion can result in fish kills and the proliferation of microfauna and flora which are harmful to waterfowl (WSDOE, 1992). Where large stands of macrophytes exist, the manufacturer recommends treating in strips where no more than 1/3 of the area is treated at one time to avoid oxygen depletion.

Finally, application rate and timing should be carefully considered when developing the management plan. If the target species are annual weeds, application should be conducted early in the growing season at the lowest recommended rates. This procedure will have less effect on perennial weeds or woody species. Likewise, application to control perennial weeds should be conducted late in the growing season at applicable rates. This will reduce the impact on annuals that have already seeded since glyphosate does not have a significant effect on seeds.

13.1.2 Algal and Planktonic Species

Numerous studies have been conducted on the effects of glyphosate on aquatic microflora and fauna. In the majority of cases, researchers concluded that at the recommended application rates, no adverse environmental effects were observed in algae or diatoms. This rate of application is based on the maximum allowable concentration in surface water of 0.5 mg/l as prescribed by USEPA (1986b). As detailed in Section 12.8, concentrations are expected to be much less.

The Monsanto Toxicology Information Summary (Monsanto, 1991) lists the 96-hour EC_{50} concentration for Skeletonema sp. as 1.2 ppm and the 7-day EC_{50} concentration for Skeletonema sp. as 0.64 mg/l. Goldsborough and Brown (1987) hypothesized that a rate of 2.5 l/ha of undiluted glyphosate applied directly to a pond would result in a water concentration of from 0.06 to 0.1 mg/l. Based on toxicity studies on periphytic algae, no observed adverse environmental effects occurred at any concentrations below 0.89 mg/l.

TABLE 13-1

AQUATIC MACROPHYTE SPECIES SUSCEPTIBLE TO GLYPHOSATE

Eichhornia crassipes	Water Hyacinth
Lemna spp.	Duckweed
Nelumba lutea	American Lotus
Nuphar advena	Spatterdock
Nuphar lutea	Yellow Cow-lilly
Nymphaea alba	European White Water-lilly
Nymphaea odorata	Fragrant Water-lilly
Pistia stratiotes	Water Lettuce
Polygonum amphibium	Water Smartweed
Salvinia spp.	Water Moss

Source: Barret, 1985

Data on four species of algae and diatoms were accumulated by Heydens (1991) to compare the range of toxicity between freshwater and marine species. This study involved the development of EC_{50} data on growth inhibition of the various species exposed to varying concentrations of undiluted glyphosate over a 7-day period. The results, listed in the table below, illustrate that the marine diatom (Skeletonema costatum) was the most sensitive species with a 7-day EC_{50} of 0.64 mg/l. This concentration is well above the expected maximum water concentration of Rodeo® or Accord® herbicides over the same time period.

Species	EC_{50} (mg/l)
Selenastrum capricornutum (Freshwater Algae)	13.8
Navicula pelliculosa (Freshwater Diatom)	42.0
Skeletonoma costatum (Marine Diatom)	0.64
Anabaena flos-aquae (Freshwater Blue-green Algae)	15.0

13.1.3 Fish, Shellfish and Aquatic Macroinvertebrates

As noted in Section 12.8.1, the potential concentration of glyphosate in surface water is dependant on several variables, including application rate, surface area of open water, depth of water, and flow of water. These factors combined with the natural dissipation and degradation rates will determine the potential exposure of aquatic organisms to glyphosate. Henry (1992) conducted a study on the effects of Rodeo® herbicide on several fish and aquatic macroinvertebrates. An aerial application of 5.8 l/ha of Rodeo® herbicide was applied to cattail stands in four different wetlands. Water samples collected at 12 hours and 8 days after application revealed extremely low levels of glyphosate in solution. The data indicated that at 12 hours after application glyphosate was present in surface water at concentrations ranging from 0.28 to 0.6 mg/l, and at 8 days after application glyphosate was present in surface water at concentrations ranging from non-detect (at a detection limit of 0.1 ug/l) to 0.49 ug/l.

The majority of research conducted on the toxicity of glyphosate containing compounds on aquatic fauna has involved either Roundup® (a mixture of glyphosate, water and the surfactant MONO818) or an undiluted form of glyphosate (i.e., either technical glyphosate or its isopropylamine salt). The majority of these studies have found that glyphosate herbicides are not toxic to aquatic organisms when applied at the prescribed rates. The only organism found to be sensitive to glyphosate at a concentration less than the 3.7 mg/l, as presented in the hypothetical model, was a species of marine diatom (Skeletonema costatum) with an EC_{50} of 0.64 mg/l (Heydens, 1991). This EC_{50} concentration was based upon a 7-day exposure period in stagnant conditions. Under normal field conditions, the glyphosate concentration over this 7-day period would drop off dramatically, with dilution, dissipation, and degradation being the significant fate factors.

As noted above, Henry (1992) studied the toxicity of Rodeo® herbicide on a number of fish and aquatic macroinvertebrate species. This study also compared the toxicities of the Rodeo® herbicide with those of a surfactant (Valent X-77 Spreader) and a field application of the Rodeo® herbicide and surfactant (0.5% surfactant) combined. Her findings indicated that the Rodeo®

herbicide was practically non-toxic to all organisms tested and that the field application mixture of Rodeo® herbicides and surfactant was also practically non-toxic. The results of these investigations are listed in Table 13-2.

Mitchell et.al. (1987) conducted acute and chronic toxicity studies on chinook and coho salmon. Exposed to a test mixture of Rodeo, surfactant and water for 96 hours, these salmon species were found to have acute LC_{50} values ranging from 600 to 1,440 mg/l. The estimated maximum water concentrations utilized (i.e., 0.27, 0.6 or 3.7 mg/l), showed there is essentially no threat of acute toxicity to salmon at recommended application rates of Rodeo® and Accord® herbicides. In the same study, Mitchell et al. (1987) exposed coho salmon smolts to concentrations of Roundup® ranging from 0.29 to 2.78 mg/l (0.12 to 0.99 mg/l glyphosate) for a period of 10 days in fresh water. These smolts were later placed into salt water to determine whether their ability to adapt to the change in environment expected during the migration to the ocean would be impaired. The results indicated that no adverse effects were observed.

Additional toxicity studies for Rodeo® herbicide and glyphosate have been conducted on a variety of freshwater and marine organisms by Monsanto (1993) (Table 13-3). All of the studies indicated that Rodeo and glyphosate were practically non-toxic, except for glyphosate concentrations in trout and Atlantic oyster (Crassostrea virginica) at 86 and >10 mg/l, respectively. These values were considered slightly toxic. The study conducted on the Atlantic oyster showed no observed adverse effects for developmental abnormalities within the fertilized egg at a concentration of 10 mg/l. This value represents the level at which no adverse effects were observed, and should not be considered an LC or EC_{50}. Rodeo® herbicide applied at its recommended rate is not expected to cause any adverse effects on either the Atlantic oyster or the trout, particularly when dilution, dissipation, and degradation factors are considered based upon their respective habitat characteristics.

Some of the indirect impacts of glyphosate based herbicide treatment of aquatic macrophytes on invertebrates were investigated by Solberg (1989). In this investigation, invertebrate populations in monotypic cattail stands were studied before and after treatment with the Rodeo® herbicide. The results of the investigation concluded that the population density had not changed but the diversity had. This type of change is potentially beneficial to the ecosystem because it can potentially lead to increased diversity in other species at different trophic levels as well.

Although there were no studies located regarding the effects of Rodeo and Accord treatments on fish habitat, several assumptions can be made. If the macrophyte population consists of monotypic stands of cattail or phragmites, there will be little habitat value to fish due to the density of the rhizome mat typical of these types of stands. By controlling these stands of vegetation and allowing the reintroduction of other emergent species, habitat can improve resulting in increased diversity in fish species.

13.1.4 Avian Species

The EPA has classified glyphosate as being "slightly toxic" to birds based upon an acute oral LD_{50} of >4640 mg/kg in quail and 8-day dietary LC_{50} values of >4640 for both bobwhite quail

TABLE 13-2

SURFACTANT TOXICITY TESTS RESULTS

SPECIES	TEST	EC50 or LC50 (mg/L)	95% C.I. (LL-UL)
Daphnid	Rodeo® herbicide individually Field application mixture X-77 individually	545 130 2	(436-680) (93-182) (1.4-2.6)
Midge	Rodeo® herbicide individually Field application mixture X-77 individually	1308 293 10	(1035-1652) (208-414) (4-7)
Scud	Rodeo® herbicide individually Field application mixture X-77 individually	727 213 6	(554-953 180-252) (4-7)
Wild Scud	Field application mixture	116	(83-162)
Snail	Field application mixture	242	(195-301)
Leech	Rodeo® herbicide individually Field application mixture[a] X-77 individually	1157 201 11	(907-1474) (154-264) (8-16)
Minnow	Field application mixture	127	(100-161)

[a]: These animals were tested in 15 L of solution instead of 3 L as the other leeches were.

Notes: 95% C.I. = 95% Confidence Interval
LL-UL = Lower Limit to Upper Limit

Reference: Henry, 1992

TABLE 13-3 ENVIRONMENTAL TOXICITY DATA	
Rodeo® Herbicide:	
96 hr. LC_{50} Bluegill Sunfish	= >1000 mg/l, practically nontoxic
96 hr. LC_{50} Trout	= >1000 mg/l, practically nontoxic
96 hr. LC_{50} Carp	= >10,000 mg/l, practically nontoxic
48 hr. LC_{50} Daphnia magna	= 930 mg/l, practically nontoxic
Glyphosate:	
96 hr. LC_{50} Bluegill Sunfish	= 120 mg/l, practically nontoxic
96 hr. LC_{50} Trout	= 86 mg/l, slightly toxic
96 hr. LC_{50} Carp	= 115 mg/l, practically nontoxic
48 hr. LC_{50} Daphnia magna	= 780 mg/l, slightly toxic
48 hr. TL_{50} Atlantic Oyster	= >10 mg/l, slightly toxic
96 hr. LC_{50} Shrimp	= 281 mg/l, practically nontoxic
96 hr. LC_{50} Fiddler Crab	= 934 mg/l, practically nontoxic
96 hr. LC_{50} Harlequin Fish	= 168 mg/l, practically nontoxic

Reference: Monsanto, 1993

and mallard duck (Grover, 1988). In these investigations the bobwhite quail (Colinus virginianus) and mallard (Anas platyrhynchus) were studied for behavioral abnormalities as well as acute toxicity. The only behavioral abnormality observed involved a transitory lethargy one day after treatment at the highest treatment dose (4,640 mg/kg).

Reproductive studies were also conducted on the bobwhite quail and mallard (Grover, 1988) to determine whether exposure to dietary concentrations of 1,000 mg/kg of glyphosate had any effect on the number of eggs laid, eggs cracked, egg shell thickness, viable embryos, normal hatchlings, and post-hatching growth and survival. This study did not reveal any adverse effects in any of these categories. Like fish and invertebrates, the indirect effects of the use of Rodeo® herbicide on monotypic stands of cattail, phragmites, and purple loosestrife can be beneficial. The net result of reducing the extent of these monotypic stands of vegetation is increased open water space, increased diversity in aquatic insects and increased diversity in indigenous emergent macrophytes, according to studies conducted by Solberg (1989). All of these factors will lead to an increased utilization of the waterbody by breeding pairs of waterfowl.

An indirect impact of glyphosate herbicides on monotypic stands of cattail and phragmites also has an important economic impact. These stands of vegetation tend to attract large flocks of migrating blackbirds for nesting and roosting purposes. In many parts of the country these flocks have a tendency to destroy large amounts of nearby agricultural crops. This is particularly true of sunflower crops located in the Dakotas. Linz (1992) has pointed out that between 10 and 20% of a sunflower crop can be destroyed by blackbirds nesting or roosting in a nearby wetland containing monotypic stands of cattails. The use of Rodeo® herbicides to control these stands will help reduce the over population of these birds in a single area, thereby, reducing their economic as well as environmental impacts.

13.1.5 Mammals

There is a large body of information on the toxicological effects of glyphosate containing herbicides on mammals. In all cases the acute toxicity was very low (Table 13-4). A listing of some common chemicals follows in Table 13-5 as a relative reference.

Chronic toxicity studies (Monsanto, 1993) also indicate minimal toxicological effects from the oral administration of glyphosate. Glyphosate was fed to rats and mice for their lifetimes and to dogs for two years. These studies revealed no evidence of carcinogenicity, and USEPA has classified glyphosate as "Category E". This is the most favorable category classification for a pesticide active ingredient and indicates evidence of noncarcinogenicity to humans.

Several investigations have been conducted to determine the effects of glyphosate containing herbicides on habitat utilized by mammals. Barrett (1985) found that black-tailed deer (Odocoileus hemionus) did not change browsing habits due to glyphosate treated vegetation and showed no adverse effects from its consumption. Several studies conducted on populations of rodents such as deer mice (Peromyscus maniculatus), Oregon voles (Microtus oregoni), Townsend's chipmunk (Eutamias townsendi), and shrews (Sorex spp.) decrease shortly after spraying of glyphosate containing herbicides. These investigations, however, have determined

TABLE 13-4 ACUTE TOXICOLOGICAL DATA	
Rodeo® Herbicide:	
Oral LD_{50} (Rat)	>5000 mg/kg, practically nontoxic
Dermal LD_{50} (Rabbit)	>5000 mg/kg, practically nontoxic
Eye Irritation (Rabbit)	(FHSA) Score = 0.0 on a scale of 110.0, practically nonirritating
Skin Irritation (Rabbit)	(FHSA) Score = 0.1 on a scale of 8.0, practically nonirritating
Glyphosate:	
Oral LD_{50} (Rat)	5600 mg/kg, practically nontoxic
Dermal LD_{50} (Rabbit)	>5000 mg/kg, practically nontoxic
Eye Irritation (Rabbit)	(FHSA) Score = 29 on a scale of 110.0, severely irritating
Skin Irritation (Rabbit)	(FHSA) Score = 0.1 on a scale of 8.0, practically nonirritating

Reference: Monsanto, 1983

TABLE 13-5

APPROXIMATE TOXICITY VALUE FOR OTHER COMMON CHEMICALS RELATIVE TO RODEO/ACCORD

COMPOUND	LD50
Glyphosate	>5,000 mg/kg*
Table Salt	3,000 mg/kg
Vitamin A	2,000 mg/kg
Aspirin	1,000 mg/kg
Caffeine	164 mg/kg
Nicotine	53 mg/kg

* For oral exposure to rats

that the change in population is due to loss of habitat due to death of vegetation rather than to direct toxicological effects. The lowering of the population was the result of migrational movement of the organisms from the area of reduced vegetative cover and that normal populations are restored once vegetative cover approaches preapplication levels (Barrett, 1985). Sullivan (1988) noted that habitat treated with glyphosate supported more breeding deer mice (Peromyscus maniculatus) than the control habitat.

13.1.6 Reptiles and Amphibians

A recent paper prepared for the US Department of Agriculture (USDA, 1989), determined LD_{50} concentrations for several amphibian species to glyphosate. The results were:

Rough-skinned newt (Taricha granulosa)	1250 mg/kg
Ensatina salamander	1070 mg/kg
Tailed frog (Ascaphus truei)	>2000 mg/kg
Western red-back salamander (Plethodon vehiculum)	1170 mg/kg
Pacific giant salamander (Dicamptodon ensatus)	<2000 mg/kg

These results would indicate that glyphosate is practically non-toxic to amphibians. No information was identified in the literature concerning the potential for impacts to reptiles from the exposure to glyphosate. However, based on a physiological comparison of reptiles to amphibians and the preceeding LD_{50} values for amphibians, the potential for impacts to reptiles is considered negligible.

13.1.7 Federal and State Listed Rare, Threatened, and Endangered Species

Endangered species are those organisms faced with extinction in all or much of their distribution. Threatened species are those organisms that seem likely to become endangered. Rare species are those organisms which have widely scattered populations or are few in number. These organisms are rare for a variety of reasons, including changes in habitat (both natural and man-made), at the extent of its geographical range, and predation pressure. Federal identified species are listed under the 50 CFR § 17.11 and § 17.12. State listed species are identified in NYCRR § 193.3.

USEPA (1986b) notes that acute aquatic toxicity values and Maximum Allowable Toxic Concentrations (MATC's) suggest that potential hazards to aquatic organisms would only be seen at sustained concentrations higher than labeled application rates. However, there is still a possibility that rare, threatened, and endangered species, especially aquatic macrophytes, may be susceptible to Rodeo® and Accord® herbicides. Possible impacts to such species could either be direct toxicity or indirect impacts such as changes in habitat. Identification of any rare, threatened, or endangered species should be made in the site specific evaluation as part of a permit application. A partial listing of rare plants in NYS, as discussed in Mitchell and Sheviak (1981), is presented in Table 13-6.

TABLE 13-6

PARTIAL LISTING OF AQUATIC RARE PLANTS OF NEW YORK STATE

Common Name	Scientific Name	Possible Location (by county)
Auricled twayblade	Listera auriculata	Lewis, Warren
Calypso	Calypso bulbosa	Genessee, Herkimer, Jefferson Lewis, Oneida, Onondaga, Oswego, St. Lawrence, Schenectady
Climbing fern	Lygodium palmatum	Chenango, Greene, Oneida, Onondaga, Saratoga
Crest fringed orchid	Platanthera cristata	Suffolk
Curly grass	Schizaea pusilla	Suffolk
Featherfoil	Hottonia inflata	Jefferson, Nassau, Richmond, Rockland, Suffolk
Globeflower	Trollius laxus	Bronx, Cayuga, Chautauqua, Erie, Genesee, Herkimer, Livingston, Madison, Monroe, Oneida, Onondaga, Ontario, Orange, Otsego, Rockland, Schenectady, Schuyler, Sullivan, Tompkins, Ulster, Westchester, Wyoming
Heartleaf Plantain	Plantago cordata	Albany, Bronx, Columbia, Dutchess, Greene, New York, Ulster
Hill's Pondweed	Potamogeton hillii	Columbia, Dutchess, Tompkins, Washington
Long's Bittercress	Cardamine longii	Suffolk

TABLE 13-6 (CONTINUED)

Common Name	Scientific Name	Possible Location (by county)
Lowland fragile fern	Cystopteris protrusa	Erie, Richmond, Suffolk
Micranthemum	Micranthemum micranthemoides	Dutchess
Northern bulrush	Scirpus ancistrochaetus	Washington
Pale Beakrush	Rhynchospora pallida	Suffolk
Prairie white-fringed orchid	Platanthera leucophaea	Niagara, Onondaga, Oswego, Wayne
Quill-leaved arrowhead	Sagittaria teres	Suffolk
Ram's-head Ladyslipper	Cypripedium arietinum	Albany, Clinton, Essex, Fulton, Herkimer, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Otsego, Schenectady, Warren, Wayne
Round-leaved orchid	Amerorchis rotundifolia	Herkimer, Lewis
Slender marsh bluegrass	Poa paludigena	Bronx, Chemung, Lewis, Monroe, Wayne, Tompkins
Small white ladyslipper	Cypripedium candidum	Erie, Genesee, Livingston, Onondaga
Small whorled pogonia	Isotria medeoloides	Nassau, Onondaga, Rockland, Suffolk, Ulster, Washington
Striped coralroot	Corallorhiza striata	Lewis, Madison, Monroe
Torrey's muhly	Muhlenbergia torreyana	Suffolk

13.1.8 Biodiversity Sites

The use of Rodeo®/Accord® herbicides has the potential for impacting rare, threatened, or endangered species. Information on the known location of rare species and significant natural communities can by obtained from the NYS Natural Heritage Program, which maintains a database on those resources. A determination of whether the proposed location of a Rodeo/Accord herbicides application would occur in one of these areas should be made through the Natural Heritage Program as part of the site specific evaluation as part of a permit application.

13.2 POTENTIAL FOR IMPACT FROM THE ACCUMULATION/DEGRADATION OF TREATED PLANT BIOMASS ON WATER QUALITY

The control of aquatic plants in the water column can negatively impact Dissolved Oxygen (DO) levels in the waterbody as a result of the biological degradation of the organic material. This can impact the fish populations in the surrounding area. No research has been specifically conducted on the possibility of deoxygenation due to rapid degradation, however several authors have mentioned it as a concern (Linz, 1992). Sacher (1978) reports that deoxygenation is not likely due to the use of Rodeo® herbicide due to the relatively slow mode of herbicidal action. To reduce the possibility of this type of deoxygenation, the Washington State Department of Ecology (WSDOE, 1992) suggests a phased approach in the destruction of these monotypic stands. They also suggest that portions of these stands remain to provide habitat for existing organism prior to the reemergence of new indigenous vegetation. The manufacturer recommends treating in phases (strips) if a majority of the waterbody is infested.

To further ensure that the accumulation of dead plant matter does not result in deoxygenation of the waterbody, several authors (WSDOE, 1992; Jones, 1985; Jones, 1990) have suggested that the dying emergent plant parts be burned off. This is particularly useful in the management of phragmites, cattails, and purple loosestrife due to the large amount of biomass created. This burn-off procedure has the added benefit of improving access for reinvasion of indigenous macrophytes and for humans to conduct a second treatment if necessary. Burning vegetation has direct and indirect environmental impacts (i.e., smoke) which should also be considered.

13.3 IMPACT OF RESIDENCE TIME OF RODEO®/ACCORD® HERBICIDES IN THE WATER COLUMN

As discussed in the previous sections, Rodeo® and Accord® herbicides dissipate and degrade very rapidly in aquatic systems. They also dilute very rapidly in flowing or deep bodies of water. Therefore, it is not anticipated that the residence time in the water column would alter the projected impacts that have been discussed.

13.4 RECOLONIZATION OF NON-TARGET PLANTS AFTER CONTROL OF TARGET PLANTS IS ACHIEVED

To maintain control of macrophyte populations in a waterbody, several actions can be pursued. If the invasive species being controlled spreads due to artificial environmental factors such as drawdown or excess nutrients, an attempt can be made to stop or at least reduce these factors so that the possibility of reinvasion is limited. The Washington State Department of Ecology (1992) suggests that every treatment of a waterbody for the reduction or elimination of nuisance macrophytes be followed up by a mitigation with indigenous species. This procedure will help to reduce the possibility of reinvasion. A combination of the above actions would be the most likely to successfully control the macrophyte populations in the waterbody of concern.

13.5 IMPACTS ON COASTAL RESOURCES

As noted in Section 13.1.3, the use of Rodeo® and Accord® herbicides at the recommended application rates is not likely to result in any adverse toxicological effects to marine species. The likelihood of any effects is also reduced by the probability of heavy dilution of any herbicide reaching the water column due to wave, current, and tidal activity.

If the use of Rodeo®/Accord® herbicides effects the NYS Coastal Zone, or is proposed to be located within the NYS Coastal Zone, and is determined to require federal licensing, permitting or approval, or involves federal funding, then the action would be subject to the NYS Coastal Zone Management Program (19 NYCRR Section 600). This determination would be required during the preparation of an individual permit.

14.0 POTENTIAL PUBLIC HEALTH IMPACTS OF THE RODEO®/ACCORD® HERBICIDES

14.1 BRIEF OVERVIEW OF GLYPHOSATE TOXICITY

The USEPA (1986b) has determined that Rodeo and Accord are Category IV pesticides based on acute dermal and acute oral testing. This classification is given to those pesticides that are considered practically nontoxic. Rodeo/Accord have also been determined not to be primary skin irritants and have been designated Category IV pesticides for this route of contact. For eye irritation, Rodeo/Accord are classified as nonirritating. It has also been found not to be teratogenic or mutagenic in rats or rabbits (USEPA, 1986a).

Subchronic toxicity studies have shown a low degree of toxicity from oral, dermal, and inhalation exposure. The No Observable Effect Levels (NOEL) for oral 3-month studies in rats and mice were approximately 1400 mg/kg and 1000 mg/kg, respectively. When glyphosate was applied dermally to rabbits for 21 days, the NOEL was greater than the highest dose tested of 114 mg/kg. In a one-month inhalation study, the only effect observed was minor irritation of the respiratory tract at the highest dose tested. The systemic NOEL in the inhalation study was 360 mg/m3.

No birth defects were observed in teratology studies conducted with both rats and rabbits. When glyphosate was fed to rats for two consecutive generations, only minor effects on pup weight were observed at the highest dose. The reproductive toxicity NOEL was 740 mg/kg. A battery of genetic toxicity tests have been conducted with glyphosate with no evidence of mutagenic activity. Following oral administration, only 30 to 36% of glyphosate is absorbed. When applied dermally, 2% or less is absorbed. Glyphosate is almost completely eliminated unchanged in the urine or feces.

Based upon the results of lifetime feeding studies in rats and mice, the USEPA has given glyphosate a Category E rating for carcinogenicity (USEPA, 1992b). This rating is given to those pesticides for which there is "evidence of noncarcinogenicity in humans", and is the USEPA's most favorable category.

USEPA (1992a) has established the MCL for glyphosate at 700 ug/l, based upon a Drinking Water Equivalent Level of 105 mg/l (derived from a reference dose of 3.5 mg/kg/day) (USEPA, 1992a). The MCL is the level considered protective of a person who in theory may drink water at that level of contamination every day for his/her lifetime. There have been no water use restrictions placed on surface waters treated by glyphosate. Rodeo/Accord cannot be applied within 1/2 mile upstream of a potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 mile of a potable water intake in a standing body of water such as a lake, pond, or reservoir. No use or application restrictions have been placed on glyphosate with respect to potable water wells, or for terrestrial applications near potable water intakes.

The majority of reported illnesses attributable to glyphosate have involved eye irritation in workers involved in the mixing of the concentrated product Roundup®. These injuries are due to the surfactant in Roundup®, which essentially breaks down fatty acids, similar to what soap does when it comes in contact with eyes. Inhalation and dermal exposure are possible during the application of the product particularly when being sprayed manually or aerially. Label precautions for personal protective equipment should always be followed.

Use of water treated specifically with Rodeo® and Accord® herbicides at recommended application rates is not restricted either for recreation, irrigation or domestic purposes. The only application restriction for Rodeo® and Accord® herbicides is that they not be applied to aquatic systems within 1/2 mile upstream of potable water source intake on lotic (flowing) waterbodies or within 1/2 mile in any direction on lentic (standing) waterbodies.

The USEPA (1986b) has determined that a groundwater advisory statement for glyphosate containing products was not necessary because of the strong adsorptive affinity to soil. Because of this affinity, glyphosate is not expected to migrate through soil to groundwater.

14.2 NYS DRINKING WATER STANDARD

The drinking water standard established in New York State for any organic chemical compounds not specifically identified in the standards is either 5 ppb or 50 ppb, depending on its chemical structure. Based on its chemical structure, the drinking water standard for glyphosate is 50 ppb. Studies were conducted by Danhouse (1983) in which Rodeo® herbicide was applied to emergent vegetation along a flowing stream at a rate of 6 lb. a.e./acre (well above the maximum recommended dose of 3.75 lb a.e./acre). The results of that study indicated a rapid reduction of glyphosate concentrations at downstream sampling locations. At sampling locations 20 and 300 feet downstream of the treatment area, glyphosate was detected at 40 ppb and 10 ppb, respectively, one-half hour after application. These concentrations decreased further during sampling events conducted 2 and 4 hours after application. This study indicates that when Rodeo® and Accord® herbicides are applied to an aquatic system at the recommended rate and required distance from a potable water inlet, concentrations of glyphosate would not be expected to exceed the NYS water quality standard of 50 ppb.

Even if concentrations of glyphosate in drinking water were to exceed the NYS standard, all studies indicate that there would be insignificant toxicological effects at concentrations of several orders of magnitude above the standard. USEPA (1992b) has established the MCL for glyphosate at 700 ppb, based upon a Drinking Water Equivalent Level of 105 ppm (derived from a reference dose of 3.5 mg/kg/day).

A human health risk assessment for Rodeo® herbicide (glyphosate) is included in Appendix D to this GEIS. This risk assessment will be submitted to the New York State Department of Health to support the manufacturers request for an individual (as opposed to generic) drinking water standard for glyphosate. The results of the risk assessment indicate that the use of Rodeo® aquatic herbicide to control aquatic macrophytes in and around waterways in New York State poses negligible risk to human health.

To prevent impacts to potable water supplies obtained from surface water systems, the use of Rodeo® and Accord® herbicides is restricted within 1/2 mile upstream of a water supply inlet on a lotic waterbody and within 1/2 mile in any direction on a lentic waterbody. As noted in Section 12.8.1, Rodeo® and Accord® herbicides dissipate and degrade extremely rapidly in aquatic systems, particularly in lotic systems.

15.0 MITIGATION MEASURES TO MINIMIZE ENVIRONMENTAL AND HEALTH IMPACTS FROM THE HERBICIDES RODEO®/ACCORD®

Mitigation measures describe those guidelines necessary to mitigate or lessen the potential for impacts from the use of Rodeo®/Accord® herbicides in the waters of NYS. While no impacts to humans are expected from the use of these products in the waters of NYS, there is the potential for some ecological effects. The mitigation measures described in this section will reduce the potential for ecological effects, without reducing the efficacy of the products.

15.1 USE CONTROLS

As noted throughout Section 13 of this GEIS, Rodeo® and Accord® herbicides have no significant toxicological impacts to animal species or submerged vegetation when applied at the manufacturer's recommended doses. The most important use controls to protect non-target species is to monitor mixture concentrations (application rates), application timing, and application methods.

The more significant potential impact from the use of Rodeo®/Accord® herbicides is to non-target floating, emergent, and terrestrial vegetation located in the vicinity of the target area. Because these glyphosate based herbicides are tightly bound to soil and sediment particles, any herbicide not making contact with the plant is immobilized until degradation occurs. The final breakdown products are nitrogen, carbon dioxide, phosphate, and water. Therefore, the important factor in use control is in the accuracy of the initial application rather than any concerns over mobilization. The first step in any management plan which utilizing these herbicides is a thorough macrophyte inventory of the target area to determine the presence or absence of rare, threatened, or endangered species. The next step is to determine the most feasibly accurate means of application. In the majority of cases the application will be conducted by broadcast spraying. Hand held sprayers are usually more accurate than boom or aerial spraying; however, often the vertical and horizontal extent of the target vegetation requires the use of the latter methods of application.

To prevent unnecessary reapplication of Rodeo® or Accord® herbicides, the timing of the treatment should be carefully considered to insure the most effective results. Glyphosate herbicides are most effective when applied to plants during periods of greatest translocation. These periods vary from species to species and may vary within a given species depending on stress factors and plant physiology. Generally, best treatment times are during the spring time for annuals and during late summer and early fall for perennials (see Section 12.0 for further details). Additionally, these herbicides are less effective if the target plants are under stress due to such factors as disease, drought or pest infestation. The period of application should be postponed if stress is evident.

15.2 LABEL INSTRUCTIONS

Under broadcast spray application methods two label instructions should be closely adhered to:

1) Attention must be paid to atmospheric conditions. Drift is most likely to occur under gusty conditions or when winds exceed 5 mph. Application methods, application pressure, nozzle selection, and additives can greatly reduce drift in certain atmospheric conditions.

2) Spray nozzle settings should be set to avoid fine mist sprays which are capable of drifting even under calm atmospheric conditions.

When applying Rodeo® and Accord® herbicides aerially, the following additional precautions are prescribed to reduce impacts to non-target macrophytes including:

1) Proper calibration and set-up (i.e., nozzle placement);

2) Proper nozzle selection and orientation;

3) Establishment of buffer zones;

4) Avoidance of spraying during low-level atmospheric inversion conditions; and

5) Use of drift control agents.

To insure for the protection of potable water supplies obtained from surface water systems, the use of Rodeo® and Accord® herbicides in aquatic applications is restricted within 1/2 mile upstream of a water supply intake on a lotic waterbody and within 1/2 mile in any direction on a lentic waterbody.

The label warns that rainfall within 6 hours after application may result in reduced performance and within two hours after application may result in complete removal and loss of effectiveness.

15.3 RELATIONSHIP TO NYS DRINKING WATER STANDARD

The drinking water standard established in New York State for any organic chemical compounds not specifically identified in the standards is either 5 ppb or 50 ppb, depending on the chemical structure. Based on its chemical structure, the drinking water standard for glyphosate is 50 ppb. Studies were conducted by Danhouse (1983) in which Rodeo® herbicide was applied to emergent vegetation along a flowing stream at a rate of 6 lb. a.e./acre (well above the maximum recommended dose of 3.75 lb a.e./acre). The results of that study indicated a rapid reduction of glyphosate concentrations at downstream sampling locations. At sampling locations 20 and 300 feet downstream of the treatment area, glyphosate was detected at 40 ppb and 10 ppb, respectively, one-half hour after application. These concentrations decreased further during sampling events conducted 2 and 4 hours after application. This study indicates that when Rodeo® and Accord® herbicides are applied to an aquatic system at the recommended rate and required distance from a potable water inlet, concentrations of glyphosate would not exceed the NYS water quality standard of 50 ppb.

Even if concentrations of glyphosate in drinking water were to exceed the NYS standard, all studies indicate that there would be insignificant toxicological effects at concentrations of several orders of magnitude above the standard. In addition, USEPA (1992a) has established the MCL for glyphosate at 700 ppb, based upon a Drinking Water Equivalent Level of 105 ppm (derived from a reference dose of 3.5 mg/kg/day).

A human health risk assessment for Rodeo® herbicide (glyphosate) is included in Appendix D to this GEIS. This risk assessment, in addition to updated toxicology data, will be submitted to the New York State Department of Health to support the manufacturers request for an individual (as opposed to generic) drinking water standard for glyphosate. The results of the risk assessment indicate that the use of Rodeo® aquatic herbicide to control aquatic macrophytes in and around waterways in New York State poses negligible risk to human health.

To prevent impacts to potable water supplies obtained from surface water systems, the use of Rodeo® and Accord® herbicides is restricted within 1/2 mile upstream of a water supply inlet on a lotic waterbody and within 1/2 mile in any direction on a lentic waterbody. As noted in Section 12.8.1, Rodeo® and Accord® herbicides dissipate and degrade extremely rapidly in aquatic systems, particularly in lotic systems.

15.4 RULEMAKING DECISIONS

As of April 7, 1993, all pesticides labeled for use in aquatic settings are listed as restricted use products. Under this regulation, 6 NYCRR Parts 325 and 326, the use of aquatic pesticides, including Rodeo®/Accord® herbicides, is limited to persons privately certified or commercially certified in Category 5 or possess a purchase permit for the specific application that is proposed. Additionally, only those persons who are certified applicators, commercial permit holders or have a purchase permit may purchase aquatic use pesticides. The rules are designed to reduce the potential for environmental risks to public health and the environment.

Under Part 327, a site specific permit will be required for the use of Rodeo®/Accord® herbicides in the waters of NYS. The permit is issued through the NYSDEC. Potential permit applicants are cautioned to utilize the most recent product label in the development of their permit application. The applicants for the permit are required to be a riparian owner, or a lessee of a riparian owner, or an association of such persons. The applicant is required to submit the permit on a form provided by the NYSDEC. The information required for the application includes:

1. A scale drawing or map, including depth soundings adequate to determine: the size and depth of the treatment area; the concentration of the chemical within the area and the conformity to the limitations set forth in the regulations; the location and type of submerged and emergent weed beds; the location of water users relative to the area and along the outlet; and any further information required by the permit-issuing official.

2. Applications that involve public water supply waters or their tributaries will be referred to the State DOH for approval before the permit is issued.

3. The applicant must certify: that the listed chemical will be employed in conformance with all conditions specified in the permit issued; that the applicant obtained agreements to the treatment from water users whose use may be restricted as set forth in the application; that the applicant agrees that the issuance of the permit is be based on the assumed accuracy of all statements presented by him; that the applicant is legally responsible for damages resulting from the application of the chemical, or from the inaccuracy of any computations or from improper application of the chemical; and that the applicant assumes full legal responsibility for the accuracy of all representations made in obtaining approvals or releases, and for any failure to obtain approval or releases from the persons likely to be adversely affected.

A full copy of the Part 372 regulation is contained in Appendix E to this GEIS.

15.5 SPILL CONTROL

Care should be taken to use Rodeo®/Accord® herbicides properly and in accordance with the most recent approved labels. The spill or leakage of undiluted product could result in the release glyphosate concentrations that could result in an impact to public health or the environment. Any leaks or spills should be promptly addressed. Any liquid spills on an impervious surface should be contained or diked and cleaned up using absorbent materials. Liquid spills on soil should be handled by digging up and disposing the effected soil, in a proper manner. Leaking containers should be separated from non-leaking containers and either the container or its contents emptied into another container. Any residual material left after a spill is cleaned up should be thoroughly diluted with rinse water.

15.6 OTHER MITIGATION CONSIDERATIONS

In addition to the above mentioned activities, the following measures may be considered to further reduce, or mitigate any potential for environmental effects, without reducing the efficacy of the product.

15.6.1 Timing of Application

The potential for non-target impacts may be mitigated by the selection of an optimum time for application. It is recommended that Rodeo/Accord be applied on "actively growing plants." This general recommendation is given because the effectiveness may be reduced on plants under stress, i.e., they are not actively growing. As mentioned earlier, Rodeo/Accord are most effective on annual weeds during early stages of growth when the most robust growth is occurring. It should be noted that not all annuals are in early stages of growth in the spring, e.g., winter annuals. The most effective time of application for most perennials is after the reproductive stages of growth are reached. This varies considerably for certain species, i.e., some perennials bloom in the spring or summer as well. In general, the most effective time of application is during periods of low stress (e.g., drought, disease, nutrient depletion, infestation, etc.) and maximum translocation. To determine the most effective time of application an understanding of the physiology of the targeted species is recommended; however, in general, Rodeo/Accord are effective herbicides during any stage of growth and other considerations may dictate that applications be made at times that are not "the most effective." An example would be a rare, threatened or endangered plant species which is dormant during a target weed species non optimal spraying stage. Desirable, dormant plants would not translocate the active ingredient while the target species would, thereby providing target species control without affecting desirable species, i.e., rare, threatened, or endangered species.

15.6.2 Application Techniques

The choice of application techniques could serve as a means of mitigating the potential for impacts to non-target macrophytes. Rodeo/Accord may be applied using broadcast sprays (ground-rig or aerial), handgun and backpack spray-to-wet, wiper, cut stem and cut stump, and tree injection techniques. For broad spectrum control over large areas, broadcast sprays are the most efficient method. Handgun and backpack sprayers may be used when the spray needs to be targeted onto certain plants/areas and away from desirable species. Backpack sprayers are especially effective in directing spray on plants to be controlled with a minimal impact on non-target species. Wiper, trunk injection, and cut stump/stem are very effective methods of application without damaging non-target species. However, the more selective treatments are only practical for treating relatively small areas. For monotypic stands like phragmites and cattails, broadcast sprays may be needed. Many aquatic areas may require the broadcast spray to be applied with aerial equipment depending upon accessibility to the target weed stand.

The manufacturer also recommends adding a non-ionic surfactant to spray mixtures of Rodeo or Accord to promote the adhesion and spreading of spray droplets on the plant surface and aid in penetration of the plant cuticle layer on the leaves. This maximizes absorption and effectiveness of the treatment.

Drift control agents and color marking dyes may also be warranted by the application method and atmospheric conditions. Consult the most recent product labels for recommendations for all types of application.

16.0 UNAVOIDABLE ENVIRONMENTAL IMPACTS IF USE OF THE HERBICIDES RODEO®/ACCORD® IS IMPLEMENTED

Many ecosystems have been affected by such human activities as water recreation, introduction of exotic species, and overexploitation of fisheries. In many situations, these activities have resulted in an altered ecosystem with low aesthetic or economic value. In cases where the modification have significantly affected the structure and function of the plant community, herbicides may be used as a tool to manage the damaged ecosystem. Herbicides are designed to kill plants and, if they work properly, will cause some unavoidable changes in both the structure and function of the target plant community. The key is to ensure that those unavoidable changes are beneficial to the values of the community. Following is a list of some of the more important of these affects.

1. Direct Toxicological Effects

   Glyphosate is a broad-spectrum contact herbicide. To be effective, these herbicides must come in direct contact with the plant. That portion of the compound that does not directly contact the plant surface rapidly becomes unavailable in soil or water through binding with soil or suspended solids. Consequently, the extent of direct toxic effect on non-target plants primarily depends on the method of application. Most target ecosystems for glyphosate treatment are monotypic stands of the target species which should minimize the treatment of non-target species. Rodeo/Accord have low potential for directly affecting animals when used according to the approved labels.

2. Indirect Effects on Habitat

   Treatment of damaged ecosystems with herbicides will result in the death of target plant species and, possibly some non-target plant species. The effect on small rapidly reproducing species, such as periphyton or duckweed, will be minor since these species have a high reproductive potential and can rebound quickly. Larger plants with lower relative reproduction rates, such as cattails and phragmites, will have a more lasting impact. Death of these plants will significantly alter the structure of the plant community. This will likely have positive effects for some animal species, and negative for others. Likewise, the addition of new dead and decaying material to the aquatic system will affect the functional attributes of the ecosystems (dissolved oxygen, nutrient loadings, etc.). These effects are complex and difficult to predict generically. Specific predictions and recommendations would need to be based on the unique characteristics of the target ecosystem.

17.0 ALTERNATIVES TO THE HERBICIDES RODEO®/ACCORD®

This section details the various alternatives to the proposed action. The other alternatives include the no-action alternative to the use of Rodeo®/Accord® herbicides (which entails the lack of any aquatic macrophyte control measure, except as specified), chemical alternatives to Rodeo®/Accord® herbicides, mechanical alternatives to Rodeo®/Accord® herbicides, biological alternatives to Rodeo®/Accord® herbicides, and various other options. The no-action alternative does not preclude the ability of an applicant to apply for a permit for the use of those products described in the Final Programmatic Environmental Impact Statement on Aquatic Vegetation Control (NYSDEC, 1981a). Each of the possible alternatives will be evaluated from the standpoint of efficacy, positive and negative environmental impacts, and relative costs. The choice of a particular alternative over the proposed use of Rodeo®/Accord® herbicides should be based on the management objectives for the waterbody and the specific characteristics of the problem.

17.1 NO-ACTION ALTERNATIVE

In the no-action alternative, aquatic macrophyte control measures which could be utilized in the waterbodies of potential concern would be those chemical and mechanical means identified in the Final Programmatic Environmental Impact Statement on Aquatic Vegetation Control (NYSDEC, 1981a). Under the no-action alternative, the use of the Rodeo®/Accord® herbicides is not considered for the control of the growth and spread of the target macrophytes in the waterbodies of concern. In this scenario, the only controlling measures, other than natural fluctuations in the plant populations, would be those activities presently permitted in NYS waterbodies. Without any controlling measures, the spread of invasive weeds such as cattail, phragmites, and purple loosestrife could result in significant modifications of the native aquatic habitat of a particular waterbody. Uncontrolled invasive macrophytes produce seeds and/or other reproductive parts that can be spread to other aquatic sites.

Because of certain physiological features of the three target emergents, they are capable of out competing most other indigenous emergent macrophytes, forming monotypic stands of vegetation that reduce the biodiversity of the aquatic ecosystem. This alteration in biodiversity begins with the elimination of indigenous plant species which are the primary producers for any well developed ecosystem. Because there is little nutritive value in cattail, phragmites, or purple loosestrife, the herbivores which were dependant on the indigenous plant species no longer have a suitable habitat. These alterations will impact every trophic level, sooner or later simplifying the structure of the food web resulting in a decrease in biodiversity. These food web modifications will also extend to nesting, spawning, and roosting habitat.

As detailed in Section 11.0, the success of cattail, phragmites, and purple loosestrife stems from their abilities to cope with extremes in environmental conditions (e.g., inundation, pollution, pH, etc.) and to rapidly reproduce (vegetatively and/or sexually) and infiltrate any openings left by other stressed vegetation. The fluctuations in environmental conditions which tend to stress indigenous macrophytes and allow the introduction of the three target species are very often anthropogenic in origin. The most common anthropogenic factors include artificially induced water level fluctuations and the introduction of nutrients or pollutants. Unless anthropogenic environmental stresses can be eliminated, the spread of these three emergent macrophytes will continue.

If the anthropogenic alterations in the natural environment discussed above can be controlled, populations of cattails and phragmites may be kept in check (Smith, 1967; Nature Conservancy, 1986). This, however, is not the case with purple loosestrife. All three species of target emergent macrophyte have been referred to as invasive due to their rapid spread throughout North America; however, purple loosestrife is the only one of the three not indigenous to this area. Unlike cattail and phragmites populations in undisturbed areas, purple loosestrife does not remain benign and will outcompete indigenous emergent macrophytes regardless of the presence or absence of environmental stress.

Some positive factors have been noted for the advent of dense monotypic stands of cattails (Stromstad, 1992). Since these stands have developed throughout the Dakotas, there has been a marked increase in the number of white-tail deer and ring-necked pheasant. These population increases can be attributed to the increase of wintering habitat created by the dense cattail stands. Similar overwintering habitat can be provided by phragmites and, to a lesser degree, purple loosestrife when present in dense stands. However, this view of habitat suitability is based upon game management rather than ecological diversity.

The ramifications of a no-action alternative in the control of cattail, phragmites, and purple loosestrife extend beyond habitat considerations and include impacts to recreation and commerce. The presence of a dense vegetation layer encompassing the fringe of a waterbody makes access for recreational purposes (e.g., boating, fishing, swimming, etc.) very difficult. These restrictions on recreational use also have economic consequences to local fishing and boating supply companies as well as to the value of real estate surrounding the waterbody of concern. Other economic impacts attributable to the presence of these nuisance emergents include blockage of irrigation and stormwater runoff ditches, disruption of navigation and mooring, and the attraction of other nuisance species. The attraction of other nuisance species may include such things as the concentration of redwinged blackbirds in cattail stands adjacent to agricultural areas, particularly those growing sunflowers and corn (Linz, 1992). Attracted to cattail stands for nesting and roosting purposes, redwinged blackbirds have been known to devastate nearby crops of sunflowers and corn in the Dakotas and elsewhere (Stromstad, 1992).

17.2 CHEMICAL ALTERNATIVES

As noted in Section 10.3, herbicides are categorized as either systemic or contact in nature. The glyphosate containing herbicides, Rodeo® and Accord®, are systemic herbicides that differ from most systemics in that they require contact with emerged or floating foliage to be absorbed into plant tissue and are ineffective if submersed in water. Glyphosate containing herbicides also differ from most other systemics in that they are not absorbed by the roots, even if applied in a terrestrial setting, due to a high affinity to soil particles. These characteristics can be viewed as beneficial because they reduce the mobility of Rodeo® and Accord® herbicides so that they act only those plants on which they are directly applied.

It is important to note that control of the targeted emergents requires the use of a systemic to insure the removal of the root or rhizome system. Contact herbicides will only remove that section of the plant contacted. The tap root of purple loosestrife and the rhizomes of cattail and phragmites are the main organs of perennation, and because they are generally submerged, contact herbicides will have little effect on them. This will result in rebudding as early as the same growing season.

NYSDEC (1990) notes that aquatic herbicides are chemicals used primarily to manage specifically-targeted aquatic macrophyte species. Herbicides are applied in either a liquid or granular form. Herbicides can be successfully used in most lakes. In those lakes which serve as a potable water supply, however, certain use restrictions may be in place for the herbicides. NYSDEC (1990) lists endothall, diquat, and 2,4-D as the most commonly used aquatic herbicides in NYS. The average cost of aquatic herbicides ranges between $200 - $400 per treated acre (NYSDEC, 1990).

17.2.1 Endothall

Endothall was reviewed by the NYSDEC (1981). Endothall compounds are contact herbicides, which are primarily used for the control of most pondweeds and coontail. Endothall is not effective for floating or emergent species. As a result, this chemical is not considered to be a significant chemical alternative to the Rodeo® and Accord® herbicides, which are not effective against completely or mostly submerged plants. The active ingredient in endothall is 7-oxabicyclo [2.2.1]heptane-2,3-dicarboxylic acid. The dipotassium salt of endothall is sold under the trade name Aquathol® K, as an aquatic herbicide. The mono(N,N-dimethylalkylamine) salt of endothall is sold under the trade name Hydrothol® 191, as an aquatic algicide and herbicide.

WSDOE (1992) reports that endothall may have significant adverse impacts on non-target aquatic plants. NYSDEC (1981) notes that endothall is highly toxic to humans. WSDOE lists the acute toxicity of dipotassium or disodium endothall as ranging from 95 ppm for redfin shiners (Notropis umbratilis) to 710 ppm for striped bass (Morone saxatilis) fingerlings. Elf Atochem (1992) reports a tolerance level in water for fish of 60 to 100 ppm of dipotassium or disodium endothall. Toxicity values are significantly lower for the amine formulation of endothall. Endothall is rapidly taken up and produces quick results. This can lead to depleted oxygen levels in the water due to the sudden contribution of decaying plant biomass to the water column. Endothall is neither bioaccumulated nor persistent in the aquatic environment.

Vermont Department of Environmental Conservation (VDEC, 1993) notes that the advantage of endothall is that it is a fast acting herbicide. They also report that the disadvantages include: 1) the potential need for water use restrictions; 2) the potential need for an alternate water supply for a period of time; 3) the fact that endothall does not kill the roots, only the leaves and stems it comes in contact with; and 4) the fact that control is short-termed.

17.2.2 Diquat

Diquat was reviewed by NYSDEC (1981). Diquat dibromide (6,7-dihydrodipyrido (1,2-a:2',1'-c)pyrazinediium dibromide) is a contact herbicide used to control several submergent, floating, and emergent macrophytes at one to two gallons per acre. Diquat is sold under the tradename Reward®. It is a broad spectrum contact herbicide with only local plant translocation. It is absorbed through the cuticle and works by interfering with photosynthetic activity within the plant. As a contact herbicide, it is taken up quickly and produces rapid results. This can result in decreased oxygen levels due to the sudden addition of decaying plant biomass to the water column. NYSDEC (1981) considers diquat to have moderate toxicity to fish and invertebrates, moderate toxicity to test mammals, high oral toxicity to humans, and moderate to low toxicity to birds.

VDEC (1993) notes that the advantage of diquat is that it is a fast acting herbicide. They also report that the disadvantages include: 1) the potential need for water use restrictions; 2) the potential need for an alternate water supply for a period of time; 3) the fact that diquat does not kill the roots, only the leaves and stems it comes in contact with; and 4) that fact that control is short-termed.

17.2.3 2,4-D

The aquatic herbicide 2,4-D was reviewed by NYSDEC (1981). The active ingredient is a granular formulation of 2,4-dichlorophenoxyacetic acid, butoxyethyl ester. 2,4-D is sold under the tradename Aqua-Kleen®. It is a systemic herbicide which kills by inhibiting cellular division, though at low concentrations it may stimulate growth (VDEC, 1993). It is used to control several floating and submerged species (NYSDEC, 1990). As a result, this chemical is not considered to be a significant chemical alternative to the Rodeo® and Accord® herbicides, which are not effective against completely or mostly submerged plants. Pullman (1993) reports that when 2,4-D is applied at label-recommended rates, little or no impact to non-target species is observed. NYSDEC (1981) considers 2,4-D to have moderate toxicity to humans, low toxicity to test mammals, low toxicity to birds and varying toxicities to fish. VDEC (1993) reports that a concern has been raised by the USEPA's Office of Pesticide Programs concerning the potential carcinogenicity of 2,4-D, which is being evaluated by that office.

17.2.4 Dicamba

This selective aquatic herbicide is no longer permitted for use in New York State (NYSDEC, 1981a).

17.3 NON-CHEMICAL ALTERNATIVES

Non-chemical alternatives to Rodeo® and Accord® herbicides were evaluated with respect to their effectiveness, their advantages and their disadvantages. Generally, the non-chemical alternatives to Rodeo® and Accord® herbicides can be divided into mechanical alternatives, biological alternatives and water level manipulation (drawdowns).

17.3.1 Mechanical Alternatives

17.3.1.1 Harvesting (Mowing or Pulling)

Harvesting of nuisance emergent vegetation is similar in concept to harvesting of submerged vegetation; however, the use of specialized floating machinery is not possible due to shallow water depths. Several other mechanisms are available for harvesting emergents that are equally as effective as the floating machines. Harvesting can be conducted by either cutting the stem as close to the root or rhizome structure as possible or by simply pulling the nuisance weed out by hand. This mechanism of pulling weeds is probably the most efficient and effective harvesting method because it eliminates the weed, roots and all, and it is low cost. For obvious reasons there are limitations to pulling as a harvesting method in the control of aquatic weeds. This procedure is only practicable for either very small stands of weeds or for controlling the spread of larger stands. Although pulling can be very effective at long term elimination of small stands of weeds, rapid regrowth through vegetative budding is possible if the entire root or rhizome is not extracted with the plant. This is particularly true of the deep rooted purple loosestrife and the matted, expansive rhizomes of cattail and phragmites.

Cutting or mowing is the preferred method of harvesting emergent weeds when stands are large or when managing an entire lake. Several different methods of cutting are available including handheld tools, such as sickles or grass hooks, and rotary mowers pulled by tractors. According to Payne (1992), rotary cutters are capable of cutting up to 6.5 ha/day of dense cattail stand.

Unless supplemented by other methods of control, mowing is at best a temporary means of controlling cattail, phragmites, and purple loosestrife, and at best must be done at least once each year. The reason for the lack of long term effectiveness is that the root or rhizome is not effected by mowing and is capable of vegetatively regenerating a new stem. Several studies have demonstrated, however, that when mowing was supplemented by reflooding of up to 7.6 cm (Payne, 1992), up to 75% of the cattail stand was killed. This is effective against cattail because, unlike phragmites and purple loosestrife, its rhizome is incapable of surviving an anaerobic environment containing less than 0.5% dissolved oxygen (See Section 3.5).

Additional studies have indicated that successive cuttings of phragmites or cattail conducted prior to the advent of carbohydrate storage (generally late July) can eventually eliminate a colony by reducing stored energy to such an extent that shoot budding becomes impossible. The obvious drawback to this approach is that the weeds are present during most of the growing season and for several years after initiation of the program. This procedure is not effective on purple loosestrife, and there are no other studies available which indicate that any mowing program would have any effect at long term control of purple loosestrife.

Two important factors need to be considered when initiating a mowing program. Because cattail and phragmites are monocots, they are capable of increasing the density of the stand by vegetative growth if cut during the wrong part of the season. As mentioned above, the optimum time for mowing these species is just before maturation of the flowering head. The second consideration for all three targeted emergent is that the mowed stems must be collected from the waterbody due to the potential for deoxygenation, created by decomposition of a large biomass, and vegetative sprouting of cut stems.

Potential environmental impacts from harvesting include: 1) an increase in water turbidity due to suspended sediment; 2) the potential elimination of desired plants and/or threatened or endangered plants; 3) the deoxygenation of water by an increase in decomposing plant mass; 4) death of up to 25% of fry (WSDOE, 1992); 5) the death of up to 22% of macroinvertebrates in the treated area (WSDOE, 1992); and 6) short-term effectiveness, particularly for purple loosestrife.

The cost of harvesting can vary considerably depending upon individual circumstances. In some cases costs can be kept very low by soliciting volunteers to undertake some the more labor intensive methods of harvesting.

17.3.1.2 Benthic Barriers

Benthic barriers are any compound, fabric or physical structure that can be placed between the sediment and the water column to block sunlight and prevent the photosynthetic activities of the targeted plants. Benthic barriers may drastically alter lake plant and fish communities if used on more than a spot basis. Benthic barriers are difficult to use on emergent macrophytes. This would limit its use on species such as purple loosestrife, cattails, and phragmites, unless used in conjunction with other methods (Payne, 1992).

The advantages of benthic barriers include multi-year control after initial installation. WSDOE (1992) notes that the effectiveness may range from 1 to 2 years up to 10 years. Benthic barriers can be used in confined areas around docks or in swimming areas. They are generally easy to install and durable, though they can be difficult to install if the water is not shallow. VDEC (1993) notes that the advantages to bottom barriers include: 1) long-term control if properly installed; 2) the method provides immediate control throughout the entire water column; 3) the use in areas not accessible to other mechanical means; and 4) the fact that there is no interference with water supplies or water use if properly installed.

The disadvantages include the high cost of initial installation. NYSDEC (1990) noted that benthic barriers can cost between $2,000 and $8,000 per acre, depending on the choice of fabric. VDEC (1993) considers this technique as not feasible on a large scale because of cost. Benthic barriers often require maintenance on a yearly basis and will require a relatively smooth lake or pond basin substrate. Additionally, benthic barriers may interfere with fish spawning and may significantly impact the benthic invertebrate community (NYSDEC, 1990 and WSDOE, 1992). Bartodziej (1992) noted that the use of benthic barriers in a lake in Florida resulted in significant adverse impacts to the benthic community under the barriers. Further, benthic barriers are not selective within the treatment area.

17.3.1.3 Disking

Similar to rototilling, disking is the process by which a tractor pulls a trailer containing several cutting discs which slice through the top several inches of soil or sediment, cutting up the stem and root of the vegetation as it goes. Disking is ineffective for the long-term control of all three target emergents due to their abilities to vegetatively resprout from root or rhizome fragments. This is particularly true of cattail and phragmites. According to Payne (1992) disking of purple loosestrife and cattail after drainage of an impoundment successfully controlled the growth of these species after reflooding. However, unless additional controls or mitigation measures are implemented purple loosestrife seed will likely survive and be the first emergent species to germinate, resulting in the reinfestation of this nuisance species to the exclusion of desired indigenous ones.

There are several disadvantages to this method. As with mechanical harvesting, this method is broad spectrum and can facilitate the spread of the weed through the generation of plant fragments. Also, because this method occurs in the hydrosoil, significant sediment load in the water column can be generated which could smother fish eggs and fry. Invertebrate habitat in the benthic area will be destroyed, which could impact the fish and wildlife species dependent on those organisms. If drawdown is utilized in conjunction with disking, the negative impacts will include those discussed in Section 17.3.3 as well.

17.3.1.4 Controlled Burning

Controlled burning is used on expansive stands of phragmites and cattail, and can presumably be used on purple loosestrife; although, no record of such a procedure on purple loosestrife was located in the literature. Burning only affects the exposed stem of the targeted species and will have no effect on the submerged stem or rootstock. The result is only temporary control of the macrophyte. Some limited success has been shown on cattail stands that were burned after drawdown and drying of the rhizome. The success was still limited because not all of the rhizome dried sufficiently to allow burning (Payne, 1992).

Like mowing, this procedure may be effective on phragmites and cattail when conducted over several growing seasons by reducing carbohydrate store in the rhizome. Again the timing of the burn is critical to the success of this procedure. In the case of cattail and phragmites, burning is recommended after the application of glyphosate containing herbicides to reduce the potential effects of deoxygenation as well as to enhance future control measures if they become necessary (Jones, 1992).

The potential problems associated with the use of controlled burns include: 1) loss of control of the burn; 2) broad spectrum nature of control could result in the impact to desirable species, smoke pollution, including those which are threatened or endangered, both animals and plants, and 3) short-term control. If drawdown is utilized in conjunction with burning, the negative impacts will include those discussed in Section 17.3.3 as well.

Controlled burning can be a very low cost method of control unless it is done in conjunction with drawdown, which is more costly but more effective. The potential secondary costs incurred by loss of fire control must, however, be considered.

17.3.1.5 Crushing

Utilization of crushing devices such as a 55 gallon drum filled with water, have been utilized to destroy the rhizomes of cattail stands (Weller, 1975). This procedure requires the drawdown and subsequent reflooding for effectiveness. This procedure generally also requires a second season of crushing to control seedlings.

The negative impacts of this procedure are similar to disking and include: 1) potential elimination of desired plants and/or threatened or endangered plants; 2) deoxygenation of water by decomposing plant mass; 3) death of fish and macroinvertebrates; and 4) questionable effectiveness, particularly for purple loosestrife.

17.3.2 Biological Alternatives

Biological methodologies consists of the use of introduced biota to control the targeted aquatic macrophytes. This alternative poses all of the potential problems of the invasive exotic aquatic macrophytes in that once they are released, the biota cannot be controlled.

17.3.2.1 Insects

Batra (1986) indicates that the chance of biological control of purple loosestrife is excellent. Six European insect species have been identified as parasitic to purple loosestrife. These include: 1) a gall producing cecidomyiid fly which has demonstrated a 75% reduction in plant foliage and an 80% reduction in seed production; 2) a boring weevil which effects both roots and stem; 3) two chrysomelid beetles responsible for up to 50% reduction in foliage; and 4) two other weevils which successfully mine the ovaries and seeds of purple loosestrife.

17.3.2.2 Muskrat and Nutria

The muskrat is small herbivorous, aquatic rodent which is indigenous to most parts of North America. The nutria is similar in appearance (except larger) and behavior to the muskrat, but it is an introduced species from South America which has successfully competed with the muskrat for habitat. Both species feed on the rhizomes of cattail and phragmites and are capable of maintaining open water areas within dense stands. The use of these species in a control program can be a tricky due to the need to maintain population balances. An overpopulation of muskrat or nutria can result in total eat-outs of cattail or phragmites. At first glance this may be a desired goal, however, because the rodents no longer have an adequate supply of their preferred food, they will resort to other plant species for nourishment.

Additionally, it should be noted that nutria are an introduced species which has been competing with the muskrat for habitat. Before utilizing this species in a control program, consultation with state and federal wildlife officials would be advised.

17.3.3 Water Manipulation - Drawdown/Flooding

Water manipulation methods can be effective on certain emergent species to varying degrees. The prerequisite to water manipulation, however, is a mechanism to either drain or dam the waterbody to achieve the desired water level, and even if this water manipulation can be achieved, it must be sustained for an extended period to be effective. Flooding of cattail to 65 cm above the rhizome was required for a period of two years before adverse effects were observed (Wisconsin DNR, 1969); however, draining of a cattail dominated pond resulted in increased stands due to new growth in areas where water had previously been too deep (Motivans and Apfelbaum, 1989). Likewise, flooding of phragmites to 3 feet above the rhizome for a period of at least four months during the growing season was an effective control measure, but drawdown has limited success by itself because the phragmites rhizome is capable of reaching 2 meters below ground in search of water. For all three of the target species, particularly purple loosestrife, drawdown is one of the major mechanisms for their introduction and spread, therefore, this mechanism of control, if used alone, can be dangerous.

Most drawdowns are used in conjunction with other control mechanisms such as burning or disking. The combination of these procedures increases the opportunity for success. The major drawbacks to the use of water manipulation include: 1) broad spectrum destruction of plant species; 2) death of fish and macroinvertebrate species; 3) need for water manipulation devices such as drains, dams or tidal gates; 4) short-term control if not supplemented by mitigation; and 5) bank destabilization due to destruction of shoreline vegetation.

17.4 INTEGRATED PEST MANAGEMENT

The optimal method of addressing aquatic macrophyte concerns is in a coordinated effort that brings the most effective and environmentally sound techniques to bear on the problem. An integrated approach would be based on the use of all techniques, depending on the characteristics of the specific problem in a waterbody. An integrated approach, however, would not only be based on a variety of techniques to address the immediate issue of excessive aquatic macrophyte growth, but also the inherent causes of the problem. Such an approach would include measures to reduce artificially stimulated lake eutrophication that exacerbates nuisance weed growth. Such activities would include measures such as management and control of nutrient loading, reduction of wastewater flow and reduction of sedimentation on a lake watershed basis. However, such techniques can be expensive and slow to implement. Integrated pest management is an ideal goal is lake management, but is not always a practical solution.

17.5 ALTERNATIVES ANALYSIS

As discussed throughout Sections 10.0 and 11.0 of this GEIS, the uncontrolled growth of aquatic macrophytes in surface waterbodies can substantially impact the ecological characteristics of that waterbody. Desired water uses, such as recreational uses may also be prevented or made hazardous by unwanted plant growth. This is particularly true for exotic species such as purple loosestrife, cattails and phragmites, which are capable of exponential growth. It is the responsibility of the lake manager or lake association to decide upon a course of action that would not only effectively control the macrophyte of concern, but would also be ecologically sound. The use of Rodeo® and Accord® herbicides is one of the alternatives that is available for the control of emergent and floating aquatic macrophytes. This section describes a general approach to deciding upon the use of Rodeo® and Accord® herbicides with respect to the other alternatives described in Section 17.0.

Upon the decision by the lake manager, lake association, or custom applicator that the quantity of macrophytes in the waterbody is a current concern for ecological or recreational reasons, or is anticipated in the future to be a concern, an appropriate management approach should be chosen using the following general guidelines. This assumes that the no-action alternative is not an appropriate alternative for the waterbody. Any subsequent decisions regarding macrophyte management approaches must consider all permit requirements, including those specified in Part 327 as described in Section 15.4. In waterbodies or wetlands containing emergent or floating macrophytes, the appropriate glyphosate formulation would be one alternative for the management of purple loosestrife, cattails, and phragmites.

In comparison to other possible herbicides, Endothall compounds are contact herbicides and would not control the entire plant (i.e. roots or rhizomes), and is not effective for floating or emerged species. Diquat is also a contact herbicide and would not control the entire plant, thereby ensuring regrowth of the target macrophyte. Diquat does not offer as favorable a toxicity package as the glyphosate herbicides. 2,4-D is not as effective against emergent and floating macrophytes and poses a greater toxicity to fish. With respect to mechanical alternatives, Rodeo® and Accord® herbicides would produce longer lasting results with less environmental damage than mechanical harvesting, benthic barriers or dredging. Drawdown also is not a preferred option as it is not always a choice with a particular waterbody and the drawdown may not be able to effect the deeper parts of the waterbody. The potential ecological impacts from drawdowns include the possible depletion of oxygen in the remaining water that could possibly result in fish kills, nutrient releases which could produce algal blooms and the increase in the spread of other macrophyte species. Increased turbidity and resuspension of sediments may also occur (NYSDEC, 1990). Other disadvantages are listed in Section 17.3.3.

As discussed in Section 17.3.2, biological alternatives in NYS are either not permitted or are still in the testing phase. At present, biological alternatives are not developed for use.

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* Peer-reviewed journals are noted in **bold**

APPENDIX A

APPROVED LABELS FOR SONAR® A.S. AND SONAR® SRP AND THE MATERIAL SAFETY DATA SHEET FOR FLURIDONE

Specialty Products Supplemental Labeling

DowElanco

DowElanco Quad IV, 9002 Purdue Road P.O. Box 681428 Indianapolis, Indiana 46268-1189 USA

This is a Restricted Use Pesticide in New York State

Sonar* A.S. Herbicide

EPA Reg. No. 62719-124)
24(c) Special Local Need Registration (SLN NY-930001)
(For Distribution and Use Only in the State of New York)

For Management of Eurasian Watermilfoil in Fresh Water Ponds, Lakes and Reservoirs

Active Ingredient:
fluridone: 1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4(1*H*)-pyridinone 41.7%
Inert Ingredients 58.3%

ATTENTION

- It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.
- Read all directions carefully before applying.
- **In the state of New York, Sonar A.S. is registered under FIFRA Section 24(c) as a Special Local Need (SLN) registration. For the state of New York, this 24(c) supplemental labeling provides directions for use, including use precautions and limitations applicable to use of Sonar A.S. and supersedes directions for use on the product label.**
- **See product label for Precautionary Statements, Environmental Hazards, STORAGE AND DISPOSAL, Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies.**
- This labeling must be in the possession of the user at the time of application.
- **Notice To All Pesticide Applicators:** Before application under any project program, notification of and approval by the NYS Department of Environmental Conservation is required, either by an aquatic permit issued pursuant to ECL Section 15.0313(4) or issuance of purchase permits for such use.
- This supplemental labeling must accompany every container of Sonar A.S. (EPA Reg. No. 62719-124) sold or distributed in New York State.
- Sonar A.S. (EPA Reg. No. 62719-124) is a Restricted Use Pesticide in New York State and may be sold, offered for sale, distributed, possessed or used only by a certified applicator or purchase permit holder.
- Swimming in treated waters is prohibited for a period of 24 hours following application of Sonar A.S.
- All restrictions and precautions on the EPA registered label are to be followed.

Directions for Use:

Sonar AS General Information

Sonar A.S. herbicide is a selective systemic aquatic herbicide for management of aquatic vegetation in fresh water ponds, lakes and reservoirs. Sonar is absorbed from water by plant shoots and from hydrosoil by the roots of aquatic vascular plants. It is important to maintain the recommended concentration of Sonar in contact with the weeds as long as possible. Rapid water movement or any condition which results in rapid dilution of Sonar in treated water will reduce its effectiveness. In susceptible plants, Sonar inhibits the formation of carotene. In the absence of carotene, chlorophyll is rapidly degraded by sunlight. Herbicidal symptoms of Sonar appear in seven to ten days and appear as white (chlorotic) or pink growing points. Under optimum conditions 30 to 90 days are required before the desired level of aquatic weed management is achieved with Sonar. Species susceptibility to Sonar A.S. may vary depending on time of year, stage of growth, and water movement. For best results, apply Sonar A.S. prior to initiation of weed growth or when weeds begin active growth.

Sonar A.S. is not corrosive to application equipment.

General Use Precautions

- **Obtain Required Permits:** Before applying this product, notification of and approval of the NYS Department of Environmental Conservation is required, either by an aquatic permit issued pursuant to ECL Section 15.0313(4) or issuance of purchase permits for such use.

- **Shake well before using.**

- **Chemigation:** Do not apply Sonar A.S. through any type of irrigation system.

- **Potable Water Intakes:** In lakes and reservoirs, do not apply Sonar A.S. within one-fourth mile (1320 feet) of any functioning potable water intake. ***Note:*** *Existing potable water intakes which have been disconnected and are no longer in use, such as those replaced by connections to potable water wells or a municipal water system, are not considered to be functioning potable water intakes.*

- **Irrigation:** Irrigation with Sonar A.S. treated water may result in injury to the irrigated vegetation. DowElanco recommends informing those who irrigate from Sonar A.S. treated areas of the irrigation time frames presented in the table below. These time frames are suggestions which should be followed to reduce the potential for injury to vegetation irrigated with Sonar A.S. treated water:

	Days After Application		
Application Site	Established Tree Crops	Established Row Crops/ Turf/Plants	Newly Seeded Crops/Seedbeds or Areas to be Planted Including Overseeded Golf Course Greens
[1]Ponds	7	30	30
[2]Lakes and Reservoirs	7	14	14

[1]For purposes of Sonar A.S. labeling, a pond is defined as a body of water 10 acres or less in size. A lake or reservoir is greater than 10 acres.

[2]In lakes and reservoirs where one-half or greater of the body of water is treated, use the pond and static canal irrigation restrictions.

Aquatic Weed Control Information

Application of Sonar A.S. at dosage rates recommended in this supplemental labeling will provide a fluridone concentration of 0.015 to 0.05 ppm (15 to 50 ppb) in treated water. When applied within this rate range, Sonar A.S. will control **Eurasian watermilfoil** and may not be used to control other aquatic species.

Mixing and Application Directions

The aquatic plants present in the treatment site should be identified prior to application of Sonar A.S. It is important to determine the area (acres) to be treated and the average depth in order to select the proper application rate. Do not exceed the maximum labeled rate for a given treatment site per annual growth cycle.

Shake Sonar A.S. well before using. Add the recommended amount of Sonar A.S. to water in the spray tank during the filling operation. Agitate while filling and during spraying. Surface or subsurface application of the spray can be made with conventional spray equipment. Sonar A.S. can also be applied near the surface of the hydrosoil using weighted trailing hoses. A spray volume of 5 to 100 gallons per acre may be used. Sonar A.S. may also be diluted with water and the concentrated mix metered into the pumping system.

Application to Ponds, Lakes and Reservoirs

The following treatments are recommended for treating entire ponds, lakes or reservoirs or large quiescent areas of lakes or reservoirs (bays, etc.) where little dilution within the treatment area is expected. For best results in lakes and reservoirs, Sonar A.S. treatment areas should be a minimum of 5 acres in size. Treatment of areas smaller than 5 acres or treatment of narrow strips such as boat lanes or shorelines may not produce satisfactory results due to dilution by untreated water. In lakes and reservoirs, do not apply Sonar A.S. within one-fourth mile (1320 feet) of any functioning potable water intake. ***Note:*** *Existing potable water intakes which have been disconnected and are no longer in use, such as those replaced by connections to potable water wells or a municipal water system, are not considered to be functioning potable water intakes.*

Rates may be selected to provide 0.015 to 0.05 ppm (15 to 50 ppb) of active ingredient in the treated water. Application rates necessary to obtain these active ingredient concentrations in treated water are shown in the following table.

Average Water Depth of Treatment Site (feet)	Quarts of Sonar A.S. per Treated Surface Acre
1	0.04 to 0.13
2	0.08 to 0.27
3	0.12 to 0.40
4	0.16 to 0.54
5	0.20 to 0.67
6	0.24 to 0.81
7	0.28 to 0.94
8	0.32 to 1.10
9	0.36 to 1.20
10	0.40 to 1.30
11	0.45 to 1.50
12	0.50 to 1.60

Use the higher rates within the rate range where there is a greater probability of dilution by untreated water. The lower rates are recommended for treating entire ponds or lakes where little dilution by untreated water is expected.

Application Rate Calculation - Ponds, Lakes and Reservoirs

The amount of Sonar A.S. to be applied to provide the desired ppm concentration of active ingredient in treated water may be calculated as follows:

- Quarts of Sonar A.S. required per treated surface acre = Average water depth of treatment site (feet) x Desired ppm concentration of active ingredient x 2.7

For example, the quarts per acre of Sonar A.S. required to provide a concentration of 0.025 ppm of active ingredient in water with an average depth of 5 feet is calculated as follows:

5 x 0.025 x 2.7 = 0.33 quart per treated surface acre.

When measuring quantities of Sonar A.S., quarts may be converted to fluid ounces by multiplying quarts to be measured x 32. For example, 0.25 quarts x 32 = 8 fluid ounces.

Note: Calculated rates should not exceed the maximum allowable rate in quarts per treated surface acre for the water depth listed in the application rate table for the site to be treated.

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123-T3ESP002 Approved 02/05/93
Initial printing.

Amendments:
1) Use directions for the state of New York added via 24(c) Special Local Need registration.

Specimen Label

DowElanco

Sonar* SRP

Vegetation Management

Specialty Herbicide

A herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, drainage canals, irrigation canals and rivers.

Active ingredient:
fluridone: 1-methyl-3-phenyl-5-[3-(trifluoromethyl) phenyl]-4(1*H*)-pyridinone 5.0%
Inert ingredients 95.0%
Total 100.0%

Contains 2 pounds active ingredient per 40-pound container.

EPA Reg. No. 62719-123
EPA Est. 39578-TX-1
Net Weight 40 pounds

Precautionary Statements

Hazards to Humans and Domestic Animals:
Keep Out of Reach of Children

CAUTION PRECAUCION:

Precaucion al usuario: Si usted no lee inglés, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.

Harmful If Swallowed, Absorbed Through Skin, Or If Inhaled

Avoid breathing of dust or contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling. Wash exposed clothing before reuse.

First Aid:
If in eyes: Flush eyes or skin with plenty of water. Get medical attention if irritation persists.
If swallowed: Call a physician or poison control center, drink one or two glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.
If inhaled: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

Environmental Hazards
Follow use directions carefully so as to minimize adverse effects on nontarget organisms. In order to avoid impact on threatened or endangered aquatic plant or animal species, users must consult their State Fish and Game Agency or the U.S. Fish and Wildlife Service before making applications.

Do not contaminate water when disposing of equipment washwaters. Trees and shrubs growing in water treated with Sonar SRP may occasionally develop chlorosis. Do not apply in tidewater/brackish water.

Lowest rates should be used in shallow areas where the water depth is considerably less than the average depth of the entire treatment-site, for example, shallow shoreline areas.

Notice: Read the entire label before using. Use only according to label directions. **Before buying or using this product, read "Warranty Disclaimer" and "Limitation of Remedies" elsewhere on this label.**

In case of emergency endangering health or the environment involving this product, call collect 517-636-4400

Specialty Chemical: Keep away from food, feedstuffs and water supplies. Do not ship or store with food, feeds, drugs or clothing.

Sonar* SRP

Directions for Use:

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

Read all Directions Carefully Before Applying Sonar SRP.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Store in original container only. Do not store near feed or foodstuffs. In case of leak or spill, contain material and dispose as waste.

Pesticide Disposal: Wastes resulting from use of this product may be used according to label directions or disposed of at an approved waste disposal facility.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by State and Local authorities, by burning. If burned, stay out of smoke.

General Information

Sonar SRP herbicide is a selective systemic aquatic herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, drainage canals, irrigation canals, and rivers. Sonar SRP is a pelleted formulation containing 5% fluridone. Sonar SRP is absorbed from water by plant shoots and from hydrosoil by the roots of aquatic vascular plants. It is important to maintain the recommended concentration of Sonar SRP in contact with the weeds as long as possible. Rapid water movement or any condition which results in rapid dilution of Sonar SRP in treated water will reduce its effectiveness. In susceptible plants, Sonar SRP inhibits the formation of carotene. In the absence of carotene, chlorophyll is rapidly degraded by sunlight. Herbicidal symptoms of Sonar SRP appear in seven to ten days and appear as white (chlorotic) or pink growing points. Under optimum conditions 30 to 90 days are required before the desired level of aquatic weed management is achieved with Sonar SRP. Species susceptibility to Sonar SRP may vary depending on time of year, stage of growth and water movement. For best results, apply Sonar SRP prior to initiation of weed growth or when weeds begin active growth.

Sonar SRP is not corrosive to application equipment.

Special Use Precautions

Obtain Required Permits: Consult with appropriate state or local water authorities before applying this product. Permits may be required by state or local public agencies.

Potable Water Intakes: In lakes and reservoirs, do not apply Sonar SRP within one-fourth mile (1320 feet) of any functioning potable water intake.

Irrigation: Irrigation with Sonar SRP treated water may result in injury to the irrigated vegetation. DowElanco recommends informing those who irrigate from Sonar SRP treated areas of the irrigation time frames presented in the table below. These time frames are suggestions which should be followed to reduce the potential for injury to vegetation irrigated with Sonar SRP treated water:

Application Site	Days After Application		
	Established Tree Crops	Established Row Crops/ Turf/Plants	Newly Seeded Crops/Seedbeds or Areas to be Planted Including Overseeded Golf Course Greens
[1]Ponds and Static Canals	7	30	30
Canals	7	7	30
Rivers	7	7	7
[2]Lakes and Reservoirs	7	7	7

[1]For purposes of Sonar SRP labeling, a pond is defined as a body of water 10 acres or less in size. A lake or reservoir is greater than 10 acres.

[2]In lakes and reservoirs where one-half or greater of the body of water is treated, use the pond and static canal irrigation restrictions.

Weed Control Information

Vascular Aquatic Plants Controlled by Sonar SRP:

Submersed Plants:

- Bladderwort (*Utricularia* spp.)
- Common coontail (*Ceratophyllum demersum*)
- Common Elodea (*Elodea canadensis*)
- Egeria, Brazilian Elodea (*Egeria densa*)
- Fanwort, Cabomba (*Cabomba caroliniana*)
- Hydrilla (*Hydrilla verticillata*)
- Naiad (*Najas* spp.)
- Pondweed (*Potamogeton* spp., except Illinois pondweed)
- Watermilfoil (*Myriophyllum* spp.)

Shoreline Grasses:

- Paragrass (*Brachiaria mutica*)

Vascular Aquatic Plants Partially Controlled by Sonar SRP:

- Alligatorweed (*Alternanthera philoxeroides*)
- American lotus (*Nelumbo lutea*)
- Cattail (*Typha* spp.)
- Creeping Waterprimrose (*Ludwigia peploides*)
- Giant cutgrass (*Zizaniopsis miliacea*)
- Illinois pondweed (*Potamogeton illinoensis*)
- Parrotfeather (*Myriophyllum brasiliense*)
- Reed Canarygrass (*Philaris arundinaceae*)
- Smartweed (*Polygonum* spp.)
- Spatterdock (*Nuphar luteum*)
- Spikerush (*Eleocharis* spp.)
- Southern watergrass (*Hydrochloa caroliniensis*)
- Torpedograss (*Panicum repens*)
- Waterlily (*Nymphaea* spp.)
- Waterpurslane (*Ludwigia palustris*)
- Watershield (*Brasenia schreberi*)

Vascular Aquatic Plants Not Controlled by Sonar SRP:

Algae (*Chara* and *Nitella*)
American frogbit (*Limnobium spongia*)
Arrowhead (*Sagittaria* spp.)
Bacopa (*Bacopa* spp.)
Big floatingheart, Banana Lily (*Nymphoides aquatica*)
Bulrush (*Scirpus* spp.)
Floating waterhyacinth (*Eichhornia crassipes*)
Maidencane (*Panicum hemitomon*)
Pickerelweed, lanceleaf (*Pontederia cordata*)
Rush (*Juncus* spp.)
Tapegrass, American Eelgrass (*Vallisneria americana*)
Waterlettuce (*Pistia stratiotes*)
Water pennywort (*Hydrocotyle umbellata*)

Application Directions

The aquatic plants present in the treatment site should be identified prior to application to determine their susceptibility to Sonar SRP. It is important to determine the area (acres) to be treated and the average depth in order to select the proper application rate. Do not exceed the maximum labeled rate for a given treatment site per annual growth cycle.

Application to Ponds

Sonar SRP may be applied to the entire surface area of a pond. Rates may be selected which are equivalent to addition of 0.06 to 0.09 ppm of active ingredient to the treated water, although actual concentrations in treated water may be substantially lower at any point in time due to the slow-release formulation of this product. Application rates of Sonar SRP necessary to obtain these active ingredient equivalents in treated water are shown in the following table. When average water depth of the treatment site is greater than 5 feet, apply 20 to 30 pounds of Sonar SRP per treated surface acre.

Average Water Depth of Treatment Site (feet)	Pounds of Sonar SRP per Treated Surface Acre
1	3.2 - 5
2	6.5 - 10
3	10 - 15
4	13 - 20
5	16 - 25

Use the higher rate within the rate range where there is a dense weed mass or when treating more difficult to control species.

Application to Lakes and Reservoirs

For best results in lakes and reservoirs, Sonar SRP treatment areas should be a minimum of 5 acres in size. Treatment of areas smaller than 5 acres or treatment of narrow strips such as boat lanes or shorelines may not produce satisfactory results due to dilution by untreated water. In lakes and reservoirs, do not apply Sonar SRP within one-fourth mile (1320 feet) of any functioning potable water intake.

Rates may be selected which are equivalent to addition of 0.075 to 0.15 ppm of active ingredient to the treated water, although actual concentrations in treated water may be substantially lower at any point in time due to the slow-release formulation of this product. Application rates of Sonar SRP necessary to obtain these active ingredient equivalents in treated water are shown in the following table. When average water depth of the treatment site is greater than 10 feet, apply 60 to 80 pounds of Sonar SRP per treated surface acre.

Average Water Depth of Treatment Site (feet)	Pounds of Sonar SRP per Treated Surface Acre
1	4 - 8
2	8 - 16
3	12 - 24
4	16 - 32
5	20 - 40
6	24 - 48
7	28 - 56
8	32 - 64
9	36 - 72
10	40 - 80

Use the higher rate within the rate range where there is a dense weed mass or when treating more difficult to control species.

Application Rate Calculation - Ponds, Lakes and Reservoirs

The amount of Sonar SRP to be applied to provide the desired ppm concentration of active ingredient equivalents in treated water may be calculated as follows:

Pounds of Sonar SRP required per treated acre = Average water depth of treatment site x Desired ppm concentration of active ingredient equivalents x 54

For example, the pounds per acre of Sonar SRP required to provide a concentration of 0.075 ppm of active ingredient equivalents in water with an average depth of 5 feet is calculated as follows:

5 x 0.075 x 54 = 20 pounds per treated surface acre.

Note: Calculated rates should not exceed the maximum allowable rate in pounds per treated surface acre for the water depth listed in the application rate table for the site to be treated.

Application to Drainage Canals, Irrigation Canals and Rivers

In drainage canals, irrigation canals and rivers, Sonar SRP should be applied a the rate of 40 pounds per treated surface acre. Where water retention is possible, the performance of Sonar SRP will be enhanced by restricting water flow. In slow moving bodies of water, use an application pattern that will provide a uniform distribution and avoid concentration of the herbicide.

WARRANTY DISCLAIMER

DowElanco warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. **DowElanco makes no other express or implied warranty of merchantability or fitness for a particular purpose or any other express or implied warranty.**

INHERENT RISKS OF USE

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to the label instructions (including conditions noted on the label, such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of DowElanco or the seller. All such risks shall be assumed by the buyer.

LIMITATION OF REMEDIES

The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at DowElanco's election, one of the following:

(1) Refund of purchase price paid by buyer or user for product bought, or
(2) Replacement of amount of product used.

DowElanco shall not be liable for losses or damages resulting from handling or use of this product unless DowElanco is promptly notified of such loss or damage in writing. In no case shall DowElanco be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer above and this Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of DowElanco or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or this Limitation of Remedies in any manner.

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DowElanco • Indianapolis, IN 46268, U.S.A

LABEL CODE 113-36-004 DATE CODE 892
EPA APPROVAL 07/21/92

Revisions Include:
1. Sonar SRP label reformatted and edited for clarity.
2. Precautionary Statements and Environmental Hazards sections updated.
3. Use prohibition in areas used for crayfish farming removed.
4. Weeds (plants) controlled section revised and plants "not controlled" by Sonar SRP added.
5. Application rate recommendations for ponds, lakes and reservoirs refined to provide more accurate control of herbicide concentrations in water.
6. Added DowElanco Warranty and Disclaimer, Inherent Risks of Use, and Limitation of Remedies sections.
7. Precautions section revised as per EPA request.

Material Safety Data Sheet

DowElanco

Emergency Phone: 517-636-4400
General Phone: 1-800-352-6776

EPA Reg. Number: 62719-124
Effective Date: February 19, 1993
Product Code: 20158
MSDS Number: 004000
DowElanco - Indianapolis, IN 46268

SONAR* A.S. Herbicide

1. INGREDIENTS: (% w/w, unless otherwise noted)

1-Methyl-3-phenyl-5-(3-(trifluoro-methyl)phenyl)-4 (1H)-pyridinone (Fluridone)
CAS# 059756-60-4 .... 41.7%

Other Ingredients, total, including: 58.3%
Proprietary surfactants
Propylene glycol . . . CAS# 000057-55-6
Water . . . CAS# 007732-18-5

This document is prepared pursuant to the OSHA Hazard ommunication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

2. PHYSICAL DATA:

BOILING POINT: (@ 1 atmosphere) 212°F, 100°C

VAP. PRESS: 2.3 mm Hg at 25°C

VAP. DENSITY: 1.178 relative to air at 25°C

SOL. IN WATER: Disperses in water

SP. GRAVITY: 1.15 at 25°C

APPEARANCE: Light tan to gray opaque liquid

ODOR: Slight odor

pH: (aqueous 50/50) 8.45

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: Greater than 200°F, 93.3°C

METHOD USED: SCC

FLAMMABLE LIMITS:
LFL: Not applicable
UFL: Not applicable

AUTO-IGNITION TEMPERATURE: Not applicable

EXTINGUISHING MEDIA: SONAR A.S. is a water based suspension and will not burn. If product is involved in fire and water has evaporated, use water fog, CO2, dry chemical, or foam.

FIRE AND EXPLOSION HAZARDS: This product will not burn until a sufficient amount of water has evaporated. At this point, the product will exhibit the flammability characteristics of the organic portion of this formulation. Keep unnecessary people away; isolate hazard area and deny unnecessary entry. Highly toxic fumes are released in fire situations.

FIRE-FIGHTING EQUIPMENT: Wear positive-pressure, self-contained breathing apparatus and full protective equipment.

4. REACTIVITY DATA:

STABILITY: (CONDITIONS TO AVOID) None known

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) None known

HAZARDOUS DECOMPOSITION PRODUCTS: If product is allowed to dry, will emit toxic vapors as it burns.

HAZARDOUS POLYMERIZATION: Does not occur.

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ENVIRONMENTAL DATA: Follow use directions carefully so as to avoid adverse effects on nontarget organisms. In order to avoid impact on threatened or endangered aquatic plant or animal species, users must consult their state fish and game agency or the U.S. Fish and Wildlife Service before making applications. Do not contaminate water when disposing of equipment washwaters. Trees and shrubs growing in water treated with Sonar A.S. may occasionally develop chlorosis. Do not apply in tidewater or brackish waters. Lowest rates should be used in shallow areas where the water depth is considerably less than the average depth of the entire treatment site, for example, shallow shoreline areas.

ACTION TO TAKE FOR SPILLS: Use absorbent material to contain and clean up small spills and dispose as waste. Large spills report to CHEMTREC and DowElanco for assistance. Prevent runoff.

DISPOSAL METHOD: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

6. HEALTH HAZARD DATA:

EYE: May cause slight transient (temporary) eye irritation. Corneal injury is unlikely.

SKIN CONTACT: Prolonged exposure may cause slight skin irritation. Did not cause allergic skin reactions when tested in guinea pigs.

SKIN ABSORPTION: A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts. The LD50 for skin absorption in rabbits is greater than 2000 mg/kg.

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DowElanco

Emergency Phone: 517-636-4400
General Phone: 1-800-352-6776

SONAR* A.S. Herbicide

EPA Reg. Number: 62719-124
Effective Date: February 19, 1993
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DowElanco • Indianapolis, IN 46268

INGESTION: Single dose oral toxicity is low. The oral LD50 for rats is greater than 500 mg/kg. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury.

INHALATION: At room temperature, vapors are minimal due to physical properties; a single exposure is not likely to be hazardous.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: In chronic toxicity studies in animals, fluridone has been shown to cause liver and kidney effects.

CANCER INFORMATION: The components did not cause cancer in long-term animal studies.

TERATOLOGY (BIRTH DEFECTS): In animal studies on some of the components (including fluridone), this product did not cause birth defects; for fluridone, other fetal effects occurred only at doses toxic to the mother.

MUTAGENICITY (EFFECTS ON GENETIC MATERIAL): For fluridone, results of mutagenicity tests in animals have been negative; results of a battery of in-vitro mutagenicity tests, except for one, have also been negative. Based on these results and the lack of carcinogenic response in long term studies, fluridone is not considered to be mutagenic.

7. FIRST AID:

EYES: Flush eyes with plenty of water. Get medical attention if irritation persists.

SKIN: Flush skin with plenty of water. Get medical attention if irritation persists.

INGESTION: Call a physician or poison control center. Drink one or two glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.

INHALATION: Move victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

8. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINE(S): Propylene glycol: AIHA WEEL is 50 ppm total, 10 mg/m3 aerosol only.

VENTILATION: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. If respiratory irritation is experienced, use an approved air-purifying respirator.

SKIN PROTECTION: For brief contact, no precautions other than clean body-covering clothing should be needed. Use chemically-resistant gloves when prolonged or frequently-repeated contact could occur. Wash thoroughly with soap and water after handling. Wash exposed clothing before reuse.

EYE PROTECTION: Use safety glasses.

9. ADDITIONAL INFORMATION:

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Keep out of reach of children. Harmful if swallowed, absorbed through skin, or if inhaled. Avoid breathing of spray mist or contact with skin, eyes, or clothing.

MSDS STATUS: Revised sections 1, 3, 5, 6, 7, 8, 9, and reg sheet.

REGULATORY INFORMATION:

(Not meant to be all-inclusive—selected regulations represented).

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See MSD Sheet for health and safety information.

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard

TOXIC SUBSTANCES CONTROL ACT (TSCA): All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in Section 1 of the MSDS.

Material Safety Data Sheet

DowElanco

Emergency Phone: 517-636-4400
General Phone: 1-800-352-6776

EPA Reg. Number: 62719-124
Effective Date: February 19, 1993
Product Code: 20158
MSDS Number: 004000
DowElanco • Indianapolis, IN 46268

SONAR* A.S. Herbicide

CHEMICAL NAME	CAS NUMBER	LIST
1,2-PROPANEDIOL	000057-55-6	PA1

PA1=Pennsylvania Hazardous Substance
(present at greater than or equal to 1.0%).

OSHA HAZARD COMMUNICATION STANDARD:
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

Category	Rating
Health	1
Flammability	0
Reactivity	0

DowElanco
Indianapolis, IN 46268-1189

DowElanco

Material Safety Data Sheet

DowElanco   Indianapolis, IN 46268   Emergency Phone: 517-636-4400

Product Code: 20159   Page: 1

Product Name: SONAR (R) SRP HERBICIDE

Effective Date: 01/27/92 Date Printed: 05/26/93   MSDS:004001

1. INGREDIENTS: (% w/w, unless otherwise noted)

1-Methyl-3-phenyl-5-(3-(trifluoro-methyl)phenyl)-4(1H)-pyridinone (Fluridone)	CAS# 059756-60-4	5%
Other Ingredients		95%

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

2. PHYSICAL DATA:

BOILING POINT: Not applicable
VAP. PRESS: Not applicable
VAP. DENSITY: Not applicable
SOL. IN WATER: Insoluble, but disintegrates in water
SP. GRAVITY: Not applicable
APPEARANCE: Dark gray to dark brown pellet
ODOR: Faint musty odor
pH: (aqueous 50/50) 3.5

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: Not applicable
METHOD USED: Not applicable

FLAMMABLE LIMITS
LFL: Not applicable
UFL: Not applicable

AUTO-IGNITION TEMPERATURE: No ignition up to 1382F, 750C

EXTINGUISHING MEDIA: Use water, CO2 or dry chemicals.

FIRE AND EXPLOSION HAZARDS: Will emit toxic vapors as it burns.

FIRE-FIGHTING EQUIPMENT: Wear full protective clothing and use

(*) Indicates a Trademark Of DowElanco

3. FIRE AND EXPLOSION HAZARD DATA: (CONTINUED)

self-contained breathing apparatus.

4. REACTIVITY DATA:

STABILITY: (CONDITIONS TO AVOID) None known

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) None known

HAZARDOUS DECOMPOSITION PRODUCTS: Will emit toxic vapors as it burns.

HAZARDOUS POLYMERIZATION: Does not occur.

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ENVIRONMENTAL DATA: Follow use directions carefully so as to minimize adverse effects on nontarget organisms. IN ORDER TO AVOID IMPACT ON THREATENED OR ENDANGERED AQUATIC PLANT OR ANIMAL SPECIES, USERS MUST CONSULT THEIR STATE FISH AND GAME AGENCY OR THE U.S. FISH AND WILDLIFE SERVICE BEFORE MAKING APPLICATIONS. Do not contaminate water by cleaning of equipment or disposal of wastes. Trees and shrubs growing in water treated with SONAR may be injured. Do not apply in tidewater or brackish water. Do not apply in lakes, ponds, or other bodies of water where crayfish farming is performed.

ACTION TO TAKE FOR SPILLS: Contain and sweep up material of small spills and dispose as waste. Large spills report to CHEMTREC and DowElanco for assistance. Prevent runoff.

DISPOSAL METHOD: Do not contaminate water, food or feed by storage or disposal. Wastes resulting from the use of this product may be disposed of at an approved waste disposal facility in accordance with applicable regulations.

6. HEALTH HAZARD DATA:

ACUTE EXPOSURE (SONAR SRP)
Eyes - Rabbit, irritant
Skin - Rabbit, 2000 mg/kg, no deaths or toxicity, nonirritant
Inhalation - This formulation is not considered to be an inhalation hazard due to pelleted nature of material

7. FIRST AID: (CONTINUED)

ly transport to a medical care facility and see a physician.

INHALATION: If discomfort occurs, move individual to fresh air. If breathing difficulty occurs, get medical attention. If not breathing, provide cardiopulmonary resuscitation assistance and get medical attention immediately.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: No information available.

8. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINE(S): PEL and TLV not established.

VENTILATION: Good general ventilation should be sufficient for most conditions.

RESPIRATORY PROTECTION: No respiratory protection should be needed when used in accordance with label instructions.

SKIN PROTECTION: No precautions other than normal work clothing should be needed.

EYE PROTECTION: Use safety glasses.

9. ADDITIONAL INFORMATION:

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Keep out of reach of children. Harmful if swallowed, absorbed through skin, or if inhaled. Avoid breathing of dust or contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling. Wash exposed clothing before reuse.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA 704)
(4=Extreme; 3=High; 2=Moderate; 1=Slight; 0=Insignificant)
Health: 2
Flammability: 1
Reactivity: 0

SHIPPING REQUIREMENTS
DOT Hazard Class: Not regulated.

(*) Indicates a Trademark Of DowElanco

REGULATORY INFORMATION: (Not meant to be all-inclusive--selected regulations represented.)

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See MSD Sheet for health and safety information.

U.S. REGULATIONS

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard

6. HEALTH HAZARD DATA: (CONTINUED)

Ingestion - Rat, 500 mg/kg, no deaths or toxicity
Sensitization - This formulation was not tested. Fluridone technical is not a contact sensitizer in guinea pigs.

CHRONIC EXPOSURE (Fluridone Technical)
The following effects were reported in chronic, teratogenic, and reproductive toxicity studies in laboratory animals where experimental dosage levels and durations of exposure were far in excess of those likely to occur in humans.
Chronic Toxicity - Decreased survival in lifetime feeding study. Increased liver enzyme activity, liver weight, liver cell size, and microscopic liver cell changes. Increased kidney weights, and microscopic kidney cell changes. Increased serum enzyme levels.
Teratology & Reproduction - Not teratogenic. Fetal deaths at maternally toxic doses. No effects on reproductive performance.
Mutagenicity - Not mutagenic in either bacterial or mammalian cells.
Carcinogenicity - Not listed as a carcinogen or potential carcinogen by IARC, NCI/NTP, OSHA, or ACGIH. Not considered to be carcinogenic in lifetime feeding studies.

SIGNS AND SYMPTOMS OF EXPOSURE: There are no reports of significant exposure to SONAR SRP. In two reports of children swimming in water treated with SONAR, no symptoms developed.

PRIMARY ROUTES OF ENTRY: Skin and inhalation.

7. FIRST AID:

EYES: Flush eyes with plenty of water and call a physician if irritation develops.

SKIN: Wash exposed areas with plenty of soap and water. Wash all contaminated clothing before reuse. Call a physician if irritation develops.

INGESTION: Do not induce vomiting. Call a physician or Poison Control Center. If available, administer activated charcoal (6-8 heaping teaspoonfuls) with a large quantity of water. Do not give anything by mouth to an unconscious person. Immediate-

9. ADDITIONAL INFORMATION: (CONTINUED)

MSDS STATUS: Revised 1/92, Section 8

APPENDIX B

APPROVED LABELS FOR RODEO® AND ACCORD® HERBICIDES

accord
HERBICIDE

Monsanto

Complete Directions for Use in Forestry and Utility Rights-of-Way.

EPA Reg. No. 524-326-AA

AVOID CONTACT WITH FOLIAGE, GREEN STEMS, OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, SINCE SEVERE INJURY OR DESTRUCTION MAY RESULT.

This product has been approved for use in California except as stated otherwise on page 28.

1989-2 892.65-000.28/CG

Read the entire label before using this product.

Use only according to label instructions.

Read "LIMIT OF WARRANTY AND LIABILITY" before buying or using. If terms are not acceptable, return at once unopened.

REFORMULATION IS PROHIBITED. SEE CONTAINER LABEL FOR REPACKAGING LIMITATIONS.

LIMIT OF WARRANTY AND LIABILITY

This Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes set forth in the Complete Directions for Use label booklet ("Directions") when used in accordance with those Directions under the conditions described therein. NO OTHER EXPRESS WARRANTY OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. This warranty is also subject to the conditions and limitations stated herein.

Buyer and all users shall promptly notify this Company of any claims whether based in contract, negligence, strict liability, other tort or otherwise.

Buyer and all users are responsible for all loss or damage from use or handling which results from conditions beyond the control of this Company, including, but not limited to, incompatibility with products other than those set forth in the Directions, application to or contact with desirable vegetation, unusual weather, weather conditions which are outside the range considered normal at the application site and for the time period when the product is applied, as well as weather conditions which are outside the application ranges set forth in the Directions, application in any manner not explicitly set forth in the Directions, moisture conditions outside the moisture range specified in the Directions, or the presence of products other than those set forth in the Directions in or on the soil, crop, or treated vegetation.

THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF THE LIABILITY OF THIS COMPANY OR ANY OTHER SELLER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT (INCLUDING CLAIMS BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE) SHALL BE THE PURCHASE PRICE PAID BY THE USER OR BUYER FOR THE QUANTITY OF THIS PRODUCT INVOLVED, OR, AT THE ELECTION OF THIS COMPANY OR ANY OTHER SELLER, THE REPLACEMENT OF SUCH QUANTITY, OR, IF NOT ACQUIRED BY PURCHASE, REPLACEMENT OF SUCH QUANTITY. IN NO EVENT SHALL THIS COMPANY OR ANY OTHER SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

Buyer and all users are deemed to have accepted the terms of this LIMIT OF WARRANTY AND LIABILITY which may not be varied by any verbal or written agreement.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

Keep out of reach of children.

CAUTION!

MAY CAUSE EYE IRRITATION.

Avoid contact with eyes, skin or clothing.

Wash thoroughly with soap and water after handling.

FIRST AID: IF IN EYES, flush with plenty of water for at least 15 minutes. Get medical attention.

IF ON SKIN, flush with water. Wash clothing before reuse.

In case of an emergency involving this product, Call Collect, day or night, (314) 694-4000.

Environmental Hazards

Do not contaminate water when disposing of equipment washwaters. Treatment of aquatic weeds can result in oxygen loss from decomposition of dead plants. This loss can cause fish suffocation.

In case of:

SPILL or LEAK, soak up and remove to a landfill.

Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied only in stainless steel, aluminum, fiberglass, plastic and plastic-lined steel containers.

DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED STEEL OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

ACTIVE INGREDIENT:	
*Glyphosate, N-(phosphonomethyl) glycine, in the form of its isopropylamine salt	41.5%
INERT INGREDIENTS:..................	58.5%
	100.0%

*Contains 480 grams per litre or 4 pounds per U.S. gallon of glyphosate, N-(phosphonomethyl) glycine, in the form of the isopropylamine salt. Equivalent to 356 grams per litre or 3 pounds per U.S. gallon of the acid, glyphosate.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in any manner inconsistent with its labeling.

Storage and Disposal

Do not contaminate water, foodstuffs, feed or seed by storage or disposal.

STORAGE:

STORE ABOVE 10°F (−12°C) TO KEEP PRODUCT FROM CRYSTALLIZING.

Crystals will settle to the bottom. If allowed to crystallize, place in a warm room 68°F (20°C) for several days to redissolve and roll or shake container or recirculate in mini-bulk containers to mix well before using. For bulk containers, see container label.

DISPOSAL:

Wastes resulting from the use of this product that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticide disposal or in accordance with ; pplicable Federal, state or local procedures.

Emptied container retains vapor and product residue. Observe all labeled safeguards until container is cleaned, reconditioned or destroyed.

(See the individual container label for disposal information.)

GENERAL INFORMATION

This product, a water soluble liquid, mixes readily with water and nonionic surfactant to be applied as a foliar spray for the control or destruction of most herbaceous and woody plants.

This product moves through the plant from the point of foliar contact to and into the root system. Visible effects on most herbaceous weeds occur within 7 days but on most woody plants may not occur for 30 days or more.

After any site disturbance, such as logging, mechanical brush removal or mowing, allow stump sprouts, resprouts and foliar regrowth from woody brush and perennial herbaceous weeds sufficient time to regrow before treatment.

Always use the higher recommended rates of this product and surfactant when treating dense, multicanopied sites of woody vegetation or difficult-to-control woody and herbaceous plants.

Reduced control may result when woody brush, trees and herbaceous weeds are treated under poor growing conditions caused by drought, disease or insect damage. Reduced control may result if the foliage of undesirable vegetation is covered with dust at the time of treatment.

Rainfall occurring within 6 hours after application may reduce effectiveness. Heavy rainfall within 2 hours after application may wash the product off the foliage and a repeat treatment may be required.

Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of this product with herbicides or other materials that are not expressly recommended in this label. Mixing this product with herbicides or other materials not recommended on this label may result in reduced performance.

FORESTRY SITE PREPARATION AND UTILITY RIGHTS-OF-WAY

This product is recommended for the control or partial control of woody brush, trees and herbaceous weeds. This product is labeled for use in forestry and utility sites, including utility rights-of-way. This product is also recommended for use in preparing or establishing wildlife openings and maintaining logging roads.

In forestry, this product is recommended for use in site preparation prior to planting any tree species, including Christmas trees and silvicultural nursery sites.

In utility rights-of-way, this product is recommended for use along power, pipeline, telephone and in other utility sites such as substations, etc.

APPLICATION RATES AND TIMING

BROADCAST	ACCORD®	SPRAY VOLUME GAL./A
Aerial	2 to 5 qts/a	5 to 30
Ground	2 to 5 qts/a	10 to 60
SPRAY-TO-WET		
Handgun, Backpack, Mistblower	3/4 to 2% by volume	spray-to-wet

In forestry site preparation and utility rights-of-way applications, this product requires use with a nonionic surfactant. Use a nonionic surfactant labeled for use with herbicides. Use of this product without surfactant will result in reduced performance. See the "MIXING AND APPLICATION INSTRUCTIONS" section of this label for more information.

For surfactants with greater than 50 percent active ingredient, mix 2 or more quarts of the nonionic surfactant per 100 gallons of spray solution (0.5 percent or more by spray volume). Use of surfactant concentrations greater than 1.5 percent by spray volume with handgun applications or 2.5 percent by spray volume with broadcast applications is not recommended.

For surfactants with up to 50 percent active ingredient, mix 4 or more quarts of the nonionic surfactant per 100 gallons of spray solution (1 percent or more by spray volume). Use of surfactant concentrations greater than 3 percent by spray volume with handgun applications or 5 percent by spray volume with broadcast applications is not recommended.

Less than complete coverage of weeds may result from the use of spray equipment designed for motorized spot treatments. Where less than complete coverage occurs, use a 5 percent solution.

For low volume mistblower applications, up to a 5 percent solution may be used.

Use higher rates of this product within the recommended range for control or partial control of woody brush, trees and hard-to-control perennial herbaceous weeds. Increase rates within the recommended range for control of perennial herbaceous weeds any time after emergence. For best results, apply to actively growing woody brush and trees after full leaf expansion and before fall color and leaf drop.

Use the lower rates of this product within the recommended range for control of annual herbaceous weeds. Apply to the foliage of actively growing annual herbaceous weeds any time after emergence. For best results, apply to the actively growing foliage of perennial herbaceous weeds after seedheads, flowers or berries appear.

This product has no herbicidal or residual activity in the soil. Where repeat applications are necessary, do not exceed 10.6 quarts of this product per acre per year.

FORESTRY CONIFER RELEASE

POSTDIRECTED SPRAY

In established forestry conifer sites, including Christmas tree plantations and silvicultural nurseries, use a 2 percent spray solution for the control of undesirable woody brush and trees. To control herbaceous weeds, use a 1 to 2 percent solution. Avoid contact of spray, drift or mist with foliage or green bark of desirable species.

For surfactants with greater than 50 percent active ingredient, mix 2 or more quarts of the nonionic surfactant per 100 gallons of spray solution (0.5 percent or more by spray volume). Use of surfactant concentrations greater than 1.5 percent by spray volume with handgun applications or 2.5 percent by spray volume with broadcast applications is not recommended.

For surfactants with up to 50 percent active ingredient, mix 4 or more quarts of the nonionic surfactant per 100 gallons of spray solution (1 percent or more by spray volume.) Use of surfactant concentrations greater than 3 percent of spray volume with handgun applications or 5 percent by spray volume with broadcast applications is not recommended.

CONIFER RELEASE

Except where specifically recommended below, use only where conifers have been established for more than one year.

APPLICATION MUST BE MADE AFTER FORMATION OF FINAL CONIFER RESTING BUDS IN THE FALL OR PRIOR TO INITIAL BUD SWELLING IN THE SPRING.

Injury may occur to conifers treated for release, especially where spray patterns overlap or the higher rates are applied. Damage can be accentuated if applications are made when conifers are actively growing, or are under stress from drought, flood water, insects or diseases.

This product may require use with a nonioni : surfactant. For best results, tank-mix Accord herbicide with Entry™ II surfactant. Follow the instructions under the "Mixing" portion of the "MIXING AND APPLICATION INSTRUCTIONS" section of this label.

For release of the following conifer species, outside the southeastern United States:

Douglas fir *Pseudotsuga menziesii*	**Pine*** *Pinus spp.*
Fir *Abies spp.*	**Spruce** *Picas spp.*
Hemlock** *Tsuga spp.*	

*Includes all species except eastern white pine, loblolly pine, longleaf pine, shortleaf pine or slash pine.

**Use of additional surfactant is not recommended for release of hemlock species. In mixed conifer stands, injury to hemlock may result if a surfactant is used.

Apply 1 to 2 quarts of this product per acre as a broadcast spray.

In Washington and Oregon, use only where conifers have been established for at least one growing season.

To release jack pine, red pine, white pine, and white spruce, apply 1 to 2 quarts of this product with 2 ounces of Oust™ per acre. Make applications to actively growing weeds as a broadcast spray over the top of established conifers. Applications at these rates should be made after formation of conifer resting buds in the late summer or fall.

For best results, mix up to 10 fluid ounces of Entry II per quart of Accord herbicide applied per acre. Injury may occur to conifers treated with greater than 20 fluid ounces per acre of Entry II, especially where spray patterns overlap. Where conifer injury may be a concern, do not exceed 20 fluid ounces per acre of Entry II.

NOTE: In the coastal range and at elevations below 1500 feet in Washington and Oregon, conifer injury may result when rates of Entry II exceed 10 fluid ounces per acre for conifer release. When conifer injury may be a concern in these designated areas, use of Entry II at rates greater than 10 fluid ounces per acre is not recommended.

For release of the following conifer species in the southeastern United States:

Loblolly pine *Pinus taeda*	**Slash pine** *Pinus elliottii*
Eastern white pine *Pinus strobus*	

Apply 1.5 to 2.5 quarts of this product per acre as a broadcast spray during late summer or early fall after the conifers have hardened off.

In the southeastern United States, mix up to 20 fluid ounces per acre of Entry II with the recommended rate of Accord.

Always read and follow the manufacturer's label recommendations for all herbicides and surfactants used.

HERBACEOUS RELEASE

When applied as directed, this product plus Oust provides postemergence control of the annual weeds and control or suppression of the perennial weeds listed in this label, and residual control of the weeds listed in the Oust™ label. Make applications to actively growing weeds as a broadcast spray over the top of the newly established or established conifers.

To release loblolly pines, apply 16 to 24 ounces of this product, plus 2 to 4 ounces of Oust per acre.

To release slash pines, apply 12 to 16 ounces of this product, plus 2 to 4 ounces of Oust per acre.

Mix up to 6 fluid ounces per acre of Entry II with the recommended rate of Accord plus Oust tank mixtures.

Weed control may be reduced if water volumes exceed 25 gallons per acre for these treatments.

Always read and follow the manufacturer's label recommendations for all herbicide and surfactants used.

NOTE

Except where specifically prohibited, a nonionic surfactant with up to 50 percent active ingredient may be used at the same rates as are given for Entry II for conifer release or herbaceous release applications. When using a nonionic surfactant with greater than 50 percent active ingredient, use one-half the amount recommended for Entry II.

Use a nonionic surfactant labeled for use with herbicide

For conifer release or herbaceous release applications, do not mix more than one surfactant with Accord.

™Oust is a trademark of E.I. du Pont de Nemours and Company.

™Entry is a trademark of Monsanto Company.

WETLAND SITES

This product may be used in and around water and wetland found in forestry and utility rights-of-way sites, including land adjacent to and surrounding domestic water supply reservoirs, supply streams, lakes and ponds. Read and observe the following before making applications in and around water.

Consult local public water control authorities before applying this product in and around public water. Permits may be required to treat in such areas.

There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.

Do not apply this product directly to water within 1/2 mile upstream of a potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 mile of a potable water intake in a standing body of water such as a lake, pond or reservoir. This restriction does not apply to terrestrial applications made adjacent to potable water intakes.

Do not spray across open moving bodies of water where woody brush, trees and herbaceous weeds do not exist. The maximum application rate of 5 quarts per acre must not be exceeded in a single application.

MIXING AND APPLICATION INSTRUCTIONS

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES. HANDGUN APPLICATIONS SHOULD BE PROPERLY DIRECTED TO AVOID SPRAYING DESIRABLE PLANTS. NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, such as WATER FROM PONDS AND UNLINED DITCHES.

MIXING

This product mixes readily with water. Mix spray solutions of this product as follows: Fill the mixing or spray tank with the required amount of water while adding the required amount of this product (see the "DIRECTIONS FOR USE" and "WEEDS CONTROLLED" sections of this label). Near the end of the filling process, add the required surfactant and mix well. Remove hose from tank immediately after filling to avoid siphoning back into the water source. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, place the filling hose below the surface of the spray solution, terminate by-pass and return lines at the bottom of the tank and, if needed, use an approved antifoam or defoaming agent.

APPLICATION EQUIPMENT AND TECHNIQUES

ATTENTION

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift, or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants, or other areas on which treatment was not intended. The likelihood of plant or crop injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) which are likely to drift. AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.

NOTE: Use of this product in any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences. When not in use, keep container closed to prevent spills and contamination.

■ AERIAL EQUIPMENT ■

This product is recommended for application by helicopter only in forestry sites and utility rights-of-way. Use the recommended rates of this product and surfactant in 5 to 30 gallons of clean water per acre as a broadcast spray. (ACCORD PLUS OUST TANK MIXTURE MAY NOT BE APPLIED BY AIR IN CALIFORNIA.)

IN CALIFORNIA, AERIAL APPLICATION MAY ONLY BE MADE IN NONRESIDENTIAL, FORESTRY SITES AND CHAPPARAL AREAS.

AVOID DRIFT — DO NOT APPLY DURING INVERSION CONDITIONS, WHEN WINDS ARE GUSTY, OR UNDER ANY OTHER CONDITION WHICH WILL ALLOW DRIFT; DRIFT MAY CAUSE DAMAGE TO ANY VEGETATION CONTACTED TO WHICH TREATMENT IS NOT INTENDED. TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Coarse sprays are less likely to drift; therefore, do not use nozzles or nozzle configurations which dispense spray as fine droplets.

Drift control additives may be used for forestry site preparation and utility rights-of-way applications. DO NOT USE DRIFT CONTROL ADDITIVES FOR CONIFER RELEASE OR HERBACEOUS RELEASE APPLICATIONS. When a drift control additive is used, read and carefully observe the cautionary statements and all other information appearing on the additive label.

Thoroughly wash aircraft, especially landing gear, after each day of spraying to remove residues of this product accumulated during spraying or from spills. PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. LANDING GEAR ARE MOST SUSCEPTIBLE. The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion.

■ GROUND BROADCAST EQUIPMENT ■

This product is recommended for broadcast applications using suitable ground equipment in forestry sites, utility sites and utility rights-of-way. Use the recommended rates of this product plus surfactant in 10 to 60 gallons of clean water per acre as a broadcast spray. Check for even spray distribution throughout the spray pattern.

■ BACKPACK, HANDGUN OR MISTBLOWER EQUIPMENT ■

This product is recommended for application through backpack, handgun or hand-held mistblower equipment. Use the recommended rates of this product plus surfactant in clean water as a spray-to-wet application. Spray coverage should be uniform and complete, but not to the point of runoff. It is suggested that the recommended amount of this product and surfactant be mixed in a larger container and then added to the sprayer.

WEEDS CONTROLLED

When applied as recommended under the conditions described, this product CONTROLS, PARTIALLY CONTROLS or SUPPRESSES most woody brush, trees and herbaceous weeds, some of which are listed below.

WOODY BRUSH AND TREES

Alder
Alnus spp.

Ash
Fraxinus spp.

Aspen, quaking
Populus tremuloides

Bearmat (Bearclover)
Chamaebatia foliolosa

Beech
Fagus grandifolia

Birch
Betula spp.

Blackberry
Rubus spp.

Blackgum
Nyssa spp.

Bracken
Pteridium spp.

Broom:
French
Cytisus monspessulanus
Scotch
Cytisus scoparius

Buckwheat, California
Eriogonum fasciculatum

Cascara
Rhamnus purshiana

Catsclaw
Acacia greggi

Ceanothus
Ceanothus spp.

Chamise
Adenostoma fasciculatum

Cherry:
Bitter
Prunus emarginata
Black
Prunus serotina
Pin
Prunus pensylvanica

Coyote brush
Baccharis consanguinea

Creeper, Virginia
Parthenocissus quinquefolia

Dewberry
Rubus trivialis

Holly, Florida;
Brazilian Peppertree
Schinus terebinthifolius

Honeysuckle
Lonicera spp.

Kudzu
Pueraria lobata

Locust, black
Robinia pseudoacacia

Madrone
Arbutus menziesii

Manzanita
Arctostaphylos spp.

Maple
Acer spp.

Monkey Flower
Mimulus guttatus

Oak
Quercus spp.

Persimmon
Diospyros spp.

Pine
Pinus spp.

Poison Ivy
Rhus radicans

Poison Oak
Rhus toxicodendron

Poplar, yellow
Liriodendron tulipifera

Raspberry
Rubus spp.

Rose, multiflora
Rosa multiflora

Sage, black
Saliva mellifera

Sagebrush, California
Artemisia californica

Salmonberry
Rubus spectabilis

Saltbush, Sea myrtle
Baccaharis halimifolia

Sassafras
Sassafras albidum

Sourwood
Oxydendrum arboreum

Sumac
Rhus spp.

Sweet Gum
Liquidambar styraciflua

Elderberry
Sambucus spp.

Elm
Ulmus spp.

Eucalyptus, bluegum
Eucalyptus glotulus

Hasardia
Haplopappus squamosus

Hawthorn
Crataegus spp.

Hazel
Corylus spp.

Swordfern
Polystichum munitum

Tallowtree, Chinese
Sapium sebiferum

Tan Oak
Lithocarpus densiflorus

Thimbleberry
Rubus parviflorus

Tobacco, tree
Nicotiana glauca

Trumpetcreeper
Campsis radicans

Waxmyrtle, southern
Myrica cerifera

Willow
Salix spp.

HERBACEOUS WEEDS

Bahiagrass
Paspalum notatum

Balsamapple
Momordica charantia

Barnyardgrass
Echinochloa crus-galli

Bassia, fivehook
Bassia hyssopifolia

Bermudagrass
Cynodon dactylon

Bindweed, field
Convolvulus arvensis

Bluegrass, Kentucky
Poa pratensis

Brackenfern
Pteridium aquilinum

Brome
Bromus spp.

Bromegrass, smooth
Bromus inermis

Broomsedge
Andropogen spp.

Buttercup
Ranunculus spp.

Cheat
Bromus secalinus

Chickweed, mouseear
Cerastium vulgatum

Clover, red
Trifolium pratense

Clover, white
Trifolium repens

Cocklebur
Xanthium strumarium

Crabgrass
Digitaria spp.

Dallisgrass
Paspalum dilatatum

Dock, curly
Rumex crispus

Dwarfdandelion
Krigia cespitosa

Falseflax, smallseed
Camelina microcarpa

Lambsquarters, common
Chenopodium album

Lettuce, prickly
Lactuca serriola

Morningglory
Ipomoea spp.

Muhly, wirestem
Muhlenbergia frondosa

Mullein, common
Verbascum thapsus

Mustard, blue
Chorispora tenella

Mustard, tansy
Descurainia pinnata

Mustard, tumble
Sisymbrium altissimum

Mustard, wild
Sinapis arvensis

Napiergrass
Pennisetum purpureum

Nightshade, silverleaf
Solanum elaeagnifolium

Nutsedge: purple, yellow
Cyperus rotundus
Cyperus esculentus

Oats, wild
Avena fatua

Orchardgrass
Dactylis glomerata

Panicum
Panicum spp.

Pampasgrass
Cortaderia jubata

Pennycress, field
Thlaspi arvense

Pigweed, redroot
Amaranthus retroflexus

Pigweed, smooth
Amaranthus hybridus

Quackgrass
Agropyron repens

Ragweed, common
Ambrosia artemisiifolia

Fescue
Festuca spp.

Fiddleneck
Amsinckia spp.

Flaxleaf fleabane
Conyza bonariensis

Fleabane
Erigeron spp.

Foxtail
Setaria spp.

Groundsel, common
Senecio vulgaris

Guineagrass
Panicum maximum

Horsenettle
Solanum carolinese

Horseweed/Marestail
Conyza canadenis

Johnsongrass
Sorghum halepense

Kikuyugrass
Pennisetum clandestinum

Knapweed
Centaurea repens

Kochia
Kochia scoparia

Ragweed, giant
Ambrosia trifida

Ryegrass, perennial
Lolium perenne

Sandbur, field
Cenchrus spp.

Shepherdspurse
Capsella bursa-pastoris

Signalgrass, broadleaf
Brachiaria platyphylla

Smartweed, Pennsylvania
Polygonum pensylvanicum

Sowthistle, annual
Sonchus oleraceus

Spanishneedles
Bidens bipinnata

Spurry, umbrella
Holosteum umbellatum

Stinkgrass
Eragrostis cilianensis

Thistle, Canada
Cirsium arvense

Thistle, Russian
Salsola kali

Vaseygrass
Paspalum urvillei

Witchgrass
Panicum capillare

FORESTRY AND UTILITY RIGHTS-OF-WAY

INJECTION AND CUT STUMP APPLICATIONS

Woody brush and trees may be controlled using injection or cut stump applications of this product.

INJECTION APPLICATION

Apply the equivalent of 1 ml of this product for each 2 inches of trunk diameter. This is best achieved by applying 25 to 100 percent concentration of this product either to a continuous frill around the tree or as cuts evenly spaced around the tree below all branches. As tree diameter increases in size, better results are achieved by applying dilute product to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frill or cut areas in species that exude sap freely after frills or cutting. In species such as this, make frill or cut at an oblique angle so as to produce a cupping effect and use undiluted product. For best results, applications should be made during periods of active growth and after full leaf expansion.

CUT STUMP APPLICATION

Woody vegetation may be controlled by treating freshly cut stumps of trees and resprouts with this product. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut vegetation close to the soil surface. **Apply a 50 to 100 percent solution of this product to the freshly cut surface immediately after cutting.** Delay in applying this product will result in reduced performance. For best results, application should be made during periods of active growth and full leaf expansion.

When used according to directions for injection or cut stump application, this product will CONTROL, PARTIALLY CONTROL or SUPPRESS most woody brush and tree species, some of which are listed below:

Alder
Alnus spp.

Coyotebrush
Baccharis consanguinea

Dogwood
Cornus spp.

Eucalyptus
Eucalyptus spp.

Hickory
Carya spp.

Madrone
Arbutus menziesii

Maple
Acer spp.

Oak
Quercus spp.

Poplar
Populus spp.

Saltcedar
Tamarix spp.

Sweetgum
Liquidambar styraciflua

Sycamore
Platanus occidentalis

Tan oak
Lithocarpus densiflorus

Willow
Salix spp.

CALIFORNIA

Accord® herbicide has been approved by the U.S. Environmental Protection Agency for the uses, crops and sites listed on this label and by California under label designation 1989-1. Approval of the items listed below is pending under the State of California registration requirements. With the exception of these items, this booklet contains the material approved by California in label 1989-1.

These use conditions, crops and sites may not be treated with this product in California until approval is received.

- Use of any concentration other than 1 to 2 percent for spray-to-wet applications with handgun or backpack equipment.
- Hand-held mistblower equipment.
- Use of this product for control on the following species:

Beech	Pine
Broomsedge	Russian Olive

- Use of this product with Entry II surfactant.
- Use of this product for injection treatments on the following species:

Alder	Saltcedar
Coyotebrush	Tan Oak
Eucalyptus	Willow
Madrone	

- Use of this product for cut stump treatments on the following species:

Coyotebrush	Maple
Dogwood	Poplar
Hickory	Sycamore

Product protected by
U.S. Patent No. 3,799,758 and
U.S. Patent No. 4,405,531.
Other patents pending.

No license granted under any non-U.S. patent.

EPA Reg. No. 524-326-AA 892.65-000.28/CG

In case of an emergency involving this product, Call Collect, day or night (314) 694-4000.

MONSANTO COMPANY
AGRICULTURAL PRODUCTS
ST. LOUIS, MISSOURI, 63167 U.S.A.

166-89-L22

RODEO®

AQUATIC HERBICIDE BY Monsanto

Complete Directions for Use in Aquatic and Other Noncrop Sites.

EPA Reg. No. 524-343

AVOID CONTACT WITH FOLIAGE, GREEN STEMS, OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, SINCE SEVERE INJURY OR DESTRUCTION MAY RESULT.

This product has been approved for use in California except as stated otherwise on page 42.

1990-1 892.38-000.88/CG

Read the entire label before using this product.

Use only according to label instructions.

Read "LIMIT OF WARRANTY AND LIABILITY" before buying or using. If terms are not acceptable, return at once unopened.

REFORMULATION IS PROHIBITED. SEE INDIVIDUAL CONTAINER LABEL FOR REPACKAGING LIMITATIONS.

LIMIT OF WARRANTY AND LIABILITY

This Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes set forth in the Complete Directions for Use label booklet ("Directions") when used in accordance with those Directions under the conditions described therein. NO OTHER EXPRESS WARRANTY OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY OR ANY OTHER EXPRESS OR IMPLIED WARRANTY IS MADE. This warranty is also subject to the conditions and limitations stated herein.

Buyer and all users shall promptly notify this Company of any claims whether based in contract, negligence, strict liability, other tort or otherwise.

Buyer and all users are responsible for all loss or damage from use or handling which results from conditions beyond the control of this Company, including but not limited to, incompatibility with products other than those set forth in the Directions, application to or contact with desirable vegetation, unusual weather, weather conditions which are outside the range considered normal at the application site and for the time period when the product is applied, as well as weather conditions which are outside the application ranges set forth in the Directions, application in any manner not explicitly set forth in the Directions, moisture conditions outside the moisture range specified in the Directions, or the presence of products other than those set forth in the Directions in or on the soil or treated vegetation.

THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF THE LIABILITY OF THIS COMPANY OR ANY OTHER SELLER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT (INCLUDING CLAIMS BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE) SHALL BE THE PURCHASE PRICE PAID BY THE USER OR BUYER FOR THE QUANTITY OF THIS PRODUCT INVOLVED, OR, AT THE ELECTION OF THIS COMPANY OR ANY OTHER SELLER, THE REPLACEMENT OF SUCH QUANTITY, OR, IF NOT ACQUIRED BY PURCHASE, REPLACEMENT OF SUCH QUANTITY. IN NO EVENT SHALL THIS COMPANY OR ANY OTHER SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES.

Buyer and all users are deemed to have accepted the terms of this LIMIT OF WARRANTY AND LIABILITY which may not be varied by any verbal or written agreement.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

Keep out of reach of children.

CAUTION!

MAY CAUSE EYE IRRITATION.
MAY BE HARMFUL IF INHALED.
Avoid contact with eyes, skin or clothing.
Avoid breathing vapors or spray mist.

Wash thoroughly with soap and water after handling.

FIRST AID: IF IN EYES, flush with plenty of water for at least 15 minutes. Get medical attention.

IF ON SKIN, flush with water. Wash clothing before reuse.

IF INHALED, remove individual to fresh air. Seek medical attention if breathing difficulty develops.

In case of an emergency involving this product, Call Collect, day or night, (314) 694-4000.

Environmental Hazards

Do not contaminate water when disposing of equipment washwaters. Treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss can cause fish suffocation.

In case of:
SPILL or LEAK, soak up and remove to a landfill.

Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied only in stainless steel, aluminum, fiberglass, plastic and plastic-lined steel containers.

DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED STEEL OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

ACTIVE INGREDIENT:

*Glyphosate, N-(phosphonomethyl) glycine, in the form of its isopropylamine salt	53.8%
INERT INGREDIENTS:	46.2%
	100.0%

*Contains 648 grams per litre or 5.4 pounds per U.S. gallon of the active ingredient, glyphosate, in the form of its isopropylamine salt. Equivalent to 480 grams per litre or 4 pounds per U.S. gallon of the acid, glyphosate.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in any manner inconsistent with its labeling.

Storage and Disposal

Do not contaminate water, foodstuffs, seed or feed by storage or disposal.

STORAGE:
STORE ABOVE 10°F. (−12°C.) TO KEEP PRODUCT FROM CRYSTALIZING.

Crystals will settle to the bottom. If allowed to crystalize, place in a warm room 68°F. (20°C.) for several days to redissolve and shake well before using.

DISPOSAL:
Wastes resulting from the use of this product that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticide disposal or in accordance with applicable Federal, state or local procedures.

Emptied container retains vapor and product residue. Observe all labeled safeguards until container is destroyed. Do not reuse container, destroy when empty.

Triple rinse container, then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

GENERAL INFORMATION

This product, a water soluble liquid, mixes readily with water and nonionic surfactant to be applied as a foliar spray for the control or destruction of many herbaceous and woody plants.

This product moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days but on most perennial brush species may not occur for 7 days or more. Extremely cool or cloudy weather following treatment may slow the activity of this product and delay visual effects of control. Visible effects are a gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts.

Unless otherwise directed on this label, delay application until vegetation has emerged and reached the stages described for control of such vegetation under the "Weeds Controlled" section of this label.

Unemerged plants arising from unattached underground rhizomes or root stocks of perennials or brush will not be affected by the spray and will continue to grow. For this reason best control of most perennial weeds or brush is obtained when treatment is made at late growth stages approaching maturity.

Always use the higher rate of this product per acre within the recommended range when vegetation is heavy or dense.

Do not treat weeds or brush under poor growing conditions such as drought stress, disease or insect damage, as reduced control may result. Reduced results may also occur when treating weeds or brush heavily covered with dust.

Reduced control may result when applications are made to any weed or brush species that have been mowed, grazed, or cut, and have not been allowed to regrow to the recommended stage for treatment.

Rainfall or irrigation occurring within 6 hours after application may reduce effectiveness. Heavy rainfall or irrigation within 2 hours after application may wash the product off the foliage and a repeat treatment may be required.

This product does not provide residual weed control. For subsequent residual weed control, follow a label-approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used.

Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of this product or other materials that are not expressly recommended in this label. Mixing this product with herbicides or other materials not recommended on this label may result in reduced performance.

ATTENTION

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift, or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants, or other areas on which treatment was not intended. The likelihood of plant or crop injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur. When spraying avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) which are likely to drift. AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.

NOTE: Use of this product in any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences. When not in use, keep container closed to prevent spills and contamination.

MIXING AND APPLICATION INSTRUCTIONS

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES. HAND GUN APPLICATIONS SHOULD BE PROPERLY DIRECTED TO AVOID SPRAYING DESIRABLE PLANTS. NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, such as WATER FROM PONDS AND UNLINED DITCHES.

MIXING

This product mixes readily with water. Mix spray solutions of this product as follows: fill the mixing or spray tank with the required amount of water while adding the required amount of this product (see "Directions for Use" and "Weeds Controlled" sections of this label). Near the end of the filling process, add the required surfactant and mix well. Remove hose from tank immediately after filling to avoid siphoning back into the water source. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, place the filling hose below the surface of the spray solution, terminate by-pass and return lines at the bottom of the tank and if needed use an approved anti-foam or defoaming agent.

Keep by-pass line on or near bottom of tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50 mesh. Carefully select correct nozzle to avoid spraying a fine mist. For best results with conventional ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

When using this product, mix 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution. Use a nonionic surfactant labeled for use with herbicides. The surfactant must contain 50 percent or more active ingredient.

Always read and follow the manufacturer's surfactant label recommendations for best results.

These surfactants should not be used in excess of 1 quart per acre when making broadcast applications.

Clean sprayer and parts immediately after using this product by thoroughly flushing with water and dispose of rinsate according to labeled use or disposal instructions.

Carefully observe all cautionary statements and other information appearing on the surfactant label.

APPLICATION EQUIPMENT AND TECHNIQUES

■ AERIAL EQUIPMENT ■

See the supplemental label for use of this product by air in California.

Use the recommended rates of this product and surfactant in 3 to 20 gallons of water per acre as a broadcast spray, unless otherwise specified. See the "Weeds Controlled" section of this label for specific rates. Aerial applications of this product may only be made as specifically recommended on this label.

AVOID DRIFT — DO NOT APPLY DURING INVERSION CONDITIONS, WHEN WINDS ARE GUSTY, OR UNDER ANY OTHER CONDITION WHICH WILL ALLOW DRIFT. DRIFT MAY CAUSE DAMAGE TO ANY VEGETATION CONTACTED TO WHICH TREATMENT IS NOT INTENDED. TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Coarse sprays are less likely to drift; therefore, do not use nozzles or nozzle configurations which dispense spray as fine spray droplets. Do not angle nozzles forward into the airstream and do not increase spray volume by increasing nozzle pressure.

Drift control additives may be used. When a drift control additive is used, read and carefully observe the cautionary statements and all other information appearing on the additive label.

Ensure uniform application — To avoid streaked, uneven or overlapped application, use appropriate marking devices.

Thoroughly wash aircraft, especially landing gear, after each day of spraying to remove residues of this product accumulated during spraying or from spills. PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. LANDING GEAR ARE MOST SUSCEPTIBLE. The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion.

■ BOOM EQUIPMENT ■

For control of weed or brush species listed on this label using conventional boom equipment — Use the recommended rates of this product and surfactant in 3 to 30 gallons of water per acre as a broadcast spray, unless otherwise specified. See the "Weeds Controlled" section of this label for specific rates. As density of vegetation increases, spray volume should be increased within the recommended range to insure complete coverage. Carefully select correct nozzle to avoid spraying a fine mist.

For best results with ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

■ HAND-HELD and HIGH-VOLUME EQUIPMENT ■

Use Coarse Sprays Only

For control of weeds listed on this label using knapsack sprayers or high-volume spraying equipment utilizing handguns or other suitable nozzle arrangements — Prepare a ¾ to 1½ percent solution of this product in water, add a nonionic surfactant and apply to foliage of vegetation to be controlled. For specific rates of application and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section of this label.

Applications should be made on a spray-to-wet basis. Spray coverage should be uniform and complete. Do not spray to point of runoff.

Where less than complete coverage occurs with spot treatments, use a 5 percent spray solution.

Prepare the desired volume of spray solution by mixing the amount of this product in water, shown in the following table:

Spray Solution

DESIRED	AMOUNT OF RODEO®				
VOLUME	¾%	1%	1¼%	1½%	5%
1 gallon	1 oz.	1⅓ oz.	1⅔ oz.	2 oz.	6⅔ oz.
25 gallons	1½ pt.	1 qt.	1¼ qt.	1½ qt.	5 qt.
100 gallons	3 qt.	1 gal.	1¼ gal.	1½ gal.	5 gal.

2 tablespoons = 1 ounce

For use in knapsack sprayers, it is suggested that the recommended amount of this product be mixed with water in a larger container. Fill sprayer with the mixed solution and add the correct amount of surfactant.

WEEDS CONTROLLED

ANNUAL WEEDS

Apply to actively growing annual grasses and broadleaf weeds.

Allow at least 3 days after application before disturbing treated vegetation. After this period the weeds may be mowed, tilled or burned. See "Directions for Use," "General Information," and "Mixing and Application Instructions" for labeled uses and specific application instructions.

Broadcast Application — Use 1½ pints of this product per acre plus 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution if weeds are less than 6 inches tall. If weeds are greater than 6 inches tall, use 2½ pints of this product per acre plus 2 or more quarts of an approved nonionic surfactant per 100 gallons of spray solution.

Hand-Held High-Volume Application — Use a ¾ percent solution of this product in water plus 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution and apply to foliage of vegetation to be controlled.

When applied as directed under the conditions described in this label, this product plus nonionic surfactant WILL CONTROL the following ANNUAL WEEDS:

Balsamapple**
Momordica charantia

Barley
Hordeum vulgare

Barnyardgrass
Echinochloa crus-galli

Bassia, fivehook
Bassia hyssopifolia

Bluegrass, annual
Poa annua

Bluegrass, bulbous
Poa bulbosa

Brome
Bromus spp.

Buttercup
Ranunculus spp.

Cheat
Bromus secalinus

Chickweed, mouseear
Cerastium vulgatum

Cocklebur
Xanthium strumarium

Corn, volunteer
Zea mays

Crabgrass
Digitaria spp.

Dwarfdandelion
Krigia cespitosa

Falseflax, smallseed
Camelina microcarpa

Fiddleneck
Amsinckia spp.

Flaxleaf fleabane
Conyza bonariensis

Fleabane
Erigeron spp.

Foxtail
Setaria spp.

Foxtail, Carolina
Alopecurus carolinianus

Groundsel, common
Senecio vulgaris

Horseweed/Marestail
Conyza canadensis

Kochia
Kochia scoparia

Lambsquarters, common
Chenopodium album

Lettuce, prickly
Lactuca serriola

Morningglory
Ipomoea spp.

Mustard, tansy
Descurainia pinnata

Mustard, tumble
Sisymbrium altissimum

Mustard, wild
Sinapis arvensis

Oats, wild
Avena fatua

Panicum
Panicum spp.

Pennycress, field
Thlaspi arvense

Pigweed, redroot
Amaranthus retroflexus

Pigweed, smooth
Amaranthus hybridus

Ragweed, common
Ambrosia artemisiifolia

Ragweed, giant
Ambrosia trifida

Rocket, London
Sisymbrium irio

Rye
Secale cereale

Ryegrass, Italian*
Lolium multiflorum

Sandbur, field
Cenchrus spp.

Shattercane
Sorghum bicolor

Shepherdspurse
Capsella bursa-pastoris

Signalgrass, broadleaf
Brachiaria platyphylla

Smartweed, Pennsylvania
Polygonum pensylvanicum

Sowthistle, annual
Sonchus oleraceus

Spanishneedles*
Bidens bipinnata

Stinkgrass
Eragrostis cilianensis

Sunflower
Helianthus annuus

Thistle, Russian
Salsola kali

Spurry, umbrella
Holosteum umbellatum

Velvetleaf
Abutilon theophrasti

Wheat
Triticum aestivum

Mustard, blue
Chorispora tenella

Witchgrass
Panicum capillare

*Apply 3 pints of this product per acre.
**Apply with hand-held equipment only.

Annual weeds will generally continue to germinate from seed throughout the growing season. Repeat treatments will be necessary to control later germinating weeds.

PERENNIAL WEEDS

Apply this product as follows to control or destroy most vigorously growing perennial weeds. Unless otherwise directed, allow at least 7 days after application before disturbing vegetation.

Add 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution to the rates of this product given in this list. See the "General Information," "Directions for Use," and "Mixing and Application" sections of this label for specific uses and application instructions.

NOTE: If weeds have been mowed or tilled, do not treat until regrowth has reached the recommended stages. Fall treatments must be applied before a killing frost.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed.

When applied as recommended under the conditions described, this product plus surfactant WILL CONTROL the following PERENNIAL WEEDS:

Alfalfa
Medicago sativa

Alligatorweed*
Alternanthera philoxeroides

Artichoke, Jerusalem
Helianthus tuberosus

Bahiagrass
Paspalum notatum

Bermudagrass
Cynodon dactylon

Bindweed, field
Convolvulus arvensis

Bluegrass, Kentucky
Poa pratensis

Blueweed, Texas
Helianthus ciliaris

Brackenfern
Pteridium spp.

Bromegrass, smooth
Bromus inermis

Canarygrass, reed
Phalaris arundinacea

Cattail
Typha spp.

Clover, red
Trifolium pratense

Clover, white
Trifolium repens

Cogongrass
Imperata cylindrica

Cutgrass, giant*
Zizaniopsis miliacea

Dallisgrass
Paspalum dilatatum

Dandelion
Taraxacum officinale

Lantana
Lantana camara

Loosestrife, purple
Lythrum salicaria

Lotus, American
Nelumbo lutea

Maidencane
Panicum hematomon

Milkweed
Asclepias spp.

Muhly, wirestem
Muhlenbergia frondosa

Mullein, common
Verbascum thapsus

Napiergrass
Pennisetum purpureum

Nightshade, silverleaf
Solanum elaeagnifolium

Nutsedge: purple, yellow
Cyperus rotundus
Cyperus esculentus

Orchardgrass
Dactylis glomerata

Pampasgrass
Cortaderia jubata

Paragrass
Brachiaria mutica

Phragmites**
Phragmites spp.

Quackgrass
Agropyron repens

Reed, giant
Arundo donax

Ryegrass, perennial
Lolium perenne

Smartweed, swamp
Polygonum coccineum

Dock, curly
Rumex crispus

Dogbane, hemp
Apocynum cannabinum

Fescue
Festuca spp.

Fescue, tall
Festuca arundinacea

Guineagrass
Panicum maximum

Horsenettle
Solanum carolinense

Horseradish
Armoracia rusticana

Johnsongrass
Sorghum halepense

Kikuyugrass
Pennisetum clandestinum

Knapweed
Centaurea repens

Spatterdock
Nuphar luteum

Sweet potato, wild*
Ipomoea pandurata

Thistle
Cirsium arvense

Timothy
Phleum pratense

Torpedograss*
Panicum repens

Tules, common
Scirpus acutus

Vaseygrass
Paspalum urvillei

Waterhyacinth
Eichornia crassipes

Waterlettuce
Pistia stratiotes

Waterprimrose
Ludwigia spp.

Wheatgrass, western
Agropyron smithii

*Partial control.

**Partial control in southeastern states. See specific recommendations below.

Alligatorweed — Apply 6 pints of this product per acre as a broadcast spray or as a 1¼ percent solution with hand-held equipment to provide partial control of alligatorweed. Apply when most of the target plants are in bloom. Repeat applications will be required to maintain such control.

Bermudagrass — Apply 7½ pints of this product per acre as a broadcast spray or as a 1½ percent solution with hand-held equipment. Apply when target plants are actively growing and when seed heads appear.

Bindweed, field/Silverleaf Nightshade/Texas Blueweed — Apply 6 to 7½ pints of this product per acre as a broadcast spray west of the Mississippi River and 4½ to 6 pints of this product per acre east of the Mississippi River. With hand-held equipment, use a 1½ percent solution. Apply when target plants are actively growing and are at or beyond full bloom. For silverleaf nightshade, best results can be obtained when application is made after berries are formed. Do not treat when weeds are under drought stress. New leaf development indicates active growth. For best results apply in late summer or fall.

Brackenfern — Apply 4½ to 6 pints of this product per acre as a broadcast spray or as a ¾ to 1 percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.

Cattail — Apply 4½ to 6 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Apply when target plants are actively growing and are at or beyond the early-to-full bloom stage of growth. Best results are achieved when application is made during the summer or fall months.

Cogongrass — Apply 4.5 to 7.5 pints of this product per acre as a broadcast spray. Apply when cogongrass is at least 18 inches tall and actively growing in late summer or fall. Allow 7 or more days after application before tillage or mowing. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.

Cutgrass, giant — Apply 6 pints of this product per acre as a broadcast spray or as a 1 percent solution with hand-held equipment to provide partial control of giant cutgrass. Repeat applications will be required to maintain such control, especially where vegetation is partially submerged in water. Allow for substantial regrowth to the seven-to-ten-leaf stage prior to retreatment.

Dogbane, hemp / Knapweed / Horseradish — Apply 6 pints of this product per acre as a broadcast spray or as a 1½ percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth. For best results, apply in late summer or fall.

Fescue, tall — Apply 4½ pints of this product per acre as a broadcast spray or as a 1 percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained.

Guineagrass — Apply 4½ pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Apply when target plants are actively growing and when most have reached at least the 7-leaf stage of growth.

Johnsongrass / Bluegrass, Kentucky / Bromegrass, smooth / Canarygrass, reed / Orchardgrass / Ryegrass, perennial / Timothy / Wheatgrass, western — Apply 3 to 4½ pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained. In the fall, apply before plants have turned brown.

Lantana — Apply this product as a ¾ to 1 percent solution with hand-held equipment. Apply to actively growing lantana at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth.

Loosestrife, purple — Apply 4 pints of this product per acre as a broadcast spray or as a 1 percent solution using hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost.

Lotus, American — Apply 4 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost. Repeat treatment may be necessary to control regrowth from underground parts and seeds.

Maidencane / Paragrass — Apply 6 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Repeat treatments will be required, especially to vegetation partially submerged in water. Under these conditions, allow for regrowth to the seven-to-ten leaf stage prior to retreatment.

Milkweed, common — Apply 4½ pints of this product per acre as a broadcast spray or as a 1½ percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth.

Nutsedge, purple, yellow — Apply 4½ pints of this product per acre as a broadcast spray, or as a ¾ percent solution with hand-held equipment to control existing nutsedge plants and immature nutlets attached to treated plants. Apply when target plants are in flower or when new nutlets can be found at rhizome tips. Nutlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control.

Pampasgrass — Apply a 1.5 percent solution of this product with hand-held equipment when plants are actively growing.

Phragmites — For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 7.5 pints per acre as a broadcast spray or apply a 1½ percent solution with hand-held equipment. In other areas of the U.S., apply 4 to 6 pints per acre as a broadcast spray or apply a ¾ percent solution with hand-held equipment for partial control. For best results, treat during late summer of fall months when plants are actively growing and in full bloom. Due to the dense nature of the vegetation, which may prevent good spray coverage and uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptoms will be slow to develop.

Quackgrass / Kikuyugrass / Muhly, wirestem — Apply 3 to 4½ pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment when most quackgrass or wirestem muhly is at least 8 inches in height (3- or 4-leaf stage of growth) and actively growing. Allow 3 or more days after application before tillage.

Reed, giant — For control of giant reed, apply a 1.5 percent solution of this product with hand-held equipment when plants are actively growing. Best results are obtained when applications are made in late summer to fall.

Spatterdock — Apply 6 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Apply when most plants are in full bloom. For best results, apply during the summer or fall months.

Sweet potato, wild — Apply this product as a 1½ percent solution using hand-held equipment. Apply to actively growing weeds that are at or beyond the bloom stage of growth. Repeat applications will be required. Allow the plant to reach the recommended stage of growth before retreatment.

Thistle — Apply 3 to 4½ pints of this product per acre as a broadcast spray or as a 1½ percent solution with hand-held equipment. Apply when target plants are actively growing and are at or beyond the bud stage of growth.

Torpedograss — Apply 6 to 7½ pints of this product per acre as a broadcast spray or as a ¾ to 1½ percent solution with hand-held equipment to provide partial control of torpedograss. Use the lower rates under terrestrial conditions, and the higher rates under partially submerged or a floating mat condition. Repeat treatments will be required to maintain such control.

Tules, common — Apply this product as a 1½ percent solution with hand-held equipment. Apply to actively growing plants at or beyond the seedhead stage of growth. After application visual symptoms will be slow to appear and may not occur for 3 or more weeks.

Waterhyacinth — Apply 5 to 6 pints of this product per acre as a broadcast spray or apply a ¾ to 1 percent solution with hand-held equipment. Apply when target plants are actively growing and at or beyond the early bloom stage of growth. After application, visual symptoms may require 3 or more weeks to appear with complete necrosis and decomposition usually occurring within 60 to 90 days. Use the higher rates when more rapid visual effects are desired.

Waterlettuce — For control, apply a ¾ to 1 percent solution of this product with hand-held equipment to actively growing plants. Use higher rates where infestations are heavy. Best results are obtained from mid-summer through winter applications. Spring applications may require retreatment.

Waterprimrose — Apply this product as a ¾ percent solution using hand-held equipment. Apply to plants that are actively growing at or beyond the bloom stage of growth, but before fall color changes occur. Thorough coverage is necessary for best control.

Other perennials listed on this label — Apply 4½ to 7½ pints of this product per acre as a broadcast spray or as a ¾ to 1½ percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached early head or early bud stage of growth.

WOODY BRUSH AND TREES

When applied as recommended under the conditions described, this product plus surfactant CONTROLS or PARTIALLY CONTROLS the following woody brush plants and trees:

Alder
Alnus spp.

Ash*
Fraxinus spp.

Aspen, quaking
Populus tremuloides

Bearmat, Bearclover
Chamaebatia foliolosa

Birch
Betula spp.

Blackberry
Rubus spp.

Broom:
French
Cytisus monspessulanus
Scotch
Cytisus scoparius

Buckwheat, California*
Eriogonum fasciculatum

Cascara*
Rhamnus purshiana

Catsclaw*
Acacia greggi

Ceanothus
Ceanothus spp.

Chamise
Adenostoma fasciculatum

Cherry:
Bitter
Prunus emarginata
Black
Prunus serotina
Pin
Prunus pensylvanica

Maple:
Red**
Acer rubrum
Sugar
Acer saccharum
Vine*
Acer circinatum

Monkey Flower*
Mimulus guttatus

Oak:
Black*
Quercus velutina
Northern pine
Quercus palustris
Post
Quercus stellata
Red
Quercus rubra
Southern red
Quercus falcata
White*
Quercus alba

Persimmon*
Diospyros spp.

Poison Ivy
Rhus radicans

Poison Oak
Rhus toxicodendron

Poplar, yellow*
Liriodendron tulipifera

Raspberry
Rubus spp.

Rose, multiflora
Rosa multiflora

Coyote brush *Baccharis consanguinea*	**Russian-olive** *Elaeagnus angustifolia*
Creeper, Virginia* *Parthenocissus quinquefolia*	**Sage, black** *Saliva mellifera*
Dewberry *Rubus trivialis*	**Sagebrush, California** *Artemisia californica*
Elderberry *Sambucus spp.*	**Salmonberry** *Rubus spectabilis*
Elm* *Ulmus spp.*	**Saltbush, Sea myrtle** *Baccaharis halimifolia*
Eucalyptus, bluegum *Eucalyptus globulus*	**Sassafras** *Sassafrass aibidum*
Hasardia* *Haplopappus squamosus*	**Sourwood*** *Oxydendrum arboreum*
Hawthorn *Crataegus spp.*	**Sumac:**
Hazel *Corylus spp.*	**Poison*** *Rhus vernix*
Holly, Florida; Brazilian Peppertree *Schinus terebinthifolius*	**Smooth*** *Rhus glabra*
Honeysuckle *Lonicera spp.*	**Winged*** *Rhus copallina*
Kudzu *Pueraria lobata*	**Sweet gum** *Liquidambar styraciflua*
Locust, black* *Robinia pseudoacacia*	**Swordfern*** *Polystichum munitum*
Manzanita *Arctostaphylos spp.*	**Tallowtree, Chinese** *Sapium sebiferum*
	Thimbleberry *Rubus parviflorus*
	Tobacco, tree* *Nicotiana glauca*
	Trumpetcreeper *Campsis radicans*
	Waxmyrtle, southern* *Myrica cerifera*
	Willow *Salix spp.*

*Partial control

**See below for control or partial control instructions.

NOTE: If brush has been mowed or tilled or trees have been cut, do not treat until regrowth has reached the recommended stage of growth.

Apply the recommended rate of this product plus 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution when plants are actively growing and unless otherwise directed, after full-leaf expansion. Use the higher rate for larger plants and / or dense areas of growth. On vines, use the higher rate for plants that have reached the woody stage of growth. Best results are obtained when application is made in late summer or fall after fruit formation.

In arid areas, best results are obtained when application is made in the spring to early summer when brush species are at high moisture content and are flowering. Ensure thorough coverage when using hand-held equipment. Symptoms may not appear prior to frost or senescence with fall treatments.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

See "Directions for Use" and "Mixing and Application Instructions" section of this label for labeled use and specific application instructions.

Apply the product as follows to control or partially control the following woody brush and trees.

Alder / Blackberry / Dewberry / Honeysuckle / Oak, Post / Raspberry — For control, apply 4½ to 6 pints per acre as a broadcast spray or as a ¾ to 1¼ percent solution with hand-held equipment.

Aspen, Quaking / Hawthorn / Trumpetcreeper — For control, apply 3 to 4½ pints of this product per acre as a broadcast spray or as a ¾ to 1¼ percent solution with hand-held equipment.

Birch / Elderberry / Hazel / Salmonberry / Thimbleberry — For control, apply 3 pints per acre of this product as a broadcast spray or as a ¾ percent solution with hand-held equipment.

Broom: French, Scotch — For control, apply a 1¼ to 1½ percent solution with hand-held equipment.

Buckwheat, California / Hasardia / Monkey Flower / Tobacco, Tree — For partial control of these species, apply a ¾ to 1½ percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Catsclaw — For partial control, apply a 1¼ to 1½ percent solution with hand-held equipment and at least 50 percent of the new leaves are fully developed.

Cherry: Bitter, Black, Pin / Oak, Southern Red / Sweet Gum — For control, apply 3 to 7½ pints of this product per acre as a broadcast spray or as a 1 to 1½ percent solution with hand-held equipment.

Coyote Brush — For control, apply a 1¼ to 1½ percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Eucalyptus, bluegum — For control of eucalyptus resprouts, apply a 1½ percent solution of this product with hand-held equipment when resprouts are 6 to 12 feet tall. Ensure complete coverage. Apply when plants are actively growing. Avoid application to drought-stressed plants. For control of eucalyptus trees 2 to 24 inches in diameter, cut trees as close to the soil surface as desired. Apply a 50 to 100 percent solution of this product to freshly cut surface immediately after cutting. Delay in applying this product may result in poor performance.

Holly, Florida / Waxmyrtle — For partial control, apply this product as a 1½ percent solution with hand-held equipment.

Kudzu — For control, apply 6 pints of this material per acre as a broadcast spray or as a 1½ percent solution with hand-held equipment. Repeat applications will be required to maintain control.

Maple, Red** — For control, apply as a ¾ to 1¼ percent solution with hand-held equipment when leaves are fully developed. For partial control, apply 2 to 7½ pints of this product per acre as a broadcast spray.

Maple, Sugar / Oak: Northern Pin, Red — For control, apply as a ¾ to 1¼ percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Poison Ivy / Poison Oak — For control, apply 6 to 7½ pints of this product per acre as a broadcast spray or as a 1½ percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.

Rose, Multiflora — For control, apply 3 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Treatments should be made prior to leaf deterioration by leaf-feeding insects.

Sage, Black / Sagebrush, California / Chamise / Tallowtree, Chinese — For control of these species, apply a ¾ percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Saltbush, Sea myrtle — For control, apply this product as a 1 percent solution with hand-held equipment.

Willow — For control, apply 4½ pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment.

***Other woody brush and trees listed in this label** — For partial control, apply 3 to 7½ pints of this product per acre as a broadcast spray or as a ¾ to 1½ percent solution with hand-held equipment.

AQUATIC AND OTHER NONCROP SITES

When applied as directed and under the conditions described in the "Weeds Controlled" section of this label, this product will control or partially control the labeled weeds growing in the following industrial, recreational, and public areas or other similar sites.

Aquatic Sites — This product may be applied to emerged weeds in all bodies of fresh and brackish water which may be flowing, nonflowing, or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, and similar sites.

If aquatic sites are present in the noncrop area and are part of the intended treatment, read and observe the following directions:

There is no restriction on the use of treated water for irrigation, recreation, or domestic purposes.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.

NOTE: Do not apply this product within ½ mile upstream of a potable water intake in flowing water (i.e., river, stream, etc.) or within ½ mile of a potable water intake in a standing body of water such as lake, pond, or reservoir.

This product does not control plants which are completely submerged or have a majority of their foliage under water.

For treatments after drawdown of water or in dry ditches, allow 7 or more days after treatment before reintroduction of water. Apply this product within one day after drawdown to ensure application to actively growing weeds.

Floating mats of vegetation may require retreatment. Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash or by rainfall within 6 hours of application. Do not retreat within 24 hours following the initial treatment.

Applications made to moving bodies of water must be made while traveling upstream to prevent concentration of this herbicide in water. When making any bankside applications, do not overlap more than 1 foot into open water. Do not spray across open moving bodies of water, or where weeds do not exist. The maxi mum application rate of 7½ pints per acre must not be exceeded in any single application.

When emerged infestations require treatment of the total surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in fish kill.

Other Noncrop-Type Sites:

Airports	Pipeline, Power, Telephone & Utility Rights of Way
Golf Courses	
Highways & Roadsides	Pumping Installations
Industrial Plant Sites	Railroads
Lumberyards	Schools
Parking Areas	Storage Areas
Parks	Similar Sites
Petroleum Tank Farms	

INJECTION AND FRILL APPLICATIONS

Woody vegetation may be controlled by injection or frill application of this product. Apply this product using suitable equipment which must penetrate into living tissue. Apply the equivalent of 1 ml of this product per 2 to 3 inches of trunk diameter. This is best achieved by applying 25 to 100 percent concentration of this material either to a continuous frill around the tree or as cuts evenly spaced around the tree below all brancnes. As tree diameter increases in size, better results are achieved by applying dilute material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frill or cut areas in species that exude sap freely after frills or cutting. In species such as these, make frill or cut at an oblique angle so as to produce a cupping effect and use undiluted material. For best results, applications should be made during periods of active growth and full leaf expansion.

This treatment WILL CONTROL the following woody species:

Oak
Quercus spp.
Poplar
Populus spp.
Sweet gum
Liquidambar styraciflua
Sycamore
Platanus occidentalis

This treatment WILL SUPPRESS the following woody species:

Black gum
Nyssa sylvatica
Dogwood
Cornus spp.
Hickory
Carya spp.
Maple, red
Acer rubrum

CUT STUMP APPLICATION

Woody vegetation may be controlled by treating freshly cut stumps of trees and resprouts with this product. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut vegetation close to the soil surface. **Apply a 50 to 100 percent solution of this product to freshly cut surface immediately after cutting.** Delay in applying this product may result in reduced performance. For best results, trees should be cut during periods of active growth and full leaf expansion.

When used according to directions for injection or cut stump application, this product will CONTROL, PARTIALLY CONTROL or SUPPRESS most woody brush and tree species, some of which are listed below:

Alder
Alnus spp.
Coyotebrush
Baccharis consanguinea
Dogwood
Cornus spp.
Eucalyptus, bluegum
Eucalyptus glotulus
Hickory
Carya spp.
Madrone
Arbutus menziesii
Maple
Acer spp.
Oak
Quercus spp.
Poplar
Populus spp.
Salt cedar
Tamarix spp.
Sweet gum
Liquidambar styraciflua
Sycamore
Platanus occidentalis
Tan oak
Lithocarpus densiflorus
Willow
Salix spp.

RELEASE OF BERMUDAGRASS OR BAHIAGRASS ON NONCROP SITES

RELEASE OF DORMANT BERMUDAGRASS AND BAHIAGRASS

When applied as directed, this product will provide control or suppression of many winter annual weeds and tall fescue for effective release of dormant bermudagrass or bahiagrass. Make applications to dormant bermudagrass or bahiagrass.

For best results on winter annuals, treat when weeds are in an early growth stage (below 6 inches in height) after most have germinated. For best results on tall fescue, treat when fescue is in or beyond the 4 to 6-leaf stage.

WEEDS CONTROLLED

Rate recommendations for control or suppression of winter annuals and tall fescue are listed below.

Apply the recommended rates of this product in 10 to 25 gallons of water per acre plus 2 quarts nonionic surfactant per 100 gallons of total spray volume.

WEEDS CONTROLLED OR SUPPRESSED*

NOTE: C = Control
S = Suppression

	RODEO® FLUID OZ/ACRE					
WEED SPECIES	6	9	12	18	24	48
Barley, little *Hordeum pusillum*	S	C	C	C	C	C
Bedstraw, catchweed *Galium aparine*	S	C	C	C	C	C
Bluegrass, annual *Poa annua*	S	C	C	C	C	C
Chervil *Chaerophyllum tainturieri*	S	C	C	C	C	C
Chickweed, common *Stellaria media*	S	C	C	C	C	C
Clover, crimson *Trifolium incarnatum*	•	S	S	C	C	C
Clover, large hop *Trifolium campestre*	•	S	S	C	C	C
Speedwell, corn *Veronica arvensis*	S	C	C	C	C	C
Fescue, tall *Festuca arundinacea*	•	•	•	•	S	S
Geranium, Carolina *Geranium carolinianum*	•	•	S	S	C	C
Henbit *Lamium amplexicaule*	•	S	C	C	C	C
Ryegrass, Italian *Lolium multiflorum*	•	•	S	C	C	C
Vetch, common *Vicia sativa*	•	•	S	C	C	C

*These rates apply only to sites where an established competitive turf is present.

RELEASE OF ACTIVELY GROWING BERMUDAGRASS

NOTE: USE ONLY ON SITES WHERE BAHIAGRASS OR BERMUDAGRASS ARE DESIRED FOR GROUND COVER AND SOME TEMPORARY INJURY OR YELLOWING OF THE GRASSES CAN BE TOLERATED.

When applied as directed, this product will aid in the release of bermudagrass by providing control of annual species listed in the "Weeds Controlled" section of this label, and suppression or partial control of certain perennial weeds.

For control or suppression of those annual species listed on this label, use ¾ to 2¼ pints of this product as a broadcast spray in 10 to 25 gallons of spray solution per acre, plus 2 quarts of a nonionic surfactant per 100 gallons of total spray volume. Use the lower rate when treating annual weeds below 6 inches in height (or length of runner in annual vines). Use higher rate as size of plants increases or as they approach flower or seedhead formation.

Use the higher rate for partial control or longer term suppression of the following perennial species. Use lower rates for shorter-term suppression of growth.

Bahiagrass	Johnsongrass**
Dallisgrass	Trumpetcreeper*
Fescue (tall)	Vaseygrass

*Suppression at the higher rate only.
**Johnsongrass is controlled at the higher rate.

Use only on well-established bermudagrass. Bermudagrass injury may result from the treatment but regrowth will occur under moist conditions. Repeat applications in the same season are not recommended, since severe injury may result.

BAHIAGRASS SEEDHEAD AND VEGETATIVE SUPPRESSION

When applied as directed in the "Noncrop Sites" section of this label, this product will provide significant inhibition of seedhead emergence and will suppress vegetative growth for a period of approximately 45 days with single applications and approximately 120 days with sequential applications.

Apply this product 1 to 2 weeks after full green-up of bahiagrass or after the bahiagrass has been mowed to a uniform height of 3 to 4 inches. Applications must be made prior to seedhead emergence. Apply 5 fluid ounces per acre of this product, plus 2 quarts of an approved nonionic surfactant per 100 gallons of total spray volume in 10 to 25 gallons of water per acre.

Sequential applications of this product plus nonionic surfactant may be made at approximately 45-day intervals to extend the period of seedhead and vegetative growth suppression. For continued vegetative growth suppression, sequential applications must be made prior to seedhead emergence.

Apply no more than 2 sequential applications per year. As a first sequential application, apply 3 fluid ounces of this product per acre plus nonionic surfactant. A second sequential application of 2 to 3 fluid ounces per acre plus nonionic surfactant may be made approximately 45 days after the last application.

CALIFORNIA

This product has been approved by the U.S. Environmental Protection Agency for the uses, crops and sites listed in this label and by California. Approval of the items listed below is pending under the state of California registration requirements. With the exceptions of these items, this booklet contains the material approved by California in label 1990-1.

These use conditions, crops, and sites may not be treated with this product in California until approval is received:

- Use of 1.0 ml of this product per 2 to 3 inches of trunk diameter for injection and frill applications.
- Rice levees.
- Use of this product for cut stump treatments on the following species:

Coyotebrush	Poplar
Dogwood	Russian Olive
Hickory	Sweetgum
Maple	Sycamore

Product is protected by U.S. Patent No. 3,799,758 and U.S. Patent No. 4,405,531.

Other patents are pending.

No license granted under any non-U.S. patent.

EPA Reg. No. 524-343

In case of an emergency involving this product, Call Collect, day or night, (314) 694-4000.

1990-1 892.38-000.88/CG

MONSANTO COMPANY
AGRICULTURAL PRODUCTS
ST. LOUIS, MISSOURI, 63167 U.S.A.

APPENDIX C

ENDANGERED PLANT SPECIES OF NEW YORK STATE

Department of Environmental Conservation

PROTECTED NATIVE PLANTS

REVISED MARCH 1990

New York State, for the first time, has given official recognition to truly rare plants. Four lists of plants are included in the new regulation. These lists are endangered, threatened, exploitably vulnerable and rare. The exploitably vulnerable list contains plants that are commercially exploited.

The regulation gives landowners additional rights to prosecute collectors that take plants without permission. Violators of the regulation are subject to fines of $25 per plant illegally taken.

Each list of plants has its own criteria for listing. If a plant occurring in New York is recognized as endangered or threatened by the U.S. Fish and Wildlife Service, it is automatically given protection under the State regulation.

Plant names follow those in the book entitled "A Checklist of New York State Plants", by Richard S. Mitchell. Scientific names will be used to determine any violation of the regulation.

It is expected that the lists will be useful for environmental planning, determining the classification of wetlands and in educating the public on the relative rareness of plants. The lists were developed through the cooperative efforts of the New York State Science Service, the New York Natural Heritage Program and the New York State Department of Environmental Conservation. Many individuals and organizations contributed ideas and suggestions

Express Terms

6 NYCRR Part 193.3 is repealed.

A new Part 193.3 is adopted to read as follows: 193.3 Protected native plants.

(a) All plants enumerated on the lists of endangered species in subdivision (b) of this section, threatened species in subdivision (c) of this section, exploitably vulnerable species in subdivision (d) of this section, or rare species in subdivision (e) of this section are protected native plants pursuant to section 9-1503 of the Environmental Conservation Law. The common names contained on these lists are included for information purposes only; the scientific name shall be used for the purpose of determining any violation. Site means a colony or colonies of plants separated from other colonies by at least one-half mile.

(b) The following are **endangered** native plants in danger of extinction throughout all or a significant portion of their ranges within the state and requiring remedial action to prevent such extinction. Listed plants are those with 5 or fewer extant sites, or fewer than 1,000 individuals, or restricted to fewer than 4 U.S.G.S. 7½ minute series maps, or species listed as endangered by the United States Department of Interior in the Code of Federal Regulations.

Species	**Common name**
Agalinis acuta	Sandplain Gerardia
Amelanchier x nantucketensis	Nantucket Juneberry
Angelica lucida	Angelica
Arnica lanceolata	Arnica
Asplenium viride	Green Spleenwort
Aster concolor	Silvery Aster
Betula glandulosa	Tundra Dwarf Birch
Betula minor	Dwarf White Birch
Botrychium lunaria	Moonwort
Botrychium minganense	Mingan Moonwort
Botrychium rugulosum	Rugulose Grape Fern
Bouteloua curtipendula	Side-oats Grama
Calamagrostis porteri ssp. perplexa	Wood Reedgrass
Calamagrostis stricta ssp. stricta	Northern Reedgrass
Carex atratiformis	Black Sedge
Carex barrattii	Barratt's Sedge
Carex hyalinolepis	Shore-line Sedge
Carex mitchelliana	Mitchell Sedge
Carex wiegandii	Wiegand Sedge
Corallorhiza striata	Striped Coralroot
Corema conradii	Broom Crowberry
Cyperus ovularis	Globose Flatsedge
Cypripedium candidum	Small White Ladyslipper

Eupatorium leucolepis	White Boneset
Gentianopsis procera	Fringed Gentian
Geum triflorum	Prairie-smoke
Hydrocotyle verticillata	Water-pennywort
Hypericum adpressum	Creeping St. John's-wort
Hypericum densiflorum	Bushy St. John's-wort
Hypericum denticulatum	Coppery St. John's-wort
Hypericum hypercoides ssp. multicaule	St. Andrew's Cross
Juniperus horizontalis	Prostrate Juniper
Ligusticum scothicum	Scotch Lovage
Lilium michiganense	Michigan Lily
Listera auriculata	Auricled Twayblade
Loiseleuria procumbens	Alpine Azalea
Lycopodium carolinianum	Carolina Clubmoss
Lycopodium sitchense	Sitka Clubmoss
Lygodium palmatum	Climbing Fern
Lythrum lineare	Saltmarsh Loosestrife
Oryzopsis canadensis	Canada Ricegrass
Phyllitis scolopendrium	Hart's-tongue Fern
Pinus virginiana	Virginia Pine
Poa paludigena	Slender Marsh Bluegrass
Polygala lutea	Yellow Milkwort
Potamogeton ogdenii	Ogden's Pondweed
Potentilla paradoxa	Bushy Cinquefoil
Prenanthes boottii	Boott's Rattlesnake-root
Pterospora andromedea	Giant Pine-drops
Pycnanthemum torrei	Torrey's Mountain-mint
Pyxidanthera barbulata	Pixies
Quercus phellos	Willow Oak
Ranunculus cymbalaria	Seaside Crowfoot
Rhynchospora inundata	Drowned Horned Rush
Sabatia angularis	Rose-pink
Sabatia campanulata	Slender Marsh-pink
Sagittaria teres	Quill-leaf Arrowhead
Salix herbacea	Dwarf Willow
Schizaea pusilla	Curlygrass
Scirpus clintonii	Clinton's Clubrush
Scirpus cylindricus	Saltmarsh Bulrush

Sedum rosea	Roseroot
Sesuvium maritimum	Sea Purslane
Smilax pseudo-china	False China-root
Smilax pulverulenta	Jacob's-ladder
Solidago houghtonii	Houghton's Goldenrod
Thalictrum venulosum	Veiny Meadow-rue
Tillaea aquatica	Pigmyweed
Tofieldia glutinosa	Sticky False Asphodel
Trillium sessile	Toad-shade
Trisetum melicoides	Melic-oats
Uvularia puberula	Mountain Bellwort
Vaccinium cespitosum	Dwarf Blueberry
Viola brittoniana var. brittoniana	Coastal Violet
Viola novae-angliae	New England Violet
Viola stoneana	Stone's Violet
Vittaria spp.	Appalachian Vittaria
Wolffia braziliensis	Watermeal
Woodsia alpina	Alpine Woodsia
Woodsia cathcartiana	Cathcart's Woodsia
Woodsia glabella	Smooth Woodsia

(c) The following are **threatened** native plants that are likely to become endangered within the forseeable future throughout all or a significant portion of their ranges in the state. Listed plants are those with 6 to fewer than 20 extant sites, or 1,000 to fewer than 3,000 individuals, or restricted to not less than 4 or more than 7 U.S.G.S. 7½ minute series maps, or species listed as threatened by the United State Department of Interior in the Code of Federal Regulations.

Species	**Common name**
Aconitum noveboracense	Northern Monk's-hood
Adoxa moschatellina	Moschatel

Bidens bidentoides	Estuary Beggar-ticks
Bidens hyperborea	Estuary Beggar-ticks
Blephilia ciliata	Downy Wood-mint
Calamagrostis stricta ssp. inexpansa	Northern Reedgrass
Cardamine rotundifolia	Mountain Watercress
Carex backii	Rocky Mountain Sedge
Carex bullata	Button Sedge
Carex crawei	Crawe Sedge
Carex sartwellii	Sartwell Sedge
Carex scirpoidea	Canadian Single-spike Sedge
Castilleja coccinea	Scarlet Indian-paintbrush
Ceanothus herbaceus	Prairie Redroot
Cornus drummondii	Rough-leaf Dogwood
Corydalis aurea	Golden Corydalis
Cynoglossum virginianum var. boreale	Northern Wild Comfrey
Cypripedium arietinum	Ram's-head Ladyslipper
Desmodium ciliare	Tick-trefoil
Desmodium glabellum	Tall Tick-clover
Diapensia lapponica	Diapensia
Dryopteris fragrans	Fragrant Cliff Fern
Eleocharis equisetoides	Knotted Spikerush
Eleocharis quadrangulata	Angled Spikerush
Eleocharis tricostata	Three-ribbed Spikerush
Eleocharis tuberculosa	Long-tubercled Spikerush
Euonymus americanus	American Strawberry-bush
Fimbristylis castanea	Marsh Fimbry
Geocaulon lividum	Purple Comandra
Halenia deflexa	Spurred Gentian
Hedyotis uniflora	Clustered Bluets
Helianthemum dumosum	Bushy Rockrose
Helianthus angustifolius	Swamp Sunflower
Hierochloe alpina	Alpine Sweetgrass
Hottonia inflata	Featherfoil
Hydrastis canadensis	Golden-seal
Hypericum prolificum	Shrubby St. John's Wort
Juncus debilis	Weak Rush
Juncus trifidus	Arctic Rush
Lachnanthes caroliniana	Carolina Redroot
Lechea pulchella var. moniliformis	Pinweed
Linum intercursum	Sandplain Wild Flax

Linum medium var. texanum	Southern Yellow Flax
Lycopodium sabinifolium	Cypress Clubmoss
Lysimachia hybrida	Lance-leaved Loosestrife
Minuartia glabra	Appalachian Sandwort
Panicum flexile	Panic Grass
Pellaea glabella	Smooth Cliff Brake
Plantago cordata	Heart Leaf Plantain
Platanthera ciliaris	Orange Fringed Orchis
Platanthera cristata	Crested Fringed Orchis
Polemonium vanbruntiae	Jacob's-ladder
Polymnia uvedalia	Bear's-foot
Populus heterophylla	Swamp Cottonwood
Potamogeton hillii	Hill's Pondweed
Prenanthes nana	Dwarf Rattlesnake-root
Primula mistassinica	Bird's-eye Primrose
Pycnanthemum verticillatum var. verticillatum	Whorled Mountain-mint
Rhododendron lapponicum	Lapland Rosebay
Rumex hastatulus	Heart Sorrel
Rumex maritimus var. fueginus	Golden Dock
Salix cordata	Sand Dune Willow
Salix uva-ursi	Bearberry Willow
Saxifraga aizoides	Yellow Mountain-saxifrage
Scirpus cespitosus	Tufted Bulrush
Scleria pauciflora var. caroliniana	Fewflower Nutrush
Solidago rigida	Stiff-leaf Goldenrod
Sporobolus heterolepis	Northern Dropseed
Tipularia discolor	Cranefly Orchid
Trollius laxus ssp. laxus	Spreading Globeflower
Valeriana sitchensis ssp. uliginosa	Marsh Valerian
Verbesina alternifolia	Wingstream
Viburnum nudum	Possum-haw
Zigadenus elegans ssp. glaucus	White Camas

(d) The following are **exploitably vulnerable** native plants likely to become threatened in the near future throughout all or a significant portion of their ranges within the state if causal factors continue unchecked.

Scientific name	Common name
Arisaema dracontium	Green Dragon
	Dragonroot
Asclepias tuberosus	Butterfly-weed
	Pleurisy-root
	Orange Milkweed
	Tuber-root
	Chigger-flower
	Indian-paintbrush
Campanula rotundifolia	Harebell
	Bluebell
Celastrus scandens	American Bittersweet
	Waxwork
	Staffvine
	Climbing Bittersweet
	False Bittersweet
Chimaphila spp.	Spotted Wintergreen
	Pipsissewa
	Prince's Pine
~~*Cornus florida*~~	Flowering Dogwood
Drosera spp.	Dew-thread
	Threadleaf Sundew
	Sundew
	Narrow-leaf Sundew
	Round-leaf Sundew
Epigaea repens	Trailing Arbutus
	Mayflower
	Ground-laurel
Euonymus spp. (native)	Strawberry-bush
	Bursting-heart
	Running Strawberry Bush
All Native Ferns, including:	
Ophioglossaceae	Cut-leaf Grape Fern
	Lance-leaf Grape Fern
	Moonwort
	Matricary Grape Fern
	Daisy-leaf Grape Fern
	Mingan Moonwort
	Leathery Grape Fern

	Blunt-lobed Grape Fern
	Oneida Grape Fern
	Rugulose Grape Fern
	Least Moonwort
	Dwarf Grape Fern
	Rattlesnake Fern
	Adder's-tongue
Osmundaceae	Cinnamon Fern
	Interruped Fern
	Royal Fern
	Flowering Fern
Polypodiaceae	Rock Polypody
	Common Polypody
Schizaeaceae	Climbing Fern
	Curlygrass
	Curlygrass Fern
Adiantaceae	Maidenhair Fern
	Slender Cliff Brake
	Purple Cliff Brake
	Smooth Cliff Brake
Vittariaceae	Grass Fern
Hymenophyilaceae	Filmy Fern
Aspleniaceae	Virginia Chain Fern
	Bradley's Spleenwort
	Mountain Spleenwort
	Ebony Spleenwort
	Wall-rue Spleenwort
	Maidenhair Spleenwort
	Green Spleenwort
	Lady Fern
	Glade Fern
	Silvery Spleenwort
	Walking Fern
	Bulbet Fern
	Common Fragile Fern
	Lowland Fragile Fern
	Fragile Fern
	Mountain Wood Fern
	Spinulose Wood Fern
	Log Fern
	Clinton's Shield Fern
	Crested Wood Fern

Fragrant Cliff Fern
Giant Wood Fern
Goldie's Fern
Fancy Fern
Common Wood Fern
Marginal Wood Fern
Oak Fern
Netted Chain Fern
Narrow-leaf Chain Fern
Ostrich Fern
Fiddleheads
Northern Fern
Long Beech Fern
Broad Beech Fern
Hart's-tongue Fern
Christmas Fern
Shield Fern
Braun's Holly Fern
Northern Holly Fern
New York Fern
Marsh Fern
Massachusetts Fern
Alpine Woodsia
Cathcart's Woodsia
Smooth Woodsia
Rusty Woodsia
Blunt-lobed Woodsia

Azollaceae	Water Fern Mosquito Fern

But exluding:

Bracken (*Pteridium aquilinum)*
Hay-scented Fern (*Dennstaedtia punctilobula)*
Sensitive Fern (*Onoclea sensibilis)*

•	*Gentiana spp.*	Closed Gentian Bottle Gentian Blind Gentian Prarie Gentian Soapwort Gentian
	Gentianella spp.	Stiff Gentian Ague-weed Gall-of-the-Earth

Gentianopsis spp.	Fringed Gentian
Ilex spp.	Gallberry Inkberry Winterberry Smooth Winterberry Mountain Winterberry Large-leaf Holly Mountain Holly Hulver American Holly Black Alder
Kalmia spp.	Sheep Laurel Lambkill Dwarf Laurel Wicky Sheepkill Pigkill Mountain Laurel Calico-bush Spoon Wood Ivy-bush Bog Laurel Swamp Laurel Pale Laurel
Lilium spp. (native)	Canada Lily
Lobelia cardinalis	Cardinal Flower Indian-pink
All Clubmosses, including:	
Lycopodium spp.	Foxtail Clubmoss Bristly Clubmoss Stiff Clubmoss Swamp Clubmoss Carolina Clubmoss Running Cedar Staghorn Evergreen Wolf's-claws Buckhorn Coral Clubmoss Northern Running-pine Christmas Green Ground Cedar Northern Tree Clubmoss

	Running-pine
	Bog Clubmoss
	Shining Firmoss
	Shining Clubmoss
	Ground Pine
	Eastern Tree Clubmoss
	Cypress Clubmoss
	Ground Fir
	Northern Firmoss
	Fir Clubmoss
	Sika Clubmoss
	Northern Groundpine
Malus coronaria	American Crab
	Sweet-crab
Mertensia virginica	Virginia Bluebells
	Virginia Cowslip
	Roanoke-bells
Myrica pensylvanica	Bayberry
	Candleberry
Opuntia humifusa	Eastern Prickly-pear
All Native Orchids, including:	
Orchidaceae	Puttyroot
	Adam-and-Eve
	Swamp Pink
	Dragon's-mouth
	Grass Pink
	Calypso
	Fairyslipper
	Long-bracted Orchid
	Frog Orchid
	Spotted Coralroot
	Autumn Coralroot
	Striped Coralroot
	Pale Coralroot
	Early Coralroot
	Pink Ladyslipper
	Moccasin Flower
	Ram's-head Ladyslipper
	Yellow Ladyslipper
	Small Yellow Ladyslipper
	Large Yellow Ladyslipper

	Small White Ladyslipper
	Showy Ladyslipper
	Showy Orchis
	Downy Rattlesnake Plantain
	Dwarf Rattlesnake Plantain
	Rattlesnake Plantain
	Small Whorled Pogonia
	Large Whorled Pogonia
	Five-leaves
	Large Twayblade
	Purple Twayblade
	Bog Twayblade
	Yellow Twayblade
	Fen Orchid
	Auricled Twayblade
	Southern Twayblade
	Broad-lipped Twayblade
	Heartleaf Twayblade
	White Adder's-mouth
	Malaxis
	Green Adder's-mouth
	White Fringed Orchid
	Orange Fringed Orchid
	Yellow Fringed Orchid
	Green Woodland Orchid
	Crested Fringed Orchid
	Bog-candle
	White Bog-orchid
Orontium aquaticum	Golden Club
Panax quinquefolius	Ginseng
	Sang
Rhododendron spp. (native)	Smooth Azalea
	Flame Azalea
	Rhodora
	Lapland Rosebay
	Great Laurel
	Rosebay
	White Laurel
	Pinkster-flower
	Pinkster-bloom
	Purple Honeysuckle
	Election-pink
	Early Azalea

	Mountain Azalea
	Rose Honeysuckle
	Swamp Azalea
	Swamp Honeysuckle
	Clammy Azalea
	Clammy Rhododendron
Sabatia spp.	Slender Marsh-pink
	Sea-pink
	Marsh-pink
Sanguinaria canadensis	Bloodroot
	Puccon
Sarracenia purpurea	Pitcher-plant
	Side-saddle Plant
Silene caroliniana	Wild Pink
Trillium spp.	Nodding Trillium
	Purple Trillium
	Stinking Benjamin
	White Trillium
	Wakerobin
	Toadshade
	Painted Trillium
Viola pedata	Bird's-foot Violet
	Pansy Violet
	Johnny-jump-up

(e) The following are **rare** native plants that have from 20 to 35 extant sites or 3,000 to 5,000 individuals statewide.

Species	**Common name**
Agalinis virgata	Pine-barren Gerardia
Agrimonia parviflora	Agrimony
Agrimonia rostellata	Woodland Agrimony
Allium cernuum	Wild Onion
Arabis divaricarpa	Purple Rock-cress
Arabis missouriensis	Green Rock-cress
Arethusa bulbosa	Swamp Pink
Armoracia aquatica	Lake-cress
Asclepias viridiflora	Green Milkweed
Asimina triloba	Pawpaw
Aster nemoralis	Bog Aster

Betula pumila	Swamp Birch
Bidens laevis	Smooth Bur-marigold
Cacalia suaveolens	Sweet-scented Indian-plantain
Calamagrostis pickeringii	Pickering's Reedgrass
Calamagrostis porteri ssp. porteri	Porter's Reedgrass
Carex bicknellii	Bicknell Sedge
Carex bigelowii	Bigelow Sedge
Carex bushii	Sedge
Carex buxbaumii	Brown Bog Sedge
Carex chordorrhiza	Creeping Sedge
Carex collinsii	Collins Sedge
Carex complanata	Hirsute Sedge
Carex cumulata	Clustered Sedge
Carex davisii	Davis Sedge
Carex emmonsii	Emmons Sedge
Carex flaccosperma var. glaucodea	Sedge
Carex formosa	Handsome Sedge
Carex garberi	Elk Sedge
Carex gravida	Heavy Sedge
Carex gynocrates	Northern Bog Sedge
Carex hormathodes	Sedge
Carex houghtonii	Sedge
Carex lupuliformis	False Hop Sedge
Carex merritt-fernaldii	Sedge
Carex molesta	Troublesome Sedge
Carex nigromarginata	Black-edge Sedge
Carex schweinitzii	Schweinitz Sedge
Carex seorsa	Weak Stellate Sedge
Carex typhina	Cat-tail Sedge
Carex vaginata	Sheathed Sedge
Carex venusta var. minor	Sedge
Carex willdenowii	Willdenow Sedge
Chamaecyparis thyoides	Atlantic White Cedar
Chamaelirium luteum	Blazing-star
Coreopsis rosea	Rose Coreopsis
Corydalis flavula	Yellow Harlequin
Crotalaria sagittalis	Rattlebox
Cuscuta campestris	Field-dodder
Cuscuta pentagona	Field-dodder
Cuscuta polygonorum	Smartweed Dodder
Cyperus erythrorhizos	Red-rooted Flatsedge
Cyperus houghtonii	Houghton Umbrella-sedge

Cyperus polystachyos var. texensis	Cyperus
Cyperus schweinitzii	Schweinitz Flat-sedge
Digitaria filiformis	Slender Crabgrass
Diospyros virginiana	Persimmon
Draba arabisans	Rock-cress
Draba reptans	Carolina Whitlow-grass
Dracocephalum parviflorum	American Dragonhead
Eleocharis fallax	Creeping Spikegrass
Eleocharis halophila	Salt-marsh Spikerush
Eleocharis obtusa var. ovata	Blunt Spikerush
Empetrum nigrum ssp. hermaphroditicum	Black Crowberry
Equisetum palustre	Marsh Horsetail
Equisetum pratense	Meadow Horsetail
Frasera caroliniensis	Green Gentian
Gentiana saponaria	Soapwort Gentian
Geranium carolinianum var. sphaerospermum	Carolina Cranebill
Gnaphalium purpureum	Purple Everlasting
Gymnocladus dioicus	Kentucky Coffee Tree
Hedeoma hispidum	Mock-pennyroyal
Hemicarpha micrantha	Dwarf Bullrush
Heteranthera reniformis	Kidneyleaf Mud-plantain
Hydrangea arborescens	Wild Hydrangea
Isoetes macrospora	Large-spored Quillwort
Jeffersonia diphylla	Twin-leaf
Juncus subcaudatus	Woods-rush
Lathyrus ochroleucus	Wild-pea
Lechea racemulosa	Pinweed
Lechea tenuifolia	Slender Pinweed
Lespedeza stuevei	Lespedeza
Lespedeza violacea	Lespedeza
Liatris scariosa var. novae-angliae	New England Blazing-star
Linum sulcatum	Yellow Wild Flax
Liparis liliifolia	Large Twayblade
Listera australis	Southern Twayblade
Lobelia nuttallii	Nuttall's Lobelia
~~*Ludwigia sphaerocarpa*~~	Ludwigia
Lythrum hyssopifolia	Loosestrife
Malus glaucescens	American Crab
Mimulus alatus	Winged Monkeyflower

Minuartia caroliniana	Pine-barren Sandwort
Monarda fistulosa var. clinopodia	Basil-balm
Myriophyllum alterniflorum	Water Milfoil
Najas guadalupensis var. olivacea	Naiad
Najas marina	Holly-leaved Naiad
Nelumbo lutea	Yellow Lotus
Onosmodium virginianum	Virginia False Gromwell
Pedicularis lanceolata	Swamp Lousewort
Phlox maculata	Wild Sweet-william
Physocarpus opulifolius var. intermedius	Ninebark
Pinguicula vulgaris	Butterwort
Pinus banksiana	Jack Pine
Podostemum ceratophyllum	Riverweed
Polygonum buxiforme	Knotweed
Polygonum douglasii	Knotweed
Polygonum tenue	Slender Knotweed
Potamogeton alpinus	Northern Pondweed
Potamogeton confervoides	Pondweed
Potamogeton filiformis var. occidentalis	Sheathed Pondweed
Potentilla anserina ssp. pacifica	Silverweed
Proserpinaca pectinata	Mermaid-weed
Prunus pumila var. depressa	Sand-cherry
Prunus pumila var. pumila	Sand-cherry
Psilocarya nitens	Short-beaked Bald-rush
Psilocarya scirpoides	Long-beaked Bald-rush
Ptelea trifoliata	Wafer-ash
Quercus marilandica	Blackjack Oak
Rhododendron canadense	Rhodora
Rosa acicularis ssp. sayi	Prickly Rose
Rotala ramosior	Tooth-cup
Sagittaria calycina var. spongiosa	Spongy Arrowhead
Scirpus heterochaetus	Slender Bulrush
Scleria reticularis var. reticularis	Reticulated Nutrush
Scleria triglomerata	Whip Nutrush
Scutellaria parvula var. leonardii	Small Skullcap
Solidago elliottii	Coastal Goldenrod

Solidago ohioensis	Ohio Golderod
Spiranthes vernalis	Spring Ladies'-tresses
Stellaria longipes var. longipes	Starwort
Subularia aquatica ssp. americana	Water Awlwort
Tradescantia ohiensis	Ohio Spiderwort
Triglochin palustre	Marsh Arrow-grass
Utricularia biflora	Two-flowered Bladderwort
Utricularia fibrosa	Fibrous Bladderwort
Utricularia geminiscapa	Hiddenfruit Bladderwort
Utricularia juncea	Rush Bladderwort
Utricularia radiata	Small Floating Bladderwort
Vaccinium boreale	High-mountain Blueberry
Vaccinium uliginosum ssp. pubescens	Bog Bilberry
Viburnum edule	Squashberry
Viola nephrophylla	Northern Bog Violet

(f) It is a violation for any person, anywhere in the state, to pick, pluck, sever, remove, damage by the application of herbicides or defoliants, or carry away, without the consent of the owner, any protected plant. Each protected plant so picked, plucked, severed, removed, damaged or carried away shall constitute a separate violation.

APPENDIX D

HUMAN HEALTH RISK ASSESSMENT FOR GLYPHOSATE

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EXECUTIVE SUMMARY

The objective of this sectional report for the Generic Environmental Impact Statement is to perform a screening health risk assessment to support the use of Rodeo® aquatic herbicide in the state of New York. A similar report will be submitted tc the New York State Department of Health in support of Monsantos request to increase the state Maximum Contaminant Level (MCL) for glyphosate from 50 ppb to the Federa MCL level of 700 ppb. This report was originally prepared by Radian Corporation ir support of the registration of Rodeo® in the state of Connecticut. Rodeo can be used fo control of aquatic weeds in and around all bodies of water. For the purposes of this risk assessment, concentrations associated with maximum application rates were utilized

Glyphosate, the active ingredient in Rodeo, and its major metabolite aminomethylphosphonic acid (AMPA), are tightly bound to the soil and display little potential for leaching or off-site migration as a result of their lack of accumulation anc short half-lives. However, direct application of Rodeo aquatic herbicide to surface wate bodies may expose humans who come into contact with these bodies of water. Exposure may occur via ingestion of drinking water previously treated with Rodeo, direc contact with surface water during recreational activities such as swimming, or via ingestion of aquatic species. The exposure assumptions used in this assessment are generally conservative and tend to overestimate potential risk. All of the hazard quotients derived for individual pathways as well as cumulative hazard indices for combinec pathway risks are well below the Superfund site remediation goal of 1 for noncarcinogens considered to the de minimus value for use in risk management decisions. Because of the many conservative assumptions used in the exposure assessment, the results of this risk assessment indicate that the use of Rodeo aquatic herbicide to control weeds in and around waterways in New York poses negligible risk tc human health.

1.0 INTRODUCTION

Rodeo is a non-selective aquatic herbicide used to control unwanted emerged vegetation in and around water surfaces, and for noncrop weed control on terrestrial sites. Rodeo is one of only a few herbicides approved by the U.S. EPA for aquatic uses.

The objective of this study was to perform a screening health risk assessment that considers sensitive members of the population and to provide a risk assessment document presented in standard Superfund format. The risk assessment evaluated the potential pathways for human exposure, estimated concentrations at receptor contact points, and determined the cumulative hazard index as a measure of potential human health risk. This document is intended to support the use of Rodeo for aquatic herbicide in the state of New York.

2.0 RISK ASSESSMENT

2.1 Fate and Transport

The following discussion of the environmental fate and transport of glyphosate is abstracted from the Monsanto Technical Report MSL-1223 Environmental Fate of Glyphosate: Review of Laboratory and Field Studies which is presented in Attachment A.

2.1.1 Formulation and Application Rates

Glyphosate, formulated as its isopropylamine salt, is the active ingredient in Rodeo aquatic herbicide. Rodeo is composed of 53.8% isopropylamine-glyphosate in water. The only inert ingredient in Rodeo herbicide is water. Rodeo is registered for use in residential, commercial, public, and agricultural areas. Rodeo can be used for control of aquatic weeds in and around all bodies of water including lakes, rivers, ponds, seeps, canals, and reservoirs. When applied according to label directions, there are no restrictions on the use of treated water for irrigation, recreation, or domestic use. However, Rodeo® should not be applied within 1/2 mile upstream of a potable water intake.

The maximum recommended application rate is 7.5 pints per acre or 5.06 lbs. active ingredient per acre. Under most circumstances, Rodeo is applied relatively infrequently, usually once every two to five years. For the purposes of this risk assessment, concentrations associated with maximal application rates were utilized.

Rodeo differs from the other Monsanto product mentioned in the sectional report, Roundup® herbicide, in that it does not contain a surfactant. Roundup herbicide, which contains 41% isopropylamine-glyphosate, ethoxylated tallowamine surfactant and water, is approved only for terrestrial uses.

2.1.2 Soil

Studies demonstrate that glyphosate and its major metabolite, aminomethylphosphonic acid (AMPA), are tightly bound to the soil and are readily degraded by natural soil microflora. Therefore, glyphosate displays little if any potential for leaching. Glyphosate does not accumulate following multiple applications. As a result of this lack of accumulation and the short half-lives for glyphosate and AMPA (typically less than 60 days), only limited potential exists for off-site migration.

Glyphosate is extensively degraded in soil under both aerobic and anaerobic conditions. AMPA is also degraded (at a slower rate) in soil, eventually releasing carbon dioxide (CO_2). Studies have demonstrated that as much as 86% of glyphosate applied to soil is degraded to CO_2.

Half-lives for glyphosate and AMPA in soil are typically less than 60 days and range from 3 to 174 days. Consistent with metabolism studies, AMPA concentrations in soil increased with time reaching a maximum after 30 to 60 days and decreasing to very low levels by 365 days post treatment. Studies conducted to evaluate the potential for glyphosate to accumulate in soils revealed that less than 10% of the total applied glyphosate remained in the soils approximately one year after the last application was made. At the majority of the sites evaluated, AMPA levels were less than 20% of total applied glyphosate dose one year later. The rate of dissipation in soils may be dependent on the microbial composition and extent of soil binding.

Soil mobility (leaching) studies indicate that glyphosate possesses no propensity for leaching through most soils. Soil column leaching studies on even the most vulnerable soils (least adsorptive), demonstrated only modest vertical migration of glyphosate. Glyphosate is rapidly and tightly adsorbed to a wide variety of soils. It has been demonstrated that the rate of glyphosate adsorption to soil is initially rapid with 67% of the total adsorption occurring during the first hour.

2.1.3 Water

Studies conducted on natural watersheds have demonstrated that glyphosate does not migrate as a result of runoff. The maximum concentration of glyphosate residue detected in runoff water was 5.2 ppm measured one day after application of Roundup herbicide, with typical water residues of less than 0.10 ppm. It has been determined that less than 2% of the glyphosate applied is typically washed off the application site. This lack of movement is attributed to the tight binding of glyphosate to soil.

Aquatic metabolism studies demonstrated a half-life for glyphosate (in the absence of sediment) of between 49 and 70 days. Aquatic metabolism studies conducted in the presence of sediment typically result in significantly increased rates of aquatic dissipation, with half-lives measured at approximately eight days.

In a study conducted to determine the fate of glyphosate in non-flowing pond water following an exaggerated application rate of 10.7 lbs per acre to the entire surface, a maximum glyphosate residue level of 0.73 ppm at the surface was measured one hour after the initial application. This level decreased to 0.39 ppm after two days and to less than 0.005 ppm after 127 days. The half-life for glyphosate in non-flowing pond water calculated from this study was 14 days. Glyphosate concentrations were less and dissipate more rapidly in flowing streams. Maximum residues following an 8 lb per acre application of Rodeo herbicide were measured 20 feet downstream at 0.04 ppm 30 minutes after application. No glyphosate concentration greater than 0.01 ppm was ever detected 300 feet downstream.

Water treatment facilities were simulated in one study in order to determine the fate of glyphosate in a potable water treatment facility. In potable water supplies fortified with glyphosate concentrations ranging from 0.01 to 10 ppm, an average of approximately 77% of the glyphosate was removed. An average of 31.5% was removed from water fortified with 100 ppm of glyphosate. AMPA removal was much less efficient and averaged 37.6% for all fortification levels.

Studies were conducted to determine the potential for glyphosate to bioaccumulate in fish which were exposed for 10 to 14 days to concentrations three or four times higher than normal use rates. Glyphosate bioconcentration factors in fish tissues ranged from 0.1 to 0.3. Generally, bioconcentration factors in excess of 500 indicate significant bioaccumulation and, therefore, these results indicate that glyphosate does not bioaccumulate significantly in fish. Tolerances (i.e. maximum residue limits) for glyphosate in edible fish and shellfish have been established at 0.25 and 3.0 ppm, respectively (40 CFR Part 180.364; see attachment B-2).

2.2 Exposure Assessment

Exposure assessment is the determination or estimation of magnitude, frequency, duration, and route of human exposure to contaminants that are present at, or may have migrated from, a site. This section describes the approach used for identifying subpopulations that may be at increased risk from chemical exposure to Rodeo® and for identifying potential human exposure pathways.

2.2.1 Characterization of the Most Significantly Exposed Population

Subpopulations that may be more sensitive to chemical exposure include infants and children, elderly people, pregnant and nursing women, and people with chronic illnesses. Those potentially at higher risk for exposure to Rodeo due to behavioral patterns include children, who are more likely to contact soil and water during recreational use, and persons who may eat large amounts of fish from surface water bodies to which Rodeo has been applied. In considering the possible human exposure associated with the use of Rodeo aquatic herbicide, it would appear the potentially most exposed, and possibly sensitive population, would be children. Children may be exposed to residuals in surface waters through dermal contact and incidental ingestion while swimming. Including assumed ingestion of supplied drinking water or fish/shellfish, they would also show the highest values on a mg/kg-day basis. Pregnant women (and their unborn fetuses) potentially represent a sensitive subpopulation since the most notable toxicological findings associated with glyphosate are related to maternal and developmental toxicity. Therefore, for the purposes of this risk assessment, children and pregnant women are considered to be sensitive indicators of potential risk associated with Rodeo.

2.2.2 Identification of Exposure Pathways

An exposure pathway describes the course a chemical or physical agent takes from the source to the exposed individual. An exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of human exposure.

2.2.3 Identification of Releases into Receiving Media

Potential receiving media for Rodeo aquatic herbicide are discussed in Section 2.1 of this sectional report. Rodeo may be applied to emerged weeds in all bodies of fresh and brackish water which may be flowing, nonflowing, or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, and similar sites. Therefore, surface water is the most relevant receiving medium. Soil leaching studies indicate that glyphosate and its major metabolite (AMPA) possess virtually no propensity for leaching through most soils. This fact in combination with the rapid degradation of these compounds in soil make it highly unlikely that glyphosate will leach into groundwater. Glyphosate is not volatile and, therefore, is not likely to be emitted to the atmosphere.

2.2.4 Identification of Exposure Points and Exposure Routes

Exposure points are identified by determining where the potentially exposed populations (identified previously) may come in contact with the receiving media. This is done by considering the activity patterns of pertinent populations, including those subgroups that may be of particular concern. Normally, potential pathways are segregated into those that currently exist and those that may exist in the future for a specific site. However, since this risk assessment is to be used to assess applications across the state of New York, computer dispersion models for predicting contaminant migration and future contaminant concentrations normally used for site-specific risk assessments were not used. All exposure scenarios are considered to be currently possible.

Potential pathways associated with the receptors identified previously were evaluated in order to determine whether they were complete and significant. Figure 2-1 depicts potential pathways for Rodeo aquatic herbicide to move from the point of release to the point of human exposure.

Glyphosate has a vapor pressure of 1.94 x 10-7 mm/Hg at 45° C and is not considered to be volatile. Given the propensity for the active ingredient to adsorb to soils and sediments, dermal contact with soils is assumed to be a negligible contributor to risk as is volatilization from surface water or sediments. Glyphosate could be emitted to the atmosphere in the form of fugitive aerosols or dusts but this pathway is not expected to be a significant contributor to risk by comparison to those involving direct contact with water to which Rodeo has been applied. Due to its limited mobility in most soils, leaching of glyphosate into groundwater is of limited concern and for the purposes of this risk assessment, was not quantified. Since glyphosate does not migrate as a result of runoff, this pathway was not assessed in this risk assessment.

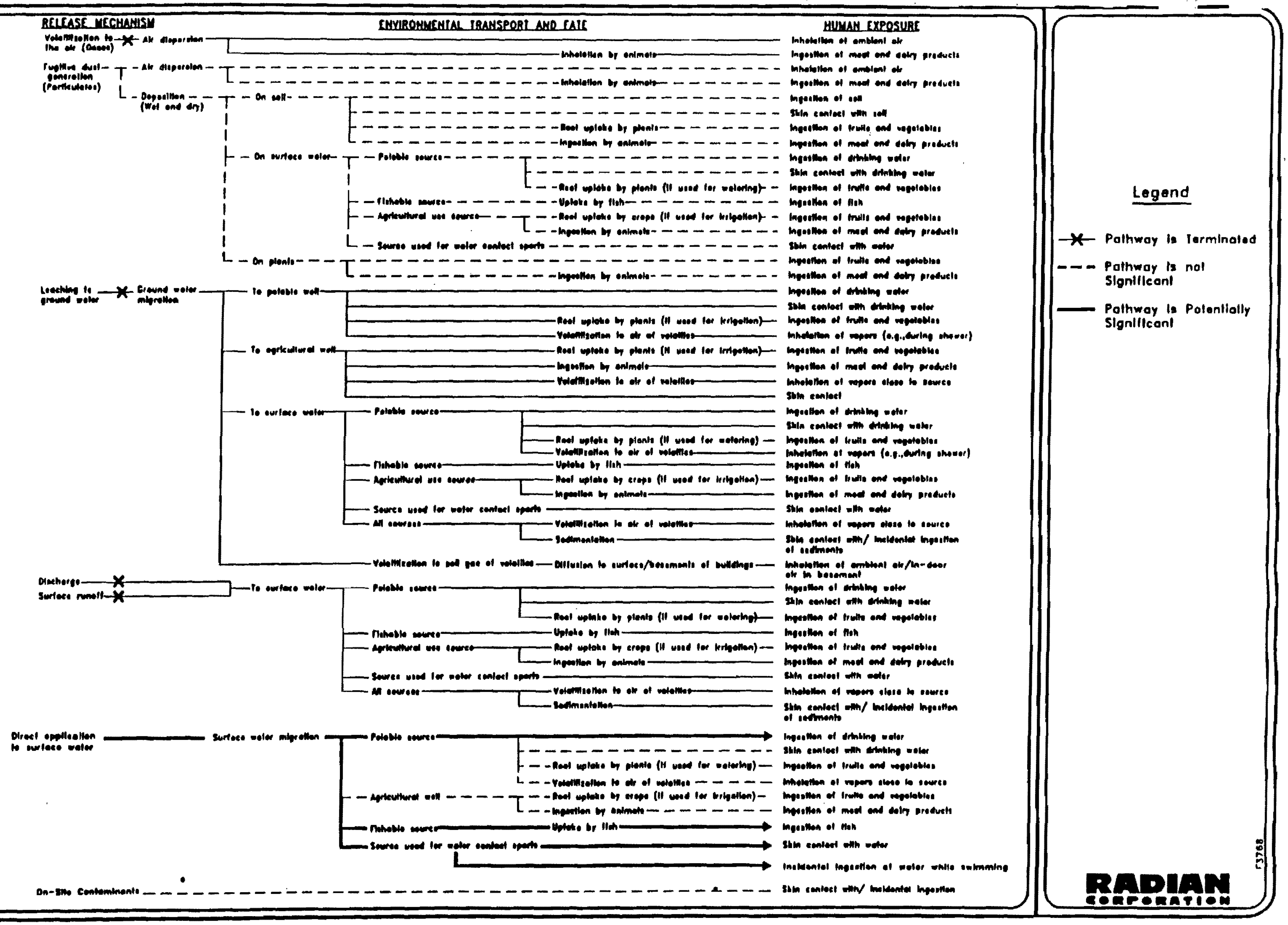

Figure 2-1. Potential Pathways of Exposure to Rodeo Aquatic Herbicide

Direct application of Rodeo aquatic herbicide to surface water bodies may expose humans who come into contact with these bodies of water either directly or indirectly.

Significant human exposure may occur via direct contact with surface water during recreational activities such as swimming. The obvious intake route is contaminant ingestion by incidental drinking of water. However, when the large surface area of skin is exposed to contaminated water while swimming, skin absorption may also be significant. The skin acts as a lipid sink for lipid-soluble contaminants and also serves as a transfer membrane for water and contaminants dissolved in it. Incidental ingestion of and dermal contact with contaminants in surface water while swimming have been quantified in this risk assessment. While glyphosate is not likely to leach into groundwater, water containing glyphosate due to ditchbank or aquatic weed control uses could enter treatment facilities and ultimately be delivered to users of municipal water supplies. Human exposure may occur via ingestion of water previously treated with Rodeo aquatic herbicide and therefore this pathway was evaluated.

Contaminated surface water used for irrigation of fruits and vegetables grown in a home garden or, on a larger scale, for irrigating farm crops, contributes to concentrations of certain chemicals in edible portions of plants. Indirect human exposure may then occur following ingestion of the contaminated produce. This pathway was, however, not assessed in this risk assessment since, as an herbicide, use of surface water with high levels of Rodeo would be expected to destroy or inhibit plant growth, making it unlikely that plants contaminated with the agent would be eaten. If low levels were applied, it is unlikely that appreciable amounts would be available for plant uptake due to soil binding characteristics and microbial degradation.

Fish in surface water bodies are exposed to contaminants in the water. Application of Rodeo aquatic herbicide to lakes, rivers, streams, ponds, and estuaries could result in uptake by fish and other aquatic species. Assuming that these sources serve as fishable resources, human exposure via ingestion of exposed aquatic species could occur. Edible tissue concentrations are a function of the level and type of biotic exposure to contaminants, the partitioning of contaminants between organ tissue and substrate media, the biodegradation of contaminants, organism-specific metabolic characteristics, and ecosystem characteristics. As discussed in the Fate and Transport section of this risk assessment, aquatic metabolism studies have demonstrated that glyphosate is practically nontoxic to aquatic species, does not bioaccumulate in the food chain, and generally dissipates rapidly from surface water bodies. Even though studies indicate that glyphosate does not bioaccumulate significantly in the food chain, uptake of glyphosate by fish and human ingestion of the fish were quantified in order to assess a worst case scenario.

2.2.5 Determination of Exposure Scenarios

Residents living near bodies of water to which Rodeo aquatic herbicide is applied and those using the water bodies for recreational purposes represent the potentially exposed populations. These individuals may be subject to chronic (long-term) or subchronic (two weeks to seven years) exposure to the media of interest (surface water). However, the short half life of glyphosate, demonstrated in numerous aquatic studies, indicates that actual exposure duration would be substantially less. Chronic exposure via water is highly unlikely due to infrequent application and rapid dissipation in water. In order to assess the most conservative possible scenario, however, reasonable maximum (30 years) chronic exposure was assessed for adults. Reasonable maximum (6 years) exposure was assessed for children. For pregnant females, an average residence time (9 yrs) was chosen as a maximum estimate for the total time spent in pregnancy.

2.2.6 Quantification of Estimated Exposure Concentrations

Once potentially exposed populations are identified, environmental concentrations at points of exposure must be determined or projected. Typically, those exposure points where the concentration that will be contacted is greatest are identified as the reasonable maximum exposures (RME). EPA defines RME as the highest exposure that is reasonably expected to occur. While it is inappropriate to conduct a health risk assessment only considering worst case scenarios, the U.S. EPA guidelines for exposure-related measurements state that this approach is appropriate for initial screening purposes (EPA, 1988). This risk assessment characterizes a reasonable maximum exposure for an adult, as well as exposures for two potentially sensitive subpopulations: pregnant females and children.

The results of numerous studies on the environmental fate of glyphosate and its major metabolite, AMPA, in all cases indicate half-lives of less than one year, and typically less than 60 days. For the purposes of this risk assessment, residual concentrations associated with the highest rate of application were used in order to assess a worst case scenario.

Levels of glyphosate in drinking water, even under the worst of circumstances, are expected to be very low. Numerous studies indicate that combined glyphosate and AMPA residues in aquatic systems do not exceed 0.5 ppm, even after exaggerated application. Due to metabolic degradation, binding to sediment, and downstream dilution, glyphosate is not expected to reach levels of 0.5 ppm in drinking water supplies. Therefore, based on an initial concentration of 0.5 ppm glyphosate 1/2 mile from a potable water well, a hypothetical drinking water concentration was calculated. Based on the assumption that a ten-fold dilution occurs in the glyphosate concentration at the point of intake and a worst case removal rate of 31.5% from water treatment facility simulations (see Fate and Transport section of this report), an estimated concentration of 0.034 ppm in drinking water was calculated.

The maximum concentration of glyphosate measured one hour after the initial application in non-flowing pond water following an exaggerated application rate of 10.7 lbs per acre (twice the recommended application) was 0.73 ppm at the surface. This residue level was used in order to assess the worst case exposure concentration while swimming. The concentration of glyphosate in fish tissue was estimated as the product of the maximum residue level in the non-flowing surface pond one hour after application and the maximum chemical-specific bioconcentration factor of 0.3, derived from aquatic studies (Attachment A).

2.2.7 Estimation of Chemical Intakes for Individual Pathways

Exposure is defined as the contact rate of an organism with a chemical or physical agent. Intake is defined as exposure normalized for time and body weight and is expressed in units of mg chemical/kg body weight-day (EPA, 1989a).

There are three categories of variables that are used to estimate intake:

1) Chemical-related variables (exposure concentration);

2) Variables that describe the exposed population (contact rate, exposure frequency and duration, and body weight);

3) Assessment related variables (averaging time).

The chemical related variables (exposure concentrations) and estimated chemical intakes for individual pathways are presented in Table 2-1. Due to the complexity of calculating exposure concentrations of chemicals that dissipate rapidly, conservative concentrations encountered one day following an exaggerated application of Rodeo aquatic herbicide to surface water and maximum levels estimated in drinking water supplies were used to estimate chemical intakes for individual pathways. Tables 2-2 through 2-5 summarize the assumptions and algorithms used to estimate exposure for each exposure pathway. The rationale for selecting individual exposure parameter values is explained in footnotes to the tables.

Table 2-1

Exposure Concentrations and Estimated Intakes for Individual Pathways

Population	Exposure Pathway	Source Concentration	Intake (mg/kg-day)		
			Pregnant Female	Adult RME	Child
Nearby residents and recreational users of surface waters treated with Rodeo aquatic herbicide	Ingestion of drinking water	0.034 mg/L in drinking water	9.3E-04	9.3E-04	2.17E-03
	Incidental ingestion of surface water while swimming	0.73 mg/L in surface water	2.6E-05	1.1E-04	7.8E-04
	Dermal contact while swimming	0.73 mg/L in surface water	1.3E-09	5.7E-09	4.2E-09
	Ingestion of fish	0.22 mg/kg in fish	2.2E-05	2.2E-05	5.2E-05

Table 2-2

Potential Exposure from Ingestion of Drinking Water

Intake (mg/kg-day) = (CW x IR x EF x ED)/(BW x AT)		Assumptions		
Parameters		Pregnant Female	Adult Reasonable Maximum	Child
CW =	Chemical Concentration in Water (mg/liter) [a]	0.034	0.034	0.034
IR =	Ingestion Rate (liters/day)	2 [b]	2 [c]	1 [d]
EF =	Exposure Frequency (days/year)	350 [e]	350 [e]	350 [e]
ED =	Exposure Duration (years)	9 [f]	30 [g]	6
BW =	Body Weight (kg)	70 [b]	70 [b]	15 [h]
AT =	Averaging Time (period over which exposure is averaged–days) –Noncarcinogenic effects	3285 [i]	10950 [i]	2190 [i]

[a] See text and Table 2-1 for concentration in drinking water.
[b] Adult, average; EPA, 1989b.
[c] Adult, 90th percentile; EPA, 1991a.
[d] Ingestion rate is age-specific; EPA, 1989b.
[e] Days/year spent at home; EPA, 1991a.
[f] National median time–50th percentile–time at one residence; EPA, 1989b, considered reasonable maximum estimate of total time in pregnancy.
[g] National upper bound time–90th percentile–time at one residence; EPA, 1989b.
[h] Body weight is age-specific, EPA, 1989b.
[i] ED x 365 days/year.

Table 2-3

Potential Exposure from Incidental Ingestion of Water While Swimming

Intake (mg/kg-day) = (CW x IR x ET x EF x ED)/(BW x AT)	Assumptions		
Parameters	Pregnant Female	Adult Reasonable Maximum	Child
CW = Chemical Concentration in Water (mg/liter)	0.73 [a]	0.73 [a]	0.73 [a]
IR = Ingestion Rate (liters/hour)	0.05 [b]	0.05 [b]	0.05 [b]
ET = Exposure Time (hours/event)	2.6 [c]	2.6 [c]	2.6 [c]
EF = Exposure Frequency (events/year)	7 [d]	30 [e]	45 [f]
ED = Exposure Duration (years)	9 [g]	30 [h]	6 [i]
BW = Body Weight (kg)	70 [j]	70 [j]	15 [k]
AT = Averaging Time (period over which exposure is averaged--days) - Noncarcinogenic effects	3285 [l]	10950 [l]	2190 [l]

[a] See text and Table 2-1 for concentration in surface water used for swimming.
[b] Exposure while swimming; EPA, 1989a.
[c] Adult average exposure time while swimming; EPA, 1991a.
[d] National average for swimming; EPA, 1989b; pregnant women considered less likely to engage in swimming.
[e] Best professional judgement for adult reasonable maximum. Assumes swimming every third day of the three summer months.
[f] Best professional judgement for 6 year old child reasonable maximum. Assumes swimming every other day of the three summer months.
[g] National median time--50th percentile--time at one residence; EPA, 1989b; considered reasonable maximum estimate of total time in pregnancy.
[h] National upper bound time--90th percentile--time at one residence; EPA, 1989b.
[i] From birth through 6 years of age.
[j] Adult, average; EPA, 1989b.
[k] 1 through 6 years old, average body weight; EPA, 1991a.
[l] ED x 365 days/year.

Table 2-4

Potential Exposure from Dermal Contact While Swimming

Absorbed Dose (mg/kg-day) = (CW x SA x PC x ET x EF x ED x CF)/(BW x AT)	Assumptions		
Parameters	Pregnant Female	Adult Reasonable Maximum	Child
CW = Chemical Concentration in Water (mg/liter)	0.73 [a]	0.73 [a]	0.73 [a]
SA = Skin Surface Area Available for Contact (cm^2)	20000 [b]	20000 [b]	10000 [c]
PC = Chemical-specific Dermal Permeability Constant (cm/hr)	1.2E-7 [d]	1.2E-7 [d]	1.2E-7 [d]
ET = Exposure Time (hours/event)	2.6 [e]	2.6 [e]	2.6 [e]
EF = Exposure Frequency (events/year)	7 [f]	30 [g]	45 [h]
CF = Conversion Factor (liter/cm^3)	0.001	0.001	0.001
ED = Exposure Duration (years)	9 [i]	30 [j]	6 [k]
BW = Body Weight (kg)	70 [l]	70 [l]	15 [m]
AT = Averaging Time (period over which exposure is averaged--days) - Noncarcinogenic effects	3285 [n]	10950 [n]	2190 [n]

[a] See text and Table 2-1 for concentration in surface water used for swimming.
[b] Average adult skin surface area; EPA, 1991a.
[c] Average child ages 2-18 yrs skin surface area; EPA 1991a.
[d] Calculated from total dermal intake; EPA, 1991b. See Attachment D for detailed calculation method.
[e] Adult average exposure time while swimming; EPA, 1991a.
[f] National average for swimming; EPA, 1989b.
[g] Best professional judgement for adult reasonable maximum. Assumes swimming every third day of the three summer months.
[h] Best professional judgement for 6 year old child reasonable maximum. Assumes swimming every other day of the three summer months.
[i] National median time--50th percentile--time at one residence; EPA, 1989b.
[j] National upper bound time--90th percentile--time at one residence; EPA, 1989b.
[k] From birth through 6 years of age.
[l] Adult, average; EPA, 1989b.
[m] 1 through 6 years old, average body weight; EPA, 1991a.
[n] ED x 365 days/year.

Table 2-5

Potential Exposure from Ingestion of Fish

Intake (mg/kg-day) = (CF x IR x FI x EF x ED)/(BW x AT)	Assumptions		
Parameters	Pregnant Female	Adult Reasonable Maximum	Child
CF = Chemical Concentration in Fish (mg/kg)	0.22 [a]	0.22 [a]	0.22 [a]
IR = Ingestion Rate (kg/meal)	0.054 [b]	0.054 [b]	0.027 [c]
FI = Fraction Ingested from Contaminated Source (unitless)	1 [d]	1 [d]	1 [d]
EF = Exposure Frequency (meals/year)	48 [e]	48 [e]	48 [e]
ED = Exposure Duration (years)	9 [f]	30 [g]	6 [h]
BW = Body Weight (kg)	70 [i]	70 [i]	15 [j]
AT = Averaging Time (period over which exposure is averaged--days) - Noncarcinogenic effects	3285 [k]	10950 [k]	2190 [k]

[a] Calculated based on maximum residue level in nonflowing pond water following exagerated application and a bioconcentration factor of 0.3. See text and Table 2-1 for concentration in fish.
[b] Average per capita nonmarine fish consumption rate; EPA, 1991a.
[c] One-half total average per capita nonmarine fish consumption rate.
[d] Assumes 100% of fish consumption is from contaminated source.
[e] Average per capita number of meals containing fish per year; EPA, 1989a.
[f] National median time--50th percentile--time at one residence; EPA, 1989b.
[g] National upper bound time--90th percentile--time at one residence; EPA, 1989b.
[h] From birth through 6 years of age.
[i] Adult, average; EPA, 1989b.
[j] 1 through 6 years old, average body weight; EPA, 1991a.
[k] ED x 365 days/year.

Exposure assumptions recommended in the Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (EPA, 1991), the Risk Assessment Guidance for Superfund (EPA, 1989a), and the Exposure Factors Handbook (EPA, 1989b) were used when available and applicable. Chemical-specific values were used when available data justified their use; otherwise, conservative default values were used.

2.3 Toxicity Assessment

Toxicity assessment involves determining whether exposure to an agent can increase the incidence of a particular adverse effect in humans, characterizing the nature and strength of evidence of causation, and if sufficient data are available, quantifying the relationship between the dose of the contaminant and the incidence of adverse health effects in the exposed population. Toxicity values are derived from the quantitative dose-response relationship. These values can be used to estimate the incidence or potential for adverse effects as a function of human exposure to the contaminant. This section summarizes the toxicity information used for this risk assessment.

2.3.1 Toxicity Values Used in the Risk Assessment

EPA has performed the toxicity assessment step for glyphosate and Rodeo. The resulting toxicity information and toxicity values have undergone extensive internal peer review. EPA has derived a new Reference Dose (RfD) of 2.0 mg/kg-day for glyphosate (EPA, 1993; Attachment B-1). This value is based on a No Observed Effect Level (NOEL) of 175 mg/kg-day and an uncertainty factor of 100. The NOEL used to derive the RfD was established in a developmental toxicity study in rabbits which showed maternal toxicity in the form of soft stool/diarrhea and nasal discharge. For more information on derivation of the RfD for glyphosate, refer to the recently published Federal Register notice (FR 58(85):26 725) documenting the new RfD for glyphosate and EPA's dietary exposure analysis.

2.3.2 Health Effects Summary

Results from studies conducted under controlled laboratory conditions indicate that both Rodeo and glyphosate are practically nontoxic to mammals following acute oral or dermal exposures. Subchronic and chronic toxicity studies have also shown limited toxicity. Glyphosate is incompletely absorbed following oral administration. Glyphosate that is absorbed is rapidly excreted (almost entirely in the urine) as unmetabolized glyphosate.

Potential reproductive and developmental toxicities of glyphosate have been investigated in rat and rabbit teratology studies, and in multi-generation rat reproduction studies. Treatment of pregnant rats with 3500 mg/kg-day (day 6 through 19 of gestation) produced signs of maternal and fetal toxicity, as evidenced by increased mortality, decreased fetal weight, and unossified sternebrae, but did not induce a teratogenic response. No treatment-related effects in maternal animals or developmental effects were observed among the lower dose groups. Treatment of rabbits with 350 mg/kg-day (day 6 through 27 of gestation) produced signs of maternal toxicity, as evidenced by increased mortality, but did not induce any developmental toxicity. A decrease in pup weights was observed in a two-generational study conducted in rats. This effect, observed at the highest dose (30,000 ppm in the diet), was slight and was noted in the presence of parental toxicity. Glyphosate did not produce teratogenic effects or adversely affect the ability of animals to reproduce. For more detailed information on the toxicology of glyphosate, refer to the Monsanto Toxicology Information summary (dated April 1993) contained in Attachment C.

The EPA has classified glyphosate as Category E - Evidence of Noncarcinogenicity in Humans (S7 FR 8739). This classification indicates that there is no evidence of carcinogenicity in adequate studies and precludes quantitative toxicity assessment for carcinogenic effects.

Rodeo and glyphosate display very low levels of toxicity in birds and fish. Rodeo herbicide is rated as practically nontoxic to all aquatic species tested. For more information on environmental toxicity, refer to the attached Rodeo and glyphosate material safety data sheets (Attachment C).

2.4 Risk Characterization

Risk characterization involves integrating the possible exposure pathways and estimated chemical intakes with the appropriate toxicity values to form quantitative and qualitative expressions of potential health risk. To characterize potential noncarcinogenic effects, comparisons are made between projected intakes over a specified time period and toxicity values, primarily oral reference doses (RfDs). The ratio of exposure to toxicity value is the hazard quotient (HQ) and the HQ is calculated for each exposure pathway. HQ values for each pathway in an exposure scenario can be added to provide a Hazard Index (HI). If the exposure level exceeds the appropriate toxicity value (i.e., the HQ or HI is greater than one), there may be cause for concern regarding the potential noncarcinogenic effects. HQ and HI results are shown in Table 2-6.

2.4.1 Risk Characterization for the Dietary Scenario

The dietary scenario includes ingestion of drinking water and ingestion of fish. The HQ for adult reasonable maximum exposure to glyphosate in drinking water is 4.7E-04. The HQ associated with exposure of pregnant females to glyphosate via ingestion of drinking water is also 4.7E-04. The HQ associated with exposure of a child to glyphosate in drinking water is 1.1E-03. The HQs associated with pregnant female and adult reasonable maximum exposure to glyphosate via ingestion of contaminated fish are both 1.1E-05. The HQ for child exposure to contaminated fish is 2.6E-05.

2.4.2 Risk Characterization for the Swimming Scenario

The swimming scenario includes incidental ingestion of water and dermal contact while swimming. The HQs for pregnant female and adult reasonable maximum exposure to glyphosate via incidental ingestion of water while swimming are 1.3E-05 and 5.6E-05, respectively. The HQ associated with exposure of a child following incidental ingestion of glyphosate in surface water while swimming is 3.9E-04. The HQ for adult reasonable maximum exposure via dermal contact with surface water while swimming is 2.8E-9. The HQ associated with dermal exposure of a pregnant female to glyphosate in water while swimming is 6.6E-10. The HQ for dermal exposure of a child to glyphosate in surface water while swimming is 2.1E-09.

2.43 Cumulative Hazard Indices

Table 2-6 presents the cumulative hazard indices for dietary and swimming scenarios for the adult reasonable maximum estimates as well as for pregnant females and children. Ingestion of drinking water drives the risks, contributing 95%, 88%, and 72% of the pregnant female, adult RME, and child exposure scenarios, respectively.

2.5 Uncertainty Analysis

The results of the risk characterization should be interpreted in light of the many assumptions required to quantify exposure, intake, and dose-response. Uncertainties associated with the exposure assessment and the toxicity assessment contribute to the level of uncertainties associated with the risk characterization. Many of the assumptions made in the exposure assessment are highly conservative and, therefore, the "true" risks to human health associated with the use of Rodeo aquatic herbicide are likely to be lower than those presented in this risk assessment. Table 2-7 presents a summary of the uncertainties associated with the risk assessment and their potential effects on the risk characterization results.

Table 2-6

Hazard Quotients and Cumulative Hazard Indices

Exposure Pathway	Hazard Quotient (Percent Contribution by Pathway)		
	Pregnant Female	Adult RME	Child
Ingestion of Drinking Water	4.7E-04 (95%)	4.7E-04 (88%)	1.1E-03 (72%)
Incidental Ingestion of Water While Swimming	1.3E-05 (3%)	5.6E-05 (10%)	3.9E-04 (26%)
Dermal Contact While Swimming	6.6E-10 (<1%)	2.8E-09 (<1%)	2.1E-09 (<1%)
Ingestion of Fish	1.1E-05 (2%)	1.1E-05 (2%)	2.6E-05 (2%)
Combined Pathway Risks	4.9E-04	5.4E-04	1.5E-03

Table 2-7

Uncertainties Associated with Risk Characterization

Assumption	Effect on Risk Characterization	
	Potential for Overestimation	Potential for Underestimation
Standard assumptions regarding body weight, life expectancy, population characteristics and lifestyle may not be representative of actual exposure conditions.	Moderate	Moderate
Exposure durations were assumed to be prolonged (6, 9, or 30 years) even though the short half-lives of glyphosate and AMPA make these durations highly unlikely.	High	
Use of maximum glyphosate residue levels in a nonflowing pond one hour after exaggerated application as the exposure concentration for recreational activities.	High	
Use of worst case removal rate from water treatment facility simulations in which concentrations of glyphosate much higher than those likely to be encountered in the environment were added to test water for estimating drinking water concentrations.	High	
Assumption of 10-fold dilution at well head in estimation of drinking water concentration.	Moderate	Moderate
Use of conservative bioconcentration factor in estimating glyphosate concentrations in fish tissue.	Moderate	

3.0 CONCLUSIONS

All of the HQs derived for individual pathways are well below the Superfund site remediation goal of 1 for noncarcinogens set forth by the National Contingency Plan and considered to be the de minimis value for use in risk management decisions. The cumulative hazard indices for the pregnant female, reasonable maximum adult and for children are 4.9E-4, S.4E-4, and 1.5E-3, respectively. These values are also well below the value of 1 which might indicate unacceptable hazard or risk with margins of safety ranging from 666 for children to 2041 or 1852 for the pregnant female or adult reasonable maximum exposure. In light of the many highly conservative assumptions made during the course of this risk assessment, these results indicate that the use of Rodeo aquatic herbicide to control weeds in and around waterways in New York poses negligible risk to human health.

4.0 REFERENCES

1. U.S. Environmental Protection Agency (EPA, 1988). Proposed Guidelines on Exposure-Related Measurements for Risk Assessments. 53 FR 48830. December 2.

2. U.S. Environmental Protection Agency (EPA, 1989a). Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual Part A. USEPA/600/8-89/043. July, 1989.

3. U.S. Environmental Protection Agency (EPA, 1989b). Exposure Factors Handbook. USEPA/600/8-89/043, July, 1989.

4. U.S. Environmental Protection Agency (EPA, 1991a). Human Health Evaluation Manual. Supplemental Guidance: Standard Default Exposure Factors. March 25, 1991.

5. U.S. Environmental Protection Agency (EPA, 1991b). Interim Guidance for Dermal Exposure Assessment. USEPA/600/8-91/011A, March, 1991.

6. Federal Register (57 FR 8739) 1982.

ATTACHMENT A

THE ENVIRONMENTAL FATE OF GLYPHOSATE:

A REVIEW OF LABORATORY AND FIELD STUDIES

The Environmental Fate of Glyphosate: A Review of Laboratory and Field Studies

By William F. Goure

I. Abstract:

The active herbicidal ingredient in Monsanto's Rodeo®, Accord® and Roundup® herbicides is glyphosate (N-phosphonomethylglycine) formulated as its isopropylamine salt. Glyphosate is the one of the most widely used herbicidal active ingredients in the world, and has been the subject of numerous environmental fate investigations. The following review summarizes the environmental fate of glyphosate based upon Monsanto-generated studies as well as studies conducted by independent investigators and reported in the general scientific literature.

A. Laboratory Studies:

Glyphosate is rapidly and tightly adsorbed to a wide variety of soils. In general, the pH, % carbon, % clay, % sand, or % silt have minimal effect upon glyphosate adsorption to soils. However, the adsorption of glyphosate does correlate with the amount of vacant phosphate sorption sites, and it has been proposed that a major contributor to glyphosate soil adsorption is binding through the phosphonic acid moiety. It has also been demonstrated that high levels of metallic cations in soil (e.g., Cu^{2+}, Fe^{3+}, and Al^{3+}) increase the amount of glyphosate adsorbed.

Numerous soil mobility (leaching) studies demonstrate that glyphosate will not leach on most soils. Indeed, using the Helling and Turner [7] classification system, glyphosate would be categorized as a "class I pesticide" that possesses no propensity for leaching. Additionally, soil column leaching studies utilizing seven different soil types and a simulated rainfall of 20 inches demonstrated that only modest vertical movement of glyphosate occurs even on the least adsorptive soils. Studies with inclined soil beds treated with glyphosate and subjected to artificial rainfalls have also demonstrate the glyphosate possesses a very low potential to move as a result of runoff.

Chemical degradation and/or photodecomposition, are at most, very minor pathways for the dissipation of glyphosate in soil and water. However, a number of studies have conclusively demonstrated that glyphosate is rapidly and extensively degraded in soil, under both aerobic and anaerobic conditions, by indigenous soil microflora. The metabolite distribution resulting from the degradation of glyphosate in unsterilized soil is similar under both aerobic and anaerobic conditions. The principal soil metabolite is aminomethylphosphonic acid (AMPA). The maximum amount of AMPA detected ranges from 15 to 28.7% of the starting glyphosate. Several other minor metabolites are

also produced. These minor metabolites included N-methylaminomethylphosphonic acid, N,N-dimethylaminomethylphosphonic acid, hydroxymethyphosphonic acid, and two unidentified metabolites. None of these minor metabolites are normally present to an extent of greater than 1% of the applied glyphosate. No metabolic products containing an intact N-phosphonomethylglycine moiety have been detected in metabolism studies. These studies also established that the major metabolite of glyphosate degradation, AMPA, is further degraded by soil microflora, although at a slower rate than glyphosate.

Half-lives for the dissipation of glyphosate in various soils under aerobic conditions range from 1.85 to 130 days, and are typically less than 25 days. It has been suggested that the decreased rate of glyphosate dissipation in certain soils is due to the microbial composition and reduced populations as well as the extent of glyphosate binding to the soil. Metabolism studies have demonstrated that 79 to 86% of the applied glyphosate is degraded to carbon dioxide during a six-month period.

Glyphosate has also been shown to have no adverse effect on soil microflora. Plate count experiments on glyphosate treated and untreated soil extracts revealed no significant difference in the microbial population or type. Additionally, the rate of microbial degradation of radiolabeled sucrose was found to be unaffected by the presence or absence of glyphosate.

Glyphosate dissipation in natural waters in the absence of sediment is very slow with half-lives that range from 7 to 10 weeks. However, in the presence of sediment, under either aerobic or anaerobic conditions, glyphosate dissipation in water is very rapid with half-lives that range from 6.5 to approximately 21 days. These studies have also demonstrated that in addition to microbial degradation, a major contributor to the aquatic dissipation of glyphosate is absorption to the sediment.

B. Field Studies:

The environmental fate of glyphosate in soil under typical field use conditions has been extensively evaluated by both Monsanto and independent investigators. The results of these studies demonstrate that glyphosate and its major metabolite, AMPA, are tightly bound to the soil, display very little, if any, potential for leaching, and dissipate with half-lives in all cases of less than one year, and typically less than 60 days. Studies have also demonstrated that glyphosate does not accumulate following multiple applications, either during the same year or over several years, and that there is little, if any, potential for off-site movement due to runoff.

The environmental fate of glyphosate in water under typical field use conditions has also been extensively evaluated by both

Monsanto and independent investigators. The results of these studies demonstrate that the residue levels of glyphosate and AMPA are very low and dissipate rapidly with time. In all cases studied, combined glyphosate and AMPA residue levels in aquatic systems treated with glyphosate, even at exaggerated use rates, are less than 0.5 ppm within 24 hours of application. Half-lives for the dissipation of glyphosate in environmental waters range from 1.5 to 14 days.

II. Introduction:

The active herbicidal ingredient in Monsanto's Rodeo®, Accord® and Roundup® herbicides is glyphosate (N-phosphonomethylglycine) formulated as its isopropylamine salt. Rodeo® and Accord® herbicides are concentrated aqueous formulations which contain, respectively, 53.8% and 41.5% glyphosate in the form of its isopropylamine salt, and do not contain any added surfactants. Roundup® herbicide is a concentrated aqueous formulation which contains 41.0% glyphosate in the form of its isopropylamine salt plus an ethoxylated tallow amine surfactant.

Glyphosate is one of the most widely used herbicidal active ingredients in the world for the non-selective, postemergence control of a wide variety of annual and perennial weeds, and has been the subject of numerous environmental fate investigations. The following review summarizes the current knowledge of the environmental fate of glyphosate based upon Monsanto-generated studies as well as studies conducted by independent investigators and reported in the general scientific literature. This review supplements other recent reviews [1,2].

III. Laboratory Studies on the Terrestrial and Aquatic Environmental Fate of Glyphosate:

A. Adsorption:

Although the mechanism of soil binding is not thoroughly understood, it is now well established that glyphosate is rapidly and tightly adsorbed to a wide variety of soils [3].

Sprankle *et. al.* [4] found that the rate of glyphosate adsorption to soil was initially rapid with 67% of the total glyphosate adsorption occurring during the first hour of a 96-hour adsorption experiment. Thereafter, the rate of adsorption decreased; between 2 and 8 hours approximately 12% additional glyphosate adsorption occurred, and between 8 and 96 hours the remaining 28% of the total glyphosate adsorption occurred.

Work reported by Hance [5] and Sprankle *et. al.* [4] demonstrated that soil type affects the adsorption of glyphosate. Hance found no correlation between glyphosate adsorption and the pH, % carbon, % clay, % sand, or % silt of the nine soil types studied. However, the adsorption of glyphosate did correlate with the amount of vacant phosphate sorption sites. These results are consistent with those of Sprankle *et. al.* [4] who found that the phosphate level in soil appeared to be the most important factor determining the amount of glyphosate adsorbed. In contrast, the pH and % organic matter of the soil had no significant effect upon glyphosate adsorption. On the basis of these results, it has been proposed that a major contributor to glyphosate soil adsorption is binding through the phosphonic acid moiety. Sprankle *et. al.* [4] and more recently Glass [6] have also shown that high levels of metallic cations in clay soils (e.g., Cu^{2+}, Fe^{3+}, and Al^{3+}) increase the amount of glyphosate adsorbed.

B. Mobility:

Soil mobility (leaching) studies demonstrate that glyphosate possesses no propensity for leaching on most soils. Utilizing the technique of Helling and Turner [7], Rueppel *et. al.* [8] separately spotted thin-layer soil plates prepared with Ray silt loam, Norfolk sandy loam, and Drummer silty clay loam soils with ^{14}C-glyphosate and developed the plates twice with water. Glyphosate was so strongly adsorbed by all three soils that 97-100% of the applied glyphosate had an R_f of less than 0.09. Similarly, 95-99% of the applied glyphosate remained at an R_f of less than 0.09 after the second development. In no case was any of the radioactivity at an R_f of greater than 0.18.

Sprankle *et. al.* [4] reported similar results utilizing thin-layer soil plates prepared with Spinks sandy loam, Toledo clay loam, and Hillsdale sandy clay loam soils. When spotted with 5 µL of radiolabeled glyphosate at a concentration of 0.0013 mol/L and developed once with water an average R_f of 0.07 was found and ranged from 0.13 for Toledo clay loam soil to 0.04 for Spinks sandy loam soil. Increasing the concentration of glyphosate five fold to 0.0066 mol/L resulted in increased glyphosate mobility, with an average R_f of approximately 0.16 and a range of 0.20 for Toledo clay loam soil to 0.14 for Spinks sandy loam soil. In the Toledo clay loam soil, mobility increased with an increase in the phosphate level of the soil. It was also found that as the pH of the soil increased the R_f values also increased. However, even in soils with a high phosphate content and a high pH, the R_f for glyphosate applied at a concentration of 0.0013 mol/L was less than or equal to 0.13, and at an applied glyphosate concentration of 0.0066 mol/L the R_f was less than or equal to 0.20. Thus, the results of these studies demonstrate that glyphosate is very tightly bound to most soils and has very limited mobility. Indeed, using the Helling and Turner [7] classification system, on the soil types studied, glyphosate would be categorized as a "class I pesticide" and thereby possess no propensity for leaching.

Soil leaching studies with glyphosate conducted by Monsanto [9] further demonstrated that glyphosate possesses no propensity for leaching on most soils. Radiolabeled glyphosate was applied to columns of seven different soil types at an application rate equivalent to 8 lb acid equivalents/acre (a.e./acre) and the columns were rapidly leached with the equivalent of 20 inches of water. The rate of leaching varied with the soil type. The leachate was collected for analysis and the soil columns were sectioned and analyzed to determine the distribution of glyphosate residues in the soil columns.

The total recovery of applied radioactivity in this study was less than 100% in those soils which required longer to leach and in those soils in which degradation of glyphosate to carbon dioxide occurs rapidly: Drummer, Ray, and Lintonia soils. Analysis of the uppermost soil segments showed 14 to 24% degradation of glyphosate to AMPA in these three soils. The leachate contained 1.0% or less of the applied radioactivity for all soils studied except Ray and Lintonia which contained 6.6% and 4.4%, respectively. Analysis of the soil segments clearly demonstrated that glyphosate possesses very low potential for leaching. For Spinks, Drummer, Hilo, and Molokai soils, greater than 97% of the radioactivity was present in the upper 10 cm of the soil columns. In the case of Hilo and Molokai soils, greater than 98% of the radioactivity was found in the upper 2 cm. In the case of Lintonia, Ray, and Leon soils, 95, 93, and 98%, respectively, of the applied glyphosate radioactivity was found in the upper 20 cm of the soil columns. The greatest mobility observed was on Leon fine sand, and even in this case only 20% of the applied radioactivity leached more than 10 cm. Thus, even on the least adsorptive soils, only modest vertical movement was observed.

The potential for glyphosate to move as a result of runoff was also investigated by Rueppel *et. al.* [8]. In this investigation, separate soil beds, inclined at 7.5°, were prepared with Ray silt loam, Drummer silty clay loam, and Norfolk sandy loam soils, and ^{14}C-glyphosate was uniformly applied at an application rate equivalent to 1.0 lb a.e./acre to the upper third of the soil surface. The entire soil surface was then subjected to three artificial rainfalls at 1, 3, and 7 days after treatment. Each simulated rainfall was continued until two consecutive 50-mL samples of runoff water and sediment were collected for each inclined soil bed. The water was separated from the sediment, and the amount of radioactivity present in the sediment and water was determined. In both the sediment and runoff water, the amount of radioactivity collected was extremely low, ranging from 6.5×10^{-3} down to 1×10^{-4} % of the applied glyphosate for the runoff water and 3×10^{-3} to 1×10^{-5} % of the applied glyphosate for the sediment. These results correspond to a maximum runoff of less than 1.78×10^{-4} lb a.e./acre, and demonstrate the very low potential of glyphosate to move as a result of runoff.

C. Degradation and Metabolism:

The degradation and metabolism of glyphosate in various soil types has been extensively investigated, and has been demonstrated to occur predominantly via microbial degradation [4,8,9,10].

Rueppel *et. al.* [8] and Brightwell *et. al.* [9] have demonstrated that chemical degradation is not a major pathway for glyphosate dissipation in soil and water. Rueppel *et. al.* [8] have also demonstrated that photodecomposition is, at most, a very minor pathway for the degradation of glyphosate in soil and water.

Elegant studies conducted by Sprankle *et. al.* [4] and Rueppel *et. al.* [8] have conclusively demonstrated that glyphosate is rapidly and extensively degraded in soil, under both aerobic and anaerobic conditions, by indigenous soil microflora. The pattern of glyphosate degradation under aerobic conditions in non-sterile soil is characterized by an initial rapid phase of degradation, followed by a slower rate of degradation after approximately seven days. No lag phase was observed with fresh soil samples. The decline in the rate of degradation with time has been proposed to reflect the decrease in soluble glyphosate due to adsorption to the soil. The pattern for the degradation of glyphosate under anaerobic conditions was similar to that found under aerobic conditions. This pattern of glyphosate degradation under both aerobic and anaerobic conditions, coupled with the fact that the amount of glyphosate degradation was nearly equivalent to that found for the degradation of sucrose in parallel experiments, supports the conclusion that glyphosate degradation occurs via co-metabolism and that a high percentage of the total microflora population are actively capable of degrading glyphosate.

Rueppel *et. al.* [8] also demonstrated that glyphosate has no adverse effect on soil microflora. Plate count experiments on glyphosate treated and untreated soil extracts revealed no significant difference in the microbial population or type. Additionally, the rate of microbial degradation of radiolabeled sucrose was found to be unaffected by the presence or absence of glyphosate.

Rueppel *et. al.* [8] found that the metabolite distribution resulting from the degradation of glyphosate was clearly similar under both aerobic and anaerobic conditions, and that the same major metabolites were observed regardless of the soil type. The principal soil metabolite was aminomethylphosphonic acid (AMPA). The maximum amount of AMPA detected was 15% of the starting glyphosate. Several other minor metabolites were also detected. These minor metabolites included N-methylaminomethylphosphonic acid, N,N-dimethylaminomethylphosphonic acid, hydroxymethyphosphonic acid, and two unidentified metabolites. None of these minor metabolites were normally present to an extent of greater than 1% of the applied glyphosate. No metabolic products containing an intact N-phosphonomethylglycine moiety were detected in these studies. These studies also established that the major metabolite of glyphosate degradation, AMPA, is further degraded by soil microflora, although at a slower rate than glyphosate. The slower degradation of AMPA compared to glyphosate was suggested to be a result of tighter binding of AMPA to soil and/or lower permeability of AMPA through the cell walls of the microflora.

The rate of dissipation of glyphosate in three general and representative soil types was determined to obtain a thorough understanding of its fate in different soil types [8]. In Ray silt loam and Drummer silty clay loam soils, 90% of the initially applied glyphosate had dissipated after 14 and 80 days, respectively. The dissipation half-lives for glyphosate in Ray and Drummer soils with an initial glyphosate concentration of 4 ppm were found to be 3 and 27 days, respectively. The half-lives for glyphosate dissipation at an initial concentration of 8 ppm in Ray and Drummer soils were 3 and 25 days, respectively, indicating that the rate of degradation is reproducible and independent of the initial glyphosate concentration. The rate of glyphosate dissipation in Norfolk sandy loam soil was significantly less: 43% dissipation occurred during 112 days with a calculated half-life of 130 days. It was suggested that the decreased rate of glyphosate dissipation in Norfolk soil was due to the microbial composition and population as well as the extent of glyphosate binding to the soil.

More recently, an aerobic soil metabolism study was conducted by Monsanto according to the U. S. Environmental Protection Agency's Pesticide Assessment Guidelines, Subdivision N, Section 162-1, which provided additional data demonstrating that glyphosate is rapidly degraded in soil to AMPA, which further degrades in soil to carbon dioxide [10]. This study was conducted following improved techniques similar to those described by Rueppel *et. al.* [8] Two different soil types were used in this study: Kickapoo sandy loam and Dupo silty loam soil. Degradation curves used to estimate the time required for 50% and 90% of the glyphosate to dissipate were mathematically generated using the method of Gustafson and Holden [11].

This study demonstrated that glyphosate is readily degraded in Kickapoo and Dupo soils with 50% of the glyphosate degraded by 1.85 and 2.06 days, respectively. The time required for 90% degradation of glyphosate was determined to be 10.9 and 16.9 days, respectively. Based on recovered radioactivity, 79 and 86% of the applied glyphosate was degraded to carbon dioxide in Kickapoo and Dupo soils, respectively. The study further demonstrated that glyphosate is degraded to AMPA which is then further degraded to carbon dioxide.

The degradation and metabolism of glyphosate in water under aerobic and anaerobic conditions has also been been extensively investigated [9,12,13]. In an early aerobic aquatic metabolism study (in the absence of sediment), dissipation half-lives for glyphosate were found to be approximately 7 weeks in Sphagnum bog (pH = 4.23) water and approximately 9 to 10 weeks in Cattail swamp (pH = 6.25) and Ballard pond (pH = 7.30) water [9]. Under anaerobic conditions in the presence of sediment, the aquatic dissipation of glyphosate was significantly increased. Using Sphagnum bog water and sediment, only 37.8% of the applied radioactivity was present in the water 21 days after treatment. In the case of Cattail swamp water and sediment, only 6.9% of the applied radioactivity remained in the water 7 days after treatment. At 35 days after treatment of Sphagnum bog water and sediment with radiolabeled glyphosate, 52.7%, 19.5%, and 21.1% of the applied radioactivity were found, respectively in the sediment, liberated carbon dioxide, and water. In the case of Cattail swamp water and sediment 35 days after treatment, the percentage of applied radioactivity in sediment, liberated carbon dioxide, and water were 78.4, 15.2, and 4.1%, respectively. In a more recent aerobic aquatic metabolism [12] study using pond water and sediment, the half-life for the dissipation of glyphosate in water was estimated to be 6.5 days. In a similar anaerobic aquatic metabolism study [13] using pond water and sediment from the same site, the half-life for the dissipation of glyphosate was estimated to be 8.1 days. In agreement with the earlier studies, these studies further demonstrated that in addition to microbial degradation, a major contributor to the aquatic dissipation of glyphosate is absorption to the sediment.

IV. Field Studies on the Terrestrial Environmental Fate of Glyphosate:

The environmental fate of glyphosate in soil under typical field use conditions has been extensively evaluated by both Monsanto and independent investigators. The results of these studies corroborate the aforementioned laboratory findings. They demonstrate that glyphosate, and its major metabolite, AMPA, are tightly bound to the soil, display very little if any potential for leaching, and dissipate with half-lives in all cases of less than one year, and typically less than 60 days. Studies have also demonstrated that glyphosate does not accumulate following multiple applications, either during the same year or over several years, and that there is little if any potential for off site movement due to runoff.

In 1982, dissipation profiles were defined for glyphosate in field soils at representative test sites in the U.S. which received a minimum tillage application of Roundup® herbicide at an application rate of 3.34 lb a.e./acre [14]. Calculated half-lives for glyphosate dissipation in this study ranged from 27 to 56 days with an average half-life of 39 days. In 1983, Roundup® herbicide was applied directly to field soils at rates of 1.48, 2.97, and 5.93 lb a.e./acre in representative states across the U.S., to evaluate glyphosate dissipation under a variety of field conditions [15,16]. For the 1.48 lb a.e./acre application rate, the average half-life for the dissipation of glyphosate was 33.5 days, and ranged from 2 to 174 days depending upon the test site. For the 2.97 lb a.e./acre application rate, the average half-life was 37 days, and ranged from 3 days to 130 days. In the case of the 5.93 lb a.e./acre application rate, the average half-life was 43.6 days, and ranged from 3 days to 167 days. Consistent with earlier laboratory studies, AMPA concentrations in soil increased to low levels with time, typically reaching a maximum concentration by 30 to 60 days after treatment, before decreasing to very low levels by the time the study was ended at one year after treatment. In both of these studies, glyphosate and AMPA residues were observed predominantly in the 0-6" soil horizon. Glyphosate and AMPA residues were so infrequently observed in the 6-12" soil horizon as to indicate that their presence was not from leaching but due to an artifact of sampling.

To evaluate the potential for glyphosate to accumulate following repeated applications, soil samples were collected and analyzed from fifteen plots in orchards or vineyards from nine different locations where multiple applications of Roundup® herbicide had been made over a period of 1 to 6 years, giving total treatments of 6 to 120 lb a.e./acre [17]. In addition, glyphosate dissipation was determined at test sites which received four 3.75 lb a.e./acre Roundup® herbicide treatments in a one year period.

For all fifteen plots, less than 10% of the total applied glyphosate remained in the soils approximately one year after the last application was made. In twelve of fifteen test plots, less than 20% of the total applied glyphosate remained in the form of AMPA one year after the last application. In three locations AMPA levels ranged from 31% to 54% of the total glyphosate applied one year after the last application. However, by 20 months after the last application, the AMPA level at the one test plot had declined from 54% to 18%, demonstrating that the degradation of AMPA was continuing. With the exception of one location, glyphosate and AMPA residues were so infrequently observed in the 6-12" soil horizon as to indicate that their presence was not from leaching but was due to an artifact of sampling. At one test site, which received a total glyphosate application of 60 lbs. a.e./acre (well above expected levels of application) over a four year period, samples from 230 days after the last application showed average glyphosate and AMPA residue of 1.49 and 0.95 ppm, respectively, in the 6-12" soil horizon poosibly indicating some limited mobility in the Astutula fine sand soil at this site.

In the case of the test sites which received four 3.75 lb a.e./acre Roundup® herbicide treatments in a one-year period, the results demonstrated that glyphosate consistently dissipated at relatively rapid rates after each treatment. At all locations, the AMPA produced as a product of glyphosate degradation also dissipated to minimal levels.

The results of these studies demonstrated that even after a series of repeated applications of Roundup® herbicide using normal or exaggerated application rates, glyphosate and its major metabolite AMPA continue to dissipate and do not accumulate in the soil.

The rapid dissipation and lack of movement of glyphosate in soils has also been confirmed by independent investigators. Roy *et. al.* have investigated the persistence, movement, and degradation of glyphosate in selected Canadian forest soils [18]. In this investigation, one sandy soil site for persistence and leaching studies and one clay soil site for a mobility study were selected. All dead wood, live brush, and as much vegetation as possible were manually removed from sandy soil site with minimal disturbance of the 5-10 cm soil horizon. For the clay soil test site, dead wood and other matter thought to have a potential for runoff channeling were removed from the site, an application strip at the top of the 8° slope was cleared as above, and a trench was prepared at the bottom of the slope for the collection of runoff water. Each site was then treated with Roundup® herbicide at a targeted application rate of 1.32 lb a.e./acre. In the case of the sandy soil test site, soils at three depths were randomly collected and analyzed for glyphosate and AMPA residues. For the clay soil test site, water samples were collected from the trench and soils at three depths from the treatment zone and 3, 6, 9, and 12 meters down slope from the application zone to determine off-site movement of glyphosate.

In the case of the sandy soil site, the half-life for glyphosate dissipation was found to be 24 days, and the time required for 90% dissipation was determined to be 78 days. The overall trend of AMPA formation showed that as the glyphosate residue levels decreased, the AMPA residue levels increased then decreased, indicating that it is a nonpersistant metabolite. With the exception of the 14 day after treatment sampling event, glyphosate was found only in the upper organic layer of the soil. For the 14 day after treatment sampling event greater than 95% of the glyphosate present was found in the upper organic layer, and 100% of the glyphosate present was in the 0-15 cm soil horizon. There was no evidence of lateral movement of glyphosate down the 8° slope at the clay soil site. No glyphosate residues greater than or equal to 0.1 ppm were detected either at any of the sampling stations located down slope from the application zone or in the runoff water collected in the trench.

In a related study, Feng and Thompson [19] investigated the persistence of glyphosate in soils following aerial applications of Roundup® herbicide to a large watershed in Canada. In this study, glyphosate was applied at rates that ranged from 0.56 to 0.76 lb a.e./acre, depending upon the location within the 10 km^2 study site, and soil samples were collected from three different plots within the study area. Glyphosate soil residues were found to dissipate with time with estimated half-lives of 45 to 60 days. At 360 days after treatment, total soil residues of glyphosate were 6 to 18% of the initial levels. Glyphosate and AMPA residues were retained primarily in the upper organic layers of the soil profile, with greater than 90% of the total glyphosate residues in the 0-15 cm layer.

Similar results have been reported by Newton *et. al.* [20] for the dissipation of glyphosate in soil at an Oregon forestry site following applications of glyphosate at a rate of 2.18 lb a.e./acre. In this study, the half-life for the dissipation of glyphosate in exposed soil was approximately 40.4 days and the half-life for the dissipation of glyphosate in leaf litter covered soil was 29.2 days.

More recently, in a forestry dissipation study conducted by Monsanto, glyphosate (formulated as Accord® herbicide) was aerially applied at the maximum label rate of 3.75 lb a.e./acre to three 20-acre forestry sites representative of areas of the U.S. where glyphosate is used in normal silviculture practice, and the distribution, mobility, and dissipation of glyphosate in the soil were determined [21]. The results of this study demonstrate that when used under normal silviculture practices according to label directions, the maximum combined glyphosate and AMPA residue level in soil is less than 5 ppm. Glyphosate and AMPA residues in soil were found to dissipated with time. The average half-life for the dissipation of glyphosate was 100 days, and ranged from 35 to 158 days. The average half-life for the dissipation of AMPA was 118 days, and ranged from 71 to 165 days. It was also determined that even under conditions of high rainfall, glyphosate and AMPA are tightly bound to the soil and do not move vertically in the soil profile.

The potential of glyphosate to move off site as a result of runoff caused by natural rainfall has been investigated in a collaborative study by Edwards *et. al.* [22] and Kramer [23]. In this study, glyphosate was applied to various watersheds and the runoff water resulting from natural rainfall was collected and analyzed for glyphosate residues. In 1973, Roundup® herbicide at an application rate of 0.74 lb a.e./acre was used in the establishment of no-tillage corn on two watersheds with average slopes of 11.3 and 6.0%. In 1974, Roundup® herbicide was applied to three old meadow watersheds for the no-tillage establishment of tall fescue pastures. Two of the watersheds were treated with Roundup® herbicide at an application rate of 0.74 lb a.e./acre and the third watershed was treated with Roundup® herbicide at an application rate of 2.22 lb a.e./acre. The average slopes of the watersheds treated in 1974 ranged from 15.8 to 14.8%

The watersheds treated in 1973 and 1974 had maximum concentrations of glyphosate in runoff water of less than 100 ppb for runoff events occurring 9-10 days after application, and decreased to less than 2 ppb within 2 months of treatment. For these watersheds, less than 1% of the glyphosate applied was transported off-site in runoff water.

V. Field Studies on the Aquatic Environmental Fate of Glyphosate:

The environmental fate of glyphosate in water under typical field use conditions has also been extensively evaluated by both Monsanto and independent investigators. The results of these studies demonstrate that the residue levels of glyphosate, and its major metabolite, AMPA, are very low and dissipate with time.

The environmental fate of glyphosate in irrigation water in canals following treatment with Roundup® herbicide was first studied by Kramer [23] and Comes *et. al.* [24] in a collaborative study. In a dry ditch treatment test, two dry canals were treated with Roundup® herbicide at an application rate of 5 lb a.e./acre below the normal water line for a distance of 0.8 km. The following spring, the water level was raised above the treated area by use of check dams and water sampling commenced downstream from the treated area as the first water began to flow. Sampling stations were located 30 meters upstream from the treated areas, and 268, 536, 804, 1,608, and 2,412 meters downstream from the upper end of the treated areas. Thus, three sampling stations were within each treated area and two sampling stations were downstream from the treated areas. No detectable residues of either glyphosate or AMPA were found in any of the water samples collected from either canal. Soil samples collected the day before the canals were filled (158 and 172 days after treatment) contained 0.37 and 0.33 ppm glyphosate and 0.74 and 0.82 ppm AMPA. Thus, these results demonstrate that glyphosate and AMPA are not readily extracted from soil by flowing water; consistent with previous laboratory studies [8].

In this same study, the distribution, mobility, and dissipation of glyphosate in five soil and concrete-lined canals containing flowing water were also investigated. At four of the test sites an aqueous solution of glyphosate was metered into the canal water at a rate sufficient to achieve a concentration of 150 ppb. At one test site glyphosate was metered into the canal water at a rate sufficient to achieve a concentration of 1500 ppb. These injection rates were determined to represent 2.5 and 25 times the expected concentration of glyphosate to be found in the water following a normal ditchbank application [25]. A marker dye was placed into the canals at the time and place where the applications began and again when the applications were terminated. The initial length of the body of treated water in each canal was approximately 1.6 km. Sampling stations were located upstream and 0.3 and 1.6 km downstream from the application sites and then at various intervals throughout the remainder of the canals. At one test site the last sampling station was located 80.5 km downstream from the application site. Water samples were taken at each station 1 min after the front of the treated water passed each station. Six water samples were collected at each station during the passage of the main body of treated water. The last samples were collected when the trailing end of the treated water passed the sampling station.

In the case of the canals treated with glyphosate to achieve a concentration of 150 ppb, the concentration of glyphosate rapidly decreased to between 69.8 and 79% of the initial concentration at the sampling stations located 1.6 km downstream from the treated zone, and then dissipated more slowly as the treated water flowed further downstream. For the canal treated with glyphosate to achieve a concentration of 1500 ppb the rate of dissipation was more rapid; only 40.6% of the initial glyphosate concentration was present 1.6 km downstream from the treated zone and at the sampling station located 10.1 km downstream from the treated zone only 22.4% of the initial glyphosate concentration remained. The results of this investigation support the conclusion that when used to treat irrigation canal banks in which water is flowing, glyphosate will become diluted and dissipate as the treated body of water moves downstream. The maximum concentration of glyphosate expected in the water from this type of treatment is less than 0.1 ppm.

More recently, Goldsborough and Beck [26] have reported the rapid dissipation of glyphosate in small forest ponds. In this study, Roundup® herbicide at an application rate of 0.59 lb a.e./acre was applied to the surface of four small boreal forest ponds and to six *in situ* microcosms contained in polyethylene basins. Each microcosm initially contained 40 L of unfiltered water collected from a nearby stream, and three randomly-selected microcosms also contained 0.01 m^3 of intact sediment collected from a nearby pond. Initial glyphosate concentrations in surface water samples collected within 0.5 to 6 hours after application averaged 53 ppb, and ranged from a high of 105 ppb to a low of 25 ppb. In all cases glyphosate dissipated rapidly with half-lives that varied from 1.5 to 3.5 days. Levels of AMPA did not exceed 2.2 ppb in any pond water samples collected during the study, and in most cases were at or below the 0.50 ppb detection limit. Glyphosate levels remained at or above the initial treatment concentration in those microcosms containing only water, but decreased rapidly in the three microcosms containing pond sediment, consistent with the results of previous laboratory studies [8,9]. The average estimated half-life for glyphosate dissipation in the microcosms containing pond sediment was 5.8 days. Concentrations of AMPA in microcosms were much lower than the levels of glyphosate, and did not exceed 20 ppb.

In addition to the aforementioned studies, several other investigations have been conducted to determine the environmental fate of glyphosate in flowing bodies of water. Rodeo® herbicide was applied at an application rate of 6 lb a.e./acre (maximum label rate is 3.75 a.e./acre) to water hyacinths growing in open water and in back water plots and the subsequent concentrations of glyphosate in the stream water were determined [27]. Water samples were taken from sampling stations 20 ft and 300 ft downstream from the treatment plots at 0.5, 2, and 4 hours after treatment. For the open water plot, the highest glyphosate concentration (0.04 ppm) in the stream water was found at the sampling station 20 ft downstream from the application zone 0.5 hours after treatment. At 4 hours after treatment at this sampling station a glyphosate concentration of 0.03 ppm was found. No glyphosate concentrations greater than 0.01 ppm were detected at any time at the sampling station located 300 ft downstream from the application zone. In the case of the backwater test plot, the only glyphosate concentrations greater than 0.01 ppm were found 4 hours after application, and were 0.06 ppm and 0.04 ppm, respectively, for the sampling stations located

20 and 300 ft downstream from the application zone. No AMPA concentrations greater than 0.01 ppm were detected at any of the sampling events.

VI. Conclusions:

The environmental fate of glyphosate and its major metabolite, AMPA, in the laboratory and under actual field use conditions has been extensively tested by both Monsanto and independent investigators. The results of these numerous studies demonstrate that glyphosate and AMPA dissipate quite rapidly in the environment. Glyphosate and AMPA dissipate with half-lives in all cases of less than one year, and typically less than 60 days. These studies have also demonstrated that glyphosate and AMPA are tightly bound to the soil, display very little if any potential for leaching or off-site movement due to runoff, and do not accumulate following multiple applications, either during the same year or over several years. Studies have conclusively demonstrated that the major route for the dissipation of glyphosate and AMPA, under both aerobic and anaerobic conditions, is microbial degradation.

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ATTACHMENT B-1

DIETARY EXPOSURE FOR THE PROPOSED USES OF GLYPHOSATE ON THE TREE NUT CROP; ON WHEAT GRAIN AND STRAW; AND ON WHEAT MILLING FRACTIONS

FEB 10 1993

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB -3 1993

OFFICE OF PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Dietary Exposure for the Proposed Uses of Glyphosate on the Tree Nut Crop Group (PP#2F4081); on Wheat Grain and Straw (PP#0F3865); and on Wheat Milling Fractions (Excluding Flour)(FAP#2H5635)

FROM: Stephen A. Schaible *Stephen A Schaible*
Dietary Risk Evaluation Section
SAB/ HED (H7509C)

TO: R.J. Taylor, PM 25
Fungicide-Herbicide Branch
Registration Division (H7505C)

THROUGH: James P. Kariya, Head *JKariya*
DRES/ Science Analysis Branch
Health Effects Division

Action Requested

Registration Division has requested that Dietary Risk Evaluation System (DRES) analyses be performed estimating the dietary exposure and risk from the proposed uses of glyphosate on the tree nuts crop group and wheat grain, straw, and milling fractions. Two analyses were performed, one estimating exposure and risk from the proposed tree nut crop group tolerance and the other from the proposed wheat grain and wheat milling fraction (excl. flour) tolerances.

Discussion:

1. Toxicological Endpoint: The DRES chronic exposure analyses used a Reference Dose (RfD) of 2.0 mg/kg body weight/day, based on a No Observed Effect Level (NOEL) of 175 mg/kg bwt/day and an Uncertainty Factor of 100. The NOEL was taken from a developmental toxicity study in rabbits which showed soft stool/diarrhea and nasal discharge as effects. There are no data gaps in the studies supporting the RfD.

The RfD for glyphosate changed from 0.1 mg/kg bwt/day to 2.0 mg/kg bwt/day as a result of a HED RfD Peer Review Committee meeting on 8/27/92 (G. Ghali memorandum dated 12/8/92); changes in risk values from previous DRES analyses for glyphosate are at least partially due to the new endpoint to which exposure is being compared.

2. Residue Information: Food uses included in these analyses

were the published food uses listed in 40 CFR 180.364; published food additive tolerances listed in 185.3500; and the proposed tolerances of 1 ppm for the tree nuts crop group, 5 ppm for wheat grain, and 20 ppm for wheat milling fractions (excluding flour). The tolerances for wheat grain and wheat milling fractions (excluding flour) reflect harmonization with the Codex Maximum Residue Limits (MRLs) for glyphosate on these commodities (R.B. Perfetti memorandum dated 1/12/93). Pending tolerances of 2 ppm for residues of glyphosate in field corn and 1 ppm for secondary residues in the kidney and liver of cattle, goats, hogs, horses, poultry, and sheep resulting from the use of field corn as a feed item were included in the analyses as well. These pending tolerances are to expire three years from the date of issuance.

The specific commodities included in the DRES analyses for the tree nuts crop group were almond, beech nut, brazil nut, butternut, cashew, chestnut, filbert, hickory nut, macadamia nut, pecan, and walnut. The only other commodity besides these listed as being a member of the tree nuts crop group in 40 CFR 180.34 is "chinquapin", for which consumption information does not exist in DRES. The proposed tolerance for glyphosate residues on wheat straw was not included in the DRES analysis because straw is not a food item. Existing tolerances for residues of glyphosate in the kidney and liver of animal commodities are considered sufficient to cover any residues expected from the use of wheat as a feed item (R.W. Cook memorandum, 1/29/91).

Incorrect tolerances for cane sugar, passion fruit, lychee, mamey, and longan fruit were identified in the most recent DRES action on glyphosate, the DRES chapter to the Reregistration Eligibility Document (S. Schaible, 12/15/92), and corrected to reflect the proper tolerances in the CFR (cane sugar from 0.2 ppm to 2.0 ppm, the rest from 0.01 ppm to 0.2 ppm). In addition, the DRES commodities "horseradish" and "wine and sherry" were included in the glyphosate file where they hadn't been in previous analyses for RD (the first by virtue of the published tolerance for horseradish in CFR 180.364 and the second indirectly through the published tolerance on grapes in 180.364).

A summary of the residue information used in these analyses is attached as Table 1.

3. Exposure Analysis: The DRES chronic exposure analyses used tolerance level residues and 100 percent crop treated to estimate the Theoretical Maximum Residue Contribution (TMRC) for the overall U.S. population and 22 population subgroups. A summary of the TMRCs and their representations as percentages of the RfD is attached as Table 2. Exposures and risks contributed individually from the proposed tolerances on the tree nuts group and the wheat food commodities are attached as Tables 3A (tree nuts group) and 3B (wheat commodities). Exposure and risk estimates are reported for the overall population and for the two most highly exposed subgroups.

The TMRC for the overall U.S. population from published uses is 0.011362 mg/kg bwt/day, which represents 0.6% of the RfD. The proposed tolerance on the tree nuts crop group would contribute 0.000012 mg/kg bwt/day (around 0.001% of the RfD) to the TMRC;

the proposed tolerances on wheat grain and wheat milling fractions (excluding flour) would contribute an exposure of 0.009217 mg/kg bwt/day (0.461% of the RfD). The pending 3 yr. tolerances on field corn and the kidney and liver of cattle, goats, hogs, horses, poultry and sheep contribute a TMRC of 0.000650 mg/kg bwt/day, or 0.03% of the RfD, so that all together, published, pending and proposed uses would contribute a TMRC for the overall U.S. population of 0.021240 mg/kg bwt/day, which represents 1% of the RfD.

The subgroup most highly exposed to glyphosate from published, pending, and proposed uses is non-nursing infants less than one year old. The TMRC to this group from these uses is 0.049503 mg/kg bwt/day, or 2.5% of the RfD. If only published uses are considered, the TMRC is 0.040699 mg/kg bwt/day (2% of the RfD). The proposed use on wheat grain and wheat milling fractions contributes an exposure of 0.006913 mg/kg bwt/day (0.35% of the RfD) and the proposed use on tree nuts contributes an exposure of 0.000005 mg/kg bwt/day (0% of the RfD).

Due to assumptions used in these analyses (e.g., that residues exist on the commodities at tolerance level, and that glyphosate is applied to 100% of the crop for every commodity included in this analysis), the exposure and risk estimates reported in this analysis are most likely to be overestimated. Even so, the chronic dietary risk from this chemical on these commodities is minimal.

Attachments

cc: DRES, CBTS, Tox 2, Caswell # 661A

ATTACHMENT B-2

40 CFR PART 180.364

GLYPHOSATE; TOLERANCES FOR RESIDUES

Commodity	Parts per million
Raspberries	10.0

[45 FR 62986, Sept. 23, 1980, as amended at 46 FR 48931, Oct. 5, 1981; 47 FR 21539, May 19, 1982; 48 FR 12087, Mar. 23, 1983; 48 FR 37212, Aug. 17, 1983; 49 FR 30701, Aug. 1, 1984; 51 FR 4499, Feb. 5, 1986; 51 FR 33900, Sept. 24, 1986]

§ 180.363 Fluchloralin; tolerances for residues.

Tolerances are established for residues of the herbicide fluchloralin [*N*-(2-chloroethyl)-1.alpha. alpha. alpha-trifluoro-2,6-dinitro-*N*-propyl-p-toluidine] in or on the following raw agricultural commodities:

Commodity	Parts per million
Cottonseed	0.05
Peanuts	0.05
Peanut, forage	0.05
Peanut, hay	0.05
Peanut, hulls	0.1
Seed and pod vegetables (dry/succulent)	0.05
Seed and pod vegetables, forage	0.1
Seed and pod vegetables, hay	0.1
Soybeans	0.05
Sunflower seeds	0.05

[47 FR 30487, July 14, 1982]

§ 180.364 Glyphosate; tolerances for residues.

(a) Tolerances are established for the combined residues of glyphosate (N-(phosphonomethyl)glycine) and its metabolite aminomethylphosphonic acid resulting from the application of the isopropylamine salt of glyphosate and/or the monoammonium salt of glyphosate in or on the following agricultural commodities:

Commodity	Parts per million
Acerola	0.2
Alfalfa	200.0
Alfalfa, fresh and hay	0.2
Almonds, hulls	1
Artichokes, Jerusalem	0.2
Asparagus	0.5
Atemoya	0.2
Avocados	0.2
Bahiagrass	200.0
Bananas	0.2
Beets	0.2
Beets, sugar	0.2
Bermudagrass	200.0
Bluegrass	200.0
Breadfruit	0.2
Bromegrass	200.0
Canistel	0.2
Carambola	0.2
Carrots	0.2
Cherimoya	0.2
Chickory	0.2
Citrus fruits	0.2
Clover	200.0
Cocoa beans	0.2
Coconut	0.1
Coffee beans	1
Cotton, forage	15
Cotton, hay	15
Cottonseed	15
Cranberries	0.2
Dates	0.2
Fescue	200.0
Figs	0.2
Forage grasses	0.2
Forage legumes (except soybeans and peanuts)	0.4
Fruits, small, and berries	0.2
Genip	0.2
Grain crops	0.1 (N)
Grapes	0.2
Grasses, forage	0.2 (N)
Guavas	0.2
Horseradish	0.2
Jaboticaba	0.2
Jackfruit	0.2
Kiwifruit	0.2
Leafy vegetables	0.2 (N)
Longan	0.2
Lychee	0.2
Mamey sapote	0.2
Mangoes	0.2
Nuts	0.2
Olives	0.2
Orchardgrass	200.0
Papayas	0.2
Parsnips	0.2
Passion fruit	0.2
Peanut, forage	0.5
Persimmons	0.2
Pineapple	0.1
Pistachio nuts	0.2
Pome fruits	0.2
Pomegranates	0.2
Potatoes	0.2
Radishes	0.2
Rutabagas	0.2
Ryegrass	200.0
Salsify	0.2
Sapodilla	0.2
Sapote, black	0.2
Sapote, white	0.2
Seed and pod vegetables	0.2 (N)
Seed and pod vegetables, forage	0.2 (N)
Seed and pod vegetable, hay	0.2 (N)
Soursop	0.2
Soybeans	6
Soybeans, forage	15
Soybeans, hay	15
Stone fruit	0.2
Sugar apple	0.2
Sweet potatoes	0.2

Commodity	Parts per million
Tamarind	0.2
Timothy	200.0
Turnips	0.2
Vegetables, bulb	0.2
Vegetables, cucurbit	0.5
Vegetables, fruiting (except cucurbits) group	0.1
Vegetables, leafy, Brassica (cole)	0.2
Wheatgrass	200.0
Yams	0.2

(b) Tolerances are established for combined residues of glyphosate (N-(phosphonomethyl)glycine) and its metabolite aminomethylphosphonic acid resulting from application of the glyphosate isopropylamine salt and/or glyphosate monoammonium salt for herbicidal and plant growth regulator purposes and/or the sodium sesqui salt for growth regulator purposes in or on the following agricultural commodities:

Commodity	Parts per million
Cattle, kidney	0.5
Cattle, liver	0.5
Fish	0.25
Goats, kidney	0.5
Goats, liver	0.5
Hogs, kidney	0.5
Hogs, liver	0.5
Horses, kidney	0.5
Horses, liver	0.5
Peanuts	0.1
Peanut, hay	0.5
Peanut, hulls	0.5
Poultry, kidney	0.5
Poultry, liver	0.5
Sheep, kidney	0.5
Sheep, liver	0.5
Shellfish	3.0
Sugarcane	2.0

(c) Tolerances are established for the combined residues of glyphosate (*N*-phosphonomethylglycine) and its metabolite aminomethylphosphonic acid, resulting from the use of irrigation water containing residues of 0.5 ppm following applications on or around aquatic sites, at 0.1 ppm on the crop groupings citrus, cucurbits, forage grasses, forage legumes, fruiting vegetables, grain crops, leafy vegetables, nuts, pome fruits, root crop vegetables, seed and pod vegetables, stone fruit, and the individual commodities cottonseed, hops, and avocados. Where tolerances are established at higher levels from other uses of glyphosate in or on the subject crops, the higher tolerance should also apply to residues from the aquatic uses cited in this paragraph.

[45 FR 64911, Oct. 1, 1980]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 180.364, see List of CFR Sections Affected in the Finding Aids section of this volume.

§ 180.366 Octhilinone; tolerances for residues.

Tolerances are established for residues of the fungicide octhilinone (2 octyl-3(2H)-isothiazolone; CAS Reg No. 26530-20-1) in or on the following raw agricultural commodities derived from plants grown from treated seed:

Commodity	Parts per million
Cotton, forage	0.01
Cottonseed	0.01

[41 FR 12012, Mar. 23, 1976, as amended at 52 FR 32306, Aug. 27, 1987; 53 FR 23396, June 22, 1988]

§ 180.367 n-Octyl bicycloheptenedicarboximide; tolerances for residues.

Tolerances are established for residues of the insecticide n-octyl bicycloheptene-dicarboximide, resulting from dermal application, in raw agricultural commodities as follows:

Commodity	Parts per million
Cattle, fat	0.3
Goats, fat	0.3
Hogs, fat	0.3
Horses, fat	0.3
Milk, fat	0.3
Sheep, fat	0.3

[41 FR 31207, July 27, 1976; 41 FR 32426, Aug. 3, 1976]

§ 180.368 Metolachlor; tolerances for residues.

(a) Tolerances are established for the combined residues (free and bound) of the herbicide metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy -1-methylethyl)acetamide] and its meta-

ATTACHMENT B-3

40 CFR PARTS 180 AND 185

PESTICIDE TOLERANCES FOR GLYPHOSATE

§ 305.13 Promotional material displayed or distributed at point of sale.

(a)(1) Any manufacturer, distributor, retailer, or private labeler who prepares printed material for display or distribution at point of sale concerning a covered product (except fluorescent lamp ballasts, showerheads, faucets, water closets, and urinals) shall clearly and conspicuously include in such printed material the following required disclosure:

Before purchasing this appliance, read important energy cost and efficiency information available from your retailer.

(2) Any manufacturer, distributor, retailer, or private labeler who prepares printed material for display or distribution at point-of-sale concerning a covered showerhead, faucet, water closet, or urinal shall clearly and conspicuously include in such printed material the product's water use, expressed in gallons and liters per minute (gpm/Lpm) or per cycle (gpc/Lpc) or gallons and liters per flush (gpf/Lpf) as specified in § 305.11(e).

* * * * *

11. Further, it is proposed that § 305.14 be amended by revising paragraph (a) introductory text and by adding a new paragraph (d), to read as follows:

§ 305.14 Catalogs.

(a) Any manufacturer, distributor, retailer, or private labeler who advertises a covered product (except fluorescent lamp ballasts, showerheads, faucets, water closets or urinals) in a catalog, from which it may be purchased, shall include in such catalog, on each page that lists the covered product, the following information required to be disclosed on the label:

* * * * *

(d) Any manufacturer, distributor, retailer, or private labeler who advertises a covered showerhead, faucet, water closet or urinal in a catalog, from which it may be purchased, shall include in such catalog, on each page that lists the covered product, the product's water use, expressed in gallons and liters per minute (gpm/Lpm) or per cycle (gpc/Lpc) or gallons and liters per flush (gpf/Lpf) as specified in § 305.11(e).

12. Further, it is proposed that § 305.15 be amended by revising paragraph (b) to read as follows:

§ 305.15. Test data records.

* * * * *

(b) Upon notification by the Commission or its designated representative, a manufacturer or private labeler shall provide, within 30 days of the date of such request, the underlying test data from which the water use or energy consumption rate, the energy efficiency rating, or the estimated annual cost of using each basic model was derived.

* * * * *

By direction of the Commission.

Donald S. Clark,

Secretary.

[FR Doc. 93–10558 Filed 5–4–93; 8:45 am]

BILLING CODE 6750-01-P

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 180 and 185

[PP 0F3865, PP 2F4081, FAP 2H5635/P559; FRL 4583–3]

RIN 2070–AC18

Pesticide Tolerances for Glyphosate

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: This document proposes tolerances and food additive regulations for residues of the herbicide glyphosate [(*N*-phosphonometyhyl)glycine]. The specific proposals are as follows: an amended tolerance in or on the raw agricultural commodities (RACs) wheat at 5.0 parts per million (ppm), wheat straw at 85 ppm, the tree nut crop group at 1.0 ppm, almond hulls at 25 ppm, and a food additive regulation for wheat milling fractions (except flour) at 20 ppm. Monsanto Co. submitted petitions requesting EPA to establish the maximum permissible residues of the herbicide in or on these RACs and the processed human food.

DATES: Written comments, identified by the document control number, [PP 0F3865, PP 2F4081, FAP 2H5635/P559], must be received on or before June 4, 1993.

ADDRESSES: By mail, submit comments to: Public Docket and Freedom of Information Section, Field Operations Division (H7506C), Office of Pesticide Programs, Environmental Protection Agency, 401 M St., SW., Washington, DC 20460. In person, bring comments to: Rm. 1128, CM #2, 1921 Jefferson Davis Hwy., Arlington, VA 22202.

Information submitted as a comment concerning this document may be claimed confidential by marking any part or all of that information as "Confidential Business Information" (CBI). Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2. A copy of the comment that does not contain CBI must be submitted for inclusion in the public record. Information not marked confidential may be disclosed publicly by EPA without prior notice. All written comments will be available for public inspection in rm. 1128 at the address given above, from 8 a.m. to 4 p.m., Monday through Friday, excluding legal holidays.

FOR FURTHER INFORMATION CONTACT: By mail, Robert J. Taylor, Product Manager, Registration Division (H7505C), Office of Pesticide Programs, Environmental Protection Agency, 401 M St., SW., Washington, DC 20460. Office location and telephone number: Rm. 241, CM #2, 1921 Jefferson Davis Hwy., Arlington, VA, (703)-305-6800.

SUPPLEMENTARY INFORMATION: EPA issued a notice in the Federal Register of July 18, 1990 (55 FR 29267), announcing that the Monsanto Co., 700 14th St., NW., Washington, DC 20005, had submitted a petition (PP 0F3865) proposing to amend 40 CFR 180.364 by establishing a regulation under section 408 of the Federal Food, Drug, and Cosmetic Act (FFDCA) (21 U.S.C. 346a), to permit combined residues of the herbicide glyphosate, [*N*-(phosphonomethyl)glycine] and its metabolite aminomethylphosphonic acid resulting from the application of the isopropylamine salt in or on the RACs wheat grain at 4 parts per million (ppm) and wheat straw at 85 ppm. In the Federal Register of June 10, 1992 (57 FR 24645), the Agency issued notices which announced that Monsanto Co. had submitted PP No. 2F4081 proposing to amend 40 CFR 180.364 under sec. 408 of FFDCA by establishing a regulation to permit the residues of glyphosate and its metabolite resulting from the application of isopropylamine salt of glyphosate and/or the monoammonium salt of glyphosate in or on almond hulls at 25 ppm and tree nut crops at 1.0 ppm and FAP No. 2H5635 proposing to amend 40 CFR 185.3500 under sec. 409 of FFDCA (21 U.S.C. 348) by establishing a food additive regulation to permit the combined residues of glyphosate and its metabolite on wheat milling fractions (excluding flour) at 12 ppm.

There were no comments or requests for referral to an advisory committee received in response to these notices of filing.

Subsequently, the petitioner amended PP 0F3865, FAP 2H5635, and PP 2F4081 by submitting revised section Fs deleting the metabolite from the expressions, increasing the proposed tolerances on wheat grain to 5 ppm and wheat milling fractions (excluding flour) to 20 ppm, and adding the monoammonium salt of glyphosate to the wheat grain (5 ppm) and wheat straw (85 ppm) expression. Because the increased tolerances for wheat grain at 5 ppm and wheat milling fractions (excluding flour) to 20 ppm have not been previously proposed, this document is being published as a proposed rule to allow a period of 30 days for public comment.

The data submitted in the petitions and other relevant material have been evaluated. The glyphosate toxicological data listed below were considered in support of these tolerances.

1. Several acute toxicology studies placing technical-grade glyphosate in Toxicity Category III and Toxicity Category IV.

2. A 1-year feeding study with dogs fed dosage levels of 0, 20, 100, and 500 milligrams/kilogram/day (mg/kg/day) with a no-observable-effect level (NOEL) of 500 mg/kg/day.

3. A 2-year carcinogenicity study in mice fed dosage levels of 0, 150, 750, and 4,500 mg/kg/day with no carcinogenic effect at the highest dose tested (HDT) of 4,500 mg/kg/day.

4. A chronic feeding/carcinogenicity study in rats fed dosage levels of 0, 3, 10, and 31 mg/kg/day with no carcinogenic effects observed under the conditions of the study at dose levels up to and including 31 mg/kg/day (HDT) and a systemic NOEL of 31 mg/kg/day (HDT). Because a maximum tolerated dose (MTD) was not reached, this study was classified as supplemental for carcinogenicity.

5. A chronic feeding/carcinogenicity study in rats fed dosage levels of 0, 100, 400, and 1,000 mg/kg/day with no carcinogenic effects noted under the conditions of the study at dose levels up to and including 1,000 mg/kg/day (HDT) and a systemic NOEL of 400 mg/kg/day based on decreased body weight and body weight gain in females, cataracts in males, decreased urinary pH in males, increased relative liver weight (to body) at 12 months, increased absolute and relative liver weight (to brain) at 24 months at 1,000 mg/kg/day (HDT).

6. A developmental toxicity study in rats given doses of 0, 300, 1,000, and 3,500 mg/kg/day with a developmental NOEL of 1,000 mg/kg/day based on an increase in number of litters and fetuses with unossified sternebrae, and decrease in fetal body weight at 3,500 mg/kg/day, and a maternal NOEL of 1,000 mg/kg/day based on decrease in body weight gain, diarrhea, soft stools, breathing rattles, inactivity, red matter in the region of nose, mouth, forelimbs, or dorsal head, and deaths at 3,500 mg/kg/day (HDT).

7. A developmental toxicity study in rabbits given doses of 0, 75, 175, and 350 mg/kg/day (HDT); a maternal NOEL of 175 mg/kg/day based on increased incidences of soft stool, diarrhea, nasal discharge, and deaths at 350 mg/kg/day (HDT).

8. A multigeneration reproduction study with rats fed dosage levels of 0, 3, 10, and 30 mg/kg/day with a developmental NOEL of 10 mg/kg/day based on increased incidence of focal tubular dilation of the kidney (both unilateral and bilateral combined) of male F_3b pups.

9. A two generation reproduction study with rats fed dosage levels of 0, 100, 500, and 1,500 mg/kg/day with a developmental NOEL of 500 mg/kg/day based on decreased pup body weight and body weight gain on lactation days 14 and 21 at 1,500 mg/kg/day (HDT).

10. Mutagenicity data included chromosomal aberration *in vitro* (no aberrations in Chinese hamster ovary cells were caused with and without S9 activation); DNA repair in rat hepatocytes; *in vivo* bone marrow cytogenic test in rats; rec-assay with *B. subtilis*; reverse mutation test with *S. typhimurium*; Ames test with *S. typhimurium*; and dominant-lethal mutagenicity test in mice (all negative).

The reference dose (RfD) based on a developmental study with rabbits (NOEL of 175 mg/kg/ bwt/day) and using a hundred-fold safety factor is calculated to be 2.0 mg/kg body weight/ day. The theoretical maximum residue contribution (TMRC) for published tolerances and food and feed additive regulations is 0.011362 mg/kg bwt/day or 0.6 percent of the RfD for the overall U.S. population. The current actions on tree nut crop group and wheat grain and wheat milling fractions will contribute 0.000012 mg/kg/ bwt/day and 0.009217 mg/kg bwt/day, respectively, to the TMRC. These tolerances and the food additive regulation will utilize a total of 0.462 percent of the RfD for the overall U.S. population.

For U.S. subgroup populations, nonnursing infants and children 1 to 6 years of age, the current action and previously established tolerances and the food additive regulation utilize, respectively, a total of 2.38 and 2.17 percent of the RfD, assuming that residue levels are at the established tolerance levels and that 100 percent of the crop is treated.

There are no desirable data lacking for this pesticide. There are currently no actions pending against the continued registration of this pesticide. No detectable residues of *N*-nitrosoglyphosate, a contaminant of glyphosate, are expected to be present in the commodities for which tolerances are established. The carcinogenic potential of glyphosate was first considered by a panel, then called the Toxicology Branch AD Hoc Committee, in 1985. The Committee, in a consensus review dated March 4, 1985, classified glyphosate as a Group C carcinogen based on an increased incidence of renal tumors in male mice. The Committee also conlcluded that dose levels tested in the 26-month rat study were not adequate for assessment of glyphosate's carcinogenic potential in this species. These findings, along with additional information, including a reexamination of the kidney slides from the long-term mouse study, were referred to the FIFR Scientific Advisory Panel (SAP). In its report dated February 24, 1986, SAP classified glyphosate as a Group D Carcinogen (inadequate animal evidence of carcinogenic potential). SAP concluded that, after adjusting for the greater survival in the high-dose mice compared to concurrent controls, that no statistically significant pairwise differences existed, although the trend was significant.

SAP determined that the carcinogen potential of glyphosate could not be determined from existing data and proposed that the rat and/or mouse studies be repeated in order to classify these equivocal findings. On reexamination of all information, the Agency classfified glyphosate as a Group D Carcinogen and requested that the rat study be repeated and that a decision on the need for a repeat mou study would be made upon completio of review of the rat study.

Upon receipt and review of the second rat chronic feeding/ carcinogenicity study, all toxicologic findings for glyphosate were referred the Health Effects Division Carcinogenicity Peer Review Commit on June 26, 1991, for discussion and evaluation of the weight of evidence o glyphosate with particular emphasis o its carcinogenic potential. The Peer Review Committee classified glyphos as a Group E [evidence of noncarcinogenicity for humans], base upon lack of convincing carcinogenic evidence in adequate studies in two animal species. This classification is based on the following findings: (1) None of the types of tumors observed the studies [pancreatic islet cell adenomas in male rat, thyroid c-cell adenomas and/or carcinomas in mal and female rats, hepatocellular adenomas and carcinomas in male r and renal tubular neoplasms in male mice) were determined to be compo related; (2) glyphosate was tested up to the limit dose on the rat and up to levels higher than the limit dose in mice; and (3) there is no evidence of genotoxicity for glyphosate. Accordingly, EPA concludes that glyphosate has not been "found to induce cancer when ingested by man or animal." 21 U.S.C. 348(c)(3).

The nature of the residue in plants is adequately understood, adequate methodology (HPLC) is available for enforcement purposes, and the methodology has been published in the Pesticide Analytical Manual (PAM), Vol. II. Any secondary residues occurring in liver and kidney of cattle, goats, horses, poultry, and sheep will be covered by existing tolerances. The pesticide is considered useful for the purpose for which the regulation is sought and is capable of achieving the intended physical or technical effect.

Based on the information cited above, the Agency has determined that the establishment of tolerances by amending 40 CFR part 180 will protect the public health, and the establishment of a food additive regulation by amending 40 CFR part 185 will be safe. It is proposed, therefore, that the tolerances and food additive regulation be established as set forth below.

Any person who has registered or submitted an application for registration of a pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as amended, which contains any of the ingredients listed herein, may request within 30 days after publication of this document in the Federal Register that this rulemaking proposal be referred to an Advisory Committee in accordance with section 408(e) of the Federal Food, Drug, and Cosmetic Act.

Interested persons are invited to submit written comments on the proposed regulations. Comments must bear a notation indicating the document control number, [PP 0F3865, PP 2F4081, FAP 2H5635/P559]. All written comments filed in response to this petition will be available in the Public Information Branch, at the address given above, from 8 a.m. to 4 p.m., Monday through Friday, except legal holidays.

The Office of Management and Budget has exempted this rule from the requirements of section 3 of Executive Order 12291.

Pursuant to the requirements of the Regulatory Flexibility Act (Pub. L. 96-354, 94 Stat. 1164, 5 U.S.C. 601-612), the Administrator has determined that regulations establishing new tolerances or raising tolerance levels or establishing exemptions from tolerance requirements do not have a significant economic impact on a substantial number of small entities. A certification statment to this effect was published in the Federal Register of May 4, 1981 (46 FR 24950).

List of Subjects in 40 CFR Part 180

Administrative practice and procedure, Agricultural commodities, Pesticides and pests.

Dated: April 22, 1993.

Douglas D. Campt,

Director, Office of Pesticide Programs.

Therefore, it is proposed that chapter I of title 40 of the Code of Federal Regulations be amended as follows:

PART 180—[AMENDED]

1. In part 180:

a. The authority citation for part 180 continues to read as follows:

Authority: 21 U.S.C. 346a and 371.

b. In § 180.364, by amending paragraph (a) in the table therein by revising the entry "grain crops" and by adding new paragraph (d), to read as follows:

§ 180.364 Glyphosate; tolerances for residues.

(a) * * *

Commodity	Parts per million
* * * * *	
Grain crops (except wheat)	0.1 (N)
* * * * *	

* * * * *

(d) Tolerances are established for the residues of glyphosate [*N*-(phosphonomethyl)glycine] resulting from the application of the isopropylamine salt of glyphosate and/or the monoammonium salt of glyphosate in or on the following raw agricultural commodities:

Commodity	Parts per million
Almond hulls	25.0
Tree nut crop group	1.0
Wheat, grain	5.0
Wheat, straw	85.0

PART 185—[AMENDED]

2. In part 185:

a. The authority citation for part 185 continues to read as follows:

Authority: 21 U.S.C. 348.

b. In § 185.3500, by adding new paragraph (a)(3), to read as follows:

§ 185.3500 Glyphosate.

(a) * * *

* * * * *

(3) Glyphosate [*N*-(phosphonomethyl)glycine] resulting from the application of the isopropylamine salt of glyphosate and or the monoammonium salt of glyphosate for herbicidal purposes.

Food	Parts per million
Wheat milling fractions (excluding flour)	20.0

* * * * *

[FR Doc. 93-10577 Filed 5-4-93; 8:45 am]

BILLING CODE 6560-50-F

40 CFR Part 721

[OPPTS-50575C; FRL-4171-4]

Adipic Acid; Polymer with 1,4-Cyclohexanedimethanol, Dipropylene Glycol, Alkanepolyol, Substituted Alkanolamines, and Carbomonocyclic Dicarboxylic Acid; Proposed Revocation of a Significant New Use Rule

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: EPA is proposing to revoke a significant new use rule (SNUR) promulgated under section 5(a)(2) of the Toxic Substances Control Act (TSCA) for a chemical substance based on receipt of new data. The data indicate that the substance will not present an unreasonable risk to health.

DATES: Written comments must be submitted to EPA by June 4, 1993.

ADDRESSES: Since some comments may contain confidential business information (CBI), all comments must be sent in triplicate to: TSCA Document Receipt Office (TS-790), Office of Pollution Prevention and Toxics, Environmental Protection Agency, 401 M St., SW., Washington, DC 20460. Comments should include the docket control number. The docket control number for the chemical substance covered in this SNUR is OPPTS-50575C-266. Nonconfidential versions of comments on this proposed rule will be placed in the rulemaking record and will be available for public inspection. Unit IV. of this preamble contains additional information on submitting comments containing CBI.

FOR FURTHER INFORMATION CONTACT: Susan B. Hazen, Director, Environmental Assistance Division (TS-

ATTACHMENT C

MATERIAL SAFETY DATA SHEETS

MONSANTO PRODUCT NAME
RODEO®
Herbicide

MONSANTO COMPANY
800 N. LINDBERGH
ST. LOUIS, MO 63167
EMERGENCY PH. NO. (CALL COLLECT) (314) 694-4000
Date Prepared: March, 1993

PRODUCT IDENTIFICATION

EPA Registration Number:	524-343
Synonyms:	None
Chemical Name:	Not Applicable, Formulated Product
Active Ingredient:	Glyphosate, N-phosphonomethylglycine, in the form of its isopropylamine salt 53.5%
Inert Ingredients:	.... 46.5%
	100.0%
	*Contains 648 grams per liter or 5.4 pounds per U.S. gallon of the active ingredient, glyphosate in the form of its isopropylamine salt. Equivalent to 480 grams per liter or 4 pounds per U.S. gallon of the acid, glyphosate.
CAS Reg. No.:	Not Applicable, Formulated Product
CAS Reg. No. Active Ingredient:	1071-83-6
DOT Proper Shipping Name:	Not Applicable
DOT Hazard Class/I.D. No.:	Not Applicable
DOT Label:	Not Applicable
Reportable Quantity (RQ) Under Clean Water Act:	Not Applicable
U.S. Surface Freight Classification:	Weed killing compound, N.O.I.B.N.

SARA Hazard Notification

Hazardous Categories Under Criteria of SARA Title III Rules (40 CFR Part 370): Not applicable

Section 313 Toxic Chemical(s): Not Applicable

Hazardous Chemical(s) Under OSHA Hazard Communication Standard: Not Applicable

WARNING STATEMENTS

Keep out of reach of children.
CAUTION!
MAY BE HARMFUL IF INHALED

PRECAUTIONARY MEASURES

- Remove contaminated clothing and wash clothing before reuse.
- Wash thoroughly with soap and water after handling.
- Do not contaminate water when disposing of equipment wash waters.
- Treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss can cause fish suffocation.

EMERGENCY AND FIRST AID PROCEDURES

First Aid:

If Inhaled: Remove individual to fresh air. Seek medical attention if breathing difficulty develops.

OCCUPATIONAL CONTROL PROCEDURES

Eye Protection: RODEO® herbicide does not present significant eye irritation or eye toxicity requiring special protection. Avoid eye contact as good industrial practice.

Skin Protection: RODEO® herbicide does not present significant skin concern requiring special protection.

Respiratory Protection: For Handling of the Undiluted Product: Undiluted RODEO® herbicide is not likely to represent an airborne exposure concern during normal handling. In the event of an accidental discharge of the material during manufacture or handling which produces a heavy vapor or mist, workers should put on respiratory protection equipment. Consult respirator manufacturer to determine appropriate type of equipment. Observe respirator use limitations specified by NIOSH/MSHA or the manufacturer.

For Application of Product Diluted in accordance with label instructions: Respirators are not required for applications of use - dilutions of RODEO® herbicide.

Ventilation: No special precautions are recommended.

Airborne Exposure Limits:

Product: **RODEO® herbicide - 100% by weight:**
OSHA PEL/TWA: None established ACGIH TLV/TWA/STEL: None established

FIRE PROTECTION INFORMATION

Flash Point: This material is not combustible as tested by the Tag Cup Test.

Extinguishing Media: Use appropriate extinguishing media for exposure fire.

Special Firefighting Procedures: Firefighters or others who may be exposed to mists or products of combustion should wear a self-contained breathing apparatus and full protective clothing. Equipment should be thoroughly cleaned after use.

Unusual Fire and Explosion Hazards: None

REACTIVITY DATA

Stability: Stable for at least 5 years under normal conditions of warehouse storage. Heated facilities are not required.

Incompatibility: Spray solutions of this product should be mixed, stored and applied using only stainless steel, aluminum, fiberglass, plastic and plastic-lined steel containers.

DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

Hazardous Decomposition Products: None known.

Hazardous Polymerization: Does not occur. This product can react with caustic (basic) materials to liberate heat. This is not a polymerization but rather a chemical neutralization in an acid-base reaction.

HEALTH EFFECTS SUMMARY

The following information summarizes human experience and results of scientific investigations reviewed by health professionals for hazard evaluation of RODEO• herbicide and development of Precautionary Statements and Occupational Control Procedures recommended in this document.

EFFECTS OF EXPOSURE

Inhalation and skin contact are expected to be the primary routes of occupational exposure to RODEO• herbicide. Occupational exposure to this material has not been reported to cause significant adverse health effects. On the basis of available information, exposure to RODEO• herbicide is not expected to produce significant adverse human effects when recommended safety precautions are followed.

TOXICOLOGICAL DATA

Data from laboratory studies conducted by Monsanto with RODEO• herbicide are summarized below.

Oral -	Practically Non-toxic, (Rat LD_{50} - >5,000 mg/kg)
Dermal -	Practically Non-toxic, (Rabbit LD_{50} - >5000 mg/kg)
Inhalation -	No more than Slightly Toxic (Rat 4-hr LC_{50} - >1.3 mg/L, the highest atmospheric concentration achievable in this study.)
Eye Irritation -	Non irritating (Rabbit, 0.0/110.0)
Skin Irritation -	Practically Nonirritating (Rabbit, 24-hr exposure, 0.1/8.0)

In repeat dosing studies (6-months), dogs fed RODEO• herbicide exhibited slight body weight changes. Following repeated skin exposure (3-weeks) to RODEO• herbicide, skin irritation was the only effect in rabbits. No skin allergy was observed in guinea pigs following repeated skin exposure. Additional toxicity information is available on glyphosate, the active herbicidal ingredient of RODEO• herbicide. Following repeated exposures (90-days) to glyphosate in their feed, decreased weight gains were noted at the highest test level in mice, while no treatment-related effects occurred in rats. Following repeated skin exposure (3 weeks) to glyphosate, slight skin irritation was the primary effect observed in rabbits. No skin allergy was observed in guinea pigs following repeated skin exposure. There was no evidence of effects on the nervous system, including delayed effects in chickens (repeat oral doses) or cholinesterase inhibition in rats (single oral doses). Reduced body weight gain and effects on liver tissues were observed with long-term (2-year) feeding of glyphosate to mice at high-dose levels. Reduced body weight gain and eye changes were observed at the high-dose level in one long-term (2 year) feeding study with rats, while no treatment-related effects occurred in a second study. No adverse effects were observed in feeding studies with dogs. Glyphosate did not produce tumors in any of these studies. **Based on the results from the chronic studies, EPA has classified glyphosate in category E (evidence of non-carcinogenicity for humans).** No birth defects were noted in rats and rabbits given glyphosate orally during pregnancy, even at amounts which produced adverse effects on the mothers. Glyphosate was fed continuously to rats at very high dose levels for 2 successive generations. Toxicity was reported in offspring from the high dose, a level which also produced adverse effects on the mothers. In a 3 generation study conducted at lower dose levels, no effects were seen on the ability of male or female rats to reproduce. Glyphosate has produced no genetic changes in a variety of standard tests using animals and animal or bacterial cells.

PHYSICAL DATA

Appearance:	Colorless solution
Odor:	Essentially odorless
pH:	4.6 - 4.8
Specific Gravity:	1.22 - 1.25 (water = 1)

NOTE: These physical data are typical values based on material tested but may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specification items.

SPILL, LEAK & DISPOSAL INFORMATION

SPILL/LEAK:

Observe all protection and safety precautions when cleaning up spills – see Occupational Control Procedures.

Liquid spills on floor or other impervious surfaces should be contained or diked, and should be absorbed with attapulgite, bentonite or other absorbent clays. Collect contaminated absorbent, place in plastic-lined metal drum and dispose of in accordance with instructions provided under DISPOSAL. Thoroughly scrub floor or other impervious surfaces with a strong industrial type detergent solution and rinse with water.

Liquid spills that soak into the ground should be dug up, placed in plastic-lined metal drums and disposed c in accordance with instructions provided under DISPOSAL.

Leaking containers should be separated from non-leakers and either the container or its contents transferrec to a drum or other non-leaking container and disposed of in accordance with instructions provided under DISPOSAL. Any recovered spilled liquid should be similarly collected and disposed of.

Do not contaminate water, foodstuffs, seed or feed by storage or disposal.

DISPOSAL:

Wastes resulting from the use of this product that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticide disposal or in accordance with applicable Federal, State and local procedures.

Emptied container retains vapor and product residue. Observe all labeled safeguards until container is cleaned, reconditioned or destroyed.

Do not reuse container. Return emptied container per the Monsanto container return program. If not returned, triple rinse container, then puncture and dispose of in a sanitary landfill or by incineration or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

STORAGE:

STORE ABOVE 10°F (-12°C) TO KEEP FROM CRYSTALLIZING.

Crystals will settle to the bottom. If allowed to crystallize, place in a warm room at 68°F (20°C) for several days to redissolve and mix well before using.

ENVIRONMENTAL EFFECTS

ENVIRONMENTAL TOXICITY INFORMATION:

96-hr LC_{50} Bluegill:	>1,000 mg/L, Practically Nontoxic
96-hr LC_{50} Trout:	>1,000 mg/L, Practically Nontoxic
96-hr TL_{50} Carp:	>10,000 ppm, Practically Nontoxic
48-hr EC_{50} *Daphnia*:	930 mg/L, Practically Nontoxic
Oral LD_{50} Goat:	5,700 mg/Kg, Practically Nontoxic

Brahman-cross heifers were given RODEO® herbicide, by gavage, at daily dosages of 0, 540, 830, 1290 and 2000 mg/Kg for 7 consecutive days. Clinical signs of toxicity, including loss of appetite, diarrhea and death (1290 and 2000 mg/Kg) were observed at 830 mg/Kg or above. The no-effect level was considered to be 54(mg/Kg/day.

For environmental toxicity information of Glyphosate, the active herbicidal ingredient of RODEO® herbicide, re to the Glyphosate Material Safety Data Sheet.

MONSANTO PRODUCT NAME
GLYPHOSATE

Monsanto Company
800 North Lindbergh Blvd.
St. Louis, MO 63167

DATE Prepared: April, 1993

ACUTE TOXICITY STUDIES

Assess effects of short-term, single dose exposure to a material.

Oral	Practically Nontoxic (Rat LD_{50} - >5,000 mg/Kg)
Dermal	Practically Nontoxic (Rabbit LD_{50} - >5,000 mg/Kg)
Eye Irritation	Severely Irritating (Rabbit, 29/110)
Skin Irritation	Nonirritating (Rabbit, 4-hr exposure, 0.0/8.0)
Intraperitoneal	(Rat LD_{50} - 3740 mg/Kg)
Subcutaneous	(Rat LD_{50} - >7500)

SENSITIZATION STUDIES

Assess potential for a material to cause an allergic skin reaction following repeated contact.

Patch testing of Hartley guinea pigs with glyphosate produced no irritation following initial application; moderate to severe erythema (redness), edema (swelling) and/or necrosis (tissue damage) were observed in some animals during subsequent repeated exposures in the induction phase. On challenge, no animals exhibited a positive dermal response. Glyphosate did not exhibit the potential to produce dermal sensitization in guinea pigs.

NEUROTOXICITY AND CHOLINESTERASE STUDIES

Assess potential for a material to cause delayed neurotoxicity or to inhibit cholinesterase.

No inhibition of plasma, erythrocyte or brain cholinesterase activities was observed in rats following administration of single oral dosages of glyphosate of 5000 or 10,000 mg/Kg.

A neurotoxicity study was conducted with glyphosate in chickens. Oral doses of 1.25 g/Kg were given twice daily for 3 consecutive days at 21 day intervals for a total dosage of 15.0 g/Kg. No gross signs of neurological effects and no microscopic evidence of demyelination were observed in brain, spinal cord, or peripheral nerve.

SUBCHRONIC STUDIES

Assess effects occurring as a result of repeated daily dosing of a material to laboratory animals for a defined part of the animals' life span.

Glyphosate was applied to the intact and abraded skin of New Zealand White rabbits at dosages of 0, 100, 1000 or 5000 mg/Kg/day for 6 hours/day, 5 days/week for 3 weeks. A slight degree of dermal irritation was observed at the site of application in the high-dose group. No adverse hematologic, biochemical or histopathologic effects were observed. The systemic no observable effect level (NOEL) was 5000 mg/Kg/day.

Glyphosate was administered for 3 months at dietary levels of 0, 5000, 10,000 and 50,000 ppm to CD-1 mice and 0, 1000, 5000 and 20,000 ppm to Sprague-Dawley rats. Decreased body weight gain was observed in the high-dose group mice. No treatment-related effects in pathologic or histopathologic evaluations were observed. The NOEL was considered to be 10,000 ppm in mice and 20,000 ppm in rats.

CHRONIC TOXICITY STUDIES

Assess the effects of long-term, possibly lifetime, exposure to a material and determine its carcinogenic potential.

Beagle dogs were orally administered glyphosate, via capsule, at dosages of 0, 20, 100 and 500 mg/Kg/day for one year. No adverse histopathologic, hematologic, biochemical, urinalysis or ophthalmic effects were observed. The NOEL was considered to be 500 mg/Kg/day.

In a 24-month feeding study, male and female Sprague-Dawley rats were fed glyphosate at dietary levels of 0, 2000, 8000 and 20,000 ppm for 24 months. Reduced body weight gain (females) and eye changes (cataracts in males) were observed at the high-dose level. No treatment-related carcinogenic effects were observed. The NOEL was considered to be 8000 ppm (100 mg/Kg).

Glyphosate was fed to CD-1 mice at dietary levels of 0, 1000, 5000 and 30,000 ppm for 24 months. Slightly reduced body weight gain and several microscopic liver changes were reported in high-dose animals. No evidence of carcinogenicity was observed. The NOEL was considered to be 5000 ppm (750 Mg/Kg).

Based on the results from these chronic studies, EPA has classified glyphosate in Category E (evidence of non-carcinogenicity for humans).

DEVELOPMENTAL STUDIES

Assess a materials effect on the development of offspring during pregnancy.

No birth defects were observed in the offspring of Sprague-Dawley rats administered glyphosate by gavage at dosage levels of 0, 300, 1000 and 3500 mg/Kg/day on days 6 through 19 of gestation. Maternal toxicity was produced in the high-dose treated animals. Mild embryotoxicity was also observed at the high dose. The NOEL for developmental toxicity is considered to be 1000 mg/Kg.

No birth defects were observed in the offspring of Dutch-belted rabbits administered glyphosate by gavage at dosage levels of 0, 75, 175 and 350 mg/Kg/day on days 6 through 27 of gestation. Maternal toxicity was produced in the high-dose treated animals. The NOEL for developmental toxicity is considered to be 350 mg/Kg/day.

REPRODUCTIVE STUDIES

Assess effects of a material on reproductive function of male and female test animals including mating, pregnancy, nursing, development and maturation of offspring.

Male and female Sprague-Dawley rats were exposed to glyphosate at dietary concentrations of 0, 2000, 10,000 or 30,000 ppm throughout premating, mating, pregnancy and nursing periods for 2 generations. At the high-dose level, decreases were observed in adult body weight gain and in pup body weight gain during the last week of nursing. Soft stools and a possible effect on litter size were also observed at the 30,000 ppm level. There were no treatment related adverse effects on other reproductive parameters and no histopathologic evidence of systemic toxicity. The definitive NOEL for reproductive toxicity is considered to be 10,000 ppm (740 mg/Kg).

GENETIC TOXICOLOGY STUDIES

Assess the potential of a material to interact with cellular genetic material.

Glyphosate was evaluated for mutagenic or genotoxic activity in the following systems: microbial assays with five *S. typhimurium* strains, one strain each of *E. coli* and rec+ and rec- strains of B. subtilis; in vitro Chinese hamster ovary (CHO) cell point mutation assay; *in vivo* rat bone marrow cell clastogenesis assay; in vitro primar culture/DNA repair assay; *in vivo* host mediated assays with *S. typhimurium* G46 conducted in both rats and mice; and an *in vivo* dominant lethal mutation assay conducted in mice. No evidence of mutagenicity was observed in any of these assays.

METABOLISM STUDIES

Assess the processes of absorption, distribution, biotransformation and elimination of a material in mammals.

Following oral administration to rats, only 30% to 36% of orally administered glyphosate is absorbed. When applied dermally, 2% or less is absorbed. Glyphosate is almost completely eliminated unchanged in the urine and feces. No significant differences in metabolism or excretion were noted between rats exposed to glyphosate once and rats exposed for fifteen consecutive days.

ENVIRONMENTAL TOXICITY STUDIES

Assess the potential for a material to cause adverse effects in non-mammalian species.

Algae	
Selenastrum 72-hr EC_{50}	450 mg/L
Selenastrum 7-day EC_{50}	13.8 mg/L
Anabaena 7-day EC_{50}	15 mg/L
Navicula 7-day EC_{50}	42 mg/L
Skeletonema 96-hr EC_{50}	1.2 mg/L
Skeletonema 7-day EC_{50}	0.64 mg/L
Aquatic Flowing Plant	
Lemna 14-day EC_{50}	25.5 mg/L
Invertebrates	
Daphnia magna 48-hr LC_{50}	780 mg/L*
Mysid Shrimp 96-hr LC_{50}	>1000 mg/L*
Grass Shrimp 96-hr LC_{50}	281 mg/L*
Fiddler Crab 96-hr LC_{50}	934 mg/L*
Sea Urchin 96-hr EC_{50}	>1000 ppm*
Oyster Larvae 48-hr TL_{50}	>10 mg/L**
Fish	
Carp 96-hr TL_{50}	115 ppm*
Rainbow Trout 96-hr LC_{50}	86 mg/L***
Bluegill Sunfish 96-hr LC_{50}	120 ppm*
Harlequin 96-hr LC_{50}	168 mg/L*
Sheepshead Minnow 96-hr LC_{50}	>1000 ppm*
Fathead Minnow 96-hr LC_{50}	97 mg/L***
Insects	
Honeybee Oral 48-hr LD_{50}	>100 μg/bee*
Honeybee Dermal 48-hr LD_{50}	>100 μg/bee*
Birds	
Bobwhite Quail Oral LD_{50}	>4,640 mg/Kg*
Bobwhite Quail Dietary 5-day LC_{50}	>4,640 ppm**
Mallard Duck Dietary 5-day LC_{50}	>4,640 ppm**
Mammals	
Spanish Goat Oral LD_{50}	3,530 mg/Kg***

* Practically nontoxic.
** No more than slightly toxic.
*** Slightly toxic.

ENVIRONMENTAL TOXICITY STUDIES - Continued

Exposure of *Daphnia magna* to glyphosate at concentrations of 0, 26, 50, 96, 186 and 378 mg/L for 21 days resulted in reduced reproduction at the upper three concentration levels. No other adverse compound-related effects were observed. The no observable effect concentration (NOEC) was considered to be 50 mg/L. In a separate study, no lethal, reproductive or other treatment-related effects occurred with exposure of *Daphnia magna* to glyphosate concentrations of up to 100 mg/L for 21 days.

Rainbow trout were exposed to glyphosate at concentrations of 0, 5.8, 11, 22, 52 and 98 mg/L for 21 days. Adverse effects, including reduced survival, were noted at the highest exposure level. The NOEL was considered to be 52 mg/L.

Fathead minnows were exposed to glyphosate at concentrations of 0, 0.7, 2.8, 7.0, 13.0 and 25.7 mg/L for 255 days. No treatment-related effects were reported on the survival, growth and egg production of first generation fish or on hatchability, survival and growth of second generation eggs and fry. The NOEC is considered to be 25.7 mg/L.

Glyphosate was fed to groups of adult Bobwhite quail for 8 weeks at dietary concentrations of 0, 100, 215, 464, 1000 and 2150 ppm. No adverse effects on growth, appearance, behavior, mortality or egg production were reported. The NOEL was considered to be 2150 ppm.

No adverse treatment-related effects on reproductive parameters were observed following dietary administration of glyphosate to Bobwhite quail and Mallard ducks at concentrations of 0, 50, 200 and 1000 ppm for 17 weeks.

A series of residue and metabolism studies have shown that glyphosate is poorly absorbed across the gastrointestinal membrane and that there is minimal tissue retention and rapid elimination of residues in several animal species, including mammals, birds and fish. Thus, it is concluded that glyphosate will not bioaccumulate.

DATE PREPARED: April, 1993 SUPERSEDES: November, 1991

ATTACHMENT D

CALCULATION OF DERMAL PERMEABILITY CONSTANT

CALCULATION OF DERMAL PERMEABILITY CONSTANT

The rate at which a compound is absorbed through the skin is commonly represented in one of three ways:

- Flux: The amount of chemical absorbed across a defined surface area of the skin per unit time (mg/cm21hr).

- Permeability coefficient (kp): A flux value, normalized for concentration that represents the rate at which the chemical crosses the skin's rate-limiting barrier layer (cm/hr).

- Percent absorbed: The percentage or fraction of the applied dose that is absorbed across the skin. Duration of exposure or decontamination time (usually 24 hrs) and observation time (usually 5 days) should be indicated along with amount applied per unit area and percent absorbed.

As recommended in the Interim Guidance for Dermal Exposure Assessment (EPA, 1991) and Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Part A (EPA, 1989), the equation currently used for Superfund Risk Assessments to estimate the percutaneously absorbed dose of a compound in aqueous media uses the permeability coefficient (Kp) as a measure of percutaneous absorption. Permeability coefficients reflect the movement of the chemical across the skin and into the bloodstream. If chemical-specific Kps are not available, the permeability of water can be used to derive a default value. It should be noted that this approach may underestimate dermal permeability for organic chemicals. However, Fick's law of diffusion is widely used to relate the flux (J) of a compound across the skin as a function of its concentration gradient across the stratum corneum. The use of this simple flux equation requires that steady-state diffusion occurs one-dimensionally, and that there is no convection in the same direction as the one-dimensional diffusion. Under the simple case where these conditions exist, the Kp can be calculated using the equation below (EPA, 1991):

$J = Kp \times Cw$

where:

J = Flux (mg/cm2/hr)
Kp = Permeability Coefficient (cm/hr)
Cw = Concentration in Aqueous Media (mg/L)

The equation rearranges to:

Kp (cm/hr) = J x l/Cw,

using:

Cw = 574 mg/ml (Franz, 1983)
J = 0.07 ,ug/cm2/hr (Franz, 1983)

then:

Kp = 0.07 ug/cm2/hr x 1/574,000 mg/L x 1000 cm3/L
x mg/1000 ug = 1.2E-07 cm/hr

REFERENCES

U.S. Environmental Protection Agency (EPA, 1989). Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual Part A. USEPA/5-40/189/002, December, 1989.

U.S. Environmental Protection Agency (EPA, 1991). Interim Guidance for Dermal Exposure Assessment. USEPA/600/8-91/OIIA, March, 1991.

Franz, TJ. (Franz, 1983). Evaluation of the percutaneous absorption of Roundup formulations in man using an in vitro technique. University of Washington (unpublished Monsanto study, UW-81-346).

DATE: March, 1993 SUPERSEDES: February, 1992 MSDS NO.: S000101

FOR ADDITIONAL NON-EMERGENCY INFORMATION, CALL: 1-800-332-3111

APPENDIX E

PART 327 REGULATION ON THE USE OF CHEMICALS FOR THE CONTROL OR ELIMINATION OF AQUATIC VEGETATION IN NYS

326.65-326.71

Historical Note

Secs. filed March 8, 1961; renum. 606.65-606.71, Sept. 1966.

326.80-326.81

Historical Note

Secs. filed March 8, 1961; renum. 606.80-606.81, Sept. 1966.

326.85-326.87

Historical Note

Secs. filed March 8, 1961; renum. 606.85-606.87, Sept. 1966.

326.95-326.96

Historical Note

Secs. filed March 8, 1961; renum. 606.95-606.96, Sept. 1966.

326.100

Historical Note

Sec. filed March 8, 1961; renum. 606.100, Sept. 1966.

326.105

Historical Note

Sec. filed March 8, 1961; renum. 606.105, Sept. 1966.

326.109-326.110

Historical Note

Secs. filed March 8, 1961; renum. 606.109-606.110, Sept. 1966.

PART 327

USE OF CHEMICALS FOR THE CONTROL OR ELIMINATION OF AQUATIC VEGETATION

(Statutory authority: Conservation Law, § 427[3])

Historical Note

Part (§§ 327.1-327.6) filed Aug. 22, 1962; repealed, new filed March 28, 1966; renum. Part 607, Sept. 1966; new (§§ 327.1-327.8) filed April 28, 1972 eff. May 1, 1972.

Section 327.1 **Permit required.** (a) No person, individual, public or private corporation, political subdivision, government agency, municipality, industry, copartnership, 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) of this section.

(b) Such permit may be issued for the use of chemicals in the control or elimination of aquatic vegetation, subject to such limitations as may be considered necessary to safeguard water quality. For the protection of riparian uses, no such permit shall be issued except where the applicant has certified that the affected riparian users have agreed to temporary curtailment of their uses incidental to treatment or unless the applicant demonstrates to the satisfaction of the commissioner that any nonconsenting riparian users will not be significantly adversely affected by the use of the chemicals subject to such limitations as are set forth in the permit. Such limitations shall prescribe what chemical or chemicals may be applied to the waters under stipulated conditions to protect the public health, safety or welfare, and terrestrial and aquatic life or the growth and propagation thereof, other than aquatic vegetation intended to be controlled or eliminated.

(c) Such permit, however, shall not be required: for the use of copper sulfate for the purpose of algae control by a duly constituted water supply agency in its water supply waters; or for chemical control of aquatic vegetation 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.

Historical Note

Sec. filed Aug. 22, 1962; repealed, new filed March 28, 1966; renum. 607.1, Sept. 1966; new filed April 28, 1972; amd. filed April 10, 1973 eff. immediately.

327.2 Permit-issuing officials. The Commissioner of Environmental Conservation or his designated representatives, may issue permits in accordance with the policy and procedures set forth in this Part.

Historical Note

Sec. filed Aug. 22, 1962; repealed, new filed March 28, 1966; renum. 607.2, Sept. 1966; new filed April 28, 1972 eff. May 1, 1972.

327.3 Policy. (a) It is recognized that:

(1) Owners of lands through which water passes or which are bordered by waters have certain vested riparian rights to the use of these waters.

(2) The provisions of article 12 of the Public Health Law safeguard uses of waters through the maintenance of water quality standards assigned by classification.

(3) Use of chemicals for controlling aquatic vegetation may result in need for temporary curtailment of certain water uses.

(b) In considering the use of such chemicals it is the intent that:

(1) Permits shall be granted under such limitations as will protect to the greatest extent possible all terrestrial life, aquatic life other than aquatic vegetation intended to be controlled or eliminated, all public and domestic water supplies and irrigational, recreational, agricultural and industrial water uses.

(2) The permit issuing official shall not make recommendations on the method, use, general handling, efficiency of the chemicals and treatment operation or other aspects involving responsibilities of the applicant, except as may be related to the public health and conservation programs and to avoid adverse effects on water uses.

(3) Regardless of conformity with other limitations, no permit shall be issued for chemical treatment of water supply waters, if the resultant chemical concentration at the water supply intake will exceed New York State Department of Health drinking water standards.

Historical Note

Sec. added, filed Aug. 22, 1962; repealed, new filed Mar. 28, 1966; renum. 607.3; new filed April 28, 1972 eff. May 1, 1972.

327.4 **Permits and permit issuance.** (a) *Permits.* The Commissioner of Environmental Conservation or his designated representative:

(1) may issue permits for the use of any chemical listed as an authorized chemical (see § 327.6) and conforming with specifications relating to purpose, dosage, area to be treated, method of application and other limitations provided herein;

(2) may issue special permits for operations relating to the control of aquatic vegetation by State and Federal agencies, which permits are subject to conditions and limitations consistent with other provisions of this Part;

(3) may issue special permits for controlling aquatic vegetation involving chemicals, dosages, methods or areas other than those provided for herein, provided such issuance will not be at variance with these regulations and the regulations relating to restricted use pesticides.

(b) *Applicant and applications.* (1) The applicant shall be a riparian owner, or a lessee of a riparian owner or an association of such persons.

(2) The applicant shall submit an application on a form provided by the department. It shall be accompanied by a scale drawing or map including depth soundings adequate to determine: the size and depth of the treatment area; the concentration of the chemical within the area and conformity to the limitations set forth herein; the location and type of weed beds (submerged, emergent); the location of inlets and outlets in relation to the treatment area; the location of water users relative to the area and along the outlet; and any further information required by the permit-issuing official.

(3) Applications that involve public water supply waters or their tributaries will be referred to the State Department of Health for approval before a permit is issued.

(4) The applicant shall certify: that the listed chemical will be employed in conformance with all the conditions specified in the permit issued; that he ob-

tained agreements to the treatment from water users as set forth in his application whose use may be restricted; that he agrees the issuance of the permit be based on the assumed accuracy of all statements presented by him; that he is legally responsible for damage resulting from the application of the chemical, or from the inaccuracy of any computations or from improper application of the chemical; and that he assumes full legal responsibility for the accuracy of all representations made in obtaining approvals or releases, and for any failure to obtain approval or releases from the persons likely to be adversely affected.

(5) The commissioner, or his designated representative, shall reject the application and issue no permit when the application involves a State-stocked trout water and it is deemed that the proposed control or elimination of aquatic vegetation would adversely affect the trout habitat in such water.

(c) *Permits—additional provisions.* (1) Each permit shall be issued in terms that indicate:

(i) that its issuance is based on the statements, agreements and restrictions made or accepted by the applicant in his application;

(ii) the approximate date of treatment;

(iii) the permissible concentration of chemical and the maximum dosage to be applied in the treatment area and the methods of application to be used;

(iv) any restrictions imposed on the use of waters during and following the application and the duration of those restrictions;

(v) other requirements in the treatment procedure including demarcation of the treatment area by buoys or markers, or posting against use of the waters by the public;

(vi) the application of chemicals shall be deemed to be in violation of the provisions of the Conservation Law and article 12 of the Public Health Law, if the applicant fails to comply with the permit terms.

(2) Permits shall require and be issued upon the condition that prior actual notice of date or dates of treatment and water-use restrictions be given to all affected riparian users and known users.

(3) A copy of the required scale drawing or map submitted with the application shall be attached to and become part of the permit.

(4) No permit shall be construed as conveying to the applicant any right to trespass upon the lands of others to perform the permitted work, or authorizing the treatment of waters lying on or passing through the property of others without their consent or relieving the applicant of any legal necessity to obtain such consent before treatment. Nor shall any permit be construed as authorizing the impairment of any right, title or interest in real or personal property held by or vested in a person not a party to the permit.

(d) *Suspensions or revocation of permits.* A permit may be suspended or revoked by the permit-issuing official at any time upon notice to the applicant upon one or more of the following grounds:

(1) False or inaccurate statements in the application or accompanying papers.

(2) Change in any condition by reason of which treatment may impair the quality of the waters for the best usages assigned to them or endanger the public health, safety or welfare.

(3) Failure to abide by the terms of the permit or the application for the permit.

Historical Note

Sec. added, filed Aug. 22, 1962; repealed, new filed Mar. 28, 1966; renum. 607.4; new filed April 28, 1972 eff. May 1, 1972.

327.5 Violations. Failure to abide by the terms of the permit or the appli-

APPENDIX F

RESUMES OF PRINCIPAL AUTHOR AND OTHER PREPARERS AS REPRESENTATIVES OF MCLAREN/HART ENVIRONMENTAL ENGINEERING CORPORATION

CHARLES R. HARMAN
Senior Environmental Scientist

Education:

M.A. Biology, Southwest Texas State University, 1986
B.S. Wildlife Ecology, Texas A & M University, 1977

Continuing Education/Training:

Hydric Soils, Cook College Continuing Education, Rutgers University, 1994
Hydrology of Wetlands, Cook College Continuing Education, Rutgers University, 1994
Wetland Construction Techniques, Cook College Continuing Education, Rutgers University, 1994
Freshwater Wetlands Permits, Cook College Continuing Education, Rutgers University, 1994
Ecological Impact, Risk Assessments, & Cleanup Decisions at Hazardous Waste Sites, SETAC Short Course, 1993
Lake Management, Cook College Continuing Education, Rutgers University, 1993
Wetlands Mitigation and Restoration - Design, Installation and Evaluation, 1993
Ecological Risk Assessment Seminar, Water Environment Federation/ATSDR, 1993
Ecological Risk Assessment, SETAC Short Course, 1992
Minimizing and Resolving Natural Resource Damage Claims, Executive Enterprises, 1992
Observer, EPA Ecological Risk Assessment Guidelines Case Studies Workshop, 1992
Wetlands Delineation/Assessment Course, REWAI Learning Center, 1990
CERCLA/Superfund Seminar, Government Institutes, 1989
RCRA/Hazardous Waste Seminar, Government Institutes, 1989
Participant, National Wetlands Policy Forum, 1988
Wetlands and Real Estate Development Seminar, Government Institutes, 1988
Impact of Environmental Law on Real Estate Transactions, Government Institutes, 1987
Wildlife Ecology Field Course, USDA Graduate School, 1982

Professional History:

As a Senior Environmental Scientist with ChemRisk, Mr. Harman specializes in ecological risk assessments and wetland evaluations. Mr. Harman directs ecological risk assessment programs and wetlands evaluations for the Warren office. Mr. Harman has delineated wetlands using both the 1987 and 1989 methods manuals and has designed and managed wetland restoration projects as part of remediation activities. Mr. Harman utilizes his expertise in vertebrate zoology and physiology, botany, and applied and systems ecology in the development of ecological risk assessments at CERCLA and RCRA sites. He has conducted biotic characterizations for hazardous waste sites located in freshwater wetlands and estuaries. He has examined the impacts and movement of heavy metals within a tidal marsh ecosystem and has utilized HEP models in evaluating impairments to habitat. This has required the use of the WET model to evaluate wetland functions. Mr. Harman has managed and prepared environmental impact statements as mandated under NEPA, New York SEQRA, Pennsylvania regulations for Municipal Waste Landfills, and the New Jersey landfill siting regulations. Mr. Harman has managed projects to evaluate the extent of chemical contamination at hazardous waste sites and has conducted environmental liability and regulatory audits at diverse industrial and commercial facilities. Additional experience has included peer review of manuscripts produced by other firms, meetings with federal and state regulators and participation in public meetings.

Key Projects:

McLaren/Hart Environmental Engineering Corporation (ChemRisk), 1987-Present

- Conducted a wetlands delineation on a CERCLA site in Southwestern New York. Presently involved with the evaluation of the wetlands through the application of the WET model.
- Supervised the completion of wetlands mitigation projects at two remediation sites in eastern New Jersey.
- Managing the preparation and implementation of a wetlands mitigation plan for a CERCLA site in southern New Jersey.
- Managing and conducting numerous wetland delineation assessment and permitting projects at sites in New Jersey, New York, Pennsylvania, Delaware, Virginia, Puerto Rico and Connecticut.
- Supervised the development of a wetlands mitigation plan for an ECRA site in eastern New Jersey.
- Developed and supervising the ongoing efforts to evaluate the potential for impacts to wetlands at a CERCLA site in central New Jersey from the implementation of the remedial design.
- Delineated the wetlands at a CERCLA site in eastern New Jersey. Providing wetlands mitigation guidance for the PRP committee.

- Developed and supervising the evaluation of ecological receptors as part of Natural Remediation Compliance Programs at hazardous waste sites in eastern and southern New Jersey.

- Managed a wetland remediation project in central New Jersey to restore a wetland filled in during construction activities.

- Evaluated the ecological impacts to vegetation from an air release from a chemical plant in Ohio.

- Delineated the wetlands at a CERCLA site in Puerto Rico. Developing permit and mitigation plans as part of the RD/RA design.

- Managing the ecological risk assessment for the site in southern Vermont. Activities included description of habitat, delineation of wetlands and the qualitative appraisal of ecological impacts.

- Preparing a generic Environmental Impact Statement for the use of an aquatic herbicide in the State of New York.

- Managed a predictive ecological risk assessment as part of a siting permit for a hazardous waste incinerator in east-central Mississippi. Assessment was based on the computer modeling of air emissions from the proposed facility.

- Conducted a baseline ecological evaluation at a CERCLA site in eastern Pennsylvania.

- Completed a wetlands delineation at a site in the Pine Barrens of southern New Jersey. Assisting with guidance on remediation options and wetlands mitigation with respect to ecological receptors.

- Served as expert witness for the defense of a PRP against natural resource damage claims filed by the USDOI. Claimed injuries were associated with a CERCLA site in New Jersey.

- Developed an ecological risk assessment protocol for a RCRA corrective action investigation at an industrial site in New York. Project involves the assessment of ecological impacts to a stream and associated wetlands from heavy metals.

- Assisted with the preparation of comments to evaluate the ecological impacts of a planned remediation at a CERCLA site in New York.

- Managed an ecological risk assessment associated with a CERCLA site in Allegan, Michigan. Project involved the assessment of potential ecological impacts to a river from petroleum hydrocarbons and heavy metals.

- Conducted an ecological evaluation at a remedial investigation site in Connecticut. Primary concern is the impact of copper and low pH leachate on a stream and associated floodplain wetland area.

- Assisted with an Environmental Impact Statement for a development project in upstate New York. Project entailed wetlands analysis and definition of potential impacts of the development.

- Assisted with the development of an Environmental Impact Statement for construction Activities in a wetland on Staten Island, New York.

- Conducted a terrestrial risk assessment as part of an Environmental Impact Statement for a site in central New York. Conducted an analysis of the local ecosystem to estimate the potential impacts of air emissions from a proposed TSDF.

- Conducted an ecological evaluation of the impacts of an illegal solid waste landfill on a stream and associated wetlands in New York.

- Conducted the environmentally sensitive area mapping required for a DPCC plan at a site in central New Jersey.

- Managed the remedial investigation of a CERCLA site in New Jersey. Site is located in a National Wildlife Refuge in New Jersey. Project remedial investigation tasks were driven by the need to evaluate the impact to sensitive wetland systems. The remedial investigation that was developed involved sampling of the flora and fauna, description of community structure and assessment of contaminant load in the abiotic matrices.

- Managed the ecological assessment associated with a RCRA corrective action investigation in Maine. The project entailed the biotic characterization of the site, which is located in an estuary, and the development of sampling and monitoring protocols to evaluate the impacts of contamination from the site on terrestrial ecosystems.

- Managed an ecological risk assessment to evaluate the impacts of chromium on a tidal marsh wetland ecosystem. The project involved the characterization of local flora and fauna, assessment of potential movement of chromium through the ecosystem by the collection of tissue samples for laboratory analysis, and surface water and sediment sampling.

- Managed the ecological assessment of the short- and long-term impacts of an oil release into a stream, wetlands and associated freshwater pond in New Jersey. Project involved the characterization of biota, surface water and sediment sampling, and assessment of the potential uptake of residual oil into the food chain.

- Developed an ecological risk assessment for a CERCLA site in eastern Pennsylvania. Project entailed the biotic characterization of the flora and fauna at the site and the hypothetical estimation of risks presented to the natural resources by heavy metal contamination.

- Assessed the uptake and movement of mercury into the food chain at a CERCLA site in Puerto Rico. Project was based on the collection of tissue samples from plants and domestic animals.

- Conducted environmental compliance and liability audits at diverse sites, both nationally and internationally.

- Conducted the ecological analysis and wetlands evaluation and assisted with the risk assessment for a landfill siting Environmental Impact Statement in southern New Jersey.

- Conducted a peer review of the ecotoxicological documentation to support an ACL application at a CERCLA site in New Hampshire. Purpose was to assess the technical and scientific approach.

- Assisted with development of an Endangerment Assessment for a CERCLA site in Tennessee.

- Conducted macroinvertebrate surveys at three proposed landfill sites in Pennsylvania to assess surface water quality through benthic population levels.

- Supervised project to develop ARAR's for carbon tetrachloride in groundwater for a CERCLA site in Puerto Rico.

- Developed an Endangerment Assessment detailing environmental risk levels at a CERCLA site in Missouri. The site was contaminated with a broad spectrum of pesticides.

Assistant Professor, Southwest Texas State University, 1986-1987

- Taught undergraduate level courses in botany, zoology, and biology.
- Developed avian species inventory list for environmental interpretation center and preserve.
- Developed wildlife management plans for white-tail deer.

Research Assistant, Southwest Texas State University, 1984-1986

- Conducted research on the impacts of rural development on avian community structure.
- Taught undergraduate and graduate level laboratories in botany, mammalogy, ornithology, ecology and wildlife management.
- Assisted with an extended research project in southern China. Project, in cooperation with the Guangdong Entomological Institute, included the inventory and life history studies of rodents and bats in bamboo cloud forests. Responsibilities included capture and museum preparation of organisms; gut and epidermal parasitological evaluations of mammals; and development of avian species list.

U.S. Navy, 1977-1981

- Surface Warfare Officer stationed aboard a supply and support ship; served as Navigator and Communications Officer.

Professional Affiliations:

American Society for Testing and Materials
    E-47 Subcommittee on Biological Effects and Environmental Fate
    E-50.5 Subcommittee on Wetlands Ecosystems
Hudson/Delaware Chapter of the Society of Environmental Toxicologists and Chemists
    Vice-President of the Chapter - 1994
Society of Environmental Toxicologists and Chemists
Society for Ecological Restoration

Society of Wetlands Scientists
The Association of State Wetland Managers
Wildlife Society
Certified as an Associate Wildlife Biologist

Publications and Theses:

Sheehan, P.J., E. Algeo and C.R. Harman. 1993. Ecotoxicology and Economics. McLaren/Hart Reporter.

Harman, C. R., W. M. Romaine and C. P. D'Alleinne. 1993. Wetlands Management at CERCLA Sites. *in* Current and Future Priorities for Environmental Management. NAEP 18th Annual Conference Proceedings. Raleigh, North Carolina: 113-124.

Harman, C. R. 1991. Environmental Liability Assessments of Former Gasoline Service Stations. *in* Proceedings of the Ninth Annual Hazardous Materials Management Conference/International. Atlantic City, New Jersey: 443-451.

Harman, C. R. 1986. Effects of Rural Development on Avian Community Structure. Southwest Texas State Univ. Master's Thesis, 57 pp.

Presentations

Harman, C.R. and C.P. D'Alleinne. 1994. Distribution of Mercury Residues in Domestic Chicken (Gallus domesticus) Samples Collected From a Hazardous Waste Site. Poster Presentation at the 15th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Denver, Colorado (ABSTRACT).

Harman, C.R. 1994. The Use of an Ecological Receptor Evaluation to Select a Remediation Strategy at a Hazardous Waste Site. Poster Presentation at the 15th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Denver, Colorado (ABSTRACT).

Harman, C.R. and T.J. Lusardi. 1994. Interrelationship of Sediments, Surface Water and Groundwater in a Connecticut Stream. Poster Presentation at the Ninth Annual Contaminated Soils Conference, University of Massachusetts, Amherst, Massachusetts (ABSTRACT).

Harman. C.R. 1994. The Use of Ecological Risk Assessments in Defining Remediation Approaches. Hudson/Delaware Chapter of the Society of Environmental Toxicology and Chemistry Annual Meeting, West Chester, Pennsylvania.

Harman, C.R. 1994. Designing a Good Ecological Sampling/Analysis Plan. Presentation at the New Jersey Water Pollution Control Association Tech Transfer Ecological Risk Assessment Seminar.

Schmitt, L.M. and C.R. Harman. 1994. The Use of Air Modeling in a Predictive Ecological Risk Assessment for a Hazardous Waste Incinerator. Poster Presentation at the 87th Annual Meeting of the Air & Waste Management Association, Cincinnati, Ohio (ABSTRACT).

Harman, C. R., C.P. D'Alleinne, P.J. Sheehan, and F.J. Dombrowski. 1993. The Use of a Predictive Ecological Risk Assessment in Support of a Hazardous Waste Incinerator Siting Permit. Poster Presentation at the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Houston, Texas (ABSTRACT).

Harman, C. R. 1993. A Review of the Natural Resource Damage Claims Case at the Asbestos Dump Superfund Site, Morris County, New Jersey. Discussion Poster Presentation at the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Houston, Texas (ABSTRACT).

Romaine, W. M. and C. R. Harman. 1993. Utilization of Diversity and Biotic Indices in Defense of Natural Resource Damage Claims. Poster Presentation at the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Houston, Texas (ABSTRACT).

Schmitt, L.M., C.R. Harman and C.P. D'Alleinne. 1993. The Consideration of Phytotoxicological Factors in Ecological Risk Assessments. Poster Presentation at the 14th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Houston, Texas (ABSTRACT).

Harman, C. R., W. M. Romaine and C. P. D'Alleinne. 1993. Wetlands Management at CERCLA Sites. Platform Presentation at the National Association of Environmental Professionals 18th Annual Conference, Raleigh, North Carolina.

Harman, C. R. and C. P. D'Alleinne. 1993. Trace Element Concentrations in Guinea Grass (Panicum maximum) Collected From a Hazardous Waste Site in Juncos, Puerto Rico. Poster Presentation at the ASTM Committee E-47 on Biological Effects and Environmental Fate Third Symposium on Environmental Toxicology and Risk Assessment, Atlanta, Georgia (ABSTRACT).

Harman, C. R. 1992. Ecological Risk Assessments, Concepts and Methodologies. Presentation to the Superfund Response Group, Mobile Oil Corporation, Princeton, New Jersey.

Keenan, R. K. and C. R. Harman. 1992. Ecological Risk Assessment in the 1990's. Presentation to the law firm Sidley & Austin, New York, New York and Chicago, Illinois.

Harman, C. R. 1992. Ecological Risk Assessments. Part of NJDEPE Proposed Cleanup Standards Seminar, Sponsored by McLaren/Hart Environmental Engineering Corporation and the law firm Herold and Haines, Warren, New Jersey.

Harman, C. R. 1991. Environmental Liability Assessments of Former Gasoline Service Stations. Platform Presentation at the Ninth Annual Hazardous Materials Management Conference/International, Atlantic City, New Jersey.

WILLIAM M. ROMAINE

Education:

M.A., Zoology, University of Vermont, Burlington, Vermont, 1983.
B.A., Biology and Political Science, Hamilton College, Clinton, N.Y. 1979.

Experience Summary:

As an associate toxicologist with ChemRisk, Mr. Romaine is responsible for technical oversite of projects involving ecological assessment of potentially contaminated sites. His experience includes evaluation of fauna and flora within an ecosystem through detailed field observation, chemical analysis of surface water, sediment and biotic tissue, and laboratory controlled acute and chronic toxicity testing. The results of these observations and analyses are then used to develop a human and wildlife risk assessment. Included in his expertise is four years experience in wetland assessment and delineation. In addition to the wetlands field experience gained while working with Professional Environmental Associates, Inc. and McLaren\Hart, Mr. Romaine acted as a liaison between the Division of Hazardous Site Mitigation and the Bureau of Freshwater Wetlands during his years with the New Jersey Department of Environmental Protection.

Selected project experience for Mr. Romaine includes:

McLaren\Hart, ChemRisk, Warren, NJ 1991-Present

- Assisted in the development of a work plan for an ecological risk assessment of the Bennington Landfill Superfund Site, and conducted all of the field work involved in implementing this work plan. Field investigations included a comprehensive inventory of all on-site and nearby off-site flora and fauna, benthic macroinvertebrate survey of on-site surface water bodies (including identification of individuals to genus or species), population studies of wetland flora and small mammals, and delineation and assessment of approximately 30 acres of wetlands on the 110 acre site.

- Developed a freshwater wetlands mitigation plan for the 43 acre Ewan Property Landfill Superfund Site. This plan included the creation of approximately one acre of forested and emergent wetland and the restoration of an additional acre of forested, scrub/shrub and emergent wetland which is to be disturbed during site remediation.

- Developed and implemented freshwater wetlands mitigation plans for two industrial facilities in central New Jersey. The mitigation plans included the restoration of approximately one-half acre of forested freshwater wetlands that were disturbed during ECRA mandated remediation activities.

- Acted as supervising scientist for numerous freshwater and tidal wetlands assessments conducted in New Jersey, New York, Mississippi, Vermont, Connecticut, Ohio, South Carolina and Pennsylvania. This included all field investigations and line placements as well as preparation of reports for submission to local, state and federal agencies. The field experience developed with McLaren/Hart has brought the total number of sites delineated and/or assessed for wetlands to approximately fifty, several of which were greater than 100 acres in size.

- Developed a Generic Environmental Impact Statement for two aquatic herbicides manufactured by two major U.S. chemical companies for the purpose of licensing the use of this product in New York State.

- Conducted a delineation and assessment of freshwater and estuarine wetlands on the 50 acre Sayreville Landfill Superfund Site. Of the 50 acres of land comprising the site, nearly 30 acres were delineated as wetland.

- Project Manager and field supervisor for the Ecological Risk Assessments for the Michigan and Ohio industrial facilities of a major international corporation. The Michigan facility is a listed superfund site.

- Project Manager and field supervisor for an ECRA (ISRA) investigation of the Jersey City, New Jersey facility of a major industrial company. This project included the supervision of all phases of the remedial investigation and feasibility study, including the development of a human health risk assessment for cadmium to be utilized for an alternate cleanup standard and a an assessment of on-site wetlands.

- Assisted in the development of a human health risk assessment for the Ohio facility of a major international corporation involved in an investigation by the Ohio Environmental Protection Agency.

- Conducted macroinvertebrate biodiversity and population density studies for use in litigation in support of National Gypsum, Inc. against the U.S. Fish and Wildlife Service. Also conducted these studies for use in an Ecological Assessment for the Portsmouth Naval Shipyard Facility in Kittery, Maine.

- Assisted in the collection, dissection and preparation of biotic tissue samples for the Ecological Assessment of the Chromite Ore Processing Residue Sites in New Jersey.

- Assisted in the design of sediment sampling procedures to be performed during the Ecological Assessment of the Chromite Ore Processing Residue Sites in New Jersey.

- Assisted in the collection and preparation of sediment and surface water samples for the Ecological Assessment of the Chromite Ore Processing Residue Sites in New Jersey.

New Jersey Department of Environmental Protection, Trenton, NJ 1989-1991

- Served as Research Scientist for the ECRA section of the Division of Hazardous Site Mitigation. Reviewed and revised hazardous site sampling and cleanup plans. Assisted in the design of cleanup plans with emphasis on innovative technologies.

- Acted as the liaison between the Division of Hazardous Site Mitigation and the Bureau of Freshwater Wetlands in cases involving potential impact to wetlands. Assisted in the design of alternative remediation techniques which would limit wetland disturbance.

- Assisted in the development of risk based cleanup levels to be used at all sites remediating hazardous materials spills.

- Developed guidelines for the use of solidification and stabilization as an innovative remediation techniques for hazardous waste sites.

- Evaluated Tier II laboratory data for QA/QC compliance.

Professional Environmental Associates, Inc., Rockaway, NJ 1987-1989

- Served as senior environmental scientist for all wetlands assessments and delineations. This included all field investigations and line placements as well as preparation of reports for submission to the New Jersey DEPE and the U.S. Army Corps of Engineers.

- Supervised all field operations and documentation for Environmental Impact Statements.

- Assisted in research involving the chronic effects of toxic metal contamination in Berry's Creek sediments on the fiddler crab (Uca minax).

<u>Publications and Presentations:</u>

Romaine, W.M. 1993. Utilization of Diversity and Biotic Indices in Defense of Natural Resource Damage Claims. Accepted for presentation at the 1993 meeting of the Society of Environmental Toxicology and Chemistry (SETAC) in Houston, Texas.

Harman, C. R., W. M. Romaine and C. P. D'Alleinne. 1993. Wetlands Management at CERCLA Sites. Presented at the National Association of Environmental Professionals 18th Annual Conference, Raleigh, North Carolina.

Romaine, W. M. 1980. Do Future Generations Have Standing? Department of Housing and Urban Development Hazardous Materials Symposium, Vermont Law School's Environmental Law Center, South Royalton, Vermont.

APPENDIX G

RESPONSES TO WRITTEN COMMENTS ON THE DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT

January 10, 1995
Version 5.0

RESPONSES TO WRITTEN COMMENTS ON THE DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT

Index

RESPONSES TO WRITTEN COMMENTS ON THE DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT

Index (Continued)

RESPONSES TO WRITTEN COMMENTS ON THE DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT

1. COMMENTS FROM: STATE OF NEW YORK DEPARTMENT OF HEALTH
ANTHONY J. GREY, PH.D.
CHIEF, TOXICOLOGICAL ASSESSMENT SECTION
BUREAU OF TOXIC SUBSTANCE ASSESSMENT
JUNE 16, 1994

Comment: Page 4-9 Fluridone Residue Tolerances for Water

The authors should also include a statement which acknowledges that the USEPA has not set a standard for fluridone in drinking water.

Response:

The GEIS notes that the USEPA has designated an acceptable residue level for fluridone in potable water of 0.15 ppm. This concentration is based on the maximum application rate for fluridone as registered under FIFRA.

Comment: Page 5-9, Table 5-2

The NOEL results in Table 5-2 should all be expressed in milligrams fluridone per kilogram body weight. In addition, the table should include footnotes which define abbreviations (ppm, mg/kg, micromole/ml, NOEL); these and other abbreviations should also be defined in the text of the document, the first time they are used.

Response:

The comment is noted and addressed in Table 5-2, page 5-9.

Comment: Page 5-10 and 5-11

The text at the top of page 5-10 gives the impression that Table 5-2 should be compared to Table 5-3. This should be revised to avoid inappropriate comparisons by the reader. Table 3 is a listing of <u>acute</u> toxicity values. The abbreviations mg/kg and LD_{50} should be defined in footnotes to Table 5-3.

Response:

The comment is noted and addressed on page 5-10.

Comment: Page 6-1 Overview of Fluridone Toxicity

The term "Category IV" for acute oral effects in the rat should be defined.

Response:

The toxicity categories are defined in 40 CFR § 156.10. The categories are assigned based on the method of application (ingestion, inhalation, etc.) and the response levels. Category IV is the category with the lowest toxic concern.

Comment: Page 6-1 NYS Drinking Water Standard

The statement "The drinking water standard established in New York State for all chemical compounds not specifically identified in the standards is 50 ppb" is incorrect. The drinking water standard established in New York State for any organic chemical contaminant not specifically identified in the standards is either 5 ppb or 50 ppb depending on chemical structure (see attached sections of regulations). Both fluridone and glyphosate do fall under the 50 ppb standard.

For clarification, it would be useful to indicate that, at the 50 ppb application rate, no restrictions are necessary on the use of SONAR beyond not allowing swimming for 24 hours and those on the federal label when referring to the Kim (1992) letter. It would be informative to also include the Kim (1992) recommendations regarding SONAR SRP formulation.

Response:

The comment is noted and addressed on page 6-1 and 6-2.

Comment: Page 9-3 to 9-5 Chemical Alternatives

Although the chemical alternatives to SONAR were reviewed by NYSDEC (1981), the authors should review and cite current USEPA fact sheets and/or drinking water advisory documents (or other more current reviews) to verify statements about health risks or relative toxicity. In addition, it would be very useful and informative if a table were included which compared toxicity values for the chemical alternatives to those in Tables 5-2 and 5-3 for fluridone.

Response:

As discussed in the scoping process for the GEIS, it is not the intention of this document to provide a complete and comprehensive evaluation of the chemical alternatives to fluridone. The intention of Section 9 was to compare, based on readily available information, the chemical alternatives to this product and their relative environmental actions. The evaluation of toxicity data, beyond what was developed for this section, is beyond the scope of this GEIS.

Comment: Page 12-1 Product Contaminants

Conclusions about the significance of low level contamination are provided with no documentation. The types of studies performed along with a brief presentation of results (a table would be helpful) which support the five conclusions should be included.

Response:

The conclusions for the statements in the document are supported by the referenced Federal Register release that states "No detectable residues of N-nitrosoglyphosate, a contaminant of glyphosate, are expected to be present in the commodities for which tolerances are established."

Comment: Page 12-5 to 12-10 Surfactant

The section addresses only the toxicity of the surfactant to aquatic organisms. A brief discussion of mammalian toxicity should be included, as well.

Response:

Surfactants do not fall under USEPA FIFRA requirements for registration, and therefore, the extensive testing required for pesticide active ingredients and end-use formulations is not required for registration. The aquatic toxicology discussion is supported by both Monsanto and third party studies. It would not be expected that the nature of the applications would cause unacceptable exposure to mammals.

Comment: Page 12-17 Glyphosate Residue Tolerances for Water

The New York State MCL for glyphosate in drinking water should also be provided in this section.

Response:

The appropriate standard for this chemical is the New York State drinking water standard of 50 ppb, as discussed. There is no New York State MCL value for glyphosate.

Comment: Pages 13-10 and 14-1 Mammalian Toxicity

The USEPA arrived at their "Category E" carcinogenicity classification after considerable review and debate. Since there may still be some uncertainty about the carcinogenic potential and it was previously in USEPA "Category C" (possible human carcinogen), some additional discussion is warranted. The authors could briefly mention this and refer the reader to the Federal Register article in Appendix D for a more detailed summary.

Response:

This is a completely subjective comment. Carcinogenicity ratings are periodically changed for pesticide active ingredients as updated toxicology studies are submitted to USEPA for evaluation. There is no information that uncertainty remains about the carcinogenic potential of glyphosate. The Federal Register article in Appendix D was included to provide historical perspective. The Department does not agree to include the comment as suggested by the NYSDOH in the GEIS.

Comment: Table 13-4 and 13-5

The tables of mammalian toxicity values for glyphosate provide only acute toxicity data. They should be expanded to provide subchronic and chronic toxicity values as was done in the fluridone section of the GEIS. In addition, footnotes should be added to the tables to define abbreviations such as LD_{50}, mg/kg, and FHSA.

Response:

Subchronic and chronic toxicity data is detailed in both the federal register notice (Appendix D) and more extensively in the "Glyphosate Toxicology Information Summary" also contained in Appendix D.

Comment: Pages 14-2 and 15-3 NYS Drinking Water Standard

See previous comment for page 6-1.

Response:

The comment is noted and addressed on page 14-2 and page 15-2.

Comment: Page 17-2 Chemical Alternatives

See comment for page 9-3.

Response:

As discussed in the scoping process for the GEIS, it is not the intention of this document to provide a complete and comprehensive evaluation of the chemical alternatives to fluridone. The intention of Section 9 was to compare, based on readily available information, the chemical alternatives to this product and their relative environmental actions. The evaluation of toxicity data, beyond what was developed for this section, is beyond the scope of this GEIS. Therefore, the authors this comment should be addressed in the document.

Comment: Appendix D Human Health Risk Assessment for Glyphosate

The screening risk assessment provides reasonable support for the conclusions in the GEIS regarding the potential public health impacts of the use of Rodeo/Accord aquatic herbicides in New York State. A similar assessment for fluridone and other chemical alternatives was not included in the GEIS. The document would be more informative and useful if such a comparative assessment were included rather than one dealing only with Rodeo.

Response:

The screening risk assessment was included in anticipation of potential human health concerns with the Rodeo/Accord® herbicides. However, this document is generally not a standard part of an EIS. This Appendix was a document that had already been prepared for a separate party/issue and was easily included in the GEIS. The development of a screening risk assessment for the Sonar® products would be costly and time consuming. Additionally, human health concerns have been previously addressed by the NYSDOH (See Kim, 1992 in the GEIS). The Department reminds the NYSDOH that the results of the scoping process for this GEIS were that health issues would be summarized in general and not presented in detail. That was an issue that had already been addressed in the registration process for both pesticides. For this reason, the Department did not require the development of a screening risk assessment for the Sonar® products for this GEIS.

2. COMMENTS FROM: ADIRONDACK PARK AGENCY
RICHARD D. JARVIS; SUPERVISING ADIRONDACK PARK PROJECT REVIEW SPECIALIST
JUNE 6, 1994

Comment: 1.3.

Add all special instructions for the SLN supplemental labeling for SONAR A.S.

Response:

Special instruction for the SLN supplemental labeling for Sonar® A.S. are listed on page 1-2.

Comment: 2.1.

What is the minimum concentration of the fluridone and minimum time duration for efficacious control of target species?

Response:

As described in Section 4.4, Mode of Action/Efficacy, the minimum concentration at which control of target species have been observed in field applications in Michigan is 8 ppb. That section also notes that the time for Eurasian water milfoil to drop out of the water column is 30 to 90 days.

Comment: 2.1.1. first paragraph.

Add that submergent aquatic macrophytes also perform valued functions (see section 3.2).

Response:

The comment is noted and addressed.

Comment: 2.1.2.

Water chestnut, Trapa natans, is another nuisance, non-native plant found in NYS. It is not listed on either plants controlled or non-controlled by SONAR SLP. Provide any known information.

Response:

The GEIS was written specifically to address those target species listed on the Sonar® SRP label and the Sonar® A.S. SLN label. Water chestnut, Trapa natans, is not listed as a target species on those labels.

Comment: 2.1.3. first paragraph. last sentence.

Is the correct controlling concentration 8ppm or 8ppb? What was the duration of time at that concentration to achieve control?

Response:

The concentration should read 8 ppb and has been corrected. Pullman (1993) reported that in applications in Michigan, the time for Eurasian watermilfoil to drop out of the water column was approximately six to eight weeks.

Comment: 2.1.3, second paragraph.

What is the size of BCMELP, how much acreage of lakes and dense milfoil?

Response:

The BCMELP (1991) notes that approximately 1000 hectares of shoreline are infested with Eurasian watermilfoil. It does not reference the density of that infestation. There is also no documentation of the total acreage of lakes in the study area (Okanagan Valley). The report does note that the study area includes seven mainstream lakes and one upper elevation lake. Clarification of this information has been included in the document.

Comment: 3.1, second paragraph.

Change 16,700 acres to miles of significance fishing streams.

Response:

The comment is noted and addressed.

Comment: 3.1, last paragraph, second and third sentences.

For more accurate characteristics of Adirondack lakes, refer to enclosure B which are two summary tables from the Adirondack Lakes Survey Corporation Summary Report, dated February 1, 1989.

Response:

The comment is noted and addressed.

Comment: 3.2, pp 3-2-3, description of lentic systems.

This appears to be an oversimplification of lake ecology and succession or trophic status. We suggest consulting and summarizing "Diet For a Small Lake, (Enclosure C)" chapter 2, especially page 2-17.

Response:

It is not the purpose of the GEIS to be encyclopedic in the description of aquatic systems. As the comments of two aquatic scientists, G. Douglas Pullman, Ph.D. of Aquest Corporation and Charles Boylen, Ph.D. of the Rensselaer Fresh Water Institute have been incorporated into the draft GEIS, the Department sees no purpose in rewriting this section. However, a sentence directing readers of the GEIS to "Diet For a Small Lake" has been added.

Comment: 3.2.1, page 3-5.

Include Smith et al (1991) definition of "intermediate levels of plant biomass." As a general note, it would be helpful to define and use throughout the document consistent terms for plant density if possible.

Response:

Smith et al. (1991) do not define what they consider to be an intermediate level of plant biomass.

Comment: 3.3.1, p. 3-8, first paragraph.

It would be most helpful to know the water temperature and range of dates in NYS or other northern states when Eurasian watermilfoil (milfoil) begins growth and when other native macrophytes begin growth. Enclosure D is two scientific papers by Charles W. Boylen and Richard B. Sheldon and John D. Madsen and Charles W. Boylen that provided seasonal growth and photosynthetic rate data for macrophytes in Lake George. This information is so important to the author's recommendation for the timing of application to achieve selective control.

Response:

The GEIS notes that Eurasian watermilfoil begins growth as the water temperature reaches 15° C. That is a figure that is given for lakes in the northern U.S., though variations can occur as a result of climate, water clarity and rooting depth. The range of dates is not available. The work by Boylen and Sheldon (1976) is addressed in the GEIS.

Comment: 3.5.1.

As noted above, it would be helpful to have a common definition of plant density, sparse to dense.

Response:

The comment is noted. No definition common to all of the authors is available.

Comment: 3.5.1, p. 3-14.

Madsen et al (1991) noted a decline in native species in a bay; what were the other observations on other milfoil sites in Lake George? Did the ponds in Honnel et al (1992) study include northern lakes, or were they all in Texas?

Response:

The paper cited in the GEIS (Madsen et al., 1991) only evaluated the decline of native vegetation under Eurasian watermilfoil canopies at one location. The ponds in the Honnel report were located in Texas.

Comment: 3.6.

We suggest making reference to "Diet for a Small Lake," chapter 5, or other literature on how to develop lake management objectives. Additional discussion should mention the need to maintain the values and functions of wetlands, and that various areas of lake's surface water can be managed for different uses, that lakes and ponds uninfested with exotic plant species should prevent introductions to the extent possible, and that annual monitoring of aquatic plants should be established. Management of nuisance aquatic plants must consider the whole lake ecosystem and it is treating a symptom, not the cause of the perceived water problem.

Response:

The comment is noted. A reference to "Diet for a Small Lake" has been included.

Comment: 4.4.

What duration of contact of the minimum concentration was needed for control? It would be most helpful to have a chart which summarizes the key factors of all treatments discussed, including, whole or partial lake treatment, size of the water body, area of treatment, date and water temperature of treatment, target species, rate of application and duration of contact period, efficacy of treatment, non-target impacts, source of information, and comments.

Response:

Pullman (1993) reported that in applications in Michigan, the time for Eurasian watermilfoil to drop out of the water column was approximately six to eight weeks. Section 4.4 also discusses the time that it takes for Eurasian watermilfoil to drop out of the water column.

Comment: 4.5.

Add that SONAR cannot be used with 1320 feet of any functioning potable water intake and comply with all other federal and state approved label requirements. Also add that treatment areas should be a minimum of five acres in size.

Response:

The comment concerning the distance from the potable water intake and compliance with approved label requirements has been included. The size of the treatment area is dependent on the size of the water body. The size of the treatment area is more accurately noted as being the entire water body for water bodies five acres or less, and a minimum of five acres in size in water bodies larger than five acres. This discussion is presented in Section 4.5.5.

Comment: 4.5.1.

Same comments as for section 3.3.1

Response:

The comment is noted and the response is the same as that to Section 3.3.1.

Comment: 4.5.2.

What is considered sufficient water movement to require use of higher application rates? This is a critical issue since the concentration is a key factor in selectivity of plant control. Should the concentration be monitored during the "extended period of contact" and are supplemented or second application necessary or recommended in the same treatment? To get selectivity for partial or spot treatment, is it best to use a low rate and monitor, being prepared to do a second treatment? A good bathmetry map should be prepared.

Response:

There is no defined value that is set for "sufficient water movement". Such a value would have to be defined during the development of a permit application for a particular site. Monitoring and the development of a bathymetric map would also be site and permit dependent.

Comment: 4.5.4.

If known, add to table 4-1 the concentration of SONAR that each plant is susceptible to control or partial control (also see section 2.3.2 and table 3-1).

Response:

These concentrations are not specifically known. For purposes of this GEIS they are the permissible concentrations of the product in NYS waters.

Comment: 4.5.5.

There should be more discussion of factors that could cause dilution and ineffective treatment. During the early spring growing season, there is often significant snow melt as well as precipitation. In larger lakes, the seiche water movements could cause significant dilution. How should treatments be timed in relation to thermoclines and spring water mixing? Is the shape or configuration of the treatment area a factor to be considered? In studies in Lake George, there was a high correlation between the presence of milfoil and inflowing streams which creates water movement.

Response:

The Department does not agree that more discussion on dilution is warranted in this document. As discussed in Section 4.5.5, the use of Sonar® in areas of water movement may not be appropriate. Timing of application should be maintained as early in the growing season as possible. The myriad of potential site-specific concerns that could result in the dilution of the applied product should be considered in the development of a permit for a specific water body.

Comment: 4.8.1.

For the West et al (1993) report, what was the initial treatment rate for each average concentration?

Response:

The Department believes that the reference in question is West et al. (1983). Initial application rates ranged from 0.84 kg/ha to 2.24 kg/ha.

Comment: 4.8.4.

Define the terms edible and inedible fish tissues and what methods were used to prepare fish tissues for analysis? Muir et al (1980) reported a residue concentration of 0.17ppm of fluridone in a fathead minnow following exposure to 0.070 ppb; this demonstrates significant bioconcentration if the units are correct and should be further discussed.

Response:

The term edible fish tissue refers to the filets. The term inedible fish tissue refers to the viscera. The residue concentration should have been noted in the GEIS as 0.17 ppb, as opposed to 0.17 ppm. This has been corrected in the document.

Comment: 4.8.6.

Discuss results of any available studies of fish eating mammals or birds that consume fluridone contaminated fish or herbivorous animals that consume fluridone contaminated aquatic vegetation.

Response:

No information is available. However, based on the low bioaccumulation rates reported in fish and plants and the high levels of fluridone necessary to produce a toxic response in mammals and birds, it is not expected that piscivorous or herbivorous animals would be impacted by the use of fluridone at the registered application rates.

Comment: 4.9.

If known, report tolerance limits of fluridone for other wildlife species.

Response:

No other information is available.

Comment: Table 5-1 and 5.1.1 on page 5-5.

If available, provide i) specific timing of the application (water temperature and dates), ii) initial applied concentration of fluridone for selective control of milfoil, iii) range of sizes of the lakes, and iv) what formulation used? Did algae, water stargrass, Robin's pondweed, Bladderwort, and Curlyleaf and Sago pondweed plants replace milfoil as nuisance species (see section 5.4)? What was the density of Eurasian milfoil? How many lake treatments were summarized by this table?

Response:

All application took place early in the growing season, at application rates ranging from 8 ppb to 29 ppb. More information is not available. Pullman (1993) notes that the production of native plant species is quickly reestablished within one growing season, replacing Eurasian watermilfoil as the dominant species.

Comment: 5.1.1, page 5-5, third paragraph.

What was SONAR concentration, 8ppb? Were these whole or partial lake treatments and what formulation and timing was used?

Response:

The concentration should read 8 ppb. The treatments were whole lake treatments and application took place between April 10 and July 5, 1992. All treatments were conducted in April and May, except the one in July.

Comment: 5.1.1, page 5-5-6, last paragraph.

How many successive yearly treatments, at what concentrations, were the 21 lake subject to in Kenaga report? Was the successive yearly treatment necessary because the first year of treatment for the target species was unsuccessful? Is the final report now available?

Response:

Of the 21 treatments conducted in 1992 that were evaluated in the Kenaga report, two were in lakes that had been treated in 1991 with Sonar®. In both lakes, the target species was curlyleaf pondweed. Kenaga noted that the development of turions in curlyleaf pondweed necessitated the second year application. The final report is not available.

Comment: 5.1.2.

Provide full citation for Hinkle, (1985) in section 18.0. Is this the only supporting data that Nitella is not controlled by SONAR as listed on the SRP label? Enclosure E is a paper by R.G. Stross and C.A. Burkhart which indicates nitella is sensitive to fluridone. It would be important to separate data on northern and southern US lakes for response to algal and planktonic species.

Response:

It is important to note that the work conducted by Stross and Burkhart was with fluridone concentrations of 100 ppb. That concentration exceeds the labeled application rates in New York State of 50 ppb, and far exceeds the concentration of fluridone found to be efficacious in the control of Eurasian watermilfoil (8 ppb to 29 ppb) in lakes in Michigan. As the Sonar® SRP label states, Nitella is not effected by fluridone at the labeled concentrations. Pullman (1993) and Kenaga (1992) note that Chara populations are not impacted by the use of fluridone, and tend to increase with its use.

Comment: 5.1.7.

Add that a qualified aquatic plant biologist should complete a plant survey of the proposed treatment area and adjacent area.

Response:

The Department does not agree with the inclusion of the statement "qualified aquatic plant biologist". The Department is not aware of an certification program for aquatic plant biologists. This is too open a comment, that could lead to confusion over the qualifications of aquatic plant biologists. Additionally, the plant survey issue arises out of the Part 327 regulations, which do not specify the use of a "qualified aquatic plant biologist".

Comment: 5.3.

Add a paragraph to discuss the impact of fluridone in the hydrosoil, including impact to benthic organisms. It should also be acknowledged that the half life of SLP is not known. Refer to sections 4.8.1 and 4.8.2.

Response:

The addition of a paragraph on the impact of fluridone to the hydrosoil is not constant with the structure of the GEIS. Sections 4.8.1 and 4.8.2 present detailed discussions on the fate of fluridone in the sediment layer of the aquatic ecosystem. The half lives of fluridone in sediment is based on the evaluation of pelleted formulation. There is no information available in the impacts to benthic organisms.

Comment: 5.4.

Define what is "low-level application rates of SONAR." This general discussion should be expanded to discuss i) whether successive repeat treatments are required and what their impact is (see 5.1.1, Kenaga), ii) what recolonizes where monotypic stand of milfoil is controlled, and iii) does milfoil recolonize where non-target native plants were also controlled?

It would be helpful to have a paragraph to discuss selective treatments that were not successful and why (example see Kenaga draft report).

Response:

Low-level application rates would range from 8 ppb to 29 ppb, based on Pullman (1993). Section 5.4 discusses the recolonization of areas treated with fluridone to the extent necessary for the purposes of this GEIS. Kenaga did not fully discuss successive treatments and their impacts. The follow up portion to Kenaga's study, which is the evaluation of the plant communities the year after treatment, is not available. Because of the sensitivity of Eurasian watermilfoil to fluridone, it is logical to assume that milfoil will not recolonize where non-target native plants have been impacted. The reason is that milfoil will have been removed from the system. Selective treatments were not part of Kenaga's study.

Comment: 5.5.

Is treatment permitted with the SRP label which states under "Environmental Hazards: Do not apply in tidewater/brackish water."? Perhaps clarify use only in freshwater coastal area.

Response:

The comment is noted and addressed.

Comment: 6.0.

It would be helpful to expand discussion i) on the prohibition of treating waters less than two feet in depth, ii) the limitation on no swimming in treated waters for 24 hours after application, and iii) why a restriction on SONAR use where potable water intakes are in water bodies less than 10 acres in size does not apply.

Response:

The prohibitions discussed here are requirements that were negotiated with the NYSDEC during the registration process. The specifics of this restriction were negotiated based on concerns raised by the Department and the DOH. The reason that the 1/4 mile restriction on SONAR use in water bodies less than 10 acres in size does not apply is that this is a practical understanding that the 1/4 mile restriction probably could not be met in a water body 10 acres or less in size.

Comment: 7.1.

It would greatly enhance the utility of this document if more specific recommendations can be included as to factors in NYS that can guide the application in the "early growing season" to achieve selective control of milfoil. Further suggestions as to how to determine water depths, a drawing(s) to explain epilimnion and metalimnion, and utility of field marking treatment areas and water depth treatment zones to better control the correct application rate. Finally, there should be a paragraph to discuss the potential wide range of treatment concentrations allowable under the label, and still be able to control milfoil, eg. between 8 to 50 ppb. It should be emphasized that milfoil is sensitive to fluridone and is controlled effectively at the lower concentrations, and that the lower concentrations better ensures selective control. Where partial lake treatments are used, reiterate the importance of sediment, water depth and movement, and minimum five acre area as factors to incorporate in control plan.

Response:

There are a variety of factors that will control the timing of application in the "early growing season". Primarily, an understanding of the aquatic macrophyte community in a water body would be necessary to evaluate the period of time after Eurasian watermilfoil would begin vegetative production, but before the remaining plant had initiated growth. This would be determined by direct observation, possibly supported by water temperature measurements following the melting of ice in the water body.

While the Department does not believe that a drawing is necessary, as stated in Smith (1980), "The freely circulating surface water, with a small but variable temperature gradient is the epilimnion. Below this is the barrier, the metalimnion, a zone characterized by a steep and rapid decline in temperature. Within the metalimnion is the thermocline, the plane at which the temperature drops most rapidly (- 1° C for each meter of depth). Below these two layers is the hypolimnion, a deep, cold layer, in which the temperature drop is gentle."

The GEIS already notes that there is a wide range of concentrations allowable under the label that will control Eurasian watermilfoil. The choice of a particular concentration would be dependent on the considerations and objectives of a water management plan, as supported by the information presented in the GEIS. Milfoil is sensitive to fluridone and is controlled effectively at the lower concentrations and lower concentrations better ensure selective control. Where partial lake treatments are used, the importance of sediment characterization, water depth and water movement determination, and a minimum of five acre areas are factors to incorporate into a control plan.

<u>**Comment: 7.2.**</u>

Add the 24 hour swimming restriction, and clarify #6 what water depths "shallow areas" is defined as and that SRP formulation cannot be applied to waters less than two feet in depth. In general direction #2, add that the restriction of use within 1/4 mile of functioning potable water intake also applies to the SRP formulation.

Response:

The subject of Section 7.2 is the label instructions. The information requested in this comment is presented in Section 7.4.

Comment: 7.4.

As discussed in the introduction to this comment letter, use of SONAR within any jurisdictional wetland in the Adirondack Park is a regulated activity requiring a wetland permit from the APA pursuant to 9 NYCRR Part 578. The Agency's permit application requests similar information as DEC, however additional details on the identification of all plant species including rare or endangered and their relative density within the treatment area will be necessary.

Response:

The comment is noted and addressed.

Comment: 7.5.

If available, provide as an appendix the Material Safety Data Sheet similar to what was provided for Rodeo in Appendix D. Provide additional information the manufacturer would advise in case of endangering health or environment from use of the product by calling 517-636-4400.

Response:

This comment is noted and addressed. The contact number will provide directions as to any additional information that would be required in such a situation.

Comment: 7.6.1.

Add more specific advice on "optimum time" of application for selective control of milfoil, if available. What is the window of time between start of growth of milfoil and pondweeds? Are there different recommendations on timing between whole and partial waterbody treatments and waterbodies with water movement?

Response:

There is no specific "optimum time" of application available. There are no different recommendations for whole and partial waterbody treatments.

Comment: 7.6.2.

Should SONAR concentrations be monitored, if so, what is a good method? Is it advisable to mark treatment area with buoys to aid application of boundaries and water depths? Reiterate the minimum treatment area and shape considerations. Choosing and properly applying the treatment concentration is a critical factor to selective control.

Response:

It is not considered that the monitoring of Sonar® concentrations in water following application is necessary. However, if an applicator wished to do so, then standard chemical analysis at a laboratory able to conduct the appropriate tests would be required to determine the concentrations. In certain circumstances, it may be appropriate to mark a treatment area with buoys, particularly in partial lake treatments. However, it is not considered that marking will be necessary on a routine basis. The minimum treatment area is described in Section 7.0 of the GEIS. Choosing and properly applying the treatment concentration is a critical factor to selective control.

Comment: 7.6.

Add separate sections on protection of rare and endangered plants, providing notice to water uses of swimming and irrigation or other use restrictions of treated water, and desirability of replanting controlled areas with desirable native macrophytes.

Response:

The issue of rare and endangered plants has been adequately addressed in the GEIS and would be part of any site-specific evaluation in the development of a permit application. The providing of notices is regulatory decision and is beyond the scope of this GEIS. While replanting could possibly enhance the revegetation of an area following the treatment with Sonar®; however, replanting is not necessary as native plants will successfully reestablish themselves once Eurasian watermilfoil has been removed from the aquatic community.

Comment: 8.0.

Can "rapid water movement" and minimum contact time be further defined? Shouldn't water movement be measured as part of the application and before treatment to determine if use of SONAR is the proper means of control?

Response:

The term "rapid water movement" applies to stream situations as described on the NYS approved labels. That would include site that obviously and apparently are subjected to moving water such as where creeks or streams enter a lake. In general, water movement should be evaluated as part of a site-specific permit application. If water movement does not allow for minimum contact time with the target macrophyte, then the efficacy of the product could be affected. In those situations, a different approach in the treatment of the nuisance aquatic vegetation may be required.

Comment: 9.1.

Add information on European aquatic moth in Cayuga Lake (Enclosure F).

Response:

The comment is noted and addressed.

Comment: 9.2.

Provide average cost per acre for SONAR treatment for comparison to other methods noted. The current DEC Water use restrictions for the other aquatic herbicides should be added to text.

Response:

The comment is noted and addressed.

Comment: 9.3.

Add that there are alternatives probably more suitable for small areas of milfoil or other target plants (less than five acres for partial treatment) and areas having significant water movement.

Response:

The comment is noted and addressed.

Comment: 9.4.

The last sentence of this paragraph could be misleading and misinterpreted; we suggest deleting it. It would be better to refer reader to "Diet of a Small Lake" since IPM for lake management cannot be fairly summarized in one paragraph. IPM is a good long term management approach to the complex problems of lake management. In-lake and watershed management techniques are needed for the health of a lake ecosystem. Aquatic plants are a key component in a dynamic ecosystem. Acknowledge that good organization and planning for a multi-year effort is necessary, and proper professional and financial resources are required. Efforts to educate the public and to control fragments transport are also important.

Response:

The comment is noted and addressed.

Comment: 9.5, third paragraph.

Add that information on sediment type and water movements should also be gathered. Substitute the word density for "nature" of the infestation in the first sentence. Other important considerations are the lake management objectives and criteria for permit under the NYS Freshwater Wetlands Act.

Response:

The comment is noted and addressed.

Comment: 9.5, page 9-13, third paragraph.

Is dilution of the other herbicides not a problem due to their quick action? Key to mention that other herbicides may not be selective in plants controlled. What about comparison with glyphosate?

Response:

Dilution is not a problem with other herbicides due to their fast action. No comparison to glyphosate is necessary as the target species and aquatic systems in which they are use are different.

Comment: 10.3.4.

"Marginal Plants" include species commonly listed as wetland species found in shrub and forested wetland covertypes and in areas subject to flooding and have free interchanged with open water.

Response:

The comment is noted and addressed.

Comment: 11.1.

See comments on section 3.1.

Response:

The comment is noted and addressed.

Comment: 11.6.

There needs to be some additional discussion on the herbicide use for forestry and utility sites and rights of way in wetlands (see section 10.1.1). In drainage ditches, there should be recognition that emergent wetland vegetation seems to help filter and trap eroded soil and debris before it enters other water bodies. Storm water management for healthy lakes includes protection of wetlands in the watershed. Some of these wetland functions could be supplemented or replaced by sediment basins (per SCS guidelines) in drainage ditches where it is desirable to control excessive plant growth (this should be also discussed in section 17.3).

Response:

The Department does not agree that additional discussion is necessary for forestry and utility uses. The objective of the GEIS is to evaluate these herbicides for aquatic application and the requested information is beyond the scope of this document. The Department notes the latter portion of the comment dealing with storm water management. However, there is no response applicable.

Comment: 12.2, second paragraph, last sentence.

typographical error, non-crop sites.

Response:

The comment is noted and addressed.

Comment: 12.5.3 and 13.1.1.

There is a need to discuss details of the risks of herbicide drift from aerial application. What is the ability of nozzle type and drift control agents to contain the control swath? What buffers to non-target areas should be provided for. The "Pesticides Application Training Manual - Category 11 - Aerial Application" can provide some details.

Response:

The Department disagrees with the need to discuss herbicide drift. In the first place, aerial application is not anticipated with the use of this herbicide in NYS. Secondly, the large complexities of all the different parameters associated with this subject are beyond the scope of this document. In the rare instances where drift mitigation measures must be addressed, then the appropriate place for that discussion is the site specific permit application.

Comment: 12.7.

The draft acknowledges some of the potential environmental toxicity effects of various substances. Perhaps here or in section 14.0, the potential health concerns of surfactants should be discussed. Enclosure G raises concern over nonylphenol polyethoxylate (NPEO) found in X-77 product.

Response:

A detailed discussion of the toxicological effects of the surfactants is presented in Section 12.7. The Department feels that the subject is adequately addressed for the scope of the GEIS and nothing further needs to be included.

Comment: 12.8.

The draft does not mention or discuss another metabolite of glyphosate, formaldehyde, as noted in enclosure H. On page 12-11, second paragraph, it is difficult to follow how the maximum concentration of glyphosate in water is less than 0.1ppm.

Response:

The formation of formaldehyde from glyphosate has never been demonstrated. Based on labelled application rates and standard assumptions regarding water movement and dissipation, 0.1 ppm or less of glyphosate in water is the maximum expected concentration.

Comment: 14.2.

What was the cause of the rapid "reduction" of Rodeo in water, degradation, dilution or both, in the Danhouse study?

Response:

The cause of rapid glyphosate reduction was both dilution in the water column and adsorption to organic matter.

Comment: 15.1.

Shouldn't it be added to use a surfactant that has lower toxicity per table 12-3? It should be reiterated the previous recommendation to control drift, replant control area with native plants, and to use selective application methods where feasible.

Response:

This subject is addressed, as previously mentioned, in Section 12.7.

Comment: 15.4.

See comments in section 7.4 regarding the Agency's regulated activities in wetlands. Also, the NYS public utilities use of herbicides in utility rights of way are regulated by the Public Service Commission (PSC) and 16 NYCRR Part 84. In 1988, PSC Case 27605 resulted in limitations on aerial spraying, use of no herbicide spray buffers to wetlands and streams, and use of various methods of applications within the Adirondack Park.

Response:

The comment is noted.

Comment: 17.0.

See comments in section 9.0. This section should be expanded to discuss alternatives to herbicides in utility right of way and forestry; contact the PSC and the Empire State Electric Energy Research Corporation.

Response:

As previously mentioned, the Department does not agree that additional discussion is necessary for forestry and utility uses. The objective of the GEIS is to evaluate these herbicides for aquatic application and the requested information is beyond the scope of this document.

Comment: 17.4.

Mention that after control of target plant, desirable native plants should be replanted (see 13.4). In utility right of way, selective cutting to favor low growing plants is a good long term control option.

Response:

The Department wishes to note that planting should only be conducted if there is no viable seed base for restoration of the vegetative community following application, or if erosion is a concern. If planting is necessary, then native plants should be used.

3. COMMENTS FROM: LAKE GEORGE PARK COMMISSION MICHAEL P. WHITE; EXECUTIVE DIRECTOR JUNE 3, 1994

General Response to the Comments From Mr. White

The GEIS is intended to provide potential users with a general understanding of the various results that might be associated with the use of Sonar® and the Rodeo®/Accord® herbicides in the waters of the State of New York. By developing this GEIS, the Applicants have provided the information necessary for individual potential applicators to easily develop the necessary permit applications. It is not intended to be encyclopedic in nature. The document has gone through numerous iterations and revisions and has been reviewed by both the NYSDEC and the Rensselaer Fresh Water Institute, who have found the detail of the document to be sufficient for its need. The great majority of the following comments would be determined in a permit application for a specific site.

1. Comment:

Generally, to be effective for the use intended, the GEIS should include a much more detailed statement of need. This should include a description of the specific conditions of Eurasian Watermilfoil colonization of a waterbody which will identify the need for Sonar® treatment and the specific regulatory criteria which will form the basis for permit decisions under the program.

Response:

The statement of need is described in Section 2.1.2 of the document. Any further information beyond that would be included in a specific site permit application. The specific condition of Eurasian watermilfoil in a waterbody would be included in that permit application. The regulatory criteria for the development of a permit for the use of Sonar® are listed in Section 1.0 and Section 7.0.

2. Comment:

What is the description of the problem that Sonar® will be used to address? Specifically, the DGEIS at 3.31 touches upon the "opportunistic ecological behavior" of Eurasian Watermilfoil and its effect. Are lake plant community and deep water marsh plant community functions negatively impacted by Eurasian Watermilfoil? Specifically, how? At what point in Eurasian Watermilfoil colonization are negative impacts measurable? Are they inevitable? Do ultimate impacts warrant control before nuisance conditions are reached?

Response:

The problem that Sonar® would address is discussed in Section 2.1.1 and in Section 3.6. As discussed in Sections 3.3 and 9.1, lake plant communities and deep water marsh plant communities can be negatively impacted by Eurasian watermilfoil. The point at which the negative impacts are measurable depends on whether the waterbody circumstances and would be determined in a permit application. Are they inevitable depends on the waterbody characteristics. The timing for control would depend on the circumstances and needs as stated in the permit application.

3. Comment:

The DGEIS states that New York State has over 3.5 million acres covered by some type of surface water system. What kinds of waterbodies are suitable for Sonar® treatments? Are there waterbodies which due to their type, size, use, characteristics, classification or jurisdiction will be excluded? If so, what are the criteria for determining exclusion/inclusion? How are these criteria determined?

Response:

Sonar® could be potentially utilized in any waterbody, taking into account the considerations specified in Section 4.4, 4.5, and 7.0.

4. Comment:

Will the use of Sonar® to control Eurasian Watermilfoil in open water areas require a separate permit under the Freshwater Wetlands Act? Under what conditions? Will mutual jurisdiction occur within the Adirondack Park and without? How will the regulatory requirements of the separate programs be integrated? How will regulatory procedures of joint DEC and APA jurisdiction be integrated?

Response:

As recently noted by the Department, open water areas and deep water habitats are not wetland areas and as such, there is no need for a wetlands permit for those areas. Further clarification on this issue would have to be addressed through the Department's Division of Regulatory Affairs. The requirements for coordination with the APA are noted in Sections 1.0 and 7.0. Further requirements would be addressed during the development of a permit application for a specific site.

5. Comment:

Section 4.8 identifies N-methylformamide as a photolytic breakdown product of Sonar®. This section should be expanded and should include conclusions. Is NMF present in the environment following Sonar® treatment? What degree of statistical confidence can be assigned this conclusion? What are the public health concerns, if any, which result from these conditions?

Response:

The issue of NMF has been well documented in the literature and in the GEIS. NMF has never been found in the natural environment following the application of Sonar® and is not considered to be a health issue. The NYSDOH has not raised an issue with NMF and has supported the registration of Sonar®, under the use constraints discussed in Sections 6.0 and 7.0.

6. Comment:

The DGEIS lists several studies on potential impacts from reduced populations of Eurasian Watermilfoil (from treatment) on fish populations. However, the section lacks any conclusions. This discussion should be expanded to include a more detailed abstract of the studies reported and a presentation of conclusions which may be drawn. These conclusions should be set in the context of regulatory decisions which will be made under the GEIS. As an example, does Eurasian Watermilfoil negatively or positively impact fish populations? Which species? Are the positive or negative impacts important for the eco-system? For fishing? When would fish or fishing impacts take precedence over other human or ecological impacts in rendering decisions on Sonar® applications?

Response:

The DGEIS presents a thorough discussion on the potential for impacts to fishery resources from Eurasian watermilfoil and from the application of Sonar®. In general, and as described in the DGEIS, once Eurasian watermilfoil reaches a level within a water body such that it is dominating the aquatic macrophyte community, fishery resources can be negatively impacted. This is particularly true with predaceous fish, though herbivorous species can also be impacted. Because of the predator-prey relationships within an ecosystem, as well as other natural habitat balances, the alteration of a component of the ecosystem through the introduction of a rapidly growing nuisance species such as Eurasian watermilfoil could have a significant negative impact on the health of the ecosystem and the use of the fisheries resource within that system. The determination of the precedence of fishing impacts over human or ecological impacts would be made based on the management objectives for a particular water body.

7. Comment:

Recolonization is discussed only briefly in Section 5.4. This section should be expanded to include a discussion of long term effects following Sonar® treatment. When has Eurasian Watermilfoil returned following treatment? Has Eurasian Watermilfoil extent coverage and density been compared to pre-treatment conditions? If so, what is the result?

Response:

As discussed in Sections 4.0, 5.0 and 8.0, Sonar® has little in the way of long-term effects. The product dissipates from the environment and is not bioaccumulative. Ecologically, it is highly selective to Eurasian watermilfoil, which is controlled for several years since this species reproduces vegetatively. Other non-target species largely reproduce by seeds and spores and have been shown to have varying degrees of sensitivity to fluridone. Most emergent species are tolerant to fluridone and exhibit little or no effect following treatment. Even susceptible submersed non-target species typically reestablish within one growing season of application. Numerous post-treatment studies have documented native recolonization and long-term Eurasian watermilfoil control. Examples of some of these lakes include: Long Lake, Washington; Lake Shinanguag, Michigan; Wolverine Lake, Michigan; Lobdell Lake, Michigan; and Barnes Lake, Michigan.

8. Comment:

Section 6.2 reports "Sonar® cannot be applied within one-fourth mile (1,320 feet) from any functioning potable water intake. Lake areas subject to Eurasian Watermilfoil tend to be rural in character with many seasonal residents relying on lakes for water intakes. This section needs to be expanded to include a much more complete and concise description of the regulatory criteria to be applied in decisions on Sonar®. Specifically, the statement needs to detail what types of water intakes are effected. Are there alternatives such as suspension of use? Can alternate water be provided for drinking and cooking temporarily? If so, when can use resume? Are unauthorized private water intakes considered functioning potable water intakes? Can use of such be voluntarily suspended to allow Sonar® treatment? If so, when may use resume? Will permittees be required to supply alternative drinking water, water for bathing, cooking? Under what circumstances? For how long?

Response:

All of the information requested in this comment would be addressed in a site-specific permit application. It is noted that the labels for Sonar® note that the product is prohibited from use within 1/4 mile of a functioning potable water intake. Any application proposed would currently require a revised SLN label. Existing potable water intake which have been disconnected and are no longer in use, such as those replaced by connections to potable water wells or a municipal water system, are not considered to be functioning potable water intakes.

9. Comment:

The DGEIS does not address the potential impact of Sonar® treatment on adjacent terrestrial vegetation. Will trees and shrubs along treatment areas be affected? To what degree? Will adjacent emergent and terrestrial wetlands be affected? Is there any reason that these should be protected by installation of physical barriers to water movement?

Response:

Sonar® is not expected to impact terrestrial vegetation. In studies conducted in Michigan, only partial chlorosis in some species of bank vegetation was observed following lake applications. Emergent and terrestrial vegetation are not considered as target macrophytes. A discussion of non-target macrophyte impacts is presented in Section 5.1.1.

10. Comment:

Section 4.5.5 contains an insufficient presentation of the relationship between water circulation, water flows and regulatory criteria which will be applied to proposed Sonar® applications.

Response:

The information in Section 4.5.5 is sufficient to support the preparation of a permit application which would develop more detailed information in this subject.

11. Comment:

Under what specific conditions is water circulation a factor in approving or denying Sonar® permits? Are offsite impacts a concern? Is efficiency a function of water flow? In open water lake treatments will circulation affect contact time and effective treatment?

Response:

In general, water movement should be evaluated as part of a site-specific permit application. If water movement does not allow for minimum contact time with the target macrophyte, then the efficacy of the product could be affected. In those situations, a different approach in the treatment of the nuisance aquatic vegetation may be required.

12. Comment:

Will circulation measurements be required? Will Sonar® be approved for streams? For open water areas of lakes with inlets/outlets?

Response:

Sonar® is not registered for use in streams. It is registered for use in open waters of lakes as described in Section 7.0. Circulation measurements could be required as a permit condition, but are not specified in this GEIS.

4. COMMENTS FROM: NY DEPARTMENT OF ENVIRONMENTAL PROTECTION DAVID H. QUENTIN; ECOTOXICOLOGIST JUNE 8, 1994

Fluridone Comments

Comment:

1. On Page 2-4 of the DGEIS Section 2.1.4 - History of Product Use, the third and fourth sentences states:

   "For treated lakes and reservoirs, the only restriction was the prohibition on the use of Sonar within 1/4 mile (1320 feet) of any potable water intake. There no restrictions on uses of treated water."

   Comment: How was this distance of 1320 feet derived? What reservoirs were used to verify the model? What parameters were incorporated into this restriction? Basically, there is not enough information to determine whether this distance is appropriate for NYC reservoirs?

Response:

The distance utilized is found on the label for both federal and state use. The number, derived through regulatory decisions, is an arbitrary value decided upon during the registration process as being the minimum distance necessary to allow for thorough mixing of the product within the water column before it moves within close proximity to a water intake.

Comment:

2. How will the inclusion of Sonar, Rodeo and Accord in the permitting process change:

   A. The quantity of permits received by the NYSDEC within the first year of allowance of use of the above mentioned pesticides?

   B. The number of permits received in future years beyond the initial year?

C. The proportion of permits received? (i.e. will permits for one pesticide decrease while another increases).

Note: As the NYC Watershed System is inclusive within the boundaries of DEC Regions 3 and 4, question 2 would be germane to aquatic pesticide use within this regions.

Response:

The Bureau of Pesticide estimates that the number of aquatic pesticide application permits will remain constant at approximately 500 per year. The major share (50%) are issued in DEC, Region 3 (lower Hudson Valley). Of the permits issued in Region 3, approximately 200 were issued to control the species that may be controlled by Sonar/Rodeo/Accord. It is presumed by the Department that a large percentage of these permitees will now apply to use Sonar/Rodeo/Accord. The registration/approval of a new aquatic pesticide may create a shift to the new chemical but should have little effect on the total number of applications for permits. Permits are usually requested on an annual basis by lake front property owners in anticipation of aquatic weed problems. According to the 1994 Aquatic Permit Annual Report from DEC Region 3, a trend in both product registration and in approved permits is moving toward least toxic yet most effective herbicides, criteria that Sonar/Rodeo/Accord seem to fit.

Comment:

3.A. Will SONAR be used solely for the eradication of Eurasian Milfoil (Myriophyllum spicatum)? If not, what other aquatic plants would it be used for as a nuisance aquatic plant management tool?

Response:

Sections 2.0 and 3.0 discuss other target aquatic macrophyte species.

Comment:

3.B. If aquatic plants other than Eurasian Milfoil (native as well as non-native) are managed using SONAR, will not Eurasian Milfoil have the possibility of invading this newly exploitable substrate, making a need for additional SONAR applications for the milfoil's eradication? What would be the potential impact of this continuous need for the use of SONAR?

Response:

When applied, the sensitivity of Eurasian watermilfoil to Sonar® would result in the removal of this species from the system, no matter what the target macrophyte was. The potential for recolonization of a site by Eurasian watermilfoil is dependent on the size of the waterbody and the location of untreated Eurasian watermilfoil beds. The literature indicates, as described in the DGEIS, that Eurasian watermilfoil is highly sensitive to Sonar® and removed from the water column in low application concentrations. The recolonization of an area by Eurasian watermilfoil is not expected to be a concern.

Comment:

4.A. On Page 4-3, Section 4.5.1 - Time of Application, Sentences 1, 3-4.

"It is recommended that Sonar be applied as early in the growing season as possible."..."As a result of those growth characteristics, an early season application is recommended. This would allow for treatment of Eurasian watermilfoil while the remaining plant community is still dormant."

Comment: Chronologically, how early would the application of SONAR occur in the lakes of southern New York?

Response:

There is no chronological time available. Eurasian watermilfoil begins to grow rapidly when the water temperature reaches 15°, which is generally before most native plants begin there spring growth. As discussed in the GEIS, application should occur as soon as possible in the beginning of the growing season.

Comment:

4.B. On Page 7-1, Section 7.1, Paragraph 2, Sentences 3 and 4, it states:

"When making lake-wide treatments it is recommended that application rates be based only on the water volume in which mixing is expected to occur. Calculations should be based on water volume in the epilimnion above any deep water areas below the metalimnion or thermocline."

Comment: Referring to Section 4.a., how would the application of SONAR at such a relatively early time of the year, be affected by spring overturn (i.e. mixing of SONAR throughout the lake or pond water column)?

Response:

From operational experience, slight temperature differences have been sufficient to concentrate Sonar® in the upper water strata for approximately 3 days after application. These minor differences in temperature may be attributed to normal spring warming processes.

Comment:

5. Page 7-3, Paragraph 1., Statement 2 states that:

"2. Applications that involve public water supply waters or their tributaries will be referred to the State DOH for approval before the permit is issued."

Through a Memorandum of Understanding between the NYSDEC and NYCDEP, the DEP has full review authority of aquatic pesticide use within the NYC Watershed System and should have the ability to review those permits for aquatic uses of fluridone and glyphosate.

Response:

This comment will be addressed by the Department's Division of Regulatory Affairs.

Comment:

6. Page 9-12, Section 9-4, Sentences 3-6 state:

"An integrated approach, however, would not only be based on a variety of techniques to address the immediate issue of excessive aquatic macrophyte growth, but also the inherent causes of the problem. Such activities would include measures such as management and control of nutrient loading, reduction of wastewater flow and reduction of sedimentation on a lake watershed basis. However, such techniques can be expensive and slow to implement."

Comment: These statements convey the idea that discovering and managing the source of the macrophyte "problem" is not feasible. If the source of the macrophyte "problem" is supposedly by nutrient enrichment of a water body, then wouldn't the management of the sources of the problem "permanently" control nuisance macrophytes? Are their studies which indicate that the integrated approach is <u>more</u> expensive in the long run than the use of aquatic herbicides as the claim states?

Response:

While studies may be available, logic would dictate that the local control of aquatic vegetation in a single waterbody, no matter what the option, is less expensive than a watershed size approach to regulating runoff. The latter option could entail immense changes in storm water management systems and septic systems. While the authors believe that the control of the nutrient problem is feasible, the practicality of its control is in question.

Glyphosate Comments

Comment:

1. Page 12-17, Section 12.9.1., Sentence 4.

Rodeo/Accord cannot be applied within 1/2 mile upstream of a potable water intake in flowing water (i.e. river, stream, etc.) or within 1/2 mile of a potable water intake in a standing body of water such as a lake, pond or reservoir."

Comment: How was this distance of 1/2 mile derived? What reservoirs were used to verify the model? What parameters were incorporated into this restriction? Basically, there is not enough information to determine whether this distance is appropriate for NYC reservoirs?

Response:

The distance utilized is found on the label for both federal and state use. The number, derived through regulatory decisions, is an arbitrary value decided upon during the registration process as being the minimum distance necessary to allow for thorough mixing of the product within the water column before it moves within close proximity to a water intake. Recently, the USEPA has approved the following potable water shutoff restriction for the Rodeo herbicide label when applied within 1/2 mile up-stream of a potable water intake in flowing water, or within 1/2 mile of a potable water intake in standing water:

> "To make aquatic application around and within 1/2 mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after application."

The Department is aware that the U.S. EPA has registered an amended label for Rodeo from which the potable water intake restriction has been removed. That label is not registered in New York at this time. Consequently, the prohibition against applying Rodeo within 1/4 mile of a functioning potable water intake is still applicable in New York. The Department cannot grant a permit for use which would not comply with the label which is registered in New York. The registrant of Rodeo may apply at any time in the future to register the amended label. Such a registration application would be reviewed for any potential impacts.

Comment:

2. Page 12-5, Section 12.5.3., Third Paragraph, Sentence 1.

"Drift control agents and color marking dyes may also be warranted by the application method and atmospheric conditions."

Comment: What is the impact of "color marking dyes" and drift control agents on the environment in association with those dyes and drift control agents used with Rodeo/Accord?

Response:

Drift control agents and color marking dyes are not part of the pesticide formulation and are not considered to be active ingredients. Therefore, they are not subject to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) requirements for pesticide registration. As a result, much of the environmental fate and toxicity information available for pesticides is limited for such additives. However, given the limited expected use of aerial application (for which they are primarily used), the timing of application (atmospheric conditions), and other parameters available to control drift (nozzle selection, spray pressure), the use of these materials is not expected to be significant.

Comment:

3. Page 17-7, Section 17.3.1.4, Paragraph 2, Sentence 2.

"In the case of cattail and phragmites, burning is recommended after the application of glyphosate containing herbicides to reduce the potential effects of deoxygenation as well as to enhance future control measures if they become necessary (Jones, 1992)."

Comment: What effect does fire have on glyphosate?

Response:

Thermal degradation studies conducted with glyphosate have shown that smoke from glyphosate treated vegetation is not measurable different from non-treated smoke.

**5. COMMENTS FROM: ADIRONDACK COUNCIL
GARY RANDORF; SENIOR COUNSELOR
JUNE 6, 1994**

Comment:

"B. The efficacy of the use of SONAR in other than small, shallow water bodies is highly questionable according to experts Terry McNabb (Resource Management of Turnwater Washington - 206-754-3460) and Kathy Hamel (known informally as the "milfoil queen") of the Washington State Department of Ecology - 206-407-6562. This is because it is very difficult to control the application, and confine it to the relatively shallow shoreline areas where milfoil occurs in steep sided lakes (such as Lake George in the Adirondack Park). To be effective SONAR needs to be in contact with the target species for an extended period. Although some control experts have consider the minimum time and concentration to be 6 weeks at 10-15 parts per billion, Kathy Hamel's recent experience (as of May 1994, personal observation) indicates the requirement to obtain control is more likely 10-20 ppb for 10-12 weeks. Hamel feels that prior to control Rotamine dye tests should be undertaken to assess current movements in the lake under consideration, to preclude the possibility of ineffective contact and control at significant expense (SONAR is very expensive material). A gentleman named Curt Getsinger - (601) 634-2498 has pioneered the correlation of SONAR effectiveness with particular lake currents. SONAR is not effective for spot treatment according to Hamel."

Response:

Most of the comments listed in this comment letter are extensively covered in the GEIS. The concentration ranges note by Mr Randorf as being efficacious are equivalent to those concentrations noted in Section 4.4, Mode of Action/Efficacy. The length of time necessary to obtain control is not out of the range of time seen by both Pullman and DowElanco in studies on the efficacy of Sonar. Knowledge of the lake conditions prior to treatment, especially water currents in partial lake treatments, can provide important information in preparing a site specific permit application under Part 327. The labels for Sonar A.S. and SRP state that the product is effective if used on a whole lake basis for ponds and lakes. Sonar is not recommended for spot treatment, i.e., partial lake treatment of 5 acres in size or less. Some of the alternative treatments found in Section 9.0 of the GEIS would be more appropriate for spot treatments for Eurasian watermilfoil.

Comment:

"C. The label prohibits treatment of waters within one-quarter mile of any potable water intake. IF use permits are granted the Council expects that the requirement expressed by the state DOH in a letter to DEC's Bureau of Pesticide Management (April 26, 1989) would need to be adhered to:"

> "Assuming NMF (a breakdown product known to cause reproductive, teratogenic, and testicular effects in animals) is not detected in the ongoing pond experiments in Massachusetts, the DOH recommendations for provisions in a special use permit are:"
>
> "1. Alternate drinking water must be provided (or must be offered in the case of a private water supply) until the concentration of fluridone is not detected (detection limit, 1 ppb). Alternate bathing water must be provided (or must be offered) until the concentration is equal to or less than 50 ppb."

"2. At public beaches within one-quarter mile of the treatment area swimming should be restricted until the fluridone levels are less than 50 ppb. Modeling calculations may be useful in evaluating the need for this restriction."

Response:

The April 26, 1989 DOH letter ceased to be relevant at the time DowElanco proposed to lower the dose rate in New York to 50 ppb. Furthermore, there will be no permits issued for application proposed to be made within 1/4 mile of a functioning potable water intake, because the label prohibits such applications. Any application proposed to be made within 1/4 mile of a functioning potable water intake would require a revised SLN label, which in turn require further evaluation by DOH.

The Department is aware that the U.S. EPA has registered an amended label for Sonar A.S.* from which the potable water intake restriction has been removed. That label is not registered in New York at this time. Consequently, the prohibition against applying Sonar within 1/4 mile of a functioning potable water intake is still applicable in New York. The Department cannot grant a permit for use which would not comply with the label which is registered in New York. The registrant of Sonar may apply at any time in the future to register the amended label. Such a registration application would be reviewed for any potential impacts.

Comment:

"D. We would like to offer that the dire predictions of the late 80's (see attached: PREDICTIONS OF MILFOIL SPREAD IN LAKE GEORGE BY PRO-SONAR ENTITIES AND INDIVIDUALS) have not come to pass. Tom Jorling (EX-DEC COMMISSIONER) stated in late 1990 that milfoil in Lake George "has been kept in check by both the plant management program (non-chemical) and environmental factors."

Response:

Comment noted.

Comment:

"E. IF this process should lead to the approval of this GEIS on behalf of the use of Fluridone (SONAR) notwithstanding, the DEC and the Adirondack Park Agency must insure the following prior to the permitted use of fluridone (or other toxic, broad spectrum pesticides) within the potable water resources of the Adirondack Park:"

"1. Site-specific analysis and evaluation of proposed fluridone use in Park water pursuant to Departmental regulations and APA requirements under the Freshwater

Wetlands Act. Such analysis should fully evaluate potential impacts to human health, water quality, wetland, fish and wildlife resources."

"2. Clear and defendable needs assessment for the use of fluridone in public and private waterbodies that emphasize the true nature of the aquatic weed situation in a waterbody where chemical application of the pesticide is proposed."

"3. Demonstration that all other safer methods of nuisance weed control (i.e. hand-harvesting, benthic mats, rotovating, mechanical harvesting, (SEE ECOSCIENCE MEMO attached) suction harvesting (see DEC news Release October 7, 1990), etc. have been forthrightly evaluated and their benefits and costs weighed equitably against the impacts of introducing chemical pesticides into water resources. See also Cornell University News attached re: caterpillar control."

Response:

1. Obviously the intent of requiring a permit to apply pesticides for aquatic pest control is to review each proposed application and evaluate potential adverse impacts to the subject matters addressed by Mr. Randorf as concerns; human health, water quality, wetlands, and fish and wildlife resources. The permit application process presently utilized by the Bureau of Pesticide Regulation requires the review of the State Health Department for human health concerns; our Division of Water Staff for water quality issues and our Bureau of Environmental Protection, the Division of Fish and Wildlife for environmental concerns. In addition, if the Adirondack Park Agency has a jurisdictional permit, Department will continue to coordinate our permit review with APA. If rare and threatened plants are identified as an issue in York Natural Heritage Program's inventory of New York's rarest animal and plant species. Based upon issues identified by these reviewers the permit can be denied or special permit requirements imposed. For instance, a permit to control Eurasian Milfoil has been issued to the Millsite Lake Association requiring implementation of a management plan which utilizes harvesting, benthic mats, and herbicides. It also restricts applications to only 10% of the lake vegetation which is divided between the property owners, i.e. 1,200 sq. ft./owner, prohibits pesticide use in lake trout spawning areas, requires posting of public access sites and notification of all property owners.

2. Again, the aquatic permit review process is an attempt to clearly evaluate the need for applying pesticides to lakes and streams and to determine if the proposal will negatively impact the environment. Although neither Environmental Conservation Law or State Regulation require risk/benefit approach for issuance of aquatic permits, it is a consideration which is reflected in permit limitations and provisions.

3. Neither Article 15 of the Environmental Conservation Law nor Title 6 NYCRR Parts 327, 328, and 329 related to application of pesticides for controlling aquatic organisms,

requires applicant to consider "safer methods of nuisance weed control," i.e., hand harvesting, benthic mats, mechanical harvesting, etc. However, the Bureau of Pesticide Regulation regional staffs routinely discuss these alternatives with applicators and may stipulate permit limitations which prohibit pesticide use in sensitive areas. These prohibitions would then trigger implementation of such alternatives.

6. COMMENTS FROM: THE NATURE CONSERVANCY
J. MARTIN CAROVANO; REGIONAL DIRECTOR
JUNE 2, 1994

Comments:

In their comment letter, The Nature Conservancy states "The Nature Conservancy is well aware of the management problems which arise as the result of aggressive, non-native species. TNC has invested a great deal of time, energy, and money into protecting rare species and exemplary natural communities from their non-native competitors."

"The New York Office of TNC is familiar with how these aquatic herbicides function to control nuisance aquatic vegetation and with their effectiveness. Because these herbicides are not entirely species specific and because there are several rare aquatic species in New York State, the Nature Conservancy would like to see a review process established to eliminate the inadvertent destruction of protected species by the application of these herbicides."

"The New York Natural Heritage Program maintains an up-to-date inventory on the location and status of New York's rarest animal and plant species and the highest quality examples of all our natural communities. The Heritage Program can provide the review that we believe is a necessary step before an applicator may receive permission to apply either of these herbicides to a waterbody."

Response:

Presently aquatic permits are issued by Pesticides Control Specialists. Policy requires that the decision take into consideration all persons and environments impacted by the application. The service provided by the New York Natural Heritage Program that identifies endangered plant species would be consulted prior to the issuance of all aquatic permits so that concerns for rare and threatened plants and animals are identified. Present practice entails the notification of any agency or group concerned with the application of a pesticide to any specific body of water that an application had been received and that their comment would be considered and would be appreciated.

7. COMMENTS FROM: GRIFFIN CORPORATION
JAMES YOWELL; REGISTRATION MANAGER
JUNE 3, 1994

Comments:

In their comment letter, Griffin Corporation states "The document fails to include copper based aquatic products as alternatives to SONAR/RODEO in the alternatives section (17.0) even though copper based aquatic herbicides for control of many of the same weed species are registered for use in NYS. Discussion of treatment costs for the Chemical Alternatives (Section 17.2) provides a broad range on an acre basis. Those lower end of the range exceeds the cost per acre of using a copper based product. There is no comparative discussion of environmental effects of toxicity of SONAR/RODEO to the alternatives. This information should be provided prior to any regulatory decision that would allow use of these products in New York."

"The document fails to include any information on tank mix combinations of the proposed products and/or their alternatives. There is evidence in initial testing that tank mix combinations of SONAR and copper, Endothall and copper, and Diquat and copper may reduce the amount of both pesticides required to obtain effective weed control. The efficacy and potential for a reduction in total chemical addition to the water system, while maintaining adequate weed control should justify tank mix combinations in the DRAFT EIS."

Response:

The GEIS is not intended to be all inclusive with respect to the possible chemicals in use in aquatic settings. The prominent ones used in herbicidal application are discussed. Copper products are registered only as an algicide and the inclusion of such a product would possibly confuse the intent of the document. Copper based products are not registered for use in New York for macrophyte control and are therefore not considered in that context. With regard to the tank mixing of copper based products with Sonar/Rodeo/Accord, the information that was provided with the comment was based on laboratory tests and unpublished literature. If the results reported by the commentor are accurate and there is an applications before the Department to control algae along with macrophytes, then DEC will consider applications for tank mixing on a case by case basis.

8. **COMMENTS FROM: TOWN OF DRESDEN, NEW YORK**
ROBERT S. BANKS; TOWN SUPERVISOR
MAY 4, 1994

Comment:

"1. I have reviewed your Sonar draft of 1 Apr 94 and appreciate your efforts and commend you for a job well done."

"2. The communities on Lake George desperately need to stop the spread of Eurasian milfoil, and its is apparent that the product Sonar is the most effective tool to accomplish that end."

Response:

This comment is noted.

9. **COMMENT FROM: SAND BEACH MOUNTAIN COTTAGES**
BRANT LAKE, NEW YORK
SALLY & JOHN RAYMOND
MAY 3, 1994

Comment:

"We are writing this letter as Brant Lake residents, as property owners and as members of the Brant Lake Association to urge you to expedite the process required to implement use of subject registered herbicides in control of nuisance aquatic vegetation in New York State. In particular, we support the use of Sonar as a viable option of control of Eurasian Watermilfoil in Brant Lake."

"The cost for controlling the spread of watermilfoil will be a hardship on many property owners given the status quo. The detrimental effects of Eurasian Watermilfoil on lake ecology, boating , fishing safety, property values, tourism have been documented and are generally well known. Left uncontrolled, milfoil results in loss of native vegetation which is considered necessary for general lake ecology and good fishing."

"We would like to thank you for past efforts in this preservation of our lakes for future generations and would appreciate you careful consideration in this matter."

Response:

This comment is noted.

10. COMMENT FROM: GLEN LAKE PROTECTIVE ASSOCIATION
MRS. MICHELE M. MAYER
JUNE 1, 1994

Comment:

"I am the environmental committee co-chairman for the Glen Lake Protective Association. Glen Lake is located 10 miles south of Lake George in Queensbury NY. As do other lakes in the area, Glen Lake has an emerging Eurasian Milfoil problem. Our association has reviewed the draft for the above project and has voted in favor of supporting the above project. We wish to go on record as supporting New York State approving the use of Sonar against Eurasian Milfoil in New York State lakes. We also hope the State will take steps to simplify and streamline the process for Lake Associations to get permits to use Sonar and other methods of control of milfoil."

Response:

This comment is noted.

11. COMMENT FROM: RIVERDALE CHEMICAL COMPANY
RUSSELL R. SAWYER; REGULATORY AFFAIRS MGR
APRIL 12, 1994

Comment:

"Thank you for the Generic Environmental Impact Statement that is prepared by McLaren Hart who was the consultant for DowElanco and Monsanto. Although we do not have any comment specific to the use of Sonar/Rodeo and Accord as aquatic use pesticides, we do hope that these Generic Environmental Impact Statements are not so generic as to involve other aquatic use products. Since the products we register for aquatic use do not contain these chemicals, we are concerned that the findings of these studies might negatively impact the use and sale of our registered products."

Response:

This GEIS is a supplement to the Final EIS on the Aquatic Vegetation Control Program of the Department of Environmental Conservation. It is specific to the products detailed in the document and should have no bearing on other chemicals.

12. COMMENT FROM: JEAN G. HUBSCH
BRADFORD, NEW YORK
MAY 16, 1994

Comment:

"I am writing to urge the NYS DEC to approve the use of SONAR in the state for the control of aquatic vegetation. I live on a small lake (Lamoka) in the Finger Lakes region and this is a serious problem. It is not being adequately addressed by harvesting and the plants are a nuisance and also are having a detrimental economic effect."

Response:

The comment is noted.

13. COMMENT FROM: VILLAGE OF LAKE GEORGE, NEW YORK
ROBERT M. BLAIS; MAYOR
APRIL 28, 1994

Comment:

"This letter is written in support of approving the chemical SONAR for control of Eurasian milfoil in Lake George. Many years have passed since the review has been initiated and I firmly believe that Sonar's use is still the safest, most practical and effective means to control the spread of this infestation."

"Throughout this long, and highly unacceptable period the weed has grown and spread creating dangerous conditions around our public bathing beaches, and actually decreasing the swim area. Mats have proven ineffective, and hand harvesting is futile, at best."

"All the data I have read, and documents of results from other lakes similar to ours, reinforces our opinion that approval should be granted. Prolonging the matter is extremely critical to the well-being and economy of our lake and residents"

Response:

This comment is noted.

14. COMMENT FROM: WRIGHT H. SCIDMORE
DORIS E. SCIDMORE
BRANT LAKE, NEW YORK
APRIL 27, 1994

Comment:

"We are writing this letter as Brant Lake residents, as property owners and as members of the Brant Lake Association to urge you to expedite the process required to implement use of subject registered herbicides in control of nuisance aquatic vegetation in New York State. In particular, we support the use of Sonar as a viable option of control of Eurasian Watermilfoil in Brant Lake."

"The cost for controlling the spread of watermilfoil will be a hardship on many property owners given the status quo. The detrimental effects of Eurasian Watermilfoil on lake ecology, boating , fishing safety, property values, tourism have been documented and are generally well known. Left uncontrolled, milfoil results in loss of native vegetation which is considered necessary for general lake ecology and good fishing."

"We would like to thank you for past efforts in this preservation of our lakes for future generations and would appreciate you careful consideration in this matter."

Response:

This comment is noted.

15. COMMENT FROM: LAKE GEORGE ASSOCIATION
BARBARA E. CHICK, M.D.; PRESIDENT
MARY-ARTHUR BEEBE; EXECUTIVE DIRECTOR
MAY 4, 1994

Comment:

"We recommend that the subject document be added as soon as is possible to the state's Final GEIS on Aquatic Vegetation Control. We also recommend that the state notify all interested public that this method of controlling aquatic weed growth is now available for use in New York State"

"We are keenly interested in the information that our own state Department of Health has determined that, at the 50 ppb application rate, no restrictions are necessary on the use of SONAR in water bodies that serve as sources of potable water. New York's safety standards for aquatic herbicides in potable water are three times more stringent than those of the federal government."

"Based on our own intensive study and reflection on all issues associated with the control of nuisance plants like Eurasian watermilfoil and based on informed review of the beneficial and negative impacts of achieving control by use of aquatic herbicides, the LGA recommends the following. The GEIS on the use of the registered aquatic herbicide fluridone (SONAR) should be accepted immediately as a supplement to the State's program. The NYS/DEC, which we has intensively studied these issues for many years, should now expedite the conclusion of this step in legal process. NYS/DEC should now cooperate and assist the Coalition of Lakes Against Milfoil in its efforts to develop a statewide aquatic plant management program to achieve effective management of lake environments in accordance with locally established goals."

Response:

The comment is noted.

**16. COMMENT FROM: EAGLE LAKE PROPERTIES OWNERS INC.
WILLIAM R. ALLEN, PRESIDENT
RHINEBECK, NEW YORK
MAY 8, 1994**

Comment:

"On behalf of the Eagle Lake Properties Owners Inc. I would like to offer comments in support of the draft GEIS. It is our hope that the Department of Environmental Conservation will adopt this document as written and to expedite the process that will allow Sonar to be used where appropriate. Based on this GEIS, Sonar has been very successful in controlling Eurasian watermilfoil, especially in the state of Michigan where it has been used quite extensively. In addition, the data indicates that when applied as prescribed by the manufacturer it is both toxicologically and environmentally safe."

Response:

The comment is noted.

17. COMMENTS FROM: COALITION OF LAKES AGAINST MILFOIL
WENDY L. DAVIS; CHAIRPERSON
TICONDEROGA, NEW YORK
JUNE 6, 1994

Comment:

"The Draft GEIS document on fluridone/Sonar is well written, well documented and relieves the burden on riparian owners and lake associations when applying for a permit for Sonar use, which is the intent of this document. However, the following are changes or addition that COLAM feels should be considered."

"A) On page 1-3 under the heading of 1.4 IDENTIFICATION AND JURISDICTION OF THE INVOLVED AGENCIES, letter d. Adirondack Park Agency, we feel you definition is too broad and raises questions as to the limits of their involvement. Other than land connected wetlands, they do not have jurisdiction. COLAM suggest that the definition be revised to read:

d. Adirondack Park Agency - responsible for implementation of the Adirondack Park Land Use and Development Plan. (As described by the Adirondack Park Agency Act.)"

Response:

The comment is noted and addressed.

Comment:

"B) On page 2-2 under the heading of 2.1.2 Need for the Product and on page 3-6 under the heading of 3.3.1 Eurasian watermilfoil (Myriophyllum spicatum L.), we suggest that the Rensselaer Fresh Water Institute's 1993 Annual Report on the Aquatic Plant Identification Program be included as a source of referral for the spread of Eurasian Watermilfoil in New York State. The report shows 38 counties with Eurasian Watermilfoil in 1993."

Response:

The comment is noted and addressed.

Comment:

"C) On page 2-3 under the heading of 2.1.3 Benefits of the Product, first paragraph, last sentence, 8 ppm we believe should read 8 ppb. On page 5.5 under the heading of 5.1.1

Macrophytes and Aquatic Plant Communities, second paragraph, first sentence, 8pp we believe should read 8ppb."

Response:

The comment is noted and addressed.

Comment:

"D) The GEIS document should include a listing of specific states in which fluridone/Sonar is registered for use, not merely a listing of neighboring States to New York."

Response:

The listing of the registration in a neighboring state is not germane to the evaluation of the products use in New York.

18. COMMENTS FROM: LAKE GEORGE ASSOCIATION
MARY-ARTHUR BEEBE; EXECUTIVE DIRECTOR
JUNE 6, 1994

Comment:

"Section 7.2 "Label Instructions" refers to the supplemental Special Local Needs label established for SONAR by NYSDEC. Special conditions on the use of SONAR A.S. say that this product can only be used for Eurasian watermilfoil only. We understand this to mean that the product may be used only when Eurasian watermilfoil is the primary target for control and that in controlling milfoil, other species may be affected to some degree"

Response:

The comment is noted as an accurate description of the label conditions.

Comment:

"Also in Section 7.2, we recommend that the first sentence of subsection 2) - "In lakes and reservoirs..." - remain as written. However, the second sentence of subsection 2) - "Existing potable water intakes..." - should be put into parentheses. This is a clarifying statement which suggests some but not all of the ways in which applicators may insure that water intake pipes are not to be used as sources of potable water immediately after the application of SONAR."

Response:

The comment is noted. Because the section in question addresses the label as it is written, the Department declines to make the suggested change. The labels for Sonar® note that the product is prohibited from use within 1/4 mile of a functioning potable water intake. Any application proposed would currently require a revised SLN label. The SLN label notes that existing potable water intake which have been disconnected and are no longer in use, such as those replaced by connections to potable water wells or a municipal water system, are not considered to be functioning potable water intakes.

19. COMMENT FROM: NYSEG
R. H. MIDER; SYSTEM TRANSMISSION FORESTER
BINGHAMPTON, NEW YORK
JUNE 3, 1994

Comment:

"New York State Electric & Gas Corporation takes this opportunity to submit comments in support of the registration of the herbicides Accord and Rodeo for aquatic application in New York State. The EIS that has been prepared in support of their registration and a wealth of other scientific studies that have been carried out document that the active ingredient glyphosate does not pose a threat to man or the environment when applied in accordance with the product labels."

Although NYSEG does not propose to utilize these products for aquatic applications there is a need for use in managing right-of-way vegetation in regulated wetland and adjacent areas. The availability of an effective herbicide that will not be harmful to wetland habitats will be of economic benefit to NYSEG customers. The acceptance of these products for use in aquatic applications should facilitate approval by the Department for use in regulated wetlands and their adjacent areas."

Response:

The comment is noted.

APPENDIX H

RESPONSES TO ORAL COMMENTS ON THE DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT AS PRESENTED AT THE THREE PUBLIC HEARINGS

RESPONSES TO ORAL COMMENTS ON THE DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT AS PRESENTED AT THE THREE PUBLIC HEARINGS

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RESPONSES TO ORAL COMMENTS ON THE DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT AS PRESENTED AT THE THREE PUBLIC HEARINGS

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RESPONSES TO ORAL COMMENTS ON THE DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT AS PRESENTED AT THE THREE PUBLIC HEARINGS

The following comments were presented at three public hearings held as part of the SEQR process. The hearings were held on: May 4, 1994 at 7:00 pm in the Lake George Town Center on Old Post Road in the Village of Lake George; May 5, 1994 at 7:00 pm in the Best Western Inn and Conference Center at 679 South Road (Route 9) in the City of Poughkeepsie; and May 11, 1994 at 7:00 pm in the Marriot Thruway at 5257 West Henrietta Road in the City of Rochester. The comments are relevant substantive excerpts from the oral statements of the stated presenters.

1. COMMENTS FROM: RICHARD HEBERT
LYCOTT ENVIRONMENTAL RESEARCH
SOUTHBRIDGE, MASSACHUSETTS
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

What I would like to say is that there are only a limited number of tools available to manage lakes and ponds. And it is important that we have the full spectrum available for our use and that we don't restrict those tools. Included among them are aquatic herbicides, and in the case specifically of SONAR and Rodeo. They have been proven fairly unequivocally by scientific research in dozens of research papers in literally thousands of lakes and ponds that Lycott has managed. They have proven to be effective, and when used responsibly and the least detrimental tool to non-target organisms.

Response:

The comment is noted. No action is necessary.

2. COMMENTS FROM: BARBARA CHICK
LAKE GEORGE ASSOCIATION
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

On behalf of the Lake George Association, I appreciate the opportunity to comment on Version 4.0 of the referenced subject prepared by DowElanco by McLaren/Hart Environmental Engineering Corp. We have carefully evaluated the document and find the information well organized, understandable, thorough, and appropriately pertinent to the established scope of work. We believe that the informative evaluation of documented evidence and reports of real world experiences involving the use of fluridone in freshwater lakes will be very useful to us and to others in New York who may be concerned about managing nuisance and exotic weed growth in lakes.

We recommend that the subject document be added a soon as is possible to the State's final GEIS on aquatic vegetation control. We also recommend that the State notify all interested public that this method of controlling aquatic weed growth is now available for use in New York State.

The GEIS on the use of the registered aquatic herbicide fluridone SONAR should be accepted immediately as a supplement to the state's program. And further that the New York State Department of Environmental Conservation, which has intensively studied these issues for many years, exert its influence as lead agency under SEQR to expedite the legal process in so doing as effected while also minimizing risks to human health.

Response:

The comment is noted. No action is necessary.

3. COMMENTS FROM: KATHY REGAN
THE NATURE CONSERVANCY
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

We would like to request that SONAR not be applied to places where there are rare threatening or endangered species.

Response:

This comment is noted. A more detailed response to the written comment from The Nature Conservancy is located in the Responses to Written Comments Section (Appendix G) of this FGEIS.

4. COMMENTS FROM: DICK BARTLETT
LAKE GEORGE PARK COMMISSION
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

Suffice it to say for this evening that we welcome the opportunity to go through the EIS. There may be some questions which we think may need to be addressed which are not specifically addressed in the EIS, and we will call those to the department's attention in our submission but we are delighted for the fact that the process is moving forward for the improving of the use of SONAR, whether it is appropriate everywhere in the lake where there is a milfoil problem remains to be determined but certainly it is a very important step toward the approval of SONAR in what I believe is the last remaining state in the nation where it is not allowed.

We will have specific comments and raise whatever questions we may have concerning the EIS in our statement. Thank you.

Response:

This comment is noted. No action is necessary.

5. COMMENTS FROM: GARY RANDORF
ADIRONDACK COUNCIL
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

I will be short on comments because we have not finished reviewing the document. When we do, we will be submitting further comment but I do just want to make some general observations. We have been concerned as may of you know that have been involved in the review of this particular situation and issue and product for some time. We are concerned about milfoil and its expansion and the like but we are also concerned about the potential human health effect and non-target species effect and the concern does continue.

Response:

This comment is noted. Written comments presented by Mr. Randorf representing Adirondack Council were addressed in the Responses to Written Comments Section (Appendix G) of this FGEIS.

6. COMMENTS FROM: ELWOOD FINDHOLT
LOON LAKE PARK DISTRICT ASSOCIATION
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

We have been lending our support to the Coalition of Lakes Against Milfoil, COLAM, to develop a plan to eliminate Eurasian milfoil. At this time the use of SONAR appears to be the most effective method of destroying this aquatic weed, without impacting native vegetation. We therefore request that your department approve the Generic Environmental Impact Statement on the use of SONAR in New York State lakes.

Response:

The comment is noted. No action is necessary.

7. **COMMENTS FROM:** **WRIGHT SCIDMORE**
BRANT LAKE ASSOCIATION
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

We number about 250 members. I have a fax from our president that I will hand in. Basically, we urge adoption of this GEIS and to expedite the process for implementing use of SONAR in our lakes.

Response:

The comment is noted. No action is necessary.

8. **COMMENTS FROM:** **WENDY DAVIS**
COALITION OF LAKES AGAINST MILFOIL
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

My purpose here tonight is to formally put COLAM on the record as favoring the adoption by the New York State Department of Environmental Conservation of the Generic Environmental Impact Statement dealing with the use of the registered aquatic herbicide fluridone, or SONAR as it is known commercially, which is one of the subjects of this hearing.

COLAM urges adoption of this document because it clears the way for the use of SONAR in New York State waters as a strategy for controlling the spread of Eurasian watermilfoil.

We support the registration of the herbicide SONAR for use in New York State waters. With the continued use of SONAR in other states, it has proven to currently be the most economical, effective and safest way of controlling and eradicating Eurasian watermilfoil, both from the environmental and public health points of view.

More importantly, SONAR provides optimum selectivity in the control of Eurasian watermilfoil, while insuring minimal damage to the native flora of the waters in which it is used.

This is because it was developed to specifically target the exotic milfoil plant for destruction by systematically interfering with the unique photosynthesis process which sustains it. Although some aquatic plant species native to the environment may also be adversely affected by the introduction of SONAR, this side effect is only temporary. The natural flora will be regenerated in the next growth cycle when the nuisance milfoil plant is no longer there to impede its development.

When given the choices of control options currently being used in New York State, they are either uneffective on dense beds or may cause more harm than good. Furthermore, with the exception of hand harvesting, are non-selective for these reasons: The optimum selectivity SONAR offers for the protection of native flora, with the long term success experienced by states who allow the use of SONAR, and its safety from both the environmental and public health points of view, we in COLAM urge that SONAR be authorized for use in New York State waters as part of a comprehensive strategy to control Eurasian watermilfoil. The GEIS is complete, well organized, understandable and thorough. With this document, we in COLAM feel there will be no need for lake by lake Environmental Impact Statements to be done.

Since approval of the GEIS is the necessary final step to authorization of SONAR use in New York State, we in COLAM strongly urge its adoption by the State of New York. Thank you.

Response:

The comment is noted. No action is necessary.

9. COMMENTS FROM: ZANDY GABRIELS
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

I would like to go on record fully supporting the comments that Dr. Barbara Chick made on behalf of the LGA. I have been involved in this particular issue, that is control strategies for Eurasian watermilfoil in Lake George since milfoil was first found there in 1985.

And the first control, one of the first control strategies, the use of SONAR, was proposed shortly thereafter. As a member of the LGA, I was a party to the adjudicatory hearings. I followed and was present at all the sessions that were held in this room back during the years of, I believe it was 1986, in the spring of 1987. In reviewing this Environmental Impact Statement, there are a couple of comments that I think that I find still questioning and uncertain that have arisen based on my history and association and involvement with that.

Mr. Lockhart indicated that this Draft Environmental Impact Statement was being written by the manufacturers of the product. He indicated that in 1981 the Department of Environmental Conservation prepared an Environmental Impact Statement, and one must have a better understanding as to why the private sector is now preparing this particular document and why the department has given this responsibility over to the private sector. This has no basis and no impact on the content of the Draft Environmental Impact Statement but merely an indication of the resources of the state to pursue and look at the issue of herbicidal control of exotic species within the State of New York, and I think it is a clear issue, one the public must clearly understand through this particular document.

Response:

DowElanco and Monsanto companies have agreed to cooperate with the Department in the preparation of this Generic Environmental Impact Statement to evaluate the applicability of using their products in the waters of New York State. The private sector companies benefit from this venture in that they may be able to sell their products within New York. The citizens of New York benefit in that they may have a product for use against a pest macrophyte and, additionally, their taxes will remain stable because the Department does not have to acquire the resources necessary to research and write a document of this type.

COMMENTS FROM ZANDY GABRIEL (CONTINUED):

I would also hope that, without giving you, the authors, in the private sector too much additional work, that we could have an understanding as to whether or not or why the Department of health has not made a specific determination with regard to the standard that apply to both these particular chemicals. Right now both those chemicals are classified with potable water limitations for 50 parts per billion because they fall within a generic classification established by the Commissioner of the Department of Health. The Commissioner of the Department of the Health has the authority and ability to make specific individual potable water limitations for specific chemicals. And after this document and the eight or nine years that the State has been looking at this, plus the additional time that U.S. EPA has worked on this, I think it would not be appropriate for the Department of Health to provide additional information as to the limits proposed through this document.

Response:

Health issues are discussed in the GEIS and comments from the DOH are addressed in Appendix G. A discussion of the applicability of the 50 ppb standard in the GEIS is beyond the scope of the document.

COMMENTS FROM ZANDY GABRIEL (CONTINUED):

The document further specifically mentions that APA may be a party involved in the adjudicating the question of herbicidal control specifically within the Adirondack Park Agency. I believe the reference is on page 1-3. Again, without unfortunately giving the authors much more additional work, one would add of the jurisdictional question would be more specifically elaborated on their question and determination of deep water wetland through the -- under the Freshwater Wetland Act seems as at least somewhat suspect, if not totally outrageous. Given the fact that after 18 years of having the statute enacted, one of the primary conditions that map of the deep water wetland within the Adirondack

Park has not been prepared so the public really has no understanding of the extent of their jurisdiction of deep water wetland within the Adirondack Park.

It is important that the public be fully aware of or understand where deepwater wetlands are so that issue can be approached in a rationale form. If that requires additional work and assistance on the part of the government agencies, then I think that the state has to commit resources to effect. It is not clear that they have done that to the best of their abilities as yet.

Response:

This is a regulatory feature and a discussion of it in the GEIS is beyond the scope of the document.

COMMENTS FROM ZANDY GABRIEL (CONTINUED):

On page 7-3, it is indicated that DEC, part of the conditions for using control strategies is the applicant's preparation of a particular map. And that's, again, pursuant -- that's pursuant to Part 3.2 as referenced in the document. I am not familiar with what happens with the deep water wetland mapping outside of the blue line. However, I do know that within the blue line those maps have not been prepared. One would hope that the authors could -- would be able to track down and identify whether or not those maps have been clearly prepared by responsible state agencies for the rest of the state outside the blue line.

Response:

This is a regulatory feature and a discussion of it in the GEIS is beyond the scope of the document.

COMMENTS FROM ZANDY GABRIEL (CONTINUED):

On page 1-2 there is a question with regard to a restriction on swimming after an application at least SONAR has been made. That restriction is limited to a prohibition of 24 hours. Based on the information that I have been able to understand from the EPA's registration process, it is not clear to me exactly why this particular limitation has been established by the department for the department. The department being DEC or the Department of Health. One would hope that issue would be a little more specifically clarified so that the distinction in the judgment between the state agencies and the federal agencies could be more clearly understood and the public would have an opportunity to consider whether or not the state agencies are being overly process in the concern for the control of exotic species. As a related issue, I think there clearly needs a much more clearer understanding of potential of potable water intakes from waters that are potentially treated. It needs to be addressed by the authors.

Response:

This is a regulatory feature and a discussion of it in the GEIS is beyond the scope of the document. The regulations and the label are very clear on the relationship of treated water to potable water intakes and the restrictions therein.

COMMENTS FROM ZANDY GABRIEL (CONTINUED):

During the adjudicatory hearings there was a large question as to the degree to which potable water intake pipes from municipalities or even private individuals drawing water from the proposed treatment area how they would insure that they would not drink this treated water. One of the strategies proposed by several people was to a physical obstruction of the pipe or dismantling of the pipe. Alternatives to that, that is public notification that potable water was not to be used for a limited period of time supplemented with drinking water at the behest of the individual involved was not readily considered by the department. I think that is an issue which has to be addressed more specifically in this document so that the public understands what the related control strategies and potential costs are when the use of this, either of these two herbicides. One has to be very attentive to the fact that public notification would be a normal -- I presume a normal course in the application of this on the special local needs process, public notification would be an adequate mechanism to insure that the public is advised whether or not they should or should not drink the water. It means it would represent their particular value judgment as to whether or not the water is safe to drink.

This strategy has been used and is now presently used by municipalities when they took at lead, copper, lead/copper concentrations at the end of the tap. If high lead or copper is found pursuant to a survey system, the public is apprised of the potential public health consequences. However, there is no prohibition that they must stop using that water. A similar strategy can be used for this particular case in the use of a particular herbicide where the public is apprised that there may be potential problems, information on the public health hazard, toxicity, et cetera, et cetera, is readily available in Environmental Impact Statement and they may make their own judgment to the degree they care to drink or not drink the water.

A physical separation of the pipes is overly extreme, and I hope the authors would be able to more specifically address this question.

Response:

A discussion of this is beyond the scope, intent and objectives of the GEIS.

COMMENTS FROM ZANDY GABRIEL (CONTINUED):

Getting back to the question of swimming, we have notification again that again a prohibition of swimming, I think may be a little extreme. If public notice is made, then the individual has the opportunity to consider whether or not swimming would be appropriate and applicable in that situation. My understanding, again, that there is no federal restriction on swimming after an application is made.

And I would hope that review of the document in greater detail and forward additional comments on this particular document at a future time knowing, of course, that prompt adoption of this particular document be of primary concern by the agencies and by the authors of this document. Thank you.

Response:

The comments from Mr. Gabriel are noted. The authors believe no further action is warranted on them.

10. COMMENTS FROM: CHARLES BOYLEN
FRESH WATER INSTITUTE
LAKE GEORGE, NEW YORK PUBLIC HEARING
MAY 4, 1994

And we have been working on the milfoil problem here in Lake George since 1985, and we now have over a hundred locations in the lake where we find the plant. So there is several issues here and certainly the issue of milfoil in Lake George is secondary to the statewide acceptance of this plan, but just as anecdotal information, we are becoming increasing -- finding it increasingly more difficult to control the milfoil in the lake and to keep it under control with available physical methods. And my concern and that of staff scientists working with us on this problem that for oligotrophic lakes like Lake George, the Adirondack lakes along the 87 corridor, this is going to become a more increasing problem because of the insidious growth habits of exotics such as milfoil. At any rate we have with the acceptance hopefully of this General Environmental Impact Statement for SONAR, we may then have an opportunity to use SONAR in some of these lakes that we currently would not be able to use it.

We have had an opportunity to review two earlier versions of this draft and have had an opportunity to put forth input into some of the ecological aspect of the draft and so I am personally pleased with the current version. It certainly can be strengthened, it may need to be in some of the health-related aspect but ecological aspects of milfoil and how it fits in this overall category of aquatic vegetation, native and exotic species, I think that the document is fairly sound. So I would just go on record to say in its present form that the state should consider accepting this document.

Response:

The comment is noted. No further action is necessary.

11. COMMENTS FROM: WILLIAM ALLEN
EAGLE LAKE PROPERTY OWNERS ASSOCIATION, INC.
POUGHKEEPSIE, NEW YORK PUBLIC HEARING
MAY 5, 1994

The Eagle Lake Property Owners, Incorporated supports the acceptance of this draft document entitled "Generic Environmental Impact Statement" as presented, and further requests that the Department of Environmental Conservation expedites the process that will allow Sonar to be used where appropriate for the control of eurasian watermilfoil.

Response:

The comment is noted. No further action is necessary.

12. COMMENTS FROM: DAVID QUENTIN
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF WATER SUPPLY
POUGHKEEPSIE, NEW YORK PUBLIC HEARING
MAY 5, 1994

I have recently read the DGEIS concerning fluridone and glyphosate, and I have two main concerns at this time. I will also submit written comments before the June 6th deadline as well.

The two topics I am concerned with is, one, what would be the impact upon the number of permits issued by the DEC regions within the New York City Watershed System, basically DEC Regions 3 and 4? What would that impact be concerning the other pesticides used? Either, one, would the number of pesticides issued for the pesticides that would complete with fluridone and glyphosate be fewer in number, or would they be still equal in number, or would the number of pesticide permits increase? For instance, would the current number of diaquat and endothall permits stay the same and then additional commercial pesticide applicators ask for permits for these two additional aquatic herbicides, or is what would happen would Sonar and Rodeo compete with the other herbicides and make a decrease in the number happen is that there would just be so few permits because everyone would go to Rodeo and fluridone, would there be actually a decrease in the number of permits issued, so basically I would like to see what would be the impact upon the permitting process in that respect. I'm sorry to have made it so confusing, but I'm trying to get my words out right.

Response:

Please refer to the Responses to Written Comments Section (Appendix G) of this FGEIS, page G-35.

COMMENTS FROM DAVID QUENTIN (CONTINUED):

My second question is concerning the use of these two herbicides near potable water intake. There's a certain distance for each of these herbicides to be used away from potable water intake. If I remember correctly, for Sonar it's 1,320 feet, approximately one-quarter of a mile. I read in the EIS that this distance was chosen as if the pesticide fluridone was applied (inaudible) it would reach a concentration of fifty parts per billion, which is the limit set by the New York State Department of Health, I believe. I would like to know how this was derived, what model was used, what reservoir examples were used to come by this figure of 1,320 feet as New York City reservoirs are possibly different than the reservoirs that were used in the model, the original model, to determine this distance.

Response:

As noted in the responses to Mr. Quentin's written comments, 1320 feet limit is an arbitrary number decided upon by the USEPA. There is no information on the model, if any, used to develop this number. Further investigation of this is outside of the scope and intent of the GEIS.

13. COMMENTS FROM: RALPH TIEDEMANN
EAGLE LAKE PROPERTY OWNERS ASSOCIATION, INC.
ROCHESTER, NEW YORK PUBLIC HEARING
MAY 11, 1994

As Co-Chairman of the Eagle Lake Properties Owners Inc.'s Weed & Pollution Control Cambodia and as a property owner on Eagle Lake, located in Crown Point, Essex County, NY, I would like to offer comments in support of the draft generic Environmental Impact Statement for the use of the herbicide Fluridone.

The document is thorough, easy to understand, answers all my questions and accurately assesses the overwhelmingly negative impact that milfoil has on aquatic environment. When faced with the choice of having either milfoil in our lake or using Fluridone to remove it the choice would be clear, to use Fluridone. Fluridone based on its plant selective design and temporary disruption to the environment, native plants and lake recreational use is the most desirable herbicide of the currently registered and available NYS herbicides.

It is my hope that this document will be finalized and available for use by the various lake associations, water authorities and other caretakers of NYS waters. It is my opinion that there is enough information in this document to call for on-site Environmental Impact Statements (EIS), ie. each lake application site should not have to have its own EIS in order to get through the application process.

It is also hoped that all government agencies involved in the process of permitting the use of Fluridone for control of nuisance aquatic plants work together. This cooperation will hopefully lead to the timely control of the nuisance that is robbing our environment of its natural beauty and recreational value.

Response:

The comment is noted. No further action is necessary.