REVIEW OF THE NATIONAL WATER QUALITY _____ ASSESSMENT (NAWQA) PROGRAM IN NATIONAL PARKS, FISCAL YEAR 1995

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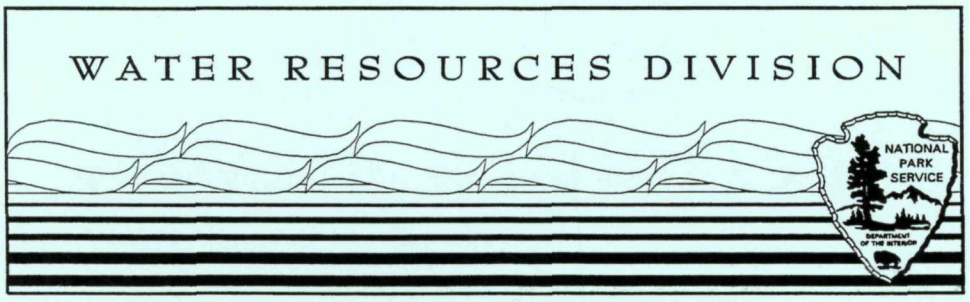
Technical Report NPS/NRWRD/NRTR-96/91



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BACKGROUND

In January of 1994, the National Park Service (NPS) and the U.S. Geological Survey (USGS) signed a formal Memorandum of Understanding to coordinate the integration of National Parks into the National Water Quality Assessment (NAWQA) Program. In 1995, the NPS and USGS entered into an Interagency Agreement (Modification No. 95-08 of 1443IA000194029) to enhance water-quality and ecological sampling and analysis in areas where park and NAWQA studies coexist. Several "pilot" collaborative projects were implemented to foster this partnership. The objectives of the "pilot" NPS-NAWQA monitoring program are to: (1) establish a cooperative partnership with a national, institutional water quality program; (2) influence monitoring decisions that result in products that address park specific water quality issues; and (3), demonstrate the efficiency and effectiveness of this partnership to support future budget initiatives that would permit full implementation of this agreement to meet high-priority water quality monitoring needs in parks. This document reviews the progress of cooperative work completed in fiscal year 1995 in nine NAWQA study units affecting ten park units. All projects were designed and implemented by NAWQA and NPS personnel working together to achieve results which addressed park needs and provided valuable information to both agencies. A summary evaluation of the success of the first year of this partnership program is included below, followed by a statement of progress for the NPS-NAWQA projects in fiscal year 1995. Expenditures for the program by agency in fiscal year 1995 are included in the summary evaluation.

SUMMARY EVALUATION OF NAWQA PROGRAM IN NATIONAL PARKS

The NAWQA Program in National Parks was designed as a "pilot" monitoring program. The cooperative program applies a partnership approach to solve water quality problems in parks. This approach has been advocated by the Department of the Interior to address resource issues in the most effective and efficient way, especially during times of budget readjustments. Both the NPS and the USGS are strong supporters of this program, and the following discussion summarizes the benefits gained by both agencies to date. Because of these successes, and the examples they provide to other agencies in a similar position with regard to water resource inventory and monitoring, it is the recommendation of the NPS Water Resources Division that this pilot program be expanded into a nationally recognized program. Funding for the expanded national program could be at various levels and from various sources, such as from discretionary funds within both agencies or a joint budget initiative. If fully-funded, the cooperative NAWQA program may provide opportunities to address water quality themes of national or regional significance (such as the effects of urbanization, recreation or river regulation on parks). Within the NPS, the NAWQA Program in National Parks provides valuable data to support the NPS Servicewide Inventory and Monitoring Program, and is a significant component of the overall NPS Water Quality Program.

The first test of this program is to evaluate whether park managers were able to effectively utilize water professionals from another agency to address NPS specific issues in parks. Many discussions among affected parties were conducted early in the process, as evidenced by letter and e-mail correspondence, and organized meetings with agencies and interest groups. A list of the primary participants from the NPS and USGS is included in the Acknowledgements section

of the report. This was only the beginning. NPS participation in NAWQA Liaison Committee meetings provided park staff with many sources of information as well as outlets for discussions of NPS issues.

The second test is to determine whether the USGS accommodated the NPS by designing and implementing monitoring studies that reflected the needs of their client, the NPS. Obviously, some NAWQA study units contained no parks or few parks with significant water resources. However, by a process of calling NAWQA study units and parks, a small group of parks within NAWQA study units were selected as candidates for the NAWQA Program in National Parks (Figure 1). All park candidates for this program had to have: (1) significant water resources; (2) water quality issues; (3) a commitment from their staff to participate; and, (4) a receptive NAWQA Study Unit Chief. The next step was to design cooperative monitoring projects that addressed park needs within the framework of the NAWQA Program (i.e. fixed-station, synoptic, or intensive study monitoring). Scheduling of existing NAWQA studies was also a factor in the final decisions. However, the cooperative projects did not have to fit into NAWQA national theme areas. After the projects were designed, negotiations were begun on budgets. The position of the NPS was that contracting with the USGS for monitoring services at full price did not representative a partnership. Therefore, negotiations occurred for each cooperative project to ensure that the projects were true collaborations. After several rounds of these discussions, cost-share agreements were reached for each project implemented in fiscal year 1995. Professional staff strategically located in USGS field offices implemented all NPS-NAWQA projects without incident. Therefore, we conclude that indeed the program was successful in conducting cooperative monitoring in parks. Notice that the NPS spent $195,000 for approximately $400,000 worth of professional water quality monitoring in fiscal year 1995 (Table 1).

The last test is related to accountability and deliverables. Many park-based and contracted monitoring projects in parks have failed this test in the past. Does the project ever get completed? Are project results documented in reports to assist managers in making resource decisions? Have the data from the project been analyzed? Are the data entered into a database that is available to others? Without hesitation, the answer to each of the above questions for the NAWQA Program in National Parks is yes. Deliverables to the NPS for all NAWQA projects include: (1) read-only access to USGS District ADAPS, QWDATA, and Biological databases; (2) hydrologic and chemical data uploaded to USGS WATSTORE and Environmental Protection Agency (EPA) STORET national databases; (3) hydrologic and chemical data published in USGS Annual Reports; (4) rating curves for new stream gages that are installed; and, (5) professional reports with analyses of the data (e.g. administrative reports, open-file reports, water-resources investigations reports, fact sheets).

The Water Resources Division of the NPS intends to maintain support for the NAWQA Program in National Parks at existing funding levels in fiscal year 1996. In the future, additional funds may be utilized to develop an expanded cooperative program. In fiscal year 1996, it is expected that monitoring will continue in eight of the nine "pilot" projects, and one new cooperative project will be implemented. The new project will be conducted in Congaree Swamp National Monument by the Santee Basin and Coastal Drainages NAWQA study unit.

National Water-Quality Assessment (NAWQA) Program
in National Parks, Fiscal Year 1995 Projects
Figure 1

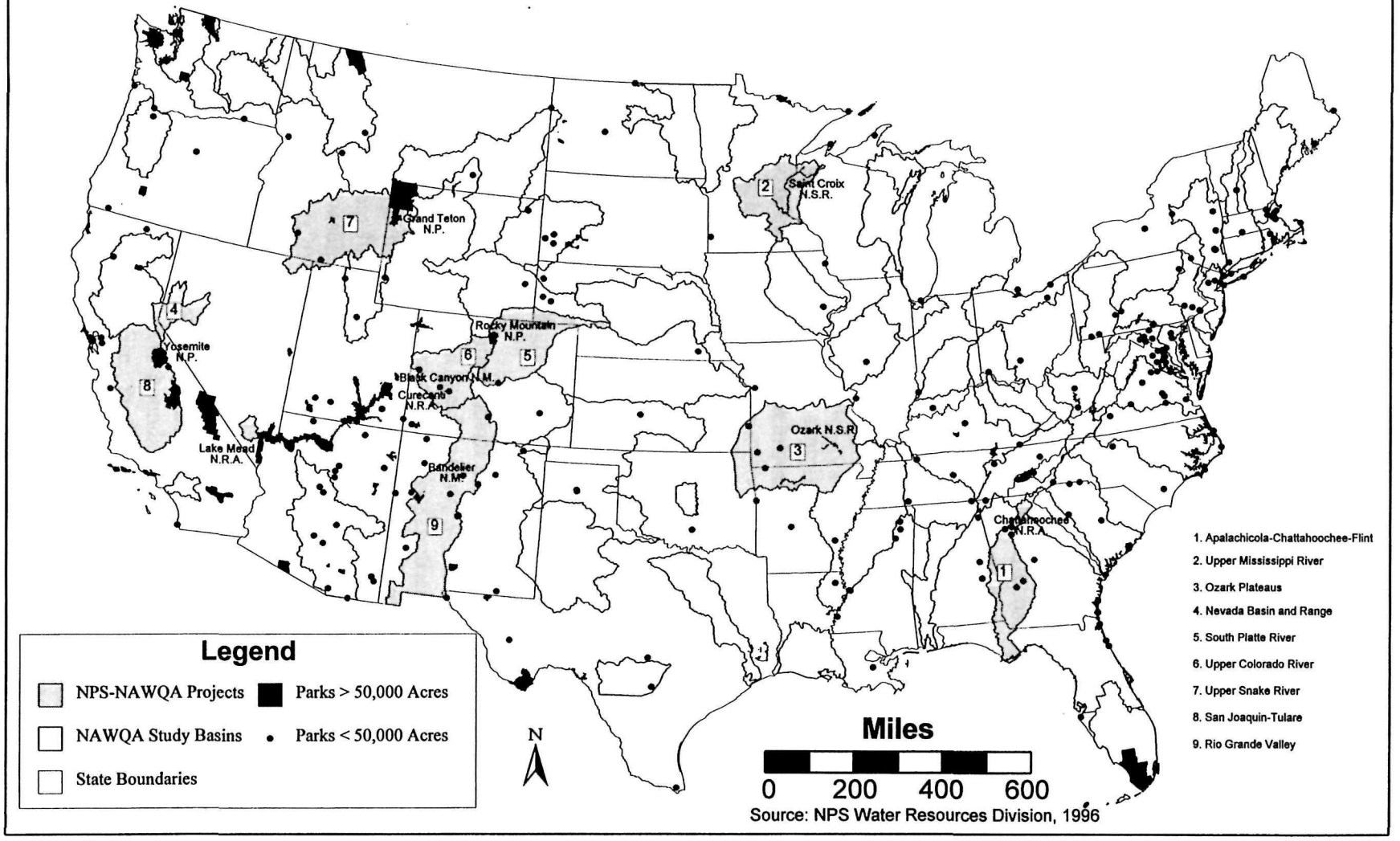

Table 1.

NAWQA PROGRAM IN NATIONAL PARKS, FISCAL YEAR 1995 BUDGET

NPS UNIT(S)	NAWQA STUDY UNIT	NPS FUNDS	NAWQA FUNDS
St Croix National Scenic River	Upper Mississippi River Basin	$15,500	$14,400
Grand Teton National Park	Upper Snake River Basin	$17,900	$17,900
Curecanti National Recreation Area, Black Canyon National Monument, Rocky Mountain National Park	Upper Colorado River Basin	$29,500	$55,400
Yosemite National Park	San Joaquin-Tulare Basins	$20,000	$11,200
Lake Mead National Recreation Area	Nevada Basin and Range	$49,400	$26,100
Chattahoochee River National Recreation Area	Apalachicola-Chattahoochee-Flint Basin	$25,000	$41,800
Rocky Mountain National Park	South Platte River Basin	$16,000	$17,000
Ozark National Scenic River	Ozark Plateaus	$15,000	$14,100
Bandelier National Monument	Rio Grande Valley	$6,000	$5,000
	TOTAL FUNDS	$195,200	$202,900

STATEMENT OF PROGRESS FOR MONITORING PROJECTS IN FISCAL YEAR 1995

St. Croix National Scenic Riverway - Upper Mississippi River Basin NAWQA Study Unit

St. Croix National Scenic Riverway is a river corridor that receives flow and constituent inputs from the surrounding forested watershed. Therefore, adjacent land uses have great potential for impacting pristine habitats within the park. The potential for organic and trace element contamination from urban development and agriculture (e.g. cranberry bog plantations) have prompted the park to partner with various entities in the basin for consultation and support.

The NPS-NAWQA project at St. Croix National Scenic Riverway is being conducted by a team of hydrologists, biologists, chemists, and hydrologic technicians stationed in Mounds View, Minnesota with support from USGS staff in Wisconsin. This team consists of personnel that specialize in water quality, environmental chemistry, data and GIS processing, aquatic biology, and geochemistry.

Water quality and ecological field work in 1995 consisted of a reconnaissance survey, water-quality sampling of the St. Croix River near Danbury, Wisconsin, and bed sediment and tissue sampling at four sites on the Namekagon and St. Croix Rivers. A reconnaissance survey was conducted in May to assess sites for water quality sampling, ecological work, and discharge measuring conditions. Physical measurements of water quality were made and samples were collected on tributaries to and mainstem of the St. Croix River to determine dissolved calcium concentrations and to screen for nitrate and triazine herbicide concentrations. The method used for nitrate is semi-quantitative, but data are useful for comparing concentrations between sites. Highest concentrations were found in St. Croix River tributaries originating in Minnesota. Triazines were not detected (detection limit, 0.5 micrograms per liter, µg/L) by immunoassay at any of the sites. Samples were collected for the determination of dissolved calcium because of the NPS interest in the possible relations between calcium concentration and zebra mussels. Calcium concentrations were less than 20 milligrams per liter (mg/L) at all sites in the St. Croix River Basin.

Water quality sampling of the St. Croix River at the Danbury, Wisconsin, fixed site began in June. Samples were collected for the determination of major ions, nutrients, suspended sediment, and suspended and dissolved organic carbon. Samples were collected over 77% of the streamflow range that occurred from June through September (approximately 800 to 2,400 cubic feet per second, cfs). Preliminary results indicate that most concentrations of nutrients were near or below detection limits of 0.01 to 0.20 mg/L. The highest concentrations of total nitrogen, total phosphorous, dissolved organic carbon, and dissolved iron occurred during streamflow recession in August.

Bed sediment and tissue samples were collected at five sites on the St. Croix River mainstem and tributaries in July. Three sites were within the boundaries of the St Croix National Scenic Riverway: Namekagon River near Leonards, Wisc., St. Croix River near Danbury, Wisc., and St. Croix River near Sunrise, Minn. Sampling near the confluence of the St. Croix and Namekagon Rivers was postponed until the 1996 survey. At this time, results are available only for organochlorine compounds in bed sediment from the three sites on the St Croix River mainstem

(near Danbury, near Sunrise, and at Hudson--downstream of the NPS boundary. Endosulfan-I, a cyclodiene insecticide applied to potatoes and strawberries in Wisconsin and Minnesota, was the only compound detected and was detected at all three sites. Concentrations ranged from 1.6 to 2.3 micrograms per kilogram near Sunrise and near Danbury, respectively. Endosulfan-I was not detected at seven other streams in the Upper Mississippi River study area (including both agricultural and urban settings) where analytical results are currently available.

Fish tissue samples were collected concurrently with bed sediment. Results of trace elements in fish liver are available for two sites (St. Croix River near Sunrise and St. Croix River at Hudson). The concentrations (parts per million-wet weight) of arsenic, copper, zinc, cadmium, selenium, and mercury in fish liver were greater than the mean concentrations of these elements reported by Schmitt and Brumbaugh (1990) for whole fish. Fish tissue (organics and trace elements) data will be available for all sites.

Grand Teton National Park - Upper Snake River Basin NAWQA Study Unit

Grand Teton National Park is dominated by the Teton Range and the Snake River Valley. In 1986, the park contracted with the USGS to monitor water quality on the Snake River at Flagg Ranch to determine background water quality entering the park. Since 1992, the Flagg Ranch site has been a NAWQA fixed-station reference site. The addition of a downstream site is important because it could provide water resource and biological information to assess potential impacts from various activities within the park (e.g. recreation, wastewater treatment, material extraction).

The NPS-NAWQA project at Grand Teton National Park involved the installation of a new streamflow gage (No. 13013650) on the Snake River at Moose, Wyoming. The gage includes a water stage recorder actuated by a pressure sensor system and a A/F logger mounted on the downstream right abutment of the Moose Bridge. The USGS Idaho District collected the water-quality and ecological data and the Wyoming District maintained the streamflow gage. A joint funding agreement with the Teton County Natural Resource District was utilized to implement this collaborative project. Water quality and ecological data were analyzed; however, no contaminant data or invertebrate data have not be received from the USGS laboratory to date.

Six discharge measurements were obtained during water year 1995 (ranging from 942 to 9,870 cfs) which were used to develop a stage-discharge rating for the gage. Using the preliminary rating, the maximum instantaneous discharge was 12,400 cfs (13.46 feet) on June 6. The minimum daily discharge for the period of operation, 963 cfs, occurred on April 13.

Water samples were collected near the gage located on the right downstream side of Teton Park Road bridge, 1/4 mile west of Moose Junction, in Grand Teton National Park. The samples were collected by wading 500 feet upstream of bridge at low flows and from immediately upstream of the bridge at higher flows. Water samples were collected on April 13, May 4 and 25, June 15 and 29, July 26, August 17, and September 6. No major storms were sampled during the year.

The following laboratory analytical schedules were used for the analysis of all water samples: common ions and trace inorganics, schedule 2701; nutrients, schedule 2702; organic constituents, schedule 2075; suspended sediment, sand/fines; and radiochemical, schedule 1142 and lab code 624 (April, June).

Water chemistry samples were analyzed at the USGS National Water Quality Laboratory (NWQL) in Denver. Suspended sediment samples were analyzed at the Cascades Volcano Observatory sediment laboratory in Vancouver. Quality Assurance/Quality Control (QA/QC) samples included an inorganic field blank for schedules 2701 and 2702, collected September 6.

The following field parameters were collected each visit: discharge (measured or from the rating curve); specific conductance at 25 °C; pH; dissolved oxygen; barometric pressure; temperature (water and air, reported to the nearest 0.5 °C); and alkalinity (fixed end-point titration, filtered sample for total, carbonate, and bicarbonate).

Samples were collected using standard methods as outlined by Shelton (1994). Alkalinity was determined on a filtered aliquot using the fixed end-point titration method. At centroid of flow, dissolved oxygen was measured and the dissolved and suspended organic carbon sample was collected in a dedicated 3-liter teflon bottle using the single vertical, depth integrated method.

The specific conductance, dissolved oxygen, and pH meters were calibrated using standard recommended methods. Water-quality meter information including make/model, serial and w-numbers, and calibration data were recorded on the field sheets.

Equipment was cleaned using standard methods as outlined in Office Of Water Quality Technical Memorandum 94.09. Two exceptions were the organic carbon filter apparatus and dedicated 3-liter bottle. This equipment was rinsed immediately after each use with organic-free deionized water and wrapped in aluminum foil. At each site prior to sampling, all equipment was thoroughly field rinsed with native water.

An intensive ecological assessment was conducted September 11-12 approximately three river miles downstream of the Teton Park Road bridge which is located 1/4 mile west of Moose Junction, in Grand Teton National Park. Access to the site was obtained from a guest ranch located in the northwest corner of Section 20, Township 42 North, Range 116 West. Due to high velocities, extreme depths and severe braiding of the channel in the area, all sampling was conducted along the right channel margin. The upper end of the sampling reach was located just below the inlet of a large diversion canal, and continued to a point 705 meters downstream. The reach mainly consisted of deep runs with very little riffle or pool habitat. Total reach length was 705 meters.

Macroinvertebrates: Semi-quantitative richest targeted-habitat (RTH) samples were collected at small riffles along the right channel margin. Depositional targeted habitat (DTH) samples were collected in shallow depositional areas along the right channel margin. Qualitative multihabitat (QMH) samples were collected at all habitats along the right channel margin within the reach. Samples were collected using methods outlined by Cuffney and others (1993) and submitted to the NWQL for taxonomic identification.

Algae: Quantitative RTH periphyton samples were collected at the same riffle areas where the RTH macroinvertebrate samples were collected. QMH samples were collected at various habitats along the channel margin within the reach. Samples were collected as outlined by Porter and others (1993) and submitted to the NWQL for taxonomic identification.

Bed sediment: Bed sediment samples were collected at depositional areas along the channel margin. Samples were submitted to the NWQL for the determination of organic compounds and trace elements. Samples were collected using methods outlined by Shelton and Capel (1994). Particle size analysis was completed at the USGS sediment laboratory in Boise.

Tissue: Five mountain whitefish were submitted to the NWQL for the determination of organic compounds in tissue. Arctopsyche were submitted for the determination of trace elements in tissue. Samples were collected using methods outlined by Crawford and Luoma (1993).

Fish community: A representative sample of the fish community was collected by back-pack operated electrofishing gear. One pass was made upstream along the right bank. Fish species collected included Cutthroat trout, Utah and mountain sucker, longnose and speckled dace, and mottled and Paiute sculpin. To obtain a tissue sample another pass was made in the diversion canal at the upper end of the reach. Fish species collected here included Cutthroat trout, mountain whitefish, Utah sucker, and Utah chub. After sample collection, fish were identified, weighed, measured, and released. Electrofishing was conducted following procedures outlined by Meador and others (1993a).

Habitat: Due to the braided channel, large size, high velocities, and extreme depths of the river an abbreviated first-level reach characterization was completed at 4 transects. These transects included both instream and riparian features. When possible, habitat data were collected using methods outlined Meador and others (1993b).

In addition, the following field parameters were collected: discharge (from the rating curve); specific conductance at 25 °C; pH; dissolved oxygen (mg/L and % saturation); and water temperature (reported to the nearest 0.5 °C). Collection permits were obtained from the Wyoming Game and Fish Department and the National Park Service. To aid further data collection activities, transect locations were determined using a Global Positioning System.

Curecanti National Recreation Area, Black Canyon of the Gunnison National Monument, and Rocky Mountain National Park - Upper Colorado River Basin NAWQA Study Unit

Curecanti National Recreation Area encompasses Blue Mesa, Morrow Point, and Crystal Reservoirs of the Colorado River Storage Project's Aspinall Unit. Black Canyon of the Gunnison National Monument is located at the outfall of the lower reservoir. Land use activities upstream and within these two parks (such as: grazing, logging, mining, development, recreation, and dam operations) may ultimately impact these high quality waters. This situation has prompted both parks to conduct baseline monitoring and actively participate in studies by other federal and state agencies. Rocky Mountain National Park has supported various water-related research in the past, but has conducted little baseline monitoring. The Colorado River site was selected to provide long-term water quality data for an important river in the park.

The NPS-NAWQA project in the Upper Colorado basin involved collaborative monitoring at three water quality stations located at Curecanti National Recreation Area, Black Canyon of the Gunnison National Monument, and Rocky Mountain National Park. The Gunnison River below the Gunnison Tunnel (or East Portal site) is on the boundary between two park units. This site was selected because it characterizes water quality discharged from three reservoirs and establishes baseline water quality for the Wild and Scenic River segment of the Gunnison River. The Gunnison River at Riverway site represents an important site to NPS because it is located between the town of Gunnison and the park. The Colorado River below Baker Gulch site represents an excellent pristine reference site on the main stem of the river.

In fiscal year 1995, ten water quality samples were collected at the Gunnison River at County Road 32 (Riverway), which is located at the inflow to the Curecanti National Recreation Area. Data collection started in January, 1995, and samples were collected monthly with an additional extreme flow sample. Water samples were analyzed for nutrients, major cations, anions, and metals, organic carbons, suspended sediment, and field parameters. Stage measurements for discharge were also collected on an hourly basis at two stations upstream of this station. Discharge was measured at the Gunnison River at County Road 32 station to compare with the discharges of the two upstream stations.

Eleven water quality samples were collected at the Gunnison River below the Gunnison Tunnel, which is located at the downstream end of the Curecanti National Recreation Area and the upstream end of the Black Canyon of the Gunnison National Monument. Data collection started in December, 1994, and samples were collected monthly with an additional extreme flow sample. Water samples were analyzed for nutrients, major cations, anions, and metals, organic carbon, suspended sediment, and field parameters. Stage measurements for discharge were collected on an hourly basis at the station.

Water quality data were analyzed to compare the two stations on the Gunnison River and to determine any significant findings. Detailed preliminary summaries with box plots and some time plots were produced. The general conclusions of the analysis follow. The nutrient concentrations are low or at reporting levels for both stations, and there is less variability in nutrient concentrations at the Gunnison Tunnel station. Many of the major ions are similar for the two stations, but the largest differences are found in potassium, chloride, and sulfate. The Gunnison Tunnel station has higher values of potassium and sulfate, whereas the County Road 32 station has slightly higher values of chloride. Iron and manganese are definitely higher at Count Road 32. In general, there is greater variability in the data from the County Road 32 station. Any constituent associated with the suspended phase definitely has a lower concentration and a very low variance at the Gunnison Tunnel station. The "reset" mechanism of the Aspinall Unit is observable as would be expected.

Ten water quality samples were collected at the Colorado River below Baker Gulch, which is located at the downstream end of Rocky Mountain National Park on the Colorado River. Data collection started in January, 1995, and samples were collected monthly with an additional extreme flow sample. Water samples were analyzed for nutrients, major cations, anions, and metals, organic carbon, suspended sediment, and field parameters. Stage measurements for discharge were collected on an hourly basis at this station.

Water quality data were analyzed to determine any significant findings at this station. Detailed preliminary summaries with box plots and some time plots of concentrations were produced. The general conclusions of the analysis follow. This station is a reference-background station, and the water quality reflects the station type. There were a few detections of ammonia and nitrite plus nitrate. All other nutrient concentrations were below the reporting levels. Some dissolved organic carbon (DOC) is present in the water, but the concentrations are low. Suspended organic carbon (SOC) concentrations are very low. Sum of cations and anions are in the 600 microequivalents per liter range reflecting the dilute water. There is some fluoride, iron, and manganese as a result of local geology, and all other concentrations are low. Conductivity is around 600 microsiemans per centimeter and pH is circumneutral.

Yosemite National Park - San Joaquin-Tulare Basins NAWQA Study Unit

Yosemite National Park receives heavy visitor use in the Merced River drainage. Synoptic and long-term water resource and biological information is needed to determine if there are changes in the water quality of the Merced River as it moves through the Yosemite Valley. The park is interested in evaluating benthic community responses to water quality changes, and analyzing long-term trends in riparian, wetland and stream habitats related to the Merced River Restoration Project.

The NPS-NAWQA project in Yosemite National Park is being conducted by USGS personnel working out of the California District Office in Sacramento, California. The project involved physical, chemical, and biological sampling at several sites on the Merced River in Yosemite Valley. All scheduled field work in the original proposal was completed. The water quality and algae synoptic had to be postponed until early September because of high water in August. The synoptic involved twelve people for a period of four full days. An item by item review of the various work elements follows:

1. Monthly sampling at Pohono Bridge: Monthly water quality sampling started in April 1995 and continued through September. Sampling included nutrients, major ions, and field parameters. Trace elements were sampled on the same schedule as the Happy Isles site which is operated under the National Hydrologic Benchmark Program. Most of the chemical analyses have been completed by the NWQL and the data has been entered into the California data base.

2. Ecological sampling: Full NAWQA ecological protocols including fish surveys, collection of invertebrate samples, collection of algae samples, and habitat surveys were completed at the Happy Isles site and at the Pohono Bridge site during the period of September 5 through 8. These surveys will complement full NAWQA ecological surveys conducted at Happy Isles in 1993 and 1994 and partial surveys conducted at Pohono Bridge in 1994.

3. Contaminants in sediment and tissue: In conjunction with the ecological sampling, sediment and tissue samples were collected for determination of levels of synthetic organic compounds. The specific chemicals analyzed are listed in the original proposal. In short, the tissue samples will be analyzed for organochlorine chemicals, primarily persistent pesticides such as DDT, and the sediment will be analyzed for the same chemicals but also for additional organochlorines and a variety of other organic compounds associated with industrial and urban uses. Sediment was

collected using a teflon spoon and coring tube. Eight Sacramento suckers were collected with a speargun. The samples have been submitted to the NWQL but the analyses have not been performed yet.

4. Water quality/algae synoptic: The synoptic was conducted during the week of September 12 through 15. Water quality sampling included field parameters, nutrients, and major ions at eight sites on the Merced River. Pohono Bridge was the most downstream site. Happy Isles was the most upstream site. The intervening six sites were located at the same sites used by Jim Carter, USGS, Menlo Park, for invertebrate surveys in previous years.

Algae samples were collected at the same sites. Five replicate samples of algae for determination of chlorophyll-a content and ash-free-dry mass were collected at each of the eight sites. These sites were frozen on dry ice and will remain frozen until analyses are conducted at the California District laboratory in Sacramento. Samples of algae for species identification were collected at all eight sites. Five replicate samples were collected at Happy Isles, Pohono Bridge, and a third site known as Swinging Bridge. The Swinging Bridge site is located near Yosemite Lodge and roughly at the downstream end of the reach of the Merced River most affected by streamside recreational use. Single samples were collected at the remaining five sites. Habitat data included measurements of stream depth, width, velocity, substrate and bank morphology. We also used several techniques for estimating light levels at each site, including
a solar pathfinder.

5. Report: Report preparation has not been started because much of the data is not yet available. Report preparation will likely begin early in calendar year 1996.

Lake Mead National Recreation Area - Nevada Basin and Range NAWQA Study Unit

Lake Mead National Recreation Area is the largest reservoir in the western United States. Lake Mead was created by the damming of the Colorado River by Hoover Dam. Although the waters of Lake Mead are used to support various uses throughout the southwest, the primary activity in the park is water-based recreation. One of the tributaries to the reservoir is Las Vegas Wash. Streamflow in Las Vegas Wash is predominantly stormwater runoff and wastewater effluent from the Las Vegas Metropolitan area. Also, one or more potential EPA Superfund sites are located in the watershed. Therefore, Las Vegas Wash and Las Vegas Bay may contain organic and biological contaminants that may pose potential threats to the health of humans and other organisms.

This cooperative investigation is being conducted at Lake Mead National Recreation Area by the NPS and the NAWQA Program to answer questions about the occurrence, distribution, and bioavailability of potential endocrine-system disrupting organic compounds and inorganic trace elements (endocrine disrupters) in Las Vegas Wash and Bay. Endocrine-system disruption results in diminished sexual development and reproductive capability and has been shown to affect wildlife and humans. This investigation was designed to be completed in two phases, and in conjunction with collaborative studies by the National Biological Service (NBS) and the U.S. Fish and Wildlife Service (USFWS). The first phase of this investigation, carried out during spring and summer of 1995, was an occurrence survey to identify endocrine disrupters that are present

in the aquatic environment of Las Vegas Wash, Las Vegas Bay, and Callville Bay (a background site), and to provide information on their distribution and bioavailability. Collaborative studies with the NBS and USFWS also were conducted to evaluate endocrine disruption, histopathologic effects, and the occurrence of semivolatile synthetic organic compounds in carp (Cyprinus carpio). The second phase of this investigation, proposed for the spring and summer of 1996, is to be a distribution survey to identify source areas that contribute endocrine disrupters to Las Vegas Wash and Bay.

Project activities for fiscal year 1995 included planning, organizing, and completing data collection activities for the occurrence-survey phase of the investigation. Following NPS approval of the project in the spring of 1995, NAWQA personnel coordinated with cooperating agencies to conduct the data collection activities. Contracts were negotiated with the USGS National Water Quality Laboratory and private-sector companies for laboratory analytic services and to obtain necessary sampling equipment and supplies to collect the samples.

A contract was negotiated with Environmental Sampling Technologies in St. Joseph, Missouri to purchase Semipermeable Membrane Devices (SPMD's), commonly called "fatbags", and stainless steel deployment devices; they were also contracted to extract compounds from the SPMD's, by using dialysis and gel-permeation chromatography. The USGS laboratory in Arvada, Colorado was contracted to analyze the SPMD extractant for the same NAWQA analytical schedules used for semivolatile organic industrial compounds and organochlorine compounds in bottom sediments. A USGS contract laboratory, Quanterra Environmental Services in Sacramento, California, was contracted to analyze for dioxins and furans in bottom-sediment samples and in the SPMD extractant.

In May, personnel from the USGS, the NPS, the NBS, the USFWS, and the Bureau of Reclamation collected and processed carp (Cyprinus carpio). Approximately twenty carp, ten males and ten females, were collected from each site. The sex of each carp was determined and they were measured and weighed. Blood-plasma, gonad, and organ (liver, kidney, gill, and intestine) samples were taken from the fish. Additionally, samples of exterior or interior abnormalities (including lesions and tumors) were collected. Each remaining fish carcass was frozen with dry ice and stored in a deep freeze at a predescribed temperature. The blood-plasma samples are being analyzed for 17-Keto Testosterone, 17-Beta Estradiol, and Vitellogenin by the University of Florida at Gainesville. The gonad, organ, and abnormality samples will be used by the NBS to assess endocrine disruption and other effects on carp in Las Vegas Wash and Bay, and evaluated as part of a NAWQA/NBS National Endocrine Disruption Study to determine if endocrine disruption is a potentially widespread problem in fish throughout the nation. In late summer the EPA agreed to analyze the fish carcasses for polycyclic aromatic hydrocarbons (PAH's) and other semivolatile organic compounds, and for chlorinated organic compounds.

In early June NAWQA and NPS personnel installed SPMD's at a site in the lower reach of Las Vegas Wash, at three sites in Las Vegas Bay, and at a site in Callville Bay. SPMD's were attached to existing buoys in Las Vegas Bay (B and C Buoys) and Callville Bay (A Buoy); a temporary buoy was installed in Las Vegas Bay near the mouth of Las Vegas Wash. Profiles of temperature, specific conductance, pH, and dissolved oxygen were made at each site to determine depths at which SPMD's would be attached. The purpose of the profiles was to determine if

water in the bays was stratified and to place SPMD's above and below the thermocline. The water was stratified and SPMD's were placed at depths ranging from 10 to 71 feet. SPMD's were deployed for approximately six weeks. Because there was little existing information on volatile organic compounds (VOC's) contributed to Las Vegas Bay by Las Vegas Wash, water samples for VOC analysis were collected at the wash site during the six-week period the SPMD's were deployed.

The SPMD's were retrieved in mid-July. Profiles of temperature, specific conductance, pH, and dissolved oxygen were measured; the bays were stratified. Bottom-sediment samples were collected, using a ponar sampler, for analyses of inorganic trace elements, PAH's, organochlorine compounds, semivolatile organic industrial compounds, and dioxins and furans. Samples were processed and shipped to laboratories for analyses. These data were returned and processed, and are being submitted to the NPS. Selected analytic results are discussed in the following section.

VOC's were detected in water samples from Las Vegas Wash. Bromodichloromethane, bromoform, chlorodibromomethane, and chloroform comprise the group of halomethanes known as total trihalomethanes (TTHM's) and are commonly formed by the interaction of residual chlorine with dissolved organic carbon. These compounds are classified by the EPA as potential carcinogens, and the current maximum contaminant level (MCL) for TTHM's in drinking water is not to exceed 80 µg/L (EPA 1994). Methyl tert-butyl-ether (MTBE) is a common gasoline additive used to increase the octane level of gasoline, thereby improving its combustion and reducing carbon monoxide and ozone levels in air. The EPA lifetime health advisory level for an adult is 40 µg/L (EPA 1994). Concentrations of VOC's in Las Vegas Wash did not exceed MCL's or health advisory levels.

Inorganic trace elements, organochlorine compounds, and semivolatile organic industrial compounds, and dioxins and furans were detected in bottom-sediment and/or SPMD samples from Las Vegas Wash, Las Vegas Bay, and Callville Bay sites. Concentrations of chromium, copper, lead, and zinc in samples from Las Vegas Bay generally are representative of moderately polluted freshwater sediment (EPA 1977). Lead has been reported as having reproductive and endocrine-disrupting effects. Concentrations in Callville Bay generally are representative of nonpolluted freshwater sediment.

Organochlorine compounds detected in bottom-sediment and/or SPMD samples from Las Vegas Wash and Bay are mostly pesticides or degradation products, and include DCPA; dieldrin; endosulfan; hexachlorobenzene, trans-chlordane, cis-chlordane, trans-nonachlor; o,p'DDD; p,p'DDD; p,p'DDE; and total polychlorinated biphenyls (PCB's). Most of these compounds are reported endocrine disrupters.

Phthalates (di-n-butyl phthalate, diethyl phthalate, and bis(2-ethylhexyl) phthalate) were detected in bottom-sediment samples from all sites in Las Vegas Bay. They are used as plasticizers to produce polyvinyl chloride, polypropylene, polyethylene, and polystyrene. Because of their widespread production and use, phthalates are frequently identified as contaminants in water, sediment, and biota of surface water systems (Smith and others 1988). These compounds are classified as priority toxic pollutants by the EPA. These compounds are reported endocrine disrupters.

Polycyclic aromatic hydrocarbons (PAH's) were detected in bottom-sediment and/or SPMD samples from Las Vegas Wash and Bay. Their presence in surface water systems is due primarily to anthropogenic sources, particularly hydrocarbon combustion or oil spills (Smith and others 1988). The most frequently detected PAH's in Las Vegas Wash and Bay include 2,3,6-trimethyl naphthalene; 4,5-methylene phenanthrene; phenanthrene; fluoranthene; pyrene; and chrysene. These compounds are reported endocrine disrupters.

Both phenol and p-cresol were detected in bottom-sediment samples from Las Vegas Bay. They are used as disinfectants and are by-products of chemical manufacturing processes (Sittig 1985). They are corrosive to tissues and can result in systemic damage when inhaled, ingested, or absorbed through the skin or mucous membranes. They also are potential endocrine disrupters.

Dioxins and furans were also detected in bottom-sediment and SPMD samples from Las Vegas Wash and Bay. Polychlorinated dibenzo-p-dioxins (PCDD's) are produced inadvertently during the manufacture of pesticides. Tetrachlorodibenzo-p-dioxins (TCDD's) and hexachlorodibenzo-p-dioxins (HxCDD's) are found in the pesticide 2,4,5-T (Smith and others 1988). PCDD's are extremely toxic compounds; TCDD's are the most toxic. Because PCDD's are by-products of any manufacturing process that involves the use of trichlorophenol, they are commonly discharged by chemical manufacturing plants, wood-processing plants, or sewage treatment plants (Smith and others 1988).

The most unexpected result of the occurrence phase sampling is the large number of PAH's detected in SPMD samples from Callville Bay. Not only were more PAH's detected at the shallow site in Callville Bay than at any other site in Las Vegas Bay, concentrations of PAH's were higher at the Callville Bay site.

Results from the occurrence survey and previous NAWQA data collection activities indicate that Las Vegas Wash is a source of inorganic trace elements and synthetic organic compounds (including pesticides, VOC's, and semivolatile industrial compounds) to Las Vegas Bay. The occurrence of relatively high concentrations of PAH's at the furthest downstream site in Las Vegas Bay and in Callville Bay, which is upstream from Las Vegas Bay, indicates that there probably are other sources of PAH's to Las Vegas Bay and to Lake Mead.

Chattahoochee River National Recreation Area - Apalachicola-Chattahoochee-Flint River Basin NAWQA Study Unit

Chattahoochee River National Recreation Area is located north of the Atlanta Metropolitan Area and receives heavy recreational use on the weekends. In addition, suburban development along the river corridor contributes significant sediment and contaminant loads to the river. Many agencies, organizations, and user groups (such as the Chattahoochee Riverkeeper) have been involved in studying and interpreting the river resources. Better coordination and cooperation amongst organizations and users is needed to protect this resource.

NAWQA personnel have been monitoring water quality conditions in several watersheds that are tributary to the Chattahoochee River within and adjacent to Chattahoochee National Recreation Area since April of 1993. The study approach was to choose 24 small watersheds throughout the

basin that are "typical" of the predominant land uses (forested, row-crop agriculture, poultry agriculture, suburban, and urban) within the basin. These watersheds receive no point-source inputs so that the effect of non-point sources on water quality can be assessed. Six of the small watersheds were sampled monthly for about two years (includes Sope and Peachtree Creeks in the park), and three of the watersheds (includes Sope Creek) were sampled weekly for one year. The remaining 18 watersheds (includes Rotten Wood and Willeo Creeks in the park) were sampled at least three times, during different seasons and flow conditions, to provide a synoptic (snapshot in time) data set for comparison with the six watersheds. Thirty-two larger tributaries (includes Big Creek in the park) and mainstem river sites were also included in the synoptic surveys to increase spatial coverage. Water samples were routinely analyzed for nutrients, major ions, organic carbon, and suspended sediment. Water samples were also analyzed for a suite of 84 pesticides at three sites. Biological samples were collected at the 24 small watersheds to document communities and their relation to land use, and to use those communities as integrators of physical and chemical quality. The most intensive biological sampling was focused in the six primary watersheds and includes samples of fish, benthic macroinvertebrates, periphytic algae, and a measure of in-stream and riparian habitat. Benthic invertebrates were collected, and a modified measure of in-stream habitat was made, at all other sites.

In fiscal year 1995, water quality data were collected from three stream basins that discharge into the Chattahoochee River within the park. The assessment was conducted by NAWQA staff with matching funding by the NPS. The project was conducted in order to assist the NPS in the evaluation of park water quality issues. The study included Big Creek and Suwanee Creek basins, as well as a small unnamed tributary to the Chattahoochee River located about 1.5 miles south (downstream) of Buford Dam. This unnamed tributary is referred to informally as "Silver Creek".

The Big Creek basin was sampled both on a routine monthly basis and synoptically to coincide with sampling of numerous streams within the Chattahoochee River basin from below Buford Dam to near the town of Whitesburg, Georgia. The Suwanee Creek basin also was sampled synoptically. The data collected from these basins was used to provide a basis for comparison of water quality of these streams with others having mostly suburban or urban land use that have been studied with greater intensity, and to generate a water quality data set that would complement those of other studies currently being conducted in the basin by state and local agencies. Data were collected from Silver Creek in order to define the water quality prior to (and possibly during) residential development of the watershed.

Sampling activities were from February through September of 1995, and included collection of onsite measurements (water discharge, water temperature, pH, specific conductance, and dissolved oxygen), nutrient, major ion, pesticide, sediment, turbidity, and biological data (fish, algae, and invertebrates). In July 1995, fish assemblage surveys were conducted at three sites in the Big Creek basin and at four sites in the Suwanee Creek basin. Daytime collections of fish present in all habitats in a 1500 meter reach at each site were conducted using two passes with a backpack DC electroshocker and two to four seine hauls in areas unobstructed by debris. The methods used are consistent with standard techniques for fish surveys conducted by NAWQA at 17 other locations in the upper Chattahoochee River basin in the vicinity of Metropolitan Atlanta. Data from the Big Creek and Suwanee Creek surveys will be analyzed in conjunction with data

sets from these 17 other locations.

Water samples were collected at an ungaged location at the Roswell water intake, the furthest downstream location that is accessible under all flow conditions, and is collocated with a Georgia Environmental Protection Division's (EPD) monitoring network site for Big Creek. Water temperature data indicate mostly seasonal fluctuations, with highest temperatures exceeding 25 degrees celsius during the months of July and August. The seasonal range of temperatures are consistent with the stream's classification as a warm water fishery. Dissolved oxygen data also indicate mostly seasonal fluctuations, with the lowest measured dissolved oxygen concentrations during the months of July and August. The lowest measured dissolved oxygen concentration of 5.0 mg/L meets the minimal criteria for a warm water fishery. However, actual concentrations of dissolved oxygen may be lower at other parts of the day and in slower reaches of the creek. The findings based on onsite measurements are consistent with other suburban and most urban sites currently studied as part of NAWQA.

Water samples collected as part of Georgia's EPD monitoring programs on Big Creek were analyzed for total ammonium and total nitrite plus nitrate forms of nitrogen, and total phosphorus. Water samples collected as part of the USGS and NPS assessment included analyses of dissolved ammonium, total and dissolved ammonium plus organic nitrogen, dissolved nitrite, and dissolved nitrite plus nitrate forms of nitrogen, as well as dissolved phosphorus, dissolved orthophosphate, and total phosphorus.

Measurements of total phosphorus concentrations in water from Big Creek ranged from 0.08 to 0.51 mg/L; these concentrations generally are higher than concentrations in several other streams draining areas of suburban and urban land use in the Atlanta Metropolitan area. The forms of phosphorus and the relation of phosphorus concentrations to stream discharge also are quite different from several other streams in the area. These data suggest inputs from one or more point sources of phosphorus in the Big Creek basin above the Roswell water intake. The phosphorus loads and yields may be higher from Big Creek than some other tributaries to the Chattahoochee National Recreation Area. Future water quality monitoring for nutrients could benefit from a more direct assessment of the relative contribution of point sources to the total nutrient load from the basin.

USGS and Georgia EPD data indicate that nitrate is the principal form of nitrogen present in water from Big Creek both seasonally and under most flow conditions, with lessor concentrations of organic nitrogen and ammonium. Nitrate concentrations in Big Creek may be slightly higher, and more variable than other streams draining areas of suburban and urban land uses. However, concentrations are well below the drinking water standard of 10 mg/L as nitrogen (as N). There is little indication of a relation of nitrate concentrations to stream discharge in the data collected during the assessment period.

Highflow samples collected in February and March of 1995 had appreciable sediment and turbidity. The limited data indicate a positive relation of suspended sediment concentration to stream discharge indicative of suspended sediment transport during runoff periods. Data collected during the assessment period indicate a good relation between suspended sediment concentration and turbidity.

Trace concentrations of seven herbicides and three insecticides were detected in Big Creek during the spring and summer of 1994 and 1995. Concentrations of these pesticides were well below existing standards and guidelines for drinking water. However, concentrations of each of the insecticides detected approach or exceed some existing guidelines for protection of aquatic life. Occurrences of the relatively persistent herbicides simazine and atrazine, probably are related to their application to lawns during the fall and winter for control of winter annual weeds in turf comprised of dormant bermuda grass. Occurrences of the insecticides probably are related to a broad range of residential, commercial, and institutional uses.

Three sites selected for fish surveys are Big Creek below the water works intake near Roswell (02335741), and two upstream sites, Big Creek at State Road 29 (02335580), and a small tributary, Kelly Mill Branch near Cumming (02335535). Instream habitat at the water works site is dominated by riffle consisting of cobble and boulders with patches of gravel. Stream banks are well vegetated with mature trees; the left bank is part of the park area. The site at State Road 29 was chosen to provide a comparative sample in the middle section of the basin above urban and suburban influences of Roswell and Alpharetta. Instream habitat in the reach sampled contains no riffles and consists of a long run dominated by deep, shifting sand and silt. A small area of gravel is present at the upstream end of the reach. Banks are eroding and vegetated with a thin riparian strip of small trees and shrubs. Pasture borders the reach on both banks. The most upstream site, Kelly Mill Branch, is a small first order tributary whose instream habitat is dominated by gravel and cobble embedded in silt.

Twelve to 14 species were collected among the Big Creek sites. Total abundance, species richness, and diversity are lower than what could be expected in high-quality stream reaches. For example, total abundance, richness, and diversity at the Snake Creek NAWQA site, located in a forested basin in Carroll County, 641, 17 and 2.16, respectively. Average values for the three sites in Big Creek are 110, 13, and 1.89. The presence of the highscale shiner at two sites is notable because this species is listed as threatened by the State of Georgia. This species is threatened by habitat loss in its geographically restricted range in the upper Chattahoochee River basin. This species requires areas of gravel for spawning. Two introduced species, the white sucker and green sunfish, were collected.

The analytical results of the algae and invertebrate samples have not been received at this time. The data and discussion based on these results will be provided at a later date.

Samples were collected from Suwanee Creek at the stream gage located on State Highway 13 about 2.4 miles southwest of the town of Suwanee and about 3.1 river miles upstream from the mouth in May and July of 1995 during baseflow conditions. Onsite measurements of water quality and analyses of nutrient and major ion concentrations were similar to baseflow water quality of other streams in the area that drain watersheds with predominately urban and suburban land use. Nitrate concentrations were 0.05 and 0.43 mg/L in May and July, respectively, and are similar to other suburban streams. Phosphorus was barely detected (concentrations of 0.02 and 0.01 mg/L); these data suggest that there was little impact of phosphorus point-source inputs during baseflow conditions at the stream gage site.

Five herbicides and two insecticides were detected in the two samples collected during May and

July of 1995. Concentrations of the pesticides detected were well below existing standards and guidelines for drinking water. However, the concentrations of diazinon, an insecticide, was above a guideline for protection of aquatic life. The insecticides detected were probably from residential uses. The herbicides were probably from applications made to bermuda grass turf (atrazine and simazine) or to roadsides and rights-of-way for utilities (bromacil, prometon, simazine, and tebuthiuron). The pesticides detected in Suwanee Creek have also been detected in other streams in the Atlanta area that drain watersheds with urban and suburban land use.

Four sites selected for fish surveys are Suwanee Creek at the Lawrenceville-Suwanee Road (02334865), at Woodward Mill Road (02334740), Ivy Creek at County Road 103 (02334812), and a small unnamed tributary of Ivy Creek which is confluent with Ivy Creek at the County Road 103 site. At Lawrenceville-Suwanee Road, instream habitat is extremely poor and consists of shifting sand and deep deposits of easily suspended silt. The Woodward Mill Road site was selected because of the presence of deep pools and gravel runs. The reach sampled at Ivy Creek encompasses riffles, cascading bedrock, and sand runs. Silt deposits in low velocity areas appear to originate from sewage line construction along the left bank. The unnamed tributary drains a small forested basin. Instream habitat is diverse with classic pool-run-riffle sequences.

With the exception of the unnamed tributary of Ivy Creek, sites in the Suwanee Creek basin also had lower abundances, species richness, and diversity than could be expected in a high-quality stream. Average values for these three sites are 152, 12, and 1.66, respectively. Notable among the species collected is the greater jumprock which is endemic to the Chattahoochee River basin. The presence of the mottled sculpin in the unnamed Ivy Creek tributary is significant as an indicator of a high quality stream. Low species richness and diversity of Suwanee and Big Creeks mostly result from the absence or low abundance of minnow species which inhabit the upper Chattahoochee River basin.

At Silver Creek, water quality and biological data (invertebrates and algae) were collected about 750 feet upstream from the mouth (02334442) on July 31, 1995, and a series of 10 cross-sections of the stream were surveyed to an arbitrary datum. The stream was at baseflow conditions at the time of data collection. The water sample contained low dissolved solids that are typical of forested watersheds (and much lower than watersheds draining suburban and urban areas). Nitrogen was present in low concentrations as ammonium (0.02 mg/L) and nitrite plus nitrate (0.13 mg/L). No forms of phosphorus were present at or above the minimum detection limit of 0.01 mg/L. No pesticides were detected at or above their minimum reporting levels.

The USGS has decided to discontinue sampling of Silver Creek, because of the delicate nature of the negotiations between the NPS and the developer on this property, and the uncertainty of further access to the sampling site. However, the USGS will consider collecting samples during residential development of the watershed if there is an opportunity based on the agreement of the developer, the NPS, and the USGS.

Rocky Mountain National Park - South Platte River Basin NAWQA Study Unit

Rocky Mountain National Park has supported water-related research in the past (e.g. Loch Vale water quality studies), but has conducted little baseline monitoring. Streams and rivers draining

east toward the South Platte River receive the heaviest recreational use in the park. Meadows in these drainages are also sanctuaries for elk. The Big Thompson River is the largest river drainage on the eastern slope of the Continental Divide in the park, and no long-term water quality data are available for this river.

The NPS-NAWQA project in Rocky Mountain National Park is being conducted as part of the study unit basic-fixed station network to assess the basic physical properties and inorganic constituents of stream water representing a minimally impacted forested land-use setting (drainage area = 39 $mi.^2$). The approach taken by NAWQA to assess the water quality of streams is based on three interrelated components: water column, biological, and bed sediment studies. The results from this station will be used as a reference upon which other sites in the basin and across the country can be compared. The station selected was located on the Big Thompson River near Estes Park, Colorado.

In 1995, the decision was made to install a streamflow gaging station on one of the major streams in the park in order to relate physical, chemical, and biological characteristics of streams to varying hydrologic conditions. Two watersheds in the South Platte River Basin; the North Vrain Creek, and Big Thompson River, were selected as possible candidates. In November 1994, personnel from the NPS and USGS toured potential monitoring sites in each basin. Based on characteristics such as adequate basin size, accessibility, previous data collection, and suitable stream hydraulics, two sites on the Big Thompson River were chosen as desirable monitoring locations. Continuous streamflow had been monitored at the sites (located above and below Moraine Park) by the NPS from June 1992 through September 1994. They were known as the "Upper Big Thompson" and "Big Thompson Bridge" sites (Jeff Hughes, NPS). Each site had pros and cons for water quality monitoring. The main concern for the lower site was that water quality might be impacted by local dwellings and nearby stables. The major drawback of the upper site was the lack of an adequate sampling structure (i.e. bridge) for non-wadeable, high flow conditions. In December 1994, the decision was made to concurrently sample the two sites through July 1995 to determine if there was discernible differences in water quality (samples could not be obtained from the upper site from mid June to early August because of high flows). In July, a review of the data indicated that the water quality was comparable between the sites with the exception that dissolved iron and manganese were higher at the lower site. Higher iron and manganese concentrations at the lower site probably resulted from natural processes occurring in the Moraine Park wetlands rather than from anthropogenic sources. More importantly, the chemical data indicated that the local dwellings and stables did not affect water quality at the lower site. By early August, it was decided that the monitoring station would be installed at the lower site.

The streamflow gaging station was installed on August 23-24, 1995 on the Big Thompson River at the bridge just upstream of Bear Lake Road in Moraine Park. The gage employs the use of a non-submersible pressure transducer to monitor stream stage. A small wooden shelter attached to the upstream, left bank, bridge wing wall houses the pressure transducer, a small nitrogen tank, a data logger, and a battery. A 1/4-inch tube contained in a 2-inch black steel pipe delivers nitrogen gas to the stream at a rate of about 60 cc per minute..Back pressure on the nitrogen gas is converted to stream stage by the transducer. A staff plate, attached to a piece of 6-inch wide channel iron is installed on the left bank, just upstream of the bridge. A stage-discharge rating

will be developed for this site in 1996 as more discharge measurements are made.

Water-column studies in NAWQA focus on assessing the physical and chemical characteristics of stream water and on relating the characteristics to hydrologic conditions, sources, and transport. As previously indicated, water-column studies were performed at two sites on the Big Thompson River in 1995. The upper (Big Thompson River above Moraine Park) was sampled five times while the lower site (Big Thompson River below Moraine Park) was sampled ten times. Additionally, one equipment blank and one replicate sample were obtained in 1995. Analyses consisted of on-site measurements of discharge, water temperature, specific conductance, pH, dissolved oxygen, and alkalinity, and laboratory determinations of suspended sediment, dissolved solids, major ions, iron, manganese, nutrients, and organic carbon. Additional sampling is planned for 1996 and will include the analysis of 47 pesticides in six water samples, and the analysis of bed sediment samples.

The biological components of NAWQA consist of ecological surveys and tissue contaminant studies. In 1995, portions of the ecological surveys were completed at the Big Thompson River below Moraine Park site. Ecological surveys are designed to characterize fish, benthic invertebrate, and algal communities and associated instream and riparian habitats. The fish community survey was completed in September, 1995. With the help of personnel from the Colorado Division of Wildlife, 83 fish were temporarily captured in a 200 meter reach in the vicinity of the stream gage. Each fish was identified, measured, weighed, and checked for abnormalities such as deformities, lesions, tumors, and blindness. All fish were immediately returned to the stream unharmed. A survey of instream and riparian habitat was also completed for the 200 meter reach in 1995. Approximately 250 survey points were acquired by measuring width and depth of channel transects, bank features, and delineation of the floodplain. Additional biological work, including benthic invertebrate and algal community surveys are planned for 1996.

Ozark National Scenic Riverways - Ozark Plateaus NAWQA Study Unit

Ozark National Scenic Riverways is located in a region influenced by karst topography. The park contains two major rivers (Current River and Jacks Fork) and several large springs. Big Springs is thought to be the largest single-outlet freshwater spring in the world. The springs are the primary sources of surface flow to the two rivers. Canoeing and fishing are traditional recreational uses that are dependent on this consistent supply of high quality water. Land use activities in the watershed posing water quality concerns to the park are: past and proposed lead mining, timber harvesting and milling, cattle and hog grazing, horse trailing, and dump sites.

The NPS-NAWQA project at Ozark National Scenic Riverways is being conducted by NAWQA personnel out of the Arkansas and Missouri District Offices. In fiscal year 1995, a site within the park on the Current River at Van Buren, Missouri was added to the NAWQA study unit's basic-fixed station network. The primary objective of this work is to provide water quality and ecological data which will help the NPS and the USGS assess differences between the Current River and Jacks Fork (an existing NAWQA basic-fixed station site). The site also will be used to describe water quality in the lower part of the Current River which represents the largest drainage area (1,667 $mi.^2$) being studied in the Ozark Plateaus.

Activities in 1995 on the Current River included: USGS collection and analysis of water quality samples; ecological assessments including sampling of the fish, invertebrate, and periphyton communities, and characterization of the stream habitat; and sampling of bed sediment and biological tissue. The activities performed are listed and described in more detail below:

1. Monthly (January - September) sampling for nutrients, common ions, dissolved and suspended organic carbon, suspended sediment, bacteria, and field parameters; bimonthly sampling for trace elements; and sampling for pesticides in May and June (the same analytes as at other study unit sites).

2. Sampling of the fish, macroinvertebrate, and algae (periphyton) communities in August or September.

3. Characterization of the instream and riparian habitat along the ecological reach.

4. Collection and analysis of one bed sediment and tissue (Asiatic clams or fish) sample for trace elements and hydrophobic organic compounds.

5. Data analyses and management including publishing NPS data in the Missouri District annual data report.

A statistical summary of water quality data was produced. More samples were collected than planned, owing partly to the fact that this site was sampled during NAWQA's high flow synoptic survey in May 1995. Ten samples (instead of nine) were collected for nutrients, common ions, dissolved and suspended organic carbon, suspended sediment, bacteria, and field parameters. Seven (instead of five) trace element samples were collected. Four (instead of two) samples (GC/MS) were collected for analysis of pesticides commonly found in the Ozarks. One (instead of two) sample (HPLC) was collected for analysis of pesticides rarely found in the Ozarks. These data will be published in the Missouri District annual data report.

Ecological assessments were performed in the spring and summer 1995. The fish community of the Current River at Van Buren, Missouri was sampled on August 2, 1995. Boat electrofishing, backpack electrofishing, and kick seining were used in the sampling. A total of 252 individuals belonging to 28 species were collected. These individuals belonged to the following taxonomic groups: stonerollers (6 percent); other minnows (32 percent); sunfish/bass (12 percent); darters (8 percent); suckers (13 percent); and others (29 percent). The relatively low abundance of stonerollers and high abundance of other minnows generally indicates that a site is not impacted by agricultural activity. Stonerollers generally are the most abundant taxa at sites in agricultural basins in the Ozarks.

Invertebrate and periphyton samples were collected on August 21, 1995. These samples currently are being analyzed. Habitat measurements of the reach were conducted on April 19, 1995. Habitat data currently are being analyzed. Bed sediment and tissue (from Asiatic clams) samples for analysis of organics and trace elements were collected on August 2, 1995. Preliminary review of the results of the trace element analysis in bed sediment indicates no unusual concentrations. Other results are pending.

Bandelier National Monument - Rio Grande Valley NAWQA Study Unit

Bandelier National Monument is a cultural resource park located adjacent to the Rio Grande. Several small streams which were used by Native peoples bisect the park. The Rito de los Frijoles is the largest stream and it flows past park headquarters. Activities in the upper watershed (such as: grazing, logging, recreation, geothermal development, and nuclear research at the Los Alamos National Laboratory) concern the park. A spill of the pesticide DDT within the park prompted the need for monitoring to assess potential effects on water resources.

The NPS-NAWQA project at Bandelier National Monument was the first collaborative, cost-share water quality monitoring project initiated by the NPS. Project activities began in fiscal year 1993 with park project funds under the authority of a separate Interagency Agreement (IA7029-3-001). The project was designed to last three years through fiscal year 1995. The project was conducted by NAWQA personnel stationed in the New Mexico District Office in Albuquerque, New Mexico.

In fiscal year 1995, NAWQA personnel continued to operate the gaging station at the Rito del los Frijoles (08313350) which was reactivated at the start of the project. Monthly water samples were collected for analysis of major ions, nutrients, suspended sediments, and field measurements of water temperature, conductivity, pH, and alkalinity. Both the computed stream discharge data and the water quality data will be published in the New Mexico USGS annual data report. A third ecological survey was conducted during the summer of 1995. During the life of the project, data were collected on streamflow, water chemistry including trace elements, organic pesticide levels (in fish, aquatic invertebrates, and bed sediments), and ecological habitat conditions for stream riparian community organisms including benthics, algae, and vascular plants. The status of the biological work is as follows.

The invertebrate and algae data were submitted to the contractors and should be released sometime in 1996. The fish survey was completed in 1994, and various age groups of brook trout and rainbow trout were collected. The habitat survey was completed in 1994, but plant identifications still require verification. Bed sediment and tissue samples were collected in 1993, and elevated levels of DDT (28 parts per million, ppm), DDE (110 ppm) and DDD (35 ppm) were found in whole body fish in Rito de los Frijoles near the confluence with the Rio Grande.

The reactivation of the streamflow gage involved recalibrating the rating curve for the weir and replacing the existing chart recorder with a data logger. The USGS also reduced (computed discharge from) approximately ten years of stage height data collected by the NPS, and trained park staff in water and biological sampling methods and gage maintenance procedures.

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