US Army Corps
of Engineers®
Northwestern Division
North Pacific Region

Water Management Division
Reservoir Control Center
Water Quality Section

1998 Water Quality Annual Report

December 1998

North Pacific Region's Headquarters

CORPS OF ENGINEERS NORTHWESTERN DIVISION

NORTH PACIFIC REGION
Portland, Oregon

1998

WATER QUALITY ANNUAL REPORT

Prepared with Input from
Portland District
Seattle District
Walla Walla District
NPR Regional Office

TABLE OF CONTENTS

	Pages
SUMMARY	06
PART I: WATER QUALITY MANAGEMENT PROGRAM	
1. INTRODUCTION	22
2. ORGANIZATION AND COORDINATION	22
3. MAJOR GOALS AND OBJECTIVES	26
4. LABORATORY AND FIELD EQUIPMENT	40
5. DATA COLLECTION AND ANALYSIS	44
6. WATER QUALITY REPORTS	50
7. DATA MANAGEMENT SYSTEM	56
8. RESEARCH AND DEVELOPMENT	60
9. WATER QUALITY PROBLEMS	64
10. SPECIAL STUDIES	72
11. PERSONNEL AND TRAINING	84
12. CONTRACT WORK	88
13. MEETINGS AND CONFERENCES	94
14. FUTURE WATER QUALITY OBJECTIVES	98

APPENDIX

NWD Engineering Regulation on Water Control
Management, Water Quality (Draft/December 1998) 102

PART II. SPECIFIC PROJECT INFORMATION

Portland District

1. Lost Creek-Applegate Lake Water Quality 110
2. Elk Creek Lake Turbidity 110
3. Willow Creek Lake Project 110
4. Cottage Grove Reservoir 111
5. Cougar and Blue River Lake Projects 111
6. Middle Fork Willamette 111
7. Willamette Valley Projects 111
8. Fern Ridge Reservoir 111
9. Detroit Dam and Reservoir 112
10. TDG Fixed Monitoring Program 112
11. Dredged Material Evaluations for Navigation Projects 112

Seattle District

1. Lake Koocanusa (Libby Dam) 113
2. Pend Oreille Lake (Albeni Falls Dam) 113
3. Rufus Woods Lake (Chief Joseph Dam) 114
4. Lake Washington Ship Canal and Locks 114
5. Wynoochee Dam and Lake 115
6. Howard A. Hanson Dam and Lake 115
7. Mud Mountain Dam 116

Walla Walla District

1. Total Dissolved Gas Monitoring System 116
2. McNary Project and Reservoir 117
3. Ice Harbor Project and Reservoir 118
4. Lower Monumental Project and Reservoir 119
5. Little Goose Project and Reservoir 120
6. Lower Granite Project and Reservoir 120
7. Dworshak Project and Reservoir 121
8. Mill Creek and Virgil B. Bennington Lake 121
9. Lucky Peak Reservoir 122

Tables and Figures

Table 1. Water Quality Staff Levels 13
Table 2. Water Quality Contracts 13
Table 3. Annual Water Quality Activity Summary 14
Table 4. Summary of Water Quality Conditions 15
Table 5. Summary of Water Quality Staff and Contracts 17
Table 6. Water Quality Staff Expertise 18
Table 7. NWP Water Quality Problems on DEQ 303(d) List 67
Table 8. Correlation between FMS and TDG Readings 73
Table 9. Water Quality Contracts Awarded in 1998 88

Figure 1. Staff and Contract Amount (1983-1998) 20
Figure 2. Pacific Northwest Reservoir System 21

Portland, OR Site of the North Pacific Region's Regional Headquarters

Ship Moving up the Columbia River Past Fish-feeding Caspian Terns Island

SUMMARY

This report on the 1998 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 Water Quality Management Program **in 1998 represented an estimated 31 staff-year effort and a combined contracts total of $2.671 million -- about the same contract total as in 1997.** Contracts for sediment work accounts for 61 percent of that total. Expenses incurred by the Dissolved Gas Abatement Study (DGAS), a water quality study funded almost exclusively by the fish program, is additional (see Part II). Contract amount was highest in Seattle District for sediment work, and highest in Walla Walla District for straight water quality work (see Table 2). The water quality part- and full-time staff numbered 37, which was 6 employees less than in 1997 (see Table 1). A number of summer hire and stay-in-school employees also provided supporting services. The staff effort was expanded mostly in reservoir water quality (85%), marine ecology (5%), sediment quality (5%), and instream and general aquatic biology (5%). However, the largest contracts awarded were for sediment quality.

A summary of Division and District activities is given in Table 3, including the three most important issues/concerns and accomplishments in each organization.

1998 was an average run-off year with a wet month of May. The January-July run-off of the Columbia River at The Dalles was 104.1 million acre-feet of water, a large decrease compared to last year's record 159 million acre-feet. On the Snake River, the January - July runoff volume at Lower Granite was 31.3 million acre-feet (105% of normal). On the mid-Columbia River, the January-July runoff at Grand Coulee was 58.3 million acre-feet (92% of normal). Despite average runoff conditions throughout the basin, a significant percentage of the spill in the lower Snake and lower Columbia Rivers early in the year was caused by flows in excess of hydraulic capacities and/or lack of load. As summer progressed and flows decreased, an increasing proportion of the spill at John Day, The Dalles and Bonneville was voluntary spill for-fish-passage up to the 115/120% total dissolved gas standards waivers.

Average monthly water temperatures were generally higher by 1-2 degrees C than in 1997 throughout the season. Maximum annual water temperatures in excess of 26 degrees C were observed in the forebay of Little Goose and McNary (Oregon) reservoirs. The average monthly water temperatures for August ranged from 17.4 to 20.9 degrees C in the mid-Columbia River, from 19.9 to 22.2 degrees C in the lower Snake River, and from 21.9 to 22.5 degrees C in the lower Columbia River.

Average daily air temperatures for October 1997 - September 1998 were 103.8% of normal, 1.78 degrees C higher than normal and warmer than in 1997 (101% of

normal). By contrast, **precipitation** above The Dalles for the same period was 21.48 inches, only 94.8% of normal. The amount of water in storage in the Northwest Coordinated System ranged from 98 to 137% of the reservoir refill goal.

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 continued to affect water quantity and quality. Based on the runoff forecast at The Dalles, the Biological Opinion (BiOp) developed by the National Marine Fisheries Service (NMFS) specified seasonal spring/summer flow targets of 228,600/200,000 cfs at McNary on the lower Columbia River and 90,300/50,600 cfs at Lower Granite, on the lower Snake River.

✓ The 1998 Supplemental BiOp, released in mid-May well into the juvenile migration, called for **water to be spilled** at the Corps' mainstem Columbia and Snake River dams up to the full 120% total dissolved gas saturation level agreed to by the States. In 1998, the average spring spill ranged from 33 to 68 kcfs (29 to 58% of the daily flow average) at Lower Snake River dams, and from 100 to 144 kcfs (33 to 49% of the daily flow average) at Lower Columbia River dams. The average summer spill range was 0.1 to 42 kcfs (0.4 to 71% of daily average) and 19 to 88 kcfs (11 to 49% of daily average) respectively. On the Columbia and Snake River mainstem, the 120% TDG saturation level was exceeded for up to 22 days in the spring, but there was no exceedence in the summer.

✓ NMFS continued to **request interim standards waivers** from the states and the Nez Perce Tribe to make it possible for the spill for-fish-passage and other flow augmentation measures to occur legally. Waivers were granted covering part or all of the April 1-August 31 period, 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.

✓ The **Districts continued to be responsible for all TDG field monitoring** functions transferred to them from the Division in FY96. NWP and NWS contracted that work out to USGS, while NWW chose to do most of the work in-house. Current TDG network included 41 fully automated data collection and transmission facilities installed in both forebays and tailwater areas of all Columbia and Snake River mainstem dams. No unusual data collection and transmission problems were encountered.

✓ **The Dissolved Gas Abatement Study** continued with more modeling and data analysis. The 60% Phase II Report was almost completed by the end of December 1998, with the final report scheduled for completion in September 2000. New deflectors recommended under this study were installed at Ice Harbor and John Day Dams during 1997-1998. The study was initiated in 1994 by the Portland and Walla Districts to develop short- and long-term structural and operational solutions to the TDG supersaturation problems,

✓ Regional TDG abatement effort received a big boost from **Canadian participation** and the ensuing formation of a US-Canada Transboundary committee in April 1998. This international technical group is designed to cooperatively undertake TDG abatement studies on a systemwide basis. Representatives of NMFS, EPA and the Northwest Power Plan-

ning Council are currently the US leads on this effort, coordinating preparation of a study plan that will be submitted to the agency heads for their approval.

✓ **EPA continued to be proactive in solving high water temperature** problems in the Columbia and Snake Rivers mainstem, although they had never before attempted to influence the operation of dams. The agency hosted its second water temperature workshop in December 1998, attended by 130 people from State, tribal and federal agencies. It has also developed a one-dimension water temperature model for regional use and proposed to add a TDG component to the same. The model has potential for being extended to cover Canadian projects as well. EPA preliminary model results showed that tributary water temperatures have limited effects on mainstem water temperatures. The workshop also suggested that **global warming** might become a more predominant topic of discussion in future environmental debates in the region.

✓ 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.** Even in the Willamette River, the Governor of Oregon has requested that pollution dumped into the river be reduced to starve off a potential ESA listing of winter steelhead. The move toward **removing or drawing down lower Snake River dams and John Day Dam** to improve impaired fish passage conditions continued. Environmental and fishing groups have also filed a petition with FERC, asking for formal ESA consultation on Idaho Power Co.'s Mid-Snake River projects. The ultimate goal is to achieve more natural river conditions for salmon runs.

✓ **Water quality conditions at the 34 reservoirs and lakes in the Northwestern Division, North Pacific Region remained practically unchanged from the previous years** (see Table 4). Conditions were rated poor at two reservoirs, fair at seven, good at 19, and excellent at three. Willow Creek Lake, in the Portland District, continued to be closely monitored for potential corrosion problems for its roller concrete structure.

More specific water quality highlights for 1998 are listed below for the Division and the three Districts.

North Pacific Regional Office

✓ Day-to-day coordination of the basinwide TDG monitoring program started by the Districts in 1996, and participation in the activities of the Technical Management Team (TMT), a regional inter-agency group to advise on the weekly reservoir operation for the salmon recovery. Winter monitoring of TDG continued for the third year at selected lower Columbia/lower Snake River projects. Water quality staff operated and maintained an Internet homepage that provides the real-time project information needed for basinwide water management.

✓ Active contribution to the preparation of the following annual planning documents: (1) 1998 Water Management Plan for the Columbia and Snake River system, for use by the TMT, (2) 1998 TDG Management Plan (for attachment to the TMT's Water Management Plan) and (3) Plan of Action for the 1998 TDG monitoring.

✓ Refinement and application of statistical procedures for predicting dissolved gas saturation levels, including (1) evaluation of the increased in TDG mass caused by the new spill up to the 120% TDG target, (2) review and application of the latest spreadsheets developed for DGAS by WES for The Dalles-Bonneville reach, (3) review of the one-dimensional water temperature model developed for DGAS by Battelle, and (4) preparation of the scope of work of a system TDG model to be used in the Chief Joseph-Grand Coulee TDG Abatement Study.

✓ Continued oversight (albeit reduced) function for the District-led DGAS Study (review of the 60% Completion Report summary) and support to the Seattle District on Gas Abatement Study at Chief Joseph (development of the 7-day 10-year flow required for the State TDG standards, and coordination of the joint Chief Joseph - Grand Coulee Study by the Corps, Bureau of Reclamation and BPA).

✓ Finalized developmental work on COLOSS (Columbia Operational Support System) to facilitate reservoir operation scheduling.

✓ Continued active participation in other regional forums dealing with water quality, including coordination of TDG-related regional research plan in NMFS's Dissolved Gas Team and assistance to EPA in the development of a basinwide water temperature model and helping them organize their 1998 water temperature workshop.

Portland District

✓ Third year successful assumption of direct responsibility for dissolved gas monitoring at 10 stations on the lower Columbia River starting from John Day forebay, using the services of the USGS. Data loss for WY 1998 was improved from 3 percent in 1997 to less than 1 percent in 1998.

✓ Completion of a summary water quality report for Lost Creek Lake that encompassed water quality since the project became operational. The report suggests re-evaluating the monitoring program.

✓ Continuation of the Volunteer Water Quality Data Collection Program at Fern Ridge Lake in which data on nutrients, phytoplankton, turbidity, DO, Temperature, pH and suspended solids was collected.

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

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

✓ Continued field data collection and analysis under the Dissolved Gas Abatement Study. Analysis of transect data near TDG Fixed Monitoring Sites (FMS) suggested that the sites did not fully reflect in-river TDG conditions. The John Day tailwater and two sites below Bonneville Dam were not good at predicting river's cross sectional TDG.

✓ 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. A report on water quality trends in Lost Creek is due in April 1999.

✓ In the Willamette River Basin, sampling continued at Cottage Grove Lake for mercury and at Detroit Lake for turbidity, in cooperation with the USFWS and the City of Salem. Routine surface-to-bottom profiling of reservoirs for limnological parameters continued during the spring and summer at most projects.

✓ Gold Beach Boat Basin was profiled, using a Hydrolab multi-parameter instrument, during a tidal cycle to determine water quality. The study was performed at request of Operations Division to check on water quality following the construction of a new entrance channel.

✓ Construction of selective withdrawal facilities at Cougar and Blue River dams in the Willamette River Basin, a popular plan supported by the region to help spring chinook salmon, was still held in abeyance in 1998 for lack of funds. Estimated construction cost is $45 million.

Seattle District

✓ A two-dimensional water quality model was used to simulate saltwater intrusion into the Lake Washington Ship Canal Mini-flushing. A low water use technique that removes saltwater from the lock chamber before it enters the ship canal, was not used in 1997 due to concerns of fishery agencies

✓ The district continued its negotiations with the City of Seattle concerning a new set of instream flows for a tributary of Lake Washington. Final details are being discussed but agreement is not certain. The Corps is seeking wording that would consider navigation in any future ESA listing.

✓ The district continued to monitor water quality at Wynoochee Dam, now owned by the City of Aberdeen and operated by Tacoma Public Works Department.

✓ The district continued to study the effect of increased conservation storage at Howard A. Hanson Dam. Main concern relates to reservoir outflow turbidity.

✓ High inflows to Mud Mountain Dam continued to require extensive debris removal operations at this flood control project. Half million cubic yards of sediment pass this project in a normal water year.

✓ Flood control considerations continued to dominate Libby Dam releases, which also affect the endangered Kootenai River white sturgeon spawning downstream from the

project. Only two sturgeon pulses of full powerhouse discharge were done. Numerous sturgeon eggs were found, and very few larval sturgeons were detected as a result of the operation.

✓ A new tailwater dissolved gas sensor was installed at Chief Joseph Dam on the spillway side of the river. Dissolved gas measured in the forebay of Chief Joseph were high (120-130%) during periods of spill at Grand Coulee in May and June. Tailwater TDG readings were as high as 145% at the new monitor location.

✓ The District has initiated a dissolved gas abatement study at Chief Joseph Dam in consultation with Washington State and the NMFS regional forum. As called for in the Biological Opinion, the study will also look at the merits of combining Chief Joseph and Reclamation's Grand Coulee in a systemwide study context.

Walla Walla District

✓ Total dissolved gas was monitored continuously along with water temperature, barometric pressure and dissolved oxygen at 11 sites in the forebays and tailwaters of each Columbia/Snake River mainstem project and at 3 sites downstream from Dworshak dam. District personnel used a state-of-the-art monitoring system that operated with a significant increase in reliability and data accuracy. A new TDG station was installed at Pasco on the Columbia River upstream of the confluence with the Snake River. A second new TDG station was installed at the Anatone gage site on the Snake River just downstream of the Grande Ronde River.

✓ The Biological Productivity Study and Baseline Limnological Study on the Lower Snake River reservoirs were completed as scheduled. The effort is aimed at assessing changes in temperature and productivity on the Lower Snake River that would result from the drawdown of the four Lower Snake River Reservoirs to natural river level. The modeling activity of this effort continues into FY99.

✓ The Dissolved Gas Abatement Study - Ice Harbor spillway flow deflector construction was fast-tracked with completion of four deflectors in 1997, four more early in 1998 and the final two currently under construction. Near-field TDG studies were accomplished at Ice Harbor and Little Goose dams, followed by an abundance of in-pool TDG and water velocity data collection throughout the spring and summer of 1998. NWP and NWW (lead districts), NWD, WES, and others actively participated in this effort.

✓ Walla Walla District personnel conducted a sediment sampling in the McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Reservoirs, as part of the Dredge Material Management Study (DMMP). Sediments were analyzed for a variety of organic and inorganic constituents.

✓ Increased smolt mortality at McNary Dam was again attributed by some to thermal stress in the collection system, and in the reservoir itself. This controversial topic will require further evaluation.

The water quality objectives proposed for 1999 are generally the same as those adopted for 1998. Water quality monitoring will continue in sensitive project areas. Most

efforts will be related to on-going planning activities and actions resulting from regional undertakings (Dissolved Gas Abatement Study, NMFS's Biological Opinion, U.S. Fish and Wildlife Service's Plan for White Sturgeon, state standards waivers, EPA's concerns for water temperature, etc.).

A summary of CENWD-NP water quality effort in terms of staff and types and amounts of contract work during the past ten years is given in Table 5 and illustrated in Figure 1. As requested by HQUSACE, the list of water quality staff expertise is provided in Table 6. The final draft Division engineering regulation on Water Control Management, Water Quality (NWD-ER-1110-2-101) is attached in Appendix.
A map of the Pacific Northwest Reservoir System is shown in Figure 2.

Table 1. 1998 Water Quality Staff Levels
(Also includes staff in water quality-related disciplines)

Offices	GS-7/8	GS-9	GS-11	GS-12	GS-13	TOTAL
Division WM			1	1	1	3
Division ET					2	2
Portland PE		1	4*	2*	1*	7*1=8
Seattle WM	1		1*1	1*		2*2=4
Seattle ER			4	3*1	1*	4*5=9
Seattle DMO				1	1	2
Seattle RGS					1	1
Seattle NS				1		1
Walla Walla PL			1			1
Walla Walla IM				1 (GSA)		1
Walla Walla EN		2*	1*			3*
Walla Walla OP			0.5*0.5	0.5*.5		1*1=2
Full-time Total*		2*	6.5*	6.5*	2*	17*
Part-time Total	1	1	7.5	5.5	5	20
Grand Total	**1**	**3**	**14**	**12**	**7**	**37**

* Full-time position

Table 2. 1998 Water Quality Contracts Summary (in $1,000s)

Offices	Universi-ties and AE's	Other Corps	Other Federal	Water Quality	Sediment Quality	Total Sediments +WQ
NWD-NP	0	0	0		0	0
NWP	297.3	0	340.2	552.5	85.0	637.5
NWS	1,276.0	13.0	62.0	73.0	1,278.0	1,351.0
NWW	682.5	0.0	0.0	407.2	275.3	682.5
TOTAL	**1,799.8**	**304.0**	**554.7**	**1,032.7**	**1,638.3**	**2,671.0**

Table 3. 1998 Annual Water Quality Activity Summary

Items	NWD-NP	NWP	NWS	NWW
A. **No. of WQ Monitoring Stations**				
A1. Reservoir	-	29	13	25
A2. Riverine.	-	31	34	10
A3. Dredging	-	99	8	4
A4. Others . .	-	-	4	0
B. **No. of WQ Studies related to**:				
B1. Planning	1	4	14	4
B2. Operations	1	10	3	2
B3. R&D	1	1	3	2
B4. Others	-		-	0
C. **No. of WQ reports**				
C1. In-progress	0	3	7	2
C2. Completed	3	12	7	10
D. **WQ Staff and Contract Amount**				
D1. FTE's ..	3	8	.9	4
D2. Full-time staff.	2	8	6	3
D3. Part-time staff.	2	1	11	2
D4. Contract Amount ($1,000)	0	637.5	1,351.0	682.5
E. **Support Rec'd** (+) **or Given** (-)				
E1. HEC/WES	+1	+2 ,-1	+1 -1	+2,-4
E2. Other districts.	-2	0	-	+2,-2
E3. Others (AE,U)	+0	0	+3	+26,-5

Three Most Important Issues/Concerns	Three Most Important Accomplishments
NWD-NP	**NWD-NP**.
1.Dissolved gas supersaturation	1. TDG: Coordination & Applications
2.Water Temperature	2. Activities within TMT and DGT Teams
3.Spill for-fish-passage Impacts.	3. Coordination of NWD-NP-WQ programs
NWP	**NWP**
1. TDG in Lower Columbia River Projects	1.Successful TDG fixed monitoring program
2. Turbidity at Detroit	2.Major reports Willow Cr/Applegate Lk
3. Methane/hydrogen sulfide in Willow Creek	3.Implementation of water quality database.
NWS	**NWS**
1.Disposal of dredged material	1.Implementation of PSDDA procedure
2. Saltwater intrusion Lake Union	2.Development of Dredged analysis info system
3.Water Temperature	3.Improved real-time regulation for WQ
NWW	**NWW**
1.Diss.Gas Supersaturation	1. State-of-the-art TDG Monitoring System
2.Impacts of proposed dam breaching	2. LSRFS Productivity & Limnological Studies
3.High Temperatures in Lower Snake and McNary	3. IHR spillway flow deflector installation and testing

Table 4. Summary of 1998 Water Quality Conditions

Dis-cts/Projects	Rat-ings	Historical Problems	1997 Problems	Future Problems
Portland				
1. Lost Creek	Good	Outflow temperature	Outflow temperature	Temperature.
2. Applegate	Good	Outflow temperature, mercury	Outflow tempera-ture	Outflow temperature., mercury, an-oxia upper end
3. Fall Creek	Good	H_2S, algae, anoxia	Temp.	Algae, Temp.
4. Hills Creek	Fair	Turbidity, algae,	Temp.	Turbidity, algae
5. Lookout Pt.	Good	None	TDG	TDG, temp
6. Dexter	Fair	Algae, macrophytes	TDG	TDG, temp
7. Dorena	Fair	Mercury	Mercury, anoxia	Mercury, anoxia
8. Cottage Gr.	Fair	Mercury	Mercury, anoxia, temp	Mercury, anoxia, temp
9. Fern Ridge	Poor	Eutrophic, enrich-ment	Nutrients	Eutrophication
10.Willow Cr.	Poor	Enrichment	Anoxia, H_2S, nutrients, methane, algae, fecals	Anoxia, H_2S, nutrients, methane, al-gae, fecals
11.Cougar	Good	Temperature	None	Temp.,algae
12.Blue River	Good	Temperature	None	Temp., algae
13.Detroit	Good	Temperature, turbidity	Turbidity	Turbidity
14.Big Cliff	Good	Temperature, turbidity	Turbidity	Turbidity
15.Green Peter	Good	Turbidity	None	Turbidity, temp
16.Foster	Good	Turbidity	None	Turbidity
17.Bonneville	Good	Dissolved gas (TDG)	TDG>110%	TDG, temperature
18.The Dalles	Good	Dissolved gas	TDG>110%	TDG, temperature
19.John Day	Good	Dissolved gas	TDG>110%	TDG, temperature
Seattle				
1. Libby Dam	Good	Nutrient, metals, temperature	None	None
2. Albeni F.	Good	No temp. controls, metals	Outflow temp.	Temperature.
3. Chief Jo.	Good	No temp. controls	Outflow temp.	Temperature.
4. Mud Mtn.	Fair	Turbidity, sediments	Turbidity	Turbidity
5. H.Hanson	Exc.	No temp. control, turbidity	None	Temperature, turbidity

6. Lake Union Nav.Locks	Fair	Saltwater, toxic + metals waste. SOD	Saltwater, SOD	Benthic O2 demand, Toxic Organics
7. Wynoochee	Exc.	Outflow temperature	Outflow temps.	Outflow Temperature
Walla Walla				
1. Dworshak	Exc.	Trash/Debris, TDG, Turbidity, potable water	Debris, Turbidity, TDG, pot. water	Decreased fish productivity
2. Lo. Granite 3. Little Goose 4. Lo. Monumen-tal 5. Ice Harbor	Good	Debris, sediments, TDG Fec. coliform, shoaling, algal blooms, bacteria, pot. water nitrate at IHR	Debris, sediments, TDG, shoaling, algal blooms, Fecal Coli-form bacteria (LWG), nitrate (IHR), urea, spill	Loss of Flood Control cap. Increase in water disposal, algae, delayed fish passage, bacteria, shoaling
6. McNary	Good	Dissolved Gas, milfoil, temperature	TDG, temperature	Temperature., radioactive sediments
7. Lucky Peak	Good	None	Swimmer's itch	None
8. Mill Creek	Fair	Stratification, anoxia, turbidity, swimmer's itch	Sedimentation due to flooding	Conditions caused by reser-voir refill

Table 5. Summary of Water Quality Staff and Contract Level

Year	IPA Staff	Part-time Staff	Full-time Staff	Contract ($ millions)	Major Contract Work
1998	1	20	17	2.671	Dissolved Abatement Study, WQ monitoring, sediment sampling E. Waterway (NWS)
1997	0	24	19	2.664	Dissolved Abatement Study, WQ monitoring, sediment sampling, Snake R. modeling
1996	0	51	17	2.085	Dissolved Abatement Study, WQ monitoring, sediment sampling
1995	0	55	9	1.877	Dissolved Abatement Study, WQ monitoring, sediment sampling
1994	0	54	6	1.603	WQ monitoring, sediment sampling, modeling
1993	2	50	6	1.473	WQ monitoring, model development/applications
1992	0	41	5	1.472	WQ monitoring, data collection, modeling
1991	0	36	2	1.521	WQ monitoring; sediment lab analysis; data collection
1990	3	36	1	1.312	WQ monitoring, Contaminants, Dredged Sediments
1989	3	31	8	2.056	Contaminants, WQ monitoring, Computer modeling
1988	7	29	11	1.452	HTW, Elk Creek Modeling, Risk Assessment, WQ gages
1987	1	25	18	4.320	HTW, Elk Cr. Modeling, Puget Sound PSDDA
1986	3	26	19	2.843	Elk Cr. Modeling, Dredged Mat. Disposal, Sediments, Everett Homeport EIS
1985	20	17	0	2.070	Shoaling Control & Sediment, Data Coll. on dredging, Chem. & Bio analyses
1984	10	10	0	0.737	WQ monitoring, Computer programming. Equipment acquisition
1983	9	16	0	0.429	WQ for fish passage, Salinity WQ studies at Spirit Lake

Table 6. Water Quality Staff Expertise (1998)

Staff	Technical Expertise	Years of Experience (Yrs in WQ)	GS Grade
CENWD-NP-ET-WR			
Bolyvong Tanovan	hydrology, hydraulics, modeling, water resources planning, reservoir regulation	35 (19)	13
Nancy Yun	data base, modeling, data analysis	15 (9)	12
Mary Todd Uhlir	biology, fisheries research, field monitoring	8(4)	11
CENWD-NP-ET			
Jim Reese	dredging, sediment quality	(18)	13
Rudd Turner	research, environmental engineering	(18)	13
CENWP-PE-HR			
Dick Cassidy	reservoir regulation, limnology, hydrology	(30)	13
Jim Britton	sediment quality, water quality, biology	29(11)	11
Mark Siipola	civil engineer, oceanography	20(11)	12
Mike Posovich	environmental engineer, water quality modeling	7	11
Tim Sherman	Biology, chemistry	21 (7)	11
George Kalli	environmental engineer, data management	5(5)	9
CENWS-EN -HH-			
David van Rijn	reservoir regulation, water quality, field work	2	11
Marian Valentine	hydrologic engineering, WQ modeling, chemistry, limnology	6	12
Louie Read	instrumentation, field work	10	8
Ray Strode	instrumentation, field work, DCP installation	17	11
CENWS-EN-HH-HY			
Bill Cronin	hydraulics, hydrology, modeling, groundwater remediation	9	11
CENWS-EN-PL-ER			
Kathy Kunz	wetlands, aquatic biology	23	13
Fred Goetz	in-stream flows, limnology, aquatic biology, habitat modeling	10	12
Merri Martz	marine biology, stream ecology, wetlands, limnology	8	11
Jeff Laufle	fisheries/aquatic biology, in-stream flows	17	12
Jeff Dillon	aquatic biology, sampling strategy, field work	5	11
Patrick Cagney	habitat restoration, ecology	13	12
Lauran Warner	shellfish biology, ecology	10	11
Steve Martin	shellfish biology, marine science	30	12
Mike Scuderi	planning	14	12
CENWS-OP-TS-DM			
David Kendall	environmental bio-geochemistry, marine ecology, benthic habitat assessment	26	13

Stephanie Stirling	marine ecology, sediment chemistry, environmental regulation	9	12
CENWS-OP-TS-NS			
Hiram Arden	project management, maintenance dredging, seasonal monitoring of WQ	29	12

CENWW-ED-H			
Tom Miller	limnology, water quality, aquatic ecology, water chemistry, biology, air entrainment, dissolved gas sampling and analysis	12	11
Russ Heaton	limnology, sediment and water chemistry, hazardous materials, lab management	8	9
Gary Slack	Survey Technical, water quality, TDG monitoring	12(1)	7
CENWW-PL-ER			
Sandy Simmons	Environmental compliance, water quality sampling, in-water work coordination	19(13)	11
CENWW-OP-RM			
Jimmie Brown	Environmental compliance, potable and swim beach water quality monitoring	24(7)	12

Comparative Precipitation, Runoff and Discharge Data (1992-1998)

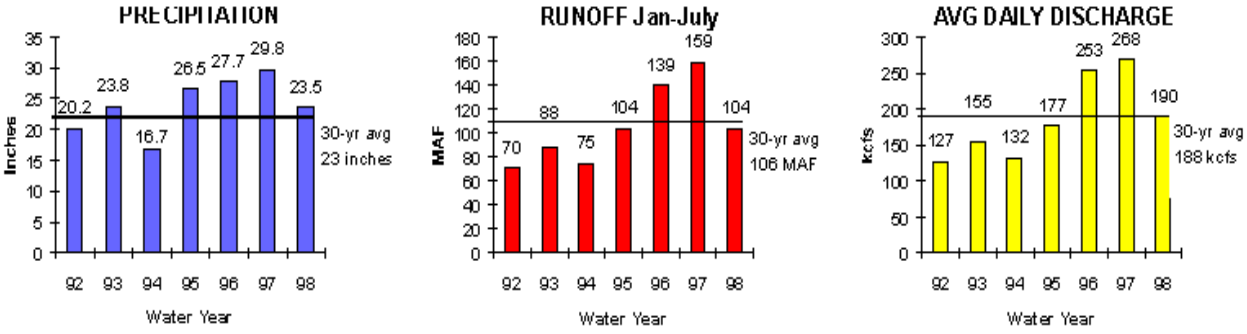
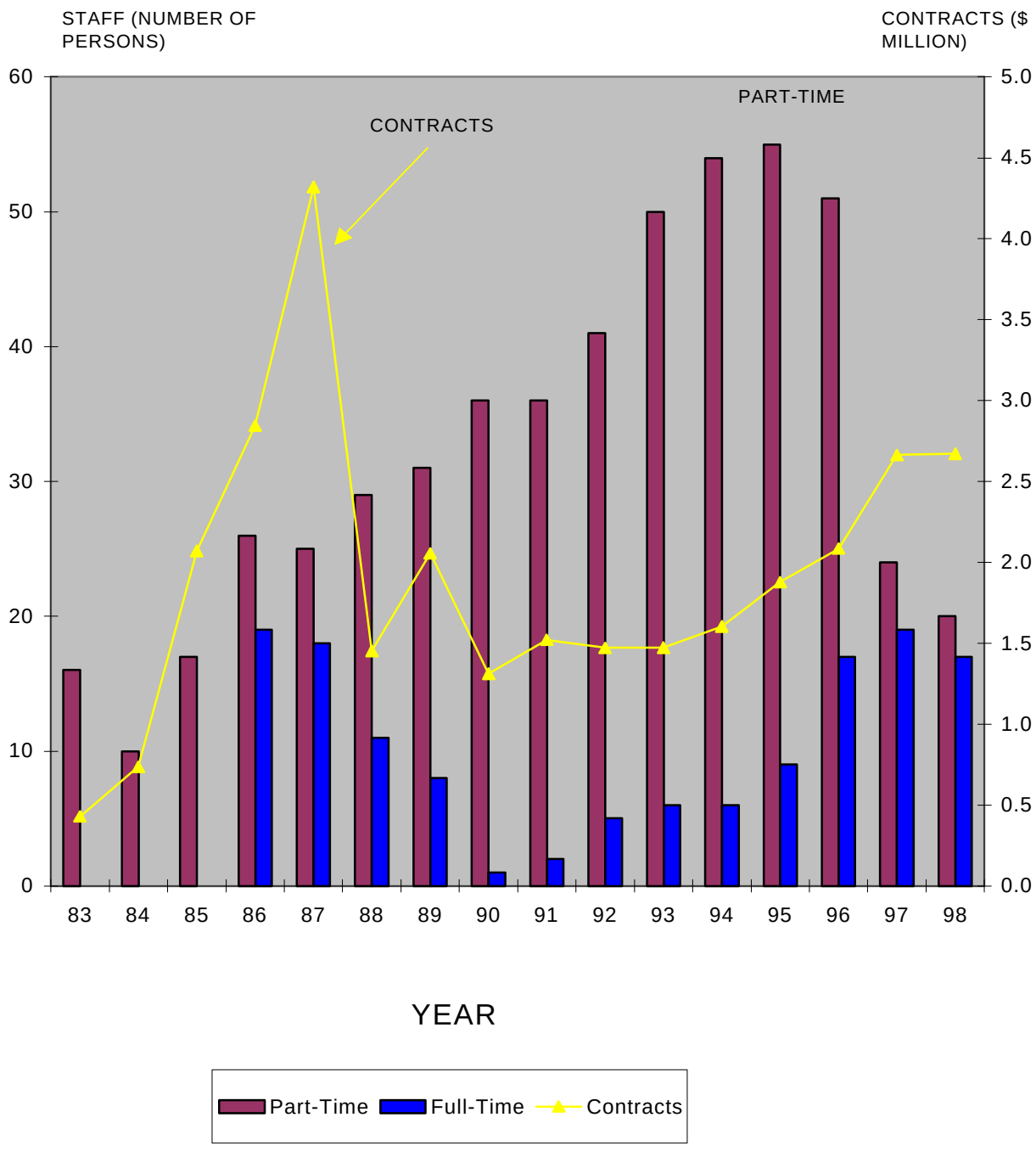
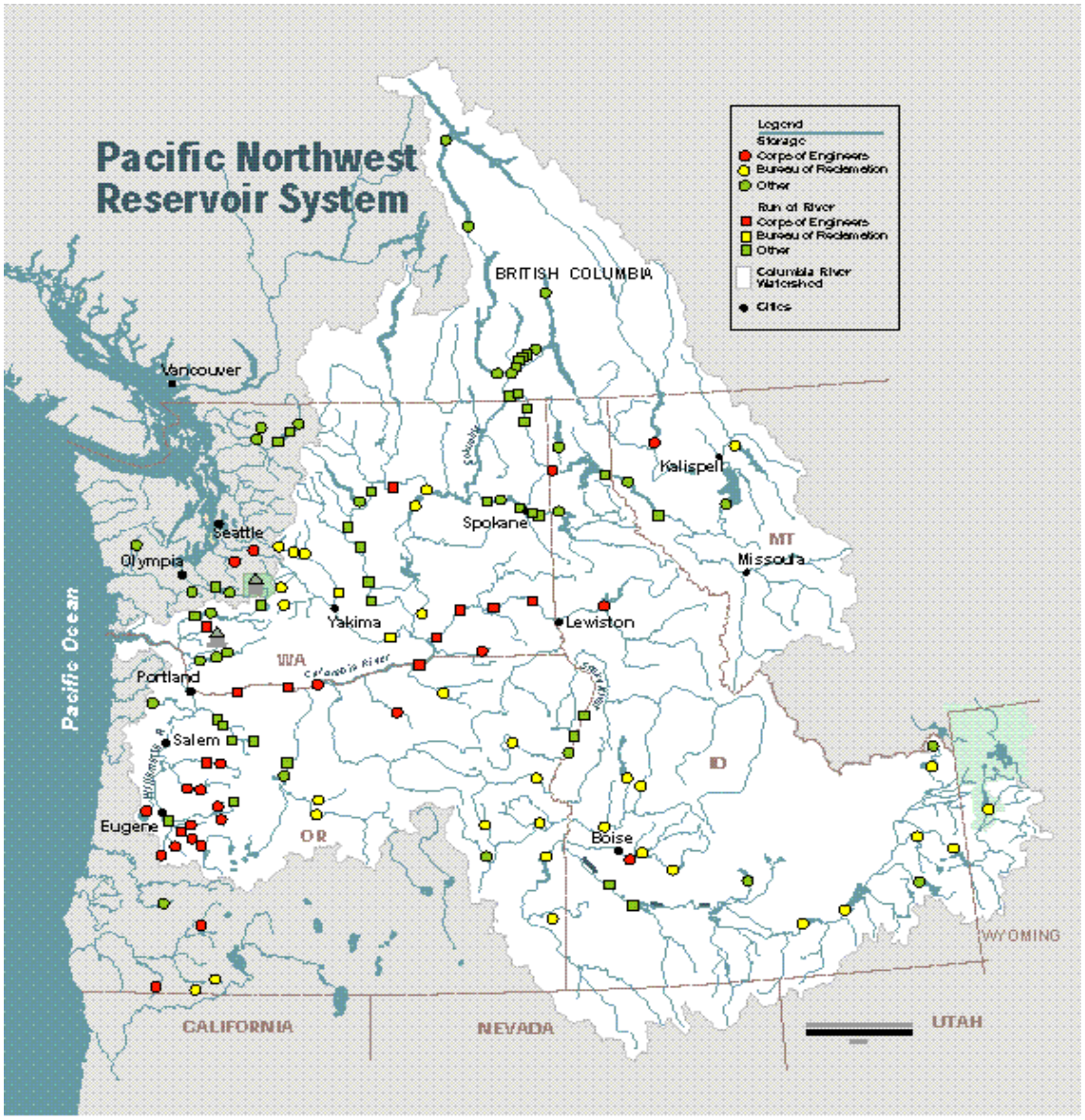


Figure 1. Water Quality Staff & Contracts (1983-1998)





Map of Pacific Northwest Reservoir System showing both storage and run of river dams owned by the Corps of Engineers, Bureau of Reclamation and others.

Figure 2. Pacific Northwest Reservoir System

1998
WATER QUALITY ANNUAL REPORT
PART I. WATER QUALITY MANAGEMENT PROGRAM

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 1998, and proposed objectives for 1999. 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. For reference purposes, information on dredge material disposal activities has also been included.

2. ORGANIZATION AND COORDINATION

Most NWD-NP 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. A good example is dissolved gas monitoring and its role in adjusting spill on the mainstem Columbia and Snake Rivers or changing spill patterns and modifying spillway and stilling basin configurations. Data from the 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.

2.1 Assigned Responsibilities

REGIONAL OFFICE

At the regional level, the Water Quality Section (WQS) in the Reservoir Control Center (Water Management Division, Engineering and Technical Services Directorate) provides technical and policy guidance on NWD-NP's water quality programs. WQS staff directly coordinates the Dissolved Gas Monitoring Program for the Columbia/Snake River System, and schedules short- and long-term reservoir operations for water quality that impact fish passage and fishery research. Coordination also extends to other water quality programs and activities by the Corps, other agencies and regional organizations. WQS provides direct input to the Technical Management Team, which makes recommendations on the operation of the Federal Columbia River Power System to benefit fish. It is primarily through this section that operational measures needed to enhance or remediate water quality problems and concerns are implemented on the mainstem Columbia and Snake Rivers. WQS is also responsible for preparing the Water Quality Annual Report, after review and synthesis of material submitted by the districts.

The Engineering Team of the Planning/Engineering Division oversees water quality studies on groundwater for possible contamination. The Environmental Resources Branch (also in the Planning/Engineering Division), and the Natural Resources Team and the Navigation Team in Operations & Construction Division, oversee another important field of water quality —dredging.

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 have to 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 Portland and Seattle. In NWW (Walla Walla), the Planning Division's Aquatic Resources Branch is responsible for reservoir water quality; the Operations Division's Natural Resources Management and Regulatory Branches handles water quality of drinking water and public beaches. The Aquatic Resources Branch also handles hazardous, toxic, and radioactive waste (HTRW) issues including ground water contamination with emphasis on contaminant identification. It provides water quality expertise and coordination for planning studies such as the Dissolved Gas Abatement Study, Lower Granite Dredging Compliance Monitoring, Lower Snake River Reservoir Drawdown, and Surface Collection Project/Program. Water quality elements coordinate their work with other district elements 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 Regional Office for review, synthesis, and posting on the Internet.

2.2 Cooperation with Other Agencies

District and Division staffs routinely coordinate with their other Federal, State, and local agencies environmental quality counterparts. The listing of several Pacific salmon species under the Endangered Species Act (ESA) made this coordination critical because the Corps is believed to hold most of the cards. All water users have a vested interest in what operation is being planned by the Corps, where, when, and how.

NWD-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 1995 Biological Opinion and its 1998 Supplement. There is a continual dialogue between RCC and the Pacific Salmon Coordination Office, the Bonneville Power Administration (BPA), other utilities, state and federal fishery agencies and Indian Tribes. Formal consultation with NMFS, which oversees the ESA's activities, is often preceded by detailed in-house discussion between all planning, operation and legal staffs involved. 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.

NWP closely coordinates water quality-related activities on the Rogue and Willamette Rivers with their Oregon State counterparts and maintains an active navigation-dredging program. NWS's representatives sit on a multi-agency advisory board for the cleanup and control of saltwater intrusion into Lake Union in the Puget Sound area. In collaboration with the States of Montana and Idaho and the U.S. Fish and Wildlife Service (USFWS) they closely coordinate flow augmentation requests for white sturgeon spawning in the Kootenai River below Libby Dam.

NWW is deeply involved in the water quality areas affecting anadromous fish survival. Their public customers include the Idaho Department of Health and Welfare, City of Hermiston Water/Wastewater Laboratory, Walla Walla County-City, Benton-Franklin County, Columbia County, Whitman County, Nez Perce County, and Central District Health Departments. They work closely with the Washington Department of Ecology, Washington Department of Fish and Wildlife, EPA, NMFS, USFW, Wyoming Department of Environmental Quality, and Idaho Division of Water Resources.

NPW 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 dioxin pollution resulting from pulp and paper mills are performed in cooperation with EPA and Washington State. Analysis of dissolved gas data and effects on fisheries and sediment and contaminant modeling and monitoring on the Lower Snake River are carried out in coordination with NMFS, BPA, USFWS and U.S. Department of Energy.

NPW maintains contacts with the USFWS, EPA, and ID-DEQ to perform regulatory actions for the proposed Auger Falls Hydroelectric Project on the Middle Snake River. Coordination with NMFS, USFWS's Cooperative Research Unit at University of Idaho, and the State of Washington Water Research Center at Washington State University is also maintained on the comprehensive limnological study of the Lower Snake River.

2.3 National Corps Committees

NWD-NP is represented on other national Corps committees. These include the Corps' Committee on Water Quality (by NWD-NP-ET-WR), Committee on Tidal Hydraulics (by NWS's Engineering), Corps Research and Development Field Review Group (by NWD-NP-ET-WR and NWP-NP-ET-HR), and Committee on Hydrology (by NWD-NP-ET-WH).

Stilling Basin of Chief Joseph Dam

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 those 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 (as contained in last year's annual water quality report) and a summary of their status for FY98 are listed in the following sections.

3.1 Regional Office

CENWD-NP-ET-WR

1. Continue to coordinate and monitor the annual dissolved gas saturation monitoring program;

2. Continue to plan and implement safe and efficient spill during the fish migration season;

3. Continue to develop a decision support system for reservoir operations for fish and water quality; and to 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 forum dealing with compliance issue involving dissolved gas and other water quality parameters, and

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

STATUS:

All seven objectives were actively pursued.

Objective 1 (**dissolved gas monitoring**) represents a continuing effort started in 1984. The dissolved gas and water temperature monitoring now includes deployment of 41 fully automated instruments at both forebay and tailwater areas of all Corps mainstem dams and other river locations. Direct monitoring responsibilities were transferred to the three Districts in 1996, but Division staff continued 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.

Under Objective 2 (**safe and efficient spill program**), 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. In 1998, the spill for-fish-passage was to be carried out to the full extent allowed by a 115/120% TDG waivers that NMFS was able to secure each year from the States. Hence, quick and appropriate changes in spill based on real-time data were critical to providing the requested spill while fully observing the TDG constraints.

Objective 3 (**COLOSS, Columbia Operational Support System**) is a continuing activity, relying only on limited staff resources. COLOSS now has a master menu and can link up with databases containing flows, project characteristics, operating limits, and sea-

sonal requirements. Planned work on keeping track of Teletype instructions to the projects had to be held in abeyance for lack of manpower.

Objective 4 (**maintain modeling capability**) continued to be pursued. This included following up with ongoing TDG model development under DGAS Study by Battelle Northwest and WES, developing spreadsheet model using empirical spill versus TDG equations for internal use, assisting EPA in calibrating their one-dimension water temperature model, and attending a 5-day workshop on the application of the two-dimensional CE-QUAL-W2 model. A scope of work for a simple basinwide TDG model has been prepared to allow for expeditious basinwide analysis of TDG operational and structural abatement alternatives.

Objective 5 (**coordination with Districts**) is institutionally a continuing activity. Division staff closely coordinated with all three Districts in many areas, including TDG monitoring, formulating plans of Lower Snake River Reservoir Drawdown study, scheduling special reservoir operations for TDG-related research and flip-lip construction, developing the 7-day 10-year flows, coordinating joint studies with other Federal agencies, sponsoring District attendance to regional forum meetings, etc.

Objective 6 (**Dissolved Gas Abatement**) was fully met. Division staff assisted this District-led study by reviewing 1- and 2-dimensional modeling work performed under contract by Battelle, reviewing portions of the DGAS 60% Completion Report, generally serving as Division technical adviser and monitor, and coordinating preparation of TDG-related Research. Plan for NMFS's Dissolved Gas Team. Division staff was also instrumental in helping the newly formed US-Canada Transboundary Team in its efforts to develop a study plan to abate TDG on both sides of the border.

Objective 7 (**modeling support to others**) is also a continuing requirement already addressed above under Objectives 3 to 6.

3.2 Portland District

WATER QUALITY OBJECTIVES

1. Continue limnological and routine water quality monitoring at Lost Creek and Applegate Lakes, Rogue River Basin, Oregon; and at Willow Creek Lake, Heppner, Oregon.

2. Continue to operate and maintain stream-gauging 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.

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. Explore the possibility of entering into a Memorandum of Agreement (MOA) with the State of Oregon regarding these rules.

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 in Cottage Grove Reservoir by measuring loading during storm events.

6. Prepare reports on the limnology and water quality of Applegate and Lost Creek Lakes that reflects data collected up to date.

7. Continue routine monitoring of Willamette System reservoirs through profiling of basic water quality parameters.

8. Continue entering current and historical data into District water quality database. Add database to District web-site.

9. Continue to implement the District Fixed Monitoring Program (FMP) for monitoring TDG below Corps Projects in the lower Columbia River.

10. Continue to implement the District Total Dissolved Gas Program for monitoring TDG below Corps Projects in the Willamette and Rogue Basin depending on need.

11. Continue to support the volunteers at Fern Ridge Reservoir who assist in collecting water quality data.

12. Continue to formulate a water temperature model below Hills Creek Reservoir using HEC-5Q.

13. Continue to develop a Willamette Basin water quality assessment tool that utilizes flow data from an existing flow routing model.

14. Continue to participate with the USFWS and the city of Salem as a team member to monitor water quality in the North Santiam Watershed.

New Goals for 1998

15. Develop a District water quality management plan based on two elements: 1) compliance with State water quality standards at District projects and 2) measures of productivity (trophic state) at District projects.

16. Initiate a water quality volunteers program at another District project.

17. In the FMP program, implement new instrumentation for measuring TDG at FMP sites in the lower Columbia River while maintaining data quality. Repair and upgrade the following FMP sites – JHAW, TDDO and CWMW. Further reduce cost of the FMP program.

18. Participate with the USFWS and the city of Salem as a team member in watershed water quality monitoring above, in, and below Detroit Reservoir. The District will provide water quality monitoring equipment, maintain a WEB site and coordinate efforts with USFWS and Salem.

19. Complete an initial assessment on the new North Santiam 1135 Restoration Study (see Section 10, Special Studies).

20. Complete hydraulic and water quality modeling on the Lower Columbia Slough.

SEDIMENT QUALITY

1. Continue the District-wide sediment quality evaluation program at Operations and Maintenance dredging projects. During 1998, sediment quality evaluations will be conducted in the Columbia River, Lower Willamette River, Columbia Slough, Westport Slough, John Day Draw Down Reconnaissance Report, Depoe Bay and Coos Bay.

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

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

4. Continue to participate in the Columbia River National Estuary Program.

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

6. Continue to participate in development of the Columbia River Regional Testing Manual for sediment quality evaluation.

STATUS

The following objectives have been fully met in 1998:

- 1 (water quality monitoring Lost Cr. Applegate and Willow Cr. Lakes)
- 2 (stream gaging)
- 5 (mercury loading at Cottage Grove)
- 7 (routine monitoring at the Willamette projects)
- 9 (TDG monitoring program)
- 10 (Willamette system monitoring)
- 11 (water quality volunteers program at Fern Ridge)
- 13 (water quality assessment tool)
- 17 (adding new equipment in District FMP program)
- 18 (USFS/Salem/COE cooperative turbidity monitoring)
- 19 (North Santiam 1135 Restoration Study), and
- 20 (hydraulic and water quality modeling of the Columbia Slough)

Objective 3 **(develop Willamette River in-stream flow rules)** is on hold as Oregon resource agencies and the Corps have made no progress on this issue.

Objective 4 **(coordination with resource agencies on compliance with water quality standards)** is an ongoing activity. The Willamette Temperature Control Study, a

plan to improve temperatures in the Mckenzie River below Cougar Reservoir by building a selective control structure, is in the Plans and Specifications phase.

Objective 6 **(limnological reports on Applegate and Lost Creek Lakes)** is partially completed. A report describing water quality at Applegate Lake since beginning of operations is completed. A report on Lost Creek is due April 1, 1999.

Objective 8 **(District water quality database)** is an ongoing activity. Water quality data from 1996-1998 has been entered into the Microsoft Access database. Contacts were made with the USGS and other contractors to obtain historical data from District projects for input into the database. A plan was set in motion to make the database available on the District web-site.

Objective 13 **(develop Willamette Basin water quality assessment tool)**. Progress on this objective was achieved by receiving training at HEC that will be useful in using the flow routing model.

Objective 15 **(develop District water quality management plan)**. Contracts for reports concerning water quality conditions at Applegate, Lost Creek, Willow Creek and Willamette Valley Projects were initiated. Two reports were completed describing current and historical water quality conditions at Applegate and Willow Creek Lakes. Reports on Lost Creek Lake and the Willamette Projects are in preparation. These reports and consultations with Project resource personnel will be used to develop a District water quality management plan. In the spring of 1998, quality plans were developed for assuring the quality of data collected at District projects.

Objective 16 **(initiate water quality volunteers program at another project)**. Because of workload at both District and Project offices this objective is on hold and may be discontinued.

SEDIMENT QUALITY OBJECTIVES

1. Continue the District-wide sediment quality evaluation program at Operations and Maintenance dredging projects. During 1998, sediment quality evaluations will be conducted in the Columbia River, Lower Willamette River, Columbia Slough, Westport Slough, John Day Draw Down Reconnaissance Report, Depoe Bay and Coos Bay.

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

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

4. Continue to participate in the Columbia River National Estuary Program.

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

6. Continue to participate in development of the Columbia River Regional Testing Manual for sediment quality evaluation.

New Goals for 1998

7. Complete the draft Dredged Material Evaluation Framework, Lower Columbia River Management Area manual.

8. Continued with the Yaquina Bay ODMDS evaluation study.

9. Continue with the Columbia River ODMDS evaluation study relative to Columbia River O&M dredging and Deepening Feasibility Study

STATUS

Objectives 1 (**sediment quality evaluations**), and 2 (**standards compliance)** were fully achieved in 1998. More work will be done still in 1999.

Under Objective 3 (**management and monitoring of ODMDS programs**), management/monitoring plans for Rogue, Coquille, Siuslaw and Umpqua were put out by Public Notice for review. Annual bathymetric surveys were completed at the ODMDSs. Mathematical models of dredged material placement and subsequent sediment transport were conducted at the mouth of the Columbia River (MCR) and Ocean Dredged Disposal (ODMDS) sites B, E and F.

Reaching Objectives 4 (**participation in the National Estuary Program**) and **5 (participation in regional dredging teams**) is an on-going activity. For the National Estuary Program, NWP's Tyrae McMahan is on the management committee and Mark Siipola is on the technical advisory committee. A team consisting of Corps, EPA, NMFS and USFWS representatives is charged with developing guidelines for regional dredging activities.

Regarding Objective 6 **(draft Dredged Material Evaluation Framework)** the draft manual was released in April 1998, a two-day seminar was held, and the draft finalized. Printing of the final manual has been delayed pending receipt of signatures of all participating agency heads.

Objective 7 **(Lower Columbia River Dredged Material Evaluation Framework)**. A Draft was completed and the final report will be out in the spring of 1999.

Objective 8 (**Yaquina Bay ODMDS evaluation**) is on going as a sub-set of Objective 3. Sediment transport and area geological studies were completed.

Regarding Objective 9 (**Columbia River ODMDS**), the draft feasibility study and EIS was released for public review on October 23, 1998.

3.3 Seattle District

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 Kootenai River white sturgeon flows (as required by the Endangered Species Act).

3. Develop and implement a total dissolved gas monitoring program for Libby Dam and the Kootenai River in the event of spill.

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 coordination with other federal, state, and local agencies involved in water quality programs, on all project planning, construction and operating efforts.

7. Continue to work with Seattle District's Geotechnical Branch to monitor/model groundwater contamination for cleanup of hazardous/toxic waste sites.

8. Insure that water quality assessment and water quality goals are included in watershed evaluations conducted by the District.

9. Continue development and application of a predictive model of salinity intrusion for the Lake Washington Ship Canal (LWSC).

10. Develop a sediment monitoring program at Howard Hanson Dam (HDD) as part of the drawdown of the turbidity pool.

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

12. 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.

STATUS

All objectives were adequately met during 1998.

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. Summaries of fish ladder operations and gate settings at the LWSC were provided to the state for water quality comparisons.

Objective 2 (**water temperature monitoring**) was completed in 1998 and will continue in 1999. The District successfully used a model to assist a multi-agency sturgeon

recovery team in planning Libby Dam releases that would encourage white sturgeon spawning in the Kootenai River.

Objective 3 (**TDG monitoring below Libby**). The District maintained readiness to operate a total dissolved gas sensor at the gage house downstream of Libby Dam in the event of spill. In the rare event of spill for flood control, District personnel plan to monitor dissolved gas between Libby Dam and the Canadian border. This has not been necessary for over a decade.

Objective 4 (**Data collection on Lake Washington**). The District continued operation of six water quality stations in the Lake Washington Ship Canal (LWSC). An additional station is located downstream of Libby Dam. 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. ArcView software was installed on all Dredged Material Management Office computers, allowing Geographic Information System (GIS) queries to be conducted in support of data quality assessments for dredging projects and other interagency cooperative actions.

Objective 6 (**Coordination with others**). The District conducted meetings with the Department of Interior, Colville Confederated Tribes and local net pen operators to address effects of high dissolved gas levels in Lake Rufus Woods. A computer model of the Kootenai River system was developed and used by other cooperating agencies. District conducted inter-agency meetings on the installation of additional generating units at Libby Dam, and organized several multi-agency wetland delineation courses throughout the Northwest and Alaska. ERS coordinated with State and Federal agencies and Tribes for water quality certification, hydraulic permits and environmental studies related to water quality.

ERS also worked on projects as part of Planning Assistance to the States programs to:

(1) Incorporate a water quality assessment in a fishery evaluation study (completed in 1998) at the Locks cooperatively with the Muckleshoot Indian Tribe, Washington Department of Fish and Wildlife, Portland District, and King County; and

(2) Investigate water and estuarine sediment quality as part of a habitat restoration study (Kenco Marine) with the City of Seattle.

Also under Objective 6, ERS worked with USFWS, Idaho Fish and Game, EPA, Idaho Department of Environmental Quality, and Idaho Department of Natural Resources on water quality issues surrounding use of herbicides for treatment of Eurasian watermilfoil. ERS conducted meetings with manufacturers and state and federal agencies to determine the best treatment method.

Objective 7 (**Assistance to the Geotechnical Branch**). Hydraulic Engineering staff assisted the Geotechnical Branch in evaluating and modifying the cleanup work performed by contractors at the Fort Lewis, WA, landfill site. Hydrology and Hydraulics Sec-

tion assisted in installation and maintenance of groundwater monitoring equipment at the Fort Lewis, WA, landfill site.

Objective 8 (**Incorporation of water quality goals**). Environmental Resources Section incorporated water quality goals into the study design of three continuing general investigations studies on the Stillaguamish and the Duwamish/Green basins. The focus of both projects is on fish and wildlife restoration. ERS incorporated sediment and water quality goals and sampling into the design and/or construction of five Section 1135 habitat restoration projects:

1) Lake Washington Ship Canal;
2) Thornton Creek;
3) Bear Creek;
4) Sammamish Weir; and
5) Turning Basin.

H&H also modeled temperature and dissolved oxygen conditions at the proposed Thornton Creek 1135.

Objective 9 (**Salinity Model**). The Hydrology and Hydraulics Section continued refinement of a predictive model of saltwater intrusion for the Lake Washington Ship Canal. The model is currently being used to predict salt wedge movement that would result from changing operations at the Locks.

Objective 10 (**Sediment monitoring at HHD**). The Hydrology and Hydraulics Section monitored sediment releases from Howard Hanson Dam as a test of impacts from drawdown of the turbidity pool. This effort will continue in WY 1999.

Objective 11 **(TDG Abatement at Chief Joseph Dam**). The District completed an initial appraisal of alternatives in May 1998 and is continuing to explore the issues of dissolved gas abatement within the System Configuration Team for the Columbia River. This effort will continue in WY 1999.

Objective 12 (**New Turbine Unit at Libby**). The District provided 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.

3.4 Walla Walla District

1. Fully integrate the water quality program into the Reservoir Regulation Section, Hydrology Branch. Assign personnel and structure the unit to provide increased efficiency to water quality projects and enhance functionality of the Reservoir Regulation Section.

2. Develop a manual that outlines and describes the standard operating procedures used by the Reservoir Regulation Section to establish, develop and conduct water quality investigations. The Manual will describe the District Water Quality Program. It will also outline the QA/QC procedures and policies pertinent to water quality.

3. Increase the cost effectiveness of the District WQ program by performing physical, inorganic nutrient and common anion and cation chemical analyses in the District WQ labo-

ratory. Develop a Water Quality Manual that outlines and describes the methods and procedures used by the district water quality lab (District lab Manual).

4. Continue to improve and enhance the capabilities of the District TDGMS to surpass 95% reliability of the fully automated system. Complete a Water Quality Manual that describes the structure and function of the system. The document should include QA/QC and reporting requirements, and operating procedures.

5. Continue and improve reservoir WQ monitoring program. Insure that the sample collection and routine analysis are in accordance with District QA/QC goals.

6. Continue the Biological Production field and modeling study of the Lower Snake River Reservoirs under the Lower Snake River Feasibility Study (LSRFS).

7. Complete the sediment nutrient and contaminant evaluation under the LSRFS.

8. Provide technical and coordination expertise for Planning and Engineering studies (e.g. CG & GI).

9. Input water quality data into the Hydrology Branch database. Develop report format and graphic display format to enhance hydrology's analysis capability of water quality data. Work towards integrating TDG, limnological, physical, and sediment quality data into the comprehensive database system for reservoir WQ monitoring data.

10. Evaluate feasibility of and subsequently coordinate installation of two additional TDGMS sites: 1) On the Columbia River above confluence with the Snake River and 2) On the Snake River above confluence with the Clearwater River.

11. Provide contracting and purchasing administrative support to the WES field team for DGAS studies. Also provide staff to augment the field data collection team during near-field studies.

12. Improve coordination and exchange with NWD and other Districts.

STATUS

Objective 1 (**Water-Quality Integration into Reservoir Regulation**, Hydrology-Engineering): Many advantages were realized after reorganization. Better management was key to the improvements made in the district water quality system. Integration of Hydrology and Water Quality allowed better communication and total information integration. The Water quality section greatly benefited Hydrology by providing expertise not present in Hydrology for many years. This objective was a success.

Objective 2 (**Develop Water Quality Manual**): This manual is under development. Progress was made with further development of Laboratory and Field measurement methods. Additional work in required and restructuring of the data storage activities will result in a revision of the existing protocols and procedures during FY99.

Objective 3 (**performing analysis in house** to reduce costs): After the transition to Engineering Division, the Water Quality Program was retained with current funding. Due

to increased CG study workloads, a decision was made to increase contract laboratory use. In-house staff efforts went towards monitoring and administrative activities.

Objective 4 (**Improve the TDGMS capabilities**): A new technician was trained-in, response capability was doubled with additional equipment, and reliability of most stations was improved. The TDGMS Manual is currently being drafted.

Objective 5 (**Improve reservoir sampling**): This objective was achieved on the Lower Snake River and Lucky Peak Reservoir, but constrained at Dworshak and McNary due to lack of funds.

Objective 6 (**Continue the LSRFS**): The final year of the LSRFS Water Quality Primary Productivity Model data collection effort was completed successfully. The model study itself continues into FY99.

Objective 7 (**Complete sediment and nutrient evaluation** of LSRFS): Under the recommendation of the USACE Water Quality committee, the Walla Walla District ceased development of a sediment transport/quality model for the LSRFS evaluation. The existing data has been analyzed and evaluated for exceedence of accepted freshwater sediment quality criteria. This evaluation is documented in the LSRFS Environmental Impact Statement Water Quality Appendix. In 1999 the data from this study will be used as part of the DMMP study and undergo further evaluation.

Objective 8 (**Provide technical expertise** to Planning and Engineering Studies): Assistance was provided on a number of studies.

Objective 9 (**Water Quality Database**): Snake River limnological data was put into an MS Access based database. The database has the capability to provide data in a graphical format with several options for defining parameters of the search and defining the type of graphical display. This system facilitates in-house data entry and analyses.

Objective 10 (**Install two new TDGMS** sites): Additional TDGMS monitoring sites were installed on the Snake River at Anatone and on the Columbia River near Pasco, Washington. This objective was accomplished

Objective 11 (**Provide support to DGAS** study): Coordination, procurement, review, field data collection, operations data and TDGMS data support were provided by Hydrology Branch staff.

Objective 12 (**Improve coordination and exchange** with NWD and other districts): always improving

Caspian Terns, a Thriving Bird Species Still on the Endangered List in the Pacific North-west….

4. LABORATORY FACILITIES & FIELD EQUIPMENT

4.1 Regional Office

No laboratory facilities and/or activities.

4.2 Portland District

1. No laboratory facilities. The District Materials Laboratory at Troutdale, Oregon was formally closed on September 30, 1997. Thereafter, water and sediment quality samples were brokered to private laboratories.

2. Portland District continued to use the U.S. Forest Service Forestry Sciences laboratory Corvallis, Oregon, to perform chemical analyses on interstitial seep waters from the concrete matrix of Willow Creek Dam, as well as nutrient analyses on samples from the lake.

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

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

4.3 Seattle District

1. The Seattle District continued to use a variety of environmental contractors to obtain field samples for biological, physical and chemical testing. A partial list of these contractors include SAIC, North Creek Analytical, AM Test, David Evans and Associates, Striplin Environmental Associates, Beak Consultants, Parametrix, Biomarine Enterprises, and Northwest Hydraulics.

2. Water Management Section maintains its own on-site laboratory for calibration and maintenance of water quality sensors.

3. Twenty-one Hydrolab sensors are deployed in the Lake Washington Ship Canal to monitor temperature, conductivity, and salinity. Several multi-parameter sensors and data loggers are maintained for remote monitoring and field-testing. Water Management Section (WMS) has three dissolved gas sensors deployed seasonally upstream and downstream of Chief Joseph Dam and downstream of Libby Dam. Two additional dissolved gas sensors are used for field studies. WMS maintains several data-logging thermistors for use in special studies.

4. Operations Division has a multi-parameter Hydrolab sensor at East Bay Marina in Olympia, Washington. The primary objective is to monitor dissolved oxygen as an indicator of need for aerator operation.

4.4 Walla Walla District

1. Walla Walla District maintains the capacity to collect water and sediment samples throughout the Division. The water quality program laboratory is capable of performing a broad array of particle size, qualitative, and quantitative sediment analyses. Equipment available includes a two man canoe, a 16' river jetboat, an 18' foot radar / night capable limnology boat with variable speed sampling and two 23' GPS equipped aluminum work vessels, a one-ton pick-up, an RDI acoustic Doppler profiler, and many water quality multi-probe profilers. There are comprehensive groundwater sampling apparatus, submersible pumps, and biological sample &analysis equipment. The Walla Walla District maintains sediment ponar and core samplers, winches and other related instruments and equipment. Walla Walla District has the capacity to handle sampling volumes in excess of 100 samples per day. The LSRFS put this capability to the test, when no less than 12 55-quart ice chests were packed and shipped per day during the month of August. On one particular day the district processed 167 sediment samples for shipment to contractor laboratories.

2. Walla Walla District enhanced the capability of its modest water quality laboratory facility. The laboratory is equipped to handle titration for the calibration of field instruments and QA/QC of total dissolved gas instrumentation. A NIST certified barometer and certified pressure sources insure that the TDG instrumentation is kept at optimal performance. The Laboratory has a comprehensive suite of equipment to maintain and repair Hydrolab, YSI, Sweeny, and CSI total dissolved gas data collection equipment. The new feature of the water quality laboratory is the ability to analyze nutrient samples for the district reservoirs. Parameters include phosphorus, nitrate, ammonia, sulfate, and total nitrogen. The district laboratory can also quantify chlorophyll a and evaluate anions and cations. The laboratory will be increasing its ability to support a variety of turbidity monitoring equipment in support of dredging and construction operations. The laboratory also monitors and maintains contracts for the analysis of metals and organic contaminants in support of district missions. New additions to the capabilities are:

(a) The District Limnologist is provided with an inverted phase contrast microscope to allow him to identify and enumerate phytoplankton, zooplankton and various larval stages of a potential *D. polymorpha* infestation.

(b) Walla Walla District now has the capability to rapidly install fixed monitoring sites within days thanks to a new modular bolt together design prototyped by HDR Engineering. Kits can be commercially constructed based on the plans and stored until use. In an emergency, it is possible to rebuild a station in about 48 hours.

(c) Additional development to a hyperbaric chamber gives the District an unprecedented capability to evaluate accuracy, repeatability, and true instrument performance against a known standard. This also provides a laboratory supply of supersaturated water and further enhances the development of the TDGMS comprehensive QA/QC program.

(d) With the additional training, experience, and parts stock, Walla Walla Distirct has the capability to perform rapid depot level instrument repairs to many of the major assemblies of Hydrolab and YSI products.

(e) The Water Quality lab (with its sub-contractors) has the capability to perform all nutrient, organic, pesticide, and metal analysis using most of the APHA and EPA methods.

3. Currently under development is a series of data analysis tools the will help the District further enhance its capability to answer many water quality related questions. The first implementation has been the development of a GIS based sediment quality trend prediction and dredge template analysis tool. This system greatly enhances the District's capability to address tier one and tier two questions and has been integrated into the DMMP study.

Lower Granite Dam on the Snake River

A new Dissolved Gas Monitoring Station at Anatone on the Lower Snake River

5. DATA COLLECTION & ANALYSIS

5.1 Regional Office

1. After January 1996, the Regional Office no longer collected any water quality data from the field. It is still, however, involved in data screen (on real-time) and analysis (at the end of the dissolved gas monitoring season). Part of the analysis effort was made easier by similar endeavor made by the Gas Abatement Study team. The Division Office, through the Water Quality Section (WQS), Reservoir Control Center, Water Management Division continued to coordinate District data collection activities. Tasks performed included the following:

- ✓ Develop an annual plan of action in coordination with the Districts involved, including number and location of monitoring stations, and quality assurance and quality control (QA/QC) protocols for data measurement, coding and transmission, and instrument calibration and maintenance;

- ✓ Coordinate the actual dates for the start and end of the monitoring season, and scheduling field instrument service and maintenance trips;

- ✓ Screen data and/or filling data gaps before and after they are stored in CROHMS;

- ✓ Prepare daily reports on dissolved gas saturation, water temperature; project spill, pool elevations and flow releases;

- ✓ Perform statistical analyses and computer modeling to refine site-specific or system-wide spill versus TDG relationships;

- ✓ Hold a post-season review of District monitoring activities with regional participation to discuss details of monitoring activities and receive their comments and recommendations; and

- ✓ Prepare an annual report on Program's highlights, auto-critique of current year's operations, and recommendations for next year's activities.

WQS staff also took care of data posting on an Internet homepage for the Technical Management Team, dissemination to regional users and researchers, and coordinated reservoir regulation details for data collection below Corps projects. The Plan of Action for TDG monitoring in 1998 was included in various documents, including the Corps' Fish Passage Plan and NMFS's application package for state standards waivers.

2. The annual TDG monitoring report prepared by the Division was based on a synthesis of inputs received from the Districts and USGS. It contained summary saturation and water temperature plots of mean, maximum and minimum values, and regression equations

between spill and TDG using all relevant data recorded since 1984. An error analysis was also presented, detailing the type and extent of errors caused by both the measuring instruments and the normal spatial distribution of dissolved gas in the reservoirs. Selected technical papers of wide interest prepared by members of the Gas Abatement Study team were also incorporated.

5.2 Portland District

1. **Applegate and Lost Creek Lakes**. In situ water quality data were collected monthly between April and November 1998. Inflow, in-lake and outflow stations were sampled. 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 transmissometer and a nephelometer were deployed monthly through the water column to obtain vertical profiles for light transmission and turbidity, respectively at Applegate Lake. A photometer (unfiltered light) was deployed once a month to determine the extent of down welling irradiance at Applegate Lake.

Water grab samples were collected at inflow and outflow sites and at various depths in the water column at Applegate 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 tributary and release water samples. This pattern of grab sample analyses alternates between Applegate and Lost Creek Lakes according to year – odd years, Applegate, even years Lost Creek. Water quality data from the two lakes will be used to monitor watershed and lake conditions and in future modeling efforts.

2. **Willow Creek Lake**. In situ water quality data were collected monthly between April and November 1998. Inflow, in-lake and outflow sites were sampled. 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 inflow and outflow sites and 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. The results will be useful for water quality modeling.

Six times, between May and December, water samples collected from throughout the water column were analyzed for methane, methane oxidation, hydrogen sulfide, DO, CO2 and nutrients. Methane analyses were done by portable gas chromatograph.

Interstitial seep waters in the concrete matrix of Willow Creek Dam were sampled monthly in 1998 and analyzed to determine chemical composition. These samples are collected for the Dam Safety Section in support of studies regarding the integrity of the roller-compacted concrete dam.

3. **Cottage Grove Lake**. In a cooperative effort with the DEQ, water and fish samples were taken in early summer and August to determine inorganic and organic (methylmer-

cury) concentrations during the anoxic period. Water samples were taken near the dam log boom, at the shallow wetlands area in the upper lake, and at an inflow station. Two depths were sampled – surface and near bottom. Additionally, fish were collected for measuring mercury levels in muscle tissue at these sites for comparison of water mercury levels to fish levels.

4. **Elk Creek**. Water temperatures and turbidity were recorded hourly by the USGS at four monitoring sites (Trail, Cascade Gorge, West Branch, 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. **Fern Ridge Lake**. A water quality volunteer group collected water quality data for the District at 3 lake sites, 9 tributary sites and 5 swim beach sites. At lake and tributary sites temperature, turbidity, pH, conductivity, salinity, secchi, fecals and total phosphorus were measured. E. coli was measured at the swim sites.

6. **Middle Fork Willamette.** Data collection was discontinued because installation of temperature control structure at Hills Creek was not approved by Congress

7. **Willamette Valley Projects** In July 1998 lake profiles of depth, temperature, DO, redox, turbidity, pH, TDS and conductivity were conducted at Cottage Grove, Dorena, Fall Creek, Hills Creek, Lookout Point, Dexter, Green Peter, Foster, Detroit and Big Cliff reservoirs. A Hydrolab model H20 was used to obtain the profiles. Each reservoir was profiled at least once. A contract was let to prepare 2 summary reports on historical water quality in the Willamette Valley Projects. One report will deal with the lower valley projects while the second report will concern upper valley projects. The first report is due 30 September 1999, the second 6 months later. These reports will be the culmination of a major effort to review and report on all data collected over the years at all District projects. The review will allow the District to evaluate the direction of its water quality monitoring program.

8. **Detroit Lake.** The District, City of Salem and USFS began routine monitoring of turbidity in the fall of 1998. Throughout the summer monitoring stations were set up in the watershed to begin monitoring water quality in earnest in the fall. The District entered into an agreement with its partners to cooperate in this effort. The District purchased a turbidity monitor to deploy at one site. The City of Salem installed a turbidity monitor in the powerhouse at Big Cliff Reservoir. The District agreed to monitor turbidity and collect water samples for suspended solids and particle size analysis during several storm events at three stations on Detroit Reservoir in the Winter and Spring of 1998-1999.

9. **TDG Fixed Monitoring Program (FMP).** New Hydrolab minisondes were used at the FMP sites to measure TDG. TDG was measured from mid-March through mid-September for most stations at District projects on the lower Columbia River. A total of 10 instruments were assigned to forebay, tailwater, and downstream stations for John Day, The Dalles and Bonneville Projects. The data is important for monitoring compliance with state TDG standards and impacts to fish. Data was transmitted real time to the Division CHROMS database. This year less than 0.33 % of the data was lost from 56,448 hours of data collection.

10. **Willow Creek, Lost Creek and Applegate Lakes**. A major effort continued in the analysis of limnological data from these reservoirs. All historical data is being gathered to-

gether, reviewed and analyzed by a contractor. Reports on Willow Creek and Applegate Lakes were produced and a report on Lost Creek Lake is in the works. All known water quality data from these lakes were gathered in this effort. This is a massive effort as the data from Willow Creek report alone is embodied in 7 appendices some 7 inches thick

11. **Dredged Material Projects.** Sediment samples were obtained during 1998 at the following federal navigation projects in the Columbia River and along the Oregon coast: Westport Ferry, Coos Bay, and Depoe Bay. 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. Sediments were collected with several types of sampling equipment, including a box corer, gravity and vibra corers. Physical tests included particle-size distribution, percent volatile solids, void ratio, specific gravity, and resuspended density. Sediments were also tested for priority-pollutant heavy metals, pesticides, dioxin/furans, P450 reporter gene system (RGS) (a dioxin/furan screen), PCBs (*polychlorobiphenyls)*, PAHs (*polyaromatic hydrocarbons*), TBT (*tributyltin)*, TOC (*total organic carbon*), and AVS (*acid-volatile sulfide*).

5.3 Seattle District

1. Water quality monitoring continued at all District projects. Real-time water temperature, salinity, dissolved oxygen, and total dissolved gas data were transmitted to the District and Division offices via the District water control data collection system. 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. These data were used to make decisions regarding saltwater intrusion control measures.

Quality control checks were performed on five water temperature probes along the Kootenai River. Physical modifications were made to a few stations to decrease the likelihood of vandalization and increase the quality of data.

2. 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 in the Lake Washington Ship Canal.

3. Data collection at Libby Dam was performed by contract with the U.S. Geological Survey. This sampling program consisted of analyses for total phosphorus, orthophosphate, nitrate, total Kjeldahl nitrogen, silica, metals, salts, heavy metals, and nitrogen saturation. Vertical profile measurements of temperature, specific conductance, pH, alkalinity, and dissolved oxygen were also performed.

4. Water quality and wastewater evaluations were included in the Environmental Review Guides for Operations (ERGO) assessment conducted for the Libby Project.

5. The District collected sediment samples at the Turning Basin sites in the Duwamish River to determine potential for water pollution problems. In ongoing support of the President's forest plan, District personnel have been participating with other agencies (primarily the US Forest Service) in several watershed analyses in Western Washington.

6. District staff continued monitoring of restoration projects for Coastal America sites.

7. Cedar River water quality data was collected by Hydrolab with data logger. ERS monitored turbidity in the Cedar River during dredging (June-July 1998).

8. District staff collected stream survey data and used remote sensing for projects at Willapa Bay and on the Stillaguamish River.

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 collect additional water quality data. When dissolved oxygen declines to levels assumed harmful to fish, the Port operates its mechanical aeration system.

10. District staff continued to collect water and crab data at Grays Harbor Channel and near-shore disposal sites.

11. ERS and H&H collected gravel samples from the Green River for analysis of fine sediment accumulation after drawdown of the turbidity pool at Howard Hanson Dam. ERS and WES collected hydroacoustic data on juvenile salmon abundance at the Chittenden Locks (Lake Washington Ship Canal).

12. R2 Resource Consultants and ERS collected water quality data and sampled juvenile fish abundance in side channel habitats of the Green River.

5.4 Walla Walla District

1. Total Dissolved Gas was monitored at 14 stations located in the forebays and tailwaters of District projects to determine gas levels resulting from various project spill events. Data was transmitted to the CROHMS database.

2. Routine Reservoir Water Quality Monitoring covering a wide array of physico-chemical parameters including photic zone depth, dissolved oxygen, temperature, conductivity, pH, and total dissolved solid depth profiles, zooplankton and phytoplankton biomass and species composition, and metals, major cations and anions, and nutrients at surface, mid-depth, and bottom.

3. In support the DMMP, sediment was sampled and analyzed for contaminants in the McNary Pool. Samples were initially analyzed for particle size distribution and total organic carbon (TOC). Samples were designated as having 20-50, 50-80 or 80-100 % fines and %TOC. Then samples were analyzed for metals, PCBs, pesticides and organic constituents.

4. Drinking and swim area water at the projects and associated recreation areas are routinely monitored by project personnel for microbiological and inorganic contamination and turbidity. The Natural Resources Management Branch, the Project Offices, and the local county health departments coordinate this monitoring effort.

5. Sediment Range surveys were conducted on the Ice Harbor and Little Goose Reservoirs. These surveys will be used to determine deposition rate and most likely areas for sediment quality sample and analysis plans in future investigations.

6. During the summer and fall of 1998 temperature loggers (HOBOS) were used to collect water temperatures at four locations in the adult fishways at the Walla Walla District Projects. These locations include: upper ladder, lower ladder, junction pool, and near the fish counting window. The HOBOS were attached to a rope and lowered in the water approximately one foot from the bottom. The data loggers were set to record water temperature once per hour.

Data collection was time consuming for the project biologists since the data needed to be downloaded every 75 days if a temperature reading was going to be taken every hour. There is a possibility that shuttles will be ordered for next season to make it easier to collect data. The project biologists would download the data from the HOBOS to the shuttle. This would eliminate the need to remove each HOBO and bring them inside to download the information.

Another alternative would be to install temperature probes that would be compatible with the existing automated fishway control systems. Also, it is possible to include a water temperature monitoring program with the dissolved gas monitoring program which is already in use.

6. WATER QUALITY REPORTS

6.1 Division Office

1. CENWD-NP-ET-WR. December 1998. “1998 Dissolved Gas Monitoring, Columbia and Snake Rivers.”

2. CENWD-NP-ET-WR. December 1998. “1998 Water Quality Annual Report.”

3. CENWD-NP-ET-WR. April 1998. “TMT Water Management Plan for 1998.”

4. CENWD-NP-ET-WR. April 1998. “Total Dissolved Gas Management Plan for 1998.”

5. Henriksen, Cynthia. CENWD-NP-ET-WR. "The role of the Technical Management Team in the Columbia River reservoir operations". Toward Ecosystem-based Management in the Upper Columbia River Basin International Conference, Castlegar, BC Canada, April 27-30, 1998.

6. Tanovan, Bolyvong. CENWD-NP-ET-WR. “Total Dissolved Gas Management in the Lower Columbia River System and Its Impacts on Upper Columbia". Toward

Ecosystem-based Management in the Upper Columbia River Basin International Conference, Castlegar, BC Canada, April 27-30, 1998.

7. Henriksen, Cynthia, CENWD-NP-ET-WR. "COE Role in Solving Pacific Northwest Salmon Problems". USCID Conference on Shared Rivers, Park City, UT October 28-30, 1998

8. Tanovan, Bolyvong. CENWD-NP-ET-WR. "Real-Time Management of Spill and Dissolved Gas on the Columbia/Snake Rivers". USCID Conference on Shared Rivers, Park City, UT October 28-30, 1998

9. Tanovan, Bolyvong CENWD-NP-ET-WR. "New and Controversial Reservoir Operations to Support the Recovery of Endangered Species in the Pacific Northwest". Corps 12th Water Quality Seminar, Kansas City, MO June 2-5, 1998.

10. Uhlir, Mary Todd, CENWD-NP-ET-WR. "Conflicts in Hydrosystem Management When Managing for Multiple Endangered Species". Corps 12th Water Quality Seminar, Kansas City, MO June 2-5, 1998.

6.2 Portland District

1. Britton, Jim L. 31 July 1998. Section 7 – Water Quality, Design memorandum No. 21, Cougar Lake Willamette Temperature Control Intake Structure Modifications.

2. Larson, Douglas W. April 1998. Applegate Lake Oregon, Limnological and Water-Quality Studies 1981-1997. Final Report.

3. Larson, Douglas W. September 1998. ISO9000 Report, Dissolved Gas Fixed Monitoring System, Dissolved Gas Compliance Program Lower Columbia River.

4. Larson, Douglas W. December 1988. Monitoring Data Report and Analysis, Dissolved Gas Fixed Monitoring System, Dissolved Gas Compliance Program Lower Columbia River.

5. Sherman T. J, U. S. Army Corps of Engineers, Portland District. 1998. Columbia River Channel Deepening, Ocean Dredge Material Disposal Site, Appendix C, Sediment Evaluation.

6. Sherman T. J, U. S. Army Corps of Engineers, Portland District. 1998. Columbia River Channel Deepening, Columbia and Willamette Rivers, Appendix B, Sediment Evaluation.

7. Sherman T.J., U. S. Army Corps of Engineers, Portland District. 1998. Westport Ferry Sediment Evaluation.

8. Sherman T.J., U. S. Army Corps of Engineers, Portland District. 1998. Coos Bay Sediment Evaluation.

9. Sherman T.J., U. S. Army Corps of Engineers, Portland District. 1998. Depoe Bay Sediment Evaluation.

10. Sherman T.J., U. S. Army Corps of Engineers, Portland District. 1998. Amazon Creek Sediment Evaluation.

11. Sherman T.J., U. S. Army Corps of Engineers, Portland District. 1998. Astoria East Boat Basin Sediment Evaluation.

12. Sherman T.J., U. S. Army Corps of Engineers, Portland District. 1998. Columbia Slough Sediment Evaluation.

13. Vogel, Allan H. 20 January 1998. Report on the 1997 Applegate Reservoir Zooplankton Samples

14. Kalli, G.; Vowerk, M.; Carroll, J. Verification Techniques for Assessing Representativeness of a Fixed Monitor Water Quality System. (In Preparation).

6.3 Seattle District

1) Kendall, D., and S. Stirling. (May 13, 1998). Sediment Management Annual Review Meeting Minutes. Prepared in conjunction with the Dredged Material Management Program agencies and Washington State Department of Ecology's Sediment Management Standards Program.

2) Goetz, F., P. Hilgert & P. Hickey. 1997. Appendix F. Environmental. Fish Restoration and Mitigation for the Howard Hanson Dam Additional Water Storage Project. Final Fessability Report and FEIS.

3) Cordell, J., H.Higgins & M. Wood. 1997. Results from 1997 pre-restoration biological monitoring of Hamm Creek, Duwamish Waterway, Seattle, Washington. UW Fisheries Research Institute for U.S. Army Corps of Engineers, Seattle District.

4) Kendall, D., D. Fox, S. Stirling. (1998). Sediment Management Annual Review Meeting Minutes. Prepared in conjunction with the Dredged Material Management Program agencies and Washington State Department of Ecology's Sediment Management Standards Program.

5) Goetz, F.A., J. Dawson, T. Shaw, and J. Dillon. Evaluation of low-frequency underwater sound emitters for guiding salmon and steeelhead away from a navigation lock at the Hiram M. Chittenden Locks, Seattle, WA.

6) Dillon, J., and F. Goetz. Manual analysis of fish presence and abundance at a large lock using fixed hydroacoustic techniques.

6.4 Walla Walla District

1. Anatek Labs Inc, 1997. 1997 Lower Snake River Feasibility Study: Analytical Results. Prepared for HDR Engineering, submitted to Walla Walla District, December 1997.

2. CH2M Hill, 1998. Lower Snake River Juvenile Migration Feasibility Study: Core Sampling Task. Contract DACW68-94-D-0006 submitted to the Walla Walla, District U.S. Army Corps of Engineers. February 1998.

3. HDR Engineering. 1998. Sediment Quality Sampling in the Lower Snake and McNary Pool: Field Documentation and Analytical Results. Contract DACW68-97-D-0003, DO # 9, Submitted to Walla Walla District, October 1998.

4. HDR Engineering and RSI Surveyors, 1998. Sediment Range Cross Sections Volume 1: Control for Hydrographic Surveys in Ice Harbor and Little Goose Reservoirs. Contract DACW68-97-D-0003, DO # 11, Submitted to Walla Walla District, September 1998.

5. HDR Engineering and RSI Surveyors, 1998. Sediment Range Cross Sections Volume 2: Hydrographic Surveys of Ice Harbor Reservoir. Contract DACW68-97-D-0003, DO # 11, Submitted to Walla Walla District, September 1998.

6. HDR Engineering and RSI Surveyors, 1998. Sediment Range Cross Sections Volume 3: Hydrographic Surveys of Little Goose Reservoir. Contract DACW68-97-D-0003, DO # 11, Submitted to Walla Walla District, October 1998.

7. Miller, Thomas D. 1998. Input to Division Water Management Report. Submitted November 1998.

8. Miller, Thomas D. and R. D. Heaton, 1998. Walla Walla District 1997 Annual Water Quality Report. January 1998.

9. Miller, Thomas D., B. J. Tice, L. A. Patton and R. D. Heaton. 1997. Automated Remote Monitoring of Total Dissolved Gas on the Lower Snake River. Presented at the 18th International Symposium of the North American Lake Management Society.

10. Miller, Thomas D. and R. D. Heaton, 1999. Walla Walla District 1998 Annual Water Quality Report. January 1999.

11. Miller, Thomas D. 1998. Breaching the Four Lower Snake River Dams: Background and Evaluation of Likely Changes in the Aquatic Environment. Presented at the 18th International Symposium of The North American Lake Management Society.

12. Miller, Thomas D. and R. D. Heaton. 1998. Predicting Productivity Changes Brought About by Return to Natural River Level. Presented at Corps of Engineers Water Quality '98 Conference.

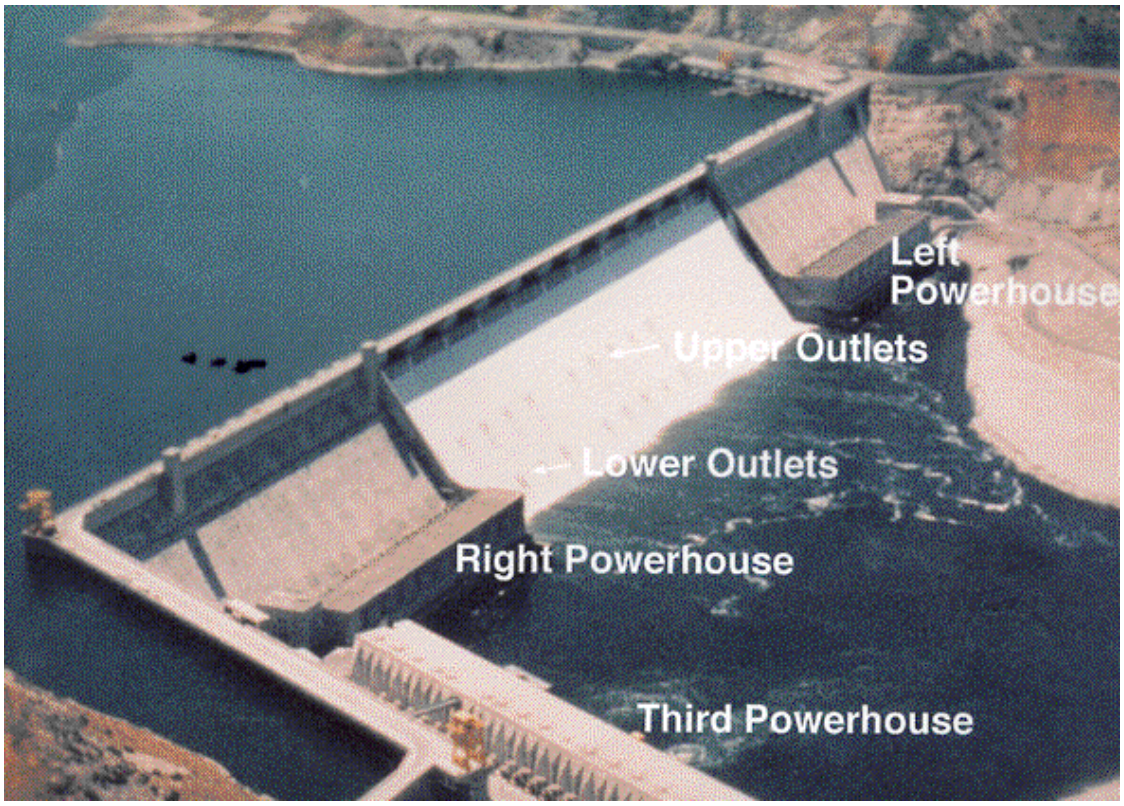
13. Normandeau Associates. 1988. Lower Snake River Juvenile Salmon Migration Feasibility Study Resident Fish Appendix. (Draft)

14. Normandeau Associates. 1988. Lower Snake River Juvenile Salmon Migration Feasibility Study Water Quality Appendix. (Draft)

15. Pierre-Louis, Phillip and R.D. Heaton, 1997. Lower Snake River and McNary Pool Sediment Quality: Analysis Report. Technical Report, Dredge Material Management Plan Study (DMMP). Vizcaya Laboratories. Submitted to Walla Walla District, December 1997.

16. Soil Technology Inc., 1997. Summary of Elutriation Procedures of Lower Snake River Sediments. Prepared for HDR Engineering, submitted to Walla Walla District, December 5, 1997.

A Multi-agency Group Visit to the Grand Coulee Project



Grand Coulee, a Bureau of Reclamation Project

7. DATA MANAGEMENT SYSTEM

7.1 Division Office

1. All water control and water quality data are now stored in a HEC-DSS database and on floppy disks. Data are available in both DSS and 132 column formats. DSS utility programs are being routinely used to store, list, display, and manage the data. Hourly total dissolved gas and water temperature data are posted on the Technical Management Team's homepage, under Reservoir Control Center's care.

2. Under EPA sponsorship, historical water temperature and discharge data collected by the Corps and others have been recompiled and stored on the EPA Internet homepage. Data for the following reaches are available:

- ✓ Mid Columbia River main stem from the Canadian border to the Snake River,
- ✓ Mid Columbia River tributaries from the Canadian border to the Snake River,
- ✓ Lower Snake River main stem from Brownlee Dam to the mouth,
- ✓ Lower Snake River tributaries from Brownlee Dam to the mouth,
- ✓ Lower Columbia River main stem from the Snake River to the mouth, and
- ✓ Lower Columbia River tributaries from the Snake River to the mouth.

Also included are separate Excel files for: (1) continuous temperature and discharge data, and (2) monthly and annual discharge summaries for the Snake River at Anatone, the Columbia River at Priest Rapids, and the Columbia River at The Dalles. A separate word document for primary contacts responsible for the data given in tables is provided, and an html file can be created to query these tables for use on the Internet.

7.2 Portland District

1. Water quality data collected at District projects in 1998 was entered into a Microsoft Access relational database. Historical data will be entered into the database as time permits. All water quality data collected by USGS over the years at Willow Creek, Lost Creek and Applegate was acquired in 1998 and will be input in 1999.

In 1998 internal discussions and interactions with contractors led to improvements in the database structure and improved data reporting by contractors. Improved column labels for data were adopted. Macros were developed to assist contractors in formatting their data so that it could easily be imported into the District database. Confusion regarding STORET remarks codes and parameter method codes was cleared up. Standard site labels and descriptions for historic and current sampling stations were adopted and input into the database. Available latitude and longitude data for many sites were entered into the database to make it compatible with any future GIS applications. Latitude and longitude data were collected in the field, using Global Positioning instrumentation, to fill in gaps of missing data for specific sites. Hard copies of project maps with labels showing historic and current sampling sites were developed. In 1999 further improvements to the database will be discussed and imple-

mented. An anticipated improvement will be the development of digitized Project maps with labeled sampling locations that will be linked to the database so that sampling sites can be visualized. In 1999 efforts to improve the database will continue.

Preparations were begun in Fall of 1998 to make District water quality data available to the public and others on the District WEB site in a format that is read only.

2. The Ocean Disposal Data (ODD), initiated by WES for the preparation and submission of annual reports on the ocean disposal of dredged material from the United States pursuant to obligations under the London Dumping Convention (LDC), was updated. Data from 1997 was added to the ODD database by the Portland District for projects under its authority. The State of Washington, Department of Ecology's (DOE) SEDQUAL database structure will be obtained in 1999 and adapted to to the Districts sediment quality database. Most likely the District database, which is a MacIntosh Foxbase product, will be transferred into the SEDQUAL database, which is WINDOWS compatible. Currently, Seattle District's DIOS database is importable into DOE's SEDQUAL. In the future Oregon's Department of Environmental Quality (DEQ) will adopt the SEDQUAL database. By adopting SEDQUAL, the District database will be compatible with DOE, Seattle District, and DEQ databases.

3. Sediment chemistry generated from 6 projects in 1998 were entered into a Macintosh Foxpro database that was used to analyze relationships between physical sediment characteristics, river basin location, and contaminant levels. Hard copies of raw sediment quality data were placed in a series of three ring binders located in the Reservoir Regulation and Water Quality Section. The State of Washington Department of Ecology's (DOE) SEDQUAL database structure will be obtained in 1999 and adapted to to the Districts sediment quality database. Most likely the District database, which is a MacIntosh Foxbase product, will be transferred into the SEDQUAL database, which is WINDOWS compatible. Currently, Seattle District's DIOS database is importable into DOE's SEDQUAL. In the future Oregon's Department of Environmental Quality (DEQ) will adopt the SEDQUAL database. By adopting SEDQUAL, the District database will be compatible with DOE, Seattle District, and DEQ databases.

4. George Kalli continued maintenance of the Microsoft Access relational database of all DGAS and DGAS related information and is responsible for data validity as well as data availability. Currently the database is 882 Megabytes in size and is in its final form. The DGAS database is available on CD.

5. TDG data from the Fixed Monitoring Program were stored in the CROHMS database at Division. The USGS, as part of their scope of work, made recommendations for adjusting the data set in CROHMS based on interpretations of anomalies in field data that could traced to instrument response.

7.3 Seattle District

1. Hydraulics and Hydrology Section’s primary data management system 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 pres-

entation. Hydrology and Hydraulics Section maintains a homepage that makes much of this data available to the public via the Internet.

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. Automated reporting features are also available in DAIS, including reports summarizing sampling, testing, and administrative data. ArcView software was added to facilitate geographic information system (GIS) queries.

3. BioStat (a bioassay statistics program) was created by Seattle District to automate the interpretation of biological testing data in sediment assessments. The use of the software provides consistency in data interpretation for dredged material testing evaluations.

4. Regulatory Branch uses the Regulatory Analysis and Management system (RAMS) to track fills in wetlands and required mitigation.

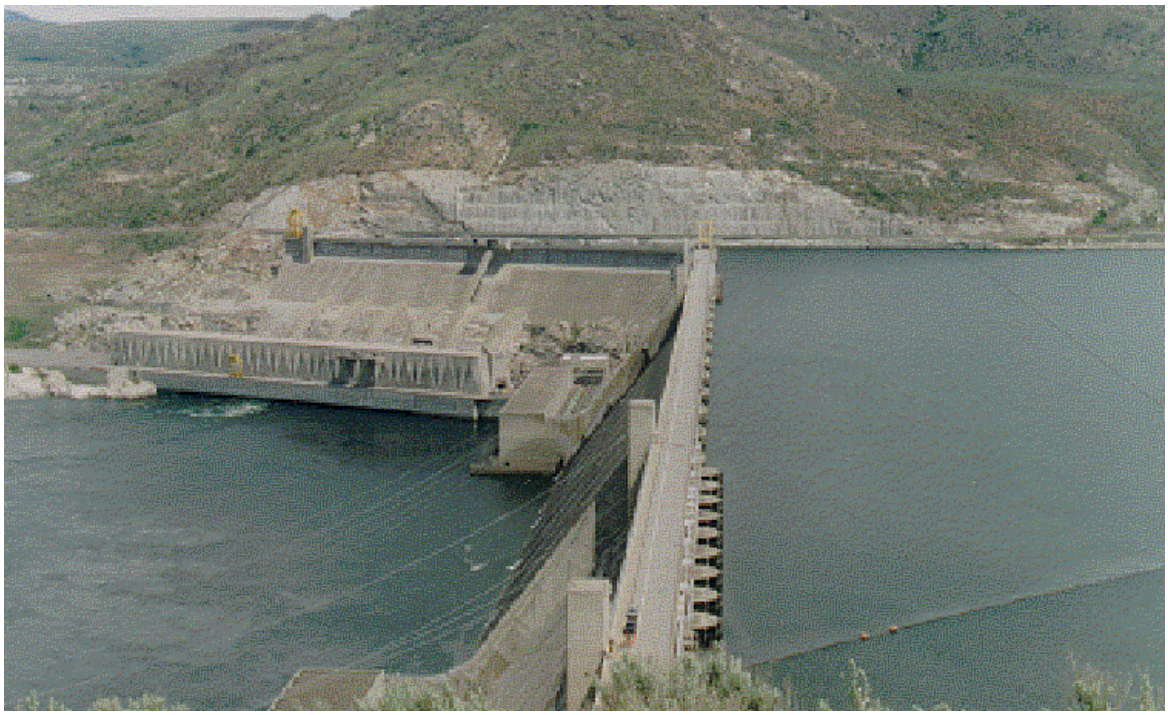
7.4 Walla Walla District

1. Total Dissolved Gas data collected by the Total Dissolved Gas Monitoring System are collected by PC's at the projects and fed into the NWW Headquarters Office ORACLE temporary database via the wide area network (WAN) system. The TDGMS data are transmitted to NWD where they are uploaded to the CROHMS database.

2. Project operation data (e.g. spill gate settings, turbine discharge, etc) are collected and stored with the TDGMS system and Oracle database.

3. Routine Reservoir Water Quality data was stored in District database. The database is based on MS ACCESS and provisions were made to place it into an oracle database. To facilitate the LSRFS Biological Productivity Study and future data efficiency goals, the Lower Snake River limnological data was put into a user-friendly front-ended Access database developed under contract to the State of Washington Water Research Center. The existing data will be archived and used by the district for water quality studies and programs. The water quality section will provide water quality data to the Operations Division but no chemical water quality will be transmitted outside of Walla Walla District. This data will also be made relational and linked to the Oracle database for GIS use.

4. Sediment quality data were entered into relational access database and then into to the District Oracle database to be available to the GIS system. The Information Management Office oversees use of the Oracle database



Grand Coulee Dam, the subject of the most recent Dissolved Gas abatement Study

8. RESEARCH & DEVELOPMENT

8.1 Division Office

1. Division staff continued to keep up with the Dissolved Gas Abatement study and update data related to the newly completed flip-lips at Ice Harbor and John Day Dams.

2. Development of a decision support system for fish and water quality-related reservoir operations continued. The system is designed to help the reservoir regulator by providing, at the touch of a button, all the information he/she needs with regards to hydraulics, hydrology, fish movement, water quality conditions, etc. It will rely on a database with existing information as well as some built-in prediction capability. Latest activity is an attempt to keep close tract of the teletype instructions sent to each of the Corps projects, thus providing the physical constraints these projects are operating under at any given day.

3. Division staff participated in a progress review meeting of contractor work on the 1- and 2-dimension models of water temperature and total dissolved gas. These models will be used in the ranking and selection of alternatives developed under DGAS Study.

4. Division staff participated in the review of development work by EPA on a one-dimension water temperature model of the Columbia/Snake Rivers system. Preliminary model results indicated that dams increase water temperature on the mainstem over pre-impoundment conditions, and that tributary impacts on mainstem temperatures are relatively insignificant because of the relative volume of water involved. These results need to be reviewed and properly qualified. The Corps will have further opportunities to test and apply the model once it is ready for peer-review early in 1999.

5. Division staff assisted Seattle District in preparing a scope of work for the TDG system model needed to perform the TDG abatement study at Chief Joseph and Grand Coulee Dams. This study, requested in the NMFS' Biological Opinion, will be done in collaboration with the US Bureau of Reclamation and Bonneville Power Administration. The model will include an optimization routine to minimize TDG levels while meeting hourly power loads to be met by the Federal Columbia River Power System.

8.2 Portland District

1. Research into the mercury contamination problem at Cottage Grove Reservoir continued. The emphasis in 1998 was to gather data on mercury levels in fish and anoxic waters. Samples were collected by DEQ. Analyses were performed by Frontier Geosciences and DEQ.

8.3 Seattle District

1. Mud Mountain Dam Sediment Management (MMD) – Seattle District staff worked internally to develop a method of releasing sediment stored behind MMD during and after

routine operations. The use of stop-log to allow work within the MMD tunnels can cause an accumulation of sediment upstream of the stop-logs. In 1998, sediment accumulation caused by the stop-log required attention to avoid heavy downstream movement of sediment during the removal of the stop-logs. District staff and project staff found that raising the pool during stop-log removal could control the release of sediments downstream. With a higher pool, project staff could delay sediment release until inflows raised above 2,000 cfs. Higher inflows help sustain sufficient flows to carry the material downstream and into the estuary. Testing and documenting of this procedure is still needed.

2. The Dredged Analysis Information System (DAIS) is currently being rewritten in Visual Basic 5.0. This process will be completed in FY99 and will make DAIS Y2K-compliant and Windows-compatible.

3. In cooperation with EPA Region 10 and Washington State Department of Ecology, District personnel are conducting a remote sensing project to identify Sitka spruce wetlands. Using a multi-spectral analyzer and GIS technology, spruce wetlands will be located and mapped in this Willapa Bay pilot study.

4. In cooperation with the University of Washington, District personnel are conducting a large woody debris study on the Stillaguamish River.

5. ERS is conducting crab population surveys in outer Grays Harbor. Surveys will identify crab use of different water and sediment habitat types.

6. In cooperation with Portland District and WES, ERS conducted fish passage studies on the use of light and sound to guide salmon and steelhead juveniles through the Locks. In 1998, a report of project findings on sound guidance was completed and the preparation of the report on strobe light guidance was begun.

7. In cooperation with the WA Department of Fish & Wildlife, Muckleshoot Indian Tribe and King County, ERS continued studies on the use of modified locking procedures at the Locks to improve survival of salmon smolts migrating through the Locks.

8. In cooperation with BioSonics, Inc., District personnel are conducting a study on the horizontal and vertical distribution of salmon smolts in the lower Lake Washington Ship Canal.

9. ERS is conducting surf smelt population and bedding area surveys at LaPush, WA, to identify surf smelt use of areas rebuilt with dredged material from the Quillayute harbor project.

8.4 Walla Walla District

1. Walla Walla District is constructing a GIS based sediment quality and distribution analysis tool for the Lower Snake River and McNary Pool. Preliminary sampling and analysis has been completed to provide tier 1 factual information for later dredging and establish baseline sediment quality conditions for the Lower Snake River and the McNary Pool. Under the current DMMP study and the LSRFS the District is developing this analysis tool to facilitate impact assessment and assist in the preparation of the compliance documentation. The sought-after abilities include interpolation between sediment quality sites for delimita-

tion of sediment type polygons, overlay analyses with sediment contaminant data and with water velocity data, and graphical mapping capabilities to enhance communications to managers. Future development of this system based on GIS will continue.

2. The Walla Walla District and Compliance Technology Incorporated developed a Hyperbaric Tonometer Chamber for use in calibration of dissolved gas measuring instruments in the lab. Further development of this chamber since last year shows the potential for complete manipulation and control of supersaturation of water in the chamber with reproducible results. Additional ports and adaptation to the Profiler® software shows potential for improved calibration and instrument QA/QC performance documentation.

3. In the past few years NWW staff have played a key role in prototyping, developing, testing, and contracting the production of self-contained automated data logging sondes with TDG capabilities to be used in the riverine environments. Walla Walla District water quality staff have also been involved in industry efforts to develop effective in-situ turbidity sensors with improved accuracy and enhanced dredge monitoring applications and the development and use of improved in-situ fluorometry based chlorophyll sensors for the evaluation of primary productivity.

4. Hydrology staff were involved in further development of a field probe system to measure spectral transmittance strength, photosynthetically active radiation (PAR), and light extinction coefficients for evaluation of primary productivity based on capacity of the potential provided energy. Further work is continuing on the development and attempts will be made to integrate other data parameters with statistical approaches.

5. Walla Walla District Engineering Division has pioneered the use of acoustic doppler scintillation counter arrays integrated into a data collection system to measure water velocities (discharges) in high velocity environments, e.g., turbine intakes. This year, further turbine intake discharge (Q) tests were conducted at Bonneville Dam in Portland District. The data collected by Walla Walla was used by HDC to improve turbine efficiency.

Another Dissolved Gas and Water Temperature Monitoring Station on the Columbia River, at Pasco, WA

9. WATER QUALITY PROBLEMS

9.1 North Pacific Region (Region-wide)

1. Starting with its 1998 Supplemental Biological Opinion, NMFS now is calling for water to be voluntarily spilled up to the full 120% TDG level at the Corps' mainstem Columbia and Snake Rivers dams. Despite the relatively average runoff conditions this spill, combined with other involuntary lack of energy spill, triggered TDG levels in excess of the State standards of 110%.

2. During the spring (April 3 – June 20 for the Snake River and April 20 – June 30 for the lower Columbia River), the average daily spill ranged from 33 to 68 kcfs (29 to 58% of the daily flow average) at Lower Snake River dams, and from 100 to 144 kcfs (33 to 49% of the daily flow average) at Lower Columbia River dams. All these dams spilled every day of the periods indicated. During the summer (starting June 21 for the Snake River and July 1 for the Columbia River and ending August 31 for both rivers), the average daily spill range was 0.1 to 42 kcfs (.4 to 71% of daily average) for Lower Snake River dams and 19 to 88 kcfs (11 to 49% of daily average) for Lower Columbia River dams. The only projects required to provide summer spill were Ice Harbor, John Day, The Dalles and Bonneville. The number of summer spill days at those projects was 72, 62, 62 and 62 respectively. Excess hydraulic capacity spill also occurred for 38 days at McNary, with daily spill averaging 19 kcfs.

Because of the much lower runoff conditions in 1998 than in 1997, the 1998 TDG levels were significantly lower than those measured in 1997 basinwide. While the 120% TDG level was exceeded for up to 22 days in the spring of 1998, no such exceedence was reported in the summer below any of the Corps dams. The peak TDG levels themselves, however, did not change much between the two years. Stations with TDG readings higher than 125% in 1998 included International Boundary (128%), Priest Rapids (126%), Lower Granite (132%), Ice Harbor (both forebay and tailwater, 128-127%), and McNary (128%). The highest TDG value recorded in 1998 was 132% below Lower Granite. In 1997 the highest TDG value, 140%, was recorded below John Day.

3. 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 exacerbate 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.

As was done in the past few years, NMFS obtained waivers from the States and the Nez Perce Tribe to allow for the spill for-fish-passage to occur. The Oregon and Washington waivers applied to the March 23 - August 31 period; the Idaho waivers, to April 15 – June 1, June 18 – July 15 and August 16 – August 31 periods; and the Nez Perce, to April 1 - August 30 period. The Oregon Environmental Council did not, however, grant TDG waivers for the for the Spring Creek Hatchery release, March 13-23.

4. The NMFS's Dissolved Gas Team (DGT) continued to provide a forum for peer review and technical exchanges of information on TDG. Although advisory in nature, DGT also played an active advocacy role. DGT provided feedback to the Corps' Gas Abatement Study and was responsible for applying for the annual TDG waivers from the States. One of its earlier efforts was to continue drafting a regional Plan of Action to regionally reduce dissolved gas levels. The Team's current priority is to promote fast-tract implementation of spillway deflectors at Federal Columbia River dams to bring about the benefits of low TDG levels to the fishery. DGT was also involved in the review of the TMT Spill Management Plan for 1998 and the TDG Monitoring Plan of Action for 1998, both of which were drafted by the Corps.

5. Regional TDG abatement effort received a big boost from Canadian participation and the ensuing formation of an US-Canada Transboundary committee in April 1998 designed to cooperatively and formally undertake TDG abatement studies on a truly system-wide basis. NMFS, EPA and the Northwest Power Planning Council currently head the committee on the US side. In 1998, the committee met in Spokane, WA (June 11) and Richmond, BC Canada (October 15) to coordinate preparation of a study plan, addressing what work needs to be done, how long it is expected to take to accomplish the tasks, and estimated costs for each element. When completed, the study plan will be presented to decision-makers in both countries with a recommended budget. Decision-makers will then need to allocate funding and/or resources to implement the study plan.

6. The States and EPA continued to press the Corps and the Bureau of Reclamation for early design and implementation of TDG abatement measures at Federal Columbia and Snake River dams. They also considered high water temperatures in the mainstem a direct result of the dams and were seeking prompt action to remedy the situation. Preliminary results of a one-dimension water temperature model developed by EPA were used to support their contention that tributaries are only a minor part of the problem. Therefore, while TMDL work is being conducted by the States and EPA on the tributaries, some regional agreement on how to proceed to address mainstem high water temperature problems will be needed in the near future.

7. 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. Even in the Willamette River, calls have been made by the Governor of Oregon to reduce pollution dumped into the river to head off a potential ESA listing of winter steelhead. The move toward removing or drawing down lower Snake River dams and John Day Dam to improve impaired fish passage conditions also continued. Preliminary estimates of costs associated with Lower Snake River dams are as follows:

- ✓ Demolition : $500 to $816 million ($848 million to $1.22 billion for concrete removal)

- ✓ Replacement power: loss of 1.231 average megawatts or $150 million/year
- ✓ Treasury obligation: $864 million
- ✓ Navigation accounts for 6.8 million tons of goods, grains and merchandises transported annually. Irrigators also risk loosing over 36,000 acres of farm land with an annual farm value ranging from $100 to 150 million.

Environmental and fishing groups have also filed a petition with FERC asking for formal ESA consultation on Idaho Power Co.'s Snake River projects. The ultimate goal is to achieve more natural river conditions for salmon runs.

9.2 Portland District

1. **Willow Creek Lake**, Oregon is eutrophic and well stratified thermally during summer. By August, the reservoir's hypolimnion is anoxic and contains high concentrations of hydrogen sulfide, methane, ammonia and other chemically reduced substances. Phytoplankton blooms, principally of blue-green algae 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). 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.

2. 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 is 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.

However, plans to install selective withdrawal facilities at Cougar and Blue River dams to restore natural river water temperatures were stalled for lack of funds. Except for a nominal amount earmarked for additional design work, there was no money set aside in the Corps' 1999 budget to start any construction activities. This $45 million temperature control project is strongly supported by the State of Oregon, the Northwest Power Planning Council and

environmental groups. It has been under discussion for 10 years and is expected to take eight years to build.

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 7 below.

Table 7. NWP Water Quality Problems on DEQ 303(d) List

Reservoir	**Res. Parameter(s)**	**Below Res. Paramater(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)

4. Oregon DEQ also proposed **new water quality Standards** for temperature, nitrate, DO, pH and bacteria. Of these, temperature is most likely to affect Corps Reservoirs. Aspects of the proposed temperature Standard that impact Corps Projects have to do with Bull Trout and Salmon habitat. DEQ is recommending that "water bodies serving as habitat to Bull Trout should not exceed maximum temperatures of 50 degrees F" and "water bodies in which salmon species spawn or rear should not exceed 55 degrees F during the spawning seasons". Further, a criterion of 64 degrees F, based on a rolling 7-day average of daily maximum temperatures, is recommended for all surface waters.

5. **Water temperature** is under scrutiny as a problem in the Columbia River. The EPA sponsored a regional meeting of agencies and interested parties to discuss the impacts of various factors (including the operation of dams) on Columbia River temperatures. The issue of high water temperatures compared to historical temperatures will continue to be debated and researched and may eventually impact operations and structures of Corps dams. A good case in point involves building temperature control towers at Cougar and Blue River dams on the McKenzie River, a tributary to the Willamette River to help spring chinook. Three years after getting approval for the project, no money has yet to be set aside for con-

struction of the towers considered crucial to rebuilding the mainstay of spring salmon stocks in the upper Willamette River.

6. Water, sediment and fish from **Cottage Grove Reservoir** show 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. Since 1993, studies have been conducted to determine the loading and distribution of mercury in the water, sediment, and food chain. . In 1998, the Oregon DEQ collected water and fish samples before and during the anoxic period to correlate methyl-mercury production with fish tissue concentrations. Cooperative studies will continue in 1999 at both Cottage Grove and Dorena Reservoirs. The State of Oregon has issued a Health Advisory concerning consuming fish from Cottage Grove Reservoir.

7. **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

8. **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 1998 for two reasons; 1) lower flows than those of 1997 which were of historic proportions, and 2) the addition of flip lips to John Day dam.

9. **Willamette River Projects** are believed to exceed TDG standards under limited discharge scenarios. .Data from Dexter Reservoir collected during high flows related to turbine repair operations showed TDG concentrations greater then 110%. The same was true for Cougar Reservoir during a high flow event (920 cfs from the regulating outlets). In light of possible listing of steelhead and perhaps salmon in the Willamette system, it may be prudent to monitor TDG during high spill below projects where fish are trapped or where spawning occurs. Cougar and Foster Reservoirs are likely candidates.

10. Most of the Willamette Projects experience **algae blooms** of blue-greens in July and August. So far these have not reached the nuisance stage where, for example, strong taste and odors are observed

9.3 Seattle District

1. Problems were encountered during construction of the seismic refit at Howard Hanson Dam. Concrete and rinse water entered the reservoir.

2. Water quality problems in 1998 included high water temperature at Albeni Falls and high water temperature and turbidity at Howard Hanson.

3. Due to high inflows at Mud Mountain Dam, extensive debris removal operations were required at this run-of-the-river flood control project. Seattle District staff worked internally to develop a method of releasing sediment stored behind MMD during and after

routine operations. See activity reported under Research and Development for the Seattle District. As stated earlier, testing and documenting of this procedure is still needed.

4. A 1998 report by the Washington Water Power Company (WWP) indicated that spill in 1997 at Cabinet Gorge Dam, on the Clark Fork River, resulted in high levels of dissolved gases entering Lake Pend Oreille and possibly the Pend Oreille River. Sampling was conducted in 1998 by a consultant to WWP, but results are not available at this time. Idaho Department of Fish and Game has been evaluating the relationship of kokanee fry survival to spill duration over past years. High total dissolved gasses into Lake Pend Oreille had not been previously documented, and further evaluations will be made if possible.

5. Approximately 36 acres of Eurasian watermilfoil were treated in Lake Pend Oreille with aquatic herbicides. This treatment is considered a "stop-gap" effort to kill off the tops of the plants and reduce the spread of plant fragments, the source of new or expanded infestations. This was considered the first step in an effort to control the spread of milfoil in the reservoir upstream of Albeni Falls Dam. Follow-up monitoring and treatments (systemic herbicides is planed for next year) will be needed to eradicate the milfoil before it spreads. If the milfoil becomes established in sloughs and wetland areas off the main river channel, it will be effectively impossible to control. Corps interests will be focussed on the impacts at recreation areas and in wildlife management areas susceptible to milfoil growth.

9.4 Walla Walla District

1. High TDG levels remain the primary water quality problem in the Walla Walla District. Spill at run-of-the-river dams on the Lower Snake and Columbia Rivers causes total dissolved gas supersaturation which often exceeds the water quality State standard and Federal criteria of 110 percent. Water passed through spillways entrains air in the form of bubbles as it passes under the tainter gate, over the spillway face, and plunges into the stilling basin water. The air (total gas) in the bubbles is forced into solution by hydrostatic pressure encountered deep in the stilling basin, increasing water TDG tensions. Major factors contributing to TDG increase caused by spill include depth of plunge, air bubble density, and turbulence. The amplitudes of these factors increase with increased spill discharge. TDG data collected in tailwaters of the four Lower Snake River and McNary dams show tailwater TDG levels are influenced most directly by the rate of spill discharge. Simple linear regression analyses of tailwater TDG versus spill discharge in very good r^2 values, indicating that the majority of variation in TDG measured just downstream of the spillway can be explained by variation in the quantity of spill. In general, as spill discharge increases, so does TDG supersaturation.

Due to relatively lower spring flows in 1998 than in 1997, involuntary spill resulting in high TDG levels was kept to a minimum. Number of hours TDG was above approximately 120% of saturation (indicating periods of involuntary spill) below each project were: Lower Granite, 195; Little Goose, 330; Lower Monumental, 495; Ice Harbor, 240; and McNary, 255. The peak TDG level recorded at each tailwater station was: Lower Granite, 134%; Little Goose, 130%; Lower Monumental, 135%; Ice Harbor, 133%; and McNary, 129%. The approximate number of hours TDG levels greater than 130% were recorded at each tailwater station were: Lower Granite, 30; Little Goose, 2; Lower Monumental, 150; Ice Harbor, 12; and McNary, 0. These records show that TDG problems were most prevalent below Lower Monumental Dam. It is also obvious that the installation of spillway flow de-

flectors resulted in TDG levels similar to the other deflectored projects during the involuntary spill season.

2. The cyanobacterial blooms were not significant enough to be a problem at Lower Snake River reservoirs in 1998. Of all the phytoplankton samples collected bi-weekly, throughout the year, none of them showed signs of blue-green dominance. This is a change from prior years where monitoring was done.

3. The levee pond system in Lewiston (Lower Granite Project) experiences contamination of nitrates, manganese, bacteria, synthetic organic compounds, dioxin, petroleum hydrocarbons, and other contaminates. It has been identified that there is a serious hazardous waste problem in the sediments of these ponds. Further, one of the ponds is actively transporting contaminants to the Snake River with out a discharge permit.

4. Water temperatures on Lower Snake River have been a problem at fish facilities. In 1998 attention has been focused by fish agencies on temperature problems at the fish facilities. Walla Walla District will begin to focus additional resources to determine the extent of temperature problems and develop recommendations.

A USGS staff responding to a service call from a Portland District TDG monitoring site

10. SPECIAL STUDIES

10.1. Division Office

1. **Modeling**. Activities that could have been shown here were already described in Section 8, Research and Development. They related to the programming work on development of a decision support system, and applications of the latest TDG field data collected under DGAS. As stated earlier, division staff participated in selected phases of the Dissolved Gas Abatement Study for which Portland and Walla Walla Districts were given the lead role.

2. **Dissolved Gas Management Plan for 1998.** In preparation for the 1998 spill season, a TDG management plan was prepared. Numerous flow and spill scenarios were assumed that needed to be assessed for TDG impacts. Empirical Spill versus TDG regression equations were used to accomplish this objective.

3. Division staff is assisting Seattle District in carrying out a Gas Abatement study at Chief Joseph Dam. This included development of the 7-day, 10-year spillway design flow in cooperation with Washington Department of Ecology, study plan coordination with NMFS regional fish forum, and preparation of a scope of work for a TDG model code-named SYSTDG. This **TDG system model** is needed to analyze various abatement alternatives at Chief Joseph and Grand Coulee in terms of reducing TDG levels under various structural and operational scenarios. Funding for the model development work will be provided by BPA. The study itself will be done jointly by the Corps and the Bureau of Reclamation, as called for in the NMFS Biological Opinion. To date, individual abatement alternatives have been developed independently at each project by each of the two agencies. Recent discussions within regional forums suggest a more coordinated, system-wide effort is needed.

10.2 Portland District

1. **Cottage Grove Mercury Contamination**. During August when the lake bottom becomes anoxic, water and fish samples were taken to determine if there is a correlation between methyl-mercury in water and fish tissue.

3. **Dissolved Gas Study Team.** The team studied the "representativeness" of selected total dissolved gas (TDG) fixed monitoring sites (FMS) in predicting gas levels in cross sections of the Columbia River. TDG instruments were set out in an array across the river, and TDGs were measured under different spill conditions. Results showed mixed results. The fixed monitor below The Dalles dam was good at predicting river cross sectional, near quad and maximum TDG under the spill conditions studied. On the other hand, the two sites directly across the river from each other, below Bonneville Dam (Warrendale and Skamania), were poor at predicting river cross sectional averages and maximums. The results also suggest that some sites may need to be repositioned depending on the importance of the data they collect to Regional Resource Agencies. Further studies would be needed if better sites have to be identified. The correlation between FMS sites TDG readings and ad-

jacent “Near Quad”, river cross sectional, and river maximum tailwater TDG data is summarized in Table 8 below.

Table 8. Correlation between FMS \and TDG Readings.

FMS Sites	River Wet'd Ave.	Near Quad	Maximum
John Day	0.36	0.96	0.91
The Dalles	0.96	0.98	0.94
Warrendale	0.22	0.70	0.47
Skamania	0.24	0.75	0.37
Camas	0.87	0.87	N/A
Kalama	0.68	0.56	0.63
Wauna	0.61	0.65	0.39

3. **Dredge Material Modeling.** Mathematical modeling studies of dredge material disposal were performed at two Ocean Dredge Material Disposal Sites off the mouth of the Columbia River. MDFATE was used to simulate the disposal of dredged material for the two-year period 1996-1998. The resulting modeled bathymetry was then fed into RCPWAVE to determine if the simulated disposal mounds would have any adverse effects on the wave climate in the area of the disposal sites. As a result of this effort temporary site expansion is being pursued.

10.3 Seattle District

1. **Olympia East Bay Marina Water Quality Mitigation**. The East Bay Marina Dissolved Oxygen Monitoring and Aeration System has been operated and maintained by the Port of Olympia since project construction in 1983. An automated water quality sensor was installed in 1991 at the project. The sensor is removed during winter months and reinstalled each summer. The data are transmitted by the District's water control data collection system and then furnished to the Corps' project manager and Port of Olympia. The District continues to review the water quality monitoring data and which is used by the Port of Olympia to determine when to operate their mechanical aeration system.

2. **Howard Hanson Dam Additional Water Storage Project Study**. The District Completed a draft and final EIS in 1998 which included the evaluation of possible impacts to sedimentation and water quality resulting from a proposed increase in the summer conservation pool at the project. The additional water stored would be used for city of Tacoma municipal water supply and higher instream flows for fisheries. The water quality studies were geared toward sediment transport, turbidity analyses, and outflow temperature. The recommended project should not adversely impact water quality and will probably improve downstream river temperatures. An additional benefit of low-flow augmentation would be to slow salinity intrusion upstream of the Duwamish Estuary.

3. **Libby Dam - Kootenai River Sturgeon.** Libby Dam was operated in 1998 to meet the flow objectives of the 1998 Biological Opinion for Steelhead, the 1995 Biological Opinion for Snake River Salmon, and the 1998 US Fish and Wildlife Service Guidelines for Kootenai River White Sturgeon. The flow regimes were coordinated through the Columbia River Technical Management Team. The sturgeon operation featured releases of 22,000 cfs for three days beginning in mid-May followed by incubation flows of 25,000 cfs (or greater)

as measured at Bonners Ferry, Idaho. The selective withdrawal facility was manipulated to produce the warmest possible water in conjunction with the peak of local runoff and optimum sturgeon movement. The District's efforts to control water temperature 70 miles downstream of Libby Dam at Bonners Ferry were not highly successful. Cold water in the reservoir combined with cold air temperatures undermined the project's ability to provide sustained water temperatures in excess of 10 degree Celsius. Spilling at Libby Dam may result in very high levels of dissolved gas supersaturation and damage to downstream fish. A total of 408 sturgeon eggs were found by Idaho Fish and Game in its 1998 sampling.

4. **Chief Joseph Dam - Dissolved Gas Supersaturation.** Staff from the Project, Hydrology and Hydraulics Section, and the USGS conducted a special study to determine the effects of varying the spill pattern on dissolved gas conditions downstream. Profiles of dissolved gas measurements were taken across the river during spill under four different gate configurations. Results of the study indicated that spreading spill across the spillway resulted in the least amount of dissolved gas supersaturation.

The District has also initiated a dissolved gas abatement study at Chief Joseph Dam in consultation with Washington State and the NMFS regional forum. As called for in the Biological Opinion, the study will also look at the merits of combining Chief Joseph and Reclamation's Grand Coulee in a systemwide study context. Spill through the regulating outlets of Grand Coulee could cause fish kills at the Columbia Fish Farm located some 20 miles below the dam, in the Chief Joseph reservoir forebay. One possibility to reduce TDG levels would be to install deflectors at Chief Joseph and then transfer power generation from Chief Joseph to Grand Coulee.

5. **Mill Creek SAMP.** District staff is completing the draft wetland management and restoration plans for the Mill Creek Basin. The plan incorporates the King County Surface Water Management Mill Creek Water Quality Management Plan and emphasizes maintaining and improving the water quality functions of the Mill Creek Basin's wetlands. The restoration plan was completed in 1997.

6. **Thornton Creek 1135 Habitat Restoration Project.** The District accomplished most of the construction for the habitat (fish/wildlife habitat and wetlands) restoration at Matthews Beach Park, on Thornton Creek, Seattle. This project restores habitat lost when Lake Washington was lowered in 1916 as part of the Lake Washington Ship Canal Project.

7. **Multi-User Disposal Site (MUDS).** The District in cooperation with EPA, Washington State Department of Ecology, Washington State Department of Natural Resources, and Washington Public Ports Association are jointly evaluating the potential for developing a multi-user disposal site for contaminated sediments. The first phase of the study will ascertain the need for and potential to site, construct, and operate one or more multi-user disposal sites. In FY98, Seattle District and the Washington Dept. of Ecology prepared the preliminary draft of the programmatic environmental impact statement.

8. **South Aberdeen Cosmopolis Levee Project.** Complete restoration of three acres of estuarine habitat as part of mitigation for levee project. All construction for this project was completed in 1997.

9. **Sammamish Weir 1135 Project.** This project was constructed in summer of 1998, modifying the weir to allow easier fish passage during low flow periods. Riparian vegetation

was planted, with help from volunteers, to reduce heavy erosion occurring along the banks. Temperature and fecal coliform data were incorporated into the study plans and specifications were completed in 1997.

10. **Bear Creek 1135 Project.** This project will modify a flume-like channel that was dredged as part of the original Sammamish River flood control project. Meanders and riparian habitat will be restored. Large woody debris will be added to reduce velocities and provide holding and rearing habitat for adult and juvenile salmon. Water temperature and velocity considerations were paramount in the design of this project. The feasibility phase was completed and the project started the plans and specifications phase during 1998.

11. **City Light North 1135 Project.** This project will restore inter-tidal habitat in the Duwamish Estuary. The feasibility phase was completed and the plans and specifications phase was started.

12. **Green Duwamish General Investigation.** This basin restoration reconnaissance study was completed in 1997. The feasibility phase began in FY98 and an EIS is currently in progress.

13. **Stillaguamish General Investigation.** This study was in the feasibility phase during 1997. It examined existing data on water quality, vegetation, fish, and wildlife to determine the limiting factors to fish and wildlife population health.

14. **Wynoochee 1135.** FY97 progress includes final feasibility-level plans. Spring flow modifications as well as year-round power generation were investigated. Purpose of the project is to provide adequate fish passage and flow for juveniles; will also allow additional flexibility in adult passage.

15. **Howard Hanson Dam 1135.** FY98 progress included limited design of fish and wildlife habitat projects and changes to the water control manual. Purpose is to provide additional storage for supplementing instream flows and to improve habitat in the new inundation zone.

16**.** **LWSC Sound Guidance Study.** This study evaluated the use of low-frequency sound emitters as a tool to guide salmon and steelhead away from the lock chamber. Results showed a 15% reduction in smolt number when sound was turned on. This was not a significantly different from the control conditions. Seattle District recommended that sound guidance not be pursued as a guidance tool.

17. **Bellingham Pilot Project.** Seattle District, in cooperation with the Environmental Protection Agency, the Puget Sound Water Quality Action Team and the State of Washington Departments of Wildlife and Fisheries, Ecology, Natural Resources and Transportation, have entered into a joint working relationship with the Port of Bellingham, City of Bellingham, Whatcom County Department of Health, Lummi Tribe and the Nooksack Tribe to facilitate comprehensive contaminated sediment cleanup in Bellingham Bay. This process has been ongoing since September 1996, and has resulted in a range of comprehensive alternatives that will be evaluated in the draft State Environmental Policy Act (SEPA) Environmental Impact Statement. The mix of potential alternatives to be considered will evaluate various combinations of capped aquatic disposal (CAD), level bottom capping, nearshore confined, and upland disposal alternatives.

18. **Lower Columbia River Dredged Material Evaluation Framework.** This inter-agency 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 is 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 final document was signed by the agency heads in November 1998.Bellingham Pilot Project. Seattle District, in cooperation with the Environmental Protection Agency, the Puget Sound Water Quality Action Team and the State of Washington Departments of Wildlife and Fisheries, Ecology, Natural Resources and Transportation, have entered into a joint working relationship with the Port of Bellingham, City of Bellingham, Whatcom County Department of Health, Lummi Tribe and the Nooksack Tribe to facilitate comprehensive contaminated sediment cleanup in Bellingham Bay.

19. **Cedar River Habitat Conservation Plan.** The district is involved in negotiations with the City of Seattle concerning a new set of instream flows for a tributary of Lake Washington that supplies most of the inflow to the lake. Any change in instream flows will need to be examined closely for its effect on saltwater control and drafting of the lake. This flow agreement is part of a Habitat Conservation Plan (HCP) for the Cedar River. Parties to the agreement include the Corps, National Marine Fisheries Service, and US Fish and Wildlife Service as well as state agencies and an Indian tribe. A completed HCP would assure the City of a reliable water yield and minimum flow requirements in the event of an Endangered Species Act (ESA) listing in the basin. All parties are currently engaged in negotiating final details, though agreement is not certain. The Corps is seeking wording that would consider navigation in any future ESA listing. A listing of Puget Sound Chinook is likely in the near future. These HCP negotiations are likely to continue in 1998.

20. **Albeni Falls Eurasian Watermifoil Treatment**. Approximately 36 acres of Eurasian watermilfoil were treated with aquatic herbicides. This treatment is considered a "stop-gap" effort to kill off the tops of the plants and reduce the spread of plant fragments, the source of new or expanded infestations. This was considered the first step in an effort to control the spread of milfoil in the reservoir upstream of Albeni Falls Dam. Follow-up monitoring and treatments (systemic herbicides is planed for next year) will be need to eradicate the milfoil before it spreads upstream into Lake Pend Oreille. If the milfoil becomes established in sloughs and wetland areas off the main river channel, it will be effectively impossible to control. Corps interests will be focussed on the impacts at recreation areas and in wildlife management areas susceptible to milfoil growth.

21. **East Waterway Navigation Improvements.** The District is evaluating deepening of the channel in the East Waterway of the Duwamish River, flowing into Elliott Bay (Seattle). The District is also coordinating with the Port of Seattle concerning use of Slip 27 for disposal of dredged materials. This is a significant action under NEPA and SEPA because of contaminated sediments, and therefore 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 largest contract was with SAIC to biologically and chemically evaluate the dredge sediments.

22. **Puyallup River Levee Restoration.** Completed the construction of a 2-mile setback levee system. This resulted in the reconnection of 121 acres of floodplain along the

Puyallup River. The project incorporated levee vegetation planting and in-water structures for salmonid habitat enhancement. Approximately 1 mile of off-channel habitat was created for salmon spawning and rearing.

23. **Green River Habitat Conservation Plan.** The District is participating in the City of Tacoma's drafting of a Habitat Conservation Plan (HCP) for all water supply-related activities on the Green River. This HCP is distinct and unlike the Cedar River HCP for two reasons. First, the City of Tacoma has already negotiated for and reached agreement on minimum instream flows on the Green River. Second, Tacoma is a sponsor of the Howard Hanson Dam (HHD) Additional water Storage Project and the HHD Section 1135 project. Both projects seek to improve current operation of HHD for protection and restoration of instream resources. Like the Cedar River HCP, Federal, State and Tribal staffs are parties to the Green River HCP. The Corps is providing input to the HCP in ensure consistency with the ongoing HHD reservoir operation and the new planing projects. HCP negotiations are likely to continue through 1999.

24. **Lake Washington Ship Canal Section 1135.** This project began its reconnaissance phase in late FY97 and feasibility phase in the 2nd quarter of FY98. This project will improve juvenile salmon passage at the Chittenden Locks. Work in 1998 included analysis of 1) available water for spill during late spring/early summer, 2) design of various low-flow surface spill facilities, 3) design and evaluation of strobe light configurations for installation at filling culvert, and 4) consider a slower fill rate of the large lock chamber.

25. **Lake Washington Ship Canal Strobe Light Guidance Study**. This study began in FY98 and evaluated strobe lights as a means to guide juvenile salmon and steelhead away from the large lock filling culverts. Preliminary results showed a 90% reduction in fish density when strobe lights were on during filling of the lock chamber. Study results are being incorporated in the LWSC Sec. 1135 project and will be shared with other resource agencies for potential application on the Columbia River.

26. **Lummi Section 103 Rock Revetment Project**. As mitigation for the revetment project, District staff worked with the Lummi Indian Tribe to design-and-build a 600-ft channel for the purpose of providing juvenile salmonid passage into a shallow pond. The pond was deepened and a channel excavated into a nearby tidally influenced slough. The mitigation project provides juvenile salmon with access to a freshwater pond. Riparian plantings are planned to reduce erosion along the excavated banks. District staff cooperated in development of a monitoring plan for the site.

27. **Section 22 Study with the City Of Oak Harbor.** This study evaluated the potential to restore a 40 acre former farmed pasture to estuarine habitat. The potential restoration area was evaluated for hydrologic and biologic characteristics to determine the feasibility of restoration.

28. **Stillaguamish General Investigation.** This study in Snohomish County, WA, moved in to the feasibility phase during FY98. The study looks to evaluate about 10 sites for their potential for fish and wildlife restoration.

29. **Seattle City Light Section 1135.** This project to restore a creek and seven acres of habitat has moved into the plans and specs phase. Construction is scheduled for FY98.

30. **Puget Creek Section 1135.** This project seeks to restore about a half-acre of estuarine habitat. Construction is scheduled for this spring (March 1999).

31. **Sammamish Temperature Study.** Seattle District is working with King County, WA. ERS and H&H are performing a 2-dimensional water quality model of the Sammamish River. This involved deploying 10 temperature loggers in the system from mid May through early November 1998.

10.4 Walla Walla District

1. **Phase II DGAS Total Dissolved Gas (TDG) Field Sampling Effort on the Lower Columbia and Lower Snake Rivers (Normandeau, Dyntel, & WES).** The Dissolved Gas Abatement Study initiated in 1994 by the Corps to develop short- and long-term structural and operational solutions to total dissolved gas (TDG) supersaturation problem, continued to make good progress. This entire study is aimed at improving water quality. Though all aspects of it are pertinent to understanding the Walla Walla District water quality program, it will not be discussed at length herein. The Study Phase II (30%) Draft Report was released for review in March of 1997. The 60% Report is scheduled to be released for review in January of 1999. The level of resources devoted to dissolved gas in the District underscores its importance relative to the entire water quality program. The document will include reports on numerical modeling, physical field research and biological research. Also included will be WES Memorandums on near-field TDG spill tests at Ice Harbor and Little Goose dams and other experiments.

The general purpose of the study remained to identify measures to reduce TDG supersaturation, but the more specific goal to meet the 110 percent water quality criteria was replaced. The new goal of the DGAS, which really presents no change in direction, is to identify means to reduce TDG at the eight Corps projects on the Lower Snake and Columbia Rivers to the extent economically, technically, and biologically feasible. Ice Harbor spillway flow deflector construction was fast-tracked with completion of four deflectors in 1997, four more early in 1998 and the final two in early 1999. Near-field TDG studies were accomplished at Ice Harbor and Little Goose dams, followed by an abundance of in-pool TDG and water velocity field data collection throughout the spring and summer of 1998. Similar activities were accomplished at Portland District projects. NWP and NWW (lead districts), NWD, WES, and others actively participated in this effort.

The general study goals were to:

- ✓ Describe water quality (dissolved gases, temperature, etc.) spatial and temporal patterns and dynamics as related to project operation and hydrology throughout the study area,

- ✓ Provide TDG data from immediately below the spillways of selected projects during specifically designed spillway studies, and

- ✓ Continue assessment of the representativeness of the fixed water quality monitoring locations relative to dissolved gas distribution.

The requirement for spatially resolute TDG data, especially immediately downstream from the projects, demanded sophisticated approaches to TDG data collection. The resulting in-

formation is being utilized for developing numerical model representations of the projects and of the river system and to support alternative evaluation for gas abatement at the structures. To accomplish these goals, the field study team conducted extensive field research both prior to and during the fish passage spill season on the Lower Columbia and Lower Snake rivers. District staff assisted with this effort throughout the year.

To address objective (1) in 1998, the WES DGAS field data collection team targeted two or more adjacent pools at a time, making deployments throughout the mainstem Lower Columbia and Lower Snake Rivers over the season.. The sampling plan for each project focused on the deployment of instruments at a sufficient number of locations to adequately describe spatial variation of appropriate water quality parameters. Sampling stations were somewhat concentrated in the upstream reaches of each pool studied to better address areas characterized by the more dynamic spatial TDG gradients. The parameters measured for most stations included total dissolved gas pressure, dissolved oxygen concentration, water temperature, and instrument depth. Supplemental information for each station included water column depth, GPS position data, river mile, and lateral river quadrant. Water velocity data were also collected during at least one time during the deployment period. Meteorological data was collected for each area sampled. The instruments were deployed for a period of time from 2 to 4 weeks, long enough to capture the dynamics of multiple generation and spill cycles and to span 2-3 retention time cycles. Vertical water quality gradients were found to be minimal downstream of the project tailraces allowing for single depth deployments.

Near field studies were used to accomplish objective (2). The near-field study approach involved selecting two different Walla Walla District projects for detailed near field study during the 1998 spill season, Ice Harbor and Little Goose. Many of the structural alternatives under consideration for the abatement of total dissolved gas were sited in the near-field region of the dam subject to aerated flow conditions. The description of processes governing the exchange of dissolved gas in aerated flow conditions remains poorly understood. A series of field investigations were conducted to investigate the processes that contribute to dissolved gas transfer associated with spillway releases in the stilling basin and tailwater channel. Walla Walla District WQ personnel participated with the WES field team in these studies. The results from these studies have greatly contributed to the understanding of TDG production at CE projects under a wide range of operational and structural conditions. They form a basis to design dissolved gas abatement alternatives and estimate their effectiveness.

The third goal of the 1998 DGAS field data collection effort was to collect larger data sets of comparable information to better determine the representativeness of the fixed monitors. This was accomplished by deploying arrays of instruments along transects normal to the channel at the TDGMS stations. The data collected were then statistically compared to answer questions regarding what the data collected at the station represent relative to measurements taken in the river channel.

2. **Total Dissolved Gas Model** (Battelle). Development of the DGAS 2-dimension model progressed to the calibration phase, which was considerably enhanced by empirical data collected by the field team.

3. **Lower Snake River Feasibility Study (LSRFS**) (Normandeau Assoc., FTN, & WSU). Determination of Lower Snake River Reservoir Biological Productivity. Returning

the Lower Snake River to pre-impoundment water surface elevations would drastically alter the existing ecological balance in the lower Snake River reservoirs. With a shift from almost standing water to free flowing water, it is likely that autotrophic production will shift from the planktonic community to the benthic community, and that primary producer standing crop biomass per area could be lower. Walla Walla District continued a data collection and modeling effort that is aimed at assessing changes in temperature and productivity on the Lower Snake River brought about by drawdown of the four Lower Snake River Reservoirs to natural river level. The LSRFS Biological Productivity Study and the Baseline Limnological Study on the Lower Snake River reservoirs were completed to meet the needs of the LSRFS schedule. The modeling activity of this effort continues into FY99.

The Biological Productivity Study gathered ^{14}C uptake and attached benthic algal (ABA) growth data to facilitate development of a model to predict ecological changes brought about by returning the lower Snake River to pre-impoundment water surface elevations. The riverine portion of the model has been completed using data from free flowing reaches upstream of backwater effects on the Snake and Clearwater Rivers. Results from simulations of the restored system are being compared to the empirical data collected in the impoundments. Using this approach, it will be possible to predict primary and secondary productivity, including resident fish production under different operational scenarios.

The Baseline Limnological Study was continued as necessary for the affected environment portion of the EIS and to provide existing condition empirical data to compare model results with. This year (1998) was the fifth year of this study. The design of this study also lends itself to the development of a long term monitoring plan provided a few more years of consistent data collection are completed.

4. **A sediment GIS database** was completed to aid in the evaluation of distribution and possible redistribution of sediments likely in the case of reservoir drawdown for the LSRFS. Analyses of sediment grain size and chemical data are being accomplished in the context of what the water column impacts might be as scouring and erosion occur during and after dam breaching. The expected water quality will be compared to criteria for the chemicals of concern and related to the possible risk of toxicity due to re-suspension of sediments.

5. **Dredge Material Management Plan (DMMP).** Chemical contaminants from agriculture, transportation, and industrial activities typically accrue in sediments due to their tendency to adsorb on fine particles. Although previous data collected under the LSRFS already provided some information on contaminant distribution in the lower Snake River, a considerable amount of additional sampling was necessary for the McNary Pool. This investigation focused on the quantification of key contaminants in the sediments of the McNay impoundment.

Walla Walla District personnel, HDR, and Ralston & Associates, conducted a sediment sampling effort in the McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Reservoirs, as part of the Dredge Material Management Plan of Study (DMMP). Walla Walla District, Vizcaya Labs, Anetek Labs, and Quanterra Labs, analyzed McNary Pool and Lower Snake River Sediments for a variety of organic and inorganic constituents. Preliminary results suggest there is no detectable PCB contamination in the Lower Snake and McNary Pool Sediments. Additional work on precision and confidence will be required. The DMMP study will continue into FY99.

6. **Special Visit from the Corps Water Quality Committee (HQUSACE).** Early in the fiscal year Pete Juhle and members of the USACE Committee on Water Quality visited the Walla Walla District and discussed the water and sediment quality studies being accomplished under the Lower Snake River Feasibility Study. The committee toured the study area, listened to presentations, participated in workshops to become familiar with the project, and provided expert input. Committee members praised Hydrology branch for its efforts and stated that the data collection was efficiently conducted and provided adequate information. They suggested that a transport model would not be cost-effective and that the preliminary data reflect a low risk potential to aquatic life. They recommended that the District look at the system as an integrated ecosystem.

Water quality monitoring station

Fixing Water Quality Instrument….

11. PERSONNEL & TRAINING

PERSONNEL

1. In 1998 NWD-NP staff involved in all or parts of water quality staff totaled 37. There were 5 staff members in the regional office, 8 in NWP, 17 in NWS and 7 in NWW (See Table 1). Of these, only 17 may be considered as assigned full-time to water quality. Stay-in-school students and GSA support contractor employees also provided help. The estimated manpower devoted to reservoir water quality is about 26 man-years for the entire division. Sediment (dredging) and environmental quality represented an additional 5 man-year effort, for a combined total of approximately 31 man-years. Funding sources are about one third O&M and the remaining two-thirds, GI and others.

2. Staff's job classification and office symbols are shown below.

CENWD-NP-ET :	1 Civil Engineer, 1 Biologist
CENWD-NP-ET-WR:	2 Hydraulic Engineers, 1 Hydrologic Technician (+ 2 Stay-in-school)
CENWP-PE-HR :	3 Environmental Engineers, 1 Civil Engineer 2 Hydraulic Engineer, 1 Biologist 1 Hydrologic Engineering Technician (+1 Hydraulic Aid stay-in-school, (+1 GSA support contractor employee)
CENWS-EN-TD-HH-WM:	2 Hydraulic Engineers, 2 Meteorological Technicians, 1 Biologist
CENWS-EN-PL-ER:	5 Biologists, 1 Environmental Protect. Specialist, 3 Fishery Biologists
CENWS-OP-TS-DM	1 Environmental Engineer, 2 Biologists
CENWS-OP-TS-NS	1 Project Manager
CENWW-ED-H	1 Limnologist, 2 Hydrologic Technicians
CENWW-PL-ER	1 Environmental Specialist
CENWW-OD-NR	1 Landscape Architect

3. In CENWD-NP--ET-WR, Mary Todd Uhlir, fishery biologist, and Aaron Brown, stay-in-school, continued to be deeply involved in TDG monitoring, including data screening, corrections, analysis, Internet homepage posting and dissemination, and reporting. Nancy Yun, hydraulic engineer, continued to refine the necessary procedures for quickly and easily extracting data from the HEC-DSS Data Storage System, coordinate preparation of various graphs needed for annual reports, and operate and maintain water quality models. Mark McCann, another stay-in-school, continued development of the COLOSS decision support system.

Other Corps staff involved in data collection, retrieval and dissemination included:

- ✓ Jim Versteeg, CENWD-NP-ET-WH
- ✓ Rick Delaney, CENWD-NP-ET-WH

- ✓ Debra Petersen, CENWP-IM

In NWP, George Kalli was kept on as a Term employee to manage the District's water and sediment quality database, as well as to assist in water quality data collection and planning studies.

In NWS, Marian Valentine is in her fifth year as the District's water quality coordinator, under the direct supervision of Wayne Wagner, Water Management Section chief. David VanRijn, a new staff member to the Section, is gradually replacing her.

In NWW, a (GS-11) Limnologist and a (GS-9) Hydrologic Technician conducted water quality sampling field and laboratory analyses. A (GS-11) Environmental Resource Specialist accomplished many of the in-water work water quality permit and compliance coordination activities. The Hydrology Branch Chief (GM-13) provided leadership/oversight. Project employees conducted project swim beach and drinking water quality monitoring. Water quality and District laboratory functions were under the Reservoir Regulation Section of the Hydrology Branch. The Reservoir Regulation section staff consists of 1 GS-12 Hydraulic Engineer, 1 GS-11 Limnologist, and 3 GS-9 Hydrology technicians. The GS-11 and two G-S9 personnel are the only personnel in the district assigned permanent water quality duties. Staff specifically involved in data collection, retrieval and transmission to NWD included:

- ✓ Tom Miller, CENWW-ED-H
- ✓ Russ Heaton, CENWW-ED-H
- ✓ Gary Slack, CENWW-ED-H
- ✓ Jerry Wren, CENWW-IM-SB

4. Primary water quality contacts in each of the offices in 1998 were as follows: Bolyvong Tanovan (CENWD-NP-ET-WR), Dick Cassidy (CENWP-PE-HR), Marian Valentine (CENWS-EN-HH), and Dave Reese (CENWW-ED-H). At the management level, Bill Branch, Chief of the Water Management Division, and Cindy Henriksen, Chief of the Reservoir Control Center, are in the chain of command over NWD-NP's water quality program.

TRAINING

11.1 Regional Office

1. Mary Todd Uhlir took a class in reservoir limnology at Portland State University during the fall of 1998.

2. Bolyvong Tanovan, Nancy Yun and Mary Todd Uhlir took a one-week class on the 2-dimensional CE-QUAL-W2 water temperature model offered at Portland State University, Portland OR by the PSU and WES (Tom Cole) staff, September 7-11, 1998.

11.2 Portland District

1. Mike Posovich, Tim Sherman and Jim Britton attended training in ArcView GIS software in Portland, Oregon in September.

2. Jim Britton received training in Fundamentals of Wetlands in July at Olympia, Washington.

3. Mike Posovich attended HEC-HMS training at HEC at Davis, California in May.

11.3 Seattle District

1. Stephanie Stirling attended an 8-hour Health and Safety at Hazardous Waste Sites refresher training course at EPA, Region 10, Seattle, WA, January 1998.

2. Pat Cagney, Carolyn Fitzgerald, Fred Goetz and Ken Brownell attended a 32-hr natural streambank restoration workshop, focusing on hydro-geomorphic considerations, and sponsored by Inter-fluve, Inc.

3. Jeff Laufle attended a 3-day ecosystem restoration symposium held by EPA, Baltimore, MD, 29-31 July 1998.

11.4 Walla Walla District

1. No training activity to report.

Caspian Terns in the Columbia River Estuary

12. CONTRACT WORK

The Northwestern Division, North Pacific Region's 1998 total contract work was $2,671,027 -- about the same as the 1997's total of $2,664,600. Over 61 percent of that contract amount involved sediment quality. The remainder of the contracts covered water quality data collection, laboratory analysis, and field equipment and related maintenance services. The Regional office awarded no contracts in 1998. A detailed listing of the contract costs follows.

Table 9. Water Quality Contracts Awarded in 1998

12.1 Division Office (CENWD-NP-ET-WR)	Amount ($)
Region's Total	0
12.2 Portland District	
1. John Salinas, The Cascade Research Group, Murphy OR; water quality monitoring of Lost Creek and Applegate Lakes, Rogue River Basin, OR	36,983
2. Dave Canoy, Environmental Testing, Salem, OR; Lake Profiling at Green Peter and Detroit Reservoirs	3,000
3. Oregon State University (Steve Pearch, X-ray diffraction studies of sediment samples from Green Peter/Foster Reservoirs and tributaries.	1,250
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.	55,788
5. Jim Sweet, Aquatic Analysts, Portland OR: identify phytoplankton in samples from Fern Ridge Reservoirs.	2,048
6. Frontier Geo-Sciences, Seattle, WA: mercury analyses, Cottage Grove Reservoir.	8,000
7. USGS: TDG monitoring in lower Columbia River.	160,791
8. Forest Science Laboratory, OSU – nutrient analyses – Willow Creek Reservoir.	6,634
9. FMP Real Estate Lease – The Fishery - Warrendale, OR	1,200
10. Hal McEwen – FMP site repairs - John Day	9,166
11. Doug Larson – Willamette Valley Projects water quality report.	16,900
12. Doug Larson – FMP Annual Report & ISO9000 Report.	18,450
13. FMP site lease - Wauna	600
14. FMS equipment - Hydrolab Mini-sondes	36,352
15. Faith Ruffing. FMS Annual Report	15,920
16. STENNIS. FMS equipment rental DCP	10,678
17. USGS – operate/maintain cooperative stream gaging programs in Willamette, Rogue and Toutle River basins (see USGS Contracts table below for details).	168,720

NWP's TOTAL (WATER QUALITY)	552,480

SEDIMENT QUALITY	
18. Sound Analytical Services – Amazon Cr. Sediment analyses	1,866
19. Sound Analytical Services – O&M sediment analyses – Westport, Coos Bay & Depoe Bay	29,366
20. Sound Analytical Services – Astoria East Boat Basin sediment analyses	18,536
21. Sound Analytical Services – Columbia Slough sediment analyses.	21,760
22. Minester & Glaeser Surveying (boat & operator)	1,529
23. Bill Jaworski – Boat crew and sampling equip. – Astoria East Boat Basin Sediment evaluation.	7,500
24. Jerry Hempal – North Bend Oyster Co. – Boat & operator – Coos Bay sediment evaluation.	1,700
25. John Vlastelicia – Boat & operator – Columbia Slough & Westport sediment evaluations.	2,752
SEDIMENT QUALITY SUBTOTAL	**85,009**
NWP's TOTAL (WATER QUALITY & SEDIMENTS)	**637,489**

USGS CONTRACTS DETAILS

NUMBER	**LOCATION**	**COST ($)**
14159500	So Fork Mckenzie Rv , Nr Rainbow , Or	0
14162200	Blue River At Blue River, Or	0
14181500	North Santiam River At Niagara, Or	0
14187200	South Santiam River, Nr Foster, Or	0
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	14,180
14337500	Big Butte Creek Nr Mcleod, Or	14,180
14337600	Rogue River Nr Mcleod, Or	3,780
14337830	Elk Creek Nr Cascade Gorge, Or	14,180
14337800	Elk Creek Blw Alco Creek, Or	22,180
14337870	West Branch Elk Cr Nr Trail, Or	3,780
14338000	Elk Creek Nr Trail, Or	14,180
14338100	Rogue River At Trail, Or	14,180
14339000	Rogue River At Dodg Br Nr Egl Pt, Or	14,180
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
14372310	Rogue River Nr Agness	0
	USGS's TOTAL.	**168,720**

12.3 Seattle District	Amount ($)
1. Sediment quality studies for Howard Hanson	2,000
2. SAIC: Sediment Management Annual Review Meeting minutes	5,000
3. Striplin Environmental: Data entry for PSDDA projects (DAIS)	4,000
4. Striplin Environmental: Physical monitoring at the Commencement Bay PSDDA Site utilizing sediment vertical profile imagery	23,000
5. Striplin Environmental: Butyl Tin Study (TBT Questionnaire and Workshop)	23,000
6. U.S. Geological Survey (Montana District): Field water quality data collection/analysis on Lake Koocanusa (3 reservoir stations, 1 riverine station)	62,000
7. Common Sensing, Inc. (Clark Fork, ID): Dissolved gas sensor operation and maintenance for Chief Joseph forebay	11,000
8. SAIC: Sediment sampling on the Cedar River	23,000
9. SAIC: Sediment Management Annual Review Meeting minutes	4,000
10. Jones & Stokes: Silt curtain installation and monitoring on Cedar River	35,000
11. SAIC: Data entry for PSDDA projects (DAIS)	5,000
12. MIPR: Reimbursable to Portland District (NWP) in support of the Lower Columbia River Dredged Material Management Plan development	13,000
13. Applied Research & Develop Lab: Water and sediment quality analysis on Thornton Creek	3,000
14. Striplin Environmental: Crab surveys in Grays Harbor	52,000
15. Striplin Environmental: Sediment sampling in Blair Waterway, Tacoma	23,000
16. SAIC: Sediment sampling in Grays Harbor	63,000
17. SAIC: Sediment sampling in East Waterway	1,000,000
TOTAL NWS DISTRICT (with sediment water quality) (Total without sediment quality: $73,000)	$1,351,000

12.4 Walla Walla District (* denotes items mostly related to sediment quality)	Amount ($)
CG Contracts	
1. Normandeau Associates (Delivery Order 7) and subcontractors Washington State University, University of Idaho and FTN Associates continued the limnological baseline study of Lower Granite, Little Goose, Lower Monumental and Ice Harbor Reservoirs and Biological Productivity Study and Modeling for the LSRFS (*).	293,193
2. Normandeau Associates (Delivery Order 7) and subcontractors Washington State University and University of Idaho to provide the Water Quality Appendix to the LSRFS DD/EIS including evaluation of sediment contaminant conditions and transport (*).	114,000
SUB TOTAL CG	407,193
3. HDR Engineering DMMP sediment sampling project. With subcontractors: Anetek and Goulder Assoc. Potential contaminants that could	77,910

affect dredge operations in McNary Pool and Snake River. Study built upon existing data collected during the LSRF Phase one and Two (*).	
4. Vizcaya Laboratories for nutrients, metals, petroleum hydrocarbons and Organic analysis, and PCBs, for sediment and water samples from McNary Pool and Lower Snake River Samples (*).	45,752
5. Endeco/YSI, For photosynthetic active radiation (PAR) sensor used in the measurement of light penetration and photic zone interpretation	2,900
6. The Boat Yard. Boat repair	6,061
7. Ralston and Associates, Lucky Peak water quality sampling	4,800
8. Mettler-Toledo, balance maintenance	392
9. Hydrolab Corporation for spares and repairs	8,570
10. Sunelco for solar equipment	3,024
11. GSA for hand tools	725
12. Sigma –Aldrich for chemicals	138
14. Newark Electronics for TDGMS parts	735
15. Pak and Ship for transport and crating of water quality equipment	696
16. GRE radios for spares and repairs of GINAs	2,246
17. HPC for lab supplies	1,836
18. Mike's two way radio for VHF repairs	340
19. Compliance Technology, modification to calibration chamber for TDGMS	2,100
20. Platt Electric Supply for TDGMS parts	310
21. Anetek Labs for sample analysis	1,520
22. HDR Engineering, complete design and installation of two TDGMS monitoring sites complete with communications, DCPs and Instruments. Approximately 65% of costs were associated with hardware. Estimated installation cost per station was approximately $8,600 each.	38,306
23. Onset corporation temperature measurement device	132
24. Berntsen International for Corps survey caps	765
25. Alpha Designs for TDGMS membranes	2,250
26. Cal Glass Research for nitrate reduction columns	427
27. GBL to SPD lab for movement of excess equipment	3,000
28. HDR Engineering Sediment range survey project. With subcon-tractor RSI, HDR conducted a sediment survey of Ice Harbor and Little Goose poll. The information will be used to further develop the district sediment quality analysis tools (*).	62,000
29. Zoom modems, modems	956
30. Project Drinking Water and Swim Area Water Analyses • Walla Walla City-County Health Department, potable and swim beach water quality analyses for Mill Creek, McNary and Ice Harbor. • Coffry Laboratories, drinking water and swim beach water quality analysis for McNary Project parks. • Benton-Franklin District Health Department, drinking water analysis for Ice Harbor and Lower Monumental projects. • Whitman County Public Health Service for analyses of Lower Granite	 1,445 170 1,500

and Little Goose drinking water. • Confluence Water Testing Laboratory, Swim beach and drinking water analyses for Clarkston Resources Office and Dworshak. • Analytical Laboratories, Boise, ID, analysis of swim beach and drinking water for Lucky Peak Project. • Anatek Labs, drinking water analyses for Mill Creek Project.	340 2,010 710 1,275
SUB TOTAL O&M:	275,345
SUBTOTAL CG	407,193
SUBTOTAL WATER QUALITY	592,855
SUBTOTAL SEDIMENT QUALITY (*)	89,683
TOTAL NWW's WQ PROGRAM CONTRACT BUDGET	682,538

RECAPITULATION	Water Quality Contracts ($)	Sediment Quality Contracts ($)	Total Contracts ($)
CENWD-NP	0	0	0
CENWP	552,480	85,009	637,489
CENWS	73,000	1,278,000	1,351,000
CENWW	89,683	592,855	682,538
GRAND TOTAL NWD-NP	**715,163**	**1,955,864**	**2,671,027**

Scenic View in the Vicinity of Grand Coulee Dam

13. MEETINGS & CONFERENCES

13.1 Regional Office

1. Water Quality Section staff (Bolyvong Tanovan, Nancy Yun and Mary Todd Uhlir) 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 meetings of the multi-agency Technical Management Team discussing weekly flow augmentation operations for fish during April-August 1998. Attendance at NMFS's Dissolved Gas Team meetings was also quite frequent. Dr. Tanovan is the Corps alternate member on the Team, which is chaired by the Corps representative. He is also the Corps' representative on the DGT and Ms. Uhlir is one of the three alternates.

2. Cindy Henriksen, Chief of the RCC and Dr. Bolyvong Tanovan attended the international conference and workshop on "Toward Ecosystem-based Management" organized by the Sustained Fisheries Foundation in Castlegar, British Columbia April 27-30, 1998. They presented papers on Columbia River System Management and Spill Management.

3. Dr. Bolyvong Tanovan represented the North Pacific Division at the Corps Water Quality Committee (CWQ) thirty-sixth meeting held in Kansas City, MO June 1 and June 5, 1998. This Committee meeting at the Wyndham Garden Hotel included an assessment of the concurrent Corps 12th Water Quality seminar hosted by the Kansas City District of NWD-MR and the FY 1999 Civil Works Program Review for the Water Quality Research Program (WQRP). Ms. Uhlir also attended the Seminar under the theme of 1998 Technology Transfer and Towards an Integrated Environmental Mission. Both Dr. Tanovan and Ms. Uhlir presented papers at the seminar (see reports).

4. The WQS staff participated in a one-day information-sharing meeting with other division and district staff involved in regional multi-species consultation held in the Water Management Division on June 30, 1998. Topics discussed included system flood control, real-time operation scheduling, system spill priority, meeting State water quality standards, and review of pertinent district activities (e.g., Willamette Basin Review, Chief Joseph TDG Abatement Study, Snake River drawdown, DGAS, etc.).

5. Dr. Bolyvong Tanovan, Nancy Yun and Mary Todd Uhlir attended an in-progress review meeting in Richland, WA on August 11, 1998. NWW had arranged for Division staff and others to familiarize themselves with the one- and two-dimension TDG models developed by Battelle Northwest for the DGAS Study, under a contract managed by the Walla Walla District.

6. Dr. Bolyvong Tanovan and Mary Todd Uhlir participated in a field trip to Chief Joseph and Grand Coulee Dams organized by the DGT and SCT (System Configuration

Team), September 20-23, 1998. The trip's objective was site-assessment of potential TDG abatement alternatives at those two projects. It also included a visit to the Columbia Fish Farm, located below Grand Coulee, that had periodically suffered from high TDG generated by spill at Grand Coulee.

7. Dr. Bolyvong Tanovan attended the US-Canada TDG Transboundary Committee meetings in Spokane, WA June 11, 1998 and in Richmond, Canada October 15, 1998. He made presentation on the Corps' TDG Monitoring and Past TDG Abatement Measures. He also attended several meetings of the Steering Committee in Portland, OR designed coordinate preparation of a basin-wide plan of action for abating TDG at dams on both sides of the international border.

8. At Headquarters' instigation, Cindy Henriksen, Chief of the RCC and Dr. Bolyvong Tanovan also attended a US Committee on Irrigation and Drainage conference on "Shared Rivers" in Park City, UT October 28-30, 1998. They presented papers on the Corps' role in bringing back Pacific salmon and on real-time spill management at Federal Columbia River Dams.

9. Dr. Bolyvong Tanovan, Mary Todd Uhlir and Laura Dutt attended EPA's second annual seminar on water temperature in Portland, OR December 3-4, 1998. The seminar dealt with a wide variety of water temperature-related issues, including tributary TMDL, global warming and problems experienced by a non-dammed system such as the Frazer River Basin in Canada. NWD-NP Deputy Commander, Colonel Mogren, was also in attendance as moderator for the session on global warming.

13.3 Portland District

1. Tim Sherman Mark Siipola attended a Contaminated Sediments seminar sponsored by the Environmental Law Education Center in January 1998 at the World Trade Center, Portland, OR.

2. Tim Sherman and Mark Siipola attended a seminar, Portland Harbor Sediment Study, sponsored by the Department of Environmental Quality in May 1998 at the World Trade Center, Portland, OR.

3. Tim Sherman attended the Dredged Material Assessment & Management Seminar co-sponsored by the Corps and EPA July 28-30, 1998 in Buffalo, NY.

4. Mark Siipola attended the Dredged Material Assessment & Management Seminar co-sponsored by the Corps and EPA July 28-30, 1998 at the Convention Center in Portland, OR.

5. Mark Siipola attended a Contaminated Sediments course sponsored by the Environmental Law Education Center in September 16, 1998.

6. Jim Britton attended Oregon DEQ's Mercury Working Group meetings held twice a year at DEQ Headquarters, Portland, OR.

13.3 Seattle District

1. David Kendall, David Fox, Stephanie Stirling participated in the tenth PSDDA Annual Review Meeting, which was held concurrently with the Washington State Sediment Management Standards (SMS) Annual Review in May 1998. The one-day meeting was hosted by EPA and moderated by Brian Applebury, Chief Operations Division.

2. Stephanie Stirling attended the World Congress of Dredging Associations , Las Vegas NV, June 30-July 2, 1998. She presented a paper on the interagency process for review of beneficial use projects in the Pacific Northwest.

3. Jeff Laufle represented the Corps on the Kootenai River White Sturgeon Recovery Team. The team presented a final draft recovery plan to the US Fish and Wildlife Service Region One Director, on October 1, 1998. The plan included several recommendations regarding water management and increasing dam release capacity.

13.4 Walla Walla District.

1. Tom Miller attended the 17th International Symposium of the North American Lake Management Society (NALMS) December 2-6, 1997 in Houston, TX. He presented a paper titled "Automated Remote Monitoring of Total Dissolved Gas on the Lower Snake River".

2. Tom Miller participated in Columbia/Snake Mainstem Water Temperature Work-group meetings throughout the year.

3. Tom Miller attended the Corps of Engineers 12th Seminar on Water Quality, "Water Quality 98", in Kansas City, MO where he gave a presentation titled " Predicting Productivity Changes Brought About by Return to Natural River Level".

4. Tom Miller participated in the Transboundary Gas Group meeting in Spokane, WA on June 11, 1998.

5. Tom Miller gave a presentation titled "Dissolved Gas Abatement on the Lower Snake River" at the University Committee on Water Resources (UCOWR) Conference in Hood River, OR, August 4-6, 1998.

6. Tom Miller and Dave Reese attended the 1998 Post Season TDG Monitoring Review at NWD Headquarters on October 5, 1998.

7. Tom Miller participated in the Transboundary Gas Group meeting in Richmond, B.C. Canada, on October 15, 1998.

8. Tom Miller attended the 18th International Symposium of The North American Lake Management Society. He chaired a session titled, "Returning the Lower Snake River to a Normative State: Changes in Physical, Chemical and Biological Aspects of the System", He also gave a presentation titled "Breaching the Four Lower Snake River Dams: Background and Evaluation of Likely Changes in the Aquatic Environment".

9. Tom Miller attended the Columbia/Snake Mainstem Water Temperature Workshop in Portland, OR, December 3-4, 1998. He gave a presentation on the LSRFS Biological Productivity Model there.

Corps and EPA Staff Discussing Water Quality Problems (1998)

14. FUTURE WATER QUALITY OBJECTIVES

Many of the 1998 water quality objectives will be extended into 1999.

14.1 Regional Office

CENWD-NP-ET-WR

1. Continue to coordinate and monitor the annual dissolved gas saturation monitoring program;

2. Continue to plan and implement safe and efficient spill during the fish migration season;

3. Continue to 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 forum dealing with compliance issue involving dissolved gas and other water quality parameters, and

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

14.2 Portland District

WATER QUALITY

1. Continue limnological and routine water quality monitoring at Lost Creek and Applegate Lakes, Rogue River Basin, Oregon; 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.

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. Explore the possibility of entering into a Memorandum of Agreement (MOA) with the State of Oregon regarding these rules.

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 in Cottage Grove Reservoir by measuring loading during storm events.

6. Prepare reports on the limnology and water quality of Applegate and Lost Creek Lakes that reflects data collected from the mid construction to the present.

7. Continue routine monitoring of Willamette System reservoirs through profiling of basic water quality parameters.

8. Obtain historical data collected by USGS and contractors for entry into District water quality database.

9. 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 program.

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

11. Continue to support the volunteers at Fern Ridge Reservoir who assist in collecting water quality data.

12. 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.

13. Finish analysis of impacts John Day Dam drawdown alternatives on water quality.

14. Develop plans and specifications for water quality monitoring during construction of the Selective Withdrawal Tower at Cougar Reservoir.

SEDIMENT QUALITY

1. Continue the District-wide sediment quality evaluation program at Operations and Maintenance dredging projects. During 1999, sediment quality evaluations are planned to be conducted in the Columbia River, Lower Willamette River, Coos Bay and John Day as part of the John Day Draw Down Reconnaissance Study.

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

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

4. Continue to participate in the Columbia River National Estuary Program.

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

6. Continue to participate in development of the Columbia River Regional Testing Manual for sediment quality evaluation.

14.3 Seattle District

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

2. Continue development and application of an operational water temperature model for Libby Dam to aid in determining the effects of Kootenai River white sturgeon flows (as required by the Endangered Species Act).

3. Develop and implement a total dissolved gas monitoring program for Libby Dam and the Kootenai River in the event of spill.

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 coordination with other federal, state, and local agencies involved in water quality programs, on all project planning, construction and operating efforts.

7. Insure that water quality assessment and water quality goals are included in watershed evaluations conducted by the District.

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

9. Continue the sediment monitoring program at HHD as part of the drawdown of the turbidity pool.

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

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

14.4 Walla Walla District

1. Transition from database management activities, and concentrate on data collection, analysis, and interpretation of water quantity and quality information. Continue to develop

methods and tools to improve the District's ability to make determination of facts and assist district operations in using water quality information.

2. Continue research and development of the hyperbaric chamber and improved precision pressure transducers. Further develop a comprehensive QA/QC program to validate the district's technical supremacy in measurement and evaluations of total dissolved gas generation at hydroelectric plants.

3. Continue Research and development of the submersible integrated physical water quality analysis platform and submarine photometer. Integrate additional parameters as necessary to correlate photon energy and primary productivity indication.

4. Continue development and improve understanding of the sediment quality interpretive skills. This includes geo-referencing existing data and future data and implementation of an automated dredge material quality evaluation tool.

5. Increase Routine Water Quality Sampling efforts in scope and duration.

6. Increase the amount of interpretive work in primary productivity and eutrophication trend detection through the implementation of long term monitoring plans.

7. Develop a manual that outlines the District Water Quality Program. The Manual will describe the standard operating procedures used by the Reservoir Regulation Section to establish, develop and conduct water quality investigations. It will also outline the QA/QC procedures and policies pertinent to water quality.

8. Continue to improve and enhance the capabilities of the District TDGMS to surpass 95% reliability of the fully automated system. Complete a Water Quality Manual that describes the structure and function of the system. The document should include QA/QC and reporting requirements, and operating procedures.

9. Provide technical and coordination expertise for Planning and Engineering studies (e.g. CG & GI).

10. Improve coordination and exchange with NWD and other Districts.

APPENDIX: NWD ENGINEERING REGULATION ON WATER CONTROL MANAGEMENT, WATER QUALITY-- DRAFT

(This regulation will, upon formal approval by Management, supersede NPDR 1110-2-101 dated 6 November 1978)

*NWDR 1110-2-101

DEPARTMENT OF THE ARMY
NORTHWESTERN DIVISION, CORPS OF ENGINEERS
North Pacific Region P.O. Box 2870 Portland, Oregon 97208-2870
Missouri River Region 12565 W. Center Road Omaha, Nebraska

CENWD-NP-ET-W
CENWD-MR-ET-R
Regulation No. 1110-2-101
(DRAFT) 28 December 1998

Engineering and Design
WATER CONTROL MANAGEMENT, WATER QUALITY

Supplementation of this regulation and/or of other local forms of regulatory guidance is prohibited without prior approval from CENWD-NP-ET-W and/or CENWD-MR-ET-R.

1. PURPOSE. This regulation provides guidance to Corps of Engineers Districts within the Northwestern Division (NWD) for water quality data collection, reporting, storage, and analysis activities necessary for supporting water management functions, and to provide for the periodic reporting to higher authorities of these and other water quality related activities.

2. APPLICABILITY. This regulation is applicable to existing NWD civil works projects, exclusive of marine/estuarine, groundwater and dredging projects.

3. REFERENCES. Publications listed below may be found on the following Corps of Engineers webpages:
http://www.usace.army.mil/inet/usace-docs/eng-tech-ltrs/etl-all.html
http://www.usace.army.mil/inet/usace-docs/eng-regs/cecw.htm

a. Required Publications.

(1) ER 15-2-4 (Committee on Water Quality, 24 April 1992), cited in paragraph 11a.
(2) ER 1110-1-261 (Quality Assurance of Laboratory Testing Procedures, 31 March 1998), cited in paragraph 6.
(3) ER 1110-1-8100 (Laboratory Investigations and Testing, 31 December 1997), cited in paragraph 6.
(4) ER 1110-2-240 (Water Control Management, 8 October 1982), cited in paragraph 9.
(5) ER 1110-2-8154 (Water Quality and Environmental Management, 31 May 1995), cited in paragraphs 4c(1), 7a, and 7b.

(6) ETL 1110-2-252 (Quality Control of Water Quality Field Sampling, 30 June 1980), cited in paragraph 7a.

b. Related Publications.

(1) ER 1110-1-263 (Chemical Data Quality Management For Hazardous, Toxic, Radioactive Waste Remedial Activities, 1 April 1996).
(2) ER 1110-2-1403 (Coastal, Hydraulic and Hydrologic Studies, 1 January 1998).
(3) ER 1110-2-1941 (Drought Contingency Plans, 15 September 1981).
(4) ETL 1110-2-239 (Nitrogen Supersaturation, 15 September 1978).
(5) ETL 1110-2-244 (Water and Wastewater Laboratory Quality Control, 14 May 1979).
(6) ETL 1110-2-253 (Measurement of Dissolved Gas, 26 September 1980).
(7) ETL 1110-2-281 (Reservoir Contaminants, 17 June 1983).
(8) ER 1110-2-1462 (Water Quality and Water Control Considerations for Nonfederal Hydropower Development at Corps of Engineers Projects, 20 February 1991)

4. RESPONSIBILITIES.

a. Corps of Engineers' responsibilities for water quality at Corps civil works projects include the effects of the impoundments on the quality of water in storage and water released downstream, and their relationships to federal and state standards.

b. At the Division level, the North Pacific Region's Water Management Division (CENWD-NP-ET-W) and the Missouri River Region's Reservoir Control Center (CENWD-MR-ET-R) will serve as the coordination point for impoundment-related water quality activities of the Division.

c. Each District is responsible for:

(1) Establishing and implementing, for each civil works project that has a potential for significant negative environmental impacts, a comprehensive water quality management program including specific water quality management objectives and/or goals consistent with ER 1110-2-8154.

(2) Keeping the Division's water quality management staff informed of potential and actual water quality problems, and corrective actions to be undertaken.

(3) Reporting annually on and preparing a management analysis of the District water quality programs and activities.

(4) Performing any corrective actions necessitated by water quality emergencies.

d. In order to provide an effective, coordinated water quality program, the District Engineer will assign a functional element, preferably one that is connected with water management, the responsibility for the coordination of District water quality activities. This coordination includes internal coordination with project managers and environmental planners in the various District elements, and with the Division regional office. All water quality concerns during pre- and post-authorization planning, construction, and operating phases of civil works projects are to be considered.

5. COORDINATION WITH OTHER AGENCIES. Each District's water quality management programs at both existing and proposed projects should be coordinated with relevant programs of Federal and State agencies, especially with regard to water quality and pollutant source monitoring. All practicable methods for sharing the work and cost should be explored. The District functional element tasked with water quality coordination responsibility mentioned above should coordinate this activity to ensure continuity and consistency.

6. PROCUREMENT OF WATER QUALITY LABORATORY SERVICES. ER 1110-1-8100 provides guidance on freshwater and saline water quality testing and related services. When circumstances preclude using in-house laboratory services, water quality testing services may be obtained by contract with other laboratories. Before contracting for such services, a quality assurance inspection should first be conducted as required by ER 1110-1-261.

7. WATER QUALITY SURVEYS AND STUDIES.

a. The scope of water quality management programs and sampling frequencies of specific projects should be in accordance with ER 1110-2-8154 and ETL 1110-2-252.

b. Pre-impoundment investigations should be made to collect physical, chemical and biological data to define existing baseline water quality conditions, and predict future environmental impacts. Use of mathematical modeling techniques is encouraged for the modeling of future conditions, including development of detailed design and operating criteria. Water quality objectives for these investigations must be established in accordance with ER 1110-2-8154.

c. Post-impoundment investigations and water quality surveys will be made to ensure that Corps civil works projects are meeting applicable state standards. If necessary, alternative solutions to the identified problem areas must be formulated, including a prediction of the expected water quality improvements that would result. Priorities for such investigations should be as follows:

(1) Problems that threaten or affect an authorized project use of storage or project function.
(2) Problems that violate stream standards.
(3) Situations in which water quality conditions may be enhanced.

d. Maintenance monitoring schedules will be established and maintained for all Corps impoundments to detect significant changes in water quality in the impoundments and in the downstream area influenced by project discharges. Parameters monitored will include, but not be limited to, those parameters found to be of concern during the initial water quality investigations and/or surveys, and needed for discharges regulation and future facilities design.

8. FUNDING.

a. Programming. In preparing budget requests, plans must consider systematic progress toward comprehensive and responsive water quality management programs. Close coordination should be maintained between Engineering, Planning, Construc-

tion/Operations, and Navigation functional elements for developing adequate funding for these programs.

b. Budgeting. Budgeting will be accomplished in accordance with the guidance furnished by HQUSACE for each annual budget submission. Water quality data collection, processing and analysis required for project operation will be considered among the highest priority water control management activities in the budgeting process.

c. Cost Data. Pre-authorization studies that include water quality activities will be funded by the appropriate survey authority. Water quality investigations for authorized projects and projects under construction will be charged to the applicable appropriation and feature account. Water quality programs conducted at completed projects will normally be funded by the O & M, General Appropriation, and costs will be reflected in the Water Control management feature (609) on the PB-2a form.

9. WATER CONTROL MANAGEMENT. The quality of reservoir releases must be controlled in strict accordance with the reservoir regulation manual, applicable water quality standards, and ER 1110-2-240. District water quality elements will periodically review basinwide water quality data collected, with special attention to reservoir and downstream water quality during low flow periods or other adverse water conditions. Corrective actions for water quality problems will be considered concurrently with related quantitative hydrologic conditions.

10. DISTRICT ANNUAL WATER QUALITY REPORT.

a. Reporting Requirements. The districts will E-mail the District's Annual Water Quality Report to the applicable regional office, Attn: CENWD-NP-ET-WR or CENWD-MR-ET-R, by 15 December each year. Based on districts and other pertinent inputs, the regional offices will compile two separated Division Annual Water Quality Management Reports, one for each region, by 1 February. The regional offices will post these reports on the regional office Internet homepage and inform HQUSACE accordingly. The districts may post the same reports, in their entirety or just the portions related to their projects, on the district homepages. This new reporting method is as outlined in a CECW-EH-W guidance letter dated 3 November 1998.

b. General.

(1) The District's Annual Water Quality Report should include concise summaries of water quality activities conducted at all District water control projects during the past calendar year. All planned activities for the forthcoming year, and use of data management systems should be included. Sufficient detail should be furnished for significant items to permit their inclusion in the Division's Annual Water Quality Management Report. Minimum requirements for the Division report are summarized in Attachment 1.

(2) Tabulations of routine data should not be included in the annual report. Such data are to be maintained by the District and be readily available upon request.

(3) The District's Annual Water Quality Report should be prepared in two separate parts. The first portion should address the District's overall water quality management program and highlight significant water quality accomplishments. The second portion should present a project by project summary.

c. Part 1. Program Status and Projected Activities. The following areas should be addressed:

(1) Technical Staff Capabilities
(2) Relationship between Water Quality and Water Control Management Activities
(3) Contracted Workload
(4) Laboratory Facilities. including any Laboratory inspection
(5) Data Management Systems
(6) Training and Areas of Needs
(7) Coordination with Other Agencies
(8) Research and Development Needs
(9) Special Studies Completed or Required.

d. Part 2. Project Summary. This part should provide basic information on all pertinent factors affecting water quality for each reservoir project. This information should include, whenever applicable, the following items:

(1) Watershed Characteristics
(2) Project Description and Background Information
(3) Physical Project Elements Affecting Water Quality (including presence/absence of selective withdrawal facilities)
(4) Project Water Quality Management Activities
(5) Project Regulation/Operation Required to Meet Water Quality Objectives
(6) Description of Water Quality Data Collection Program
(7) Overall Water Quality Conditions and Trends
(8) Special Regulation Activities that Impact on Water Quality
(9) New or Modified Water Quality Data Collection Programs
(10) Problems Encountered at Each Project
(11) Plans to Address Identified Problems
(12) Progress on Solving Past Problems
(13) Progress on Solving Present Problems
(14) Discussion on How Well Each Project Met Its Water Quality Objectives and Re-evaluation of Each Project Objective
(15) Possible Corps-wide Application of Available Data
(16) General Recommendations

11. CONSULTING SERVICES.

a. ER 15-2-14 establishes procedures for requesting consulting services from the Corps' Committee on Water Quality. District offices are encouraged to use these services and should direct questions pertaining to or requests for this service to the applicable Division regional office (CENWD-NP-ET-WR or CENWD-MR-ET-R). Some of the services currently provided by the Committee on Water Quality are as follows:

(1) Review of Water Quality Reports

(2) Design of Data Collection Programs
(3) Predicting Water Quality Effects
(4) Methods of Data Evaluation and Interpretation
(5) Investigations Related to Legislative Requirements such as P.L. 92-500
(6) Coastal and Estuarine Water Quality Programs.

b. Districts are encouraged to seek the expertise available in the Division office, other NWD Districts and Corps offices to help solve their technical problems.

12. WATER QUALITY MEETING. A Division's Water Quality Meeting will be held once every two years to provide a forum for collective discussion on and review of activities, problems, coordination, etc. To the extent feasible, the meeting will be rotated from District to District within the Northwestern Division. When applicable and feasible, bi-annual meetings may also be held in conjunction with other national water quality meetings.

FOR THE COMMANDER:

CLIFTON P. JACKSON, JR.
Executive Assistant

ATTACHMENT 1. Minimum Division Report Contents to meet Headquarters Special Requirements and Needs (Reference CECW-EH-W letter dated 3 November 1998)

(a) Narrative summary of the water quality management program for the reporting FY including highlights of division and district activities.

(b) Description of the Goals and objectives of the division's overall water quality management program, progress made toward meeting those goals and plans for next FY. Include a copy of the most current division water quality regulation.

(c) Tabular summary of water quality staff indicating technical expertise (modeling, chemistry, limnology, aquatic biology, wetlands, hydrologic engineering, etc.), years involved in water quality work and grade. Indicate any staffing changes from last year's report.

(d) Brief description of each district's water quality sampling program, including strategy, QA/QC, data management (i.e. data storage, analysis and interpretation). Describe collaboration and coordination within the Corps, with other agencies and with other interested parties. Coordination between water quality and water control management activities.

(e) List research and development needs related to water quality activities

(f) Present brief project by project narrative summary of water quality conditions, including problems and achievements and how these were addressed. Indicate for each project if there is a water quality management plan with clearly stated goals and objectives. Indicate how ell those goals and objectives are being realized.

(g) Describe special regulation activities, new or modified data collection programs, plans to address the identified problems, innovative techniques, etc. that may be applicable to other locations.

PART II


Water
Management
For The Pacific Northwest Reservoir System

1998
WATER QUALITY ANNUAL REPORT
PART II. SPECIFIC PROJECT INFORMATION

PORTLAND DISTRICT

1. **Rogue River Projects/Lost Creek Lake-Applegate Lake Water Quality**

a. Summary. John Salinas, The Cascade Research Group, is collecting monthly secchi, nutrient, phyto/zooplankton and hydrolab profiles at Lost Creek and Applegate Lakes. This work will continue from April through November of each year until November of 2001 depending on funding. Temperature data collected downstream of the dam are used throughout the summer and fall drawdown period to estimate the week-to-week availability of "cool" water stored in the impoundments. Based on these estimates, "cool" water is apportioned in releases during this critical period, thereby maintaining release-flow temperatures required for fisheries protection and enhancement.

b. Proposed Activities. Work will continue in 1999.

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. The model is used by Portland District to predict seasonal turbidity regimes for Elk Creek reservoir and release flows. 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 1999.

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 1998. A total of 8 field trips were made in 1998. They will continue on a 5-year contract ending in 2001. An added emphasis of the new contract will be to collect inflow, in-lake and outflow water quality data for future modeling efforts.

b. Proposed Activities. Limnological and water quality studies, including research on methane production, will continue in 1999. An effort will be made to determine nutrient loading and fecal concentrations during spring runoff.

4. **Cottage Grove Reservoir**

a. Summary. Oregon DEQ collected water samples at the logboom, upper wetlands and Coast Fork Willamette inflows. They also collected fish at these sites. The purpose was to 1) determine if anoxia, which develops in deep water near the log-boom, is associated with increased methyl mercury in water; 2) to determine if wetlands are correlated with methyl mercury production; and 3) to determine if a correlation exists by site with fish tissue mercury levels.

b. Proposed Activities. In 1999 efforts will continue, in cooperation with Oregon DEQ, to study mercury processing in the reservoir.

5. **Cougar Reservoir**

a. Summary. In 1998 there were two activities. 1) GPS locations for historical and current water quality sampling sites were determined. 2) John Hains from WES completed application of the SELECT model to predict outflow organic carbon and nutrient concentrations via proposed selective withdrawal.

b. Proposed Activities. In 1999 contract specifications for water quality monitoring during construction of the Selective Withdrawal Tower will be developed.

6. Middle Fork Willamette Projects

a. Summary. Routine water quality monitoring continued this year. Lake profiles were taken at Cottage Grove, Dorena, Hills Creek, Lookout Point, Dexter, and Fall Creek. A contract was awarded for preparing a report on historical water quality at these projects. The report is due in the fall of 1999.

b. Proposed activities. Portland District in cooperation with Oregon's DEQ, will continue mercury studies at Cottage Grove and Dorena Reservoirs. The study plan will be finalized in Spring of 1999. A review of water quality problems and monitoring activities will also be undertaken in the spring of 1999. One topic to be addressed is TDG below projects where fish concerns are paramount.

7. **Willamette Valley Projects**

a. Summary. A series of water quality profiles were taken at Cottage Grove, Dexter, Dorena, Fall Creek, Hills Creek, Lookout Point, Green Peter, Foster, Detroit and Big Cliff reservoirs. Parameters included temperature, turbidity, depth, redox, TDS, dissolved oxygen (DO), pH, and conductivity. Data were collected at least at each reservoir.

b. Proposed Activities. Continue general water quality monitoring as before. A start will be made on entering historical data into the District database. A report on historical water quality will be due in September 1999. In the spring of 1999 District water quality specialists will meet with project personnel to assess water quality monitoring needs.

8. Fern Ridge Reservoir

a. Summary. Lake volunteers collected water quality data at the lake for a third year. The effort was coordinated by Project and District personnel with help from Mark Sytsma from Portland State University Biology Department. James Beal, the Project supervisor recruited and trained the volunteer staff as well as coordinated their effort. The project office maintains a database of the data that is sent to the District office for inclusion in the District database. Once each year, District (Jim Britton), Project (James Beal) and PSU (Mark Sytsma) hold a coordination meeting that results in the next year's effort.

b. Proposed Activities. Same as 1998

9. Detroit Dam and Reservoir

a. Summary. The Corps, City of Salem, and USFS coordinated efforts to install turbidity

monitoring equipment in the tributaries of the reservoir.

b. Proposed Activities. In 1999 the three agencies will monitor turbidity during 3-5 storm events. The Corps will profile the lake at 3 sites and collect water samples for suspended sediment analysis during the storm events in an effort to track lake turbidity.

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

a. Summary. Monitoring of TDG concentrations continued in the forebay and tailwater of John Day and The Dalles dams and in the downstream water below Bonneville to provide real-time data for operations, and time series data for research and modeling efforts through the Fixed Monitoring Program. A study was conducted to determine how well the FMP sites predicted near quad, river cross sectional and maximum TDG levels. Results were mixed. Some sites performed well in predicting one or more of the parameters. Other sites wer poor at predicting any of the three parameters.

b. Proposed Activities. Continue TDG monitoring at the FMP sites under MIPR to the USGS. In 1999 two sites (Wauna and Kalama) may be discontinued. Possibly new sites may be added (District Proposal) to improve gas monitoring below John Day and Bonneville. The decision will be made by Divisionafter consultation with resource agencies.

11. Dredged-Material Evaluations for Navigation Projects

a. Summary. Dredged-material evaluations were conducted for sediments at Westport Ferry, Coos Bay, Depoe Bay, Columbia Slough, Amazon Creek, Astoria East Boat Basin and on going Columbia and Lower Willamette Rivers.

SEATTLE DISTRICT

1. Lake Koocanusa (Libby Dam)

a. Summary. There were no significant water quality problems at Libby Dam Project in WY 1998.

Water quality monitoring below Libby Dam and at three other reservoir sites was performed under contract by the U.S. Geological Survey. The monitoring program consists of analyses for nutrients, inorganic compounds, heavy metals, chlorophyll, pH, specific conductivity, dissolved oxygen, nitrogen saturation, and water 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. This data is shared with state and local water quality agencies to assist in that endeavor.

Real-time outflow water temperature data were also transmitted to the District Office by the water control data collection system. Daily temperature records show that the Montana State water quality standard of 19.5^{o}C (67^{o}F) was not exceeded during this water year. A river temperature rule curve was developed to provide guidance in duplicating the natural pre-project river temperatures. The curve was modified in 1978 to define near optimum mid-summer temperatures for fish. The selective withdrawal facilities at the dam allowed the temperature rule curve to be closely followed throughout WY 1997. Monthly dissolved oxygen sampling showed that the Montana State minimum standard of 7.0 mg/l was not violated.

A total dissolved gas sensor, which transmits real-time data to the District Office, was added in 1995. This sensor is deployed when spill for flood control is likely. In 1998, USGS nitrogen saturation data showed that the Montana State minimum standard of 110% saturation was not violated.

Libby Dam was operated in 1998 to meet the flow objectives of the 1998 Biological Opinion for Steelhead, the 1995 Biological Opinion for Snake River Salmon, and the 1998 US Fish and Wildlife Service Guidelines for Kootenai River White Sturgeon. The flow regimes were coor-

dinated through the Columbia River Technical Management Team.

The sturgeon operation featured releases of 22,000 cfs for three days beginning in mid-May followed by incubation flows of 25,000 cfs (or greater) as measured at Bonners Ferry, Idaho. The selective withdrawal facility was manipulated to produce the warmest possible water in conjunction with the peak of local runoff and optimum sturgeon movement. The District's efforts to control water temperature 70 miles downstream of Libby Dam at Bonners Ferry were not highly successful. Cold water in the reservoir combined with cold air temperatures undermined the project's ability to provide sustained water temperatures in excess of 10 degree Celsius.

b. Proposed Activities. The Seattle District will work to improve water temperature monitoring 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.

2. Pend Oreille Lake (Albeni Falls Dam)

a. Summary. The only water quality monitoring performed at Albeni Falls and Pend Oreille Lake in WY 1998 were measurements of outflow water temperatures.

Extensive water quality data has previously been collected by state agencies within Idaho and Washington and in large part by the U.S. Geological Survey. Daily temperature records show that the Idaho State water quality standard of 20^{o}C (68^{o}F) was exceeded from 20 July through 7 September 1997 due to local hydrometeorological conditions. Maximum recorded water temperatures did not exceed 23^{o}C (73^{o}F) during these periods. No corrective action can be taken to reduce temperatures because Albeni Falls Project does not have selective withdrawal capabilities. The project did not experience any other water quality problems during WY 1998.

Approximately 36 acres of Eurasian watermilfoil were treated with aquatic herbicides. This treatment is considered a “stop-gap” effort to kill off the tops of the plants and reduce the spread of plant fragments, the source of new or expanded infestations. This was considered the first step in an effort to control the spread of milfoil in the reservoir upstream of Albeni Falls Dam. Follow-up monitoring and treatments (systemic herbicides is planed for next year) will be need to eradicate the milfoil before it spreads upstream into Lake Pend Oreille. If the milfoil becomes established in sloughs and wetland areas off the main river channel, it will be effectively impossible to control. Corps interests will be focussed on the impacts at recreation areas and in wildlife management areas susceptible to milfoil growth.

b. Proposed Activities. Follow-up monitoring and treatments are planned for next year.

3. Rufus Woods Lake (Chief Joseph Dam)

a. Summary. Only minimal water quality monitoring was conducted. Dissolved gas data was collected via a sensor in the forebay and a newly installed sensor in the tailwater. Discharge water temperature is measured by the downstream dissolved gas sensor. Sensor maintenance and calibration was performed by Common Sensing, Inc., based in Clark Fork, Idaho.

Due to the relative lack of spill in the Upper Columbia in WY 1998, dissolved gas levels entering Rufus Woods Lake remained below 115%. Tailwater dissolved gas measurement was complicated by the location of the tailwater sensor on the spillway side of the river. Water from the spillway and powerhouse do not mix fully for several miles downstream of the project. As a result, the tailwater sensor reported high levels of dissolved gas (up to 120%) during periods of spill. A weighted average of spillway and powerhouse flow was used to predict an average value for the river cross-section, which were significantly lower.

District staff completed an initial appraisal report of dissolved gas abatement alternatives for Chief Joseph Dam. The report recommended several structural and operational alternatives. In subsequent discussions within the

System Configuration Team for the Columbia River, the number of alternatives has been reduced to two: flow deflectors to improve conditions for fish in the short-term and a side channel canal to meet a lower dissolved gas objective in the long-term. In addition, the District has begun discussions with the Bureau of Reclamation and the Bonneville Power Administration aimed at finding better methods to improve gas levels from both Grand Coulee and Chief Joseph Dams.

The Columbia River from the Washington-Oregon border to Grand Coulee Dam surface water classification is Class A (Excellent). Based on the downstream sensor temperature records, it appears that the discharge water temperature exceeded the Washington State standard for water temperature of 18^{o}C (64.4^{o}F) from 22 July through 27 September 1998. Chief Joseph Dam does not have selective withdrawal temperature control. In 1998, NWS issued two new permits for installation of net pens on Rufus Woods Lake to Columbia River Fish Farms.

b. Proposed Activities. The District plans to continue dissolved gas abatement work. Flow deflector physical model studies are planned for WY 1998.

4. Lake Washington Ship Canal and Locks

a. Summary. Saltwater intrusion into Lake Washington through the ship canal was prevented in WY 1998 The District continued to collect salinity data from six stations that automatically transmit hourly data to the Reservoir Control Center through the District's water control data collection system. This real-time data allowed a significant reduction in the field monitoring effort and closer monitoring of advances of the saltwater wedge and enabled more efficient operation of the Locks for conservation and control of saltwater intrusion. Periodic field measurements were made at sampling stations in the canal and Lake Union to ground-truth the automated sensor data.

During summer 1998, salinity intrusion was controlled through limited openings of the salt water return drain during limited periods of high lock use. In the past, mini-flushing proved a valuable tool in removing saltwater from the lock chamber before it entered the ship canal. It may be necessary to rely on this technique again in a very low water year.

b. Proposed Activities. The District plans to continue monitoring the network of salinity sensors and to use this data in determining lock operations associated with control of saltwater intrusion. In 1996, a predictive model of saltwater intrusion into the Lake Washington Ship was constructed by District personnel in order to assess the effects of changes in lock operation. The District plans to continue refinement of this model and to use it to evaluate the efficacy of various water management and saltwater control scenarios.

5. Wynoochee Dam and Lake

a. Summary. The 1998 annual shutdown of the hydroelectric plant for fish outmigration began 15 April. Discharge was transferred to the multi-level fish passage conduits in the dam for the duration of the shutdown. Hydroelectric plant operations resumed on 1 July.

During the summer stratification period, the intake temperature panel system was used to regulate downstream temperatures during operation of the hydroelectric plant. During the fish outmigration shutdown, the multi-level conduits in the dam were used to perform temperature regulation. During the very latter part of the stratification period, the intake temperature panel system was used in combination with the multi-level outlets in the dam to deliver water in the correct temperature range. This was necessary because the level of water in the lake was such that the hydroelectric intake alone was delivering water that was too warm. For a brief period of time the hydrologic generators were shut down and minimum flows were released to meet water temperature requirements. This was due to low lake levels and warm temperatures.

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. Manual readings are taken weekly to check calibration of the sensor. In addition to temperature monitoring done at the Grisdale Gauge, there is a sensor monitoring the temperature of the water in the hydroelectric plant tailrace.
Additional water quality monitoring was done as described below

Data from the intake temperature string, which transmits real-time temperature data hourly, was plotted weekly as forebay temperature profiles.

From May through October, water quality data was collected from five locations in the river, including inflow to the lake. In addition water quality profiles were taken in the reservoir forebay. Temperature, pH, dissolved oxygen, and specific conductivity were measured.

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

6. Howard A. Hanson Dam and Lake

a. Summary. During WY 1998, water quality problems at Howard A. Hanson dam were limited to occasional high temperature and turbidity readings.

The Green River specific surface water classification is Class AA (Extraordinary). Throughout the year, daily water temperature and turbidity values are collected by Tacoma Water Department personnel at their plant intake located a short distance downstream of Howard A. Hanson Dam and by project personnel at the inflow and outflow sites of the reservoir. Continuous real-time water temperature data are also collected by the Seattle District water control data collection system from the project tailwater monitoring station ¾ mile downstream of the dam. Records show the outflow temperature exceeded the Washington State water quality standard of 16^{o}C (60.8^{o}F) during 1998 occasionally in August and September due to local hydrometeorological conditions. Turbidity readings in excess of the State standards (5 NTU) were generally of short duration and occurred during or immediately following storm events.
During the period of conservation storage (generally June through October), field measurements of the reservoir water quality profiles are taken approximately every two weeks. Depth versus dissolved oxygen, temperature, pH, and specific conductivity measurements are made at seven reservoir stations. In addition, the above parameters are measured upstream of the reservoir and just below the dam. There was little change in the chemical quality of the impounded water throughout the year.

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

7. Mud Mountain Dam

a. Summary. Water quality data collection efforts in WY 1998 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.

Seattle District staff worked internally to develop a method of releasing sediment stored behind MMD during and after routine operations. The use of stop-log to allow work within the MMD tunnels can cause an accumulation of sediment upstream of the stop-logs. In 1998, sediment accumulation caused by the stop-log, required attention to avoid heavy downstream movement of sediment during the removal of the stop-logs. District staff and project staff found that by raising the pool, during stop-log removal, could control the release of sediments downstream. With a higher pool, project staff could delay sediment release until inflows raised above 2,000 cfs. Higher inflows help sustain sufficient flows to carry the material downstream and into the estuary. Testing and documenting of this procedure is still needed.

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

WALLA WALLA DISTRICT

1. Total Dissolved Gas Monitoring System (TDGMS)

a. Summary. The TDGMS system serving all sites in the Walla Walla District continued to be updated with the addition of two new stations. Though data collection at the stations was not brought on-line in FY98, the physical installations have been completed. One of the stations (ANQW) is located adjacent to the Anatone USGS gage approximately 27 miles above the confluence of the Snake and Clearwater River at Snake River Mile 167.2. The second station (PAQW) is located approximately 4 miles above the confluence of the Snake and Columbia Rivers at Columbia River Mile 329. The addition of the these two new stations will allow managers and District personnel to better understand the outside effects to the system based on incoming levels of dissolved gas. Maintenance and calibration was performed bi-monthly on all sites.

Spill season TDG monitoring was performed at Dworshak (DWQI) on the North Fork of the Clearwater River, at Peck (PEKI) and Lewiston water intake (LEWI) on the mainstem 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 and at McNary forebay Oregon (MCQO), McNary forebay Washington (MCQW) and McNary tailwater (MCPW) on the Columbia River. Year round TDG monitoring is being tested and performed at the sites listed above that are underlined.

b. Proposed Activities for 1999. Bring data collection and communications on-line at the two new stations, PAQW and ANQW. Complete sensor performance evaluations using the hyperbaric chamber. Issue a QA/QC plan for TDGMS and an annual QA/QC report to be submitted to NWW Operations Division. Evaluate additional needs and recommend improvements.

2. McNary Project and Reservoir

a. Summary. There were a few times at the McNary forbay TDGMS station when the probe could not be retrieved due to a log-boom obstruction. Because of this, membranes could not be changed nor calibration verified according to the QA/QC plan. Data that were collected during these periods are correct. However, some data gaps did occur due to wires being severed by the log-boom.

Reservoir water quality samples were taken in the forebay, near Wallula Gap, and on the Columbia above the confluence with the Snake on a bi-monthly cycle by Normandeau & Associates technicians. The samples were analyzed for nutrients, and suspended solids by the Water Research Center (WRC) at Washington State University.

Water temperature data were collected in the fishways and forebay as part of the fishway

temperature monitoring, under a contract with the Washington Department of Fish and Wildlife. Water temperatures were recorded once daily in the turbine unit gatewells and in the forebay from 15 June through 30 August. Temperature data were collected from the B bulkhead slot of all 14 turbine units at orifice depth. Forebay water temperature measurements were taken at 7 locations across the face of the powerhouse, approximately in front of every other turbine unit. Juvenile collection channel temperatures were logged hourly at units 1, 7 and 14 and on the juvenile fish facility separator every 30 minutes.

Temperature measurements were also recorded at 0700h each day in the juvenile fish facility sample-trough. Exceedence of the 10,000 smolt per day mortality in the collection facility on a few days in mid-July have been attributed by some to high water temperatures. Temperature data collected did show steep gradients in temperature across the powerhouse with highs at unit one (south shore) but temperatures in the fish facility did not rise above 70°F until just after the slightly elevated mortalities occurred. This issue needs further evaluation.

Using other data from the LSRFS and previous dredge analysis some sample location were selected from the proposed dredge templates for the Dredge Material Management Study (DMMP). Sediment samples were taken from 28 locations in the McNary pool and analyzed for particle size as percent total volume using ASTM methods. From these samples cores were composited. The samples were analyzed for pesticides, PCBs, herbcides, petroleum hydrocarbons, metals, and total organic carbon.

Problems identified by District Natural Resources Management Branch personnel included:

On 27 January 1998 an oil slick was apparent downstream of McNary Dam as far as two miles. Approximately 50 gallons of oil was believed to have been released from a generator unit.

The Madame Doriann Park potable water supply was refitted with a new chlorine pump, which has kept the chlorine levels stable enough to have the system open for use all season. In the past, high chlorine residuals have caused system closure.

The potable water supply system, which supplies the Dam, Juvenile fish facility, visitor's center and nearby parks was recently inspected. The only problem found was that the holding reservoir requires cleaning.

There were no closures at McNary swim beaches.

b. Proposed activities for 1999.

✓ Continue and improve routine reservoir water quality monitoring.

✓ Expand temperature monitoring to include a study of the Fish Facility/Bypass system at McNary Dam possibly using the TDGMS system as a data transmission mechanism.

✓ Summarize existing data and complete the water quality portion of the DMMP

3. Ice Harbor Project and Reservoir

a. Summary. Water samples were taken near Fishhook Park during the summer months on four dates by District personnel, and near Fishhook Park and Matthews Landing on seven dates by Normandeau and WRC personnel. Secchi depth and Hydrolab profile data were Samples were analyzed by WRC for suspended solids, nutrients, phytoplankton, zooplankton, and chlorophyll. Secchi data and Hydrolab profile data were also collected. Primary productivity was estimated by C^{14} uptake. Water samples were collected as part of the LSRFS to establish a baseline for a broad spectrum of physical, chemical, and biological parameters against which changes caused by implementation of LSRFS alternatives could be compared.

Natural Resources Management staff in Ice Harbor Administrative area during CY1998 identified the following water quality problems:

On 1 March 1998 a construction contractor hit a pipe causing approximately 50 gallons of oil to be released to the Snake River.

Ice Harbor Dam (System #09677R) June 16, 1998 routine bacteriologic drinking water sample was positive for total coliforms (E. coli absent). Required follow-up tests were OK. Suspect lab error in testing procedures.

On 30 June 1998 a Union Pacific train wrecked and spilled approximately 26,000 gallons of urea adjacent to the Snake River just upstream of Fishhook Park.

July nitrate tests on blended water obtained from drinking fountains were just above MCL standards. Retest results were also just above standards. Well #1 pump was found to be burned up, which meant that water was not blended using all 3 wells. Normally the blending of water from the three wells brings nitrate levels down to an acceptable level. The pump was repaired but failed again. Pump is being worked on. Also notable is that the well are non-compliant due to the fact that the wellheads are below ground level. This makes wellhead protection difficult.

Levey Park (System #46940P) August 3, 1998 routine bacteriologic drinking water sample was positive for total coliforms (E. coli absent). Required follow-up tests were OK. Contractor was using too many sprinklers to irrigate lawn and drew down domestic water tank so that chlorinator pump couldn't keep up with demand. Contractor was shown proper management of system.

b. Proposed activities for 1999.

✓ Continue and improve routine reservoir water quality monitoring.

✓ Continuation of the Limnological Baseline Study if it is a low flow year. Possible continuation of the Tri-level Thermograph Study under fisheries research.

✓ Evaluate the feasibility of automating temperature monitoring of the fish facilities and integration into the TDGMS system.

✓ Determine biological productivity. The purpose of this study would be to determine primary productivity in the Lower Snake reservoirs and use data from previous research and models to predict biomass production at higher trophic levels.

4. Lower Monumental Project and Reservoir

a. Summary. Water samples were taken near Riparia and Ayer during the season on seven dates by Normandeau and WRC personnel. Samples were analyzed by WRC for nutrients, suspended solids, phytoplankton, zooplankton, and chlorophyll. Primary productivity was estimated by C^{14} uptake. Secchi data and Hydrolab profile data were also collected. This data was to support the Limnological Base Line Study.

Sediment samples were taken from 8 locations in the Lower Monumental pool and analyzed for potential contaminant as part of the DMMP study. The core samples were composited. and analyzed for pesticides, PCBs, herbicides, petroleum hydrocarbons, metals, and total organic carbon.

District Natural Resources Management Branch personnel identified the following swim beach or drinking water quality problems:

Lower Monumental Dam (System #487202) State Health Department sent Notice of Violation for failure to take required November routine bacteriologic drinking water sample. Users at Lower Monumental were notified as required by regulation. No extra samples were required by the State. Normally required schedule of samples will be followed in accordance with regulations.

b. Proposed activities for 1999.

✓ Continue and improve routine reservoir water quality monitoring.

✓ Continue baseline limnological evaluation if it appears to be a low flow year.

✓ Continuation of the Tri-level Thermograph Study.

✓ Evaluate the feasibility of automating temperature monitoring of the fish facilities and integration into the TDGMS system.

✓ Complete the sediment range baseline data collection and tie these markers to the existing Little Goose and Ice Harbor Ranges.

✓ Evaluate existing biological productivity and water quality information.

4. Little Goose Project and Reservoir

a. Summary. District personnel collected water samples and data on seven dates near Central Ferry in support of the Limnological Base Line Study.

Normandeau and WRC personnel took water samples near Boyer Park and Central Ferry during the season on seven dates. Samples were analyzed by WRC for nutrients, suspended solids, phytoplankton, zooplankton, and chlorophyll. Primary productivity was estimated by C^{14} uptake. Secchi data and Hydrolab profile data were also collected. This data was to support the Limnological Base Line Study.

A total of 32 sediment ranges were measured in the Little Goose Pool. These measurements will be used for baseline sediment accumulation measurement, DMMP studies, and evaluation of potential areas of contamination.

District Natural Resources Management Branch personnel identified no swim beach or drinking water quality problems.

b. Proposed activities for 1999.

✓ Continue and improve routine reservoir water quality monitoring.

✓ Continuation Limnological Baseline Study if it is a low flow year.

✓ Possible continuation of the Tri-level Thermograph Study under fisheries research.

✓ Evaluate existing biological productivity and water quality information.

6. Lower Granite Project and Reservoir

a. Summary. Sediment samples were taken from 12 locations in the Lower Granite pool were partitioned and composited. The samples were analyzed for pesticides, PCBs, herbicides, petroleum hydrocarbons, metals, dioxin and total organic carbon.

WRC personnel collected water samples and data on seven dates in the Lower Granite forebay, below Silcott Island, in the Clearwater River, and on the Snake above the confluence with the Clearwater. Samples were analyzed by WRC for nutrients, suspended solids, phytoplankton, zooplankton, and chlorophyll. Primary productivity was estimated by C^{14} uptake in the reservoirs and light and dark bottle dissolved oxygen methodology in the riverine reaches.. Secchi data and Hydrolab profile data were also collected. This data is to support the Limnological Base Line Study.

Temperature data was collected in the fishways and forebay as part of the fishway temperature monitoring. This data will be related to temperature, volume, and timing of inflows to Lower Granite Reservoir and source of water for flow augmentation during the July through September period.

Temperature data was also collected from the forebay as this year's only station of the Tri-level Thermograph Study.

Problems identified by District Natural Resources Management personnel included only high E-coli levels that forced the closure of the swim beach at Swallows Park for two weeks in August 1998. This represented a success rela-

tive to past years when the swim beach there had been closed for extended periods. Project staff implemented a waterfowl reduction action, which called for application of concord grape extract to the lawn near the swim beach. This reduced the Canada goose (proven to be the source of coliform bacteria causing beach closures) density in the area. No other swim beach or drinking water problems were identified.

b. Proposed activities for 1999.

✓ Continuation of the Limnological Baseline Study if it is a low flow year.

✓ Possible continuation of the Tri-level Thermograph Study under fisheries research.

✓ Evaluate the feasibility of automating temperature monitoring of the fish facilities and integration into the TDGMS system.

✓ Determine biological productivity.

7. Dworshak Project and Reservoir

a. Summary. The Lewiston water intake TDGMS station pipe the Peck TDGMS station pipe left partially dry during the slate summer months due to low flows on the Clearwater River.

To support the Dworshak Monolith Grouting project, turbidity, pH, and alkalinity were measured by district personnel in late 1997. Turbidity and pH data were collected hourly with a Hydrolab Data Sonde III placed in the North Fork of the Clearwater River below the dam. Alkalinity was checked weekly. There were no impacts to the river from the grouting project. The grouting procedure was completed early in 1998.

Water quality data were collected from six in-reservoir stations, twelve inlet stream stations, and below the dam outlet. Light penetration, vertical profiles, nutrients, ions, suspended solids, metals, and biological parameters were measured.

District Natural Resources Management Branch personnel identified no new swim beach or drinking water quality problems. The project is still using bottled water for potable source as they have been for the past few years due to the reservoir supply system not providing sufficient treatment to comply with Idaho regulations. A new filtration system is currently being designed to provide domestic water to the 'reservoir system' which serves the Project Office, Natural Resources Office, Dam and Visitor's Center. The distribution system continues to be chlorinated and tested to assure it is ready when the filtration system comes on-line.

Big Eddie domestic water supply was served this year by a tank delivery system. A new filtration system is currently being procured for Big Eddie.

Notice of non-compliance from Idaho DEQ resulted in signing of voluntary consent orders to bring the Dworshak National Fish Hatchery, Big Eddie and Powerhouse (reservoir) domestic water systems up to compliance.

No Dworshak swim beach closures occurred in 1998

b. Proposed activities for 1999.

✓ Evaluate the long-term water quality transitions from natural river to reservoir through a thorough evaluation of all previous water quality work completed to date.

✓ Possible continuation of the Tri-level Thermograph Study under fisheries research.

✓ Continue water quality data collection.

✓ Consider extending pipes and possible shifting of the TDGMS stations on the Clearwater River avoid low flow data outages.

8. Mill Creek and Virgil B. Bennington Lake

a. Summary. Reservoir water quality samples were taken from the lake at two sites and at two depths on three dates during the summer months. Secchi data and Hydrolab profile data were also collected. The water samples were

analyzed for nutrients, metals, and suspended solids by district personnel and contract laboratory staff.

District Natural Resources Management Branch personnel identified no problems with drinking water or swim beach water quality.

b. Proposed activities for 1999.

✓ Water samples will continue to be taken periodically during the summer months from the lake.

✓ Evaluate the application and feasibility of an algal assessment.

9. Lucky Peak Reservoir

Summary. Water samples and Hydrolab profiles were taken from the reservoir by a contractor (Ralston and Associates) three times during the summer of 1998. The samples were shipped to NWW and Vizcaya laboratories and analyzed for nutrients and chlorophyll.

Problems with drinking water or swim beach water quality identified by District Natural Resources Management Branch personnel included the following:

Barclay Bay and Turner Gulch drinking fountains still closed because of contamination due to underground line leakage. However, potable water is available at the pump-house.

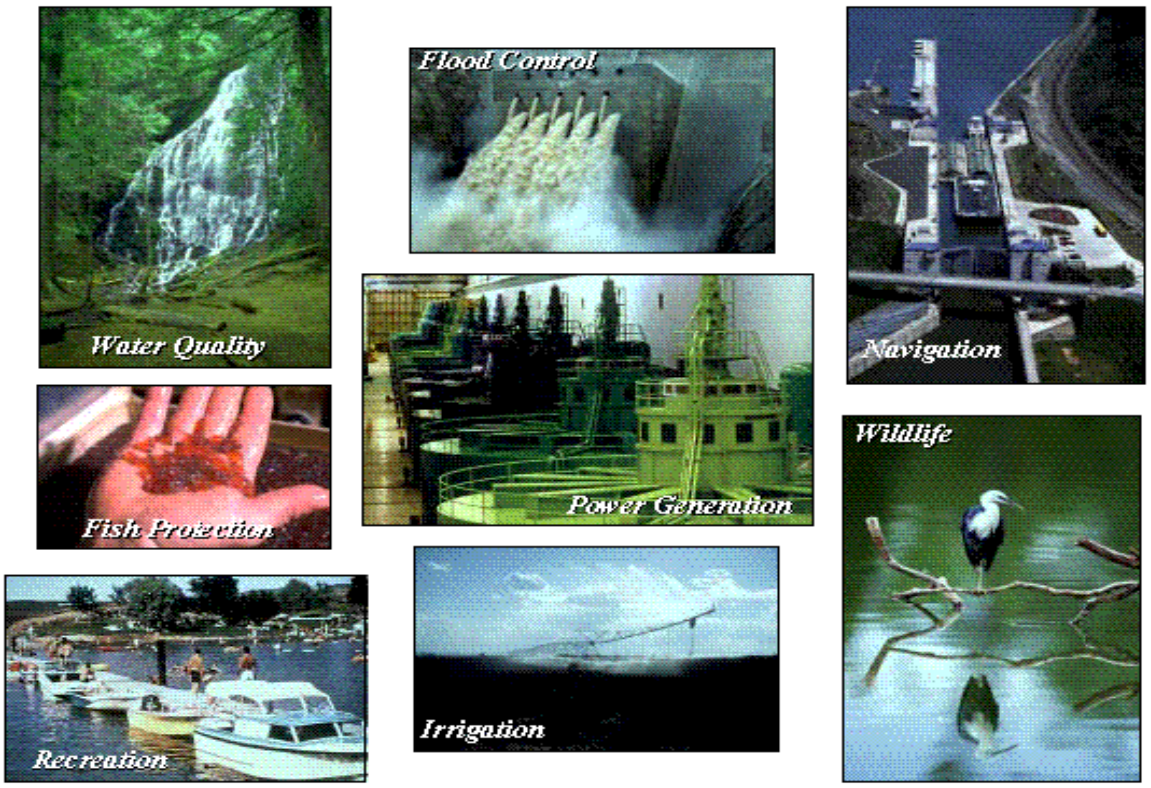
Sandy Point swim beach was closed in July due to an outbreak schistomes dermatitis (swimmer's itch).

b. Proposed activities for 1999.

✓ Continue and improve routine reservoir water quality monitoring.

✓ Begin acquisition of light measurements using the YSI 3260 profiler.

Review Chlorophyll data and adjust sampling as needed.



3