WATERSHED KEEPERS SAMPLING HEMPLE CREEK FOR INVERTEBRATES, PHOTO BY LAURIE USHER

Summary

Continued growth in Snohomish County is expected to increase the impacts of nonpoint pollution.

Substantial progress has been made toward controlling point source pollution.

Snohomish County is a rich network of natural streams, wetlands, lakes, and rivers. Helping to sustain the quality of that water for present and future generations is a fundamental mission of Surface Water Management. This report is intended to provide a summary of technical information for citizens as well as to guide future County programs toward preservation of healthy waterbodies and recovery programs for those waterbodies in decline.

Snohomish County has grown by 25 percent since 1990. Urban and rural land uses are increasing, and many pollutants are associated with these land uses. Our present data are still insufficient for most long-term trend analyses, which begin to gain statistical significance after ten or more years. However, increasing growth and urban land use are negatively impacting water quality.

Since the 1960's, substantial progress has been made toward controlling point source pollution from sewage treatment plants, pulp mills, and large industrial facilities. However, pollution associated with dispersed urban and rural land uses, known as nonpoint source pollution, continues to have significant cumulative impacts on the quality of water resources. Continued growth is expected to increase these impacts. Therefore, control of nonpoint source pollution from urban runoff, septic systems, fertilizers and pesticides, and agricultural runoff is a major challenge within Snohomish County and Puget Sound for the foreseeable future.

During the past decade, the County has begun a monitoring program to determine the health of our waterbodies. Currently, SWM monitors 17 streams and rivers, volunteers monitor approximately 27 lakes per year, and SWM staff conduct 25 detailed lake studies each year. While this monitoring gives us detailed information about the chemical and physical condition of the waterbody at the time of sample collection, additional biological evaluations are necessary to diagnose the cumulative effects of impacts over time. SWM has begun biological assessments of approximately 20-40

Only a few rivers in the County consistently meet the water quality standards established by the State.

SWM's water quality investigations show problems that follow patterns of population concentration and land use.

streams per year. To characterize the health of a watershed, biological and chemical data can be combined with the results of habitat surveys, which assess the condition of the riparian corridor, the stream banks and channel, and the substrate. This report summarizes the results of chemical and biological monitoring. Habitat studies will be discussed in future reports.

The State of the County's Waters

Only a few rivers in the County consistently meet the water quality standards established by the State. Widespread violations of water quality standards have been identified in rivers, lakes and streams. At least 37 rivers, streams, and lakes in the County fail to meet the goals of the Federal Clean Water Act, which are that our waters should support fish and be healthy for swimming.

Many pollutants are present in County waters. Copper, lead, zinc, cadmium, and mercury have been found in streams in urban, commercial, and industrial areas. High levels of fecal coliform bacteria are a problem in many streams. Bacteria can come from failing septic systems, manure, and pet waste. Many streams and lakes show high nutrient levels, and excessive nutrient enrichment is often a problem in lakes. Nutrients can come from fertilizers, detergents, septic systems, and manure. High sediment loads from development, tree harvesting, and erosion are a problem in many County streams and rivers. Low dissolved oxygen levels and high temperatures found in many County streams can be a barrier to fish.

SWM's water quality investigations show problems that follow patterns of population concentration and land use. In the most populated area in the southern part of the County, the main types of pollutants are petroleum products, toxic chemicals, soaps, industrial wastewaters, and failing sewer and septic systems. In the Snohomish basin, which comprises a mixture of rural and urban development, the main problems are petroleum products and manure from farms. Failing septic systems, toxic chemicals and industrial wastewaters are reported at a much lower frequency in the Snohomish basin than in the south county. The few problems reported from the rural Stillaguamish watershed are related to runoff from manure with some reports of petroleum products.

Trends

Information on long-term water quality trends is limited, but rapid changes in land use patterns continue to pose challenges for maintaining water quality. SWM began monitoring programs from 1992-1994 in many watersheds in the County. We are learning more about the current condition of our streams, but six to eight years of data are insufficient for most long-term trend analyses. Results of biological monitoring from 1997-1999 indicate that the aquatic life in our lowland streams and rivers is in fair or poor condition.

Chemical monitoring data show no major deterioration in the quality of our waters since the early 1990's, but most streams and rivers are still not meeting state water quality standards. We are seeing a slight decline in levels of lead in streams in the more urban areas in the Snohomish and South County watersheds. This decrease in lead is a result of the use of unleaded fuels. However, baseline monitoring in the Stillaguamish mainstem and tributaries has shown an increase in conductivity from 1994 through 1999. Conductivity is an indicator of contaminants in streams from road runoff. This increase is likely a result of increased population in the watershed and the resulting increase in traffic on roads.

Although an increase in conductivity in the Stillaguamish is a cause for concern, we are seeing decreases in bacteria concentrations in that watershed. DOE found improving trends in bacteria in both the North and South Forks as well as a significant decrease in bacteria and ammonia in the lower mainstem. This decrease in the mainstem may be a result of recent upgrades at the Arlington Sewage Treatment Plant. SWM data also show an overall decrease in bacteria and an increase in dissolved oxygen at all sites in the lower watershed since 1994. However, SWM monitoring data indicate that temperature, bacteria, nutrient, and sediment concentrations increase going downstream from the upper mainstem at Arlington to the lower mainstem at Marine Drive. In addition, bacteria concentrations still violate state standards on both the mainstem Stillaguamish and many of the tributaries. While overall bacteria levels in the Stillaguamish are declining, we still need continuing improvements to meet state standards in both the mainstem and the tributaries.

Glade Bekken, a small watershed in the Stillaguamish where SWM has monitored intensively for several years, shows decreased bacteria levels since

Aquatic life in our lowland streams and rivers is in fair or poor condition.

Lead levels are declining in urban watersheds.

In the Stillaguamish, bacteria levels are decreasing and oxygen is increasing.

Improvements in water quality require a long-term commitment from both agencies and citizens working together.

County Programs:

- *Regulations*
- *Road maintenance*
- *Watershed plans*

1994. This decrease may be a response to the numerous best management practices implemented on small farms in the watershed. However, sediment levels show only a slight decrease and nitrate concentrations have not changed. The results in Glade Bekken show that improvements in water quality require a long-term commitment from both agencies and citizens working together.

County Programs to Improve Water Quality

Snohomish County has developed numerous programs and ordinances with long range goals for improving the quality of rivers, lakes, and streams. Current **regulations** seek to protect water quality, limit and control runoff, limit uses of land along fish bearing streams, and require buffers and erosion control during and after development activity. Examples of current County regulations are the Water Pollution Control Ordinance, which prohibits discharges that violate state water quality standards, and the Building and Grading Code, which regulates development and construction activities to prevent sediment from entering surface waters. The Planning and Development Services Department conducts the County's code enforcement program.

The County is responsible for **maintenance** of 1600 miles of roads, which are potential sources of sediment, metals, petroleum, and other toxic chemicals to streams. Every year, the County cleans approximately 15,000 catch basins and 65 miles of storm sewer pipe to keep these pollutants from entering streams. Other maintenance activities which protect water quality include road sweeping, use of lead-free paints, and the use of mechanical methods rather than herbicides to remove roadside vegetation.

The County develops **watershed plans** to provide clear direction for enhancing water quality and habitat as well as minimizing flood and erosion damage. These plans provide recommendations that can be used to implement Water Cleanup Plans developed by the Department of Ecology to improve the water quality of our streams and rivers. Many restoration projects, such as planting streamside vegetation, fencing to prevent livestock access to streams, repairing existing drainage problems, or stabilizing creek banks have positive impacts on water quality. Conservation, in the form of land acquisition, developing regulations, or maintenance of facilities, is crucial in guaranteeing good water quality.

Surface Water Management has developed water quality focused watershed plans for the Swamp, North, Quilceda/Allen, and the Stillaguamish watersheds. A plan for the French Creek watershed is nearing completion. Reconnaissance level plans are a more rapid means of assessing watersheds. Field observations of the health of a watershed and opportunities for capital improvements, preservation, and education have been summarized in reconnaissance reports. In the Snohomish watershed, reconnaissance plans have been completed for the Bear-Evans, Little Bear, French, Lower Pilchuck River, Little Pilchuck Creek, and Fobes Hill area watersheds. In the Stillaguamish watershed, reconnaissance plans have been written for the Portage, Church, Pilchuck Creek, Warm Beach and Tulalip, Grandview Road area, North Fork, South Fork, and Lower Mainstem watersheds.

Implementing the recommendations of these plans and **educating the public** in watershed issues are goals of the County. Watershed stewards for the Stillaguamish, Snohomish, and South County watersheds work directly with local residents and businesses to improve water quality and fish habitat. The countywide lake management program provides citizens with resources to implement lake protection and restoration processes on their own. SWM trains citizens to be Watershed Keepers and gives training to teachers on watershed issues. The Solid Waste Division of the Public Works Department sponsors hazardous waste disposal programs for households and small businesses. Other County programs promote **watershed awareness** by labeling streams, watershed boundaries, wetlands, and detention ponds. Requirements of the Clean Water Act and the Endangered Species Act will provide increased protection for aquatic life and water quality as well as the need for continued citizen education and involvement.

The County provides assistance in areas where **citizens' groups** have special interests in watersheds. In the Quilceda/Allen watershed, Surface Water Management received a Centennial Clean Water grant from DOE to train citizens to monitor bacteria and stream flows. In Cemetery Creek, which flows to the Snohomish River, SWM is working with citizens to evaluate sources of pollution and to identify restoration projects. SWM has begun a monitoring and restoration project in the Little Bear Creek watershed in cooperation with citizens' groups and the City of Woodinville.

Cooperative efforts with other agencies can target specific problems and reach wider audiences. The County has partnerships with the Adopt-a-

County Programs:

- *Education*
- *Watershed awareness*
- *Assistance to citizens' groups*
- *Cooperation with other agencies*

County Programs:

- *Capital projects*
- *Restoration*
- *Monitoring*

Stream Foundation, a private non-profit organization engaged in a wide range of education efforts aimed at protecting and restoring stream habitat. A contract with the Snohomish Conservation District provides classes and assistance to farmers in developing farm plans to reduce pollution problems. The Snohomish Health District sends educational materials and maintenance procedures to on-site sewage system owners.

Many **capital improvement projects** provide direct water quality benefits. Phosphorus in Lake Stevens, which causes algal blooms, has decreased since the installation of an aeration system. Bank stabilization and stream restoration projects reduce the amount of sediment in streams and rivers and maintain cool water temperatures. Wetland **restoration** projects increase the capacity of a watershed to provide a buffer for stormwater runoff. SWM rehabilitates detention facilities to more effectively filter pollutants and incorporates biofiltration swales into larger projects to produce cleaner runoff.

Evaluation and **monitoring** are key elements to determine the effectiveness of County programs and to establish water quality trends. Citizens are monitoring lakes to help assess the health of lakes and establish baseline conditions. SWM staff collect baseline water quality information on streams throughout the County. SWM also conducts intensive monitoring to evaluate water quality impacts from land use activities. This information determines which educational programs and best management practices will most effectively reduce nonpoint pollution to surface water.

Recommendations for Further Actions

Although current monitoring efforts are providing needed information to reduce pollution, many data gaps remain. SWM's water quality investigations consistently find petroleum products, chemicals or hazardous wastes, and wastewater and soaps in the more urbanized parts of the County. Water quality problems resulting from stormwater runoff are countywide, but they are especially severe in the most developed areas of the county. Monitoring conducted by SWM, other agencies, local governments, and tribes should continue.

The DOE has designated 37 of our rivers, streams, and lakes as not meeting standards for water quality. The EPA requires states to establish Water Cleanup Plans for these waterbodies to identify pollution problems and develop strategies to reduce the pollution. DOE

Recommendations:

- *Monitoring*
- *Baseline data for spill assessment*
- *Temperature*

has begun to develop Cleanup Plans for 12 rivers and creeks in Snohomish County. DOE should continue to work with other agencies, local governments, and citizens to identify and implement specific best management practices to control nonpoint pollution.

Temperature is an important physical parameter for aquatic life. Ambient monitoring programs measure a single temperature at the time of sampling and not the range of temperatures to which aquatic organisms are exposed. More data are needed to characterize the temperature regimes of streams and the potential impacts to aquatic life.

Bacteria are a major pollutant in our waterbodies. It is important to be able to identify primary sources of bacteria so clean-up efforts can be successful. A survey by DOE (Sargeant 1999) found no easy, low-cost method for differentiating between human and non-human sources of fecal bacterial contamination. Quantifying the contribution from each source is still not possible. The most frequently used and well-tested source identification method is genetic fingerprinting, matching DNA in known sources to those in the waterbody. This method is expensive and usually only a portion of the water samples can be identified, but it can be effective for determining some of the sources of fecal contamination in a watershed.

The following paragraphs outline some specific recommendations for further actions to improve water quality in Snohomish County.

Monitoring: General baseline data on chemical and biological conditions are lacking for the Skykomish River and its tributaries, the lower mainstem Snoqualmie, the Pilchuck River and its tributaries, and the Marshland watershed. Monitoring efforts should be expanded to include more of these systems.

Baseline data for spill assessment: In the event of toxic spills into our rivers and creeks, baseline data on the biology and chemistry of the waterbody are essential for evaluating impacts. Information on the benthic invertebrate communities is especially useful for documenting spills. SWM has begun a program to collect baseline benthic invertebrate samples. This program should be systematically expanded to include more streams in the County.

Temperature: Continuously recording temperature loggers should be added to the existing flow gages on North Creek, Swamp Creek, upper Little Bear Creek, North Fork Skykomish River, North and South Forks of the Stillaguamish River, and the mainstem Stillaguamish River. Temperature loggers should be installed on all new stream flow

Recommendations:

- *Bacteria*
- *Septic surveys*
- *Business outreach*
- *Education and outreach*
- *Farming best management practices*
- *Detention pond maintenance*

gages, such as the one currently planned for the Pilchuck River. Temperature loggers should also be considered for Pilchuck Creek, Woods Creek, and the lower mainstems of the Skykomish and Snoqualmie Rivers.

Bacteria: In small sub-basins where bacteria levels are high and multiple sources of bacteria are present, further testing may provide information to direct cleanup efforts. To focus cleanup efforts, DOE recommends a survey of the land uses and potential sources in the watershed for bacteria source identification. Surveys by SWM and farm surveys by the Snohomish Conservation District can provide information on potential sources of bacteria in watersheds. Genetic fingerprinting, or matching DNA to known sources, may be effectively used for source identification in areas such as Cripple Creek in the French Creek watershed or sub-basins in the Stillaguamish.

Septic surveys: Septic surveys can identify septic systems with problems and provide technical assistance to homeowners. Septic surveys should be targeted for areas of special concern, such as areas with high water tables, wetlands and hydric soils, and older systems. Some of these areas include the Marysville trough along the Interstate 5 corridor in the Quilceda/Allen watershed, Sturgeon Creek on the Tulalip reservation, areas of French Creek with older septic systems, and the Marshland hillsides.

Business outreach: A program providing outreach and technical assistance to businesses could reduce many toxic pollutants identified in commercial areas of the County. Parts of the North, Swamp, Little Bear, and Quilceda/Allen watersheds should be targeted for these programs.

Education and outreach: Education programs should be targeted to address needs identified in water quality studies, such as education in erosion control for developers and engineers, proper pet waste disposal, and septic system maintenance. Outreach programs should be expanded to provide opportunities for businesses to invest in stream restoration projects and more opportunities for volunteer participation in the native plant program.

Farming best management practices: The Snohomish Conservation District has conducted surveys in the Stillaguamish and Snohomish watersheds to identify farms with the potential for causing water quality problems. A stronger effort to develop and implement farm plans in these areas would significantly reduce sources of bacteria, nutrients, and sediment in streams.

Detention pond maintenance: More frequent inspection and maintenance of

stormwater facilities would lead to substantial water quality benefits. SWM should continue to implement and expand its program to rehabilitate detention facilities to more effectively filter pollutants. Stormwater treatment systems such as biofiltration swales should be incorporated into larger projects to produce cleaner runoff. Monitoring of these projects is essential to evaluate the actual benefits to streams. Properly constructed and maintained stormwater facilities provide effective removal of sediment, metals, petroleum, bacteria, and nutrients from runoff.

Stormwater runoff: The County should emphasize the use of improved technology to treat stormwater runoff. In addition, a program to reduce impervious surfaces in new construction and existing urban areas would reduce the volume of runoff and loads of pollutants reaching surface waters.

Enforcement: Current County regulations prohibit discharges that violate state water quality standards and require erosion control for construction activities. Effective enforcement of existing ordinances is necessary to improve water quality.

Recommendations:

- *Stormwater runoff*
- *Enforcement*

What We Can Do To Improve Water Quality

A few years ago, we believed that most water pollution came from businesses and industries. Regulation, information, and treatment are reducing the impacts from these activities and have eliminated many point sources.

However, most of our current water quality problems come from rapid population growth and the cumulative impact of all our daily activities, known as non-point source pollution. The following paragraphs include information from the Puget Soundbook (Kolb and Boardman 1991) and describe actions all of us can take to improve water quality.

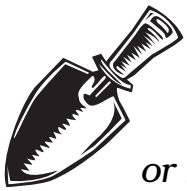
Get Involved! Education & Community Action

Learn about the watershed where you live and educate yourself in watershed issues. Many community groups have already organized activities and projects to improve water quality. Our personal actions and involvement in the public process will determine the future quality of our waters.

To help you protect your own watershed, Snohomish County Surface Water Management offers **Watershed Keepers** classes. Watershed Keepers learn how to be stewards of their streams and implement changes. The nine session training series includes community service that will promote watershed protection. If you are interested in becoming a Watershed Keeper, call Suzi Wong Swint or Roger Kelley at 425-388-3464.

Surface Water Management conducts a **Lakes Management** Program where citizen volunteers monitor the water quality of their lakes. If you are interested in monitoring the lake where you live, call Heidi Reynolds or Gene Williams at 425-388-3464.

To report a water quality violation, call the Department of Ecology at 425-649-7229. To report a hazardous waste spill, call DOE's **24-Hour Spill Hotline** at 425-649-7000.



Protect or Replant Streamside Buffers

Vegetation in wetlands, roadside ditches, and along streams and rivers is important in maintaining high water quality. Streamside vegetation protects aquatic life by providing shade, food and cover for fish, filtering pollutants from runoff, and stabilizing streambanks to reduce erosion. Property owners can protect streams and lakes by leaving a vegetative buffer strip, planting native vegetation, and fencing to restrict livestock access to the stream. Keep lawn clippings, trash, and pet wastes out of stream corridors. Call Scott Moore at the Surface Water Management **Native Plant Program** at 425-388-3464 about participating in a planting or plant salvage project. Contact the **Snohomish Conservation District** at 425-335-5634 for information about their annual native plant sale.

Conserve Energy & Water

Insulate your water heater, caulk your windows, and insulate your home to reduce energy demand and the need for new dams on rivers and streams. Dams introduce dramatic changes in both upstream and downstream plant and animal habitats and inhibit salmon from swimming upstream.

Conserving water at home and in the office can reduce the volume of water that must be treated by a sewage treatment plant or septic system. Water conservation protects streams by reducing the need for diversions and maintaining water flows, which support abundant aquatic life.

Reduce Automobile Use & Automobile Wastes

Vehicles are one of the biggest contributors to water pollution. Drive your car less by joining car pools, using public transportation, riding bicycles, and choosing to live close to your daily activities. Driving fuel-efficient cars with low emissions conserves energy and reduces pollution. Maintain your car to prevent leaks in oil, fuel, brake, and cooling systems. Recycle used motor oil and antifreeze, and never put oil or other automotive products into a storm drain. If you repair your car at home, prevent oil, antifreeze, or other fluids from contacting the ground by using drip pans and disposing of the fluids properly. Have a spill kit on hand in the case of any unexpected leaks.

Car washing contributes high levels of phosphorus, metals, petroleum products, and sediment to streams and lakes. Wash your car at a commercial car wash that treats wastewater, or better yet, find one that recycles, reuses, and then treats wastewater . If you do choose to wash your car at home, use a phosphorus-free detergent and wash on a lawn where water will not run directly to a stream or lake..

Maintain a Healthy Yard

Minimize turf area by planting native trees, plants, and groundcovers. These plants will need less attention than lawns and will grow without the use of fertilizers, pesticides, or extra watering. In periods of dry weather, the impact of water demand affects the flow in area rivers and streams; reduce your usage during these times.

Maintain lawn areas to reduce runoff by properly adjusting your lawn mower. Because mowing height determines the depth of roots and the density of grass shoots, the correct mowing height is an important factor in the formation of healthy turf. Healthy turf holds rainwater, filters sediments and chemicals and requires less frequent watering. Mowing height for most grasses should be about 1-1/2 inches. Using an electric mulching mower will reduce fuel use and return some of the plant nutrients to the soil. Maintaining your lawn through proper mowing will keep it looking healthy without the use of fertilizers or pesticides.

If your property borders a Native Growth Protection Area, stream, lake, or conservation area, maintain buffer vegetation. A buffer will help filter run-off before it enters a waterbody and will provide habitat for birds and other animals.

Pet wastes are a major contributor of bacteria to local waters. It is important to clean up after your pet, even in your own yard. Hobby livestock should not be allowed in or along streams, and keep manure from reaching streams and ditches.

Use Less Household Hazardous Wastes

Reduce your use of lawn fertilizers, pesticides, and herbicides. Choose water-based paint over oil-based paint and rinse brushes and pans in an area where the paint will not run into the storm drain system or a stream. Dispose of hazardous wastes during special collection days or by bringing containers to a hazardous waste disposal center, rather than in your regular garbage pickup or down storm drains. Contact **Snohomish County Public Works Solid Waste Management** at 425-388-3425 for more information on disposal.

You can replace many toxic household cleaners with a few non-toxic ones, such as vinegar and baking soda. Detergents are one of the most-used home cleaning products and many contain phosphorus levels as high as 13 percent. Phosphorus causes problems in streams and lakes by acting as a fertilizer and stimulating plant growth. Check the phosphorus content of detergents and buy only low phosphorus products.

Maintain Your Septic Tank

Septic systems have limited lifetimes, but regular maintenance keeps your septic system functioning longer. If you have a septic system, inspect it annually and have the tank pumped every 2-3 years to prevent failure. Reducing your water usage will reduce the amount of water that the system must handle, extending its life. Protect your drainfield from damage from vehicles or large tree roots. If you suspect that your septic system may be failing, have it evaluated right away. Contact the **Snohomish Health District** at 425-339-5200 for more information about septic system maintenance and a list of certified pumpers.

SNOHOMISH RIVER, PHOTO BY SKY MILLER

Glossary of Terms

Ambient monitoring - Monitoring that is done to determine existing environmental conditions or pollution levels in the environment and acts as a baseline for comparison with future conditions.

Beneficial uses - Activities that use water, such as swimming or fishing that are defined in the Washington State Water Quality Standards.

Benthic organisms - organisms, usually invertebrates, that live in or on the bottom of a body of water.

Best management practice (BMP) - A practice, structure, or management style that is designed to protect water quality by controlling erosion, runoff, nutrients, pesticides, or other contaminants.

Bioaccumulation - the process by which a contaminant accumulates in the tissues of an organism. For example, certain chemicals in food eaten by a fish tend to accumulate in its liver and other tissues.

Biodegradation - The conversion of organic compounds into simpler compounds through biochemical activity. Toxic compounds can sometimes be converted into nontoxic compounds through biodegradation. In some cases complex compounds are first converted into intermediate substances that can be more toxic than the original substance.

Biofiltration - The use of plants to filter contaminants and sediment out of stormwater.

Biomagnification - The process by which concentrations of contaminants increase or magnify as they pass up the food web such that each animal in the food web has higher tissue concentrations than did its food. For example, concentrations of certain contaminants can increase as they are passed from plankton to herring to salmon to seals.

Buffer strip - An intact vegetated corridor along a stream or lake.

Channelization - Straightening of a stream or dredging of a new channel to which the stream is diverted.

Channel stability - A measure of the resistance of a stream to erosion that determines how well a stream will adjust to and recover from changes in flow or sediment transport.

Contaminant - A substance that is not naturally present in the environment or is present in amounts that can, in sufficient concentration, adversely affect the environment.

Conductivity - A measure of the ability of a solution to carry an electrical current dependent on the total concentration of ionized substances dissolved in the water.

Cumulative effects - The combined environmental impacts that accrue over time from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible

impact, the combined effects can be severe.

Deposition - The settlement or accumulation of material out of the water column and onto the stream bed. Deposition occurs when the energy of flowing water is unable to support the load of suspended sediment.

Detention - The process of collecting and holding back stormwater for delayed release to streams or rivers.

Discharge, direct or indirect - The release of wastewater or contaminants to the environment. A direct discharge of wastewater flows directly into surface waters while an indirect discharge of wastewater enters a sewer system.

Dissolved oxygen - Oxygen that is dissolved in water and therefore available for fish and other aquatic animals to use. If the amount of dissolved oxygen in the water is too low, then aquatic animals may avoid the water or die. Wastewater and naturally occurring organic matter contain oxygen-demanding substances that consume dissolved oxygen.

Ecosystem - A community of living organisms interacting with one another and with their physical environment, such as a forest, lake, stream, or estuary. Damage to any part of a complex system may affect the whole. A watershed ecosystem can be thought of as the sum of organisms living in rivers, streams, lakes, wetlands, riparian areas, and uplands.

Effluent - The liquid that flows out of a facility or a household into a water body or sewer system.

Ephemeral stream - A watercourse that flows briefly only in direct response to precipitation in the immediate locality, and whose channel is at all times above the water table.

Epilimnion - the uppermost, warmest, well-mixed layer of water in a lake during summertime stratification

Erosion - The wearing away of land surface by wind and water. Erosion can occur naturally and by land use activities such as clearing for timber, development, road building and farming.

Eutrophication - The process by which a water body, usually a lake, builds up excess nutrients resulting in algae blooms and low water clarity. This is a natural aging process in lakes, but it may be accelerated by human activities.

Fecal coliform bacteria - Fecal coliform bacteria are bacteria that are found in the intestinal tracts of mammals. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated wastewater or the presence of animal feces. These organisms may also indicate the presence of pathogens that are harmful to humans. High numbers of fecal coliform bacteria therefore limit beneficial uses of a water body such as swimming and shellfish harvesting.

Groundwater - Underground water supplies stored in aquifers. Groundwater is created by rain, which soaks into the ground and flows down until it is collected at a point where the ground is not permeable. Wells tap groundwater for use.

Habitat - The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life. Typical habitats in watersheds include wetlands, deep or shallow lakes, fast or slow moving streams, riparian areas, or rivers.

Hardness - The total concentration of calcium and magnesium ions expressed as mg/l calcium carbonate. As hardness in water decreases, the toxicity of metals increases.

Herbicide - A substance used to destroy or inhibit plant growth or vegetation.

Hydrologic cycle - The continual cycling of water between the land, sea, and atmosphere through evaporation, condensation, precipitation, absorption into the soil, and stream runoff.

Hypolimnion - the lower, cooler layer of water in a lake during summertime stratification

Impervious - A surface that cannot easily be penetrated. For instance, rain does not readily penetrate asphalt or concrete pavement.

Insecticide - A substance that is used to kill insects.

Intermittent stream - A watercourse that flows only at certain times of the year, receiving water from springs or surface sources.

Land use - The way land is developed and used in terms of the types of activities allowed, such as agriculture, residences, or industries. Certain types of pollution problems are often associated with particular land use practices, such as sedimentation from construction activities.

Leachate - Water or other liquid that has washed or leached from a solid material, such as a layer of soil or debris. Leachate may contain contaminants that can pollute surface or groundwaters.

Loading - The total amount of material entering a system from all sources. A pollutant load is the total amount of a particular contaminant carried by a stream or river.

Mainstem - The main channel of a stream, river, or estuary.

Mesotrophic water body - A water body classified midway between oligotrophic and eutrophic. It is characterized by moderate amounts of nutrients entering the water body, a moderate number of shoreline aquatic plants, and occasional plankton blooms.

Metalimnion - the layer of lake water between the epilimnion and hypolimnion; water temperature and density change rapidly in this zone

Metals - Metals are elements found in rock and minerals that are naturally released to the environment by erosion, as well as generated by human activities. Certain metals, such as mercury, lead, copper, zinc, and cadmium, are of environmental concern because they are released to the environment in excessive amounts by human activity. They are generally toxic to life at certain concentrations. Since metals are elements, they do not break down in the environment over time and can be incorporated into plant and animal tissue.

National Pollutant Discharge Elimination System (NPDES) - A part of the federal Clean Water Act, which requires certain dischargers of stormwater and wastewater to obtain discharge permits which are administered by the Department of Ecology.

Nephelometric Turbidity Units - Turbidity units measured by a nephelometer, which measures light transmitted through or reflected by a water sample.

Nitrate - A nutrient, which is a stable form of nitrogen. Nitrate sources in surface waters are human and animal wastes and fertilizers.

Nonpoint source pollution - Pollution that enters water from dispersed and uncontrolled sources, such as surface runoff, rather than through pipes. Nonpoint sources such as forest practices, agricultural practices, on-site sewage disposal, or road runoff may contribute pollutants to surface water. The cumulative effects of nonpoint source pollution can be significant.

Nutrients - Essential chemicals needed by plants or animals for growth. If other conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting growth, accumulation, and subsequent decay of plants, especially algae. Some nutrients can be toxic to animals at high concentrations.

Oligotrophic water body - A water body characterized by few nutrients entering the water body, very good water clarity, few to no shoreline aquatic plants, and rarely any plankton blooms.

Perennial stream - A watercourse that flows continuously throughout the year and whose upper surface generally stands lower than the water table in the area adjacent to the watercourse.

Pesticide - A general term used to describe chemical substances that are used to destroy or control pest organisms. Pesticides include herbicides, insecticides, algicides, and fungicides. Many of these substances are manufactured and are not naturally found in the environment.

pH - The concentration of hydrogen ions that measures the degree of alkalinity or acidity of a solution. Neutral water has a pH of 7, while a higher pH indicates alkaline water and a lower pH indicates acidic water. The pH of water influences many of the types of chemical reactions that will occur in it. For instance, a slight decrease in pH may greatly increase the toxicity of cyanides, sulfides, and most metals. A slight increase may greatly increase the toxicity of ammonia.

Phosphorus - A nutrient in surface water that comes from fertilizers, human and animal wastes, and cleaning preparations.

Point source - A source of pollutants from a single point such as a pipe. The discharge pipe from a wastewater treatment plant or a factory is a point source.

Pollutant - A contaminant that adversely alters the physical, chemical, or biological properties of the environment. As defined in the federal Clean Water Act, pollutant means dredged spoil, solid waste, incinerator residue, sewage, garbage, chemical waste, biological or radioactive materials, heat, sediment, and industrial, municipal, and agricultural waste discharged into water.

Pool - A type of stream habitat often following a rapids or riffle, which is relatively deep with slowly moving water.

Riffle - A fast section of a stream where shallow water races over cobble and gravel. Riffles usually support a wider variety of bottom organisms than other stream habitats.

Riparian area - The area between a stream or other body of water and the adjacent upland identified by soil characteristics and distinctive vegetation. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

Runoff - Water that runs off the land in sheet flow, in rivulets, or in defined watercourses. Runoff from land impacted by human use may carry contaminants to surface waters.

Secchi disk - A 20-25 cm disk that is used to measure the transparency of water.

Sediment - Material suspended in or settling to the bottom of a liquid, such as the sand and silt carried in a stream or river.

Storm drain - A system of gutters, pipes, or ditches used to carry stormwater from surrounding land to water bodies.

Stratification - the layering of lake water caused by differences in temperature and density; stratification is typical of most deep lakes during summer

Stream corridor - A stream and its banks.

Substrate - The bottom material of a water body, such as mud, sands, gravel, or cobble. Different aquatic organisms are usually associated with particular substrate types.

Surfactants - A component of detergents, which are the wetting agents that cause foaming. Surfactants in surface waters are toxic to aquatic life and often require a long time before bacteria degrade them.

Total suspended solids (TSS) - The weight of particles that are suspended in waters. Suspended solids in water reduce light penetration in the water column, clog the gills of fish and invertebrates, and are often associated with toxic contaminants because organics and metals tend to bind to particles.

Toxicity, acute - Any toxic effect that is produced within a short period of time, generally 4 days or less. Although the effect most frequently considered is death, the end result of an acute affect could be any harmful biological effect.

Toxicity, chronic - Any toxic effect on an organism that results after exposure of long duration. The end result of a chronic effect can be death although the usual effects are sublethal, such as reduced reproduction or growth.

Trophic State - the degree of eutrophication in a lake, ranging from oligotrophic to mesotrophic to eutrophic

Turbidity - Relative water clarity measured by the extent to which light passing through water is reduced due to suspended materials. Plankton, carbon particles, and soluble colored organic compounds as well as suspended sediment affect turbidity.

Watershed - The geographic region within which water drains into a particular river, stream, or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains.

Sources: Hamilton et al. 1984, LaMotte 1992, U.S. Dept. Agriculture 1989.

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