A CONCEPTUAL PROGRAM FOR WATER-QUALITY MONITORING IN THE 
UPPER CHATTANOOCHEE RIVER BASIN IN GEORGIA

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Abstract. The Chattahoochee River is a major resource for drinking water, aquatic life, recreation, and wastewater assimilation in the States of Georgia, Alabama and Florida. The rapid growth of the Atlanta metropolitan area has put a substantial strain on the basin’s water resources. The U.S. Geological Survey (USGS) has developed a conceptual program to evaluate the current status of, and to monitor changes in, the water quality of the upper Chattahoochee River basin (from the headwaters to Columbus, Georgia). The concept is both multifaceted and multidisciplinary, and would be phased in over four years. Components of the program are intended to: (1) better detect health risks from bacteria and various chemical constituents; (2) implement an intensive basinwide sampling effort to provide an assessment of current water-quality conditions and identify local areas of concern; (3) establish current baseline conditions; (4) provide a framework for assessing changes in water quality; and (5) develop a state-of-the-art real-time water-quality monitoring network throughout the basin.

INTRODUCTION

The Chattahoochee River basin is a major resource for drinking water, aquatic life, recreation, and wastewater assimilation in the State of Georgia as well as in the neighboring states of Alabama and Florida. The rapid growth of the Atlanta metropolitan area has placed a substantial strain on the basin’s water resources. Between 1970 and 1995, the population of the 10-county Atlanta metropolitan area nearly doubled from 1.5 to 2.9 million (Gregory and Frick, 2000). Numerous Federal, State, and local projects have been undertaken, or are underway, to monitor selected water-quality and quantity parameters in the watershed. However, there is no comprehensive basinwide-monitoring program to provide a framework for these individual efforts.

The Chattahoochee Riverway Project (CRP) Task Force is a multi-organizational (the Trust for Public Land, the Georgia Conservancy, the Upper Chattahoochee Riverkeeper, the Turner Foundation, the Georgia Department of Natural Resources, the National Park Service Chattahoochee River National Recreation Area, the U.S. Geological Survey, and several other Federal agencies), multidisciplinary group established by the Governor of Georgia as part of the Greenway Initiative and combines aspects of former Vice-President Gore’s Partnership for Regional Livability. The Governor tasked this group with developing a strategy for maintaining the Chattahoochee watershed as a viable resource. The CRP has established a monitoring subcommittee to develop a comprehensive basinwide plan to address water-quality issues in the Chattahoochee River basin. In conjunction with the CRP Task Force, the subcommittee set three main goals for the monitoring program: (1) develop a means of establishing, as near real-time as practicable, a knowledge of bacteria levels in the river to advise recreational users of potential health risks; (2), provide a basinwide water-quality 'snapshot' of the upper Chattahoochee River basin to set reference points for current and future monitoring programs; and (3) design a state-of-the-art real-time water-quality monitoring network to facilitate timely, informed decisions relative to water-quality issues in the Chattahoochee River basin. As an active participant in the CRP and monitoring subcommittee, and at their request, the USGS developed a conceptual program to meet these three goals. The program is designed to determine the current status, and to monitor ongoing changes in the water quality of the upper Chattahoochee River basin including important tributaries (from the headwaters to Columbus, Georgia). The program was designed by augmenting the existing streamgaging and sampling network currently operated by the USGS (fig. 1). Details of the conceptual program are described herein.
THE CONCEPTUAL MONITORING PROGRAM

The conceptual program developed by the USGS for the CRP monitoring subcommittee employs a four-phase hierarchical approach, with each phase requiring approximately one year for initial implementation. The first three phases are intensive, and are designed to: (1) establish long-term real-time core monitoring stations; (2) collect substantial numbers of water-quality samples for physical, chemical, and biological analysis; and (3) analyze the resulting data to develop a broad view of the water-quality status of the upper Chattahoochee River basin. The fourth phase entails the continuation and maintenance of the monitoring network to document any changes in water quality. It should be noted that this conceptual program was designed as a starting point from which more ongoing, site-specific, monitoring efforts might emerge. Further, should the initial effort prove successful, the conceptual approach ultimately might be applied statewide.

Phase One: Core Monitoring Sites

Phase One of the water-quality monitoring program has four components: (1) establish seven 'core' continuous water-quality monitoring stations along the main-stem of the Chattahoochee River; (2) complete a real-time streamflow and rainfall monitoring network throughout the basin and surrounding areas; (3) establish monthly water-quality sampling and analysis programs at the seven sites described in component 1; and (4) enhance and continue the ongoing Chattahoochee BacteriALERT program (discussed later in this paper). Because streamflow is a requisite for estimating constituent loads, the seven core stations would be located at existing USGS streamgaging sites. These sites include: (1) Chattahoochee River at Helen; (2) Chattahoochee River at Buford Dam, near Buford; (3) Chattahoochee River near Norcross; (4) Chattahoochee River at Atlanta; (5) Chattahoochee River at Fairburn; (6) Chattahoochee River at Franklin; and (7) Chattahoochee River at Columbus. To some extent, pragmatic issues affected site selection; for example, the Fairburn site already was instrumented as a continuous water-quality monitoring station, and as a result, a substantial amount of historical data already exist for this location. Further, plans already existed and were being implemented to instrument both the Franklin and Columbus sites. The Helen location was selected as a control site because it is relatively free of human impacts. The Buford location was selected to document water-quality changes resulting from the retention of water in Lake Lanier prior to release. The Norcross and Atlanta sites are part of the ongoing BacteriALERT program. Lastly, the Columbus site was selected as the downstream limit for the conceptual monitoring program. As such, water-quality data would be required as a boundary condition for any subsequent modeling.

Stream stage, discharge, rainfall, water temperature, specific conductance, dissolved oxygen (DO), pH, and turbidity would be measured at each core site. Four sites also would be instrumented to record wind speed, wind direction, air temperature, and barometric pressure for general background information. Although these data are not critical for establishing the water-quality status of the river, these data may be useful in establishing relations between meteorological data and constituent concentrations associated with nonpoint-source runoff.

Component 1 was designed with the eventual goal of real-time modeling; hence, all water-quality sensors at the seven sites would be equipped with satellite telemetry to relay data to a central location. Following completion of Component 1, the monitoring network would consist of five streamgaging stations without satellite telemetry or rain gages (fig. 2). As part of Component 2, fifteen stations, located outside the basin, would be upgraded to record real-time precipitation data to permit an accurate estimate of areal rainfall distribution during storms. These external sites would
provide a more accurate representation of the effect of precipitation on discharge, within the upper Chattahoochee River basin. Ten of these sites would be located at existing USGS stations; whereas five either would be entirely new, or would be selected from currently inactive sites. Six of the fifteen stations also would include other meteorological sensors.

As part of Component 3, discrete water-quality samples would be collected at each of the seven core sites listed in Component 1. Sample collection would be timed so that at least 85% of normal annual flow conditions would be covered. The samples would be analyzed for various chemical constituents including trace elements, nutrients, organic and agricultural chemicals, as well as other selected constituents. Sample collection and subsequent analysis would be used for calibrating monitoring sensors in an attempt to establish relations between the discrete samples and the continuous water-quality monitoring data, with the expectation that eventually, discrete sampling could be scaled back and replaced by real-time water-quality monitoring surrogates.

Component 4 of Phase One is the Chattahoochee BacteriALERT program, which is designed to determine the most recent bacterial concentrations practicable, at the Norcross and Atlanta core sites. A pilot program currently is underway with volunteers from the National Park Service (NPS) and the Upper Chattahoochee Riverkeeper (UCR). The volunteers collect water samples Monday through Thursday each week, and deliver the samples to the USGS Georgia District Office in Atlanta. The samples are analyzed and bacterial levels are displayed on the Chattahoochee Riverway Project web page (http://ga.water.usgs.gov/bacteria). Bacteria levels are provided in conjunction with information on both State and Federal regulatory limits, so that recreational users may assess the potential human health risks from water contact. Also, the NPS posts prominent visual indicators of subjective health risks (high, medium, or low) at heavily used recreational sites along the river.

Phase Two: Basin Status

Phase Two of the conceptual monitoring program is designed to determine the water-quality status of the upper Chattahoochee River basin through the collection and analysis of water samples. This program element would begin in the second year, and has three data components: (1) a high-flow synoptic study; (2) a low-flow synoptic study; and (3) storm/event sampling.

Components 1 and 2 are labor-intensive synoptic sampling efforts that would occur during separate two-week intervals when different flow regimes exist in the watershed. Component 1 is a high-flow study designed to evaluate the effects of nonpoint-source runoff on the river; whereas Component 2 is a low-flow equivalent designed to evaluate the effects of point-source inputs on the river. About 150 sampling sites would be occupied during each synoptic—one site upstream of a tributary to the Chattahoochee River; one site downstream of the tributary inflow; and one site located near the centroid of the tributary drainage area. Complete sediment and water sample analyses would be performed as part of each synoptic. These studies are intended to identify relatively localized areas in the basin where potential water-quality problems may exist. Such areas may require subsequent evaluative monitoring. In addition, the synoptics should provide a consistent basinwide framework for utilizing and understanding additional data collected during local monitoring efforts.

Figure 2. Automated USGS monitoring network for Phase One.
annually at five of the seven core stations. Sites directly below reservoirs were not considered due to flow regulation by dams. Samples would be collected throughout a storm, with emphasis on collecting at least two samples during the rising limb, one near the peak, and two on the falling limb of the hydrograph. The samples would be analyzed for water and suspended sediment-associated constituents (e.g., trace elements, nutrients, organic, and agricultural chemicals) so that concentrations could be compared to pre-storm/baseline conditions. This program element would provide information on the significance of storms relative to the annual fluxes of various chemical parameters, as well as bacteria, in the basin.

Phase Three: Data Analysis and Network Expansion

Phase Three of the conceptual monitoring program includes data reporting and interpretation based on the information collected during the previous two years. Further, this phase may require an expansion of the real-time water-quality monitoring network. In this instance, expansion would focus on selected tributaries in the upper Chattahoochee River basin. Two analysis and two data components comprise this phase: (1) publication of a basic data report; (2) in-depth interpretive studies with accompanying published reports; (3) potential expansion of the continuous monitoring network; and (4) continued storm sampling.

Components 1 and 2 of Phase Three would lead to a data report (CD-ROM-based) which could be used as a reference for ongoing local monitoring efforts. Further, where there is sufficient justification, appropriate interpretive reports on selected water-quality issues would be published. At a minimum, a basinwide status report, based on the high- and low-flow synoptics described under Phase Two would be published. Another potential report could describe the relations between discrete sample constituent concentrations and continuously monitored water-quality parameters. Wherever feasible, appropriate surrogates would be identified for purposes of limiting subsequent water sample collection and analysis.

Component 3 might require the installation of as many as twenty new continuous water-quality monitoring stations located throughout the basin. As noted in the description of Phase Two, the synoptic and storm sampling programs would be used, in part, to identify relatively localized areas where potential water-quality problems may require additional evaluation. For example, these stations could be used to highlight such issues as point- and nonpoint-inputs, pre-development conditions, and land-use changes caused by urban growth and changing demographics. These stations would be identical to the core stations described in Phase One; however, such installations should not be viewed as long-term. Studies would be highly focused on a specific issue(s), and the sites would be maintained only long enough to determine the significance of local inputs, to specific basin water-quality concerns, and for potential modeling purposes.

Component 4 represents a continuation of the storm sampling effort initiated in Phase Two. Because only one storm per site per year would be scheduled for sampling, it would be necessary to continue the effort for a number of years to develop a complete data set. Continuation of this effort also might provide a means of tracking land-use changes throughout the basin.

Phase Four: Long-Term Monitoring

Phase Four of the conceptual monitoring program was designed with the assumption that by the end of the third year, data collection would have become routine. Phase Four and beyond should permit long-term water-quality trend analysis in the upper Chattahoochee River Basin and provide important information on evolving water-quality conditions and issues. Actual sampling would be limited, and only intended to maintain instrument and model calibration. Final structure of the long-term monitoring network would provide sufficient data for informed management of the upper Chattahoochee River basin.

BEYOND PHASE FOUR

During the ensuing years, at approximately five- to ten-year intervals, intense synoptic studies similar to those outlined in Phase Two would be performed to update the water-quality framework ('snapshot') of the basin. In addition, at regular intervals, the existing monitoring network would be re-evaluated in light of such factors as changing land-use practices, the location of new point sources (e.g., new water treatment plants), and changes in population density and demographics. These re-evaluations might necessitate changes in the existing monitoring network.

LITERATURE CITED