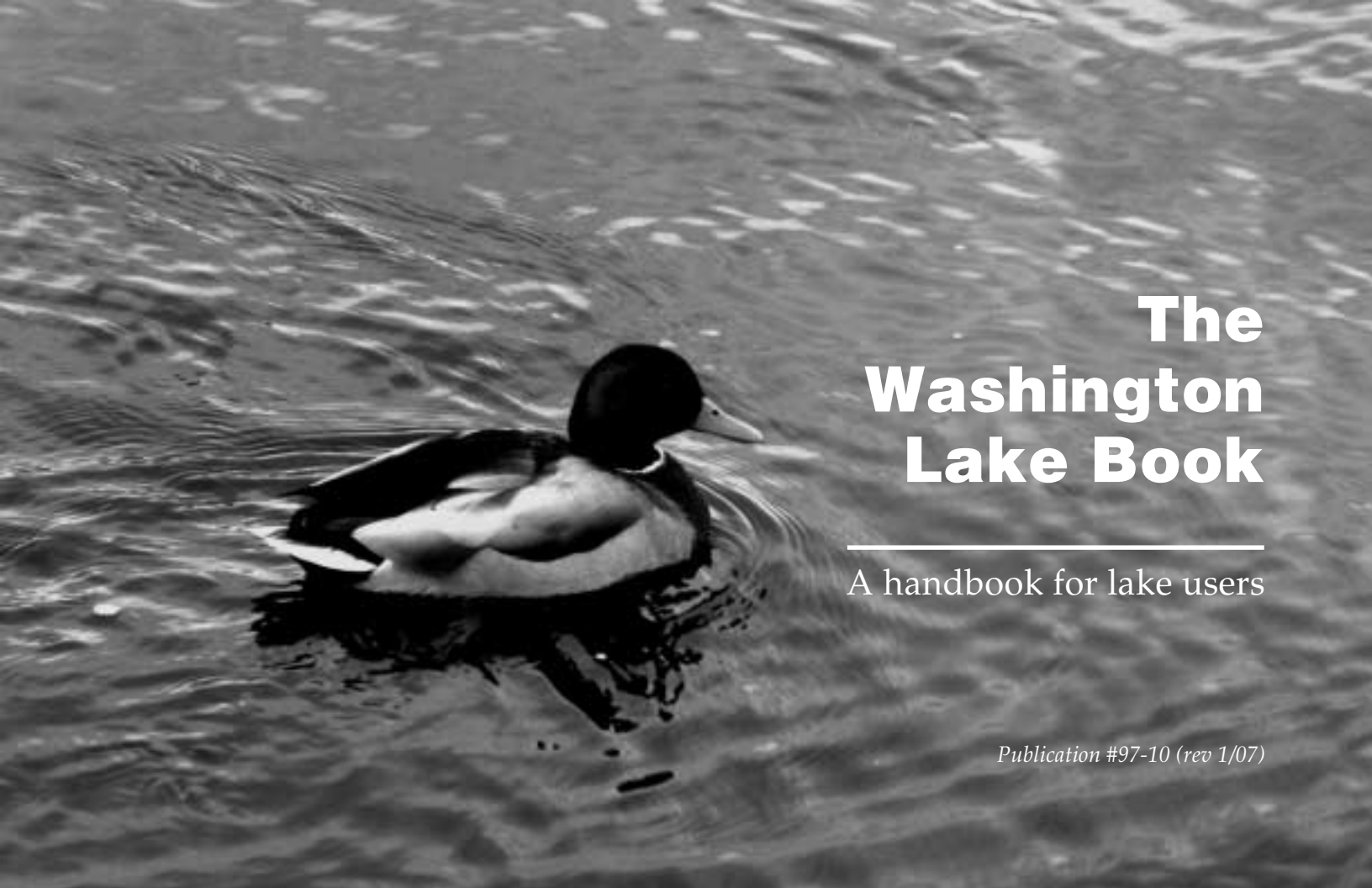

The Washington Lake Book

A handbook for lake users

Publication #97-10 (rev 1/07)

Contents

The Washington Lake Book

A handbook for lake users

Credits

Originally published by the
Washington State Lake Protection Association, *June 1995*

Reprinted by the
Washington State Department of Ecology, *1997*
Third printing, *2007*

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Photographs on cover, pages 10, 15 (background), 23, 29, 30 and back cover by *Brian Walsh*; inside back cover by *Carol Jolly*; drawings on page 9 by *Mike Crayton*

Funded by the Washington State Department of Ecology's
Aquatic Weeds Program

Introduction

Lake users must become part of the solution

WASHINGTON IS FORTUNATE TO HAVE MORE THAN 7,800 LAKES, which provide a variety of recreational opportunities as well as a diversity of ecological habitats. Many Washington residents recognize those opportunities and live close to a lake. Yet lakes face an uncertain future. You or your friends may have witnessed the decline of a good fishing lake, the takeover of a lake by invasive aquatic plants, development of a lake's shoreline, or the decreased clarity of a favorite swimming lake. Shoreline clearing, watershed development, and discharge of pollutants are among the problems causing the degradation of our lakes.

These problems, which have been building for years, come at a time of increased public awareness of the importance of lakes and also at a time of reduced government resources. Degradation of our lakes cannot be only a concern of government. Lakes and their beneficial uses can be protected, and citizens must become part of the solution.

This booklet offers a starting point for people who are concerned about their lake's future. It will help you understand lakes and their watersheds, and the causes, effects, and solutions to water quality problems. It also will help you recognize the warning signs of lake problems and tell you how you can help protect and manage your lake and who can help you.

Lake Characteristics

1

Formation:
Geologic and human events

MOST LAKES were created by geologic events. The vast lake-dotted and marshy landscapes found in North America were formed by glacier action 10,000 to 20,000 years ago. Glaciers formed lake basins by gouging holes in loose soil or bedrock, by depositing material across stream beds, or by leaving buried chunks of ice whose melting shaped lake basins. More recently, humans and other animals have created lakes and reservoirs by damming rivers and streams.

Lakes constantly undergo evolutionary change, reflecting the changes that occur in their watersheds. Most are destined to fill in with remains of lake organisms and with silt and soil washed in by floods and streams. These gradual changes in the physical and chemical components of a lake affect the development and succession of plant and animal communities.

This natural process takes thousands of years. Human activities, however, can dramatically change lakes—for better or worse—in just a few years.

Hydrologic Cycle:
How the water comes and goes

In Washington, about three-fourths of the precipitation that falls reenters the atmosphere by transpiration from plants and evaporation from the earth's surface. Much of the remaining water seeps or soaks into the ground water and moves underground toward lakes and rivers. Water that runs off the land surface also enters rivers and lakes.

Lake levels vary from season to season and year to year. Precipitation is the principal cause of lake level fluctuation. If rainfall decreases, the lake level falls; if rainfall increases, lake level rises. However,

the lag between precipitation and lake level change varies from days to years, depending on the lake. Dams can modify some fluctuations, but varying lake levels are normal. (See diagram on page 4.)

Stratification:
Layers of a lake

Water in lakes in temperate climates tends to stratify or form layers, especially during summer, because the density (weight) of water changes as its temperature changes. Water is most dense at 39 degrees Fahrenheit. Above and below that temperature, water expands and becomes less dense. Many lakes stratify in winter because ice covers the lake surface. Lakes in areas with milder winters do not stratify during the winter. In spring, as the ice melts, the surface waters warm; sink; and mix with the deeper water, a process called spring turnover.

As summer progresses, the temperature difference (and density difference) between surface and bottom water becomes more distinct, and most lakes form three layers. The upper layer, the *epilimnion*, is characterized by warmer (less dense) water and is the zone of light penetration, where the bulk of productivity or biological growth occurs.

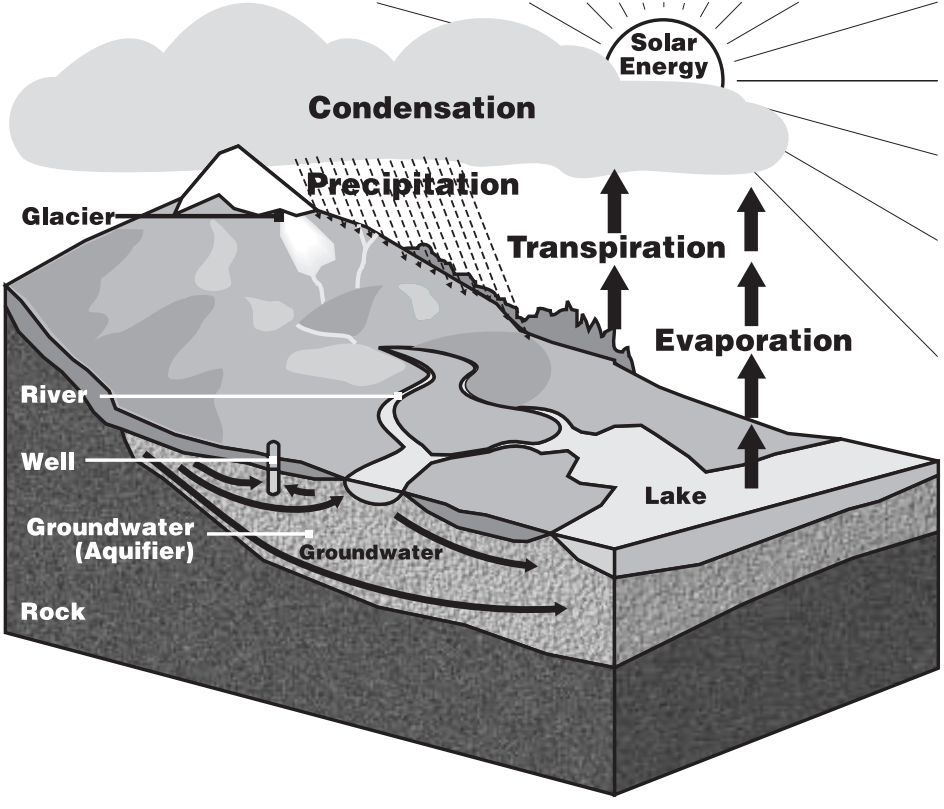
The next layer, the *metalimnion* or *thermocline*, is a narrow band—colder than the upper and warmer than the lower waters—which helps to prevent mixing between the upper and lower layers.

The (third) bottom layer, the *hypolimnion*, has much colder water. Plant material either decays or sinks to the bottom and accumulates in this stagnant layer. (See diagram on page 5.)

During the fall turnover, surface waters cool until they are as dense as the bottom waters and wind action mixes the lake so that water temperature from surface to bottom is the same.

Hydrologic Cycle

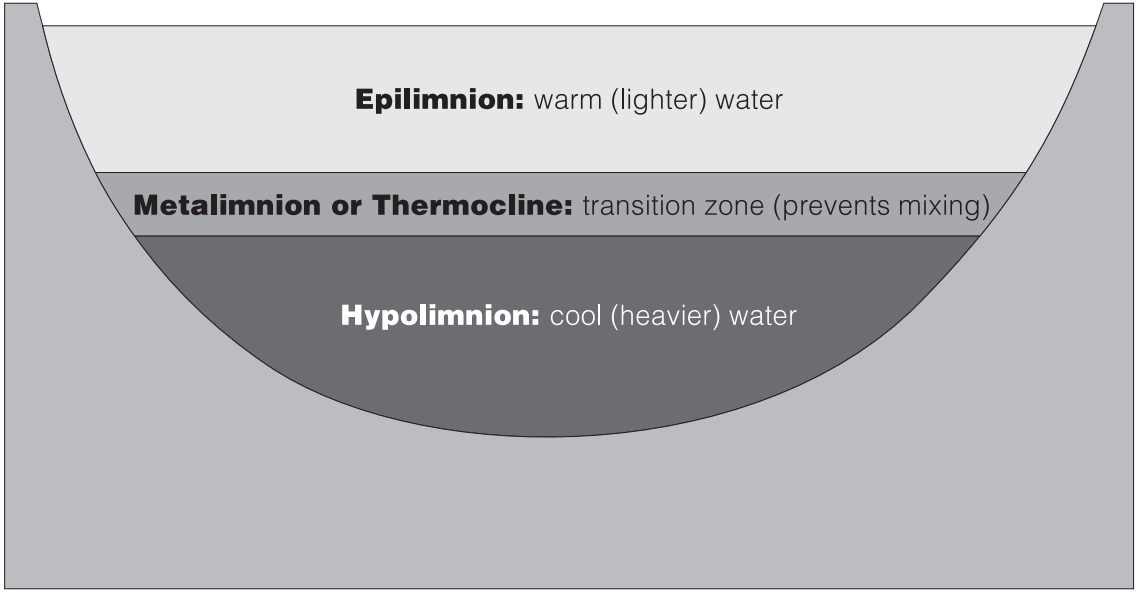
Precipitation becomes surface runoff, evaporates directly, or enters the ground water.



Lake Stratification

Most lakes develop three water layers of differing temperatures during the warm months.

Cross Section of Lake Water Layers



Loss of oxygen in bottom waters restricts habitat areas.

Oxygen:
Essential to lake life

The presence of oxygen in lake water determines where organisms such as fish and zooplankton are found. In spring, when the lake water is well mixed, oxygen is usually present at all depths and organisms may be distributed throughout the lake. In the summer, under stratified conditions, little or no oxygen is produced in the hypolimnion. Available oxygen there is consumed through decomposition of plant and animal material, and oxygen levels become too low for fish which must move to the top layer, or epilimnion.

If these conditions are prolonged and the upper waters become too warm, cold-water fish such as trout may become stressed and eventually die. In the fall, the lake layers break down and turnover replenishes oxygen to the bottom waters.

The formation of ice in winter reduces the supply of oxygen to the lake from the overlying air. If oxygen levels fall too low, fish and other aquatic life may die.

Nutrients:
Phosphorus and nitrogen

Plants require phosphorus and nitrogen for growth. The concentrations of these substances in water and sediments control the total amount of plant matter that can grow.

In most lakes, phosphorus is the least available nutrient; so its abundance—or scarcity—controls the extent of algal growth. If more phosphorus is added to the lake from sewage treatment plants, urban or farmland runoff, lawn or garden fertilizers, septic tanks or other watershed or outside sources, or even if it is released from phosphorus-rich lake bottom sediments, more algae will grow.

Under certain conditions, especially when oxygen is absent from bottom waters, phosphorus is released from bottom sediments into the overlying water.

In turn, algae cloud water clarity and decrease the depth of light penetration. By measuring the phosphorus concentration, algae abundance (by chlorophyll analysis), and water clarity (by Secchi disk measurement), the so-called trophic status is identified.

A eutrophic, or nutrient-rich lake tends to be cloudy or green with algae and may have limited oxygen in the hypolimnion. An oligotrophic lake is relatively nutrient-poor, is clear, and has adequate dissolved oxygen in the hypolimnion. A mesotrophic lake is between the two. Factors vary from lake to lake, and designations of lakes as eutrophic; mesotrophic; or oligotrophic tend to be subjective.

Levels of phosphorus and nitrogen in the water control the growth of algae and aquatic plants in a lake.

Lake Problems

2

Eutrophication:
The aging process

OVER ITS LIFETIME a lake progresses from a more oligotrophic to a more eutrophic state. When nutrients such as phosphorus and nitrogen wash into a lake with stormwater or by soil erosion, they fertilize the lake and encourage algae and larger plants to grow. As plants and the animals that feed on them die and decompose, they accumulate on the lake bottom as organic sediment. After hundreds or thousands of years of plant growth and decomposition, the character of a lake may more closely resemble a marsh or a bog. This natural transition process is called eutrophication.

Lakes also obtain nutrients from various human activities, which can literally make a lake old before its time. This accelerated transition is called cultural eutrophication. Nutrients from agricultural areas, stormwater runoff, urban development, fertilized yards and gardens, failing septic systems, land clearing, municipal and industrial wastewater, runoff from construction projects, and recreational activities contribute to accelerated enrichment or eutrophication.

Sedimentation:
Soils wash into the lake

Sedimentation is closely associated with eutrophication. Wind and water move soils from the watershed into a lake. The soils settle on the bottom of the lake, and the lake becomes increasingly shallow as part of the natural filling of the lake.

Sedimentation is greatly accelerated, however, by human activities that leave the soil exposed without vegetation for extended periods. Land development, construction and agricultural activities near lakes and streams, or farming steep slopes

leaves soils vulnerable to erosion. Sedimentation is best controlled through soil and water conservation practices, maintaining vegetation on soils, and use of best management practices (BMPs) during construction.

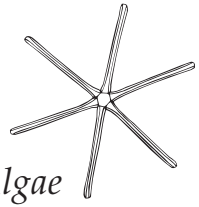
Algae:
Microscopic aquatic organisms

Algae are a source of food and energy for fish and other lake organisms and a vital part of all lakes. Too many or nuisance types of algae, however, can interfere with lake uses by clogging the filters in water treatment plants, inhibiting the growth of other plants by clouding the water so that it shades them, contributing—as they decay—to oxygen depletion and fish kills, and causing taste and odor problems in water and fish. Some species of algae release toxins.

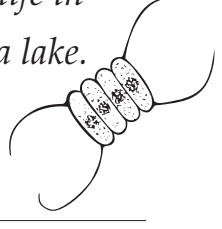
Excess algae can interfere with the simple pleasure of looking at a lake for its beauty. Unsightly scums are usually caused either by tangled masses of filamentous algae or by "blooms" of blue-green algae that float on the lake surface forming scums. Blue-green algae are now classified as cyanobacteria, and these organisms can produce toxins. The regular occurrence of visible algal blooms often indicates that nutrient levels, especially phosphorus, are too high.

Aquatic Plants:
Large rooted or floating plants

Aquatic plants also limit many lake uses. Like algae, aquatic plants (*macrophytes*) are a vital part of the lake because they provide cover, habitat and sometimes food for fish, the organisms that fish eat, and other wildlife. However, too many rooted and floating plants can limit swimming, fishing, skiing, sailing, boating, and aesthetic appreciation. Excessive plant growth can physically prevent mixing of oxygen through the water.



Algae are the base of the food chain and essential to the life in a lake.



Macrophytes are vital to a lake - but in excess can limit uses.

When plants die back they can introduce significant quantities of nutrients and organic matter to the water, stimulating algal blooms and raising dissolved oxygen consumption. Macrophytes are grouped into classes called emergents (cattails and bulrushes), floating-leaved (water lilies and duck weed), and submersed (waterweed and pondweeds).

Submersed plants grow profusely only where underwater light is sufficient. Steep-sided lakes have fewer common nuisance weeds because most of the sediments are too far below the surface. Thick sediments can create a favorable weed habitat unless the sediment loading also creates severe water turbidity (cloudiness).

Most macrophytes obtain their nutrients from lake sediments via roots. Therefore, they can grow abundantly even in lakes in which the nutrient concentration of the water has been reduced.

Contamination:
Pollution from toxic substances

Lakes can be contaminated by toxic substances including industrial chemicals such as PCBs (polychlorinated biphenyls), metals, and solvents; pesticides from agricultural runoff; urban stormwater runoff containing petroleum hydrocarbons, metals and pesticides; and air-deposited chemicals.

Toxic contamination may cause dramatic impacts such as fish kills. Less obvious impacts include decreased reproduction or slower growth rates in fish and reductions in invertebrate diversity.

One long-term danger of toxic contamination is the bioaccumulation or build-up of toxic substances—mercury, for example—in fish flesh. The toxic effects may be passed on to humans eating the fish.

Lakes constantly undergo change, reflecting changes in their watersheds.

Watershed Management

3

Watershed:
Area draining to a lake

A WATERSHED is the area of land from which water drains into a given lake or river. A lake reflects its watershed because the watershed contributes both the water required to maintain a lake and the majority of the pollutants that enter the lake. Effective lake management programs must include watershed management practices. Lake problems cannot be solved without controlling the sources in the watershed.

Pollutant Sources:
From pipes and run-off

Lake pollutants may originate from either point sources or nonpoint sources in the watershed. Point sources discharge pollutants from a distinct source such as a wastewater treatment plant or industrial facility. Point sources are usually regulated by state and federal permits.

Nonpoint pollutants include silt, nutrients, organic matter, and other substances originating over a relatively broad area. Water running over the land picks up these materials and transports them to the lake, either directly in runoff or through a tributary stream, drainage system, or ground water. Water running off a lawn or driveway during a heavy rain is nonpoint source runoff. Land uses such as agriculture, construction, and roadways contribute higher nonpoint pollutant loads than other land uses such as forests. Nonpoint pollution sources are usually

controlled by implementing best management practices.

Point sources were traditionally considered to be the primary dischargers of pollution to water bodies. However, nonpoint sources (harder to identify, isolate, and control) are now more likely to be the principal contributors of nutrient and sediment loads to lakes.

Pollutant Source Assessment:

Where pollutants come from

Not all areas of the watershed are equal pollutant contributors. By identifying those critical areas that contribute excessive amounts of soil and nutrients to the lake, the most effective controls can be developed.

For example, agricultural runoff carrying animal wastes, soil, and nutrients can be a critical pollutant contributor. Urban runoff from lawns, gardens, streets, and rooftops may be significant sources of sediment, oils and greases, nutrients, and heavy metals to lakes. Construction and forestry activities can provide significant quantities of sediments, especially during rainstorms.

In large watersheds, the contributions from urban, forestry, and agricultural areas are generally more significant than those from lakeshore homes. In small watersheds, lakeside resident activities may be more critical pollutant contributors.

Not all areas of the watershed are equal pollutant contributors.

The watershed contributes both the water required to maintain a lake and the majority of pollutants that enter the lake.

Best Management Practices:
Methods to control pollutant sources

Managers of lakes and streams focus on best management practices to control four primary processes: erosion and sedimentation, stormwater runoff, nutrient inputs, and pesticides or toxic substances. These processes are highly interactive. For example, runoff control helps to reduce sediments, nutrients, and pesticide contamination in streams and lakes.

Best management practices for urban areas would include flood storage and control, street cleaning, and use of porous pavements. Such practices for construction would include stabilizing soils and limiting disturbed areas. These practices are also important to agriculture and forestry. The best place for any lake resident to use best management practices is in their own backyard, as described in the next chapter.

Shoreline Management

4

Protecting the shoreline

HOMEOWNERS AND LAKE associations can implement many practices that will help to reduce lake pollution and protect water quality. Appropriate landscaping, reduced use of fertilizers and pesticides, proper maintenance of septic systems, and judicious use of household products are discussed below. Before beginning any activity, think about potential pathways and risks to water quality from soil erosion, chemical amendments, and yard waste.

Shoreline Development:
Lakeside Building

Shoreline development can hurt a lake. The shorelines and wetlands act as a buffer between water and land as they trap nutrients, filter pollutants, retard erosion, and provide habitats for plants and animals.

Shoreline development directly affects lakes in two ways. First, wildlife habitats and buffering capacity are lost through destruction of the natural vegetation around lakes. Second, pollution from increased surface runoff and nutrient additions from fertilized lawns and septic systems can affect lake water quality.

Landscaping:
Lawns and gardens

Lawns and gardens adjacent to lakes must be carefully planned and maintained to prevent contamination of surface and ground waters. Consider native vegetation as a quality alternative to cultured lawns and landscapes because it provides a more diverse and balanced plant community and habitat. Contact a nursery that supplies native plants for species best adapted for your needs.

Shoreline Management Regulations prohibit intensive removal of vegetation near the shore or on steep slopes. Check with your local jurisdiction for specific regulations.

Take steps to offset problems which could occur under the following conditions:

- ❖ Areas of exposed soil or poorly established vegetation.
- ❖ Coarse textured soils such as sands or sandy loams.
- ❖ Property sloping toward water.
- ❖ Impervious surface such as sidewalks and driveways.
- ❖ Lawn/landscape maintenance close to water.
- ❖ Application of fertilizers, pesticides, or soil amendments.

A sample landscape plan that protects water quality is illustrated on page 20.

A balanced approach to waterfront landscaping retains some natural habitat and reduces pollution and erosion while also meeting your aesthetic and access needs.

Fertilizers:

Growth stimulators

Avoid the use of chemical fertilizers if possible. Native vegetation does not require the application of additional fertilizer. Compost or manure is preferable to chemical fertilizers; however, they can degrade (damage) water quality if used in excessive amounts.

If you apply fertilizers to lawns and gardens, adhere to the following guidelines:

- ❖ Have your soil tested to determine how much fertilizer is needed.
- ❖ Water your lawn after fertilizing, but do not allow excess water to run off into surface waters.

- Sweep up any fertilizer which is spilled on hard surfaces such as walks and driveways.
- Be careful when applying fertilizer near surface waters. Do not spread fertilizer within 75 feet of surface waters or wetlands. Use a "drop" spreader and not a "cyclone" spreader to reduce the chances of getting fertilizer in the water.

Pesticides:
Insect and weed control

Avoid the use of chemical pesticides if possible. Consult a professional from the Washington State University Cooperative Extension Service to determine alternative methods for pest controls if needed.

The following practices will minimize the potential of contamination from pesticides:

- Properly identify whether an insect, disease, or other factor is causing the problem.
- Determine whether there is an economic or aesthetic justification to initiate control of the pest.
- Consider controlling the pest without a pesticide.
- Use the least toxic and most readily degradable pesticide.
- Read the pesticide label carefully. Pay special attention to warnings about use near water and safety precautions.
- Do not apply pesticides when it is windy to avoid the possibility of drift.
- Purchase only what is needed to control the problem (this season).
- Dispose of waste pesticides properly. Do not pour them on the ground or into storm drains, surface waters, or sanitary treatment systems. Consult with your local solid waste office for proper disposal methods.

Septic Systems:

They need to be maintained

With routine maintenance a properly installed septic system should not pollute the lake. The following practices will reduce contamination from septic systems.

- ❖ Have your septic tank checked every other year and pumped when necessary.
- ❖ Use nonphosphate detergents, wash full loads of clothes, and use water-saving showers and toilets to avoid stressing your septic system.
- ❖ Do not use a garbage disposal.
- ❖ Do not use septic system additives. Keep solvents, plastics, paper diapers, and other similar products out of your septic system.
- ❖ Do not pave over or park on your drain field. The soil needs to breathe.

Hazardous Household Products:

Cleaners can be toxic

Many common household cleaners and products contain ingredients that are corrosive, toxic, or flammable. When used or disposed of improperly, these products can affect personal health and safety and can also contaminate ground water and soil, eventually polluting our lakes.

Think before buying household cleaning and maintenance products. General purpose products may work as well as products developed for a specific surface or appliance. Purchase water-based nontoxic or less toxic products rather than solvent-based paints and cleaners. Alternatives to hazardous cleaning products are cheaper and some are equally effective. Information on these alternatives is available from the Washington State Department of Ecology.

Protecting the shoreline can make an effective buffer around the lake.

Landscaping

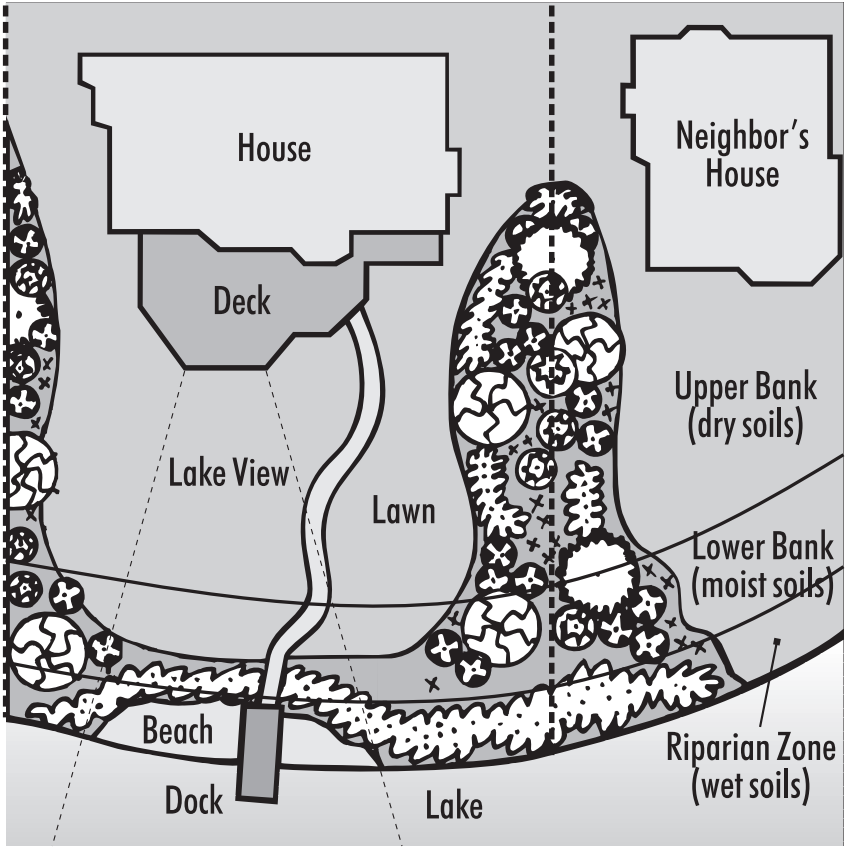
Example of a lake-friendly landscape plan:

Riparian Zone:
Lady fern, sedges (many species), flag iris

Lower Bank
Shrubs: redosier dogwood, red elderberry, evergreen huckleberry; Ground Covers: lady fern, bunchberry, sword fern; Shade trees: chokeberry, Oregon ash, western hemlock; Shade & Cover: vine maple, western crabapple, hazelnut

Upper Bank:
Shrubs: serviceberry, mock orange, red flowering currant; Ground Covers: salal, sword fern, pig-a-back; Shade Trees: Chokeberry, Oregon ash, western hemlock; Shade & cover: Vine Maple, western crabapple, hazelnut

- conifer trees
- deciduous trees
- large understory shrubs
- medium-sized shrubs
- ground covers
- Fern



If you must use a hazardous product, read the label carefully before purchasing. Make sure the product will do what you want it to. Buy only the amount you need. If you cannot use it all, give it to someone who can.

Invasive Exotic Species:
Foreign invasion

Invasive exotic species, organisms introduced into habitats where they are not native, are considered to be severe threats to our lakes. They are a major cause of the continuing loss of biological diversity throughout the world and have caused extinction of some native species.

In the absence of predators, parasites, pathogens, and competitors from their native habitat, species introduced into new habitats can overrun their new home and crowd out native species. Once established, invasive exotics rarely can be eliminated. Examples of invasive exotic species are common cordgrass (*Spartina angelica*), purple loosestrife (*Lythrum salicaria*) and Eurasian watermilfoil (*Myriophyllum spicatum*). State law prohibits the sale, distribution, or planting of these and other invasive species.

You can take the following actions to minimize the spread of exotic plants and animals:

- Learn what these species look like and monitor for their presence. Report a new infestation to the Washington State Department of Ecology or the Noxious Weed Control Board.
- Do not introduce exotic species — especially don't dump unwanted aquarium contents into a lake.
- Remove plants and animals from your boat, trailer, and accessory equipment before leaving the water access area. Then wash all equipment with hot water. If possible, let everything dry for three days before transporting your boat to another body of water.

Exotics can destroy native habitat and drive out native species.

Lake Management

5

EVERY LAKE is unique. Specific strategies to address a lake's water quality problems should focus on activities in the watershed and/or in-lake restoration techniques, depending on the nature and extent of the problem.

Lake management approaches fall into two categories, the "quick-fix" and long-term management. The quick-fix offers a short-term solution such as the application of herbicides to control unwanted algae or macrophytes (large plants). It treats the biological symptoms of a lake problem, but does not address the underlying causes. Plant and fish productivity are dependent on the chemical and physical processes going on in and around the lake, and these must be considered in any plan to change the biology of a lake.

Long-term lake management considers all of the environmental, cultural, and biological factors affecting the lake and sets a priority on finding lasting solutions. If immediate in-lake restoration techniques are necessary, they should be followed by appropriate long-term management actions to control sediment, nutrient, and toxic inputs.

Lake management is a complicated job and likely will be a joint effort of community groups, individuals, landowners, and government. To be effective, lake management is a long-term commitment and investment. This and following sections briefly summarize various methods to improve a lake's water quality and indicate necessary permits and possible grants and loans.

In-Lake Restoration:
Cleaning up problems

Controlling pollution sources will not improve lake water quality immediately in many cases. Years may pass before lakes cleanse themselves of accumulated nutrient loads and wastes. For this reason, in-lake restoration techniques have been developed to accelerate recovery. In-lake restoration techniques are briefly described in Table 1 on page 24. Consult the references at the end of this booklet for more details on these techniques.

Aquatic Plant Control

Many techniques have been developed for controlling aquatic plants and are briefly described in Table 2 on page 25. Additional information on advantages, disadvantages, permits, costs, and contacts for each technique are available from the Washington State Department of Ecology and in references provided at the end of this handbook. See this website for management methods: *http://www.ecy.wa.gov/programs/wq/plants/management/index.html*

Appropriate long-term management actions to control nonpoint pollutant sources must also be taken.

Table 1 In-Lake Restoration Techniques

Method	Advantages	Drawbacks
Dilution: Flush with low nutrient water	Reduces nutrient levels. Washes out surface algae.	Requires large volumes of water. Does not eliminate sources of phosphorus from sediments or watershed.
Aluminate sulfate (alum) treatment	Lowers lake phosphorus content. Inhibits release of phosphorus from sediment. Increases water column transparency.	Temporary measure (may last 5 or more years.) Potential toxic impacts during application. Increased macrophyte growth due to water clarity.
Artificial circulation	Disrupts or prevents stratification. Provides aeration and oxygenation. Increases aerobic habitat.	Does not decrease algal biomass. May decrease water clarity. Adverse impact on cold-water fish. No effect on macrophytes.
Hypolimnetic aeration	Maintains oxygen in hypolimnion. Limits release of phosphorus from sediments. Increases habitat and food supply.	Difficult to supply adequate oxygen. Potential for destratification and subsequent algal blooms. No effect on macrophytes. High cost
Dredging	Controls aquatic vegetation, deepens lake. Increases lake volume. May improve water quality.	Temporary resuspension of sediments. Temporary destruction of habitat. Disposal concerns. Very high cost.
Water level drawdown	Controls macrophytes. Consolidates sediments. Facilitates dredging or excavation. Facilitates dock repairs.	Poor effectiveness in mild, wet climates. Short-term benefit. Intensifies algal blooms. Temporary adverse impacts on fish and invertebrates. May leave docks high and dry.
Biomanipulation: Adjust fish species composition	Encourages growth of zooplankton, which eat algae.	Considered experimental. Not effective where blue-green algae dominate.

Table 2 Aquatic Plant Control Techniques

Method	Advantages	Drawbacks
Manual Methods: Hand-pulling, raking and cutting	Inexpensive. Flexible. Easy to use around docks, swim areas.	Not practical for large areas. Stirs up sediment. Disturbs bottom-dwellers.
Sediment Covers (Bottom barriers)	Inhibits or prevents macrophyte growth. Nontoxic. Low environmental impact in small applications. Ability to target problem areas. Can be installed in areas that are inaccessible to harvesters.	High cost. Prone to damage, displacement, and plant regrowth. Must be correctly installed to prevent flotation. Maintenance required.
Weed Rolling: Rolls plants flat or detaches them from bottom sediment	Inexpensive, easy to operate. Can give season-long control.	Detached plants need to be removed from water. Good only for limited area around dock.
Mechanical Cutting: Cutters clip plants several feet below surface	Hand-held cutters easily maneuvered. Fish habitat retained. Low cost for individuals/associations.	Plant fragments must be removed to prevent rerooting. Several cuts required in growing season.
Mechanical Harvesting	Removes plant material from lake. Requires no toxic substances. Vegetation may be composted.	Labor intensive, seasonally dependent. Access constraints. May facilitate colonization of new areas due to fragmentation. High costs. Repeat treatments needed. Depth restriction (.5m - 5 ft). Plant disposal needed.
Rotovation: "Roto-tilling" to dislodge plants and roots	2-3 acres can be rotovated daily. Removes roots.	Large equipment, high costs. Disrupts sediment, causing turbidity, nutrient and toxics release. Disturbs bottom dwellers. For milfoil control.
Sterile Grass Carp	Controls some aquatic vegetation. Requires no toxic substances.	Potential impacts on other organisms. May increase nutrient cycling and stimulate algal blooms due to grazing and digestive activities. Possible escape and infestation of nontarget areas. Introduction of parasites. May prefer native plant species over exotics.
Herbicides: Apply chemicals to kill or control plants.	Inexpensive to expensive. Easy to apply around obstructions. May control macrophyte and algae growth.	Potential toxic effects. Decomposing plant material releases nutrients to water column. Short-term benefit may require temporary restriction on recreational activities. Dissolved oxygen depletion due to decomposing plants. Repeat applications needed.

Permits

6

ANY LAKE MANAGEMENT activity or construction work near any water body may require one or more of the following permits. Contact the permitting agencies listed early in the planning stages of your project. The landowner, agent, or contractor must obtain the required permits to avoid violation of local, state, and federal laws.

See "The Permit Handbook" *www.ecy.wa.gov/pubs/9029.pdf*

Table 3 Permits

Permit Name
Shoreline Substantial Development Permit
Flood Plain Development Permit
Hydraulic Project Approval Permit (*www.wdfw.wa.gov/hab/hpapage.htm*)
National Pollutant Discharge Elimination System Permit or similar permit
Fish Planting Permit (grass carp) (*www.wdfw.wa.gov/fish/trnsport.htm*)
Natural Heritage Program Letter
Aquatic Lands Lease and/or Authorization (*www.dnr.wa.gov/htdocs/agr*)
Forest Practice Approval
United States Army Corps of Engineers Permit (Sec. 10 and 404)

Purpose	Example	Contact
Required for activities within the 100-year flood plain or within 200 feet of the shoreline of certain lakes (20 acres or more), rivers (flowing at 20 cubic feet per second or greater), and other water bodies.	Bottom barriers, rotovation, harvesting, and herbicide application may require this local permit.	Your local planning department
Required for all activity within the 100-year flood plain.	Buildings, mining, filling, dredging, grading, paving, drilling operations, and storing equipment or materials.	Your local planning or public works department
Required for activities that will use, divert, obstruct, or change the natural flow or bed of any fresh or salt water of the state.	Bottom barriers, rotovation, drawdown, dredging., harvesting, and cutting.	Washington State Department of Fish and Wildlife at 360/902-2534
Required for chemical applications in any state waters. (*www.ecy.wa.gov/programs/wq/pesticides/index.html*).	Herbicides, handpulling, algaecides, alum, microbial products	Washington State Department of Ecology's Water Quality Program at 360/407-6400
Required to stock triploid (sterile) grass carp to control aquatic plants.	Grass carp planting	Washington State Department of Fish and Wildlife at 360/902-2820
Program is state's bank of data on endangered, threatened, & sensitive plant species; native wetland plant communities, & aquatic & non-vegetated wetland systems. Should get letter confirming search of critical plant species before any plant control activity. Program has limited data for lakes; specialist should survey for critical plant species.	Aquatic plant control	Washington State Department of Natural Resources, Natural Heritage Program at 360/902-1667 (*www.dnr.wa.gov/nhp*)
May be needed for proposed actions involving construction, filling, dredging, drilling, mining, road construction, utility installation, or other activities within the beds or shorelines of certain waters.	Dredging, rotovation	Washington State Department of Natural Resources, Aquatic Resources Division at 360/902-1100
Required for forest activities relating to growing, harvesting or processing timber, road construction and maintenance, brush clearing, slash disposal, as well as forest chemical applications undertaken around water bodies or other areas.	Forest activities (*www.dnr.wa.gov/forestpractices*)	Washington State Department of Natural Resources, Division of Forest Practices at 360/902-1400
Required for placing dredged or fill material in the waters and/or wetlands, as well as work in navigable waters of the United States. Navigable waters include major rivers and Lakes Washington, Sammamish, Chelan, and Vancouver.	Dredging, rotovation	U.S. Army Corps of Engineers at 206/764-3495

Lake Organizations

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PEOPLE WHO live on lake shores enjoy advantages not available to other citizens. They also share responsibilities which may be difficult for them to deal with as individuals. Working with others can stimulate problem solving and offer remedies to lake and watershed problems. Outlined below are four types of organizations of lake property owners which conduct various activities to address lake problems.

Lake Association:
Concerned volunteers

A lake association is a volunteer organization consisting of interested property owners. There are more than 200 lake associations in Washington state, most of which are organized as non-profit organizations. A lake association is an appropriate organization for promoting stewardship and bringing a community together to form consensus on common goals and objectives. Lake associations are flexible and voluntary. As a result, solutions to lake problems which require large amounts of money usually are not implemented. Membership dues and fund-raisers are the principal means of raising money to fund association activities.

Homeowners' Association:
Membership required

A homeowners' association is usually mandatory, established by a developer through recorded deed covenants. The covenants require each lot buyer to be a member of the association and pay dues.

Special Purpose Government:
Electing board, paying taxes

A special purpose government allows property owners in unincorporated areas to develop solutions to problems. Examples include water, sewer, stormwater drainage, and conservation districts. The district is run by an elected board and funds are raised by property taxes. A special purpose government can apply for grants but its activities are generally limited by statute.

Lake Management Districts:
Assessing property for funds

The process for forming Lake Management Districts (LMD) is established under state law [Title 36 Revised Code of Washington (RCW) Chapter 36.61] and allows property owners to assess property to finance lake management activities. An LMD may include all or part of one or several lakes. Private and public lake front property, upland lots with access to a community beach area, and any other property within the watershed which benefits from management activities can be included.

Unlike special purpose governments which have their own board of directors, LMDs operate under the authority of the county or city officials, but lake property owner involvement is crucial to a successful program. Owners of at least 15 percent of the acreage in the proposed district must sign a petition to the jurisdiction. A county or city also has the authority to initiate formation of an LMD on its own.

Property may be assessed based on various factors including benefit, use, front footage, acreage, improvements, or service to be provided. The process includes a public hearing and vote. LMD funds may be used to match state or federal grants and can finance a broad range of activities.

Sources of Money

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SOURCES OF GRANTS are available in Washington State for lake management activities and are outlined in the table on page 31. The state also provides low-cost loans for projects under the State Revolving Fund for Water Pollution Control. Additional information is available from the Washington State Department of Ecology, Water Quality Program at 360/407-6400.

For more information about Ecology grants and loans, see *http://www.ecy.wa.gov/fap.html*

Table 4 Available Washington State Department of Ecology Grants

	Aquatic Weed Management Fund	Centennial Clean Water Fund	Algae Control Program
Purpose	Supports local aquatic weed projects.	Supports water quality planning and implementation projects.	Supports freshwater algae and nutrient-reduction projects.
Eligibility	Local, state governments, and Tribes and special purpose districts are eligible. For lakes with public boat ramp. Lakes with noxious weeds get funding priority.	Local, state governments, tribes, conservation and special districts eligible. For lakes with public access.	Local, state governments, tribes and special purpose districts are eligible.
Match	Provides 75 percent matching funds. Projects limits of $30,000 to $75,000.	50-75 percent matching funds.	Provides 75 percent matching funds.
Project	Funds start-up costs only; not ongoing operations & maintenance.	Funds start-up costs only; not ongoing operations & maintenance.	Education, control, equipment purchase.
Deadline	Applications due November 1.	Applications due October.	Applications due November 1
Budget	$400,000 available each year.	Future availability uncertain.	Approximatley $150,000 per year

See Ecology's website for more details about these programs at *http://www.ecy.wa.gov/programs/wq/links/plants.html*

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* Available on Ecology's web site at *http://www.ecy.wa.gov/programs/wq/links/plants.html*

The Washington State Lake Protection Association

THE WASHINGTON LAKE BOOK was written by WALPA volunteers and was reprinted by the Washington State Department of Ecology with the permission of the WALPA board.

Who is WALPA?

THE WASHINGTON STATE LAKE Protection Association (WALPA) is a nonprofit, all-volunteer organization working with all lake users and government agencies to achieve effective management of our lakes and watersheds.

- WALPA is working with individuals, organizations, and agencies to help ensure that Washington's lakes are healthy and usable for today and tomorrow.
- WALPA has a diverse membership: lake front owners and associations; anglers; boaters and other recreationists; educators; scientists; legislators; and staffs of Native American tribes, and local, state and federal agencies.
- WALPA is a state chapter of the North American Lake Management Society (NALMS), an international organization committed to protecting our nation's lakes.
- WALPA's website is *http://www.nalms.org/walpa*