

## 7.0 Aquatic Vegetation Control Strategies

Based on the experience of other lakes, effective and affordable control requires a long-term commitment and early action. It involves frequent surveying to determine milfoil locations, implementation of control actions up to 2 or 3 times per year, and education to prevent continued re-infestation.

This section outlines common methods used to control aquatic weeds. Much of the information in this section is quoted directly from the Ecology's website (<http://www.ecy.wa.gov/programs/wq/plants/management/index.html>).

Additional information is derived from the Spring Lake Integrated Aquatic Vegetation Management Plan, King County Department of Natural Resources and Parks. Information therein is gathered from the field experience of the King County Noxious Weed Control Program, in particular from Drew Kerr, Aquatic Noxious Weed Specialist and WSDA licensed aquatic herbicide applicator. Recommendations therein were also derived from the 2001 draft version of the King County Regional Milfoil Plan.

Control/eradication methods discussed herein include the No Action Alternative, Environmental Manipulation (Water Level Control, Nutrient Reduction), Mechanical Controls (Rotovation, Harvesting, Cutting, and Diver Dredging), Manual Controls (Hand Pulling, Cutting, Raking, and Bottom Barriers-Screens), Biological Controls (Grass Carp and Watermilfoil Weevil), and Chemical Controls (Aquatic Herbicides).

## **7.1 No Action Alternative**

One option for managing aquatic weeds in Newman Lake is to let milfoil continue to grow, and do nothing to control it. This “no action” alternative would acknowledge the presence of the aquatic weeds but would not outline any management plan or enact any planned control efforts. Effectively, a no action determination would preclude any integrated treatment and/or control effort, placing the choice and responsibility of aquatic weed control with lakefront property owners.

### **Application for Newman Lake**

The milfoil infestation in Newman Lake is currently moderate in density and contained to limited areas within the lake; if control measures are not continued, it is likely to increase each growing season in the future until the entire shoreline and littoral zone of the lake is dominated by milfoil especially in heavily organic sediment areas which dominate Newman Lake. Based on annual survey results by the NLFCZD and Clearwater Company and Newman Lake and nearby Liberty Lake surveys, the infestations of milfoil have cycled based on treatment areas, and during some years, experienced rapid growth and population expansion. If there is no control effort, it is likely that weed infestations will continue to grow, making Newman Lake a prime source of milfoil fragments for other nearby lakes with public access and boat launch facilities. Even if some of the residents chose to control the aquatic weeds near their properties, large areas of milfoil would remain. The surviving plants would fragment each autumn, spreading to other areas of the lake, including those that were treated by residents. Consequently, a once thriving recreational lake would become unfavorable for the community and its inhabitants. The NLFCZD and the Newman Lake community do not support the No Action alternative for Newman Lake.

## **7.2 Environmental Manipulation**

### **Water Level Control**

Lowering the water level of a lake or reservoir could have a dramatic impact on some aquatic weed problems. Water level drawdown can be used where there is a water control structure that allows the managers of lakes or reservoirs to drop the water level in the waterbody for extended periods of time. Water level drawdown often occurs regularly in reservoirs for power generation, flood control, or irrigation; a side benefit being the control of some aquatic plant species. However, regular drawdown can also make it difficult to establish native aquatic plants for fish (esp. spawning areas), wildlife, and waterfowl habitat in some reservoirs.

### **Application for Newman Lake**

Newman Lake has no natural outlet; the only outlet or disposal for flows from the lake and runoff is through an outlet control gate and 3-mile long outlet channel to an infiltration area of permeable gravels at the north edge of the Spokane-Rathdrum Prairie Aquifer. This control and drainage system was begun in the late 1800's by local farmers but was repaired and reconstructed in 1981 under a SCS Watershed Work Plan. At that time design early summer lake elevation was set at 2125.6 feet and normal winter elevation at 2123.9 feet. The decision was designed to maintain adequate lake storage levels to control flooding and runoff, while preserving recreational use and accommodate farmers at the north and south ends of the lake. Even though the outlet gates become dry at an elevation of 2120.0 lowering the lake below 2123.9 feet is not normally feasible. This is only done when extremely high winter snow pack dictates the need for more spring runoff storage. Lowering can risk not being able to fill the lake back to the normal early summer elevation of 2125.6 impacting boat access and recreational use of the lake. Resident's water intake pipes become susceptible to freezing. Drawdown would also cause significant damage to the ecosystem, particularly in the large wetlands at the south and north ends of the lake. The amount of drawdown required to impact milfoil would damage native plants and animals in both the lake and the adjacent wetland and have many negative implications for residents living around the lake. Also, response of the fragrant water lily to water level drawdown has been variable. Drawdown is not a viable control strategy for Newman Lake.

### **Nutrient Reduction Alternative**

At lakes in watersheds with identifiable sources of excess nutrients, a program to reduce nutrients entering the lake could possibly be an effective method of controlling aquatic vegetation. Sources of excessive nutrients might include failing septic tanks, other accidental or planned wastewater effluent, or runoff from agricultural lands. If nutrient reduction were enacted as the primary method of weed control, extensive research would be necessary to determine the current nutrient budget for the lake and surrounding watershed, whether nutrient reduction would result in milfoil reduction, and to identify and mitigate the natural and human-mediated nutrient sources.

### **Application for Newman Lake**

Since the 1970s, nuisance water quality conditions occurring in Newman Lake initiated scientific studies to verify and refine nutrient sources from sediment, recycling, and the interaction of aquatic plants and algae blooms.

Newman Lake area citizens began to raise water quality concerns in the late 1970's and early 1980's. Serious algae blooms were having an impact on the beauty and recreational use of the lake. To allow the District to assist in efforts to study and alleviate water quality problems, citizens initiated a campaign to revise state law to allow flood control zone districts to fund water quality improvements. This was accomplished in 1983.

In 1985, again driven by community concern, the District applied for and received a grant from the Washington State Department of Ecology (DOE) to study the Lake's water quality problems. This began Phase I of the Lake Restoration Program. This study identified the problem as overloading of nutrients, most particularly phosphorus from watershed runoff and recycling of in-lake sediments. This was feeding excessive algae growth and creating a high biological oxygen demand that was causing extremely low oxygen levels in the lower level of the lake, damaging fish habitat. Proposed solutions included: an alum treatment to bind up phosphorus in the water column and cap sediments to reduce nutrient recycling; a hypolimnetic aeration system to increase oxygen in lower lake levels and thereby reduce nutrient recycling and improve fish habitat; and reduce sediment/nutrient loading input from the watershed with a watershed management plan, public education, and a septic system survey.

These recommendations were implemented as Phase II of the Lake restoration with grant funding from DOE in 1989. The goal of this grant was reduction of nutrient levels in the lake now and into the future. The District provided 25% of the matching funds with a lake restoration benefit assessment that it began collecting in 1989. Total cost of the Phase II restoration program was about one million dollars. The surface alum treatment (about 520 dry tons alum) was done in 1989 at total cost of \$265,000. The Hypolimnetic Aeration system, constructed at a cost of \$539,000, began operation in 1992. In addition, the Spokane Regional Health District conducted a survey of lake front septic systems and public involvement was encouraged through the establishment of the Newman Lake Watershed Committee (NLWSC), a watershed management plan was prepared, a "Lake Book" was published to provide information to homeowners, and a water quality monitoring program was initiated.

The implementation of Phase II has significantly improved Lake water quality, with improved dissolved oxygen levels, and reduced algae blooms. Since 1992, the NLFCZD has taken many measures to protect and maintain the Newman Lake Water Quality. In 1997, with the effects of the initial surface alum treatment decreasing, the District continued Lake water quality improvement efforts with construction of a Micro-Floc alum injection system, using the existing aeration system as a distribution system. Total cost, funded solely from District lake restoration benefit assessments, was about \$57,000. Prior to this construction, the District prepared the Comprehensive Plan of Development for Stormwater Control in the Newman Lake Watershed. This report's recommendations provide the guidance for our current watershed management and water quality improvement activities.

The Outline for Implementation of the Comprehensive Plan of Development in the Newman Lake watershed has several major parts. Implementation requires the cooperation and assistance of the Newman Lake community, including the Newman Lake Watershed Committee and the Newman Lake Property Owners Association. The Implementation Plan includes the following:

- a. Land Use Regulation Enforcement: The use of District and community volunteer resources to implement and encourage enforcement of existing land use regulations (Federal, State and local agencies) in the Newman Lake watershed.

- b. Education of the Community: This will take the form of regular newsletters, Watershed Committee meetings, preparation of educational materials, and involvement of residents and students in restoration projects and monitoring, etc.
- c. Restoration Projects: Work with property owners on riparian, wetland and floodplain preservation and restoration projects and other structural Best Management Practices (BMP's) in the watershed, with priority to Thompson Creek.
- d. Septic Systems: Plan includes efforts to work with the Spokane Regional Health District to improve septic compliance and monitoring in-lake for problem areas.
- e. Operation of the Alum Injection and Aerator Systems: These systems are needed to control internal recycling of nutrients.
- f. Monitoring: A comprehensive lake and watershed water quality monitoring program is also part of the plan.
- g. Annual Report: The final major component of the Implementation Plan is a comprehensive Annual report covering all district and volunteer activities in the watershed and results of water quality monitoring.

Given the numerous studies conducted, and the protective measures already in place for algae control, nutrient reduction for aquatic weeds alone is not an appropriate method for Newman Lake. Protective measures coexist with an already established nutrient reduction program, and if used alone, nutrient reduction is not likely to be an effective control on milfoil. Milfoil has the ability to live in various environmental conditions; it can withstand a broad range of aquatic environments, from oligotrophic to eutrophic waters, and it grows in water depths from as shallow as 0.5 meters to as deep as 8 meters. It also can grow in substrates ranging from poor, sandy sediment to highly organic soils and can survive in wide ranges of salinity, pH, and temperature conditions (Aiken *et. al.*, 1979; Nichols and Shaw, 1986; as cited in Creed and Sheldon, 1995).

Macrophytes were also used as an indicator for healthy nutrient levels in Liberty Lake. Morency (1979) found an inverse (opposite) relationship between macrophyte productivity and inorganic nutrient concentrations. Thus, macrophyte and phytoplankton productivity were also inversely related, possibly due to increased competition for limited nutrients. For example, reduced inorganic nutrient input may reduce phytoplankton productivity, increase light penetration, and stimulate macrophyte productivity. Nutrient supply is also dependent on the importance of sediment nutrient release in supplying phytoplankton and macrophyte growth (Bronmark and Hansson, 1998). The removal of macrophytes as part of lake restoration could reduce nutrient competition, thereby enhancing phytoplankton productivity (Hartman, 2001).

Historic water quality problems and lake characteristics suggest a need to reduce the external nutrient loading into Newman Lake. Water quality improvements would likely result if each watershed resident reduced or eliminated sources of nutrient input to the lake; this would not be likely to be an effective primary method of controlling aquatic weeds. Nutrients in the sediments would be more likely to have an impact, since milfoil and other targeted aquatic weed species obtain more than 85% of their nutrients from the sediment (King County Department of Natural Resources and Parks, 2003).

Nutrient reduction as the primary method of weed control would be beyond the scope of any project that could be undertaken at Newman Lake and would not be effective in reducing milfoil populations. The

nutrient reduction program and protective measures already established will continue in order to reduce and prevent point and non-point source pollution.

## 7.3 Mechanical Controls

### Rotovation, Harvesting, And Cutting

#### **Rotovation**

Rotovators use underwater rototiller-like blades to uproot Eurasian watermilfoil plants. The rotating blades churn seven to nine inches deep into the lake or river bottom to dislodge plant root crowns that are generally buoyant. The plants and roots may then be removed from the water using a weed rake attachment to the rototiller head or by harvester or manual collection.

#### **Harvesting**

Mechanical harvesters are large machines that both cut and collect aquatic plants. Cut plants are removed from the water by a conveyor belt system and stored on the harvester until disposal. A barge may be stationed near the harvesting site for temporary plant storage or the harvester carries the cut weeds to shore. The shore station equipment is usually a shore conveyor that mates to the harvester and lifts the cut plants into a dump truck. Harvested weeds are disposed of in landfills, used as compost, or in reclaiming spent gravel pits or similar sites.

#### **Cutting**

Mechanical weed cutters cut aquatic plants several feet below the water's surface. Unlike harvesting, cut plants are not collected while the machinery operates.

#### **Application for Newman Lake**

None of these options is suitable for the level of milfoil infestation at Newman Lake. They are not eradication tools, but rather are used to manage and control heavy, widespread infestations of aquatic weeds. These processes create plant fragments, and should not be used in systems where milfoil is not already widespread. In a moderate infestation such as Newman Lake, these methods would probably serve to spread and expand the infestation. According to Ecology, "There is little or no reduction in plant density with mechanical harvesting." Since the overall goal is to eliminate milfoil from the system, these are not compatible control strategies. Harvesting and cutting do not remove root systems, and rotovation would cause disturbance to the highly organic lake sediments. All are scenarios that are not favorable for Newman Lake.

Again with the small scale of fragrant water lily infestation at Newman Lake mechanical controls are probably not the best option. Mechanical controls such as cutting and harvesting are popular methods of controlling water lilies. Cutting is less efficient than harvesting because cut plants must then be removed from the water. Harvesters both cut and collect the plants. Both methods create open areas of water. However, because water lilies grow in shallow water and grow rapidly, they must be cut several times a year. Harvesting has been used extensively on Long Lake, Thurston County to control water lilies.

Underwater rototilling (called rotovation) was successfully used to remove water lilies from a small Seattle area lake where the drowning of two people was attributed to the presence of dense plant beds. Rotovation dislodges the large, fleshy water lily rhizomes which can then be removed from the water.

Although rotovation is a much more expensive process than harvesting or cutting, it results in the permanent removal of water lily rhizomes.

Thurston County has experimented with using a barge-mounted backhoe to excavate water lily rhizomes from the sediment. Like rotovation, excavating the rhizomes results in permanent removal of the plant. Both rotovation and excavation requires that the project proponent obtain a number of environmental permits before proceeding.

### **Diver Dredging**

Diver dredging (suction dredging) is a method whereby SCUBA divers use hoses attached to small dredges (often dredges used by miners for mining gold from streams) to suck plant material from the sediment. The purpose of diver dredging is to remove all parts of the plant including the roots. A good operator can accurately remove target plants, like Eurasian watermilfoil, while leaving native species untouched.

The suction hose pumps the plant material and the sediments to the surface where they are deposited into a screened basket. The water and sediment are returned back to the water column (if the permit allows this), and the plant material is retained. The turbid water is generally discharged to an area curtained off from the rest of the lake by a silt curtain. The plants are disposed of on shore. Removal rates vary from approximately 0.25 acres per day to one acre per day depending on plant density, sediment type, size of team, and diver efficiency. Diver dredging is more effective in areas where softer sediment allows easy removal of the entire plants, although water turbidity is increased with softer sediments. Harder sediment may require the use of a knife or tool to help loosen sediment from around the roots. In very hard sediments, milfoil plants tend to break off leaving the roots behind and defeating the purpose of diver dredging.

Diver dredging has been used in British Columbia, Washington, and Idaho to remove early infestations of Eurasian watermilfoil. In a large-scale operation in western Washington, two years of diver dredging reduced the population of milfoil by 80 percent (Silver Lake, Everett). Diver dredging is less effective on plants where seeds, turions, or tubers remain in the sediments to sprout the next growing season. For that reason, Eurasian watermilfoil is generally the target plant for removal during diver dredging operations.

#### **Advantages**

- Diver dredging can be a very selective technique for removing pioneer colonies of Eurasian watermilfoil.
- Divers can remove plants around docks and in other difficult to reach areas.
- Diver dredging can be used in situations where herbicide use is not an option for aquatic plant management.

#### **Disadvantages**

- Diver dredging is very expensive.

- Dredging stirs up large amounts of sediment. This may lead to the release of nutrients or long-buried toxic materials into the water column.
- Only the tops of plants growing in rocky or hard sediments may be removed, leaving a viable root crown behind to initiate growth.
- In some states, acquisition of permits can take years.

### **Permits**

Diver dredging requires Hydraulic Approval from the Department of Fish and Wildlife. City, county, or local government permits may also be required. Verification of requirements is recommended before proceeding with a diver-dredging project. In addition, diver dredging may require a Section 404 permit from the U.S. Army Corps of Engineers.

### **Costs**

Depending on the density of the plants, specific equipment used, number of divers, and disposal requirements, costs can range from a minimum of \$1,500 to \$2,000 per day.

### **Other Considerations**

Might be good spot control method in subsequent years (coordinated with diver surveys).

### **Application for Newman Lake**

Diver dredging could be used after herbicide applications to remove plants that were missed or unaffected by the herbicide. The soft sediments in Newman Lake should make this method effective. However, this would cause disturbance to the highly organic lake sediments, a scenario that is not favorable for Newman Lake. Diver dredging greatly disturbs sediments and can affect nutrient concentrations and algal production in a lake (see Disadvantages above). Stirring up the sediments also reduces the visibility to zero which makes it difficult for divers to target milfoil instead of native species. If other techniques for removal are suitable, this should not be considered.

## 7.4 Manual Controls

### Hand-Pulling, Cutting, And Raking

#### **Hand-pulling**

Hand-pulling aquatic plants is similar to pulling weeds out of a garden. It involves removing entire plants (leaves, stems, and roots) from the area of concern and disposing of them in an area away from the shoreline. In water less than three feet deep no specialized equipment is required, although a spade, trowel, or long knife may be needed if the sediment is packed or heavy. In deeper water, hand pulling is best accomplished by divers with SCUBA equipment and mesh bags for the collection of plant fragments. Some sites may not be suitable for hand pulling, such as areas where deep flocculent sediments may cause the person who is hand pulling to sink deeply into the sediment. Organic sediments also tend to create turbid conditions limiting visibility.

#### **Cutting**

Cutting differs from hand pulling in that plants are cut and the roots are not removed.

Cutting is performed by standing on a dock or on shore and throwing a cutting tool out into the water. A non-mechanical aquatic weed cutter is commercially available. Two single-sided, razor sharp stainless steel blades forming a “V” shape are connected to a handle, which is tied to a long rope. The cutter can be thrown about 20 – 30 feet into the water. As the cutter is pulled through the water, it cuts a 48-inch wide swath. Cut plants rise to the surface where they can be removed. Washington State requires that cut plants be removed from the water. The stainless steel blades that form the V are extremely sharp and great care must be taken with this implement. It should be stored in a secure area where children do not have access.

A battery-operated cutting tool called a Swordfish is also commercially available. It works similarly to an underwater lawn mower.

#### **Raking**

A sturdy rake makes a useful tool for removing aquatic plants. Attaching a rope to the rake allows removal of a greater area of weeds. Raking literally tears plants from the sediment, breaking some plants off and removing some roots as well. Specially designed aquatic plant rakes are available. Rakes can be equipped with floats to allow easier plant and fragment collection. The operator should pull towards the shore because a substantial amount of plant material can be collected in a short distance.

#### **Clean-up**

All of the manual control methods create plant fragments. It is important to remove all fragments from the water to prevent them from re-rooting or drifting onshore. Plants and fragments can be composted or added directly to a garden.

#### **Advantages**

- Manual methods are easy to use around docks and swimming areas.
- The equipment is inexpensive.

- These methods are environmentally safe.
- Manual methods do not require expensive permits, and can be performed on aquatic noxious weeds with Hydraulic Project Approval obtained by reading and following the pamphlet *Aquatic Plants and Fish* (publication #APF-1-98) available from the Washington Department of Fish & Wildlife.

### **Disadvantages**

- As plants re-grow or fragments re-colonize the cleared area, the treatment may need to be repeated several times each summer.
- Because these methods are labor intensive, they may not be practical for large areas or for thick weed beds.
- Even with the best containment efforts, it is difficult to collect all plant fragments, leading to re-colonization.
- Some plants, like water lilies that have massive rhizomes, are difficult to remove by hand pulling.
- Pulling weeds and raking stirs up the sediment and makes it difficult to see remaining plants. Sediment re-suspension can also increase nutrient levels in lake water.
- Hand pulling and raking impacts bottom-dwelling animals.
- The V-shaped cutting tool is extremely sharp and can be dangerous to use.

### **Diver Harvesting**

- Hand-pulling allows the flexibility to remove undesirable aquatic plants while leaving desirable plants.
- Appropriate in conditions of low milfoil density.
- Can provide precise location and control of individual plants.
- Potential rapid mobilization and response.
- High risk of fragmentation-appropriate care must be given.

### **Milfoil Diver Requirements**

- Special training required.
- Experienced in milfoil identification.
- Highly competent divers only, especially in buoyancy control and navigation skills.
- Motivated- requires patience and meticulous attention to root removal and fragment control.

### **Diver services**

- Especially useful for accurate detection and mapping in moderate to low visibility conditions.
- Useful for treatment assessment and follow-up. (after Moore, 2003)

### **Permits**

Permits are required for many types of manual projects in lakes and streams. The Washington State Department of Fish and Wildlife requires a *Hydraulic Project Approval* permit for all activities taking place in the water including hand pulling, raking, and cutting of aquatic plants. For

noxious weed removal projects a pamphlet called *Aquatic Plants and Fish*, available from WDFW can serve as *Hydraulic Project Approval*.

### **Costs**

Hand-pulling costs up to \$130 for the average waterfront lot for a hired commercial puller. A commercial grade weed cutter costs about \$130 with accessories. A commercial rake costs about \$95 to \$125. A homemade weed rake costs about \$85 (asphalt rake is about \$75 and the rope costs 35-75 cents per foot).

### **Other Considerations**

Manual methods must include regular scheduled surveys to determine the extent of the remaining weeds and/or the appearance of new plants after eradication has been attained

### **Application for Newman Lake**

Much of the currently infested areas in Newman Lake are too large and visibility is too poor to use manual techniques as the sole source of control for Eurasian watermilfoil. These methods would fit best as a supplement to other control methods such as herbicide applications. As with diver dredging, the hand pulling method could be used after herbicide applications to remove plants that were missed or unaffected by the herbicide. Also, the hand pulling method can be used when there is only an occasional scattered plant and water restrictions associated with herbicide use, such as irrigation or drinking water restrictions, are not feasible. Hand harvesting is the most applicable manual method for the supplemental control of milfoil in Newman Lake. Additionally, the soft sediments in Newman Lake should make this method effective. However, caution should be used when using manual methods as they have the potential for missing Eurasian watermilfoil plants, (especially after stirring up sediments) and for fragmentation, exacerbating the existing Eurasian watermilfoil problem. Manual methods will also be vital in combating new infestations of Eurasian watermilfoil that may appear, or in helping contain the infestation at the current level at current locations.

### **Bottom Barriers - Screens**

A bottom barrier or benthic screen covers the sediment like a blanket, compressing aquatic plants while reducing or blocking light. Materials such as burlap, plastics, perforated black Mylar, and woven synthetics can all be used as bottom barriers. Some people report success using pond liner materials. There is also a commercial bottom barrier fabric called Texel, a heavy, felt-like polyester material, which is specifically designed for aquatic plant control. An ideal bottom barrier should be durable, heavier than water, reduce or block light, prevent plants from growing into and under the fabric, be easy to install and maintain, and should readily allow gases produced by rotting weeds to escape without “ballooning” the fabric upwards. Even the most porous materials, such as window screen, will billow due to gas buildup. Therefore, it is very important to anchor the bottom barrier securely to the bottom. Unsecured barriers can create navigation hazards and are dangerous to swimmers. Anchors must be effective in keeping the material down and must be regularly checked. Natural materials such as rocks or sandbags are preferred as anchors.

The duration of weed control depends on the rate that weeds can grow through or on top of the bottom barrier, the rate that new sediment is deposited on the barrier, and the durability and longevity of the

material. For example, burlap may rot within two years; plants can grow through window screening material, and can grow on top of felt-like Texel fabric. Regular maintenance is essential and can extend the life of most bottom barriers. Bottom barriers will control most aquatic plants; however, freely floating species such as the bladderworts or coontail will not be controlled by bottom barriers. Plants like Eurasian watermilfoil will send out lateral surface shoots and may canopy over the area that has been screened giving less than adequate control. In addition to controlling nuisance weeds around docks and in swimming beaches, bottom screening has become an important tool to help eradicate and contain early infestations of noxious weeds such as Eurasian watermilfoil.

Pioneering colonies that are too extensive to be hand pulled can sometimes be covered with bottom screening material. For these projects, it is suggested using burlap with rocks or burlap sandbags for anchors. By the time the material decomposes, the milfoil patches will be dead as long as all plants were completely covered. When using this technique for Eurasian watermilfoil eradication projects, divers should recheck the barrier within a few weeks to make sure that all milfoil plants remain covered and that no new fragments have taken root nearby.

Bottom barriers can be installed by the homeowner or by a commercial plant control specialist. Installation is easier in winter or early spring when plants have died back. In summer, cutting or hand pulling the plants first will facilitate bottom barrier installation. Research has shown that much more gas is produced under bottom barriers that are installed over the top of aquatic plants. The less plant material that is present before installing the barrier, the more successful the screen will be in staying in place. Bottom barriers may also be attached to frames rather than placed directly onto the sediment. The frames may then be moved for control of a larger area. See Appendix D for instructions on constructing and installing bottom barriers (<http://www.ecy.wa.gov/pubs/wqfa9401.pdf>).

### **Advantages**

- Installation of a bottom barrier creates an immediate open area of water.
- Bottom barriers are easily installed around docks and in swimming areas.
- Properly installed bottom barriers can control up to 100 percent of aquatic plants.
- Screen materials are readily available and can be installed by homeowners or by divers.

### **Disadvantages**

- Because bottom barriers reduce habitat by covering the sediment, they are suitable only for localized control.
- Cost and maintenance of bottom barriers confine them to very small-scale use.
- For safety and performance reasons, bottom barriers must be regularly inspected and maintained.
- Harvesters, rotovators, fishing gear, propeller backwash, or boat anchors may damage or dislodge bottom barriers.
- Improperly anchored bottom barriers may create safety hazards for boaters and swimmers.
- Poorly maintained anchors used to pin bottom barriers to the sediment may injure swimmers.
- Some bottom barriers are difficult to anchor on deep muck sediments.
- It is sometimes very difficult to place and secure the fabric to densely packed, tough, fleshy waterlily rhizomes
- Bottom barriers interfere with fish spawning and bottom-dwelling animals.
- Without regular maintenance, aquatic plants may quickly colonize the bottom.

### **Permits**

Bottom screening in Washington requires hydraulic approval, obtained free from the Department of Fish and Wildlife. In certain instances, a shoreline permit may also be required.

### **Costs**

Barrier materials cost \$0.22 to \$1.25 per square foot. The cost of some commercial barriers includes an installation fee. Commercial installation costs vary depending on sediment characteristics and type of bottom screen selected. It costs up to about \$750 to have 1,000 square feet of bottom screen installed. Maintenance costs for a waterfront lot are about \$120 each year.

### **Application for Newman Lake**

The Eurasian watermilfoil infestation at Newman Lake is too wide spread to consider this method for large-scale eradication. The extent of the infestation encompasses large area at the north and south end's of the lake. The infested areas are too scattered and cover too large an area to use a bottom barrier without becoming cost prohibitive. Most importantly, the bottom barrier would also just reduce habitat and native vegetation by covering the sediment and blocking all growth.

Bottom barriers at Newman Lake would be appropriate on small stretches of shoreline that are free from native vegetation and habitat (i.e. Peninsula or McFadden or Sutton Bay area where sandy bottoms are prevalent). Barriers could also be effective in preventing re-infestation after initial control, or in areas that have dense milfoil and have shown resistance to the herbicide.

## 7.5 Biological Controls

Many problematic aquatic plants in the western United States are non-indigenous species. Plants like Eurasian watermilfoil, Brazilian elodea, and purple loosestrife have been introduced to North America from other continents. Here they grow extremely aggressively, forming monocultures that exclude native aquatic plants and degrade fish and wildlife habitat. Yet, often these same species are not aggressive or invasive in their native range. This may be in part because their populations are kept under control by insects, diseases, or other factors not found in areas new to them.

The biological control of aquatic plants focuses on the selection and introduction of other organisms that have an impact on the growth or reproduction of a target plant, usually from their native ranges. Theoretically, by stocking an infested waterbody or wetland with these organisms, the target plant can be controlled and native plants can recover.

### **Classic Biological Control**

Classic biological control uses control agents that are host specific. These organisms attack only the species targeted for control. Generally, these bio-control agents are found in the native range of the nuisance aquatic plants and, like the targeted plant, these bio-control agents are also non-indigenous species. With classic biological control, an exotic species is introduced to control another exotic species. However, extensive research must be conducted before release to ensure that biological control agents are host specific and will not harm the environment in other ways.

Search for a classical biological control agent typically starts in the region of the world that is home to the nuisance aquatic plant. Researchers collect and rear insects and/or pathogens that appear to have an impact on the growth or reproduction of the target species. Those insects/pathogens that appear to be generalists (feeding or affecting other aquatic plant species) are rejected as biological control agents. Insects that affect the target species (or very closely related species) exclusively are considered for release. Once collected, these insects are reared and tested for host specificity and other parameters. Only extensively researched, host-specific organisms are cleared by the United States for release. It generally takes a number of years of study and specific testing before a biological control agent is approved. The cost for researchers to locate, culture, and test bio-control agents is high. Once approved for use, insects can sell for \$1.00 or more per insect. Sometimes it is possible to establish nurseries where weed specialists can collect insects for reestablishment elsewhere.

Even with an approved host-specific bio-control agent, control can be difficult to achieve. Some biological control organisms are very successful in controlling exotic species and others are of little value. A number of factors come into play. It is sometimes difficult to establish reproducing populations of a bio-control agent. The ease of collection of the bio-control and placement on the target species can also have a role in the effectiveness. Climate or other factors may prevent its establishment, with some species not proving capable of over-wintering in their new setting. Sometimes the bio-control insects become prey for native predator species, and sometimes the impact of the insect on the target plant just is not enough to control the growth and reproduction of the species.

People who work in this field say that the more biological control species that you can put to work on a problem plant, the better success you will have in controlling the targeted species.

There are some good examples where numerous biological control agents have had little effect on a targeted species, and other examples where one bio-control agent was responsible for the complete control of a problem species. However, even when biological control works, a classic biological control agent generally does not totally eliminate all target plants. A predator-prey cycle establishes where increasing predator populations will reduce the targeted species. In response to decreased food supply (the target plant is the sole food source for the predator), the predator species will decline. The target plant species rebounds due to the decline of the predator species. The cycle continues with the predator populations building in response to an increased food supply.

Although a successful biological control agent rarely eradicates a problem species, it can reduce populations substantially, allowing native species to return. Used in an integrated approach with other control techniques, biological agents can stress target plants making them more susceptible to other control methods.

### **Biological Control Agents**

#### **Grass Carp (*Ctenopharynogodon idella*)**



The following information and citations are taken from the Washington State Department of Ecology's website on Aquatic Plant Management (<http://www.ecy.wa.gov/programs/wq/plants/management/aqua024.html>).

Another type of biological control uses **general agents** such as grass carp to manage problem plants. Unlike classical bio-control agents, these fish are not host specific and will not target specific species. Although grass carp do have food preferences, under some circumstances, they can eliminate all submersed vegetation in a waterbody. Like classic biological control agents, grass carp are exotic species and originate from Asia. In Washington, all grass carp must be certified sterile before they can be imported into the state. There are many waterbodies in Washington (mostly smaller sites) where grass carp are being used to control the growth of aquatic plants.

The grass carp, also known as the white amur, is a vegetarian fish native to the Amur River in Asia. Because this fish feeds on aquatic plants, it can be used as a biological tool to control nuisance aquatic plant growth. Legalized in 1990 for plant management, triploid (sterile) grass carp may be permitted for introduction into Washington waters. Permits are most readily obtained if the lake or pond is privately owned, has no inlet or outlet, and is fairly small. The objective of using grass carp to control aquatic plant growth is to end up with a lake that has about 20 to 40 percent plant cover, not a lake devoid of plants. In practice, grass carp often fail to control the plants, or in cases of overstocking, all the submersed plants are eliminated from the waterbody.

The Washington Department of Fish and Wildlife determines the appropriate stocking rate for each waterbody when they issue the grass carp-stocking permit. Stocking rates for Washington lakes generally range from 9 to 25 eight- to eleven-inch fish per vegetated acre. This number will depend on the amount and type of plants in the lake as well as spring and summer water temperatures. To prevent stocked grass carp from migrating out of the lake and into streams and rivers, all inlets and outlets to the pond or lake must be screened. For this reason, residents on waterbodies that support a salmon or steelhead run are rarely allowed to stock grass carp into these systems.

Once grass carp are stocked in a lake, it may take from two to five years for them to control nuisance plants. Survival rates of the fish will vary depending on factors like presence of otters, birds of prey, or fish disease. A lake will probably need restocking about every ten years.

Success with grass carp in Washington has been varied. Sometimes the same stocking rate results in no control, control, or even complete elimination of all underwater plants. It has become the consensus among researchers and aquatic plant managers around the country that grass carp are an all or nothing control option. They should be stocked only in waterbodies where complete elimination of all submersed plant species can be tolerated.

Grass carp exhibit definite food preferences and some aquatic plant species will be consumed more readily than others will. Generally, in Washington, grass carp do not consume emergent wetland vegetation or water lilies even when the waterbody is heavily stocked or over stocked. A heavy stocking rate of triploid grass carp may result in the loss of most submersed species, whereas the emergent or floating vegetation remains at pre-stocking levels.

Pauley and Bonar (Bonar, et. al, 1995) performed experiments to evaluate the importance of 20 Pacific Northwest aquatic plant species as food items for grass carp. Grass carp did not remove plants in a preferred species-by-species sequence in multi-species plant communities. Instead, they grazed simultaneously on palatable plants of similar preference before gradually switching to less preferred groups of plants. The relative preference of many plants was dependent upon what other plants were associated with them. The relative preference rank for the 20 aquatic plants tested was as follows in Table 7.1.

Grass carp stocked into Washington lakes must be certified disease free and sterile. Sterile fish, called triploids because they have an extra chromosome, are created when the fish eggs are subjected to a temperature or pressure shock. Fish are verified sterile by collecting and testing a blood sample. Triploid fish have slightly larger blood cells and can be differentiated from diploid (fertile) fish by this characteristic. Grass carp imported into Washington must be tested to ensure that they are sterile. Because Washington does not allow fertile grass carp within the state, all are imported into Washington from out of state locations. Most grass carp farms are located in the southern United States where warmer weather allows for fast fish growth rates. Large shipments are transported in special trucks and small shipments arrive via air.

<i>Potamogeton crispus</i> (curly leaf pondweed)
<i>P. pectinatus</i> (sago pondweed)
<i>P. zosteriformes</i> (flat-stemmed pondweed)
<i>Chara</i> spp.(muskgrasses)
<i>Elodea canadensis</i> (American waterweed)
<i>Potamogeton</i> spp. (thin-leaved pondweeds)
<i>Egeria densa</i> (Brazilian elodea) (large fish only)
<i>P. praelongus</i> (white-stemmed pondweed)
<i>Vallisneria Americana</i> (water celery)
<b><i>Myriophyllum spicatum</i> (Eurasian watermilfoil)</b>
<i>Ceratophyllum demersum</i> (coontail)
<i>Utricularia vulgaris</i> (bladderwort)
<i>Polygonium amphibium</i> (water smartweed)
<i>P. natans</i> (floating leaved pondweed)
<i>P. amplifolius</i> (big leaf pondweed)
<i>Brasenia schreberi</i> (watershield)
<i>Juncus</i> spp.(rush)
<i>Egeria densa</i> (Brazilian elodea) (fingerling fish only)
<i>Nymphaea</i> spp. (fragrant waterlily)
<i>Typha</i> spp. (cattail)
<i>Nuphar</i> spp. (spatterdock)

**Table 7.1** Relative preference rank of Pacific Northwest aquatic plant species as food items for grass carp. (Bonar, et. al, 1995).

### Grass Carp Facts:

- Are only distantly related to the undesirable European carp, and share few of its habits.
- Generally live for at least ten years and possibly much longer in Washington State waters.
- Will grow rapidly and reach at least ten pounds. They have been known to reach 40 pounds in the southern United States.
- Feed only on plants until aquatic vegetation is depleted, although juvenile grass carp are omnivorous
- Feed from the top of the plant down so that mud is not stirred up. However, in ponds and lakes where grass carp have eliminated all submersed vegetation the water becomes turbid. Hungry fish will eat organic material out of the sediments.
- Have definite taste preferences. Plants like Eurasian milfoil and coontail are **not** preferred. American waterweed and thin leaved pondweeds are preferred. Water lilies are rarely consumed in Washington waters.
- Are dormant during the winter. Intensive feeding starts when water temperatures reach 68°F.
- Prefer flowing water to still waters (original habitat is fluvial).
- Are difficult to recapture once released.
- May not feed in swimming areas, docks, boating areas, or other sites where there is heavy human activity.

## **Advantages**

- Grass carp are inexpensive compared to some other control methods and offer long-term control, but fish may need to be restocked at intervals.
- Grass carp offer a biological alternative to aquatic plant control.

## **Disadvantages**

- Depending on plant densities and types, it may take several years to achieve plant control using grass carp and in many cases, control may not occur.
- If the waterbody is overstocked, all submersed aquatic plants may be eliminated. Removing excess fish is difficult and expensive.
- The type of plants grass carp prefer may also be those most important for habitat and for waterfowl food.
- If not enough fish are stocked, less-favored plants, such as Eurasian milfoil, may take over the lake.
- Stocking grass carp may lead to algae blooms.
- All inlets and outlets to the lake or pond must be screened to prevent grass carp from escaping into streams, rivers, or other lakes.

## **Permits**

Stocking grass carp requires a fish-stocking permit from the Washington Department of Fish and Wildlife. Also, if inlets or outlets need to be screened, an Hydraulic Project Approval application must be completed for the screening project.

## **Costs**

In quantities of 10,000 or more, 8 to 12 inch sterile grass carp can be purchased for about \$5.00 each for truck delivery. The cost of small air freighted orders will vary and is estimated at \$8 to \$13 per fish.

## **Other Considerations**

- Would not achieve immediate results – takes time and is not guaranteed to work.
- Community may have concerns with introduced species.
- Potential damage to the native plant community of the lake, which could result in the establishment of other aggressive plant species as pioneers.
- The native plants preferred by grass carp are also preferred by migratory waterfowl
- Concerns from anglers about grass carp.
- Initial investment very expensive.
- Introduction of grass carp has generally been discouraged by State agencies, especially in systems like Newman Lake.

## **Application for Newman Lake**

Grass carp are not suitable for aquatic plant control in Newman Lake. The infestation of milfoil has not reached a level where a bio-control such as grass carp would be necessary. Their preferred food species include the dominant submersed aquatic species in Newman Lake (thin leaved pondweeds and American waterweed), which might be grazed before the milfoil. They could remove all the beneficial plants that support a healthy fish habitat and provide erosion protection. Without cover, and the invertebrates associated with beneficial native aquatic vegetation, the water quality would be degraded and some species (invertebrates, fish, etc.) may be eradicated. In addition, if grass carp eliminated all

beneficial submersed vegetation, the removal could reduce nutrient competition, thereby enhancing phytoplankton productivity. Research in lakes with grass carp in Washington has shown that grass carp increase the turbidity mostly due to increased suspension of sediment into the water column. Newman Lake is visited by migratory waterfowl and removal of palatable aquatic plants by grass carp may adversely impact these and resident waterfowl. If other techniques are suitable, stocking grass carp into Newman Lake should not be considered.

### **Watermilfoil Weevil (*Euhrychiopsis lecontei*)**



**Size:** 2-3 mm, equivalent to a grain of rice

The following information and citations on the watermilfoil weevil are taken from the Washington State Department of Ecology's website on Aquatic Plant Management (<http://www.ecy.wa.gov/programs/wq/plants/management/weevil.html>).

During the past decade, a third type of control agent has emerged. In this case, a native insect that feeds and reproduces on northern milfoil (*Myriophyllum sibiricum*), which is native to North America, was found to utilize the non-native Eurasian watermilfoil (*Myriophyllum spicatum*). Vermont government scientists first noticed that Eurasian watermilfoil had declined in some lakes and brought this to the attention of researchers. It was discovered that a native watermilfoil weevil (*Euhrychiopsis lecontei*) feeding on Eurasian watermilfoil caused the stems to collapse. Because native milfoil has thicker stems than Eurasian watermilfoil, the mining activity of the larvae does not cause it the same kind of damage. A number of declines of Eurasian watermilfoil have been documented around the United States and researchers believe that weevils may be implicated in many of these declines.

Several researchers around the United States (Vermont, Minnesota, Wisconsin, Ohio, & Washington) have been working to determine the suitability of this insect as a bio-control agent. The University of Washington conducted research into the suitability of the milfoil weevil for the biological control of milfoil in Washington lakes and rivers. Surveys have shown that in Washington the weevil is found more often in eastern Washington lakes and it seems to prefer waters that are more alkaline. However, it is also present in cooler, wetter western Washington.

The milfoil weevil has been associated with declines of Eurasian watermilfoil in the United States (e.g. Illinois, Minnesota, Vermont, and Wisconsin). Researchers in Vermont found that the milfoil weevil could negatively affect Eurasian watermilfoil by suppressing the plants growth and reducing its buoyancy (Creed and Sheldon 1995). In 1989, state biologists reported that Eurasian watermilfoil in Brownington Pond, Vermont had declined from approximately 10 hectares (in 1986) to less than 0.5 hectares. Researchers from Middlebury College, Vermont hypothesized that the milfoil weevil, which

was present in Brownington Pond, played a role in reducing Eurasian watermilfoil (Creed and Sheldon 1995). During 1990 through 1992, researchers monitored the populations of Eurasian watermilfoil and the milfoil weevil in Brownington Pond. They found that by 1991 Eurasian watermilfoil cover had increased to approximately 2.5 hectares (approximately 55-65 g/m<sup>2</sup>) and then decreased to about 1 hectare (<15 g/m<sup>2</sup>) in 1992. Weevil abundance began increasing in 1990 and peaked in June of 1992, where 3 – 4 weevils (adults and larvae) per stem were detected (Creed and Sheldon 1995). These results supported the hypothesis that the milfoil weevil played a role in reducing Eurasian watermilfoil in Brownington Pond.

Another documented example where a crash of Eurasian watermilfoil has been attributed to the milfoil weevil is in Cenaiko Lake, Minnesota. Researchers from the University of Minnesota reported a decline in the density of Eurasian watermilfoil from 123 g/m<sup>2</sup> in July of 1996 to 14 g/m<sup>2</sup> in September of 1996. Eurasian watermilfoil remained below 5 g/m<sup>2</sup> in 1997, then increased to 44 g/m<sup>2</sup> in June and July of 1998 and declined again to 12 g/m<sup>2</sup> in September of 1998 (Newman and Biesboer, in press). In contrast, researchers found that weevil abundance in Cenaiko Lake was 1.6 weevils (adults and larvae) per stem in July of 1996. Weevil abundance, however, decreased with declining densities of Eurasian watermilfoil in 1996 and by September 1997 weevils were undetectable. In September of 1998 weevil abundance had increased to >2 weevils per stem (Newman and Biesboer, in press). Based on observations made by researchers in Vermont, Ohio and Wisconsin it seems that having 2 weevils (or more) per stem is adequate to control Eurasian watermilfoil. However, as indicated by the study conducted in Cenaiko Lake, Minnesota, an abundance of 1.5 weevils per stem may be sufficient in some cases (Newman and Biesboer, in press).

In Washington State, the milfoil weevil is present primarily in eastern Washington and occurs on both Eurasian and northern watermilfoil, the latter plant being native to the state (Tamayo *et. al.* 1999). During the summer of 1999, researchers from the University of Washington determined the abundance of the milfoil weevil in 11 lakes in Washington. They found, that weevil abundance ranged from undetectable levels to 0.3 weevils (adults and larvae) per stem. Fan Lake, Pend Oreille County had the greatest density per stem of 0.6 weevils (adults, larvae and eggs per stem). The weevils were present on northern watermilfoil. These abundance results are well below the recommendations made by other researchers in Minnesota, Ohio, Vermont, and Wisconsin of having at least 1.5 – 2.0 weevils per stem in order to control Eurasian watermilfoil.

To date, there have not been any documented declines of Eurasian watermilfoil in Washington State that can be attributed to the milfoil weevil. Creed speculated that declines of Eurasian watermilfoil in Lake Osoyoos and the Okanogan River might have been caused by the milfoil weevil. In Minnesota, Cenaiko Lake is the only lake in that state that has had a Eurasian watermilfoil crash due to the weevil; other weevil lakes are yet to show declines in Eurasian watermilfoil. [This is somewhat out of date information. Recent information shows that stocking milfoil weevils into some Midwestern lakes has resulted in declines in milfoil populations in those lakes.- Kathy Hamel, 7/6/05]

Researchers in Minnesota have suggested that sunfish predation may be limiting weevil densities in some lakes (Sutter and Newman, 1997). The latter may be true for Washington State, as sunfish populations are present in many lakes of the state, including those with weevils. Work by Ecology botanist Jenifer Parsons seems to support Dr. Newman's premise that sunfish populations may control weevil densities in lakes. In addition, other environmental factors that may be keeping weevil

populations in check in Washington, but have yet to be studied, include over-wintering survival and habitat quality and quantity (Jester *et. al.* 1997; Tamayo *et. al.*, in press).

Although the milfoil weevil shows potential as a biological control for Eurasian watermilfoil, more work is needed to determine which factors limit weevil densities and what lakes are suitable candidates for weevil treatments in order to implement a cost and control effective program.

There are no effective biological control agents available at this time for water lily control, nor are there likely to be any.

### **Advantages**

- Milfoil weevils offer a biological alternative to aquatic plant control.
- They may be cheaper than other control strategies.
- Bio-controls enable weed control in hard-to-access areas and can become self-supporting in some systems.
- If they are capable of reaching a critical mass, bio-controls can decimate a weed population.

### **Disadvantages**

- There are many uncertainties as to the effectiveness of this bio-control in western Washington waters.
- There have been no documented declines of Eurasian watermilfoil in Washington State that can be attributed to the milfoil weevil, although there are some lakes in eastern Washington that once had thriving populations of Eurasian watermilfoil that has declined, perhaps due to weevil or other invertebrate feeding.
- Many of our lakes, including Newman Lake, have introduced sunfish populations that may predate on the milfoil weevils.
- Bio-controls often do not eradicate the target plant species, and there would be population fluctuations as the milfoil and weevil follow predator-prey cycles.

### **Permits**

The milfoil weevil is native to Washington and is present in a number of lakes and rivers. It is found associated with both native northern milfoil and Eurasian watermilfoil. A few companies are selling milfoil weevils commercially. However, to import these out-of-state weevils into Washington requires a permit from the Washington Department of Agriculture. As of July 31, 2003, no permits have been issued to bring in outside weevils to Washington. There are concerns about introducing a different genotype of weevil into Washington, but also concerns over exotic hitchhikers in the transport water (e.g. zebra mussels). However, there have been a few studies using weevils in Washington. In these cases, weevils were collected in Washington and reared on Washington milfoil. The offspring (larvae) were used to augment existing weevil populations or to introduce weevils to the test sites (Kathy Hamel, pers. comm. 2003).

### **Application for Newman Lake**

Since the milfoil weevil is a new bio-control agent, it has not been intentionally released widely in Washington to control Eurasian watermilfoil. It is uncertain how effective the weevil will be and whether populations per stem can be maintained at levels high enough to control Eurasian watermilfoil.

In addition, the infestation of milfoil in Newman Lake is not heavy enough to warrant bio-control introduction when other methods are still available. Bio-control is generally used when the target species is widely spread within a water body. The infested areas in Newman Lake are too scattered over a large area for bio-controls to be effective. Newman Lake also has introduced sunfish populations that may predate on the milfoil weevils. At this time, the milfoil weevil is not an option for milfoil control at Newman Lake

## 7.6 Chemical Controls

### Aquatic Herbicides

#### **Description of Method**

The following information and citations were taken from the Washington State Department of Ecology's website on Aquatic Plant Management

(<http://www.ecy.wa.gov/programs/wq/plants/management/aqua028.html>).

Aquatic herbicides are chemicals specifically formulated for use in water to eradicate or control aquatic plants. Herbicides approved for aquatic use by the United States Environmental Protection Agency (EPA) have been reviewed and considered compatible with the aquatic environment when used according to label directions. However, individual states may also impose additional constraints on their use.

Aquatic herbicides are sprayed directly onto floating or emergent aquatic plants, or are applied to the water in a liquid or pellet form. *Systemic* herbicides are capable of killing the entire plant by translocating from foliage or stems and killing the root. *Contact* herbicides cause the parts of the plant in contact with the herbicide to die back, leaving the roots alive and capable of re-growth (chemical mowing). *Non-selective* herbicides will generally affect all plants that they are exposed to, both monocots and dicots. *Selective* herbicides will affect only some plants (usually dicots – broad-leaved plants like Eurasian watermilfoil will be affected by selective herbicides whereas monocots like Brazilian elodea and our native pondweeds may not be affected).

Because of environmental risks from improper application, aquatic herbicide use in Washington State waters is regulated and has certain restrictions. The Washington State Department of Agriculture must license aquatic applicators. In addition, because of a March 2001 court decision (Federal 9th Circuit District Court), coverage under a discharge permit called a National Pollutant Discharge Elimination System (NPDES) permit must be obtained before aquatic herbicides can be applied to some waters of the United States. This ruling, referred to as the Talent Irrigation District decision, has further defined Section 402 of the Clean Water Act. Ecology has developed a general NPDES permit that is available for coverage under the Washington Department of Agriculture for the management of noxious weeds growing in an aquatic situation and a separate general permit for nuisance aquatic weeds (native plants) and algae control. For nuisance weeds (native species also referred to as beneficial vegetation) and algae, applicators and the local sponsor of the project must obtain a NPDES permit from the Washington Department of Ecology before applying herbicides to Washington water bodies. However as of 2005, Ecology is working on developing a new lakes NPDES permit that will combine both the nuisance and noxious weed permits into a single permit. This permit will break down projects into control project and eradication projects. The Newman Lake milfoil project is classified as an eradication project. This permit should be available by March, 2006.

Although there are a number of EPA registered aquatic herbicides, the Department of Ecology currently issues permits for seven aquatic herbicides (Diquat dibromide, Endothall, Glyphosate, 2, 4-D, Fluridone, Imazapyr, and Triclopyr) noxious aquatic weed treatment for lakes, rivers, and streams. Weed control in

irrigation canals is covered under another permit. Other herbicides are undergoing review and it is likely that other chemicals may be approved for aquatic use in Washington in the future.

The chemicals that are permitted for use in 2005 are listed below (see Appendix E for applicable herbicide labels).

### **Washington Department of Ecology Permitted Aquatic Herbicides**

- **Glyphosate** - Trade names for aquatic products with glyphosate as the active ingredient include Rodeo®, AquaMaster®, and AquaPro®. This systemic broad-spectrum herbicide is used to control floating-leaved plants like water lilies and shoreline plants like purple loosestrife. It is generally applied as a liquid to the leaves. Glyphosate does not work on underwater plants such as Eurasian watermilfoil. Although glyphosate is a broad spectrum, non-selective herbicide, a good applicator can somewhat selectively remove targeted plants by focusing the spray only on the plants to be removed. Plants can take several weeks to die and a repeat application is often necessary to remove plants that were missed during the first application.
- **Fluridone** – Trade names for fluridone products include Sonar® and Avast!®. Fluridone is a slow-acting non-selective systemic herbicide used to control Eurasian watermilfoil and other underwater plants. It may be applied as a pellet or as a liquid. Fluridone can show good control of submersed plants where there is little water movement and an extended time for the treatment. Its use is most applicable to whole-lake or isolated bay treatments where dilution can be minimized. It is not generally considered effective for spot treatments of areas less than five acres, but new slow-release formulations may now be effective for spot treatment. It is slow acting and may take six to twelve weeks before the dying plants fall to the sediment and decompose. When used to manage Eurasian watermilfoil in Washington, fluridone is applied several times during the spring/summer to maintain a low, but consistent concentration in the water. Although fluridone is considered a broad-spectrum herbicide, when used at very low concentrations, it can be used to selectively remove Eurasian watermilfoil. Some native aquatic plants, especially pondweeds, are minimally affected by low concentrations of fluridone.
- **2,4-D** –There are two formulations of 2,4-D approved for aquatic use. The granular formulation contains the low-volatile butoxy-ethyl-ester formulation of 2,4-D (trade names include AquaKleen® and Navigate®). The liquid formulation contains the dimethylamine salt of 2,4-D (Trade name - DMA\*4IVM). Both the granular and liquid formulations can be effective for spot treatment of Eurasian watermilfoil and other broad-leaved species. 2,4-D has been shown to be selective to Eurasian watermilfoil when used at the labeled rate, leaving native aquatic species relatively unaffected. For additional information on 2,4-D characteristics and environmental impacts, refer to Ecology’s risk assessment for 2,4-D conducted by toxicologists at Compliance Services International, 2000 (see Ecology’s website).
  - **Navigate® and AquaKleen®** - (Appendix E) Active ingredient 2,4-D BEE. These granular products contain the low-volatile butoxy-ethyl-ester (BEE) formulation of 2,4-D. 2,4-D is a relatively fast acting selective, systemic herbicide. It is applied in a granular formulation and can be effective for spot treatment of Eurasian watermilfoil. When used at a rate of 100 pounds per acre, 2,4-D has shown to be selective to Eurasian

watermilfoil, leaving native aquatic species relatively unaffected. Species controlled with Navigate® and AquaKleen® and effectiveness of control are listed in Appendix F.

- **DMA\*4IVM®** - (Appendix E) Dimethylamine Salt of 2,4-D. This is a liquid formulation that is labeled for aquatic weed control. Since 2,4-D DMA (like 2,4-D BEE) is rapidly converted to 2,4-D acid, the two products should be equally effective in controlling Eurasian watermilfoil.
- **Triclopyr (TEA)** – (Appendix E) Trade name Renovate® was registered on April 4, 2003 (EPA Registration number 62719-37-67690). This aquatic herbicide is a selective systemic herbicide used to control submerged, emergent, and floating aquatic plants. Triclopyr functions by disrupting plant growth metabolism by mimicking the plant hormone auxin, causing uncontrolled and disorganized plant growth that ultimately leads to plant death. It has little or no impact on grasses. There are two basic formulations of triclopyr - a triethylamine salt, and a butoxyethyl ester, however only the salt is registered for aquatic use. In soils, both formulations degrade to the parent compound, triclopyr acid. In water, the salt formulation is soluble and degradation occurs primarily through photolysis and hydrolysis and may degrade in several hours. Renovate® water-soluble triethylamine salt formulation contains three pounds of triclopyr acid equivalent per gallon (<http://tncweeds.ucdavis.edu/products/handbook/20.Triclopyr.pdf>).
- **Endothall - Dipotassium Salt** – Trade name Aquathol®. Endothall is a fast-acting non-selective contact herbicide that destroys the vegetative part of the plant but generally does not kill the roots. Endothall may be applied in a granular or liquid form. Typically, endothall compounds are used primarily for short-term (one season) control of a variety of aquatic plants. However, there has been some recent research that indicates that when used in low concentrations, endothall can be used to selectively remove exotic weeds; leaving some native species unaffected. Because it is fast acting, endothall can be used to treat smaller areas effectively. Endothall is not effective in controlling Canadian waterweed (*Elodea canadensis*) or Brazilian elodea (*Egeria densa*).
- **Diquat** – Trade name Reward®. Diquat is a fast-acting non-selective contact herbicide that destroys the vegetative part of the plant but does not kill the roots. It is applied as a liquid. Typically, diquat is used primarily for short-term (one season) control of a variety of submerged aquatic plants. It is very fast acting and is suitable for spot treatment. However, turbid water or dense algal blooms can interfere with its effectiveness. Diquat was allowed for use in Washington in 2003.
- **Imazapyr** - Imazapyr (Habitat®) is from the herbicide family imidazolinone, non-selective systemic and slow acting herbicides for control of weeds, broadleaved herbs, and woody species. It is suitable only for the control of emergent species or floating leaved species such as the water lily.

### Advantages

Aquatic herbicide application can be less expensive than other aquatic plant control methods, especially when used in controlling widespread infestations of state-listed noxious aquatic weeds.

- Aquatic herbicides are easily applied around docks and underwater obstructions.
- Washington has had some success in eradicating Eurasian watermilfoil, a state listed noxious weed, from some smaller lakes (350 acres or less) using fluridone products.

- 2,4-D has been shown to be effective in controlling smaller infestations (not lake-wide) of Eurasian watermilfoil in Washington.
- Westerdahl and Getsinger report excellent control of the fragrant water lily with glyphosate. Good control was obtained with endothall dipotassium salt and fluridone. Generally glyphosate is the recommended herbicide for water lily control because it can be directly applied to the floating leaves, unlike fluridone or endothall which must be applied to the water. The application of glyphosate allows specific plants or areas of plants to be targeted for removal. Generally two applications of glyphosate are needed. The second application controls the plants that were missed during the first herbicide application.
- Newly registered imazapyr may also be a good choice to control water lilies.

### **Disadvantages**

- Some herbicides have swimming, drinking, fishing, irrigation, and water use restrictions (check the label and general permit).
- Herbicide use may have unwanted impacts to people who use the water and to the environment.
- Non-targeted plants as well as nuisance plants may be controlled or killed by some herbicides.
- Depending on the herbicide used, it may take several days to weeks or several treatments during a growing season before the herbicide controls or kills treated plants.
- Rapid-acting herbicides like endothall and diquat may cause low oxygen conditions to develop as plants decompose. Low oxygen can cause fish kills.
- A drawback of using herbicides, is the "uplifting" of mats of decomposing waterlily roots that can form large floating islands in the waterbody after the herbicides have killed the plants.
- To be most effective, generally herbicides must be applied to rapidly growing plants.
- Some expertise in using herbicides is necessary in order to be successful and to avoid unwanted impacts.
- Many people have strong feelings against using chemicals in water. Find out what lake residents think about chemical use before deciding to treat your water plants with herbicides.
- Some cities or counties may have policies forbidding or discouraging the use of aquatic herbicides. Check before hiring an aquatic herbicide applicator.

### **Permits**

A National Pollutant Discharge Elimination System (NPDES) permit is needed to apply any aquatic pesticide (including herbicides) to waters of the state. Both the noxious aquatic weed and nuisance plant and algae NPDES permits require the development of integrated aquatic vegetation management plans before the third season of treatment. Some herbicide residue monitoring may also be required. . In addition, only state-licensed applicators with an aquatic endorsement may purchase and legally apply herbicides to state waters.

For nuisance weeds and filamentous algae control, apply to the Ecology's Eastern Regional office for a permit in winter before plants become a problem. If you are accepted for coverage under the permit, the permit fee is \$300 per year. Talk to your regional permit writer for details.

With the development of a new lakes NPDES permit, permitting requirements may change. Check with the Kathy Hamel and the regional permit writer to determine new permitting requirements

**Costs of Herbicide Treatment**    Approximate costs for one-acre herbicide treatment:

- Glyphosate: \$250
- Fluridone: \$900 to \$1,000
- Endothall: \$650
- 2,4-D: \$600
- Diquat: \$300 to \$400
- Triclopyr: \$300 to \$800
- Imazapyr: Not sure of costs since this is so new, but it is expensive.

These costs are estimates and will vary from site to site depending on treatment rates and water depths.

### **Other Considerations**

The focus of the discussion below is the active ingredient 2,4-D. The Newman Lake Flood Control Zone District, and with input from Watershed Committee, community, DOE and consultants, have chosen this chemical as the primary control option for Eurasian watermilfoil for Newman Lake (see Chapter 8). Since 2,4-D is a relatively fast-acting, selective, systemic herbicide it was chosen as the primary option. It can be effective for spot treatment of Eurasian watermilfoil, and when used at a rate of 100 pounds per acre, 2,4-D has shown to be selective to Eurasian watermilfoil, leaving native aquatic species relatively unaffected.

EPA studies yield the parameters LD50 (acute lethal dose to 50% of a test population), NOEL (No Observable Effect Level, which is the highest test dosage causing no adverse responses), and RfD (EPA Reference Dose determined by applying at least a 100-fold uncertainty factor to the NOEL). The EPA defines the RfD as the level that a human could be exposed to daily with reasonable certainty of no adverse effect from any cause, in other words, a "safe" dose. Exposures to bystanders or consumers are deemed safe when the RfD is not exceeded (Felsot, 1998). The LD50 value is useful for comparing one compound with another and for grouping compounds into general hazard classes.

According to Felsot (1998), any pesticide that does not produce adverse effects on aquatic organisms until levels in water reach milligram per liter (i.e., mg/L, equivalent to a part per million, ppm) would be considered of comparatively low hazard. Also, compounds that have half-lives less than 100 days are considered non-persistent compared to compounds having half-lives approaching one year or longer. The half-life of 2,4-D is about 7 days in water. Since there are multiple factors that modulate the pesticides' hazard, just focusing on the half-life itself is a bit misleading for hazard assessment. It is now known that the longer a residue remains in soil/sediment, the less likely it will be taken up by plants, leach, or runoff (Felsot, 1998). This phenomenon is called residue aging and involves changes in the forces governing interactions of the chemical with the soil matrix over time.

The granular formulation of 2,4-D is typically applied using a bow-mounted centrifugal or blower-type spreader and the pellets are uniformly spread over the water above the milfoil beds and slightly beyond. The clay particles sink to the bottom or are caught up in the plants. The herbicide slowly releases from the clay over the next day. A few days after the 2,4-D treatment, observers will see the growing tips of milfoil plants twist and look abnormal. These plants will sink to the sediments usually within one to two weeks of treatment. Unless treatment takes place in dense beds of milfoil, it is unlikely for low oxygen conditions to develop. Results of spot treatment may be variable depending on water movement, size of treatment plot, density of milfoil, weather conditions, underwater springs, etc. Granular formulations are generally recommended for spot treatment since liquid applications may have tendencies to drift away

from the milfoil beds. When the liquid formulation is used, it is applied using subsurface trailing hoses ([http://www.ecy.wa.gov/programs/wq/plants/management/2,4D\\_strategies.html](http://www.ecy.wa.gov/programs/wq/plants/management/2,4D_strategies.html)).

Restrictions for aquatic 2,4-D applications are limited compared to other herbicides; there are no fishing restrictions, and three to five days after treatment the water is generally below the drinking and irrigation water standards when using the granular formulation. Although 2,4-D should not damage grass or other monocots, it is recommended that no one use treated water to water lawns and especially other landscape plants during the first three to five days after a treatment. Water within the treatment areas cannot be used for drinking until 2,4-D concentrations have declined to 70 ppb, and water used for irrigation cannot be used until 2,4-D concentrations are 100 ppb or less. There is no swimming restriction for 2,4-D use although the Washington Department of Health advises waiting 24 hours after application before swimming in the treated area.

### **Human and General Mammalian Health**

The oral LD50 for 2,4-D (acid) is 764 mg/kg and the dermal LD50 is >2000 mg/kg. This chemical has a low acute toxicity (from an LD50 standpoint, is less toxic than caffeine and slightly more toxic than aspirin). The RfD for 2,4-D (acid) is 0.01 mg/kg/d. Recent, EPA studies continue to find that it is not considered a carcinogen or mutagen, nor does it cause birth defects. It has a relatively short persistence in water, since it tends to bind to organic matter in the sediments. The herbicide 2,4-D generally does not bioaccumulate to a great extent, and the small amounts which do accumulate are rapidly eliminated once exposure ceases (Washington State Department of Ecology, 2001).

The risks to human health from exposure to aquatic 2,4-D applications were evaluated in terms of the most likely forms of contact between humans and the water to which the herbicide was applied. Ecology's Risk Assessment results indicate that 2,4-D should present little or no risk to the public from acute (one time) exposures via dermal contact with the sediment, dermal contact with water (swimming), or ingestion of fish (Washington State Department of Ecology, 2001). Based on the low dermal absorption of the chemical, the dose of 2,4-D received from skin contact with treated water is not considered significant. Dose levels used in studies are often far beyond what an animal or human would experience from an aquatic application. Many experiments have examined the potential for contact by the herbicide applicator, although these concentrations have little relevance to environmental exposure by those not directly involved with the herbicide application. Once the herbicide has entered the water, its concentration will quickly decline because of turbulence associated mixing and dilution, volatilization, and degradation by sunlight and secondarily by microorganisms (Felsot, 1998).

Results of chronic exposure assessments indicate that human health should not be adversely impacted by chronic 2,4-D exposure via ingestion of fish, ingestion of surface water while swimming, incidental ingestion of sediments, dermal contact with sediments, or dermal contact with water (Washington State Department of Ecology, 2001). Pharmacokinetic investigations have demonstrated that 2,4-D is rapidly absorbed from the gastrointestinal tract and is quickly excreted. Animal toxicological investigations carried out at high doses showed a reduction in the ability of the kidneys to excrete the chemical, and resulted in some systemic toxicity. However, the high doses tested may not be relevant to the typical low dose human exposures resulting from labeled use. A review of the scientific and medical literature failed to provide any human case reports of systemic toxicity or poisoning following overexposure to these herbicide products when used according to label instructions (Washington State Department of Ecology,

2001). The risks to mammalian pets and wildlife should be closely related to these reported human risks, especially since many of the toxicity experiments are carried out on test animals by necessity.

The potential hazard to pregnant women and to the reproductive health of both men and women was evaluated. The results of the 2,4-D developmental or teratology (birth defects) and multigenerational reproduction studies indicate that the chemical is not considered to be a reproductive hazard or cause birth defects (teratogen) when administered below maternally toxic doses (Washington State Department of Ecology, 2001). A review of the histopathological sections of various 2,4-D subchronic and chronic studies provides further support that the chemical does not affect the reproductive organs, except in some higher dose groups beyond the potential level of incidental exposure after an aquatic weed application.

### **Fish Health**

Based on laboratory data reported in the Department of Ecology's Risk Assessment of 2,4-D, 2,4-D DMA (liquid formulation) has a low acute toxicity to fish (LC50 = 100 to 524 mg a.i./L for the rainbow trout and bluegill sunfish respectively). Chinook and coho salmon have been tested by the University of Washington (unpublished data) and did not exhibit high toxic effects. Since the maximum use rate of 2,4-D DMA would be no higher than the maximum labeled use rate (4.8 mg a.i./L) even the most sensitive fish species within the biota should not suffer adverse impacts from the effects of 2,4-D DMA.

In conclusion, 2,4-D DMA will not effect fish or free-swimming invertebrate biota acutely or chronically when applied at typical use rates of 1.36 to 4.8 mg a.i./L (Washington State Department of Ecology, 2001). However, more sensitive species of benthic invertebrates like glass shrimp may be affected by 2,4-D DMA, but 80 and 90% of the benthic species should be safe when exposed to 2,4-D DMA acutely or chronically at rates recommended on the label. Field work indicates that 2,4-D has no significant adverse impacts on fish, free-swimming invertebrates and benthic invertebrates, but well designed field studies are in short supply.

According to the Department of Ecology's Risk Assessment of 2,4-D, in the United States, 2,4-D BEE is the most common herbicide used to control aquatic weeds. 2,4-D BEE, has a high laboratory acute toxicity to fish (LC50 = 0.3 to 5.6 mg a.i./L for rainbow trout fry and fathead minnow fingerlings, respectively). Formal risk assessment indicates that short-term exposure to 2,4-D BEE should cause adverse impact to fish since the risk quotient is above the acute level of concern of 0.01 (RQ = 0.1 ppm/0.3 ppm = 0.33). However, the low solubility of 2,4-D BEE and its rapid hydrolysis to 2,4-D acid means fish are more likely to be exposed to the much less toxic 2,4-D acid. 2,4-D acid has a toxicity similar to 2,4-D DMA to fish (LC50 = 20 mg to 358 mg a.i./L for the common carp and rainbow trout, respectively). In contrast, formal risk assessment with 2,4-D acid indicates that short-term exposure to 2,4-D BEE should not cause adverse impact to fish since the risk quotient is below the federal level of concern of 0.01 (RQ = 0.1 ppm/20 ppm = 0.005). To conclude, 2,4-D BEE will have no significant impact on the animal biota acutely or chronically when using applied rates recommended on the label (Washington State Department of Ecology, 2001). Although laboratory data indicates that 2,4-D BEE may be toxic to fish, free-swimming invertebrates and benthic invertebrates, data indicates that its toxic potential is not realized under typical concentrations and conditions found in the field. This lack of field toxicity is likely due to the low solubility of 2,4-D BEE and its rapid hydrolysis to the practically non-toxic 2,4-D acid within a few hours to a day following the

application. Also data collected under the Noxious Weed NPDES permit indicates that levels of 2,4-D in the water column following application of BEE granules rarely exceed the irrigation water standard of 100 ppb.

### **Application for Newman Lake**

Aquatic herbicides can provide an effective method for control and eventual eradication of noxious weeds when used in conjunction with diver hand removal or bottom barrier installation. 2,4-D is a selective herbicide and milfoil is particularly susceptible at a labeled rate of about 100 -200 pounds per acre (granular product). Most milfoil plants are killed, while re-growth can be controlled for as little as six weeks to as long as one year. The use of a formulation of 2,4-D should provide excellent primary control of the Eurasian watermilfoil while allowing for the more-appropriate spot treatments in scattered infestation areas. For localized reductions of scattered plants especially in more populated stretches of shoreline, the Newman Lake Flood Control Zone District with the input of the NLWSC and the community through this AWMP, recommends hand pulling. These methods can improve swimming safety and fishing conditions in limited areas. Follow-up is essential to ensure the success of eradication. Used alone, 2,4-D is not an eradication tool. Some plants survive the treatment and regrow, so these plants must be removed by other means. In this case, the NLFCZD recommends hand pulling, or depending on the initial treatments success, a secondary 2,4-D treatment.

However, there are factors to consider when choosing this chemical treatment. The most important of which is the possibility of over application. This would be detrimental to fish and wildlife and possibly to water quality. Based on laboratory data reported in the Department of Ecology's Risk Assessment of 2,4-D, 2,4-D DMA has a low acute toxicity to fish. Since the maximum use rate should be no higher than the maximum labeled use rate (4.8 mg a.i./L), even the most sensitive fish species within the biota should not suffer adverse impacts from the effects of 2,4-D DMA. In conclusion, neither formulation of the herbicide (2,4-D BEE or 2,4-D DMA) will effect fish or free-swimming invertebrate biota acutely or chronically when applied at typical use rates of 1.36 to 4.8 mg a.i./L (Washington State Department of Ecology, 2001).

There is also some concern that the granular formulations of 2,4-D BEE found in Navigate® and AquaKleen® may settle by gravity into high organic and flocculent sediments, which could inhibit the release of the 2,4-D to the water column. If this was the case, we may not achieve the predicted level of control of Eurasian watermilfoil because the concentrations released to the water column may not be high enough to kill the plants. This phenomenon is called residue aging and involves changes in the forces governing interactions of the chemical with the soil matrix over time. Since the liquid formulation 2,4-D DMA is now available for use in Washington State, this may provide better control than the granular formulation in certain instances. However, the experience to date has shown the granular formulation to be effective at Newman Lake, though liquid may be considered in the future. There has been some experience to date in Washington of high long-term residual concentrations after liquid applications. After 10 days, 2,4-D residual concentrations were still above the Label irrigation restriction level of 100 ppb. (See monitoring results for Spring Lake and other Washington Lakes at [http://www.ecy.wa.gov/programs/wq/pesticides/final\\_pesticide\\_permits/noxious/monitoring\\_data/monitoring\\_index.html](http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/monitoring_data/monitoring_index.html).) The use of the liquid formulation could limit the ability of Newman Lake residents to irrigate when needed, therefore the preferred herbicide formulation remains the BEE formulation in areas near water intakes.

One of the main reasons to eradicate milfoil is to maintain the health of the native aquatic plant community for all of the species that utilize them in their life cycles, as well as to maintain the viability of the lake for human recreational uses. The nature of the control methods to be implemented will minimize impacts to native aquatic vegetation. The control of the Eurasian watermilfoil will be conducted by methods designed to preserve (and eventually enhance or conserve) the native plant communities. Most of the native submersed macrophyte species are monocots (i.e. *Potamogeton* spp.) that should be relatively unaffected by the 2,4-D application. Removing the noxious invaders will halt the degradation of the system and allow the dynamic natural equilibrium to be maintained. A herbicide selective to Eurasian watermilfoil will be used for its ability to spot treat scattered milfoil infestations and will not require a whole-lake treatment that would expose all the submersed plants to the herbicide. Follow-up control methods will focus specifically on the target species and should leave beneficial plants intact.

An experienced herbicide applicator can selectively target individual weed species and minimize collateral damage to other species. This is especially true when infestations are small so that large areas with a diverse plant distribution do not have to be treated. Since the Eurasian watermilfoil infestations at Newman Lake are still confined largely to the shoreline, it should be relatively simple for the control applicator to avoid collateral damage and preserve the native plant community. We have noted that in 2003 when the treating areas that included Nuphar polysepala (Spatterdock), the Nuphar was “burnt” back some and experienced some curled growth the next year. We therefore now minimize application to the nuphar-dominated areas. This is a stable and important native plant community that we do not want to damage. This would be the preferred method in sensitive wetland areas to avoid damage to native plants.

Since 2003, aquatic 2,4-D (Navigate® and AquaKleen® granular 2,4-D) herbicide treatments have occurred on Newman Lake with success. We have had great decimation of Eurasian watermilfoil plants using AquaKleen® granular 2,4-D applied at the labeled use rate. Most of these treatments inherently have had variable overall success due to the plant’s capacity for rapid vegetative spread. When treatments first began in 2003, an herbicide treatment (AquaKleen® granular 2,4-D) was initiated treating nearly 20 acres, later treatments occurred over smaller acreages. Monitoring showed that 2,4-D levels in the lake remained very low, while still providing effective treatment for milfoil plants.

Long-term success for control and eventual eradication of Eurasian watermilfoil will require long-term community commitment and involvement as well as educational and communication efforts. The Newman Lake Flood Control Zone District is willing to fund the follow-up activities necessary to ensure continued milfoil management and control. Milfoil management has been incorporated into the mission and goals of the NLFCZD with the strong support of the Newman Lake community. Monitoring and management of the plant community will allow the beneficial uses such as fishing, boating, and swimming to exist.