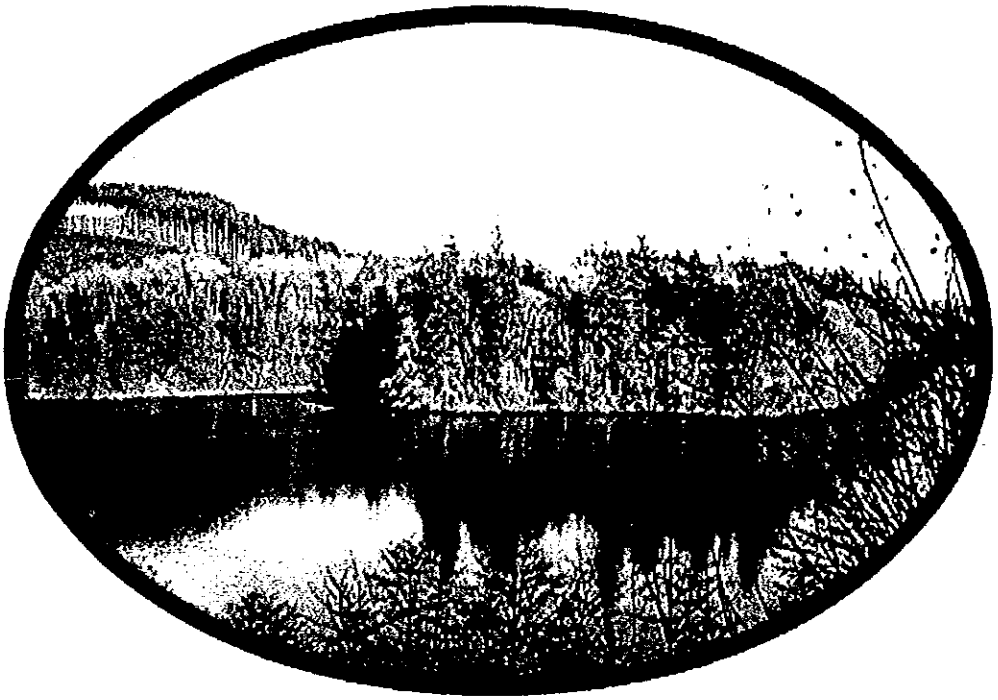
Attachment B

LAKE MCMURRAY
INTEGRATED AQUATIC PLANT MANAGEMENT PLAN

FEBRUARY 1998
FINAL



PREPARED BY:

ENVIROVISION CORP.
in association with
RESOURCE MANAGEMENT INC.

ACKNOWLEDGMENTS

A number of Lake McMurray residents attended all of the steering committee/public meetings held during development of the plan. These 10 to 15 residents consistently participated in the process even though the meetings were held on Friday or Saturday nights. Liz Reese deserves special thanks for coordinating the meetings, scheduling them with the Fire District, setting up the fire hall, and other activities. Dawn Severin with the Skagit County Aquatic Weeds Program was always helpful in providing necessary information, helping with coordination, and providing feedback and guidance. Kathy Hamel, the project manager from Washington State Department of Ecology, provided technical support and current information and updates on the science of aquatic plant control as well as review of the report. Staff from Resource Management Inc., performed plant surveys, provided detailed maps, and helped with development of control scenarios and cost estimates.

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PROJECT OVERVIEW

Lake McMurray, lies approximately 9 miles southeast of Mount Vernon in Skagit County, Washington. It is part of the 2,080 acre Nookachamps watershed. Lake McMurray has a surface area of 160 acres and is the deepest lake in the Nookachamps watershed with a mean and maximum depth of 29 feet and 52 feet, respectively. The lake is one of the most popular lakes for recreational fishing in the region, and is considered to have good water quality.

Following discovery of the invasive aquatic plant Eurasian watermilfoil (*Myriophyllum spicatum*) in Lake McMurray, Skagit County in concert with lake residents, applied for funding assistance. The County was awarded a grant for development of an Integrated Aquatic Vegetation Management Plan (IAVMP) in May 1996. A survey conducted as part of this planning effort was conducted on July 15, 1996. Eurasian watermilfoil was found growing at varying densities throughout the littoral zone intermixed with *Elodea canadensis*. To date, no herbicides have been used to control aquatic plants in the lake.

The Lake McMurray Steering Committee was organized in the fall of 1996 to guide the development of the Integrated Aquatic Vegetation Management Plan. Four meetings were held between September of 1997 and March of 1998. An additional meeting scheduled for June was canceled due to schedule conflicts with the residents. Due to the small nature of the community, steering committee meetings were open to the public and essentially worked as public meetings. During this time the committee completed the problem statement, identified and developed management goals, and reviewed aquatic plant control alternatives. However, no final strategy was selected by the committee. The local community is currently involved in a more urgent issue, and due to the amount of funds that would need to be generated to implement the plan, it was agreed that a decision would be more appropriate at a later time when more of the community can be involved.

This report provides a description of two alternatives for controlling Eurasian watermilfoil in Lake McMurray. Both alternatives rely on the use of Sonar, a herbicide specially formulated for use against this plant. One alternative describes the use of Sonar in a liquid form and the other in a pellet form. These two alternatives were selected to represent different levels of reliability and cost for plant control. It is recommended that these alternatives and new

methods that may become available in the near future, be reviewed and a method selected at the time when lake residents decide to move forward on aquatic plant control.

In addition to recommendations for control of the Eurasian watermilfoil, the plan calls for use of hand control tools and hand pulling to control lily beds, an early detection and prevention program, and public education for long term lake protection.

LAKE AND WATERSHED CHARACTERISTICS

Physical Characteristics

Lake McMurray is part of the 2,080 acre Nookachamps watershed. The lake is 158 feet above sea level and located approximately 9 miles southeast of Mount Vernon in Skagit County, Washington (Figure 1). Lake McMurray has a surface area of 160 acres and a total lake volume of 4,500 acre-feet. The lake is the deepest lake in the Nookachamps watershed with a mean depth and maximum depth of 29 feet and 52 feet, respectively. Physical characteristics of the lake are summarized in Table 1.

The Lake McMurray watershed has been evaluated in detail as part of the Nookachamps Watershed Action Plan (Skagit County 1995). Water enters Lake McMurray from several streams along the western shore and one intermittent stream along the eastern shore (Skagit County 1995). The most northwestern stream is used by anadromous fish and is therefore classified as Type 3 according to the Washington Department of Natural Resources (WDNR). Three streams classified by WDNR as Type 4 (not used by anadromous fish) enter Lake McMurray also along the western shore. A stream with intermittent drainage (Type 5) enters the lake along the northeastern shore. Additionally, there is a Type 9 stream which flows into the lake along the southwestern shoreline. Type 9 streams are those where the water quality does not directly affect other stream types.

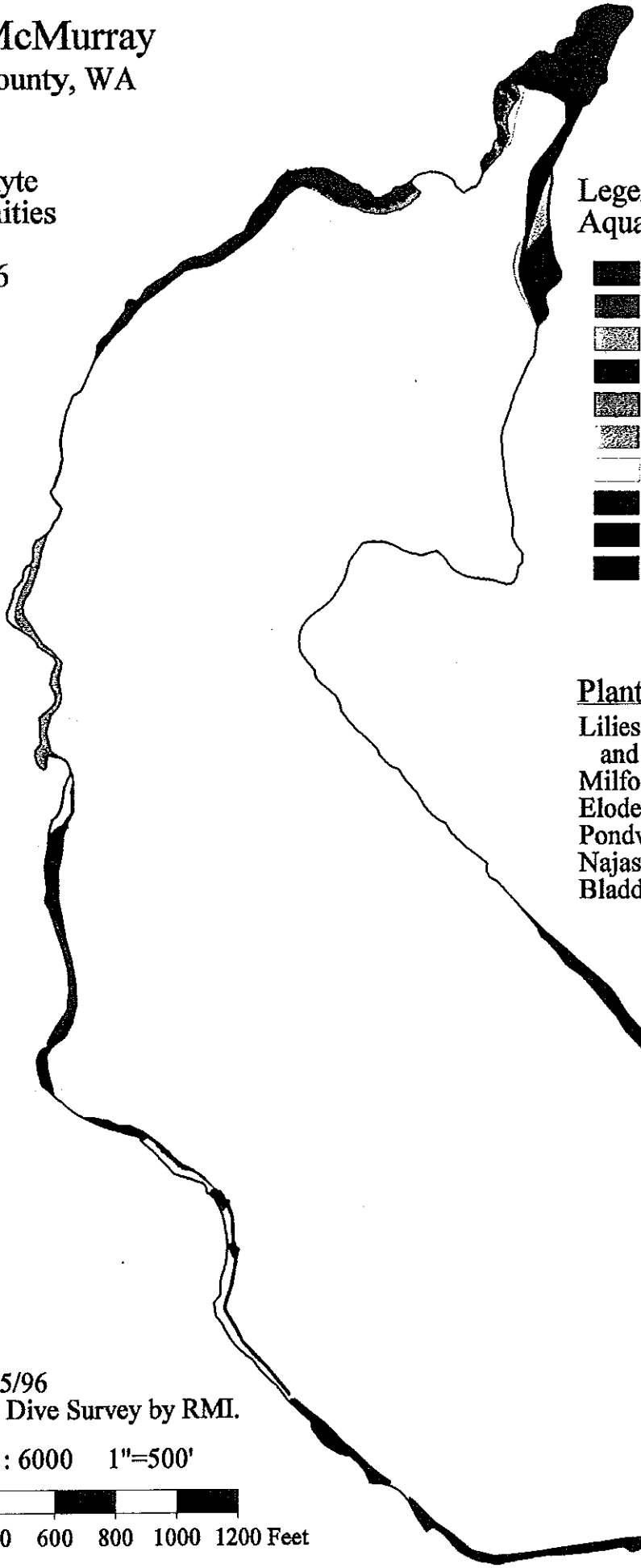
The main outlet for Lake McMurray is Lake Creek located at the northern end of the lake. Lake Creek flows approximately 4 miles before emptying into Big Lake. Flows measured in Lake Creek at the outlet during a 1992 Lower Skagit Project ranged from an average high flow of 5.2 cfs to an average low

Lake McMurray

Skagit County, WA

Aquatic
Macrophyte
Communities

July 1996



Legend:
Aquatic Macrophytes

- Lilies
- Dense Milfoil
- Sparse Milfoil
- Dense Milfoil/Elodea
- Sparse Milfoil/Elodea
- Dense Milfoil/Elodea/Pondweed
- Sparse Milfoil/Elodea/Pondweed
- Najas/Elodea/Milfoil
- Elodea
- Elodea/Bladderwort
- No plants / very sparse

Plant Species:

Lilies: Nymphaea odorata
and Nuphar polysepalum
Milfoil: Myriophyllum spicatum
Elodea: Elodea canadensis
Pondweed: Potamogeton foliosus
Najas: Najas flexilis
Bladderwort: Utricularia minor

Mapped 7/15/96
via SCUBA Dive Survey by RMI.

SCALE = 1 : 6000 1"=500'

0 200 400 600 800 1000 1200 Feet

EnviroVision

RMI Resource Management, Inc.

flow of 2.0 cfs (Entranco 1993). During seasons of extreme rainfall, the level of Lake McMurray has been observed to rise to the point where the lake also drains to the south into the Pilchuck Creek Watershed which is part of the Stillaguamish River system (Skagit County 1995).

Lake McMurray watershed soils are primarily Chuckanut-Cathcart (Skagit County 1995). Soils in this category generally range in depth from 40 to 60 inches, are well drained and found on moderate to steep slopes. The runoff potential for this category of soils is moderately low indicating that infiltration does occur when the soils are thoroughly wet and denuded of vegetation. The soils in the watershed also have a medium potential for mass wasting (Skagit County 1995). Mass wasting refers to a variety of processes both natural and human induced, which cause large masses of earth material to move downslope by gravity (e.g. massive erosion and landslides).

The Lake McMurray watershed has a long history of timber harvesting beginning in 1890 with the founding of the McMurray Cedar Lumber Company at the northwest end of the lake (Skagit County 1995). For almost one hundred years, a mill remained active at the northwest end of the lake under various ownership until finally being demolished in 1969. Second and third growth forests cover most of the surrounding hills in the watershed (roughly 79 percent) and timber harvesting is still active on forested lands. The remaining land use includes some small farms and pasture lands (11 percent) and residential development (3 percent) (USGS 1976; USGS 1985). The town of McMurray (also called McMurray Camp) was established on the west side of the lake in 1891. The town of McMurray is now a small residential community overlooking the lake in the same area McMurray Camp did 100 years ago. Most of the future development in the Nookachamps watershed is expected to take place along the corridors of State Highways 9 and 538 (Skagit County 1995). This could lead to significant changes in land use in the project area since Highway 9 runs through the Lake McMurray watershed and adjacent to the western shoreline.

Much of the water flowing into Lake McMurray originates within the Devil's Mountain Jurisdictional area which includes most of the area north of State Highway 534 and west of State Highway 9 (Skagit County 1995). This property has been given special designation by the Department of Natural Resources (WDNR) for the management of timber harvesting activities to control cumulative impacts.

Table 1. Physical characteristics of Lake McMurray and its watershed.

Characteristic	English Units	Metric Units
Watershed area	2,080 acres	842 hectares
Surface area	160 acres	65 hectares
Lake volume	4,500 ac-ft	5,550,700 m^3
Maximum depth	52 feet	15.9 meters
Mean depth	29 feet	8.8 meters
Shoreline length	13,728 feet	4,185 meters

Water Quality

Water quality data for Lake McMurray is limited. The lake was sampled by the USGS on July 3, 1973 and July 9, 1981 (USGS 1979; USGS 1985). During each of these sampling events, grab samples were collected from a depth of one meter and 13 meters. Results from these sampling events are summarized in Table 2.

Phosphorus concentrations measured at a depth of 13 meters were high, 170 ug/L and 60 ug/l in 1973 and 1981, respectively. During both summers, the dissolved oxygen concentrations at the lake bottom were low (below 2 mg/L). When oxygen concentrations near the lake bottom drop below 2 mg/L, sediments are likely to become *anoxic* (oxygen-starved). Under anoxic conditions, phosphorus bound in the sediments as iron phosphate is released to the water column. As oxygen concentrations increase above 2 mg/L, iron and phosphorus combine to form an insoluble precipitate that settles to the lake bottom. The high phosphorus concentrations at a depth of 13 meters indicates that the sediment at the bottom of the lake are releasing phosphorus during the summer months when the lake bottom becomes anoxic.

Table 2. Trophic State Classification (1)

Trophic State	Total Phosphorus (μg/L)	Chlorophyll *a* (μg/L)	Transparency (meters)
Oligotrophic	< 10	< 4	> 4
Mesotrophic	10 - 20	4 - 10	2 - 4
Eutrophic	> 20	> 10	< 2
McMurray(2)	17 / 10	ND(3) / 1.9	4.3 / 4.3
Lake Outlet(4)	34 / 94	ND	NA(5)

(1) Source: As modified from Gilliom, R.J. and G.C. Bortleson. 1983.

(2) Data shown is from samples collected at a one meter depth on July 1973 / July 1981

(3) ND = No Data

(4) Average high flow concentration and average low flow concentration.

(5) NA = Not Applicable.

The lake outlet, Lake Creek, was sampled several times during 1992 as part of the Lower Skagit Project (Entranco 1993). While not directly comparable to the data collected from the lake, these samples provide information about water quality conditions near the outlet area. Samples collected from the lake outlet had high phosphorus concentrations, particularly during low flow conditions (Table 2). The dissolved oxygen concentrations at the outlet were low relative to the other stations in the Lower Skagit Project, averaging 3.3 mg/L and 8.3 mg/L during low flows and high flows, respectively (Skagit County 1995). The minimum dissolved oxygen concentration measured at the outlet was 1.3 mg/L. Eleven of the 17 samples collected at the outlet fell below the state standard of 9.5 mg/L dissolved oxygen for Class AA waters, the Washington State classification under which Lake Creek falls. The low dissolved oxygen concentrations were not readily explainable and follow-up monitoring and evaluation was recommended.

A common way of evaluating lakes is by their trophic state, which defines a lake in relation to the degree of biological productivity that it supports. Lakes with low nutrients, low algae levels, and clear water are classified as nutrient poor or "oligotrophic". Lakes with high nutrients, high algae levels, and low water clarity are classified as nutrient rich or "eutrophic". "Mesotrophic" lakes have water quality characteristics between these two classifications. "Eutrophication" is a term used to describe the physical, chemical, and biological changes associated with enrichment of a lake due to increases in nutrients and sediment over time. Although eutrophication can be a natural process that occurs slowly over time, it can be greatly accelerated by human activities in a watershed. Natural eutrophication processes occur on a time scale of hundreds to thousands of years and are generally not observable in a single human lifetime. Human induced or "cultural" eutrophication can result from activities within the watershed including development, forestry, resource extraction (i.e., peat mining), landscaping, gardening, and animal keeping. All of these activities contribute nutrients and sediment to surface waters. Sediment inputs from watershed activities results in the slow filling in of lakes which also accelerates the overall eutrophication process. Cultural eutrophication can result in observable changes within a few decades, or less.

Classifying a lake based on its trophic state is a useful way to describe changes in a lakes' water quality over time and assess the potential sensitivity of a lake to additional nutrient loading. Total phosphorus, chlorophyll *a*, and transparency are the three water quality parameters most often used to rate the overall trophic condition of a lake. Phosphorus is one of the essential nutrients for plant and algae growth. Chlorophyll *a* concentration is a measure of the abundance of phytoplankton in a lake. Water transparency is a measure of a lakes color and clarity. Threshold values for trophic state are also presented in Table 2.

Based upon the limited data available, Lake McMurray may be classified as borderline oligotrophic-mesotrophic. The single chlorophyll *a* measurement is low and well within the oligotrophic range. Secchi disk depths also fall within the oligotrophic range. However, the total phosphorus concentrations were within the mesotrophic range.

All of the homes within the watershed use on-site methods of sewage disposal (i.e. septic systems). Soil properties are an important factor in determining whether a given system can be expected to adequately treat waste. Septic system failures can be caused by many factors such as inappropriate soils, inadequate maintenance and upkeep, poor design, poor

installation, and a clogged drainfield. Soils in the watershed to the north, west and south of Lake McMurray are considered to be a high risk for septic tank failure (Skagit County 1995). This means that many of the existing septic systems may be inadequately treating waste and contributing nutrients and other pollutants to the lake. New homes built using today's standards for designs are probably less of a problem because of higher treatment standards. However, even a properly functioning on-site system can only be expected to remove 90 percent of the nutrients. This means that even properly functioning systems may be a nutrient source to the lake.

Fish And Wildlife Community

Lake McMurray has been one of the most popular lakes for recreational fishing in the region (Johnston, J. Personal Communication). There are an estimated 3,000 anglers present on the lake on opening day tapering down to 300 to 450 anglers per day until the season closure on October 31. According to local residents fish caught include; Yellow Perch, Large Mouth Bass, Black Crappie, Rainbow trout, and natives. There are also crayfish in the lake.

The Washington Department of Fish and Wildlife (WDFW) has managed Lake McMurray for many years. The lake is stocked annually in late May with roughly 50,000 fingerling Rainbow trout (Salmo gairdneri) ranging 3 to 4 inches in length, that are expected to reach catchable size by the following year. Since the majority of these fish (approximately 80%) are lost quickly due to predation by birds, and competition with perch and crappie, the fisheries is supplemented between March 15 and April 15 with 17,000 to 18,000 legal size Rainbow trout. The lake has been chemically treated in the past to remove competitive fish species. However, this method of control is no longer taking place due to the potential impact to stream dwelling steelhead trout (Johnston, J. 1997, personal Communication).

Steelhead trout, sea-run cutthroat trout, and coho salmon all spawn in Lake Creek (Johnston, J. personal communication; Beamer, E. personal communication). Surveys conducted by the Skagit Valley Cooperative of Indian tribes have observed Coho salmon in the largest tributary which enters Lake McMurray on the northwest shore.

Open water habitats are important for many wildlife and waterfowl species. The emergent and floating-leafed vegetation along the shoreline provides cover for fish, migratory and resident waterfowl and other birds. Wildlife observed in the area include beavers, otters, deer, cormorants, herons, eagles

(nests), and osprey. There are no rare, threatened or endangered species documented in the area.

Aquatic Plant Community

The aquatic plant community was surveyed on July 15, 1996 to document plant coverage. Baseline aerial photography was used to develop a diver survey protocol. Divers established transect lines perpendicular to the shoreline every 300 feet along the shoreline with additional transects placed at unique shoreline areas such as small coves or near cleared lots. Using a measured polychain line, divers surveyed at five foot intervals along each transect, and data was radio transmitted back to the boat. Plant composition, density, and coverage were recorded. Divers also scanned the area between transects to improve survey accuracy.

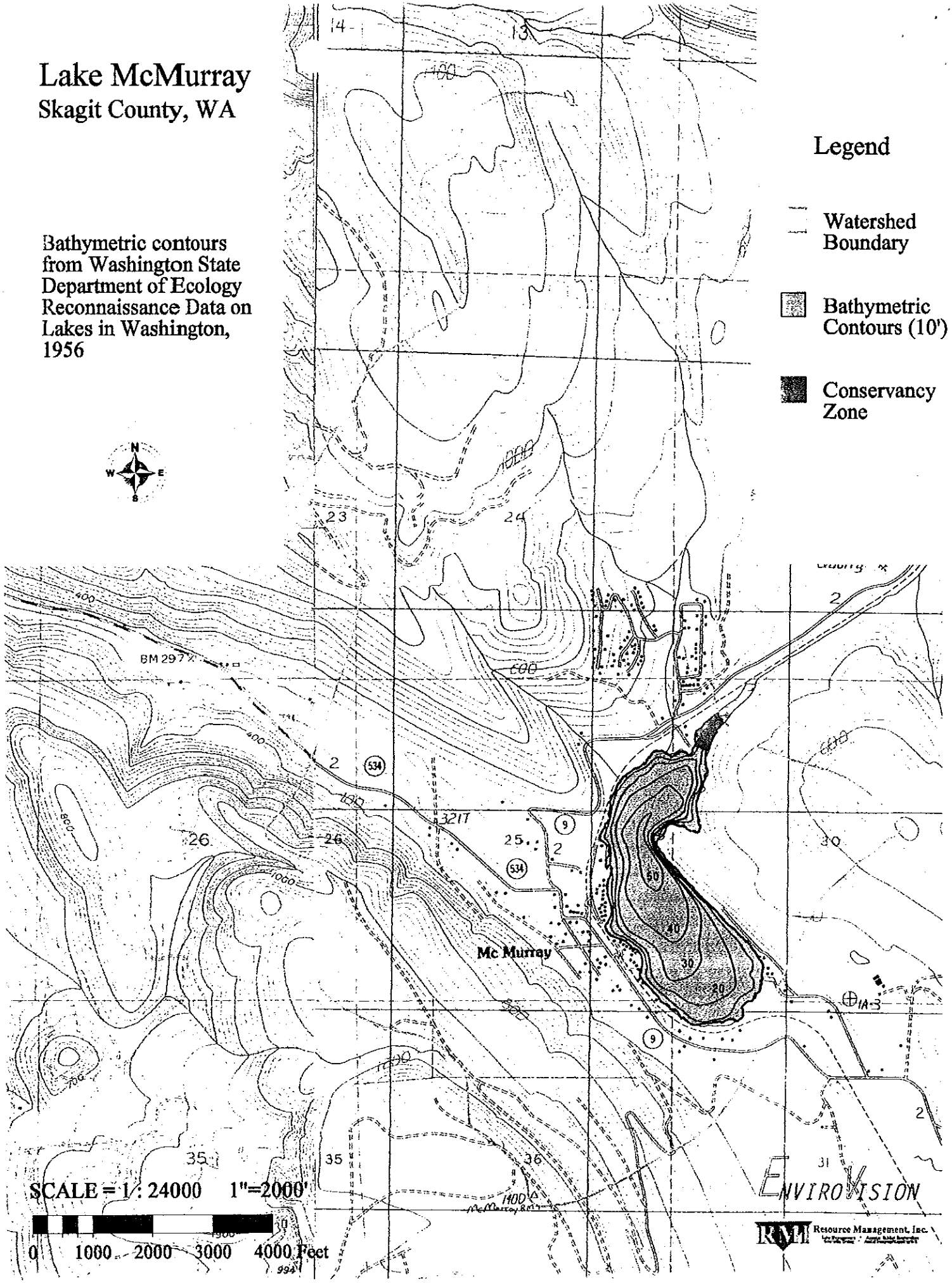
The aquatic plant distribution in Lake McMurray is illustrated in Figure 2. The littoral zone (the shallower portion of a lake where aquatic plants can grow) of Lake McMurray is limited by the steep shoreline slope surrounding most of the lake. Lake McMurray had a total of 11.1 acres of aquatic plants in 1996, of which 3.0 acres were floating leaved plants (lilies), and 8.1 were submerged. Of the 8.1 acres of submerged plants 5.8 acres contained watermilfoil.

The least amount of plant growth occurs around the northeast shoreline from the peninsula area northward. The steep slope of this shoreline, as well as shading by tall trees and submerged logs, limits aquatic plant growth in this area. At the north end of the lake near the outlet, the shoreline slope is reduced and the littoral zone extends further from shore. This northern area is where the greatest diversity and density of aquatic plants occurs. There is also a small transition wetland community at the lake outlet.

Elodea canadensis (waterweed), *Myriophyllum spicatum* (Eurasian watermilfoil) and *Nymphaea odorata* (fragrant white pondlily) were found throughout the lake. Watermilfoil was typically mixed with waterweed with greater densities of watermilfoil occurring at depths up to 10 feet. Water lily coverage in the lake is limited to small patches found largely at the north end and southwest corner near the Fish and Wildlife boat launch. Homeowners along the shoreline have controlled lily growth along much of the shoreline by hand pulling. Other plants observed in the lake were *Potomogeton foliosus (Narrow-leaved pondweed), Najas* spp. (Bushy pondweed), and *Ceratophyllum demersum,* (Coontail).

Lake McMurray
Skagit County, WA

Bathymetric contours from Washington State Department of Ecology Reconnaissance Data on Lakes in Washington, 1956



Characteristic Use

During development of this plan the steering committee was asked to develop a list of beneficial uses the lake provides and identify where those uses occur. Beneficial uses included; swimming, boating (a 5 mph speed limit is in effect in the entire lake), canoeing, sailing, sailboarding, fishing, picnicking, aesthetic enjoyment, wildlife viewing, and fish and wildlife habitat. Public access is provided by a Washington State Department of Fish and Wildlife boat launch located at the south end of the lake. A private resort is located near the north end of the lake. Some of the wildlife that utilize the lake include; salmon, beavers, otters, deer, bald eagles (nesting), osprey, herons, and cormorants. Other than the fact that swimming occurs primarily near the shoreline, these uses are not associated with specific areas and occur throughout the lake.

LAKE McMURRAY PROBLEM STATEMENT

The following list of problems was developed by the Lake McMurray steering committee.

- Eurasian watermilfoil is the major aquatic weed problem in the lake. During low water years the watermilfoil tops are at the surface of the lake and create even greater problems.

- Water lilies are also a problem in certain locations.

The list of problems was used to create a problem statement for Lake McMurray to describe as clearly as possible how the lake and its inhabitants are being impacted by aquatic plants. The following problem statement was developed for the lake:

> *Lake McMurray is a pristine lake which provides important wildlife habitat and offers many recreational opportunities including; fishing, swimming, boating (motor, sailing, canoeing, boarding) and shoreline related activities (aesthetics, picnicking).Beneficial uses of the lake are now threatened by the appearance of the aggressive, non-native plant Eurasian watermilfoil (Myriophyllum spicatum). In the past few years Eurasian watermilfoil has been colonizing the shallow regions of the*

lake. The tall and dense growing nature of this plant can cause excessive deterioration of the quality of the lake and its value to the community. The lake community is concerned about the loss of recreational use of the lake, the long term deterioration in water quality the plants will cause, the safety hazard the plants present to swimmers and boaters, and the commensurate loss in property values.

AQUATIC PLANT MANAGEMENT GOALS

The final step before beginning development of a plant control plan was to define goals against which the program could be evaluated. Setting project goals is an important step because they are used to determine what control strategies will work, and will ultimately be used to evaluate whether the program has been a success. The following list of management goals for Lake McMurray was developed by the steering committee.

- Maintain pristine lake conditions. This includes supporting a diverse and healthy balance of native plant communities at a level to support lakeside residents needs as well as benefit fish and wildlife.
- Remove Eurasian watermilfoil from the lake.
- Control Water lilies in problem areas.
- Develop an educational program that promotes lake and watershed stewardship and provides a greater awareness of the continual threat of noxious weeds and the importance of homeowner Best Management Practices (BMPs) for the long-term protection of Lake McMurray.

RECOMMENDED PLANT CONTROL PLAN

All control alternatives described by Ecology (1994) were considered for use in Lake McMurray. However, since Eurasian watermilfoil is the primary focus of lake problems, control alternatives were quickly reduced to a few potential

methods. Appendix I provides information on the most feasible methods that were presented to the steering committee as possible strategies.

After presenting the range of available alternatives for control of Watermilfoil, two different control strategies were presented to the Lake McMurray community for consideration in selecting a recommended action plan.

- A whole-lake liquid Sonar treatment for the eradication of Eurasian watermilfoil

- A shoreline treatment using a granular form of Sonar to control Eurasian watermilfoil

Detailed descriptions of each of these strategies as presented to the committee is also provided in Appendix I. It is expected that a number of important considerations will change between now and when this plan is implemented. These considerations include; plant community changes, cost of Sonar, availability of other herbicides, new application technologies, and funding available. To insure flexibility for implementation, both sonar application strategies are described in detail in this report and both are considered as recommended options for implementation. In addition, a no-action alternative is included in this section in the event that the committee decides to take no action to control Eurasian watermilfoil.

Eurasian Watermilfoil Eradication

At Lake McMurray, Eurasian watermilfoil is the major aquatic plant concern for the lake. Once Eurasian watermilfoil has infested a lake it will continue to proliferate until it becomes the dominant submerged plant. Fluridone formulated as Sonar® for aquatic application was chosen as the preferred method for Eurasian watermilfoil control or eradication because of its effectiveness in other Washington State lakes, its specificity for Eurasian watermilfoil, and its relatively long duration of control. Sonar is a systemic herbicide which means it is adsorbed by plants and translocated to both roots and shoots. It then inhibits the plants ability to photosynthesize which effectively kills the plant. Effects of Sonar treatment become noticeable within 7 to 10 days of application, with complete control often requiring 60 to 90 days.

Sonar is an herbicide approved for use in aquatic environments by both the State and federal governments. To be approved for use in aquatic environments a herbicide must pass stringent toxicity testing by the Federal government. These tests are designed to assess impacts to the target population (plants) as well as non-target populations such as fish, aquatic insects, and other organisms. The tests also examine what happens to the chemical over the long term to insure it quickly breaks down into a non-toxic form and does not accumulate in sediments or fish tissue. Washington State has set even more stringent standards and many of the aquatic herbicides approved for use by the Federal government are not approved for use in this State. The very low toxicity of Sonar warranted its acceptance as one of a handful of herbicides allowed for use in Washington. Appendix II contains a fact sheet developed by the Washington State Department of Health, that provides more detailed information on this product.

This herbicide is considered to have very low toxicity to aquatic animals and comes with no swimming or fishing use restrictions. The only water use restriction for Sonar applications is a "precaution" against using the water for irrigation. It is recommended that treated water should not be used for irrigation of turf or plants for a period of 14 days. Sonar also impacts submerged plant species other than Eurasian watermilfoil. However, due to physiological differences between them, native plants are generally less affected and recolonize treated areas by the following year. Since Sonar is a chemical control method, there are implied concerns associated with the use of toxins in natural environments. Other than chemical use concerns, the primary environmental drawback of Sonar use is the water quality impact from the release of nutrients by decaying plants. (Since the plants are treated during the summer months, the released nutrients enter the lake system during the period when they are most likely to feed algae blooms.)

Sonar® is applied to the water surface either as a liquid or slow-release pellets (SRP). Application of the liquid form of the herbicide often requires a whole-lake treatment and is recommended for shallow lakes where watermilfoil infestation is or has the potential to spread throughout the lake. The slow-release pellet form of Sonar SRP® was developed to provide greater exposure to plants where currents keep water moving. However, the use of the granular form is also applicable in lakes where colonization is patchy and the infestation potential is limited by a narrow littoral region.

As previously described, neither application strategy was selected as the preferred approach at this time. Costs, application strategies, and available

chemicals for control are expected to change before lake residents move forward on implementing this plan. At that time, this information and new information should be reviewed before deciding on an application strategy. Therefore, both application strategies are described in this report.

Whole-lake Sonar Treatment

This application strategy requires that the entire lake is initially treated with enough of the chemical in liquid form to reach an in-lake concentration of 20 parts per billion (ppb) in the epilimnion of the lake (between the surface and the thermocline) and that a concentration of 10 to 20 ppb is held in the epilimnion for at least a six week period. This requires close monitoring of the lake, and additional herbicide applications every two weeks. Sonar when applied in this fashion has been proven to be highly effective in eliminating Eurasian watermilfoil, when supported by an adequate follow-up program (T. McNabb, Personal Communication). The whole-lake treatment approach is the most reliable and effective of the two strategies proposed, however, it is also the most expensive. Cost for the treatment, including the initial and follow up applications, has been estimated at $110,000. This cost assumes that four lake treatments would be required; one initial treatment at 20 ppb and three additional treatments at two week intervals using 10 ppb (T. McNabb, Personal Communication). This cost includes provisions for the required public notices and permits.

Shoreline Sonar Treatment

In Lake McMurray, application of a Sonar granular treatment (Sonar SRP) could effectively control Eurasian Watermilfoil along the shoreline in target areas (T. McNabb, Personal Communication). In this case, the liquid herbicide is used to saturate clay pellets, and the pellets are applied to plant control zones where they fall to the lake bottom and the herbicide is slowly released. Application of the granular form of the herbicide at the base of the plant beds where water movement is obstructed helps to maintain herbicide concentrations over time. One factor influencing the effectiveness of Sonar® granular treatments is the type of sediment upon which the granules will fall. In watery sediments, such as those in Lake McMurray, or sediments with a high level of organic material, the granules may fall far enough into the sediment to become inactive. This makes repeated applications necessary (T. McNabb, Personal Communication). The more intense labor involved in spreading the pellet form can make its use more expensive than liquid treatment depending upon the extent of the target area.

For Lake McMurray, the maximum target area for use of SRP, was defined as all of the shoreline area that is less than 15 feet deep. This would include the entire existing submerged plant bed and represents an area approximately 23 acres in size. (A smaller area of 10 acres could be targeted and would include only the existing submerged plant beds. However, since the watermilfoil is spread throughout the lake and will continue to spread into new area, treatment of the entire littoral zone is recommended to insure complete treatment.) This application strategy again requires that a concentration of 10 parts per billion of Sonar pellets be maintained in the vicinity of the target area for eight to ten weeks. This would be accomplished with four applications of SRP at a rate of 30 ppb. Sonar SRP application costs for the maximum target area using this application method are estimated at $61,000.

The use of Sonar pellets for eradicating watermilfoil is an emerging technology. Promising results are currently being obtained in a number of lakes in research settings (McNabb, T. Personal Communication). At this time the use of pellets is not considered as reliable a method as use of liquid Sonar in eliminating watermilfoil, however it will provide a very high level of control. More extensive follow-up surveys and contingency funds should be assumed with this method.

Regardless of which treatment method is selected, follow up diver surveys should be scheduled for the three years following the treatment to insure any remaining plants are quickly removed before they can again colonize the lake. A cost of $2,000 per year for the first three years after treatment, has been included in final cost estimates to cover the diver surveys. The Sonar application should also include setting aside contingency money to remove any new infestations found during the surveys. A contingency fund of $5,000 per year should be set aside for at least the first 3 years to allow for this. Contingency actions (and associated costs) will be dependent upon the extent and location of infestations. A few plants spread out over a small area can be hand pulled by divers. Larger infestations that are found in one or two areas may be best controlled by bottom barrier, while larger areas that are spread out through the lake may require spot treatments with Sonar in pellet form (Sonar SRP) or another chemical if others become approved for use in Washington State (e.g. Trichlopyr).

The total cost for the liquid Sonar treatment including follow-up dives and contingency funds is estimated at $136,250 over 10 years, or $13,625 per year if averaged over a 10 year period. The total cost for treatment with pellets, including follow-up dives and etc. is estimated at $87,250 over 10 years, or

$8,725 per year on average. (Note: the cost for Sonar has been steadily increasing and may be expected to continue to rise, therefore these estimates are approximate.)

Alternative Herbicides

Two other herbicides may become available in the near future for use in Washington State which would be applicable for watermilfoil treatment in Lake McMurray. The herbicide triclopyr is a selective herbicide and may be EPA registered for aquatic use by 1999. While triclopyr may be as expensive as Sonar, it may be more effective for spot treatment because it is very fast-acting and the granular form could be dropped directly into the target areas. Another, less expensive alternative, is 2,4-D. This herbicide is also selective and the Washington State Department of Ecology may consider allowing its use specifically for watermilfoil control depending upon the results of the most recent toxicity testing.

Waterlily Control

Waterlily beds were also identified as being problematic for some residents. These beds are comprised of native (Nuphar sp.) and non-native (Nymphaea sp.) species. These provide important wildlife habitat and a necessary diversity of habitat types. The control method for these beds needs to both insure they are largely retained while also allowing lakeside residents with a method of controlling their extent as needed. The largest bed is in the shallow embayment and transitional wetland area located at the north end of the lake by the outlet to Lake Creek. This portion of the lake should be left as conservancy area to protect the outlet and the large wetland system that exists between Lake McMurray and Big Lake downstream. (Conservancy in this case refers to activities other than the initial efforts to rid the lake of watermilfoil.) There are also waterlily beds interspersed around the lake shore. It is recommended that a hand operated tool such as a lake "weed shaver" be purchased for shared use by the lake residents. Tools such as this can be effective at controlling small stands of lilies, but require time and energy on the part of the resident. This should indirectly control the amount of habitat that is removed in any one year from the shoreline. The additional cost for purchase of one or two hand operated cutters and seining nets to trap the plants has been estimated at $1,500.

No-Action Alternative

In the event that no action is taken to control Eurasian watermilfoil it is likely that this invasive plant will colonize most of the littoral region to a depth of roughly 10 feet. The littoral region in Lake McMurray is somewhat limited to a narrow band along the perimeter of the lake due to steep shoreline slopes. The northeast shoreline may exhibit less watermilfoil growth due to shading by shoreline trees and submerged logs.

Uncontrolled growth of Eurasian watermilfoil along the shoreline can cause a variety of ecological problems as the natural, diverse plant community is replaced by monotypic stands. Problems may include loss of habitat for fish and other aquatic organisms. Dense shoreline growth will further impede recreational access to the deeper waters of the lake. In addition, fragments from watermilfoil plants growing in Lake McMurray may thwart efforts to control invasive plants in other lakes as they are transported by unsuspecting boat owners. Fragments may also be transported to Big Lake by way of Lake Creek.

Invasive Plant Prevention and Detection Program

The use of herbicide treatments in Lake McMurray is expected to greatly reduce or eliminate Eurasian watermilfoil from the lake for the time being. However, this plant could return to the lake from the introduction of Eurasian watermilfoil fragments. Other non-native, highly invasive plants of concern include; Parrot feather (*Myriophyllum aquaticum*), Brazilian Elodea (*Egeria densa*), Hydrilla (*Hydrilla verticillata*), Fanwort (*Cabomba caroliniana*), and Water Hyacinth (*Eichhorinia crassipes*). Re-introduction of Eurasian Watermilfoil or introduction of Brazilian Elodea is especially of concern in this lake because these plants already exist in Big Lake which is just a few miles downstream. The focus of control efforts for non-native plants is a prevention and detection program. A contingency plan is also presented in case control of a large area is required.

To be effective this program should include both a source control component (a plan for keeping these plants out of the lake) and a detection program. The objective of source control is to prevent non-native submerged plants from entering the lake. In addition to the threats posed by Eurasian watermilfoil and Brazilian elodea, two now common non-native submerged plants that we have been dealing with for a number of years, there is the more serious

threat associated with the discovery of Hydrilla sp. in King County area lakes. The public boat launch represents an area where there is a high potential for introduction of invasive plants. The addition of boat and trailer wash facilities is sometimes recommended to enhance plant fragment removal. However, this can be expensive to install and it is difficult to regulate use. At a minimum, a sign warning about exotic plant introductions should be placed at the launch with specific instruction on how to properly clean boats and trailers to prevent the spread of plant fragments. This should replace or be used in combination with the current, less conspicuous "Stop Spreading Watermilfoil" warning sign.

Lake residents should also receive informative brochures on an annual basis reminding them of plant invasion problems and the importance of keeping their own equipment free of plants. It is also recommended that the lake community institute some public information campaign for opening day of the fishing season and a few other key weekends. Simply having volunteers hand out brochures for a few hours and help with boat and trailer checks will emphasize the importance of the effort and remind boaters of their responsibility to check equipment.

Early detection is the next step to protect against new infestations. While an infestation is still relatively small there are options for control that are much less expensive than the whole lake treatment methods required at this point. Early detection if done properly, requires both a trained group of lake volunteers who are responsible for occasional patrol of the lake, and periodic (bi-annual) diver surveys to assess the plant community. The main purpose of these surveys is to search for Eurasian watermilfoil and any other exotic plants. However, it will also provide a means for monitoring the native submerged plant community and determining where future control efforts should be focused. Volunteers would be trained each year in plant identification and survey techniques and each would be given the responsibility for surveying a certain section of shoreline once a month during the growing season. Their purpose would be to note any substantial changes in the plant community and to look for new invasions of nuisance species. Professional divers would perform a more complete survey every other year. (While divers are surveying the lake they can determine whether new infestations can be handled by hand pulling the plants or whether, for example, bottom barrier should be installed in a few places to ensure complete control.)

The primary advantage of controlling small infestations is that it reduces the chance that a large area would need to be controlled by a more intensive technique. A drawback of controlling small infestations are the high costs associated with diver surveys and hand pulling. A survey of the entire plant habitat would take approximately 1 day and cost approximately $2,000. (Costs for hand pulling by contract divers range from $500 to $2,400 per day depending upon plant type, acreage, and density.) A volunteer training workshop cost of $1,500 has been included in plan implementation cost estimates.

The exotic plant control plan complements the plan for the eradication of Eurasian watermilfoil. The surveys that occur every two-to-three years would be relied upon to detect new infestations of Eurasian watermilfoil and allow immediate removal of the plants. If Eurasian watermilfoil or another exotic is found, a second dive should be planned for later in the same year to insure there were no surviving colonies. If the area infested is too large to control by hand pulling, or if after two follow-up dives the exotic is still found, bottom barriers would be placed in all areas where the plant was detected. Treatment with herbicide is recommended as a final resort if these efforts do not result in eradication of the exotic plant.

These additional diver surveys, bottom barrier installation, and herbicide treatments are contingency elements to the overall aquatic plant control plan for the lake. Since these costs would only accrue in the event of another infestation by Eurasian watermilfoil or another exotic plant, the costs could be covered through an "early infestation grant" by the Department of Ecology. However, due to grant uncertainties, a contingency fund has been included as one of the plan cost elements, to insure protection of the lake.

Plant Control Advisory Committee

Proper implementation of the described plan relies upon formation of a lake plant control advisory committee. This committee would have the following responsibilities:

- Review annual plant survey information and track potential problem areas.
- Insure permit requirements are met.

- Review submerged exotic plant problems and determine the appropriate control strategy and urgency of control needed.
- Recruit and direct volunteers for annual surveys.
- Select and hire contractors when necessary for tasks such as providing training, spraying, diving, and etc.
- Provide information and newsletters to lake residents and perform as spokes people for answering questions on plant control problems and supporting long term implementation of this plan.

PUBLIC EDUCATION PROGRAM

The public education program for Lake McMurray consists of three parts; the exotic plant prevention plan previously described, educational activities to alert homeowners about lawn, garden, and home keeping best management practices for protecting the lakes' water quality, and annual workshops on the use of the hand cutting tools, plant survey results, and other lake issues.

- All watershed residents should also be sent copies of a Eurasian watermilfoil prevention brochure. A group of lake homeowners should be trained to identify Eurasian watermilfoil and other invasive plants and perform periodic volunteer surveys of the lakeshore.
- To protect the lake from future water quality degradation, lakeside residents should also be provided with a series of informational brochures describing how lawn garden and housekeeping practices can impact lake water quality. Brochures could cover proper landscaping techniques to deter waterfowl and prevent pollution, maintaining a pollutant free zone near the shoreline, providing shoreline fish habitat and other timely subject matter.
- Public education and involvement will also center around the annual plant survey. In the spring of each year the plant control advisory committee should plan a short workshop to describe plant survey results from the past year and their plant control strategy for that year. During the workshop, a schedule should be agreed upon for volunteer

surveys. At this time everyone should be trained or re-trained on plant identification and survey techniques.

Since much lake related public education information is already contained in available brochures, there is little cost associated with developing the information. A $1000 cost has been included for development and reproduction of brochures, with an additional $250 for mailing and postage. It is assumed that the first plant workshop would be done by a professional who can develop a training and survey program. After that the workshops would be put on by lake resident volunteers. The cost for the initial workshop is estimated at $1,500. This cost was included as part of the invasive plant protection program.

Watershed Protection/Pollution Prevention

Lake residents need to monitor watershed related activities to insure that appropriate best management practices (BMP's) are being carried out in nearby commercial and residential developments. This should include; tracking where activities are occurring, reviewing permit applications to insure proper BMP's have been included, reporting violations to permit conditions or water quality standards, and generally keeping informed about the watershed problems. As future development is expected along the State Highway 9 corridor which encompasses most of the tributaries that enter Lake McMurray, watershed activities will have an increasingly significant impact on the water quality conditions of the lake.

Lakeside Stewardship Education

In addition to monitoring watershed activities, each lakeside resident should be educated about how to reduce the amount of pollutants entering the lake from their property, as well as about things they should do to help retain a complex, diverse, and therefore healthier lake environment. The properties located directly adjacent to the lake have great potential for adversely impacting the lake since pollutants generated on these properties have direct access to the water.

Typically, lakeside property owners plant turf grass and ornamental landscapes right to the waters edge. Next, they remove shoreline or riparian vegetation, logs, rocks, and other natural structures to create a large expanse of unobstructed shoreline. The ornamental turf and plants require watering,

fertilizing, and herbicide treatment. This in combination with the removal of shoreline and riparian vegetation means that these fertilizers and poisons have direct and immediate access to the water. The removal of structures (i.e., logs, rocks, and plants) reduces the utility of the area to fish and other aquatic organisms; from turtles and salamanders to dragonflies and butterflies.

Lakeside property owners, as well as property owners adjacent to creeks, should be provided with information about problems associated with typical urban type landscapes around lake and stream shorelines. This should include information on the drawbacks of using ornamental turf (lawns), and the benefits of adding shoreline plants and diversified lawn plantings which create habitat structure for birds and wildlife. Since much of the shoreline and watershed are currently undeveloped, Lake McMurray residents are in a unique position to begin this process of education before lake conditions deteriorate from poor planning.

Some important considerations for proper stewardship of lakeside property are described here. An informative brochure or newsletter articles should be used to educate lakeside property owners about these BMP's:

- If turf and landscaped areas are desired, this area should be limited to no closer than 25 feet to the shoreline. Native plants and grasses should be considered for landscaped areas to decrease the amount of fertilizers, pesticides, and other pollutants used.

- Establish a "pollutant free zone" within 50 feet of the shoreline. Try to keep all pollutants; gas for boats, painting projects, landscape fertilizers and poisons, etc. away from this zone.

- Plant a shoreline buffer of shrubs and tall grasses, preferably native species. This one small activity will cause multiple environmental benefits. If properly designed it will keep geese and other waterfowl from moving onto lawn areas. The vegetation will help filter out pollutants from landscaped areas before they reach the lake. It will provide protection from shoreline erosion, and it will provide habitat for the many wildlife species that utilize nearshore areas.

- Do not remove natural "structure" that exists along the shoreline, or if necessary clean up only a narrow strip alongside the dock area. If a tree along the shoreline finally falls in, leave it. Add structure in the form

of tree tops, twig bundles, and rocks to diversify and naturalize your waterfront area and attract more fish and wildlife.

- Allow emergent vegetation, such as cattails, bulrush, and other plants to colonize some portion of your waterfront area.

PLAN ELEMENTS, COSTS, AND FUNDING

Table 3 provides a summary of each element identified in this plan and the associated costs. Total cost for the plan for the first ten year period is estimated at $136,250 or $87,250 depending upon the control strategy selected. The majority of the cost occurs during the first year when all the plan components are implemented simultaneously. Some items listed for the first year (e.g., volunteer training, and public education brochures) could be offset to the following year to spread out the costs.

To implement this plan a stable long-term funding source would be a great advantage. Formation of a special taxing district or a Lake Management District (LMD) has become the most common way of obtaining funding for lake projects. LMD's are similar to Local Improvement District's (LID) and are formed when a capital project is planned that primarily or wholly benefits only a subset of the local community. Each property owner is assessed a "tax" based on some equitable plan for valuation. For example, the most simple valuation plan for a lake is based on the number of feet of shoreline owned or property size. Rate structures can also be fairly complex taking into account some combination of lakefront footage, property acreage, the extent of improvements, proximity to the lake, and the extent to which the improvement will benefit the property. The development of the rate structure can be critical to approval of an LMD, since voting is weighted to provide one vote for each dollar of tax paid to the LMD.

The Department of Ecology Aquatic Weed Management Program can be applied to for additional funds to implement this plan once it has been approved by the Department. However, this program is not appropriate for use as a long-term funding source because there would be no guarantee from year-to-year that funding would be received.

If exotic plants were found in the lake again after Eurasian watermilfoil was eradicated and it was necessary to implement the exotic plant control portion of this plan, the additional diver surveys, purchase of bottom barrier, and future herbicide treatments required to control re-invasion of Eurasian watermilfoil or invasion by another non-native plant, could be funded through an early-infestation grant from the Department of Ecology Aquatic Plants Program. However, due to grant uncertainties, a contingency fund should still be set aside to cover this possibility.

IMPLEMENTATION AND EVALUATION

The following is a detailed step-by-step approach to implementation of this plan:

Step 1) Set up a Plan Implementation Committee

The first step to implementing the plan is to set up an organization or committee that will take responsibility for it. The lake community will control how and whether the plan is implemented. Many of the tasks this committee will need to carry out are described in the plan under the "Plant Control Advisory Committee" section.

Step 2) Secure a Funding Source

Depending upon the Sonar treatment option selected, plan implementation for the first year will cost an estimated $118,000 or $69,000. Over a 10 year period, implementation of all plan elements would cost an average of $13,600 or $8,700 each year. The source for this money should be identified and a budget created.

Step 3) Apply for a Plan Implementation Grant

Grants for up to $75,000 are available through the WDOE Aquatic Weeds Program for implementation of approved Aquatic Plant Management Plans. There is a 25 percent matching funds requirement for Aquatic Weeds grant funds, although only half of the match need be in the form of cash contributions. Lake residents should work through Skagit County to apply

for these grant funds. Applications are due in the fall. To insure adequate time for preparation of applications, this step should begin by mid-summer.

Step 4) Apply Sonar

A bid to apply Sonar should be prepared for release in winter or early spring. The bid should include application costs and follow-up monitoring to characterize the success of the application. Application should be scheduled to occur by late June.

Step 5) Prepare a Public Education Plan

Contact the Washington Lake Protection Association (WALPA) or the Washington State Department of Ecology to get information about available brochures. There are also may good educational products available through the internet. Encourage lake residents to become members of WALPA. Solicit professionals to volunteer to make presentations to the community and set up dates for presentations. Also develop a newsletter which includes articles describing different lake protection issues.

Step 6) Institute a Long-Term Plant Monitoring Program

Develop a list of lake volunteers interested in conducting annual aquatic plant surveys. Develop a plan for training volunteers, doing the surveys, and handling and reviewing information. Contact profession aquatic plant experts for conducting bi-annual surveys.

Step 7) Conduct Annual Evaluation

Complete a written annual evaluation that describe what elements of the plan have been implemented, relates the existing plant community to established goals, and makes recommendations for the next years activities.

As implied in Step 7, it is important that there is some mechanism in place for periodic evaluation of this plan and determination of whether it is meeting stated goals or whether the goals have changed. This evaluation should be done on a yearly basis. It should begin with a description of which elements of the plan have been fully implemented, which have not, and why. It should also include a summary of the aquatic plant monitoring results, both those obtained by volunteers and those by professionals. These results should be used to aid in the determination of whether goals have been

met. The community should also be asked for input on their satisfaction with plant conditions. (It is possible that the goals will be met, but that some people will still be dissatisfied. Although it is unlikely that everyone's needs will be met, an effort should be made to track concerns, especially if they are widespread.) This information should be used to decide on the following years activities; Does a herbicide treatment need to be scheduled? Has there been a re-infestation of Eurasian watermilfoil? Have any other invasive plants been identified? Do hand tools need to be purchased? Is it necessary to implement the back-up or contingency plan? Over the long-term, adequate annual evaluations can make the difference between project success or failure.

Table 3. Estimated cost for implementation of the Lake McMurray Aquatic Plant Control plan.

	Year 1	Year 2	Year 3	Year 4	Year 5	Total 10 year
Watermilfoil Eradication						
Liquid Sonar(1)	110,000					110,000
Sonar SRP(1)	61,000					61,000
Follow up Dives		2,000	2,000	2,000		6,000
Contingency	5,000	5,000	5,000			15,000
Waterlily Control						
Hand operated Tools		1,500				1,500
Invasive Plant Program						
Signage Improvement	1,000					1,000
Volunteer Training	1,500					1,500
Volunteer Surveys	0	0	0	0	0	0
Public Involvement						
Brochures & Mailing	250	250	250	250	250	2,500
Advisory Comm.	0	0	0	0	0	0
Total Cost/Liquid	117,750	8,750	7,250	2,250	250	136,250
Total Cost/Pellet (SRP)	68,750	8,750	7,250	2,250	250	87,250

(1) Only one of the two options for Eurasian watermilfoil control would be implemented. Selection of the preferred alternative will be made at the time of plan implementation.

SUMMARY AND CONCLUSIONS

Eurasian watermilfoil infestation in Lake McMurray is currently patchy throughout the littoral zone. Without taking some control steps the aerial coverage of the plant is likely to increase and further impede recreational use of the lake. This report details two approaches for controlling Watermilfoil with the use of the aquatic herbicide, Sonar, as well as a no-action alternative. Re-invasion by Eurasian watermilfoil or other non-native plants will be closely monitored through annual diver surveys and a contingency plan is included in case invasions do occur. Public education and awareness programs focus on preventing Eurasian watermilfoil infestations as well as providing general pollution prevention and best management practices information to lake residents. Furthermore, lake residents will be involved in development of the yearly plant control strategy and will be responsible for soliciting volunteers for surveys and plant control activities. This will insure long-term involvement of lake residents in lake management decisions and activities. Implementation of this plan is estimated to cost a maximum of $136,000 or $88,000 over ten years, depending upon the option selected for control. These equate to a maximum average of $13,600 or $8,800 per year.

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APPENDIX I

AQUATIC PLANT CONTROL METHODS and STRATEGIES CONSIDERED FOR LAKE McMURRAY

AQUATIC PLANT CONTROL METHODS CONSIDERED FOR LAKE McMURRAY

The following is a description of the methodologies initially considered for eradication of Eurasian watermilfoil in Lake McMurray. Essentially two methods are available to achieve control of the Eurasian watermilfoil; use of the herbicide Sonar (either in liquid or slow release pellet form) and stocking with Grass Carp. Currently, floating-leaved plants (water lilies) are controlled by homeowners handpulling the plants. Additional methods for the control of floating-leaved plants are included here in the event that the problem warrants further consideration.

EURASIAN WATERMILFOIL ERADICATION

Herbicides - Sonar Treatment

At Lake McMurray, Eurasian watermilfoil is found growing at varying densities throughout the narrow littoral region, mostly intermixed with *Elodea canadensis*. Once Eurasian watermilfoil has infested a lake it will continue to proliferate until it becomes the dominant submerged plant. Of the herbicides currently approved for use in Washington State, fluridone is the preferred herbicide for submerged plant control. Fluridone formulated as Sonar® for aquatic application.

Fluridone is effectively adsorbed by plants and translocated by both roots and shoots and then inhibits carotenoid synthesis. Carotenoids (yellow pigments) are an important part of the plant's photosynthetic (food making) system. The carotenoids protect the chlorophyll (green pigments) from decomposition by sunlight (photodegradation). When carotenoid synthesis is inhibited, the plant is exposed to photodegradation and is gradually destroyed. Effects of fluridone treatment become noticeable within 7 to 10 days of application, with complete control often requiring 60 to 90 days. Within one to two weeks after the first treatment, Eurasian watermilfoil will start to show signs of chlorosis, the tips of the plants and leaves will start to bleach out. It takes approximately 10 weeks for the plant to fall out of the water column. Because it kills the plant and roots it has a relatively long control duration; four to five years. Many of the local native pondweeds may survive exposure to fluridone at moderate to low concentrations.

Advantages of fluridone are that the treatments are low cost coupled with

relatively long-term control of the plants. It is considered to have very low toxicity to aquatic animals and comes with no swimming or fishing use restrictions. The only water use restriction for Sonar applications is a "precaution" against using the water for irrigation. It is recommended that treated water should not be used for irrigation of turf or plants for a period of 14 days. It is a chemical control method and therefore there are implied concerns associated with the use of toxins in natural environments. Other than chemical use concerns, a primary drawback of fluridone use is temporary loss of habitat in the year of treatment. The water quality impact from the release of nutrients by decaying vegetation is also a concern.

Sonar® is applied to the water surface either as a liquid or slow-release pellets. Application of the liquid form of the herbicide is most appropriate for whole-lake treatments and is recommended for shallow lakes where watermilfoil infestation is or has the potential to spread throughout the lake. The slow-release pellet form of Sonar® was developed to provide greater exposure to plants where currents keep water moving. However, the use of the granular form is also applicable in lakes where colonization is patchy and the infestation potential is limited by a narrow littoral region. These two application strategies are discussed below.

Whole-lake Sonar Treatment

Fluridone has been found to be extremely effective at eradicating Eurasian watermilfoil in Washington State lakes through whole-lake treatments. The use of liquid fluridone is most applicable to lake-wide treatments. When used for spot treatments liquid fluridone has a tendency to become dilute resulting in an ineffective treatment. In whole-lake applications fluridone concentrations can be applied and maintained for several weeks resulting in sufficient plant/herbicide contact time to kill targeted plants. Therefore, the control zone typically includes the entire open water area of the lake. A drawback of liquid fluridone is that it requires a whole-lake treatment to be effective and therefore cannot be used to target specific zones and impacts beneficial submerged plants as well as nuisance plants.

Shoreline Sonar Treatment

Sonar® granular treatments have been proven to be highly effective in controlling Eurasian watermilfoil growth along the shore. The herbicide is saturated in clay pellets and the pellets are applied to plant control zones where they fall to the lake bottom and the herbicide is slowly released.

Application of the granular form of the herbicide at the base of the plant beds where water movement is obstructed helps to maintain herbicide concentrations over time. The more intense labor involved in spreading the pellet form makes its use more expensive than the liquid for whole-lake treatments.

One factor influencing the effectiveness of Sonar® granular treatments is the type of sediment upon which the granules will fall. In highly aqueous sediments, or sediments with a high level of organic material, the granules may fall far enough into the sediment to become inactive.

Treatment Protocols

To control Eurasian watermilfoil in a lake system, 10 parts per billion of fluridone must be maintained in the vicinity of the weed for eight to ten weeks. An initial treatment would be made in the early summer at 20 parts per billion. This application rate accounts for the entire volume of the lake where fluridone will mix. Fluridone will begin photodegrading soon after application. Subsequent treatments would be scheduled at two, four, six, and if necessary, eight week intervals. Prior to follow-up treatments, water samples are collected in the vicinity of the target vegetation and analyzed for fluridone concentrations. This data is then used to determine the quantity of herbicide needed to maintain 10 to 20 parts per billion.

Multiple treatments have become the standard application protocol for both liquid and granular formulations of Sonar. This methodology has been used with liquid fluridone to eradicate Eurasian watermilfoil from a number of Washington Lakes including Steel and Killarney Lakes in Federal Way. Sonar granule treatments at Clear Lake, Pierce County were successful at controlling excessive watermilfoil growth along the shore.

Permits are required from Ecology prior to any aquatic herbicide treatment. Once a permit has been granted, a number of public notification requirements must be fulfilled prior to the application.

Treatment Costs

Treatment costs by private contractor range from $700 to $1,000 per acre. It should be noted that the cost per acre used here is taken from an Ecology reference manual for developing aquatic plant management plans. The actual cost of the most recent fluridone (as Sonar®) treatment of Steel Lake

was $15,000 for two applications (one treatment). The higher cost estimate was used to provide the most conservative estimate of the expected cost for implementation of this alternative.

Grass Carp

Grass Carp are plant-consuming fish native to China and Siberia. Sterile (triploid) Grass Carp are raised in the southeast US for lake-wide, low-intensity control of submerged aquatic plants. Known for their high growth rates and wide range of food preference, these fish can control certain nuisance aquatic plants under the right circumstances. Stocking rates depend on climate, water temperature, type and extent of plant species, and other site-specific conditions. In 1990, Washington state adopted Grass Carp regulations that require the following conditions:

- Only sterile (triploid) fish can be planted.
- Inlets and outlets must be screened to prevent fish from getting into other water bodies.
- To insure sufficient vegetation is retained for fish and wildlife habitat, stocking rates are defined by WDFW based on the current planting model.
- Lakes with public access require a lake restoration study.

Effectiveness of Grass Carp in controlling aquatic plants depends on feeding preferences and metabolism. Recent laboratory and field studies in Washington state indicate that thin-leaved Pondweeds and *Elodea canadensis* are highly preferred, broad leaf Pondweed and Eurasian watermilfoil are less preferred, and that Water lilies are generally not eaten. The primary advantage of Grass Carp is the low cost (if a lake restoration study has been performed).

Primary drawbacks are that effects are unpredictable and that all beneficial plants may be removed, resulting in serious impacts to fish and wildlife. It takes a number of years for the Grass Carp population to reach the size where they can effectively reduce the plant population, thus they do not achieve immediate control as chemicals do. Lake residents would need to be willing to accept existing plant populations for a 3-5 year period to allow the carp to grow. The main disadvantage from a management viewpoint, is that the

carp represent an unknown level of control. Results from stocking projects have been mixed. If the stocking rate is too low, the carp are not able to effectively control the plants. Conversely, if stocked too high they can completely eradicate aquatic plant populations. If the latter occurs, there can be serious long-term affects on fish, waterfowl, and other wildlife. In addition, it can be difficult to obtain a stocking permit from Washington Department of Fish and Wildlife (WDFW) due to the potential impacts to fish and wildlife. Because there are salmon in the lake and screening of streams is required, it is unlikely that WDFW would allow a Grass Carp stocking permit.

Costs range from $50 to $2,000 per acre, at stocking rates ranging from 5 to 200 fish per acre and average cost of $15 per fish. However, additional costs would likely include more than $200,000 for an environmental checklist, Phase I lake restoration study, and outlet screening required by the fish planting permit. In addition to a game fish planting permit, hydraulic project approval permit (HPA) is required by WDFW for installation of screens.

FLOATING-LEAVED PLANT CONTROL FOR SMALL AREAS

By character, floating-leaved plants are found in nearshore areas and are most problematic in areas of four feet depth or less. Currently, lily coverage in Lake McMurray is limited to small patches found largely at the north end and southwest corner near the Fish and Wildlife boat launch.

To meet WDFW requirements, the floating-leaved plant control plan must leave a minimum of 25 percent of the lily habitat for fish and wildlife habitat.

Hand Pulling

Hand pulling is a manual method of removing the entire plant, including roots. It is typically performed by divers uprooting individual plants, placing them in a mesh bag, and disposing or composting the removed material. Handpulling is not limited by depth or access problems, and in theory all problem areas could be controlled in this manner. However, it may not be feasible to hand pull waterlily tubers given the size of the root systems. In addition, the labor intensive nature of the work would limit control by this method to a maximum of 2 acres a year. Adequate control may be achieved by hand pulling plants once during early summer of each year in designated areas. Continual use of this method should help limit expansion of plant beds and maintain lower overall densities of the problem plants. The plant

density and the level of effort should decrease in subsequent years.

Costs for hand pulling by contract divers range from $500 to $2,400 per day. The primary advantage of hand pulling is that non-target (beneficial) plants are not removed and may even colonize area inhabited by nuisance plants, due to the large competitive advantage they would be given. The primary drawback is that the target plant in Lake McMurray are water lilies which have really big root systems making hand pulling a difficult task. The high cost per unit area controlled due to the high labor cost is also a drawback. A Hydraulic Project Approval permit (HPA) from WDFW is required for large scale handpulling efforts.

Hand Cutting

Hand cutting is a manual method of cutting stems of aquatic plants close to the sediment surface. Two tools that are most effective on water lilies include the Water Weed Cutter and the Lake Weed Shaver (McComas 1993). The Water Weed Cutter has a V-shaped, straight-edge blade that cuts a 3-foot path. It is best used by throwing it from the shore or dock and pulling it back with a jerky motion. The Lake Weed Shaver has a straight-edge blade that cuts a 6-foot path. Because of its weight, it is best used by dragging it behind a boat. To be most effective, either tool should be used before the water lilies become very dense and the blade must be routinely sharpened.

There is no depth limitations for these tools and therefore the control zone for this method could include any portion of the lake's floating-leaved plant beds. However, since it requires manual labor it is best suited for small patches of lilies that may be hindering lake access. Because plant roots (tubers) are not removed using these tools, the duration of control is comparatively low. The frequency of application is dependent on water depth; monthly cuts will maintain deep areas, but more frequent cuts may be necessary for areas less than 3 feet deep.

Plant fragments should be removed to prevent aesthetic impacts from floating debris and onshore decay of the plant material. In addition, cut tuber (root) fragments of floating-leaved plants will re-root and grow which may cause the lilies to spread to other areas around the lake. Cut fragments float and are best removed with a modified fish seine that encircles small working areas or is positioned down-wind of the working area. The net should have at least a 1-inch mesh so that it will not trap small fish.

Equipment costs are low: $100 for the Water Weed Cutter, $200 for the Lake Weed Shaver, and $500 for a modified fish seine. The estimated 10-year cost is $2,600 which includes purchase of two nets and one of each cutting tool and replacement of the tools after five years. This cost does not include labor provided by property owners. The primary advantage of hand cutting is the low cost and the ability to be very selective about the area controlled. The primary drawback is the high amount of labor required to provide adequate control. It has been estimated to require about one hour to cut a 50' x 100' area when using a boat to assist the effort. A Hydraulic Project Approval permit (HPA) from WDFW is required for large scale handcutting efforts.

Weed Rolling

The Weed Roller is a relatively new product that controls aquatic plant growth by periodically disturbing the lake bottom. The drive head is typically mounted to the end of a dock in water depths of up to 8 feet. It slowly rotates a string of three aluminum tubes which repeatedly roll over a broad arc on the lake bottom. Each 6-inch by 10-foot tube is connected with a flexible coupler to follow the bottom contour. The Weed Roller converts 110-volt household current to 24-volt direct current (DC) and covers up to a 270• sweep in 15 minutes. Adequate control is typically achieved by operating the Weed Roller continuously overnight once every week or two during the growing season.

Since a power source and structural support is required to operate the weed roller, the control zone is limited to area directly adjacent to docks. King County Surface Water Management Division tested the use of these Weedrollers at three lake sites during 1995. The Weedroller was found to effectively decrease waterlily and Eurasian watermilfoil stands from 50-90% coverage to less than 25% coverage with fewer than 12 hours of operation a month. Some temporary indirect affects were noted for increased water turbidity and possibly affects on bottom dwelling organisms.

A complete unit with accessories sells for approximately $2,500. This cost does not include installation and electricity. This tool should not be considered for use on controlling large areas. Advantages of the Weed Roller include the high degree of control, low amount of labor, and the fact that it will control all plant types within its path. The main drawback is the limited area of control. Also, the plant fragments that are formed can cause problems for nearby residents if not removed. The Weed Roller requires hydraulic approval from the Washington Department of Fish and Wildlife.

Bottom Barriers

Bottom barriers are manufactured sheets of material that are anchored to the lake bottom to prevent plants from growing, similar to weed barriers commonly used in lawn and garden activities. Several bottom covering materials have been used with varying degrees of success. A woven polyester material such as Texel (is one of the most effective bottom barriers because it is durable and it provides efficient exchange of gas produced from decaying organic matter (roots). It is typically installed in the winter by unrolling 30x50 foot sections and anchoring them with sand bags spaced 10 feet apart. Bottom barriers should be maintained on an annual basis to ensure adequate coverage and anchoring. Bottom barriers can be relocated to other areas after 2 years if sediment accumulation is not excessive. Re-installation may be necessary to control encroachment of plants in areas adjacent to dense growth.

There are no limits to the control zone for bottom barriers. They are effective in deep as well as shallow water and do not have special requirements that eliminate their use in different areas. The control zone would be defined by the number of 30x50 foot sections installed. Control intensity and duration varies depending upon sediment accumulation and encroachment from adjacent area. If properly installed and maintained annually, bottom barriers can provide a high level of control for five years or more.

The cost of applying bottom barriers is approximately $0.80 per square foot ($35,000 per acre). Annual maintenance costs are estimated to be $3,750 per acre. The primary advantage of bottom barriers is the intense level of control and the ability to be very selective about the control area. The main disadvantage is the high cost per acre controlled. Bottom barriers require hydraulic approval from the Washington Department of Fish and Wildlife.

Herbicides

Glyphosate is typically the herbicide recommended for floating-leaved plant control because of its low toxicity, fairly low cost, and because it kills the entire plant rather than just causing it to die-back. Glyphosate is a systemic herbicide that is applied to the leave of actively growing waterlilies. Glyphosate is formulated as Rodeo® or Pondmaster®. the herbicide is rapidly absorbed by the leaves and translocated throughout the entire plant including the roots. Wilting and yellowing of plants occurs within 7 days,

followed by browning and death. Complete control may require a second treatment in the following year. Submerged plants are typically not affected by a glyphosate treatment.

Duration of control varies with depth and distance to nearest lily bed. Encroachment from adjacent stands of lilies will begin immediately and will be most efficient in nearshore areas. Experience on Steel Lake in the City of Federal Way indicates control from glyphosate should last for a period of three to four years.

The primary advantage of glyphosate treatments are the low cost coupled with relatively long-term control of the plants. It is considered to have a very low toxicity to aquatic animals and comes with no swimming or fishing use restrictions. However, it is a chemical control method and therefore there are implied concerns associated with the use of toxins in natural environments. Other than chemical use concern, the primary drawback of glyphosate use is the water quality impact from the release of nutrients by decaying vegetation. There is also concern associated with the possibility of affecting emergent vegetation from drift of the applied herbicide. Also, herbicides can cause "rafts" of dead roots to form and float around the lake. Hydraulic approval from the Washington Department of Fish and Wildlife is required to remove these "rafts".

APPENDIX II

SONAR INFORMATION SHEETS

Health

Environmental Health

Office of Toxic Substances Fact Sheet

May 1994

FLURIDONE (SONAR®)

WHAT IS FLURIDONE?

Fluridone (1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4(1H)-pyridinone) is a fluorinated pyridinone-based aquatic herbicide (Trade name: Sonar®). Fluridone is a systemic herbicide that is absorbed from water by plant shoots and from hydrosoil by roots. Fluridone controls aquatic plants by inhibition of carotenoid synthesis.

Fluridone has a water solubility of 12 ppm. It was initially registered with the U.S. Environmental Protection Agency in 1986 and is sold in granular or liquid form.

PUBLIC HEALTH

Drinking water. Fluridone cannot be used within 1/4 mile of a drinking water intake. Potential routes of exposure to the general public are: 1) drinking treated water, 2) swimming in treated water, and 3) eating aquatic organisms from treated water. Washington State Departments of Ecology (Ecology) and Health (DOH) reviewed these three routes of exposure and concluded that no adverse health effects are anticipated from exposure to fluridone if used according to label instructions.

Ground Water. No direct ground water contamination issue is associated with the application of fluridone to aquatic sites. There are no label restrictions for drinking (with the exception of 1/4 mile buffer for a potable water intake), swimming, or fishing in water treated with fluridone. Fluridone is degraded primarily by photolysis, biodegradation, and volatilization.

RESTRICTIONS

Recreation. There are no swimming restrictions associated with fluridone treatment.

Agricultural Crops. There is no evidence that ingestion of treated agricultural crops would be of human health concern. Plants irrigated with fluridone-treated water would likely be injured or killed.

Fish. Fluridone has no fishing restrictions and fish are not significantly affected at treatment concentrations. According to Ecology documents reviewed by DOH, ingestion of aquatic organisms does not pose a threat to human health (as calculated from a daily fish ingestion rate multiplied by a bioconcentration factor). The bioconcentration factor of fluridone in fish ranges from 0.9 to 15.5 (a value of 100 is usually regarded as significant). Thus, there is a very low probability that fluridone will bioaccumulate or biomagnify in fish.

TOXIC SPILLS

There have been no reports of significant exposure to fluridone through spills. In case of a large spill, material should be prevented from flowing into streams, ponds, or lakes.

OTHER POTENTIAL CONCERNS

Other Potential Concerns. Fluridone itself has not been shown to be teratogenic, mutagenic, or carcinogenic. However, NMF (N-methyl formamide), a photolytic breakdown product of fluridone under artificial conditions but an unlikely breakdown product under natural conditions, is a potential teratogen, fetotoxin, liver toxin, and cell toxin in animals exposed to elevated levels. NMF has never been observed under natural conditions where fluridone was applied at label amounts. Using data from animal studies and worst-case exposure estimates, Ecology and DOH agree it is unlikely for fluridone and/or NMF to cause harmful effects to humans.

Little research has been conducted on synergistic effects of fluridone with other aquatic herbicides.

Inert ingredients included in the formulation of fluridone are confidential and under control of the parent company. Consequently, DOH requested and received a list of inert ingredients which were then reviewed for toxicity. DOH concluded that these chemicals are not of human health concern at applied concentrations.

FOR MORE INFORMATION

Please contact:

- Your Local County Health Agency
- Washington State Department of Health
  Office of Toxic Substances - (206) 586-5403
- Washington State Department of Ecology
  Water Quality Program - (206) 407-6400
- Washington State Department of Agriculture
  General Information - (206) 902-2010

Copies of this fact sheet may be obtained from your Local County Health Agency, or:

- Washington State Department of Health
  Office of Toxic Substances
  P.O. Box 47825
  Olympia, Washington 98504-7825
  (206) 586-5403

Material Safety Data Sheet

SePRO

Emergency Phone: 317-580-8282
General Phone: 1-317-580-8282

EPA Reg. Number: 67690-3
Effective Date: August 25, 1994

SONAR* SRP Herbicide

SePRO Corporation • Carmel, IN

1. INGREDIENTS: (% w/w, unless otherwise noted)

1-Methyl-3-phenyl-5-(3-(trifluoromethyl)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 1382°F, 750°C

EXTINGUISHING MEDIA: Use water, CO_2 or dry chemicals.

FIRE AND EXPLOSION HAZARDS: Will emit toxic vapors as it burns.

FIRE-FIGHTING EQUIPMENT: Wear full protective clothing and use 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 SePRO Corporation 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
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.

*Trademark of SePRO Corporation

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 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 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. **Note: Existing potable water intakes which 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 SRP treated water may result in injury to the irrigated vegetation. SePRO 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:

	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 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 (*Phllaris 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

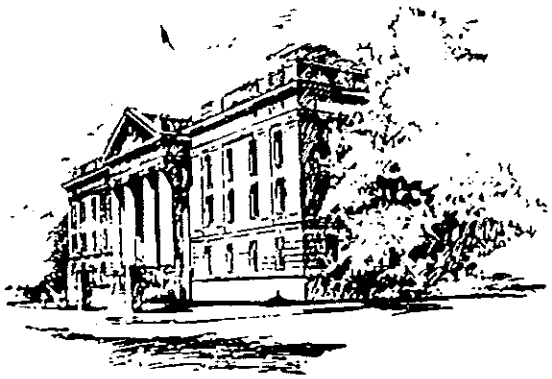
The aquatic plants present in the treatment site should be identified prior to application to determine their susceptibility to Sonar SRP. It is important to determine the area (acres) to be treated and the average depth in order to select the proper application rate. Do not exceed the maximum labeled 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.

Attachment C

Attachment D



SKAGIT COUNTY

BOARD OF COMMISSIONERS
Skagit County Administration Building
700 S. Second, Room 202
Mount Vernon, Washington 98273
(360) 336-9300
FAX # (360) 336-9307

Instructions

Ballot of Property Owners on Creation of Skagit County Lake Management District No. 2 for Lake McMurray

1. The purpose of this ballot is to determine whether to form a new Lake Management District for Lake McMurray. The Skagit County Commissioners have previously held a hearing on this proposal and are now submitting the issue to a vote of property owners. All property owners within the boundaries of the proposed district may vote on this issue.

2. **Ballots must be received by 4:30 p.m. on** November 12th, 1999 by the Office of the Skagit County Commissioners, 700 South Second Street, Room 202, County Administration Building, Mount Vernon, WA 98273.

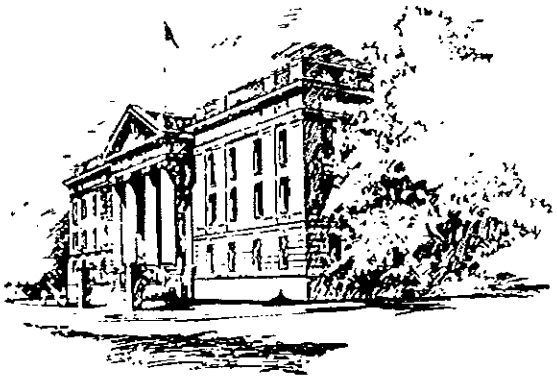
3. **All ballots must be signed by the owner, or reputed owner** of the property according to the Assessor's tax rolls. Other owners including spouses may sign in addition to the owner as shown. Each property owner shall mark his or her ballot for or against the creation of the proposed Lake Management District.

4. The number of votes accorded each property owner is one vote per dollar of proposed Lake Management District charge, as specified by RCW 36.61.090.

5. The ballots shall be tabulated and a simple majority (over 50%) of valid votes cast shall determine whether the proposed Lake Management District No. 2 shall be approved or rejected.

6. If the District is approved, the Skagit County Commissioners will hold an additional public hearing for the specific purpose of considering appeals or correction to assessments. All property owners in the District will be mailed a notice of this hearing. The notice will include specific proposed assessments for each parcel.

Please direct any questions to Mike Cawrse, Skagit County Public Works Surface Water Management at (360) 336-9333 ext. 284



SKAGIT COUNTY

BOARD OF COMMISSIONERS
Skagit County Administration Building
700 S. Second, Room 202
Mount Vernon, Washington 98273
(360) 336-9300
FAX # (360) 336-9307

Ballot on creation of Skagit County Lake Management District No. 2 for Lake McMurray

Return by mail or in person to the Office of the Skagit County Commissioners by 4:30 on November 12th, 1999.

(See attached instructions and resolution for additional information)

Question: **Shall Lake Management District No. 2 be formed?**

Yes _____

No _____

_____
Signature of Property Owner

_____
Signature of Property Owner (if applicable)

Property you own within the proposed District (according to the records of the Skagit County Assessor), and the proposed Lake Management District charges to your property are shown below. One vote is allocated per whole dollar of proposed LMD charge, as specified by RCW 36.61.080.

Parcel Number:
Property Owner:
Proposed LMD Charge:

Chapter 36.61 RCW requires receipt of the ballot at the above address by the designated time. Ballots received after that time are not valid, even if post-marked earlier.

Resolution No. _____

A RESOLUTION SUBMITTING ESTABLISHMENT OF SKAGIT COUNTY LAKE MANAGEMENT DISTRICT NO. 2 FOR LAKE MCMURRAY

WHEREAS, the Board of County Commissioners for Skagit County adopted Resolution No. 17084 on July 28, 1998 setting out its intention to consider formation of Skagit County Lake Management District No. 2 for Lake McMurray.

WHEREAS, a public hearing was held on September 1, 1998 to consider formation of Lake Management District No. 2 for Lake McMurray and Skagit County Lake Management District No. 2 or other public comments regarding the proposal; and

WHEREAS, representatives from the Department of Ecology and Department of Fish and Wildlife had the opportunity to make presentations and comments on the proposal;

The Board of Skagit County Commissioners makes the following findings of fact:

1. A: Broad public support as evidenced by the petitions and other written evidence submitted by Lake McMurray community, as well as input from community meetings.

   B: The invasion of non-native aquatic plants threatens water quality and fish habitat.

   C: The invasion of non-native aquatic plants represents a threat to the safety of swimmers and small boat operators who risk entanglement in the weeds.

   D: An aquatic plant management plan was completed and published in February 1998 detailing an environmentally acceptable means of managing aquatic weeds in Big Lake and restoring a more natural ecosystem to the lake.

2. The financing of the lake improvement and maintenance activities is feasible since the revenues to be raised match the activities set out in the proposed plan for Skagit County Lake Management District No. 2 as set out below.

3. The plan for proposed lake improvement and maintenance activities avoids adverse impacts on fish and wildlife and provides measures to protect and enhance fish and wildlife. The plan is as follows: Sonar ™ aquatic herbicide treatment concentrating on Eurasian Watermilfoil growth region in pellet form; Post-application surveys to locate remaining exotic plant colonies; sonar follow-up application; Benthic barrier installation and/or hand-picking for remaining exotic plants; possible Benthic barrier installation for individual homeowners providing swim areas within dense native plant growth.

Estimated Cost Summary for Implementation of the Aquatic Plant Management Plan for Lake McMurray							
	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6-10	Total 10 Year
Watermilfoil Eradication							
Liquid Sonar*	126,200						126,200
Follow up Dives		3,000	3,000	3,000			9,000
Contingency	15,000	15,000	15,000				45,000
Waterlily Control							
Hand-operated Tools		1,500					1,500
Invasive Plant Program							
Signage Improvement	1,000						1,000
Volunteer Training	1,500					250	1,750
Volunteer Surveys	0	0	0	0	0	0	0
Public Involvement							
Brochures and Mailing	460	250	250	250	250	1,250	2,710
Advisory Committee	0	0	0	0	0	0	0
Total Cost	**144,160**	**19,750**	**18,250**	**3,250**	**250**	**1,500**	**$187,160**

**Use of Sonar SRP (pellets) may lower the total.*

4. Lake Management District No. 2 will exist for a period of ten years.

5. The amount to be raised through rates and charges is $187,160, collectible in annual assessment over ten years.

6. The rates and charges to be imposed are as follows:

ANNUAL REQUIRED FUNDING			
TYPE	**# OF PARCELS**	**RATE**	**REVENUE**
Residential Waterfront Parcels	116	$ 116	$ 13,456
Benefiting Property Owners of Community Access Parcels	105	$ 28	$ 2,940
WA Fish and Wildlife Boat Launch	20 Residential	$ 2,320	$ 2,320
		Annual Generated Revenue	$ 18,716

While not anticipated at this time, it is possible bonds, including revenue bonds, could be issued that would be payable from the assessment.

NOW, THEREFORE, BE IT RESOLVED by the Skagit County Board of Commissioners that the question of whether to form Skagit County Lake Management District No. 2 for Lake McMurray be submitted to the property owners within the proposed district; ballots for said question to be returned to the office of the Board of Skagit County Commissioners, 700 South Second, Room 202, Mount Vernon, Washington 98273 no later than **November 12th, 1999.**

PASSED this_____ day of _____ 1999.

BOARD OF COUNTY COMMISSIONERS
SKAGIT COUNTY, WASHINGTON

ATTEST:

_____
TED W. ANDERSON, Chair

_____
HARVEY WOLDEN, Commissioner

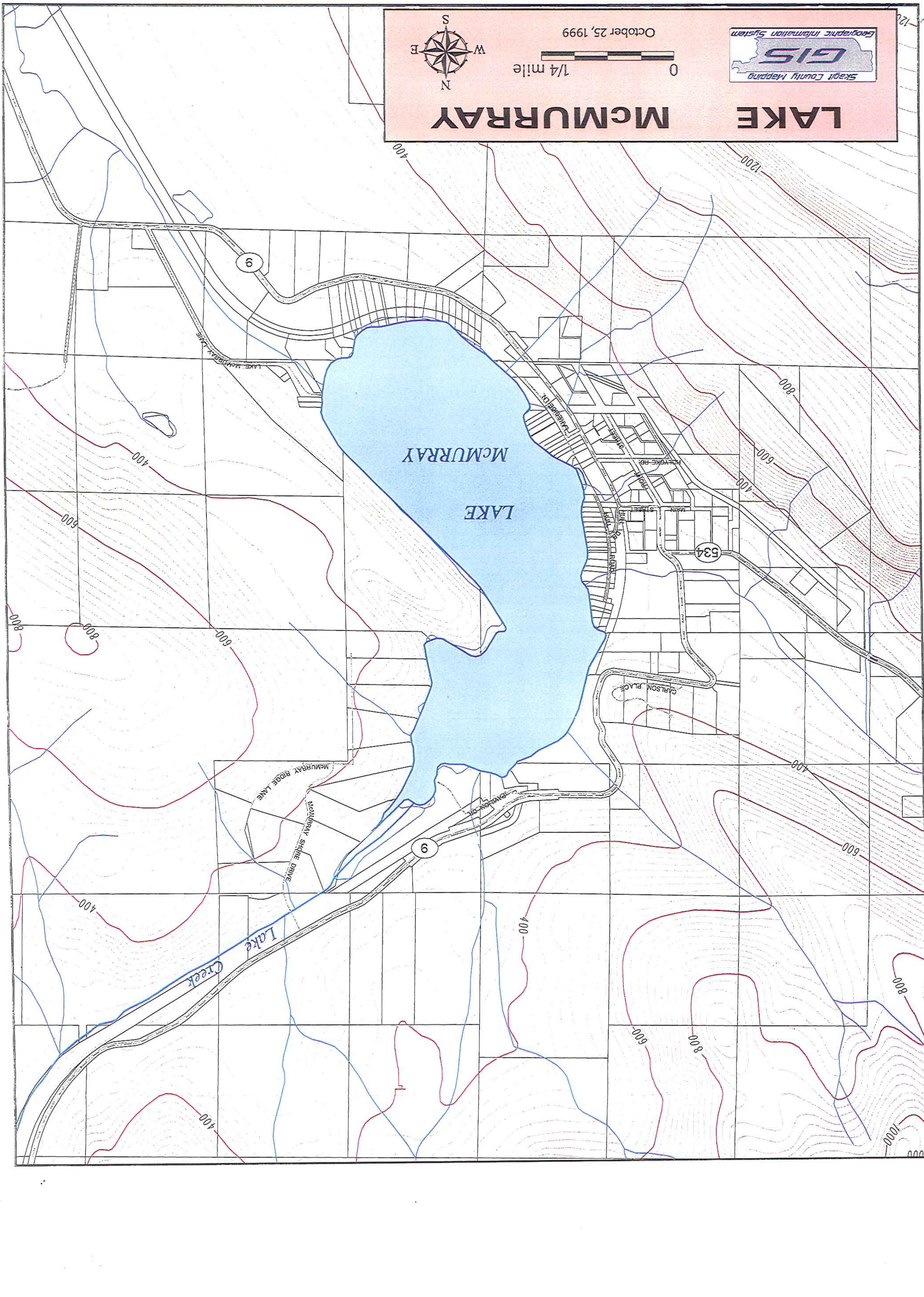
_____
ROBERT HART, Commissioner

_____
Patti J. Chambers
Clerk of the Board

APPROVAL AS TO FORM:

_____
Hilary A. Thomas
Civil Deputy

NOTE: Ballots mailed by approximately October 6, 1999. Balloting period must be 20-30 days long.



Attachment A