Condition of Fresh Waters in Washington State for the Year 2003

WASHINGTON STATE DEPARTMENT OF ECOLOGY

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Cover photo: *The Columbia River, looking upstream towards McNary Dam. Sampling equipment is shown in the foreground.*

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Monitoring the Quality of our Fresh Waters

In 2001, Governor Locke signed into law the Watershed Health and Salmon Recovery Monitoring Act. The law requires state agencies to develop a comprehensive strategy and action plan for monitoring watershed health statewide, with a focus on salmon recovery. The strategy and action plan were submitted to the governor and the legislature in 2002. The action plan recommends that information collected under the strategy be evaluated and reported every two years. This report was produced to comply with this recommendation.

The Freshwater Monitoring Unit of the Environmental Assessment Program at the Washington State Department of Ecology (Ecology) routinely collects information on the aquatic resources of Washington State. Monitoring is conducted to collect data on water quality and biological health of our fresh waters. The freshwater monitoring program is designed to provide guidance for management decisions faced by the state.

The comprehensive monitoring strategy identifies four questions for which monitoring information is needed to manage the quality of our fresh waters:

1. What is the quality of surface waters?

2. How are surface water-quality conditions changing over time?

3. Where do water-quality conditions not support aquatic life and recreational uses?

4. How effective are clean-water programs at meeting water-quality criteria?

The monitoring activities conducted by the Freshwater Monitoring Unit are designed to answer these four questions. This report presents results from these activities. This report also identifies the degraded elements in the aquatic environment (physical and chemical) as well as sources of pollution affecting aquatic life.

Chad Wiseman collecting insects from Wide Hollow Creek. Photo by Rick Frye.

What is the quality of surface waters?

One of the most often-asked questions is: What is the overall status of water quality in Washington State? This is the same question the state is required to address for the report to Congress under the federal Clean Water Act Section 305(b). It is impossible to conduct a full census of conditions by monitoring every water body in the state to answer this question. The approach instead is to randomly sample water bodies to infer conditions statewide. This approach, known as sample survey monitoring design, provides a statistically representative view of surface water over a broad spatial scale.

Ecology is conducting statewide sampling of wade-able streams as part of the U.S. Environmental Protection Agency (EPA) Western Environmental Monitoring and Assessment Project. This project uses a sample-survey monitoring approach and is part of an assessment of 12 western states. Field sampling is conducted to assess the ecological status of streams based on water chemistry, physical habitat, and biological assemblages. Sampling was conducted through 2003, and the results are being analyzed to infer freshwater conditions statewide.

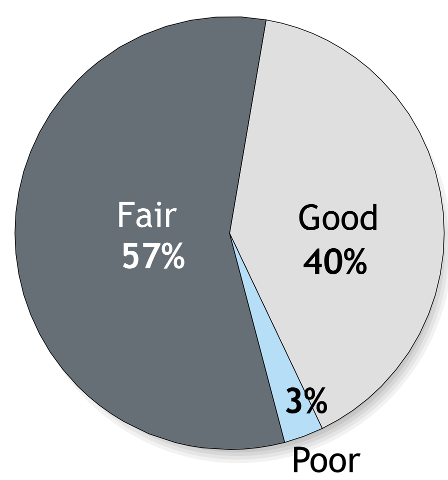
Ecology has operated a long-term river and stream monitoring program since 1970. The current program conducts monthly monitoring of 12 water-quality constituents and flow at 62 stations across the state. These long-term monitoring stations are generally located near the mouths of major rivers and below major cities. These stations are assumed to represent the cumulative effect of human disturbances within the watershed.

The comprehensive monitoring strategy mandates that Ecology use the Stream Water Quality Index (WQI) to evaluate the status of water quality to guide management decisions. The WQI also is used as a performance measure in the Salmon Scorecard report to the governor and the legislature.

The WQI is represented by numbers ranging from 1 to 100, indicating the general water quality at each station. The higher index numbers are indicative of better water quality. Multiple water-quality constituents are converted to an index score for each sampling visit, then scores are aggregated to produce a single annual score for each sample station. We made several changes since the 2002 Conditions report that will affect WQI scores. Scores in the two reports should not be compared. To compare year-to-year changes, see results posted to the Web (*http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html*), where scores were re-calculated using consistent procedures.

The WQI was calculated for each of the long-term monitoring locations in 2003. Results show the distribution of index scores statewide (*Figure 1*). Waters of highest concern are labeled as poor, those of moderate concern are fair, and those of lowest concern are considered good.

Figure 1: Water Quality Index Based on 62 Long-term Monitoring Stations



How are surface water-quality conditions changing over time?

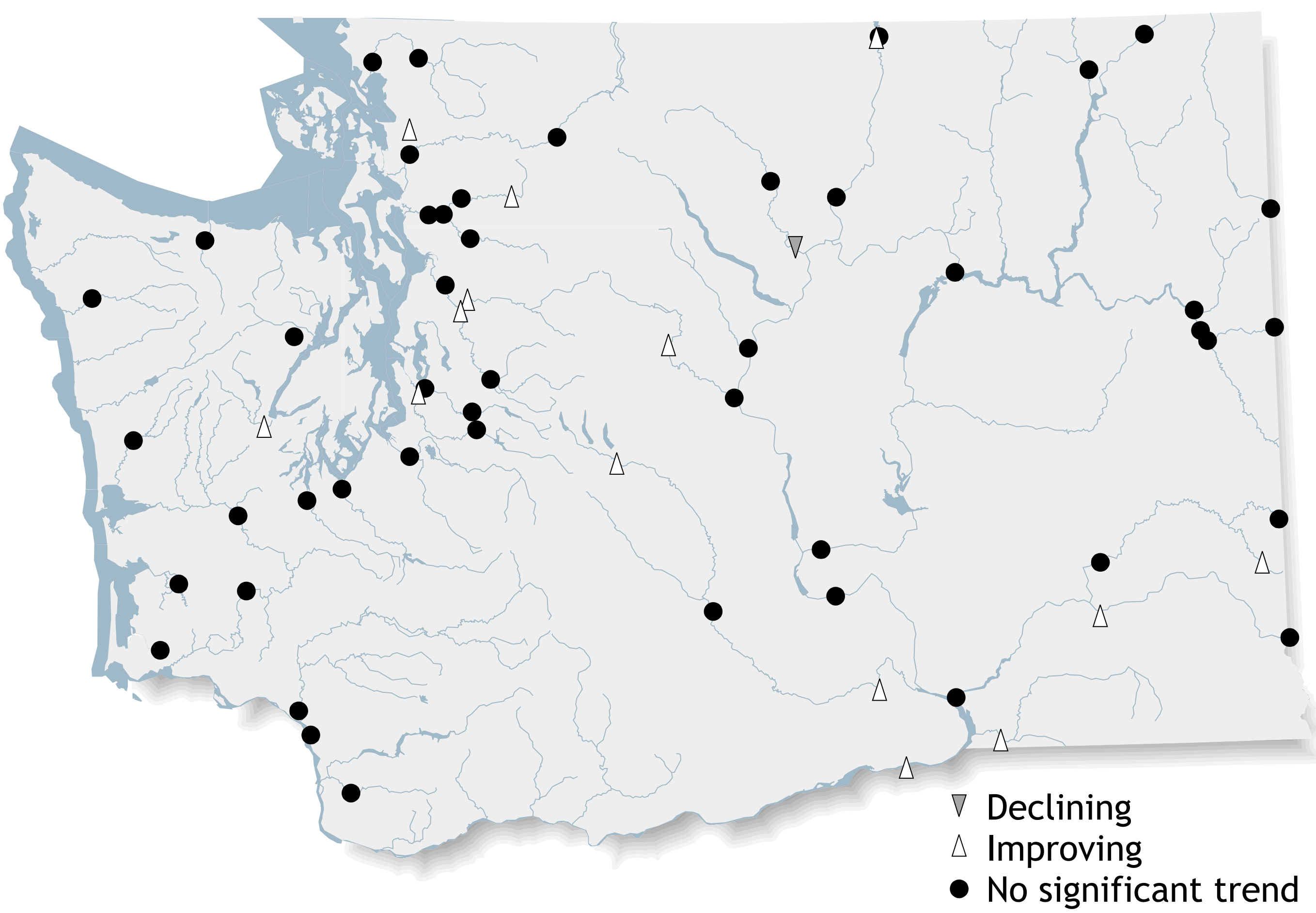
To identify trends, water-quality data must be collected routinely over long periods of time. The presence or absence of trends is a good indication of the degree to which water quality is responding to changes in the watershed. Formal statistical trend analysis provides a rational, scientific basis for addressing issues that can be confused by natural variations in water quality.

WQI scores derived from data collected by the river and stream monitoring program from 1994 through 2003 were used to assess the trends in water quality. Monthly WQI scores were evaluated for trends by using a statistical analysis called the Seasonal Kendall's Tau test. The test tells whether there is a trend in water quality at a prescribed level of certainty. Trends in individual constituents were not evaluated.

Trends of multiple stations can be evaluated together using a statistical method called meta-analysis. Stations can be grouped from various geographic regions or watershed land uses to draw a collective assessment of trend for each group. Stations were grouped according to their location in each ecological region as defined by EPA. Results of the station trend test were used in meta-analysis to evaluate trends in indicators for each ecoregion and on a statewide basis.

Fourteen stations exhibited improving conditions and only one station a declining condition (*Figure 2*). Statewide, there was a slight but statistically significant improvement in water-quality conditions (0.3 WQI units per year). The greatest improvement was in the Columbia Basin Ecoregion, though water-quality conditions remain of moderate concern in Columbia Basin rivers and streams.

Figure 2: Water Quality Trends



Where do water-quality conditions not support aquatic life and recreational uses?

Washington is required under the Clean Water Act Section 303(d) to periodically assess water quality and to prepare a list of waters whose beneficial uses may be impaired. Waters with impairment caused by pollutants from human sources require further pollution controls. Water-quality data collected by Ecology and others are evaluated to determine compliance with the Washington State water-quality standards.

Ecology's Freshwater Monitoring Unit conducts five types of monitoring activities to assess aquatic life and recreational uses of fresh waters.

Basin Stations

Ecology's river and stream monitoring program consists of both long-term trend and annual basin-monitoring stations. The basin stations are selected to support Ecology's basin approach to water-quality management and to address site-specific, water-quality issues. Basin stations are typically monitored for one year to collect current water-quality information. This information is used to verify recent water-quality complaints, support TMDL modeling efforts, or evaluate the effectiveness of TMDL implementation activities. The current program conducts monthly monitoring of 12 water-quality constituents and flow at approximately 20 stations across the state.

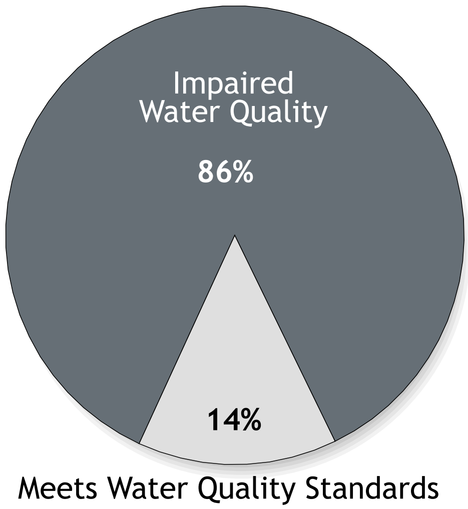
Data collected at basin monitoring stations in 2003 were assessed against the numeric criteria of Washington's water-quality standards. Impairments to water quality were identified at 86 percent of the basin stations for at least one of several water-quality indicators (*Table 1* and *Figure 3*).

Table 1: Basin monitoring stations showing 2003 conditions that did not meet water-quality standards.

WRIA	Stream	Indicators not meeting water-quality standards (and month not met)
10	Puyallup River	Mercury (Aug)
10	White River	pH (May)
15	Union River	Fecal coliform bacteria (Oct-Dec, Jun, Jul), Dissolved oxygen (Nov, Sep)
15	Little Mission Creek	Fecal coliform bacteria (Dec, Jun)
15	Stimson Creek	Fecal coliform bacteria (Dec)
15	Big Mission Creek	Fecal coliform bacteria (Dec), Temperature (Jul)
15	Olalla Creek	Fecal coliform bacteria (Nov, Dec, Jul)
23	Chehalis River	Temperature (Jun-Aug)
28	Columbia River	Temperature (Jul-Aug)
32	Touchet River	Temperature (Jun-Aug), Fecal coliform bacteria (Jul-Sep), Dissolved oxygen (Jul, Aug)
32	Mill Creek	Fecal coliform bacteria (Oct), Dissolved oxygen (Aug)
41	Lind Coulee	Fecal coliform bacteria (Aug, Sep), Temperature (Jul, Aug), pH (Nov, Feb, Jun)
43	Goose Creek	Dissolved oxygen (Nov)
45	Chumstick Creek	Fecal coliform bacteria (Aug, Sep)
45	Brender Creek	Fecal coliform bacteria (Aug, Sep)
45	Mission Creek	Fecal coliform bacteria (Aug, Sep), Temperature (Aug), pH (Oct, May)
45	Eagle Creek	Fecal coliform bacteria (May)
45	Noname Creek	Fecal coliform bacteria (Oct-Feb, Apr, Jun-Sep)
62	Pend Oreille River	Temperature (Jul-Sep), pH (Aug)

WRIA – Water Resource Inventory Area

Figure 3: Water Quality Impairments at Basin Stations. Water quality was considered impaired if one or more results exceeded water-quality pollution limits.



Continuous Temperature

During the summer of 2003, Ecology recorded continuous temperature data at 30-minute intervals at 54 of the basin and long-term monitoring stations. The purpose of monitoring temperature was to determine compliance with current and proposed water-quality standards. The current standard is based on individual temperature measurements. The proposed standard is based on a seven-day average and requires that temperature be measured on consecutive days to apply the criterion.

Temperature measurements collected in 2003 at long-term stations were assessed against current standards using Ecology's policy for identifying impairments under the Clean Water Act Section 303(d). Temperature exceeded the current standard at 83 percent of the stations monitored in 2003 (*Figures 4* and *5*).

Figure 4: Temperature Conditions

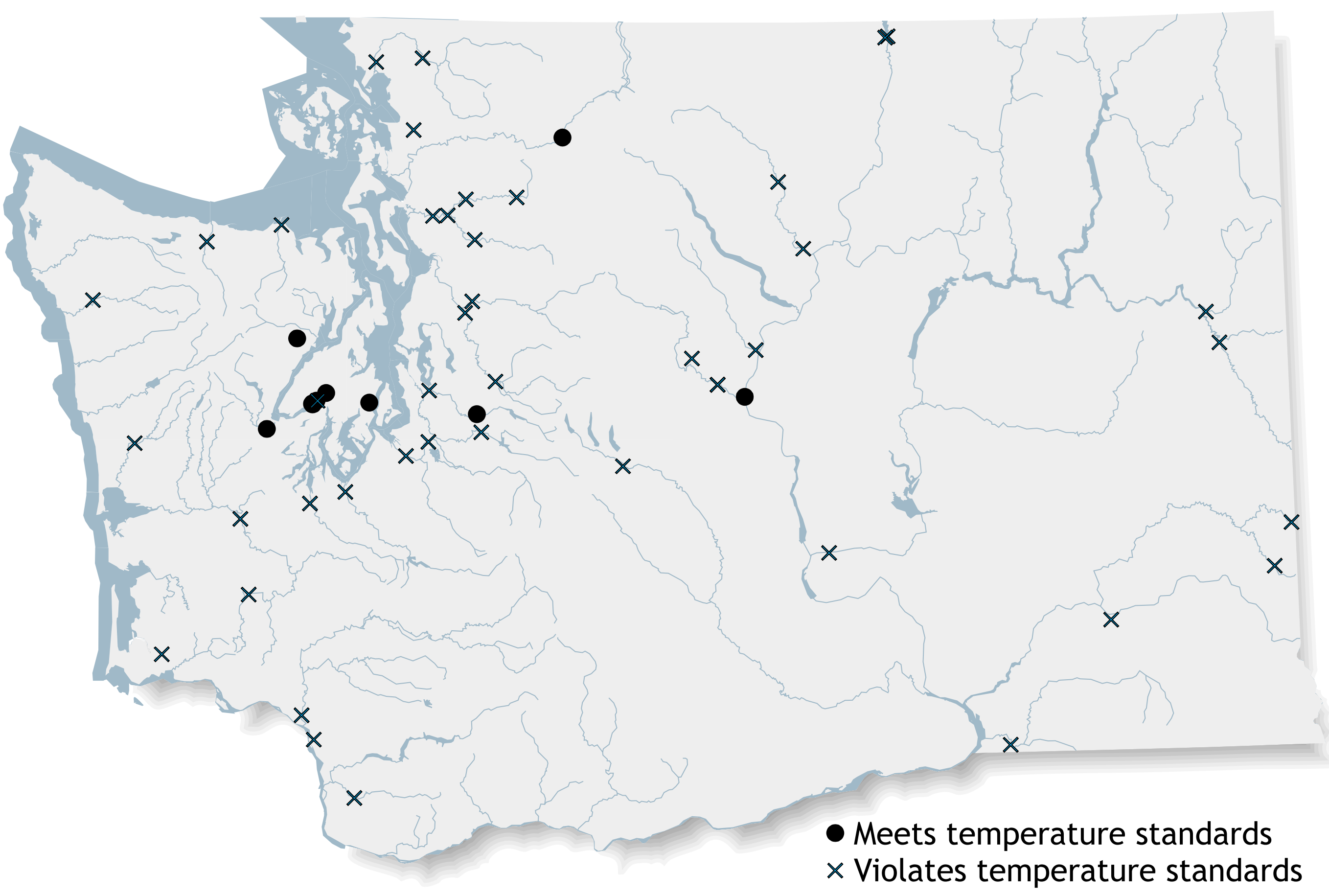
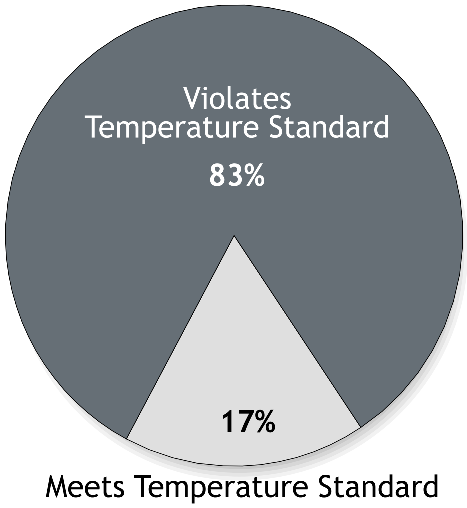


Figure 5: Temperature Conditions

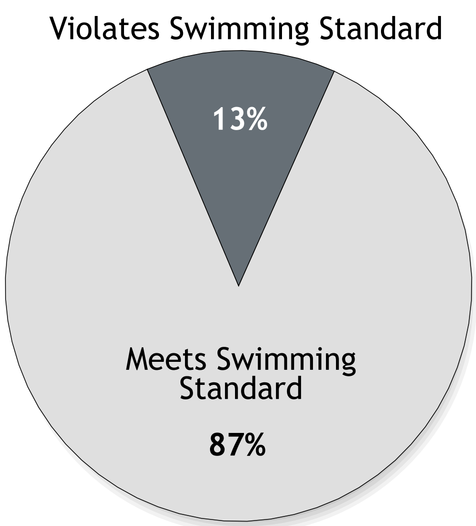


Sanitary Conditions

Fecal coliform contamination is evaluated to determine the sanitary condition of fresh waters. Since it is impossible to test for all pathogenic organisms that could cause human illness, fecal coliform bacteria are used as an indicator of potential risk of contracting illnesses. These bacteria originate from the intestinal tract of warm-blooded animals, and the levels in water are relatively easy to measure. Water-quality standards for fecal coliform have been established to protect the use of swimming or wading in fresh waters.

During the summer of 2003, Ecology began a new monitoring project that sampled freshwater swimming beaches for bacteria.

Figure 6: Sanitary Conditions



The reasons for initiating this sampling project were twofold:

1. Provide additional data to local health and parks departments that have freshwater swimming beach monitoring programs.

2) Where no beach sampling program exists, provide current bacteria data to local jurisdictions that enables them to make decisions about public safety, and about the need for such monitoring programs.

Ten lakes were chosen for sampling during 2003 – five lakes in Pierce County and five lakes in King County. Of these 10 lakes, five lakes had at least one fecal coliform violation based on Washington's water-quality standards. In one instance, a swimming beach was closed, in part based on data collected by Ecology staff.

Water samples collected in 2003 at the basin and long-term river and stream monitoring stations were assessed using Ecology's policy for identifying swimming use impairments under the Clean Water Act Section 303(d). Bacteria counts at 13 percent of the stations exceeded water pollution limits established to protect swimming (*Figure 6*). In addition, a statistical approach was applied using these river data to determine the level of reduction in pollution needed to meet water-quality standards. This information is being used by Ecology to help decide where pollution-control efforts should be targeted to protect the health of swimmers (Table 2). Several of these streams are currently being targeted for pollution reduction.

Table 2: Locations where 2003 bacteria levels were higher than recommended levels for swimming, and the pollution reduction needed to meet water-quality standards.

WRIA	Stream	Reduction required
34	South Fork Palouse River	91%
56	Hangman (Latah) Creek	70%
34	Palouse River	51%
13	Deschutes River	44%
54	Spokane River	37%
8	Cedar River	9%
35	Tucannon River	8%
10	Puyallup River	7%

WRIA – Water Resource Inventory Area

Biological Monitoring

Traditional measurements of chemical and physical components for rivers and streams do not provide sufficient information to detect or resolve all surface-water problems. Biological evaluation of surface waters provides a broader approach because degradation of sensitive ecosystem processes is more frequently identified. Biological assessments supplement chemical evaluation by:

- Directly measuring the most sensitive resources at risk.
- Measuring a stream component that integrates and reflects human influence over time.
- Providing a diagnostic tool that can detect changes in chemical, physical, and biological conditions.

Ecology collects biological information from rivers and streams throughout the state. The long-term monitoring program was established in 1993 to explore spatial patterns and identify temporal trends in benthic macroinvertebrates. Gradually, the program has developed a large base of information that describes biological characterisics of reference and degraded conditions.

Our current ambient biological monitoring strategy is to determine the biological status and trends of ambient water-quality monitoring sites. We believe that sampling water quality and benthic macroinvertebrates at common locations results in an integrated assessment that is more accurate than either approach alone. We also sample a small network of reference sites every year to obtain estimates of variability in our surveys and long-term trends in the reference condition.

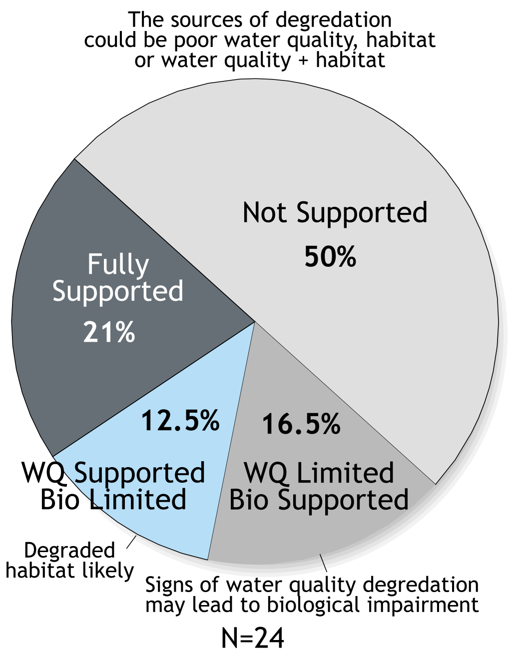
Figure 7: Biological Conditions Results from Summer 2003 Sampling

Two types of biological criteria are used. Biological expectations for both criteria are based on a regional reference site network.

1. The River Invertebrate Prediction and Classification System (RIVPACS) uses ecoregions as well as reach-scale characteristics to predict biological expectations. At this time, our RIVPACS model can be applied only to Western Washington streams. We expect to have a separate Eastern Washington, or integrated statewide model, by 2005.

2. A set of multimetric indices for the Puget Lowland and combined Cascade ecoregions have been published in a previous Ecology document. Coast Range and Eastern Washington indices have undergone a draft calibration and are currently being tested.

Figure 8: Results of Ambient Biological and Water-Quality Surveys at 24 Stream Reaches. Water quality (WQ) results are based on the WQI, and biological (Bio) results are based on benthic multimetric indexes.



We surveyed 31 sites in 2003 (*Figure 7*). The biological condition of these sites is presented in terms of multimetric index scores. Sites labeled as impaired indicate that their index score falls below the 25th percentile of their associated reference stream distribution. Sites labeled as healthy indicate that they have index scores above the 25th percentile of their associated reference-stream distribution.

Biological and water-quality conditions were compared at sites where current and historical ambient monitoring has occurred. Water quality and biological quality do not necessarily agree, because physical habitat modifications often affect biological quality but not water quality. Biological quality is the ultimate arbiter of aquatic ecosystem health. Companion information such as water quality and habitat characterizations identifies the source for biological degradation. Examination of both indicators and their respective constituents provide a much more accurate assessment of our state's aquatic resources.

In *Figure 8*, water quality was considered supported when the WQI resulted in a good assessment and limited when the WQI resulted in a fair or poor assessment. The biology was considered supported when its independent assessment was good and limited when its independent assessment was fair or poor.

Aquatic Plants

Ecology has been collecting information on aquatic plants from lakes and rivers throughout the state since 1994. The main objective of this program is to inventory and monitor the spread of invasive non-native aquatic plant species. Other objectives are to provide technical assistance on identifying aquatic plants and controlling invasive species and to conduct special projects evaluating the effects of invasive non-native species and their control.

For most lakes, the method used is to circumnavigate the littoral zone in a small boat. When a different plant or type of habitat is observed, samples are collected for identification. Notes on species distribution, abundance, and maximum depth of growth are made. In addition, secchi depth and alkalinity data are collected. The most commonly occurring exotic species are shown in *Figure 9*. To date, 412 lakes and rivers have been surveyed statewide; 250 of these (61 percent) have been found to contain invasive exotic species (*Figure 10*). (Surveyed sites are often chosen based on reported weed problems or other indications of a potential infestation, so results are not representative of statewide conditions.)

Figure 9: Invasive Exotic Weed Species Found in Water bodies Where Invasive Exotic Weeds Were Present.

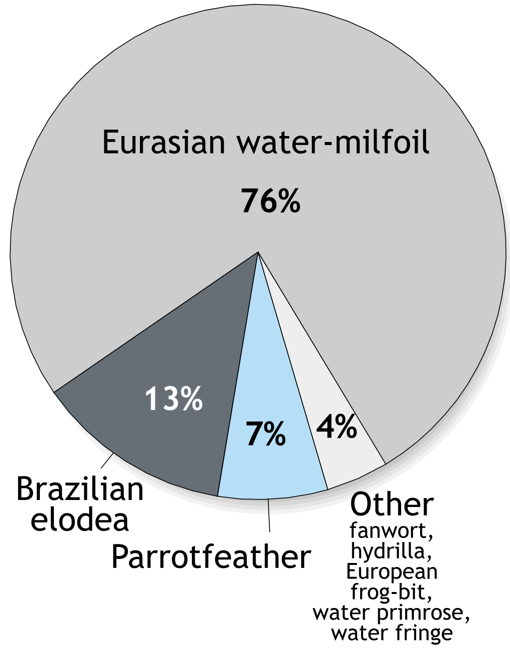
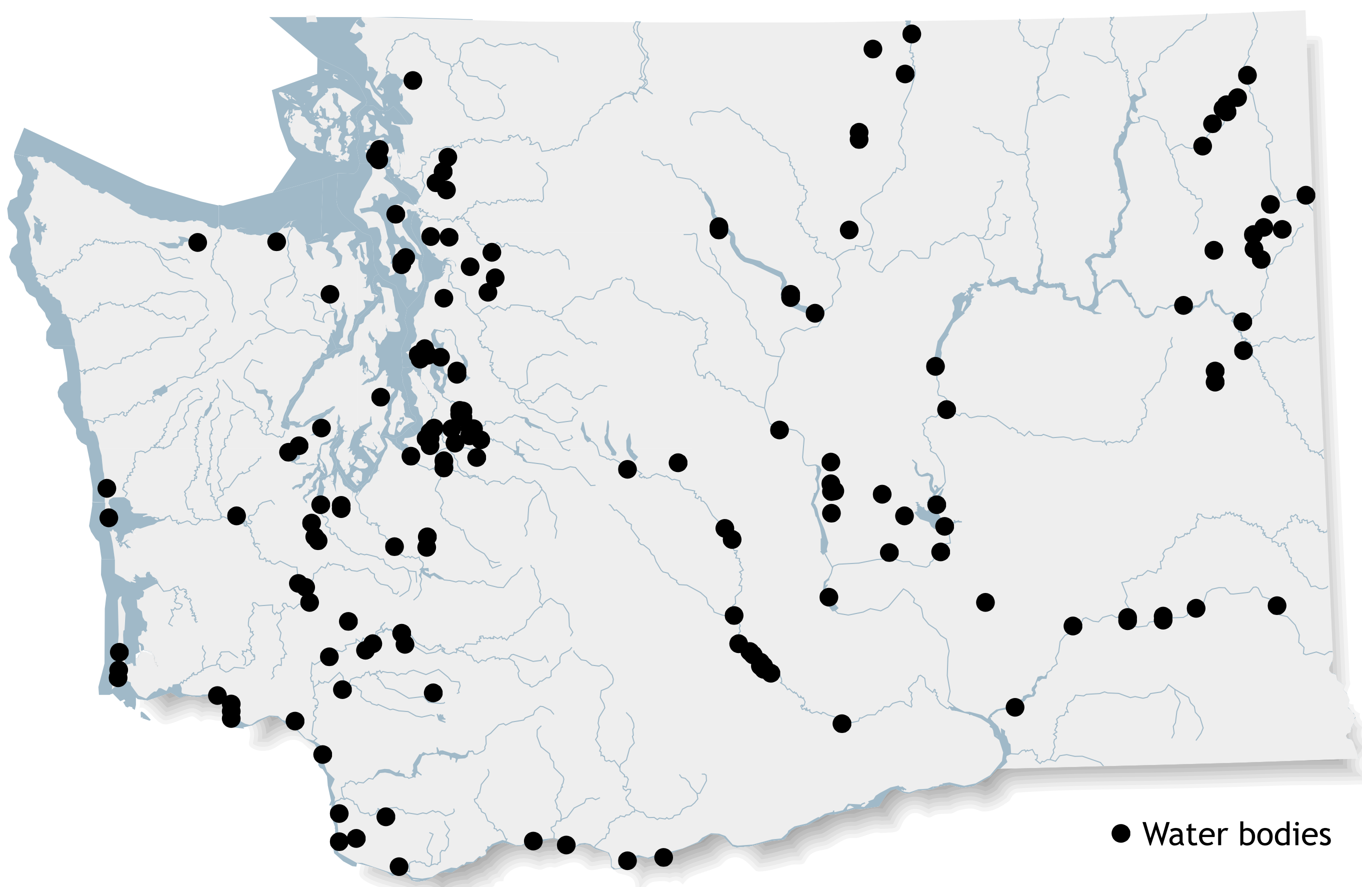


Figure 10: Locations with Invasive Exotic Aquatic Weeds



How effective are clean-water programs at meeting water-quality criteria?

As a delegated state under the Clean Water Act, Ecology is required to develop cleanup plans called total maximum daily loads (TMDLs) for impaired waters. Ecology also is required to evaluate how effective these cleanup plans are in achieving cleaner water.

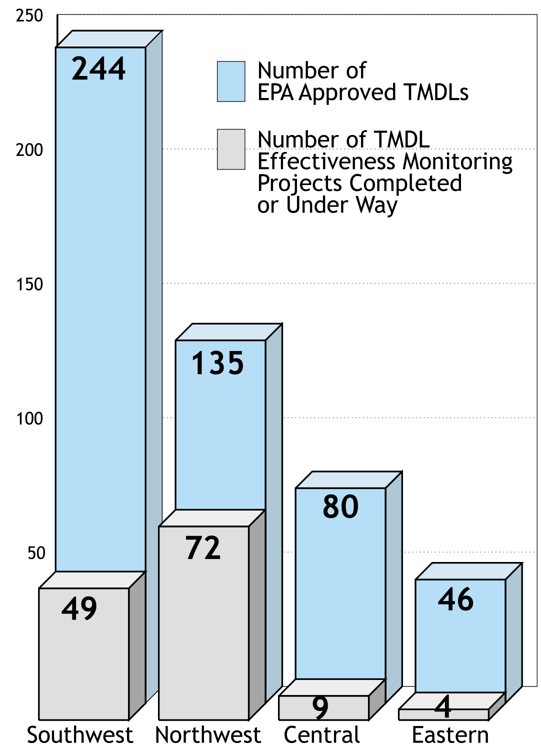
Effectiveness monitoring is a fundamental component of any TMDL implementation. It involves monitoring water quality after watershed plans are implemented, and it attempts to measure to what extent work performed in the watershed has resulted in the improvement recommended in the TMDL to comply with state water-quality standards.

The benefits of TMDL effectiveness evaluation include:

- A measure of current water-quality conditions, to measure change following watershed cleanup efforts and to serve as a benchmark for future monitoring.
- A measure of progress toward watershed improvements; how much watershed restoration has been achieved and how much more effort is required.
- More-efficient allocation of funding and optimization in planning and decision-making.
- Technical feedback to refine the TMDL model, best-management practices, nonpoint-source pollution plans, and water-quality permits.

Some progress has been made with TMDL effectiveness monitoring to evaluate the efficiency of cleanup plans (*Figure 11*). Ecology is engaged in an ongoing process that involves TMDL modelers, agency planners, and local partnerships in developing cleanup plans prior to effectiveness monitoring.

Figure 11: Comparison of the Number of TMDL Effectiveness-monitoring Efforts to the Number of EPA-approved TMDLs by Ecology Region



Scant data exist to evaluate water-quality conditions and trends for TMDL effectiveness monitoring. Besides the limited Ecology data, only a few data sets collected by cities, counties, tribes, and other local agencies have been available to assess progress with EPA-approved TMDLs.

As discussed in the following sections, Ecology's Freshwater Monitoring Unit has compiled monitoring data to assess the effectiveness in meeting water-quality goals from these TMDLs.

Following are the four current effectiveness-monitoring projects:

Snoqualmie River Basin

Following several summer low-flow, critical-period (August through October), water-quality investigations in the Snoqualmie River basin, EPA approved a TMDL in 1996 for load capacities for biochemical oxygen demand (BOD), ammonia, and fecal coliform bacteria.

The TMDL required wasteload allocations for BOD and ammonia when the three existing municipal wastewater treatment plants (WWTPs) were permitted to expand. Allocations were to be implemented through effluent limitations in NPDES permits for the facilities.

Additionally, nonpoint-source fecal coliform load allocations would be implemented through the Snoqualmie River TMDL Nonpoint Source Action Plan, which identified control measures and an implementation schedule for some targeted tasks. The plan lists action activities and studies related to nonpoint-source pollution that had been accomplished or were in progress within the basin at the time the plan was written. They represent collective efforts with the local entities and interested parties.

Completed and current activities address nonpoint-source water-quality issues in the Snoqualmie River basin between North Bend and just above Monroe at the confluence with the Snohomish River. Participants include Ecology, county and city governments, conservation districts, and local residents, both individually and through groups.

The Snake River separates Lewiston, Idaho on the left and Clarkston, Washington on the right.

Specific issues being addressed include dairy-waste management, other livestock management, protection of recreational swimming areas, septic systems and groundwater-quality protection, and county acquisition of properties that have septic systems and are prone to flooding.

According to their permit requirements and discharge monitoring reports, the three municipal WWTPs in the basin generally exceeded expectations in reducing nutrient loads, although the Snoqualmie WWTP discharges to land, not water, during the river's low-flow period. According to Ecology's sampling, two of the WWTPs' discharges exceeded state water-quality limits for bacteria at least on one occasion.

Bacteria were more of a problem at some tributaries than at others, particularly in the Snoqualmie South Fork tributaries. One transect of 10 mainstem sites near Falls City yielded high bacteria levels for all samples (1,200 to 2,600 colony-forming units per 100 mL). This appears to have been a transient event. Bacteria levels generally rose during late summer and fall rainy periods – especially during flood events. Following flood events, bacteria concentrations subsided. Flood waters appear to flush much surface fecal material in a short period of time.

Colville River

EPA has approved a TMDL for fecal coliform in the Colville River basin. To complete a detailed implementation plan for the cleanup, monitoring was conducted in the headwaters of the Colville River. The monitoring identified areas in the basin where sources of the fecal contamination need to be identified. If resources are available, this source identification will begin in 2004. The monitoring results will be part of the detailed implementation plan.

South Fork Palouse River

Point-source controls for ammonia were implemented with the approval of a TMDL in 1994. Monitoring above the point sources has been done since 1978. In 2003, a monitoring project commenced to determine the effectiveness of the TMDL in reducing ammonia loads to the river. Preliminary data indicate the controls are working and the South Fork Palouse River is meeting state standards for ammonia. The project will be completed in September 2004, followed by a final report by January 2005. Follow-up monitoring will occur on a regular basis to ensure continued success of the source controls.

Yakima River

During the National Water Quality Assessment (NAWQA) studies in 1989-90 by the U.S. Geological Survey (USGS), the lower half of the Yakima River was identified as threatened by high loads of sediment and high turbidity. NAWQA also examined the presence of pesticides in the water column and in the tissue of resident fish in the lower reaches of the river. Excessive levels of the banned pesticide, DDT, and its breakdown products, DDD and DDE, were found to be closely associated with sediment suspended in the water column. DDT was also found in the tissue of Yakima River fish, at some of the highest levels in the country.

After USGS reported its findings, the Washington Department of Health issued an advisory that recommended limiting the consumption of certain fish from the lower Yakima River. Shortly thereafter, Ecology began an in-depth study characterizing and quantifying sediment and pesticides in the lower Yakima. Several years were spent gathering and analyzing data, and in 1998 EPA approved The Lower Yakima River Suspended Sediment and DDT TMDL, a plan developed to reduce suspended sediment, turbidity, and DDT in the Yakima River.

The TMDL was established with targets set in five-year increments. The first five-year target, due by the start of 2003 irrigation season, called for state turbidity standards in the mainstem Yakima River and the major agricultural drains to meet a 90th-percentile maximum turbidity of 25 NTU. (NTU, or nephelometric turbidity units, are a measure used to quantify cloudiness caused by particles in the water.)

Meeting the TMDL turbidity target in the mainstem river requires more than an 80 percent reduction in sediment coming from project area drains. Meeting the turbidity target also depends on the success of Yakama Nation projects aimed at reducing sediment from Yakama Reservation lands bordering the river. The lands and water of the Yakama Reservation do not fall under the jurisdiction of Ecology; however, an informal partnership has existed throughout the development and implementation of the TMDL. Successive 10-, 15-, and 20-year targets will further reduce sediment and associated DDT to levels that meet state and federal standards for aquatic and human health criteria.

Agriculture has long been suspected as the major contributor of sediment to the Yakima River. Hundreds of thousands of acres of irrigated farm land parallel the banks of the Yakima River as it meanders approximately 120 miles through the

Yakima River at Kiona, looking upstream.

fertile Yakima Valley to its confluence with the Columbia River at Richland. The river system provides the water to the agricultural industry that dominates the land use and economy of the region. A primary method of irrigation throughout the Yakima basin historically has been rill and furrow. Using this ancient irrigation method, water is released into parallel furrows at the top of a field and allowed to run down hill and out the bottom of the field. While this is an easy way to get water to the crops, it often has the undesirable result of excess tail water running off the lower end of the field, carrying eroded soil into the agricultural return drains and finally to the Yakima River. The TMDL studies of 1994-95 indicated that an average of 300 tons of soil per day were entering the Yakima River from the major drains during the late part of the irrigation season.

In the mid-1990s and continuing to the present, the U.S. Department of Agriculture, EPA, and Ecology began funding projects in the Yakima Basin to reduce the erosion of farm soil and foster clean-up of the Yakima River. Grants and low-interest loans were channeled through North Yakima, South Yakima, and Benton conservation districts; the Natural Resource Conservation Service; Washington State University Extension; and the Roza and Sunnyside Valley irrigation districts.

Major changes were implemented to convert furrow irrigation systems to drip and sprinkler, install pump back basins that could catch turbid tailwater and move it back to the top of the field, build and maintain sediment catchments and settling ponds, and create an artificial wetland to filter water before it was returned to the river. Funding also was used to build demonstration projects, establish and support local water-quality monitoring programs, and develop local policy and authority to oversee water-quality enforcement within the major irrigation district boundaries.

The Roza-Sunnyside Board of Joint Control organized a professionally facilitated, monthly workshop to keep interested groups aware of and involved in ongoing TMDL implementation activities. These workshops were well attended by growers, educators, technicians, state and federal agency representatives, and occasionally politicians. These workshops were a crucial element in the ongoing success of this TMDL. They provided an opportunity for dialogue and an exchange of knowledge between seemingly disparate groups and individuals.

Effectiveness monitoring was performed in 2003 to measure compliance with the fifth-year target of the TMDL. Bi-weekly monitoring began with the start of the irrigation season on April 15 and finished in mid-October. Preliminary analysis of the mainstem data indicates that the TMDL target of achieving state standards for turbidity at the compliance point, located at the lower end of the project area, was met. However, mainstem monitoring sites between the lower compliance point and the background site (above the project area) still exceeded state turbidity standards. Further, it appears that all but one of the four major agricultural drains within the TMDL project area met their turbidity requirements, although the one drain that does not appear to be achieving the 90th-percentile 25 NTU requirement has shown remarkable improvement. Yakama Nation data are not available, but the Nation's Environmental Management Program reports that significant improvements have been made in Yakama Reservation water bodies as well.

Throughout the irrigation season, sediment delivery to the Yakima River by the four major agricultural drains – Moxee Drain, Granger Drain, Sulphur Creek Wasteway, and Spring Creek – has been reduced by approximately 80 percent from that seen in 1995. This extraordinary accomplishment was recognized by Governor Locke and the Department of Ecology with the presentation of Washington State's Environmental Excellence Award to the growers and the organizations of the lower Yakima Valley that have worked to achieve these improvements.

While sediment and turbidity levels are waning, high nutrient levels are becoming more evident. The improved clarity of the lower Yakima River allows greater light penetration, which has resulted in the expected but underestimated growth of rooted aquatic plants in the mainstem. The South Yakima and Benton conservation districts have partnered with USGS in an ambitious five-year project, partially funded through a Centennial Clean Water Fund grant, to examine nutrient loads in the lower reaches of the river and characterize the effects on the river system.

Freshwater Monitoring Needs

Probability-based Monitoring

The action plan of the comprehensive monitoring strategy identifies the highest monitoring need as the continuation and expansion of monitoring using a sample-survey design. Funding for the current sample-survey monitoring program, the EMAP Western Pilot Program, is scheduled to end in April 2005. Permanent funding should be established for sample-survey design monitoring of water quality, habitat, biological, and invasive aquatic plants. In the short-term, this monitoring could be conducted within particular regions or watersheds, with the intent to expand into a statewide monitoring program.

Lake Monitoring

Ecology has monitored rivers and streams since before 1959 and, with federal grants, was able to monitor lakes from 1989 through 1999. During that period, Ecology collected data from more than 180 lakes, with help from about 250 volunteers. In 2000, however, Ecology was unable to obtain sufficient funding and had to discontinue the full program. At present, there is no statewide monitoring or assessment of lake water quality. Lake monitoring is required for Sections 305(b) and 314(a) of the Clean Water Act. In addition, the water-quality standards require lake monitoring in order to establish lake-specific nutrient criteria. Lakes are unique water bodies; chemical, physical, and biological properties are lake-specific. Current regulations describe the process for establishing water-quality standards for individual lakes. Funding should be secured to re-establish a lake-monitoring program to meet the requirements of federal and state regulations.

Snoqualmie River near Monroe, looking upstream.

River Geomorphometry Monitoring

Ecology should establish a monitoring program to assess changes in geomorphologic characteristics of river systems. River geomorphology, or the forming of land by rivers, occurs due to a series of complex processes that are not adequately described by scientific theories. A poor understanding of these processes and inadequate quantification of the influence of changes (natural or otherwise) that occur on the landscape and within the flood plain can cause a variety of ecosystem problems. A small constriction from a culvert under a road, or the removal of vegetation along a small section of a river bank, might change the course of a river and result in deepening, widening, increased scour, or failure of stream banks. These changes cause harm to aquatic biota and surrounding ecosystems.

Don Peterson, volunteer lake monitor, and Maggie Bell-McKinnon sampling Crawfish Lake in Okanogan County.

Lake Sediment Monitoring

Lake sediment cores provide qualitative and quantitative information on air, water quality, and land-use changes over long time periods. New techniques examining sediment cores can reconstruct concentrations of total phosphorus in lakes by using information from fossil diatom taxa or chironomid mandibles. Long-term changes in phosphorus loading can be quantified from lake sediment cores. Cores are dated and stratigraphically correlated using 210Pb, 137Cs, or 14C. Estimates of lake total phosphorus concentration prior to European settlement can help determine natural conditions which form the basis of water-quality standards for lakes. This information would be particularly useful in TMDLs for lakes.

Reference Stations

The Department of Ecology collects biological information from rivers and streams throughout the state. The monitoring program is designed to explore spatial patterns and identify temporal trends in benthic macroinvertebrates. The program has developed a large base of information that describes biological characteristics of reference and degraded conditions. Reference conditions are found in streams with no or little human impact. Funding should be secured to increase the number of reference stations that represent high-quality landscape fragments.

Sanitary Conditions

Additional information is needed to assess the sanitary condition of swimming beaches. In 2003, Ecology began monitoring a few freshwater beaches to provide information to the BEACH Program, with full implementation to 14 counties planned for 2004. This successful pilot study showed there will be a need to expand the freshwater beach sampling to lakes and streams with high public use.

Aquatic Plants

Ecology collects information on aquatic plants from lakes and rivers throughout the state. The main objective of this program is to inventory and monitor the spread of invasive non-native aquatic plant species. Funding should be secured to increase the number of aquatic plant surveys conducted each year.

An unusual steam-powered outboard on Big Meadow Lake, Pend Oreille County.

Related Information

Related Publications

◆ Condition of Fresh Waters in Washington State for the Year 2003 - Technical Appendix
Ecology Publication No. 04-03-034
http://www.ecy.wa.gov/biblio/0403034.html

◆ Condition of Fresh Waters in Washington State for the Year 2002
Ecology Publication No. 03-03-030
http://www.ecy.wa.gov/biblio/0303030.html

◆ Condition of Fresh Waters in Washington State for the Year 2002 - Technical Appendix
Ecology Publication No. 03-03-031
http://www.ecy.wa.gov/biblio/0303031.html

◆ River and Stream Ambient Monitoring Report for Water Year 2003
Ecology Publication No. 04-03-031
http://www.ecy.wa.gov/biblio/0403031.html

◆ Aquatic Plants Technical Assistance Program – 2003 Activity Report
In progress.

◆ *A Water Quality Index for Ecology's Stream Monitoring Program*
Ecology Publication No. 02-03-052
http://www.ecy.wa.gov/biblio/0203052.html

◆ *Using Invertebrates to Assess Quality of Washington Streams and to Describe Biological Expectations*
Ecology Publication No. 97-332
http://www.ecy.wa.gov/biblio/97332.html

◆ *Assessment of Water Quality for the Section 303(d) List*
Ecology Water Quality Program Policy No. 1-11

◆ *Washington Comprehensive Monitoring Strategy for Watershed Health and Salmon Recovery*
Interagency Committee on Outdoor Recreation, December 2002

◆ *Environmental Monitoring and Assessment Program: West* – Research Strategy
U.S. Environmental Protection Agency, February 2001

Related Web Sites

◆ River and stream water quality monitoring
http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html

◆ Stream biological monitoring
http://www.ecy.wa.gov/programs/eap/fw_benth

◆ Aquatic plant monitoring
http://www.ecy.wa.gov/programs/eap/lakes/aquaticplants

◆ Additional resources available from Ecology's Environmental Information page
http://www.ecy.wa.gov/programs/eap/env-info.html