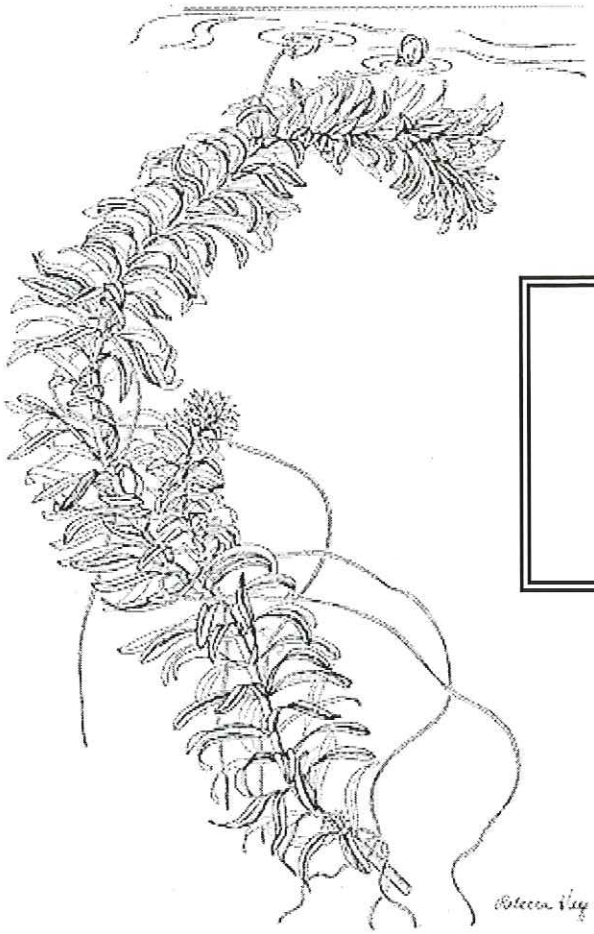


Lone Lake
Brazilian elodea Project

An
Integrated Aquatic Vegetation Management Plan

- Draft-

Developed in Cooperation With

Lone Lake
Homeowners Association

Island County
Noxious Weed Control Board

Washington State Department of Ecology

ACKNOWLEDGEMENTS

A community comes together to make a project of this nature successful. Many people have put their time, thought and energy into the success of the Lone Lake Brazilian elodea Project. This is to acknowledge their efforts and dedication to the restoration of Lone Lake.

Lone Lake Steering Committee

Pat Clark, Jan Clark, Steve Ford
Kathy Hamel, John Lees, Mark Miller
Bonnie Murdock, Ron Murdock, Ellen Nelson
Gil Nyerges, Dick Robbins, Bill Russell
Scott Strodel, Larry Tsunoda

The Fishing Clubs – Gil Nyerges

Alpine Fly Fishers ▪ Clark-Skamania Fly Fishing Club ▪ Clearwater Fly Casters Columbia Basin Flycasters ▪ Dryside Fly Club ▪ Evergreen Fly Fishing Club Fidalgo Fly Fishing Club ▪ Foufth Corner Fly Fishers ▪ Greywolf Fly Fishing Club Inland Empire Fly Fishing Club ▪ Lower Columbia Fly Fishers ▪ Methow Valley Fly Fishers ▪ Northwest Fly Anglers ▪ Northwest Fly Fishers ▪ Olympic Fly Fishers of Edmonds ▪ Overlake Fly Fishing Club ▪ Puget Sound Anglers – Oak Harbor ▪ Puget Sound Anglers – South ▪ Puget Sound Fly Fishers ▪ Seattle Police Department Fly Fishing Club ▪ South Sound Fly Fishers ▪ Spokane Fly Fishers The Fishin' Club ▪ Washington Council – FFF ▪ Washington Fly Fishing Club Wenatchee Valley Fly Fishers ▪ Yakima River Fly Fishers

The Audubon Society
Steve Ellis

South Whidbey Parks and Recreation District
Lee McFarland and Linda Kast

Whidbey Island Conservation District
Carol Osterman

State Agency Staff
Kathy Hamel, Department of Ecology
Larry Tsunoda and Doug Thompson, Department of Fish and Wildlife

Board of Island County Commissioners
William J. Byrd, Chair, William L. McDowell, Mike Shelton

Island County Noxious Weed Control Board
Sheila Case-Smith, Chair, Tom Eisenberg
Ron Muzzal, Bill Stipe, Fred VanBenshoten

Island County Staff

Washington State University Cooperative Extension, Island County
Debbie Thompson, Prosecutors Office, Joshua Choate, Prosecutors Office
Kathleen Parvin, Environmental Health, Doug Kelley, Environmental Health
Sandy Sandritter, Public Works

Consultants
Doug Henderson, ReMetrix, Ryan Moore, ReMetrix
Scott Ruch, ReMetrix, Terry McNabb, ReMetrix

EXECUTIVE SUMMARY

This project was initially undertaken to reduce the abundance and density of aquatic vegetation in Lone Lake. Though the goal of eradicating *Egeria densa* will continue to be the primary focus of this project, the participants now see the wisdom in taking a holistic approach to lake health. The implementation project will work to eradicate both *Egeria* and *Lythrum salicaria*. A lake stewardship program will be developed to monitor water quality and reduction in infestation. There will be an on-going commitment to public outreach and education.

The Lone Lake Brazilian elodea Project Steering Committee, for purposes of IAVMP development, reviewed all methods currently available for noxious weed control. They carefully considered whether or not these methods can be applied effectively against the infestation in Lone Lake. They believe it is necessary to use an integrated approach toward control in order to eradicate the *Egeria*. A three-year intensive control plan formulated in the Lone Lake Integrated Aquatic Vegetation Management Plan will be followed to achieve the goal of eradication. The lake will be treated with herbicide followed by the introduction of Triploid Grass Carp as a biocontrol agent. These control methods will be implemented in conjunction with lake monitoring, surveying and an educational outreach component to ensure long-range health of the lake. In subsequent years, control efforts will focus on the remaining localized infestations. Hand pulling and bottom barriers will be employed to eliminate these smaller infestations.

The one known Lythrum salicaria site is currently being managed with biocontrol agents and mechanical removal. Additional biocontrols will be released, if necessary, and mechanical control will continue. In the future, this site will be monitored by the Lone Lake Stewardship program and the Bioagent Enhancement Program.

Table of Contents

INTRODUCTION

Lone Lake is located on the south end of Whidbey Island in rural Island County, Washington. The lake is located 2.5 miles southwest of the city of Langley and one mile southeast of Goss Lake. It is approximately 101 acres in size having a maximum depth of thirteen feet and a mean depth of seven feet. The lake is fed by two small inlets and drains into Useless Bay. Lone Lake has 1.6 miles of shoreline with 44 waterfront homes and a residential community of over 100 homes having access to the lake. It is designated a Trophy Lake by the Washington State Department of Fish and Wildlife providing some of the best trout fishing in the state. Washington State Department of Ecology surveyed Lone Lake in 1996. At that time, the lake was determined to be macrophytic and eutrophic. The predominant species was identified as *Potamogeton praelongus.* Ecology found high levels of total phosphorus with heavy epiphytic algal growth associated with the *Potamogeton praelongus*. Surface water monitoring (swim beach surveillance) takes place yearly and only on a few occasions have those limits exceeded the normal range. In the summer of 2003, it was brought to the attention of the Island County Noxious Weed Control Board (ICNWCB) and Ecology that plant growth in the lake had reached unacceptable levels. Historical uses of the lake are now in jeopardy due to the very high levels of one plant species in particular. Swimming, boating and fishing are becoming increasingly more difficult and far less enjoyable. Concerns with safety on the lake are increasing. Another fear is that property values will decline. Concerned homeowners took samples of the weed species to a workshop held by Ecology. There, Ecology identified the sample as *Egeria densa*. The Washington State Noxious Weed Control Board has listed *Egeria* as a Class B Noxious Weed Species designated for control in Island County.

PROBLEM STATEMENT

The introduction of Brazilian elodea (*Egeria*) is changing Lone Lake. People are finding it increasingly difficult to use the lake for fishing, boating, swimming and other traditional activities. Lone Lake has been identified as a macrophytic lake (Ecology, 2004). There has always been an abundant plant population in this lake environment. However, over the past several years the over abundance of Egeria has severely impacted beneficial use of Lone Lake.

Swimming safety is an issue and can no longer be enjoyed in Lone Lake. Shoreline property owners no longer allow their children to swim in the lake fearing entanglement. The children willing comply (Steering Committee, 2004). The South Whidbey Parks and Recreation District sponsors an annual triathlon. The swimming portion of the Whidbey Island Triathlon is held in Lone Lake. Vegetation, now, reaches the water surface along the course. Becoming entangled in the weeds makes the swim more difficult and far less enjoyable for

the participants. Triathletes have approached the Island County Noxious Weed Control Board wanting to know what can be done about the abundance of vegetation in Lone Lake and when they will see some relief (Hall, 2004). For practical purposes, Lone Lake is the only lake that can be used for this triathlon. The other lakes in the area are Goss and Deer Lakes. The staging area at Goss Lake is not large enough for this event. If Deer Lake were to be used, the triathlon would have to cross a state highway. This is a high quality event, in its ninth year, that draws approximately 250 participants. Many participants train year-round in anticipation of this triathlon. Some participants come from off island and remain over night. The local area would be negatively impacted if the Whidbey Island Triathlon were no longer held (Lone Lake Brazilian elodea Project Proposal, 2003).

Boating has already been impacted. Homeowners are pulling their boats out of the water because enjoyment has declined and there is an increase safety concerns. Kayakers and canoeist are now unable to paddle the lake as they once could. The potential for boating and/or swimming accidents to occur is increasing. Competition for the decreasing open space available in the lake is bringing motorized boats closer to swimmers and fishermen.

Water skiing is increasingly more difficult. One well accomplished water skier is convinced that a fall, resulting in an injury, was caused by the water ski becoming entwined in the vegetation. This caused the motion of the ski to rapidly decelerate bending the skier's leg backward resulting in hamstring damage.

Fishermen, more than most recreational lake users, understand the importance of aquatic vegetation. Over the past several years they, too, have become concerned with the environment in Lone Lake. The fishermen often use float tubes while fly-fishing. It has become increasingly more difficult to navigate the lake in float tubes because vegetation now reaches the surface through much of the lake. This has also reduced the usable portion of the water column for fly-fishing. It has made the use of lures virtually impossible. Lone Lake has a Washington Department of Fish and Wildlife Trophy Lake designation. The fishing clubs were instrumental in having Lone Lake designated as such, because they have enjoyed consistently catching large trout when fishing this lake. The fishermen are concerned that monotypic stands of Egeria will cause an overall reduction in the size of trout. These dense mats and entangled stems cause mature fish to lose foraging space. They become less efficient at obtaining prey and the quality of foraging material declines. Egeria does not support the abundance of invertebrate species that a macrophytic lake with native species would (Aquatic Ecosystem Restoration Foundation (AERF), 2004). This, along with the reduction in open space could lead to a population of small fish.

The Lakefront homeowners fully understand the potential for property values to decline if this noxious weed is left uncontrolled. Over time, the

impenetrable mats of Egeria can decrease water flow and trap sediments. Water depth has decreased since the 1996 Ecology survey. This may very well cause an increase in flooding (AERF, 2004). If lake sedimentation increases and the abundance of invasive plant species increase then the Lone Lake environment may very well shift toward characteristics more normally associated with bogs. This will reduce the esthetics of the lake resulting in lower property values.

MANAGEMENT GOALS

The ultimate goal for implementing this Integrated Aquatic Vegetation Management Plan is to eradicate Egeria from Lone Lake while protecting habitat. The first three years of implementation, will consist of intense control efforts put forth to achieve eradication. The key people in this project are well aware of how difficult it is to eradicate Egeria. They are dedicated to tracking the reduction of infestation and if necessary, maintaining the Egeria population at very low levels in the lake. The hope is that these control efforts will restore the lake to a more natural state and that beneficial uses will return.

In the course of developing the Lone Lake IAVMP, the Steering Committee has carefully considered the health of not only Lone Lake, but the wetlands adjacent to the lake. Because of the Priority Habitat status given to Lone Lake and the adjacent wetlands, it is critical that control methods used to eradicate *Egeria* and *Lythrum* do not harm the ecosystem or the species it supports. Implementation of this plan will make it possible for native vegetation to reestablish in the lake environment and along the shoreline. Native vegetation is known to provide better habitat for fish and wildlife by supporting a more diverse food supply than monotypic stands of invasive plant species. Implementing this IAVMP will help to ensure the preservation of this unique waterfowl habitat and fishery as well as restore beneficial uses of the lake.

Eradication of *Egeria* will make it possible and more desirable to continue the tradition of the Whidbey Island Triathlon. It will be safer and more enjoyable because of it. Local merchants will continue to enjoy the benefits of business generated as a result of the triathlon event.

With a decrease in BioVolume (percent of the water column filled with plants), open water surface area will be increased. This increase in usable water surface area will make it safer for swimmers. Their safety will be enhanced by decreasing the competition from other recreational users of this same space. Swimmers will also be in less contact with the vegetation, reducing the possibility of entanglement.

Paddling boats through the lake closer to shore will, again, be possible and pleasurable. The area of the lake where vegetation reaches the surface will be pushed back to the margins. The water column will be free of vegetation from the surface down several feet, in an increased percentage of the lake. The

frequency of a paddle coming in contact with vegetation will decrease. This will enhance the freedom of motion desired by participants in this sport at this site.

Water-skiers will once again be able to enjoy their sport without fear of injury. The larger surface area devoid of vegetation will benefit the skiers, in that it will create a safer environment. Water-skis will no longer become entangled in the vegetation and the greater open space will give them more room to maneuver.

The implementation of this IAVMP will work to return native species as the dominant submersed vegetative cover in Lone Lake. The goal is for native vegetative cover to fall in the range of 20-80%, in support of fish habitat (AERF, 2004), and help preserve this unique fishery. A reduction in BioCover (percentage of lakebottom covered with plants) and BioVolume will make the use of fishing lures in Lone Lake once again possible. It will also increase the depth of water column usable in fly-fishing. Those using float tubes will have enhanced freedom of movement.

Eradication of Egeria from this environment will help eliminate the concerns due to abundant vegetation and the esthetic value of shoreline property. This will help to protect Lone Lake shoreline property owners' investment.

CHARACTERISTICS OF THE WATERSHED AND WATERBODY

GENERAL INFORMATION

Lone Lake is located 2.5 miles southwest of the city of Langley and one mile southeast of Goss Lake. This portion of Island County is unincorporated and has tripled in population over the last 30 years (Island County Planning Department, 2004). Lone Lake has 1.6 miles of shoreline. The shoreline parcels are zoned rural, rural residential, rural agriculture and rural forest. There are 44 waterfront homes and a residential community of over 100 homes adjacent to the lake. This long-plat, known as Lone Lake Terrace, owns a lake-front parcel as a community, allowing them access to the lake (Figure 1). Along with growth in population there has been road construction, parcel development and timber harvesting in the vicinity of Lone Lake. (Island County Public Works, archived permits) (Lone Lake Brazilian elodea Project Steering Committee (LLBePSC), October 10, 2004). Timber has been harvested on the west side of the lake (Strodel, 2004) where slopes are 40% and greater. There is at least one large shoreline parcel in agricultural use near the critical areas associated with Lone Lake (Figure 2).

Lone Lake is found at an elevation of seventeen feet. It is approximately 101 acres in size having a maximum depth of thirteen feet and a mean depth of seven feet (Figure 3). The maximum depth determined by ReMetrix in the survey performed in September 2004 is four feet less than that recorded in the Ecology survey of 1996. The lake volume in 1996 was recorded to be 909 acre-

Figure 1. Land Use Map, Lone Lake and Vicinity

Island County Planning Department

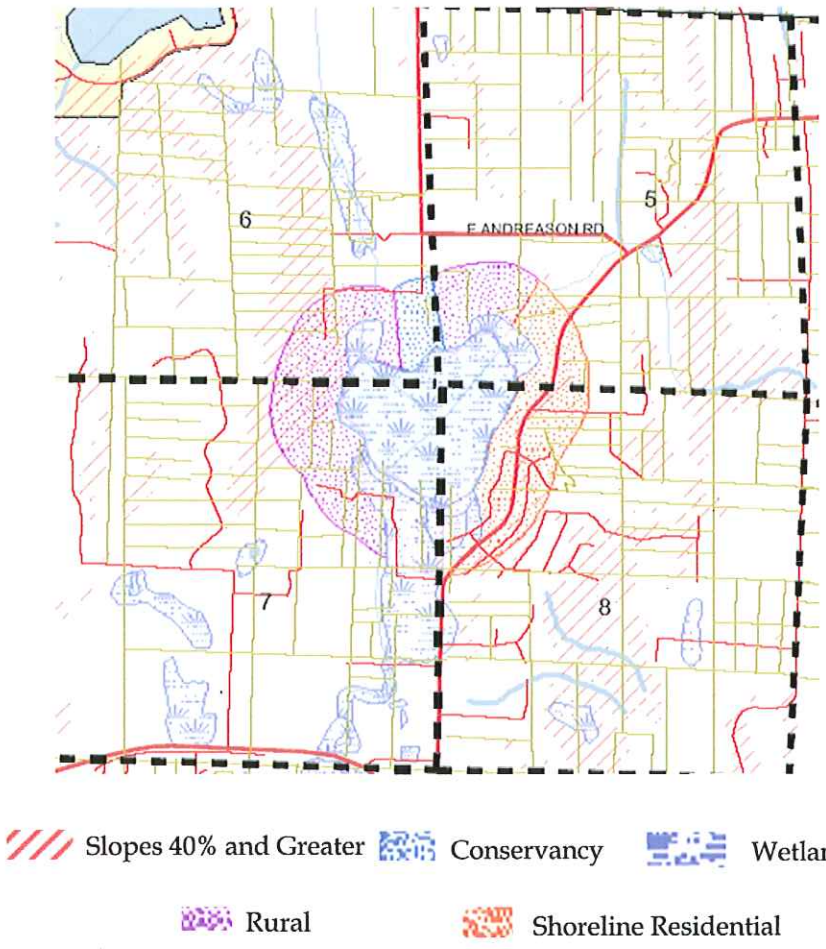


Figure 2. Critical Areas Map, Lone Lake Vicinity Island County Planning Department

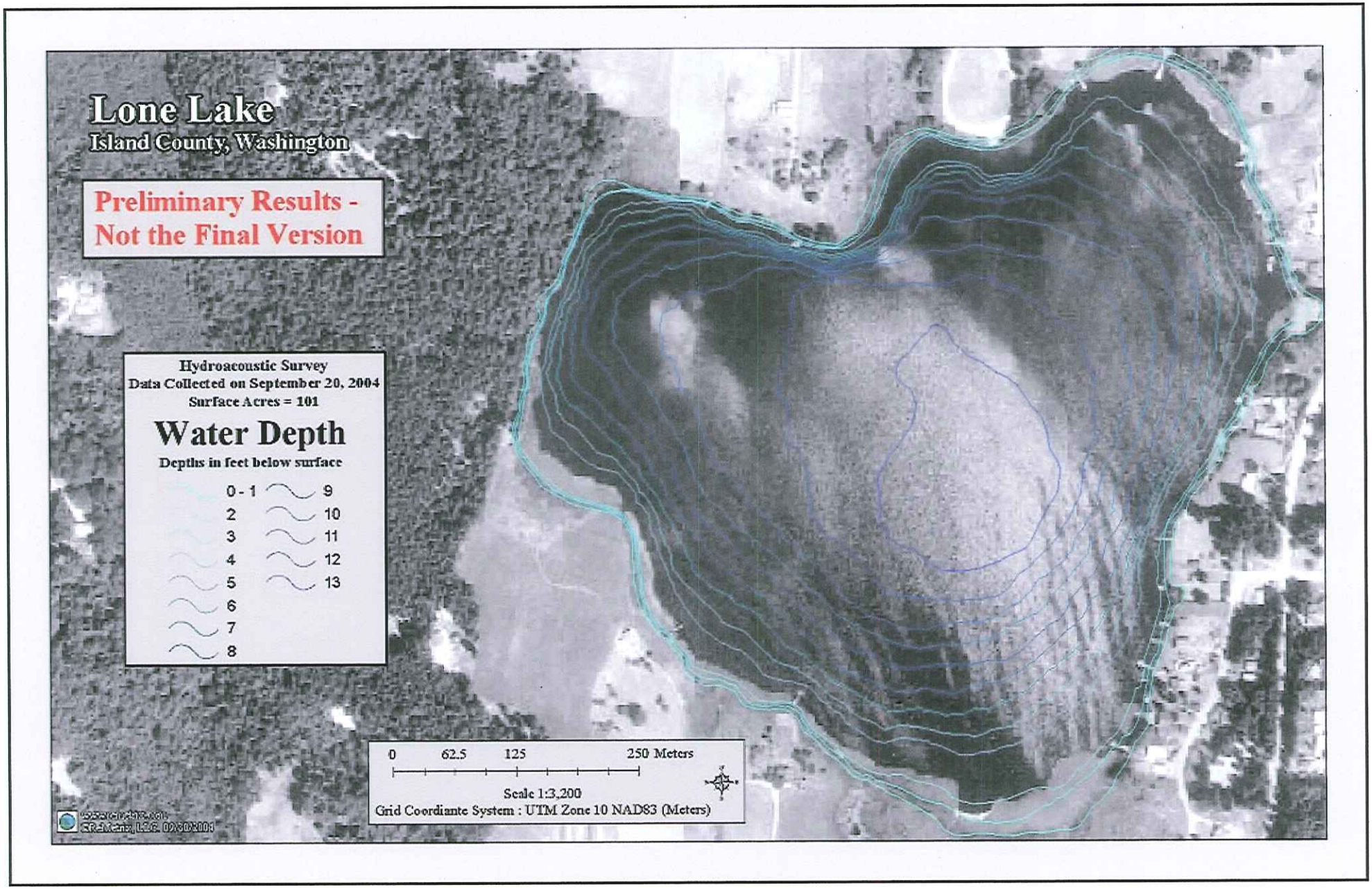


Figure 3. Water Depth of Lone Lake Map by ReMetrix

feet with a drainage area of 2.80 square miles. The lake is fed by two small inlets with one outlet that drains into Useless Bay (Ecology, 1996) (Figure 4). The lake outlet structure is in a state of disrepair. From all accounts the outlet has been dry for the last ten years. The topography is such that it would, likely, take a catastrophic flood event for surface water to flow from Lone Lake into Useless Bay (Lone Lake Brazilian elodea Project Proposal, 2003).

SOILS (This section is taken directly from the "Soil Survey Report of Island County, Washington", August 1958)

The climate is fairly uniform throughout Island County and, except for the prairie areas, the vegetation is fairly uniform. Therefore, though climate and vegetation were the most important factors that affected the formation of the soils, they do not account for the pronounced differences among the soils. These differences were caused largely by differences in parent materials, relief, and age of the soils.

Island County has a maritime or somewhat modified continental climate, influenced by winds from the Pacific Ocean. The winters are mild and wet. The summers are cool and dry. Temperatures rarely go as low as zero or as high as 90°F. The average temperature is about 50°F. Most of the precipitation falls between December and March, and there is a distinct dry season during the summer. The annual rainfall at Coupeville averages between 18 and 19 inches, but the rainfall is apparently somewhat heavier south and east of Coupeville. The southern part of Whidbey Island is believed to receive approximately 35 inches of rainfall annually. The precipitation falls as gentle rains. During the winter many of the days are overcast and foggy. The relative humidity is high during most of the year, but occasionally drops to 50 percent or less during the summer. Little snow falls, and ground freezes only occasionally below a surface crust.

The predominant vegetation consists of a dense growth of conifers-largely Douglas-fir and hemlock and a ground cover of ferns, mosses, and vines. A few shrubs grow in the more open areas, and maple trees, shrubs, and vines grow in the depressions. The marshy areas are covered by sedges, reeds, and other water plants.

The soils of Island County were derived mainly from materials deposited by glaciers. Granite, gneiss, and schist were the principal rocks from which these materials originated, but considerable amounts also came from parent material that was derived from marine deposits or from glacial lake sediments. The glacial ice that came from the north was a lobe, or tongue, of the Cordilleran icecap. The Vashon glacier, the most recent of the glaciers, left the extensive deposits from which most of the soils were formed. Older Pleistocene deposits are exposed in the sea cliffs at various places on the islands. These older deposits, however, did not contribute to the parent materials of any of the soils because they were later covered by deposits left by the Vashon glacier. During the interglacial periods the land rose to higher elevations, became eroded, and

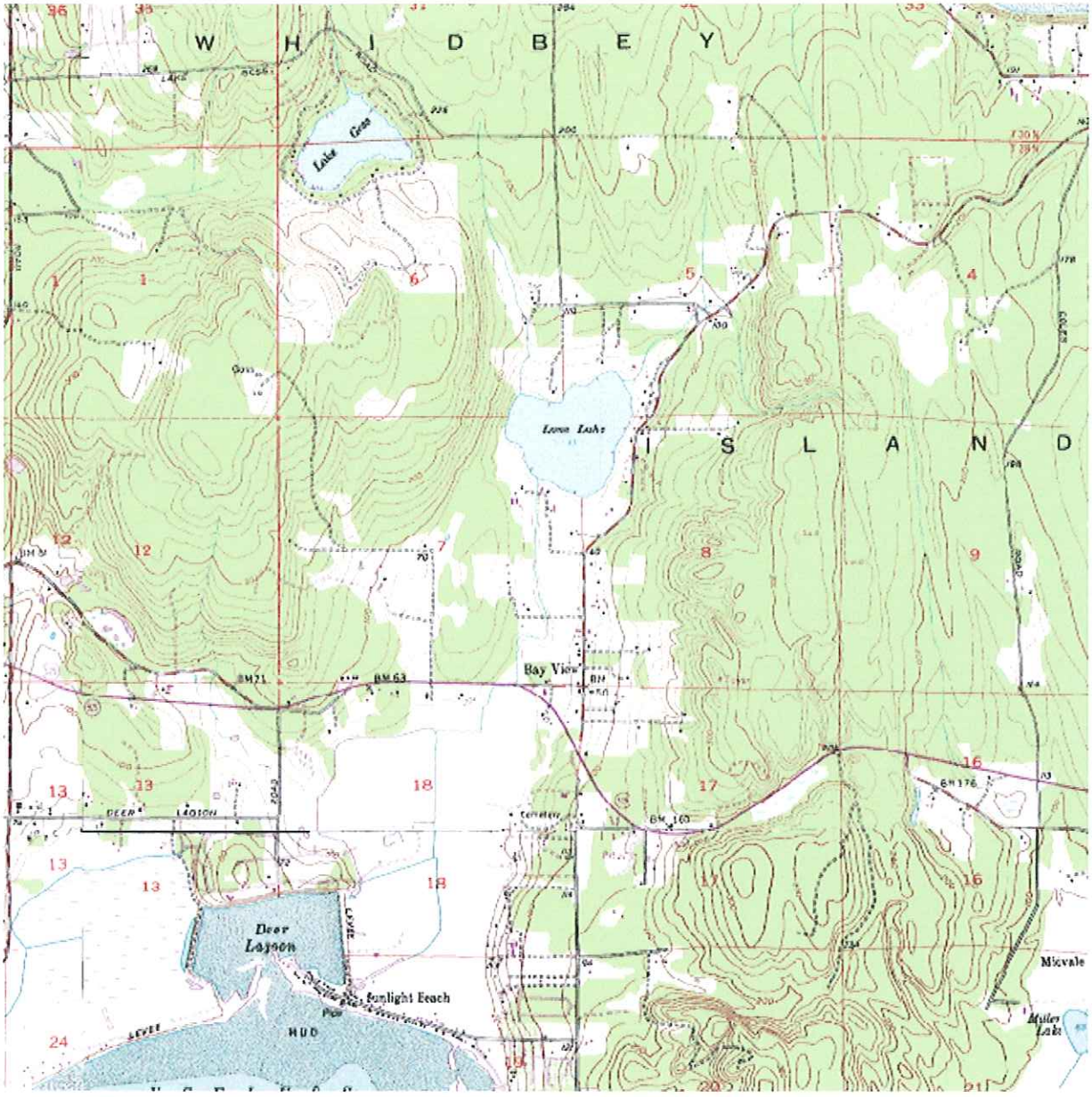


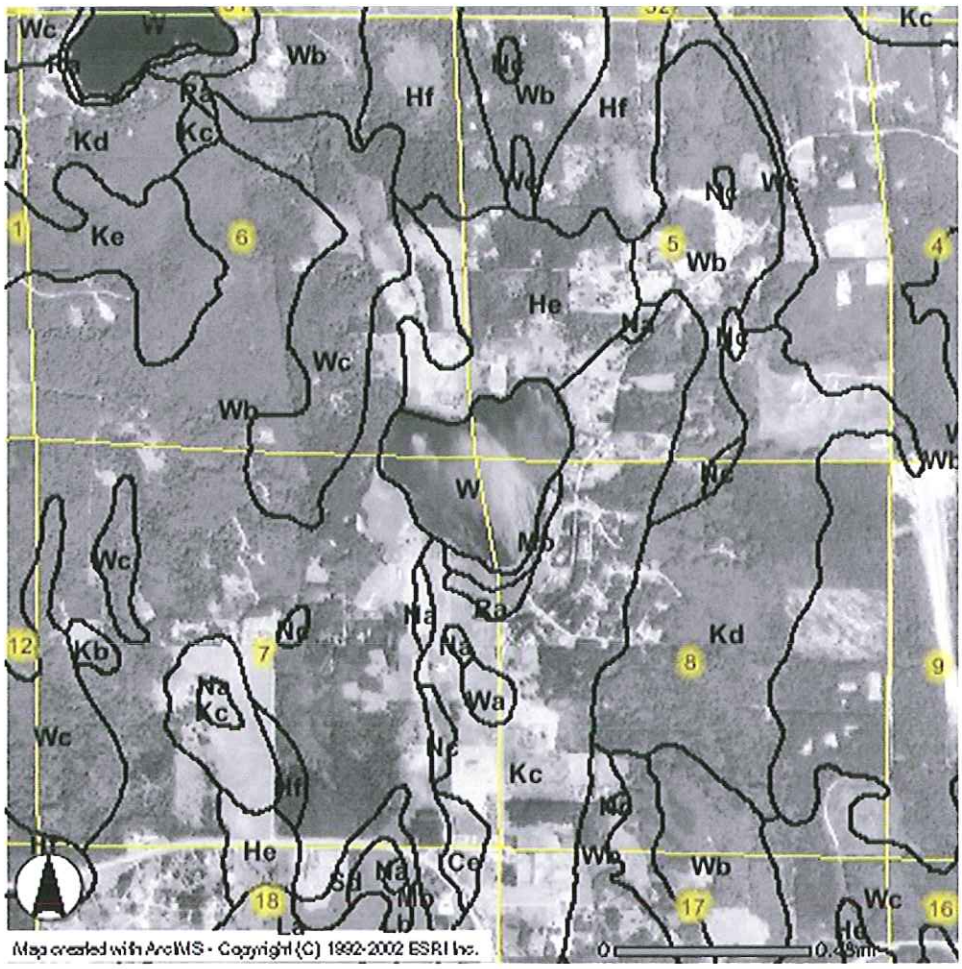
Figure 4. Topographic Map of Lone Lake and Vicinity Map by TopoZone

than sank. Apparently, all these processes contributed to the formation of the principal land features and regional drainage systems. Though the glacial till deposits vary considerably, they are partially or strongly cemented, which suggests that the parent materials may have been submerged by glacial waters for long periods. The gray glacial till that covers most of the county is of a sandy texture. Many rounded pebbles and cobblestones are embedded in it. In many places boulders occur, especially in the surface materials. The glacial outwash is loose in consistence. In some places it is very gravelly, but in other places it is sandy. A small part of the parent materials consisted of marine and glacial lake sediments.

The topography of the county has been affected by glacial action. It is predominantly morainic. The relief is generally undulating to rolling, but a few slopes are steeper than 15 percent. Most of the soils occur at elevations of 100 to 300 feet. Except for the depressional areas, which are not extensive, the soils have enough slope so that natural drainage is adequate. The soils of Island County have been developing since the retreat of the Vashon glacier, the last glacier that covered the Puget Sound area. The glacial materials from which the soils were formed were deposited near the close of the Pleistocene epoch.

Of the six great soil groups represented in Island County, most of the soils found in the vicinity of Lone Lake are members of a single group known as Podzols. The Podzols found adjacent to the lake are Whidbey Gravelly Sandy Loam, 5 to 15 Percent Slopes, Hoypus Gravelly Loamy Sand, 0 to 5 Percent Slopes, and Keystone Loamy Sand, 5 to 15 Percent Slopes. Mukilteo Peat, 0 to 2 Percent Slopes is an organic soil that is found adjacent to the lake as well (Figure 5).

The Whidbey soils, developed from cemented gravelly till, occupy about 36% of the county. The present vegetation on these soils consists largely of second-growth Douglas-fir and hemlock with a scattering of deciduous trees, shrubs, and ferns. The Hoypus and Keystone soils have developed from loose, permeable, coarse-textured glacial drift. The Hoypus soils have developed from somewhat modified gravelly and stony drift. They occur on uplands. The Keystone soils originated from sandy drift. Compared to the Hoypus soils, they occupy uplands such as hummocks and kettleholes. The Organic soils have a muck or peat surface layer that is underlain by peat. These soils occur in low basins or depressions where the water table is high. They have developed under a swamp or marsh type of vegetation, generally in a humid or subhumid climate. These soils were derived from the remains of plants in various stages of decomposition. Mukilteo peat has developed from sedges and reeds that grew in open marshes. The sediments found in Lone Lake are deep, flocculent and easily disturbed. (Steering Committee Meeting, September, 2004).



He Houpus Gravelly Loamy Sand, 0 to 5 Percent Slopes
Kc Keystone Loamy Sand, 5 to 15 Percent Slopes
Mb Mukilteo Peat, 0 to 2 Percent Slopes
Wb Whidbey Gravelly Sandy Loam, 5 to 15 Percent Slopes
W Water

Figure 5. Soils Adjacent to Lone Lake

VEGETATION

The aquatic plant species present in Lone Lake were documented in the 1996 Ecology survey. That list was updated in 2003 to include *Egeria* and remove *Nuphar lutea.* In 1996 the dominant species was *Potamogeton praelongus.* Included in the 1996 Ecology survey were comments "that the lake was difficult to survey because there were so many plants in a wide littoral zone" (Ecology, 1996). In the 2004 survey performed by ReMetrix *Elodea canadensis* was not found. This may be due to the time of year the survey was performed.

Table 1. AQUATIC PLANTS IN LONE LAKE (Ecology, 2003)

Ceratophyllum denersum.	*Chara spp.*	*Elodea canadensis*
Egeria densa	***Lythrum salicaria***	*Nuphar polysepala*
Phalaris arundinacea	*Potamogeton praelongus*	*Potamogeton nodosus.*
Potamogeton zosteriformis	*Schoenoplectus tabernaemontani*	*Typha spp.*

Of the aquatic plant species identified in Lone Lake, three are noxious weeds. They are *Egeria densa, Lythrum salicaria* and *Phalaris arundinacia. Egeria densa* and *L. salicaria* are Class B noxious weed species designated for control in Island County. This project will concentrate on the eradication of these two species. *Phalaris arundinacia* is a Class C noxious weed. It is cosmopolitan in this region therefore eradication is not likely, but control is strongly encouraged.

Egeria densa

Egeria densa is a freshwater, submersed, perennial herb. The leaves are in whorls of 4 to 8 around the stem. They can be found drifting or rooted to the bottom sediments in water up to twenty feet deep. It is a popular aquarium plant known as *Anacharis* and dumping of aquaria in lakes is often the cause of initial infestation (Fish and Wildlife). *E. densa* can reproduce sexually or from fragmentation. They form a small white flower (18-25mm) with petals. When fragmentation occurs roots are produced from double-nodes on the stem (Washington State Noxious Weed Control Board (NWCB, 2004). Another means by which *Egeria* spreads is through underground branching known as rhizomes. These rhizomes are known to persist several feet down into a flocculent sediment layer (Hamel, 2004).

The highly aggressive *Egeria* displaces and replaces native vegetation. It forms impenetrable mats that decrease water flow. The tangled stems provide habitat for mosquitoes and reduces insect diversity. The decline in diversity is caused by the formation of a dense canopy and a reduction in light penetration. A less diverse animal community lowers the value as a food source for waterfowl (AERF, 2004).

Egeria densa foliage supports a lower abundance and diversity of invertebrates which serve as fish food. Dense stands of Egeria are poor spawning beds. The tangled stems allow less space for larger fish to prey. This often results in a less efficient predator. These impacts, combined, may lead to populations of smaller fish.

In the 2004 ReMetrix survey *Egeria* covered 95% of Lone Lake (Figure 6). Of the 74 sites sampled *Egeria* was identified at 70 of them. At the eleven foot mark and above Egeria's BioVolume was 75% or greater. From the eleven foot mark and below it was found to be approximately 20% of the BioVolume (Figure 7).

Lythrum salicaria

According to the "Written Findings" of the Washington State Noxious Weed Control Board, "*Lythrum salicaria* is a perennial, emergent aquatic plant. As many as 30 to 50 herbaceous, erect annual stems rise to about nine feet tall from a persistent perennial tap root and spreading rootstock. There is a somewhat squarish stem. Upper leaves are alternant, 1.5 to 4 inches long with shape varying from lanceolate to narrowly oblong. The showy, magenta flowering stems end in a 4-16 inch flowering spike. Flowers appear from July to early October. Each flower is complete, containing five to seven petals, with the same number of sepals as petals, and twice as many stamens as petals. The ovary is superior, with two fused carpels. The fruit is a two-valved capsule enclosed in the pubescent calyx. Purple loosestrife is invasive and competitive and unavailing to native wildlife. It replaces native plants used for ground cover, food, or nesting material. Loosestrife stands are dense at the top and open at the base. Structures of root masses create a three foot opening, in the water, between plants. This provides, virtually, no cover for nesting ducks." (NWCB, 2004).

Pharlaris arundinacia

"This rhizomatous perennial grass, also known as reed canarygrass, can reach three to six feet in height. Stems can be up to 0.5 inches in diameter with some reddish coloration near the top. Leaf blades are flat and hairless 0.25 to 0.75 inches wide. Flowers are borne in panicles on culms high above the leaves. Panicles are 3-6 inches in length and it flowers in June and July. *Pharlaris* forms dense highly productive single species stands that pose a major threat to many wetland ecosystems. The species grows so vigorously that it is able to inhabit and eliminate competing species. This species typically occurs in soils that are saturated or nearly saturate for most of the growing season. Established stands can tolerate extended periods of inundation. Unlike native wetland vegetation dense stands of reed canarygrass have little value for wildlife. Few species eat the grass and the stems grow too densely to provide adequate cover for small mammals and waterfowl" (NWCB, 2004).

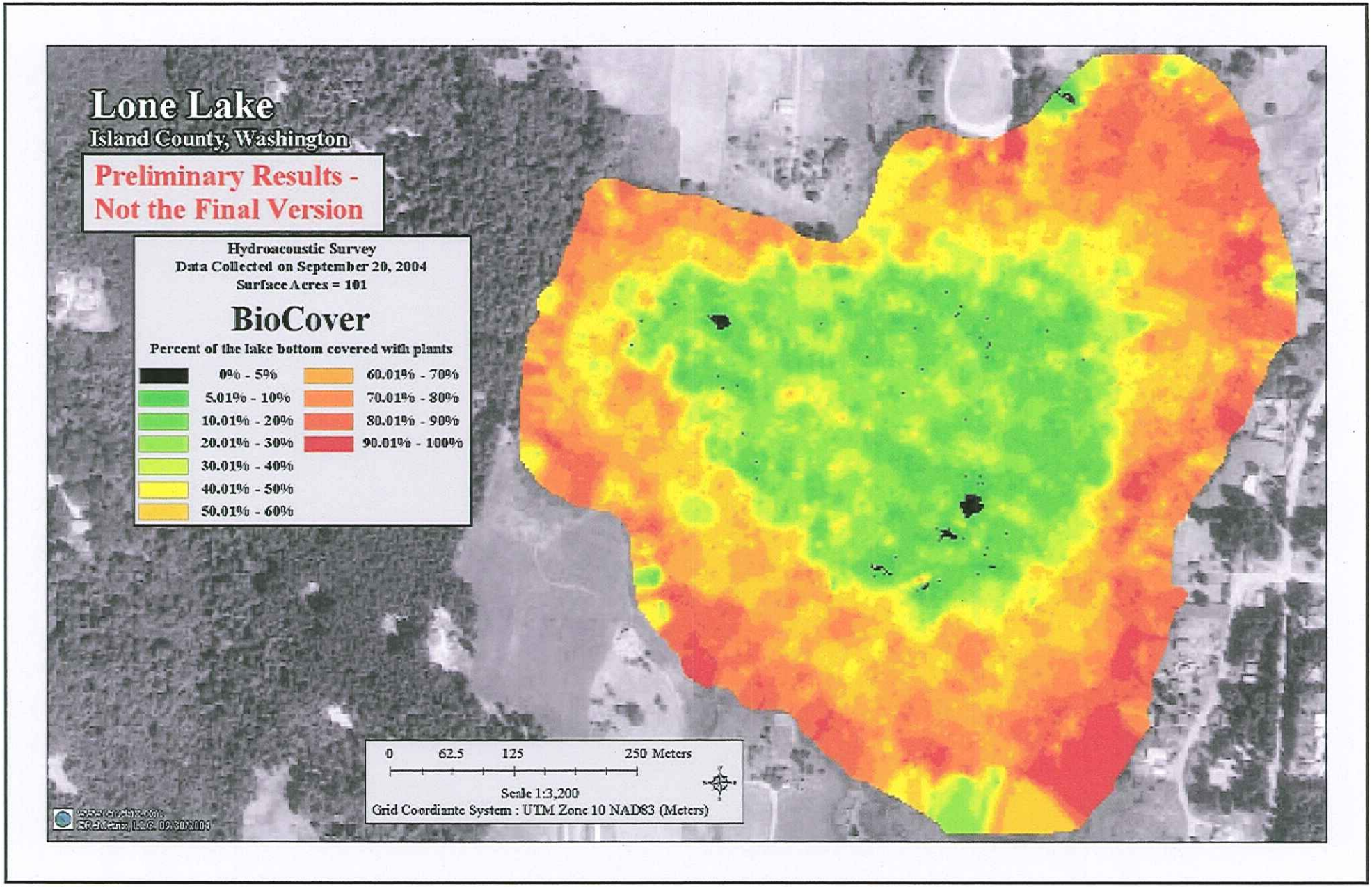


Figure 6. BioCover in Lone Lake Map by ReMetrix

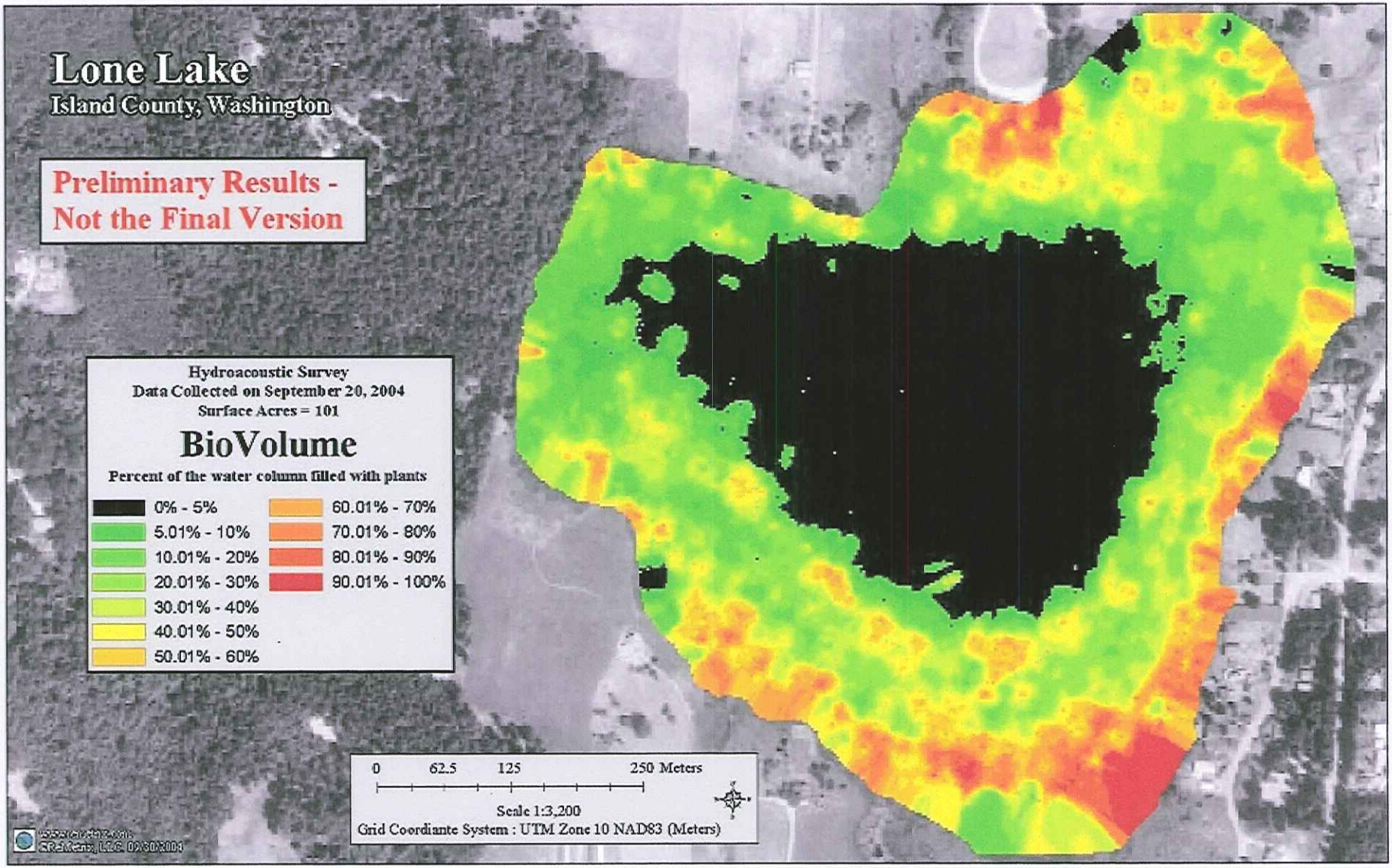


Figure 7. BioVolume in Lone Lake Map by ReMetrix

PRIORITY HABITAT

Lone Lake and much of the surrounding area has been designated Priority Habitat by the Washington Department of Fish and Wildlife. (Fig. 8) Virtually all the scrub-shrub, forested and emergent wetlands along the shoreline of Lone Lake has this priority designation. The wetlands associated with Lone Lake have been prioritized as such because they support an abundance of regularly occurring waterfowl. It is an important food resources and refugia for waterfowl, shorebirds and marine birds. The lake, and its vegetation, also support regularly occurring waterfowl and have the same Priority Habitat designation (Washington Department of Fish and Wildlife, 2004).

BIRDS

Lone Lake is host to quite a diverse bird population and serves as habitat for regularly occurring and migratory birds. All of Lone Lake and much of the surrounding area was identified as an "active and productive Bald Eagle territory in 1992" (WDFW, 2004). The Bald Eagle is a listed state (and federally) threatened species. Great -blue heron use Lone Lake and is a "Species of Local Concern" in Island County. This species is being monitored by the state as well. The pied-billed grebe is known to nest here and that is unusual in western Washington. This is by and large the best place to see yellow warblers on Whidbey Island and it is only one of a few places that willow flycatchers have been found breeding in Island County. (Ellis, 2004).

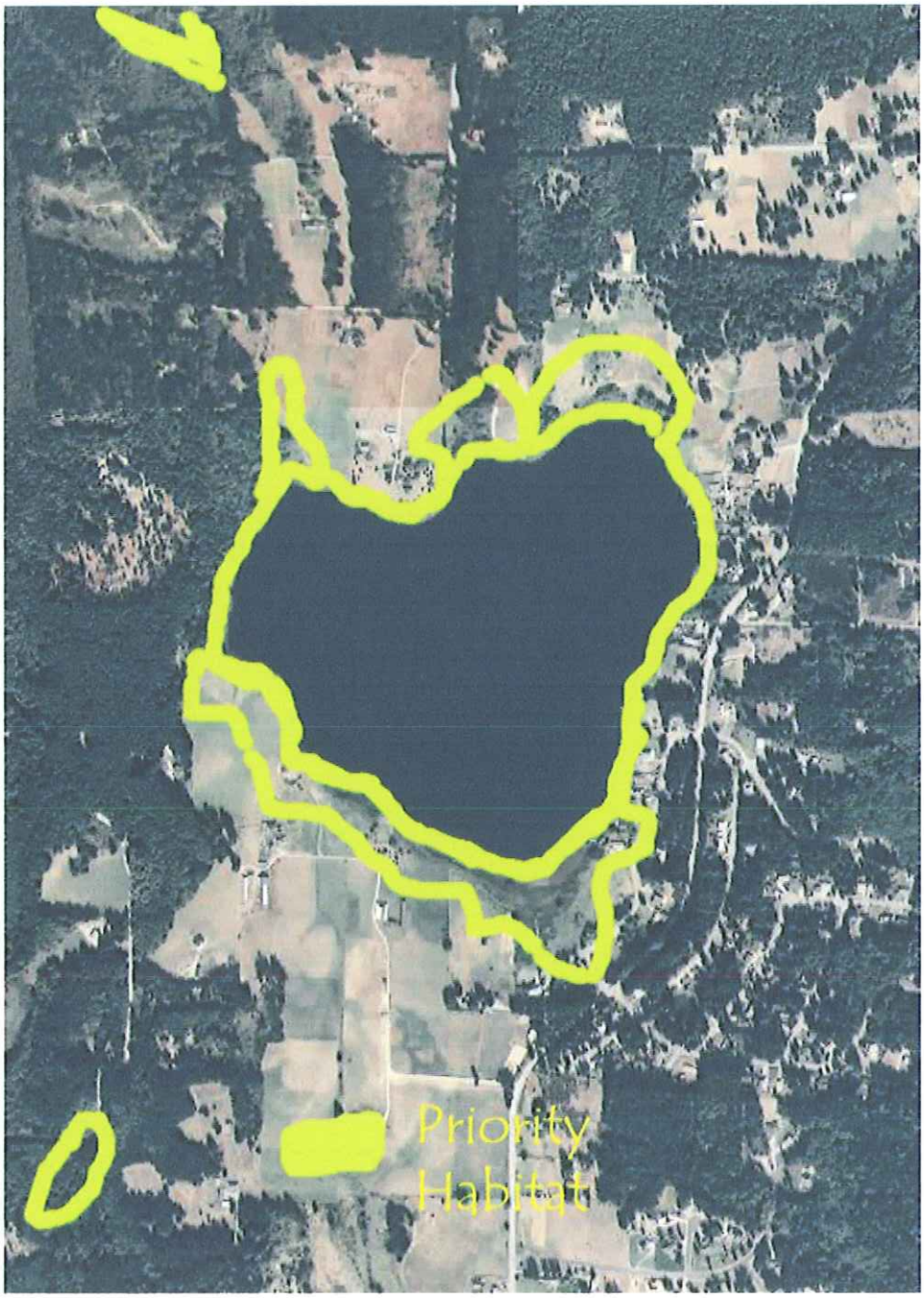


Figure 8. Lone Lake Priority Habitat Use Map (Information Courtesy WDFW)

Table 2. BIRDS OF LONE LAKE Species list provided by Steve Ellis, Audubon Society

M = Migrant B = Breeding B? = Possible Breeding ST = State Threatened SM = State Monitor		
Species Using Deep Water		
Common Loon (M)	Double-crested Cormorant	Ring-necked Duck (M)
Common Merganser (M)		Osprey
Bald Eagle (ST)		Kingfisher (B?)
Species Using Shallows/Emergent Vegetation		
Pied-billed Grebe (B)	Great-blue Heron (SM)	Canada Goose (B)
Mallard (B)	Blue-winged Teal (M)	Cinnamon Teal (B?)
Gadwall (B?)	American Wigeon (M)	Hooded Merganser (B)
American Coot		Glaucous-winged Gull
Species Using Shoreline		
Killdeer (B?)	Spotted Sandpiper (M)	Least Sandpiper (M)
Species Using Riparian		
Rufous hummingbird (B)	Downy Woodpecker (B)	Northern Flicker
Willow Flycatcher (B?)	Tree Swallow (B)	Violet-green swallow (B)
Black-capped Chickadee(B)	Bushtit (B)	Winter Wren (B)
Marsh Wren (B)	Cedar Waxwing (M)	Orange-crowned Warbler (B?)
Yellow Warbler (B)	Yellow-rumped Warbler (M)	Wilson's Warbler (B)
Song Sparrow (B)	Lincoln's Sparrow (M)	White-crowned Sparrow (B)
Golden-crowned Sparrow (M)	Red-winged Blackbird (B)	Brewer's Blackbird (B?)
House Finch (B)		Pine Siskin (M)

WATER QUALITY

Surveys

There is very little water quality data available on Lone Lake. In September of 1988 an Island County Assistant Planner began laying the ground work for restoring Lone Lake. Provisions for funding this type of project were made available through passage of the Centennial Clean Water Act. The approach would be to perform a lake survey and develop a restoration plan as Phase I of the project. Phase II would be the implementation of that plan. In October of that same year, Deborah Howe of Ott Engineering, Incorporated prepared a "Proposal for Restoration of Lone Lake." In that report the author noted "the rich biological production of the lake resulting in exceptional growth rates of trout and of aquatic weeds." She went on to speculate that the "high density of algal blooms may cause fish kills." She refers to a water sample collected in May 1974 that "strongly indicates eutrophic conditions." "The surface water was super-saturated with Dissolved Oxygen (DO), while bottom waters contained hydrogen sulfide, indicating no oxygen present. Ammonia-nitrogen was high throughout the water column with correspondingly low values of nitrate-nitrogen. Phosphorous levels were high on the surface and on the bottom. The nutrient levels in association with observed DO are characteristic of eutrophic conditions." (Ott Engineering, 1988). This analysis is in agreement with what Ecology found in their 1996 survey of Lone Lake. Comments included with that survey stated that "all Trophic State Indices were indicative of a eutrophic lake. The large plant populations and considerable algal growth are additional indicators of a eutrophic lake." (Ecology, 1996)

Later in the process, a memo was sent to the Assistant Planner by a County Commissioner. In that memo he addressed the lack of in-kind match funding for the proposed project. He then suggested that the Lone Lake community begin monitoring the lake voluntarily as part of an Ecology-trained lake stewardship program. There is no documentation or verbal record indicating the lake stewardship program was pursued.

Water Monitoring

The Island County Health Department performs surface Water Monitoring (Swim Beach Surveillance) of Lone Lake twice each year. The samples are collected at the boat ramp and are checked for either E. Coli or Fecal Coliform. According to protocol "E. Coli organism levels must not exceed a geometric mean value of 126 per 100 ml, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 406 per 100ml (the estimated upper 90th percentile for a population of bacterial samples with a geometric mean of 126 and a log10 standard deviation of 0.4)" The protocol for Fecal Coliform is "five consecutive samples shall not exceed 200 per 100ml. Failure to meet these

standards will result in closure of the beach. Any single sample over 1,000 per 100ml will result in closure."

Since 1990, there has only been three times where contaminants have reached unacceptable levels. June 29, 1992 a water sample tested for E. coli reported having levels of 400 E. coli bacteria per 100ml. The sample taken was associated with a high rainfall event. On August 31, 1992 a sample tested came back reporting 114 fecal Coliform in 100 ml of water. June 12, 1995 was the last time a sample has come back with adverse results. The sample was tested for E. coli and there were 145 E. coli bacteria in 100ml of water.

Hydrologic Data

A large geographical portion of Island County draws its drinking water from a sole-source aquifer. Because of that, the County has allocated a great deal of time and revenue to understanding and protecting this crucial natural resource. Drinking water wells are sampled for oxygen, chlorine and NO3 levels. The average nitrogen level in the Lone Lake Basin ranges from 0 to 912 with nitrogen levels in the County, in general, on the rise. (Kelley, 2004)(Salmon TAG, 2004).

Possible Sources of Non-Point Pollution

All structures in this part of the county requiring sewage disposal have septic systems. This is thought to be, by and large, the greatest contributor to non-point pollution in this area of Island County. There are several large parcels, designated for agricultural use, adjacent to Lone Lake. These parcels support many head of cattle Here, the cattle have been allowed to graze to the waters edge and draw water from the lake (Russell, 2004). Island County Ordinance C-151-99 outlines permissible uses of agricultural lands near Critical Areas. Section VIII, A, 1 of that ordinance calls for a 50-foot agricultural buffer from lakes.

FISHERY

The Washington Department of Fish and Wildlife (WDFW) have a long history of managing the Lone Lake fishery. What follows is a brief history of stocking of Lone Lake with fish and of rehabilitation efforts. This information comes from a draft report, prepared by Bob Pfeifer, an Area Biologist with WDFW that evaluated the trout fishery of this lake.

Stocking History

1918 - 65,000 Kokanee were introduced
1922 - 9,000 bass and 15,000 catfish fry were released
1923 - 36,000 bass fry
By 1946 – yellow perch and black crappie had been stocked
1956 through 1987 – managed as 'Trout Only' water by the former Washington Department of Game

1988 to Present – managed as 'Quality Trout Water'. This means it is a productive lake ecosystem contributing to fast growth rates and larger fish per acre than other Whidbey island lakes.
2003 – 4,250 trout stocked. This is a rate of 46 trout/acre.
2004 – 4,240 trout stocked. This rate is 45.9 trout/acre.
1980 and 1982 – illegal re-introduction of largemouth bass.

Lake Rehabilitation History
1956 – first rehabilitation event to remove brown bullhead catfish, yellow perch, and unidentified freshwater cottids. This event initiated a nearly 30-year program of trout monoculture, with periodic re-treatments to control competitive species. The lake was probably treated with rotenone.
1959 – treatment with rotenone
1962 – treatment with toxophene
1969 – treatment with rotenone
1974 – treatment with rotenone
1982 – treatment with rotenone. Brown bullhead catfish believed to be Eradicated.
(Pfiefer, 1998) (Tsunodo, 2004)

WDFW manages fisheries all over the state. Over time, people that fish Lone Lake have consistently harvested large trout. They have identified the Lone Lake fishery as being unusual in its high productivity. Because of that, members of the various fishing clubs worked together with WDFW to prepare the necessary documentation to have Lone Lake designated a Trophy Fishing Lake. The macrophytic characteristic of Lone Lake provides good habitat for fish. It supports abundant and diverse foraging material that helps to optimize size-carrying capacity.

BENEFICIAL USE

Lone Lake has one public access for fishermen, recreational boaters, water-skiers and swimmers. It is a boat ramp located on a 7.95 acre parcel owned by the Washington Department of Fish and Wildlife. This parcel is found on the north side of the lake having 528 feet of shoreline. There is quite a large area on the WDFW parcel, opposite the boat ramp, that serves as the staging area for the swimming portion of the Whidbey Triathlon, among other things. The lake is used daily for both power and paddle boating as well as fishing. In the warmer months, you can find swimmers, water-skiers and an occasional SCUBA diver enjoying Lone Lake (Figure 9).

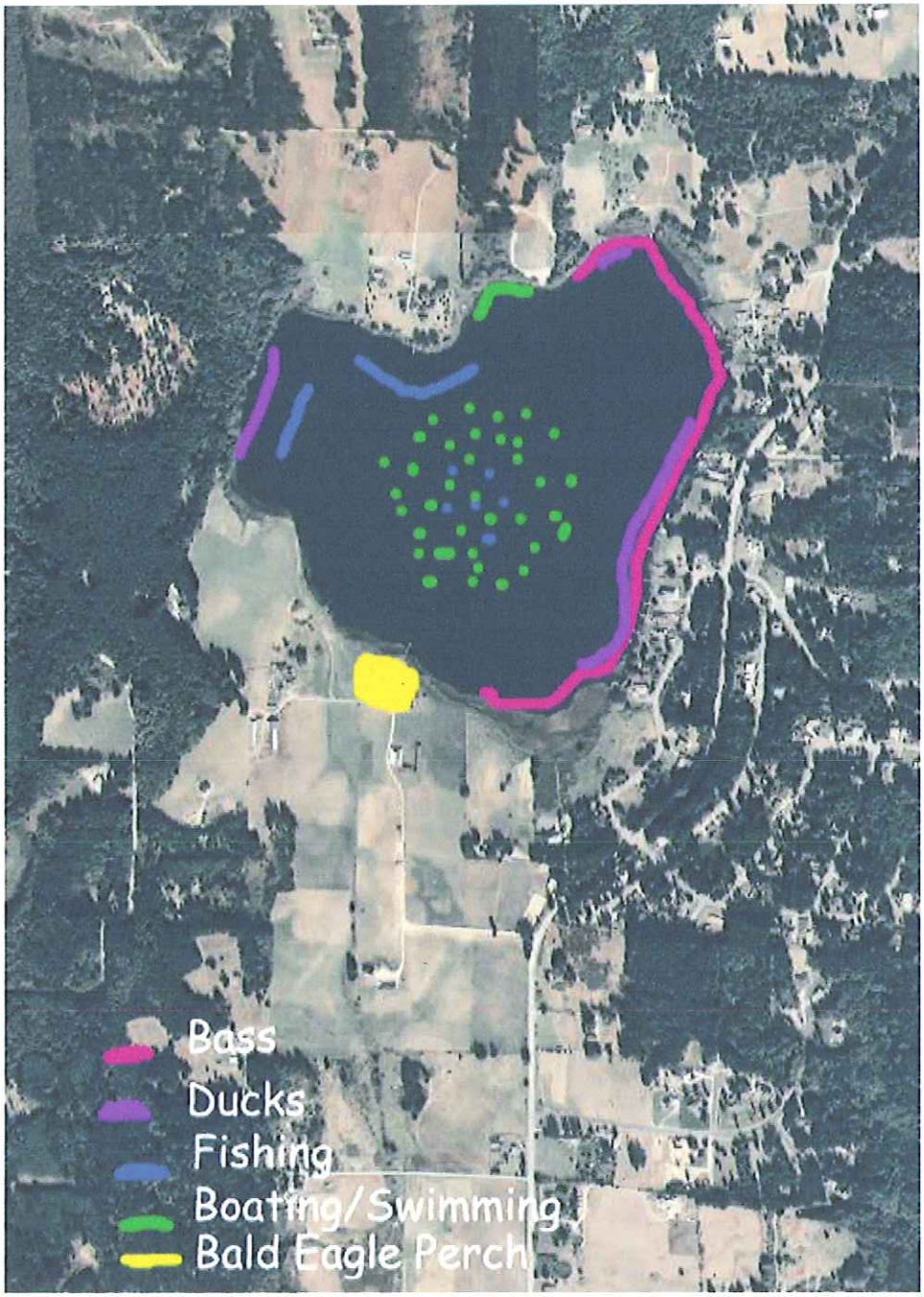


Figure 9. Lone Lake Beneficial Use Map

AQUATIC PLANT CONTROL METHODOLOGY

The contents of this section were borrowed, heavily from Ecology's Aquatic Plant Management methodologies, AERF's Aquatic Plant Management handbook and John Madsen's article on Aquatic Plant Management Techniques. The format is similar to those found in the Spring Lake, Big Lake and Long Lake aquatic vegetation projects and integrated for use here. The Steering Committee considered effective methods for the control of the Egeria infestation, only. Integrated methods to control *Lythrum salicaria* are already in place.

Once it had been decided that action must be taken in response to this aquatic weed infestation, it became apparent that all available methods and technologies for control should to be investigated and considered for use. In researching the various methodologies, efficacy of control and potential long and short term impacts were be identified. Knowing the control methods available and what it takes to implement each of them will make it possible to develop a well balanced and workable plan. It will also make the critical component of educating the local community and general public achievable. It is easier to present and defend a well thought-out plan.

What follows are the various methods available for controlling aquatic noxious weeds. There will be a description of each method, a discussion of efficacy of use and feasibility of application in Lone Lake against *Egeria*.

NO CONTROL

What would happen to Lone Lake as a result of inaction? "Nonnative plants are a biological pollutant with the potential to biomagnify in lakes (Magsen, 2000).

Advantage

There is no bureaucratic punishment if a plan fails (Madsen, 2000). No time or resources are spent. This allows time and money to be used for other purposes.

Disadvantage

The disadvantage to doing nothing is that in most cases the problem eventually requires a solution. The period of inaction amounts to time lost in the battle against the infestation. This often results in a more challenging problem requiring a far greater amount of resources.

Discussion

The option of 'no control' is shortsighted and an example of poor stewardship of a valuable resource. The short term impacts of no control can already be seen in Lone Lake. Beneficial uses are declining and the investment required to get the infestation under control is increasing. Inaction is no longer an option at Lone Lake. Comparing the 1996 Ecology survey with the survey in this project, dramatic changes to the Lone Lake environment can be seen. Water depth has decreased by four feet and the dominant species has shifted from *P.*

praelongus to *Egeria densa*. If *Egeria* is left uncontrolled, sediments may continue to accumulate, further reducing the water volume of the lake. *Egeria*, as the dominant species in Lone Lake, will have lasting effects on the entire food web in this Priority Habitat. The monotypic stands of *Egeria* do not support the abundance and diversity of invertebrates which serve as fish food. It may also cause a decline in value as a food source for waterfowl. Mosquito populations are likely to increase with a potential to impact public health.

Costs

Immeasurable

AQUATIC HERBICIDES

The passage of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) in 1972 imposed more stringent and costly standards for the testing and registration of pesticides. The United States Environmental Protection Agency (EPA) has approved a number of herbicides for aquatic use. They have been reviewed and are considered compatible with the aquatic environment when used according to label directions. The state of Washington imposes additional constraints on herbicide use. The Washington State Department of Ecology currently issues permits for seven aquatic herbicides (AERF, 2004).

Herbicides that can be used in aquatic environments in Washington can be placed into two categories. These are contact or systemic herbicides. Contact herbicides act immediately on the tissues contacted, typically causing extensive cellular damage at the point of uptake but not affecting areas untouched by the herbicide. Typically, these herbicides are faster acting, but they do not have a sustained effect. Results of contact herbicides are often described as chemical mowing. In many cases it does not kill root crowns, roots, or rhizomes. If repeated, over time, this may cause enough disruption in normal plant metabolism that it will inhibit plant growth. Systemic herbicides are translocated throughout the plant. The chemical is introduced into the plant and drawn down into the root mass. These herbicides are slower acting but often result in mortality of the entire plant (AERF, 2004).

Another way to categorize herbicides is to identify their selectivity. Herbicides are generally placed into two categories; non-selective and selective. Non-selective herbicides are broad spectrum herbicides that generally affect all plants that they come in contact with. Selective herbicides will affect only some plants. Often the adverse effects of these herbicides are targeted at dicots. Monocots are often unaffected. That is, broad leafed plants like *Myriophyllum spicatum* will die back or show some ill effect as a result of a selective herbicide application, whereas, monocots like *Egeria densa* may not show any adverse effects at all.

There are many regulatory requirements that must be met once it is decided that herbicide will be applied to an aquatic environment. In March 2001, the 9th Circuit District Court passed down a decision that a permit must be

obtained before aquatic herbicides can be applied to the waters of Washington State. It was decided that coverage would be made under a discharge permit called a **National Pollutant Elimination System Discharge (NPDES) permit**. This permit is held by the Washington State Department of Agriculture and coverage maybe obtained by licensed aquatic herbicide applicators when controlling noxious weeds. Once coverage is secured then notification of the local citizens and posting public access is required. If more than two applications of herbicide are used then development of an Integrated Aquatic Vegetation Management Plant (IAVMP) is required. In developing an IAVMP investigating and accumulating information on the watershed is obligatory. If in that process, it is discovered that threatened and endangered species are present or there is a need to protect rare plants then additional mitigation measures maybe proposed.

There are seven herbicides available for use in Washington waters. Two are effective in the control of Egeria (Hamel, 2004).

Fluridone

Fluridone is a slow-acting systemic herbicide that disrupts carotenoid synthesis. This causes bleaching of chlorophyll. It can show good control of submersed plants where there is little water movement and extended time for the treatment.

Advantage

- Applied at very low doses
- Safety factor of greater than 20
- Broad-spectrum, effecting most submersed species
- Can be used selectively at low concentrations
- Most applicable to whole-lake treatments
- Die-off is more gradual
- Few label restrictions
- Not found to cause genetic mutations or cancer in tested lab animals
- Easily defended in relation to environmental concerns pertaining to herbicides

Disadvantage

- Slow acting
- Long contact time required
- Broad-spectrum, effecting most submersed species
- Half-life of 21 days

Discussion

It is critical that there is no long lasting negative impact as a result of noxious weed control work in Lone Lake. The Priority Habitat and selective fishery must be preserved. There are citizens in the local area that have voiced their concerns about applying herbicides to an aquatic environment. Fluridone,

because of its effectiveness in controlling Egeria and very low level of assessed risk, is the best choice of herbicide in this environment.

Costs

Based on the water volume and the application rates that can impact Egeria, the cost of a whole lake treatment would be approximately **$52,000** plus monitoring costs of **$2,000-3,000.**

Diquat

Diquat is a rapid-acting, contact herbicide that disrupts plant cell membrane integrity. There is limited drift associated with diquat and is suitable for spot treatments. It is typically used for short term control of a variety of submersed aquatic plants.

Advantage

- Broad spectrum herbicide
- Controls some filamentous algae
- Die-off within 7 days
- Not harmful to most fish

Disadvantage

- Broad spectrum herbicide
- Die-off within 7 days
- Does not kill the roots
- Binds with suspended solids

Discussion

Turbid water or dense algal blooms can interfere with the effectiveness of diquat. Lone Lake has flocculent soils and yearly algal blooms, though the algae, generally, blooms later in the growing season. Herbicides would be applied earlier in the growing season at the most effective time and while avoiding the algal bloom. Diquat binds to suspended particles, and when bound, it is not considered bioavailable. Rapid-acting herbicides like diquat may cause low oxygen conditions to develop as plants decompose. Low oxygen can cause fish kills. Diquat carries a bit of a higher risk then fluridone. It has a safety factor of 5. Due to the concerns of adverse environmental impact, as expressed by the local citizenry, this herbicide is a less desirable choice than fluridone (Public Meeting, 2004).

Costs

To reduce the negative impacts of the plant die-off, the lake would be treated in phases over the course of several weeks. This will allow the lake environment to recover somewhat between the applications of herbicide. Treatment of infested acres would cost approximately $30,000 with monitoring costs of $2,000-3,000.

BIOCONTROL

Triploid Grass Carp

Currently, there is one biocontrol agent with proven efficacy against Egeria permitted for use in Washington. The species is *Ctenopharyngodon idella,* also known as Grass Carp or White Amur. These fish have strong feeding preferences. They will selectively feed on plants in a mixed community from the most to the least preferred species of vegetation.

Advantage

- Inexpensive in the long term
- Effective in isolated water bodies
- Feed on *Egeria*
- Herbivorous fish won't feed on other fish or eggs

Disadvantage

- Cannot control feeding sits
- Difficult to contain in water body
- Longer response time than other control methods
- If overstocked they are difficult to remove
- May lead to algal blooms

Discussion

Vegetation control using Triploid Grass Carp is often an all or nothing thing. Grass carp are discouraged from use in **public lakes** and **permitting requires approval from the Director of WDFW** (Tsunoda, 2004). If the lake is over stocked they can denude a lake leaving it devoid of vegetation causing harm to other species. Grass Carp exacerbate nutrient cycles in the lake. They use approximately 0.33 of what they eat excreting the balance into the water. Approximately 0.66 of the nutrients (nitrogen and phosphorous) tied up in the vegetation is again made available for plant growth. The nutrients released from the vegetation can lead to accelerated aquatic vegetation growth, including explosive blue-green algae blooms which can be poisonous to pets and children. When all of the aquatic vegetation is removed they will feed on vegetative parts in sediments. This adds to nutrient loads by releasing nutrients from the sediments and it negatively affects water clarity by increasing turbidity (Tsunoda, 2004).

Costs

Stocking rates depend on biomass. "Planting rates for aquatic plant eradication objectives may range from 15-25 grass carp per surface acre of targeted vegetation. Planting rates for aquatic vegetation control objectives may range from 5-10 grass carp per surface acre of targeted vegetation (Tsunoda, 2004)

To make cost estimates for the purpose of planning, a conservative prediction of herbicide success will be used and eradication stocking rates will be utilized. That is, 25 fish per infested acre assuming 35 acres of infestation at $20.00/ fish for a total of **$17,500**. The **outlet from Lone Lake will need to be**

repaired, before stocking with Grass Carp is **permitted** (Thompson, 2004). This repair, if possible, will be made through in-kind contributions.

PHYSICAL METHODS

Water Level Drawdown

Water is taken down to a level that exposes the weed infestation to desiccation and freezing. This will stress the plant enough to effectively control problem plant populations.

Advantage

- May occur on a regular basis
- Cost effective if water control structure is in place
- Provides opportunity to improve or repair docks, etc.
- May encourage growth of some aquatic plant species

Disadvantage

- Milder climates may not experience the freezing or dewatering conditions needed
- May be followed by algal blooms
- Can impact fish and wildlife
- May encourage growth of some aquatic plant species

Discussion

There is no water control structure in Lone Lake. The winters generally do not get cold enough for this method to be effective. In order to expose the entire Egeria infestation to desiccation or dewatering, virtually all of the lake would have to be drained. This would have adverse affects on fish, their food source and the food source for the regularly occurring waterfowl. Recreational use of the lake would be eliminated.

Costs

A high capacity pump must be used.

Benthic Barriers

Plants are covered over with a layer of a growth-inhibiting substance. Benthic barriers will typically kill plants under them within 2 months. They are effective for limited areas and well suited to high-intensity use areas. Installation of these barriers requires **Hydraulic Project Approval**.

Advantage

- Creates immediate open water
- Easily installed
- Can get 100% control
- Material are readily available

Disadvantage

- Reduces habitat
- Must be regularly inspected
- Easily damaged

- May create safety hazard
- Can be difficult to anchor
- Nonselective

Discussion

Due to the size of the infestation in Lone Lake this is not an option for the whole lake. It will work well in localized areas, such as at the boat launch and around private docks. If an individual installs a benthic barrier, it can be used as an in-kind contribution.

Costs

$0.22 - $1.25/square foot of material. There are labor and maintenance costs associated with the barriers.

MECHANICAL METHODS

Hand Pulling

This involves removing leaves, stems and roots by hand. Shallow water requires no special equipment. In water deeper than three feet SCUBA equipment and a mesh bag are needed. **Hydraulic Project Approval** is required before work is initiated.

Advantage

- Selective
- Suitable for early infestations

Disadvantage

- Expensive
- Time intensive
- Can cause fragmentation

Discussion

The infestation in Lone Lake is far to apply this method as the major component of eradication. It will, however, be a useful tool once the infestation levels are reduced as a result of herbicide and biocontrol. This method can be utilized by individual property owners and be regarded as an in-kind contribution. One limiting factor is the flocculent soils and turbidity. If the soils are determined to be suitable, then the goal is to have at least one community hand-pulling event each year. Participants will be trained in proper technique and disposal of the plant. Issues concerning fragmentation will be emphasized.

Costs

Time.

Cutting

There are several tools made to accomplish this control method, all of which cut the plant and leave the root mass. They can be manually operated or powered by either batteries or motors. Hydraulic Project Approval required.

Advantage

- Immediate clearing of water column

- Uncomplicated

Disadvantage

- Roots remain
- Fragmentation occurs
- Time consuming
- Proper disposal
- Sharp blades can be dangerous

Discussion

This technique is not advisable when controlling Egeria. The fragmentation caused by the cutting spreads infestation.

Costs

These tools range from $57.00 to 2,000 plus time spent cutting.

Raking

Raking tears the plant from the sediment, breaking some plants off and removing some roots. Using a back and forth motion like a vacuum cleaner works best. Hydraulic Project Approval is required.

Advantage

- Clears water column
- Not complicated

Disadvantage

- Some plant parts remain
- Fragmentation
- Time consuming
- Proper disposal

Discussion

Plant parts remain and fragmentation is likely, therefore, this in not a viable option in control of Egeria.

Costs

$87.00 plus time

Diver dredging

SCUBA divers use hoses attached to small dredges to suck plant material, including roots, from the sediment. Water and sediments are returned while plant material is retained. Hydraulic Project Approval is required. Section 404 permit from Army Corp of Engineers may be required.

Advantage

- Selective
- Creates deeper water
- Long lasting effects.

Disadvantage

- Time consuming (0.25 - 1 acre/day)
- Expensive

- Plants break off in hard soils
- Increased turbidity
- May release nutrients or toxic material

Discussion

The size of the Egeria infestation in Lone Lake makes this method cost prohibitive.

Cost

$1,500 to 2,500 per day.

Rotovation

Rotovation is underwater rototilling. The machine churns seven to nine inches deep, plant part float and are removed using a weed rake. This method is most effective when plant senesces. Sunken logs impede rotovation. Underground utilities need to be located. Hydraulic Project Approval is required. Local shoreline permit may be needed. Section 404 permit from Army Corp of Engineers may be required.

Advantage

- Native aquatics may be simulated
- Control work best performed in winter and spring

Disadvantage

- Marginally time consuming (2- 3 acres/day)
- Fragmentation is possible
- High cost and large equipment
- Reinfestation is possible if all plant parts are not removed
- Disrupts sediments
- Labor intensive

Discussion

This is not a good option in the control of Egeria due to the possibility that large numbers of fragments may be spread.

Cost

Cost prohibitive. It would take 20 to 30 days to do the control work due to the size of the infestation in Lone Lake. The equipment is expensive and labor costs would be high.

Harvesting

Harvesters are mechanized having both a sickle-bar cutting blade and a conveyor belt that loads the cut material on a boat. Disposal vehicles carry the plant material away.

Advantage

- Creates immediate open water
- Habitat is not eliminated
- Can target specific areas
- Removing plants removes the plant nutrients

- Can remove organic material
- Helps slow sedimentation rate

Disadvantage

- Cosmetic
- Non-selective
- Short-term
- Plants grow back
- Fragmentation

Discussion

Harvesting at Lone Lake has occurred for the past several years. The homeowners bought a harvester to seek relief from the weed infestation. They provided a service to the Whidbey Island Triathlon by clearing the course prior to the event. Harvesting is known to cause fragmentation and is one of the reasons for the rapid acceleration of infestation in Lone Lake. The harvester will be retired.

Costs

$35,000 to 110,000 for equipment plus labor.

NUTRIENT REDUCTION

Some nutrient reduction is possible through reduction in non-point pollution. Educating the local citizenry on possible non-point sources of pollution and the means to reduce these pollutants is the best way to address this issue. Water quality monitoring through the Lake Stewardship Program will help define nutrient issues in the lake. Currently, it is not understood.

Nutrient levels and algal blooms may become a serious issue once the *Egeria* is eradicated. If nutrients reach undesirable levels reduction treatments will be considered. The first course of action would be to investigate an alternative method such as introducing barley hay to the system to counter nutrient effects. This type of method is usually less expensive and less harmful to the environment. At this time alum treatments have not being considered.

INTEGRATED MANAGEMENT PLAN

The Lone Lake Integrated Aquatic Vegetation Management Plan will take a holistic approach to vegetation management. The goal is to eradicate Egeria. Along with this goal of eradication the project will work to eradicate *Lythrum salicaria* along the shoreline. It will also educate the property owners on the aggressive and destructive nature of *Phalaris* and encourage them to remove this species as well. A lake stewardship program will be formed. This program will collect water quality data as well as, survey and monitor vegetation. The water quality data collected will be used to understand how control methods are affecting certain water quality parameters. Surveying and monitoring the vegetation will provide information on the efficacy of control methods that have

already been implemented. This understanding will help guide future vegetation control decisions.

The first three years of implementation will be aggressive. The subsequent years will be used to further reduce plant infestations using more localized methods and to ensure water quality standards remain high.

VEGETATION CONTROL

Egeria densa

A comprehensive attack on Egeria will be made in Lone Lake (Table 3). The initial control work will begin early in the growing season with an application of a low risk herbicide. This will be used to greatly reduce the infestation. Fluridone has been chosen because of its efficacy in control of Egeria and to mollify concerns of the local citizens. One of the leading causes of concern is depletion of oxygen when the plants die-off. This is less of a concern with fluridone because the die off is more gradual than with other herbicides. Fluridone is not always successful in flocculent soils such as those present in Lone Lake. Rhizomes are able to reach very far down into the sediments escaping lethal effects of the herbicide (Hamel, 2004). An experienced aquatic herbicide applicator was contacted and it is his belief that there are formulations available to deliver the herbicide effectively, resulting in a high kill rate (McNabb, 2004).

The following year, biomass will be determined and stocking rates for Grass Carp will be calculated. "The introduction of conservative numbers of grass carp in multiple stocking events spaced far enough apart to assess the impact of the grass carp presence on the vegetation might be best" (Tsunoda, 2004). The Project will go through the permitting process and seek approval for stocking Grass Carp. Upon approval, fish will be purchased and planted in the lake.

Once the infestation is reduced to a far lower level, localized physical and mechanical control methods can be implemented. Benthic barriers and hand pulling will be employed to ensure eradication.

Table 3. *Egeria* Eradication Timeline

1st Year	**Spring 2005**	**Summer 2005**	**Fall 2005**
	Herbicide application	Stand-up Lake Stewardship Program	Survey and Monitor
	Bayview/Tilth Markets (edu.)	Island County Fair (edu.)	Bayview/Tilth Markets (edu.)
	- Community Outreach -		
2nd Year	**Spring 2006**	**Summer 2006**	**Fall 2006**
	Survey and Monitor	Determine Biomass	Permitting /Stocking Triploid Grass Carp
	Bayview/Tilth Markets (edu.)	Island County Fair (edu.)	Bayview/Tilth Markets (edu.)
	- Community Outreach -		
3rd Year	**Spring 2007**	**Summer 2007**	**Fall 2007**
	Survey and Monitor		Survey and Monitor
	Bayview/Tilth Markets (edu.)	Island County Fair (edu.)	Bayview/Tilth Markets (edu.)
	Evaluate Need for Sustained Funding (outside of LLHA) - Community Outreach -		
4th through 8th Year	**Spring 2008 - 2012**	**Summer 2008 - 2012**	**Fall 2008 - 2012**
	Survey and Monitor		Survey and Monitor
	Bayview/Tilth Markets (edu.)	Island County Fair (edu.)	Bayview/Tilth Markets (edu.)
	- Community Outreach -		

Lythrum salicaria

With heightened awareness of noxious weed issues, brought on by the IAVMP process, efforts to reduce the *Lythrum* infestation in the Lone Lake ecosystem are currently, underway. There is one known *Lythrum salicaria* site along the shores of Lone Lake. The Island County Noxious Weed Control Board coordinated with the Washington State Invasive Weed Species Bioagent Enhancement Program to release beetles at that site. In August 2004, the Program Coordinator for the Bioagent Enhancement Program collected beetles at the Winchester wasteway and released one thousand *Galerucella pusilla* for the purposes of reducing the Lythrum infestation in the Lone Lake area. The site was surveyed in mid-September and leaf destruction, caused by the beetles, was evident. Flowers were removed prior to seed set, bagged and disposed of

properly. Additional biocontrols will be released in the future, if necessary, and mechanical control will continue. In the future, this site will be monitored by the Lone Lake Stewardship program and the Bioagent Enhancement Program.

LAKE STEWARDSHIP

A lake stewardship program will be stood up for the purposes of monitoring and surveying Lone Lake. It is critical that integrity of water quality in Lone Lake be maintained while implementing the Integrated Aquatic Vegetation Management Plan. Aspirations are to improve water quality as a result of the education and outreach component of the project (discussed in the next section). Nutrient levels will be tracked. In doing so, unsafe water conditions may be avoided, by modifying control work in the lake. Through the duration of this project, as funding allows, a "water quality assessment" regimen of sampling will be followed that will include analysis of phosphorous and nitrogen. The guidelines outlined in "A Citizen's Guide to Understanding and Monitoring Lakes and Streams" will be followed (Ecology, 2004).

Surveying the lake, regularly, will provide information on BioCover and BioVolume. This will be used to plan, localized, physical and mechanical control projects. The results of these surveys will also point toward necessity to form a Lake Management District. If additional control treatments are required the survey information will provide evidence of necessity to fund these expensive treatments.

EDUCATION AND OUTREACH

The education and outreach component will ensure success of the Lone Lake IAVMP. Workshops will be held for purposes of native and noxious weed identification. These workshops will include proper removal methods pertaining to *Egeria* and *Lythrum* in particular. The fishing clubs have already shown interest in participating in a workshop of this nature. Meetings will be called to keep the general public informed on the progress of the eradication project. Press releases and mass mailings will be disseminated with news of the progress being made in Lone Lake. Educational materials concerning nutrient effects on lake systems and nutrient reduction will be a large part of the community education. The local citizens will be informed on what they need to do to reduce nutrient loading in Lone Lake. Members of the Steering Committee and the Island County Noxious Weed Control Board will make themselves available for presentations to individual organizations or public events such as the county fair and farmer's markets.

COSTS

A whole lake herbicide application will be made, followed by introduction of the biocontrol agent to control the *Egeria*. Mechanical control to further reduce the *Lythrum* site will continue. Additional biocontrol agents will be procured to

supplement those already on the *Lythrum* plants if needed. Concurrently, monitoring and surveying will be employed. This will provide applicable information concerning efficacy of control and progress toward eradication. Grant administration, oversight of the project, monitoring/surveying protocol development and training as well as education and outreach will be provided for (Table 4).

Table 4. Budget Summary (by task)

Herbicide Application	$52,000
Triploid Grass Carp	17,500
Outlet Repair	2,500
Boat Washing Station	5,000
***Lythrum* Control**	1,000
Monitoring, Survey and Education	6,000
Grant Administration, Salary/Wage/Final Report	16,000
Total	$100,000

SOURCES OF FUNDING

Grants

This plan was developed to meet the standards of the Aquatic Weed Management Fund and qualify for funding in the 2004-2005 funding cycle. It is the beliefs of participants in this project that awards from this fund will make implementation of the Lone Lake IAVMP most expeditiously. It is important on many different levels that control of Egeria be initiated as soon as possible.

Matching Funds

There is widespread interest in this project. Both volunteer labor and monetary means of support have been pledged by interested parties. As is apparent in the Lone Lake Brazilian elodea Project, the Steering Committee members and local supporters have worked tirelessly and enthusiastically to make this project successful. The will continue this level of support and participation through the completion of the Lone Lake Egeria Eradication Project. The fishing clubs will help build the boat washing station. They will consider contributing funds to offset costs concerning Grass Carp introduction. Once the Egeria infestation is reduced, community 'dig day' events will be scheduled. Labor for the monitoring/surveying component of this plan and all of the education and outreach will be in-kind contributions. This will total the AWMF required 25% match of the total project.

Formation of a Lake District

If funding is not made available through a grant, the Lone Lake Homeowners Association is fully prepared to pursue the formation of a lake district.

COMMUNITY INVOLVEMENT

There is a long established commitment to preserving and protecting Lone Lake. The Lone Lake Community was eager to support the Assistant Planner with the lake restoration project in 1988. In June of 1990, the County proposed road improvements to Andreason Road. A county road that runs between Goss Lake and Lone Lake. The County received $250,000 through the Rural Arterial Program to do the necessary improvements to Andreason Road to gain Scenic Back Road designation. The project met local community opposition because of the potential negative impacts to the water quality of Lone Lake. The project was dropped and the money was returned.

The Lone Lake Homeowners Association and Steering Committee members are highly intelligent and motivated people. Members of the shoreline community brought the weed infestation to the attention of the proper government agencies. Wanting to eradicate the weed they were told an Integrated Aquatic Vegetation Management Plan must be developed before qualifying for implementation funding.

Over the course of the past year they have worked tirelessly to make the planning process work. They initiated partnerships and secured funding for plan development. The contract between Ecology and Island County was not executed until June 14, 2004. To qualify for a 2004-2005 AWMF award, a survey of the lake needed to be performed and Integrated Aquatic Vegetation Management Plan developed by November 1, 2004. Members of the Lone Lake Homeowners association and Steering Committee commute daily to the Seattle area and some of them are part-time residents. Despite these complications the Steering Committee has met several times (Attachment A) and fulfilled the requirements of plan development. They worked diligently to provide the in-kind contribution to this project. Through hard work and dedication they met this objective in only four months.

The Lone Lake Homeowners Association and the Lone Lake Brazilian elodea Project Steering Committee are not being led through this process. They are leaders. Without prompting from the ICNWCB or Ecology they formed the Steering Committee, compiled contact information to distribute news and materials about the weed infestation in Lone Lake. They have called all meetings, drafted the agendas and invited guest speakers.

Though this has been an expedited process, the Steering Committee members are dedicated to producing a quality plan. For them the driving force is the health of Lone Lake. It is imperative that Lone Lake be relieved of the

weed infestation that now degrades the quality of the lake. It is important to implement a well though out plan that will eradicate Egeria and make the local citizens better stewards of Lone Lake.

There are twenty seven fishing clubs with well over 1,000 members in support of eradicating *Egeria* from Lone Lake. In meetings with the fishermen, we have educated them on the problems *Egeria* poses to the sustained health of Lone Lake. Many of them now know how to identify Egeria and better understand its growth habits. They have been educated on the various control options for eradication of Egeria, along with their advantages and disadvantages. The fishermen understand the potential for temporary adverse affects to fish habitat associated with the control of Egeria. The majority of the club-members present at these meetings support the recommendations made in the IAVMP. They believe it is important to implement the plan and eradicate *Egeria* to restore the incredible Lone Lake fishery upon which its reputation is based. Many members have written letters in support of this project (Attachment B).

The fishing clubs believe funds are available from individual fishing clubs conservation committees to use in implementation of certain components of the Lone Lake IAVMP. Currently they are researching funding the design and installation of a boat washing facility at the Lone Lake boat ramp. This important component will help reduce the possibility of cross contamination of neighboring lakes. The fishing clubs may also help offset the biocontrol costs.

Island County Noxious Weed Control Board (ICNWCB) is also committed to this project. Outside of grant administration, the ICNWCB will partner with the LLHA and local citizens to make the monitoring and survey component of the IAVMP successful. It will train participants on the tasks required and methods used in monitoring and surveying. The ICNWCB will also make itself available for outreach and education and will visit neighboring lakes to survey and address local concerns about cross contamination.

RFERENCES

1. Aquatic Ecosystem Restoration Foundation. Best Management Practices Handbook in Support of Fish and Wildlife. Available on-line. www.aquatics.org/aquatic_bmp.pdf

2. Department of Ecology. A Citizen's Guide to Understanding and Monitoring Lakes and Streams. Available on-line. 2004 www.ecy.wa.gov/programs/wq/plants/management/joysmanual/lakemonitoring.html

3. Department of Ecology. Aquatic Plant Identification Manual for Washington's Freshwater Plants. Available on-line. 2004. www.ecy.wa.gov/programs/wq/plants/plantid2/index.html

4. Department of Ecology. Aquatic Plant Management/Control Methods. Available on-line. 2004. www.ecy.wa.gov/programs/wq/plants/management/index.html

5. Ellis, Steve. Audubon Society. Personal Communication. Species List. October 2004.

6. Envirovision. Big Lake Aquatic Plant Management Plan. 1997.

7. Hall, Janet. Triathlete. Personal Communication. Whidbey Island Triathlon. June, 2003.

8. Hamel, Kathy. Department of Ecology. Aquatic Weed Management Fund Workshop. September 28, 2004.

9. Hamel, Kathy. Department of Ecology. Personal Communication. Herbicide Efficacy. September, 2004.

10. Howe, Deborah. Ott Engineering. Proposal for Initial Environmental Studies for Restoration of Lone Lake. 1988.

11. Island County Health Department. 2000. Surface Water Monitoring (Swim Beach Surveillance) Protocol.

12. Island County Planning and Community Development. Agricultural Best Management Practices Program for Island County. 2003.

13. Island County Salmon TAG Meeting. July, 2004.

14. Kelley, Doug. Lone Lake Basin Hydrologic Data. Island County Environmental Health Department. July 2004.

15. King County Department of Natural Resources and Parks Water and Land Resources Division. Spring Lake Integrated Aquatic Vegetation Management Plan. 2003. Available on-line.
www.ecy.wa.gov/programs/wq/plants/Spring%20Lk%20IAVMP.pdf

16. Lone Lake Brazilian elodea Project Steering Committee (LLBePSC). Minutes from Steering Committee Meeting. September 2004.

17. Lone Lake Brazilian elodea Project Steering Committee. Public Meeting Minutes. October 10, 2004.

18. Madsen, John. North American Lake Management Society; LakeLine, v.20,no.1,pp.22-34. Spring 2000.

19. McNabb, Terry. ReMetrix. Personal Communication. Egeria Abundance and Herbicide Efficacy. October, 2004.

20. Ness, A. O. Soil Survey of Island County, Washington,. 1958. United States Department of Agriculture in Cooperation with Washington Agricultural Experiment Station, Institute of Agricultural Sciences, State College of Washington Scanned version available on-line.
www.or.nrcs.usda.gov/pwn_soil/washington/wa029.html

21. Parvin, Kathleen. Island County Environmental Health, Swim Beach Surveillance. Personal Communication. July, 2004.

22. Pfeifer, Bob. Trout Fishery Evaluation of Lone Lake, Whidbey Island, Island County, Washington, Spring-Fall 1998. Washington Department of Fish and Wildlife.

23. Russell, Bill. LLBePSC Member. Personal Communication. Nutrient loading in Lone Lake. March 2004.

24. Smith, A. Kirk and Jilie Rector. Water Quality Assessments of Selected Lakes within Washington State. Department of Ecology, 1994. 1997. Washington State Department of Ecology Environmental Investigations and Laboratory Services Program. Pp.205-207.

25. Thompson, Doug. WDFW, Habitat Biologist. Personal Communication. Stocking Grass Carp. October 2004.

26. Thurston County Department of Water and Waste Management. Long Lake Eurasian Watermilfoil Eradication Project. 1995.

27. Tsunoda, Larry. WDFW, Biologist. Personal Communication. Draft Grass Carp Stocking Policy. October 2004.

28. Washington Department of Fish and Wildlife. Habitats and Species Report in the Vicinity of T29R03E Section 6. October 12, 2004.

29. Washington State Noxious Weed Control Board. Written Findings. Information About Brazilian elodea - Egeria densa. 2004. Available on-line. www.nwcb.wa.gov/weed_info/egeria.html

30. Washington State Noxious Weed Control Board. Written Findings. Information About Purple Loosestrife - Lythrum salicaria. 2004. Available on-line. www.nwcb.wa.gov/weed_info/ploosestrife.html

31. Washington State Noxious Weed Control Board. Written Findings. Information About Reed Canarygrass - Phalaris arundinacia. 2004. Available on-line.
www.nwcb.wa.gov/weed_info/reedcanary.html