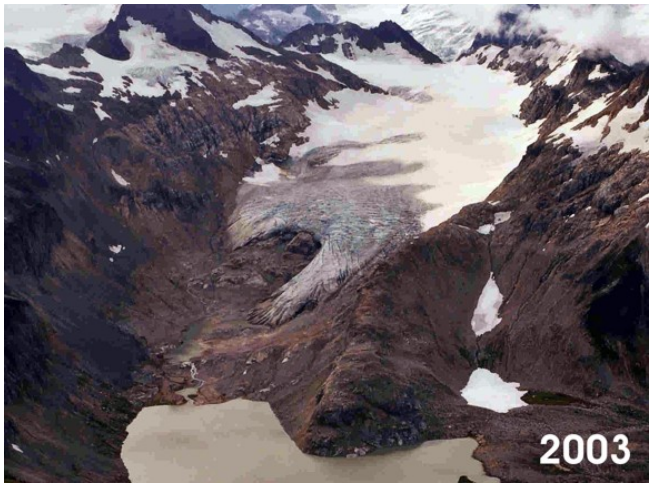
Washington's Environmental Health

2004



WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

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Washington's Environmental Health

2004

Prepared by:
Washington State Department of Ecology

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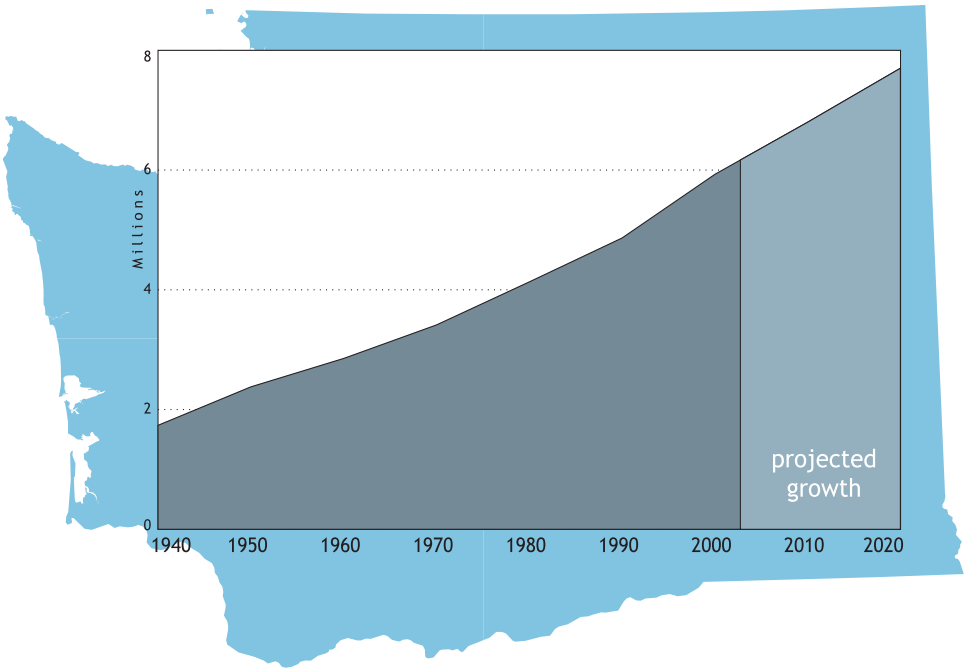
Cover photos: 1979 to 2003 South Cascade Glacier Photo Comparison, U.S. Geological Service.

Estimates of glacier volume in water equivalent, South Cascade Glacier:

Year	km^3
1650	0.49
1890	0.49
1928	**0.32**
1958	0.24
1970	0.22
1985	0.19
2001	**0.16**

For more information, see: http://ak.water.usgs.gov/glaciology/south_cascade/reports/index.htm

Ecology is Washington's principal environmental management agency. Our **mission** is to protect, preserve and enhance Washington's environment, and promote the wise management of our air, land and water for the benefit of current and future generations. Our **goals** are to prevent pollution, clean up pollution, and support sustainable communities and natural resources. We are **working with you** for a better Washington.



Everyone should care about the condition of this planet that we leave to our children. Future generations deserve to enjoy the same natural beauty and precious natural resources that we enjoy.

We need abundant, clean and cold water in our rivers and streams for people, fish and farms. Our wild salmon – a sacred symbol of Native people and an icon for our state – are indicators of environmental quality. As we restore wild salmon runs, we will be enhancing the pristine environment we so much cherish.

And when we protect ourselves from greenhouse gases, toxins like mercury, unsafe pipelines and oil spills, we are preserving a legacy of environmental health for our children's children.

When we seek and encourage renewable energy sources, we are preserving a legacy of sustainability, and passing along the right to live in and enjoy a clean and healthy environment.

-- Governor Gary Locke, *2004 State of the State Address*

Washington's Environmental Health 2004*

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*Note on Updates:

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John Erickson, *Editor:* e-mail: jeri461@ecy.wa.gov

Washington's Environmental Health 2004*

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Section 1: Water

Section 2: Air

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Section 1: Water

1-1 Water availability

Background

Washington residents have historically enjoyed an abundance of clean and cheap water, in what commonly has been viewed as a water-rich state. This is changing. Washington increasingly lacks water where and when it is needed for communities and the natural environment. Unprecedented population and economic growth fueled and highlighted the growing demand for water.

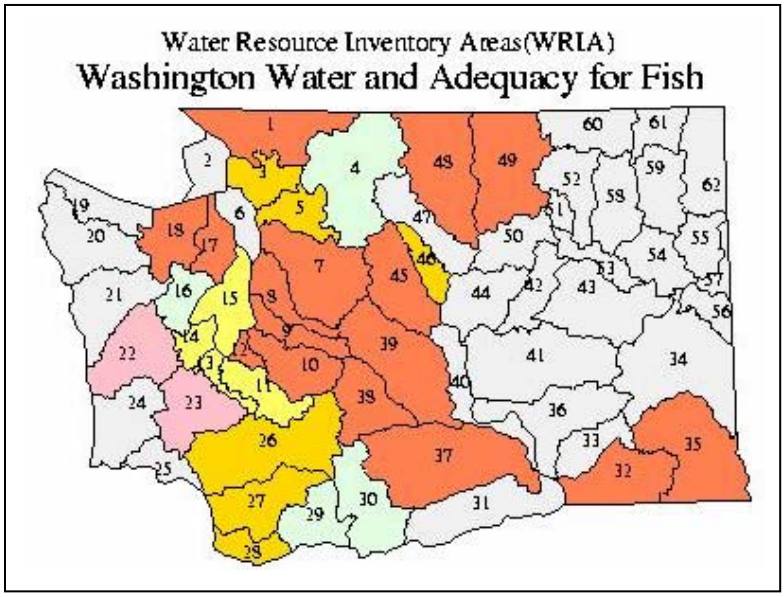


Figure 1-1a
Washington water and adequacy for fish
(Water Resource Inventory Areas – WRIAs)

Concern:

A number of factors have combined to broaden awareness about water availability:

- The threat of extinction to once-abundant fish stocks and the Federal Endangered Species Act response.
- The lack of water available in many areas for further allocation without impairing senior water rights, instream flows or depleting aquifers.
- Increased competition and litigation over water.
- Lengthy delays and uncertainty for water rights applicants.
- Drought conditions resulting in dry streams, withered crops, dead fish, wildfires, and reduced hydropower production.
- Limitations in modern tools and funding to manage water.
- Growing awareness and concern over the longer term effects of climate change on water availability.

Tools for Success:

- See more on Ecology's Water Resources Program at www.ecy.wa.gov/wr/wrhome.html.

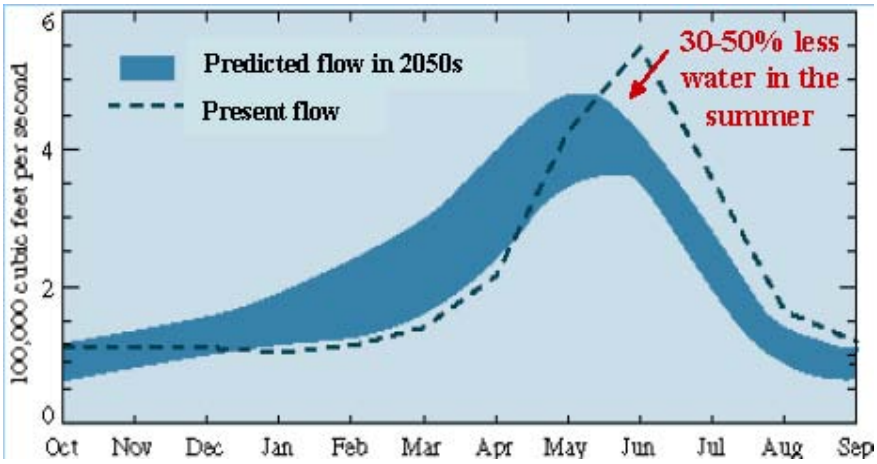
1-2 Climate-change concerns for water and current trends

Washington's location in the temperate Pacific Northwest makes the state particularly susceptible to climate change impacts. Winter temperatures in Washington's mountains are often just below freezing, so even a slight increase in those temperatures can reduce the state's mountain snowpack, which provides a large portion of the state's summertime water supplies.

The mountain snowpack functions as a natural reservoir, holding water that falls in the winter as snow until it melts later in the spring and summer months, and can be used to meet water needs when precipitation is lower. Man-made storage reservoirs account for only about 10% of Washington's winter water storage; most of what we use is in the snowpack; the balance is in soils. Climate models suggest that a warming of Washington's climate is leading to reduced winter snowfall in the mountains, to more precipitation falling as rain rather than snow, and to an earlier melting of the snowpack. Data from the past 50 years for Washington and other western states is illustrated in Figures 1-2b and 1-2c on the next page.

The trend is toward less water being available to meet the state's summer water needs for people, farms, and fish. The most likely scenario would be earlier melting and runoff of the snowpack, resulting in lower stream flows in the summer months. The reduction in summertime water supplies would harm fisheries production plus diminish water supplies available to meet the demands of irrigation, industrial water use, energy production, and urban water uses.

At the same time, increased rainfall in the winter could increase the potential for winter flooding (and possible more hydropower production). The climate models also suggest that the frequency and intensity of extreme weather events could continue to increase as changes to the climate increase, leading to greater variability and uncertainty for water planners and water users.



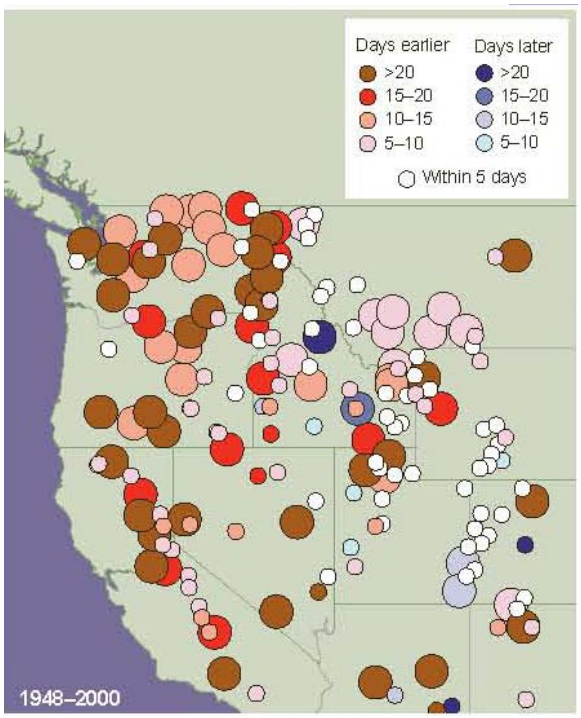
Courtesy of Univ. of Washington Climate Impacts Group
http://www.cses.washington.edu/cig/pnwc/pnwwater.html

Figure 1-2a Natural Columbia River flow at the Dalles, OR

Tools for Success:

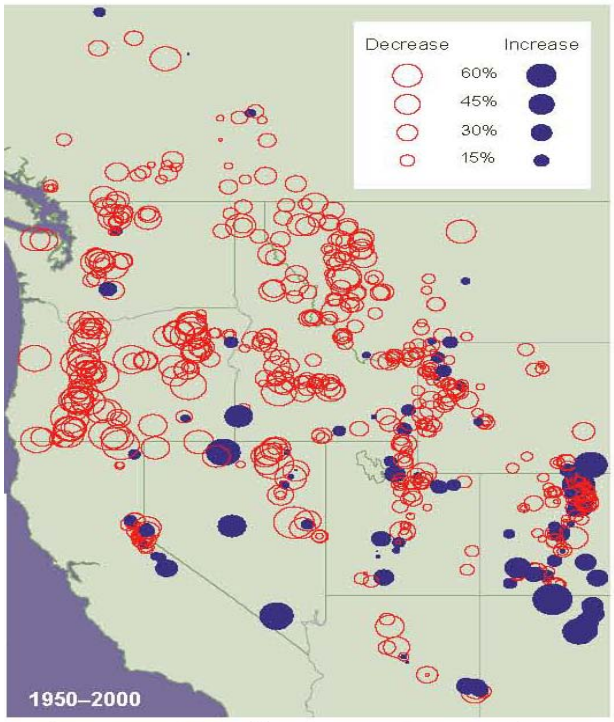
- For water supply-related monitoring information, especially for precipitation, see http://www.nwrfc.noaa.gov/water_supply/water_supply.cgi
- For information on irrigation projects and weather from the U.S. Bureau of Reclamation in the Pacific Northwest, see http://www.usbr.gov/pn/agrimet/
- For stream flow conditions in Washington, see http://wa.water.usgs.gov/

These two illustrations from the Climate Impacts Group at the University of Washington show that spring snowpacks are melting earlier than 50 years ago, and that the total annual snowpack has decreased since that time.



From: *Climate Change in the Pacific Northwest (PNW)*
By Edward L. Miles, Team Leader JISAO/SMA Climate Impacts Group (CIG) Center for Science in the Earth System (CSES) University of Washington

Figure 1-2b Earlier snowmelt



In retreat. A modest temperature rise since the 1950s has reduced spring snowpacks throughout the West (*top*) and shifted the peak snowmelt earlier in the year (*left*).

From: www.sciencemag.org SCIENCE VOL 303 20 FEBRUARY 2004

Figure 1-2c Reduced spring snow packs

Tools for Success, Continued:

- The University of Washington Climate Impacts Group website has excellent information on climate change and its effect on water resources. See http://www.cses.washington.edu/cig/pnwc/pnwwater.shtml .
- For snow survey information related to water supply forecasts for Washington, see http://www.wa.nrcs.usda.gov/Snow/
- The U.S Climate Change Science Program at www.climatescience.gov has research information on climate change effects in the U.S.
- The International Panel on Climate Change is an international site on global climate changes, sponsored by the United Nations Environmental Programme (UNEP) and the World Meteorological Organization. See www.ipcc.ch Climate Solutions at www.climatesolutions.org is a Washington organization based in Seattle and Olympia providing educational materials focusing on practical steps to take for climate change prevention.

1-3 Statewide Water Quality: Stormwater; fish; and cold, clean, clear water

Concern

Declining populations of many salmon species resulted in their listing as either endangered or threatened under the federal ESA. Currently 15 species have been listed, affecting the inland fisheries and waterways of 75% of Washington State. Salmon require cold, clean and clear water. Several factors contribute to poor water quality, chief among them being stormwater.

- Urban and rural stormwater runoff is the water that runs off roads, pavement and roofs during rainstorms or snow melt. Stormwater can also come from hard grassy surfaces. Stormwater flows over land to surface water bodies: streams, lakes and wetlands.
    - Pollutants in stormwater are metals, oil and grease, organic toxins toxic to aquatic plants and animals.
    - Stormwater flows erode stream channels, destroying spawning beds.
    - On paved and hard surfaces, more water flows away during the wet season contributing to low summer base flows. This leads to drying out the habitat for salmon rearing.

Current Statewide Trends

For the past nine years, Ecology has been systematically collecting water quality data at 62 long-terms stations around the state, which generally correspond to the 62 Water Resource Inventory Areas, or watershed planning areas. The graph below indicates the trends over nine years for four main parameters: Water Temperature, Dissolved Oxygen, Fecal Coliform, and pH (the primary measure of acidity). The graph below shows the percent of stations recording "Good" levels for each parameter, as set by water quality standards, by water year (October-September).

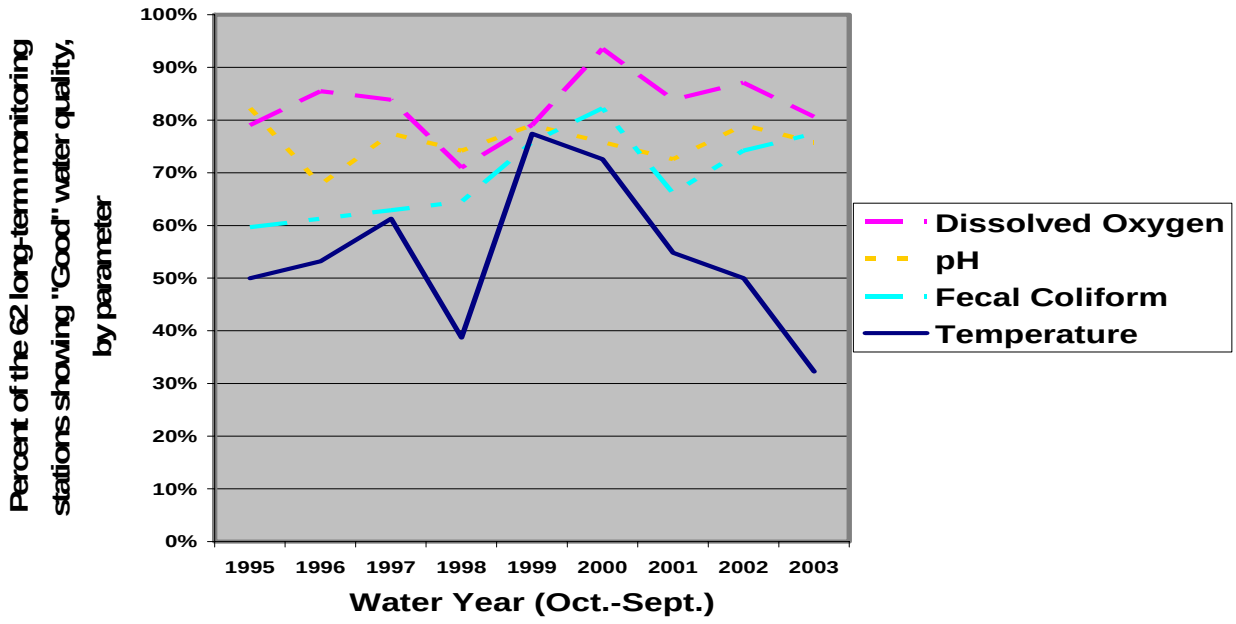
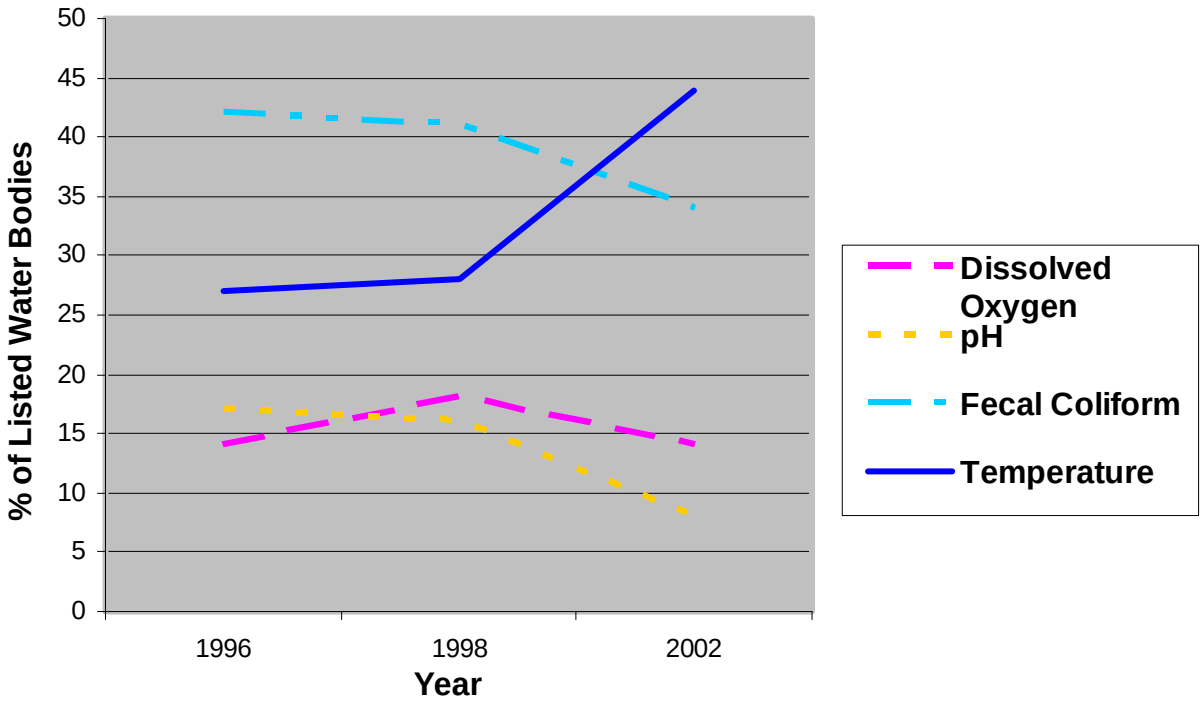


Figure 1-3a Statewide Water Quality

Trends in 303(d) Listings

More detailed water quality information is also developed for specific water bodies of concern, and for specific watersheds. The federal Clean Water Act, adopted in 1972, requires that all states restore their waters to be "fishable and swimmable." The Clean Water Act established a process to identify and clean up polluted waters. Every two years, all states are required to prepare a list of water bodies that do not meet water quality standards. This list is called the 303(d) list because the process is described in Section 303(d) of the Clean Water Act. Ecology and EPA use the 303(d) listing process to identify water quality problem areas for clean up and restoration. The graph below indicates the trends from the 303(d) lists for 1996, 1998, and 2002 (draft) for the same four main parameters: Water Temperature, Dissolved Oxygen, Fecal Coliform, and pH.

Figure 1-3b Trends in 303(d) Listings



This graph shows similar trends as are shown in the first graph for the 62 long-term monitoring stations for the same four parameters. Fecal coliform listings, the greatest problem in 1996, have declined, while temperature listings are increasing and pH listings are showing a general decrease. The trends are not surprising, as Ecology and many other people across the state have made a concerted effort to reduce the amount of fecal coliform entering our water. This has been done in large part by the passage and implementation of the Dairy Nutrient Management Act. At the same time, municipal wastewater treatment has generally kept pace with rising populations. Increased temperatures can primarily be attributed to the loss of vegetation along streams, and to lower flows of water remaining in streams after withdrawals.

Further 2002 Information on Washington's Water Quality

In 2002 the Department of Ecology embarked on development of a new, more comprehensive assessment of water quality in Washington. Assessed waters include all the rivers, lakes and

marine waters in the state where data were available through many different sources. The assessed waters are listed below in categories that describe the status of water quality. The 303(d) list is now one of those five categories.

While the overall assessment is still in draft form, preliminary results can be drawn from this comprehensive review, which assessed over 32,000 water body segments and related pollutant parameters. Percentage results are as follows:

- 66% meet the parameters they were tested for
- 13% are waters of concern, but not polluted
- 3% have water cleanup plans to correct problems
- 10% are impaired by a non-pollutant, such as fish passage barriers or habitat degradation
- 8% are on the polluted waters list (the 303(d) list)

Of the total number of assessed water segments, a high percentage -- about two-thirds of those assessed -- appear to be in good shape for the pollutant monitored, based on monitoring results. Of the remaining one-third that are showing evidence of problems for a specific pollutant, most are not yet polluted and should be given attention to prevent further degradation

Tools for Success

- Information in the Water Quality Assessment, including the 303(d) list of impaired waters, can be viewed using a **simple query tool**, which can create a list of waters that are specific to your needs. You can create lists for specific categories, water bodies, pollutant parameters, and other information, in whatever combination you choose. The simple query tool can be found on Ecology's website at: http://apps.ecy.wa.gov/wats/WATSQBEHome.asp

- An **interactive mapping tool** can also be used to see a graphic representation of the Water Quality Assessment. This is a GIS (Geographic Information System) application developed specifically by Department of Ecology to help you to find waters you are interested in and the associated information for segments of waters. The interactive mapping tool can be found on Ecology's website at http://apps.ecy.wa.gov/wqawa/viewer.htm

1-4 Fishable waters: Stream temperature and dissolved oxygen

Declining populations of many salmon species resulted in their listing as either endangered or threatened under the federal Endangered Species Act. Currently 15 species have been listed, affecting the inland fisheries and waterways of 75 percent of Washington State.

The Institute for Fisheries Resources estimates that more than $500 million in annual economic benefits and 25,000 jobs in commercial and sport fishing have been eliminated in the Northwest through the loss of salmon. Recovery of these species is important for many other Washingtonians as well — particularly for the First Nations that have deep cultural roots in the land and its resources.

Concern

Cold, clean, clear water is indispensable for salmon and many other species of fish. The entire aquatic ecosystem rests on a delicate balance of conditions, among which temperature is one of the most important. Among other factors, cold clear water contains more dissolved oxygen than warmer water. A female salmon's energy reserves are already depleted by the time she digs her nest (her *redd*). Warm water and other poor water quality conditions can kill her before spawning can occur, or kill her smolts before they can make it to salt water, or stress the smolts making them more vulnerable to disease and predation. Lower flows can also result in increased temperature and lower oxygen. Trees, shrubs, and other vegetation along rivers and stream helps stabilize stream banks, prevent erosion, and provide cold hiding places for salmon.

Unsustainable site use and site development practices, poor forestry practices, and polluted runoff result in increased water temperature and other problems. The spawning salmon, their eggs and smolt are sensitive enough that even minor increases in temperature and water quality can be fatal. Less obvious and less well understood are the loss of smaller plants and animals that are part of our interdependent web of life.

Current trends

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

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 proposed standard is based on a seven-day average, and requires measuring temperature on consecutive days to apply the criterion. Temperature measurements collected in 2003 at the long-term stations were assessed using Ecology's policy for identifying impairments under the federal Clean Water Act (Section 303(d)). The proposed standard was exceeded (violated) at 83 percent of the monitored stations, up from 77 percent in 2002.

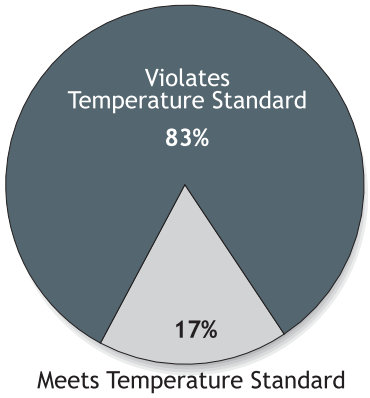


Figure 1-4a.
2004 temperature conditions

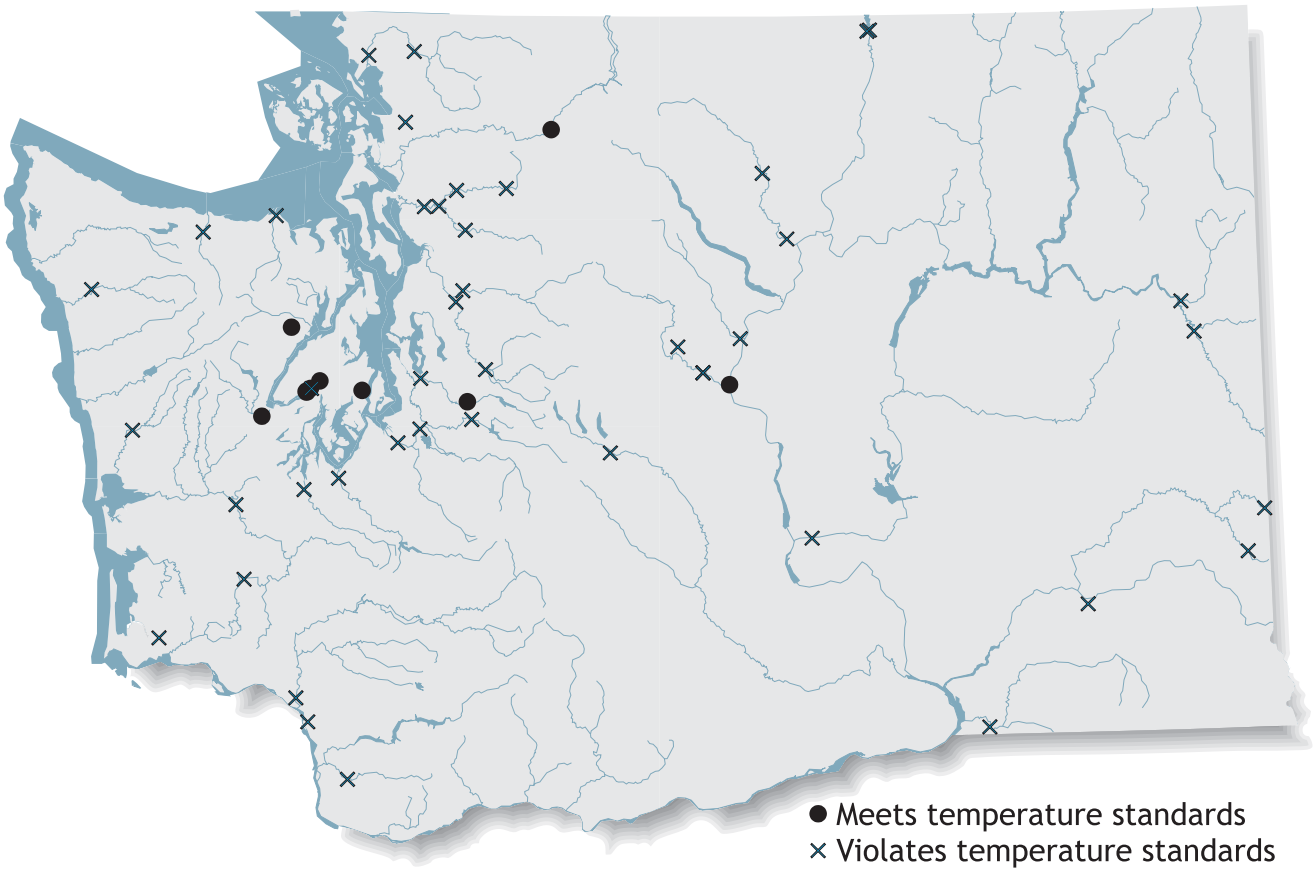


Figure 1-4b: 2003 temperature testing results at long-term stations.

Tools for Success

- If you live by a stream or river, leave native vegetation alone and let the stream get the shade it needs. Check out the benefits and techniques of natural lawn care and salmon-friendly gardens at http://www.seattle.gov/util/Directory/Conservation_Index/index.asp.
- Landscape with native plants, which are beautiful and good for stream shading. Contact the Washington Native Plant Society at http://www.wnps.org or (800) 723-1763 for a nursery list. Also check out *Landscaping with Native Plants for the Inland Northwest* from Washington State University (http://www.pubs.wsu.edu).
- The Governor's Salmon Recovery Office Home Page: http://www.governor.wa.gov/gsro/office.htm .
- For more detailed information on environmental conditions and trends in the state, see http://www.ecy.wa.gov/programs/eap.

1.5 Swimmable waters: Fecal coliform

Background

Roaming farm animals, domestic pets, and failing septic systems all lead to contamination of water by fecal bacteria, posing risks to both aquatic species and humans. Different kinds of fecal coliform bacteria naturally inhabit the intestinal tracts of humans and other animals, but when the wrong kinds are ingested from water, they can pose serious health risks. Bacteria in water at certain levels impair the natural functioning of streams and rivers, can make people very sick, and may ruin uses of water we all enjoy, such as swimming, clam digging, and other forms of recreation. The Department of Ecology shares regulatory responsibility for clean water with the Department of Health, which monitors drinking water quality and issues public health advisories when high levels of fecal bacteria are found in drinking water.

Concern

Animals enter rivers and streams when they are not fenced out. One dairy cow produces 100 pounds of fecal waste per day, so cattle in streams and runoff from larger animal operations (sometimes referred to as CAFOs, for confined animal feeding operations), can greatly affect water quality. Failing septic systems are also among the primary contributors of bacterial contamination in water.

Effects from bacteria in water can range from stomach and intestinal distress to more serious diseases, such as hepatitis, salmonella, cholera, and typhoid. Contact with the bacteria comes from the simple act of swimming, fishing, or drinking water. In addition to the effects seen in the rivers and streams themselves, the bacteria can be carried into marine waters where shellfish can become contaminated. In turn, this leads to illness in humans as well as economic problems for the shellfish industry. (The nutrients released with the bacteria also contribute to unnaturally large algae blooms in both fresh water and salt water. When the algae die, they begin to decompose rapidly, drawing oxygen out of the water column. (This process is called *eutrophication*.) In some cases, fish kills can result from the lack of dissolved oxygen (*anoxia*).

Current Trends

Fecal coliform contamination is often evaluated to determine the sanitary conditions 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. As such, water-quality standards for fecal coliform have been established to protect the use of swimming or wading in fresh waters.

Statewide, the long-term trend shows a reduction in fecal coliform contamination (see Figure 1-3a). Where improvements are seen, they typically are attributed to fencing initiatives and technical assistance through the Department of Ecology, the Department of Health, the Department of Agriculture, and the Washington Conservation Commission. There are several progressive dairy-management programs that have been very successful. As partners learn about each other's needs, trust develops and industry practices shift to become more efficient and environmentally sound. Effective July 2001, all dairies had to have a "dairy–nutrient" management plan approved by their local conservation district. These plans address water-quality-related resource and waste-management issues. Dairy nutrient management is now under the Department of Agriculture.

In addition, many public utility districts and health departments have developed septic–system outreach and training programs. Septic systems can leak when the drainfield is flooded with more water than it can effectively absorb, reducing the ability of the system to drain wastes and filter sewage before it reaches surface water or underground water (ground water).

WRIA	Stream	Reduction required
34	South Fork Palouse	91%
56	Hangman (Latah)	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

Figure 1-5a.
Locations where 2003 bacteria levels were higher than recommended levels for swimming, showing the reduction of pollutant required to meet water-quality standards for swimming.

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

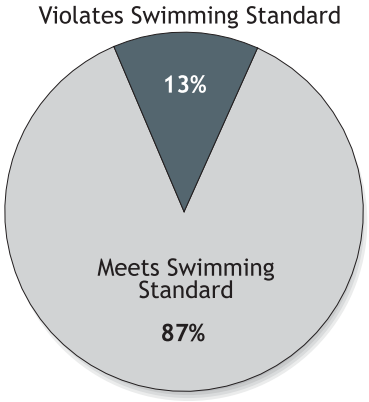


Figure 1-5b:
Sanitary conditions

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 1-5a).

Tools for Success

- If you are a farmer, work with your local conservation district to fence your animals properly and prevent runoff. See http://www.wa.nrcs.usda.gov or call (509) 323-2900. Additional information for management is available from the Dairy Federation at http://www.wsdf.org , the Washington State University at http://www.puyallup.wsu.edu/dairy , and the Washington State Conservation Commission at http://www.scc.wa.gov/programs/dairy/.
- Properly install and maintain septic systems. See Washington State Department of Health's Wastewater Management Program at http://www.doh.wa.gov/ehp/ts/pubs-ww.htm or call (888) 586-9427.
- An easy description of how septic systems work can be found at http://www.montana.edu/wwwpb/pubs/mt9401.html .

1-6 Habitat: The biological condition of the state's surface waters

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 synthesizes chemical, physical, and biological perturbations.

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 (e.g., insect larvae, worms, snails, and other macroinvertebrates found in freshwater streams). The program has developed a large base of information that describes biological characteristics 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. Reference conditions are found in streams with no or little human impact.

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.

We surveyed 31 sites in 2003 (Figure 1-6a). 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.

Figure 1-6a: Biological health of streams in Washington sampled in summer, 2003

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 1-6b, 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 considered *limited* when its independent assessment was *fair* or *poor*.

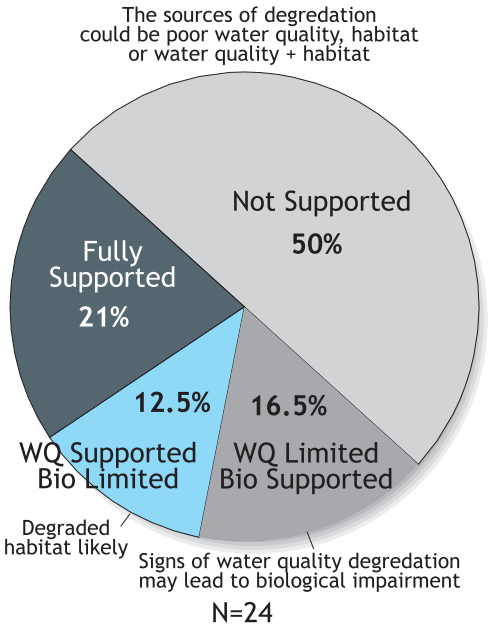


Figure 1-6b. Results of Ambient Biological and Water-Quality Surveys at 24 Stream Reaches. Water quality (WQ) results are based on the WQI, and biological (Bio) results are based on benthic multi-metric indexes.

Tools for Success

- Dr. James Karr at the University of Washington is widely recognized as an expert on the biological health of streams. He served on EPA's Panel of Experts overseeing the preparation of the second edition of the EPA guide: *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition* available at http://www.epa.gov/owow/monitoring/rbp/ .

1-7 Watershed planning

Background

The 1998 Legislature passed the Watershed Planning Act to establish a more localized, place-based, voluntary process by which the residents, businesses, and local and state governments in a watershed could address the water quantity, water quality, salmon habitat, and "instream flows" issues and needs in their communities. This collaborative planning process is designed to ensure adequate water supplies are available to serve future population growth and provide sufficient quantity and quality of water to protect salmon populations, habitat and watershed health.

A *watershed* is the landscape of mountains, hills, and the course of waters that drain into certain patterns. They are often referred to as "basins" or "drainages" and are usually named for their major river or tributary. Washington is divided into 62 watersheds or Water Resource Inventory Areas (WRIAs).

Concern

Effective problem-solving and planning for water issues is difficult. Different locales have different problems confronting them, different priorities, and different opportunities for improvement. A watershed-based planning approach can be comprehensive in scope and involve stakeholders in developing solutions.

Water quality, stream flows, water quantity and salmon habitat are concerns for households and businesses alike. Degraded environments interfere with commerce (fishing, shellfish, agriculture, tourism) and recreation (swimming, fishing, bird watching). They add costs to commerce and infrastructure development, such as water purification. They threaten our health and degrade our quality of life. They continue to endanger salmon, which have been fundamental to Northwest economies and cultures since the First People took up residence here. Today, salmon are part of our recreation and special occasion meals on both sides of the cascades, but also represent an endangered multi-billion-dollar industry.

Current trends

Currently, 45 of the state's 62 WRIAs have voluntarily organized into local watershed planning units to begin assessing the condition of their watersheds and develop strategies to meet future needs. To look ahead and plan for future growth, the condition of the watershed must be analyzed first. Do we have enough water for current and future needs? If water quality is not good, why not, and how do we restore it to good water quality? In the process of analyzing watershed conditions, the planning units can then work to identify those personal and business practices that tend to disrupt the natural functioning of the watershed. Once those source problems can be identified, innovative and cooperative strategies and projects can be developed to help ensure further deterioration does not occur.

Figure 1-7a shows areas of Washington where watershed planning units have been created and are developing watershed plans. Two-thirds of the state's WRIAs are participating in watershed planning, and most of those are addressing all four elements (water quantity, water quality, habitat, and instream flows). By the end of 2004, almost half of the plans are scheduled to be

completed. Watershed planning is about bringing diverse interests together, including citizens, farmers, developers, industry, and business to identify common goals and plan cooperatively to ensure there is enough high-quality water to meet everyone's needs in the future. This can be accomplished only by seizing opportunities to use water more efficiently, using innovative water management and land-protection mechanisms, and addressing the manifold sources of declining watershed health.

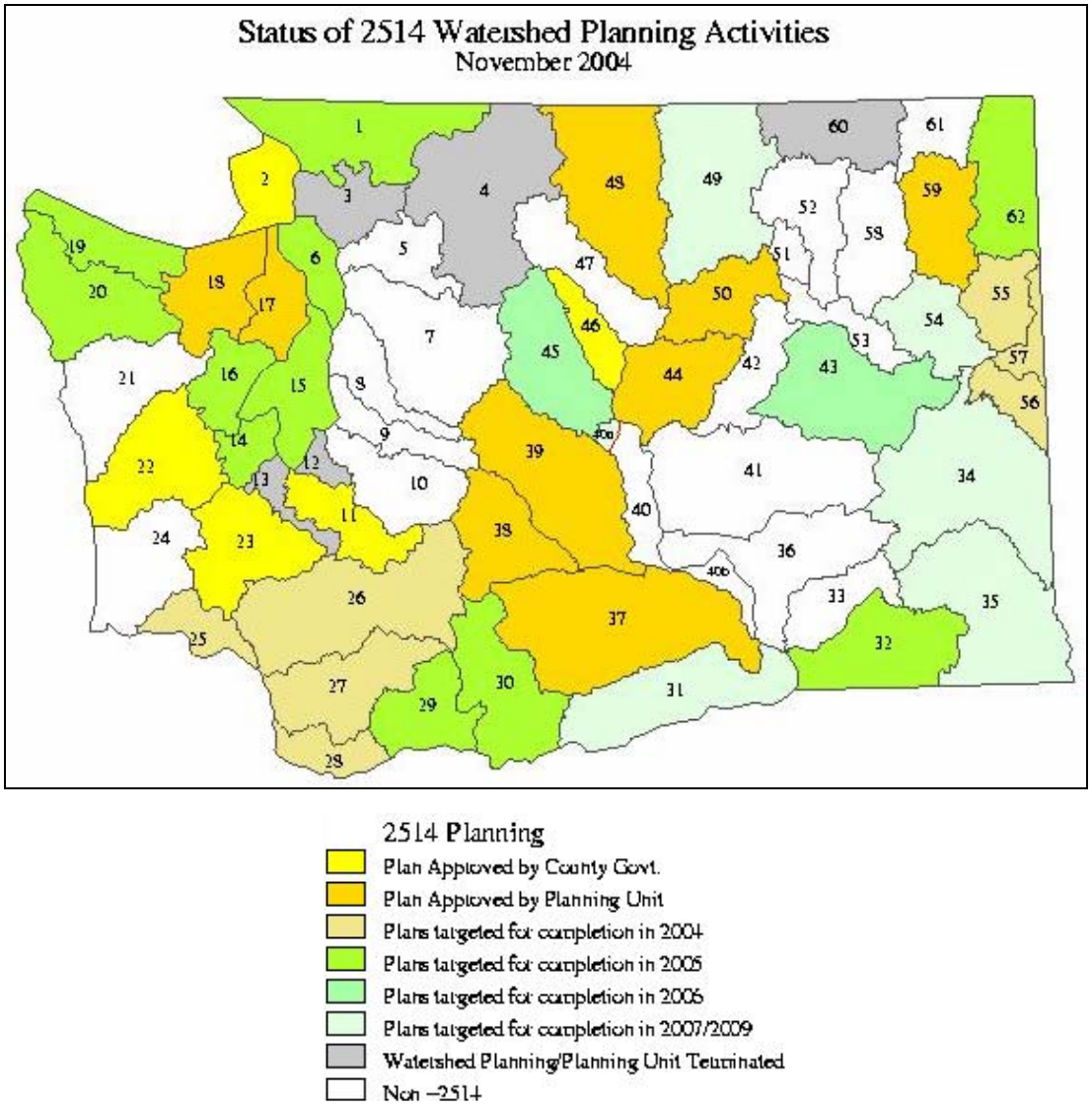


Figure 1-7a: Plan Approved by Planning Unit

Tools for Success

- Check on the status of watershed planning where you live and get involved! See http://www.ecy.wa.gov/watershed or call (360) 407-6548.
- View watershed maps at http://www.ecy.wa.gov/services/gis/maps/wria/wria.htm .

- Be water smart by doing any number of easy things to use less water for the same thing. See http://www.seattle.gov/util/services/ or call (206) 684-7283.
- Minimize stormwater runoff at the source by using pervious (porous) alternatives to impervious surfaces when building. See http://www.greenbuilder.com for information on where to buy pervious paving materials. Porous surfaces don't lead to polluted or scouring runoff like impervious surfaces do (and they are often more attractive).

1-8 Shellfish

Concern

When chemicals, sewage, or other pollutants are present in sediments and shoreline waters, shellfish in these areas can become contaminated and, hence, unfit for eating.

Biotoxins are produced seasonally by certain species of naturally occurring marine phytoplankton. Eating shellfish carrying elevated levels of biotoxins can, and have, caused death to shellfish consumers. Phytoplankton levels increase with higher sewage and animal waste runoff. Threats to shellfish safety include the exploding population and development patterns of Puget Sound that directly contaminate shellfish growing areas. As surfaces are paved with impervious materials, oil, chemicals, pet wastes, and other contaminants run directly, untreated, into Puget Sound and other coastal areas. In addition, failing septic systems, boater wastes, and polluted runoff from livestock waste also contribute significantly to the problem.

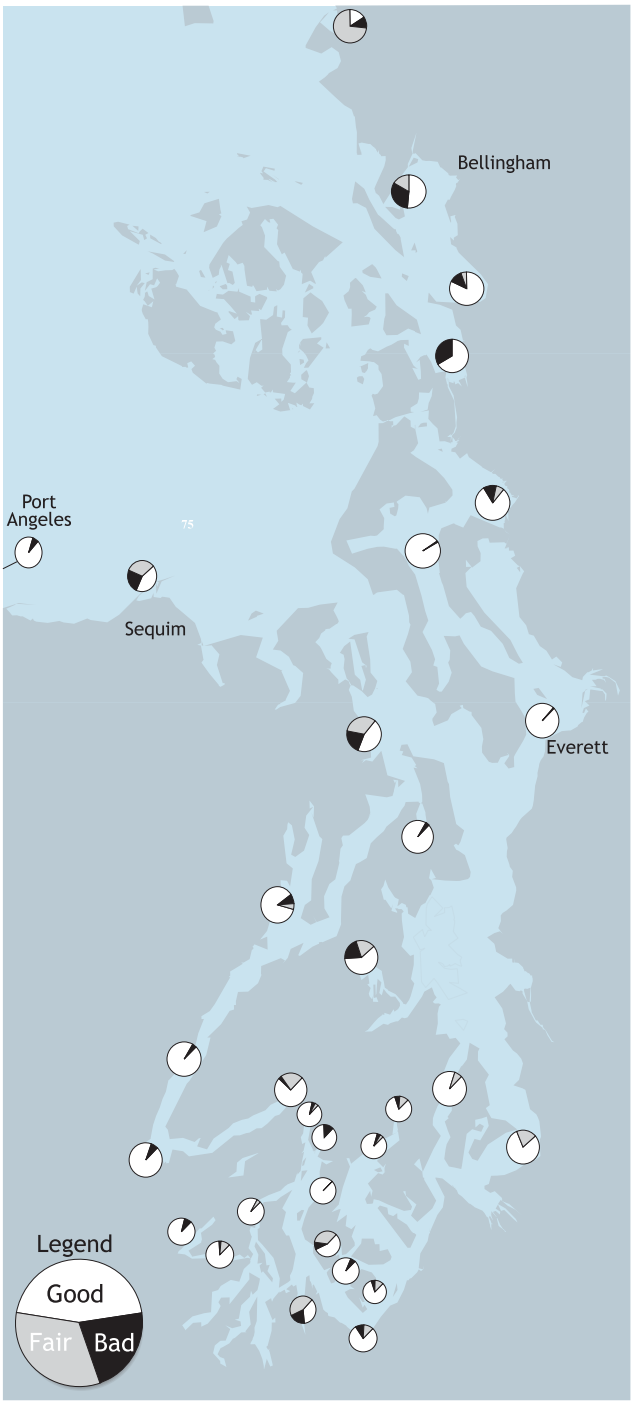
Shellfish are good indicators of the health of shoreline ecosystems, and are also part of what should be a healthy nearshore habitat for salmon and other fish.

Current Trends

The Washington State Department of Health classifies both recreational and commercial shellfish-growing areas to ensure the safety of shellfish served at our own tables, in restaurants, and retail food stores. Classification tells us the extent to which contamination restricts our ability to harvest shellfish. From 2000 to 2002, the Department of Health reclassified 17 shellfish-growing areas based on monitoring data the agency collects, with upgrades outweighing downgrades by 3,590 acres.

In 2001, the Department of Health added a new category termed *shellfish harvesting not advised*, which currently spans the shoreline from Commencement Bay in Tacoma to Tulalip Bay north of Everett. This is intended to help focus educational efforts for recreational and subsistence harvesters.

The Department of Health is paying increasing attention to pollution trends, as measured by fecal coliform levels in shellfish-growing waters. A significant number of fecal coliforms in the water means there is also a risk of other bacterial or viral pathogens. The fecal coliform index is a way of measuring the level of these bacteria in shellfish-growing areas.



Good: *Statistic* <= 30MPN/100ml
Fair: *Statistic* >= 30MPN/100ml but <= 43MPN/100ml
Bad: *Statistic* > 43MPN/100ml

MPN is "most probable number" and represents the concentration of fecal coliform bacteria.

Figure 1-8a: Condition of shellfish beds as indicated by fecal coliform levels.

Tools for Success

- Washington State Department of Health: Call (360) 236-3311 to get a copy of the *Atlas of Fecal Coliform Pollution in Puget Sound: Year 2001.* This report contains detailed local information regarding fecal coliform monitoring results. More information on shellfish from the Department of Health is available at http://www.doh.wa.gov/ehp/sf.
- Marine Biotoxin Hotline for information on marine toxins that affect shellfish harvesting and eating: (800) 562-5632.
- Emergency Shellfish Regulation Hotline: (360) 796-3215.
- Washington State Department of Agriculture: For information on managing dairy waste, farm plans and how to control polluted runoff: http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/Livestocknutrient.htm .
- Puget Sound Action Team: (360) 407-7300 or (800) 54-SOUND; http://www.wa.gov/puget_sound. For their shellfish indicator report and other links, see http://www.wa.gov/puget_sound/Programs/Shellfish.htm.
- The Pacific Shellfish Growers Association: http://www.pcsga.org or (360) 754-2744.

1-9 Low dissolved oxygen (hypoxia) in Hood Canal

Concern

Hood Canal has been the most productive basin, for both shellfish production and phytoplankton, in all of the greater Puget Sound. It has long been known to have low dissolved oxygen concentrations (hypoxia) in the bottom waters of the southern end, as indicated from data from the 1950's. Also, occasional fish kills have been documented that were linked to the hypoxia. However, many indications are that in the last decade, low oxygen conditions in southern Hood Canal are significantly worsening in severity, extent, and duration.

Current Trends

Deepwater oxygen normally follows a seasonal cycle, with the lowest in late summer-fall and highest in late winter-spring. The deep waters of southern Hood Canal have been at critically low levels since June 2002 that have not re-bounded. A comparison of the wintertime deep oxygen inventory, based on data from the UW PRISM program, shows a steady decrease from 1998, with the December 2003 value 25% lower than any other on record, including the data from the 1950's and 1960's. This was calculated from data stretching form Dabob Bay to the Great Bend. An even more precipitous decrease has been seen in the minimum oxygen concentration recorded in the water column during the period 1990-present at two Ecology Marine Waters Monitoring stations, one in Lynch Cove and one just east of the Great Bend. Both 2002 and 2003 saw substantial fish kills, some of which were as early as June.

The factors involved are not yet known and can be from a variety of sources, including nutrient loading (which produce more algae that ultimately die, sink and rot, consuming oxygen), changes in circulation (from either river or ocean driven changes), or changes in ocean or climate conditions.

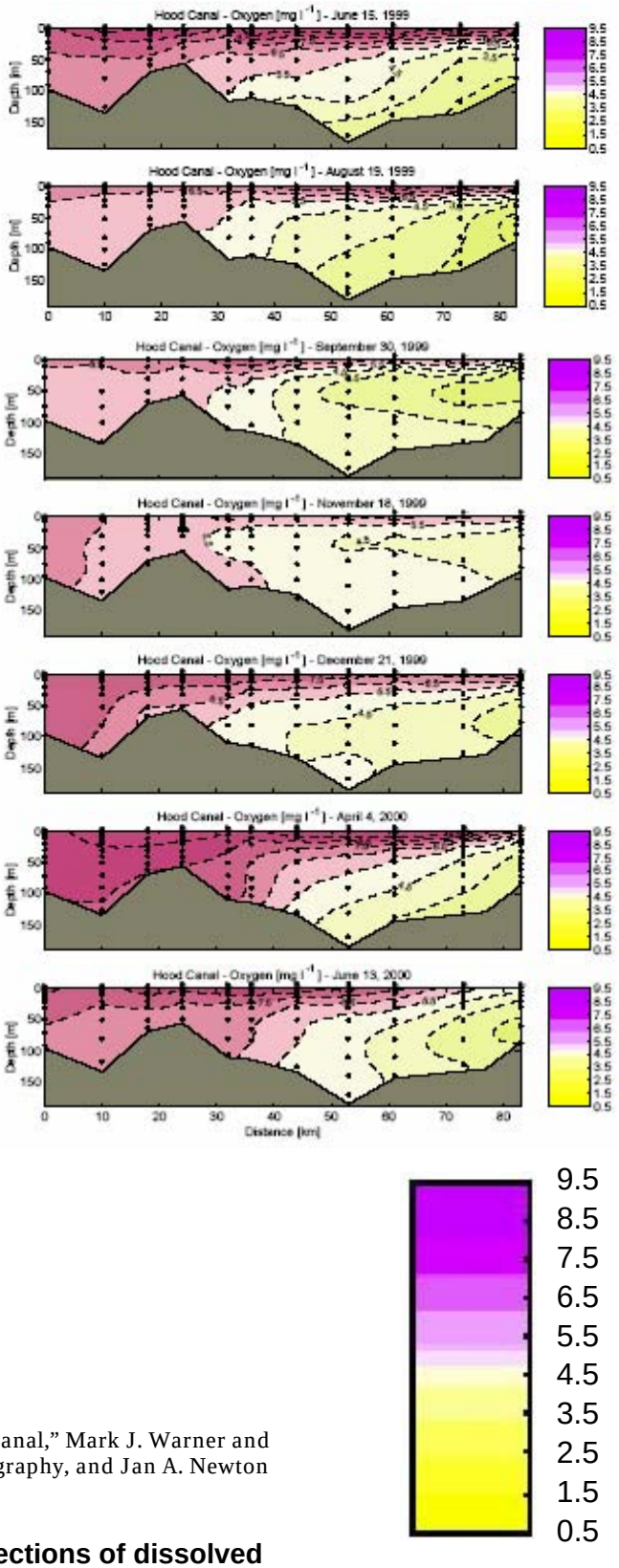
Tools for Success

- The University of Washington's Hood Canal Dissolved Oxygen Program maintains a web site with updated information and links to other sites at http://www.prism.washington.edu/hcdop/index.html .
- The Puget Sound Action Team has Hood Canal information at http://www.psat.wa.gov/Programs/hood_canal.htm .

Dissolved oxygen concentrations measured in April 1998 are consistent with a lack of flushing during the previous autumn (Fig. 3). The lowest values, near the Great Bend, are less than 2.5 mg l-1 in contrast to values near 3.5 mg l-1 in April of 1999 and 2000. The distributions of dissolved oxygen are consistent with the flushing scenario described for salinity above, but they are complicated by the non-conservative behavior of dissolved oxygen. Respiration of organic matter produced by photosynthesis in the upper portion of the water column which then sinks into the lower layer reduces the dissolved oxygen concentration over time. The upper layer remains oxygenated due to gas exchange, which drives the surface dissolved oxygen concentrations towards solubility equilibrium, and photosynthesis, which produces dissolved oxygen.

The deep waters which spill over the sill are generally a source of higher dissolved oxygen to the lower layer. In instances where the incoming waters are denser than the lower layer, the dissolved oxygen clearly shows the highest values along the bottom and lower values at mid-depth (e.g. June 17, 1998). Whereas when the three-layer mode exists, the lowest dissolved oxygen values are found at the bottom and towards the Great Bend (e.g. April-June 1999 and 2000). During the course of the summer, dissolved oxygen values decrease as a result of decreased flushing rates and increased primary productivity of the overlying water with the associated increase in sinking particles.

An unexpected finding of these studies is the presence of ammonium at the sill during April to September of each year. This plume has the highest concentrations (greater than 3.4 µmol kg-1) in August. Its location at the sill indicates that there must be a source at this location. The annual cycle suggests that it is probably of biological origin. Further research is being carried out to understand this plume.



From "Recent Studies of the Overturning Circulation in Hood Canal," Mark J. Warner and Mitsuhiro Kawase University of Washington, School of Oceanography, and Jan A. Newton Washington State Department of Ecology.

Figure 1-9a: Hood Canal bathyscape: Vertical sections of dissolved oxygen (mgl-1) for 14 occupations of Hood Canal stations between June 15, 1999 (top) and June 13, 2000. The Sample locations are marked by dots. Admiralty Inlet is on the left and the Great Bend on the right.

1-10 Nitrates in ground water

Background

Nitrates are chemicals used in agricultural and home fertilizers. They also are found in the waste (fecal) of animals and humans. Ground water becomes contaminated when excessive amounts of fertilizers are used, when farm animals wander into streams or their waste is poorly managed, or when on-site sewage systems are improperly located, designed, operated, or maintained.

Ground water is any water beneath the surface of land that flows freely through tiny pores and cracks in rock and soil. Ground water is the sole source of drinking water for many communities. Nitrate can most easily affect water from wells that are shallow, poorly constructed, or improperly located.

Public drinking-water supplies are required to monitor for nitrate under the Federal Safe Drinking Water Act (administered by the state). The federal drinking-water standard for nitrate is 10 milligrams per liter (mg/L). One milligram per liter is equivalent to a teaspoon of water in a swimming pool.

Private wells are regulated by county government. In most counties, private wells are tested only when they are drilled.

Concern

Drinking water with nitrate at levels above the federal drinking-water standard is considered a health risk and can cause a condition called methemoglobinemia – known as blue-baby syndrome - in infants less than one year of age. Pregnant or nursing women and people who have reduced stomach acid also have a higher risk of health problems. Methemoglobinemia reduces the body's ability to carry oxygen through the blood. Infants are at greater risk than older children and adults because they have a largely liquid diet and because they have lower stomach acidity. Low stomach acidity allows certain kinds of bacteria to grow in the stomach and intestines. If a baby is fed formula made from nitrate-contaminated water, these bacteria convert nitrate to nitrite. Nitrite then changes the oxygen carrying hemoglobin to methemoglobin, which does not carry oxygen. Severe cases among infants, if left untreated, can be fatal.

Current Trends

Between 1997 and 2001, more than 16,000 public drinking water supply wells were sampled for nitrates. The percentage of public water supply wells that tested high (above 5 mg/l) for nitrate remained about the same each year.

During 2001, 7 percent (333) of the 4,826 wells sampled had high (above 5 mg/l) nitrate levels, requiring more-frequent monitoring of the well by the water system. Of these wells, 2.4 percent (114) had nitrate levels at or above the state drinking-water standard of 10 mg/l. If the nitrate level is above the standard, the water supplier must notify its customers and take steps to reduce the level of nitrate through treatment and/or the use of other water sources.

Clustering of higher nitrate levels is seen in both agricultural and highly populated areas around the state. Between 1997 and 2001, the percentage of public water supply wells that tested high (above 5 mg/l) for nitrate-nitrogen levels remained about the same each year. These public wells are within the jurisdiction of local health authorities under the Safe Water Drinking Act and must be monitored. However, privately owned wells operate at their own risk, so innovative partnerships, described below, become quite valuable in protecting ground water and, hence, drinking water.

When nitrate levels are at or above 10 mg/l, this leads to regulatory action by the federal Environmental Protection Agency and can result in emergency drinking-water restrictions imposed by local health authorities. In 2001, about 219 of the sampled wells had nitrate levels between 5 and 10 mg/l, which will require more frequent monitoring. Of the more than 4,800 wells sampled in 2001, 114 had nitrate levels exceeding regulatory thresholds, meaning that 114 wells across the state could not be used for drinking water.

Great progress has been made in reducing nitrates in ground water by transferring septic systems to sewers, an action that helped Spokane reduce its nitrate levels in the early 1990s, as well as voluntary initiatives such as the Columbia Basin Ground Water Management Area (GWMA). The Columbia Basin GWMA is a voluntary, local planning effort to reduce nitrate in ground water. Formed by locally elected leaders and citizens of Adams, Franklin and Grant counties, it is intended to reduce the need for mandated control measures and gives local citizens and government a way to work together to find innovative solutions for protecting ground water. In many communities, ground water is the only source of drinking water.

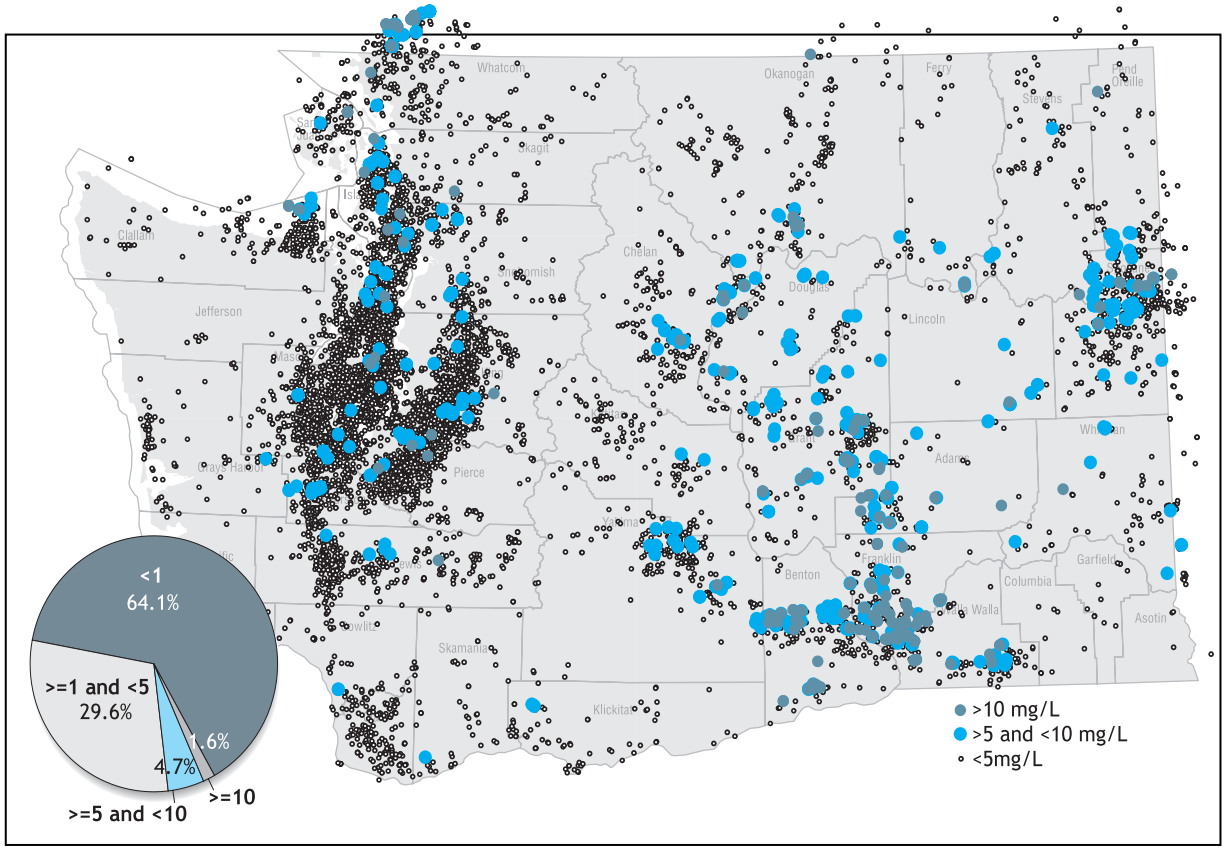


Figure 1-10a: Nitrate contamination

Tools for Success

- Groundwater Protection Council: Jean McDowell at (405) 416-8340 and jean.mcdowell@chguernsey.com. The council collects information from states about current efforts to protect ground water.
- The Columbia Basin Ground Water Management Area: (509) 488-2802 and http://www.gwma.org.
- Washington State Department of Health, Division of Drinking Water: (360) 236-3100 or http://www.doh.wa.gov/ehp/dw.

1-11 Invasive 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.

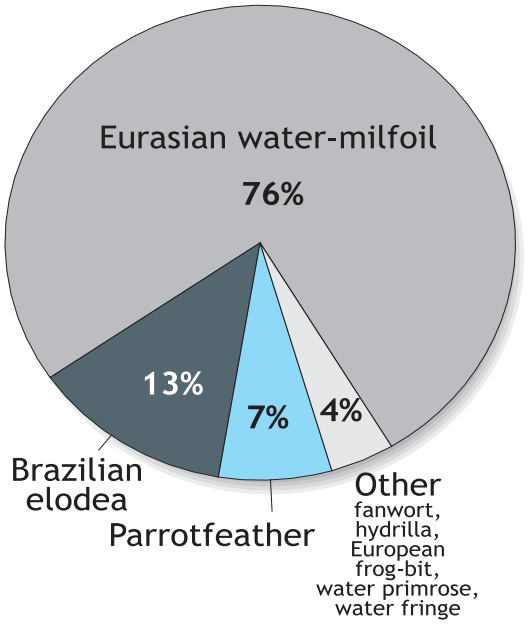


Figure 1-11a: Proportion of water bodies sampled in which invasive exotic aquatic weeds were found

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 1-11a. To date, 412 lakes and rivers have been surveyed statewide; 250 of these (61 percent) have been found to contain invasive exotic species (Figure 1-11b). (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.)

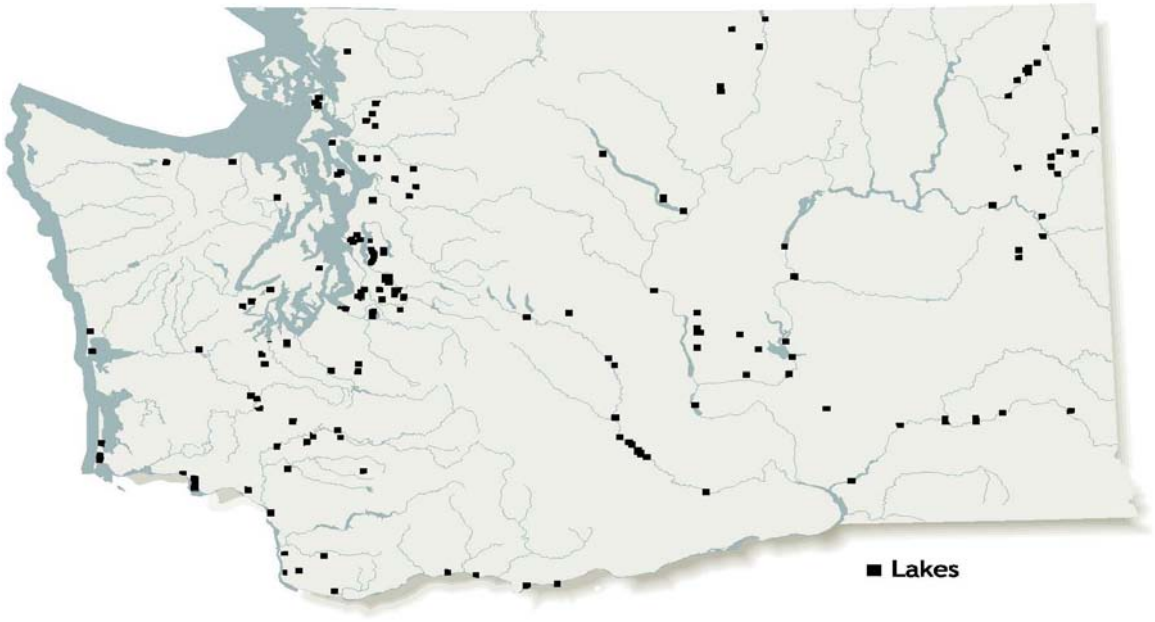


Figure 1-11b:
Locations with invasive exotic aquatic weeds

Tools for Success

- For detailed descriptions of invasive exotic aquatic plants, see http://www.ecy.wa.gov/programs/wq/plants/weeds/exotic.html .
- For an overview of Ecology's aquatic plant monitoring program, see http://www.ecy.wa.gov/programs/eap/lakes/aquaticplants/index.html

Section 2 – Air

2-1 Air Quality: Particulate matter and ozone

Concern

Even after substantial improvements in air quality, air pollution in Washington continues to harm public health, the environment and the economy. Hundreds of scientific, peer reviewed studies show that current air quality standards are not protective of life or health. Short- and long-term exposure to air pollution at levels routinely measured in Washington causes or contributes to hundreds of deaths per year, thousands more respiratory illnesses, restricted activity, school and work absence, hospitalization, increased cancer risk, increased asthma rates and other costly effects. Over 50% of the state's population suffers from one or more medical conditions that make them vulnerable to air pollution. We estimate the current annual cost of air pollution-associated death and illness to the Washington economy is at least $500,000,000.

Motor vehicle exhaust contributes more than half of the air pollution burden in the state and more than half of the fine particle pollution so closely linked to much of the health damage from air pollution. Regulations for controlling heavy-duty diesel vehicles should help decrease particle concentrations. Off-road diesel (farm and construction vehicles, boats, trains, and stationary diesel engines) contribute more than half of the diesel emissions in Washington. If these could be likewise controlled, cost of health-care for particle-associated illness and death could be reduced by a significant amount.

Incomplete combustion of all types adds fine particles, toxic air pollutants, including benzene, formaldehyde, butadiene, and many other solvent molecules to our air. These can react with nitrogen oxides, also from combustion, and become energized by sunlight to form ground-level ozone. Ozone is a trigger for asthma, is a deep lung irritant that prematurely ages the lung, and has effects on immune defenses.

Air pollution affects the environment and the economy in other ways. Air pollution, primarily particles, the metals that form some of the particles, and the hundreds of combustion products that adsorb to the surface of particles, eventually fall and are deposited in lakes, rivers and soil. There they contaminate soils, pollute water, damage plants, including forests and crops, harm animals and disrupt ecosystems. Persistent toxic compounds can also magnify in the food web and be consumed by people in fish and meats, thus representing another significant exposure route in addition to breathing the contaminants.

Air pollution can create haze that obstructs scenic views; it can disrupt climate and weather. Contaminants such as ozone and fine particles contribute to the formation of smog and haze, which in addition to affecting health reduce visibility. Smog and haze have an economic impact since they impair people's ability to enjoy the state's beautiful vistas, which can affect tourism revenue in the state. When air pollution creates noxious odors or irritating fumes, it can harm the economic value of homes and other real estate, as well as personal comfort and well-being.

Most current efforts to control air pollution focus on particles of dust, smoke, and soot and the six chemicals for which there are national air quality standards. However, we now know that hundreds of chemicals, called toxic or hazardous air pollutants, enter the atmosphere from a wide variety of sources. These chemicals are not subject to national health-based air quality

standards. Because of limited air quality and health risk data for Washington State, the level of public health and environmental damage caused by toxic air pollutants is less well understood.

Current Trends

Even though levels of air pollution in Washington have been improving, population and economic growth and increased vehicle use add to the air pollution burden and serve to offset gains from clean air strategies.

Ozone is of particular concern during the summer months. In 1998, during a very hot summer, Washington experienced a significant spike of ozone that exposed the central Puget Sound region to levels exceeding federal health based standards. More sunny, hot days may be expected with global warming, potentially resulting in increased ozone formation that threatens health and visibility.

While levels of particulate matter in the state have been improving, increasing vehicle use and growth make it harder to keep pollution levels in check. Between 1984 and 2002, population increased 27 percent, while vehicle miles driven increased 36 percent (Figure 2-1a). In 2002, Washington residents and our visitors drove more than 150 million miles per day in the state, contributing more than 6,000 tons of pollutants to the air every single day.

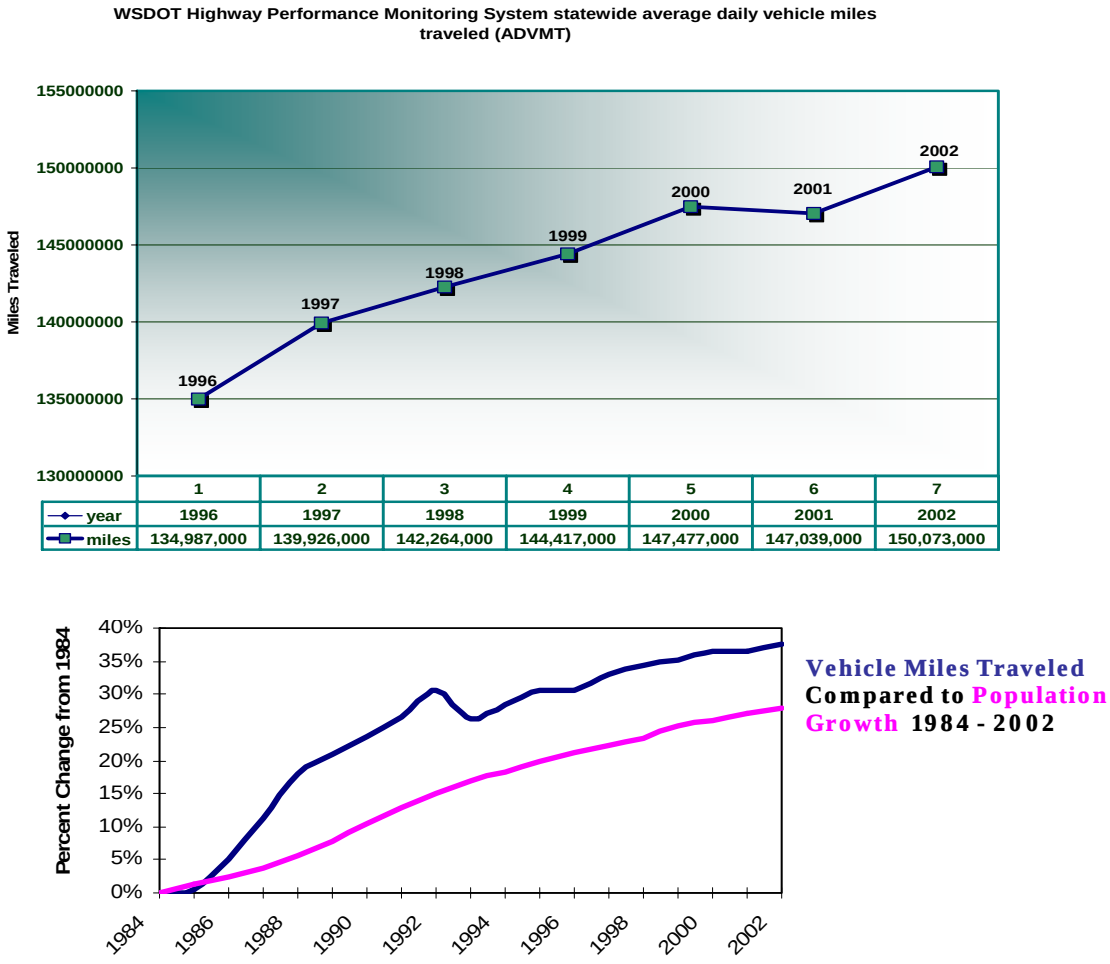


Figure 2-1a: Average daily vehicle miles traveled in Washington State -- 1996-2002

Tools for Success

- Check out information on outdoor burning, efficient wood-burning stoves, and other interesting information at http://www.ecy.wa.gov/programs/air/airhome.html Or, call (360)407-6000 and ask for the Air Quality Program.
- For more information on the University of Washington/Environmental Protection Agency's N.W. Research Center for Particulate Air Pollution and Health, see http://depts.washington.edu/pmcenter or call (206)543-2026.

2-2 Air toxics

The Washington results of U.S. EPA's National-Scale Air Toxics Assessment (NATA) indicate that levels of cancer-causing chemicals in our air are so high that lifelong exposure to them probably results in many cancer deaths. Our best estimate of the number of toxic air pollution-associated cancers is 26 per year in Washington. The range of the number of air pollution-associated cancer cases that could be occurring here is somewhere between 5 and 180 per year. The true number depends on just how potent diesel exhaust is as a carcinogen and upon many other factors that determine population cancer risk.

The following figure shows air pollution-associated cancer risk estimates for each county. The risks are itemized by their source category contributions,* and expressed in lifetime "chances per million." An average Washingtonian's lifetime risk of dying from cancer of any cause is about 13%. Toxic air pollution is a contributor to this risk, and the chances of survival with most types of toxic air pollution-associated cancers are poor. As shown, people living in larger metropolitan areas are at greater risk than people living in more rural areas. The average urban risk is about 333 per million whereas the rural average is about 155 per million. Even in the least polluted areas, the cancer risk from air toxics exceeds the U.S. EPA's "acceptable *de minimus*" risk level by more than 50-fold.

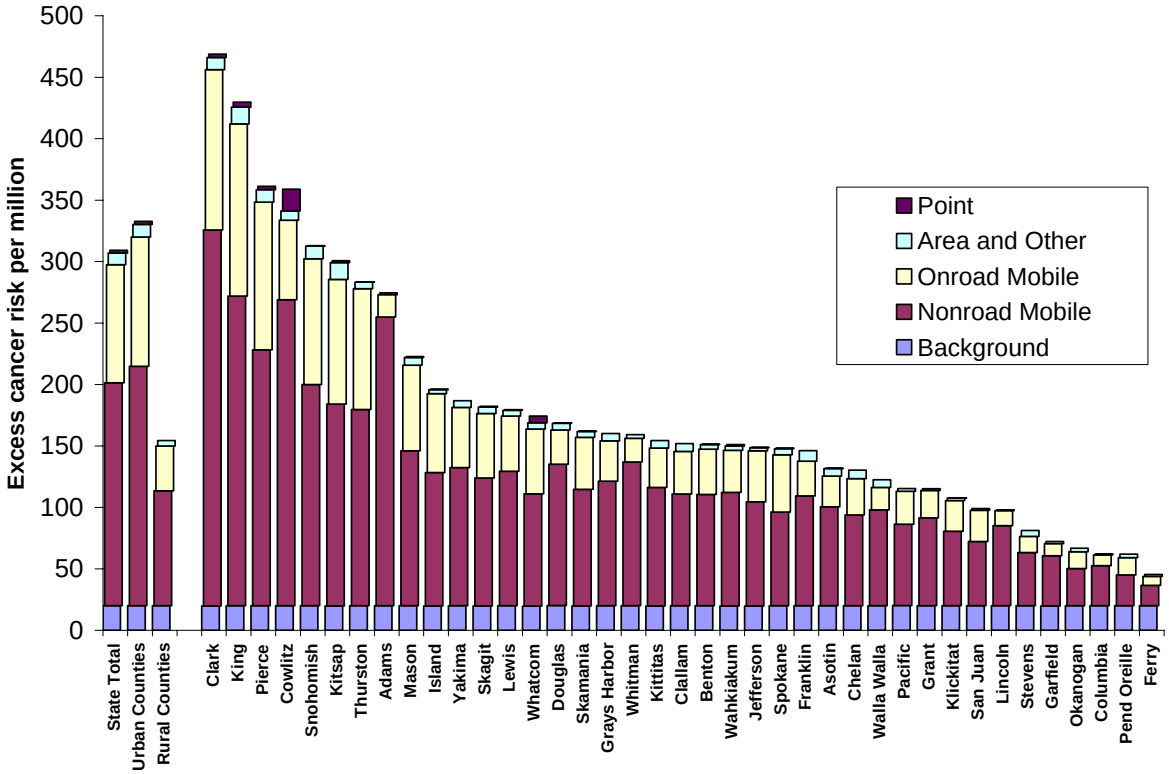


Figure 2-2a. Estimated lifetime inhalation cancer risks of 33 toxic air pollutants by source category

*Mobile sources include cars, trucks, construction equipment, ships, trains, etc. Area and other sources include activities that have smaller emissions individually: many of which are ubiquitous in nature including small industrial facilities, residential heating, consumer products, dry cleaners, wildfires, etc. Major "point" sources are mostly industrial activities that exceed 10 tons of a single air toxic or 25 tons of multiple air toxics per year. Background sources include atmospheric chemical reaction products, lingering "persistent" chemicals and a few naturally occurring air toxics.

The WDOE Air Quality Program is working to reverse the increasing trends in cancer risk from air toxics. We are also concerned about the ecological effects of air pollution, but targets for ecological protection are as yet undefined. This is because the ecological effects of air toxics have received less study than human risks, and because ecological functions are discounted by risk managers more than public health is.

The Air Quality Program has identified the toxic air pollutants most likely to pose unallowable risks based on cancer potency weighting of their emission inventories (WEI) and with reference to NATA results. The air toxics thus identified are shown in the following figure.

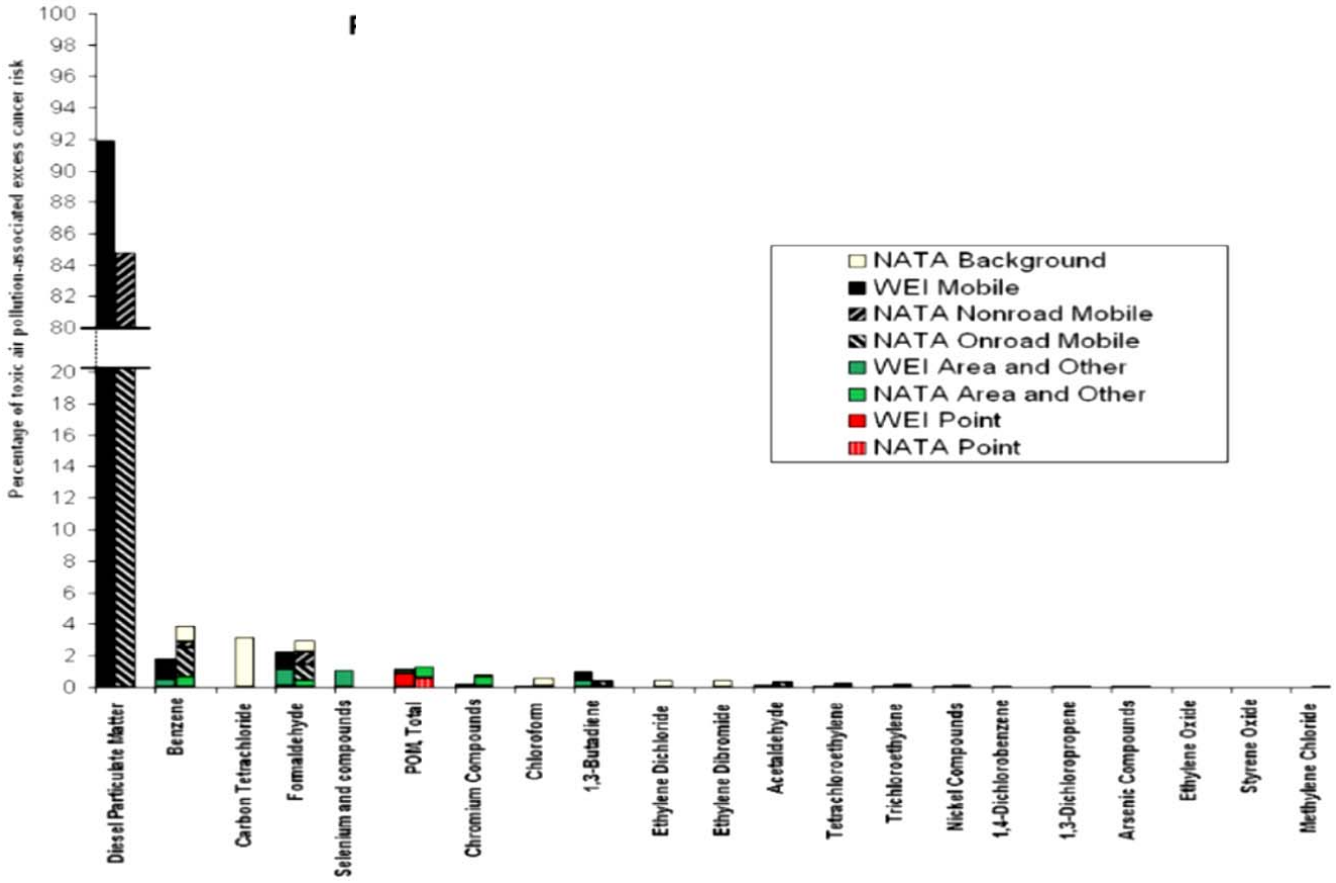


Figure 2-2b Provisional toxic air pollutants of concern

Tools for Success

- For more information on combustion-related problems, see the Puget Sound Clean Air Agency and its *Diesel Solutions* project at: http://www.pscleanair.org/dieselsolutions/index.shtml Or call (206) 343-8800 or (800) 552-3565.

2-3 Greenhouse gases and global warming

Concern: Washington State contributes to the global warming problem, and is beginning to suffer some of the effects of climate change.

For the Pacific Northwest, the most significant consequence of climate change is likely to be the reduction in all-important summer water supply. As the climate warms, snowpack will shrink and summer streamflow will drop considerably. This and other climate changes will have a wide range of consequences, most of them negative, for humans and ecosystems.

Water resources

The benefits to dry land agriculture of a longer growing season and greater precipitation may be offset by the losses to irrigated, high-dollar-value crops. Past experience offers some lessons: In the dry Yakima Valley of Washington, a string of years with below-average snowpack (1991-1994) led to selective water shortages and economic losses that reached $140 million in 1994. Even though water will become less plentiful in summer, higher winter precipitation (as occurred during the winter of 1998-99) will probably also increase wintertime flooding in many rivers.

Salmon

Climate variations have clearly played a role in PNW salmon history, with low summer streamflow and warm coastal ocean temperatures tending to reduce salmon production. Unfortunately, these conditions are likely to become more common in a warming climate, adding to the already long list of human-caused problems that now threaten the survival of salmon in the PNW.

Forests

Some types of trees grow better with more carbon dioxide in the air, but for most Northwestern coniferous forests, growth tends to be lower (and forest fires more extensive) during warmer, drier years. It is not yet clear how forests will change in the future, but some changes in forest composition, area, and density are likely.

Coasts

Both the physical landscape and the ecosystems of the coasts will be affected by climate change and rising sea level. Changes in wave direction may increase coastal erosion, as often happens during El Niño events. Increased winter precipitation will probably lead to more frequent landslides; recent wet winters have shown that thousands of homes are at risk from landslides around Puget Sound and on the Oregon coast, and climate models consistently project wetter winters.

From: ***The Potential Impacts of Global Warming of the Pacific Northwest:*** *Critical Findings for Washington and Oregon from the First National Assessment of the Potential Consequences of Climate Variability and Change* -- An overview prepared by Phil Mote, Ph.D. (University of Washington) and Blair Henry (Northwest Council of Climate Change) --

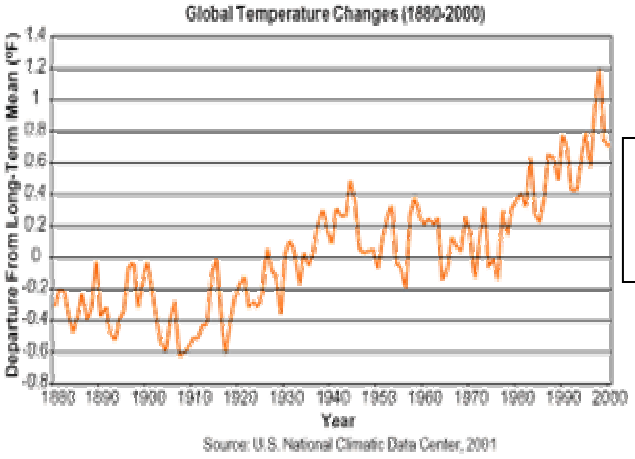


Figure 2-3a: Global Temperature Changes by Year (1880-2000)

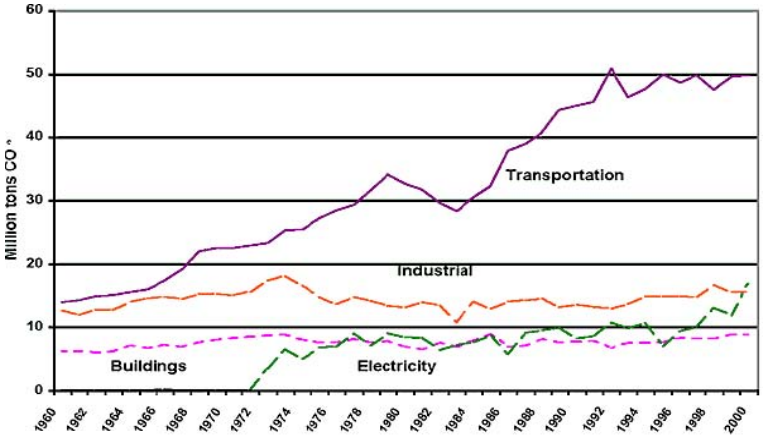


Figure 2-3b. Carbon Dioxide Emissions by Energy Sector, Washington State

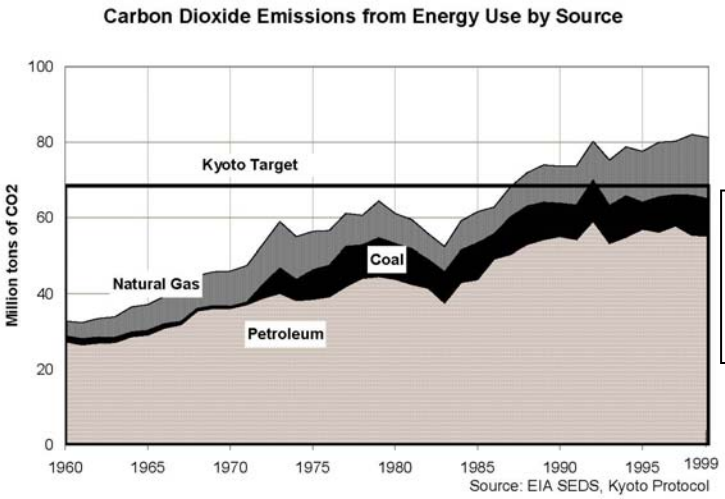


Figure 2-3c: Carbon Dioxide Emissions from all Energy Uses by Fuel Type

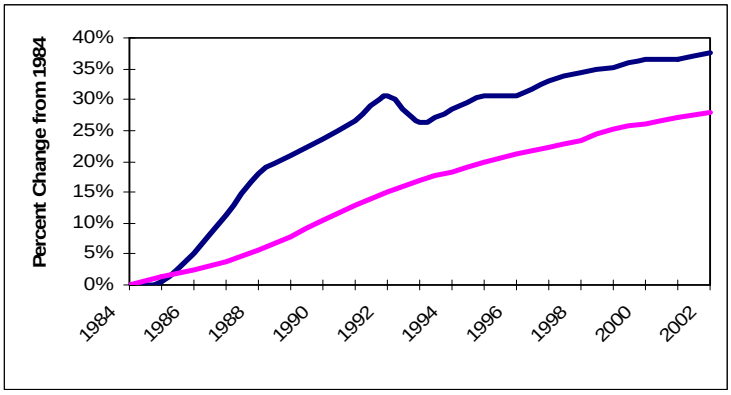


Figure 2-3d: Vehicle Miles Traveled Compared to Population Growth 1984 - 2002

An Introduction to Greenhouse Gases and Climate Change (Borrowed from EPA)

According to the National Academy of Sciences, the Earth's surface temperature has risen by about 1 degree Fahrenheit in the past century, with accelerated warming during the past two decades. There is new and stronger evidence that most of the warming over the last 50 years is attributable to human activities. Human activities have altered the chemical composition of the atmosphere through the buildup of greenhouse gases – primarily carbon dioxide, methane, and nitrous oxide. The heat-trapping property of these gases is undisputed although uncertainties exist about exactly how earth's climate responds to them.

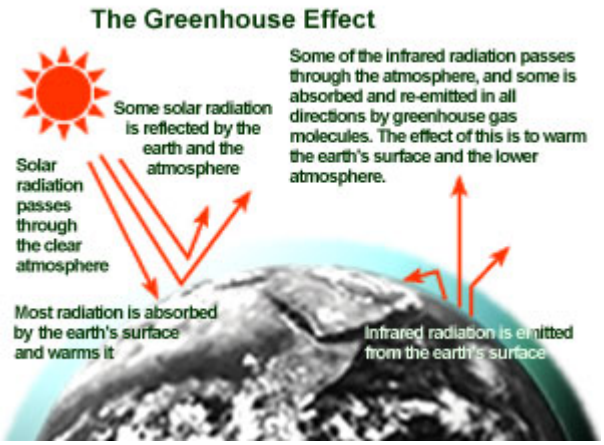


Figure 2-3e: The Greenhouse Effect

Our Changing Atmosphere

Energy from the sun drives the earth's weather and climate, and heats the earth's surface; in turn, the earth radiates energy back into space. Atmospheric greenhouse gases (water vapor, carbon dioxide, and other gases) trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse.
Without this natural "greenhouse effect," temperatures would be much lower than they are now, and life as known today would not be possible. Instead, thanks to greenhouse gases, the earth's average temperature is a more hospitable 60°F. However, problems may arise when the atmospheric concentration of greenhouse gases increases.

Since the beginning of the industrial revolution, atmospheric concentrations of carbon dioxide have increased nearly 30%, methane concentrations have more than doubled, and nitrous oxide concentrations have risen by about 15%. These increases have enhanced the heat-trapping capability of the earth's atmosphere. Sulfate aerosols, a common air pollutant, cool the atmosphere by reflecting light back into space; however, sulfates are short-lived in the atmosphere and vary regionally.

Why are greenhouse gas concentrations increasing? Scientists generally believe that the combustion of fossil fuels and other human activities are the primary reason for the increased concentration of carbon dioxide. Plant respiration and the decomposition of organic matter release more than 10 times the CO2 released by human activities; but these releases have generally been in balance during the centuries leading up to the industrial revolution with carbon dioxide absorbed by terrestrial vegetation and the oceans.

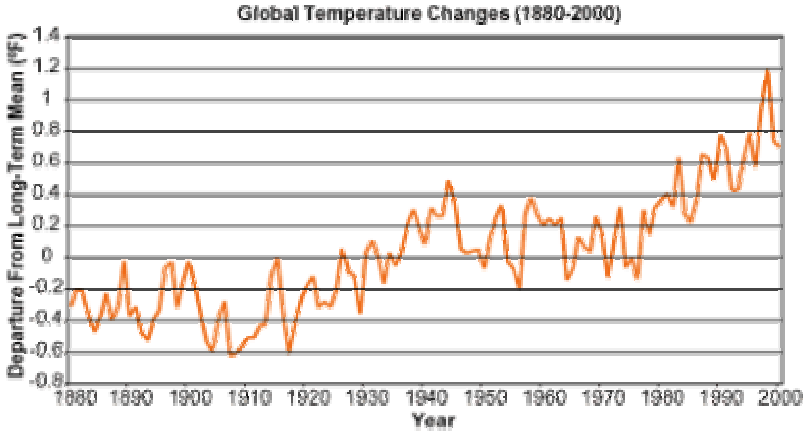
What has changed in the last few hundred years is the additional release of carbon dioxide by human activities. Fossil fuels burned to run cars and trucks, heat homes and businesses, and power factories are responsible for about 98% of U.S. carbon dioxide emissions, 24% of methane emissions, and 18% of nitrous oxide emissions. Increased agriculture, deforestation, landfills, industrial production, and mining also contribute a significant share of emissions. In 1997, the United States emitted about one-fifth of total global greenhouse gases.

Estimating future emissions is difficult, because it depends on demographic, economic, technological, policy, and institutional developments. Several emissions scenarios have been developed based on differing projections of these underlying factors. For example, by 2100, in the absence of emissions control policies, carbon dioxide concentrations are projected to be 30-150% higher than today's levels.

Changing Climate

Global mean surface temperatures have increased 0.5-1.0°F since the late 19th century. The 20th century's 10 warmest years all occurred in the last 15 years of the century. Of these, 1998 was the warmest year on record. The snow cover in the Northern Hemisphere and floating ice in the Arctic Ocean have decreased. Globally, sea level has risen 4-8 inches over the past century. Worldwide precipitation over land has increased by about one percent. The frequency of extreme rainfall events has increased throughout much of the United States.

Figure 2-3f: Global Temperature Changes (1880-2000)



Increasing concentrations of greenhouse gases are likely to accelerate the rate of climate change. Scientists expect that the average global surface temperature could rise 1-4.5°F (0.6-2.5°C) in the next fifty years, and 2.2-10°F (1.4-5.8°C) in the next century, with significant regional variation. Evaporation will increase as the climate warms, which will increase average global precipitation. Soil moisture is likely to decline in many regions, and intense rainstorms are likely to become more frequent. Sea level is likely to rise one foot along most of the U.S. coast by the year 2050.

Calculations of climate change for specific areas are much less reliable than global ones, and it is unclear whether regional climate will become more variable.

Tools for Success

- Information on climate-friendly farming practices is available from WSU at http://cff.wsu.edu/ .

- Information on green energy and energy conservation is available through the WSU Energy Office at http://www.energy.wsu.edu/ .
- More information on climate change and what you can do about it is available from the Department of Ecology's Air Program at http://www.ecy.wa.gov/programs/air/pdfs/air1297.pdf .
- Green Car Buying Guide: http://greenercars.com or call the American Council for an Energy Efficient Economy at (202) 429-0063 (EPA has a green-car rating Web site as well).
- If you live in the Seattle area, consider car sharing through FlexCar: http://www.flexcar.com or (206) 323-FLEX.
- Get in shape and ride your bicycle to work. The Bicycle Alliance in the Seattle area has a bike-buddy program, in which experienced cyclists will show you the safest route to work: http://www.bicyclealliance.org or (206) 224-9252.

Section 3 - Waste

3-1 Hazardous waste and pollution prevention

Concern

Hazardous waste raises a number of environmental and human health concerns. In addition, there is considerable legal liability associated with injuries connected to generating hazardous waste (either through health problems, environmental damage, worker injuries, explosions, or other physical events associated with handling hazardous waste), negative publicity, increased insurance premiums, additional business procedures to manage the waste, and the obvious cost of managing and disposing of the waste itself.

Current Trends

1992 was the first year in which pollution-prevention plans were required to be submitted for certain hazardous wastes. Pollution-prevention plans help a business find ways to prevent waste before it becomes an expensive hazardous waste to manage and dispose.

In 1992, Washington industries generated 317 million pounds of hazardous waste. Since then, the hazardous-waste generation rate has been reduced by 110 million pounds. By 2000, the rate was reduced to 207 million pounds (a 59 percent reduction), thereby meeting the state's goal of 50 percent waste reductionT[1]. This considerable reduction is due to pollution-prevention awareness, implementing pollution-prevention business practices, reduced business activity, and better compliance with regulations.

In 2000, the primary source of hazardous waste was the metals industry, which accounted for 58 percent of the overall generation rate that year. This sector is dominated by aluminum production, in which efforts to extend the life of the pot liner by replacing or relining it creates considerable waste. However, the industry is making some headway in reducing waste through process changes.

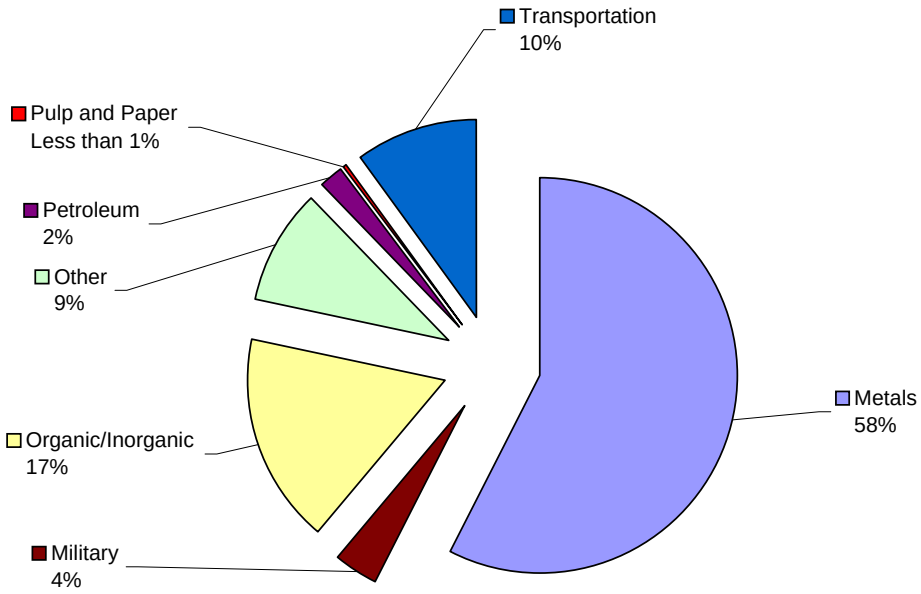


Figure 3-1a: Hazardous waste by sector

[1] From the *Reducing Toxics in Washington Report*, 2000 Annual Progress Report. Published November 2002

The next largest contributor in 2000 was the chemical industry, which accounted for 17 percent of the hazardous waste generated. This includes chemicals used in other manufacturing, chemical materials and supplies such as paints and fertilizers, and finished chemical products such as drugs, cosmetics, and soaps.

The third-largest contributor in 2000 was aircraft and transportation, which represented 10 percent of the generation rate, and was dominated by Boeing's aircraft operations. However, in the last five years, Boeing has eliminated more than 300,000 pounds of hazardous *material use* and 1.3 million pounds of hazardous *waste generation*. Its Auburn plant has been particularly successful in reducing waste.

Between the years 1990 and 2000 the population of the State of Washington has increased 1,027,429 people or 21 percent.[2] At the same time, hazardous waste generation has decreased from 52 lbs. per person to 35 lbs. per person, a 33 percent decrease.

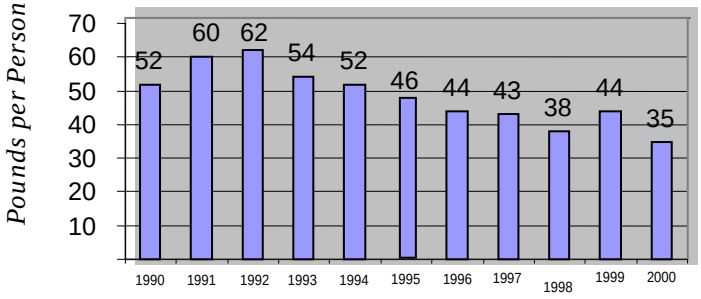


Figure 3-1b: Per capita hazardous waste generation—1990-2000

There is a growing trend toward using materials more efficiently to reduce waste. Adopting environmental management systems (EMS), setting sustainability goals, using total cost accounting, and a number of other practices are leading to greater awareness, and to balancing the interests of material efficiency, economics, and community values. The Department of Ecology recently embarked on an ambitious project called *Beyond Waste*, which is mapping out a long-term plan for developing completely closed-loop systems for materials production and use. Rather than discarding valuable materials as waste (either hazardous or non-hazardous), they are re-used in production processes, in other products, or returned to biological systems, similar to composting. These closed-loop processes save money, reduce liability, create more jobs, avoid harmful emissions to the environment, and tend to be safer because there is less exposure.

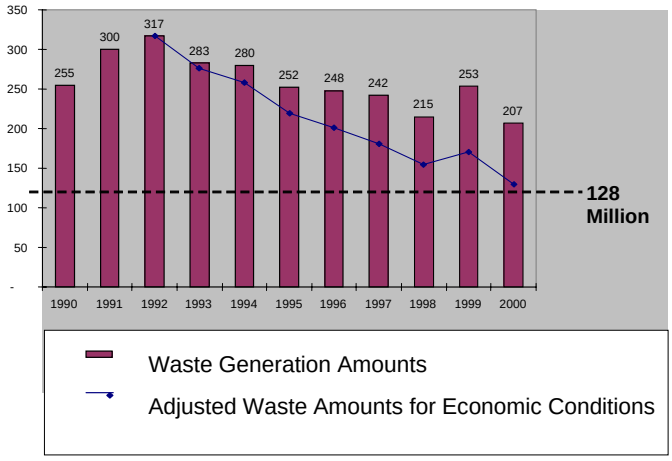


Figure 3-1c: Hazardous waste trends: Millions of pounds of recurrent waste

[2] U.S. Census Bureau: State and County QuickFacts: http://quickfacts.census.gov/cgi-bin/state_QiuickLinks?53000.

Tools for Success

- Washington State Department of Ecology: Hhttp://www.ecy.wa.gov/programs/hwtr or call (360) 407-6000. See the 2000 Annual Progress Report *Reducing Toxics in Washington at* http://www.ecy.wa.gov/biblio/hwtr.html .
- Pollution-prevention tips: Contact the Environmental Protection Agency at www.epa.gov/p2/ or (206) 553-1200.
- See the materials from the National Pollution Prevention Roundtable: http://www.p2.org/ or call (202) 299-9701.
- For reducing household hazardous waste, contact the Hazardous Waste Management Program in King County. They have great documents, advice, and even in-home training. See http://www.govlink.org/hazwaste or call (206) 263-3050 or e-mail haz.waste@metrokc.gov.

3-2 Beyond solid and hazardous waste: Toward sustainability

Concern

Overall, the amount of waste we dispose of is on the rise, despite massive recycling programs and pollution-prevention efforts. We are using natural resources much faster than nature can replenish them. After we have used resources extracted from the earth's surface, we discard them, often in more harmful forms, back into the environment. Humans depend on this same environment to provide water to drink, air to breathe and soil to grow food.

Concerned with community safety, the public is becoming more aware of how much hazardous material is hauled by road, rail and sea. Given the dangers of these substances, whether they are new products or waste, the risk of accidents climbs as the volume transported continues to grow.

The average person in Washington creates about 44 pounds of hazardous waste and 2,840 pounds of non-hazardous waste a year. Handling any waste is expensive and can be hazardous. Exposure to certain chemicals, whether it is waste or in the products we use, may pose greater risks to health, air, water and land than previously believed.

A vehicle, a plastic bag, a modular piece of furniture, a food package – virtually any manufactured product we touch – represents only a fraction of its life. Manufacturing products normally involves polluting, energy-intensive and water-intensive processes that include raw material extraction and refining (e.g., metal ore mining and refining), processing, finishing, packaging, and transportation – sometimes thousands of miles – and finally to your retailer. When we choose to dispose of these products as garbage, we lose opportunities to remanufacture, refurbish, repair, or deconstruct for future product development. In the process, we lose thousands of potential new jobs. In addition, garbage disposal in landfills can contaminate both ground and surface waters, generate greenhouse gases (climate change), and use up valuable open space. Incinerators also create problems, emitting acid gases, carbon dioxide, toxic chemicals, and fine particulates. (Also see *Air Quality* and *Toxic Chemical Release* concerns and indicators).

Solid and Hazardous Waste Concerns:

Safety: When we purchase a product, most of us assume that it has been tested and declared safe for the intended purpose. What we may not know, however, is that:

- There are thousands of chemicals in the everyday items we use. Some of these chemicals would be considered hazardous waste if they were byproducts from production, but when they are incorporated into a product, they are assumed safe for the intended purpose.
- Toxic chemicals can leach from products and cause health concerns. The Consumer Product Safety Commission has found that children who play on play sets made of pressure treated wood face an increased risk of getting lung or bladder cancer.
- Pregnant women, children and infants are at greater risk of harm from exposure.

Current gaps in regulation:

- Over 3000 small businesses and millions of households are excluded from hazardous waste regulations.

- Most persistent toxic chemicals end up in products, not as waste from production. Studies show that legal toxins in products, such as PBDE flame retardants, are accumulating in women's breast milk.
- More than three quarters of the hazardous waste sites that have existed in Washington have had some degree of clean-up obligation because of contaminated soil or groundwater.

Landfill Concerns:

- Hazardous substances are present in many wastes being disposed. A landfill operator's legal liability for monitoring and providing financial assurance typically ends 30 years after a landfill is closed. Toxics can remain a threat for centuries.
- There is an increasing amount of waste being generated in Washington state
- Every pound of waste going into a one-way landfill means we must rely on extracting increasing amounts of diminishing natural resources to meet the material needs of our growing population.

Recycling Concerns:

- Most products are not designed for recycling so it can be difficult and expensive to recover and reprocess materials.
- Government subsidies to resource extracting industries, such as aluminum, distort the true cost of virgin material, placing recycled material at an economic disadvantage.
- The presence of toxic substances renders many products not useable for recycling.

Tools for Success

- For information about the Beyond Waste project that is focusing on the development of new state solid and hazardous waste plans, see www.ecy.wa.gov/beyondwaste/.
- Support economically viable, environmentally sound and fair product development. See the Northwest Product Stewardship Council at http://www.productstewardship.net or (206) 723-0528.
- For TREE engineering consulting, see http://www.ecy.wa.gov/programs/hwtr/TREE/index.html or call (360) 407-6338.
- The Department of Ecology's Solid Waste Program: http://www.ecy.wa.gov/programs/swfa/index.html or (360) 407-6105. This Web site contains useful waste-reduction information.
- Reduce your paper generation, the top waste product outside food. See Re-think Paper at http://www.rethinkpaper.org or (415) 788-3666.
- Food waste is one of the largest components in our waste stream, comprising 96 billions pounds of edible food a year! For commercial kitchens, see http://www.dpw.co.santa-cruz.ca.us/full_report.html.
- Donate food and be a good neighbor! See Food Lifeline at http://www.foodlifeline.com.

3.3 Solid waste: Beyond waste

Concern

Vehicles, a plastic bag, a modular piece of furniture, food packaging -- virtually everything we touch -- represents only a fraction of its life. Manufacturing products involves a polluting and energy and water-intensive process that includes raw material extraction (e.g., metal ores), processing, and transportation—sometimes thousands of miles -- and finally to you. When we choose to dispose of these products as garbage, we lose opportunities to remanufacture, refurbish, repair, or deconstruct for future product development. In the process, we lose thousands of potential new jobs. In addition, garbage disposal in landfills can contaminate both ground and surface waters, generate greenhouse gases (climate change), and use up valuable open space. Incinerators also create problems, emitting acid gases, carbon dioxide, toxic chemicals, and fine particulates. (Also see the *Air Quality* and *Toxic Chemical Release* indicators in this report).

Current Trends

Solid waste comprises basic household "garbage," demolition, inert and wood waste, industrial and commercial waste, petroleum-contaminated soils, and other sources. In 2002, Washingtonians disposed 7.4 million tons of solid waste, or 0.78 tons per person per year (about 4.3 pounds a day per person). Most of this waste travels to three major landfills: Roosevelt Regional Landfill in Klickitat County, Cedar Hills in King County, and Columbia Ridge in Oregon. Because 24 counties in Washington have no capacity to take municipal solid waste, that waste has to be shipped over long distances, creating air pollution during transport. In addition to being land-filled, some solid waste is incinerated. In 2002, our three incinerators burned 311,474 tons of waste, comprising 4.2 percent of our waste stream.

Recycling materials, in which used items are returned to subsequent manufacturing processes that avoid using energy and water, and create less waste, can only partially offset our growing waste-generation woes. For example, in 2002, Washington residents recycled 187,585 tons of newsprint, down significantly from the year before. In 2002, we also recycled 12,718 tons of aluminum cans -- the recycling of which has the most significant energy savings of all commodities — but that also represented a downward trend from an impressive 17,945 tons recycled in 2000.

Washington State helped pioneer very successful recycling and waste separation programs. The statewide municipal solid waste recycling rate was almost 35% for 2002. An additional 10% was diverted from the waste stream for other re-use or recycling. Washington citizens have demonstrated that we are concerned about our environmental impacts and diligent about handling our waste responsibly. This ethic is shared by many—but far from all—who do business in Washington or visit from elsewhere.

To respond to these overall trends, the Solid Waste and Hazardous Waste programs at the Department of Ecology, in collaboration with public and private-sector partners, developed the *Beyond Waste Project*, which is mapping out a long-term plan for eliminating as much waste as possible and for developing better systems for using remaining excess materials production and use. Rather than discarding valuable materials as waste (either hazardous or non-hazardous), they are re-used in production processes, in other products, or returned to biological systems,

similar to composting. These closed-loop processes save money, tend to be safer because there is less exposure, reduce liability, create more jobs, and avoid harmful emissions to the environment.

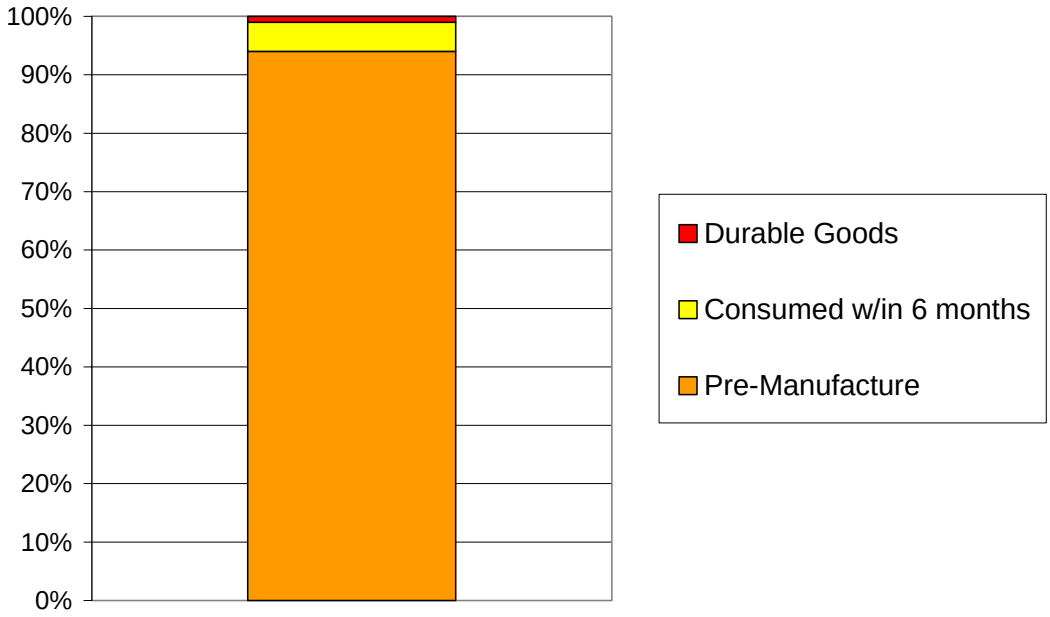


Figure 3-3a: Life cycle wastes

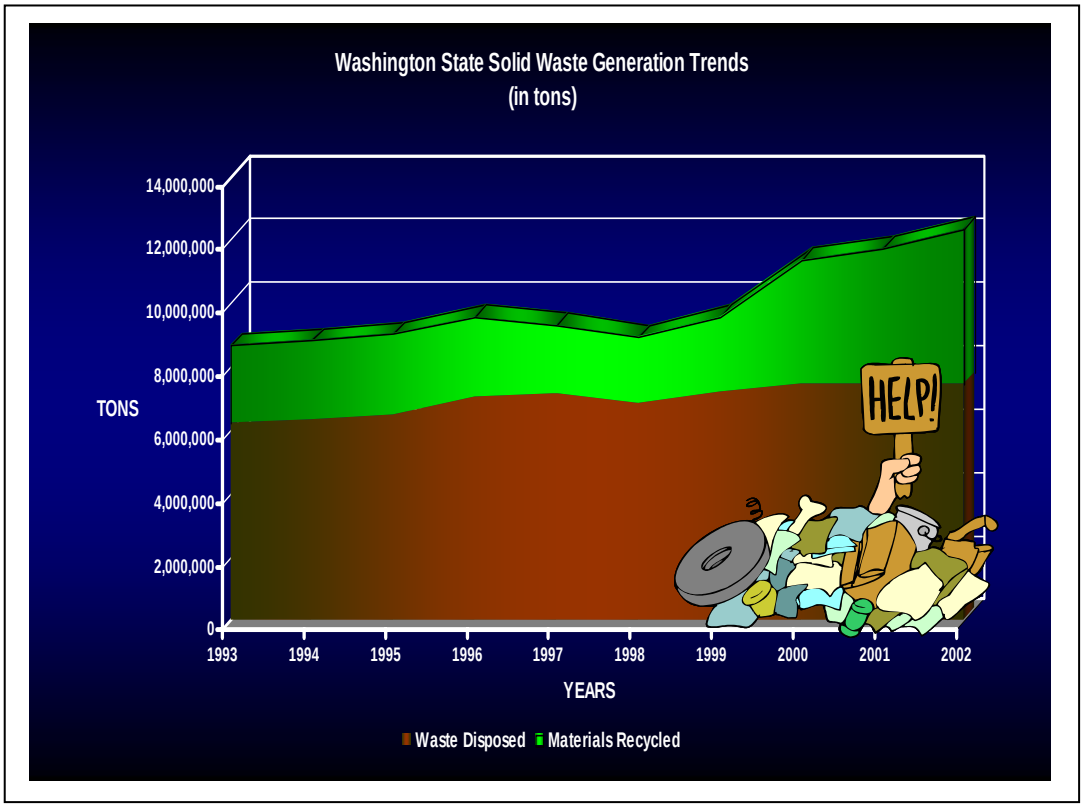


Figure 3- 3b: Washington State solid waste generation trends (1993-2002)

3-4 Nuclear waste management

Environmental Concerns

The Hanford Site consists of 560 square miles located in southeast Washington. Hanford's half-century of plutonium production has created one of the world's most polluted areas. The clean up challenges include:

- Removing and vitrifying an estimated 53 million gallons of radioactive and chemically hazardous waste in Hanford's 177 underground storage tanks.
- Removing 2,100 tons of disintegrating nuclear fuel rods stored in two old concrete basins near the Columbia River.
- Cleaning up approximately 190 square miles of contaminated ground water that flows toward and eventually enters the Columbia River. Approximately 95 square miles of contaminated ground water currently violate both federal and state drinking water standards.
- Operating and closing 50 hazardous waste treatment, storage, and disposal sites, ranging from small demolition sites to half-mile long concrete canyons.
- Cleaning up 1,500 waste sites, ranging from liquid waste disposal ditches to former reactor facilities, including 9.35 million tons of contaminated soil adjacent to the Columbia River.

Hanford Tank Waste Storage, Treatment, and Disposal

Ensure safe operation of Hanford's high level tank waste and treat the tank waste to support closure of Hanford's tank systems by 2028.

- Full scale operations Hanford Tank Waste Treatment Facility by January 2011.
- Develop an approach for waste that will not be treated in the Treatment Facility.
- Develop a system for interim storage, transport, and disposal of treated tank waste.
- Improve safety of double shell tank system operations through permitting.
- Remove pumpable liquids from single shell tanks by September 2004.

Hanford Environmental Restoration:

Restore the public use of the air, soil and water at Hanford and remove or reduce the risks associated with past Hanford activities to people and the environment.

- Clean Hanford's 100 Areas to allow for unrestricted surface use by 2012, and to prevent further groundwater contamination.
- Restore 100 Area groundwater to its highest beneficial use by 2018.
- Prevent contaminant spread in Hanford's 200 Area soil waste sites by stabilizing existing contamination by 2024.
- Restore 200 Area groundwater to its highest beneficial use by 2024 through implementation of the Hanford Groundwater Strategy.

- Remediate 300 Area groundwater by 2018.
- Restore, mitigate or replace injured natural resources.

Hanford Waste Management:

Safe management, including storage, treatment, and disposal of radioactive mixed waste at Hanford Site.

- Complete the Low Level Waste Burial Grounds permit review.
- Utilize new or expanded and protective disposal facilities to accelerate waste treatment and disposal at Hanford.
- Continue transuranic waste shipments to the Waste Isolation Pilot Plant.
- Complete the commercial low-level radioactive waste disposal facility investigation and determine MTCA cleanup actions by June 2006.

Hanford Facility Transition:

Decommission large complex facilities throughout Hanford which require coordination of multiple regulatory and technical requirements for transition to safe and stable conditions.

- Transition Hanford's 300 Area by 2018.
- Complete transition of the Plutonium Finishing Plant by 2016.
- Transition all of Hanford's 100 Area reactors to Interim Safe Storage by 2012.
- Close the Framatome Company's storage lagoons by August, 2006.

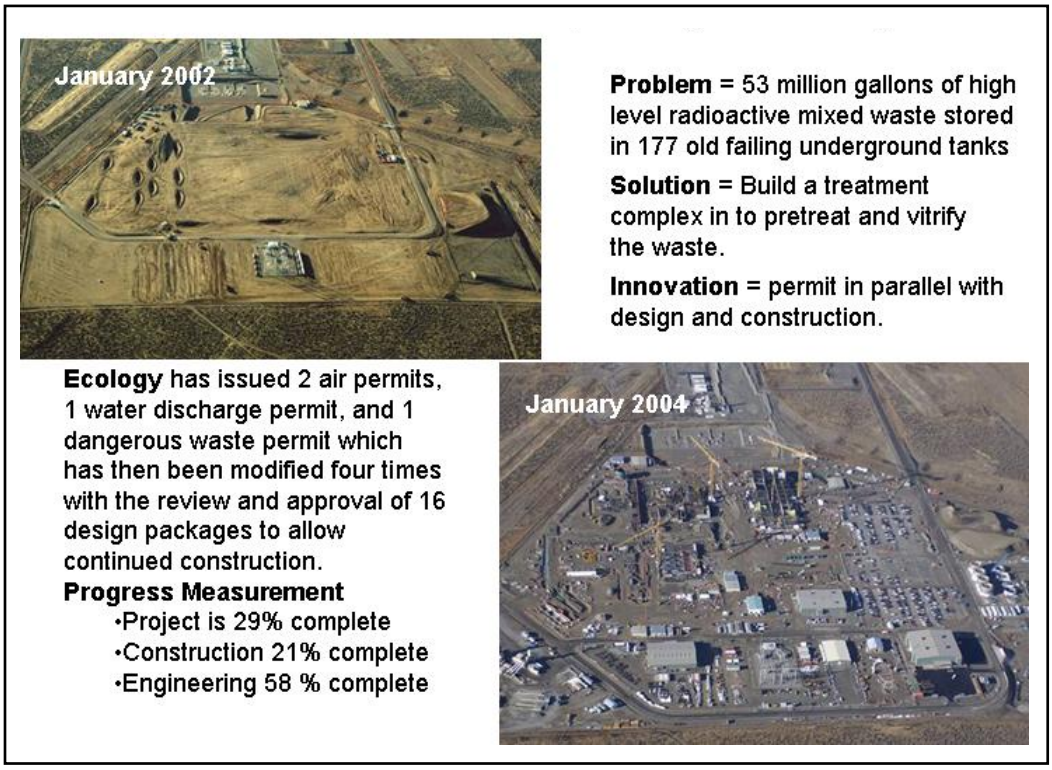


Figure 3-4a: Hanford Tank Waste Treatment Complex Progress – January 2004

Tools for Success

- Department of Ecology's Nuclear Waste Program: http://www.ecy.wa.gov/programs/nwp/index.html or call the Hanford Hotline at 800-321-2008.
- Department of Energy's Office of River Protection: http://www.hanford.gov/orp/.
- For a detailed history of Hanford, including information on the entire Manhattan Project, see the Nuclear Waste Program Web site or http://www.hanford.gov/docs/rl-97-1047/index.pdf

3-5 Toxic chemical releases

Concern

In the natural environment, substances are broken down by small microscopic organisms or physical processes. These natural systems are not designed to assimilate and break down manufactured chemicals or byproducts not found in natural systems. Even at concentration levels that can be likely to exist because of continuous or recurring releases from facilities, chemicals can be and in many cases are absorbed into tissues and organs, and they can affect the natural biological functioning of other natural systems. It is estimated that more than 50 percent of all TRI chemicals are suspected or known developmental or neurological toxins. These chemicals can affect the way a fetus or a child's body and brain develop, can cause premature and low-birth-weight babies, and can cause learning disabilities and behavioral disorders.

Current Trends

Toxic chemical release reporting is tracked through an annual summary called the Toxics Release Inventory (TRI). The TRI tracks the amount of toxic chemicals released into the air, land and water by certain facilities. Over 600 chemical compounds and/or chemical categories are reported under TRI. In Washington State, each year about 350 facilities report for one or more of about 110 of those 600 chemicals. *In the year 2002, 19.7 million pounds of toxic chemicals were reported released to the air, land and water in Washington State. This was a decrease of 2.5 million pounds from 2001. Since 1995, total releases of all reported chemicals by manufacturing sectors decreased by over 46%.*

With over 7.7 million pounds of reported releases, the paper and allied products manufacturing category accounted for nearly 40% of the releases reported in the state, a decrease of 800,000 pounds from 2001. This decrease has been attributed to new technology for removing methanol from air stacks and improved measurement of other chemicals. Reported releases from this industry have decreased by about 5 million pounds since 1994. Other major (industrial) types of sources of toxic chemical releases are electric generation, primary metals, petroleum refining, and chemical and allied products manufacturing.

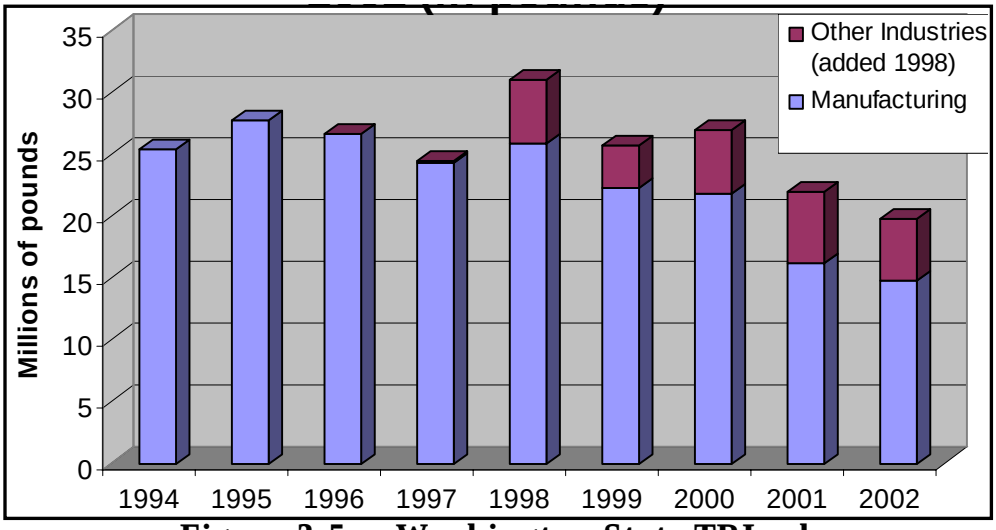


Figure 3-5a: Washington State TRI releases, 1994-2002 *(in pounds)*

Of Washington's 39 counties, 30 had facilities that reported under TRI. Lewis County had the greatest amount of reported releases, primarily from one facility, Transalta Centralia Generation/Mining. The releases in the ten counties with the highest releases accounted for 86% of all TRI releases statewide.

For 2002, Washington ranked 37th out of the 50 states for on-site TRI releases.

Toxics Release Inventory Results for Air, Land, and Water

The data serve as a valuable tool for monitoring progress toward reducing chemicals and toxins in our environment. Although releases to air have decreased over the past several years, most of the releases are still emitted into the air. Air toxics pose a persistent public health concern.

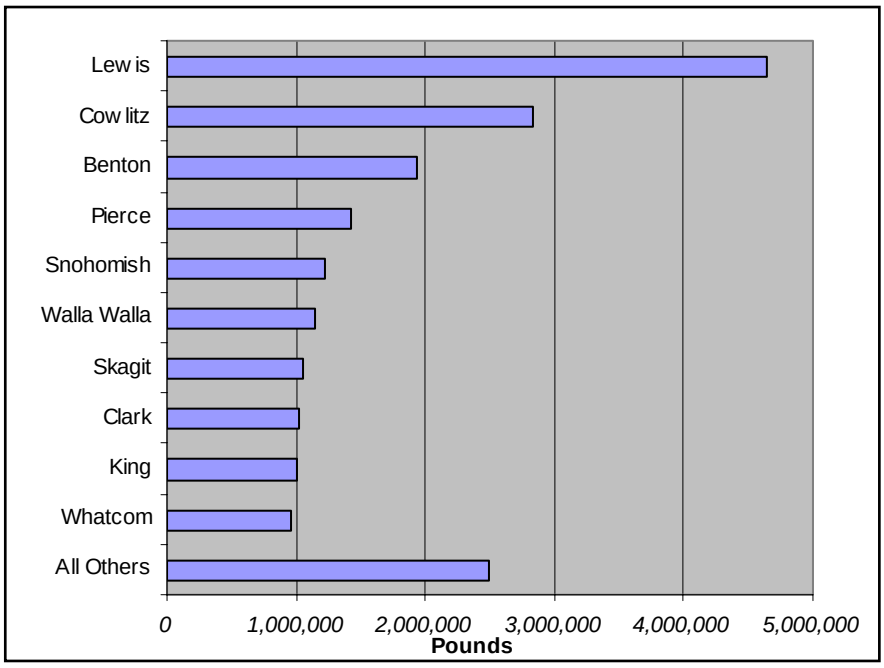


Figure 3-5b: Washington State TRI releases, 1994-2002 (in pounds)

Facilities that report under TRI are also required to develop pollution-prevention plans that specify how to prevent or reduce toxic wastes. In the past 10 years, more than 500 facilities have submitted pollution-prevention plans to Ecology. They have identified and implemented opportunities to reduce their use of hazardous substances, reduce their toxic waste, increase recycling, and save money. In 2000 alone, businesses that submitted updates to their existing pollution-prevention plans identified more than 2,200 distinct benefits from their efforts. Most notable reductions have taken place in the aluminum industry, which has worked diligently to reduce its 100-year-old process that historically produced large amounts of pot liner waste.

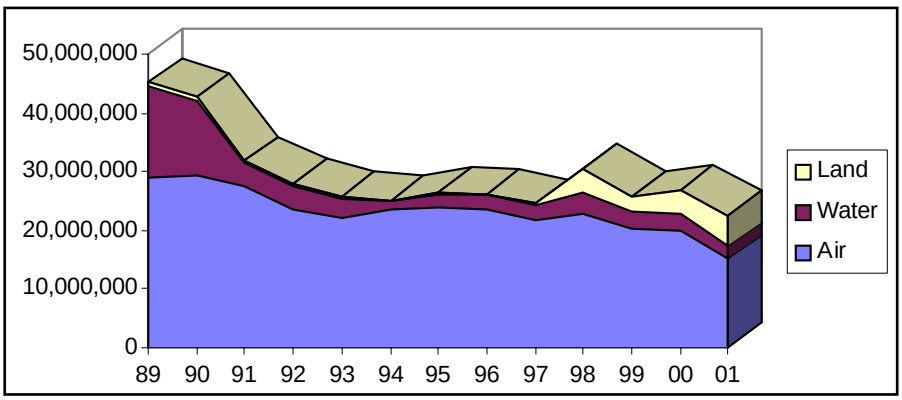


Figure 3-5c: Pounds of toxic chemicals releases to land, air and water

In recent years, the Department of Ecology has developed an engineering consulting program called TREE, for Technical Resources for Engineering Efficiency. By re-engineering industrial processes, TREE has shown that businesses can dramatically reduce waste, to benefit the environment and the bottom line. Since 2000, the businesses working cooperatively with TREE's engineering and industrial-process experts have saved participating businesses more than $360,000 in efficiency improvements alone. In a metal plating operation, for example, the wastewater was converted to a closed-loop system, resulting in no waste of plating chemicals and no water pollution.

As more and more companies realize the monetary, worker, community health, and other benefits of reducing toxic waste, TRI releases are expected to decline through pollution-prevention efforts, the use of services like TREE, and an overall commitment to sustainability by all of us.

Tools for Success

- The Washington State Department of Ecology publishes an annual summary of TRI data and a hazardous chemical inventory called the *Chemicals in Washington State Summary Report 2002*, publication number 04-04-020. There's also a computer-based graphic display of the TRI data, "TRIDS," which can be downloaded from: http://www.ecy.wa.gov/epcra/trids/index.html. TRIDS compact discs are also available for free.
- The Department of Ecology's Hazardous Substance Information Office responds to questions from the public on toxic chemicals, 800-633-7585.
- For TREE engineering consulting, see http://www.ecy.wa.gov/programs/hwtr/TREE/index.html or call (360) 407-6338.
- For detailed information on developmental and neurological toxins, see *Polluting Our Future: Chemical Pollution in the U.S. that Affects Child Development and Learning.* This report can be downloaded from http://www.safekidsinfo.org or contact Physicians for Social Responsibility (www.psr.org), the National Environmental Trust (www.environet.org) or the Learning Disabilities Association of America (www.LDAAmerica.org).

3-6 Oil and hazardous materials spills and spill prevention

Concern

Puget Sound is one of most biologically diverse marine environments in the world, supporting a complex ecosystem from microscopic organisms to familiar large species, including octopus, herring, rockfish, crab, shellfish, wolf eels, harbor seals, and orcas. The western Strait of Juan de Fuca and outer coast contain extensive natural resources and protected areas. The northern outer coast -- which is the area at highest risk of major and catastrophic oil spills -- contains a national park, wildlife refuge, and marine sanctuary. Damage from oil spills can reduce food sources for surviving species, kill fish, birds and mammals, and destroy plant life. Sometimes the effects profoundly affect reproduction, immune systems, and development, and may alter feeding habits. The extent of environmental harm may not be related to the size of the spill but to the type and amount of toxins in the petroleum product, including extremely toxic polycyclic aromatic hydrocarbons, or PAH.

Figure 3-6a: Vessel Incident Response Map

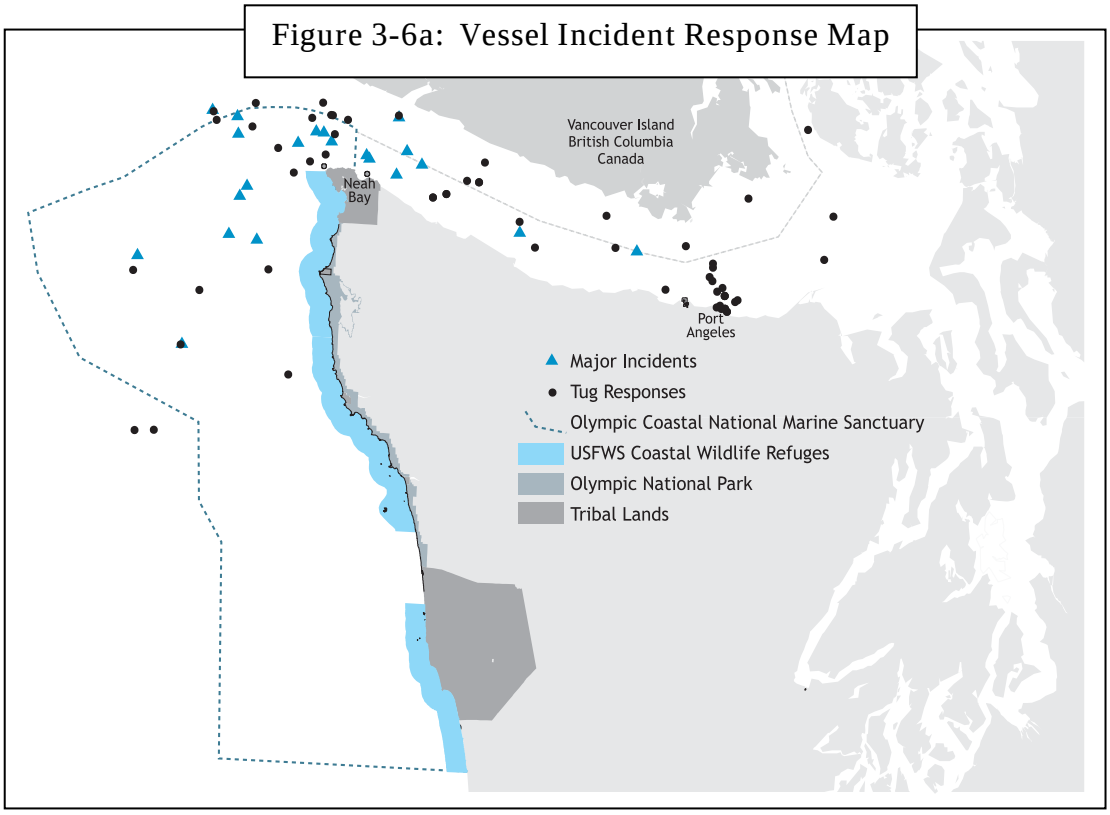


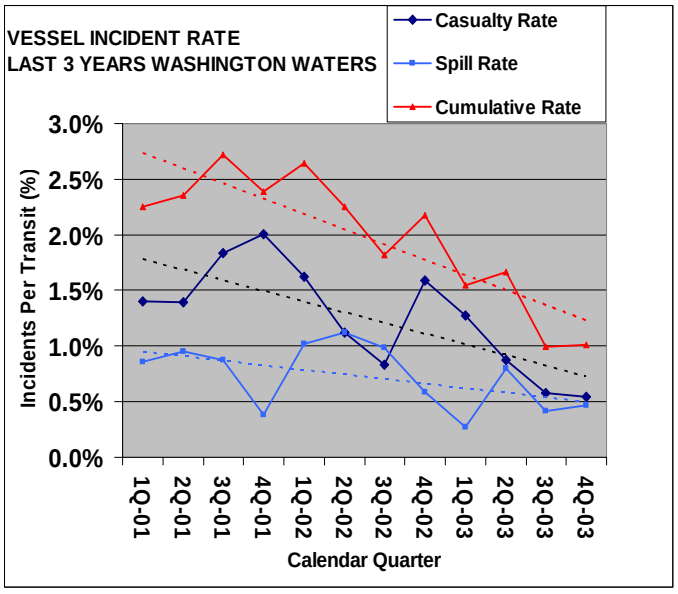
Figure 30 shows precise locations where large commercial vessels have lost propulsion, lost steering, or had other significant problems since 1999.

Current trends

Since accidents can happen despite the best prevention efforts, a rescue tug has been stationed at Neah Bay, in position to intercept a disabled tanker or drifting barge before it runs aground or spills. The rescue tug has been in place during the last five winters to intervene when a ship or barge is in trouble. The rescue tug has demonstrated its value by assisting 25 of these vessels.

The Department of Ecology's Spills Program brings a strong focus on preventing major oil spills. We are fortunate that the combined efforts of industry, the Coast Guard, and Ecology have

resulted in keeping the number of maritime accidents and major oil spills to a relatively low number. However, it takes only a single major spill to cause extensive and persistent environmental and economic damage.



The state's efforts to prevent spills include a wide range of activities, including extensive training, interagency preparedness drills, and prevention-oriented inspections. More recently, Ecology adopted a new, voluntary Best Achievable Protection Program for tank vessels. The spill prevention program is having a positive effect. The vessel incident rate is declining in recent years *(Figure 31)*.

Figure 3-6b: Vessel incident rate

Frequent inspections appear to have a positive effect on spill prevention. *Figure 32* correlates the number of bunker spills with the time since the last inspection.

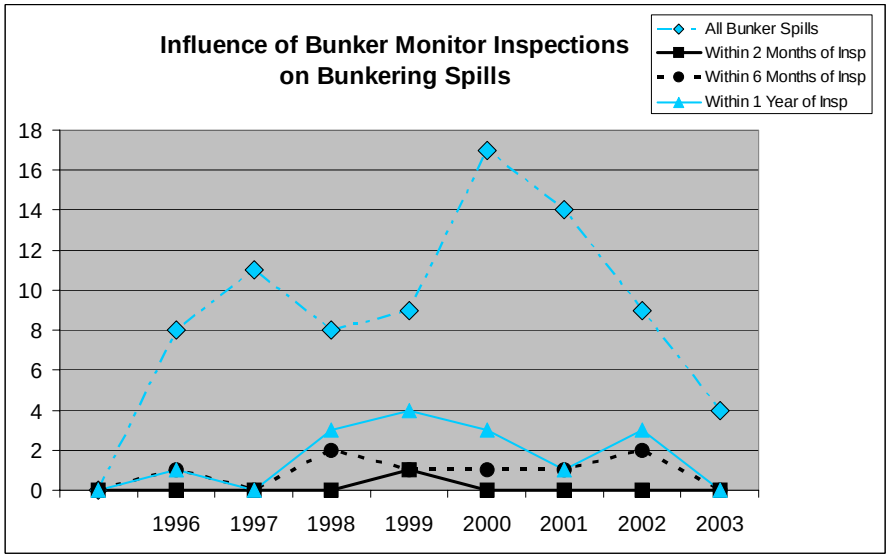


Figure 3-6c: Influence of Bunker Monitor Inspections

In addition to marine-related spills, Ecology works with local law enforcement to dispose of drug-lab chemicals and paraphernalia from illicit methamphetamine ("meth") drug labs and disposal sites. Response teams average more than four cases each day, and the state's meth problem ranks among the highest in the nation. The number of drug labs reported in Washington State in 2002 – 1,697 -- decreased for the first time since 1995 *(Figure 33)*. Counties with the highest number include Pierce, King, Spokane, and Thurston, and the largest percentage increase in cases occurred in Cowlitz County.

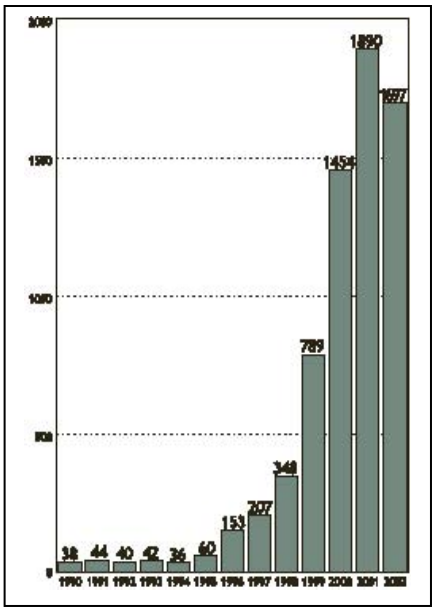


Figure 3-6d: Statewide Reported Drug Labs by Year (1990-2002)

Tools for Success

- Ecology's Spill Program: http://www.ecy.wa.gov/programs/spills or (360) 407-7455.
- For information on resource damage assessments (which pay for repairing environmental damage), see http://www.ecy.wa.gov/programs/spills/preparedness/preparednesstable.htm.
- For interesting stories on near groundings and responses by vessels, Ecology, and other responders, see http://www.ecy.wa.gov/programs/spills/prevention/pasteompom.htm .

- N.W. Straits Commission: http://www.nwstraits.org/nsc.html or call (360)428-1083.
- For information on Puget Sound Marine Protected Areas: http://www.psat.wa.gov/Programs/MPA.htm

3-7 Upland toxics cleanup

Concern

The agency has identified over 9,600 contaminated sites in Washington. Roughly 6,000 of these are the result of an underground storage tank leaking into the environment and contaminating the soil and/or ground water. The mission of the Toxics Cleanup Programs is to get and keep contaminants out of the environment. Contamination at each site is unique and can pose a different type and level of risk to public health and the environment.

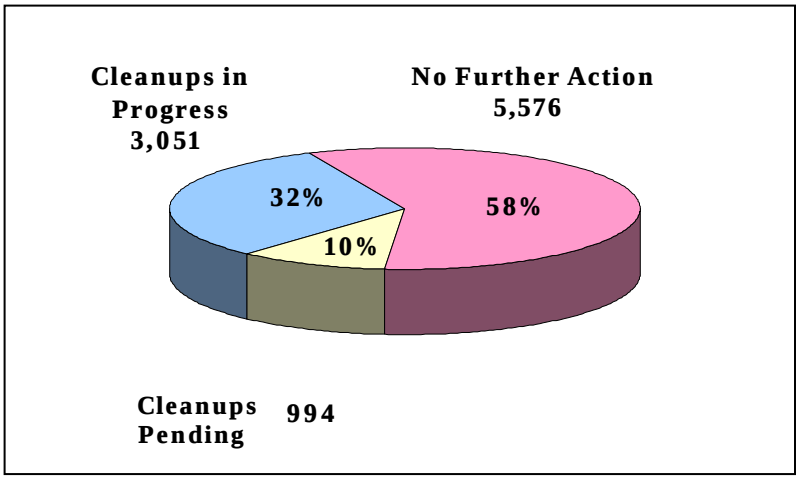


Figure 3-7a: Known and suspected contaminated sites: 9,621 (*as of October 18, 2004*)

For example:

- Soils contaminated by arsenic and covering several miles have been discovered in school playgrounds, parks, and backyards, as well as at industrial facilities.
- Fish and shellfish living near chemically contaminated sediments can retain toxins in their system and expose people to toxins when eaten. Contaminated sediments can also contribute to declining fish populations.
- Contamination can affect drinking water sources and exposes people to chemicals in the water they drink and use at home.

We know cleaning up contaminated sites protects human health and the environment. It's also important to note that restoring contaminated property and putting it back into productive use preserves undeveloped lands and preserves further decline of state resources such as fish and shellfish habitat.

Major activities and results

Clean the Worst Contaminated Sites First (Upland and Aquatic)

The agency protects public health and natural resources by cleaning up and managing contaminated sites on land and in marine sediments. Resources are first focused on cleaning up contaminated land and sediment sites that pose the greatest risk to public health, aquatic resources and the environment. These include sites where contamination threatens drinking water, exists in a large quantity, is very toxic, may affect a water body, or may affect people that are living, working, or recreating near the site. Contamination may be in the soil, sediments, underground water, air, drinking water, and/or surface water. The clean up of these sites protects public health, aquatic habitat, safeguards the environment, and promotes local economic development by making land available for new industries and other beneficial uses, such as shellfish harvest.

Intended results

The most highly contaminated sites are cleaned up, public and environmental health is protected, and sites are ready for redevelopment and job creation.

- Increase the number of sites cleaned up by over 3% annually (includes sites cleaned up voluntarily).
- Increase the number of sites with clean up actions in progress.
- Decrease the number of sites that are awaiting cleanup.
- Increase the number of acres remediated (cleaned up and managed) by 80 over the 2003-05 biennium.
- Increase the sediment acreage evaluated for source control, cleanup, or constructive purposes.

Manage Underground Storage Tanks to Minimize Releases

The agency currently regulates 11,189 active tanks on 4,074 different properties, including gas stations, industries, commercial properties, and governmental entities. This includes working to ensure that tanks are installed, managed, and monitored in accordance with federal standards and in a manner that prevents releases into the environment. This is done through compliance inspections and providing technical assistance to tank owners and operators. Properly managing such tanks saves millions in clean up costs and prevents contamination of limited drinking water and other ground water resources. (Authorizing law - 90.76 RCW)

Result

Underground storage tanks are properly installed, monitored and/or decommissioned to minimize the release of oil, gas, and other toxic materials into drinking water and other underground water sources.

- Decrease the number of reported releases from underground storage tanks over time.
- Increase the number of leaking underground storage sites that are cleaned up or considered "No Further Action."
- Increase the percentage of underground storage tanks inspected that pass operational compliance for leak detection.
- Increase the number of leaking underground storage sites that are cleaned up or considered "No Further Action."
- Increase the percentage of underground storage tanks inspected that pass operational compliance for leak detection.

Services to Site Owners that Volunteer to Clean up their Contaminated Sites

The agency provides services to site owners or operators who initiate clean up of their contaminated sites. Voluntary clean ups can be conducted in a variety of ways: completely

independent of the agency; independent with some agency assistance or review; or with agency oversight under a signed legal agreement (an agreed order or a consent decree). They may be done through consultations, prepayment agreements, prospective purchaser agreements, and brownfields redevelopment. Carrying out the voluntary cleanup program facilitates overall clean up efforts by encouraging site owners to initiate and complete site cleanup. It also minimizes the need to have public funding used for such clean up, and promotes local economic development through new industries and other beneficial uses of cleaned properties. (Authorizing laws - 70.105D, 90.48, and 90.71 RCW)

Result

Contaminated sites are voluntarily cleaned up by site owners and prospective buyers using private funding.

- Increase the number of sites voluntarily cleaned up.
- Increase the number of sites with cleanup actions in progress.
- Decrease the number of sites that are awaiting cleanup.
- Increase the number of determinations made on final clean up reports submitted by parties who voluntarily cleaned up sites.

Tools for Success:

- For cleanup site information, this site includes fact sheets on specific sites, site lists, and program reports: http://www.ecy.wa.gov/programs/tcp/sites/sites.html.
- Voluntary Cleanup Program: Ecology provides services to individuals who volunteer to clean up their contaminated sites. See http://www.ecy.wa.gov/programs/tcp/vcp/Vcpmain.htm.
- Underground Storage Tanks and Leaking Underground Storage Tanks: The agency conducts compliance inspections and provides technical assistance to tank owners. For information see http://www.ecy.wa.gov/programs/tcp/ust-lust/tanks.html.
- Facility Site/Atlas: Here is a mapping program to locate contaminated sites, facilities, and natural geographic features in the state. http://apps.ecy.wa.gov/website/facsite/viewer.htm.
- Here are tools for calculating soil and ground water cleanup levels. http://www.ecy.wa.gov/programs/tcp/tools/toolmain.html.

3-8 Contaminated sediments cleanup

Concern

Puget Sound has the unfortunate legacy of persistent sediment contamination from a range of industrial activities, as well as shipbuilding, naval operations, and polluted runoff from developed areas. Over the past several decades, regulatory controls and industrial practices have succeeded in reducing emissions to air and direct discharges of pollutants to water bodies. However, pollutants do still find their way into the Puget Sound from various outfalls, and as runoff from developed lands. Many of these pollutants do not biodegrade or otherwise break down. In particular, polycyclic aromatic hydrocarbons (PAH), which occur in a variety of soot, coal, tar, cutting fluids, and petroleum products, cause cancer or contain substances that essentially activate or promote the growth of cancerous cells. PAH concentrations are increasing in Puget Sound sediments.

Pollutants that adhere to sediments can directly harm aquatic organisms. These contaminated sediments also can be transferred and accumulate in higher levels of the food chain. As the tiniest bottom-dwelling organisms, such as worms and crustaceans, are eaten by increasingly larger fish and marine mammals, pollutants in their body tissues can increase. Increased body burden of pollutants, in turn, can interfere with the biological functioning of all levels of marine life, including humans who consume contaminated aquatic life such as shellfish, sea cucumbers, and fish.

Current Trends

Contaminated sediment sites are often listed according to what phase of investigation and remedial activity they are in. *Sites not started* have been identified for study and potential action. *Sites being studied* are undergoing initial investigation. *In progress* refers to sites that are anywhere in a process of remedial investigation (identifying risk), feasibility studies in which costs and benefits and potential for commercial development are considered, and cleanup design. *Cleanup and monitoring* refers to sites where cleanup is under way and environmental monitoring is taking place. *No further action* refers to sites in which cleanup and monitoring are complete.

Currently, there are 28 sites not started, 34 sites being studied, 38 sites in progress, 13 sites in cleanup and monitoring, and 20 sites completed (*Figure 16)*. Most of these sites are marine, with a smattering of freshwater sites, and are located in the Puget Sound basin. In many cases, the land is state-owned. More than one-half of the sites are contaminated from industrial activities, including metal fabrication, aluminum smelting, pulp-and-paper operations, wood processing, and petroleum refining. Puget Sound is still one of the largest petroleum refining centers in the United States.

Puget Sound Sediment Quality: Sediment quality indicators (chemical contamination, toxicity, and invertebrate community structure) were measured throughout Puget Sound by Ecology and NOAA from 1997-1999. A Sediment Quality Triad Index was generated that combines the results of these analyses and ranks them into four categories from high to degraded sediment quality.

Sediments in Puget Sound were generally of high quality but almost one-third (31%) of the study area had sediments ranking as only intermediate quality, while 1% of sediments ranked as degraded (Figure 3-8a). Poor and intermediate sediments were most prevalent in the Whidbey, Central Basin, and South Sound regions, with degraded sediments primarily found in Everett Harbor, Elliott Bay, Commencement Bay, and Budd Inlet (Figure 3-8b).

Sediment Quality Triad Index Category	Stations		Area	
	No.	Percent	km^2	Percent
Total Study Area	300	100.0	2363.3	100.0
High Quality	138	46.0	1616.1	68.4
Intermediate/High Quality	85	28.3	627.6	26.6
Intermediate/Degraded Quality	40	13.3	96.5	4.1
Degraded Quality	37	12.3	23.1	1.0

Figure 3-8a: Sediment Quality Triad Index for the entire Puget Sound study area.

Typically, the most highly degraded sediments are found in urban harbor areas near river mouths and along shallow, nearshore areas. While small in area, these locations represent some of the most important biological habitats in Puget Sound. Before modern industrialization and development, these now urbanized harbors and river mouths historically provided critical habitat for many species of marine biota. High levels of PAHs and PCBs have been measured in shellfish, fish, birds, and marine mammals that are associated with the more highly contaminated Central and South Puget Sound regions.

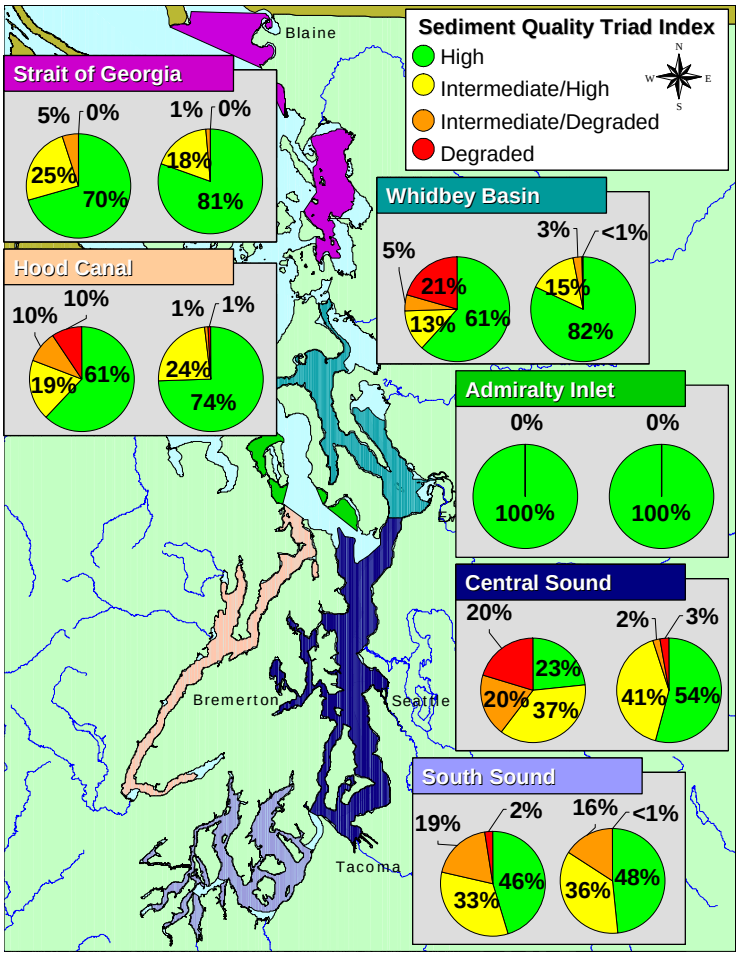


Figure 3-8b: Sediment Quality Triad Index for six Puget Sound monitoring regions.
Percent of stations (left pie chart) and percent of area (right pie chart) representing each index category are depicted for each region.

Tools for Success

- Ecology's sediment management unit: http://www.ecy.wa.gov/programs/tcp/smu/sediment.html and (360)407-6914.
- U.S. Army Corps of Engineers Dredged Material Management Office: (206) 764-3768.
- Pollution Prevention and Technical Resources for Engineering Efficiency: http://www.ecy.wa.gov/programs/hwtr/tree/html.
- The public health assessment for a site on Bainbridge Island by the Centers for Disease Control: http://www.atsdr.cdc.gov/HAC/PHA/kitsap_toc.html.
- Use pervious (porous) surfaces when building. See http://www.greenbuilder.com. Porous surfaces don't lead to the same magnitude of polluted runoff as impervious surfaces and often are more attractive.

3-9 Persistent bioaccumulative toxins (PBTs)

Concern

Persistent, bioaccumulative toxins (PBTs) raise special challenges for our society and the environment because they share common properties:

- They are long-lasting chemicals that break down very slowly when released into the environment.
- As PBTs move up the food chain, they increase in concentration and they can build up in the tissues of animals and people.
- Exposure to PBTs has been linked to a wide range of toxic effects in fish, wildlife, and humans, including effects on the nervous system, reproductive and developmental problems, immune-response suppression, cancer, and endocrine (reproductive system) disruption. Children are especially sensitive to the damaging effect of mercury on the development of their nervous and circulatory systems.
- Damage to children's ability to learn and control their behavior has great social and economic cost.

PBTs can transfer among environmental media: air, land, and water. Many persistent, bioaccumulative and toxic chemicals travel long distances, and stay in the environment for a long time. Due to the long-range transport abilities of some PBTs, these chemicals are present in higher levels in the tissues of people (e.g. Eskimos and other Arctic populations) who have never used these chemicals but have had environmental exposure to them. Some PBTs, such as dioxin, mercury, PCBs, and DDT, have accumulated in animal tissue (especially fish and shellfish) to levels that have led Washington health agencies to issue fish consumption advisories for 15 different water bodies in Washington warning of potential exposure hazards attendant to eating contaminated fish or shellfish. Due to elevated levels of mercury in small-mouth and large-mouth bass through-out Washington, the Department of Health has issued a "state-wide" fish consumption advisory for children and women of child-bearing age.

In addition, several PBTs have concentrated in high enough levels in some of our state's waters and sediments that Ecology has placed these water bodies on a "303D list" which makes the water bodies subject to clean up requirements of the Clean Water Act.

Federal and state regulatory structures have been in place for many years and have been generally successful at regulating the discharge of these chemicals by limiting those discharges to technologically manageable levels. Although these regulations are based on the best science available and on public/legislative discourse and intent, these regulations are designed primarily to address single environmental media: air, land, sediment, or water. Current regulations weren't designed with the issue of cross-media transfer in mind.

Many individual activities result in the release of PBTs into the environment: outdoor burning; the disposal of mercury thermometers, fluorescent lights, and banned pesticide residuals; and many industrial processes.

Current Trends

The Ecology/Health Mercury Chemical Action Plan, completed in 2003, determined that 3,800 to 5,000 pounds of mercury are released into Washington's environment each year from human sources within the state. Mercury pollution comes from land-filling, incinerating, or flushing down the drain a variety of consumer products, mining, coal-power plant emissions, refineries, municipal sewage plants, and other sources. Since mercury discharged to land, air, or water can eventually find its way to lakes, rivers, and the ocean, where it settles into sediments, we need to focus on better waste disposal, management, and recycling of mercury and mercury-containing products. If we do so, mercury pollution can be greatly reduced.

Additional mercury reducing activities included holding several fluorescent lamp recycling events to encourage fluorescent lamp recycling, helping local governments to finance thermometer collection efforts in King, Kitsap, Thurston, Kittitas Counties and in Tacoma, and participating with the Washington State Hospital Association in "Mercury Reduction in Hospitals" seminars to further reduce the use and disposal of mercury-containing products in hospitals. Ecology is also working with the Washington State Dental Association to encourage dental offices to better manage their dental amalgam waste, and other hazardous wastes in the dental office setting.

Since eating fish is the greatest source of mercury exposure for most people (as opposed to breathing mercury or absorbing it though the skin), preventing the entry of mercury into the environment is the best way to reduce mercury exposure that causes health effects. The long-term strategy for reducing exposure to mercury is to lower concentrations of methylmercury in fish by limiting mercury releases into the atmosphere from burning mercury-containing fuel and waste and from other industrial processes. Reducing the use of consumer products that use mercury, trading in mercury-using products for those that don't, also helps to prevent spills that contribute to environmental mercury contamination. Mercury that is released into the atmosphere today may end up on our dinner table tomorrow.

In January 2004, Gov. Locke signed Executive Order #04-01- which directs Ecology to draft a second chemical action plan on toxic flame retardants – known as "polybrominated diphenyl ethers" (PBDEs). The Executive Order also directs Ecology to develop a PBT List in regulation and a process for selecting chemicals from that list to do additional chemical action plans on in the future and to fully

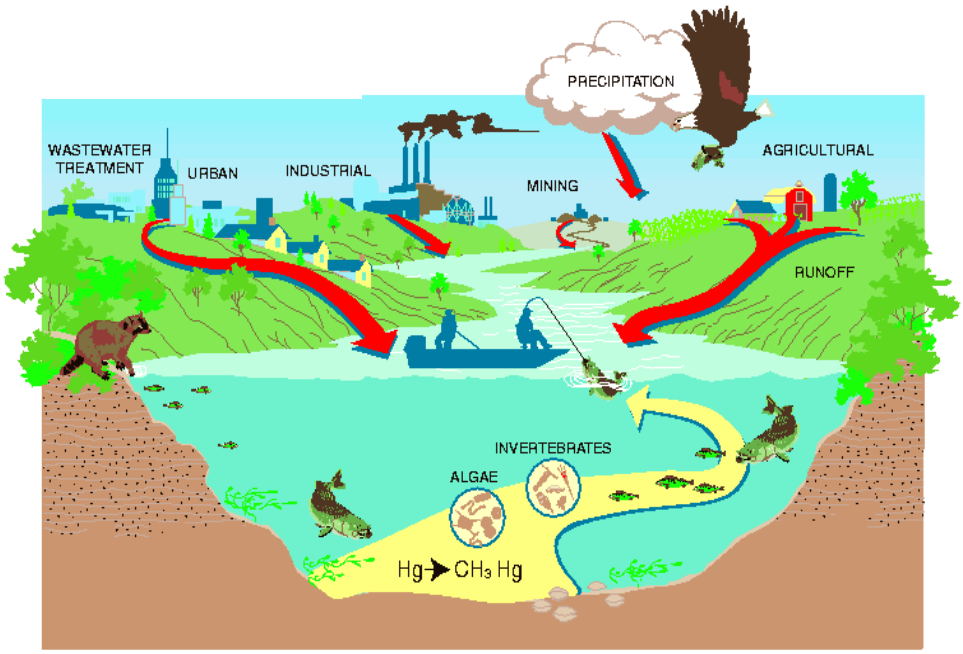


Figure 3-9a The mercury cycle

implement the Mercury Chemical Action Plan to the extent funding is provided. In March 2004, the State Legislature did provide funding to Ecology to move forward with these three projects.

To date, Ecology has completed a draft PBDE Chemical Action Plan and will be releasing a final chemical action plan on PBDEs by the end of 2004. Ecology is also drafting a PBT Rule, which will include a list of PBT chemicals. The draft PBT Rule will be completed by the end of 2004, and undergo public hearings and possibly legislative hearing during Spring 2005, before being finalized in Summer 2005. Implementation of the Mercury Chemical Action Plan is focused on increasing ongoing fluorescent lamp recycling efforts and working with the hospital and auto recyclers to better manage the proper disposal of mercury-containing products in their waste streams.

Tools for Success:

- For more information on the development of the PBT Rule, see: http://www.ecy.wa.gov/programs/eap/pbt/rule/index.html
- For more information on PBDE flame retardants, see: http://www.ecy.wa.gov/programs/eap/pbt/pbde/index.html
- For more information on Ecology's Chemical Action Plan for Mercury, see: http://www.ecy.wa.gov/programs/eap/pbt/mercuryplan.html