Water Quality and Biological Monitoring Plan

Alcovy Watershed Protection Project

Prepared for:

Technical Advisory Committee

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Water Quality and Biological Monitoring Plan

I. Introduction

Project Background

The project involves the completion of watershed and source water assessments, modeling, development of a long term monitoring plan, preparation of a watershed protection plan and development of implementation strategies for the Alcovy River watershed. The assessment activities will address water quality, aquatic integrity, and source water protection. Alternative scenarios will be considered and modeled to predict water quality under different growth and management conditions. Additionally, a public education and involvement program, incorporated into key phases of the process, will involve the community in the management of the watershed.

Scope and Purpose

The scope of work for the watershed characterization task includes a biological, chemical and habitat assessment of the Alcovy River watershed. Additional sub-tasks include identification of potential pollutant sources above water intakes, input into the long-term management of the watershed, and assisting the public involvement task manager with educational outreach.

The primary objectives of the watershed characterization task are to:

- Develop a program for collection and assessment of water quality and quantity data;
- Assess the current status of streams used for drinking water supply or streams that are not meeting designated use criteria within the Alcovy River watershed.
- Identify potential sources of pollutants upstream of water supply intakes;
- Provide public information and education assistance;
- Provide data to support acquisition and maintenance of additional water withdrawal permits and potential wastewater NPDES permits;
- Provide data to assist in the development of a flexible, implementable, and legally defensible non-point source pollution control strategy for consideration; and
- Provide data to assist in development and identification of Best Management Practices (BMPs) and control measures that will maintain stream water quality within designated standards, based upon current and future land use plans.

The water quality monitoring activities are designed to obtain data required to define load-flow relationships for each monitored tributary. This information will be used to build a reliable database that accurately reflects current water quality conditions for several purposes, including:

- To compare observed values to State standards when the monitoring is complete;
- To provide input to the watershed model;
- To create loading coefficients from particular land uses and from specific sub-basins;
- To provide a calibration data set for the watershed model; and
- To develop targets for watershed management using the observed water quality data.

- To use observed water quality data to help define appropriate long-term watershed management goals.

II. Sampling Station Locations

The Alcovy River watershed has four permitted water supply intakes and one NPDES permitted discharge within its boundaries. No other point sources of pollution have been identified. Therefore this study is designed to focus on contributions from non point sources of pollution within the watershed. Efforts will be made to isolate contributions of pollution from specific land uses whenever possible.

Table 1 summarizes the location of monitoring stations within the Alcovy River watershed. The locations are shown on Figure 1.

III. Water Quality Sampling Methods

A team composed of Brown and Caldwell staff will conduct the water quality and quantity monitoring within the Alcovy River watershed. Monitoring will take place over eight months and will include both wet and dry weather sampling. Specific details of water quality monitoring will include:

- A training session for all members of the water quality sampling team.
- Water quality and water quantity monitoring at fifteen sampling stations during eight base flow and four storm events of varying magnitude.
- Collection for multiple grab samples throughout the hydrograph at all monitoring stations during one of the four storm events.
- Clean sampling for priority pollutants and trace metals during one base flow and one storm flow event on primary water supply streams and on streams not meeting designated use criteria.
- Manual monitoring of stream stage and velocity during base flow conditions and during storm events of various magnitudes.
- Water quality and stream gauging data analysis.

All stations will be sampled 12 times for the standard water quality parameters listed in Table 2. Eight (8) of the sampling events will occur during base flow conditions and four (4) during storm flow conditions. During two (one dry weather and one wet weather) of the sampling events, samples from designated stations will be analyzed for additional, non-standard, water quality parameters. These parameters are also listed in Table 2. The listed metal analytes require clean sampling methods. The analytical parameters were selected to meet minimum source water assessment requirements, modeling needs, and stormwater management criteria. However, there are not clear standards for all of the analytical parameters.

A storm flow event is defined as any storm that causes the streams to rise more than three-tenths of a foot. This is anticipated to be any rainfall event of more than 0.10 inches of rain in a two-hour period or more than 0.25 inches in a twelve-hour period. In addition, protocols require that total rainfall in the 72-hours prior to a storm not exceed a total of 0.10 inches.

Table 1. Monitoring Station Locations – Alcovy Watershed Protection Project

Station Designation and Stream Location	Drainage Area (miles^2)	Land Use and Rationale for Selection	Stage/Flow Monitoring	Standard Chemical Monitoring	Non-Standard Chemical Monitoring	Benthic Macro	Fish IBI
AR-1 Rocky Creek at Rocky Creek Road	2.5	Land use consists primarily of forest and pasture land Station located immediately upstream of large wetland area	4	4			
AR-2 Alcovy River at Newton Factory Mill Road	256.5	Estimate pollutant load from entire Alcovy River system to Lake Jackson; Not meeting designated use criteria (fecal coliform); Longitudinal trend analysis of Alcovy River	Stage Only	4		4	4
AR-3 East Bear Creek at Poplar Hill Road	6.9	Land use consists primarily of forest and agricultural lands, some residential development; City of Mansfield in headwaters of drainage area	4	4	4		
AR-4 West Bear Creek at Highway 213	8	Development beginning to occur along I-20 corridor in the headwaters; Estimate pollutant load from largest tributary in the Bear Creek system; Primary tributary to proposed Bear Creek Reservoir	4	4		4	4
AR-5 Alcovy River at Highway 278	226.4	USGS gauging station; Estimate loading from I-20; Longitudinal trend analysis of Alcovy River	Stage Only	4			
AR-6 Alcovy River at County Line Road	140.5	Upstream of water supply intake; Estimate contributions from Richland Creek; Longitudinal trend analysis of Alcovy River	4	4			
AR-7 Cornish Creek at Lower Jersey Road	9.8	Estimate pollutant load into Lake Varner; Upstream of water supply intake	4	4	4	4	4
AR-8 Big Flat Creek at Monroe-Jersey Road	29.5	Upstream of water supply intake; Longitudinal trend analysis of Big Flat Creek	4	4			
AR-9 Alcovy River at Monroe Jersey Road	109.7	Upstream of water supply intake; Longitudinal trend analysis of Alcovy River	4	4	4	4	4
AR-10 Mountain Creek at McDaniel Street	4.7	Estimate contributions from City of Monroe non-point source drainage	4	4			
AR-11 Beaverdam Creek at Stock Gap Road	3.7	Upstream of Beaver Creek Reservoir; Estimate pollutant loading	4	4	4	4	4
AR-12 Alcovy River at New Hope Church Road	82.8	Upstream of water supply intake; Longitudinal trend analysis of Alcovy River	4	4			
AR-13 Big Flat Creek at Old Zion Cemetery Road	3.6	Stream is partially supporting designated use criteria (Dissolved Oxygen, Toxicity); City of Loganville WPCP discharge located upstream; Primarily urban land use; Longitudinal trend analysis of Big Flat Creek	4	4	4	4	4
AR-14 Alcovy River at Highway 81	59.2	Visible sediment load in stream; Not meeting designated use criteria at County line (lead); Inert materials landfill located nearby; Longitudinal trend analysis of Alcovy River	4	4	4	4	4
AR-15 Alcovy River at New Hope Road	30.8	Gwinnett County monitoring station; Provides correlation between Gwinnett County model and Alcovy model	4	4			

Table 2. Summary of Analytical Parameters for Tributary Sampling

NUMBER OF SITES		15	
STREAM SAMPLING EVENTS		(Includes water quality sampling and flow monitoring)	
Standard Base Flow Sampling Events		8	
Non-Standard Base Flow Sampling Events at designated stations (see Table 1)		1	
Standard Storm Sampling Events		4	
Non-Standard Storm Sampling Events at designated stations (see Table 1)		1	
Stage		Recorded during all monitoring events	
STANDARD ANALYTICAL PARAMETERS (method)		Base flow/ Storm flow	Additional Storm Samples
Ammonia	(350.2)	√	
Fecal coliform bacteria	(SM9222C)	√	√
E. Coli	(SM9225C)	√	√
Nitrite + nitrate	(353.3/352.1)	√	√
Total Kjeldahl Nitrogen	(351.3)	√	
Phosphorus – Total	(365.3)	√	√
Phosphorus – Ortho	(365.2)	√	
Total dissolved solids	(160.1)	√	
Total Suspended Solids	(160.2)	√	√
Total Hardness ($CaCO_3$)	(130.2)	√	
$CBOD_5$	(SM5210B)	√	
TOC	(415.2)	√	
Dissolved Organic Carbon	(415.2)	√	
COD	(410.4)	√	
NON-STANDARD ANALYTICAL PARAMETERS			
Dissolved cadmium	(1638 mod)	√	
Total cadmium	(1638 mod)	√	
Dissolved chromium	(1638 mod)	√	
Total chromium	(1638 mod)	√	
Dissolved copper	(1638 mod)	√	
Total copper	(1638 mod)	√	
Dissolved lead	(1638 mod)	√	
Total lead	(1638 mod)	√	
Dissolved zinc	(1638 mod)	√	
Dissolved zinc	(1638 mod)	√	
Priority Pollutant Scan (Methods 200.7, 335.3, 420.2, 608, 615, 624, and 625)		√	
QUALITY ASSURANCE SAMPLES		One random field duplicate per event. One trip blank per event.	

Base flow sampling events for the standard analytical parameters will occur during the third week of each month starting in October 1999 and ending in May 2000. Flow monitoring data will be collected at designated stations during all base flow events and at selected times throughout the remainder of the sampling period.

During one storm event at each station, multiple samples will be collected throughout the storm. The first flush sample will be analyzed for all standard parameters. An additional sample will be collected on the rising limb of the hydrograph, one at the peak of the hydrograph, and two on the falling limb of the hydrograph. These additional samples will be analyzed for a subset of the standard parameters that are considered to be indicator species and which are vital for modeling purposes.

This task requires coordination with other tasks. The results of the water quality monitoring will be summarized in a Water Quality Technical Memorandum that will be used in the Watershed Management Task to develop basic frameworks for watershed management. The stream gauging results will be summarized into a usable format in Microsoft Excel and delivered to the Watershed Modeling team.

Field Monitoring Activities

A manual flow monitoring cross section will be established at each monitoring station and manual velocity and discharge calculations will be made using a Marsh McBirney Flo-Mate 2000 flow meter.

Additional measurements made by field technicians during base flow and storm flow conditions include pH, conductivity, temperature, turbidity, dissolved oxygen, and stage.

Equipment installation at manual stations will include a staff gauge. A cross section will also be selected and staked for flow monitoring purposes throughout the study period.

Water quality monitoring will occur at all stations during eight base flow and four storm flow events of varying magnitude. All water samples will be collected from streams directly into sample bottles by placing the sample bottle under the surface of the stream with the bottle mouth pointed into the flow. The technician will hold the bottle upstream of his or her position. Care will be taken so that no floating debris or particles enter the bottle. Technicians will be instructed not to wade upstream of the sampling station prior to collecting the sample. This will minimize the collection of sediments or other material while taking water samples.

In the event that the stream is unsafe to enter, samples will be collected by lowering an Alpha water sampler or a Kemmerer bottle into the stream from the bridge or culvert crossing the stream. Water will then be poured directly from the sample collection device to the sample bottle.

Stand-alone rain gauges will be installed throughout the study area during the eight-month monitoring period. These devices will capture variations in the timing and intensity of rainfall events. The collected rainfall data will allow for better calibration of the hydrologic segments of the model.

Priority Pollutant, Trace Metal, and Bacterial Sampling Procedures

Analyses for Priority Pollutants and Trace Metals will be conducted at six of the fifteen sampling stations. Four of these stations were selected due to their location upstream of water supply intakes. One station was selected due to its location relative to a proposed water supply watershed and one was selected due to its location within a stream segment that is not meeting designated use criteria for dissolved oxygen and toxicity.

Priority Pollutants. Priority pollutant samples will be collected at the designated stations twice during the course of the monitoring period. Samples will be collected during one base flow sampling event and during one storm flow sampling event. All samples will be manually collected directly from the stream as grab samples. All priority pollutant samples will be analyzed for volatile organic carbons (VOCs), semi-volatile organic carbons (SVOCs), pesticides/PCBs, herbicides, phenols, 13 metal species, and cyanide.

Trace Metals. Trace metal samples will be collected at the designated stations twice during the course of the monitoring period. Samples will be collected during one base flow sampling event and during one storm sampling event. All samples will be collected manually using clean grab sampling techniques as described in EPA sampling method 1669. At the laboratory's request, no samples will be filtered in the field. All trace metal samples will be filtered immediately upon receipt at the laboratory. Samples will be analyzed for total and dissolved concentrations of Cadmium, Chromium, Copper, Lead, and Zinc.

Bacteria Species. Fecal coliform and E. Coli samples will be collected using the grab sampling techniques described above and delivered to the lab for analysis using standard method 9222C.

Manual Flow Monitoring Procedures

Flow at each stream is measured at an established cross section. The cross section will be established at point in the stream channel that is located in a straight section of the stream where there is laminar flow. It is preferable to select a location that has a flat streambed cut into bedrock.

To begin monitoring stream flow, Brown and Caldwell technicians will suspend a tape measure tightly across the stream channel and record the left and right edges of water on the data sheet. Stream flow measurements will be made along the cross-section defined by the tape measure. Flow measurements will be taken at a minimum of 20 points in the cross-section. If the stage is changing rapidly, the number of points in the cross-section will be reduced. Flow measurements will be made using a Marsh McBirney Flow Mate 2000 with a top-set wading rod, or a bridgeboard if stage is too elevated for safe wading. The technician will stand downstream of the measuring point and hold the wading rod so that it points straight up and the head of the flow meter points directly upstream. At each point in the cross section, the point on the tape measure, the depth of water (measured with the wading rod), and the flow will be recorded. In water less than three feet deep, flow will be measured at 6/10 the recorded depth. In water more than three feet deep, flow will be measured at 2/10 and 8/10 depth and those values averaged.

To calculate the discharge of the cross-section, BC will calculate the discharge around each monitoring point in the cross-section and add them all together. Discharge is equal to the area around each point times the flow (A*V). In a numerical sequence of monitoring points, the discharge at point "2", area is defined as half the distance from point "3" to point "1" times the depth at point "2".

Stage Measurements

Staff gages will be installed at all monitoring stations and stage will measured during sampling events by sampling crews when collecting samples or when measuring discharge. A relationship will be derived between the stream discharge measurements and the corresponding stage. This relationship will be applied to the daily stage records of the USGS gauging stations on the Alcovy River to develop a daily record of stream discharge. The daily stream discharge will allow for calculation of daily pollutant loads.

On tributaries to the Alcovy River, every effort will be made to identify volunteers to record staff gauge readings at each station on at least a daily basis. A relationship will be derived between the stream flow measurements and the corresponding stage. This relationship will be applied to the data collected by volunteers to develop records of stream discharge and allow for calculation of daily pollutant loads.

IV. Biological Sampling Methods

Under EPD protocol for conducting watershed assessments, monitoring the biological component of the waterways within the watershed is integral with assessing water quality in order to determine current condition or any impairment(s) that may exist. Biological criteria are used to assess the biological integrity of the watershed and are based on the premise that an aquatic biological community's structure and function provide critical information about the quality of surface waters (EPA, 1990). The Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6, define biological integrity as "the condition of the aquatic community inhabiting least impaired waterbodies of a specific habitat measured by community structure and function". The current biotic integrity/conditions within the Alcovy River watersheds will be evaluated by assessing the macroinvertebrate and fish communities in the watershed.

A Biological Monitoring Technical Memorandum (BMTM) will be prepared summarizing the results of the biological monitoring and habitat assessment at each of the study sites. The various benthic macroinvertebrate and fish community assessment indices will be used to assess the biological integrity of the Alcovy River watersheds and its primary streams. Habitat assessments and *in situ* water quality measurements will be used to supplement the macroinvertebrate and fish data. The final deliverable will be a BMTM that will summarize the monitoring results. This document will include a drawing of each sampling reach indicating the habitats that were sampled.

Macroinvertebrates and fish are excellent monitors of quality in the aquatic environment. They inhabit study waters for most or all their life cycle (up to 10 years or longer) and therefore reflect past and recent environmental conditions. These biological communities integrate the prevailing

and past interactions of stream flow, pollutant loading, habitat, and chemical quality of their aquatic environment.

The primary components of the biological monitoring activities in the Alcovy River watershed will include:

1) Physical habitat assessments at six study sites and two reference sites;
2) Benthic macroinvertebrate sampling at six study sites and two reference sites;
3) Fish species assessment at six study sites and two reference sites.

Biological Sampling Stations

Biological sampling stations were selected to provide a longitudinal trend analysis of the Alcovy River and to evaluate the biota and habitat of streams that feed water supply reservoirs. The selected stations are identified in Table 1.

Reference Stations

Two reference stations will be selected to provide baseline comparison data for the sampling stations. These stations will reflect the size and physical characteristics of the sampling stations in order to provide a valid comparison. Reference stations used during other studies will be reviewed and utilized to the full extent possible. Data gathered at reference stations in previous studies will be reviewed and incorporated into this project to the full extent possible.

Physical Habitat Assessment

Habitat assessments will be conducted at all study sites in accordance with the Georgia *Draft Standard Operating Procedures: Freshwater Macroinvertebrate Biological Assessment* (DNR, 1997). Assessing habitat allows the quality of the structure of the surrounding habitat that influences water quality and condition of the aquatic biota to be evaluated and may identify non-water quality related factors of biological impairment, if present.

The DNR's Habitat Assessment Worksheet requires visual evaluation of ten physical habitat parameters, including instream cover, substrate, channel morphology and flow, bank stability and vegetation, and riparian zone condition. Worksheets exist for two basic stream types - riffle/run or glide/pool prevalent streams. Field data sheet selection will be dependent upon reference stream characteristics (prevalent stream type at reference).

At each site, all ten individual habitat parameters are scored (values of 0-20 or 0-10), and a total score is obtained. Two independent biologists will conduct the habitat assessments and their scores averaged to reach a habitat score for each site. Monitoring site habitat scores will then be compared to the reference habitat score to classify each site on the basis of its similarity to expected conditions (reference site) and its apparent potential to support acceptable levels of biotic integrity. Percent of comparability (ratio) of each monitoring site to the reference will fall into one of four assessment categories: comparable to reference, similar, partially similar, or dissimilar.

Biological Assessment Protocol

Biological sampling will be conducted in early spring (March) to assess community structure during optimal biological conditions. Sampling and data analysis protocols will follow guidelines developed by the Georgia Department of Natural Resources (DNR) and the United States Environmental Protection Agency (EPA). Study sites will be approximately 100 - 150 meters in length, dependent on habitat distribution at each site. In general, benthic macroinvertebrates will be collected via dip netting, and fish will be sampled by electrofishing (supplemented with seining, where applicable). All habitat types will be sampled.

The following habitats will be sampled:

- Riffles – 3 kick nets (not seine) in faster current, 3 in slower current
- Undercut banks – 6 jabs (each about 0.5 meters long)
- Woody debris – 5 to 6 pieces (each about 0.5 meters long) washed into sieve
- Pools – 3 one-meter sweeps of bottom to a depth of 2-3 cm.
- Leaf packs (CPOM) – approximately four (4) liters.

One composite macroinvertebrate sample from all other habitats will be analyzed for species diversity. Macroinvertebrate samples will be preserved and analyzed in the laboratory; whereas, fish primarily will be processed (enumerated and identified) in the field and returned to the collection area. Some voucher fish specimens may be preserved and returned to the laboratory for identification.

In situ measurements of water temperature, dissolved oxygen, pH, and conductivity will be taken at each study site during all biological sampling events.

Benthic Macroinvertebrate Community Assessment

The benthic macroinvertebrate community will be assessed under the Georgia Bioassessment Protocol (GBP) (DNR, 1997). Standardized qualitative sampling for macroinvertebrates will be conducted at each site for a variety of habitat types, including riffles (riffle/run streams), undercut banks/roots, woody debris, macrophytes (if present), sand, and leaf packs/coarse particulate organic matter (CPOM). Also included are a 15 - 30 minute visual search and sampling of all habitat types at the study site. The GBP will be somewhat modified by compositing the various habitat samples (except the CPOM sample) for analysis and data evaluation.

Data analyses follow a modified version of the EPA Rapid Bioassessment Protocol (Plafkin *et al.*, 1989). Under the GBP, assessment scoring is based on a variety of metrics and is ecoregion-specific. The study area appears to lie within the Upper Piedmont and would follow the Ecological Condition Worksheet (scoring) for that ecoregion. While ten possible metrics are described in the GBP, only six metrics are utilized for assessment scoring in the Piedmont ecoregion. These metrics are as follows: 1) taxa richness, 2) EPT Index, 3) Indicator Assemblage Index (IAI), 4) percent contribution of dominant taxon, 5) North Carolina Biotic Index (NCBI), and 6) percent shredders. Other metrics outlined in the GBP that may be utilized include number of Chironomidae taxa, percent Diptera, Florida index, and percent filterers. Percent comparability of each site's score to the reference site score will be assessed to determine

ecological condition and are categorized as follows: Very Good (ecological condition) - > 83% comparability; Good - 83-54%; Poor - 53-21%; or Very Poor - < 21%.

Fish Community Assessment

The fish community will be assessed under the EPA Rapid Bioassessment Protocol V (Plafkin *et al.*, 1989) or a similar protocol developed by the DNR's Ft. Valley Fisheries Office. Both are based on the Index of Biotic Integrity (IBI) developed by Karr (1981) and refined by Karr *et al.* (1986). Sampling is done identically under both protocols and utilizes electrofishing to collect fish. Seining also may employed during this study, particularly if some of the less vulnerable species (e.g., darters, minnows, or other smaller fish) are not being adequately collected. Both protocols utilize twelve scoring metrics for assessing biotic integrity, assigning a value of 1, 3, or 5 for each metric and summing these values for a total IBI score at each site. Scoring is based on criteria relative to reference site data and from fixed criteria for a particular ecoregion. Both the RBP V and DNR protocols are based on five integrity or quality classes, although scoring ranges are slightly different for each. The DNR scoring protocol also is based on stream order.

Fish tissue samples will not be collected or analyzed at any of the sampling stations during this project unless water quality sampling activities indicate that a potential problem may exist.

V. Quality Control Procedures

Quality control procedures for this project is discussed in this section.

Field Procedures

*Field Duplicates***.** The purpose of field duplicates is to quantify measurement precision associated with the sampling and analysis system. During the course of the project, duplicate samples will be collected. One duplicate sample will be collected during each sampling event. The location of the duplicate sample will be randomly chosen. Data from field duplicates will be considered acceptable if the relative percent difference does not exceed 20 percent.

*Field Blanks***.** The purpose of these samples will be to detect significant contamination during field activities and serve as a basis for estimating the system quantitation limit. Field blanks will be collected by pouring deionized water into a clean sampling bottle, and processing the water as a normal water sample. One field blank will be collected during each sampling event. Field blank results will be considered acceptable if they do not exceed twice the reporting limit.

Internal Laboratory Procedures

The laboratory conducting the analyses for this project will be required to utilize laboratory duplicates, laboratory spike samples, method blanks and laboratory blanks for quality control purposes. In addition, the laboratory will be required to provide certification that deionized water utilized for preparation of field and equipment blanks is free of all analytes required for analysis.

Review of Analytical Results

Analytical results from the laboratory will be subject to a rigorous scrutiny to assess the validity of the results. Results from blanks and duplicates will be evaluated to determine if any contamination may have been introduced into the samples. Dissolved concentrations will be compared to total concentrations and laboratory procedures questioned if the dissolved concentration is reported to exceed the total concentration. A review of laboratory procedures would include a thorough review of internal laboratory QA/QC results to verify that reported results are valid. After several months of sampling, it will be possible to conduct trend analyses on the analytical results. Any analytical results that prove to be outliers will be reviewed for validity.

When documenting the analytical results of the watershed characterization, Brown and Caldwell will treat reported "non-detects" of specific parameters as 1/2 the detection limit.

Data Management

Three types of data records will be compiled during this project: the field data sheets from tributary sampling, field log books for each of the field crews, and chain-of-custody forms from sample shipment. The following sections describe how these forms will be managed.

Field Data Sheets. Field data sheets will be collected at the end of each field day. The original sheets will be kept in three-ring binders at Brown and Caldwell's offices.

Field Log Books. Field log books serve as a daily record of events and observations during field activities. Each crew will maintain an individual field log. All information pertinent to sampling activities is recorded in the log books. Entries in the log book will include:

- Name and title of author
- Name(s) of field crew
- Date and time of field activities
- Field observations
- Any observations related to equipment maintenance or replacement needs

Field activities are comprised of two components: 1) base flow tributary sampling and flow monitoring, and 2) elevated flow tributary sampling and flow monitoring. The base flow tributary sampling and flow monitoring will be conducted following a specified schedule. The elevated-flow tributary sampling and flow monitoring will be conducted during four storm events at each stream to provide for more accurate estimation of stream loading.

Field data sheets for water quality and biological sampling activities are found in Appendix B.

VI. Sample Handling and Custody Requirements

Transportation and Storage of Samples. All sample bottles will be placed in a cooler on ice immediately upon collection by a sampling technician. The laboratory will provide a temperature

blank with each cooler to verify that samples are delivered to the laboratory at approximately 4°C. Coolers containing fecal coliform samples should be delivered to the laboratory within the 4 hours of sample collection. Remaining samples will be delivered within 24 hours of the sampling event.

Sample Packing and Shipping Requirements. Sample packaging and shipping procedures are designed to ensure that the samples and the chain-of-custody forms will arrive at the laboratory intact and together. Samples should be packed appropriately so that there is no bottle breakage during shipment to the laboratory.

Chain-of-Custody Forms. Completed chain-of-custody forms will be required for all samples to be analyzed. Chain-of-custody forms will be prepared by the field sampling crew during the sample collection events. The chain-of-custody form will contain the sample's:

- Identification number;
- Sample date and time;
- Sample description;
- Sample type;
- Sample preservation (if any) and;
- Analyses required.

The original chain-of-custody form will accompany the samples to the laboratory. Copies will be made prior to shipment for separate field documentation. The chain-of-custody forms will remain with the samples at all times and will be signed by a representative of the laboratory upon receipt of the samples. The samples and signed chain-of-custody form will remain in the possession of the sampling crew until the samples are delivered to the laboratory.

VII. Sampling Team

Watershed Characterization Task Leader. This individual is responsible for coordinating and scheduling all sampling activities, for assuring that all necessary equipment and supplies are available to the teams, and for checking the field and analytical results for validity and accuracy. He or she must also train the field crews and implement the Health and Safety Plan.

Water Quality Field Team Leader. This individual is responsible for coordinating all activities for his or her team, for verifying that the work is completed in a thorough and concise manner, for checking notes and observations in the field, for equipment maintenance and repair, for delivering samples to the laboratory in a timely fashion, for reporting any problems or concerns about methodologies or field conditions, and for following the Health and Safety Plan.

Sampling Team Members. These individuals are responsible for collecting samples, completing all appropriate field data sheets, for reporting any problems or concerns about sampling methodologies or field conditions, and for following the Health and Safety Plan.

Field Biologists. These individual are responsible for completing the biological and habitat assessments required for this project, and for following the Health and Safety Plan.

VIII. Schedule

Water quality and flow monitoring activities are scheduled to begin in October 1999 and continue through May 2000. Base flow water quality sampling and flow monitoring events will typically occur during the third week of each month. The four storm sampling and flow monitoring events will occur whenever practical and are dependent upon weather conditions.

Biological monitoring is scheduled to occur in the early Spring of 2000 in order to capture the widest diversity of species at each location.

Reports summarizing the biological and water quality results should be available in May and July 2000 respectively.

IX. Literature Cited

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