Corps of Engineers Northwestern Division
North Pacific Region
Portland, Oregon

2002

Water Quality Annual Report

Prepared with input from:
Portland District
Seattle District
Walla Walla District
North Pacific Region

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1. Summary

This report on the 2002 Water Quality Program was prepared in conformance with ER 1110-2-8154 and NPDR 1110-2-101. Dredging was also included for reference purposes. The report only covers programs and activities within the North Pacific Region of the Northwestern Division (Portland, Seattle and Walla Walla Districts).

NWD-NP division-wide 2002 Water Quality Management Program Contracts is estimating a total of $2 million. (See Table 1).

A summary of Division and District activities is given in Table 2, including the three most important issues/concerns and accomplishments in each organization.
The water quality and water quality-related highlights of the year included the following events/activities:

- ✓ Flow augmentation and spill for-fish-passage measures needed to improve fish survival in the Columbia/Snake waterway continued to affect water quantity and quality.

- ✓ The Corps took appropriate actions for attaining a water quality variance from the State of Oregon for the 2002 spill season. A report was provided to the Oregon Department of Environmental Quality and the Washington Department of Environmental Quality on December 28, 2002. The Oregon Environmental Quality Commission met on March 8, 2002 and approved a variance for the 2002 spill season, subject to specific conditions. Waivers were granted for the April 1-August 31 periods, temporarily raising the dissolved gas standards from 110 percent to 120 percent in the tailwater of the spilling dam, and from 110 percent to 115 percent in the forebay of the next downstream dam. On August 23, 2002, the Portland District requested a special variance from Oregon outside the normal spill season for a spill survival test at The Dalles Lock and Dam in October 2002.

- ✓ The State of Washington modified its rule on TDG standards for multi-year to accommodate fish passage spill as called for in the NMFS Biological Opinions. The rule is in effect until 2003. Additional actions with the State were not required for the 2002 water year. The August 23, 2002 letter from the Portland District was a multiple address letter that also went to the Washington Department of Environmental Quality.

- ✓ The State of Idaho was approached in 2000 concerning a variance to water quality standards. The State, in conjunction with the tribes, provided a set of conditions that must be met as part of the variance process. Due to the conditions provided by the State and tribes, the forecasted runoff conditions and the foreseen use of Dworshak water releases, there was no further pursuit of a water quality variance by the Corps for the 2002 water year.

- ✓ The Corps continued informal discussions with Oregon and Washington about replacing the year-to-year variances with a three or five year long-term variances.

- ✓ To achieve the objectives of the 2000 BiOp, NMFS developed the jeopardy analysis framework. There are 14 RPAs (namely, RPAs 130 to 143) identified as part of a water quality strategy in the NMFS 2000 BiOp. Specifically, RPA's 131 and 132 deal with water quality monitoring. RPA 131 indicates that the physical and biological monitoring programs are to be developed in consultation with NMFS Forum regional Water Quality Team and the Mid-Columbia Public Utility Districts (PUDs). Efforts moved forward in 2002. RPA 132 specifies that a plan must be developed to perform a systematic review and evaluation of the TDG fixed monitoring stations (FMSs) in the forebays of all the mainstem Columbia and Snake River dams. Efforts at the Portland District sites moved forward in 2002.

- ✓ The Districts continued to be responsible for all TDG field monitoring functions. Portland and Seattle Districts contracted out the field calibration and maintenance. Walla Walla District contracted out the routine calibration of the instruments and chose to perform the routine and emergency maintenance with internal staff. The current TDG network included 27 Corps fully automated data collection and transmission facilities installed in forebays and tailwater areas of all Columbia and Snake River mainstem dams and some riverine sites. No data was collected at Skamania in 2002 in order to be able to test a new potential site at Corbett, Oregon.

- ✓ The US-Canada Transboundary Gas Group (TGG) continued to meet twice a year. This international technical group is designed to cooperatively undertake TDG abatement studies on a systemwide basis. Representatives of NMFS, EPA and the Northwest Power Planning Council are currently the US leads on this effort.

- ✓ Design and/or operational actions associated with the salmon and steelhead recovery effort continued to drive many of the water quality programs in the North Pacific Region.

- ✓ Water quality conditions at most reservoirs and lakes in the Northwestern Division, North Pacific Region remained practically unchanged from the previous years (see Table 4).

- ✓ The Portland District cooperated with resource agencies by monitoring water quality during construction activities at Cougar. This year the diversion tunnel was tapped in February 2002. In spring of 2002 construction of the temperature tower begun. Monitoring involved measuring temperature and turbidity upstream of the project and temperature, turbidity, and DO downstream of the project as well as Hydrolab profiles of the lake at three stations.

- ✓ The Seattle District continued to pursue a dissolved gas abatement study at Chief Joseph Dam in consultation with Washington State and the NMFS regional forum. As called for in the 2000 NMFS Biological Opinion for salmon, the merits of

operating Chief Joseph and Grand Coulee Dams jointly for dissolved gas abatement were examined in a system wide study.

- ✓ The Walla Walla District removed bridges above two spill bays at McNary Dam to reduce TDG generation, which came from the water hitting the bridges.

- ✓ The Walla Walla District and the Dworshak National Fish Hatchery water systems are operating under voluntary consent orders with the State of Idaho. Corrective actions to bring these systems up to Safe Drinking Water Standards are scheduled for December 2003.

- ✓ The Walla Walla District continues deployment of temperature sensor strings to collect temperature data using techniques employed in FY2002 at various dams and fish ladders. Pursuant to 2000 FCRPS Biological Opinion, the installation of a temperature monitoring system to allow accurate measurements of temperature for comprehensive investigation to improve fish passage systems.

Listed below for the Division and the three Districts are more specific water quality highlights for 2002.

1.1. North Pacific Northwestern Division, North Pacific Region

- ✓ Day-to-day coordination of the basin wide TDG monitoring program in the Columbia River Basin.

- ✓ Pursue actions needed from the State of Idaho, Oregon, and Washington to obtain a yearly variance, as well as a long-term variance.

- ✓ Implement relevant sections of the 2000 BiOp regarding operations that impact Water Quality and Environmental issues.

- ✓ Participation in the activities of the Technical Management Team (TMT), a regional inter-agency group to advise on the weekly or biweekly reservoir operation for the salmon recovery in the Columbia River Basin.

- ✓ Water quality staff operated and maintained an Internet homepage that provides the real-time project information needed for basin-wide water management.

- ✓ Active contribution to the preparation of the following annual planning documents: (1) 2002 Water Management Plan for the Columbia and Snake River system, for use by the TMT, (2) 2002 TDG Management Plan (for attachment to the TMT's Water Management Plan) and (3) Plan of Action for the 2002 TDG monitoring.

- ✓ Refinement and application of statistical procedures for predicting dissolved gas saturation levels, including evaluation of the increase in TDG mass caused by spill up to the 120% TDG target.

- ✓ Continued active participation in other regional forums dealing with water quality, including coordination of TDG-related regional research plan in NMFS's Water Quality Team, the regional Water Quality Plan group, and coordination with EPA, the states and tribes in the development of mainstem Columbia River TMDLs.

1.2. Portland District

- ✓ Completion of the seventh year of successful assumption of direct responsibility for dissolved gas monitoring at 8 stations on the lower Columbia River starting from John Day forebay, using the services of the USGS. Data loss for WY 2002 was less than 1 percent.

- ✓ Completion of a summary water quality report for the Toutle River Sediment Retention Structure (SRS), Mount St. Helens, Washington that encompassed water quality investigations since the project became operational.

- ✓ Participation in a cooperative effort with the U. S. Forest Service/ City of Salem concerning turbidity studies in the upper Santiam River watershed.

- ✓ Water continued to be released from Lost Creek and Applegate to improve Spring Chinook and Fall Chinook salmon spawning conditions. Flow and water temperature targets were again met. Routine water quality monitoring for nutrients and limnological parameters continued at both projects.

- ✓ In the Willamette River Basin turbidity was measured at Detroit Lake outflows in cooperation with a watershed monitoring program involving the USFWS, COE, USGS and the City of Salem.

- ✓ As part of the PAS program (Planning Assistance to the States) water temperatures were monitored at 10 locations – 3 above Green Peter, one below Hills Creek, one each above Lookout Point, Dorena and Cottage Grove, and three in the McKenzie River – all to assist the state in it's modeling effort regarding a temperature TMDL.

- ✓ The selective withdrawal structure at Willow Creek Lake was again used to aid locals in improving downstream water temperatures.

- ✓ Continuous findings of no contamination in dredged material samples collected from selected NWP's project sites.

1.3. Seattle District

- ✓ The District continued to be an active participant in the Instream Flow Commission, a multi-agency commission to establish flows for the Cedar River, a tributary to Lake Washington.

- ✓ The District continued to monitor water temperature at Wynoochee Dam, owned by the City of Aberdeen and operated by Tacoma Public Works Department.

- ✓ The District continued to study the water quality effects of increased conservation storage at Howard A. Hanson Dam. Routine water quality monitoring for conventionals, nutrients, and phytoplankton was conducted from May through October.

- ✓ Temperature strings were installed in Lake Rufus Woods at three locations. These strings measured temperature at various water column depths from August through October.

- ✓ A temperature string was installed in Lake Koocanusa at the forebay. This string measured temperature at various water column depths from June through November.

- ✓ The District conducted a total dissolved gas (TDG) exchange study at Libby Dam during June and July 2002. The purpose of the study was to define and quantify processes that contribute to dissolved gas transfer during spill releases at Libby Dam. Monitoring consisted of measuring TDG at 31 locations downstream of the dam during voluntary and involuntary spill that occurred from June 24 to July 7, 2002.

- ✓ The District monitored ground water quality in the Kootenai River valley near Libby Dam before, during and after the spill test to better quantify how river flows affect the ground water system.

- ✓ The District implemented a surface and ground water monitoring study with the USGS on the North Satus Creek Drain in the Yakima River Basin. The purpose of the study is to determine if the water quality of agricultural return flows water in the North Satus Creek Drain is acceptable for use in a wetland mitigation project.

- ✓ TDG was monitored at the two permanent water quality sites (forebay and tailwater) at Chief Joseph Dam.

- ✓ The District continued to monitor water quality throughout the Lake Washington Ship Canal (5 permanent water quality stations collecting salinity and temperature data), and in Lake Koocanusa and the Kootenai River (4 permanent water quality stations collecting conventionals, nutrients, metals, and phytoplankton data).

- ✓ The District continued to monitor temperature and discharge in rivers and streams throughout Washington, Northern Idaho, and Western Montana.

- ✓ A two-dimensional water quality model was used to simulate saltwater intrusion into the Lake Washington Ship Canal.

- ✓ The District continued to participate in the numerous fish studies through out the Green and Cedar River basins to improve the water quality and habitat of salmonids.

1.4. Walla Walla District

- ✓ The 2002 water year was an average flow year. The average inflow at Lower Granite Dam was approximately 17,400 KAF compared to the long-term mean of 19,000 KAF.

- ✓ Temperature measurements were made in Dworshak Reservoir using Optic StowAway® temperature loggers. Temperature sensor arrays were located at six reservoir locations and recorded data hourly throughout the year. The objectives of the study were to gather information that could be used by the water quality staff to: (a) advise operations regarding water releases intended for downstream cooling, and (b) select additional locations for temperature monitoring as needed.

- ✓ The new Total Dissolved Gas (TDG) sonde deployment systems installed at Ice Harbor and Lower Monumental Dams tail water stations proved inadequate. Russ Heaton re-designed the systems, reverting to the submerged pipe system. The latest design included several new improvements that will be detailed in the research and development section.

- ✓ Improvements in sampling and systems operations of water and wastewater were attained at Little Goose and Lower Granite Dams. Letters were drafted for new National Pollution Discharge Elimination System (NPDES) permits. Sampling and testing were performed according to state and federal guidelines.

- ✓ The District Dredge Evaluation Framework is to be superseded by a regional evaluation framework. Russ Heaton attended the first Regional Sediment Evaluation Team (RSET) meeting.

- ✓ The nine district swim beaches were monitored for fecal coliform bacteria.

1.5. Contracts

District water quality contracts are summarized in Table 1.

Table 1. 2002 Water Quality Contracts (in $1,000s)

Offices	Universities and AE's	Other Corps	Other Federal	Water Quality	Sediment Quality	Total WQ+SQ
NWD-NP						
NWP	845.7	7.0	455.9	738.3	569.9	1308.2
NWS	17.0	170.0	65.0	252.0	133.4	385.4
NWW	717.0	16.0	18.0	168.0	30.0	198.0
TOTAL	1579.7	193.0	538.9	1158.3	733.3	1891.6

1.6. Summary of Water Quality Conditions

Three most important issues & accomplishments are shown in table 2.

Table 2. Issues/Concerns & Accomplishments

Three Most Important Issues/Concerns	Three Most Important Accomplishments
NWD-NP 1. Dissolved gas supersaturation 2. Water Temperature 3. Regional coordination for the NMFS forum and TMDLs.	NWD-NP. 1. TDG: Coordination & Applications 2. Activities within TMT and DGT Teams 3. Coordination of NWD-NP-WQ programs
NWP 1. TDG in Lower Columbia River Projects 2. TDG and T ^{0} TMDLs in Willamette & L. Columbia River 3. Columbia and Willamette River BiOPs – RPAs.	NWP 1. Successful TDG fixed monitoring program 2. Sediment Retention Structure Water Quality Report. 3. PAS support to Oregon for TMDL development.
NWS 1. Disposal of dredged material 2. Saltwater intrusion in Lake Union 3. Water Temperature at Libby Dam and Chief Joseph Dam	NWS 1. Libby Dam TDG study 2. Kootenai River valley ground water study 3. Howard Hanson Reservoir limnological study
NWW 1. Public health 2. Impacts of proposed dam breaching and dredging 3. High temperatures in Lower Snake and McNary Reservoirs.	NWW 1. Increased support to water and wastewater problems 2. Feasibility and Dredged Material Management Draft EIS section reports 3. Installation of fish facility temperature

	monitors. 4. Multi level temperature thermister units were designed and installed at McNary forebay. 5. Continuation of the temperature study at Dworshak Reservoir.

A summary of Northwestern Division water quality conditions is shown in Table 3.

Table 3. Summary of 2002 Water Quality Conditions

Districts/ Projects	Ratings	Historical Problems	2002 Problems	Future Problems
Portland				
1. Lost Creek	Good	Outflow temperature	Outflow temperature, algae bloom	Outflow temperature, algae blooms
2. Applegate	Good	Outflow temperature, mercury	Outflow temperature, algae bloom	Outflow temperature, mercury, anoxia
3. Fall Creek	Good	H_2S, algae, anoxia	Outflow temperature	Algae, temp.
4. Hills Creek	Fair	Turbidity, algae, outflow temperature	Outflow temperature, major anabaena bloom	Turbidity, algae blooms
5. Lookout Pt.	Good	None	TDG, Outflow temperature	TDG, temp
6. Dexter	Fair	Algae, macrophytes	TDG, Outflow temperature, anabaena bloom	TDG, temperature, algae blooms
7. Dorena	Fair	Mercury	Mercury, anoxia	Mercury, anoxia
8. Cottage Gr.	Fair	Mercury	Mercury, anoxia, temp	Mercury, anoxia, temp
9. Fern Ridge	Poor	Eutrophication, nuisance aquatic plants	Nutrients, nuisance aquatic plants	Eutrophication, aquatic plants
10. Willow Cr.	Poor	Enrichment	Anoxia, H_2S, nutrients, methane, algae blooms, fecals	Anoxia, H_2S, nutrients, methane, algae blooms, fecals
11. Cougar	Poor	Outflow Temperatures	Outflow temperature, anabaena bloom	Temperature, algae blooms
12. Blue River	Good	Outflow temperatures	Outflow temperature	Temperature, algae blooms

13. Detroit	Good	Outflow temperatures, turbidity	Turbidity, outflow temperature	Turbidity, outflow temperature, algae blooms
14. Big Cliff	Good	Temperature, turbidity	Turbidity, outflow temperature	Turbidity, outflow temperature
15. Green Peter	Good	Turbidity, Outflow temperatures	Outflow temperature	Turbidity, outflow temperature, algae blooms
16. Foster	Good	Turbidity, temperature	Outflow temperature	Turbidity, outflow temperature
17. Bonneville	Good	Dissolved gas, temperature	TDG>110%	TDG, temperature, nutrients, toxics
18. The Dalles	Good	Dissolved gas, temperature	TDG>110%	TDG, temperature, nutrients, toxics
19. John Day	Good	Dissolved gas, temperature	TDG>110%	TDG, temperature, nutrients, toxics
Seattle				
1. Libby Dam	Good	Nutrients, metals, temperature	None	Temperature, TDG
2. Albeni Falls	Good	Temperature, metals	Temperature	Temperature, TDG, nutrients, macrophytes
3. Chief Joseph	Good	Dissolved gas, temperature	TDG > 110%	Temperature, TDG, nutrients, algae, macrophytes
4. Mud Mountain	Good	Turbidity, sediments	None	Turbidity
5. Howard Hanson	Good	Temperature, turbidity	None	Turbidity, temperature, nutrients, algae
6. Lake Washington Ship Canal	Fair	Saltwater intrusion, contaminated sediments	Saltwater intrusion	Benthic O_2 Demand
7. Lake Union	Fair	Contaminated sediments, sediment oxygen demand, saltwater intrusion	Contaminated sediments, sediment oxygen demand	Contaminated sediments
8. Wynoochee	Good	Temperature	Temperature	Temperature
Walla Walla				
1. Dworshak	Good	Trash/Debris, TDG, Turbidity, potable water	Potable water operating under MOU with State of Idaho. Separate	Increase withdraw and drawdown, Decreased fish productivity

			MOU for Dworshak National Fish hatchery. Currently looking at participation in local water district.	
2. Lower Granite	Fair	High levels of Total Dissolved Gas during high flow periods. In the summer high water temperatures, increase nutrient loading, and slower water velocities contribute to blue-green algae blooms.	Have No NPDES permits for Fish facility outflow. Systems need to be operated and maintained on a daily basis. System equipment operations need to be formatted.	Contaminated Sediments impacting dredging operations and contributing to eutrophication conditions during low flow periods. Increased pesticides and herbicides in the runoff. Many of the newer pesticides and herbicides have not been tested for their deleterious effects.
3. Little Goose	Fair	High levels of Total Dissolved Gas during high flow periods.	Have No NPDES permits for Fish facility outflow. Systems need to be operated and maintained on a daily basis. Effluent sample needs to be a composite to be more representative.	Contaminated Sediments impacting dredging operations and contributing to eutrophication conditions during low flow periods. Increased pesticides and herbicides in the runoff. Many of the newer pesticides and herbicides have not been tested for their deleterious effects
4. Lower Monumental	Fair	High levels of Total Dissolved Gas during high flow periods.	Problems with potable water exceeding nitrates. Problems with potable water exceeding coliform level. Problem getting all required	Contaminated Sediments impacting dredging operations and contributing to eutrophication conditions during low flow periods

			testing done. Problems posting of water system. Well #3 not approved by Washington Dept of Health for potable water.	
5. Ice Harbor	Fair	The potable water has been a problem at Ice Harbor for several years. Fecal coliform at swims beaches and in water supplies have been historical problems. High levels of Total Dissolved Gas during high flow periods.	Problems with well #1 in Hood Park. Not approved for potable water by Washington Dept of Health. High dissolved gas and water temperatures were a problem	High Temperatures. Increase in water disposal, algae, delayed fish passage, bacteria, shoaling problems with well #1 in Hood Park. Not approved for potable water by Washington Dept of Health. Non- point source nutrient loading. Increased pesticides and herbicides in the runoff. Many of the newer pesticides and herbicides have not been tested for their deleterious effects
6. McNary	Fair	Dissolved Gas, temperature	High TDG and water temperatures were a problem	Temperature. Non-point source nutrient loading. Increased use of pesticides and herbicides. Unknown concentrations in the runoff present a challenge to making factual determinations
7. Lucky Peak	Good	None	Swimmer’s itch	Increase demand, non-point source nutrient loading
8. Mill Creek	Fair	Stratification, anoxia, turbidity, swimmer's itch	Sedimentation due to flooding	High Turbidity, Conditions caused by reservoir refill

2. Water Quality Management Program

2.1. Introduction

This portion of the report summarizes the Northwestern Division (North Pacific Region) Water Quality Management Program for program objectives, major activities, accomplishments in 2002, and proposed objectives for 2002. The report conforms to ER 1110-2-8154, Water Quality and Environmental Management for Corps Civil Works Projects dated 31 January 1995, and with NPDR 1110-2-101, Water Control Management - Quality, dated 19 December 1986.

2.2. Organization And Coordination

Most NWD-NP Reservoir Control Center water quality programs are surveillance and monitoring in nature. These programs are to ensure that Corps activities meet all applicable federal, state and local standards to the full extent possible. In some cases, water quality programs can be project-specific and lead to changes in project operations and/or design features. An example is dissolved gas monitoring and its use in adjusting real-time spill on the mainstem Columbia and Snake Rivers or longer term efforts of changing spill patterns and modifying spillway and stilling basin configurations. Data from the dissolved gas monitoring program is also being used to help refine existing regression-based and deterministic dissolved gas models.

In many districts, compliance with the Clean Water Act (e.g. NPDES — National Pollutant Discharge Elimination System, and Section 404(b)(1) evaluations) is managed under the water quality program. Although most division and district water quality elements have no direct regulatory responsibility, their annual reporting requirements are more extensive than those of other functional elements.

2.2.1. Assigned Responsibilities

2.2.1.1. Northwestern Division, North Pacific Region

At the regional level, the Water Quality Team (WQT) in the Reservoir Control Center (Water Management Division, Engineering and Technical Services Directorate) provides technical and policy guidance on CENWD-NP's water quality programs. The WQT is responsible for monitoring the TDG and water temperature conditions in the forebays and the tailwaters of the lower Columbia River/ lower Snake River dams, and selected river sites. The operational water management guidelines are to change spill levels and subsequently, spill patterns at the dams (daily if necessary) so that the forebays are close to, but do not exceed State Water Quality Standards. This team also addressed variances from the total dissolved gas water quality standard with the appropriate States and tribes impacted by the program implemented in the Federal Columbia River Power System (FCRPS) for which the Corps has responsibility. As a long-term strategy, the Corps opened discussions with Oregon and Washington states about replacing the year-to-year variances with long-term variances.

Coordination also extends to other water quality programs and activities by the Corps, other agencies and regional organizations.

- ✓ The WQT staff directly coordinates and schedule short- and long-term reservoir operations for water quality that impact fish passage and fishery research.

- ✓ The WQT prepares a dissolved gas Plan of Action each year. It is a supporting document for the NMFS Forum Technical Management Team, which makes recommendations on the operation of the Federal Columbia River Power System for multi-purpose use. The Plan stipulates what to measure, how, where, and when to take the measurements and how to analyze and interpret the resulting data. The Plan also provides for periodic review and alteration or reduction of efforts when monitoring results and/or new information from other sources justifies a change.

- ✓ The WQT represents the Corps as active participants in the NMFS BiOp Water Quality Team, which is expanding to address regional TMDL issues.

- ✓ The WQT is responsible for preparing an annual TDG Annual Report for distribution to the region, after review and synthesis of materials submitted by the districts.

2.2.1.2. Districts

At the district level, all three NWD-NP districts are assigned broad responsibilities in developing and implementing water quality management programs. Districts are responsible for identifying and monitoring the sources of water quality problems affecting (or caused by) their projects. They inform State and Federal agencies of water quality changes that could present a public health hazard. They report emergency events to the Division's Readiness Management (Operations, Construction & Readiness Directorate). Some of their water quality activities overlap with other programs, such as the Defense Environmental Restoration Program and EPA Superfund Program. Water quality problems that can be resolved through reservoir operations are reported to the Reservoir Control Center for appropriate actions.

Primary responsibility for reservoir water quality programs usually rests with the planning and engineering elements. This is true for the Portland and Seattle Districts. In CENWW (Walla Walla District), the Engineering H&H Branch and Operations Division's Natural Resources Management manages water quality. The H&H Branch also handles hazardous, toxic, and radioactive waste (HTRW) issues including ground water and sediment contamination with emphasis on contaminant identification. It provides water quality expertise and coordination for planning studies such as the Dissolved Gas Monitoring, Lower Granite Dredging Compliance Monitoring, Lower Snake River Project Water and Wastewater operation, and Public Health activities. The District Water Quality steering committee coordinates work with other districts and division as needed.

All NWD-NP districts have direct access to the Waterways Experiment Station in Vicksburg, MS and the Hydrologic Engineering Center in Davis, CA for physical and mathematical modeling support. Each district reports its water quality activities annually to the Northwestern Division, North Pacific Region for review, synthesis, reporting and posting on the Internet.

2.2.2. Cooperation with Other Agencies

District and Division staffs routinely coordinate with Federal, State, and local agency environmental quality counterparts and state Department of Health for Public Services. The listing of twelve Pacific salmon species under the Endangered Species Act (ESA) has made this coordination critical since the Corps is responsible for the operation of its project for multiple purposes. All water users have a vested interest in what operation is being planned by the Corps, where, when, and how.

CENWD-NP's Reservoir Control Center (RCC), in the Water Management Division, plays an active role in implementing the flows measures contained in the NMFS's 2000 Biological Opinion. There is continual dialogue between RCC and the Pacific Salmon Coordination Office, the Bonneville Power Administration (BPA), utilities, state and federal fishery agencies and Indian Tribes. The RCC makes all final reservoir regulation decisions, frequently based on recommendations from the Technical Management Team, a mid-management level group set up by NMFS in 1995 and chaired by the Corps representative.

NWW cooperates with the U.S. Department of Energy in analysis of existing data, development of GIS, and plans for future activities in water quality and fishery programs. Studies of sediment pollution for dredging activities are performed in cooperation with EPA and the Washington Department of Ecology. State of Washington Department of Ecology, State of Idaho Division of Environmental Quality (IDEQ), NMFS, and ODEQ in performing NPDES permitting activities. Contacts with IDEQ, State of Washington Department of Ecology, EPA, and U.S. Department of Energy are also needed to help address sediment transport and contaminant concerns.

2.2.3. National Corps Committees

CENWD-NP is represented on national Corps committees. These include the Corps' Committee on Water Quality (by CENWD-CM-WR-N), Committee on Tidal Hydraulics (by CENWS's Engineering), Corps Research and Development Field Review Group (by CENWD-CM-WR-N and CENWP-NP-ET-HR), and Committee on Hydrology (by CENWD-NP-ET-WH).

2.3. Major Goals And Objectives

Executive Order 12088, dated 8 November 1978 made it a national policy for the Federal Government to provide leadership in a nation-wide effort to protect and enhance the quality of air, water, and land resources. ER 1110-2-8154 (Water Quality and Environmental Management for Corps Civil Works Projects) dated 31 May 1995 establishes a policy for the water quality management program at Corps civil works

projects. In accordance with this policy and additional guidance provided in NPDR 1110-2-101 ("Water Control Management, Water Quality") dated 19 December 1986, the established long-term goal of the Division's Water Quality program is to ensure that waters at each project are of suitable quality for the project's established project use(s).

To meet this goal, there is a need to:

- ✓ Develop a good understanding of the physical processes affecting water quality, including relationship between project operations and ambient water quality conditions; and

- ✓ Monitor water quality trends and current conditions so that future conditions can be reliably predicted and efficient corrective actions taken.

In order to achieve these objectives, there is a need to:

- ✓ Maintain staff capability in state-of-the-art water quality techniques and procedures, and correct application thereof;

- ✓ Implement reliable and adequate monitoring programs to support water management functions in an efficient and expeditious manner;

- ✓ Provide a comprehensive, up-to-date, and easily accessible data base; and

- ✓ Foster close cooperation with other Federal, State, and local agencies involved in water quality programs.

Objectives set by each district reflect the district's own priorities and requirements. These objectives and a summary of their status for FY02 are listed in the following sections.

2.3.1. Northwestern Division, North Pacific Region

2.3.1.1. Water Quality Objectives and Goals

1. Continue to monitor and adjust spill levels at Corps projects in the Columbia River Basin during the spill season to maintain levels below the state standards for TDG (115% in the forebays and 120% in the tailraces) and temperature (68F);

2. Work with States to resolve state water quality variance issues.

3. Continue to improve Division-District coordination on water quality and related issues; develop an inter-agency Water Quality Plan for the Columbia/Snake system.

4. Continue to provide water quality and general environmental support to others as needed.

5. Participate in the development of a CENWD – North Pacific Water Quality Team to provide regional program management guidance.

6. Develop and implement 1-year and 5-year Water Quality Plans as specified in the 2000 NMFS BiOp.

7. To achieve the objectives of the 2000 BiOp, NMFS developed the jeopardy analysis framework. There are 14 RPAs (namely, RPAs 130 to 143) identified as part of a water quality strategy in the NMFS 2000 BiOp.

2.3.1.2. Water Quality Status

Objective 1. The Corps total dissolved gas and water temperature monitoring now includes deployment of 27 fully automated instruments at both forebay and tailwater areas of all Corps mainstem dams and other river locations. Division staff continues to coordinate the monitoring program on a system-wide basis, prepare real-time data reports, disseminate relevant information, and store the information in a permanent database.

Objective 2. Monitor and adjust spill levels, information collected through the dissolved gas monitoring program was used by the Inter-agency Technical Management Team on a real-time basis for adjusting project spill in an attempt to control total dissolved gas levels to the State standards. A spill and dissolved gas management policy was formulated and implemented annually division-wide. As was the case in the previous five years, NMFS required that spill be implemented at lower Columbia and lower Snake Rivers mainstem dams to improve juvenile passage conditions.

Objective 3. Project operational information including fixed monitoring station data (TDG and temperature) is published real time from CROHMS on the TMT web page to aid regional decision makers. Monthly historical summaries of the FMS data are also published on the TMT web page.

Objective 4. Active participation in regional forums dealing with water quality issues with EPA, the states and tribes in the development of mainstem TMDLs.

Objective 5. Division staff closely coordinated with all three Districts in many areas, including TDG monitoring scheduling special reservoir operations for TDG-related research.

2.3.2. Portland District

2.3.2.1. Water Quality Objectives and Goals

1. Develop problem-specific water quality studies for Lost Creek & Applegate Lakes in the Rogue basin, and at Willow Creek Lake, Heppner, Oregon.

2. Continue to operate and maintain stream-gaging programs in the Willamette and Rogue River Basins, Oregon, Willow Creek basin, and in Toutle River basin,

Washington, and in the Lower Columbia River main stem. Upgrade some of the Willamette gages to obtain temperature data to support DEQ TMDL modeling efforts.

3. Work with Oregon resource agencies to develop instream-flow rules for the Willamette River requiring the Corps of Engineers to provide specific flows year-round for fisheries and water quality enhancement.

4. Continue coordination with resource agencies to assure Portland District's compliance with Federal and State water quality regulations at existing and proposed Federal projects.

5. Continue studies of mercury contamination in Cottage Grove and Dorena Reservoirs.

6. Continue selective withdrawal at Willow Creek Reservoir to aid locals in reducing temperatures in Willow Creek below the project.

7. Review historic and current data to determine problem specific water quality studies to conduct at Corps projects.

8. Continue to implement the District Fixed Monitoring Program (FMP) for monitoring TDG below Corps Projects in the lower Columbia River. Evaluate the need for dropping and/or moving FMP sites to improve the programs goal of monitoring compliance with water quality standards.

9. Continue to monitor TDG below Corps Projects in the Willamette and Rogue Basin on an as-needed basis.

10. Continue to participate with the U.S.F.S. and the city of Salem as a team member to monitor water quality in the North Santiam Watershed.

11. Implement plans and specifications for water quality monitoring during construction of the Selective Withdrawal Tower at Cougar Reservoir and Blue River Reservoir.

12. Continue to support efforts to set up water quality models of District Projects that have important water quality problems.

13. Support the State in developing TMDLs for the Willamette River.

14. Continue participation in developing a Water Quality Plan for District projects in the Lower Columbia River as required in the NMFS Biological Opinion on saving threatened fish species.

15. Assist the U. S. Forest Service in monitoring the blue green algae bloom at Hills Creek and Cougar Reservoirs for 2003.

16. Develop plans for implementing the RAMS (Restoration of Abandoned Mines) program at the Black Butte Mine in the watershed of Cottage Grove Reservoir for 2003.

17. Set up Bureau of Reclamation (BOR) weather stations at Hills Creek, Lookout Point and Detroit Reservoirs to aid water quality modeling efforts at these projects that will support the State of Oregon in its temperature TMDL program for 2003.

2.3.2.2. Water Quality Status

Objectives 1 through 11 for 2002 were met.

Objective 12. NWP assists NWD in Columbia River BiOP Water Quality Plan.

2.3.2.3. Sediment Quality Objectives

1. Implementplans and specifications for water quality monitoring duringconstruction of the Selective Withdrawal Tower at Cougar Reservoir.

2. Continue the District-wide sediment quality evaluation program at Operations and Maintenance dredging projects. During FY 2003, sediment quality evaluations will be conducted in the Columbia River, Lower Willamette River, Rogue River, Port Orford and Chetco River federal projects.

3. Continue coordination with resource agencies to assure Portland District's compliance with Federal and State water quality regulations at existing and proposed Federal navigation projects.

4. Additionally, advise the Regulatory and Environmental Resource Branch (CENWP-EC-R) on testing procedures and interpretation of results for Section 404/103 permit actions.

5. Continue to develop management/monitoring plans and implement the management/monitoring programs for ODMDS.

6. Continue to participate in development of regional dredging teams as defined in the December 1994 MARAD report.

7. Continue the implementation and updating of the Columbia River Regional Testing Manual for sediment quality evaluation through the regional Sediment Evaluation Team (RSET).

8. Continue populating and managing the SEDQUAL database.

9. Continue development of SEDQUAL database for 2003.

10. Complete ODMDS evaluation study and Section 103 selection for 2 new ODMDS at MCR for 2003.

2.3.2.4. Sediment Quality Status

Objectives 1. Sediment quality evaluations, standard compliance, and ODMDS studies were fully achieved in FY 2002. More work will be done still in FY 2003.

Objective 2. Management and monitoring of ODMDS programs. Annual bathymetric surveys were completed at the ODMDSs. Mathematical models of dredged material placement and subsequent sediment transport were conducted at MCR and ODMDSs E.

Objective 3. Participation in regional dredging teams is an on-going activity. A team consisting of Corps, EPA, NOAA Fisheries, USFWS, ODEQ, WDOE and WDNR representatives is charged with updating (DMEF) guidelines for regional dredging activities.

Objective 4. SEDQUAL is an ongoing effort.

Objective 5. Yaquina Bay ODMDS evaluation was completed.

2.3.3. Seattle District

2.3.3.1. Water Quality Objectives and Goals

1. Continue performing project and related data evaluation and reduction.

2. Continue development and application of an operational water temperature model for Libby Dam to aid in determining the effects of temperature on the Kootenai River white sturgeon.

3. Continue limnological and routine water quality sampling of Lake Koocanusa, Howard Hanson Reservoir, the Kootenai River, and the Green River.

4. Continue automating data collection capabilities with emphasis on the Lake Washington Ship Canal.

5. Continue maintenance and updates to the Dredged Analysis Information System (DAIS).

6. Continue interagency discussion to develop solutions to dissolved gas problems above and below Chief Joseph Dam, and study the feasibility of joint operations of Grand Coulee Dam and Chief Joseph Dam as an alternative for reducing TDG in Lake Rufus Woods.

7. Continue to evaluate the possibility of installing at least one new generating unit at Libby Dam to allow high flows with reduced risk of spill and high TDG levels.

8. Perform a total dissolved gas exchange study at Libby Dam and the Kootenai River during voluntary spill conditions.

9. Study the impacts of high Kootenai River flows on the ground water near Libby Montana.

10. Implement a water column temperature study at Chief Joseph Dam to determine the water temperature change in Lake Rufus Woods between Grand Coulee Dam and Chief Joseph Dam.

11. Implement a water column temperature study at Libby Dam to determine changes in forebay temperatures from the spring through fall.

12. Implement an intensive water quality sampling program at Howard Hanson Reservoir during the Additional Water Storage Project test pool study.

2.3.3.2. Water Quality Status

Objective 1 (data evaluation). Efforts were made to continually re-evaluate and enhance the District's water control data collection system. A cooperative data collection program was continued with the U.S. Geological Survey.

Objective 2 (Libby water temperature monitoring). The District successfully used a numerical model to assist a multi-agency recovery team in planning Libby Dam releases that would benefit sturgeon larval releases from the Kootenai Indian Tribe’s fish hatchery.

Objective 3 (Routine sampling at Lake Koocanusa and Howard Hanson Reservoir). The District monitored water quality in Lake Koocanusa and the Kootenai River at 3 in-reservoir stations from April through October and 1 downstream station from January through December. The District monitored water quality in Howard Hanson Reservoir and the Green River at 1 upstream station, 6 in-reservoir stations, and 1 downstream station.

Objective 4 (Data collection on Lake Washington). The District continued operation of six water quality stations in the Lake Washington Ship Canal (LWSC) in 2002. All stations transmit real-time data to the District's Reservoir Control Center. The LWSC data are used to make operational decisions for control of saltwater intrusion.

Objective 5 (Dredge Analysis). The Dredged Analysis Information System (DAIS) continued to be used successfully to manage data used in the assessment of sediment quality for regulated and federal operations and maintenance projects.

Objective 6 (TDG issues at Chief Joseph Dam). The District continues to participate in interagency discussion to develop solutions to dissolved gas problems above and below Chief Joseph Dam. A study to evaluate the possible joint operations of Chief Joseph Dam and Grand Coulee Dam was implemented in 2002 and will continue in 2003.

Objective 7 (New Turbine Unit at Libby). The District continues to provide information to outside agencies that are exploring power unit installation as a means of reducing the risk of spill and high TDG levels at Libby Dam.

Objective 8 (TDG exchange study at Libby). The District performed a TDG exchange study at Libby Dam. Monitoring at Libby Dam consisted of measuring TDG at 31 locations downstream of the dam during voluntary and involuntary spill that occurred from June 24 to July 7, 2002.

Objective 9 (Kootenai River flow). The District sampled ground water in the Kootenai River valley from June through December. The goal of the monitoring program was to characterize the shallow and deep ground water quality of properties adjacent to the Kootenai River downstream of Libby Dam before, during, and after the spill test to determine if water quality impacts are occurring during high flow conditions.

Objective 10 (Temperature study at Chief Joseph Dam). The District implemented a preliminary temperature study at Chief Joseph Dam during 2002. Temperature strings were placed at three locations in Lake Rufus Woods between Grand Coulee Dam and Chief Joseph Dam from August through October 2002. This study will continue in 2003.

Objective 11 (Temperature study at Libby Dam). The District implemented a preliminary temperature study at Libby Dam during 2002. A single temperature string was placed at the forebay of Lake Koocanusa from June through November 2002. This study will continue in 2003.

Objective 12 (Limnological study of Howard Hanson Reservoir). The District began an annual limnological study of Howard Hanson Reservoir to determine the possible water quality impacts of storing additional water in the reservoir during the summer months. This study will continue in 2003.

2.3.4. Walla Walla District

2.3.4.1. Water Quality Objectives and Goals

Objective 1. Finalize the District potable water program that encompasses procedures and contacts for all operation and emergency situations. The program will include training systems and test / evaluation programs. A final work product of this effort will be to document the outline of this program.

Objective 2. Finalize development of the district sanitary system program similar to the program in objective number one.

Objective 3. Identify existing facilities that need coverage under the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA) and compliance status. Plan for corrective actions and develop budgets specifically to correct the problems. Also determine necessary permits and operations to comply with Phase II NPDES and WRDA 96.

Objective 4. Identify personnel needs required to monitor and operate district water plants and wastewater plants.

Objective 5. Hire and train required personnel to satisfy compliance with the SDWA and CWA.

Objective 6. Pursuant to the Interagency Draft Water Plan for Compliance with the CWA (dated 21 September 2002), evaluate requirements necessary for compliance monitoring of CWA section 303(D) listing of the following:

a. Snake River from confluence with the Columbia (RM324.3) to the confluence with the Palouse River (RM59.3) for dissolved oxygen.
b. Snake River from the Washington Border with Oregon to the Salmon River for mercury.
c. Columbia River at McNary to the confluence with the Yakima River for bioassay.
d. Lower Snake River from the confluence with the Columbia to the confluence with the Salmon River for temperature.
e. Snake River from the confluence with the Columbia to the confluence with the Clearwater River for TDG.
f. Lower Snake River (unspecified) for pH.

Objective 7. Complete a multi-year evaluation of swim beach monitoring program, evaluate training, equipment, and evaluate trends. Produce a report outlining the current status.

Objective 8. Pursuant to RPA-5 of the 2000 FCRPS Biological Opinion (dated 21 September 2000), provide technical assistance to Mr. Rick Emmert for the implementation of his one- and five-year plans for Walla Walla District Projects. Additionally, provide technical assistance towards completion of the annual performance report specified in RPA-13.

Objective 9. Pursuant to RPA-33 and 34 of the 2000 FCRPS Biological Opinion (dated 21 September 2000), Begin installation of a temperature monitoring system to allow accurate measurements of temperatures at specific elevation to assist in the adjustment of the temperature control structures at Dworshak Dam.

Objective 10. Pursuant to RPA-114 and 115 of the 2000 FCRPS Biological Opinion (dated 21 September 2000), provide technical assistance to Mr. Rick Emmert for the comprehensive investigation of depth and temperature in the fish passage systems and the project near field to determine potential passage problems and facilitate other model and temperature investigation efforts. Use economy of force operations to maximize cost benefit to all water quality studies present and future in conjunction with other studies. Finally, the feasibility of replacing old-style mercury tubes with improved accuracy platinum RTDs coupled into TDGMS to insure a cyclic frequency will be evaluated.

Objective 11. Pursuant to RPA-131 and 132 of the 2000 FCRPS Biological Opinion (dated 21 September 2000), provide technical assistance to Mr. Rick Emmert for the comprehensive review of the dissolved gas monitoring stations in the Walla Walla District and provide recommendations for implementation of remedial actions. Special attention will be given to correcting thermocline related problems associated with the forebay monitors. The district will continue to operate the TDGMS to provide the region with the highest quality data obtainable within the annual O&M budgeted appropriation line item.

Objective 12. Pursuant to RPA-139 of the 2000 FCRPS Biological Opinion (dated 21 September 2000), provide technical assistance to Mr. Rick Emmert with good science practices to evaluate gas abatement options at Dworshak Dam.

Objective 13. Pursuant to RPA-143 of the 2000 FCRPS Biological Opinion (dated 21 September 2000), provide technical assistance to Mr. Rick Emmert with quality temperature monitoring data for use in all present and future modeling studies. In addition, all data collection efforts will be conducted under a peer reviewed SAP and undergo a rigorous QA/QC procedure to optimize its usefulness to all interested parties.

2.3.4.2. Water Quality Status

1. (District Potable Water Program finalization) This goal is currently on track provided the installation of another system at the Illia Housing Complex and the Drinking Water O&M manual are completed in this fiscal year. The UV radiation water treatment system installed at the Mill Creek Project continues to provide excellent service. In FY 2003 a similar system will be installed at the Illia Housing Complex. Over the course of five years we hope to achieve a major reduction in both the incidence of coliform detection and O&M costs by 60% or greater. A final district operations manual for the water systems should be completed sometime in FY 2003.

2. (Develop a district sanitary systems program similar to objective 1) The draft operations manual was not completed in FY 2002. The goal of total operational compliance in FY 2004 is still on target.

3. (Identify existing facilities that need permit coverage) The new Phase II rules apply as of April 2003. The report is not completed. This objective is behind schedule but it is anticipated it will be completed on time.

4. (Identify personnel needs required to monitor and operate district water plants and wastewater plants) There were some additional personnel hired last year to manage attrition. One new person to be hired to the water quality program is on target for mid FY 2003. Attrition management and training goals are still an issue. Otherwise, this objective is considered to be complete.

5. (Hire and train required personnel to fulfill Objective 4) Training is available and personnel training requirements are identified. Some district individuals will need to complete their individual required training otherwise the objective was met.

6. (Evaluate requirements necessary for compliance monitoring of CWA section 303(D)) No progress was made due to lack of resources.

7. (Complete 5year evaluation of swim beach monitoring program and report findings) No progress was made on this objective and it will be carried over to FY 2003. As of FY 2004, the requirement will be six years old and meets the criteria for funding under level one baseline.

8. (Pursuant to RPA-5 of the 2000 FCRPS Biological Opinion provide technical assistance to managers for preparation of one- and five-year water quality plans.) District water quality personnel participated in the preparation of the water quality appendix of the water management report, appendix "D" of the fish passage plan, and the annual water quality report forwarded to HQ USACE.

9. (RPA-33 and 34 of the 2000 FCRPS Biological Opinion, provide technical assistance for redesign of the fish water re-use system at the Dworshak National Fish Hatchery) The design work was completed in FY2002 and the construction phase is scheduled to be completed in FY2003.

10. (RPA-114 and 115 of the 2000 FCRPS Biological Opinion, provide technical assistance for a comprehensive investigation of water depth and temperature in the fish passage systems) For RPA 114, an in-depth water quality study was completed on the four Lower Snake River fish facilities. A QA/QC program to include standardization and accuracy testing was implemented in FY2002. The instrumentation in the fish ladder are to be evaluated for inclusion into the telemetry system in FY2003. A final report should be completed in FY2003. For RPA 115, the biological study of fish and temperature is still in progress.

11. (RPA-131 and 132 of the 2000 FCRPS Biological Opinion, provide technical assistance to Mr. Rick Emmert for the comprehensive review of the dissolved gas monitoring stations deferred to FY 2003) For RPA 131, it was decided to upgrade existing infrastructure (tailwater FMS pipes) with 8-inch HDPE pipe and improved

anchoring systems. Since many of the stations were in need of repairs, the upgrades will allow for greater reliability and improved flow performance. A contract was awarded in FY 2002 to Sweeny Aquametrics for the delivery of twenty improved TDG, temperature, depth, and dissolved oxygen sondes. These units will operate along side the existing Hydrolab® instruments until they are completely phased out for the new equipment sometime in FY2004. After the FY2003 purchase of additional instruments the Districts TDG FMS will be completely redundant for instrumentation.

12. (RPA-139 of the 2000 FCRPS Biological Opinion provide technical assistance to evaluate gas abatement options at Dworshak) Cancelled due to lack of funding. The future of this RPA appears uncertain at this time.

13. (RPA-143 of the 2000 FCRPS Biological Opinion provides technical assistance with quality temperature data collection for use in all present and future modeling studies.) A preliminary in-pool reconnaissance study was completed with the report due in January 2003. The modeling efforts were un-funded in FY2002 but in-house water modeling efforts will use the data to evaluate potential operational changes to enhance the existing efforts. A QA/QC protocol was developed as a spin-off project to the QA/QC efforts developed under water quality objective ten.

2.4. Laboratory and Field Equipment

2.4.1. Northwestern Division, North Pacific Region

No laboratory facilities or activities.

2.4.2. Portland District

1. No laboratory facilities.

2. The USGS laboratory at the Water Resources Division was used for calibration, maintenance and repair of TDG saturometers and DCPs for the Fixed Monitoring Stations (FMSs). The District purchased 5 Hydrolab mini-sondes for measuring TDG at the FMS sites.

3. Portland District has 3 Hydrolab H20s and 3 TDG saturometers that are used for routine water quality monitoring.

4. Various contract analytical companies analyzed water and sediment samples.

2.4.3. Seattle District

1. The Seattle District continues to use a variety of environmental contractors to obtain field samples for water quality and sediment quality sampling and analysis. A partial list of these contractors include Aquatic Research, Tetra Tech, HDR, R2 Resource Consultants, Economic and Engineering Services, Montgomery Watson

Harza, D.M.D., Inc Environmental and Toxicological Services, Montana Environmental Laboratory, Kootenai Surveyors, University of Arizona, USGS, and the COE Engineer Research and Development Center (ERDC).

2. The Seattle District maintains its own on-site laboratory for the collection and analysis of water and sediment samples. Analysis equipment available includes Hydrolab multi-probe water quality samplers (containing one or more of the following probes: total dissolved gas, turbidity, conductivity, pH, dissolved oxygen, temperature, depth), Orion pH, dissolved oxygen and conductivity meters, Hach turbidity meters, Vemco temperature loggers, and NIST certified thermometers and barometers. Sampling equipment available includes vertical point water samplers, a Ponar sediment sampler, and simple plankton net. In addition, each project in the Seattle District operates and maintains sampling boats equipped with winches and depth sounders. The on-site laboratory is equipped to handle the calibration of field instruments and the QA/QC of total dissolved gas and temperature instruments. The laboratory has equipment to maintain and repair Hydrolab and Orion sampling equipment. In addition, the laboratory has sieves and ovens for sediment analysis.

2.4.4. Walla Walla District

1. Walla Walla District maintains the capacity to collect water and sediment samples throughout the Division. . Equipment available includes:
    a. A two-man canoe.
    b. An18-ft river jet boat.
    c. One 23-ft, GPS equipped aluminum work vessel.
    d. A Ford F350 super duty service body truck (GSA).
    e. A RDI acoustic Doppler profiler.
    f. Over fifty water quality multi-probe profilers.
    g. Comprehensive groundwater sampling apparatus, including submersible pumps, plus biological sample and analysis equipment.
    h. Sediment Ponar and core samplers, winches and other related instruments and equipment.

2. Walla Walla District enhanced the capability of its modest water quality laboratory facility. Features include:
    a. Calibration of field instruments and completion of necessary QA/QC for TDG instrumentation. A NIST certified barometer and certified pressure sources insure that the TDG instrumentation is kept at optimal performance.
    b. A comprehensive suite of equipment to maintain and repair Hydrolab®, YSI®, and TDG data collection equipment. A special 2-HP electric mixer for the constant water temperature bath is used during calibration and instrument evaluation.
    c. The water quality laboratory has the capacity to analyze nutrient samples for the district reservoirs. Parameters include phosphorus, nitrate, ammonia, sulfate, total nitrogen, chlorophyll *a*, plus selected anions and cations.
    d. The laboratory can also support a variety of turbidity monitoring equipment in support of dredging and construction operations. A full complement of

sieves, ovens, shakers, and cabinets allow for volume production of particle-size grain analysis along with other selected qualitative and quantitative sediment analyses.

3. The laboratory also monitors and maintains contracts for the analysis of metals and organic contaminants in support of District missions. The laboratory has detailed apparatus for the evaluation of most wastewater parameters. At the time of print, the District lab function is in the process of awarding a new organic analysis contractor. We are also on the course of awarding a hazardous waste and safety supply contract to support ECC operations at the projects.

4. The district acquired eighteen replacement barometers for the dissolved gas monitoring system this year. The new barometers are equipped to provide multiple SDI-12 output and are capable of providing pressure transducers with real-time differential corrections. The new barometers are accurate to one-tenth of a millimeter of mercury and are equipped with a digital display.

5. Beginning in FY 2002, the region required that each TDG fixed-monitoring station (FMS) have a replacement (classified as "redundant" instrument by NMFS) water quality sonde. The Walla Walla District operates some of the oldest Hydrolab® Datasonde 4's in existence. Consequently, most of these have been overhauled at the factory at least once and some instruments have undergone a second rehabilitation. Twenty new sondes were purchased from Sweeny Aquametrics in FY 2002 as instruments to be used in the "redundancy" initiative. Some of these instruments will go towards replacing in-service sondes that require factory level repairs. The current plan is to meet the duplicate sonde requirement (plus spares) in FY 2003.

6. Additional temperature monitoring was also implemented. Onset Optical® temperature recorders were purchased for the fish ladder temperature monitoring. Three new RTD temperature sensor string sets were purchased for McNary Pool. An additional set, plus new floatation pontoons (Mark III buoy system), will be procured in FY 2003 towards implementing the forebay temperature monitoring system.

2.5. Data Collection and Analysis

2.5.1. Northwestern Division, North Pacific Region

In January of 1996 the water quality collection activities in the Columbia River Basin were turned over to the district offices. The Northwestern Division, North Pacific Region serves as the data collection site for the real-time FMS data. The Northwestern Division, North Pacific Region, through the Water Quality Team (WQT), Reservoir Control Center, Water Management Division continues to coordinate District data collection activities. Tasks performed included the following:

- ✓ Develop an annual plan of action in coordination with the Districts, including number and location of monitoring stations, quality assurance and quality

control (QA/QC) protocols for data measurement, data coding and transmission, and instrument calibration and maintenance;
- ✓ Coordinate the start and end dates for the monitoring season;
- ✓ Monitor FMS data received, coordinate with responsible party when an FMS mal-functions, fill data gaps and correct data in the water quality copy of the CROHMS data set which is used for water quality reporting;
- ✓ Prepare daily reports on dissolved gas saturation, water temperature, project spill, pool elevations and total flow;
- ✓ Perform statistical analyses and computer modeling to refine site-specific or system-wide spill versus TDG relationships;
- ✓ Hold a post-season review of Corps monitoring activities with regional participation to discuss details of monitoring activities, receive comments and recommendations and plan for future changes and improvements; and
- ✓ Prepare an annual report on the FMS performance with a discussion of the current year's operations, and recommendations for next year's activities.

The WQT staff also posted information to the regional Technical Management Team (TMT) homepage for dissemination to regional users and researchers, as well as coordinating reservoir regulation details for data collection below Corps projects. The Plan of Action for TDG monitoring in 2002 was included in various documents, including the Corps' Fish Passage Plan and NMFS's application package for state standard water quality waivers.

The annual TDG monitoring report prepared by the Division was based on information received from the district and division water quality staffs and the US Geological Survey. Refer to the Annual TDG Report for a summary of the FMS Program.

2.5.2. Portland District

1. Applegate and Lost Creek Lakes.
   A contractor (John Salinas of Cascade Research Group) collected water temperatures at various locations up to 40 miles downstream of the Lost Creek and Applegate projects in the Rogue and Applegate rivers. The purpose is to determine under normal flow conditions the distance downstream that the projects can influence water temperatures.

2. Hills Creek and Cougar Lakes.
   Portland District paid for analyses of water samples from Hills Creek and Cougar reservoirs to track blue green algae blooms. The work was performed in cooperation with the USFS, which collected the samples. The USFS was concerned that algae may produce toxins in concentrations sufficient to become a health problem. The lake was posted temporarily to advise against prolonged contact with water in certain sections of the lake where algae cell densities exceeded 15,000 cells/ml.

3. Willow Creek Lake.

In situ water quality data were collected monthly between August, September and October. In situ measurements for dissolved oxygen, pH, specific conductance, and temperature were taken in the water column with a Hydrolab H20 instrument. Lake water transparency was determined with a Secchi disk. A photometer (unfiltered light) was deployed once a month from June to September to determine the extent of downward irradiance.

Water grab samples were collected at various depths in the water column at Willow Creek Lake. Samples were analyzed for dissolved oxygen, chlorophyll a, nutrients, ammonia, fecal coliforms, TSS, TDS, organic carbon, silica, manganese, iron, sulfide and sulfate. The same analyses were performed on incoming and release water samples.

Two reports will be prepared summarizing the data collection efforts. One report will detail methane production characteristics of the lake and the report will discuss the ecology of algae in the lake.

4. Elk Creek.
   Water temperatures and turbidity were recorded hourly by the USGS at four monitoring sites (Trail, Cascade Gorge, and Alco Creek) on Elk Creek in the Rogue River Basin, Oregon. This work continues a database useful for assessing water quality impacts resulting from the partially completed Elk Creek Dam.

5. Detroit Lake.
   The District, City of Salem and USFS began routine monitoring of turbidity in the fall of 1998. The District entered into an agreement with its partners to cooperate in this effort. Monitoring according to the agreement continued this year.

6. TDG Fixed Monitoring Program (FMP).
   TDG was measured from mid-March through mid-September for most stations at District projects on the lower Columbia River. A total of 8 instruments were assigned to forebay, tailwater, and downstream stations for John Day, The Dalles and Bonneville Projects. Data was transmitted real time to the Division CHROMS database. This year less than 1 % of the data was lost. The data is important for monitoring compliance with state TDG standards and impacts to fish. The Camas gage was evaluated for representativeness according to requirements of RPA132 of the NMFS Columbia River BiOP. Gas monitors were placed on a transect across the river from the Camas site as well as up and downstream. WES personnel performed this work.

7. Hills Creek, Green Peter and Lookout Point Reservoirs.
   Lake profiles were collected at each reservoir near the dam. Parameters measured from surface to bottom were pH, turbidity, temperature, and conductivity. Sampling frequency was once every three weeks. In addition, temperature loggers were placed above and below the projects to measure inflow and outflow

temperatures on an hourly basis. This data will be used by the State to assist it in temperature modeling and TMDL development in the Willamette River.

8. Temperature Monitoring – Willamette System.
Temperature loggers were deployed in the McKenzie, Row, and Coast Fork Willamette to gather hourly data for the State to use in its temperature TMDL modeling effort.

9. Dredged Material Projects.
Sediment samples were obtained during FY 2002 at the following federal navigation projects and Study Projects: Chetco River, Rogue River, Port Orford, Lower Willamette River, Bonneville Dam Forebay, Bradford Island Fish Ladder, Kellogg Lake, and two events at Cougar Reservoir. Bulk physical and chemical analyses were performed on samples to determine compliance with water quality standards and, in some cases, suitability for ocean disposal. Physical and chemical tests were conducted in accordance with Corps of Engineers and Environmental Protection Agency water/sediment analytical guidelines (Dredge Material Evaluation Framework-DMEF). Sediments were collected with several types of sampling equipment, including box core surface sampler, gravity and vibra corers. Physical tests included particle-size distribution, percent volatile solids, void ratio, specific gravity, and re-suspended density. Sediments were also tested for priority-pollutant heavy metals, pesticides, dioxin/furan, PCBs (polychlorobiphenyls), PAHs (polynuclear aromatic hydrocarbons), organotin (TBT), TOC (total organic carbon), phenols, phthalates and miscellaneous extractables. DMEF Tier III, bioassay and bioaccumulation samples were collected as part of the Reference Site Study on the Lower Willamette River.

2.5.3. Seattle District

1. Water quality monitoring at Chief Joseph Dam and Lake Rufus Woods consisted of real-time monitoring TDG and temperature at forebay and tailwater stations, and installing temperature strings at three locations in Lake Rufus Woods from Grand Coulee Dam to Chief Joseph Dam. Temperature strings consisted of Vemco data loggers attached at various depths to a weighted cable and secured in place with an anchor and buoy. Temperature was recorded every hour from August through October 2002.

2. Water quality monitoring at Libby Dam and Lake Koocanusa continued during 2002. Water quality grab samples were collected at monthly intervals in Lake Koocanusa at three stations between the international border and the forebay from April through October. Samples collected from the epilimnion and hypolimnion were analyzed for conventionals, nutrients, and metals. A composite sample from the photic zone was analyzed for chlorophyll a and algae. Vertical profiles of temperature, conductivity, pH, and dissolved oxygen were also recorded at each station. A downstream station on the Kootenai River was monitored at monthly intervals from January through December, with samples being analyzed for conventionals, nutrients, and metals.

3. A temperature string was set up in the forebay at Lake Koocanusa during 2002. The string consisted of Vemco data loggers attached to a weighted cable. The temperature string logged hourly temperature at various depths between the surface and bottom of the reservoir.

4. A ground water monitoring study was conducted in the Kootenai River valley during 2002. The goal of the monitoring program was to characterize the shallow and deep ground water quality of properties adjacent to the Kootenai River downstream of Libby Dam before, during, and after the voluntary and involuntary spill that occurred from June 24 to July 7, 2002 to determine if water quality impacts occurred during high flow conditions. Specifically, there was a concern about the potential for increased flows to lead to contamination of drinking water wells or saturation of on-site wastewater treatment and disposal systems.

5. A TDG exchange study was conducted at Libby Dam. Monitoring consisted of measuring TDG at 31 locations downstream of the dam during voluntary and involuntary spill that occurred from June 24 to July 7, 2002. The purpose of the study was to define and quantify processes that contribute to dissolved gas transfer during spill releases at Libby Dam. The study focused on resolving questions regarding accurate source and sink descriptions of mass conservation of dissolved gases in the Kootenai River below the dam.

6. Water quality samples were collected during the Additional Water Storage Project test pool at Howard Hanson Reservoir from April through October 2002. The goal of the monitoring program was to characterize the water quality of Howard Hanson Reservoir during the test pool to determine if water quality impacts are occurring during elevated reservoir storage conditions. Specifically, there is concern about the potential for increased reservoir elevations to lead to increased concentrations of nutrients, organic matter, and phytoplankton in the reservoir. To meet the project goals, water quality was monitored in the Green River and Howard Hanson Reservoir during the test pool. Water quality parameters of concern for Howard Hanson Reservoir include temperature, dissolved oxygen, nutrients (i.e. phosphorus and nitrogen), organic matter, chlorophyll a, and phytoplankton. Additional water quality parameters such as pH, conductivity, and alkalinity were monitored to help with the basic understanding of the limnology of the reservoir. Sampling consisted of collecting monthly grab samples from the epilimnion and hypolimnion and conducting vertical profiles for temperature, pH, conductivity, and dissolved oxygen at bi-weekly intervals.

7. Real-time water quality monitoring continued at many District projects, including the Lake Washington Ship Canal. Real-time water temperature, conductivity salinity, dissolved oxygen, and TDG data were transmitted to the District and Northwestern Division, North Pacific Regions. These data were supplemented by field turbidity measurements at Howard A. Hanson and Mud Mountain projects. The automated salinity sensors installed in the Lake Washington Ship Canal were ground-truthed periodically to ensure accuracy.

8. During the summer conservation season, additional water quality data were collected at Howard A. Hanson reservoir and the Lake Washington Ship Canal. In-situ measurements of temperature, dissolved oxygen, pH and specific conductivity were collected at various depths in the water column. The City of Aberdeen collected similar data for Wynoochee reservoir and furnished copies of the data to the District. The data were used to monitor reservoir thermal stratification at Wynoochee and Howard A. Hanson reservoirs and saltwater intrusion and dissolved oxygen concentration in the Lake Washington Ship Canal.

9. Seasonal water quality monitoring data is collected at one station in the East Bay Marina, Olympia Harbor, in South Puget Sound. Data is reviewed to determine when the Port of Olympia must operate its mechanical aeration system to increase dissolved oxygen levels to levels that are not harmful to fish.

10. A maintenance dredging sediment quality evaluation was performed on the Grays Harbor Navigation Channel sediments.

11. A contract effort for the Dredged Material Management Office and the Dredged Material Management Program evaluated "Paralytic Shellfish Poisoning Potential from Dredged Material disposal in Bellingham Bay.

2.5.4. Walla Walla District

1. Drinking water was sampled monthly for coliform bacteria at Little Goose and Lower Granite Dams. Additional tests were performed for organic and inorganic substances to meet monitoring requirements.

2. Wastewater was also sampled at Little Goose and Lower Granite Dams in accordance with the NPDES permit requirements. Discharge Monitoring Reports (DMR) that include effluent loading and quality were prepared monthly and mailed quarterly to the EPA. Tests were performed at the lab in Walla Walla to improve project wastewater processes. Recommendations were made and procedures implemented to improve compliance with permit criteria.

3. Sediment sampling was conducted in and around the confluence of the Yakima and Columbia Rivers. The work was funded as part of the reconnaissance study and dredge material O&M evaluations. The Lower Yakima River is listed as impaired by the EPA national sediment contamination study and since it is a major tributary to McNary pool a baseline study of the sediment quality was necessary.

4. Total Dissolved Gas was monitored hourly at sixteen stations located in the forebay and tailwater of District projects to determine gas levels resulting from various project spill events. Data were transmitted to the CROHMS database.

5. Temperature loggers were used to collect data in the adult fish ladders and in the juvenile system at the Walla Walla District Projects during the summer and fall.

The loggers were attached to a rope and lowered to approximately one foot from the bottom. The data loggers were set to record water temperature once per hour. The project biologists download the data to a shuttle. The district plans to publish a report detailing the temperature monitoring at the ladders and the fish facilities throughout the year. Evaluation of the data and drafting of the report is on going as this document goes to press.

2.6. Water Quality Reports

2.6.1. Northwestern Division, North Pacific Region

Annually the Northwestern Division, North Pacific Region publishes this comprehensive report and a separate report for Total Dissolved Gas Monitoring in the Columbia Basin.

2.6.2. Portland District

1. Tanner, D.Q., Johnston, M.W., and Bragg, H.M., 2002, Total Dissolved Gas and Water Temperature in the Lower Columbia River, Oregon and Washington, 2002. U.S. Geological Survey Water-Resources Investigations Report 02-4283.

2. Larson, D. W., September 2002. Toutle River SRS, Mount St. Helens, Washington Limnological and Water Quality Studies 1985-1990. Final Report.

3. Sherman T. J., 2002, U. S. Army Corps of Engineers, Portland District. Chetco River and Boat Basin, Sediment Quality Evaluation.

4. Sherman T. J., 2002, U. S. Army Corps of Engineers, Portland District. Rogue River, Sediment Quality Evaluation.

5. Sherman T.J., 2002, U. S. Army Corps of Engineers, Portland District. Port Orford, Sediment Quality Evaluation.

6. Hart Crowser, Inc., 2002, US Army Corps of Engineers. Willamette River Reference Site Study.

2.6.3. Seattle District

1. U.S. COE. 2002. Libby Dam Spill Test Groundwater Monitoring Project: Sampling and Analysis Plan. U.S. Army Corps of Engineers, Seattle District.

2. U.S. COE. 2002. Howard Hanson Reservoir Sampling and Analysis Plan. U.S. Army Corps of Engineers, Seattle District.

3. Schneider, M. and J. Carroll. 2002. Total Dissolved Gas Exchange at Libby Dam June – July 2002. Draft report prepared for the U.S. Army Corps of Engineers,

Seattle District by the U.S. Army Corps of Engineers, Engineer and Research Development Center (ERDC), Dallesport, WA.

4. U.S. COE. 2002. Additional Water Storage Project Turbidity Risk Assessment. Prepared for the U.S. Army Corps of Engineers and Tacoma Public Utilities by Economic and Engineering Services and Montgomery Watson Harza.

5. U.S. COE. 2002. Howard Hanson Dam Additional Water Storage Project: Water Quality Supply Protection Framework. Prepared for the U.S. Army Corps of Engineers and Tacoma Public Utilities by Economic and Engineering Services and Montgomery Watson Harza.

6. Dredged Material Management Program Biennial Report for Dredging Years 2000/2002. Prepared by the Dredged Material Management Office.

7. Sediment Management Annual Review Meeting Summary – May 1, 2002. Prepared under contract for the Dredged Material Management Office and the Dredged Material Management Program Agencies.

8. Kendall, David R., et.al. Thirteen Year Implementation Retrospective on the Dredged Material Management Program (DMMP) in the Northewest. "Dredging 02" Symposium Proceedings.

2.6.4. Walla Walla District

1. Heaton, R.D., G. Slack, and F. J. Fishella, 2002. Quality Assurance and Quality Control for Total Dissolved Gas Monitoring-Lower Snake River, Washington; Clearwater River, Idaho; and Columbia River, Oregon and Washington Water Year 200. Walla Walla District U.S. Army Corps of Engineers, December 2002, 20 pages + appendices.

2. US Army Corps of Engineers, 2002. Dissolved Gas Abatement Study Phase II - Technical Report -Referenced Reports (published on CD-ROM). Walla Walla District U.S. Army Corps of Engineers, May 2002, 12 Adobe *.pdf sections, 51 megabytes.

2.7. Data Management System

2.7.1. Northwestern Division, North Pacific Region

All water control and water quality data are stored in a HEC-DSS database. Data are available in both DSS and 132 column formats. DSS utility programs are routinely used to store, list, display, and manage the data. Hourly total dissolved gas, water temperature, project flow and project spill data are posted on the Technical Management Team's homepage (http://www.nwd-wc.usace.army.mil/TMT/).

2.7.2. Portland District

1. Portland District currently stores historic water quality data into a Microsoft Access relational database.

2. The District, along with Seattle and Walla Walla, worked with Division to consider database alternatives and to screen pre-packaged databases for potential Division-wide use. A variety of software packages are currently being presented to the Northwestern Division for consideration. Possibly, each District may adopt their own database that could be linked to the Division office via a WEB site. Portland District is also considering adopting a "packaged" water quality database to replace the current one.

2.7.3. Seattle District

1. Hydraulics and Hydrology Section's primary data management is a microcomputer database using HECDSS with a user-friendly Visual Basic front-end. This database system has facilitated access and communication with the District's water control and water quality data collection system and has improved accessibility for data analysis and presentation. The Northwestern Division, North Pacific Region maintains a homepage that makes much of this data available to the public via the Internet. Data collection continues to be performed by Seattle District Office.

2. The Dredged Analysis Information System (DAIS) stores chemical and biological testing data submitted for proposed dredging projects. These data are used by the Dredged Material Management Office and other participating Dredged Material Management Program (DMMP) agencies to make suitability determinations for disposal of dredged sediments at eight open-water disposal sites in Puget Sound and three open-water disposal sites each in Grays Harbor and Willapa Bay along the Washington side of the lower Columbia River. Automated reporting features are also available in DAIS, including reports summarizing sampling, testing, and administrative data. ArcView software is used for geographic information system (GIS) queries.

2.7.4. Walla Walla District

1. Walla Walla District currently uses the SEDQUAL database for the storage of its dredging and sediment quality data. The Walla Walla District is currently using the guidance document developed by Portland District to populate the database templates. The data is sent to the Washington Department of Ecology's main system via E-mail.

2. Walla Walla District water-quality personnel are participating in the regional Water Quality Database discussions with Northwest Division. The District continues to participate and looks forward to an implementation solution sometime in FY2003.

3. The GOES satellite system remains the primary method of water-quality data transmission to the existing database infrastructure.

2.8. Research and Development

2.8.1. Northwestern Division, North Pacific Region

The Northwestern Division, North Pacific Region was involved in efforts with the Walla Walla and Seattle Districts, reviewing the current numerical modeling capabilities with a focus on how each model available serves the needs of the region. Different models have been developed, with data from specific years and weather conditions, for long range planning and prediction as well as for use as operational decision-making tools. These models are being reviewed and tentative plans are being drafted to implement these tools into a cohesive management plan. Numerical models under review are SYSTDG, MASS1 and MASS2.

2.8.2. Portland District

1. Portland District FY2002 carried out no water quality research and development activities.

2. Water and sediment samples were measured for PCBs at the Bradford Island Disposal Site located at the Bonneville project.

2.8.3. Seattle District

1. A TDG model was developed by ERDC to determine spill ratios for Grand Coulee Dam and Chief Joseph Dam under joint operating conditions. The goal of the model was to determine which spill ratio produced the lowest average TDG below Chief Joseph Dam.

2. The Seattle District investigated the sources of groundwater in the Kootenai River valley using stable isotopes of hydrogen and oxygen as tracers. Groundwater and river samples were collected during high flow and low flow events and analyzed for stable isotopes to determine if the river was the source of groundwater or if groundwater was originating elsewhere.

2.8.4. Walla Walla District

1. The district purchased new temperature strings and telemetry equipment for the temperature buoys in the McNary forebay. The new strings will give greater accuracy and readily accept analog to digital conversion using A-D converters. Three of these systems were tested. It is planned to install these three units plus three improved temperature systems in the McNary forebay to collect data for future modeling. Experience gained here will be applied to installation of instruments in the forebays of Dworshak and Lower Granite Dams.

2. Russ Heaton is testing the improved TDGMS sondes for the TDG monitoring program. The new sondes will have a depth total accuracy of 0.01 ft from 1 to 10 ft and 0.02 ft from 11 to 90 ft. The absolute accuracy for the temperature sensors will be 0.05 ^{o}C over the range of –5 to 27 ^{o}C. The dissolved oxygen absolute accuracy will be 0.1 mg/L and the TDG sensor will have an absolute accuracy of 0.1 mmHg.

3. Russ Heaton is currently a member of the Regional Sediment Evaluation Team (RSET). The purpose of this group is to serve as a scientific advisory board to the Regional Dredge Management Team (RDT) and recommend standardized evaluation tools to be used uniformly by federal, state, and port agencies in the Northwest Region and EPA Region10. The team is currently evaluating sediment test methods and sediment quality guidelines.

2.9. Water Quality Problems

2.9.1. Northwestern Division, North Pacific Region

1. Since it's 1998 Supplemental Biological Opinion, NMFS calls for water to be voluntarily spilled up to the full 120% TDG level at the Corps' mainstem Columbia and Snake River dams during the spill season. NMFS pursued and obtained waivers with the states and tribes to spill to the higher TDG levels.

2. Compliance with the State TDG standards is a recurring issue with no easy solution in sight. In some cases, water entering Corps and other federal reservoirs is already supersaturated. Any further increase in spill, either to provide a safer passage route to fish or to accommodate limited plant capacities, can only further exacerbates TDG conditions. Given the sensitivity of the spill and the related TDG issue, TDG data continued to be closely scrutinized by various agencies and interest groups. As a result, the demands on the monitoring program increased significantly. Because of limited plant capacity spill is required at most Lower Snake River dams as soon as flows exceeded 100 kcfs. Decreasing spill through upstream storage or passing more water through the powerhouse is not always feasible. The need to operate all turbine units at flows within 1 percent of their peak efficiency flow to avoid more extensive damages to fish contributed to a *de facto* decrease in powerhouse capacities.

3. The NMFS's Water Quality Team (WQT) continued to provide a forum for peer review and technical exchange of information on TDG. Although advisory in nature, the NMFS WQT also played an active advocacy role. The NMFS WQT reviewed and commented on the 2002 Plan of Action and TMT Spill Management Plan, as well as participating in the TDG post-season review meeting.

4. The Transboundary Gas Group met in March and October. Discussion subjects included treaty obligations and limitations, TDG monitoring and abatement measures on the Canadian side of the border and monitoring issues on the US side of the border.

5. EPA, the states and the tribes coordinated on a combined approach to TMDL issues in the Columbia and Snake River mainstems. The Corps attempted to keep abreast of these issues and provide support where feasible. The initial TMDL effort is focused on TDG and water temperature.

6. Many of the water quality programs in the North Pacific Region continued to be driven by design and/or operational actions associated with the salmon and steelhead recovery effort.

2.9.2. Portland District

1. Willow Creek Lake, Oregon is eutrophic and by August, the reservoir's hypolimnion is anoxic, containing high concentrations of hydrogen sulfide, methane, ammonia and other chemically reduced substances. Phytoplankton blooms aggravate water quality problems in the impoundment. A recent report analyzing trends in the limnology of the lake suggests that conditions are improving (Willow Creek Lake, Oregon Limnological and Water Quality Studies 1984-1996 Final Report, April 1997). However, this year methane levels increased over previous years suggesting that a declining trend may be questionable. The fluctuations in methane production need to be further examined to provide direct links to lake limnology. High nutrient input to the lake from the watershed continues to be a problem. Monitoring data shows inputs of phosphorus and nitrogen from Balm Creek and Willow Creek. Cracks and voids in the dam concrete matrix provide avenues for leakage of hypolimnetic waters. Seepage entering the dam's tunnels and gallery is enriched with hydrogen sulfide and dissolved lime. There were concerns that oxidation of hydrogen sulfide and ammonia by chemosynthetic bacteria is producing sulfuric and nitric acid, respectively, that could be corroding the concrete in the dam. Deposition of calcium carbonate on the gallery walls and floors could be potential signs of corrosion. Studies in the late 1980s were completed on the geochemistry, microbiology, and hydrodynamics of seepage waters to determine whether the structural integrity of the dam is at risk. These studies, combined with other engineering analyses, including petrographic studies, indicate that the dam is safe. Yearly monitoring of seepage continues along with limnological surveys of Willow Creek Lake.

   Willow Creek (below the lake) is on the State 303(d) list for temperature and pH. This year temperature improvements below the dam were again achieved by lowering the selective withdrawal device in the lake.

2. Cougar Project. The U.S. Fish and Wildlife Service and Oregon Department of Fish and Wildlife reported in 1988 substantial reductions in the number of anadromous fish using the McKenzie River in the Willamette River Basin. The agencies attribute much of this reduction to Corps of Engineers impoundments, claiming that water released from these projects tends to be thermally sub-optimal for fish migration and reproduction. Thus, the agencies have urged the Corps to

provide more favorable release-flow temperatures at projects on the McKenzie River (Cougar and Blue River) for the purpose of improving habitat and thereby sustaining larger fish populations downstream. The greatest threat to the chinook occurs in the fall when water 10 degrees F warmer than the river temperature are released from an outlet near the surface of the reservoirs. Other reservoirs in the Willamette System (Hills Creek, Fall Creek, Lookout Point, Green Peter and Detroit) may affect downstream water temperatures in ways that impact anadromous fish as well.

Construction of the Selective Withdrawal Structure at Cougar has resulted in increases in turbidity during storm events in spring and winter below the project. Because of construction delays, drawdown of the reservoir was delayed until April. Unfortunately, an unusual spring storm caused erosion of the upper sediment wedge in the reservoir. This led to increased downstream turbidity, averaging around 100 NTUs, until drawdown to elevation 1450 feet was completed in late May. Turbidity rapidly decreased as clear inflowing water helped dilute turbidity in the lake. Locals were concerned that the project was exporting DDT in turbid water based on concentrations found in exposed sediment in the reservoir. To address this concern the District plans to monitor DDT in outflow water during high turbidity events. Also the District plans to measure turbidity-suspended solids relationships to help determine sediment export from the reservoir – another concern of downstream locals.

3. State 303(d) Listings. In 1998 the Oregon Department of Environmental Quality (DEQ) released a new 303(d) list of "water quality limited waters". Some District reservoirs and stretches of river below reservoirs were on the 303(d) list. Interpretation of the reservoir listings is straightforward. However, listings of rivers below the reservoirs are subject to interpretation. The impact of a reservoir on downstream conditions must be evaluated on a case-by-case basis. For instance, the Coast Fork Willamette is listed for high summer temperatures from the mouth to Cottage Grove Reservoir, but the reservoir releases water in mid August that is below the 64° F Standard. In this case, the reservoir may actually be helping to make the problem less severe in a specified reach of river below. District projects with associated in-lake and downstream water quality problems described in the DEQ 303(d) list are given in Table 4 below.

Table 4. NWP Water Quality Problems on DEQ 303(d) List

Reservoir	Res. Parameter(s)	Below Res. Parameter(s)
Applegate		Flow, Temp. (summer)
Cottage Grove	Toxics – tissue, water	Temp. (summer)
Dorena	Toxics – tissue, water	Temp. (summer)
Fall Creek		Temp. (summer)
Dexter		Temp. (summer)
Fern Ridge	Turbidity, Bacteria	Temp. (summer), Bacteria
Blue River		Temp. (summer)

Cougar		Temp. (summer)
Willow Creek		Temp., PH (summer)
Bonneville		Toxics, pH, Temp.,TDG
The Dalles		Temp., TDG
John Day		Temp., TDG
Elk Creek		Temp. (summer)

Water, sediment and fish from Cottage Grove Reservoir contain elevated levels of mercury. The mine tailings from Black Butte Mine about 8 miles above the reservoir are the probable source of mercury. Some fish in the reservoir exceed the FDA action limit for mercury in muscle. Studies have been conducted to determine the loading and distribution of mercury in the water, sediment, and food chain. The State of Oregon has issued a Health Advisory concerning consuming fish from Cottage Grove Reservoir.

Fish in Dorena Reservoir contain high concentrations of mercury but for a less obvious reason than fish at Cottage Grove. Although some fish exceed the FDA action limit, concentrations are not as high as in fish from Cottage Grove Reservoir. High mercury levels may be related to the historic use of mercury in the process of refining gold in the Dorena watershed. However there is no direct evidence to support this view. The State of Oregon has issued a Health Advisory concerning consuming fish from Dorena Reservoir.

4. Total Dissolved Gas (TDG) supersaturation in the Lower Columbia River continues to exceed the 110% water quality standard below projects (John Day, The Dalles and Bonneville). Increased spill to promote fish passage has contributed to this problem. In the past, spill was minimized to try to keep TDG within the standards. TDG levels were substantially lower in 2001 because of reduced flows due to the drought. In late 2001 and early 2002 new flip lips will be installed at Bonneville, which should improve gas levels below this project.

5. Willamette River Projects are believed to exceed TDG standards under limited discharge scenarios. Data from Green Peter and Foster Reservoir collected during high flows TDG concentrations greater then 110% immediately below the dams. Water at Harrisburg and Salem during this period hovered around 100 % TDG well below the standard.

   Most of the Willamette Projects experience algae blooms of blue-greens in July and August. So far, these have not reached the nuisance stage that would lead to strong taste and odors or organic loading in water below the projects.

   According to the NMFS Willamette River Biological Opinion on threatened Salmon and Bull Trout, Willamette Projects operations affect habitat and water quality below dams because of changes in stream hydrology. Changes in riparian habitat and aquatic ecology may be impacting fish.

6. Columbia River Projects, according to a NMFS Biological Opinion on threatened Salmon and Bull Trout, affect habitat and water quality in and below dams because of project operations. Total dissolved gas and temperature are the main culprits, but other water quality variables may also impact threatened and endangered species.

   Bradford Island disposal site at Bonneville is a source of PCBs and other contaminants to the Columbia River. PCBs have been found in clams (Corbicula) and in crayfish residing on the site.

7. Rogue River Projects. Water samples were taken by the monitoring contractor and measured for geomin, a taste & odor compound, in response to complaints from a local water district that the river below the project has taste & odor problems in the summer.

2.9.3. Seattle District

1. High TDG levels were measured below Chief Joseph Dam during 2002. The Chief Joseph forebay station had 53 days exceeding the 12 hour average 115 % TDG concentration. These exceedances began on June 14 and lasted through August 5, 2002. Because little degassing occurs during transport through Lake Rufus Woods, TDG levels measured at the Chief Joseph forebay station are largely a function of TDG levels released from Grand Coulee Dam. The Chief Joseph tailwater station had 11 days exceeding the 12 hour average 120 % TDG concentration. These exceedances occurred between June 2 and July 4, 2002, and were largely due to involuntary spill resulting from a combination of high river flows and the derating of the DC and AC intertie lines in early June, and flood control operations in early July.

2. High TDG levels were measured downstream of Libby Dam during voluntary and involuntary spill conditions that existed from June 24, 2002 to July 7, 2002. The TDG saturation of spillway flows in the stilling basin showed a marked increase over forebay and powerhouse flows. The initiation of spill (0 – 4 kcfs) resulted in an abrupt increase in stilling basin TDG saturation (104 – 130 percent). A mild increase (130 – 134 percent) in TDG saturation was noted for greater spill volumes (4 – 15 kcfs). A decline in TDG saturation was typically observed in the Kootenai River between the dam and Kootenai Falls (about 16 miles downstream of the dam). For example, maximum TDG saturations measured in the river were 130+ percent at the USGS transect (about 0.6 miles downstream of the dam), 120+ percent at the Highway 37 Bridge transect (about 1.6 miles downstream of the dam), and a maximum of 117 percent below the Haul Bridge transect (about 6.3 miles downstream of the dam).

2.9.4. Walla Walla District

1. Improvements were made in the operation of wastewater plants at Little Goose and Lower Granite Dams. It was determined that there was no hydraulic overloading on the present systems as previously postulated. Hauling off of accumulated sludge in

the effluent tank at Lower Granite and adjusting the food to microorganism ratio of the aeration tank at the Little Goose facility resulted in significant improvements in effluent quality. Maintaining a pool of trained personnel with applicable certifications remains a problem that stands in the way of completing our water quality objective of compliance by FY 2004.

2. Drinking water quality is still a major concern at IIlia Community downstream from Lower Granite Dam. Coliform bacteria were present on several occasions when the chlorine injection system failed. Additional tests were performed on all wells before chlorination at Lower Granite and Little Goose areas. Results showed that total and fecal coliforms at all wells were less than 3 CFU/100 mL. We believe the ultra violet radiation system should correct the problem and provide additional cost savings from an O&M stand point.

3. High TDG levels remain the primary water quality problem in the Walla Walla District. TDG data was collected at the tail waters of the four Lower Snake River and McNary Dams.

4. Eutrophic conditions were noted in the forebays and sloughs of the four Lower Snake River dams. Dissolved oxygen sensors on the TDGMS identified the stratification potential and we were able to predict oxygen depletion rates. A few profiles confirmed shifts in oxidation-reduction potential coupled with pH shifts. Some private citizens reported large blue-green algal blooms in the Lower Granite Pool in early July. Clarkston Resource personnel provided water samples containing *Aphanizomenon* sp. in early May. Additional water samples were examined in July, August and September. These phenomena were due to the combination of (a) diminished flow that facilitated lake-like conditions in the reservoir, and (b) an inoculation of cyanobacteria (some originated from oligotrophic Dworshak Reservoir) into the nutrient rich and warm Lower Snake River. The few zooplankton samples that were collected also indicated a potential correlation with a community shift from *Cladocera to Copepoda* as the *Chlorophyta* died off and were quickly replaced by *Cyanophyta*.

2.10. Special Studies

2.10.1. Northwestern Division, North Pacific Region

The Water Quality Unit completed an evaluation of available water quality databases and prepared a recommendation of a consolidated water and sediment quality database that would meet regional long-term needs. This recommendation was presented to the November of 2002Water Management Board. Several subsequent meetings were held to discuss the recommendation and brainstorm possible alternative approaches. Work continues on this issue and an update will be given in the 2003 report.

2.10.2. Portland District

1. Willamette River Sediment Reference Area Study. Ten potential reference area locations were selected and targeted for Phase I sampling. The sampling was conducted by Hart Crowser and consisted of preliminary chemical analysis and sediment grain-size analysis to assist in the selection and recommendation of three locations that will undergo Phase II sampling and analysis. The reference area study is part of the effort to develop a Dredged Material Management Plan (DMMP) for the Willamette River.

2. Willamette Temperature Study. Temperature loggers were deployed in tributaries to Green Peter, Lookout Point, Cottage Grove, and Dorena as well as in the outflow from Hills Creek to gather data to assist the state of Oregon in a modeling effort that will be used to determine temperature TMDLs for the Willamette River.

3. Willow Creek Water Quality Improvement. Water temperature and pH in Willow Creek below the reservoir are elevated above Oregon Water Quality Standards during the summer months. The city of Heppner asked the Corps to operate the selective withdrawal device built as part of the reservoir project in order to improve water quality in Willow Creek. The Corps maintained its withdrawal outlet at a depth of 17 feet to release cooler water from the project.

4. The Springfield Millrace 206 Study continued. The aim is to construct a consistent connection to the Willamette River to increase flows in the Millrace. The Millpond is proposed for removal and replacement with meanders and smaller detention ponds.

5. RPA 132 work. The Columbia River Biological Opinion on endangered salmon contained a Reasonable and Prudent Alternative (RPA) number 132 that required studies of representativeness of forebay gas monitors at Columbia River projects. That work continued last year at John Day and the Dalles dams.

6. Lower Columbia River Dredged Material Evaluation Framework. Because of Endangered Species issues and evolving concerns with dredging and dredged material placement revisions to the DMEF are considered necessary. Representatives of various federal (COE, EPA, USFWS, and NMFS) and state (ODEQ, WDOE, and WDNR) began discussions on areas requiring updating.

2.10.3. Seattle District

1. The Seattle District conducted a total dissolved gas (TDG) monitoring study at Libby Dam during June and July 2002. The purpose of the study was to define and quantify processes that contribute to dissolved gas transfer during spill releases at Libby Dam. The study focused on resolving questions regarding accurate source and sink descriptions of mass conservation of dissolved gases in the Kootenai River below the dam. TDG time history information across fixed station sampling transects as related to specific project operations were of particular interest. The data was analyzed to provide estimates of the gas transfer throughout the tailwater

area, guidance on the relative importance of gas exchange processes within the stilling basin and in the downstream tailrace channel, and to determine the downstream changes in TDG saturation in the Kootenai River.

The original study design called for spillway flows at Libby Dam to be increased incrementally by 1 kcfs up to a maximum of 10 kcfs for a three-hour duration over a three-day testing period between June 24 and June 26, 2002. However, high project inflows coupled with limited lake storage resulted in involuntary spill superceding the scheduled test spill. The involuntary spill began on June 25 and lasted 13 days until July 7. The involuntary spill resulted in a range of spill events with a longer duration than scheduled in the original spill test. Spillway flows less than 4 kcfs were limited because of the volume of involuntary spill required for pool management. A series of events were identified during the spill window to correspond with fixed operations for a duration of 1 hour or longer. A total of 23 spill events were identified using this criterion. The shortest events lasted only 45 minutes. The longest event occurred during July 5th and 6th with a duration of 20.75 hours. The TDG exchange in the Kootenai River below Libby Dam was determined for each event and the TDG response evaluated as a function of project operations.

The TDG saturation of spillway flows in the stilling basin showed a marked increase over forebay and powerhouse flows. The initiation of spill (0 – 4 kcfs) resulted in an abrupt increase in stilling basin TDG saturation (104 – 130 percent). A mild increase (130 – 134 percent) in TDG saturation was noted for greater spill volumes (4 – 15 kcfs). A decline in TDG saturation was typically observed in the Kootenai River between the dam and Kootenai Falls (about 16 miles downstream of the dam). For example, maximum TDG saturations measured in the river were 130+ percent at the USGS transect (about 0.6 miles downstream of the dam), 120+ percent at the Highway 37 Bridge transect (about 1.6 miles downstream of the dam), and a maximum of 117 percent below the Haul Bridge transect (about 6.3 miles downstream of the dam).

2. A ground water monitoring study was conducted in the Kootenai River valley during 2002. The goal of the monitoring program was to characterize the shallow and deep ground water quality of properties adjacent to the Kootenai River downstream of Libby Dam before, during, and after the voluntary and involuntary spill that occurred from June 24 to July 7, 2002 to determine if water quality impacts occurred during high flow conditions. Specifically, there was a concern about the potential for increased flows to lead to contamination of drinking water wells or saturation of on-site wastewater treatment and disposal systems.

   To meet the project goals and objectives described above, water quality and water levels were monitored before, during, and after the voluntary and involuntary spill event. Water quality was monitored in the Kootenai River and in eight public and private wells to assess the influence of increased flows in the river on ground water quality, and to identify the possible source(s) of the ground water. In addition,

water levels were monitored in the Kootenai River and in eight monitoring wells to identify ground water flow paths on properties adjacent to the Kootenai River.

3. Water quality samples were collected during the Additional Water Storage Project test pool at Howard Hanson Reservoir from April through October 2002. The goal of the monitoring program was to characterize the water quality of Howard Hanson Reservoir during the test pool to determine if water quality impacts occurred during elevated reservoir storage conditions. Specifically, there was concern about the potential for increased reservoir elevations to lead to increased concentrations of nutrients, organic matter, and phytoplankton in the reservoir. To meet the project goals, water quality was monitored in the Green River and Howard Hanson Reservoir during the test pool. Water quality parameters of concern included temperature, dissolved oxygen, nutrients (i.e. phosphorus and nitrogen), organic matter, chlorophyll a, and phytoplankton. Additional water quality parameters such as pH, conductivity, and alkalinity were monitored to help with the basic understanding of the limnology of the reservoir. Sampling consisted of collecting monthly grab samples from the epilimnion and hypolimnion, and conducting vertical profiles for temperature, pH, conductivity, and dissolved oxygen at bi-weekly intervals.

4. Water quality monitoring was conducted at Libby Dam and Lake Koocanusa during 2002. Water quality grab samples were collected at monthly intervals in Lake Koocanusa at three stations between the international border and the forebay from April through October. Samples collected from the epilimnion and hypolimnion were analyzed for conventionals, nutrients, and metals. A composite sample from the photic zone was analyzed for chlorophyll a and algae. Vertical profiles of temperature, conductivity, pH, and dissolved oxygen were also recorded at each station. A downstream station on the Kootenai River was monitored at monthly intervals from January through December, with samples being analyzed for conventionals, nutrients, and metals.

5. Chief Joseph Dam/Lake Rufus Woods temperature study. A temperature study of Lake Rufus Woods was initiated in 2002. The purpose of the study was to determine changes in water column temperature in Lake Rufus Woods between Grand Coulee Dam and Chief Joseph Dam. Three temperature strings were deployed in the reservoir between Grand Coulee and Chief Joseph. Temperature strings consisted of Vemco data loggers attached at various depths to a weighted cable and secured in place with an anchor and buoy. Temperature was recorded every hour from August through October 2002. This study will continue in 2003.

6. Libby Dam/Lake Koocanusa temperature study. A temperature study of Lake Koocanusa was initiated in 2002. The purpose of the study was to study the thermal properties in the forebay to aid in determining Libby Dam release temperatures that would benefit downstream sturgeon populations. A single temperature string was deployed in the forebay consisting of Vemco data loggers

attached at various depths between the surface and bottom of the reservoir. Temperature was recorded every hour from June through November 2002.

7. Lower Columbia River Dredged Material Evaluation Framework. This interagency team includes representatives from Seattle District, Portland District, Northwestern Division, Washington Departments of Ecology and Natural Resources, EPA Region 10 and the Oregon Department of Environmental Quality. The team has developed a regional manual for the evaluation of dredged material intended for disposal in the aquatic environment. A full public interest review was completed, and the agency heads signed the final document in November 1998.

8. Regional Sediment Evaluation Team (RSET). NWS is participating on the RSET to develop a regional dredged material management manual for use in Oregon, Idaho, and Washington.

9. East Waterway Navigation Improvements. Section 356 of the Water Resources Development Act (WRDA) 96 directed the Corps of Engineers to a) expedite review of potential deepening of the channel in the East Waterway (Duwamish River) from Elliott Bay to Terminal 25 to a depth of up to 51 feet, and b) if determined to be feasible, implement such deepening as part of the project maintenance. This is a significant action under NEPA and SEPA because of contaminated sediments, and requires an EIS. The District and the Port have each contracted several consultant firms to obtain ecological baseline information for the Federal/State EIS. The Biological evaluations have been completed. The largest contract was with SAIC to biologically and chemically evaluate the sediments. Stage I was completed in February 2000 and the Stage II Evaluation study are in progress. (Larry Scudder needs to update this to reflect that the Port of Seattle is now using CERCLA cleanup authority to address the contaminated sediments cleanup, while moving ahead to complete the deepening of the waterway under Corps regulatory permit authorities.)

2.10.4. Walla Walla District

Fish ladder temperature evaluations are initiated in 2002 and are discussed elsewhere in this report.

2.11. Contract Work

The Northwestern Division, North Pacific Region awarded no contracts in 2002. A detailed listing of the contract costs listed in Table 5.

Table 5. Water Quality Contracts Awarded in 2002

Northwestern Division, North Pacific Region	Amount ($)
Region's Total	0
Portland District	
WATER QUALITY	
1. John Salinas, The Cascade Research Group, Murphy OR; water quality	29,900

monitoring of Lost Creek and Applegate Lakes, Rogue River Basin, OR	
2. Dave Canoy, Environmental Testing, (ET) Salem, OR; Hydrolab profiles of Green Peter/Foster, Detroit/Big Cliff, Lookout Point, and Hills Creek	13,725
3. Dave Canoy, Environmental Testing, Salem, OR; Temperature monitoring in Mckenzie River.	3,325
4. Jim Sweet, Aquatic Analysts, Portland, Oregon; water quality and limnological monitoring of Willow Creek lake and dam-seepage waters, Willow Creek Lake Project, Oregon.	37,420
5. USFS water quality monitoring at Cougar Lake	25,824
6. Miscellaneous equipment purchases	8,790
7. USGS: TDG monitoring in lower Columbia River.	147,574
8. Cooperative Agreement with OSU to perform mercury studies at Cottage Grove Reservoir.	7,800
9. FMP Real Estate Lease – The Fishery - Warrendale, OR	1,200
10. Cooperative Agreement city of Salem for temperature model of Detroit reservoir.	6,000
11. USFS for water quality monitoring at Cougar and Blue River Reservoirs.	12,800
12. Oregon Department Environmental Quality (DEQ) Planning Assistance to States funding for Willamette River modeling to develop temperature TMDL	45,250
13. Water quality data entry by AIS of SRS temperature, flow and conductivity data.	3,690
14. STENNIS. FMS equipment rental DCP	7,688
15. Columbia River BiOP RPA132 – representiveness of forebay gas monitor studies by ERDC.	32,000
16. CBE, Lower Columbia River Projects forebay gas monitoring sites evaluation according to RPA 132 of the Columbia River BiOP	15,000
17. Blue River Project – HEC5Q temperature model analysis at Blue River by RMA Associates. Objective – determine if project as designed can meet target temperatures under new flow requirements.	63,274
18. Set-up of 3 Bureau of Reclamation Agrimet weather stations in support of temperature modeling work at three projects – Hills Creek, Lookout Point and Detroit Reservoirs.	33,000
19. USGS, install and maintain water quality equipment in gages above & below Cougar Reservoir	45,250
20. Develop CE-QUAL-W2 temperature models of Hills Creek and Lookout Point Reservoirs.	185,000
WATER QUALITY SUBTOTAL	724,510
USGS GAGING STATION CONTRACTS DETAILS	
NUMBER - LOCATION	
14252580 Toutle River, Twr Road, Nr Silver Lake, Wa	35,000
14330000 Rogue River Blw Prospect, Or	3,780

14335075 Rogue River At Mcleod, Or	14,500
14337500 Big Butte Creek Nr Mcleod, Or	14,500
14337600 Rogue River Nr Mcleod, Or	3,780
14337830 Elk Creek Nr Cascade Gorge, Or	14,500
14337800 Elk Creek Blw Alco Creek, Or	22,500
14337870 West Branch Elk Cr Nr Trail, Or	3,780
14338000 Elk Creek Nr Trail, Or	14,500
14338100 Rogue River At Trail, Or	14,500
14339000 Rogue River At Dodg Br Nr Egl Pt, Or	14,500
14359000 Rogue River At Raygold, Or	3,780
14362000 Applegate River Nr Copper, Or	3,780
14366000 Applegate River Nr Applegate, Or	3,780
14369500 Applegate River Nr Wilderville, Or	3,780
USGS GAGING STATIONS SUBTOTAL	170,960
TOTAL WATER QUALITY	895,470
SEDIMENT QUALITY	
SEDIMENT QUALITY & ODMDS EVALUATIONS	
1. Sound Analytical Services – Umpqua River and Winchester Bay, Sediment analyses	10,261
2. Sound Analytical Services –Skipanon Channel and Boat Basin, Sediment analyses.	8,831
3. Sound Analytical Services – Oregon Slough, VANALCO and CRCD #76, Sediment analyses.	18,713
4. Sound Analytical Services – Astoria EBB P-3, Sediment analyses	7,600
5. Sound Analytical Services – Springfield Mill Pond, Sediment analyses	1,383
6. Sound Analytical Services – Willamette Mission State Park	2,748
7. Sound Analytical Services – Siuslaw River, Sediment analyses	3,456
8. Sound Analytical Services – Chetco River, Sediment analyses	4,299
9. Sound Analytical Services – Coquille River, Sediment analyses	3,326
10. Hart Crowser, Inc. Willamette River Reference Site Project – Total $119,630	66,993
11. G & L Sablefish, Inc. - Boat & operator, Siuslaw River, and Umpqua River, Sediment sampling.	4,182
12. Marine Sampling Services – Boat crew and sampling equip, Oregon Slough, VANALCO, CRCD #76, Astoria EBB P-3, Sediment sampling.	31,250
13. John Vlastelicia – Boat & Operator , Skipanon, Sediment sampling.	1,610
14. Sediment Trend Analysis-MCR ODMDS study	259,845
15. Sidescan Sonar/Sediment Acoustic Characterization	31,432
16. Hydrosurvey Boat and Crew	29,125
17. Sidescan Sonar Yaquina Bay	35,231

18. Benthic Infauna Evaluation Yaquina Bay	49,600
NWP SEDIMENT QUALITY SUBTOTAL	569,885
TOTAL PORTLAND DISTRICT	1,465,355
Seattle District	
1. U.S. Geological Survey (Montana District): Field water quality data collection/analysis on Lake Koocanusa (3 reservoir stations, 1 Riverine station)	65,000
2. Common Sensing, Inc. (Clark Fork, ID): Dissolved gas sensor operation and maintenance for Chief Joseph forebay and tailwater	6,000
3. Aquatic Research Inc.: Howard Hanson Reservoir Water Quality Analysis	3,500
4. Montana Environmental Laboratory: Libby Dam Well Sampling Water Quality Analysis	5,000
5. University of Arizona: Libby Dam Well Sampling Isotope Analysis	2,500
6. Engineering Research and Development Center (ERDC): Libby Dam Total Dissolved Gas Exchange Study	150,000
7. Engineering Research and Development Center (ERDC): Chief Joseph/Grand Coulee Joint Operations Water Quality Study	10,000
8. Engineering Research and Development Center (ERDC): Chief Joseph Temperature Model	10,000
9. SAIC: 2002 Sediment Management Annual Review Meeting minutes	3,950
10. Striplin Environmental Associates: Grays Harbor Operations and Maintenance Dredging Sediment Quality Evaluation	32,269
11. Striplin Environmental Associates: Paralytic Shellfish Poisoning Potential from Dredged Material Disposal in Bellingham Bay	8,000
12. SAIC: DAIS data entry of dredged material characterization data	50,773
13. Striplin Environmental Associates: Sediment Profile Imagery Survey of the Elliott Bay nondispersive disposal site	15,500
14. Striplin Environmental Associates: Sediment Profile Imagery Survey of the Sinclair Inlet Confined Aquatic Disposal (CAD) site	20,435
15. D.M.D., Inc. Environmental and Toxicological Services to Review analytical methodologies for the Characterization of Environmental PCBs discussed at the SETAC Environmental Workshop PCBs Workshop, entitled "Managing Polychlorinated Biphenyls (PCBs) in Puget Sound and the Georgia Basin" held at Friday Harbor Laboratory on September 16-19, 2002.	2,451
Walla Walla District	
1. A MIPR was sent to HEC-Davis for water modeling support.	

2. Various local laboratories were awarded purchase orders to perform some of the swim beach, drinking water and wastewater analyses. Some engineering samples for design and modification to water systems were awarded at various times during the year.	48,000
3. HDR Engineering was awarded a contract to perform routine maintenance on TDGMS systems.	225,000
4. OA Systems was awarded a contract to provide numerical mode expertise for the development of the Snake River Temperature Model.	145,000
5. OA Systems was awarded a contract to conduct data collection and analysis for a reconnaissance temperature study of the Lower Snake River. The study developed a QA procedure for data validation, provided relative thermal distribution analysis and recommended location of telemetry data collection efforts in support of model development.	190,000
6. Sweeny Aquametrics was awarded a contract to provide replacement barometers and TDG instruments to fulfill TDG FMS redundant monitoring requirements.	120,000
7. HDR Engineering was awarded a contract assist the district in refurbishment of the TDG FMS stations.	157,000
8. Several contracts for analysis of sediments in the Yakima River Delta, Lewiston Levee ponds, and Clarkston Resources area were awarded for sediment sample analysis and chemical analysis	78,000
9. A MIPR was sent to the USGS for assistance in converting temperature-monitoring device to telemetry.	18,000

2.12. Meetings and Conferences

2.12.1. Northwestern Division, North Pacific Region

1. Water Quality Team staff (Richard Cassidy, Nancy Yun and Laura Hamilton) attended numerous in-house, public, and inter-agency meetings in conjunction with the implementation of the spill for-fish-passage and fish flow augmentation measures requested by NMFS. Meetings were held with National Marine Fisheries Service, US Fish and Wildlife Service, Bureau of Reclamation, Bonneville Power Administration, Power Planning Council, State Environmental Departments, Indian tribes, and others. Most of the attendance has been at the weekly or biweekly meetings of the regional Technical Management Team discussing weekly flow augmentation operations for fish during April-August 2002. Attendance at NMFS's Water Quality Team monthly meetings.

2. Water Quality Team staff attended monthly regional meetings concerning Total Dissolved Gas and water temperature TMDL development and implementation.

3. Richard Cassidy attended the US-Canada Transboundary Gas Group meeting in Wenachee, Washington on April 9 and 10, 2002 and Vancouver, BC, Canada on October 22 and 23, 2002. He made a presentation on the 2002 spill season at the mainstem Columbia and Snake projects.

4. Laura Hamilton coordinated several regional database meetings.

2.12.2. Portland District

1. Jim Britton attended monthly Water Quality Team (WQT) meetings at the NMFS office.

2. Jim Britton attended the Oregon DEQ's Model Coordination Team (MCT) meetings that advise the State in its temperature TMDL modeling effort.

3. Jim Britton attended the Cougar Reservoir Environmental Coordination Committee meetings.

4. Jim Britton attended the Columbia River BiOP RPA143 Snake River temperature modeling meetings.

2.12.3. Seattle District

1. Kent Easthouse and Marian Valentine participated in various Program Management Plan meetings in Portland.

2. Kent Easthouse attended the Sustainable Fisheries Society Meeting in Spokane (April 2002).

3. Kent Easthouse and Marian Valentine attended the Transboundary Gas Group Meeting in Wenatchee (April 2002).

4. Kent Easthouse presented the results of the Libby Dam TDG exchange study at the Transboundary Gas Group conference in Vancouver, B.C. (October 2002).

5. Kent Easthouse attended a meeting regarding Washington State's Review of the Water Quality Standards in Olympia (November 2002).

6. David Kendall participated in the 2002 Sediment Management Annual Review Meeting and made several presentations, which included a summary of 2002/2002 DMMP actions and accomplishments, and a presentation on the comparative surface/subsurface sediment bioassay performance responses within the DMMP.

7. David Kendall presented a paper at the Dredging 02 Conference in Orlando, Florida entitled: Thirteen Year Implementation Retrospective on the Dredged Material Management Program (DMMP) in the Northwest.

8. David Kendall attended the Regional Sediment Evaluation Team (RSET) meeting at Portland District (10-11 December) and made a short presentation on the Dredged Material Management Office process model used at Seattle District to implement the interagency Dredged Material Management Program.

9. Lauran Warner participated in the 2002 Sediment Management Annual Review Meeting and made presentations on clarification of program policy for interstitial ammonia in amphipod bioassays, and on considerations for data recency.

10. Lauran Warner (OD-TS-DM) attended the National Society of Environmental Toxicology and Chemistry Conference, Baltimore, MD, November 2002.

11. Stephanie Stirling chaired the Western Dredging Association Annual Meeting in Oakland California in November 2002.

2.12.4. Walla Walla District

1. Russ Heaton attended the annual TDG conference in Portland, Oregon, November2002.

2. Russ Heaton attended the first RSET meeting in Hood River, Oregon, September 2002.

2.13. Future Water Quality Objectives/Reports

2.13.1. Northwestern Division, North Pacific Region

1. Continue to coordinate and monitor the Corps annual total dissolved gas monitoring program.

2. Continue to monitor and adjust spill levels at Corps projects during the spill season to maintain TDG levels below the state standards of 115% in the forebays and 120% in the tailraces.

3. Continue to develop, maintain and operate an active homepage for real-time use in water management of the Columbia River reservoir system.

4. Continue to improve modeling capability.

5. Continue to improve Division-District coordination on water quality and related issues.

6. Continue to provide the required level of oversight to the Dissolved Gas Abatement Study team; and to represent the Division at regional forums dealing with compliance issues involving total dissolved gas and other water quality parameters.

7. Provide water quality and general environmental modeling support to others as needed.

8. Work with HQ to resolve state water quality variance issues.

9. Work with the development of an inter-agency Water Quality Plan for the Columbia/Snake system.

10. Participate in TMDL development for TDG and water temperature on the Columbia/Snake mainstems.

11. Participate in the development of a CENWD – North Pacific Water Quality Team to provide regional program management guidance.

12. Develop and implement 1-year and 5-year Water Quality Plans as specified in the 2000 NMFS BiOp.

13. Participate with BPA and BOR in water temperature and TDG modeling as specified in the 2000 NMFS BiOp.

2.13.2. Portland District

WATER QUALITY

1. Continue to operate and maintain stream-gaging programs in the Willamette and Rogue River Basins, Oregon, Willow Creek basin, and in Toutle River basin, Washington, and in the Lower Columbia River main stem. Upgrade some of the Willamette gages to obtain temperature data to support DEQ TMDL modeling efforts.

2. Work with Oregon resource agencies to develop instream-flow rules for the Willamette River requiring the Corps of Engineers to provide specific flows year-round for fisheries and water quality enhancement.

3. Continue coordination with resource agencies to assure Portland District's compliance with Federal and State water quality regulations at existing and proposed Federal projects.

4. Develop study plan for RAMS program and seek funding for Black Butte mine in the watershed of Cottage Grove Reservoir. Continue studies of mercury contamination in Cottage Grove and Dorena Reservoirs.

5. Continue selective withdrawal at Willow Creek Reservoir to aid locals in reducing temperatures in Willow Creek below the project.

6. Review historic and current data to determine problem specific water quality studies to conduct at Corps projects.

7. Continue to implement the District Fixed Monitoring Program (FMP) for monitoring TDG below Corps Projects in the lower Columbia River. Evaluate the need for dropping and/or moving FMP sites to improve the programs goal of monitoring compliance with water quality standards.

8. Continue to monitor TDG below Corps Projects in the Willamette and Rogue Basin on an as-needed basis.

9. Continue to participate with the U.S.F.S. and the city of Salem as a team member to monitor water quality in the North Santiam Watershed.

10. Implement plans and specifications for water quality monitoring during construction of the Selective Withdrawal Tower at Cougar Reservoir and Blue River Reservoir.

11. Continue to support efforts to set up water quality models of District Projects that have important water quality problems.

12. Support the State and EPA in developing TMDLs for the Willamette and Columbia River.

13. Continue participation in developing a Water Quality Plan for District projects in the Lower Columbia River as required in the NMFS Biological Opinion on saving threatened fish species.

SEDIMENT QUALITY

1. Continue the District-wide sediment quality evaluation program at Operations and Maintenance dredging projects during FY 2003, sediment quality evaluations are scheduled in the Columbia River, Port Orford, Rogue River, In Lieu Fishing Treaty Sites, Bradford Island Fish Ladder Project, with possible return to sample Skipanon and Chetco Projects.

2. Continue coordination with resource agencies to assure Portland District's compliance with Federal and State water quality regulations at existing and proposed Federal navigation projects.

3. Additionally, advise the Regulatory and Environmental Resource Branch (CENWP-EC-R) on testing procedures and interpretation of results for Section 404/103 permit actions.

4. Continue to develop and update management/monitoring plans and implement the management/monitoring programs for ODMDSs.

5. Continue to participate in development of regional dredging teams as defined in the December 1994 MARAD report.

6. Continue to updating and implementation of the Columbia River Dredged Material Evaluation framework for sediment quality evaluation.

7. Complete Section 103 selection documentation for new disposal sites at MCR.

8. Conduct biological baseline studies at the MCR Deep Water Site.

9. Conduct biological infauna studies at MCR ODMDSs.

2.13.3. Seattle District

1. Continue maintenance and updates to the Dredged Analysis Information System (DAIS).

2. Continue to operate and maintain stream-gauging programs throughout the District.

3. Continue to monitor water quality in Lake Koocanusa and the Kootenai River.

4. Continue automating data collection capabilities in the Lake Washington Ship Canal.

5. Continue development and application of a predictive model of salinity intrusion for the Lake Washington Ship Canal.

6. Continue interagency discussion to develop solutions to dissolved gas problems above and below Chief Joseph Dam.

7. Continue to evaluate the water quality impacts of installing at least one new generating unit at Libby Dam to allow high flows with reduced risk of spill and high TDG levels.

8. Continue to monitor and assess the possible water quality impacts of additional water storage at Howard Hanson Dam.

9. Continue to monitor water column temperatures in Lake Rufus Woods (Chief Joseph Dam) and Lake Koocanusa (Libby Dam).

10. Conduct a total dissolved gas exchange study at Albeni Falls Dam to determine the impacts of the dam on downstream gas levels.

11. Complete water quality report for Howard Hanson Dam and ground water quality report for Libby Dam.

12. Implement a real-time total dissolved gas data collection program for Libby Dam and the Kootenai River.

13. Develop a real-time total dissolved gas data collection program for Albeni Falls Dam and the Pend Orielle River.

14. Develop and implement water and sediment quality monitoring programs at Chief Joseph Dam (Lake Rufus Woods) and Albeni Falls Dam (Pend Orielle River).

2.13.4. Walla Walla District

1. Continue to provide reports and water-quality documents in accordance with the provisions of Biological Opinion RPA-5.

2. Finish deployment of temperature sensor strings and collect another set of temperature data in FY2003 using the techniques employed in FY2002 studies to fulfill RPA 143. Conduct the temperature data collection using the protocol developed in FY2002.

3. Complete the fish ladder temperature data report to satisfy the provisions in biological Opinion RPA-114.

4. Complete the forebay dissolved gas evaluation report to fulfill the obligations of RPA-132. Make any necessary modifications to the forebay FMS as recommended by the report in FY2003.

5. Conduct limnological investigations on the Snake and Columbia Rivers. Review past Dworshak limnology and provide for the appropriate level of water quality monitoring.

6. Continue to provide input and participation in the regional database activities as per the provisions of RPA-198.

7. Participate in the WDOE dissolved gas and temperature TMDL development process.

8. Russ Heaton will continue to represent the District and work on the regional sediment evaluations team testing framework development.

9. Facilitate the transition of limnological data to a regional database by loading this information into STORET.

3. Specific Project Information

3.1. Portland District

3.1.1. Rogue River /Lost Creek Lake-Applegate Lake Water Quality

a. Summary. John Salinas, The Cascade Research Group, collected temperature data at selected sites below Lost Creek and Applegate Reservoirs to obtain data on how far downstream each project impacts water temperature. Contractor will prepare report of findings.

3.1.2. Rogue River Projects/Elk Creek Turbidity

a. Summary. A limited turbidity monitoring program was continued at the Elk Creek dam site. The objective was to assess the impact of dam construction on Rogue River water quality, and to obtain data for use in the verification of a numerical model. Turbidity data are collected hourly at four stream gauging stations, which are operated and maintained by the USGS under contract with the Portland District.

The history and monitoring capabilities of each of these stations are as follows:

- ID/STREAM/LOCATION/PARAMETERS/INITIATION YEAR
- 14338000/Elk-Creek-NR-Trail/TEMP-TURB-TEMP/June 1973
- 14337800/Elk-Creek-NR-Cascade-George/TEMP-TURB-TEMP/Aug 1973
- 14337830/Elk-Creek-Below-Alco-Creek/TEMP-TURB/May 1986
- 14338100/Rogue-Riv-Below-Trail/TEMP-TURB/May 1988

Also selected as a turbidity monitoring site was a stream-gaging station located on West Branch Elk Creek (USGS Gage Number 14337870). Stream discharge and temperature data have been collected at this site since October 1973 and August 1977, respectively. As directed, the USGS installed a turbidimeter at this station, but was not able to supply the equipment with electrical power. Thus, the station was excluded from the turbidity-monitoring network in the Elk Creek drainage basin.

In 1988, the turbidimeter at Station 14338000 (Elk Creek near Trail, located 0.4 miles upstream of Elk Creek's confluence with the Rogue River) was transferred to a newly constructed USGS gage house located roughly one mile farther upstream near the Elk Creek dam site

b. Proposed Activities.
Work will continue in 2002.

3.1.3. Willow Creek Lake Project

a. Summary. Aquatic Analysts, Portland, and Dr. Marvin Lilley, University of Washington, continued with water quality and limnological studies at Willow Creek Lake Project in 2002. Methane and hydrogen sulfide production as well as

temperature profiles of the lake were conducted once per month in August, September and October.

b. Proposed Activities.
Limnological and water quality studies, including research on methane production, will continue in 2003.

3.1.4. Willamette Valley Projects

a. Summary. Most monitoring this year occurred at Cottage Grove, Dorena, Hills Creek, Lookout Point, Cougar, Green Peter and Detroit Reservoirs. To assist Oregon DEQ in its TMDL modeling efforts in the Willamette River, the Corps collected temperature data below Hills Creek, above lookout Point, Green Peter, Dorena, and Cottage Grove Reservoirs. Routine lake profile data (pH, temperature, turbidity, secchi depth, DO, % DO SAT, redox, and TDS) were collected at Detroit, Green Peter, Hills Creek, and Lookout Point. Similar data was collected at Cougar and Blue River reservoirs by the USFS. This data was collected to provide historical data to help in assessing the impacts of construction of the remodeled Selective Withdrawal Tower on water quality. Under contract, CBE collected data at three sites on the Willamette River – Albany, Salem, and Newberg Pool – to help the State monitor the impacts of low flows, resulting from the drought, on water quality.

b. Proposed Activities.
Spill related TDG concentrations in waters below projects, where fish concerns are paramount, will continue to be measured on a spot basis. Temperature data will continue to be collected above and below projects mentioned in the above paragraph to support DEQ TMDL modeling efforts. Specific water quality problems will be investigated as the need arises. Water quality models will be set up for Cougar and Blue River reservoirs to aid in the operation of the projects and help the State in developing a temperature TMDL.

3.1.5. Detroit Dam and Reservoir

a. Summary. The USGS collected lake profiles once every 3 weeks from April through October. A BOR weather station was set up at the USFS office site next to the lake. The data will be used to develop a temperature model of the reservoir.

b. Proposed Activities.
In 2003 the BOR weather station will be maintained.

3.1.6. Columbia River Projects - TDG Fixed Monitor Program (FMP)

a. Summary. Monitoring of TDG concentrations continued in the forebay and tailwater of John Day, The Dalles and Bonneville dams and at Camas below Bonneville to provide real-time data for operations, and time series data for research and modeling efforts through the Fixed Monitoring Program. Columbia River BiOP RPA132 studies were initiated at Corbett Landing to compare its representativeness to that of the Camas Station. Alternate forebay monitors were set up at John Day and The Dalles project to check the current forebay sites for representativeness.

b. Proposed Activities.
Continue TDG monitoring at the FMP sites under MIPR to the USGS. Continue forebay representativeness studies at John Day and The Dalles.

3.1.7. Dredged-Material Evaluations for Navigation Projects

a. Summary. Dredged-material evaluations were conducted for sediments at Astoria EBB, Umpqua River and Winchester Bay, Siuslaw River, Springfield Mill Pond, Oregon Slough, VANALCO, CRCD # 76, Chetco River and Boat Basin, Coquille River and Skipanon Channel and Boat Basin.

3.2. Seattle District

3.2.1. Lake Koocanusa (Libby Dam)

a. Summary. The U.S. Geological Survey performed water quality monitoring below Libby Dam and at three sites within the reservoir. The monitoring program consists of analyses for nutrients, inorganic compounds, heavy metals, chlorophyll, pH, specific conductivity, dissolved oxygen, and temperature. These analyses help identify pollution from upstream agricultural, mining, industrial, and municipal sources. They also establish a baseline for identifying similar types of pollution from sources downstream from the project.

A TDG exchange study was conducted at Libby Dam. Monitoring consisted of measuring TDG at 31 locations downstream of the dam during voluntary and involuntary spill that occurred from June 24 to July 7, 2002. The purpose of the study was to define and quantify processes that contribute to dissolved gas transfer during spill releases at Libby Dam. The study focused on resolving questions regarding accurate source and sink descriptions of mass conservation of dissolved gases in the Kootenai River below the dam.

A ground water monitoring study was conducted in the Kootenai River valley during 2002. The goal of the monitoring program was to characterize the shallow and deep ground water quality of properties adjacent to the Kootenai River downstream of Libby Dam before, during, and after the voluntary and involuntary spill that occurred from June 24 to July 7, 2002 to determine if water quality impacts occurred during high flow conditions. Specifically, there was a concern about the potential for increased flows to lead to contamination of drinking water wells or saturation of on-site wastewater treatment and disposal systems.

A temperature study of Lake Koocanusa was initiated in 2002. The purpose of the study was to study the thermal properties in the forebay to aid in determining Libby Dam release temperatures that would benefit downstream fisheries.

b. Proposed Activities.

The Seattle District will continue to monitor water temperature in both Lake Koocanusa, and downstream in an effort to meet water temperature criteria set forth by the US Fish and Wildlife Service in their annual guidelines for white sturgeon recovery. The District will continue to monitor water quality in Lake Koocanusa at three stations and in the Kootenai River at one downstream station.

3.2.2. Pend Oreille Lake (Albeni Falls Dam)

a. Summary. Water quality data collected in 2002 were limited to daily measurements of temperature and flow below the dam. Monitoring of Eurasion milfoil in the Pend Orielle River above the dam continued in 2002.

b. Proposed Activities.
A total dissolved gas exchange study is planned for 2003. The purpose of the study will be to define and quantify processes that contribute to dissolved gas transfer during normal operations (including involuntary spill) at Albeni Falls Dam. The study will focus on resolving questions regarding accurate source and sink descriptions of mass conservation of dissolved gases in the Pend Orielle River below the dam.

3.2.3. Rufus Woods Lake (Chief Joseph Dam)

a. Summary. Dissolved gas and water temperature data were collected in the forebay and in the tailwater. Common Sensing, Inc., based in Clark Fork, Idaho performed sensor maintenance and calibration. A temperature study of Lake Rufus Woods was initiated in 2002. The purpose of the study was to determine changes in water column temperature in Lake Rufus Woods between Grand Coulee Dam and Chief Joseph Dam. Three temperature strings were deployed in the reservoir at three locations between Grand Coulee and Chief Joseph. Vertical profiles of temperature, conductivity, pH, and dissolved oxygen were collected in August and October at each temperature string location.

b. Proposed Activities.
The District will continue to monitor temperature and TDG in 2003.

3.2.4. Lake Washington Ship Canal and Locks

a. Summary. Saltwater intrusion into Lake Washington through the ship canal was prevented in WY 2002. The District collected salinity and temperature data from five stations, including one new station, that automatically transmit hourly data to the Reservoir Control Center through the District's water control data collection system. . Periodic field measurements were made at sampling stations in the canal and Lake Union to ground-truth the automated sensor data.

b. Proposed Activities.
The District plans to update water quality monitoring equipment in 2003, and will continue to monitor salinity levels and temperatures in the Lake Washington Ship Canal and Lake Union This data will be used to determine lock operations associated

with control of saltwater intrusion. The District will continue to look at operational effects on water quality upstream of the locks and in the ship canal.

3.2.5. Wynoochee Dam and Lake

a. Summary. During the summer stratification period, the intake temperature panel system was used to regulate downstream temperatures during operation of the hydroelectric plant. The downstream temperature control point for the Wynoochee Project is the USGS River Gauging Station known as the Wynoochee River at Grisdale Gauge. A sensor at that gauging station reports river temperature on a real-time basis. In addition to the Grisdale Gauge, there is a sensor monitoring the temperature of the water in the hydroelectric plant tailrace.

b. Proposed Activities.
No new activities are currently planned.

3.2.6. Howard A. Hanson Dam and Reservoir

a. Summary. An intensive limnological study of Howard Hanson Reservoir was implemented in 2002. Nutrients, alkalinity, chlorophyll *a*, phytoplankton, and organic matter were monitored monthly in the epilimnion and hypolimnion at two in-reservoir stations from May through October. In addition, water column profiles of temperature, pH, dissolved oxygen, and conductivity were monitored bi-weekly at six in-reservoir locations.

b. Proposed Activities.
The Seattle District will continue to monitor upstream, in-reservoir, and downstream water quality at Howard Hanson Dam. The intensive limnological study implemented in 2002 will continue in 2003 with the addition of a new downstream station and including sampling for zooplankton in the reservoir.

3.2.7. Mud Mountain Dam

a. Summary. Water quality data collection efforts in WY 2002 were limited to daily measurements of temperature and turbidity above and below the reservoir as a guide in regulating release patterns and to comply with State and Federal regulations. Most water quality problems at Mud Mountain Project are related to a high suspended-solids load associated with upstream glacial melt and erosion of sediment accumulations upstream of the project and in the reservoir. During and immediately following high flows and in association with some project maintenance procedures, relatively short-term high turbidity levels will be experienced that will exceed State of Washington water quality standards.

The White River has a natural high sediment load during storm events. During significant storms, a large amount of debris from the upstream watershed may enter the reservoir. While much of the debris is usually collected in upstream areas, some of it may accumulate on the trash-rack. As debris is removed from the trash-rack, the river lowers and can cut channels through accumulated sediment upstream of the dam resulting in higher turbidity during these operations.

b. Proposed Activities.
No new activities are currently planned.

3.3. Walla Walla District

3.3.1. Columbia River Projects - TDG Fixed Monitor Program.

a. Summary. The TDGMS system operated all sixteen sites in the Walla Walla District. Ten of the sites were operated year round and six were seasonal. Sensor performance evaluations were completed using the primary standards calculated to quantify the absolute accuracy capability and repeatability of the TDGMS instruments. A comprehensive QA/QC program for TDGMS was utilized.

Seasonal TDG monitoring was performed at specific sites:

- ✓ Dworshak (DWQI) on the North Fork of the Clearwater River.
- ✓ Peck (PEKI) and Lewiston water intake (LEWI) on the main stem Clearwater River.
- ✓ Lower Granite (LWG), Lower Granite tailwater (LGNW), Little Goose (LGS), Little Goose tailwater (LGSW), Lower Monumental (LMN), Lower Monumental tailwater (LMNW), Ice Harbor (IHR), Ice Harbor tailwater (IDSW) on the Snake River.
- ✓ Pasco (PAQW), McNary forebay Oregon (MCQO), McNary forebay Washington (MCQW) and McNary tailwater (MCPW) on the Columbia River.

TDG station barometers were recalibrated to implement a temperature correction factor. New TDG-monitoring deployment systems were installed at Lower Monumental and Ice Harbor Dam tail waters. These stations had a major change in design that is currently being evaluated. Proposed activities for 2003 include implementing this new design for the repair of three other stations.

b. Proposed activities for 2003.
Study of the FMS representation of TDG in the forebays of the dams. Depth of instruments will also be closely monitored. Installation of the improved precision barometric pressure sensors will be completed prior to the beginning of the summer TDG season in FY2003. Programmed replacement of sondes will continue beginning with those instruments that are in need of repair but were not repaired in 2002. Future instrument retirement schedules will be programmed and the redundancy requirement will be maintained. A comprehensive QA/QC plan and operation manual update will be completed to include the enhancements to the TDG FMS system made in FY2002.

3.3.2. McNary Project and Reservoir

a. Summary. District personnel constructed and installed six multiple level thermister data buoys at McNary Dam forebay in FY2002. These catamaran pontoon mounted

data collection systems measure temperature at various depths on an hourly basis. The units were pulled from the forebay this year and received a partial electronics update. The data can currently be transferred from shore via SDI-12 radio modem links to a central GOES DCP. The temperature platforms were scheduled for conversion to telemetry in FY2002 but funding shortfalls delayed re-deployment until FY2003.

Corps fish biologists placed battery operated temperature sensors that recorded readings hourly at fish passage facilities from 1 April through 31 October at the North ladder exit, entrance and first diffuser as well as at the South Ladder diffuser, junction pools 10 and 20 and at the collection channel between Units 8 and 9.

Terrestrial soil sampling was conducted on Corps property at Wallula Junction adjacent to McNary National Wildlife Refuge to evaluate use of material for shoreline restoration.

b. Proposed activities for 2003.
The primary focus for FY2003 will be the re-deployment of the temperature buoys into the forebay. The data collected from these systems will be used to develop District in-house model capabilities.

3.3.3. Ice Harbor Project and Reservoir

a. Summary. Corps fish biologists placed battery operated temperature sensors that recorded readings hourly at fish passage facilities from 1 April through 31 October at: the North Ladder exit pool, upper and bottom diffusers and upper and lower junction pools; at the South ladder exit pool, bottom diffuser, upper diffuser unit 6 and junction pool; Juvenile facilities at the North and South collection channels.

Previous repairs to this FMS station failed again this year. Subsequently, the new 8-inch HDPE pipe was installed at this location with extra anchoring. We obtained a rock drill and used concrete to install stainless steel suspension cable. Approximately 1,800 pounds of steel was used to anchor the pipe on this site. The anchors were constructed of 1-inch plates welded together in groups of four. An additional set of anchors was buried into the ground to provide stiffening to the mid-section joints. The re-design of this FMS should withstand a 15-year flood event and since the HDPE is flexible it could potentially withstand even higher flows without snapping.

b. Proposed activities for 2003.
Some limnological samples will be taken after a review of the existing data is completed. If funding allows, it is planned to install a single temperature string into the forebay of this dam.

3.3.4. Lower Monumental Project and Reservoir

a. Summary. The new water quality sonde deployment system was also installed at the Lower Monumental Dam tailwater TDG station. Improve the temperature monitoring

capabilities by installation of a few temperature sensors in the fore bay and fish ladders. Evaluate the feasibility of scroll case temperature monitoring improvements.

Corps fish biologists placed battery operated temperature sensors that recorded hourly readings at fish passage facilities from 1 April through 31 October at: the North Ladder exit pool, upper and lower diffusers, junction pool and collection channel; South Ladder exit pool, upper and lower diffuser, transition pool; Juvenile Facility collection channel, primary dewatering, raceway, separator and sample holding tank.

The downstream TDG FMS site received a major refurbishment to the instrumentation well pipe. The station was fitted with the cable-pulley system designed by the AE-contractor. Only two locations were fitted with this system last year (Ice Harbor tailwater and Lower Monumental) as these were a prototype design. While they were functional, the operation of these systems required a hammer drill to operate the winch system. This added a considerable amount of time to the operation of the station. However, the cable pulley-system proved extremely useful when installing the pipe. It was a simple matter of winching the pipe down to the existing nose anchor tripod. The cost of the cable and pulley installation was off set by the labor savings in the installation of this FMS. The old gray 4-inch diameter PVC pipe was replaced with new 8-inch HDPE with a 5/8-inch wall thickness. The joints were heat welded as opposed to joining them by glue/cement and stainless steel screws as used with the previous PVC installations. Furthermore, new anchors were placed in the water and additional stainless steel cable suspension were included into this design.

b. Proposed activities for 2003.
Improve the temperature monitoring capabilities by installation of a few temperature sensors in the fore bay and fish ladders. A review of the water quality data associated with this pool is scheduled for FY2003.

3.3.5. Little Goose Project and Reservoir

a. Summary. Corps fish biologists placed battery operated temperature sensors that recorded hourly readings at fish passage facilities from 1 April through 31 October at: the exit pool, two pools below diffuser 13, diffuser 1, junction pool and north shore entrance and at the Juvenile Facility primary dewatering structure, separator, raceway 10 and Sample Holding Tank.

The district placed a series of Onset® optical temperature data loggers in a series of chains and single ended units in strategic locations in the pool. The data from these instruments will be used to determine locations of telemetry sites throughout the pool. If funds are available, there is a potential to install telemetry units in the forebay of this project.

Routine drinking water samples were taken monthly at service connections and tested according to Washington State Department of Health guidelines.

The downstream TDG FMS site received a major refurbishment to the instrumentation well pipe. The old gray 4-inch diameter PVC pipe was replaced with new 8-inch HDPE with a 5/8-inch wall thickness. The joints were heat welded as opposed to joining by glue/cement and stainless steel screws as previously done. Additionally new anchors were placed in the water and additional stainless steel cable suspension was included into the design.

Wastewater was tested monthly for suspended solids, 5-day BOD and fecal coliform bacteria. Wastewater system operational controls were analyzed and adjusted. All laboratory results and Corps project test results were posted on the network drive. Monthly discharge monitoring reports were forwarded to the EPA.

b. Proposed activities for 2003.
Limnological trend detection and water quality data review is scheduled to take place in FY2003. A single temperature string will be installed in the forebay of this project if funding permits.

3.3.6. Lower Granite Project and Reservoir

a. Summary. Corps fish biologists placed battery operated temperature sensors that recorded hourly readings at fish passage facilities from 1 April through 31 October at: the exit pool, diffuser 14, below diffuser 14, between lower diffusers, the junction pool, north powerhouse channel, north shore collection channel; at the Juvenile facility separator, raceway 5, sample holding tank, collection channel by unit 1 and the collection channel by unit 6.

Routine drinking water samples were taken monthly at service connections and tested according to Washington State Department of Health guidelines. Wastewater was tested monthly for suspended solids, 5-day BOD and fecal coliform bacteria. Wastewater system operational controls were analyzed and adjusted. All laboratory results and Corps project test results were posted on the network drive.

The District placed a series of Onset® optical temperature data loggers in a series of chains and single ended units throughout the Lower Granite Pool. The data from these instruments were used to determine locations of telemetry sites throughout the pool.

Extensive repairs were completed on the tailwater dissolved gas FMS. Before placement of the new pipe structure was commenced, a thorough reconnaissance of the bottom was conducted. The use of the side-scan sonar proved invaluable. When coupled with bathymetry the side-scan data gave an accurate location and orientation of larger submerged boulders. This information allowed us to sink the pipe structure into position without the risk of placement on the large uneven structure found in the tailrace of this dam.

In addition to the continuation of the waste water and water supply monitoring, limnological sampling is planned to be resumed. The forebay of this project is also

slated to receive a temperature sensor chain with telemetry to collect data for water quality modeling. The temperature data collected in FY02 from the temperature strings suggests significant stratification is present during critical summer fish migration periods.

3.3.7. Dworshak Project and Reservoir

a. Summary. Water temperatures downstream of Dworshak Dam and high dissolved gas concentrations remain the primary water quality concerns at this project. Temperature data logger strings (Onset® optical units) placed at the traditional water quality sites suggest that significant stratification changes occur during the year. Limnological studies completed in the 1990s were compared to the pre-impoundment studies of the 1970s. Preliminary data evaluations suggest that episodic limnological sampling is required to assess the nutrient loading and determine general lake health through trend analysis.

The downstream TDG FMS site received a major refurbishment to the instrumentation well pipe. The location of this FMS is adjacent to the main water intake structure of the Dworshak National Fish Hatchery. The old gray 4-inch PVC diameter pipe was replaced with new 8-inch HDPE with a 5/8-inch wall thickness. The joints were heat welded rather than joined by glue/cement and stainless steel screws as done previously. Furthermore, new anchors were placed in the water and additional stainless steel cable suspension was included into the design. In addition to this station, both the Lewiston and Peck FMS sites were refurbished in the similar manner.

b. Proposed activities for 2003.
A single 600-foot long temperature sensor will be installed in the Dworshak forebay at river mile three. The specifications calls for approximately 60 individual sensors connected to a single SDI-12 radio link to a shore based data collection platform. The platform will transmit data directly to a database system yet to be named. A direct radio link to the power plant control room is planned to give the power plant operator real-time temperature data for better control of the variable intake structure. The stored data will be used for in-house District model activities.

3.3.8. Mill Creek and Virgil B. Bennington Lake

a. Summary. Water temperature concerns were the primary issue raised with the operation of this project. Plans were made to install temperature data recording devices in the dam and diversion structures. Funding for the procurement of the equipment was cut and no equipment was available.

b. Proposed activities for 2003.
Implement a monitoring program at Mill Creek for temperature using existing data acquisition platforms or purchase updated equipment if older instrumentation is not feasible. We plan to have the equipment installed in FY2003 by mid-to-late spring. After that, we plan to operate the instrumentation year round.

3.3.9. Lucky Peak Reservoir

a. Summary. No routine water quality activities were conducted at this project. Most of the identified water quality problems associated with the Boise River occur downstream and independent of the project. Restoration and assistance services were not requested last year.

b. Proposed activities for 2003.
District personnel will continue to evaluate previously collected water-quality data from Lucky Peak. Most of the water quality work for this project will encompass loading data templates for inclusion into the STORET database.