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# Watershed Briefing Paper for the Western Olympic Water Quality Management Area

September 1995

Publication No. 95-351

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# Watershed Briefing Paper for the Western Olympic Water Quality Management Area


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September 1995

Water Body Nos. WA-20-0000, WA-21-0000, WA-22-0000, WA-23-0000


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# Executive Summary

## Purpose

The Department of Ecology's Environmental Investigations and Laboratory Services Program (EILS) has reviewed water quality information on the Western Olympic Water Quality Management Area (WQMA). The Western Olympic consists of the watersheds on the western slope of the Olympic Mountains and the entire Chehalis River basin including Grays Harbor.

The purpose of the review is to describe what is known about this region and identify water quality issues that may require monitoring or intensive studies over the next two years. This evaluation is part of an agency-wide scoping and data collection effort being done for the Water Quality Program's Watershed Approach to water quality management, a five-year process culminating in issuing water quality permits and implementing other pollution prevention and control actions.

## Content

This report contains individual briefing papers with information on the following subjects about the Western Olympic WQMA:

Chapter 1. FRESHWATER AMBIENT MONITORING - Temperature, fecal coliform bacteria, turbidity, and nutrient data are analyzed for the Chehalis, Satsop, Humptulips, Quinault, Queets, and Hoh Rivers. Qualitative biological surveys of the Hoh and Humptulips, and limited lakes data are reviewed.

Chapter 2. MARINE WATER AMBIENT MONITORING - Water quality of Grays Harbor estuary is assessed in terms of fecal coliform bacteria, dissolved oxygen (DO), pH, and nutrients.

Chapter 3. TMDLs AND OTHER WATERSHED ASSESSMENTS - An overview is given of intensive studies in a variety of areas including the Chehalis River Total Maximum Daily Load (TMDL) project and Timber/Fish/Wildlife evaluations on the effectiveness of forest practices BMPs.

Chapter 4. SURFACE WATER TOXICS INVESTIGATIONS - Topics include the occurrence of pesticides in streams and chemical contaminants in fish tissue. The issues of Grays Harbor salmon survival and use of Sevin to control burrowing shrimp on oyster beds are discussed.

Chapter 5. GROUND WATER STUDIES - Ground water impacts from fish farms, dairy wastes, and food processing plants in the Chehalis basin are described. Findings of an investigation on interactions between ground water and the Chehalis River are summarized. Data are reviewed on pesticides and nitrate in drinking water wells.

Chapter 6. COMPLIANCE INSPECTIONS - Inspection results and permit status of the 49 facilities currently under NPDES or State waste discharge permits are described.

## Conclusions and Recommendations

### Freshwater Ambient Monitoring

Rivers in the Chehalis basin periodically exceed temperature standards, primarily due to loss of shading on mainstem tributaries. Riparian restoration may alleviate some temperature problems.

The impact of gravel pit operations on stream turbidity, temperature, and biological integrity should be evaluated.

Conduct biological and physical habitat assessments to identify land use impacts on streams of the western Olympic Range and the Chehalis River drainage. Coordinate surface water monitoring activities with Federal and State watershed analysis programs to best evaluate land use and tributary effects.

### Marine Water Ambient Monitoring

Grays Harbor consistently exceeds the Class A standard for fecal coliform bacteria and is classified as "prohibited" (inner harbor) or "conditionally approved" (outer harbor) by the Washington State Department of Health. The contribution of *Klebsiella*, a bacterium associated with wood waste fills, and lumber and pulp mills, should be determined.

Very high concentrations of ammonium-nitrogen are observed sporadically at nearly all Grays Harbor stations and may imply anthropogenic inputs. DO and pH do not appear to be significant water quality problems for the harbor.

### TMDLs and Other Watershed Assessments

Implementation of the Upper Chehalis River and Black River TMDLs (DO, fecal coliform, temperature, and total phosphorus) is the top priority. The keys to success are effective and comprehensive nonpoint source controls, establishing point source control strategies, and finding a basin-wide solution to the overallocation of water.

Other high priority actions in the Chehalis basin include: evaluating nutrient impacts on DO and pH; conducting adequate ambient monitoring and synoptic surveys to evaluate progress on the TMDL; evaluating flows and the impact of low flows on beneficial uses; development of comprehensive GIS coverage in coordination with other agencies, tribes, and organizations; and evaluating metals and other toxic conditions. A detailed list of tasks is provided in the briefing paper.

**Surface Water Toxics Investigations**

With the exception of Grays Harbor, not much data have been collected on the occurrence of toxic chemicals in the surface waters of the Western Olympic WQMA. Due to a lack of definitive water column data, the perception lingers that toxics may be a problem in the inner harbor. Poor ocean survival of Chehalis River coho in recent years clouds the issue of whether water quality has improved.

The primary data need identified is on the potential adverse impacts of pesticides used on cranberry bogs, especially organophosphorus insecticides.

Ecology is part of a recently initiated cooperative effort to develop an integrated pest management plan (IPMP) as an alternative to present applications of Sevin to control burrowing shrimp on oyster beds.

**Ground Water Studies**

A better understanding is needed of the effects on ground water from all types of agricultural related practices. Significant issues so far identified include impacts to ground water from fish farming, dairy waste storage lagoons and land application of dairy wastewater, and land application of wastewater from food processing plants.

Another related issue, not yet investigated, is the disposal of waste from the many sewage treatment plants in the area or leachate from septic systems in the rapidly developing I-5 corridor. Based on study results, pesticides in ground water are not a major concern.

**Compliance Inspections**

Most waste dischargers have not received a Class II Inspection in the last five years, and permits for a number of the minor industrial and municipal dischargers have either expired or are near expiration. Class II Inspections are needed for the following high priority facilities: Industrials - Pacific Power & Light, Centralia Mining Company, Darigold, and National Frozen Foods; Municipals - Hoquiam, Centralia, Chehalis, and Aberdeen.

# Acknowledgements

This report draws on data collected by many of EILS' field staff. Most of the sample analyses were conducted by EILS and EPA chemists at the Manchester Environmental Laboratory.

Ken Dzinbal, Larry Goldstein, and Will Kendra reviewed the report. Final proofreading and formatting was done by Joan LeTourneau. Paul Pickett and Art Larson provided the description of the WQMA on page 1.

# Introduction

## Purpose

The Department of Ecology's Environmental Investigations and Laboratory Services Program (EILS) has reviewed water quality information on the Western Olympic Water Quality Management Area (WQMA). The purpose of the review is to describe what is known about this region and identify water quality issues that may require monitoring or intensive studies over the next two years. The review draws primarily on data collected by EILS.

This evaluation is part of an agency-wide scoping and data collection effort being done for the Water Quality Program's Watershed Approach to water quality management. The Watershed Approach is a five-step, five-year process culminating in issuing water quality permits and implementing other pollution prevention and control actions to respond to priority water quality issues.

## Description of the WQMA

The Western Olympic is one of 23 WQMAs across Washington State and consists of the watersheds on the western slope of the Olympic Mountains and the entire Chehalis River basin including Grays Harbor (Figure 1). Upland areas of the WQMA include the Willapa Hills in the Chehalis River headwaters, the Bald Hills in the eastern Chehalis basin, the Black Hills near Olympia, and the Olympics. Elevations range from almost 8,000 feet at the crest of the Olympics to the ocean shore of Grays Harbor and the Pacific Coast north to Cape Flattery. The Chehalis River basin is about 2,000 square miles in area, making it the second largest watershed in Washington behind the Columbia basin. Grays Harbor is the one major estuary in the WQMA.

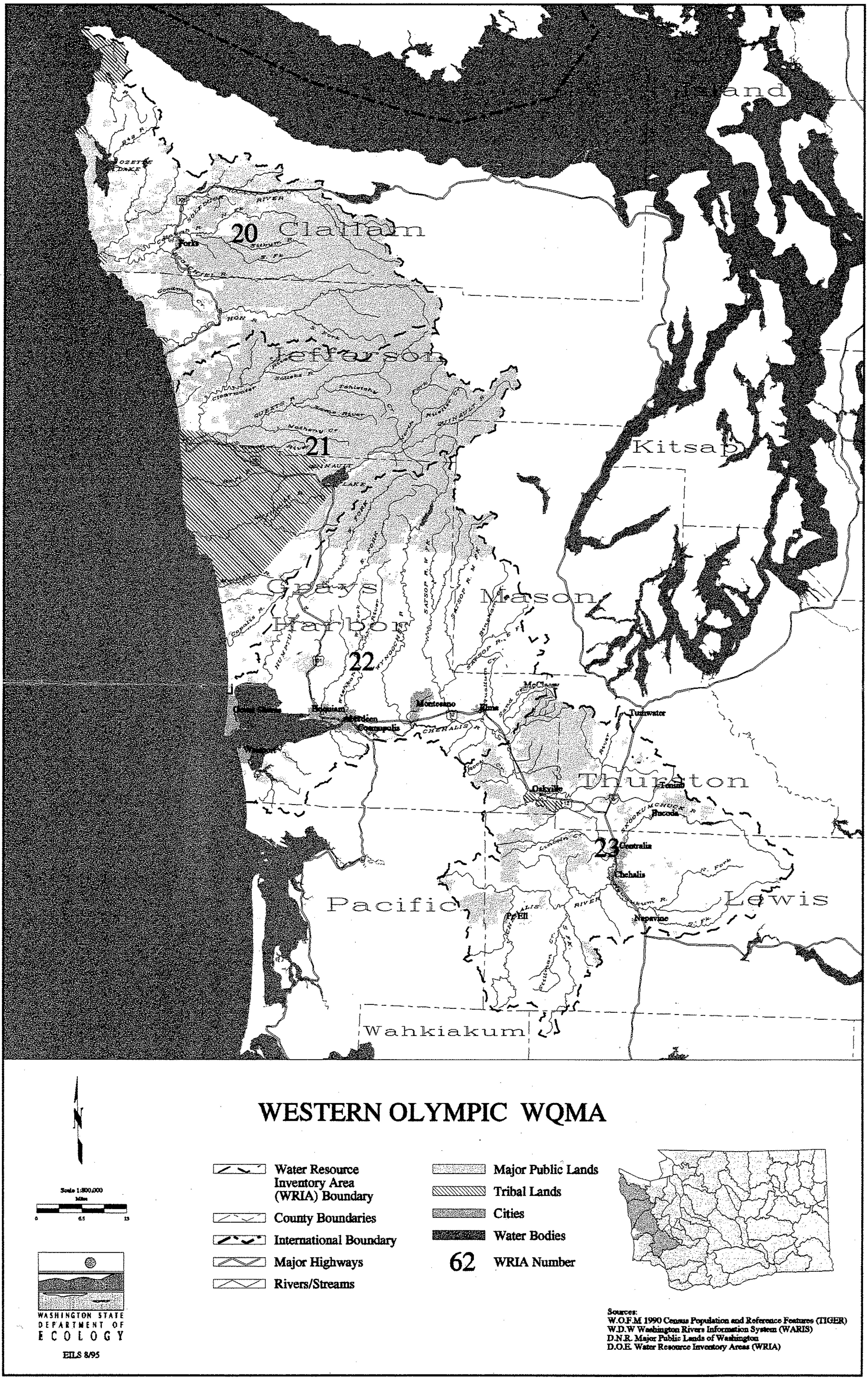
Table 1 lists the major rivers in this WQMA, their basin area, and mean monthly high and low flows. Waters not meeting standards are shown in Appendix A.

Rainfall ranges from over 200 inches per year in the southwest slope of the Olympics to about 45 inches per year in the Chehalis River valley in Lewis and Thurston counties. Almost all the rivers have maximum flows during the late fall and winter. Flows reach their minimum levels in the late summer, mostly supported by ground water inflows. Spring snowmelt contributes only a very small portion of flow in these rivers, except in tributaries draining the high Olympics.

Significant ground water resources are primarily limited to the valleys of major rivers, especially along the Pacific Coast. The coarseness of the glacial outwash materials that constitute the most common aquifer material between Centralia and Grays Harbor makes these aquifers vulnerable to contamination.

Much of this region is timbered and subject to silviculture activities. Stream degradation has occurred in clearcut areas. The Lower Chehalis and Upper Chehalis WRIAs contain the most complex pattern of land uses in the Western Olympic WQMA. Much of the mainstem Chehalis River has slow-moving water and meanders through agricultural land and rural residential development. The Grays Harbor area has significant forest products industries including pulp and paper.

The largest population centers are Centralia and Chehalis, Aberdeen and Hoquiam, and the southwest portions of Olympia and Tumwater. Tribal areas include the Chehalis, Quinault, Hoh, Quileute, Ozette, and Makah Indian Reservations.



WESTERN OLYMPIC WQMA
Clallam
Jefferson
Grays Harbor
Mason
Kitsap
Thurston
Pacific
Lewis
Wahkiakum
20
21
22
23
Forks
Montesano
Elma
McCleary
Tumwater
Oakville
Tenino
Bucoda
Centralia
Chehalis
Napavine
Aberdeen
Hoquiam
Cosmopolis
Westport
Pe Ell
Water Resource Inventory Area (WRIA) Boundary
County Boundaries
International Boundary
Major Highways
Rivers/Streams
Major Public Lands
Tribal Lands
Cities
Water Bodies
62 WRIA Number
Scale 1:800,000
Miles
0
6.5
13
WASHINGTON STATE DEPARTMENT OF ECOLOGY
EILS 8/95
Sources:
W.O.F.M 1990 Census Population and Reference Features (TIGER)
W.D.W Washington Rivers Information System (WARIS)
D.N.R. Major Public Lands of Washington
D.O.E. Water Resource Inventory Areas (WRIA)

Table 1. Western Olympic WQMA Rivers with Drainage Area and Mean Monthly High and Low Flows (Paul Pickett)

| River Name | Area ($mi^2$) | Gage Location | Mean Monthly Low Flow (cfs) | Mean Monthly High Flow (cfs) |
|---|---|---|---|---|
| Chehalis | 113 | @ Doty | 48.5 (Aug) | 1256 (Jan) |
| South Fk Chehalis | 125 | @ Boistfort | 7.4 (Aug) | 473 (Jan) |
| Newaukum | 158 | nr Chehalis | 54.5 (Aug) | 1124 (Jan) |
| Skookumchuck | 181 | nr Bucoda | 82.3 (Aug) | 894 (Jan) |
| Chehalis | 895 | nr Grand Mound | 234 (Aug) | 6560 (Jan) |
| Black | 136 | | | |
| Chehalis | 1294 | @ Porter | 398 (Aug) | 10113 (Jan) |
| Satsop | 299 | nr Satsop | 329 (Aug) | 4202 (Jan) |
| Wynoochee | 185 | abv Black Ck nr Montesano | 242 (Aug) | 3033 (Dec) |
| Wishkah | 102 | | | |
| Hoquiam | 90 | | | |
| Humptulips | 245 | nr Humptulips | 246 (Aug) | 2750 (Dec) |
| Quinault | 434 | @ Quinault Lk | 964 (Aug) | 4848 (Dec) |
| Queets | 449 | nr Clearwater | 1015 (Aug) | 8086 (Dec) |
| Clearwater | 153 | nr Clearwater | 173 (Aug) | 2435 (Dec) |
| Hoh | 299 | @ U.S. Hwy 101 nr Forks | 1321 (Sept) | 4245 (Dec) |
| Quillayute | 629 | | | |
| Dickey | 108 | | | |
| Bogachiel | 287 | | | |
| Soleduck | 226 | nr Fairholm | 164 (Aug) | 1206 (Dec) |

# Chapter 1. Freshwater Ambient Monitoring

by

Rob Plotnikoff
Ambient Monitoring Section

## Introduction

Drainages that comprise the Western Olympic WQMA are among the most scenic and variable within a small geographical area of the state. Distinct names identifying major rivers of this region add to its mystique. Translation of the names Soleduck, Hoh, Queets, Quinault, Humptulips, and Chehalis reflect the Native American heritage along the banks of these rivers as well as their importance to the livelihood of earliest and then later inhabitants.

Physical, climatological, and water source characteristics of drainages within the Western Olympic WQMA vary throughout this geographic region. Tributaries of the larger mainstem rivers flow through steep, bedrock formations. These tributaries can have extremely high gradients and are contrasted by meandering and slightly "tea"-colored streams. Mainstem rivers are mainly low gradient, meandering and, in some cases, will have braided channels. Presence of water is preserved throughout the year in these large mainstem rivers by tributaries, rainfall, and glacial snowmelt.

Climate patterns range from 50 inches of annual rainfall in the Chehalis River basin to over 200 inches in the Hoh River basin (Henderson et al., 1989). Intensity and frequency of rainfall influence the physical condition of channels and the biological communities that depend on this habitat. The source of water that sustains flow in these drainages is premier in defining conditions under which stream biology can exist. Sources for surface water flow in the Western Olympic drainages are glacial snowmelt, surface runoff from precipitation, ground water, and rain-on-snow events. Unique combinations of these water sources that supply streams and rivers occur during characteristic periods of the year.

## Basin Characteristics

The primary land use activity in the Soleduck-Hoh and Queets-Quinault water resource inventory areas (WRIAs) is forest practices. In many cases forested land tracts have been harvested two or three times. Stream degradation has occurred in clearcut areas. Excessive erosion occurs when steep-sided slopes cannot contain the volume of water entering the stream. Availability of woody debris in the stream channel and retention of water on the hillslopes are important characteristics of a drainage that may prevent immediate signs of land use impact. Degraded streams in these WRIAs exhibit excessive woody debris piles that create an impassable barrier to migrating salmon or very little woody debris due to flash floods.

Land in the lower basin of the Soleduck-Hoh and Queets-Quinault WRIAs are predominantly state managed (Department of Natural Resources) and federally managed in the upper basin areas (United States Forest Service and Olympic National Park). Forest practice activity is most prevalent in the lowermost portion of each drainage area.

The Lower Chehalis and Upper Chehalis WRIAs contain the most complex mosaic of land uses in the Western Olympic WQMA. Land ownership is predominantly private with limited state holdings in the Capitol State Forest. United States Forest Service manages land in the upper areas of the Lower Chehalis WRIA. Much of the mainstem Chehalis River has slow-moving water and meanders through pastoral land. Agricultural land use dominates the valley bottoms of the Chehalis River drainage. Livestock operations and crop production are prevalent agricultural activities.

Effluent discharges into the river are contributed by some industrial sources (e.g., agriculture, forest practice, and municipal wastewater treatment plants). Lands at higher elevations in the drainage are managed for timber production. An increasing pressure from residential development represents permanent change to hydrologic characteristics of some tributaries in the Chehalis River drainage.

## Available Ambient Monitoring Information

The Department of Ecology's Ambient Monitoring Section (AMS) has surface water information available beginning Wateryear (WY) 1960 to the present. Locations of ambient monitoring stations within the Western Olympic WQMA are found in Figure 1. The Soleduck-Hoh River basin (WRIA 20) contains four historical and current monitoring stations (Table 1). Most of the information gathered from these stations is greater than ten years old. The Hoh River at DNR Campground station had recently been designated a long-term monitoring location in WY 1994.

The Queets-Quinault River basin (WRIA 21) contains six historical and recently monitored sites. Queets River at Queets and the Quinault River at Lake Quinault have had the most recent data collected (WY 1994) from any stations in this WRIA. Remaining information from other sites is limited by length of collection effort.

Lower Chehalis (WRIA 22) and Upper Chehalis (WRIA 23) sub-basins contain nine and twelve monitoring stations, respectively. There are several sites at which long-term information has been collected in both sub-basin areas. Three stations -- Humptulips River near Humptulips, Chehalis River near Montesano, and Satsop River near Satsop -- have the longest collection efforts in the

Lower Chehalis region. Upper Chehalis monitoring sites with the longest period of data collection are: Chehalis River at Porter, Chehalis River at Centralia, and Chehalis River at Dryad.

A combination of seven stations were chosen from these WRIAs for further analysis. These stations represent the variety of stream water quality conditions that occur in the Western Olympic region. Comparison of water quality variables among streams in each WRIA provides a basis for understanding natural processes or identifying anthropogenic degradation in a drainage.

**Chehalis River Mainstem Stations**

Maximum temperatures for each month at three mainstem Chehalis River stations follow a seasonal pattern (Figure 2). The uppermost station (Chehalis River at Dryad) reaches a maximum temperature one month earlier than the two lower mainstem stations. Flow volume is lower in the upper reaches of the Chehalis basin and responds more quickly to the influence of warming or cooling by ambient air temperatures. The two lower mainstem stations (Chehalis River at Porter and Chehalis River at Centralia) take one month longer to reach their temperature maxima and begin a cooling trend one month later from the response of surface water at the upper basin station.

Fecal coliform bacteria were at maximum concentrations in surface waters during spring and fall seasons (Figure 3). The highest fecal coliform concentrations were recorded at the lower mainstem stations. Fecal coliform contaminants exceeded the criterion at two stations (Chehalis River at Porter and Chehalis River at Centralia) during most months of the year. The highest bacterial contaminant level at the uppermost station was primarily during the fall season.

**Hoh River at DNR Campground**

Limited water quality information was available from the Hoh River sampling station. Surface water temperature was chosen to describe the seasonal influence on Hoh River water quality. This drainage originates on the north side of Mount Olympus and has a baseflow contributed by glacial snowmelt. Water temperatures never exceed the Class AA criterion. Warm air temperatures that increase water temperature in the river during June through August do not persist long enough to heat the near- freezing headwaters.

**Humptulips River near Humptulips**

Water temperatures in the Humptulips River do exceed its Class A criterion during July and August (Figure 4). An extensive data collection effort at this station accounts for variability of environmental conditions over a long time period. Resulting water temperature exceedances indicate the vulnerability of this river to periodic drought. A combination of low flow and warmer than normal air temperatures can cause excessively warm water temperatures. In contrast to rivers that have their baseflow water source from glaciers, ground water baseflow in the

Humptulips River drainage is initially warmer and takes less energy to raise surface water temperatures.

**Satsop River near Satsop**

The Satsop River mainstem has not experienced any documented surface water temperature problems. Water temperature observations are analogous to those of the nearby Humptulips River during all months of the year except July and August. Water source for baseflow in the Satsop River drainage is ground water during the summer months. Two factors may account for the water temperature compliance in the mainstem of the Satsop River: 1) frequent, well-shaded pools along the river's length, and 2) contribution of cooler water from one or more of the major "forks" in this drainage.

**Quinault River at Quinault**

A limited number of water quality observations are available for this Quinault River station, but represents a unique baseflow water source condition. The Quinault River is a Class AA water and has a water temperature criterion of sixteen degrees celsius. Water temperatures measured during the months July, August, and September have all exceeded this water quality standard. This station is located within one-half mile of Lake Quinault, the water source for the lower river. Surface water temperature in the lake likely warms beyond sixteen degrees celsius. Water quality characteristics at this Quinault River station are reflective of the lake surface water quality.

**Water Quality Contrasts**

Three streams in the Western Olympic WQMA were compared by examining three water quality variables: turbidity, total phosphorus, and nitrate+nitrite-nitrogen. Monthly maximums were compared during the same monitoring period at the Hoh River, Satsop River, and Chehalis River. Turbidity observations were generally the same among all stations except during the winter months. High turbidity measurements were recorded in December at the Hoh River and in January at the Satsop River (Figure 5). Heavy precipitation events that normally occur during the winter supply higher loads of erosional material to these stream channels. The predominantly mountainous terrain in which the Humptulips River and Satsop River are set partially explain why erosion is a primary influence on water quality.

Nutrient variables among the three stations had similar concentration patterns. Monthly total phosphorus and nitrate+nitrite-nitrogen concentrations were consistently high at the Chehalis River station and lowest at the Hoh River station. Peak total phosphorus concentrations at Chehalis River at Porter occurred during heavy precipitation events. Both nutrient variables increased at the Chehalis River and Hoh River during December. Overland runoff from precipitation must mobilize nutrient-laden materials and deposit them in tributaries and directly into the mainstem rivers.

**Biological Condition of Streams**

Qualitative biological surveys were conducted in the Humptulips River and Hoh River. Aquatic insects (benthic macroinvertebrates) were collected or examined periodically during the sampling period beginning October 1994-September 1995. Most notably, emergence patterns (transition from aquatic dweller to terrestrial inhabitant) of aquatic insect communities identified two general stream conditions. Timing for emergence of aquatic insects is determined by water temperature, growth rate, and food availability (Hynes, 1970).

When cooler water temperatures prevail, such as in the Hoh River, aquatic insect communities may develop slowly and infrequently emerge from the stream as adults. Fully developed and emerging insects were observed earlier in the Hoh River than in the Humptulips River. The emergence pattern of Hoh River aquatic insects suggests that water temperature limits the optimal growth period for several species resulting in a single emergence period.

In contrast, the Humptulips River does have high water temperatures during a portion of the year and this condition may facilitate growth rate. Multiple generations of insect species are able to appear annually in this drainage. Further activities in this drainage that would increase water temperature to beyond criterion levels may alter life cycles of the present community. Changes in the aquatic insect community can be detrimental to the survival of salmonid predators who survive on this food source during specific portions of their life cycle.

**Lakes Monitoring**

Relatively few lakes have been surveyed by AMS in the Western Olympic WQMA. Lakes for which data are available are located in the lower and upper Chehalis River areas. The following summary details what is known about lake condition in this region.

There are three lakes that have been monitored. Duck Lake, in Grays Harbor County, is a eutrophic lake near the Pacific Ocean in Ocean Shores. A phase I study has been conducted on this lake and plans for restoration have been approved. This lake is a high priority lake for restoration (1994 Statewide Water Quality Assessment Lakes Chapter, 305(b) report). Nahwatzel Lake, in Mason County, is an oligotrophic lake and is bordered by privately owned timber land along approximately one-third of its shoreline. Lake Carlisle, in Lewis County, is a small, shallow man-made eutrophic lake located in Onalaska.

## Conclusions and Recommendations

- Rivers in the upper and lower Chehalis River basin periodically exceed temperature standards. Most of the exceedances can be attributed to loss of effective shading on tributaries to the mainstem. Riparian restoration may alleviate temperature problems in some portions of the Chehalis basin.

- Although the larger coastal rivers of the Western Olympic drainages do not appear to have water temperature problems, a number of creeks are water quality limited for temperature (Appendix A).

- Gravel pits may be influential in raising turbidity and surface water temperatures. Evaluation of gravel pit operations on receiving waters would indicate the severity of physical impacts. Physical impacts have a strong influence on the biological integrity of a stream. Biological assessments should be conducted to directly measure any loss of beneficial uses in the receiving water.

- Coordinate surface water monitoring activities with Federal and State watershed analysis programs. Identify upper drainage and lower drainage stations to evaluate land use and tributary effects.

- Conduct biological assessments on stream reaches that are representative of land use impacts in the Western Olympic and Chehalis River drainages. Identify physical habitat alterations that have resulted from human activities. Use the description of biological condition to identify physical impairment of streams where surface water quality information fails to show obvious changes.

## References

Henderson, J.A., D.H. Peter, R.D. Lesher and D.C. Shaw, 1989. Forested Plant Associations of the Olympic National Forest. USDA Forest Service, Pacific Northwest Region. R6-ECOL-TP 001-88.

Hynes, H.B.N., 1970. The Ecology of Running Waters. Liverpool University Press, Liverpool, England. 555 pp.

Table 1. Rivers and streams monitored by the Ambient Monitoring Section in the Western Olympic Water Quality Management Area.

| Station No. | Name | Wateryears Sampled | Sampled in 1995 |
|---|---|---|---|
| **WRIA 20** (Soleduck-Hoh) | | | |
| 20A090 | Soleduck R nr Forks | 1972-74, 1994 | |
| 20A130 | Soleduck R nr Fairholm | 1960-67, 1969-70 | |
| 20B070 | Hoh R @ DNR Campground | 1960-70,1972-74, 1978-80, 1994 | X |
| 20C070 | Ozette R @ Ozette | 1959-61 | |
| **WRIA 21** (Queets-Quinault) | | | |
| 21A070 | Queets R @ Queets | 1960-70, 1972, 1994 | |
| 21A080 | Queets R nr Clearwater | 1978-85 | |
| 21A090 | Queets R abv Clearwater | 1973-74 | |
| 21B090 | Quinault R @ Lake Quinault | 1959-60, 1964-70, 1972-74, 1978-80, 1994 | |
| 21C070 | Clearwater R nr Queets | 1973-74 | |
| 21D070 | NF Quinault R @ Amanda | 1971-85 | |
| **WRIA 22** (Lower Chehalis) | | | |
| 22A070 | Humptulips R nr Humptulips | 1959-70, 1972-74, 1978-94 | X |
| 22B070 | WF Hoquiam R nr Hoquiam | 1963-67, 1973-74, 1994 | |
| 22C050 | Chehalis R nr Montesano | 1971, 1978-92 | |
| 22C070 | Chehalis R nr Fuller | 1971, 1975 | |
| 22D070 | Wishkah R nr Wishkah | 1963-67, 1973-74, 1977 | |
| 22F090 | Wynoochee R nr Montesano | 1959-67, 1969-70, 1973-74, 1977 | |
| 22G070 | Satsop R nr Satsop | 1960-71, 1975, 1977-91, 1993 | |
| 22H070 | Cloquallum Cr nr Elma | 1962-65, 1972, 1975, 1977 | |
| 22J070 | Wildcat Cr nr McCleary | 1971 | |
| **WRIA 23** (Upper Chehalis) | | | |
| 23A070 | Chehalis R @ Porter | 1959-73, 1975-94 | X |
| 23A110 | Chehalis R @ Galvin | 1972, 1975, 1977 | |
| 23A120 | Chehalis R @ Centralia | 1978-91, 1993 | |
| 23A140 | Chehalis R @ Adna | 1972, 1975, 1977 | |
| 23A160 | Chehalis R @ Dryad | 1959-66, 1978-94 | X |
| 23B050 | Newaukum R @ Mouth | 1993 | |
| 23B070 | Newaukum R nr Chehalis | 1960-67, 1973, 1975, 1977 | |
| 23B090 | SF Newaukum R @ Forest | 1975 | |
| 23C070 | NF Newaukum R @ Forest | 1975 | |

Table 1 (Continued). Rivers and streams monitored by the Ambient Monitoring Section in the Western Olympic Water Quality Management Area.

| Station No. | Name | Wateryears Sampled | Sampled in 1995 |
|---|---|---|---|
| **WRIA 23** (Continued) | | | |
| 23D055 | Skookumchuck R @ Centralia | 1993 | |
| 23E070 | Black R @ Moon Rd Bridge | 1990-91, 1993 | X |
| 23F070 | Mill Cr nr Bordeaux | 1993 | |

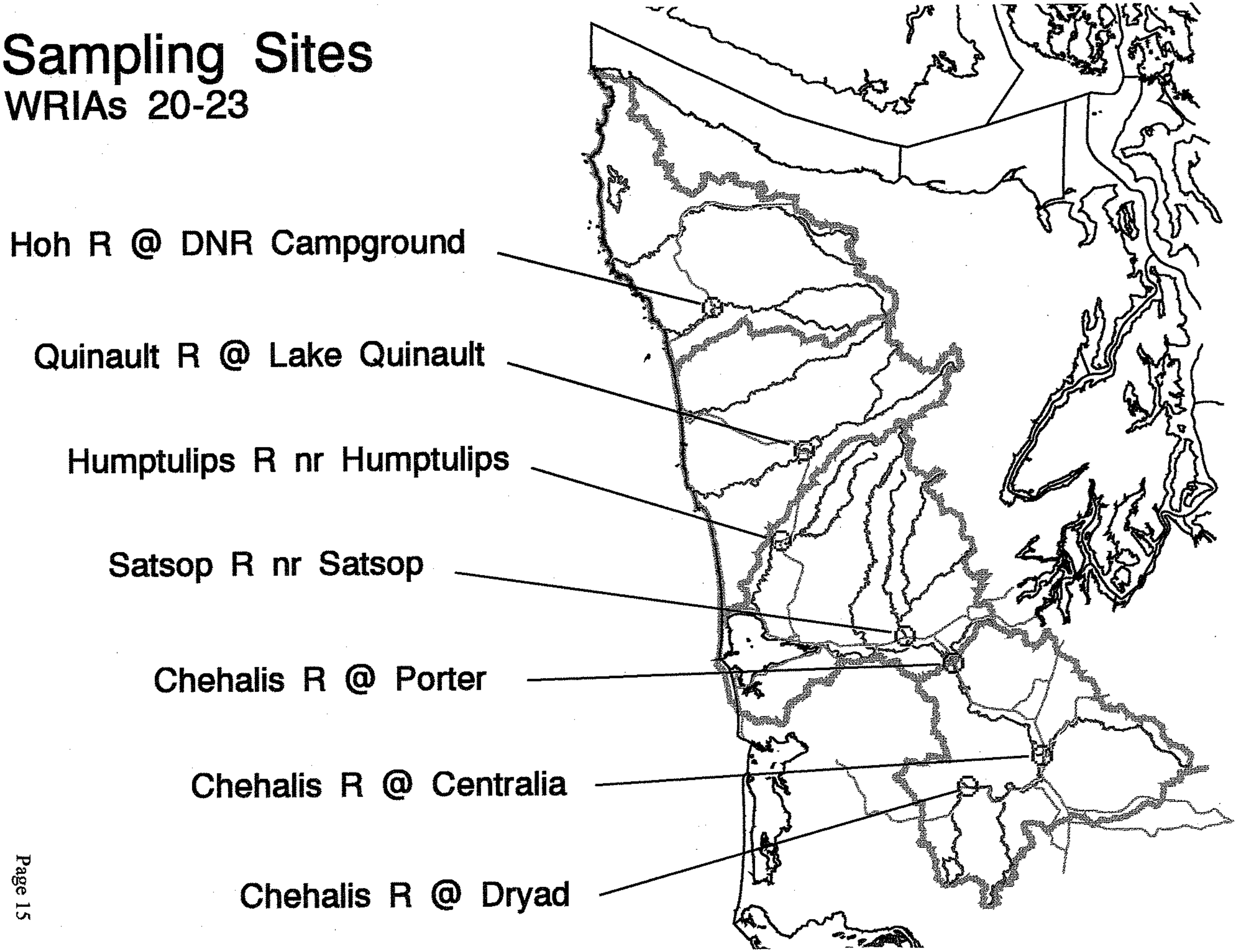



Figure 1. Drainages comprising the Western Olympic Water Quality Water Resource Inventory Areas.

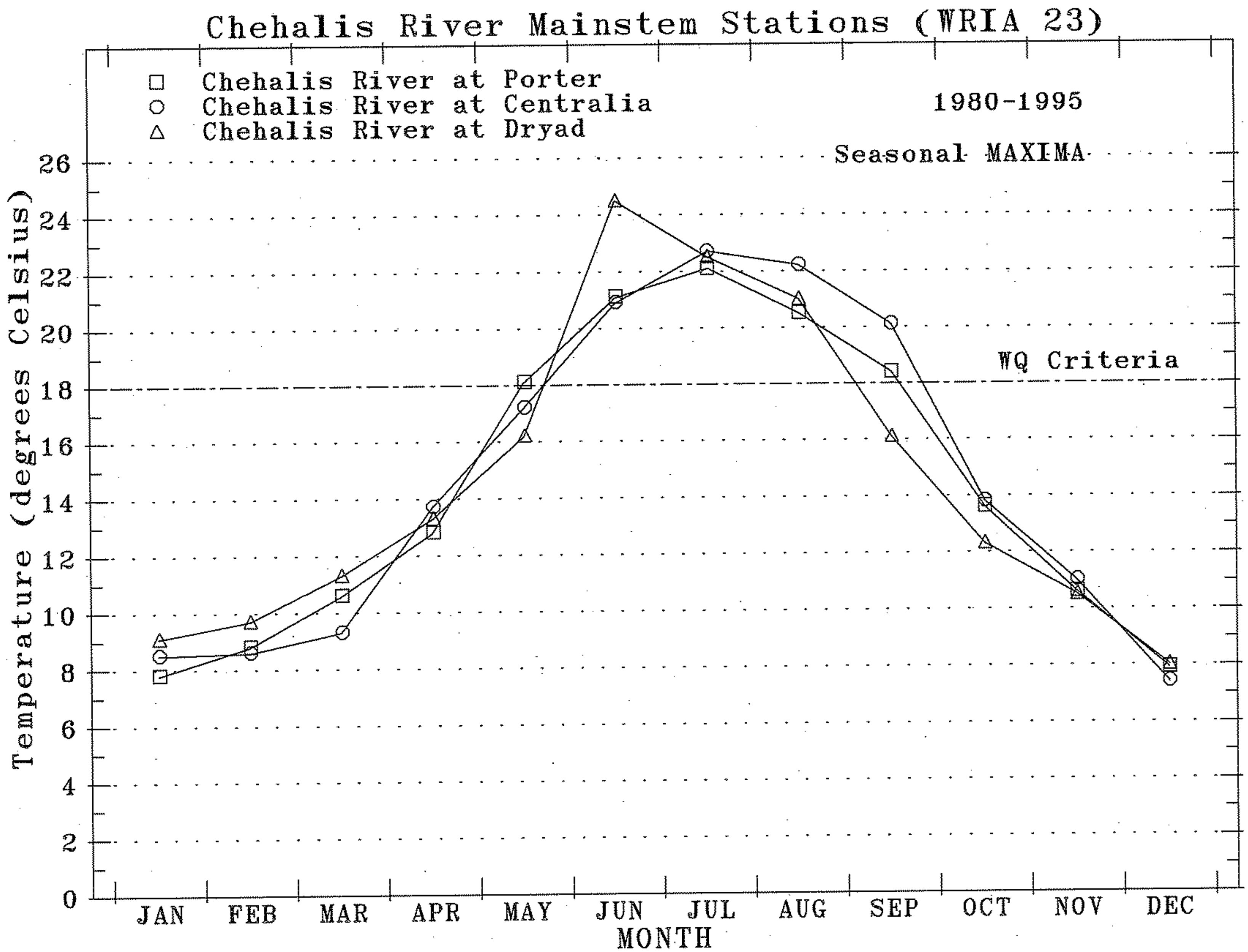



Figure 2. Maximum monthly temperature relationships among three Chehalis River mainstem stations.

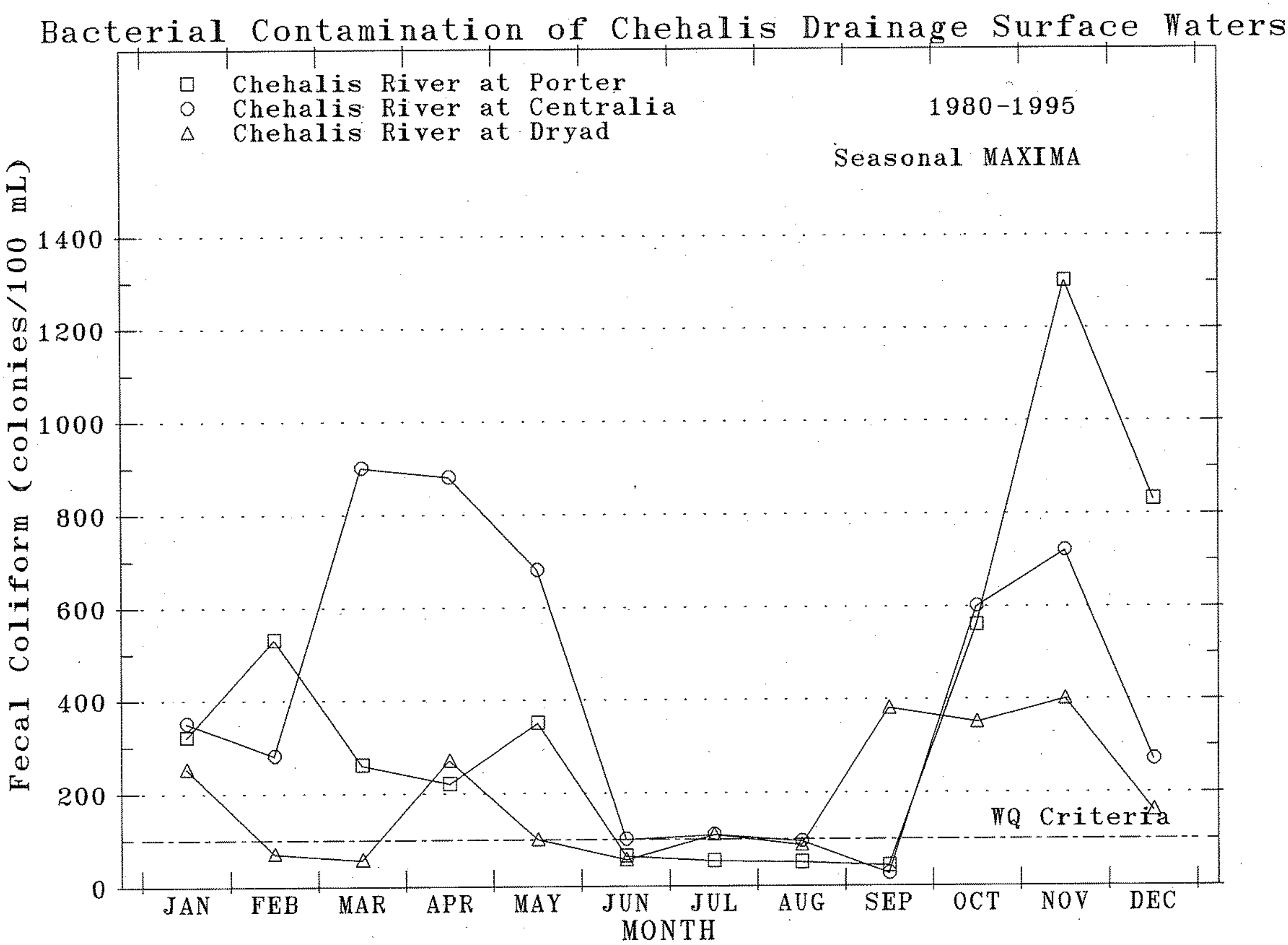



Figure 3. Maximum monthly fecal coliform bacterial concentrations among three Chehalis River mainstem stations.

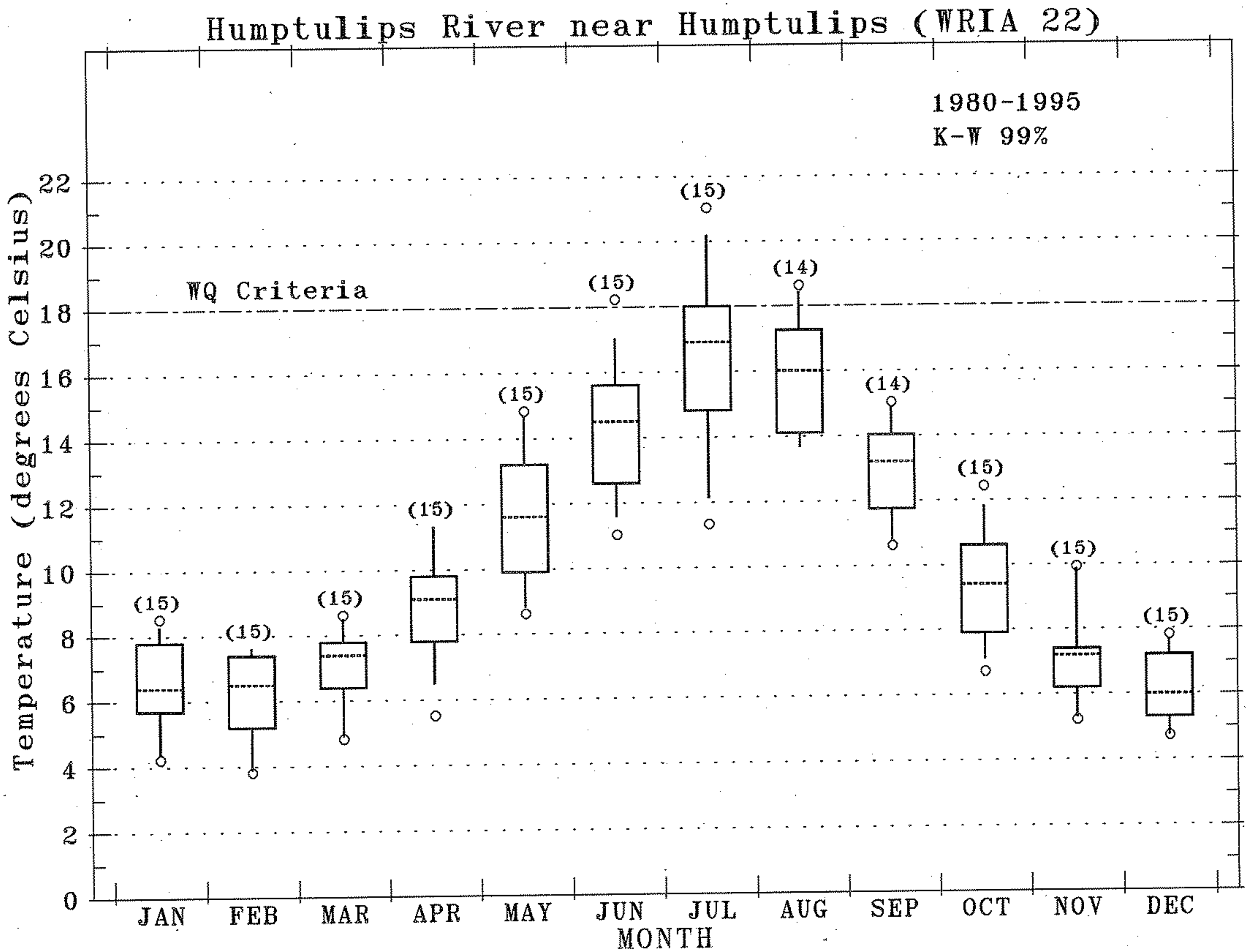



Figure 4. Surface water temperature information collected from the Humptulips ambient monitoring station.

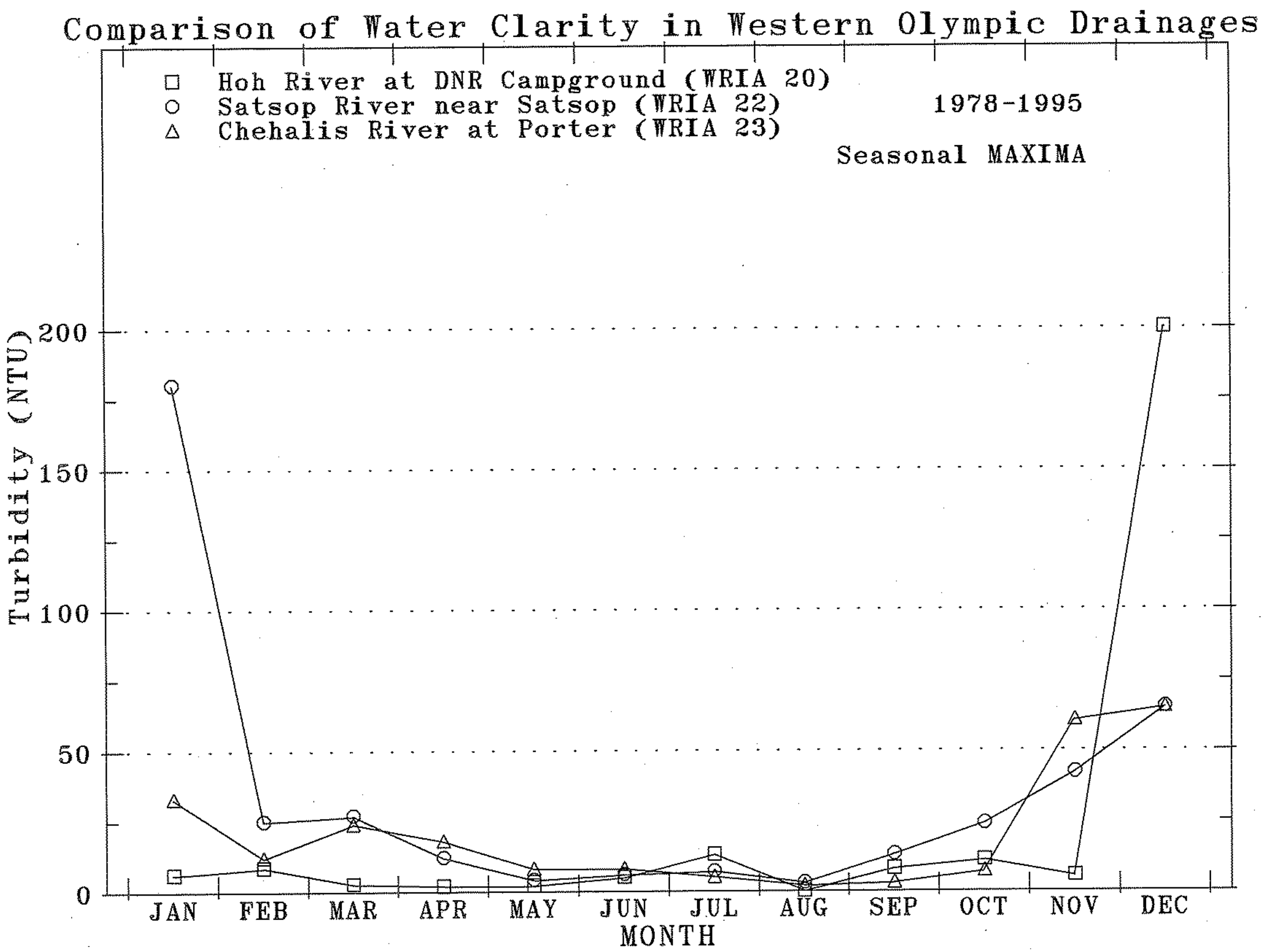



Figure 5. Comparison of monthly turbidity values collected at three ambient monitoring stations in the Western Olympic Drainage.

# Chapter 2. Marine Water Ambient Monitoring

by

Jan Newton and the
Marine Water Monitoring Team
Ambient Monitoring Section

## Introduction

The Marine Water Monitoring program of the Ambient Monitoring Section is responsible for monitoring the marine waters of Puget Sound and the coastal estuaries Grays Harbor and Willapa Bay. The Western Olympic region includes marine water monitoring stations from Grays Harbor only. Ecology does not monitor the outer Pacific Ocean coast.

Station coordinates and the data record for all stations sampled by the Marine Water Monitoring Team in Grays Harbor are listed in Table 1. The types of marine water column data available from Ambient's database for both the historical and current stations are listed in Table 2. Although the data collected from a particular station have not always included all of the parameters in Table 2, temperature, salinity, and Secchi disk depth have consistently been collected. Methods for monitoring are found in Janzen (1992), as modified by Newton (1995).

The Grays Harbor estuary receives marine water input from the Pacific Ocean and freshwater input from the Chehalis River as well as several other rivers. Depending on the location within the estuary and the degree of tidal and wind mixing, the oceanic and fresh waters are either density-stratified or homogeneously mixed. Conditions within the harbor can vary substantially and rapidly, due to large variations in tidal, wind and density-driven forces. Because the estuary is relatively shallow, these variations can have significant impact. In this review, highlighted are observations on Grays Harbor water quality based on fecal coliform bacteria, DO, pH, and nutrient data.

## Data Review

### Fecal Coliform Bacteria

While Grays Harbor waters are rated class A (WAC, 1992), the waters consistently exhibit high fecal coliform bacteria counts, substantially in excess of the WAC standard (Figure 1). The Washington Department of Health classifies inner Grays Harbor as "prohibited" and outer Grays Harbor as "conditionally approved" for commercial shellfish growing based on their assessment of water quality surveys and human uses within the estuary. Inner harbor waters are 303(d) listed for fecal coliform bacteria (Appendix A).

Because the estuary is a mix of fresh and marine water, the proper fecal coliform bacteria standard to apply can be argued. However, regardless of whether 14 org./100 mL (marine standard) or 200 org./100 mL (freshwater standard) is used, excursions are frequent and widely distributed within the estuary (Figure 1). Even at the most freshwater influenced station, GYSOO4, many counts over 200 have been recorded. Only at GYSO16, the station farthest seaward on the northern shore, has the marine standard not been exceeded.

The contribution from the bacteria *Klebsiella* to these counts should be determined. These fecal coliforms can persist in wood waste fills, and lumber and pulp mills, and may not indicate direct sewage input. Such sources are located in Grays Harbor.

**Dissolved Oxygen**

Although the DO standard for class A waters is set at 6.0 mg/L (WAC, 1992), there is no known harm to marine organisms from DO concentrations below 6.0 but above 5.0 mg/L. A few excursions below the class A DO standard have been observed in Grays Harbor; however, DO concentrations below 5.0 mg/L have been exceedingly rare (2 observations in the entire database) and were not severe (4.6 and 4.9 mg/L). The shallow depth of the estuary allows wind mixing to occur that can aerate the water column. Density stratification is not strong enough to prevent this process at all times.

**pH**

The 303(d) list reports 7 excursions beyond criteria at GYSOO4. Only one of these was significant, at 4.4. Such a low pH probably indicates a anthropogenic influence, but the lack of repeated observations suggests that a water quality problem is not prevalent, at least during the times we have monitored. The other pH excursions were all >6.5 and represented times when freshwater influence was evident. The freshwater pH standard is 6.5, so these excursions are probably not of concern.

**Nutrients**

There have been very high dissolved ammonium-N concentrations (>0.20 mg/L) observed sporadically at nearly all the Grays Harbor stations (GYSOO4, GYSOO6, GYSOO7, GYSOO8, GYSOO9, and GYSO15). Ammonium-N is preferred by phytoplankton and is, thus, rapidly taken up in marine waters. Typically, the maximum ammonium-N concentration of Pacific Ocean water is quite low, at about 0.03 mg/L (e.g., Landry et al., 1989). Higher concentrations usually imply anthropogenic inputs. The observations were frequently during summer months, though nearly all months were represented.

## Miscellaneous Notes

We have no data regarding chemical contaminants (e. g., pesticides, metals) in the water column. Agricultural and industrial practices may contribute these contaminants, but these have not been monitored for. Water quality problems due to chemical contamination may be present (see Chapter 4. Surface Water Toxics Investigations).

The occurrence of harmful or toxic phytoplankton in these waters is not well-documented. To some extent the lack of data indicates a lack of outbreaks, but it also indicates a lack of monitoring. Samples from Westport have been recently analyzed through the Washington Department of Health and have shown the presence of some toxic species (R. Horner, UW, pers. comm.). Samples from farther inside the estuary have not been obtained.

## References

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Landry, M.R., J.R. Postel, W.K. Peterson, and J. Newman, 1989. Broad-scale distributional patterns of hydrographic variables on the Washington/Oregon shelf, p. 1-40. *In*: M.R. Landry and B.M. Hickey [eds.], Coastal Oceanography of Washington and Oregon. Elsevier, New York.

Newton, J.A., 1995. Marine Water Column Ambient Monitoring Wateryear 1995 Longterm Monitoring Implementation Plan. Publication No. 95-324, Washington State Department of Ecology, Olympia, WA.

Table 1. Marine water column data available from the Ambient Monitoring Section for Western Olympics. An "X" denotes monthly data, although parameters sampled, methods and sampling design has varied to some extent (Table 2). Continuous profiles and winter data were not obtained until WY 1989.

| Station Number | Station Name | Latitude (deg min N) | Longitude (deg min W) | WY: 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Grays Harbor** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GYS004 | Chehalis R. | 46 58.7 | 123 47.0 | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| GYS006 | E. Rennie Island | 46 57.4 | 123 50.5 | | | | | X | X | X | X | X | X | | | | | | | | | | | | | |
| GYS007 | N. Ch. Rayonier | 46 58.1 | 123 52.3 | | | | | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | |
| GYS008 | Mid-S. Channel | 46 56.3 | 123 54.7 | | | X | X | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| GYS009 | Moon Island Reach | 46 57.9 | 123 56.9 | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| GYS014 | At the Bar | 46 55.5 | 124 07.0 | X | X | X | X | | | | | | | | | | | | | | | | | | | |
| GYS015 | N. Whitcomb Flats | 46 55.4 | 124 04.5 | | | | | | | | | | X | X | X | X | X | X | X | | | | X | X | X | X |
| GYS016 | Damon Point | 46 57.2 | 124 05.5 | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X | X |

Table 2. Data available from the Ambient Monitoring Section. The field name, EPA STORET parameter code, units, and parameter name are listed below. Not all parameters are sampled at every station. Typically, parameter values are available for 0, 10, and 30 m (exceptions are fecal (0 m), pigments (0, 10 m), Secchi disk depth, and stations shallower than 30 m).

| DBFIELD | PCODE | UNITS | NAME | |
|---|---|---|---|---|
| ***Physical parameters:*** | | | | |
| TEMP | P10 | °C | temperature* (also contains stn #, date, time, and depth) | |
| SALIN1 | P480 | ppt | salinity*† | (Oct 1986 - present) |
| SALIN2 | P70305 | mg/L | salinity† | (1973 - Sep 1986) |
| COND | P95 | µmhos | specific conductivity | |
| *light:* | | | | |
| SECCHI | P78 | m | Secchi disk depth | |
| TRANSMIS | P74 | % | percent light transmission | (via transmissometer) |
| ***Chemical parameters:*** | | | | |
| OXYGEN | P300 | mg/L | dissolved oxygen* | |
| PCTSAT | P301 | % | percent oxygen saturation | |
| PH | P400 | units | pH* | |
| *nutrients‡:* | | | | |
| NH3_DIS | P608 | mg/L | dissolved ammonium-N | (Oct 1990 - present) |
| NH3_N | P610 | mg/L | total ammonium-N | (1973 - Sep 1990) |
| NO2_DIS | P613 | mg/L | dissolved nitrite-N | (Oct 1990 - present) |
| NO2_N | P615 | mg/L | total nitrite-N | (1973 - Sep 1990) |
| NO23_DIS | P631 | mg/L | dissolved nitrate + nitrite-N | (Oct 1990 - present) |
| NO2_NO3 | P630 | mg/L | total nitrate + nitrite-N | (1973 - Sep 1990) |
| NO3_N | P620 | mg/L | total nitrate-N | (1973 - Sep 1990) |
| OP_DIS | P671 | mg/L | dissolved ortho-P | (Oct 1990 - present) |
| OP_TOT | P70507 | mg/L | total ortho-P | (1973 - Sep 1990) |
| TP_P | P665 | mg/L | total P | (1973 - Sep 1990) |
| *pigments:* | | | | |
| CHL | P32211 | µg/L | chlorophyll *a* | (extracted fluorescence) |
| PHEO | P32218 | µg/L | phaeopigment | " " |
| ***Biological parameters:*** | | | | |
| FC | P31616 | #/100 mL | fecal coliform bacteria | (membrane filter method) |

NOTES:

*Since Nov 1989, *in situ* CTD sensors have been used to obtain depth, temperature, salinity, light transmission, DO, and pH data. Prior to Nov 1989, these data were obtained using a variety of methods, except for light transmission which was not measured. Information on sensors and methods used is available upon request.

†Salinity was measured: via conductance using a CTD from Nov 1989 - present;
via refractometer from 1987 - Oct 1989;
and via titration from 1973 - 1987.

‡Nutrients were sampled for dissolved rather than total concentrations beginning in Oct 1990. Samples for dissolved nutrient concentrations are filtered through 0.45 µm pore size cellulose filters. As of June 1992, dissolved nitrite-N has been determined in three urban embayments only (Bellingham Bay, Budd Inlet, Commencement Bay).

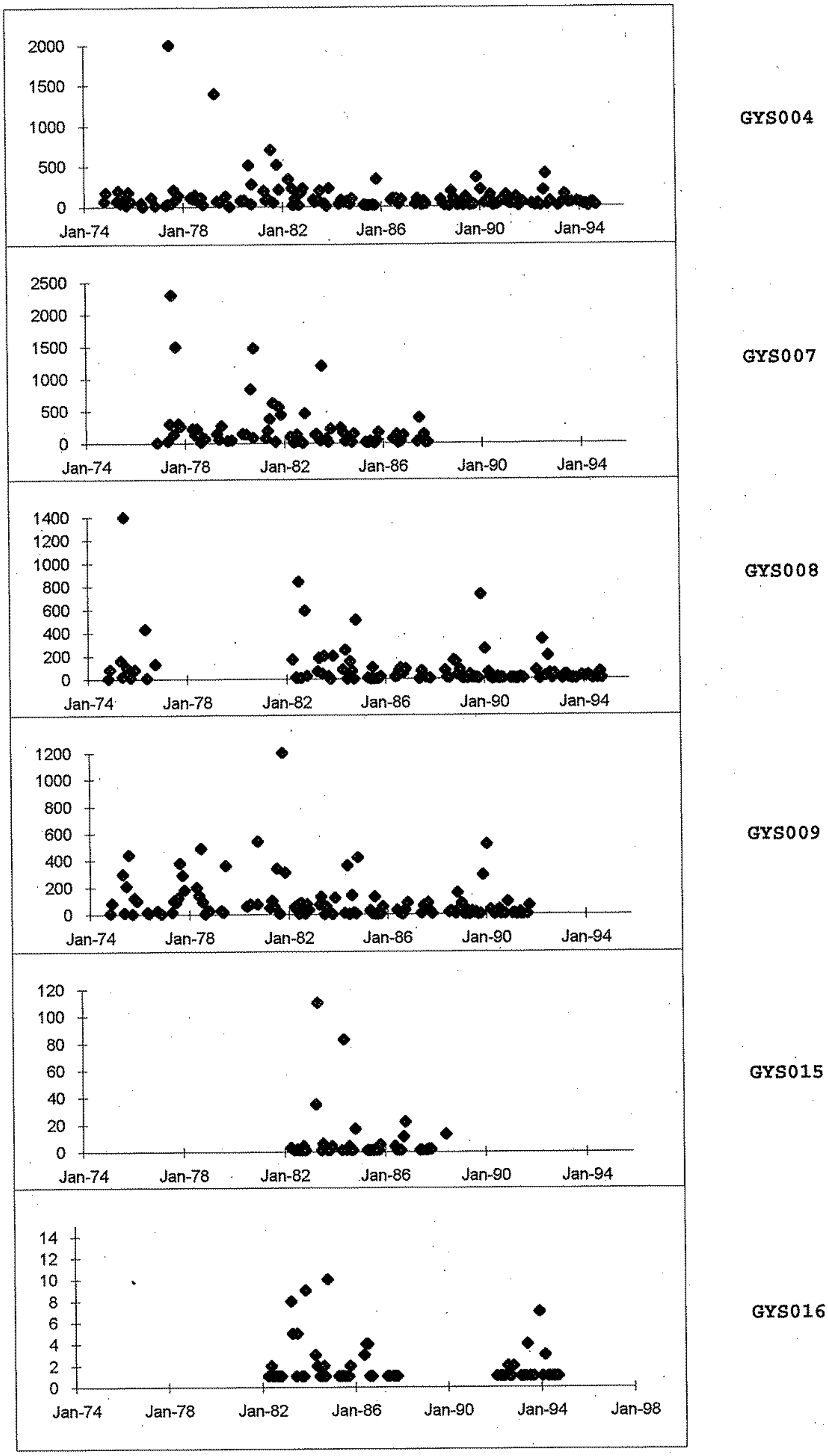




Figure 1. Concentration of fecal coliform bacteria (# org./100 mL) at Grays Harbor marine water monitoring stations. The WAC (1992) standard is 14 for marine waters and 200 for freshwaters.

# Chapter 3. TMDLs and Other Watershed Assessments

by

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Watershed Assessments Section

## Introduction

### Purpose

This paper provides an overview of the water quality information collected over the last ten years for the Western Olympic WQMA by the Watershed Assessments Section (WAS) of EILS. WAS conducts intensive water quality studies in the areas of:

- Timber/Fish/Wildlife and the effect of forest practices activities
- Total Maximum Daily Load (TMDL) technical studies
- Point source mixing zone evaluations
- Regional Environmental Monitoring and Assessment Program (REMAP)
- Evaluation of nonpoint source pollution
- Effectiveness of Best Management Practices (BMPs)

## Review of Studies

### Olympic West Slope, North Half (WRIA 20)

No intensive surveys have been conducted by WAS in this area.

### Olympic West Slope, South Half (WRIA 21)

Work in this area has focused on Pacific Beach and Joe Creek. The Pacific Beach Wastewater Treatment Plant (WWTP) discharges to Lower Joe Creek in an area that is a strongly stratified lagoon-like estuarine system. A freshwater lens overlies a saline water mass whose circulation is restricted by a shallow sill at the mouth of the estuary.

A study in 1985 (Joy, 1985) found that chlorine from the Pacific Beach discharge did not pose a threat to Joe Creek, but that further study of the receiving water during low flow was recommended.

Seiders (1995) evaluated Joe Creek to address water quality concerns related to the proposed expansion of the WWTP. Sampling occurred during critical conditions of low streamflow and restricted tidal exchange. Dissolved oxygen (DO) and bacteria fell below the state Water Quality Standards. The proposed upgrade of the WWTP must produce a high quality effluent to protect receiving water quality. Stringent effluent limits have been proposed for inclusion in the NPDES permit (Seiders, 1994).

**Lower Chehalis and Grays Harbor (WRIA 22)**

Grays Harbor has a long history of DO, bacteria, temperature, and toxic pollution problems. Although considerable work has been done in Grays Harbor by EILS, most of the work has focused on toxic contaminants, salmon survival, and on the major industrial dischargers in the area (see Chapter 4. Surface Water Toxics Investigations). Because of extensive shellfish culture areas, bacteria have also been a major concern in Grays Harbor. Septic systems, livestock operations, the urban areas, and industrial operations have all been examined to evaluate bacteria pollution sources. The state Department of Health has been particularly active with this issue.

Work has also been conducted by WAS staff in the Chehalis basin as part of the efforts of the Timber/Fish/Wildlife Cooperative Monitoring, Evaluation, and Research Committee (TFW/CMER). As part of the evaluation of forest practice BMPs to protect stream temperature (Rashin and Graber, 1992), Black Creek (a tributary of the Wynoochee River) and North Fork Rabbit Creek (in the Satsop River basin) were found to violate temperature criteria as a result of inadequate BMPs.

A TFW/CMER study on BMPs for the aerial application of forest pesticides (Rashin and Graber, 1993) included two streams in WRIA 22 and four streams in WRIA 23 (six out of seven sites studied). BMPs in use during the study were only partially effective in protecting water quality, were not effective in complying with Forest Practice Rules, and did not adhere to applicable EPA-approved label instructions. Pesticide application at a Christmas tree plantation on Foster Creek (in the South Fork Chehalis River watershed) resulted in violations of water quality standards. Exceedance of standards at a site on Gibson Creek (Chehalis River tributary in eastern Grays Harbor County) was suspected, although not directly measured. A number of changes to BMPs were recommended that could increase the protection of surface water bodies.

**Upper Chehalis (WRIA 23)**

An event of major significance in the Upper Chehalis basin was the "Black River Fish Kill", a large die-off of aquatic life in the Black River and Chehalis River in August 1989 (Ecology, 1989).

This event brought enormous media coverage and a massive effort by Ecology to determine the cause. At the time, the shut-down of an aquaculture facility on the Black River was believed to be a primary cause. No evidence was ever found of a deliberate release of toxic pollutants. However, the shut-down was capable of causing rapid changes in flow and temperature in the Black River, and possibly the inadvertent release of ammonia. In addition, evidence collected since then suggests that poor waste management at a large dairy near the Black River may also have contributed to the conditions causing the kill. Ultimately, the true cause may never be known, but problems at the dairy have been identified and are being corrected. It is highly likely that no aquaculture facility in the Upper Chehalis Basin will shut down rapidly during the summer low-flow season again.

To a large extent as a consequence of the Black River Fish Kill, the Chehalis TMDL project was conducted. The products of that effort include a wet season screening survey (Dickes, 1992); a review of historical data for the Upper Chehalis River (Pickett, 1992); a report on the problem found near a dairy on the Black River (Pickett, 1991); the Black River Dry Season TMDL report (Pickett, 1994a); the Black River Wet Season TMDL report (Coots, 1994); the Upper Chehalis TMDL report (Pickett, 1994b); and a number of supporting ground water and effluent surveys done during the TMDL study and cited in these other reports. A summary of the three TMDL reports was published in Ecology (1994). Key issues from the historical data review and from the three TMDL studies are included in Table 1.

The key finding of the TMDL studies was the need for extensive controls on BOD, ammonia, temperature, and bacteria in the Black River, Upper Chehalis River, and several other tributaries. In addition, phosphorus controls are necessary for the Black River. The recommended allocation scenario calls for widespread implementation of nonpoint source controls; limitations for discharges from the City of Pe Ell and City of Centralia WWTPs; and severe limitations or complete removal of the City of Chehalis and Darigold WWTP discharges.

Recommended actions from the TMDL study reports are listed in Table 1. Implementation of the TMDL is obviously one of the highest priority issues in the basin. Major remaining issues are resolving the allocation strategy for the Upper Chehalis, particularly the Centralia Reach (Newaukum River to Skookumchuck River); implementing point source controls or the removal of discharges; and implementing nonpoint source controls.

As an offshoot of the TMDL, Ecology received grant funds from the U.S. Fish and Wildlife Service (USFWS) as part of the Chehalis Basin Fisheries Restoration Program (CBFRP). Under the grant, a six-year project was initiated to evaluate the effectiveness of Best Management Practices and fisheries habitat restoration efforts, focusing on areas that were identified as priority areas in the TMDL (Sargeant, 1995a;b;c). A summary of the monitoring sites and the work completed or in progress follows:

Bunker/Deep Creek: Pre-BMP summer and winter monitoring. Preliminary results show wet season turbidity problems in Deep Creek, and dry season fecal coliform problems at one monitoring site on Deep Creek. In spring 1995, macroinvertebrate sampling was done for two sites in the upper Deep Creek watershed.

Beaver/Allen Creek: Pre-BMP wet season monitoring, post-BMP monitoring for Allen Creek. The main problems are high fecal coliform counts and higher ammonia levels upstream of Allen Creek (most likely due to a particular dairy operation), and higher fecal coliform at the mouth of Beaver Creek.

North Lincoln Creek: Spring 1995 macroinvertebrate sampling done for two sites on North Lincoln Creek. Pre/post, upstream/downstream temperature monitoring done on North Lincoln Creek. Preliminary temperature data show some violations in temperature criteria at both sites and at a temperature monitoring site near the mouth of Lincoln Creek.

Mill Creek, Money Creek: Pre/post upstream/downstream temperature monitoring.

Chehalis River: Wet season pre-BMP monitoring being done on a mainstem Chehalis site (near a dairy operation). A wet season discharge was found, violations in fecal coliform, turbidity, and chronic ammonia criteria were noted. Chehalis River stations violated fecal coliform criteria at times.

Black River: Wet and dry season post-BMP monitoring. Dry season sampling found continuing improvement over 1991 for conductivity, turbidity, ammonia, total persulfate nitrogen, and total phosphorus downstream of the dairy BMP site. Wet season sampling showed some problems still present following rainfall events for fecal coliform and ammonia. Full implementation and maintenance of BMPs and proper management over several years is needed before further water quality improvements can be expected.

Other temperature monitoring: Temperature monitoring is also being done at the mouth of the Newaukum River, at the mouth of the South Fork Chehalis, the Chehalis River above Newaukum, and near the mouth of the Black River.

A number of water quality studies and monitoring programs have been conducted by other agencies in the Upper Chehalis basin. Thurston County Environmental Health under an Ecology grant conducted a water quality monitoring study of the Black River and Black Lake. [Note - Black Lake should properly be considered a part of the Percival Creek basin, but is often included in the Black River basin. No direct outlet from Black Lake to the Black River exists.] The Chehalis Tribe has had a water quality monitoring network for the Upper Chehalis River and tributaries for several years. The Lewis County Conservation District has monitored Dillenbaugh Creek as part of its model watershed project, done under grants from Ecology and the USFWS CBFRP. Final reports have not been issued for these monitoring projects.

## Cross-Program Considerations

The Upper Chehalis TMDL has raised extensive cross-program issues. These are summarized below.

**Water Resources**

The Upper Chehalis and Black River Dry Season TMDL studies found very low flows, especially during 1992, a critically dry year. Data collected during the TMDL surveys confirmed the findings of earlier water quantity studies, including the overallocation of the basin, and the dependence of the rivers and streams on ground water to maintain dry season low flows. The Watershed Assessment for water resources was released shortly after the TMDL report, and cross-program cooperation allowed for the two reports to generally support each other. However, the TMDL recommendation to remove the City of Chehalis wastewater discharge led to a conflict with the need to maintain instream flows. In general, the TMDL brought additional focus to the issue of the inadequacy of water resource laws and agency resources to support the beneficial use of fisheries by maintaining adequate instream flow, at the same time that the TMDL supports fisheries through protection of temperature and DO standards.

**Toxics Cleanup**

The TMDL has required coordination at several cleanup sites near the Chehalis River. In particular, the Centralia Landfill site has the potential of discharging BOD and ammonia as a nonpoint pollutant source to Salzer Creek and the Chehalis River. TMDL recommendations should be included in the cleanup standards for this site.

**Spills**

The Black River Fish Kill brought Spills into close cooperation with EILS and the WQP. EILS staff supported the spill response on that event, as well as on a later fish kill and a highway spill in the Black River basin. EILS has also helped with training of Spills staff. The sensitivity of the Chehalis and Black Rivers and their proximity to the I-5 corridor makes continued cooperation necessary.

**Shorelands**

The Black and Upper Chehalis TMDLs call for significant work towards control of nonpoint pollutant sources. The Shoreline Management Act has the potential to be a powerful tool for mandating TMDL-related nonpoint source control. To date, Shorelands staff has had little involvement with TMDL issues.

### Local Action Teams

Ecology management recently approved the "Local Action Team" (LAT) concept as a new initiative to coordinate cross-program and inter-agency activities in specific basins and work closely with local interests in the basins. The Chehalis Basin has been chosen as one of three basins statewide to implement this new approach. The LAT program is still draft and under development, but will likely be implemented within the first year of this biennium. A Team Leader will be hired within the Regional Office, staff assigned to the LAT, and the watershed approach and its five-year cycle will need to be integrated with LAT efforts.

## Conclusions and Recommendations

The recommendations of this briefing paper based on previous studies have been summarized in Table 1.

Implementation of the Upper Chehalis TMDL is the top priority within the WQMA, this being the worst identified water quality problem in the WQMA. The key issues to success are implementation of effective and comprehensive nonpoint source controls, and finding a basin-wide solution to the overallocation of water resources. Issues with toxics and nutrients also need attention if resources allow. The Local Action Team may prove to be a key element for success in the Chehalis River basin.

Several issues should be considered in WRIAs 20, 21, and 22 where additional work may be needed, depending on what other information is already available. In Grays Harbor, bacteria are an important issue for which further monitoring and study may be needed. Additional focused monitoring of the rivers in WRIA 20 and 21 is needed, and temperature and turbidity are the most likely potential problems.

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| Table 1. Recommended Actions from Previous Studies (Pickett, 1992; 1994a; 1994b; Coots, 1994) | | | |
|---|---|---|---|
| **Waterbody** | **Recommended Action** | **Cate-gory** | **Pri-ority** |
| Black R | Implement TMDL for DO, Total Phosphorus, and Fecal Coliform Bacteria:<br>● Include TMDL criteria in WQ Standards<br>● Investigate and correct livestock problems<br>● Inspect & correct on-site system problems<br>● Require Puget Sound Stormwater Manual standards for all development<br>● Implement fertilizer management program to reduce ammonia and phosphorus inputs<br>● Protection of wetlands and riparian areas<br>● Revised action plan and revitalized citizens group for the Black R basin<br>● Implement BMPs through Shoreline Management & Growth Management Acts<br>● Coordinate with federal, state, local, and tribal agencies, CDs, and citizens groups | Monit, Coord | High |
| Upper Chehalis R | Implement TMDL for DO, and Fecal Coliform Bacteria:<br>● Establish Wasteload Allocation for Chehalis and Darigold<br>● Agronomic waste disposal at National Frozen Foods, Midway Meats, and any dairies adjacent to river<br>● No release of BOD or ammonia from Centralia Landfill site<br>● Investigate and correct livestock problems<br>● Inspect & correct on-site system problems<br>● Require Puget Sound Stormwater Manual standards for all development upstream of Scammon Creek<br>● Implement fertilizer management program to reduce ammonia inputs<br>● Protection of wetlands and riparian areas<br>● Local action plans and citizens groups for subbasins<br>● Implement BMPs through Shoreline Management & Growth Management Acts<br>● Coordinate with federal, state, local, and tribal agencies, CDs, and citizens groups | Monit, Coord | High |

| | | | |
|---|---|---|---|
| Littlerock Ditch<br>Beaver Ck<br>Mima Ck<br>Salzer/Coal Ck<br>Dillenbaugh Ck<br>Berwick Ck<br>Stearns Ck<br>Bunker Ck<br>So Fk Chehalis R<br>Elk Ck | Correct dissolved oxygen and fecal coliform bacteria problems through implementation of nonpoint source controls | Monit, Coord | High |
| Chehalis R<br>Black R<br>Scatter Ck<br>Salzer Ck<br>Dillenbaugh Ck<br>Skookumchuck R<br>Newaukum R<br>So Fk Chehalis R | Correct temperature problems through riparian restoration canopy planting project - "Shade the Chehalis". | Monit, Coord | High |
| Lower Black R<br>Scatter Ck<br>Chehalis R<br>(Galvin to Porter) | Evaluate nutrient impacts on DO and pH through macrophyte and periphyton primary productivity | Monit, TMDL | High |
| Chehalis R<br>(Centralia Reach) | Conduct synoptic surveys of Centralia Reach during May through October period. | Monit | High |
| Black R (middle) | Conduct synoptic surveys of slow middle river reach during May through October period. | Monit | High |
| Chehalis R<br>Black R | Evaluate dissolved metals with low-level methods at ambient stations | Monit | High |
| Chehalis R basin | Develop GIS database for monitoring data. Coordinate GIS coverage with other agencies and organizations. | GIS | High |
| Chehalis R and tributaries | Establish minimum instream flows to protect water quality and beneficial uses. Conduct flow TMDLs for WQ-limited reaches. | Monit, Coord, TMDL | High |
| Chehalis R<br>Black R | Establish permanent flow monitoring in conjunction with all ambient water quality monitoring sites. | Monit, Coord | High |
| Chehalis R<br>(Centralia Reach)<br>Dillenbaugh Ck | Evaluate sediment toxicity and water column impacts from American Crossarm and Conduit contaminant releases | Monit | Med |

| | | | |
|---|---|---|---|
| Garrard Ck<br>Independence Ck<br>Scatter Ck<br>Lincoln Ck | Correct dissolved oxygen and fecal coliform bacteria problems through implementation of nonpoint source controls | Monit, Coord | Med |
| Upper Chehalis R | Evaluate turbidity problems | Monit | Med |
| Wildcat Ck | Evaluate nutrient impacts on DO and pH | Monit, TMDL | Med |
| Chehalis R and tributaries | Evaluate ambient in-stream toxicity with bioassays (follow-up to Michaud (1988) study) | Monit | Med |
| Chehalis R<br>(Pe Ell to Porter) | Evaluate the effect on river water quantity and quality of withdrawals from ground water, and the river, and of ground water inflows to the river | Monit | Med |
| Black R | Evaluate ground water/surface water interactions on water quantity and quality | Monit | Med |
| Chehalis R<br>(Centralia Reach) | Study of sediments, including SOD and nutrient recycling, and possibly sediment modeling | Monit | Low |
| Skookumchuck R | Investigate cause of pH exceedances and recommend corrective actions | Monit, TMDL | Low |
| Black R | Evaluate impacts on Black River due to releases from Black Lake | Monit | Low |
| Hanaford Ck | Evaluate mining impacts - turbidity, temperature, dissolved solids, and toxicity | Monit | Low |

# Chapter 4. Surface Water Toxics Investigations

by

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## Introduction

The Toxics Investigations Section (TIS) does a variety of studies on chemical contamination of surface and ground waters, and conducts compliance inspections of industrial and municipal wastewater treatment facilities. Except for pesticides, as mentioned below, TIS does not have any program to systematically monitor or collect data on toxics in state waters. TIS ground water and compliance inspection data are reviewed in Chapters 5 and 6, respectively.

TIS has the following data on the occurrence of toxic pollutants in the surface waters of the Western Olympic WQMA:

- pesticides in cranberry bog drainage
- pesticides in creeks near Christmas tree farms
- chemical contaminants in Chehalis and Soleduck River fish
- broadscale chemical screens of Grays Harbor estuary

The data available on pesticides and fish tissue are, for the most part, recently collected but limited to relatively few samples. The Grays Harbor work was part of a 1987 - 1990 cooperative study led by the Washington Department of Fisheries (WDF) to determine the cause of poor survival of Chehalis River coho. Although large numbers of samples were analyzed, the focus was on effluents from pulp mills that have since either changed their pulping process/wastewater treatment (Weyerhaeuser) or gone out of business (ITT Rayonier). An additional area of possible interest in terms of toxics is the use of the pesticide Sevin to control burrowing shrimp on Grays Harbor oyster beds.

## Review of Studies

### Cranberry Bogs

As part of EILS' Washington State Pesticide Monitoring Program (WSPMP), water samples have been analyzed in 1994 and 1995 from "Grayland Creek", an unnamed stream draining bogs around Grayland (Davis and Johnson, 1995-in prep.). The creek flows into Grays Harbor's South Bay near Bay City (Figure 1). Results available as of this writing are summarized in Table 1. Pesticide monitoring at this site will continue at least through October 1995.

Based on the approximately 30 WSPMP sites sampled statewide since 1992, Grayland Creek stands out in the large number of pesticides detected and the potential for aquatic toxicity due to several insecticides, especially diazinon, chlorpyrifos (Dursban), and azinphos-methyl (Guthion). The diazinon and chlorpyrifos concentrations recently observed in June 1995 are acutely toxic to some invertebrate crustaceans. The majority of the insecticides and herbicides found are registered for use on cranberry bogs. DDT was used on cranberries prior to its ban (Patterson, 1994). The detection of DDE/DDD in April and June 1995 meets 303(d) listing requirements.

The WSPMP sampling program is limited in scope and not closely timed to coincide with periods of pesticide application or runoff. Grayland Creek is the only cranberry bog drainage that has been sampled. Therefore, it is not known if the present data are representative of pesticide impacts to surface waters from use on cranberries.

**Christmas Tree Farms**

Water samples have been analyzed from Kearney Creek (an upper Newaukum tributary) in 1994 and an unnamed creek near Adna in 1993, as part of the WSPMP (Davis and Johnson, 1994; Davis and Johnson, 1995-in prep.). Pesticides were rarely detected in Kearney Creek, specifically sub-ppb amounts of the herbicides hexazinone and simazine. Trace amounts of 2,3,4,6-tetrachlorophenol were detected once in Adna creek but this compound is not used on Christmas trees. The Washington State Department of Agriculture has also done pesticide monitoring of Kearney Creek with similar results (Steve Foss, personal communication).

These results contrast with the TFW findings of water quality impacts from pesticide use on Christmas tree farms, previously described in Chapter 3. This may be due to timing of the WSPMP sampling, mode of application, or other factors.

**Chehalis/Soleduck Fish**

In 1993, WSPMP analyzed Chehalis River mountain whitefish fillets and whole largescale suckers for 42 pesticides/breakdown products and PCBs; a similar analysis was done on Soleduck River whitefish in 1994 (Davis et al., 1995; Davis and Johnson, 1995-in prep.). The Chehalis River samples were collected just below Chehalis.

Low levels of DDT and metabolites, chlordane and related compounds, and PCBs were detected in both the Chehalis River whitefish and suckers. Although the concentration of total PCBs in the whitefish sample (143 ppb) is not extremely high compared to fish from other parts of the state, it exceeds the 303(d) list criterion of 1.4 ppb for a 10E-6 cancer risk (Appendix A). No pesticides or PCBs were detectable in Soleduck whitefish.

Some whole fish data also exist for the Chehalis River at Porter (Hopkins, 1991). Few compounds were detected, but detection limits were somewhat high compared to more recent analyses.

**Grays Harbor Estuary**

Extensive analyses of the water column, sediments, and biota have been done by various agencies in Grays Harbor in connection with the above-mentioned salmon survival study and for Corps of Engineer dredging projects. Much of this information is summarized in Schroder and Fresh (1992) and Johnson and Coots (1989). Results have shown the level of sediment and tissue contamination to be relatively low. The water column data (Schroder and Fresh, 1992) is less comprehensive, leaving room for questions.

Based on results of the salmon survival study, WDF concluded the cause of high mortality of Chehalis River coho was degraded water quality in inner Grays Harbor, coupled with high loadings of a trematode parasite in lower river smolts (Schroder and Fresh, 1992). The specific aspect of water quality that was adversely affecting the smolts could not be identified.

Dave Siler, Washington Department of Fish and Wildlife (WDFW), provided the following information on survival of coho salmon since completion of the salmon survival study: Survival of Chehalis River fish that emigrated in the spring of 1990, after the process and treatment plant modifications at the Weyerhaeuser and ITT pulp mills, was 80% of that for Humptulips River fish (control). This is the highest survival of Chehalis coho WDFW has observed. Whether the marked improvement is coincidence or casual is unknown. Fish returning the following two years, 1992 and 1993, survived at only 50% compared to the Humptulips, but marine survival was poor for both year groups. Survival was also low in 1994 but no tagging was done in the Humptulips for comparison.

An inventory of storm drains to inner Grays Harbor was conducted early in the salmon survival study (Pelletier and Determan, 1988). Six of the 29 drains sampled exhibited anomalous pollutant levels (e.g., pH, fecal coliforms, nutrients, turbidity, visual appearance).

**Sevin and Oyster Beds**

In 1987, Ecology conducted a review of available information to determine the environmental implications and appropriateness of granting short-term water quality modifications for continued use of Sevin (carbaryl) to control ghost and mud shrimp in Grays Harbor and Willapa Bay oyster beds (Johnson, 1987). Approximately 100 acres of tidelands were treated annually in Grays Harbor, with another 300 acres in Willapa Bay. The review raised concerns about the persistence of carbaryl and a degradation product, 1-napthol, in the sediments and the absence of data showing what impact the treatments had on benthic invertebrates, especially crustaceans.

Since this review, the total amount of acreage allowed treated in the two waterbodies has been doubled to 200 acres in Grays Harbor and 600 acres in Willapa Bay. Ecology and other agencies, the tribes, other organizations, and the oyster industry have recently begun working with the Battelle Sequim Laboratory to develop an integrated pest management plan (IPMP) to control burrowing shrimp. This positive step, coupled with a study by Aquatic Environmental Sciences, Port Townsend, that showed recovery of most epibenthic taxa to pre-carbaryl application densities after one year, was the basis for the decision to permit larger areas to be treated (Bill Young, SWRO, personal communication).

## Conclusions and Recommendations

With the exception of Grays Harbor, not much data have been collected on toxics in the surface waters of the Western Olympia WQMA. Numerous analyses of various media in the Grays Harbor estuary have failed to find substantial chemical contamination. Due to a lack of definitive water column data, the perception lingers that toxics may be a problem in the inner harbor.

The primary issue identified in recent TIS studies is the potential adverse impacts of pesticides used on cranberry bogs. More data are needed on the occurrence and significance of pesticides in bog drainage to downstream waters. Ideally, this would be done in cooperation with the growers, WSU Long Beach Experiment Station, Washington State Department of Agriculture, and other interested parties. The objective would be to determine if modifications or alternative management strategies should be considered for any pesticides, probably focusing on the organophosphorus insecticides.

The application of Sevin to oyster beds is a longstanding issue yet to be resolved. Depending on success of current efforts to achieve a timely implementation of a successful IPMP strategy, further evaluation may be needed of the impact of Sevin treatments to the Grays Harbor and Willapa Bay estuaries.

## References

Davis, D. and A. Johnson, 1995 (in prep.). Washington State Pesticide Monitoring Program, 1994 Surface Water, Fish and Sediment Sampling Report. Washington State Department of Ecology, Olympia, WA.

Davis, D., A. Johnson, and D. Serdar, 1995. Washington State Pesticide Monitoring Program, 1993 Fish Tissue Sampling Report. Washington State Department of Ecology, Olympia, WA. 29 pp. + append.

Hopkins, B., 1991. Basic Water Monitoring Program Fish Tissue and Sediment Sampling for 1989. Washington State Department of Ecology, Olympia, WA. 37 pp.

Johnson, A., 1987. Review of Data on Sevin. Memorandum to John Neel, Washington State Department of Ecology, Olympia, WA. 27 pp.

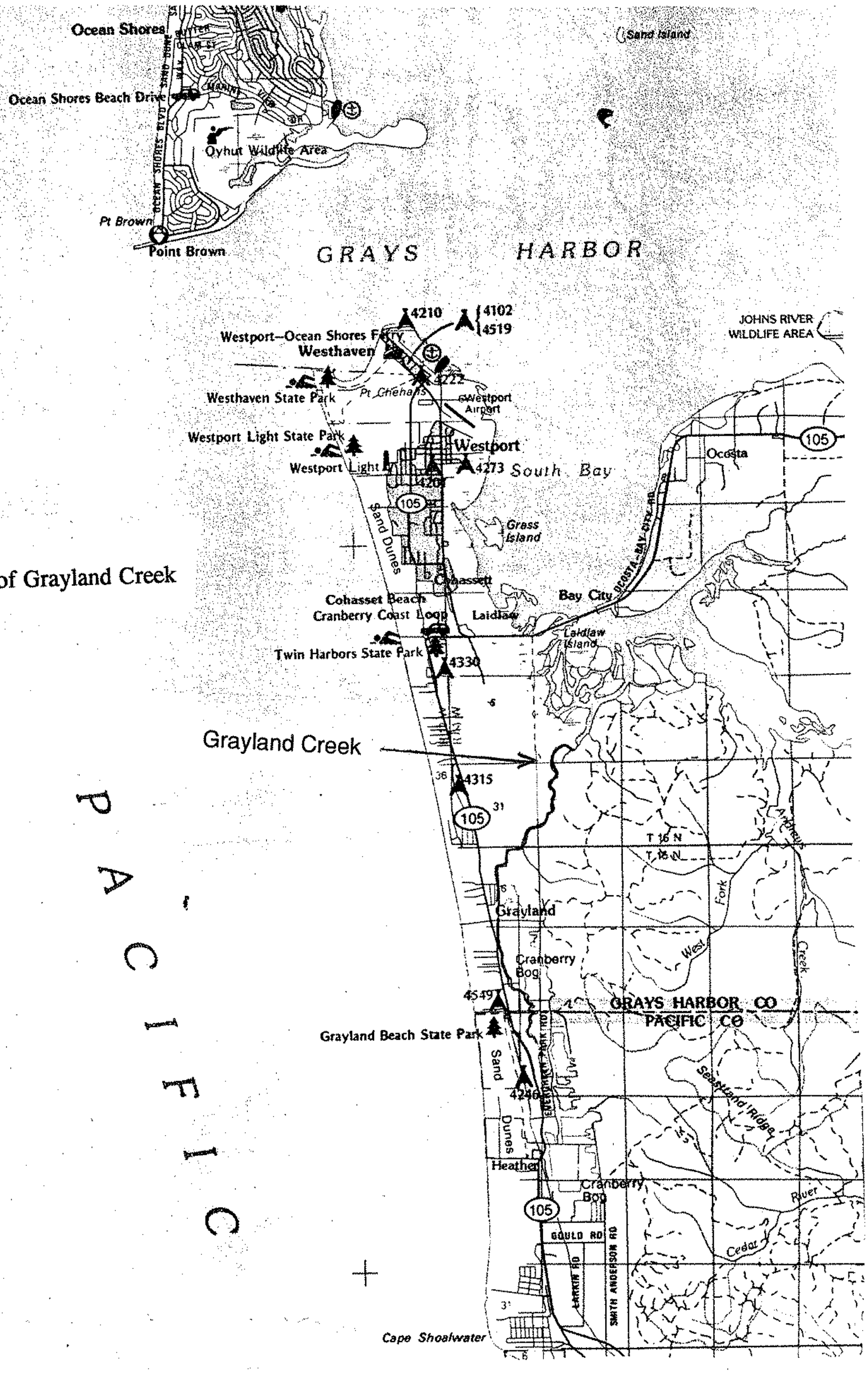
Johnson, A. and R. Coots, 1989. Survey of Chemical Contaminants in the Bottom Sediments of Grays Harbor Estuary. Washington State Department of Ecology, Olympia, WA. 38 pp. + append.

Patterson, B., 1994. Pesticide Use on the Cranberry in Washington: An Evaluation of the Environmental Risks and Regulations. Essay of Distinction, Evergreen State College, 91 pp.

Pelletier, G. and T. Determan, 1988. Urban Storm Drain Inventory, Inner Grays Harbor. Washington State Department of Ecology, Olympia, WA. 14 pp.

Schroder, S. and K. Fresh (editors), 1992. Results of the Grays Harbor Coho Survival Investigations, 1987-1990. Washington State Department of Fisheries, Tech. Rep. No. 118. 393 pp. + append.

Figure 1. Location of Grayland Creek



| Table 1. Pesticides and Breakdown Products Detected in Grayland Creek (ppb) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1994 | | | 1995 | | Detection Frequency | Water Quality |
| Pesticide | April | June | October | April | June | Statewide* | Criteria** |
| Insecticides | | | | | | | |
| diazinon | 0.01 | | 0.03 | 0.014 | 0.22 | 23 % | 0.009 |
| chlorpyrifos | | 0.02 | 0.03 | 0.045 | 0.012 | 17 % | 0.041 |
| azinphos-methyl | | 0.01 | | | 0.21 | 16 % | 0.01 |
| carbofuran | 0.08 | 0.05 | | | 0.4 | <10 % | 1.75 |
| hydroxycarbofuran | | 0.05 | | | | <10 % | |
| DDE | | | | 0.008 | 0.006 | <10 % | 0.001 |
| DDD | | | | 0.011 | 0.008 | <10 % | 0.001 |
| Herbicides | | | | | | | |
| 2,4-D | 0.11 | 0.22 | 0.09 | 0.93 | | 44 % | 6 |
| simazine | 0.02 | | | 0.06 | | 33 % | 10 |
| dichlobenil | 1.7 | | | 3.1 | 7.5 | 24 % | 37 |
| dicamba | | | | 0.01 | | <10 % | 10 |
| dichlorprop | | 0.01 | | 0.08 | | <10 % | |
| napropamide | 0.20 | | | 1.5 | 0.38 | <10 % | |
| norflurazon | 0.16 | | | 0.59 | 0.44 | <10 % | |
| MCPA | | | | 0.02 | | < 10 % | 2.6 |
| triclopyr | | 0.02 | | 0.03 | | <10 % | 7 |
| Fungicide | | | | | | | |
| pentachlorophenol | | | | 0.03 | | < 10 % | 3.5 |

* 1992 - 94 data, 21 sites, n = 70

** State or EPA chronic standard (chlorpyrifos, azinphos, DDE, DDD, PCP) or other recommendations

[box] = at or above criteria

# Chapter 5. Ground Water Studies

by

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## Introduction

WRIA 23, the Chehalis Basin, is the only area in the Western Olympic WQMA in which ground water studies were found during the literature search. The focus of most reports was the effects on ground water quality of the storage and land application of wastewaters from various agricultural and food processing practices. Of particular interest is the contamination of ground water by nitrate, and the interaction between ground water and surface water, especially the Chehalis River and its tributaries.

## Review of Studies

There are a number of fish farms in the lower Chehalis Basin, and concerns have been raised both on the quantity of ground water consumed by these operations and the resultant quality of the surficial runoff. In 1990, a ground water quality investigation was conducted in the Rochester vicinity to determine if wastewater discharged to an unlined flood channel from the Steelhammer Salmon Farm was affecting ground water (Erickson, 1990a). Water quality samples from 22 wells were obtained and tested. The study showed that the ground water flow pattern and quality were affected by the facility discharge. Downgradient wells had elevated concentrations of iron and total organic carbon and to a lesser extent total and fecal coliform bacteria, phosphorus, and ammonia. The study concluded that alternate discharge methods should be implemented because continued degradation of ground water was likely if disposal of wastewater to the channel continued.

In August 1989 a fish kill occurred in the Black River. In response, a study was initiated investigating whether the Global Aqua Fish Farm was a contributor to this fish kill (Erickson, 1990b). Two monitoring wells were installed near "Big Rock" spring between the farm and the Black River. Water levels and quality were monitored from November 3 to December 20, 1989. The study found nothing conclusive relating the fish farm to the earlier fish kill. However, elevated specific conductance, chloride, temperature, and nitrate concentrations at the spring suggest that ground water degradation was occurring as a result of discharges from the farm.

Dairies and their associated wastewater storage lagoons are another area of concern. EILS monitored ground water quality for one year at a seven-year-old dairy lagoon near Adna (Erickson, 1992). The monitoring was part of a larger study to define the impact of dairy lagoons on ground water quality at four locations within the state. Ground water was tested for chloride, total dissolved solids, total organic carbon, chemical oxygen demand, total phosphorus, ammonia-N, nitrate+nitrite-N, and total and fecal coliform bacteria. The lagoon did not appear to have affected ground water quality. Although nitrate+nitrite-N concentrations were elevated relative to upgradient conditions in two downgradient wells, none of the other parameters tested, particularly chloride, was elevated.

EILS is currently investigating the effects of land application of dairy wastes on ground water quality (Erickson, 1995). The study will document ground water quality before and after a waste storage lagoon is constructed at an operating dairy near Maytown. Waste management at the dairy will be upgraded to meet current BMPs and the results on ground water quality monitored. Wells downgradient of the land application site and the new storage lagoon will be sampled. Target analytes include nitrogen (total, nitrate+nitrite-N, ammonia-N), total phosphorus, total organic carbon, chloride, total dissolved solids, and fecal coliform bacteria.

Effects on ground water quality from land application of vegetable and meat processing plant wastewater in Centralia were investigated by Carey (Carey, 1992). Total dissolved solids, pH, iron, and fecal coliform bacteria exceeded Washington State Ground Water Quality Standards in three monitoring wells at the application site. In addition, several parameters were found at higher concentrations in wells assumed to be downgradient of the site than those in the presumed upgradient well. These parameters included biological oxygen demand, ammonia, chloride, specific conductance, iron, total dissolved solids, total suspended solids, total phosphorus, and sodium. Anaerobic conditions were indicated in downgradient wells by predominantly unoxidized forms of nitrogen and high iron concentrations. The study recommended additional study of the effects on the nearby Chehalis River from the increased ammonia and oxygen demand.

Interactions between ground water, both quantity and quality, and the Chehalis River were further investigated by Erickson (Erickson, 1993). He found that the Chehalis River between the Thurston/Lewis County border and Adna hydraulically interacts with an extensive surficial aquifer (East Chehalis Surficial Aquifer) and serves as a regional ground water sink. He estimated ground water inflow to the river at between 0.1 to 10.3 cubic feet per second per mile. Samples from 28 wells showed that ground-water quality was highly variable. Chloride and organic loading via ground water were highest along the reach between river miles 72 to 77.5.

As part of a statewide assessment of pesticides in ground water, pesticides were tested in samples from the East Chehalis Surficial Aquifer (Larson, 1994). Eleven wells near Chehalis were sampled in 1993 for 123 pesticides and nitrate+nitrite-N. Several of the wells sampled in the above study (Erickson, 1993) were resampled during this investigation. Four pesticides were detected in the initial samples: atrazine, simazine, diuron, and dichlobenil. One or more of these chemicals were detected in three wells; however, concentrations were below health related levels set by the EPA. One well had a nitrate+nitrite-N concentration greater than the 10 mg/L standard for public drinking water supplies.

Also, the Department of Health recently completed a study of pesticides in public drinking water supply wells (DOH, 1995). They tested 1,326 wells, several of which were located within the Western Olympic WQMA. Although pesticides were detected, no serious problems were identified and they concluded that pesticide contamination of Washington's drinking water presents a low public health risk.

## Conclusions and Recommendations

Significant issues identified include impacts to ground water from fish farming, from dairy waste storage lagoons and land application of dairy wastewater, and from land application of wastewater from food processing plants. Based on past investigations, the major concerns appear related to treatment and discharge of the waste stream from various agricultural related activities. Another related issue, but not yet investigated, is the disposal of waste from the many sewage treatment plants in the area or leachate from septic systems in the rapidly developing I-5 corridor. Based on study results, pesticides in ground water are not a major concern.

A better understanding of the effects on ground water from all types of agricultural related practices is needed. These include fish farms, poultry raising, turf farming, dairies, food processing, and other practices where a waste stream is either stored over an aquifer or is applied as land treatment.

## References

Carey, B., 1992. Results of Ground Water Sampling at National Frozen Foods/Midway Meats, Centralia, October 1991. Washington State Department of Ecology, Olympia, WA. 12 pp.

DOH, 1995. Results of the Areawide Ground Water Monitoring Project (DRAFT). Division of Drinking Water, Department of Health.

Erickson, D., 1990a. Rochester Ground Water Quality Investigation. Washington State Department of Ecology, Olympia, WA. 23 pp.

Erickson, D., 1990b. Global Aqua Start Up Ground Water Monitoring Investigation, Rochester, Washington. Memorandum to John Bernhardt. Washington State Department of Ecology, Olympia, WA. 11 pp.

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Larson, A., 1994. Pesticide Residues in the East Chehalis Surficial Aquifer, Pesticides in Ground Water - Report No. 5. Washington State Department of Ecology, Olympia, WA. 10 pp.

# Chapter 6. Compliance Inspections

by

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## Introduction

In the Western Olympic watershed there are currently 31 dischargers that have permits under the National Pollution Discharge Elimination System (NPDES) and 18 dischargers that are permitted under the State Waste Discharge Permit Program (WAC 173-216). These include:

- NPDES Major Permits - 2 Industrial, 4 Municipal
- NPDES Minor Permits - 13 Industrial, 12 Municipal
- State Discharge to Publicly Owned Treatment Works (POTW) Permits- 11 Industrial
- State Discharge to Ground Permits - 3 Industrial, 3 Municipal

The following summarizes the information from one industrial and three municipal discharge facilities that have had EILS enhanced or limited Class II Inspections over the last ten years. Ground water inspections of facilities that land apply effluent have also been included. All other facilities have either not been inspected or were inspected more than ten years ago. Data from studies more than ten years old are considered unrepresentative of current treatment facility effluent characteristics and these studies are not referenced. It should be noted that data from Class II Inspections more than five years old may also be non-representative of current facility effluent and should be viewed with caution.

## Review of Inspections

Results of ground water sampling at National Frozen Foods/Midway Meats, Centralia, in October 1991 found that four constituents exceeded Washington State Ground Water Quality Standards: pH, total dissolved solids, iron, and fecal coliform bacteria (Carey, 1992). In addition, several parameters were found at higher concentrations in wells downgradient of the land application site than in the upgradient well. These parameters included five-day biological oxygen demand ($BOD_5$), ammonia, chloride, specific conductance, iron, total dissolved solids (TSS), total suspended solids, total phosphorus, and sodium.

Limited Class II Inspections were conducted at eight NPDES permitted dischargers in the Chehalis River Basin, August 1991-August 1992 (Das, 1993). All facilities were operating reasonably well at the time of inspection and met effluent discharge limitations with the following exceptions:

Centralia WWTP - Effluent did not meet the requirement of 85% removal for $BOD_5$ and TSS in August 1991. Increases in wastewater loads in the ensuing years since the last inspection may have compounded the problem and increased effluent discharge concentrations.

Chehalis WWTP - Effluent had high levels of residual chlorine.

Pe Ell WWTP - Removal efficiency for $BOD_5$ was marginally less than the 85% requirement, and the design flow was exceeded.

Darigold WWTP - Plant failed to meet permit limits for fecal coliform, residual chlorine, and TSS concentrations. $BOD_5$ and TSS loadings in the effluent were excessive.

Fish Farms - Effluents collected from four fish farms met NPDES permit limits for settleable solids and TSS.

Ecology conducted a Class II Inspection at the Maple Lane School WWTP on October 22-23, 1991 (Das, 1992). High concentrations of arsenic, copper, mercury, and zinc were found in the wastewater. Four base-neutral-acid compounds and three volatile organic carbon compounds were also detected.

A Class II Inspection was conducted at the McCleary WWTP on August 26-27, 1986 (Reif, 1987). The inspection indicated no NPDES permit violations.

## Conclusions and Recommendations

- Major industrial dischargers who have not received a Class II Inspection during the last five years include: Pacific Power & Light and Centralia Mining Company.
- Major municipal dischargers who have not received a Class II Inspection during the last five years include: Hoquiam; Centralia; Chehalis; and Aberdeen.
- Minor industrial dischargers who have not received a Class II Inspection during the last five years and whose NPDES permits have either expired or are near expiration include: Bay

Fish & Oyster; National Frozen Foods (Repack); Associated Seafoods; Conifer Pacific; Darigold; Washington Crab; Sea Farm of Satsop Company; and Qualicast.

- Minor municipal dischargers who have not received a Class II Inspection during the last five years and whose NPDES permits have either expired or are near expiration include: Westport; Elma; Ocean Shores; McCleary; Lewis County Water District 2; Montesano; Pacific Beach; Cedar Creek; Maple Lane School; Olympic Correction Center; and Bogies Truck Stop.

Based on consideration of location on 303(d) waterbodies, Class II Inspections conducted, permit expiration date, and size of the discharge, Class II Inspections are recommended for the following high priority facilities:

Industrials - Pacific Power & Light Company, Centralia Mining Company, Darigold, and National Frozen Foods

Municipals - Hoquiam, Centralia, Chehalis, and Aberdeen

## References


Carey, B., 1992. Results of Ground Water Sampling at National Frozen Foods/Midway Meats, Centralia, October 1991. Technical Document, Washington State Department of Ecology, Olympia, WA. 12 pp.+ append.

Das, T., 1992. Maple Lane School, Centralia, Basin Class II Inspection on October 22-23, 1991. Technical Document, Washington State Department of Ecology, Olympia, WA. 8 pp. + append.

------, 1993. Chehalis River Basin Class II Inspections at Eight NPDES Permitted Dischargers, August 1991-August 1992. Washington State Department of Ecology, Olympia, WA. 54 pp.

Reif, D., 1987. McCleary Wastewater Treatment Plant Class II Inspection. Washington State Department of Ecology, Olympia, WA. 12 pp.

# Appendix A

## 1996 Section 303(d) List Decision Matrix

(current to August 28, 1995)

| WATERBODY SEGMENT NUMBER | WATERBODY NAME | PARAMETERS EXCEEDING STANDARDS | BASIS FOR LISTING (strikeouts indicate citation is not in administrative record) | SCHEDULED OR COMPLETED ACTIVITIES EXPECTED TO ACHIEVE WATER QUALITY STANDARDS | LISTING DECISION |
|---|---|---|---|---|---|
| WA-20-1033 | MAXFIELD CREEK | Temperature | Quileute Tribe data show numerous excursions beyond criteria between 6/22/92 and 9/28/92 at T28N-R14W-S28. | | Retain |
| WA-20-1200 | KAHKWA CREEK | Temperature | Hoh Tribe data show 13 excursions beyond criteria between 7/1/92 and 8/31/92.<br><br>These measurements were collected in Olympic National Park virgin old growth forest and represent natural conditions, which are not a violation of state standards. | | Remove |
| WA-20-1300 | MOSQUITO CREEK | Temperature | Hoh Tribe data show 2 excursions beyond criteria between 7/1/92 and 8/31/92.<br>These measurements were collected in Olympic National Park virgin old growth forest and represent natural conditions, which are not a violation of state standards. | | Remove |
| WA-20-2090 | FISHER CREEK | Temperature | Hoh Tribe data show 47 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2100 | SPLIT CREEK | Temperature | Hatten, 1992. = shows 47 excursions beyond criteria in 1991.;<br><br>Hoh Tribe data show 54 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2110 | LINE CREEK | Temperature | Hoh Tribe data show 20 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2150 | NOLAN CREEK | Temperature | Hoh Tribe data show 49 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2200 | ANDERSON CREEK | Temperature | Hoh Tribe data show 11 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2270 | WINFIELD CREEK | Temperature | Hoh Tribe data show 44 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2275 | ELK CREEK | Temperature | Horrocks and Lombard, 1995. = 11 excursions beyond criteria during 1994. | | Retain |
| WA-20-2280 | ALDER CREEK | Temperature | Hoh Tribe data show 31 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |

| WATERBODY SEGMENT NUMBER | WATERBODY NAME | PARAMETERS EXCEEDING STANDARDS | BASIS FOR LISTING (strikeouts indicate citation is not in administrative record) | SCHEDULED OR COMPLETED ACTIVITIES EXPECTED TO ACHIEVE WATER QUALITY STANDARDS | LISTING DECISION |
|---|---|---|---|---|---|
| WA-20-2300 | WILLOUGHBY CREEK | Temperature | Hatten, 1992. = shows 16 excursions beyond criteria in 1991.;<br><br>Hoh Tribe data show 35 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2330 | ROCK CREEK | Temperature | Hoh Tribe data show 30 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2350 | TOWER CREEK | Temperature | Hoh Tribe data show 2 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2400 | MAPLE CREEK | Temperature | Hoh Tribe data show 9 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2500 | OWL CREEK | Temperature | Hatten, 1992. = shows 18 excursions beyond criteria in 1991.;<br><br>Hoh Tribe data show 34 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2600 | CANYON CREEK | Temperature | Hoh Tribe data show 2 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-20-2800 | UNNNAMED CREEK Q | Temperature | Hoh Tribe data show 6 excursions beyond criteria between 7/1/92 and 8/31/92.<br>These measurements were collected in Olympic National Park virgin old growth forest and represent natural conditions, which are not a violation of state standards. | | Remove |
| WA-20-5010 | COAL CREEK | Temperature | Quileute Tribe data show numerous excursions beyond criteria between 6/23/92 and 9/28/92 at T28N-R15W-S12 and T29-R15W-S35. | | Retain |
| WA-20-5100 | DICKEY RIVER, W.F. | Temperature | Quileute Tribe data show numerous excursions beyond criteria between 7/19/90 and 10/14/91 at T29N-R14W-S30 and T30-R14W-S21. | | Retain |
| WA-20-5200 | DICKEY RIVER, E.F. | Temperature | Quileute Tribe data show numerous excursions beyond criteria between 7/19/90 and 9/20/90 at T29N-R14W-S29 and T30-R13W-S30. | | Retain |
| WA-20-5300 | DICKEY RIVER, M.F. | Temperature | Quileute Tribe data show 2 excursions beyond criteria between 7/24/91 and 7/30/91 at T30N-R14W-S14 and T30-R14W-S23. | | Retain |
| WA-20-6210 | CROOKED CREEK, N.F. | Temperature | Quileute Tribe data show numerous excursions beyond criteria between 6/23/92 and 9/28/92 at T30N-R14W-S29. | | Retain |

| WATERBODY SEGMENT NUMBER | WATERBODY NAME | PARAMETERS EXCEEDING STANDARDS | BASIS FOR LISTING (strikeouts indicate citation is not in administrative record) | SCHEDULED OR COMPLETED ACTIVITIES EXPECTED TO ACHIEVE WATER QUALITY STANDARDS | LISTING DECISION |
|---|---|---|---|---|---|
| WA-21-1010 | QUEETS RIVER | Temperature | 1 excursion beyond criteria at Ecology ambient monitoring station 21A070 on 7/26/94.<br>A single excursion does not meet the Program policy for listing. | | Remove |
| | | Fecal Coliform | 1 excursion beyond criteria at Ecology ambient monitoring station 21A070 in 10/93.<br>A single excursion does not meet the Program policy for listing. | | Remove |
| WA-21-1100 | COAL CREEK | Temperature | Hoh Tribe data show 3 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-21-2010 | HOQUIAM RIVER | Temperature | 3 excursions beyond criteria at Ecology ambient monitoring station 21B090 on 7/26/94, 8/23/94, 9/27/94. | | Retain |
| WA-21-3000 | KALALOCH CREEK | Temperature | Hoh Tribe data show 10 excursions beyond criteria between 7/1/92 and 8/31/92. | | Retain |
| WA-21-4000 | JOE CREEK | Dissolved Oxygen | Seiders, 1995. = 2 excursions beyond criteria on 8/31/94 and 9/27/94. | | Retain |
| | | Fecal Coliform | Seiders, 1995. = 2 excursions beyond criteria on 8/31/94 and 9/27/94. | | Retain |
| WA-22-0020 | GRAYS HARBOR (OUTER) | Temperature | 4 excursions beyond criteria at Ecology ambient monitoring station GYS015 on 6/23/86, 6/1/93, 7/13/93, and 8/2/93.;<br><br>4 excursions beyond criteria at Ecology ambient monitoring station GYS016 on 6/32/86, 7/29/91, 7/13/93, and 8/2/93.<br><br>These excursions beyond criteria are a natural condition with no direct anthropogenic influence due to solar heating of the surface water based on the 4/95 judgement of Jan Newton (Dept. of Ecology) | | Remove |
| | | Dissolved Oxygen | 2 excursions beyond criteria at Ecology ambient monitoring station GYS015 on 5/26/87 and 7/27/92.;<br><br>2 excursions beyond criteria at Ecology ambient monitoring station GYS016 on 7/15/85 and 5/26/87. | | Retain |

| WATERBODY SEGMENT NUMBER | WATERBODY NAME | PARAMETERS EXCEEDING STANDARDS | BASIS FOR LISTING (strikeouts indicate citation is not in administrative record) | SCHEDULED OR COMPLETED ACTIVITIES EXPECTED TO ACHIEVE WATER QUALITY STANDARDS | LISTING DECISION |
|---|---|---|---|---|---|
| WA-22-0030 | GRAYS HARBOR (INNER) | Fecal Coliform | 8 excursions beyond criteria at Ecology ambient monitoring station GYS004 between 1985 and 1993.;<br>5 excursions beyond criteria at Ecology ambient monitoring station GYS007 between 1984 and 1987.;<br>6 excursions beyond criteria at Ecology ambient monitoring station GYS008 between 1984 and 1992.;<br>3 excursions beyond criteria at Ecology ambient monitoring station GYS009 between 1984 and 1990.;<br>Dept. of Health Prohibited Commercial Shellfish Area based on water quality surveys. | | Retain |
| | | pH | 7 excursions beyond criteria at Ecology ambient monitoring station GYS004 between 1990 and 1993.;<br>1 excursion beyond criteria at Ecology ambient monitoring station GYS008 on 2/7/89. | | Retain |
| | | Dioxin | EPA National Bioaccumulation Survey = excursions beyond criteria in samples of flounder tissues. | TMDL based on permits for Weyerhaueser at Cosmopolis and ITT Rayonier at Hoquiam submitted on 3/9/92;<br>EPA approved the TMDL on 7/2/92. | Remove |
| | | Temperature | 6 excursions beyond criteria at Ecology ambient monitoring station GYS004 between 1988 and 1991.;<br>4 excursions beyond criteria at Ecology ambient monitoring station GYS008 between 1989 and 1993.;<br>4 excursions beyond criteria at Ecology ambient monitoring station GYS009 between 19189 and 1993.<br>These excursions beyond criteria are a natural condition with no direct anthropogenic influence due to solar heating of the surfcae water based on the 4/95 judgement of Jan Newton (Dept. of Ecology) | | Remove |
| WA-22-1010 | HUMPTULIPS RIVER | Temperature | 6 excursions beyond criteria at Ecology ambient monitoring station 22A070 between 1985 and 1994. | | Retain |

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|---|---|---|---|---|---|
| | | Fecal Coliform | 1 excursion beyond criteria at Ecology ambient monitoring station 22A070 in 10/89.<br>A single excursion does not meet the program policy for listing. | | Remove |
| WA-22-4025 | BLACK CREEK | Temperature | Rashin and Graber, 1992. | | Retain |
| WA-22-4040 | CHEHALIS RIVER | Fecal Coliform | 21 excursions beyond criteria at Ecology ambient monitoring station 22C050 between 1984 and 1990. | | Retain |
| | | Temperature | 12 excursions beyond criteria at Ecology ambient monitoring station 22C050 between 1985 and 1992. | | Retain |
| WA-22-4045 | WILDCAT CREEK | Temperature | Kendra, 1987. | | Retain |
| | | Dissolved Oxygen | Kendra, 1987.;<br>Musgrove, 1977. | TMDL based on effluent limits placed on the McCleary wastewater discharge submitted 3/9/92;<br>EPA approved the TMDL on 2/12/93. | Remove |
| | | Fecal Coliform | Kendra, 1987.;<br>Musgrove, 1977. | TMDL based on effluent limits placed on the McCleary wastewater discharge submitted 3/9/92;<br>EPA approved the TMDL on 2/12/93. | Remove |
| | | Ammonia-N | Kendra, 1987.;<br>Musgrove, 1977. | TMDL based on effluent limits placed on the McCleary wastewater discharge submitted 3/9/92;<br>EPA approved the TMDL on 2/12/93. | Remove |
| | | Chlorine | Kendra, 1987.;<br>Musgrove, 1977. | TMDL based on effluent limits placed on the McCleary wastewater discharge submitted 3/9/92;<br>EPA approved the TMDL on 2/12/93. | Remove |
| WA-22-4050 | SATSOP RIVER | Fecal Coliform | 1 excursion beyond criteria at Ecology ambient monitoring station 22G070 in 10/89.<br>A single excursion does not meet the Program policy for listing. | | Remove |
| WA-22-4085 | RABBIT CREEK | Temperature | Rashin and Graber, 1992. = 14 excursions beyond criteria measured in 1991. | | Retain |
| WA-22-9030 | DUCK LAKE | Total Phosphorus | Completed Phase I State Clean Lakes Restoration Project in 1994:<br>KCM, 1994. | | Retain |

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|---|---|---|---|---|---|
| WA-23-1010 | CHEHALIS RIVER | Temperature | 22 excursions beyond criteria at Ecology ambient monitoring station 23A070 between 1985 and 1994.; Pickett, 1994a. | | Retain |
| | | Dissolved Oxygen | 2 excursions beyond criteria at Ecology ambient monitoring station 23A070 on 8/25/86 and 6/22/92.; Pickett, 1994a. | | Retain |
| | | PCBs | Hart Crowser, 1995. = edible mountain whitefish tissue exceed criteria. | | Retain |
| | | Fecal Coliform | 9 excursions beyond criteria at Ecology ambient monitoring station 23A070 between 1984 and 1992.; 3 excursions beyond criteria at USGS station 12031000 between 7/1/87 and 7/1/91 | | Retain |
| WA-23-1014 | GARRARD CREEK | Dissolved Oxygen | Pickett, 1994a. | | Retain |
| WA-23-1015 | BLACK RIVER | Fecal Coliform | 2 excursions beyond criteria at Ecology ambient monitoring station 23E070 in 11/90 and 1/91.; Pickett, 1994a. Coots, 1994. Dickes, 1990. | | Retain |
| | | Dissolved Oxygen | 9 excursions beyond criteria at Ecology ambient monitoring station 23E070 between 1990 and 1991.; Pickett, 1994a. Dickes, 1990. | | Retain |
| | | Temperature | 1 excursion beyond criteria at Ecology ambient monitoring station 23E070 on 7/30/90.; Pickett, 1994a. Dickes, 1990. | | Retain |
| WA-23-1017 | INDEPENDENCE CREEK | Dissolved Oxygen | Pickett, 1994a. | | Retain |

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|---|---|---|---|---|---|
| WA-23-1018 | SCATTER CREEK | Temperature | Pickett, 1994a. | | Retain |
| | | pH | Pickett, 1994a. | | Retain |
| | | Fecal Coliform | Pickett, 1994a. | | Retain |
| WA-23-1019 | LINCOLN CREEK | Dissolved Oxygen | Pickett, 1994a. | | Retain |
| | | Fecal Coliform | Pickett, 1994a. | | Retain |
| WA-23-1020 | CHEHALIS RIVER | Temperature | 19 excursions beyond criteria at Ecology ambient monitoring station 23A120 between 1985 and 1993.;<br><br>Pickett, 1994a. | | Retain |
| | | Dissolved Oxygen | 1 excursion beyond criteria at Ecology ambient monitoring station 23A120 on<br>7/25/89.;<br><br>Pickett, 1994a. | | Retain |
| | | pH | 2 excursions beyond criteria at Ecology ambient monitoring station 23A120 on 7/25/89 and 11/27/90. | | Retain |
| | | Fecal Coliform | 11 excursions beyond criteria at Ecology ambient monitoring station 23A120 between 1/1/90 and 1/1/92.;<br><br>Pickett, 1994a. | | Retain |
| WA-23-1023 | SALZER CREEK | Dissolved Oxygen | Crawford, 1987.;<br>Pickett, 1994a. | | Retain |
| | | Temperature | Crawford, 1987.<br>Pickett, 1994a. | | Retain |
| | | Fecal Coliform | Crawford, 1987.<br>Pickett, 1994a. | | Retain |
| WA-23-1024 | COAL CREEK | Dissolved Oxygen | Pickett, 1994a. | | Retain |
| | | Fecal Coliform | Pickett, 1994a. | | Retain |

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|---|---|---|---|---|---|
| WA-23-1027 | DILLENBAUGH CREEK | Dissolved Oxygen | Crawford, 1987.<br>Pickett, 1994a. | | Retain |
| | | Temperature | Crawford, 1987.<br>Pickett, 1994a. | | Retain |
| | | Fecal Coliform | Crawford, 1987.<br>Pickett, 1994a. | | Retain |
| WA-23-1028 | BERWICK CREEK | Fecal Coliform | Pickett, 1994a. | | Retain |
| WA-23-1030 | SKOOKUMCHUCK RIVER | Temperature | Pickett, 1994a. | | Retain |
| | | pH | Pickett, 1994a. | | Retain |
| WA-23-1070 | NEWAUKUM RIVER | Fecal Coliform | 4 excursions beyond criteria at Ecology ambient monitoring station 23B070 between 1992 and 1993. | | Retain |
| | | Temperature | Pickett, 1994a. | | Retain |
| WA-23-1080 | NEWAUKUM RIVER, N.F. | Fecal Coliform | 12 excursions beyond criteria at Ecology ambient monitoring station 23C070 between 10/74 and 9/75. Data has not been collected at this station since 1975. | | Retain |
| WA-23-1100 | CHEHALIS RIVER | Temperature | 17 excursions beyond criteria at Ecology ambient monitoring station 23A160 between 1985 and 1994. | | Retain |
| | | Dissolved Oxygen | Pickett, 1994a. | | Retain |
| | | pH | 2 excursions beyond criteria at Ecology ambient monitoring station 23A160 on 1/29/90 and 5/27/91. | | Retain |
| | | Fecal Coliform | 4 excursions beyond criteria at Ecology ambient monitoring station 23A160 between 1986 and 1993.;<br><br>Pickett, 1994a. | | Retain |
| WA-23-1102 | STEARNS CREEK | Dissolved Oxygen | Pickett, 1994a. | | Retain |
| WA-23-1104 | BUNKER CREEK | Dissolved Oxygen | Pickett, 1994a. | | Retain |
| | | Fecal Coliform | Pickett, 1994a. | | Retain |

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|---|---|---|---|---|---|
| WA-23-1106 | CHEHALIS RIVER, S.F. | Temperature | Pickett, 1994a. | | Retain |
| | | Fecal Coliform | Pickett, 1994a. | | Retain |
| WA-23-1108 | ELK CREEK | Fecal Coliform | Pickett, 1994a. | | Retain |
| WA-23-1110 | CHEHALIS RIVER | Temperature | 17 excursions beyond criteria at Ecology ambient monitoring station 23A160 between 1985 and 1994. | | Retain |
| | | pH | 2 excursions beyond criteria at Ecology ambient monitoring station 23A160 on 1/29/90 and 5/27/91. | | Retain |
| | | Fecal Coliform | 4 excursions beyond criteria at Ecology ambient monitoring station 23A160 between 1986 and 1993. | | Retain |
| WA-23-2010 | MIMA CREEK | Fecal Coliform | Coots, 1994. | | Retain |
| WA-23-2015 | MILL CREEK | Fecal Coliform | 1 excursion beyond criteria at Ecology ambient monitoring station 23F070 in 3/93.<br>A single excursion does not meet the Program policy for listing. | | Remove |
| WA-23-2020 | BEAVER CREEK | Fecal Coliform | Coots, 1994. | | Retain |
| WA-23-2021 | LITTLEROCK DITCH | Fecal Coliform | Coots, 1994. | | Retain |
| WA-23-9010 | BLACK LAKE | Total Phosphorus | Phase I State Clean Lakes Restoration Project grant awarded in 1994 was declined by Thurston County which had applied for the grant.<br>Problems Encountered: Recreational uses have been severly curtailed due to severe blue-green algae blooms. Complaints have been made about skin irritation after swimming from contact with algae. Area residents and resort operators report that frequency and longevity of algae blooms have been increasing in recent years. | | Retain |
| WA-23-9030 | CARLISLE LAKE | Total Phosphorus | Completed Phase I State Clean Lakes Restoration Project in 1985 - Problems Encountered: Blue-green algae, tributary nutrient inputs, aquatic macrophytes, high turbidity, fecal coliform bacteria. | Completed Phase II State Clean Lakes Restoration Project in 1991 - Control Measures Implemented: Sediment removal/dredging, watershed nutrient management (dairy waste BMPs, streambank fencing):<br>Moore, 1990. | Remove |