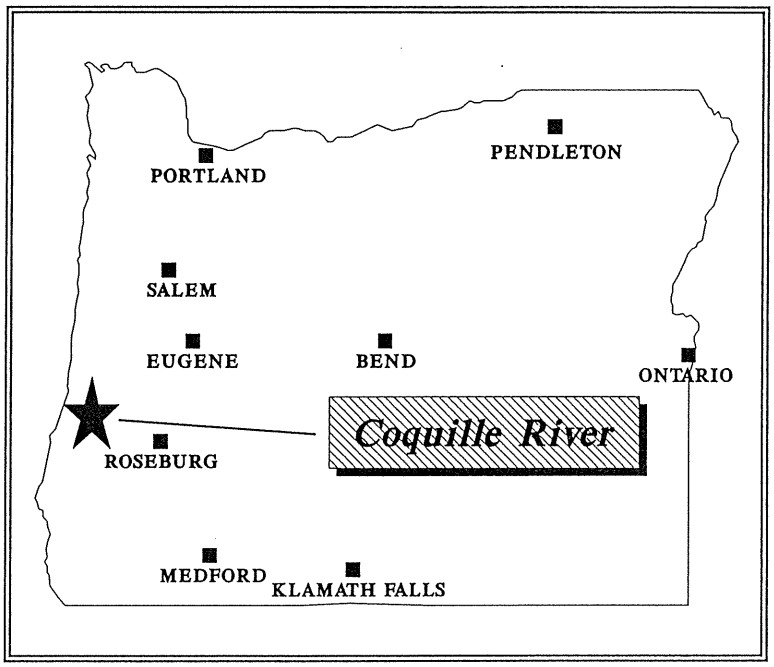
March 1994

Coquille River & Estuary

Water Quality Report

Total Maximum Daily Load Program



State of Oregon

Department of Environmental Quality
Standards & Assessments Section
811 Sixth Avenue
Portland, Oregon 97204

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Coquille River & Estuary

Water Quality Report

Total Maximum Daily Load Program

This report describes the work that the Oregon Department of Environmental Quality (DEQ) has conducted to address water quality concerns in the Coquille River and Estuary. The assessment is part of the Total Maximum Daily Load (TMDL) process within DEQ's Water Quality Program and reflects the State's water-quality-based approach to water quality problems.

For more information on the State's TMDL Program, contact:

Robert Baumgartner

TMDL Program Manager
Department of
Environmental Quality
811 S.W. Sixth Avenue
Portland, OR 97204
(503) 229-5877

For questions regarding Permit Wasteload Allocations, contact:

Dick Nichols

WQ Technical Serv. Manager
Department of
Environmental Quality
2020 SW 4th Avenue, #400
Portland, OR 97201
(503) 229-5323

To receive additional copies of this or other TMDL reports, contact:

Elizabeth Thomson

Technical Reports Editor
Department of
Environmental Quality
811 S.W. Sixth Avenue
Portland, OR 97204
(503) 229-5358

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Oregon's Total Maximum Daily Load Program

OVERVIEW

BENEFICIAL USES

The quality of Oregon's streams, lakes, estuaries, and groundwaters is monitored by the Department of Environmental Quality (DEQ). The information collected by DEQ is used to determine whether water quality standards are being violated and, consequently, whether the **beneficial uses** of the waters are being threatened. The beneficial uses include fisheries, aquatic life, drinking water, recreation, shellfish, irrigation, hydroelectric power, and navigation. Specific State and Federal rules are used to determine if violations have occurred: these rules include the *Federal Clean Water Act of 1972*, Oregon's Revised Statutes (ORS), and Oregon's Administrative Rules (OAR Chapter 340).

WATER QUALITY LIMITED STREAMS AND TOTAL MAXIMUM DAILY LOADS

The term **water quality limited** is applied to streams and lakes where required treatment processes are being used but violations of water quality standards occur. With a few exceptions, such as in cases where violations are due to natural causes, the State must establish a **Total Maximum Daily Load** or **TMDL** for any waterbody designated as water quality limited. A **TMDL** is the total amount of a pollutant (from all sources) that can enter a specific waterbody without violating the water quality standards.

WASTELOAD AND LOAD ALLOCATIONS

The total permissible pollutant load is allocated to point, nonpoint, background, and future sources of pollution. **Wasteload allocations** are portions of the total load that are allotted to point sources of pollution, such as sewage treatment plants or industries. The wasteload allocations are used to establish effluent limits in discharge permits. **Load allocations** are portions of the total load that are attributed to either natural background sources, such as soils, or from nonpoint sources, such as agricultural or forestry activities. Allocations can also be set aside in reserves for future uses.

TMDL PROCESS

The establishment of TMDLs is required by Section 303 of the Clean Water Act. The process of establishing a TMDL includes studying existing data, collecting additional data to answer specific questions, using mathematical models to predict the effects of changes in wasteloads, evaluating alternative strategies for implementation, and holding public hearings and allowing public comment on the TMDL.

PURPOSE OF THIS REPORT

This report provides information on one of the waterbodies in Oregon's TMDL Program. The report includes background information on the drainage basin, the pollution sources, and the applicable water quality standards; a summary of the monitoring data and the technical analyses; and a discussion of the current pollution control strategy.

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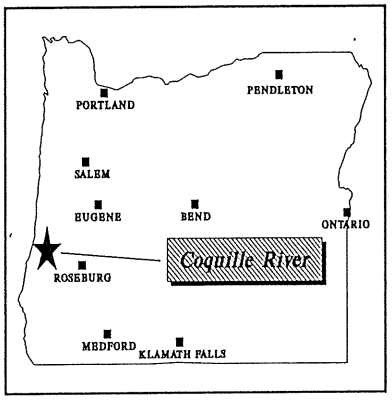
Coquille River & Estuary

WQ CONCERNS AT A GLANCE:

Water Quality Limited?	*Yes*
Segment Identifiers:	*14B-COQU, 14B-COSF, 14B-CONF*
Parameter of Concern:	*Dissolved Oxygen*
Uses Affected:	*Aquatic Life*
Known Sources:	*Point Sources — STPs* and Industries*
	Nonpoint Sources — Agriculture and Forestry



BACKGROUND INFORMATION

The Coquille is the longest river in Oregon's South Coast Basin. Including the South Fork, which is one of the river's major tributaries, the Coquille measures almost 100 miles in length. The river drains a watershed that encompasses 1,058 square miles. The watershed is predominantly mountainous with a narrow lowland valley region. Approximately three miles from the mouth, the river widens and empties into the long, narrow Coquille Estuary before entering the Pacific Ocean near the town of Bandon. The lower 37 miles of the river are tidally influenced.

Rainfall in the watershed follows a seasonal pattern of wet winters and dry summers. Annual precipitation ranges from 50 to 100 inches per year, with the largest amount occurring in the winter months. The Coquille has a mean annual discharge of 3,288 cubic feet per second or 2,400,000 acre-feet per year. Ninety percent of the discharge occurs between November and April.

Many of the residents of the Coquille Basin live and work near the estuary. Development in the basin is concentrated in the communities of Coquille (population 4,330), Myrtle Point (population 2,700), Bandon (population 2,500), and Powers (population 750). Land use in the Coquille Basin is a mix of forestry, agriculture, and small communities. Approximately 76 percent of the land in the basin is forested. The vast majority of the forest land in the basin is designated for commercial harvest and is held by the Bureau of Land Management, the U.S. Forest Service, and by large industrial owners. Agriculture and livestock grazing account for approximately 6 percent of the land use. Agricultural land in the fertile river valley is used for dairy pasture, for hay and silage production, and for growing fruit, berries, and specialty produce. Beef cattle and sheep graze in both valley and upland areas. Less than 5 percent of the basin is dedicated to residential, commercial, and industrial development, with "other uses" accounting for the remaining 13 percent of the land.

The economy of the basin is based largely on forestry, agriculture, and tourism. Many of the recreational and tourist activities in the basin — such as harvesting shellfish, angling for anadromous and resident fish, and boating — are dependent on the area's natural resources. Fish and wildlife are abundant in the basin. Near the estuary, eelgrass beds, wetlands, and tidal flats provide critical habitat and refuge for

* Sewage Treatment Plants.

many species of terrestrial and aquatic life. Many species use the estuary for feeding, spawning, breeding, and nesting.

WATER QUALITY CONCERNS

Available Monitoring Data

The Oregon Department of Environmental Quality (DEQ) has monitored the ambient water quality of the Coquille River and its tributaries since 1976. Because of concerns related to low levels of dissolved oxygen and high levels of bacteria, DEQ initiated more extensive data collection in 1989: monitoring sites were located on all major tributaries to the tidally influenced lower 39 miles; on selected minor tributaries; in the ocean; at major point-source discharges; and at approximate one-mile intervals of the mainstem. During the intensive surveys, monitoring sites throughout the river system were sampled at approximately the same time so that data would be directly comparable; these surveys are referred to as "synoptic" surveys.

To complement DEQ's efforts, the City of Bandon contracted with Brown and Caldwell Engineers to conduct a study describing the amount of mixing and the fate of effluent from the Bandon sewage treatment plant. Results of the data collection efforts are presented in Appendix C.

Applicable Water Quality Standards

Water quality standards presented in the Oregon Administrative Rules (OARs) for the South Coast Basin are applicable to stream segments within the Coquille drainage. Criteria values have been adopted as regulatory standards for a number of water quality parameters, including dissolved oxygen, bacteria, and nutrients. Current State rules also identify minimum treatment requirements for the basin. Existing policies for establishing permit conditions include: the dilution rule [OAR 340-41-335]; the antidegradation policy [340-41-026 (1)(a)]; and the narrative rule which states that, in certain situations, natural background becomes the standard [340-41-325 (3)]. (See Appendix B for additional information.)

Dissolved Oxygen: Dissolved oxygen is critical for the protection of aquatic life. The applicable dissolved oxygen criteria, as listed in OAR 340-41-325(2)(a) for the Coquille, are:

- *Freshwaters* — 90 percent of saturation (95 percent in active spawning areas).
- *Estuarine Waters* — 6.0 milligrams per liter (mg/L).
- *Marine Waters* — Not less than saturation.

Bacteria: Water quality standards for bacteria have been established to protect water-contact recreation (e.g., swimming) and shellfish harvesting. Current criteria for bacterial pollution as listed in OAR 340-41-325(2)(e) are:

- *Water-Contact Recreation* — 200/100 ml Fecal coliform.
- *Shellfish Harvesting* — 14/100 ml Fecal coliform.

Nutrients: OAR 340-41-150 addresses nuisance phytoplankton growth resulting from excessive nutrients such as phosphorus. For rivers and estuaries, chlorophyll ***a*** values above 0.015 mg/L are used to identify waterbodies where phytoplankton may impair the recognized beneficial uses. A federal guidance level of 0.1 mg/L total phosphorus is also used to indicate nutrient levels which are likely to degrade aesthetic quality.

Minimum Treatment Requirements: OAR 340-41-335 sets minimum design criteria for treatment and control of sewage wastes. Limits of 20 mg/L for biochemical oxygen demand (BOD) and 20 mg/L for total suspended solids are included.

Beneficial Uses

The designated uses of the Coquille River system are identified in Oregon's Administrative Rules (OARs). Uses include water supply, aquatic life, shellfish harvesting, recreation, and aesthetics. The criteria used to evaluate the level of support of beneficial uses are described in Appendix B.

Oregon's *1992 Water Quality Status Assess-*

ment Report (also referred to as the *305(b) Report*) lists those streams where beneficial uses are not fully supported. The beneficial use found to be most at risk in the Coquille system is aquatic life, which is listed as not supported. Water contact is listed as partially supported in most of the Coquille River; in some portions of the estuary, water contact is not supported and aesthetic quality is partially supported.

Segments of Concern

The term **water quality limited** is applied to streams and lakes where required treatment processes are being used but violation of water quality standards occur. With a few exceptions, such as in cases where violations are due to natural causes, the State must establish a **total maximum daily load (TMDL)** for the specific problem parameters. After the TMDLs are established, wasteload and load allocations are assigned to the contributing point and nonpoint sources.

Three segments in the Coquille Basin have been identified as **water quality limited** in Oregon's *1992 Water Quality Status Assessment Report* [*1992 305(b) Report*]:

Segment	Name	Boundaries
14B-COQU	Coquille River	R.M. 0 — 39
14B-COSF	S.F. Coquille River	R.M. 0 — 30
14B-CONF	N.F. Coquille River	R.M. 0 — 10

Primary Parameters of Concern

Dissolved Oxygen: The Coquille River has been identified as water quality limited due to violations of the State's dissolved oxygen standard (see *Applicable Water Quality Standards*). Ambient water quality monitoring indicates that the Coquille Estuary and portions of the North and South Forks experience periodic low levels of dissolved oxygen. A TMDL has been established to address the dissolved oxygen problem.

Bacteria: Although fecal coliform levels exceed standards in some segments, the Coquille has not currently been designated for TMDL development to address bacteria concerns; the effectiveness of other regulatory mechanisms must first be evaluated.

Additional Water Quality Concerns

Additional concerns regarding nutrients, sedimentation, and loss of wetlands are described in Appendix A. Although these are not included in the TMDL process for the Coquille River, they are being addressed by DEQ and other agencies.

POLLUTION SOURCES

Water quality in the Coquille drainage is affected by both point-source and nonpoint-source discharges. Point sources include several municipal wastewater treatment plants, as well as industrial sources such as forest-products facilities. Major nonpoint sources include runoff from both agriculture and forestry activities. Water-quality-limited segments above the estuary are affected by many of the same sources because of tidal currents which can carry pollutants upstream.

Point Sources

Permitted point sources in the Coquille River Basin are regulated by individual and general National Pollution Discharge Elimination System (NPDES) permits and by Water Pollution Control Facilities (WPCF) permits. The WPCF permits do not allow direct discharge to surface waters; disposal of wastewater is typically accomplished by spray irrigation.

Municipal Sewage Treatment Plants: Sewage treatment plants (STPs) in the Coquille Basin are located at Bandon, Coquille, Powers and Myrtle Point. Under their NPDES permits, the Bandon, Coquille and Powers facilities have been required to meet a standard of 20 milligrams per liter (mg/L) of five-day biochemical oxygen demand (BOD_5) for effluent discharged during dry-weather conditions; Myrtle Point's permit allows 30 mg/L. State-of-the-art technology could reasonably achieve an even lower limit of 10 mg/L.

Increases in measured BOD suggest that the Myrtle Point STP is a likely contributor to the reductions in dissolved oxygen levels which result in standards violations. A smaller increase in BOD was observed near the Coquille STP outfall. Studies indicate that the Bandon STP discharge does not significantly affect dissolved oxygen in the Coquille Estuary.

Other Municipal Sources: Bullards Beach State Park holds a no-discharge WPCF permit. The City of Coquille Water Plant holds a general NPDES permit for settling-basin washdown water.

Industrial Sources: Industrial sources in the Coquille Basin that hold NPDES or WPCF permits include: Bandon Fisheries (seafood processing), Roseburg Forest Projects (manufacture and storage of forest products), Main Rock Products (mining), and Erdman Packing (meat processing). Georgia Pacific Corporation operated a sawmill and plywood mill in Coquille until 1990.

Nonpoint Sources

Nonpoint source discharges in the Coquille watershed come from a variety of urban and rural areas. Although Best Management Practices are being implemented in some areas to control nonpoint source discharges from entering the Coquille River and Estuary, not all nonpoint source impacts have been eliminated. Potential nonpoint source impacts include erosion and bacterial contamination from the use of streambanks by livestock; sedimentation from previous forest-harvest activities in the upper watershed; bacteria from failing septic systems; and oils and toxics from roads.

POLLUTION CONTROL STRATEGY

DEQ has conducted an ongoing monitoring program in the basin, established a waste-treatment standard for the basin, developed preliminary and final TMDLs for the Coquille, and reviewed facility plans for the STPs in the basin. DEQ completed a Nonpoint Source Assessment for the basin in 1988 and is working with Designated Management Agencies to evaluate management practices that affect water-quality-limited stream segments.

In cases where waters do not meet water quality standards even after technology-based treatment controls have been applied, a **total maximum daily load (TMDL)** must be established which takes into account the capacity of the stream to assimilate wastes and the cumulative impact of all discharges.

Point Sources

Using the TMDL process, DEQ is addressing three major point sources on the Coquille River: Myrtle Point, Coquille, and Bandon. DEQ is currently working with these sources to establish wasteload allocations and to develop facility plans which will satisfy the TMDL requirements. The treatment facilities for the cities of Myrtle Point and Coquille are currently operating under Stipulated and Final Orders (SFOs) which describe interim effluent limits and provide timetables for complying with State regulations.

Myrtle Point STP: Effluent from the Myrtle Point STP generally meets Federal minimum design criteria. The dissolved oxygen sag in the Coquille river downstream of the outfall is presumed to result from BOD loading from the STP, however. The Myrtle Point STP violates several of the permit limits for its National Pollutant Discharge Elimination System (NPDES) permit and is currently under a Stipulated and Final Order to correct these violations. In order to meet permit limits, significant upgrades to the Myrtle Point plant are needed.

Prior to any proposed upgrade, an evaluation of the no-discharge option is required. Because of the potential effect of Myrtle Point's discharge on sediment oxygen demand (SOD) and on water quality, DEQ initially recommends the no-discharge option. Justification for alternative effluent-discharge limits needs to be made by evaluating costs and environmental impacts.

Coquille STP: Although the Coquille STP typically achieves its NPDES permit conditions, the observed effluent quality from the STP has been variable. The Coquille plant is currently under a Stipulated and Final Order (SFO) to improve treatment. The SFO requires that Coquille undertake a plant optimization study and implement the optimum treatment strategies

which the study generates. Although no major upgrades to the STP are required at this time to achieve permit conditions, the Coquille STP will need to justify discharging rather than adopting the no-discharge alternative when major plant upgrades are required in the future.

Bandon STP: A mixing-zone study conducted by Brown and Caldwell, along with DEQ's analysis, indicated that Bandon's discharge did not significantly affect dissolved oxygen in the water-quality-limited section of the Coquille. Therefore, no WLA strategy is required. However, Bandon has violated its permit conditions for bacterial pollution and suspended solids. Bandon's new treatment plant is expected to achieve those permit conditions.

Maximum Allowable Loads — TMDLs

Table 1 lists the total maximum daily loads which have been proposed by DEQ for total oxygen demand in the Coquille River. Preliminary wasteload allocations are listed in Table 2.

Table 1. TMDLs for UBOD for the Coquille River

Maximum Allowable Pollutant Loads to the Coquille River from June through October	
Streamflow (cfs)	**Maximum Total Ultimate Oxygen Demand (lb/d UBOD)**
50 to 75	270
75 to 100	405
100 to 125	540
125 to 150	675
150 to 175	810
175 to 200	945
200 to 250	1,080
250 to 300	1,350

Table 2. Preliminary Wasteload Allocations (1988)

Source	STP Loads			Estimated UBOD (lb/d)
	Flow (mgd)	$CBOD_5$ (mg/L)	Nitrogen (Total Kjeldahl) (mg/L)	
Coquille STP	0.76	10	4	200
Myrtle Point STP	0.36	10	4	100

Nonpoint Sources

Control of pollution from nonpoint sources will be addressed using existing regulations and strategies, including Memorandums of Agreement with other agencies and implementation of Best Management Practices. In the Coquille Basin, emphasis should be placed on reducing particulate organic matter and bacteria which are contributed by nonpoint sources.

WATER-QUALITY-RELATED PROJECTS IN THE BASIN

State and local agencies, cities, ports, and industries have joined in addressing water quality problems in the Coquille River Basin. Examples of recent activities include the Near Coastal Waters Pilot Project (DEQ and EPA); the Salmon Trout Enhancement Program (Oregon Department of Fish and Wildlife); Coordinated Resources Management Planning (Port of Coquille and the Soil and Water Conservation District); projects funded by the Governor's Watershed Enhancement Board; and studies and projects conducted by the Cities and Ports in the basin. (See Appendix A for additional information.)

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APPENDIX D — POLLUTION SOURCE SUMMARY

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APPENDIX A

EXPANDED BACKGROUND INFORMATION

GEOGRAPHIC DESCRIPTION

The Coquille is the longest river in Oregon's South Coast Basin. Including the South Fork, which is one of the Coquille's major tributaries, the river measures almost 100 miles in length. The Coquille empties into the Pacific Ocean through the Coquille Estuary, located south of Coos Bay near Bandon. The river drains a 1,058 square-mile watershed that is predominantly mountainous with a narrow lowland valley region.

The mainstem is formed by the confluence of the South Fork and the North Fork at river mile (RM) 36.3 of the Coquille River (Figure A-1). The Middle Fork Coquille joins the South Fork at river mile 9.1 of the South Fork, and the confluence of the East Fork and the North Fork is at river mile 9.1 of the North Fork. The head of tide is upstream from the town of Myrtle Point, between 38 and 41 river miles above the Pacific Ocean. This tidally influenced zone defines the estuary. Within the 763-acre estuary, saltwater intrusion has been noted as far as river mile 20, near the City of Coquille.

POPULATION

Many of the residents in the Coquille Basin live and work near the estuary. Development has predominately occurred in four communities: Bandon (located at the mouth of the Coquille River estuary), Coquille and Myrtle Point (located on riverine terraces in the river valley), and Powers (near the South Fork in the foothills of the Siskiyou Mountains). Coquille is the largest community, with a population of 4,330 residents. Bandon has a population of 2,500; Myrtle Point has 2,700. Powers has a population of 750.

CLIMATE

Rainfall in the watershed follows a seasonal pattern of wet winters and dry summers. Annual precipitation ranges from 50 to 100 inches per year, with the largest amount occurring in the winter months. The Coquille has a mean annual discharge of 3,288 cubic feet per second or 2,400,000 acre-feet per year. Ninety percent of the discharge occurs between November and April. The low summer flows often create water shortages, fail to provide adequate dilution for waste discharges, allow greater diurnal fluctuations in temperature, and allow greater intrusion of saltwater.

LAND USE

As in much of rural Oregon, land use in the Coquille watershed is a mix of forestry, agriculture, and small communities. Approximately 76 percent of the land in the basin is forested. Agriculture and livestock grazing cover another 6 percent. Less than 5 percent is dedicated to residential, commercial, and industrial development. "Other uses" account for the remaining 13 percent.

ECONOMY

Forestry, agriculture, and tourism are important economic resources within the basin. The vast majority of forest land is designated for commercial harvest and is held by the Bureau of Land Management, the U.S. Forest Service, and large industrial owners. Agricultural land in the fertile river valley is devoted to dairy pasture, hay and silage production, fruits, berries, and specialty produce. Beef cattle and

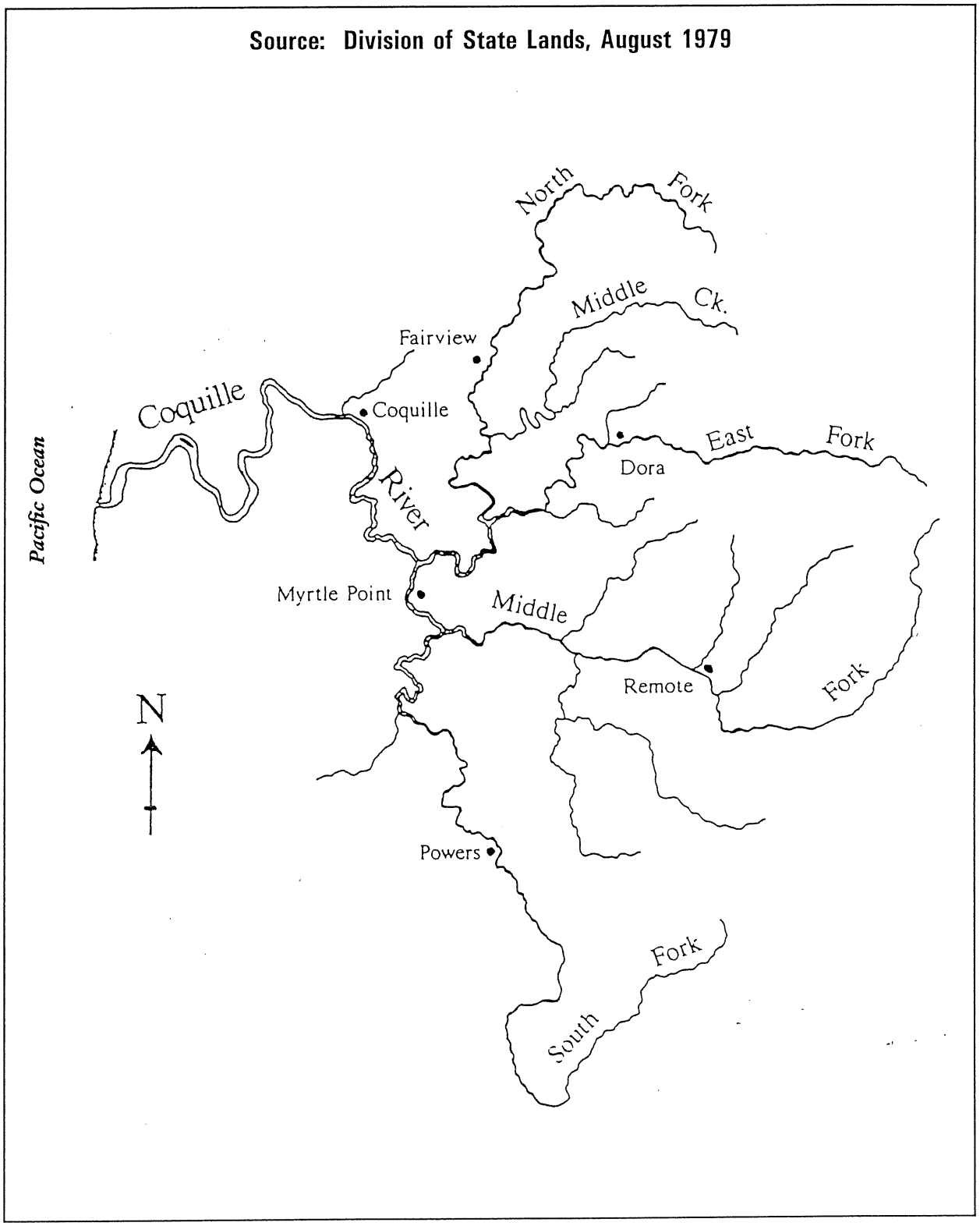

Figure A-1. Basin Map of the Coquille River, Oregon

sheep graze in both valley and upland areas.

NATURAL RESOURCES

Many of the recreational and tourist activities in the basin — such as harvesting shellfish, angling for anadromous and resident fish, and boating — are dependent on the area's natural resources. Fish and wildlife are abundant in the basin. Raptors, waterfowl, wading birds, marine mammals, coho salmon, chinook salmon, steelhead, cutthroat trout, flounder perch, shrimp, crab, clams, and many other types of fish and wildlife use the estuary for feeding, spawning, breeding, nesting, and as nursery areas. Near the estuary, eelgrass beds, wetlands, and tidal flats provide critical habitat and refuge for many species of terrestrial and aquatic life.

WATER QUALITY CONCERNS

A total maximum daily load (TMDL) for dissolved oxygen has been developed for the Coquille. The Coquille has not currently been designated as requiring a TMDL for bacteria; the effectiveness of other regulatory mechanisms must first be evaluated.

Dissolved Oxygen

The Coquille River has been identified as water quality limited due to violations of the State's dissolved oxygen standard. Ambient water quality monitoring indicates periodic low levels of dissolved oxygen in the estuary as well as in portions of the North and South Forks.

Several factors can influence the concentration of dissolved oxygen in water; these factors include temperature, salinity, oxygen-demanding substances, and reaeration. In the Coquille Estuary, variations in dissolved oxygen appear to be related to marine water quality and sediment oxygen demand. At RM 25 of the Coquille (which is above the saltwater mixing zone but is tidally influenced) and in the tidally influenced portions of the North Fork, lower levels of dissolved oxygen (measured as both concentration and percent saturation) occur during the summer period than during the winter period. The relatively lower levels of dissolved oxygen occur as early as June and remain low as late as October.

Bacteria

During summer monitoring surveys, fecal coliform levels were below the State's criteria levels for water-contact recreation and shellfish harvesting. An exception was observed near RM 25, just above Coquille, where bacterial levels exceeded the criteria.

In the fall, bacterial concentrations which exceeded criteria were observed throughout the estuary. Possible sources of elevated bacteria included the Myrtle Point and Bandon sewage treatment plants (STPs), which were not adequately disinfecting wastes, and nonpoint sources.

Nutrients

Excessive amounts of nutrients, such as phosphorus and nitrogen, can contribute to nuisance levels of algal growth. As algae decays, it removes dissolved oxygen from the stream and causes unpleasant odors. Numeric guidance levels for chlorophyll ***a***, pH, and phosphorus are used to identify nutrient problems. In the 1992 305(b) Report, the presence of excessive amounts of algae was noted during the summer at one of the sampling stations in the Coquille.

Sedimentation

Excessive sedimentation from erosion in the watershed was identified as a potential cause for concern by the Soil and Water Conservation District and the Port of Bandon and was listed as a concern in DEQ's 1988 Statewide Nonpoint Source Assessment.

Loss of Wetlands

Ongoing development in the watershed has significantly modified low-lying wetland areas. In the past, landowners were encouraged to dike, drain, and convert wetlands for agricultural production. Since the late 1800s, an estimated 80 to 90 percent of the wetlands in the basin have been filled.

WATER-QUALITY-RELATED PROJECTS IN THE COQUILLE BASIN

Department of Environmental Quality (DEQ)

DEQ has conducted an ongoing monitoring program in the basin, established a waste-treatment standard for the basin, developed preliminary and final TMDLs for the Coquille, and reviewed facility plans for the STPs in the basin. DEQ completed a Nonpoint Source Assessment for the basin in 1988 and is working with Designated Management Agencies to evaluate management practices that affect water-quality-limited stream segments.

DEQ also coordinated the ***Near Coastal Waters Pilot Project*** for the Coquille River and Estuary. This EPA-funded project was a three-year effort (1988-91) designed to identify sources of pollution that may be contributing to dissolved oxygen problems in the basin and to develop a process for long-term management of near-coastal waters. A local Citizen's Advisory Committee provided input during the project.

Oregon Department of Fish and Wildlife (ODFW)

ODFW has developed a Fish Management Plan to guide the management and protection of fish, shellfish, and habitat in the basin. ODFW also sponsors the Salmon Trout Enhancement Program (STEP). STEP volunteers build and tend hatch boxes to raise and release young salmonids into the Coquille River. Volunteers also work on habitat improvement projects.

Port of Coquille and the Soil and Water Conservation District (SWCD)

In 1990, the Port of Coquille and SWCD began developing a Coordinated Resources Management Plan. The goal of the Port and SWCD is to bring landowners and technical experts together in an effort to control nonpoint source problems.

Soil Conservation Service (SCS)

SCS is examining and developing plans for controlling runoff from Confined Animal Feeding Operations (CAFOs) in the Coquille Basin.

Governor's Watershed Enhancement Board (GWEB)

In 1987, GWEB was authorized to provide a coordinated effort to fund projects which improve riparian habitat, water quality, or general watershed conditions. ODFW, the Bureau of Land Management (BLM), STEP, the Oregon State University (OSU) Extension Service, and SCS have submitted a joint proposal to GWEB for a Coquille River project.

City of Bandon

Bandon sponsored a study describing the amount of mixing and the fate of effluent from its sewage treatment plant.

Port of Bandon

The Port created a one-acre estuarine wetland which is monitored to determine how the ecosystem evolves.

Port of Coquille

The Port has begun restoration of a stretch of badly eroding river bank.

Oregon Coastal Zone Management Association (OCZMA)

In cooperation with Oregon State University, OCZMA conducted a study to determine the feasibility of using constructed wetlands to provide additional treatment and nutrient removal from Coquille's STP effluent.

Cities of Myrtle Point and Coquille

The Cities developed the first phase of facility modification plans for their treatment plants. The modifications are designed to improve effluent quality in order to meet TMDL requirements. The plans also explore alternatives to discharging during summer low flows.

South Coast Organic Growers' Association

The growers have developed a plan to research and assemble information on opportunities for public education and awareness with respect to water quality protection and to organize related projects.

APPENDIX B

APPLICABLE WATER QUALITY STANDARDS

The Coquille River and Estuary have been designated as water quality limited, indicating that water quality standards have been violated. The primary parameters of concern are dissolved oxygen and bacteria. Nutrients and pH, which affect the growth of algae, are also of concern but to a lesser degree.

Within the State of Oregon, water quality standards are published pursuant to Oregon Revised Statutes (ORS) 468.020. Authority to adopt rules, regulations, and standards as are necessary and feasible to protect the environment and health of the citizens of the State is vested with the Environmental Quality Commission. Through the adoption of water quality standards, Oregon has defined the beneficial uses to be protected in each of its drainage basins and the criteria necessary to protect those uses.

SEGMENTS OF CONCERN

Segments within the Coquille drainage are covered under Oregon's water quality standards for the South Coast Basin, as described in the Oregon Administrative Rules. Within the Coquille, three segments have been identified as **water quality limited** in Oregon's *1992 Water Quality Status Assessment Report* [*305(b) Report*]:

Segment	Name	Boundaries
14B-COQU	Coquille River	R.M. 0 — 39
14B-COSF	S.F. Coquille River	R.M. 0 — 30
14B-CONF	N.F. Coquille River	R.M. 0 — 10

Ambient water quality monitoring data have shown that the estuary as well as portions of the North and South Forks are water quality limited due to periodic low levels of dissolved oxygen and high levels of bacteria.

BENEFICIAL USES AFFECTED

Oregon Administrative Rule (OAR) Chapter 340, Division 41, Rule 322, lists the beneficial uses for which water quality will be protected in the Coquille Basin (see Table B-1). This list of beneficial uses was established by the Oregon Water Resources Commission pursuant to direction given in Oregon Revised Statute (ORS) 536.300. As charged by ORS 468.020, the Oregon Environmental Quality Commission adopted rules and standards that were necessary to protect the recognized beneficial uses. In practice, water quality rules and standards have been set at levels to protect the most sensitive of the uses: aquatic life and human health.

Criteria used to evaluate beneficial use support are described in Table B-2. Water quality assessments have indicated that aquatic life is not fully supported in any of the water quality limited segments of the mainstem, South Fork, and North Fork Coquille Rivers; water-contact recreation (e.g., swimming) is partially supported in the riverine segments and is not supported in the estuary. Aesthetic quality is only partially supported in the estuary. (See Table B-3.)

APPLICABLE WATER QUALITY STANDARDS

A number of water quality parameters have criteria values which have been adopted as regulatory standards for the Coquille Basin. Included are dissolved oxygen, pH, bacteria, and temperature.

Table B-1. Beneficial Uses to be Protected in the South Coast Basin

Beneficial Uses	Estuaries and Adjacent Marine Waters	All Streams & Tributaries Thereto
Public Domestic Water Supply[1]		X
Private Domestic Water Supply[1]		X
Industrial Water Supply	X	X
Irrigation		X
Livestock Watering		X
Anadromous Fish Passage	X	X
Salmonid Fish Rearing	X	X
Salmonid Fish Spawning	X	X
Resident Fish and Aquatic Life	X	X
Wildlife and Hunting	X	X
Fishing	X	X
Boating	X	X
Water-Contact Recreation	X	X
Aesthetic Quality	X	X
Hydroelectric Power		X
Commercial Navigation and Transportation	X	

[1]With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.

Source:

Oregon Administrative Rules, Chapter 340, Division 41 — Table 4, South Coast Basin.

Table B-2. Criteria for Evaluating Beneficial Use Support

FISHERIES AND AQUATIC LIFE	
Partially Supported	10% exceedence of basin standard for dissolved oxygen (concentration or percent saturation).
	10% exceedence of basin pH standard.
Not Supported	25% exceedence of basin standard for dissolved oxygen (concentration or percent saturation)
	25% exceedence of basin pH standard.
WATER-CONTACT RECREATION	
Partially Supported	10% exceedence of upper-range standard for bacteria.
Not Supported	25% exceedence of upper-range standard for bacteria.
AESTHETICS	
Partially Supported	10% exceedence of guidance of 15 μg/L chlorophyll *a*.
	25% exceedence of federal guidance level of 0.1 mg/L total phosphorus.
Not Supported	25% exceedence of basin pH standard.

Source:

Oregon's 1992 Water Quality Status Assessment Report (305(b)) Report; pp. B3—6.

Basin standards are listed in Oregon Administrative Rules, Chapter 340, Division 41.

Table B-3. Water Quality Assessment Summary for The Coquille River — DEQ Ambient Data for 1982-1992

Stream	STORET Number	River Mile of Sampling Station	Reach Limits (River Miles)	Assessment Parameter	Season	Beneficial Use Support	Beneficial Uses Affected	TMDL Required
S. Fork Coquille	404250	1.20	0-30	DO % Sat.	Summer	Not Supported	Aquatic Life	No
				DO % Sat.	FWS	Partial Support	Aquatic Life	No
				Fecal Coliform	FWS	Partial Support	Water Contact	No
				Enterococcus	FWS	Partial Support	Water Contact	No
	404165	10.00		Fecal Coliform	FWS	Partial Support	Water Contact	No
Middle Fork Coquille	404164	27.20	0-36	DO % Sat.	FWS	Partial Support	Aquatic Life	No
				Fecal Coliform	FWS	Partial Support	Water Contact	No
				Enterococcus	Summer	Partial Support	Water Contact	No
N. Fork Coquille	402063	0.20	0-10	DO % Sat.	FWS	Not Supported	Aquatic Life	No
				DO % Sat.	Summer	Not Supported	Aquatic Life	No
	404252	4.10		DO % Sat.	FWS	Not Supported	Aquatic Life	No
				Enterococcus	Summer	Partial Support	Water Contact	No
Coquille	412113	3.30	0-39	DO % Sat.	FWS	Not Supported	Aquatic Life	Yes
	412114	16.00		DO % Sat.	FWS	Not Supported	Aquatic Life	Yes
				Fecal Coliform	FWS	Partial Support	Water Contact	No
	404390	18.00		DO % Sat.	Summer	Not Supported	Aquatic Life	Yes
	402273	26.40		DO % Sat.	Summer	Not Supported	Aquatic Life	Yes
				Algae	Summer	Partial Support	Aesthetics	No
				Fecal Coliform	FWS	Not Supported	Water Contact	No
				Fecal Coliform	Summer	Partial Support	Water Contact	No
				Enterococcus	Summer	Not Supported	Water Contact	No

LEGEND:

Summer = June 1 to September 31.
FWS = Fall-Winter-Spring — October 1 to May 31.

Source:

1992 305(b) Report.

Dissolved Oxygen

[OAR 340-41-325(2)(a)] — The dissolved oxygen standard for the South Coast Basin contains separate criteria for freshwater and for mixed fresh/marine waters. The application of the dissolved oxygen criteria depends on the extent of saltwater intrusion, which depends on tidal conditions. DEQ's monitoring data indicate that the intrusions reach as far upstream as river mile (RM) 20. Based on that data, the applicable dissolved oxygen criteria are:

- *Freshwater (upstream of RM 20)* — 90 percent of saturation.
- *Mixed Fresh/Marine Water (below RM 20)* — 6.0 mg/L.

Paragraph (A) — "Fresh waters: DO concentrations shall not be less than 90 percent of saturation at the seasonal low, or less than 95 percent of saturation in spawning areas during spawning, incubation, hatching and fry stages of salmonid fishes."

Paragraph (B) — "Marine and estuarine waters (outside of zones of upwelled marine waters naturally deficient in DO): DO concentrations shall not be less than 6 mg/L for estuarine waters, or less than saturation concentrations for marine waters."

pH

[OAR 340-41-325(2)(d)] — "... pH values shall not fall outside the range of:

(A) Estuarine and fresh waters: 6.5 to 8.5;

(B) Marine waters: 7.0 to 8.5."

Bacteria

[OAR 340-41-325(2)(e)] — Water quality standards for bacteria are designed to protect the beneficial uses of water-contact recreation (e.g., swimming) and shellfish harvesting. Current criteria for bacterial pollution:

- *Freshwaters* — 200/100 ml Fecal coliform.
- *Estuarine Waters Other than Shellfish-Growing Waters* — 200/100 ml Fecal coliform.
- *Marine Waters and Estuarine Shellfish-Growing Waters* — 14/100 ml Fecal coliform.

General

[OAR 340-41-325(3)] — "Where the natural quality parameters of waters of the South Coast Basin are outside the numerical limits of the above assigned water quality standards, the natural water quality shall be the standard."

Nutrients

[OAR 340-41-150] — For rivers and estuaries, chlorophyll *a* values above 0.015 mg/L are used to identify waterbodies where excessive growth of phytoplankton may impair the recognized beneficial uses. A federal guidance level of 0.1 mg/L total phosphorus is also used as an indicator of nutrient levels which are likely to degrade aesthetic quality.

Minimum Treatment Requirements

[OAR 340-41-335] — Current State rules also identify minimum treatment requirements of 20 mg/L biochemical oxygen demand (BOD) and 20 mg/L suspended solids for the South Coast Basin during periods of low flow (approximately May 1 to October 31). A minimum of secondary treatment or equivalent control must be used during periods of high flow (approximately November 1 to April 30). Wastes must also be disinfected prior to discharge.

Basin water-quality management plans require that the effluent concentration of BOD divided by the dilution factor (the ratio of receiving streamflow to effluent flow) shall not exceed one. Although the dilution ratio was originally established for free-flowing water, it applies to estuaries as well.

In addition to the requirements for the discharge of sewage wastes, the minimum treatment rule also provides for the development of specific provisions for the discharge of industrial wastes.

Review of Dissolved Oxygen Standard: Even

without the existing point source discharges, it is DEQ's judgment that the numerical criteria for dissolved oxygen would not be attained in the Coquille. DEQ has considered the possibility of changing the dissolved oxygen standard for the Coquille or for coastal waters in general. Another alternative would be to change the definition of estuary to include all of the tidally influenced portion of the river (to approximately river mile 36), such that the 6.0 mg/L criteria applies throughout the lower river. (Typically, non-estuarine areas are subject to the 90 per cent of saturation criteria rather than the concentration-based criteria.)

Although the information developed in the evaluation of these alternatives may be used in DEQ's triennial standards review, DEQ does not believe it is necessary to change standards at present. Adequate flexibility exists within current rules to implement rational pollution-control decisions for the Coquille River.

APPENDIX C

AVAILABLE MONITORING DATA

Robert Baumgartner, Water Quality Division, DEQ

In December 1988, the Oregon Department of Environmental Quality (DEQ) began an intensive monitoring effort in the Coquille River Basin to identify the magnitude and probable causes of water quality problems. The ambient monitoring network in the Coquille was expanded from 4 to 11 sites, and regular monitoring at the 4 sewage treatment plants was initiated. In addition to the conventional monitoring activities, DEQ conducted dye studies and intensive monitoring (cross-sectional, longitudinal, and diurnal) to provide data needed for water quality modelling.

A separate monitoring effort was conducted to characterize the extent of pollution from fecal coliform bacteria in the estuary and to determine if water quality standards for the protection of shellfish resources were being violated.

In DEQ's 1988 Nonpoint Source Assessment Report, several segments in the Coquille Basin were identified as being severely impacted by nonpoint sources of pollution. In conjunction with the intensive monitoring efforts in the Basin, DEQ conducted biomonitoring in many of the Coquille's tributaries to help identify the nonpoint sources.

REVIEW OF HISTORICAL DATA

The determination that the Coquille River is water quality limited was made by reviewing historical water quality data for the Coquille. DEQ has monitored the ambient water quality of the Coquille River and its tributaries since 1976. DEQ's historical monitoring sites are located on: the South Fork; the Middle Fork; the North Fork; the mainstem at RM 25 above Coquille; and in the estuary.

Review of the data indicated that levels of dissolved oxygen were too low and levels of bacteria were too high at several locations. The historical data was used to develop the preliminary TMDL for dissolved oxygen for the Coquille River. In 1989, DEQ began additional monitoring to determine the causes of the water quality problems in the basin and to better define the TMDL.

HISTORICAL TRENDS IN DISSOLVED OXYGEN

The distribution of dissolved oxygen during summer low-flow conditions (July through September, 1969 – 1978) is presented in Figure C-1. Dissolved oxygen levels at free-flowing tributary sites were typically near saturation levels. Dissolved oxygen levels in the North Fork at RM 36, which is tidally influenced, and the mainstem near Coquille were typically be-

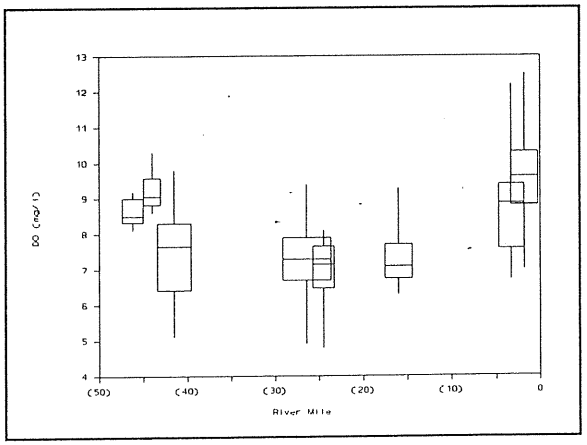

Figure C-1. Historical Summer Dissolved Oxygen Levels (mg/L), Coquille River (July to September 1969 – 1978).

low the "90 percent of saturation" criterion for freshwaters during the summer.

Seasonal variation in dissolved oxygen at Coquille (RM 21 to 23) is illustrated in Figure C-2. At RM 25 and in the tidally influenced portions of the North Fork, lower concentrations and lower percent saturation levels for dissolved oxygen occurred during the summer period. Reduced levels of dissolved oxygen (measured as percent saturation and as concentration) occurred as early as June and remained low as late as October.

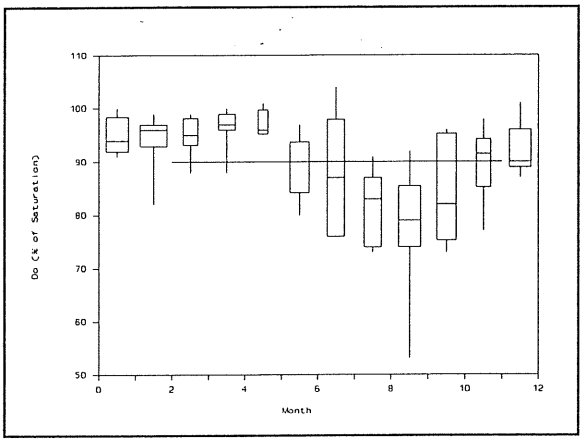

Figure C-2. Seasonal Variation in Dissolved Oxygen Levels (Percent of Saturation), Coquille River near Coquille.

Not all of the bay/estuary stations are illustrated in Figure C-2, however. Review of the limited historical data set indicated that the level of dissolved oxygen observed during the summer in the estuary occasionally dropped to near the 6.0 mg/L standard. During other summer surveys, much higher levels of dissolved oxygen were observed. The variation in dissolved oxygen during the summer appeared to be related to the lower temperatures and higher salinities in the estuary due to the presence of oceanic waters.

SYNOPTIC SURVEYS — 1989 AND 1991

Sampling Dates

In 1989, initial screening data were collected at selected sites and used to develop a more extensive monitoring program for the Coquille River. Synoptic data sets were collected over a period of two tidal cycles during September 1989 and September 1991. An additional synoptic data set was collected during November 1991.

Parameters

Data were collected for several water quality parameters, including: dissolved oxygen, temperature, conductance, salinity, 28-day biochemical oxygen demand (BOD), ammonia, nitrate+nitrite, total Kjeldahl nitrogen, ortho phosphorus, total phosphorus, suspended solids, and total solids.

Monitoring Sites

During the synoptic surveys in 1989 and 1991, monitoring sites were located on all major tributaries to the tidally influenced lower 39 miles; on selected minor tributaries; in the ocean; and at approximately one-mile intervals of the mainstem. Major point sources were monitored twice throughout the synoptic sampling efforts.

Point Sources

Major point sources were characterized by pollutant loads during the synoptic surveys and during additional mixing-zone surveys (Table C-1). Effluent samples and receiving-water samples which were collected near the sources of discharge were analyzed to determine the various components of the biochemical oxygen demand. During the source characterization surveys, calculations were made for the bottle decay rates and for the five-day, ultimate-carbonaceous, and total oxygen demands.

Samples were collected near the Myrtle Point outfall to determine the ultimate biochemical oxygen demand, to separate out the carbonaceous and nitrogenous demands, and to estimate the decay rates of carbonaceous BOD and ammonia (Table C-2). The bottle decay rates were used as an initial starting point for model calibration.

Streamflow

Data were collected on stream-flow, cross-sec-

Table C-1. Results of Routine and Intensive Monitoring

Summer 1990				
Point Source	Flow, Q (mgd)	BOD, 28-day (mg/L)	Ammonia, NH_3 (mg/L)	Suspended Solids (mg/L)
Myrtle Point STP	0.11	36 – 77	14 – 18	25 – 48
Coquille STP	0.76 – 0.97	04 – 09	2.8 – 14.5	4 – 35
Bandon STP	0.26 – 0.35	08 – 21	5.0 – 18	15 – 60

Table C-2. Myrtle Point STP — UCBOD and Decay Rate

Summer Conditions — Myrtle Point STP					
Parameter	Upstream of Myrtle Point STP	Near Outfall	200 Feet Downstream of Outfall		
			Undiluted	Diluted	QA
UCBOD (mg/L)	1.5	2.8	14.3	13.3	13.4
Decay Rate, K (day^{-1})	0.05	0.07	0.14	0.14	0.14

tional area and channel depth. Using the historical data for the time period 1950 to 1990 at Powers, the low-flow statistic 7Q10 was calculated from the USGS gauge. Information on stream depth was available from the Port of Bandon. Additionally, DEQ calculated cross-sectional area for selected locations in the Coquille River and determined stream depth throughout much of the Coquille using a chart-recording depth sounder. Streamflows for the major tributaries were measured at the time of the synoptic surveys in September 1990 and 1991 (Table C-3).

Bandon Sewage Treatment Plant

Coincident with DEQ's monitoring efforts, the City of Bandon contracted with Brown and Caldwell Engineers to conduct a study describing the amount of mixing and the fate of effluent from the sewage treatment plant. This study demonstrated that the effluent from Bandon was not reaching the freshwater zone of the estuary in significant concentrations. Because the effluent from Bandon did not appear to be contributing to the observed dissolved oxygen violations, DEQ did not propose wasteload allocations (WLAs) for Bandon to address the dissolved oxygen violations. Further monitoring was conducted to assess effluent quality from Bandon and water quality in the estuary.

RESULTS OF SYNOPTIC SURVEYS

Bacteria

Bacteria levels during the summer surveys were below the criteria levels for water-contact recreation and shellfish harvesting. An exception was observed near RM 25, just above Coquille, where bacterial levels exceeded the criteria. This increase in bacteria could not be associated with treatment plant discharge from Coquille, however. At the time of the monitoring survey, Coquille was adequately disinfecting wastewater. The source of the observed high levels of bacteria is unknown.

Table C-3. Streamflow — North and South Forks of the Coquille

September 1990 and 1991			
Stream	Flow, cfs (DEQ measurement)		Est. 7Q10* (USGS Gauge)
	1990	1991	
North Fork Coquille	28	12	—
at Fairview (1974-1981)	—	—	3
at Myrtle Point (1963-1968)	—	—	7
South Fork Coquille	35	27	—
at Powers	—	—	13
above Middle Fork (extrapolated)	—	—	13
Middle Fork (extrapolated)	—	—	3
*7Q10 = The average 7-day low flow with 10-year recurrence interval.			

During November 1991, bacterial concentrations were above criteria throughout the estuary. Possible sources of elevated bacteria included both the Myrtle Point and Bandon STPs, which were not adequately disinfecting wastes at the time of the survey, and nonpoint sources.

Dissolved Oxygen

Dissolved oxygen concentrations can be influenced by several factors, including temperature, salinity, oxygen-demanding substances, and reaeration. In the historical data for the Coquille, much of the variation in dissolved oxygen observed in the estuary could be explained by the effect of mixing fresh and ocean waters and by variations in salinity and temperature.

During both synoptic surveys, dissolved oxygen concentrations and temperature were monitored throughout the water column at selected sites in the estuary. Dissolved oxygen levels were not observed to be stratified at these locations. Minimum levels of dissolved oxygen appear to coincide with the area of low salinity and warm temperatures.

Dissolved oxygen levels were observed to drop to approximately 8 mg/L (1 mg/L below saturation) in a pool above the Myrtle Point STP. This area is tidally influenced and it is possible that dissolved oxygen levels are affected by the STP discharge.

Below Myrtle Point, near the confluence with the North Fork, the concentration of dissolved oxygen dropped significantly, apparently due to increased sediment oxygen demand near RM 35. By RM 30, the oxygen level increased to near the 90 percent of saturation standard. Moving downstream from RM 30 to RM 20, the observed level of dissolved oxygen was reduced due to BOD demands, sediment demands, and low reaeration rates in the relatively deep and slow flooded-river estuary.

During the 1991 survey, levels of dissolved oxygen increased from RM 20 downstream to the ocean. In contrast, during the 1990 survey, dissolved oxygen continued to decrease to RM 10. The differing patterns in dissolved oxygen result from differences in the effect of tides and ocean water on mixing, salinity, and temperature.

A similar pattern of near-saturation of waters entering the estuary and lowered concentrations in the upper area of saltwater intrusion appears to occur in other estuaries in Oregon. The historical data for the estuaries of the Yaquina and Siuslaw Rivers indicate a pattern

similar to that observed in the Coquille. The estuarine five-day biochemical oxygen demand (BOD_5) was moderately low (1 to 1.5 mg/L), and dissolved oxygen concentrations reached minimum levels near the zone of saltwater intrusion.

Temperature and Salinity

During the summer, the cold ocean water which enters the Coquille Estuary on incoming tidal cycles reduces temperatures and increases salinity. Temperature and salinity affect the amount of oxygen that water can hold. Cold water can hold more oxygen than warm water. At the saturation point, fresh water can hold more oxygen than saline water of the same temperature.

During both synoptic surveys, the observed temperatures in the free-flowing river and in the freshwater part of the estuary were approximately 20°C; no effort was made to describe diurnal variations in temperature. At a temperature of 20 degrees, the saturation level for dissolved oxygen is approximately 9 mg/L. The applicable criterion, which is 90 percent of saturation, would be approximately 8.1 mg/L.

During the 1991 surveys, low levels of salinity were observed above RM 20. Temperatures were reduced below 20°C from about RM 12 to the estuary. The applicable criterion downstream of RM 20 would be 6.0 mg/L. During the 1990 survey, low levels of salinity were observed as far upstream as RM 17; data collection for that survey did not continue through the lower estuary.

Oxygen-Demanding Substances

Depending on the substances involved, oxygen demand can be categorized as biochemical oxygen demand (BOD), carbonaceous BOD, sediment oxygen demand, ammonia demand, and others. Areas of suspended solids and high turbidity have been associated with increased biological activity and increased BOD, resulting in decreased dissolved oxygen.

Five-Day BOD: By historical convention, the concentration of biochemical oxygen demand is often measured as the amount of oxygen consumed during a five-day period (BOD_5). The observed concentrations of BOD_5 were near 1.0 mg/L throughout most of the estuary except near Myrtle Point.

UCBOD: Oxygen demand is also expressed as ultimate carbonaceous BOD (UCBOD). Instream increases in UCBOD are dependent on effluent quality and on the quantity of the receiving water available for dilution.

Oxygen-demanding substances at levels of approximately 3 mg/L UCBOD enter the estuary from the major tributaries. Observed levels of UCBOD were greater in the vicinity of the Myrtle Point STP outfall. The increase in UCBOD at Myrtle Point was more noticeable during the September 1991 survey than during the 1990 intensive survey due to relatively less dilution from streamflow at that time. Below the Myrtle Point STP and extending throughout most of the estuary, UCBOD was reduced, with a smaller increase in concentration near the Coquille STP. The lower observed UCBOD levels at the Coquille STP were partly due to increased dilution from the North Fork.

Sediment Oxygen Demand: Sediment oxygen demand (SOD) is yet another way of characterizing oxygen demand. Using benthic respirometers, SOD was measured at selected locations near the Myrtle Point STP outfall during the 1991 Coquille survey. Measured concentrations of SOD increased from less than 1 g/m^2-d above the Myrtle Point STP to 4 g/m^2-d below the STP at the confluence of the North and South Forks of the Coquille. The observed increase in SOD coincided with an observed decrease in dissolved oxygen. The closeness of the increased SOD to the discharge would suggest that the STP is a likely contributor. However, information is not available which would directly link the increased SOD solely to the Myrtle Point STP. The level of SOD estimated by calibration throughout most of the estuary was 0.5 g/m^2-d.

Nonpoint source loads may also influence SOD in an estuary. Howarth, et al. (1991), studying the Hudson River, suggested that water quality management efforts in estuaries have focused too much on improving sewage treatment and have not dealt adequately with nonpoint sources of nutrients and organic carbon.

Nitrogen usually controls eutrophication in temperate-zone estuaries and nonpoint sources can be a major contributor. Howarth, et al., suggest that anoxic conditions were due to the nonpoint source runoff, especially agricultural and urban, increases organic carbon and sediment loads to the estuary and can have a major influence on the metabolism and functioning of large estuaries. Officer, et al. (1984), studied the origin of the anoxic conditions (the depletion of dissolved oxygen) in Chesapeake Bay. Citing Taft, et al. (1980), they suggest that the anoxic conditions were due to the oxygen demand resulting from the biological decomposition of organic matter originating from nonpoint sources during the previous summer and fall.

Ammonia: Background ammonia levels during the synoptic surveys were at or below detection levels. Ammonia concentrations increased due to discharges from the Myrtle Point STP but rapidly decreased downstream. Much smaller and more variable increases in ammonia were observed near the Coquille STP. Throughout most of the estuary, the ammonia levels were at or below detection levels (0.03 mg/L). Increased levels near RM 10 during the 1990 survey may have resulted from intrusions of ocean water with higher levels of ammonia.

Ammonia increases in areas of low salinity, as observed in the Coquille, have been assumed to be produced by bacterial decomposition of organic detritus. Inputs of marine and riverine organic detritus must provide a continuous supply of nitrogen required to maintain this process.

Turbidity

Turbidity was not modeled as part of the Coquille TMDL assessment. However, both turbidity (measured as NTUs) and suspended solids were monitored. In the North Fork Coquille, turbidity levels were affected by tannins (likely due to decaying leaves) and by suspended solids. The high levels of suspended solids in ocean water decreased moving up the estuary. The highest concentrations of suspended solids in freshwater were found just above the extent of measured saltwater intrusion.

Morris, et al. (1982) note that partially stratified to well-mixed estuaries usually exhibit a zone of high turbidity within the upper estuary; in this zone, concentrations of suspended solids can be several orders of magnitude greater than in the contributory fresh and marine waters. This maximum turbidity zone acts as a trap which retains some materials either in suspension or cycling between suspended and deposited states. Morris also observed that minimum dissolved oxygen levels were encountered in the low salinity region, somewhat below (down estuary of) the turbidity maximum.

It is not clear whether turbidity patterns in the Coquille River are similar to those studied by Morris. Morris found that the upper estuarine limit of enhanced turbidity coincided with the limit of marine penetration. This does not appear consistent with observed levels of suspended solids in the Coquille. However, the observed pattern in the Coquille of dissolved oxygen depletion from saturation to a minimum occurring at low levels of salt water does appear consistent with other studies in well mixed estuaries.

Reaeration

Reaeration from turbulence and wind acts to increase oxygen levels. Fast, shallow streams regain lost oxygen faster than slow, deep waters. During both synoptic surveys, dissolved oxygen at or near saturation levels entered the estuary from the free-flowing, major tributaries — the South and North Forks of the Coquille.

Algal growth due to photosynthesis may increase the amount of oxygen in water, while algal decay can decrease the amount of oxygen. The amount of algal production may be dependent on the availability of nutrients.

Nutrients

Algal-growth potential in coastal marine waters is usually limited by the amount of nitrogen. However, algal assays conducted by Sprecht (1974) indicated that a boundary exists in Oregon estuaries between ocean waters (which are nitrogen limited) and freshwaters (which are phosphorus limited). This boundary shifts depending on tide and streamflow conditions. Inputs of nu-

trients from STPs could cause an increase in algal-growth potential in the upper estuary.

Nutrient concentrations during the summer low-flow surveys indicated that the Coquille Estuary is significantly influenced by point sources and by ocean water quality. Total- and ortho-phosphorus and nitrate concentrations increased below the Myrtle Point STP. The increase in nitrate concentrations (from near 0.05 mg/L to 0.25 mg/L) in the lower estuary appeared to be due to the influence of ocean water. During the fall survey (1991), nitrate concentrations were higher in the tributaries (0.9 mg/L in the South Fork and 0.7 mg/L in the North Fork), and remained relatively high throughout the estuary.

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APPENDIX D

POLLUTION SOURCE SUMMARY

Water quality in the Coquille drainage is affected by discharges from point sources and nonpoint sources. Point sources include several municipal wastewater treatment plants, as well as industrial sites such as forest products facilities (Table D-1). Major nonpoint sources include runoff from agriculture and forestry activities. Because of tidal currents, pollutants can be carried upstream as well as downstream in the Coquille system.

POINT SOURCES

Municipal Sewage Treatment Plants

Sewage treatment plants are located at Bandon, Coquille, Powers, and Myrtle Point. The NPDES permits held by Bandon, Coquille, and Powers require that they meet a limit of 20 mg/L BOD_5 for effluent discharged during dry-weather conditions; the limit for Myrtle Point is 30 mg/L. State-of-the-art technology could reasonably achieve an even lower limit of 10 mg/L BOD_5. At the next expansion or modification of the treatment systems at Myrtle Point or Coquille, DEQ expects that the lower limits will be applied.

Myrtle Point: The City of Myrtle Point operates a trickling filter sewage treatment plant that has a dry-weather design capacity of 360,000 gallons per day. DEQ monitoring at the plant and in the South Fork Coquille River downstream from the discharge point indicated that the plant was not adequately treating its wastewater prior to discharge, resulting in increases in instream BOD loads and contributing to reductions in dissolved oxygen during the 1989 low-flow period. Data suggest that the effluent from the Myrtle Point STP contributed to reductions in dissolved oxygen levels, resulting in violations of standards: levels of ultimate carbonaceous BOD (UCBOD) were elevated in the vicinity of the Myrtle Point STP outfall; UCBOD declined moving downstream of the STP; reduced levels of UCBOD extended throughout most of the estuary; dissolved oxygen levels were observed to drop in a tidally influenced pool above the STP; and just downriver from the STP, the concentration of dissolved oxygen dropped significantly, apparently due to increased sediment oxygen demand near RM 35.

Since DEQ identified treatment deficiencies at the plant, Myrtle Point has taken several steps to improve the quality of its STP effluent. A pretreatment program was initiated with Georgia Pacific's log-handling facility, the major industrial discharger to the plant. Necessary operational and mechanical modifications were identified and changes have been made. The City of Myrtle Point has entered into a Stipulated and Final Order to establish interim permit limits and a compliance schedule. Proposed wasteload allocations would reduce the UBOD load from 600 to 100 pounds per day; TKN would be reduced from 24 to 4 mg/L.

Coquille: The Coquille STP is an activated sludge facility with a design flow of one million gallons per day. Monitoring by DEQ indicated that the facility was generally operating within its permit limits; BOD and TSS concentrations were generally low and adequate disinfection was achieved, except during bypass events. The sewerage system for Coquille has had major inflow and infiltration problems which contribute to excessive hydraulic loads to the plant during the winter. The City is now taking steps to correct this common problem.

Impacts from the STP effluent, such as a small increase in UCBOD concentrations near the discharge, have been observed. It is uncertain

Table D-1. Point Sources in the Coquille Basin.

Facility Name	Type of Permit	Average Dry-Weather flow	Location	Type of Waste
MUNICIPAL SOURCES				
Bandon STP	NPDES Individual	0.5 mgd	RM 1.1 Coquille	Domestic Sewage
Coquille STP	NPDES Individual	1.0 mgd	RM 24.5 Coquille	Domestic Sewage
Coquille Water Plant	NPDES General	0.2 mgd	RM 25.7 Coquille	Settling Basin Washdown
Myrtle Point STP	NPDES Individual	0.36 mgd	RM 0.8 South Fork Coquille	Domestic Sewage
Powers STP	NPDES Individual	0.3 mgd	RM 28.3 South Fork	Domestic Sewage
Bullards Beach State Park (Parks & Recreation)	WPCF	No Discharge — Land Irrigation	Coquille R. North of Bandon	Domestic Sewage, Activated Sludge
INDUSTRIAL SOURCES				
Georgia Pacific Corporation Sawmill/Plywood Mill (Closed in 1990)	NPDES Individual (mill) and General (log pond)	0.1 mgd	RM 25.5 Coquille	Oily Waste, Cooling Water, Log Handling
Roseburg Forest Products Plywood Plant	NPDES General	0.5 mgd; No-Discharge Log Pond	RM 23.5 Coquille	Cooling Water, Log Pond Overflow
Bandon Fisheries	NPDES General		RM 1.1 Coquille	Seafood Processing Waste
Erdman Packing	WPCF	No Discharge — Land Irrigation	Spring Creek	Livestock Holding & Processing
Main Rock Products	NPDES Individual		RM 4.2 Kentuck Creek, and RM 2.0 Gray Creek	Mine Dewatering & Settling Pond

whether the effluent significantly reduces dissolved oxygen: levels below the discharge approach 6.0 mg/L as a seasonal minimum with or without the discharge.

The preliminary TMDL for Coquille proposes a reduction in wasteload UBOD from 511 pounds per day to 200 pounds per day. Total Kjeldahl nitrogen would be reduced from 11 to 4 mg/L. Improved secondary treatment with nitrification could achieve these proposed limits. Alternative treatment methods such as constructed wetlands are also being examined.

Bandon: The Bandon STP is an activated sludge facility designed to treat 450,000 gallons of wastewater per day. Until 1987, the STP discharged secondary-treated but undiluted municipal effluent into sensitive areas of the estuary. The outfall was exposed at low tide and was close to an area used for recreational shellfishing. Poor mixing of the effluent and the

receiving water during low tides threatened the suitability of clams collected in the area for human consumption. In response to the problem, the City relocated the outfall to a deeper channel where better mixing occurred. DEQ requested an evaluation of the new area to insure that proper mixing and dilution were occurring and an evaluation of the previous outfall location to document its recovery.

A mixing-zone study conducted for the City of Bandon, along with DEQ's analysis, indicated that Bandon's discharge did not significantly affect dissolved oxygen in the water-quality-limited section of the Coquille. However, the plant has been operating under a Stipulated and Final Order (SFO) due to violations of its NPDES permit. Hydraulic overloading at the plant has resulted in violations of limits for biochemical oxygen demand, suspended solids, and bacteria. The City has submitted plans for facility upgrades; the plans will be reviewed by DEQ.

Powers: The discharge from the Powers STP did not appear to contribute appreciably to the dissolved oxygen problems of the lower river. However, mixing-zone surveys indicated that the effluent was poorly mixed during low-flow periods. Monitoring also indicated inadequate disinfection.

Other Municipal Sources

Bullards Beach State Park holds a no-discharge WPCF permit. The City of Coquille Water Plant holds a general NPDES permit for settling-basin washdown water.

Industrial Sources

Industrial sources in the Coquille Basin that hold NPDES or WPCF permits include: Bandon Fisheries (seafood processing), Roseburg Forest Projects (manufacture and storage of forest products), Main Rock Products (mining), and Erdman Packing (meat processing). Georgia Pacific Corporation operated a sawmill and plywood mill in Coquille until 1990.

NONPOINT SOURCES

DEQ's synoptic surveys focused on low-flow conditions, when water quality impacts from nonpoint source (NPS) runoff would be less evident. However, NPS loads clearly resulted in violations of bacterial criteria during the fall surveys and NPS loads may be influencing the observed increase in sediment oxygen demand in the upper estuary. Although the bacteria data were not modelled (due to a lack of available flow data), it is apparent that both point-source and nonpoint-source loads contribute to the bacteria violations in the estuary.

DEQ anticipates that controlling the point source discharges will eliminate a majority of the observed violations of the dissolved oxygen standard. Interagency agreements between DEQ and the Departments of Forestry and Agriculture will be used to promote Best Management Practices designed to reduce nonpoint sources of pollution in the basin, particularly those resulting in bacterial problems.

APPENDIX E

TECHNICAL ANALYSIS AND TMDL DEVELOPMENT

Robert Baumgartner, Water Quality Division, DEQ

Modelling results were used to guide development of total maximum daily loads for stream segments with low dissolved oxygen.

APPROACH USED

A computer model, DYNHYD5-WASP4, was used to describe the relationship between observed levels of dissolved oxygen and anthropogenic loads of oxygen demand to the Coquille River and Estuary. DYNHYD5-WASP4 is a quasi-dynamic, one-dimensional model developed and supported by EPA. Using constant loads to the stream, the model simulates the effect of varying tides on the order of days to months. When the simulation is run for a sufficient length of time, any errors in estimating initial conditions are minimized and the model approaches steady-state conditions.

The observed data from the synoptic sampling surveys are used to calibrate and validate the model. In Figure E-1, the model results are compared to the observed data. The lines represent estimated dissolved oxygen at different times of the day; differences are due to tidal variation. Variations within a single day are calculated. The variation does not, however, include the effect of photosynthesis.

PARAMETERS

Physical Parameters

Data for temperature and salinity collected during the synoptic surveys were entered into the model. Streamflows and upstream water quality were measured at the time of sampling and were assumed to be constant over the time

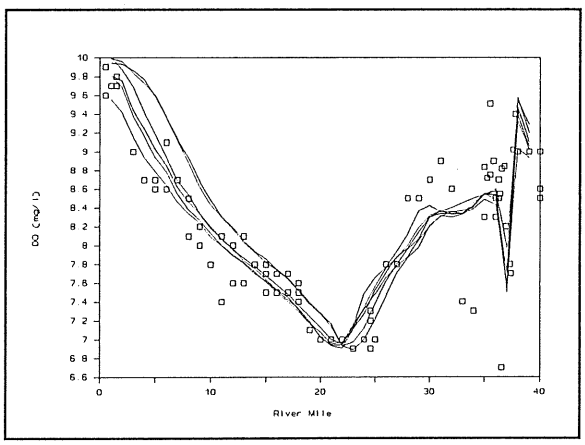

Figure E-1. Predicted and Observed Dissolved Oxygen Levels (mg/L), September 1991.

period simulated. Similarly, wasteloads from the treatment plants were assumed to be constant. Regressions based on observed tidal conditions were used to model tidal variations.

Although data were not collected for wind speed, field notes indicate that wind was negligible during the synoptic surveys. Wind-induced aeration was not modeled for the Coquille. Reaeration rates were calculated using O'Conner and Dobbins' equation, as recommended by EPA (1985) and consistent with Cerco's (1985) observation that under low wind speeds (1 m/s), bottom stress should dominate the reaeration equation.

Decay Rates

Model parameters and appropriate coefficients are listed in Table E-1. This level of kinetic complexity has been extremely popular for simulating dissolved oxygen and the impact of oxygen-demanding substances. A single decay rate was used to represent the entire estuary

Table E-1. Model Parameters and Decay Rates

Parameter	Model K (Day^{-1})	Method Used to Derive the Decay Rate, K	Typical K Range from Literature (Ref: EPA)
UCBOD	0.055	Laboratory Tests and Model Calibration Using Stream Data	0.05 to 0.40
NH_3 - NO_3	0.70	Laboratory Tests and Model Calibration Using Stream Data	0.02 to 20
Organic Nitrogen (Hydrolysis)	0.10	Literature	0.001 to 0.14
Reaeration Rate of Dissolved Oxygen	O'Conner and Dobbins' Equation	Literature	O'Conner and Dobbins' Equation
SOD	0.05 to 4.0	Calibrated Using In Situ SOD Data (above RM 35); Literature and Calibration to DO (below RM 35).	0 to 10
Dispersion	—	Calibrated Using Observed Salinity.	—

for each parameter. It is not likely that this simplification represents actual conditions, but based on the apparent accuracy of the calibration, this simplification does represent the observed conditions reasonably well.

CBOD: The low decay rates observed for carbonaceous oxygen demand appear to be consistent with the relatively low BOD concentrations (1 mg/L BOD_5). Settling and resuspension of sediments could complicate the estimation of decay rates. Suspended sediment is continually exchanged with the bed sediment, providing a mechanism for both removal and addition of BOD.

DEQ collected a limited number of samples to segregate adsorbed and dissolved CBOD. Dissolved CBOD estimates were in excess of the estimated total CBOD samples and results are therefore uncertain; however, the analyses were assumed to indicate that dissolved CBOD was the primary component of total CBOD.

Ammonia: The ammonia decay rates were calibrated to explain the loss of ammonia below the Myrtle Point STP discharge. This is the region of highest ammonia concentration. The rate of nitrification is expected to be higher at locations near ammonia sources than in areas of low ammonia concentrations. Owens (1986) noted that maximum nitrification rates coincide with turbidity maxima. Field data showed that the organisms responsible for nitrification were associated with the periodically resuspended particulate material.

MODELLING RESULTS

Modelling results indicate that sediment demand and ocean water quality are important variables influencing the observed concentrations of dissolved oxygen in the Coquille. Similar results have been described for models of Grays Harbor in Washington, where the quality of the incoming seawater and benthic oxygen demand were extremely important variables affecting water quality, both in the Harbor and in the lower Chehalis River (EPA 1974). Point sources of BOD and ammonia and hydraulic conditions also significantly influence the expected concentrations of dissolved oxygen.

Sensitivity and component analyses were conducted to describe the effect of different

components on the predicted concentrations of dissolved oxygen. The results indicate that even without discharge from the major sources, the numerical criterion of 90 percent of saturation would not be achieved during the summer period. Under these conditions, the existing natural water quality becomes the criterion.

The estimated relationship between alternative wasteload allocations and dissolved oxygen under the conditions observed in the synoptic surveys is illustrated in Figure E-2. These relationships provide important information for determining and implementing water-quality policy in the Coquille. As reflected in Figure E-2, the relationship between wasteloads and water quality is usually linear: as wasteloads decrease, dissolved oxygen levels should increase. The relationship between wasteloads and observed levels of dissolved oxygen is complicated, however, by the uncertainty in understanding the cause of the increase in SOD below Myrtle Point and the uncertainty in predicting how changes in treatment strategies or nonpoint source control strategies would affect future levels of SOD.

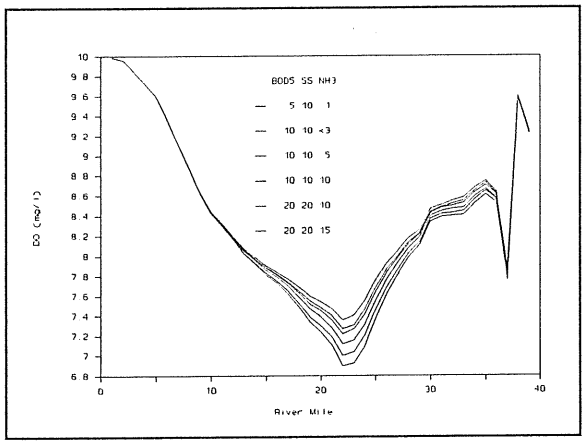

Figure E-2. Model Results — Predicted Relationship Between Dissolved Oxygen and Alternative Wasteload Allocations for BOD_5, Suspended Solids, and Ammonia (NH_3), Coquille River (September 1991).

SOD Considerations

DiToro, et al. (1989) evaluated existing models of SOD and proposed an SOD model using methane and ammonia oxidation. They reported that the amount of particulate organic matter (POM) going to the sediment is the primary cause of SOD and other fluxes to the sediment. The POM includes particulate carbon, nitrogen, and phosphorus. With existing models, it is not clear how to measure or model consumption rates or relate them to the flux of POM to the sediment. This is a severe weakness, since the questions that need to be answered would start with the input of POM to the sediment. Although a sediment-flux model was developed for Chesapeake Bay, such research is well beyond the scope and resources of this project.

Application of the SOD model proposed by DiToro, et al., would require simultaneous measurements of SOD, ammonia flux, and methane and nitrogen gas fluxes. In practical terms, these measurements require resources that DEQ does not have. Suspended solids in the effluent from the Myrtle Point STP have been measured at greater than 30 mg/L. These relatively high concentrations, which would consist largely of particulate organic matter, would indicate that some of the increase in SOD could be attributed to the Myrtle Point discharge.

No-Discharge Option

Figure E-3 indicates that the instream dissolved oxygen resulting from a wasteload allocation

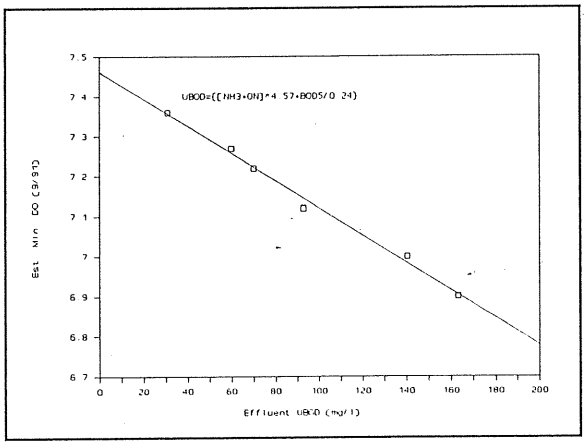

Figure E-3. Predicted Minimum Levels of Dissolved Oxygen Resulting from Varying Levels of Effluent UBOD, Coquille River (RM 21-23), September 1991.

based on the no-discharge option of 0 mg/L would be only minimally better than the dissolved oxygen resulting from a wasteload allocation based on the basin standard of 20 mg/L BOD and 20 mg/L suspended solids; the difference would be less than 1 mg/L dissolved oxygen near Coquille.

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APPENDIX F

PERMIT WASTELOAD ALLOCATIONS

TMDLs AND WASTELOAD ALLOCATIONS

Based on a review of DEQ's existing ambient data, TMDLs and preliminary wasteload allocations for total oxygen demand in the Coquille River were proposed in February 1988 by DEQ (Tables F-1 and F-2). The purpose of the preliminary wasteload allocations is to provide the sources in the basin with an estimate of the allocations they can expect; final wasteload and load allocations for point sources, nonpoint sources, and background will be established after DEQ evaluates water quality impacts which could result from various wastewater control alternatives being developed by the Cities of Myrtle Point and Coquille in their facility planning process.

Costs of the various discharge alternatives will be evaluated with respect to the projected impacts on water quality. The less stringent requirements will be accepted only if it can be determined that there will be no significant impacts on water quality; in contrast, the more stringent requirements (such as no-discharge) will be required only if it is determined that the costs are warranted by improvements in water quality. This process is consistent with EPA's phased implementation approach to development of TMDLs.

PERMIT LIMITS

Current permit limits for the Coquille sources are listed in Table F-3; these do not reflect wasteload allocations derived from the preliminary TMDL. When final wasteload allocations are established, DEQ will issue revised NPDES permits based on those limitations.

Table F-1. TMDLs for UBOD for the Coquille River

Maximum Allowable Pollutant Loads to the Coquille River from June through October	
Streamflow (cfs)	**Maximum Total Ultimate Oxygen Demand (lb/d UBOD)**
50 to 75	270
75 to 100	405
100 to 125	540
125 to 150	675
150 to 175	810
175 to 200	945
200 to 250	1,080
250 to 300	1,350

Table F-2. Preliminary Wasteload Allocations (1988)

Source	STP Loads			Estimated UBOD (lb/d)
	Flow (mgd)	$CBOD_5$ (mg/L)	Nitrogen (Total Kjeldahl) (mg/L)	
Coquille STP	0.76	10	4	200
Myrtle Point STP	0.36	10	4	100

Table F-3. Current Dry-Weather NPDES Permit Limits for Coquille Basin STPs

Parameter	Effluent Concentration		Mass Load		
	Monthly Average (mg/L)	Weekly Average (mg/L)	Monthly Average (lb/d)	Weekly Average (lb/d)	Daily Maximum (lb)
Bandon: *Flow = 0.5 mgd*					
BOD	20	30	75	113	150
TSS	20	30	75	113	150
FC/100 ml	200	400	---	---	---
Coquille: *Flow = 1.0 mgd*					
BOD	20	30	167	250	334
TSS	20	30	167	250	334
FC/100 ml	200	400	---	---	---
Myrtle Point: *Flow = 0.36 mgd*					
BOD	30	45	90	135	180
TSS	30	45	90	135	180
FC/100 ml	200	400	---	---	---
Powers: *Flow = 0.30 mgd*					
BOD	20	30	50	75	100
TSS	20	30	50	75	100
FC/100 ml	200	400	---	---	---

LEGEND:

BOD = Biochemical Oxygen Demand.
TSS = Total Suspended Solids.
FC = Fecal Coliform Bacteria.
mgd = Million Gallons Per Day.
mg/L = Milligrams Per Liter.

FACILITY PLANS

Myrtle Point

Effluent from the Myrtle Point STP generally meets Federal treatment standards when the plant is operating properly. The dissolved oxygen sag in the Coquille River downstream of the Myrtle Point outfall is presumed to result from BOD loading from the STP, however. The magnitude of the sag is not totally explained by the effluent BOD concentrations measured by the STP. Additional data collection is needed to determine the contribution from sediment oxygen demand and to determine if there are other inputs to the river which have not been identified.

The City's treatment system does have problems due to sewage bypasses. More information is needed as to the quantities of inflow and infiltration (I/I) which occur. The City is currently installing flow-measuring equipment which will provide better information on flows entering the STP and flows which bypass the STP. This information will be used in the development of the facility plans which are due in 1995. In those plans, the City must examine the impacts of several system-design and discharge alternatives, including a no-discharge alternative for the low-flow period (generally May through October) and the State's minimum design criteria of monthly averages of 20 mg/L BOD and 20 mg/L total suspended solids.

In order to comply with the TMDL, the City will be required to upgrade its treatment system. The STP is currently operating under a Stipulated and Final Order (SFO) which provides interim limits for effluent concentrations.

Coquille

DEQ's analysis has indicated that the Coquille discharge does not make a major contribution to the dissolved oxygen sag in the Coquille River. The City's sewerage facility does have periodic overflows of raw sewage to the Coquille River, however. These overflows are the result of combined sewers in the core area of town. Pursuant to an SFO between DEQ and the City, the City is required to start construction in the summer of 1994 to eliminate the combined sewers. The City will evaluate discharge alternatives, including no-discharge, during development of their facility plans which are due in 1995.

Powers and Bandon

The discharges from the Cities of Powers and Bandon have not been shown to have a significant impact on dissolved oxygen in the Coquille River. No facility upgrades are planned at this time.