Clean Water Act Section 319(h) Nonpoint Source Pollution Control Program Projects

Silviculture Nonpoint Source Pollution Abatement and Prevention Project.

TSSWCB Project # FY05-04

Quality Assurance Project Plan

Texas State Soil & Water Conservation Board

Prepared by

Texas Forest Service

Effective Period Sept 2005 to Aug 2008

Questions concerning this quality assurance project plan should be directed to:

Hughes Simpson, TFS Project Manager

Texas Forest Service

PO Box 310

Lufkin, TX 75901

hsimpson@tfs.tamu.edu

Section A1 Approval Sheet

Silviculture Nonpoint Source Pollution Abatement and Prevention Project—QAPP

United States Environmental Protection Agency (USEPA), Region VI

Name: Donna Miller
Title: Chief; State/Tribal Programs Section

Signature:________________________________Date:_____________

Name: Randall Rush
Title: USEPA Texas Nonpoint Source Project Manager

Signature:________________________________Date:_____________

Texas State Soil and Water Conservation Board (TSSWCB)

Name: Lee Munz
Title: TSSWCB Project Leader

Signature:________________________________Date:_____________

Name: Donna Long
Title: TSSWCB Quality Assurance (QA) Officer

Signature:________________________________Date:_____________

Section A1 Approval Sheet

Silviculture Nonpoint Source Pollution Abatement and Prevention Project—QAPP

United States Environmental Protection Agency (USEPA), Region VI

Name: Donna Miller
Title: Chief; State/Tribal Programs Section

Signature: Donna R. Miller Date: 9-22-06

Name: ~~Randall Rush~~ Ellen Caldwell
Title: USEPA Texas Nonpoint Source Project Manager

Signature: Ellen Caldwell Date: 9-5-06

Texas State Soil and Water Conservation Board (TSSWCB)

Name: Lee Munz
Title: TSSWCB Project Leader

Signature: Lee Munz Date: 7-28-06

Name: Donna Long
Title: TSSWCB Quality Assurance (QA) Officer

Signature: Donna K. [illegible] Date: 8-1-06

Texas Forest Service (TFS)

Name: Hughes Simpson
Title: TFS Project Manager

Signature: Hughes Simpson Date: 7/10/06

Name: Donna Work
Title: Field Operations Supervisor/ Project Biologist/ Quality Assurance (QA) Officer

Signature: Donna Work Date: 7-10-06

Ana-Lab Corporation

Name: Bill Peery
Title: Laboratory Manager

Signature: Bill Peery Date: 7/14/06

Texas Forest Service (TFS)

Name: Hughes Simpson
Title: TFS Project Manager

Signature:________________________________Date:____________

Name: Donna Work
Title: Field Operations Supervisor/ Project Biologist/ Quality Assurance (QA) Officer

Signature:________________________________Date:____________

Ana-Lab Corporation

Name: Bill Peery
Title: Laboratory Manager

Signature:________________________________Date:____________

Section A2: Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

ASTM	American Society of Testing & Materials
BACI	before-after-control-impact
BMP	best management practices
CAR	corrective action report
COC	chain of custody
CWA	Clean Water Act
DO	dissolved oxygen
DQO	data quality objectives
EDAS	Ecological Data Application System
EPA	Environmental Protection Agency
ETBU	East Texas Baptist University
GIS	geographic information system
GM	General Maintenance
GPS	global positioning system
HDPE	high density polyethylene
HUC	hydrologic unit code
MDL	method detection limit
ID	identification
NPS	nonpoint source
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity units
NWS	National Weather Service
PDF	portable document format
pH	potential Hydrogen
QA	quality assurance
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
RBP	Rapid Bioassessment Protocol
SOP	standard operating procedure
SWCD	Soil and Water Conservation District
TFS	Texas Forest Service
TCEQ	Texas Commission on Environmental Quality
TMDL	total maximum daily load
TPWD	Texas Parks and Wildlife Department
TSS	total suspended solids
TSSWCB	Texas State Soil and Water Conservation Board
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WQMP	water quality management plan

Section A3: Distribution List

Organizations, and individuals within, which will receive copies of the approved QAPP and any subsequent revisions include:

United States Environmental Protection Agency, Region VI
6WQ-AT
1445 Ross Avenue
Suite 1200
Dallas, Texas 75202-2733

Name: Donna Miller miller.donna@epamail.epa.gov
Title: Chief; State/Tribal Programs Section

Name: Randall Rush rush.randall@epamail.epa.gov
Title: USEPA Texas Nonpoint Source Project Manager

Texas State Soil and Water Conservation Board
P.O. Box 658
Temple, TX 76503

Name: Lee Munz lmunz@tsswcb.state.tx.us
Title: TSSWCB Project Leader

Name: Donna Long dlong@tsswcb.state.tx.us
Title: TSSWCB Quality Assurance Officer

Texas Forest Service
P.O. Box 310
Lufkin, TX 75901

Name: Tom Boggus tboggus@tfs.tamu.edu
Title: TFS Associate Director

Name: Hughes Simpson hsimpson@tfs.tamu.edu
Title: TFS Project Manager

Name: Donna Work dwork@tfs.tamu.edu
Title: TFS Operations Supervisor / Project Biologist / Quality Assurance Officer (QAO)

Name: Shane Harrington sharrington@tfs.tamu.edu
Title: TFS Project Technician

Ana-Lab Corporation
2600 Dudley Rd.
P.O. Box 9000
Kilgore, TX 75901

Name: Bill Peery bpeery@analab.com
Title: Laboratory Manager

Section A4: Project/Task Organization

The following is a list of individuals and organizations participating in the project with their specific roles and responsibilities:

USEPA – United States Environmental Protection Agency (USEPA), Region VI, Dallas. Provides project overview at the Federal level.

Randall Rush, USEPA Texas Nonpoint Source Project Manager

Responsible for overall performance and direction of the project at the Federal level. Ensures that the project assists in achieving the goals of the federal Clean Water Act (CWA). Reviews and approves the quality assurance project plan (QAPP), project progress, and deliverables.

TSSWCB –Texas State Soil and Water Conservation Board (TSSWCB), Temple, Texas. Provides project overview at the State level.

Lee Munz, TSSWCB Project Leader

Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified.

Donna Long, TSSWCB Quality Assurance Officer

Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB and USEPA participants. Responsible for verifying that the QAPP is followed by project participants. Determines that the project meets the requirements for planning, quality assessment (QA), quality control (QC), and reporting under the CWA Section 319 program. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures.

TFS – Texas Forest Service (TFS), Lufkin, Texas. Project Coordinator. Provides the primary point of contact between the Texas State Soil and Water Conservation Board (TSSWCB) and the project contractors. Responsible for the data analysis and interpretation in field and laboratory samples. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified. Responsible for coordination, review, and delivery of quarterly reports and the final project report.

Hughes Simpson, TFS Project Leader

Responsible for ensuring that tasks and other requirements in the contract are executed on time and as defined by the grant work plan; assessing the quality of work by participants; submitting accurate and timely deliverables and costs to the TSSWCB Project Leader; and coordinating attendance at conference calls, meetings, and related project activities. Responsible for development of data quality objectives (DQOs) and a quality assurance project plan (QAPP). Maintains records of QAPP distribution, including appendices and amendments. Responsible for ensuring that scheduled tasks and other requirements in the contract are executed on time and in accordance with the QA/QC requirements in the system as defined by the contract work plan and in the QAPP.

Donna Work, TFS Quality Assurance Officer (QAO), Project Biologist, and Field Operations Supervisor

Responsible for determining that the Quality Assurance Project Plan (QAPP) meets the requirements for planning, quality control, quality assessment, and reporting for activities conducted by TFS. Coordinates and supervises field sampling activities. Responsible for ensuring that field personnel have adequate training and a thorough knowledge of standard operating procedures (SOPs) specific to the field analysis or task performed. Ensures that tasks and other requirements in the contract are executed on time and with the QA/QC requirements in the system as defined by the contract work plan and in the QAPP. Coordinates the review of technical QA material and data related to water quality monitoring system design and analytical techniques. Responsible for the facilitation of audits and the implementation, documentation, verification, and reporting of corrective actions. Performs validation and verification of data before the report is sent to the primary contractor.

Ana-Lab – Ana-Lab Corporation, Commercial Analytical Laboratory, Kilgore, Texas. Laboratory Support. Responsible for data analysis and reporting tasks for the project

Bill Peery, Laboratory Manager; Ana-Lab Corporation, Analytical Laboratory

Responsible for oversight of laboratory operations and ensuring that quality-assurance control requirements are met regarding the TFS Project samples. Responsible for documentation related to laboratory analyses to include, ensuring adequate training and supervision of all activities involved in generating analytical data, the facilitation of audits and the implementation, documentation, verification and reporting of corrective actions. Enforces corrective action, as required. Conducts in-house audits in conjunction with the TFS QAO to ensure compliance with written SOPs and to identify potential problems.

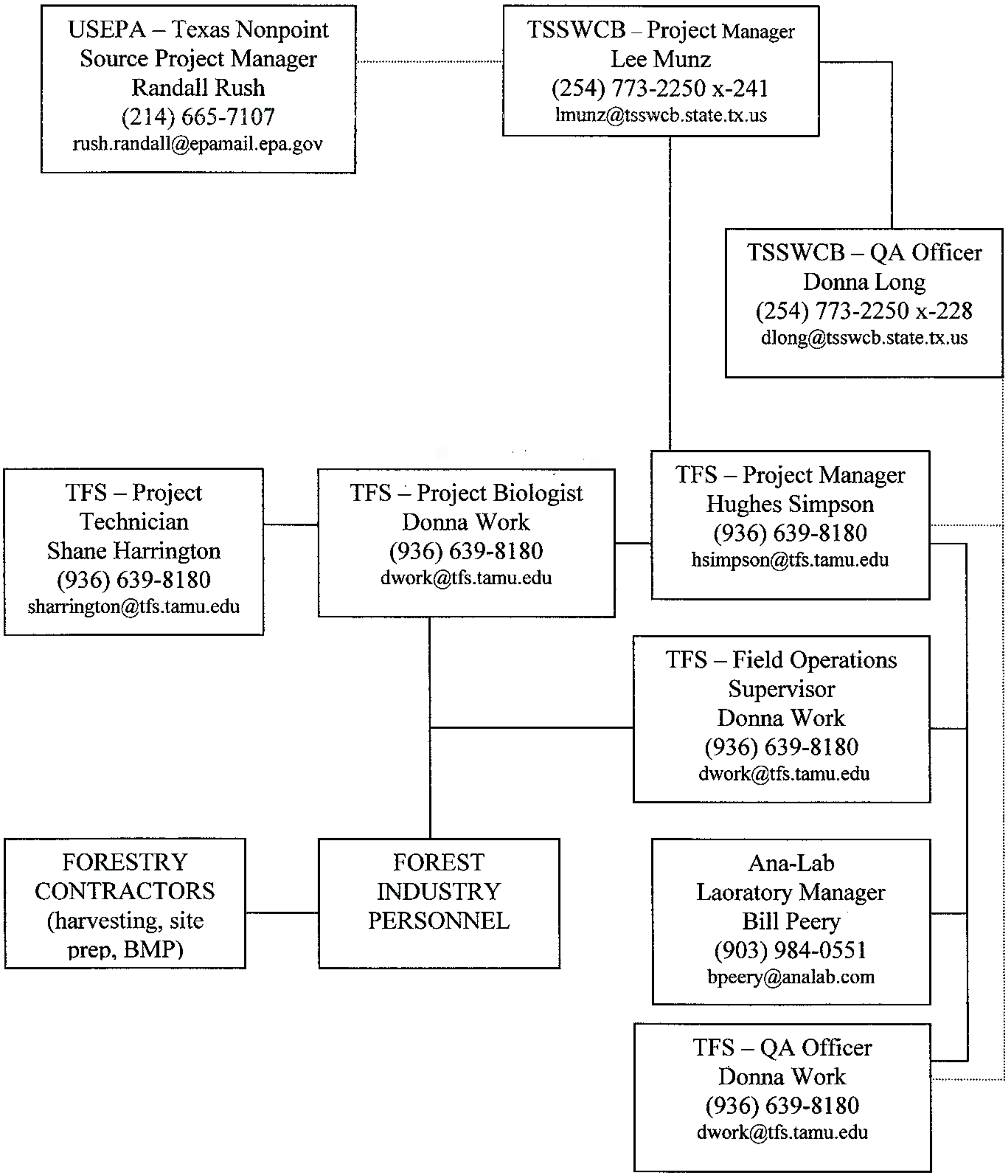
Additional Project Personnel

Forest Industry Personnel – Assist in site location and harvest planning
Forestry Contractors – Perform harvesting, site preparation, and reforestation activities
ETBU – Benthic macroinvertebrate species identification
TPWD – Fish species identification

Principal Data Users

Forestry community (foresters, contractors, landowners)
Government Agencies: EPA, USFS, USFWS, TCEQ, TSSWCB, TFS, TPWD
General Public

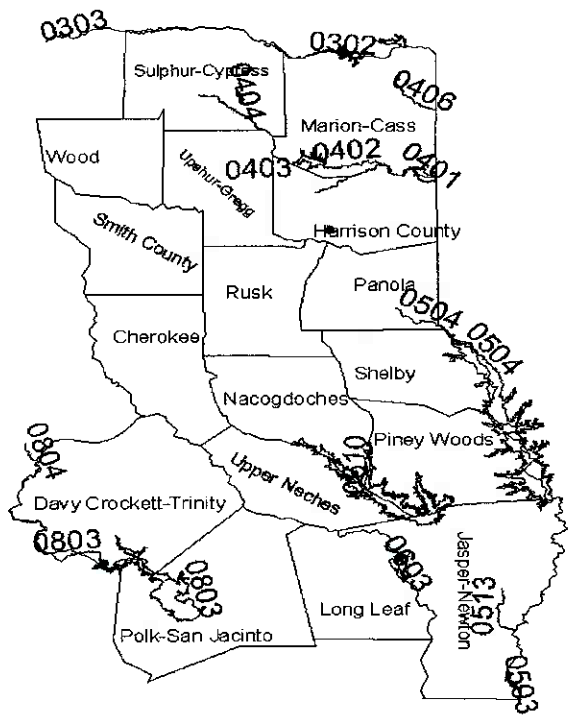
Figure A4-1. Project Organization Chart
Dashed lines indicate communication only



Section A5: Problem Definition/Background

Many water bodies in East Texas have been listed as impaired on the 2000 *State of Texas Water Quality Inventory and List of Impaired Waters* report due to dissolved oxygen (DO) water quality standard violations. These violations may be caused by point and/or nonpoint source (NPS) pollution and extensive monitoring is currently underway to gain a better understanding of this problem. Forestry operations are widely present throughout this region, making potential nonpoint source pollution contributions from silvicultural activities a concern.

Figure A5-1. Project Area



This area encompasses the watersheds of five major river basins. They are the Sulphur, Cypress Creek, Sabine, Neches, and Trinity River basins. These river basins have 52 water bodies listed on the *2000 State of Texas Water Quality Inventory and List of Impaired Waters* Report. Twenty-six of those water bodies are listed for D.O. This five-basin area concentrates in a seventeen-Soil and Water Conservation District (SWCD) area in East Texas. These SWCDs include the following: Wood, Harrison County, Smith County, Rusk, Panola, Cherokee County, Shelby, Nacogdoches, Upper Neches, Long Leaf, Sulphur-Cypress, Marion-Cass, Upshur-Gregg, Piney Woods, Jasper-Newton, Davy Crockett-Trinity, and Polk-

San Jacinto (see figure A5-1 above). Many of these SWCDs are currently involved in implementation projects designed to mitigate various potential nonpoint source (NPS) concerns that implicate agriculture.

The Texas Forest Service (TFS) has been working in conjunction with Soil and Water Conservation Districts (SWCDs) to implement best management practices (BMPs) on forestry operations to mitigate NPS pollution involving silviculture. However, there has been no formal project designed to test the effectiveness of the state recommended BMPs. In order to quantify the effectiveness of these implementation strategies, it is imperative to initiate a pre- and post- harvest in-stream monitoring regime.

Numerous studies have been conducted in the South to determine the effects of specific forest practices on water quality, both with and without the use of BMPs. Similar studies designed to look at more of a holistic approach of the entire operation are not as common. There has been only one project to take the latter approach (Florida Division of Forestry, 2000).

This type of monitoring project is also mandated by federal law. The reauthorization of the Clean Water Act of 1987 requires that "states develop methods for determining BMP effectiveness." The results of this project may ultimately lead to a revision in the *Texas Forestry Best Management Practices* handbook (Texas Forest Service, 2004) to ensure that water quality is protected during forestry operations.

Section A6: Project/Task Description

To better quantify BMP effectiveness, four sites under intensive forest management that are crossed by perennial streams will undergo rigorous habitat assessments, physiochemical, and biological monitoring before and after forestry operations. Selected sites will encompass the higher topography and erodibility hazards found in East Texas commercial forestlands.

This project will follow the Before - After / Control – Impact (BACI) study design (Green, R.H. 1979). Stream monitoring will be conducted above and below the forestry operation, as well as before and after the treatment. This will allow the results to be compared to determine if forestry activities applying minimum recommended BMP guidelines can protect water quality.

Project sites will undergo intensive forest management at an operational level. This will include a regeneration harvest, site preparation, and replanting of loblolly pine trees. The productivity of the site will determine the site preparation method that is used (i.e. chemical applications may also be used if there is extensive competing vegetation.)

TCEQ's Surface Water Quality Monitoring Procedures, Volume 1 and Volume 2 will be followed to assess BMP effectiveness. The RBP protocols to be followed are listed in publication TCEQ RG-415, Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, December 2003, and TCEQ RG-416, Surface Water Quality Monitoring Procedures, Volume 2: Methods for collecting and Analyzing Biological Community and Habitat Data, August 2005. The habitat assessment and biological monitoring will be conducted two times per year (spring and fall). Fish will be collected using an electroshocker and seine and benthic macroinvertebrates will be collected using D-frame dip nets. Total Suspended Solids, total phosphorous, total Kjeldahl nitrogen and nitrate-nitrite nitrogen will be analyzed from scheduled routine grab samples and storm water samples. Portable water quality samplers will be used to monitor the physiochemical parameters (DO, pH, temperature, turbidity, and conductivity) on the four project sites every month. Stream flow data will also be obtained on the four project sites monthly.

The benthic macroinvertebrate samples will be sent to East Texas Baptist University and the fish samples will be sent to Texas Parks and Wildlife Department for species identification. Upon identification, the Texas Forest Service will analyze the results and calculate the biological metrics for determining water quality. Grab and storm samples will be sent to Ana-Lab Corporation laboratory for testing and analysis of total suspended solids, total phosphorous, total Kjeldahl nitrogen and nitrate-nitrite nitrogen.

Data will be entered into the EPA-recommended Ecological Data Application System (EDAS), an electronic database for storage, retrieval, and analysis, or other similar database.

Global Positioning Systems (GPS) and Geographic Information Systems (GIS) will be used to map project sites. A final report will be produced documenting the results of this project. Tasks & Deliverables for this project include the following:

1. Evaluation of BMP Effectiveness
   - QAPP
   - Monitor BMP effectiveness on 4 project sites
   - Provide additional water quality and biological monitoring data (dissolved oxygen, total phosphorous, potential hydrogen, specific conductivity, total suspended solids, total Kjeldahl nitrogen, nitrate-nitrite nitrogen, turbidity, water temperature, stream flow, fish and benthic macroinvertebrate species present, and assessment of habitat) on specific East Texas streams associated with forestry operations.
   - BMP Effectiveness Monitoring Report
   - GIS data and maps showing monitoring sites in relation to 303(d) listed segments
   - Photographs and/or descriptions of before and after project sites

2. BMP Education
   - Photographs of BMPs
   - Copies of articles published in newsletters through project

3. Develop and Implement Forestry Water Quality Management Plans
   - Document spatially (GIS) approximate locations of any TSSWCB certified WQMPs if applicable
   - Newspaper/media articles regarding WQMPs

4. Project Coordination
   - Establishment and function of BMP Effectiveness Monitoring Committee
   - Copies of newspaper articles of committee activity

Subtasks are outlined in Table A6-1 along with a listing of the responsible agency or agencies and an activity schedule.

Table A6-1. Project Plan Milestones

TASK	PROJECT MILESTONES	AGENCY	START	END
1.1	The TFS, in cooperation with TSSWCB, will prepare a revised QAPP to submit to EPA for approval before data collection is started on the 05-4 project.	TFS	February 06	August 06
1.2	The TFS will monitor the effectiveness of forestry BMPs in protecting water quality on four project sites located throughout East Texas. The monitoring will be conducted by TFS trained staff. Monitoring will be conducted on four intensively managed sites, both above and below the treatment area. The treatment area will consist of harvesting, site preparation and reforestation activities. These sites will be monitored prior to the treatment and at the culmination of treatment.	TFS	October 06	September 07
1.3	The TFS will maintain a BMP database for the project results, including GIS data, for Hydrologic Unit Codes (HUCs), as provided by the TSSWCB	TFS	October 06	September 07
1.4	The TFS will produce maps of the project sites using GIS.	TFS	October 06	September 07
1.5	The TFS, in cooperation with SWCDs, will prepare and distribute a BMP Effectiveness Monitoring Report to interested entities.	TFS & SWCDs	October 06	September 07
2.1	The TFS will install BMPs on the project sites for educational purposes.	TFS	October 06	September 07
2.2	The TFS will include articles regarding this project in quarterly newsletters to natural resource professionals in Texas and forest landowners in target watersheds.	TFS	October 06	September 07
2.3	The TFS will coordinate field tours of the project sites throughout the duration of the project.	TFS	October 06	September 07
3.1	The TFS will increase forest landowner awareness of silvicultural WQMPs via media options listed in subtask 2.2 as well as other means that may be made available.	TFS	October 06	September 07
3.2	The TFS, in cooperation with SWCDs, will enroll the forest landowners in WQMPs, if applicable.	TFS & SWCDs	October 06	September 07
4.1	The TFS will create and chair a BMP Effectiveness Monitoring committee made up of state, federal, academia, and industry cooperators. Industrial and private interest groups will include Temple Inland, International Paper, Texas Forestry Association, and Texas Logging Council.	TFS	October 06	September 07
4.2	The TFS will work with local media to promote project activities.	TFS	October 06	September 07
4.3	The TFS will give BMP presentations to various groups in East Texas. These groups will consist of, but not limited to the following, Kiwanis, Rotary, and Lions clubs.	TFS	October 06	September 07

Section A7: Data Quality Objectives (DOQ) for Measurement Data

The primary objective of this project is to reduce significant risks to water quality from silvicultural NPS pollution by implementing BMPs and increasing silvicultural NPS awareness. This will be done by completing a statewide evaluation of silvicultural BMP implementation, providing technical assistance, education, coordination, and monitoring the effectiveness of forestry BMPs.

It is necessary to assess the voluntary adoption of Texas' recommended BMPs by forest landowners and producers. Critical areas will be identified by the implementation evaluation task of this project. A statewide evaluation program will track voluntary BMP Implementation by conducting 150 assessments of recently logged tracts. Data will be entered into a computer database for storage and retrieval. Global Positioning Systems (GPS) and Geographic Information Systems (GIS) will be used to record BMP site evaluations and their proximity to 303(d)-listed stream segments. A final report will be produced in the summer of 2008, documenting the results. A statistical guide will also be produced to assist the other states in conducting this monitoring.

The TFS, in cooperation with local SWCDs, will offer technical assistance to varying interest groups. BMP workshops will be provided to foresters, logging contractors, forest landowners, and other interested groups that focus on the proper implementation of BMPs. Forested wetlands provide many important benefits to the environment, making mitigation critical when these areas are developed. The TFS will investigate this process, enabling it to provide technical assistance to involved parties. The Tree Farm Program, a voluntary certification program designed to encourage the use of good forest management and BMPs, will be promoted to forest landowners. The TFS will also build and maintain strong local associations, which ultimately lead to sound forest management, protecting water quality. TFS foresters provide forestry and water quality expertise to thousands of people every year throughout the project.

Educational outreach programs will also be an integral part of this task. New and innovative technology transfer such as commercials and hands-on interactive displays will educate and encourage project participation. Local media will be used to promote project tasks, and a quarterly silviculture newsletter will promote various BMPs to landowners and natural resource professionals. This will increase communication, maintaining frequent, periodic technology transfer between natural resource professionals and forest landowners.

This project will also provide a one year extension on the FY 03 *BMP Effectiveness Monitoring Project*, allowing the TFS to continue data collection through the summer of 2007. This is critical in order to allow for a better understanding of BMPs and their effectiveness.

The TFS will lead this project with coordination among federal, state, and local agencies and entities, ensuring effective performance. The TFS will continue to lead the Wetland BMP

Coordinating Committee and will also be an active participant in the SGSF Water Resources Committee, as well as the Four-State BMP meeting. The TFS will supply all project deliverables to the TSSWCB project manager and will cooperate with and involve SWCDs and TSSWCB field representatives in all project activities, as appropriate.

Assessment of BMP effectiveness for forestry operations—(One year FY 03 *BMP Effectiveness Monitoring Extension*)

Water samples will be analyzed if they meet preservation requirements and holding times (see Section B1 "Sample Process Design (Experimental Design p.21)" for more detail). Water samples will be analyzed within the estimated accuracy and precision limits of measured parameters to insure data quality (Table A7-1). Values below the method detection limit will be reported as less than the Method Detection Limit (MDL) followed by the MDL value, and one-half the MDL will be used for data evaluation as recommended by Gilliom and Helsel (1968) and Ward et al. (1988).

Table A7-1. Estimated Accuracy and Precision Limits of Measured Parameters

NA = Not applicable; mg/L = milligrams per liter; fps = feet per second; µS/cm = microsiemens per centimeter; ft = feet; m = meters; °C = degrees Celsius: NTU = nephelometric turbidity units

Parameter	Precision Limits[1] (RPD)	Accuracy Limits	Method Detection Limit[2]
Laboratory Parameters			
Phosphorous	≤20%	± 15%	.100 mg/L
Total Suspended Solids	≤20%	± 10%	1 mg/L
Nitrate-Nitrite Nitrogen	±20%	±10%	1.00 mg/L
Total Kjeldahl Nitrogen	20%	±20%	.0500 mg/L
Fish	NA	NA	NA
Benthics	NA	NA	NA
Field Parameters[3]			
Dissolved Oxygen	NA	± 0.2 mg/L	2.0 mg/L
Potential Hydrogen (pH)	NA	± 0.2 units	0.2 pH units
Specific Conductance	NA	± 2% of range	20 µS/cm
Turbidity		± 1 NTU	.01 NTU
Water Temperature	NA	± 0.25°C	0.2 °C
Velocity	NA	+ 0.2 fps	0.2 fps
Water Level	NA	NA	0.2 m

[1] RPD = relative percent deviation
[2] Estimated MDL for Ana-Lab Corporation laboratory parameters as of December, 2005. MDLs for laboratory parameters are reevaluated about once every six months. MDLs for field parameters represent manufacturer specifications.
[3] Manufacturer specifications are presented for accuracy limits and method detection limits for field parameters.

Data Quality Indicators (DQIs) are a simplistic way of referring to data characteristics by consideration of commonly used measures of environmental quality. The principal DQIs are precision, representativeness, comparability, and completeness and although discussed as separate items are actually inter-related. For instance, lack of representativeness could lead to bias and lack of completeness. These DQIs are individually defined below:

Precision

The precision of data is a measure of the reproducibility of a measurement when an analysis is repeated. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions.

Ana-Lab Corporation laboratory will determine precision of its analyses by completing the entire analysis of a duplicate sample once per batch or once per 10 samples, whichever is the greater frequency. Relative percent deviation (RPD) of duplicate analyses (X_1 and X_2) will be calculated with the formula with the precision limits indicated in Table A7-1:

$$\text{Relative Percent Deviation} = \frac{(X_1 - X_2)}{(X_1 + X_2)/2} \times 100$$

Accuracy

Accuracy is the degree of conformity with a standard. Accuracy relates to the quality of a result, and is distinguished from precision, which relates to the quality of the operation by which the result is obtained. Accuracy of each measurement will be recorded by reporting the measurements of know quantities with each batch. Accuracy will be calculated utilizing percent recovery.

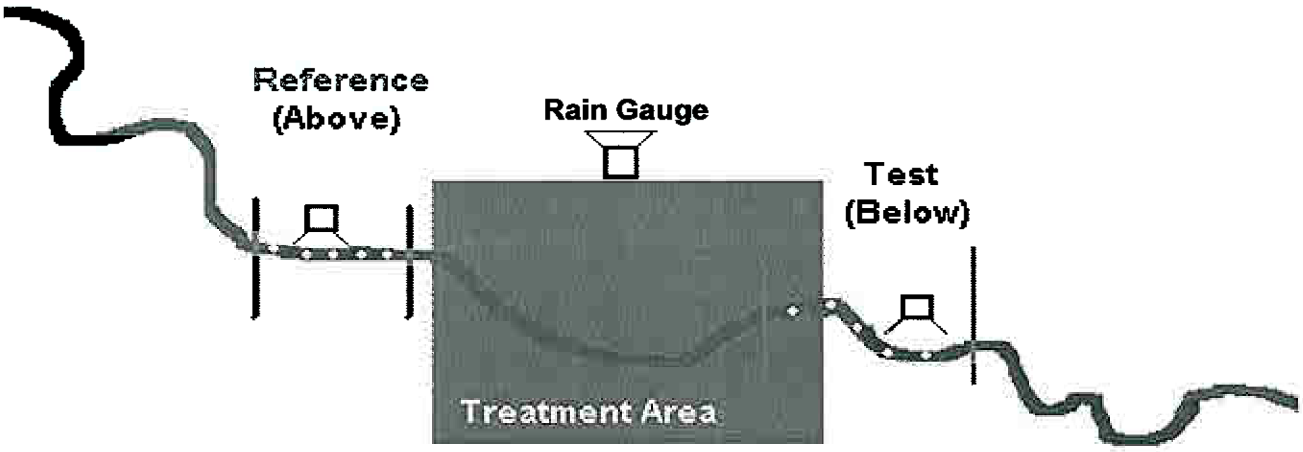
Representativeness

Site selection and sampling of all pertinent media (water, soil and plant material), and use of only approved analytical methods, will assure that the measurement data represents the conditions at the site. Representativeness also depends on the number of samples taken to accurately reflect the technological effectiveness at a given site. The goal for meeting total representation for effectiveness of each technology is tempered by the potential funding for complete representativeness.

The biological monitoring assessment of this project focuses on low gradient streams that are characteristic of East Texas. The sites that are selected for this project are indicative of this habitat type and the sampling techniques used will correspond to this stream type. Manual grab samples will be collected monthly when adequate flow occurs (see Table B1-2). Measurements of dissolved oxygen (DO), conductivity, total Kjeldahl nitrogen, pH, total phosphorous, total suspended solids (TSS), nitrate-nitrite nitrogen, turbidity, stream flow, and water temperature will be obtained through grab samples taken above and below each assessment site location. Stormwater samples will be taken during and/or following each storm event and analyzed for total suspended solids, turbidity, total Kjeldahl nitrogen, nitrate-nitrite nitrogen and total phosphorous. The fish and benthic macroinvertebrate sampling will occur at each above and below location (See Figure A7-1), for each site semiannually.

Special care will be taken during the site selection process to ensure the above and below stream and habitat locations are similar.

Figure A7-1. Typical Study Site Layout.



Comparability
Confidence in the comparability of data sets from this project to those for similar uses is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP and project SOPs. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format.

Completeness
The project biologist and technician will collect fish, benthic, water chemistry, and stream habitat assessment data from the monitoring sites. Weather conditions may prevent the collection of some samples; in each case, documentation/field notes of such adverse conditions will be recorded.

Stream sites monitored by TFS that are representative of those in proximity to forestry operations in East Texas are listed in Table A7-2. Any changes to the monitoring sites listed in table A7-2 will be made as an amendment to the QAPP.

Although 100 percent of collected data should be available, accidents, insufficient sample volume, or other problems must be expected. A goal of 90 percent data completeness will be required for data usage. Should less than 90 percent data completeness occur, the Program Manager will initiate corrective action procedure (Quality Control Requirements Section B5).

Data completeness will be calculated as a percent value and evaluated with the following formula:

$$\% \text{ completeness} = \frac{SV}{ST} \times 100$$

Where: SV = number of samples with a valid analytical report
ST = total number of samples collected

Database checks for validity will be performed on an on-going basis. Data will be reviewed for abnormalities or any unusual results, prior to entry into the database. Any unusual results will be traced for error sources. In the event no error is found, the data will be assumed normal and appropriate for decision determinations. If an error is found and cannot be resolved, the data will be discarded.

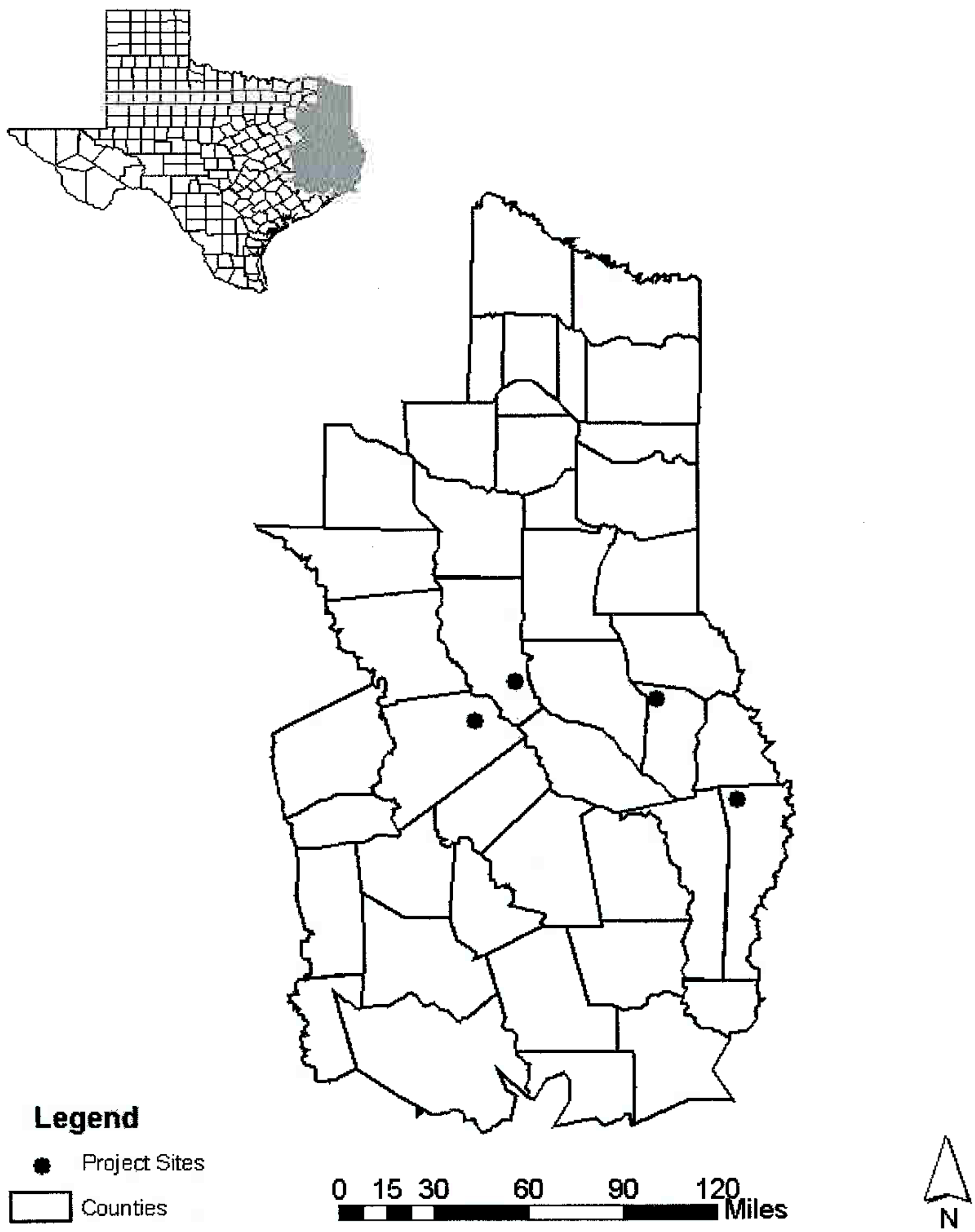
The Project Manager will coordinate with the Laboratory Manager, Field Operations Manager, and Field Biologist to ensure that proper protocols are utilized.

Table A7-2. Sampling Sites Locations Monitored by TFS

CR = County Road; FM = Farm to Market Road; SH = State Highway

Site	Latitude & Longitude (DD) (Datum = NAD83)	Subwatershed & General Location
Cherokee County	31.60 -94.97	HUC 12020004 Walker Creek located off FM 1911 east of Hwy 69 near Wells, TX
Houston County	31.47 -95.26	HUC 12020002 Johnson Creek located off FM 1733 and FSR 526 near Kennard, TX
Newton County	31.15 -93.90	HUC 12020005 East Prong McKim Creek located off Hwy 96 and CR 207 near Pineland, TX
San Augustine County	31.62 -94.30	HUC 12020005 Located off FM 711 and Hwy 7 near Martinsville, TX

Figure A7-2. Project Site Locations



Section A8: Special Training Requirements/Certification

All personnel involved in sampling, sample analyses, and statistical analyses have received the appropriate education and training required to adequately perform their duties. No special certifications are required. TFS personnel involved in use of global positioning system (GPS) instruments have been trained in the appropriate use of GPS and have been certified.

Management-level field personnel have received hands-on training in stream sampling and habitat assessment by working directly with EPA, TCEQ, River Authorities, and other organizations prior to sampling/assessment activities. They have also completed certification training in *Aquatic Life Monitoring* administered by the TCEQ-Monitoring Operations Division. All new field personnel receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the QA Officer (or designee) their ability to properly calibrate field equipment and perform field sampling and analysis procedures. All field personnel training certificates and general proficiency training are documented and retained in the personnel file and will be available during a monitoring systems audit. Forestry contractors will have received and provided documentation of their Pro-Logger Certification prior to treatments assessed.

Ana-Lab Corporation laboratory will analyze prescribed water quality parameters according to EPA approved methodology. Laboratory analysts have a general knowledge of laboratory operations, test methods, and quality assurance. The also have a combination of education, experience, skill, and training to perform their specific function. All training certificates and certification documents will be filed at Ana-Lab Corporation facilities. The Ana-Lab QA Manager will be responsible for these documents.

Section A9: Documentation and Records

The QA Manager will be responsible for ensuring that the project staff has the most recent version of the QAPP. When the original project QAPP and the required annual updates are produced, and approved by TSSWCB and EPA, they will be emailed as a PDF file to the project staff. All changes will be discussed with the project staff to ensure understanding.

Hard copies of all field data sheets, general maintenance (GM) records, chain of custody forms (COCs), laboratory data entry sheets, field data entry sheets, calibration logs, corrective action reports (CARs), GPS and GIS data, digital photographs, instrument calibration, laboratory analysis reports, billing receipts, and silvicultural prescriptions will be archived by TFS at the Cudlipp Forestry Center in Lufkin, Texas for at least five years. In addition, TFS will archive electronic forms of all project data for at least five years. A CAR form is presented in Appendix A, a copy of a COC is presented in Appendix A, and copies of GM and field data sheets are presented in Appendix A.

Ana-Lab Corporation laboratory manager will produce an annual quality assurance/quality control report, which will be kept on file at TFS with copies made available upon request. Any items or areas identified as potential problems and any variations or supplements to QAPP procedures noted in the laboratory quality assurance/quality control report will be made known to pertinent project personnel and included in an update or amendment to the QAPP.

Quarterly progress reports will note activities conducted in connection with the water quality monitoring program, items or areas identified as potential problems, and any variations or supplements to the QAPP. CARs will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference at TFS. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP.

Section B1: Sampling Process Design (Experimental Design)

This project is designed to evaluate changes in water quality that occur as a result of the implementation of WQMPs and associated BMPs primarily focused on reducing sediment losses and potential adverse affect on water quality parameters from forestry operations in proximity to streams and tributaries of East Texas. The water quality parameters that will be measured are shown in Table B1-1.

Table B1-1. Biological & Physiochemical Parameters

Parameter	Status	Reporting Units
Laboratory Parameters		
Total Phosphorous	Critical	milligrams per liter (mg/L)
Total Suspended Solids	Critical	milligrams per liter (mg/L)
Total Kjeldahl Nitrogen	Critical	milligrams per liter (mg/L)
Nitrate-Nitrite Nitrogen	Critical	milligrams per liter (mg/L)
Fish	Critical	NA
Benthics	Critical	NA
Field Parameters		
Dissolved Oxygen	Non-critical	milligrams per liter (mg/L)
Potential Hydrogen (pH)	Non-critical	pH standard units
Turbidity	Non-critical	nephelometric turbidity units (NTU)
Specific Conductance	Non-critical	microsiemens per centimeter (µS/cm)
Water Temperature	Non-critical	degrees Celsius (°C)
Velocity	Critical	feet per second (fps)
Water level	Critical	feet (ft)

Four sites under intensive forest management and adjacent to perennial streams (with headwaters on industry land) will undergo rigorous habitat assessments, water chemistry and biological monitoring for two years before forestry operations and for a period of two years following operations. Site conditions will encompass the higher topography and soil erodibility where intensive forest management is practiced.

The sampling schedule for this project includes semiannual biological monitoring (fish and benthic macroinvertebrates) as well as monthly water quality grab sampling. Habitat assessments will be conducted before each biological monitoring session begins. Biological samples will be stored in a 70% ethanol alcohol solution and sent along with the grab samples to East Texas Baptist University (benthics), Texas Parks and Wildlife Department (fish) and Ana-Lab Corporation (grab samples).

The objective of the sampling is to compare the above (reference) and below (test) segments before and after the treatment. At each of the four sites, an above and below location (with regard to the treatment or harvested area) will be marked. The biological sampling will be done twice a year for benthics and fish. The water sampling will occur monthly when adequate flow occurs at a prescribed sampling site (marked by GPS) for each location assessed. Stormwater runoff samples will also be collected during and/or following storm events on all four project sites. The regularly scheduled sampling program accompanied with storm water samples will characterize water quality of stream sites. The breakdown is as follows:

- Water quality grab samples will be collected at monthly intervals for all constituents. Routine grab samples will be collected only when sites are flowing. If a site is not flowing but pooled or dry, that will be noted on the field data sheet and/or field log book.

- Water quality parameters that will be measured include specific conductance, dissolved oxygen, total Kjeldahl nitrogen, pH, TSS, nitrate-nitrite nitrogen, turbidity, total phosphorous, stream flow, and water temperature. Stormwater samples will be taken during and/or following storm events.

- Any modifications to the location of sampling sites will be reflected in amendments to this QAPP and along with impacts on the selected sample design.

- Field procedures for determining a time-history of flow at each sampling site will consist of recording water level, which will be used to calculate stream discharge. Flow is determined from site specific stage discharge relationships which exist or will be developed from wading-type flow measurements taken at various stage conditions that are then related to the cross-sectional area of each stream at the sampling site. At some sites, mathematical fluid mechanics equations may be used to estimate flow.

Table B1-2. Biological and Physiochemical Monitoring Breakdown.

Fish: 4 (sites) * 2 (locations) * 2 (time per year) * 4 (years) = **64**

Benthics: 4 (sites) * 2 (locations) * 2 (times per year) * 4 (years) = **64**

Grab: 4 (sites) * 2 (locations) * 12 (times per year) * 4 (years) = **384**

Storm: 4 (sites) * 2 (locations) * 20[1] (times per year) * 4 (years) = **640**

Continuous: 4 (sites) * 2 (locations) * 12 (times per year) * 4 (years) = **384**

[1] Estimated number of storm events per year based on rainfall patterns.

Section B2: Sampling Method Requirements

Field sampling activities are documented on Field Activity Forms as presented in Appendix A. The following will be recorded for all sampling events:

- station ID / location
- sampling time
- date
- sample collector's name/signature
- COC number

Recording Data

For the purposes of this section and subsequent sections, all field and laboratory personnel follow the basic rules for recording information as documented below:

- Legible writing with no modifications, write-overs or cross-outs;
- Correction of errors with a single line followed by an initial and date;
- Close-outs on incomplete pages with an initialed and dated diagonal line.

Failures in Sampling Methods Requirements and/or Deviations from Sample Design and Corrective Action

Examples of failures in sampling methods and/or deviations from sample design requirements include but are not limited to such things as sample container problems such as inadequate sample volume due to spillage or container leaks, contamination of a sample bottle during collection, failure to preserve samples appropriately, storage temperature and holding time exceedance, sampling at the wrong site, etc. Any deviations may require corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the Field and Data Supervisors, in consultation with the TFS QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. The Field and Data Supervisors will determine if the deviation from the QAPP compromises the validity of the resulting data. The Field and Data Supervisors, in consultation with the TFS QAO, TFS Project Leader, and TSSWCB QAO will decide to accept or reject data associated with the sampling event, based on best professional judgment. Resolution of the situation will be reported to the TSSWCB in the quarterly report.

<u>Equipment</u>

For water chemistry, habitat assessments and biological sampling, the following equipment will be used:

- Continuous portable water quality sampler (2) with the capability of sampling water temperature, dissolved oxygen, pH, and conductivity
- Portable turbidity meter (1)
- Flow meter and top-set wading rod for stream flow

- Collection bottles for water samples to be sent to lab
- Automatic Stormwater Samplers (8)
- Bubbler Flow Meters (8)
- Laptop Computer (1)
- NWS Rain Gauges (4)
- HOBO tipping bucket rain gages (4)
- D-frame dip nets (2) for collecting benthic macroinvertebrates
- Dishpans for sorting through dip net samples
- Forceps and pipettes for collecting benthic macroinvertebrates
- Plastic jars for benthics collected, with labels
- 90% Formalin for euthanizing and preserving fish collected
- 70% Ethanol alcohol for storing benthics and fish collected
- Backpack electrofisher
- Seine
- 5 gallon buckets
- Aerator
- Dip net for gathering fish
- Large plastic HDPE jars/containers, with labels, for collected fish
- Waders (3)
- Linesmens gloves (4 pair)
- Camera
- Densiometer
- GPS unit

All battery-powered equipment (water-testing meters, GPS, and the electrofisher) will be tested prior to going out into the field to make sure they are in good working order. Backup batteries will be available in the field in case of failure of those already in place.

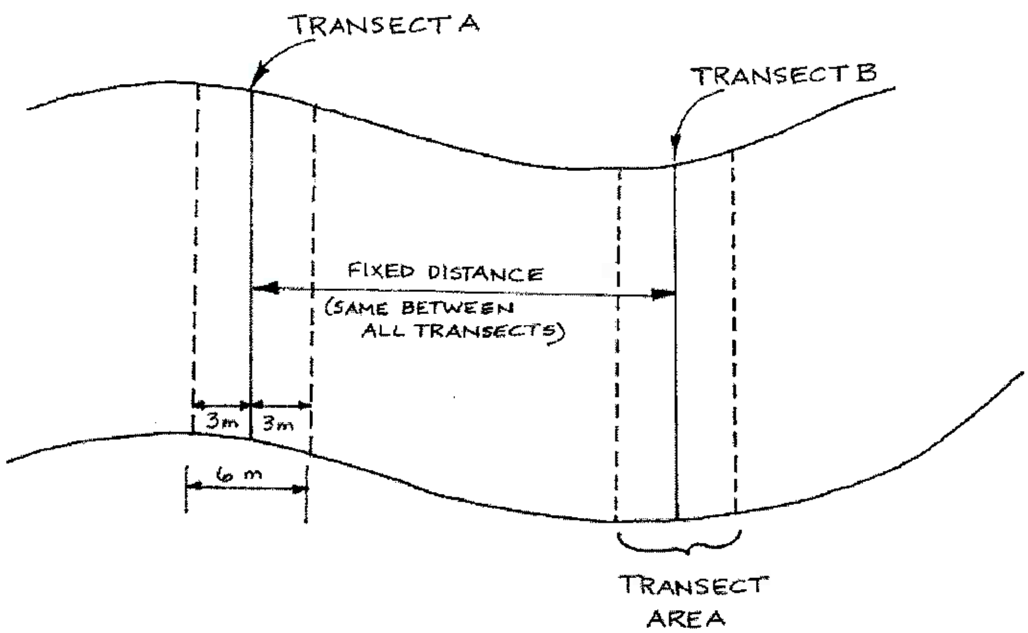
Field Sampling Procedures:

Habitat Assessment

Stream reach or length of stream assessed will be evaluated by walking the stream for several hundred meters to locate areas where biological collections will be made. The reach length of a wadeable stream is based on 40 times the average stream width, but not less than one-hundred fifty meters. For most wadeable streams, this will result in a reach length of approximately two-hundred to three-hundred meters. A maximum reach length of five-hundred meters will be used. The stream reach will encompass the biological collection areas and will include as many different geomorphic channel units (riffles, runs, etc.) as possible.

Five Transects will be marked at predetermined intervals no greater than 75 meters apart in stream reaches of three-hundred meters or less. Six transects will be located no greater than 100 meters apart for stream reach lengths from three-hundred to five-hundred meters.

Figure B2-1. Transect Placement



Each habitat parameter (habitat type, # of riffles, dominant substrate, in-stream cover, stream morphology and riparian environment) within a transect is assigned a numerical value by the observer based on the appearance of the stream. The individual values are summed to obtain a total score for the site. The same person(s) will do the evaluation at each site (habitat assessment forms Appendix A). In completing the habitat assessment form the same area covered in the physiochemical, benthic and fish sampling protocol will be evaluated. Data sheets and habitat assessment forms will be completed accurately with the proper information.

Care will be taken to assure that all tests have been performed, all data recorded, and all samples are labeled correctly. Before leaving the sampling site, protocol will be reviewed as specified in Standard Operating Procedures (Appendix B) to insure that procedural sampling activities coincide with those described.

Assessment of Ambient Water Conditions – Stream Flow

Velocity and depth measurements will be manually taken at a sufficient number of segments across the stream cross section to allow determination of flow from the average velocity and cross-sectional area of each segment of the cross section following USGS guidelines. If a stream is more than 20 feet wide, at least 10 measurements are taken across the stream; if less than 20 feet, measurements are taken at least at approximately one-foot intervals. Increments will be set so that no one measurement represents more than 10 percent of the total flow. For low to moderate stream flow conditions, flow measurement procedures will involve wading the stream perpendicular to flow direction and taking velocity and depth measurements at successive distances along the cross section. A surveyor's tag line, marked in one-foot increments, will be stretched across each stream as both a reference for maintaining position at the cross-section and for accurately measuring increments. At locations where the water level is less than two and a-half feet, velocity measurements are taken at 60 percent of total depth using a Marsh-McBirney Model 2000 Flowmeter. For water levels deeper than two and a-half feet, measurements will be taken at 20 percent and 80 percent of the total depth, and averaged. The flow probe measures velocity throughout the column.

When water velocity or depth exceeds levels which allow safe measurement by wading, less precise measurements will be used in the absence of a bridge. At many sites, the absence of a bridge crossing prevents the more accurate measurement of velocity by cable suspension of velocity meter with attached weight. To measure velocity at unsafe water levels, field personnel will time a floating object over a distance of 100 feet. This will be repeated multiple times. A second method that may be used at high flows is to stake the high water marks along a reach of the stream. The stakes are later surveyed and, together with stream cross-sectional area information, are used in Manning's equation to estimate flow. This is the slope-area method for determining discharge (Dalrymple & Benson, 1967; Soil Conservation Service, 1985).

In recording flow data, care will be taken to accurately document stream, date of observation, and segment description/designation since this is critical to the data analysis comparisons. Information will coincide with the data sheets and habitat assessment forms to ensure accuracy.

Care will be taken to assure that all tests have been performed, all data recorded, and all samples are labeled correctly. Before leaving the sampling site, protocol will be reviewed as specified in Standard Operating Procedures (SOP) (Appendix B) to insure that procedural sampling activities coincide with those described.

<u>Grab and Storm Water Sampling</u>

Routine grab samples and continuous monitoring data will be collected by TFS at designated sampling sites on a monthly basis when adequate flow occurs. Stormwater runoff samples will be collected during and/or following rainfall events from all sites. All water samples collected for transport to lab will be of a volume no less than 1 liter. Water temperature, pH, specific conductivity, and dissolved oxygen will be measured and recorded *in-situ* with a multiprobe datasonde with the appropriate display device only when routine grab samples are collected (Appendix B – Field Data Collection SOP). The probe of the meter(s) will be carefully inserted into the stream at mid-stream and mid-column level. Readings for each parameter will be recorded. After each procedure, probes will be rinsed with distilled water. All post-calibration, maintenance and calibration procedures will be done back at the lab to prevent contamination of future samples and to maintain the equipment.

Upon collection, all samples will be labeled appropriately (see Section B3) and transported in an iced container to the laboratory for analysis. All filtration and preservation, other than temperature reduction by ice, will be performed in the laboratory. TFS retrieves all samples obtained during storm events within 30 hours of collection, including weekends and holidays.

Readings of all the instruments, current weather conditions, etc. will be recorded on the TFS Water Quality Sampling Data Sheet (Appendix A). Other observations that could possibly influence stream condition, such as evidence of flooding or other events, will also be recorded on field activity forms.

In labeling the water samples, care will be taken to accurately place the proper date, stream name and sample location (above vs. below) on the containers, since this is critical to the proper analysis comparisons. Labeling will coincide with COC forms, data sheets and habitat assessment forms to ensure accuracy.

Care will be taken to assure that all tests have been performed, all data recorded, and all samples are labeled correctly. Before leaving the sampling site, protocol will be reviewed as specified in Standard Operating Procedures (Appendix B) to insure that procedural sampling activities coincide with those described.

A Chain of Custody form will accompany each sample batch and will be signed each time the batch changes hands between TFS personnel, from TFS to the lab, throughout the lab procedures, and from the lab back to TFS. If samples are mailed to the lab, a copy of the signed COC form will be faxed to TFS once received.

Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate sampling procedures will follow those found in TCEQ's Surface Water Quality Monitoring Procedures, Volume 2 (August 2005). After running the D-frame dip net through a small portion of the sampling area, the contents will be placed into a dishpan. Benthic macroinvertebrates will be removed using forceps and pipettes and placed in a collection jar with alcohol. Sampling and collecting continues until 100 individual macroinvertebrates are collected or after one hour has passed with two people collecting. If one person is doing the sampling and collecting, two hours will be the designated time limit. The collected benthics will be preserved in 70% isopropyl or ethanol alcohol in jars, using one jar per collection point. The collection jar will be labeled appropriately (see Section B3). Specimens will be transported in a light restrictive container.

In labeling the benthic samples, care will be taken to accurately place the proper date, stream name and sample location (above vs. below) on the containers, since this is critical to the proper analysis comparisons. Labeling will coincide with the data sheets and habitat assessment forms to ensure accuracy.

Care will be taken to assure that all data is recorded, and all samples are labeled correctly. Before leaving the sampling site, protocol will be reviewed as specified in Standard Operating Procedures (Appendix B) to insure that procedural sampling activities coincide with those described.

A Chain of Custody form will accompany each sample batch and will be signed each time the batch changes hands between TFS personnel, from TFS to the lab, throughout the lab procedures, and from the lab back to TFS. If samples are mailed to the lab, a copy of the signed COC form will be faxed to TFS once received.

To obtain calculations of bioassessment metrics, bioassessment scores, and functional feeding group compositions, the numbers of benthics collected will be entered in their proper taxonomic groups into a database created for EPA (EDAS) or other similar database. This database uses taxonomic classification, feeding groups, and tolerance levels to assess the biological condition of an aquatic community.

Fish Sampling

Appropriate scientific collection permits will be obtained from Texas Parks and Wildlife Department (TPWD) prior to any sample collection. A backpack electrofisher will be used to collect fish species in the sample area (Appendix B – SOP – Fish Community Sampling).

Once floating, the fish will be scooped up in a net (other than the ones used for collecting benthics) and fish will be rinsed with ambient water. Any samples not identified in the field, or samples kept for reference will be placed in a 90% formalin solution.

In labeling fish samples, care will be taken to accurately place the proper date, stream name and sample location (above vs. below) on the containers, since this is critical to the proper analysis comparisons. Labeling will coincide with the data sheets and habitat assessment forms to ensure accuracy. Upon collection, all samples will be labeled appropriately (see Section B3) and transported to the laboratory for analysis.

A Chain of Custody form will accompany each sample batch and will be signed each time the batch changes hands between TFS personnel, from TFS to the lab, throughout the lab procedures, and from the lab back to TFS. If samples are mailed to the lab, a copy of the signed COC form will be faxed to TFS once received.

Care will be taken to assure that all tests have been performed, all data recorded, and all samples are labeled correctly. Before leaving the sampling site, protocol will be reviewed as specified in Standard Operating Procedures (Appendix B) to insure that procedural sampling activities coincide with those described.

Section B3: Sample Handling and Custody Requirements

Each container will be marked with a designated identifier. The field biologist will document on a field activity form and chain-of-custody (COC) form the sample number, site, date, time, location, and sample type. The COC form will accompany all sets of sample containers. The sample identification, location, date, changes in possession and other pertinent data will be recorded in indelible ink on the COC. The sample collector will sign the COC and transport it with the sample to the laboratory, where the laboratory staff member who receives the sample will sign it. A copy of a blank COC form used on this project is included as Appendix A.

Table B3-1 delineates sample container, preservation and holding time information for parameters of interest in this project.

Table B3-1. Sample Procedures and Handling Methods

Parameter	Method	Container	Preservation	Temperature	Holding Time
Laboratory Parameters					
Total Phosphorous	EPA 200.7	HDPE	HNO_3 to pH <2	4°C	7 days
Total Suspended Solids	EPA 160.2	HDPE	NA	4°C	7 days
Total Kjeldahl Nitrogen	EPA 351.2	HDPE	H_2SO_4 to pH <2	4°C	7 days
Nitrate-Nitrite Nitrogen	EPA 300.0	HDPE	H_2SO_4 to pH <2	4°C	7 days
Fish	TCEQ	HDPE	90% Formalin	Ambient	5 yrs
Benthics	TCEQ	HDPE	70% Isopropyl-OH^-	Ambient	5 yrs
Field Parameters					
Dissolved Oxygen	EPA 360.1	NA	NA	NA	NA
Potential Hydrogen (pH)	EPA 150.1	NA	NA	NA	NA
Specific Conductance	SM 2510-B	NA	NA	NA	NA
Turbidity	EPA 180.1	NA	NA	NA	NA
Water Temperature	EPA 170.2	NA	NA	NA	NA
Velocity	Flow Probe	NA	NA	NA	NA
Water Level	USGS	NA	NA	NA	NA

EPA = Methods for Chemical Analysis of Water and Wastes, March 1983
HDPE = High Density Polyethylene bottles
H_2SO_4= concentrated sulfuric acid
HNO_3 = concentrated nitric acid
-OH^- = Alcohol
°C = degrees centigrade
SM = Standard Methods for Examination of Water and Wastewater, 18^{th} and 20^{th} editions
NA = not applicable; measured *in situ*
Flow Probe = Marsh-McBirney Manual
USGS = Techniques of Water Resources Investigations, Book 3, Chapter A8, 1980

After samples are received at the laboratory, they will be inventoried against the accompanying COC. Any discrepancies will be noted at that time and the COC will be signed for acceptance of custody. Samples will then be placed in a refrigerated cooler dedicated to sample storage, where required.

The Laboratory Manager has the responsibility to ensure that all holding times are met. This is documented on COC for sample dates and times and on analytical run logs for analysis dates and times. Any problems will be documented with a corrective action report (CAR). CARs will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference at TFS. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP. Any items or areas identified as potential problems and any variations or supplements to QAPP procedures noted in the laboratory quality assurance/quality control report will be made known to pertinent project personnel and included in an update or amendment to the QAPP.

Hard copies of all field data sheets, general maintenance (GM) records, chain of custody forms (COCs), laboratory data entry sheets, field data entry sheets, calibration logs, corrective action reports (CARs), GPS and GIS data, digital photographs, instrument calibration, laboratory analysis reports, billing receipts, and silvicultural prescriptions will be archived by TFS at the Cudlipp Forestry Center in Lufkin, Texas for at least five years. In addition, TFS will archive electronic forms of all project data for at least five years. A CAR form is presented in Appendix A, a copy of a COC is presented in Appendix A, and copies of GM and field data sheets are presented in Appendix A.

Section B4: Analytical Methods Requirements

Dissolved oxygen, stream flow, water temperature, conductivity, turbidity, and pH of water at sampling sites for this project will be measured *in-situ*. The remainder of the physiochemical parameters listed in Table B3-1 will be analyzed by Ana-Lab Corporation. A listing of analytical methods and equipment is provided in Table B4-1. Standard operating procedures have been established for all procedures undertaken by TFS staff and contracted entities that concerns water quality monitoring and analysis, and copies of the SOPs are found in Appendix B.

In the event of a failure in the analytical system, the Project Manager will be notified. The Laboratory Manager, Quality Assurance Officer, and Project Manager will then determine if the existing sample integrity is intact, if re-sampling can and should be done, or if the data should be omitted.

Table B4-1. Laboratory Analytical Methods

Parameter	Method	Equipment Used
Laboratory Parameters		
Total Phosphorous	EPA 200.7	Lab
Total Suspended Solids	EPA 160.2	Lab
Total Kjedahl Nitrogen	EPA 351.2	Lab
Nitrate-Nitrite Nitrogen	EPA 300.0	Lab
Fish	TCEQ	Species ID/Count
Benthics	TCEQ	Species ID/Count
Field Parameters		
Dissolved Oxygen	EPA 360.1	Hydrolab Datasonde or YSI Multiprobe
Potential Hydrogen	EPA 150.1	Hydrolab Datasonde or YSI Multiprobe
Specific Conductance	SM 2510B	Hydrolab Datasonde or YSI Multiprobe
Turbidity	EPA 180.1	Hydrolab Datasonde or YSI Multiprobe
Water Temperature	EPA 170.1	Hydrolab Datasonde or YSI Multiprobe
Velocity	USGS	Marsh Mcbirney Flowmeter, Bubbler Flow Meter
Water level	USGS	Available Data and Calculation

EPA = Methods for Chemical Analysis of Water and Wastes, March 1983
SM = Standard Methods for Examination of Water and Wastewater, 18th and 20th editions
TCEQ = TCEQ Surface Water Quality Monitoring Procedures Manual, Volume I (December 2003) and Volume 2 (August 2005).
USGS = Techniques of Water Resources Investigations, Book 3, Chapter A8, 1980

Section B5: Quality Control Requirements

Ana-Lab Corporation laboratory will determine the precision of their analyses. Annual laboratory audits, TFS sampling site audits, and quality assurance of field sampling methods will be conducted by the project QA officer.

Most analyses of water samples have the precision and accuracy of data determined on the particular day that data were generated. This requires the analysis of a minimum of one duplicate and one spike each time a particular parameter is measured in the laboratory. Larger batches of samples require that additional precision and accuracy checks be made on 10 percent of the total batch. A field duplicate is also included every time grab water samples are submitted to the laboratory, with at least one field duplicate included for every ten samples. Depending on the analysis, certain methodologies require that water blanks, standards, and reagent blanks be analyzed to verify that no instrument or chemical problem will affect data quality. Table B5-1 outlines the required analytical quality control for the parameters of interest.

Table B5-1. Required Quality Control Analyses

Parameter	Blank	Standard	Duplicate	Spike
Laboratory Parameters				
Fish	NA	NA	NA	NA
Benthics	NA	NA	NA	NA
Total Phosphorous	A	A	B	B
Total Suspended Solids	A	NA	B	NA
Total Kjeldahl Nitrogen	A	A	B	B
Nitrate-Nitrite Nitrogen	A	A	B	B
Field Parameters				
Dissolved Oxygen	NA	NA	NA	NA
Potential Hydrogen (pH)	NA	A	NA	NA
Specific Conductance	NA	A	NA	NA
Turbidity	NA	A	NA	NA
Water Temperature	NA	NA	NA	NA
Velocity	NA	NA	NA	NA
Water Level	NA	NA	NA	NA

A - Where specified, blanks and standards shall be performed each day that samples are analyzed.
B - Where specified, duplicate and spike analyses shall be performed on a 10% basis each day that samples are analyzed. If one to 10 samples are analyzed on a particular day, then one duplicate and one spike analysis shall be performed
NA indicates not applicable

The use of approved sampling and analytical methods will ensure that measured data accurately represent conditions at each monitoring site. The comparability of the data produced is predetermined by the commitment of the project laboratory staff to use EPA-approved or EPA-recommended analytical methods. Table A7-1 in Section A7 "Data Quality Objectives" lists the required accuracy limits for the parameters of interest. The completeness of the data will be affected by the reliability of the equipment, frequency of field and laboratory errors or accidents, and unexpected events; however, the general goal requires 90 percent data completion.

In the database, missing values will be left as blanks. Questionable data will be traced through the Chain of Custody sheets, Corrective Action Reports, and, as necessary, through laboratory notebooks and field data sheets to ensure that data are properly entered. Changes will be made only if an error is found in transcription into database. Values determined to be below the laboratory method detection limit will be noted as such in the comments column of the database and used in statistical analyses as one-half the method detection limit (MDL), as recommended by Gilliom and Helsel (1968) and Ward *et al.* (1988). Values that are greater than the upper method detection limit will be noted in the comment column of the database as greater than the maximum detection limit. For values greater than the MDL, the maximum detection limit will be used in subsequent non-parametric statistical analyses, as recommended by Ward *et al.* (1988).

It is the responsibility of the Project Manager to verify that the data are representative. The chemistry data's precision, accuracy, and comparability will be the responsibility of the Laboratory Manager. The Project Manager has the responsibility of determining that the 90 percent completeness criteria is met, or will justify acceptance of a lesser percentage. All incidents at Ana-Lab Corporation requiring corrective action will be documented through use of Corrective Action Reports (Appendix A).

Section B6: Equipment Testing, Inspection, & Maintenance Requirements

Manufacturers' recommendations for scheduling testing, inspection, and maintenance of each piece of equipment will be followed or exceeded. All equipment testing, inspection and maintenance will meet the requirements specified by the EPA. Maintenance and inspection logs will be kept on each piece of field and laboratory equipment; general maintenance checklists will be filled out for sampling equipment prior to each sampling event and serviced as needed. A general maintenance (GM) sheet will be filled out for all sampling equipment during each GM inspection. The GM sheet contains a check list for all equipment and routine maintenance activities (Appendix A). Any equipment, which needs attention, will be serviced during the presampling inspection, with all additional activities described in the comment section. Any maintenance or other required activities that can not be completed during the scheduled GM inspection will be reported to the field supervisor, who then arranges for resolution. The field supervisor checks the pre-sample GM sheets and schedules additional follow-up to ensure that any problems or potential problems are resolved as soon as possible.

To minimize downtime of all measurement systems, all field measurement and sampling equipment, in addition to all laboratory equipment, must be maintained in a working condition. Also, backup batteries or common spare parts will be made available if any piece of equipment fails during use so that repairs or replacement can be made quickly, allowing measurement tasks to be resumed. All staff who use chemicals, reagents, equipment whose parts require periodic replacement and other consumable supplies receive instruction concerning the remaining quantity (unique for each supply) which should prompt a request to order additional supplies.

Section B7: Instrument Calibration and Frequency

All instruments or devices used in obtaining environmental measurement data will be used according to appropriate laboratory or field practices. Written copies of TFS standard operating procedures are available for review upon request.

All instruments or devices used in obtaining environmental measurement data will be calibrated prior to use. Each instrument has a specialized procedure for calibration and a specific type of standard used to verify calibration. All calibration procedures will meet the requirements specified in the USEPA-approved methods of analysis. The frequency of calibration recommended by the equipment manufacturer, as well as any instructions specified by applicable analytical methods, will be followed. All information concerning calibration will be recorded by the person performing the calibration and will be accessible for verification during either a laboratory or field audit.

All calibration procedures used in the field or laboratory will meet or exceed the calibration frequencies published in the test methods used for this project. Additional calibration procedures may be conducted if laboratory personnel determine additional calibration is warranted as beneficial to this project. Instruments and laboratory equipment used in the analyses of these samples are listed in Table B4-1 in Section B-4 "Analytical Methods Requirements." All instruments that require calibration prior to use will be calibrated before each day's analysis. The analytical balance for TSS requires no calibration other than class "S" weights to check the balance.

Section B8: Inspection/Acceptance Requirements for Supplies and Consumables

All supplies and consumables received by the TFS and Ana-Lab Corporation laboratory are inspected upon receipt for damage, missing parts, expiration date, and storage and handling requirements. Labels on reagents and chemicals are examined to ensure they are of appropriate quality, initialed by staff member and marked with receipt date. Volumetric glassware is inspected to ensure class "A" classification, where required.

Glassware and high density polyethylene containers used for chemical analyses and to obtain water samples are cleaned in laboratory grade soapy water, rinsed in tap water, soaked in 1N HCl a minimum of five minutes, then rinsed a minimum of five minutes in type II ASTM (American Society for Testing and Materials) water, i.e., water with conductivity of less than 2 microsiemens per centimeter. For certain analyses, cleaning with solvents and oven drying may be required. Glassware is never rinsed with compounds of the constituent being analyzed.

Section B9: Data Acquisition Requirements (Non-direct Measurements)

Water quality determinations at sampling sites will be based upon data collected during the time frame of the current FY 03-04 project and this project. However, data collected within the scope of this project under approved QAPPs from other state or federal projects will be used as supplemental information to meet data quality objectives (see Section A7). In determining reductions in NPS pollution at sampling sites, data collected prior to this project's initiation will be used to provide some of the pre-treatment data used for pre- and post-treatment comparisons.

The data collected under approved QAPPs from other projects will be referred to as historical data (with the exception of the current FY03-04 project). The historical data will supplement data from this project in the assessment of changes in water quality and determinations of forestry operation contributions of NPS to the water quality of the sites under analysis.

An example of historical water quality data that may be included are data collected by various Texas Commission on Environmental Quality (TCEQ) Clean Rivers Program Partners, TCEQ and TSSWCB TMDL contracted entities, and TCEQ and TSSWCB CWA 319(h) contracted entities. Data that may be used from these partners include TMDL assessment or implementation monitoring, and National Weather Service (NWS) rainfall and United States Geological Survey (USGS) water level (streamflow) information.

Geographic information system data regarding topography, land use, and soils will be obtained from accepted sources, such as the United States Bureau of Census, the USDA NRCS Cartographic Center in Fort Worth, Texas, the State Soils Geographic Database maintained by the NRCS, and standard DEMs from the USGS.

Section B10: Data Management

Field Collection and Management of Routine Samples

Field staff will visit sampling sites on a monthly basis to collect grab water samples and measure field water quality parameters. Site identification, date and time, personnel, water depth, measurements of field parameters, and any comments concerning weather or conditions at the site are noted on a field data sheet. Field log book or field data sheet is filled out on site for each location visited. An example of a field data sheet is shown in Appendix A. If no flow is observed at a site, samples are not collected, information about the site visit is recorded on the field data sheet and the site is noted as pooled with no flow or dry. Information on the dates that sites were visited when no flow was occurring is recorded.

Field staff will measure dissolved oxygen, pH, water temperature, and specific conductance at each stream site, using calibrated multisonde equipment. Turbidity is measured on site with a portable turbidity meter. Measurements read from the instrument are recorded on the field data sheet or log book. Stream flow measurements are taken with a Marsh-McBirney flowmeter. Grab samples are then collected at the site for further analysis at the lab, and an identifier (either a sample identification number or a site code) is written in marker on the outside of the HDPE sample bottles. The containers are placed in an iced chest for transportation to the Ana-Lab Corporation laboratory.

Unique sample identifiers are assigned using each sites initials and an indication of the above or below location. Sample ID's are recorded on the COC forms. Sample containers being processed are typically placed in order of collection time, so the order of the sample container matches the order of the field data and the COC sample ID's, reducing transcription errors. Site name, time of collection, comments, and other pertinent data are copied from the field data sheets to the COC. The COC and accompanying sample containers are submitted to laboratory analysts, with relinquishing and receiving personnel both signing and dating the COC.

Samples collected from storm events are taken to the Ana-Lab Corporation laboratory sample processing room. The sample ID, date, time, site name, sample type, preservative, container, and other pertinent comments are recorded on a COC form.

Chain of Custody Forms

A chain of custody (COC) form is used to record water sample identification parameters and to document the submission of samples from the field staff to the analytical laboratory staff. A copy of the COC is found in Appendix A. All entries onto the COC forms will be completed in ink, with any changes made by crossing out the original entry, which should still be legible, and initialing and dating the new entry. COCs are kept in the TFS office for at least five years.

Laboratory Analysis and Data Collection

Aliquots of each sample are used by the laboratory staff in running the various analytical procedures. The sample identifier is marked on all containers to which aliquots are transferred. Aliquots are filtered, as necessary, and analyzed as per standard operating procedures. Data pertaining to analyte measurements are recorded in bound personal logbooks, which are specific to each procedure and analyst. Printouts of data from automated analytical equipment are taped into the bound notebooks. Measurement data are entered into the water quality database from the laboratory notebooks by laboratory personnel.

Water Quality Data Entry

The project data management process relies heavily upon the integrity of an EPA created database (EDAS), or other similar database. This database will be used to store, retrieve, and analyze (calculate metrics) biological, water chemistry, and physical (habitat) data collected from the sample sites. This database will be backed up to a CD electronically along with a new printout of the data, and filed in accordance with the Texas Forest Service's standard office record keeping procedures. This information will be stored at the Cudlipp Forestry Center Forest Resource Development office.

As a quality control measure, the field staff will agree on any data that is collected before it is written on the field sheet. At the end of the day, the field staff will again look at the field sheets to make sure there is no missing data and that it has reasonable values.

Random spot checks will be performed on the data in which manual calculations will help detect any potential errors. The Quality Assurance manager will conduct these spot checks.

The EDAS database, or other similar database will be periodically imported into ArcGIS software. This will allow for the geographical representation of project sites along with the production of maps.

Field data and COC information will be verified by field personnel and/or a data analyst. As laboratory analyses are completed, laboratory personnel will enter the results from laboratory notebooks into EDAS or other appropriate database. The laboratory manager will be responsible for verifying that data in the EDAS, or other similar, database match the data in the laboratory notebooks. After verification has been completed on all data for a group of samples, the laboratory manager will notify the data analyst that a group of data is ready for review. The data analyst will check for abnormalities or problems by examining all sample data, that is, COC, field, and laboratory data for a sample. Site names, appropriateness of data values, completeness of data, dates and times, container numbers, comments and all other data will be reviewed within the EDAS, or other similar, database. Any questions or abnormalities will be investigated, relying largely on field data and general maintenance sheets, field biologist, laboratory notebooks, and laboratory personnel. As appropriate, corrections will be made to the EDAS, or other similar, database with appropriate documentation maintained.

Backup and Disaster Recovery

The electronic data are backed up daily onto an alternate device (i.e – CD, Zip, or comparable media). In the event of a catastrophic systems failure, the media can be used to restore the data. Data generated on the day of the failure may be lost, but can be reproduced from raw data in most cases.

Archives and Data Retention

Original data recorded on paper files are stored for at least five years. Data in electronic format are stored on alternate media and/or drives in a climate controlled, fire-resistant storage area at TFS headquarters.

Information Dissemination

Pertinent water quality data will be sent as requested for dissemination to project collaborators. Summaries of the water quality data will be presented in the final project report.

Section C1: Assessments and Response Actions

The commitment to use approved equipment and approved methods when obtaining environmental samples and when producing field or laboratory measurements requires periodic verification that the equipment and methods are, in fact, being employed and being employed properly. This verification will be provided through an annual field and laboratory performance audit performed by the QA officer. Individual field personnel will be observed during the actual field investigation to verify that equipment and procedures are properly applied. Any problems that are discovered in the monitoring procedures that would affect the quality of data collected at the demonstration sites will be addressed by the project participants and followed up with a CAR. Follow-up observations will occur within three months when discrepancies are noted. In addition, TSSWCB and EPA will conduct yearly performance audits for this project.

All laboratory analyses will have the precision and accuracy of data determined on the particular day that the data were generated. Depending on the analysis, certain methodologies require that water blanks and reagent blanks be analyzed to verify that no instrument or chemical problem will affect the quality of the data. The specific requirements are presented in Section B5 of the QAPP.

To minimize downtime of all measurement systems, all field measurement and sampling equipment, and all laboratory equipment must be maintained in a working condition. Also, backup equipment or common spare parts will be available if any piece of equipment fails during use so that repairs or replacement can be made quickly and the measurement tasks resumed.

Section C2: Reports to Management

Quarterly progress reports will note activities conducted in connection with the water quality monitoring program, items or areas identified as potential problems, and any variations or supplements to the QAPP. Corrective action report forms will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference at TFS. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP.

The field measurement and sampling for the project will be done according to the QAPP. However, if the procedures and guidelines established in this QAPP are not successful, corrective action is required to ensure that conditions adverse to quality data are identified promptly and corrected as soon as possible. Corrective actions include identification of root causes of problems and successful correction of identified problem. Corrective Action Reports will be filled out to document the problems and the remedial action taken. Copies of Corrective action reports are included with TFS and Ana-Lab Corporation annual Quality Assurance reports. The Quality Assurance reports will contain a quality assurance section to address Ana-Lab Corporation's laboratory' accuracy, precision and completeness of the measurement data. They will also discuss any problems encountered and solutions made. These QA reports are the responsibility of the Quality Assurance Officer and the Laboratory Manager and are available for review upon request.

Section D1: Data Review, Validation and Verification

All data obtained from field and laboratory measurements will be reviewed and verified for integrity and continuity, reasonableness, and conformance to project requirements, and then validated against the data quality objects outlined in Section A7, "Data Quality Objectives for Measurement Data." Only those data that are supported by appropriate quality control data and meet the DQOs defined for this project will be considered acceptable for use.

The procedures for verification and validation of data are described in Section D2, below. The TFS Project Manager is responsible for ensuring that field data are properly reviewed, verified, and submitted in the required format for the project database. Likewise, the Laboratory Manager is responsible for ensuring that laboratory data are reviewed, verified, and submitted in the required format for the project database. The QA officer is responsible for validating that all data collected meet the data quality objectives of the project.

Section D2: Validation and Verification Methods

Quality control aspects of databases include the following:

- Sample data are identified with a unique identifier, which is documented on Chain of Custody (COC) forms and all laboratory logbooks. A standard operating procedure has been written for sample custody and control to ensure proper identification and analyses of all samples.
- Ana-Lab Corporation laboratory logbooks and graphs are reviewed by the Laboratory Manager for passage of quality control parameters before the data are entered onto the COC. This constitutes an ongoing internal audit.
- Data are entered into the EDAS or other similar database only after COC forms have been completed. Data are reviewed to ensure a complete record for each sample.
- Entries into the EDAS or other similar database are verified against COCs, field data sheets and laboratory notebooks prior to transfer into the EDAS or other similar database. This constitutes an on-going internal audit.
- Correctly entered values that appear to be outliers are statistically analyzed. Those that are found to be extreme outliers, according to Ott (1984) will be eliminated from the analyzed data but left in the database. The outlier test described by Ott assumes a normal distribution of the data. Since water quality data are often skewed to the right following a lognormal distribution, data for each constituent at each site will be evaluated for a normal distribution prior to applying the outlier test. If a lognormal distribution is indicated, the Ott outlier test will be performed on the natural log transformation of the data.
- All extreme outliers will be verified by review of the field data sheets or laboratory notebooks to make sure these points are not transcription errors. If an error is found, the data manager will be notified with the appropriate documentation of the change that is needed in the EDAS or other similar databases.
- Corrective Action Reports are completed for each water quality analysis discrepancy or for missing information that cannot be immediately resolved. These reports serve as checks for subsequent queries concerning the database.
- Unusual circumstances associated with sampling sites or collection of samples are noted in the Comments section of the field notebooks. Comments are copied onto COC forms and into the databases to provide additional information for any questionable results.
- Entries in water quality databases are verified by someone other than the person who enters the data.
- Print-outs of electronically generated data are archived for subsequent verification of data.

- Mistakes in COCs and logbooks are crossed out with a single line, corrected, initialed and dated by the person correcting it. This ensures proper lines of communications concerning queries of data validity.
- Quality assurance field duplicate samples are marked as such in the comments section of the COC, along with the unique identifier duplicated. Duplicate parameter data should not be used in data analysis because it doubles the influence of the duplicated sample on the data set. To avoid this, duplicate data are split into a separate database from the EDAS or other similar database when data are transferred.
- The COC is filled out by the field person bringing in the samples to eliminate misunderstandings in data transfer from the field data sheet to the COC.
- Samples are transferred to the laboratory immediately to avoid violating holding times.
- Unique identifiers are assigned at the time that they are used to prevent more than one sample from having the same identifier and to avoid gaps in the system if fewer samples were obtained than were estimated.

Section D3: Reconciliation with Data Quality Objectives

The Laboratory Manager shall be responsible for reviewing raw data produced by the Ana-Lab Corporation laboratory. The Laboratory Manager shall check calculations to verify that data are entered into the database correctly and be responsible for internal lab error corrections. Corrective Action Reports will be initiated in cases where invalid or incorrect data have been detected.

Data completeness in this project will be relative to the number of weather events sampled and the number of monthly sampling events. Accidents in handling, shipping and laboratory analysis may also reduce the completeness of the sampling program. It will be the goal of this project to achieve 90 percent completeness; however, statistical analysis will be the final indicator of data validity.

Representativeness and comparability of data, while unique to each individual collection site, is the responsibility of the Project Manager. By following the guidelines described in this QAPP, and through careful sampling design, the data collected in this project will be representative of the actual field conditions and comparable to similar applications. Representativeness and comparability of laboratory analyses will be the responsibility of the Laboratory Manager.

The Project Manager will review the final data to ensure that it meets the requirements as described in this QAPP.

References

APHA, American Public Health Association, American Water Works Association, and Water Environment Federation. 1992 & 1999. *Standard Methods for the Examination of Water and Wastewater*, 18th & 20th editions.

Buchanan, T.J., and W.P. Sommers. 1980. *Discharge measurements at gaging stations. Techniques of Water*-Resources Investigation of the United States Geological Survey - Book 3, Chapter A8. U.S. Geological Survey. Washington, D.C.

Dalrymple, T. and M.A. Benson. 1967. *Measurement of peak discharge by the slope-area method. Techniques of Water*-Resources Investigation of the United States Geological Survey - Book 3, Chapter A2. U.S. Geological Survey. Washington, D.C.

EPA, United States Environmental Protection Agency. *Methods for Chemical Analysis of Water and Wastes*. March 1983. Washington, D.C.: EPA, Office of Water.

Gilliom, R.J. and Helsel, D.R. 1968. Estimation of distributional parameters for censored trace level water quality data. 1. Estimation techniques. *Water Resources Research* 22:135-126.

Green, R.H. 1979. *Sampling Design and Statistical Methods for Environmental Biologists*. New York: Wiley.

Hydrolab Corporattion. 1997. Revision G, April 1999. *DataSonde 4 and MiniSonde Water Quality Multiprobes User's Manual.*

Hydrolab Corporation. 1997. Revision D, April 1999. *Surveyor 4 Water Quality Data Display User's Manual.*

Isco, Inc. 1996. Revised: E, October 1999. *3700 Portable SamplerInsstrucion Manual.*

Isco, Inc. *Flowlink 4 for Windows. Version 4.16.*

Isco, Inc. 1994. Rev. J, August 1996. *Instruction Manual Model 4230 Flow Meter.*

Marsh-McBirney, Inc. December 1990. Revised January 1995. *FLOW-MATE Model 2000 Portable Water Flowmeter Instruction Manual.*

Merritt, R.W. and Cummins, K.W. Third Edition. 1996. *An Introduction to the Aquatic Insects of North America.*

NovaLynx Corporation, Auburn, California. 2000 *Model 260-2510 Standar Rain and Snow Gage Instsruction Manual.*

Onset Computer Corporation. 1995-2001 *BoxCar Version 3.7+ for Windows User's Manual.*

Ott, L. 1984. *An Introduction to Statistical Methods and Data Analysis*, 2nd Edition. Duxbury Press, Boston., Massachusetts.

Spooner, J., R.P. Maas, S.A. Dressing, M.D. Smolen, and F.J. Humenik. 1985. *Appropriate Designs for Documenting Water Quality Improvements from Agricultural NPS Control Programs*, pp. 30-34. In: Perspectives on Nonpoint Source Pollution. EPA 440/5-85-001.

SCS, United States Department of Agriculture Soil Conservation Service. 1985. National Engineering Handbook, Section 4 - Hydrology. Engineering Division. Washington, D.C. Report No. SCS/ENG/NEH-4-2.

TCEQ, Texas Commission on Environmental Quality. December 2003. *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue*. Austin, Texas.

TCEQ, Texas Commission on Environmental Quality. August 2005. *Surface Water Quality Monitoring Porcedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data*. Austin, Texas.

TFS, Texas Forest Service. August 2004. *Texas Forestry Best Management Practices*.

Vowell, J.L. 2000. *Using stream bioassessment to monitor best management practice effectiveness*. Forest Ecology and Management 5273: 1-8.

Ward, R.C., J.C. Loftis, H.P. DeLong, and H.F. Bell. 1988. *Groundwater quality: A data analysis protocol*. Journal of the Water Pollution Control Federation 60:1938-1945.

Appendix A

Project Data Forms

Chain of Custody
Corrective Action Report
Field Activity Form
General Maintenance Sheet
Battery Maintenance and Tracking
DI & Acid Rinse Preparation
Bottle Washing Tracking
Enable/Disable Sampler History
Sampler History/Review
Monthly Maintenance
Stream Flow Measurement
Seining
Stream Quality Sampling Data Sheet
Habitat Assessment Forms

ANA-LAB CORP.

Corporate P.O. Box 9000 -- Kilgore TX 75663-9000
903-984-0551 FAX 903-984-5914

Project Chain of Custody

Liquid Aqueous 05/02/2005 Page 1 of 1

Report To: TFS2 S1 Storm Water Composite

Texas Forest Service
P.O. Box 310
Lufkin, TX 75902-
Attention Hughes Simpson
Phone: 936-639-8180 Fax 936-639-8185

Additional Information

Site Location: ______________________________

Start:
Time: ______________
Date: ______________
Tech: ______________

Stop:
Time: ______________
Date: ______________
Tech: ______________

Bottles Required for Requested Tests

_______ *Plastic 1/2 gal (White)
4 C: TSS TSSS

_______ *HNO3 to pH <2 plastic 500 ml for Metals
*TP1 3011

_______ *H2SO4 to pH <2 250 ml Plastic
4 C: 1NNL TKCL TKN

Requested Laboratory Tests

Nitrate-Nitrite Nitrogen	1NNL	W	EPA Method 300.0
Phosphorus	*TP1	W	EPA Method 200.7
Liquid - Metals Digestion	3011	W	EPA 200.2
TKN Block Digestion	TKCL	W	EPA Method 351.2
Total Kjeldahl Nitrogen	TKN	W	EPA Method 351.2
Total Suspended Solids	TSS	W	EPA Method 160.2
TSS Set Started	TSSS	W	

Ana-Lab #	Sample ID	Bottles	Date	Time	Tech	Notes

Relinquished by	Date	Time	Received by	Date	Time

Received on Ice? ☐ Yes ☐ No Method of Shipment: ☐ UPS ☐ FedEx ☐ Lone Star ☐ Mail ☐ Airborne ☐ Other
Cooler/Sample secure? ☐ Yes ☐ No Tracking or Shipping Number: ______________________

Corporate Shipping: 2600 Dudley Rd. Kilgore, TX 75662 -- http://www.ana-lab.com

nelac MEMBER ACIL

NELAP-accredited #02008

ANA-LAB CORP.

Corporate — P.O. Box 9000 – Kilgore TX 75663
903 984-0551 FAX 903 9[illegible]

Project Chain of Custody

Liquid Aqueous — 05/02/2005 — Page 1 of

Report To: TFS2 — S2 — Water Aqueous Grab

Texas Forest Service
P.O. Box 310
Lufkin, TX 75902-
Attention Hughes Simpson
Phone 936/639-8180 Fax 936/639-8185

Additional Information

Sample Location:______________________________

Bottles Required for Requested Tests

_______ *Plastic 1/2 gal (White)
4 C: TSS TSSS

_______ *HNO3 to pH <2 plastic 500 ml for Metals
*TPI 3010L

_______ *H2SO4 to pH <2 250 ml Plastic
4 C: 1NNL TKCL TKN

Requested Laboratory Tests

Nitrate-Nitrite Nitrogen	1NNL	W	EPA Method 300.0
Phosphorus	*TPI	W	EPA Method 200.7
Liquid - Metals Digestion	3010L	W	EPA 200.2
TKN Block Digestion	TKCL	W	EPA Method 351.2
Total Kjeldahl Nitrogen	TKN	W	EPA Method 351.2
Total Suspended Solids	TSS	W	EPA Method 160.2
TSS Set Started	TSSS	W	

Ana-Lab #	Sample ID	Bottles	Date	Time	Tech	Notes

Relinquished by	Date	Time	Received by	Date	Time

Received on Ice? ☐ Yes ☐ No Method of Shipment: ☐ UPS ☐ FedEx ☐ Lone Star ☐ Hand ☐ Airborne
Cooler/Sample Secure? ☐ Yes ☐ No Tracking or Shipping Number:____________________

Corporate Shipping 2600 Dudley Rd Kilgore, TX 75662 — http://www.ana-lab.com

nelac

NELAP-accredited #02008

Chain of Custody Record - Benthic Samples

Report To:
Texas Forest Service
P.O. Box 310
Lufkin, TX 75902-0310
Attention: Hughes Simpson
Phone: 936-639-8180 Fax: 936-639-8185

Report From:
Roy Darville, PhD
East Texas Baptist University
1209 N Grove St.
Marshall, TX 75670
Phone: 903-923-2246

Date Collected	Collected By	Number of Containers	Sample Method	Preservation Method	Sample Location	Date of Completion		
						sorting	identification	reference

Relinquished By	Date	Time		Received By	Time

Chain of Custody Record - Fish Samples

Report To:
Texas Forest Service
P.O. Box 310
Lufkin, TX 75902-0310
Attention: Hughes Simpson
Phone: 936-639-8180 Fax: 936-639-8185

Report From:
Greg Conley
11426 F.M. 3226
Arp, Texas 75750-9300

Date Collected	Collected By	Number of Containers	Sample Method	Preservation Method	Sample Location	Date of Completion		
						sorting	identification	reference

Relinquished By	Date	Time		Received By	Time

Corrective Action Report

CAR #:______________________

Date:____________________ Area/Location:______________________________

Reported by:___________________ Activity:___________________________________

State the nature of the problem, nonconformance or out-of-control situation:

____
____
____
____
____

Possible causes:

____
____

Recommended Corrective Actions:____

____
____

CAR routed to:________________________________

Received by:__________________________________

Corrective Actions taken:

____
____
____
____

Has problem been corrected?: YES NO

Immediate Supervisor:______________________________

Program Manager:__________________________________

Quality Assurance Officer:____________________________

Field Activity Form

Date: ____________ Location Name/County: ______________________________

Time: ____________ Section ID: ______________________________

Observer(s) Name: ______________________________

Weather Conditions: ______________________________

____

Activities Conducted/Comments/Observations/Problems:

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

Page _____ of _____

General Maintenance

Date	Maintenance Performed

Battery Maintenance and Tracking Form

Date	Battery #	Service/Maintenance Performed	Comments/Initials of Person Performing Service/Maintenance

Page __________

DI and Acid Rinse Preparation
BMP Effectiveness Monitoring Project

Date Made	Type of Rinse Made	Date Discarded	Total # Bottles Rinsed*	Comments	Initials
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				
	Acid & DI				

*Rinses used for only a Max of 936 bottles, or 3 months, whichever comes first. Derive total number of bottles washed from Bottle Washing Tracking Form.

Bottle Washing Tracking

Date Rinses Made: ____________ **Date Rinses Discarded:** ____________

Date	# of Bottles Washed	Total Bottles	Comments	Initials

Enable/Disable Sampler History

Date: ____________ **County:** ______________________________ **Location:** ______________________________

Enabled		Disabled		Enabled		Disabled	
Date	Time	Date	Time	Date	Time	Date	Time

Sampler History/Review Information

Date: ______________ Location Name/County: ______________________________

Time: ______________ Section ID: ______________________________

Observer(s) Name: ____

Program Started at (date/time): ______________ ________ of 25/50/66 Samples

Program Halted at (date/time): ______________

Sample	Time	Date	Source	Mssg.	Sample	Time	Date	Source	Mssg.
1					34				
2					35				
3					36				
4					37				
5					38				
6					39				
7					40				
8					41				
9					42				
10					43				
11					44				
12					45				
13					46				
14					47				
15					48				
16					49				
17					50				
18					51				
19					52				
20					53				
21					54				
22					55				
23					56				
24					57				
25					58				
26					59				
27					60				
28					61				
29					62				
30					63				
31					64				
32					65				
33					66				

Source Codes: E = Enable, F = Flow , O = Other
Mssg. Codes: 1 = Sample missed, no liquid detected; 2 = Sample missed, sampler inhibited; 3 = Sample missed, no more liquid; 4 = Sample missed, pow er lost; 5 = Sample missed, pump stop key hit; 6 = Sample missed, float/w eight tripped.

Monthly Maintenance

County: ______________________ Date: ______________

_____ Download HOBO raingage data:
File Name: ______________________ Battery status: ______________

_____ Measure NWS raingage amount:
Total inches: ______________ Time: ______________

Above Monitoring Station

Time: ______________

_____ 4230 Flow Meter status: ______________________________

_____ 3600 Sampler status: ______________________________
_____ Download 4230 Flow Meter data:
File Name: ______________________ & Report/History/Program ________ (init

_____ Change battery: Battery Change Date: ______________
Old battery # ________
New battery # ________ Volt status: ______________

_____ Change dessicants:
4230 Flow Meter ______________________________
3600 Sampler: ______________________________

_____ Clean solar panel: ________ Check Paper/Ink ______________

_____ Measure flow depth: ______________________________
____

Below Monitoring Station

Time: ______________

_____ 4230 Flow Meter status: ______________________________

_____ 3600 Sampler status: ______________________________
_____ Download 4230 Flow Meter data:
File Name: ______________________ & Report/History/Program ________ (init

_____ Change battery: Battery Change Date: ______________
Old battery # ________
New battery # ________ Volt status: ______________

_____ Change dessicants:
4230 Flow Meter ______________________________
3600 Sampler: ______________________________

_____ Clean solar panel: ________ Check Paper/Ink ______________

_____ Measure flow depth: ______________________________
____

Stream Flow (Discharge) Measurement Form

Stream:______________________________ Date:______________

Station Description:______________________________

Time Begin:______________ Time End:______________ Meter Type: Marsh/McBirney

Observers:______________________________ Stream Width*:__________ Section Width:__________

4230 Flow Meter Status: E/D ft = mGal = cfs =

Elevation (angle iron):

Section Midpoint (ft) (m)	Section Depth (ft) (m) (cm)	Observational Depth** ft-m-cm	Veolcity At Point (ft/s) (m/s)	Veolcity Average (ft/s) (m/s)	Area W x D (ft^2) (m^2)	Flow (Q) V x A (m^3/s) (ft
		Total Flow (Discharge) (SumQ) (ft3/s)				

$m^3/s \times 35.3 = ft^3/s$

* Make a minimum of 10 measurements when the total width is >5.0 ft, 20 measurements preferred.
For stream widths 0-5', take 10 measurements, >5-7', take 12, >7-10', take 15, and >10' take 20

** Measure at 60% of depth from surface where <2.5 ft deep. Measure at 20% and 80% of depth in waters > 2.5 ft deep.
For 20%, multiply the total depth by 2, for 80% divide total depth by 2, line up the rod with these numbers.

BMP Effectiveness Monitoring
Seining

Date: ____________________ County: ____________________

ABOVE
Start Time: ____________________ End Time: ____________________

Seiners: ____________________

Haul #	Haul Length (m)	# of Fish (keep)

BELOW
Start Time: ____________________ End Time: ____________________

Seiners: ____________________

Haul #	Haul Length (m)	# of Fish (keep)

*** A minimum of six effective seine hauls should be done, being a minimum of 10 meters in length (~33 ft), 20 meters preferred (~66 ft). Hauls are considered effective based on whether or not the haul was negatively affected in any way (ie. Hanging the seine on woody debris or lifting the net in such a way that allows escapement = ineffective haul).

TFS BMP Effectiveness Monitoring

Stream Quality Sampling Data Sheet

Date__________________ County______________________________

Samplers' Names____

Rainfall last 30 days/reporting station: _____________________ Age/size of clearcut:______/______
****Equipment Used (circle one): H20 / MiniSonde 4a (A or B)****

ABOVE/REFERENCE/CONTROL
Weather___________________________ Ambient temp_____________ Time _______________

pH _______________ Water temp (°C) _______________ DO (mg/L) _________________

Conductivity (mS/cm) ________________ Turbidity (NTU) ___________________

Grab Sample Secured – Yes______ No______ Flow______________________

SMZ width ________________ Thinned? Yes____ No____ Basal Area ______________

On sampled area: runs riffles runs/riffles / glides pools glides/pools

---

BELOW
Weather___________________________ Ambient temp_____________ Time _______________

pH _______________Water temp (°C) _______________ DO (mg/L)__________________

Conductivity (mS/cm) ________________ Turbidity (NTU) ___________________

Grab Sample Secured – Yes______ No______ Flow______________________

SMZ width ________________ Thinned? Yes____ No____ Basal Area ______________

On sampled area: runs riffles runs/riffles / glides pools glides/pools

---

Distance between sampling sites? ___________________ Stream: Intermittent Perennial
Clearcut on: one both side(s) of stream ?
If one, adjacent land use similar above and below: Yes___ No____

Part I - Stream Physical Characteristics Worksheet

Observers:________________ Date ____________ Time:__________ Weather conditions:________________

Stream:________________ Location of site ________________ Length of stream reach __________

Stream Segment No.:__ Observed Stream Uses:______ Aesthetics (circle one) **(1) wilderness (2) natural (3) common (4) offensive**

Stream Type (Circle One): **perennial or intermittent w/ perennial pools** Stream Bends: No. Well Defined_; No. Moderately Defined_; No. Poorly Defined_

Channel Obstructions/Modifications:________________ No. of Riffles:__________ Channel Flow Status (circle one) **high moderate low no flo**

Riparian Vegetation (%):
Left Bank: Trees_______ Shrubs_______ Grasses, Forbs_______ Cult. Fields_______ Other_______
Right Bank: Trees_______ Shrubs_______ Grasses, Forbs_______ Cult. Fields_______ Other_______

Location of Transect	Stream Width (m)	Left Bank Slope ( )	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:											Right Bank Slope ( )	Right Bank Erosi Potential (%)
	Habitat Type (Circle One) **Riffle Run Glide Pool**		Dominant Substrate Type			Dominant Types Riparian Vegetation: Left Bank: Right Bank:										% Gravel or
	Algae or Macrophytes (Circle One) **Abundant Common Rare Absent**		Width of Natural Buffer Vegetation (m) LB: RB:	Instream Cover Types:												% Instream

Location of Transect	Stream Width (m)	Left Bank Slope ( )	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:											Right Bank Slope ( )	Right Bank Eros Potentia (%)
	Habitat Type (Circle One) **Riffle Run Glide Pool**		Dominant Substrate Type			Dominant Types Riparian Vegetation: Left Bank: Right Bank:										% Gravel o
	Algae or Macrophytes (Circle One) **Abundant Common Rare Absent**		Width of Natural Buffer Vegetation (m) LB: RB:	Instream Cover Types:												% Instream

Location of Transect	Stream Width (m)	Left Bank Slope ( )	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:	Right Bank Slope ( )	Right Bank Erosion Potential (%)
	Habitat Type (Circle One) Riffle Run Glide Pool		Dominant Substrate Type	Dominant Types Riparian Vegetation: Left Bank: Right Bank:		% Gravel or Lar
	Algae or Macrophytes (Circle One) Abundant Common Rare Absent		Width of Natural Buffer Vegetation (m) LB: RB:	Instream Cover Types:		% Instream Cov
Location of Transect	Stream Width (m)	Left Bank Slope ( )	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:	Right Bank Slope ( )	Right Bank Erosion Potential (%)
	Habitat Type (Circle One) Riffle Run Glide Pool		Dominant Substrate Type	Dominant Types Riparian Vegetation: Left Bank: Right Bank:		% Gravel or Lar
	Algae or Macrophytes (Circle One) Abundant Common Rare Absent		Width of Natural Buffer Vegetation (m) LB: RB:	Instream Cover Types:		% Instream Cov
Location of Transect	Stream Width (m)	Left Bank Slope ( )	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:	Right Bank Slope ( )	Right Bank Erosion Potential (%)
	Habitat Type (Circle One) Riffle Run Glide Pool		Dominant Substrate Type	Dominant Types Riparian Vegetation: Left Bank: Right Bank:		% Gravel or Lar
	Algae or Macrophytes (Circle One) Abundant Common Rare Absent		Width of Natural Buffer Vegetation (m) LB: RB:	Instream Cover Types:		% Instream Cov

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach

Stream Name ____________________

Date of Assessment ____________

Stream bed slope over evaluated reach
(from USGS map; elevation change in meters/reach length in meters) ________

Approximate drainage area above the transect furthest downstream
(from USGS or county highway map in km²) ________

Stream order ________

Length of stream evaluated (in meters or kilometers) ________

Number of lateral transects made ________

Average stream width (in meters) ________

Average stream depth (in meters) ________

Instantaneous stream flow (in ft³/sec) ________

Indicate flow measurement method ________

Channel flow status (high, moderate, low, or no flow) ________

Maximum pool width (in meters) ________

Maximum pool depth (in meters) ________

Total number of stream bends ________

- Number of well defined bends ________
- Number of moderately defined bends ________
- Number of poorly defined bends ________

Total number of riffles ________

Dominant substrate type ________

Average percent of substrate gravel sized or larger ________

Average percent instream cover ________

Number of stream cover types ________

Average percent stream bank erosion potential ________

Average stream bank slope (in degrees) ________

Average width of natural buffer vegetation (in meters) ________

Average riparian vegetation percent composition by: (total to equal 100%)

- Trees ________
- Shrubs ________
- Grasses and Forbes ________
- Cultivated fields ________
- Other ________

Average percent tree canopy coverage ________

Overall aesthetic appraisal of the stream ________

Part III - Habitat Quality Index

Habitat Parameter	Scoring Category			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score__________	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate, i.e., gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score__________	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score__________	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score__________	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; <5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel, or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools, or stream is dry
Score__________	3	2	1	0

Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30	**Moderately Stable** Some evidence (10-29%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60
Score________	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** < 3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score________	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score________	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score________	3	2	1	0
Total Score________				

Appendix B

Standard Operating Procedures (SOPs)

Flow Meter Programming
Autosampler Programming
Surveyor and MiniSonde Programming,
Field Deployment and Retrieval
Data Downloading Protocol
Field Activity Form and Corrective Action Reports
Chain of Custody (COC) Protocol
Baseflow Grab Sampling
Storm Event Sample Preparation and Preservation
Storm Runoff Sample Collection
Precipitation Measurement
Stream Flow Measurement
Bottle Washing
Battery Changing
Benthic Macroinvertebrate Sampling
Fish Community Sampling
Habitat Assessment

SOP-001
BMP Effectiveness Monitoring Project
Flow Meter Programming

1.0 Applicability

This procedure applies to the process of programming the ISCO Flow Meters at each of the BMP Effectiveness Monitoring Project sites.

2.0 Purpose

This procedure provides general guidelines for programming the ISCO Flow Meters for each of the BMP Effectiveness Monitoring Project sites. Detailed information and troubleshooting are provided in the respective programming manual.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 Field Activity Form – Field Activity Forms are used to record field activities, observations, and notes. They are kept in three-ring binders in the Texas Forest Service FRD/BMP Laboratory.

4.0 Equipment, Reagents, and Standards

4.1 ISCO Model 4230 Flow Meter.

5.0 Programming Procedure

ISCO Model 4230 Flow Meter.

5.1 Program Configurations
- 5.1.1 Flow Meter program configurations will have to be verified if a flow meter is sent off for service or when new equipment is installed.
- 5.1.2 Program configurations are given in the attached Programming Worksheet.

5.2 Setting Clock
- 5.2.1 The clock will have to be reset if the internal battery fails or for spring and fall time changes.
- 5.2.2 To set the clock press the "Enter/Program" key and select "Setup".
- 5.2.3 Enter the correct date and time.
- 5.2.4 Exit out of the configuration setup and verify that date and time is correct.

5.3 Replace tubing annually or as necessary.

6.0 Quality Control and Safety Aspects

6.1 Any problems in sampler configuration that results in a compromise of data integrity will generate a CAR.

7.0 References

7.1 Instruction Manual Model 4230 Flow Meter. Isco, Inc., 1994. Rev. J, August, 1996.

8.0 Attachments

8.1 Field Activity Form.
8.2 Corrective Action Report.
8.3 Programming Worksheet for ISCO Model 4230 Flow Meter.

SOP-002
BMP Effectiveness Monitoring Project
Autosampler Programming

1.0 Applicability

This procedure applies to the process of programming the ISCO Samplers at each of the BMP Effectiveness Monitoring Project sites.

2.0 Purpose

This procedure provides general guidelines for programming the ISCO pumping samplers for each of the BMP Effectiveness Monitoring Project sites. Detailed information and troubleshooting are provided in the respective programming manual.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 Field Activity Form – Field Activity Forms are used to record field activities, observations, and notes. They are kept in three-ring binders in the Texas Forest Service FRD/BMP Laboratory.

4.0 Equipment, Reagents and Standards

4.1 ISCO Model 3700 Automatic Sampler.

5.0 Programming Procedure

ISCO Model 3700 Automatic Sampler.

5.1 Program Configurations
- 5.1.1 Sampler program configuration will have to be verified if a sampler is sent off for service or when new equipment is installed.
- 5.1.2 Program configuration is given in the attached Programming Instructions.

5.2 Calibrating Sampler Volume
- 5.2.1 Whenever samplers return from factory service or experiences periodic volume discrepancies, the volume collected by the sampler will have to be calibrated.
- 5.2.2 To calibrate, press "Stop", then "Enter/Program" and select "Program".
- 5.2.3 Press "Enter/Program" key to scroll through menu. Select "Calibrate Sample Volume" and select "Yes".
- 5.2.4 Press the "Manual Sample" key.
- 5.2.5 Measure the actual volume delivered by the sampler and enter that volume where indicated.
- 5.2.6 Repeat the procedure to verify that the sampler is operating properly. If proper volume is not collected, adjust volume requested to accommodate

discrepancy. Record noted discrepancies on Activity Log and generate CAR if samples are missed or of insufficient volume for analysis.

5.2.7 To resume or begin sampling:
  5.2.7.1 Press "Start Sampling".
  5.2.7.2 Press "Start".
  5.2.7.3 Display should read "Sampler Inhibited!" if flow is below the level condition and Flow Meter is in disabled condition. Display should read "Sample X of 66 after 1 Pulses" if flow level is above the level condition and Flow Meter is in enabled condition.

5.3 Setting Clock
  5.3.1 The clock will have to be reset if the internal battery fails or for spring and fall time changes.
  5.3.2 To set the clock, press the "Enter/Program" key and select "Configure".
  5.3.3 Select "Set Clock". Enter the correct time and date.
  5.3.4 Exit out of the configuration setup and verify that time is correct. Press "Exit Program" and the "Start Sampling".

5.4 Replace pump tubing annually or as necessary.

6.0 Quality Control and Safety Aspects

6.1 Any problems in sampler configuration that results in a compromise of data integrity will generate a CAR.

7.0 References

7.1 3700 Portable Samplers Instruction Manual. Isco, Inc., 1996. Revised: E October, 1999.

8.0 Attachments

8.1 Field Activity Form.
8.2 Corrective Action Report.
8.3 Programming Instructions for ISCO Model 3700 Sampler.

SOP-003
BMP Effectiveness Monitoring Project
Surveyor and MiniSonde Programming, Field Deployment and Retrieval

1.0 Applicability

This procedure applies to the process of programming the MiniSonde 4a Multiprobes using the Surveyor 4a Data Display for each of the BMP Effectiveness Monitoring Project sites. This procedure also outlines field deployment and retrieval of the MiniSonde 4a Multiprobes.

Data collection is used to characterize existing water quality and emerging problems, define long-term trends, determine water quality standards compliance, and describe seasonal variation and frequency of occurrence of selected water quality constituents. Continuous water quality parameters are to include conductivity, pH, water temperature, and dissolved oxygen.

2.0 Purpose

This procedure provides general guidelines for programming the MiniSonde 4a Multiprobes by using the Surveyor 4a Data Display to create files in the MiniSonde 4a Multiprobes for each of the BMP Effectiveness Monitoring Project sites. This procedure also outlines field deployment and retrieval of the MiniSonde 4a Multiprobes. Detailed information and troubleshooting are provided in the respective programming manuals.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 Field Activity Form – Field Activity Forms are used to record field activities, observations, and notes. They are kept in three-ring binders in the Texas Forest Service FRD/BMP Laboratory.
3.3 Multiprobe Calibration/Maintenance Log – Multiprobe Calibration/Maintenance Logs are used to record calibration, post-calibration and maintenance activities that are performed on the Hydrolab MiniSonde 4a Multiprobes and the Surveyor 4a Data Displays. They are kept in three-ring binders in the Texas Forest Service FRD/BMP Laboratory.

4.0 Equipment, Reagents, and Standards

4.1 Hydrolab Surveyor 4a Data Display.
4.2 Hydrolab MiniSonde 4a Water Quality Multiprobes.
4.3 Interface cable.

5.0 Instrument Method or Calibration

5.1 Calibration, Post-Calibration and maintenance procedures for the MiniSonde 4a Mulitprobes are documented in the TNRCC Surface Water Quality Monitoring Procedures Manual (1999) and the DataSonde4 and MiniSonde Water Quality Multiprobes User's Manual (1999).
5.2 Calibration, Post-Calibration and maintenance will be performed to each Multiprobe before it is placed in the field for continuous water quality data collection.
5.3 All Calibration, Post-Calibration and maintenance performed must be logged on the General Maintenance form and the appropriate Mulitprobe Calibration/Maintenance Logs.

6.0 Programming Procedures

Creating Files in the MiniSonde 4a Multiprobe and Surveyor 4a.

6.1 Connect the Surveyor 4a to the MiniSonde 4a with the interface cable.
6.2 Turn Surveyor 4a on.
6.3 Select "Files".
6.4 Select "Sonde".
6.5 Select "Create".
6.6 Select "Time trg".
    6.6.1 Make sure to use MiniSonde 4a "A" for the "Above" sites and MiniSonde 4a "B" for the "Below" sites. Name the file per each site with the keypad. Be sure to also identify each site with deployment date (i.e., NCA060204 = Newton County Above, deployed June 2, 2004. Or NCB060204 = Newton County Below, deployed June 2, 2004, etc.).
6.7 Select "Done". The Surveyor 4a will automatically go to a "Start Date" screen. Key in new date and time of when deployment is desired (i.e., date = MMDDYY, time = HH:MM:SS). Use military time when entering start time.
6.8 Select "Done". The Surveyor 4a will automatically go to a "Stop Date" screen. Key in the date and time of when the end of the data collection is desired. Use the same format as shown in step 6.7.
6.9 Select "Done". The Surveyor 4a will automatically go to a "Logging Interval" screen. Using the keypad set the interval for every 30 minutes (i.e., HH:MM:SS = 00:30:00).
6.10 Select "Done". The Surveyor 4a will automatically go to a "Sensor Warmup Time" screen. Set for two (2) minutes.
6.11 Select "Done". The Surveyor 4a will automatically go to a "Set Circulator Warmup Time" screen. Set for two (2) minutes.
6.12 Select "Done". The Surveyor 4a will automatically go to an "Audio Off/On" screen. Turn audio "ON".

6.13 Select "Done". The Surveyor 4a will automatically go to a "Select Parameters to Collect" screen.

6.13.1 Select "Add" button to select parameters needed. Scroll down to and then select:

6.13.1.1 "D/T: MDY/HMS" (date and time).

6.13.1.2 "IBatt: % Left" (% internal battery left).

6.13.1.3 "Temp: °C" (temperature).

6.13.1.4 "SpCond: mS/cm" (specific conductivity).

6.13.1.5 "DO: mg/l" (dissolved oxygen)

6.13.1.6 "pH: Units".

6.13.1.7 Select "Done". Message should read "File Created".

6.14 Turn Surveyor 4a off and disconnect interface cable.

6.15 Repeat programming procedures for the second MiniSonde 4a.

7.0 Field Deployment and Retrieval of MiniSonde 4a's

Field Deployment of MiniSonde 4a's.

Note: Before the MiniSonde 4a is placed in the field for continuous data collection, the "AutoLog" must be turned on. Make sure that the correct MiniSonde 4a (either "A" or "B") is placed in the correct site on the stream (either "Above" or "Below").

7.1 Connect Surveyor 4a to the MiniSonde 4a with the interface cable.

7.2 Turn the Surveyor 4a on.

7.3 Select "Setup/Cal".

7.4 Select "Setup".

7.5 Select "Sonde". This will open a "Parameters" screen. Scroll down to and select "AutoLog: Off/On". Turn AutoLog "ON".

7.6 Select "Done".

7.7 Follow the remainder of the screen directions to close out the "Parameters" screen.

7.8 Turn Surveyor 4a off and disconnect interface cable.

7.9 Put black 6-pin Female marine connector on the 6-pin Male marine bulkhead connector.

7.10 Unscrew water filled calibration and storage cap, discard water, and replace with weighted sensor guard.

7.11 Place MiniSonde 4a in special PVC tubing, making sure to screw white mooring fixture over the top of the 6-pin Female marine connector, and securely put on PVC cap.

7.12 Place MiniSonde 4a in protective PVC tubing and place both in stream so that all sensors are covered with water.

7.13 Secure PVC tubing, with MiniSonde 4a in it, to a tree or other stable object with the attached cable.

7.14 Repeat Field Deployment Procedures for the second MiniSonde 4a.

Retrieval of Hydrolab 4a's

7.15 Remove PVC tube containing MiniSonde 4a from water.
7.16 Unsecure attached cable from tree or other stable object.
7.17 Remove MiniSonde 4a from protective PVC tube.
7.18 Remove weighted sensor guard and replace with calibration and storage cap that has stream water in it.

Note: Before MiniSonde 4a's are brought back to the lab, the "AutoLog" must be turned off and the files downloaded so no false readings are collected during transport from the field.

7.19 Connect Surveyor 4a to the MiniSonde 4a with the interface cable.
7.20 Turn the Surveyor 4a on.
7.21 Follow procedures as outlined in steps 7.3 – 7.6. For step 7.5 be sure to turn AutoLog "OFF".
7.22 Select "Go Back" until main menu choices are displayed in selection portion of Surveyor 4a screen.
7.23 Select "Files".
7.24 Select "Sonde".
7.25 Scroll down and select "Download".
7.26 Select which file needs to be downloaded. The Surveyor 4a screen will let you know if the download was successful. Be sure to write down on the Field Activity Form the time the MiniSonde 4a was removed from the water, as well as the last "good" data reading, and the information for each file that is downloaded (i.e., NCA060204 - set 060204 160340, 2865 bytes, or AutoLog – set 011004 112340, 3818 bytes, etc.).

Note: Each MiniSonde 4a ("A" and "B") will have two (2) files that must be downloaded. One will be the file that was created in section 6.0 and the other one will be the AutoLog file created in section 7.0.

7.27 Return to main screen on Surveyor 4a and turn Surveyor 4a off.
7.28 Disconnect interface cable from MiniSonde 4a and the Surveyor 4a.
7.29 Repeat retrieval procedures for the second MiniSonde 4a.

8.0 Quality Control and Safety Aspects

8.1 An initial demonstration of performance is conducted prior to analysis. In this demonstration, the Multiprobe instruments are calibrated to four standards. Any instrument failing to calibrate to all four standards will not be used for data collection until it can demonstrate proper performance.
8.2 Any data collected from a Multiprobe instrument, which has failed to meet performance demonstrations, will be rejected.
8.3 Any problems in sampler configuration that results in a compromise of data integrity will generate a CAR.

9.0 References

9.1 Surveyor 4 Water Quality Data Display User's Manual. Hydrolab Corporation, 1997. Revision, D April 1999.
9.2 DataSonde 4 and MiniSonde Water Quality Multiprobes User's Manual. Hydrolab Corporation, 1997. Revision G, April 1999.
9.3 Surface Water Quality Monitoring Procedures Manual. TNRCC. Volume 1, December 2003 and Volume 2, August 2005.

10.0 Attachments

10.1 Field Activity Form.
10.2 Corrective Action Report.
10.3 Multiprobe Calibration/Maintenance Log.
10.4 General Maintenance Form.

SOP-004
BMP Effectiveness Monitoring Project
Data Downloading Protocol

1.0 Applicability

This procedure applies to the retrieval of data from the dataloggers to the laptop computer and the Surveyor 4a Data Display at each site of the BMP Effectiveness Monitoring Project.

2.0 Purpose

This procedure details steps necessary for the retrieval of data from the dataloggers to the laptop computer and the Surveyor 4a Data Display at each site of the BMP Effectiveness Monitoring Project. Data are to be downloaded from the dataloggers on a 4 - 6 week schedule coinciding with monthly maintenance. Data are to be downloaded from the MiniSonde 4a Water Quality Multiprobes immediately upon retrieval from the field sites.

3.0 Definitions

3.1 BMP – Best Management Practices.

3.2 Field Activity Form – Field Activity Forms are used to record samples collected or missed, equipment malfunctions, general maintenance and recommended corrective actions. They are kept in three-ring binders at the Texas Forest Service BMP/FRD Laboratory.

3.3 CAR – Corrective Action Reports are used to record and report problems that lead to missed samples and actions or steps taken to correct the problem.

4.0 Equipment, Reagents and Standards

4.1 Laptop PC with download cables.

4.2 Hobo Event Logger.

4.3 ISCO Model 4230 Flow Meter.

4.4 HydroLab MiniSonde 4a Water Quality Multiprobes.

4.5 HydroLab Surveyor 4a Water Quality Data Display with download cable.

5.0 Data Download Procedure

5.1 Hobo Event Loggers

5.1.1 Downloading Using Laptop PC:

5.1.1.1 Hobo event loggers are installed on tipping bucket-recording raingages. They can hold up to the equivalent of 8000 tips or 80 inches of precipitation. They should be downloaded at the same time that monthly maintenance is performed, about every 4-6 weeks.

5.1.1.2 First open the Boxcar 3.7.3 software on the laptop.

5.1.1.3 Connect the laptop to the event logger using the interface cable supplied.

5.1.1.4 Under the "Logger" Menu, select "Readout". The Laptop will then connect to the logger and collect all information. Be sure to pay attention to the computer screen for a message that will alert you to disconnect the event logger from the laptop before proceeding.

5.1.1.5 Next a prompt for the storage location for the file will appear. Name files by site and date, i.e. raingage located in Cherokee County for a download on 12/31/01 = CC123101.dtf. The .dft file extension will automatically be assigned by the software. Data files must be saved to the appropriate month and year files created in default to c:\boxcar3.

5.1.1.6 After saving the file, the datalogger must be relaunched to resume data collection. First, reconnect the datalogger to the Laptop PC. Under the "Logger" menu, select "Launch". Then select "Start" button to begin logging again. Note battery condition on monthly maintenance form. Make sure that the red light, located on top of the datalogger, is blinking, indicating that it is ready to go.

5.1.1.7 Record Download on the Monthly Maintenance Form and Field Activity Form as well as any discrepancies or observed problems. Problems resulting in data loss must be recorded on CAR form.

5.2 ISCO Model 4230 Flow Meters

5.2.1 Downloading using Laptop PC:

5.2.1.1 First open the Flowlink 4 software on the laptop.

5.2.1.2 Connect the laptop to the flow meter using the interface cable supplied and connecting it to the 'interrogator' connection on the flow meter.

5.2.1.3 When prompted click on "Direct" connection in Flowlink 4 software.

5.2.1.4 After Flowlink software has connected with the flow meter select the "Retrieve Data" box to download saved data.

5.2.1.5 After data finishes retrieving, select the "Site Setup" tab and click on "Reports", then "Save to File", put this information in appropriate file that is located in c: //fl416/reports_histories_programs file. Repeat this step under the "Site Setup" tab for "History" and "Programs". Name each file with site identifier, what the file is (rpt = reports, hist = history, prgm = programs), and date of download (i.e. CCArpt020204 = Cherokee County Above, Reports, February 2, 2004).

5.2.1.6 Select the "Disconnect" tab.

5.2.1.7 Close Flowlink 4 software and disconnect interface cable.

5.2.1.8 Be sure to archive and rename the data retrieved from the flow meters before downloading from the same sites again. If data is not archived and renamed then further data retrieval will overwrite the previous data collected. Assign file names based on site location and date (ie. CCA020204 = Cherokee County Above, February 2, 2004 retrieval date).

5.2.1.9 Record Download on the Monthly Maintenance Form and Field Activity Form as well as any discrepancies or observed problems. Problems resulting in data loss must be recorded on CAR form.

5.3 Hydrolab MiniSonde 4a Water Quality Multiprobes

5.2.1 Downloading using Hydrolab Surveyor 4a:

5.2.1.1 Due to limitations from battery usage for the MiniSonde 4a Multiprobe, they should be downloaded immediately upon retrieval from field sites.

5.2.1.2 First connect the interface cable to the MiniSonde 4a Multiprobe and the Surveyor 4a.

5.2.1.3 Turn Surveyor 4a on.

5.2.1.4 Select "Files".

5.2.1.5 Select "Sonde".

5.2.1.6 Select "Download".

5.2.1.7 Highlight previously created file for that site (ie. CCA020204 = Cherokee County Above, created February 2, 2004).

5.2.1.8 Select "Select".

5.2.1.9 Screen will display "Download complete" message when done.

5.2.1.10 Return to main menu display on Surveyor 4a, turn Surveyor 4a off, disconnect interface cable.

5.2.1.11 Be sure to transfer the data retrieved from the Surveyor 4a before deleting the files from each MiniSonde 4a.

5.2.1.12 See SOP-003, Surveyor and MiniSonde Programming, Field Deployment and Retrieval, section 7.15 – 7.29 for complete retrieval and downloading procedures.

6.0 Data Storage and Archival

6.1 After downloading data, all data files are either transferred to a zip disk, CD, Flash drive or e-mailed to the Texas Forest Service for archival and storage.

7.0 Quality Control and Safety Aspects

7.1 Any problems with equipment should be noted on the Field Activity Form and should be diagnosed and corrected ASAP.

8.0 References

8.1 BoxCar Version 3.7+ for Windows User's Manual. Onset Computer Corporation. 1995-2001.
8.2 DataSonde 4 and MiniSonde Water Quality Multiprobes User's Manual. Hydrolab Corporation. 1997. Revision G, April 1999.
8.3 Flowlink 4 for Windows®. Version 4.16. Isco, Inc.
8.4 Surveyor 4a Water Quality Data Display User's Manual. Hydrolab Corporation. 1997. Revision D, April 1999.
8.5 Surface Water Quality Monitoring Procedures Manual. TNRCC. Volume 1, December 2003 and Volume 2, August 2005.

9.0 Attachments

9.1 Field Activity Form
9.2 Monthly Maintenance Form
9.3 HydroLab Parameter Specifications
9.4 Corrective Action Report

SOP-005
BMP Effectiveness Monitoring Project
Field Activity Form and Corrective Action Reports

1.0 Applicability

This procedure details the steps necessary to complete a Field Activity Form and a Corrective Action Report for the BMP Effectiveness Monitoring Project.

2.0 Purpose

This procedure details steps necessary for completing a Field Activity Form and for initiating, filling out and distributing a Corrective Action Report for the BMP Effectiveness Monitoring Project. Field Activity Form will be used to document any field activities related to the BMP Effectiveness Monitoring Project. Corrective Action Reports will be used to document, address and rectify problem situations resulting in missed samples for the BMP Effectiveness Monitoring Project.

3.0 Definitions

3.1 BMP – Best Management Practices.

3.2 Field Activity Form – Field Activity Form are used to record samples collected or missed, equipment malfunctions, general maintenance and recommended corrective actions. They are kept in three-ring binders in the Texas Forest Service FRD/BMP Laboratory.

3.3 CAR – Corrective Action Reports are used to record and report problems that lead to missed samples and actions or steps taken to correct the problem.

4.0 Equipment, Reagents, and Standards

4.1 Field Activity Form.

4.2 Corrective Action Report Form.

5.0 Procedure

5.1 **Field Activity Form**: Required Fields.

Note: The following are required fields on the Field Activity Form. No fields should be left blank.

5.1.1 **Date**: Month, day and year activity was conducted.

5.1.2 **Technician**: Name of person or persons conducting activity.

5.1.3 **Time**: Time activity began.

5.1.4 **Location/County Name**: County in which site is located.

5.1.5 **Section ID**: Above or Below Monitoring Station, Rain gage Station, or other unique identification given in order to easily identify where the activity took place.

5.1.6 **Weather Conditions:** Note general and/or unusual weather conditions for each site.

5.1.7 **Activities Conducted/Comments/Observations/Problems:** Note what activities were performed during the visit. Include any minor or major problems that occurred or were observed. Indicate potential solutions to observed/identified problems. Field personnel have responsibility for suggesting best course of action for repair or replacement of equipment. Problems identified with procedures, techniques and other issues fundamental to the quality and success of the project are the responsibility of Project managers and Project Coordinators.

Note: Any observed instances of missed samples shall be immediately brought to the attention of a Project Manager or Project Coordinator who will in turn initiate a Corrective Action Report.

5.2 **Corrective Action Report Forms**: Required Fields.

Note: The following are required fields on the Corrective Action Report Form. No field should be left blank.

5.2.1 **CAR#**: Unique identifier of where problem occurred plus date when problem was discovered (i.e. NCA120404 = Newton County Above, December 4, 2004).

5.2.2 **Date**: Month, day and year CAR was initiated.

5.2.3 **Area/Location**: Unique label or identifier for watershed where problem occurred or for the sample(s) of concern (i.e. Newton County Above monitoring station).

5.2.4 **Reported By**: Name of person or persons initiating CAR.

5.2.5 **Activity**: What general activity was being done when problem was discovered (i.e. monthly maintenance, storm sample collection, etc.).

5.2.6 **State the Nature of the Problem, etc.**: Description of the problem.

5.2.7 **Possible Causes**: What may have caused the problem.

5.2.8 **Recommended Corrective Action**: Potential solutions to observed/identified problems must be indicated. Field personnel have responsibility for suggesting best course of action for repair or replacement of equipment. Problems identified with procedures, techniques and other issues fundamental to the quality and success of the project are the responsibility of Project managers and Project Coordinators.

5.2.9 **Corrective Actions Taken**: Implemented course of action determined to best address the problem situation and bring about problem resolution. Field should also include Date of problem resolution.

Note: Initiated CARs should be sent to a Project Coordinator or directly to the Project Manager for distribution to appropriate personnel.

Copies of completed CARs will be archived at the Texas Forest Service FRD/BMP Laboratory in a three-ring binder. Be sure to reference the CAR# on the corresponding dates Field Activity Form.

6.0 Quality Control and Safety Aspects

6.1 Any equipment or problems or malfunctions will be noted on the Field Activity Form. Problems that resulted in a failure to collect samples will be noted on the Field Activity Form. Problems may be diagnosed and corrected in the field. If the problem cannot be diagnosed and corrected at time of sample collection, then the problem will be corrected by a qualified person ASAP.

6.2 Problems that result in the loss of a collected sample or could compromise sample integrity will be noted on a Field Activity Form and a Corrective Action Report will be written to document and rectify the problem

7.0 Attachments

7.1 Field Activity Form
7.2 Corrective Action Report

SOP-006
BMP Effectiveness Monitoring Project
Chain of Custody (COC) Protocol

1.0 Applicability

These procedures apply to filling out Chain of Custody (COC) Forms for Ana-Lab, the contract laboratory for analysis of samples, for Greg Conley, the contracted individual for identifying and sorting the fish samples, and for Roy Darville, the contracted individual for identifying and sorting the benthic samples, collected from each site of the BMP Effectiveness Monitoring Project.

2.0 Purpose

These procedures apply to filling out COC Forms for grab and storm run-off event sample analysis, fish sample identification, and benthic sample identification, as collected from each site of the BMP Effectiveness Monitoring Project. Ana-Lab is currently the contract laboratory responsible for grab and storm-runoff event sample analysis, Greg Conley is currently the contacted individual responsible for sorting and identifying fish samples, and Roy Darville is currently the contracted individual responsible for sorting and identifying the benthic samples.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 Ana-Lab TFS2 – S1-Comp COC – Chain of Custody for storm-runoff event samples (See SOP-008, Storm Event Sample Preparation and Preservation).
3.3 Ana-Lab TFS2 - S2-Grab COC – Chain of Custody for Grab samples (See SOP-007, Baseflow Grab Sampling).
3.4 COC – Fish Samples – Chain of Custody for Fish samples (See SOP-015, Fish Community Sampling).
3.5 COC – Benthic Samples – Chain of Custody for Benthic samples (See SOP-014, Benthic Macroinvertebrate Sampling).

4.0 Equipment, Reagents, and Standards

4.1 Ana-Lab TFS2 – S1-Comp COC Forms.
4.2 Ana-Lab TFS2 - S2-Grab COC Form.
4.3 COC – Fish Samples – COC Form.
4.4 COC – Benthic Samples – COC Form
4.5 Pencil/Pen.

5.0 Procedures

5.1 Filling out Ana-Lab COC
5.1.1 The COCs for Grab and Storm Event samples are similar, except for the top of

the page. Following the "Report To" information of TFS2, either "S1 Storm Water Composite" or "S2 Water Analysis Grab" will be printed, indicating COC type.

5.1.2 All information specific to the BMP Effectiveness Monitoring Project is already on the COC.

5.1.3 Under the "Additional Information" heading of the COC is a place for site location identification. This area is to be completed by indicating the name of the appropriate county where the samples are collected, as well as if the collected samples come from the "above" or "below" site location. (i.e. – samples collected from the above monitoring station located in Cherokee County = Cherokee County – Above). Be sure to also indicate if sample is a "Duplicate".

5.1.3.1 Additional Information needed for COC S1 – Storm Water Composite, include Start time, date, and tech name, and Stop time, date, and tech name. The 'start' and 'stop' times and dates are derived from the ISCO 3700 Portable Sampler during the "display/history status" data collected as outlined in section 5.1 of SOP-009, Storm Runoff Sample Collection. The 'start' time and date is the first water sample showing as collected, and the 'stop' time and date is the last water sample showing as collected. If the display history status data indicates a missed sample, do not count it as the first, or last, 'start' or 'end' date and time.

5.1.4 Under the "Bottles Required for Requested Tests" section of the COC's is the number of bottles required for each test. Listed is each bottle type, preservative, and tests. Typically, 1 bottle of each type is sent, so the number 1 is printed in the blank in front of the bottle type and description. Should there be no water for a particular sample bottle; make sure to put a "0" in the corresponding space.

5.1.5 Following bottle type is the list of standard laboratory tests. Ensure that any additional tests of interest are noted on the bottom of the form.

5.1.6 The lower part of the COC consists of a series of 7 column headings, including Ana-Lab #, Sample ID, Bottles, Date, Time, Tech, and Notes.

5.1.7 Ana-Lab # - filled out by Ana-Lab.

5.1.8 Sample ID - Identification for a given sample based on the bottle label. (See SOP-007, Baseflow Grab Sampling, and SOP-008, Storm Event Sample Preparation and Preservation).

5.1.9 Bottles - the number of bottles sent for analysis. Typically, 3 bottles per sample are sent for analysis, one ½ gallon unpreserved, white label bottle, one 250 ml yellow label bottle, preserved with H_2SO_4, and one 500 ml red label bottle, preserved with HNO_3.

5.1.10 Date - date of sample collection.

5.1.11 Time - time the sample is put in the bottles. Be sure to use military time (HH:MM).

5.1.12 Tech - the name of the technician collecting the samples.

5.1.13 Notes - any relevant notes regarding samples.
Note: It is imperative that all the information on bottle labels and information on the COC match exactly. It is also imperative that every sample is recorded on the COC and that every ID recorded on the COC matches with a bottle label. The COC acts as a double check for any potential errors in bottle labeling. A CAR must be filled out for any bottle labeling/COC errors that could compromise sample integrity/identity.

5.1.14 Below the sample ID portion is the section for the signature of the persons relinquishing and receiving the samples, as well as the date and time of sample transfer. This portion is to be signed and the date and time recorded with each transfer of possession.

5.1.15 The COC is to be signed by the person relinquishing the samples and the person who receives the samples, including date and time. Copies are to be made and held by Texas Forest Service until completed reports are received back by Ana-Lab.

5.2 Filling out Fish Sample COC

5.2.1 This form consists of a series of 7 main column headings including Date Collected, Collected By, Number of Containers, Sample Method, Preservation Method, Sample Location, and Date of Completion which includes sorting, identification and reference columns.

5.2.2 Date Collected – date of sample collection.

5.2.3 Collected By – name of person/persons collecting samples (may just put in TFS if all samples are collected by TFS employees).

5.2.4 Number of Containers – the number of containers sent for sorting and identification. Typically 1 bottle per sample location.

5.2.5 Sample Method – note whether sample was collected through seining or electrofishing.

5.2.6 Preservation Method – indicate preservative type at the time that samples are relinquished to contracted individual.

5.2.7 Sample Location – indicate county name and unique location of where samples were collected (i.e. – CCA = Cherokee County Above Monitoring Station, CCB = Cherokee County Below Monitoring Station, HCA = Houston County Above Monitoring Station, HCB = Houston County Below Monitoring Station, NCA = Newton County Above Monitoring Station, NCB = Newton County Below Monitoring Station, SACA = San Augustine County Above Monitoring Station, SACB = San Augustine County Below Monitoring Station).

5.2.8 Date of Completion – to be completed by contracted individual, indicates date of when sorting, identification, and reference sample made (as determined by TFS).

Note: It is imperative that all the information on bottle labels and information on the COC match exactly. It is also imperative that every sample is recorded on the COC and that every container is correctly labeled both inside and outside. The COC acts as a double check for any potential errors in bottle labeling. A CAR must be filled out for any bottle labeling/COC errors that could compromise sample integrity/identity.

5.2.9 Below the sample information portion is the section of the signature of the persons relinquishing and receiving the samples, as well as the date and time of sample transfer. This portion musts be signed with the date and time recorded with each transfer of possession.

5.3 Filling out Benthic Sample COC

5.3.1 This form consists of a series of 7 column headings including Date Collected, Collected By, Number of Containers, Sample Method, Preservation Method, Sample Location, and Date of Completion which includes sorting, identification and reference columns.

5.3.2 Date Collected – date of sample collection.

5.3.3 Collected By – name of person/persons collecting samples (may just put in TFS if all samples are collected by TFS employees).

5.3.4 Number of Containers – the number of containers sent for sorting and identification. Typically 1 bottle per sample location.

5.3.5 Sample Method – note how sample was collected, will generally be "Kick net".

5.3.6 Preservation Method – indicate preservative type at the time that samples are relinquished to contracted individual.

5.3.7 Sample Location – indicate county name and unique location of where samples were collected (i.e. – CCA = Cherokee County Above Monitoring Station, CCB = Cherokee County Below Monitoring Station, HCA = Houston County Above Monitoring Station, HCB = Houston County Below Monitoring Station, NCA = Newton County Above Monitoring Station, NCB = Newton County Below Monitoring Station, SACA = San Augustine County Above Monitoring Station, SACB = San Augustine County Below Monitoring Station).

5.3.8 Date of Completion – to be completed by contracted individual, indicates date of when sorting, identification, and reference sample made (as determined by TFS).

Note: It is imperative that all the information on bottle labels and information on the COC match exactly. It is also imperative that every sample is recorded on the COC and that every container is correctly labeled both inside and outside. The COC acts as a double check for any potential errors in bottle labeling. A CAR must be filled out for any bottle labeling/COC errors that could compromise sample integrity/identity.

5.3.9 Below the sample information portion is the section of the signature of the persons relinquishing and receiving the samples, as well as the date and time of sample transfer. This portion musts be signed with the date and time recorded with each transfer of possession.

6.0 Quality Control and Safety

6.1 Errors in filling out any COC that could result in compromising sample integrity/identity will be noted on a Corrective Action Report to document and rectify the problem. All information written on the COC must be neat and legible to prevent possible errors in sample identity.

7.0 Attachments

7.1 Corrective Action Report
7.2 Ana-Lab TFS2 – S1-Comp COC
7.3 Ana-Lab TFS2 - S2-Grab COC
7.4 COC – Fish Samples
7.5 COC – Benthic Samples

SOP-007
BMP Effectiveness Monitoring Project
Baseflow Grab Sampling

1.0 Applicability

This procedure applies to the collection of baseflow grab samples for each site of the BMP Effectiveness Monitoring Project.

The objective of water chemistry sampling and testing is to demonstrate whether continuing compliance with specific regulatory requirements has been achieved. Samples are presented to the laboratory for specific determinations with the sampler being responsible for collecting a valid and representative sample. Baseflow grab samples will be tested for Total Suspended Solids, Total Phosphorus, Nitrate-Nitrite Nitrogen, and Total Kjeldahl Nitrogen.

This objective implies that the relative proportions of concentrations of all pertinent components will be the same in the samples as in the water being sampled, and that the sample will be handled in such a way that no significant changes in composition occur before analysis is complete.

2.0 Purpose

This procedure details steps necessary for the collection of grab samples for each site of the BMP Effectiveness Monitoring Project. Ana-Lab is currently the contract laboratory responsible for grab sample analysis. This procedure details the collection of grab samples to be sent to Ana-Lab for analysis.

3.0 Definitions

3.1 BMP – Best Management Practices.

3.2 Baseflow – streamflow resulting primarily from throughflow, interflow, or ground water flow in a stream. Overland storm-runoff is not a component of baseflow. If a watershed consists of a series of quiescent pools with no flow between pools, then the stream is considered dry and no samples are to be taken.

3.3 Field Activity Form – Forms are kept to record activities and problems with the equipment at that site for each operation on a particular watershed. They are kept in three-ring binders at the Texas Forest Service FRD/BMP Laboratory.

4.0 Equipment, Reagents, and Standards

4.1 Ana-Lab Sample Bottles:

- 4.1.1 One 2 liter white label, unpreserved.
- 4.1.2 One 250 ml yellow label, preserved with H_2SO_4.
- 4.1.3 One 500 ml red label, preserved with HNO_3.

4.2 1 liter plastic, graduated beaker.

4.3 Ice Chests with Ice.

4.4 Sharpie® Permanent Markers or pen.

4.5 Clear packing tape.
4.6 Ana-Lab Grab Chain of Custody; TFS2-S2 GRAB COC.

5.0 Procedures

5.1 Sample Collection
- 5.1.1 Water sample collection procedures are documented in the TNRCC Surface Water Quality Monitoring Procedures Manual (1999).

5.2 Sample Delivery
- 5.2.1 Ana-Lab should be contacted at 903-984-0551 to arrange for pickup of samples and delivery of additional empty sample bottles.
- 5.2.2 Grab sampling schedules are typically flexible, so samples should be collected at such a time as Ana-Lab can pick up the samples and allow for sufficient time for analysis so that the seven-day hold time is met. However, no grab sample should be collected immediately after a storm runoff event occurs. A minimum of one full day should separate these sampling events. Any samples not picked up or delivered before the seven-day hold time will result in the samples being discarded. Loss of samples due to hold time will be noted on a Corrective Action Report to document and rectify the problem.

5.3 Preparing and Labeling Sample Bottles
- 5.3.1 Prepare one (1) set of three (3) AnaLab bottles for each sample
  One (1) plastic 250 ml with H_2SO_4 (yellow label).
  One (1) plastic 500 ml with HNO_3 (red label).
  One (1) plastic 2 liter unpreserved (white label).
- 5.3.2 For each grab sample, label each of the three Ana-Lab bottles as follows:
  Sample ID: Site - Grab (E.g. CCA-G = Cherokee County Above, Grab sample. "Duplicate" as needed).
  Client: TFS2.
  Collector: your name.
  Date and Time (military) collected: (MM/DD/YY) / (HH:MM).
- 5.3.3 Place a piece of clear tape over each label.

5.4 Grab Sampling
- 5.4.1 Grab samples at each monitoring station site are typically taken immediately upstream of the float-arm assembly in an area as close to the sample intake as possible and deep enough to allow for water to be dipped out with a 1-liter beaker.
- 5.4.2 Use a clean, 1-liter beaker or other suitable collection container to dip sample water out of the stream and fill each of the three sample bottles.
- 5.4.3 Avoid overfilling bottles since dilution of the acid may occur.

5.4.4 **It is imperative that under no circumstances any stray H_2SO_4 or HNO_3 comes in contact with sample water.** Anything that could potentially come in contact with sample water and has been exposed to the outside of the sample bottles must be thoroughly washed to prevent sample contamination. Cross-contamination between samples must also be avoided. If acid contamination or cross-contamination occurs, then discard sample and take another one. If this is not possible, a CAR must be filled out documenting the problem.

5.4.5 Place bottles into ice chest and cover with ice. Samples must be put on ice within 45 minutes of collection. If this is not possible, sample will be discarded, another sample taken, and a CAR notating the problem must be generated.

5.4.6 Record sample on Ana-Lab Grab Chain of Custody (COC); TFS2-S2 GRAB COC form (See SOP – 005 – Filling out Ana-Lab COC).

5.4.7 Beaker should be washed with DI water prior to collecting a sample from the next site.

5.4.8 Record activity on the Field Activity Form and Stream Quality Sampling Data Sheet.

5.4.9 Duplicate samples from one monitoring site will be collected each month during grab sampling.

6.0 Quality Control and Safety

6.1 Problems that result in the loss of a collected sample or could compromise sample integrity will be noted on a Corrective Action Report to document and rectify the problem.

6.2 Field split samples should be submitted to the laboratory with every tenth sample, or at least once per month.

7.0 References

7.1 Surface Water Quality Monitoring Procedures Manual. TNRCC. Volume 1, December 2003 and Volume 2, August 2005.

8.0 Attachments

8.1 Corrective Action Report.
8.2 Ana-Lab TFS2-S2 Grab COC.
8.3 Field Activity Form.
8.4 Stream Quality Sampling Data Sheet

SOP-008
BMP Effectiveness Monitoring Project
Storm Event Sample Preparation and Preservation

1.0 Applicability

This procedure applies to the preparation and preservation of storm water samples for shipment to contract laboratory for each site of the BMP Effectiveness Monitoring Project.

2.0 Purpose

This procedure details steps necessary for the preparation and preservation of water samples collected at each site of the BMP Effectiveness Monitoring Project. Ana-Lab is currently the contract laboratory responsible for sample analysis. This procedure details the process for sending samples to Ana-Lab.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 CAR – Corrective Action Reports are used to record and report problems that lead to missed samples and actions or steps taken to correct the problem.

4.0 Equipment, Reagents, and Standards

4.1 1000 mL container, labeled DI Water.
4.2 1-liter plastic, graduated beaker.
4.3 Sample bottles from Ana-Lab.
4.4 Sharpie® Permanent Markers or pen.
4.5 Clear packing tape.
4.6 DI water.
4.7 Large coolers.
4.8 Ice.

5.0 Procedures

5.1 Composite Samples – General Procedures
- 5.1.1 Storm event samples are automatically composited in the 10 Liter collection bottle in each ISCO Model 3700 Portable Sampler. After retrieval of storm water samples (See SOP-009, Storm Runoff Sample Collection), samples should be put in the appropriate Ana-Lab sample bottles and placed on ice in coolers within 45 minutes of retrieval.
- 5.1.2 Sample preservation is done in the field and care must be taken in order not to contaminate any potential samples, sample preservation bottles, or other specially prepared containers that are for handling collected samples.

5.1.3 Should the weather not allow for sample preservation in the field, then the collected storm water sample bottles are labeled accordingly for each site, dated, put on ice, and the appropriate procedures are followed for storm sample preservation in the Texas Forest Service FRD/BMP Laboratory.

5.1.4 Each bottle containing collected storm water sample must be swirled to re-suspend any sediment that has settled before placing measured amounts in the Ana-Lab sample preservation bottles.

5.1.5 Only specially cleaned bottles and graduated beakers will be used for measuring collected storm water samples (See SOP-012, Bottle Washing, for proper bottle washing procedures).

5.1.6 All bottles, containers, and graduated beakers must be rinsed a minimum of two times with DI water before being used for any other collected samples. All used bottles, container and graduated beakers will be properly cleaned per SOP-012, Bottle Washing, after each storm event/days use.

5.1.7 Before collected storm water samples are placed into the Ana-Lab preservation bottles, field technicians will verify whether the total amount collected meets the minimum required sample amounts for each different Ana-Lab sample bottle. A minimum total of 467 mL is needed for analysis. Minimum required samples, rounded to nearest whole number, for each Ana-Lab bottle are as follows:

250 mL bottle preserved with H2SO4 (yellow label) – 63 mL.

500 mL bottle preserved with HNO3 (red label) – 167 mL.

½ gallon bottle unpreserved (white label) – 237 mL.

5.1.8 During the collection of storm event samples, if any of the monitoring stations does not collect at least the total minimum required amount for storm water samples, then any storm water samples collected from that site will be preserved in the following preferred order:

1st – ½ gallon bottle unpreserved (white label) – TSS

2nd – 500 mL bottle preserved with HNO3 (red label) – TP

3rd – 250 mL bottle preserved with H2SO4 (yellow label) – TKN/TNN

5.1.9 Any discrepancies, problems, or discarded samples will be noted on the Field Activity Form or Corrective Action Report as needed.

5.2 Preparing and Labeling Sample Bottles

5.2.1 Prepare the appropriate number of Ana-Lab bottles needed for each sample.
One (1) plastic 250 ml with H_2SO_4 (yellow label).
One (1) plastic 500 ml with HNO_3 (red label).

One (1) plastic ½ gallon unpreserved (white label).

5.2.2 For composite samples, label each of the Ana-Lab bottles as follows:
Sample ID: Site Identifier, followed by an "S" for storm sample.
(E.g. CCA-S = Cherokee County Above - Storm).
Client: TFS2
Collector: name of person collecting sample.
Date and Time: Date and time samples were put in preservative/bottles. Be sure to use military time.

5.2.3 Place a piece of clear tape over each label to prevent smearing.

Note: It is imperative that under no circumstances any stray H_2SO_4 or HNO_3 comes in contact with sample water. Anything that could potentially come in contact with sample water and has been exposed to the outside of the sample bottles must be thoroughly washed to prevent sample contamination. Cross-contamination between samples must also be avoided. If acid contamination or cross-contamination occurs, a CAR must be filled out documenting the problem.

5.2.4 Pour correct measured amount of storm water sample in appropriate bottles.

5.2.5 Carefully squeeze out excess air and put lid on.

5.2.6 Place bottles into ice chest and cover with ice.

5.2.7 Complete Ana-Lab Chain of Custody (COC) document (See SOP-006, Chain of Custody (COC) Protocol).

5.3 Sample Delivery

5.3.1 Ana-Lab should be contacted at 903-984-0551 ASAP after sampling occurs to arrange for pickup of samples and delivery of additional empty sample bottles and coolers.

5.3.2 If Ana-Lab cannot pick up the samples for analysis and still meet the critical hold time, then TFS personal will deliver the samples to Kilgore. This is a common problem if samples are collected on Friday, Saturday, or holidays. Driving directions to Ana-Lab from TFS are as follows: Take Hwy 59 N to 259 N to Kilgore. At the 2nd stoplight, just past the hospital, turn right on Dudley Road. Drive 1.25 miles and Ana-Lab is on the right.

6.0 Quality Control and Safety

6.1 Problems that result in the loss of a collected sample or could compromise sample integrity will be noted on a Corrective Action Report to document and rectify the problem.

7.0 Attachments

7.1 Field Activity Form
7.2 Corrective Action Report
7.3 Ana-Lab TFS2 – S1 COMP COC

SOP-009
BMP Effectiveness Monitoring Project
Storm Runoff Sample Collection

1.0 Applicability

This procedure applies to the retrieval and temporary storage of all storm runoff samples and associated data collected by automated field sampling units for each site of the BMP Effectiveness Monitoring Project.

2.0 Purpose

This procedure details steps necessary for the retrieval and temporary storage of all storm runoff samples and associated data collected by automated field sampling units for each site of the BMP Effectiveness Monitoring Project.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 Field Activity Form – Field Activity Forms are used to record samples collected or missed, equipment malfunctions, general maintenance and recommended corrective actions. They are kept in three-ring binders at the Texas Forest Service FRD/BMP Laboratory.
3.3 CAR – Corrective Action Reports are used to record and report problems that lead to missed samples and actions or steps taken to correct the problem.

4.0 Equipment, Reagents, and Standards

4.1 ISCO Model 3700 Automatic Sampler (**Primary Autosampler**). Autosampler Programming – See SOP-002 and ISCO Model 3700 Portable Water Sampler Instruction Manual.
4.2 ISCO Model 4230 Flow Meter.
4.3 ISCO 10 Liter polypropylene sample bottles and lids.
4.4 Sharpie® Permanent Markers, Pencils.
4.5 Ice Chests.
4.6 Ice.
4.7 Ana-Lab Composite Chain of Custody form; TFS2-S1 Comp COC.
4.8 Field Activity Form.
4.9 Sampler History Form.
4.10 Enable/Disable History Form.

5.0 Procedure

Autosampler Procedures

NOTE: Before proceeding with the Autosampler Procedures, notate on the Field Activity Form the information displayed on the ISCO Model 4230 Flow Meter. Information is to include date, time, current level (in feet), cfs, and mgal status. Also be sure to verify the external marine battery status by selecting "Enter Program Step", "Setup", and "Status". Available voltage will be displayed after selecting "Enter" two times. Be sure to "Exit Program" until normal display is shown.

5.1 **ISCO Model 3700 Autosampler**

5.1.1 Verify whether samples have been collected:
Display will read, "Sample X of ## after Y Pulses".
If X>1, X-1 samples were collected.

5.1.2 Press "Stop" key.

5.1.3 Press "Display Status" key to view sample history (Date, time and details of collection).

5.1.4 Select "Review" and then "Results".

5.1.5 Record program start time on Sampler History Form. Record all enable/disable information on Enable/Disable History Form. Press "Enter" key to obtain each line of information. Record date and time when program was halted on Sampler History Form. It is important that all headers on both the Sampler History and Enable/Disable History Forms are completely and correctly filled out. Failure to do so could result in data becoming mixed up or lost.

5.1.6 Press "Enter" key until display shows time, date, counts, and if applicable any error messages for each sample collected.

5.1.7 Record sample collection date, time and source (see code key on bottom of Sampler History Form) for each sample collected on Sampler History Form. If there are any error messages associated with any sample collected, use the error code key that is located on the bottom of the Sampler History Form to correctly identify error message.

5.1.8 Note any discrepancies on the Field Activity Form.

5.1.9 Press "Exit Program" key to return to sampler main display.

5.2 Retrieve Samples

5.2.1 Unbuckle sampler from sampler base.

5.2.2 Lift off sampler from base.
5.2.3 Remove bottle containing collected samples.
5.2.4 Put lid on 10-Litre bottle and label as follows: Label bottle by site. (i.e. "NCA represents Newton County Above.)
5.2.5 Replace sample bottle in sampler base with clean bottle.
5.2.6 Align and replace sampler onto base.
5.2.7 Buckle sampler into position atop sample base.
5.2.8 See SOP-006, Chain of Custody (COC) Protocol and SOP-008, Storm Event Sample Preparation and Preservation, for correct storm sample preservation procedures.

5.3 Reinitiating the Sampler.
When the water level is at or below the initiation level, the sampler is ready to be reset. If stage > initiation level when sampler is reset, then sampling will begin immediately. If this is not desired, then initiation level should be set above stage (see SOP-001, Flow Meter Programming).

5.3.1 Reinitiate sampler:

5.3.1.1 Press "Start Sampling" key to start new program. If sampler display does not display "Start Sampling" press the "Stop" key again to make sure previous program is stopped, then continue as follows.

5.3.1.2 Select "Start" sampling.

5.3.1.3 Press "Enter" key for yes. If the ISCO Model 4230 Flow Meter is still in the "Enabled" mode the display should read "Sample 1 of ## after 1 Pulse" if sampler is reset correctly. If the ISCO Model 4230 Flow Meter is in the "Disabled" mode the display should read "Sampler Inhibited!"

Related Procedures

5.4 SOP-001 Flow Meter Programming.
5.5 SOP-004 Data Downloading Protocol.
5.6 SOP-005 Field Activity Form and Corrective Action Report.
5.7 SOP-006 Chain of Custody (COC) Protocol.
5.8 SOP-008 Storm Event Sample Preparation and Preservation.
5.9 SOP-010 Precipitation Measurement.

5.10 **ISCO Model 4230 Flow Meter**

5.10.1 After the ISCO Model 3700 Autosampler has been reinitiated the Totalizer needs to be reset to "0" on the ISCO Model 4230 Flow Meter. The Totalizer is reset as follows:

5.10.1.1 On the 4230 Flow Meter touch pad, select "Go To Program Step".
5.10.1.2 Enter "4" for the step number.
5.10.1.3 Select "Enter".
5.10.1.4 Select "Yes" for Reset Flow Totalizer.
5.10.1.5 Select "Enter" for Enable Totalizer.
5.10.1.6 Select "Yes" for Reset Sampler Enable Totalizer.
5.10.1.7 Select "Exit Program" to return to main screen display. MGAL reading on the display panel should now read "0.000 MGAL".

5.10.2 On Field Activity Form again notate the display information, as outlined under section 5.0 (Autosampler Procedures), for both the ISCO Model 3700 Autosampler and the ISCO Model 4230 Flow Meter.

6.0 Quality Control and Safety Aspects

6.1 Any equipment or problems or malfunctions will be noted on the Field Activity Form. Problems that resulted in a failure to collect samples will be noted on the Field Activity Form. Problems may be diagnosed and corrected in the field. If the problem cannot be diagnosed and corrected at time of sample collection, then the problem will be corrected by a qualified person ASAP.

6.2 Problems that result in the loss of a collected sample or could compromise sample integrity will be noted on a Corrective Action Report to document and rectify the problem. See SOP-005, Field Activity Form and Corrective Action Reports, for correct procedures in completing a Corrective Action Report.

7.0 References

7.1 3700 Portable Samplers Instruction Manual. Isco, Inc., 1996. Revised: E October, 1999.

8.0 Attachments

8.1 Field Activity Form.
8.2 Corrective Action Report.
8.3 Ana-Lab Composite Chain of Custody form; TFS2-S1 Comp COC.
8.4 Sampler History Form
8.5 Enable/Disable History Form

SOP-010
BMP Effectiveness Monitoring Project
Precipitation Measurement

1.0 Applicability

This procedure applies to the measurement and recording of precipitation data from standard raingages and precipitation intensity from HOBO Event Logger tipping bucket raingages associated with the storm events at each site of the BMP Effectiveness Monitoring Project.

2.0 Purpose

This procedure details steps necessary for measuring and recording precipitation and precipitation intensity at each site of the BMP Effectiveness Monitoring Project. Precipitation intensity is measured to the nearest 100^{th} inch for every event with recording raingages. Precipitation is also measured with standard, non-recording raingages.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 Field Activity Form – Forms on which collection and event information are recorded for non-recording raingages. They are kept on file at the Texas Forest Service BMP/FRD Laboratory.
3.3 NWS – National Weather Service.

4.0 Equipment, Reagents, and Standards

4.1 NovaLynx Model 260-2510 Standard 8" non-recording rain and snow gage.
4.2 Raingage measuring stick, in hundredths of an inch.
4.3 Field Activity Form
4.4 Daily Precipitation Log.
4.5 HOBO Event Logger Tipping Bucket Recording Raingage.

5.0 Procedure

5.1 Filling out Field Activity Form
- 5.1.1 Complete basic information section of Field Activity Form as follows:
  - 5.1.1.1 Date: current date.
  - 5.1.1.2 Location Name/County: location of raingages.
  - 5.1.1.3 Time: current time.
  - 5.1.1.4 Observer(s) Name: name of collector(s)
  - 5.1.1.5 Weather Conditions: current weather conditions.
  - 5.1.1.6 Activities Conducted/Comments/Observations/Problems: fill out as needed, this is where actual measurement information will be recorded.
- 5.1.2 At each raingage station, the following information will be recorded:

5.1.2.1 Amount: total measured precipitation to the nearest 100th inch.
5.1.2.2 Time: time of measurement.

5.1.3 All measured precipitation amounts will then be recorded to a daily precipitation log as supplied by NovaLynx.

5.2 Precipitation Measurement – Standard Non-Recording Raingage

5.2.1 Carefully remove black metal funnel top from the raingage assembly.
5.2.2 Press measuring stick along the back wall of the raingage inner cylinder and slowly slide down into opening until stick rests upon the bottom.
5.2.3 Note and record depth of precipitation in inches to two decimal places (0.01").
5.2.4 Remove black metal raingage inner cylinder from the base.
5.2.5 Discard precipitation from the inner cylinder and thoroughly shake excess water from inside.
5.2.6 Place black raingage inner cylinder on level raingage stand base.
5.2.7 Place raingage funnel top onto raingage inner cylinder.
5.2.8 Rain events >2" will overflow the inner cylinder and precipitation will be captured in the larger diameter, outer cylinder. Pour additional precipitation into funnel/inner cylinder assembly.
5.2.9 Repeat steps 5.2.2, 5.2.3 and 5.2.5 until all precipitation in raingage assembly is measured.
5.2.10 Replace black inner cylinder into outer white cylinder.
5.2.11 Replace funnel top.

5.3 Precipitation Measurements – Recording Rain gages: See SOP-004, Data Downloading, Section 5.0.

6.0 Quality Control and Safety Aspects

6.1 Any problems with raingage catch or other collection problems will be noted on the Field Activity Form.

7.0 References

7.1 Model 260-2510 Standard Rain and Snow Gage Instruction Manuel. NovaLynx Corporation. 2000. Auburn, California.

8.0 Attachments

8.1 Field Activity Form
8.2 Daily Precipitation Log

SOP-011
BMP Effectiveness Monitoring Project
Stream Flow Measurement

1.0 Applicability

This procedure applies to the measurement of stream flow for all stream sites of the BMP Effectiveness Monitoring Project. The type and amount of water motion is a stream's single most important environmental feature since it controls the physical structure of the streambed. This, in turn, influences the amount of benthic biomass. The greater the flow, the greater the current, and also the amount of suspended material that is transported. Floods are of major importance to streams, they can uproot and kill large numbers of organisms and change the chemical composition of streams. Particulates are also scoured from riverbeds during floods. Conversely, low flows can be as damaging to a stream as a flood. Significantly lower than normal flows can also result in the demise of large numbers of organisms and changed in the chemical composition of a stream. During extreme low flows dissolved solids can concentrate and the stream can become more susceptible to changes in ambient temperature.

2.0 Purpose

This procedure details steps necessary for the measurement of stream flow for all stream sites of the BMP Effectiveness Monitoring Project. Measured stream flow is used to calculate discharge for storm events, which in turn is used to calculate load (or content) from concentration.

3.0 Summary of Method

If a flow measurement is required at a site, measure and record flow after recording visual observations and collecting chemical and biological samples. Begin by measuring width of stream and determining the number of flow cross sections and the mid-point of the cross section. Complete the process by adjusting sensor depth at each cross section and measuring and recording the velocity at this depth.

4.0 Definitions

4.1 BMP – Best Management Practices
4.2 Flow meter – a scientific instrument designed to monitor the level of water in a stream, pipe, or other system.

5.0 Health and Safety Warnings

5.1 Collect data safely, avoiding situations that may lead to accidents. When in doubt as to the level of safety precautions needed, consult a knowledgeable industrial hygienist or safety professional. Under storm conditions, personnel should be aware of their surroundings and be mindful of rising water levels.
5.2 Always work with a partner.

5.3 Never wade into stream when lightning.
5.4 Never wade into stream when greater than waist deep without safety line.

6.0 Interferences

6.1 Flow should be recorded on straight reaches with laminar flow bank to bank, when possible. Sites should have an even streambed free of large rocks, weeds and protruding obstructions that create turbulence. The site should not have dead water areas near the banks, and a minimum amount of turbulence or back eddies.

7.0 Personnel Qualifications

7.1 Personnel should be trained in-house on proper collection techniques and safety. Personnel should also have knowledge of and ability to reset and program the Flow Meter for the appropriate conditions.

8.0 Equipment, Reagents, and Standards

8.1 Marsh-McBirney FLO-MATE 2000 Portable Flowmeter.
8.2 Top-set wading rod (measured in tenths of feet).
8.3 Measuring rod or tape (with gradations every tenth of a foot).
8.4 Stream Flow (Discharge) Measurement Form.
8.5 Pencil or pen.
8.6 Field Activity Forms.
8.7 Waders.
8.8 5-gallon bucket or ISCO sampler top cover.
8.9 Extra batteries.

9.0 Sample Collection

9.1 Flow data collection procedures are documented in the TNRCC Surface Water Quality Monitoring Procedures Manual (1999).

10.0 Instrument Method or Calibration

10.1 Marsh-McBirney FLO-MATE 2000 Portable Flowmeter is initially calibrated at the factory. Periodic calibration is as outlined in section 11.1 and will be used for when flowmeter has not been used for a period of at least three months.

11.0 Procedure

11.1 Calibrate FLO-MATE 2000

11.1.1 Fill 5-gallon bucket with stream water.
11.1.2 Connect sensor to top-set wading rod.
11.1.3 Insert rod into bucket and allow to stand still until no ripples or currents are observed (10 – 15 minutes).
11.1.4 Turn on FLO-MATE.
11.1.5 Press <RCL> and <STO> buttons simultaneously.
11.1.6 When Display reads "3", press the "down arrow" button until display reads "0".
11.1.7 Press <RCL> and <STO> buttons simultaneously.
11.1.8 Display will read "32", countdown to "0" and turn itself off.
11.1.9 Instrument is now zeroed and ready for flow measurements.
11.1.10 Record date and time of calibration on General Maintenance form.

11.2 Flow Measurement Procedure (open channel)

11.2.1 Record information regarding stream (watershed ID), time flow measurements began and ended, and Observer name(s) (technician) in the header on the Stream Flow Discharge Measurement form.
11.2.2 Carefully wade into stream.
11.2.3 Divide stream width into equal segments using site-specific measuring rod or measuring tape. Note: Site Specific Measuring Rod divisions are based on TNRCC (TCEQ)/EPA guidelines.
11.2.4 Stand at first section midpoint division, downstream of the measuring rod.
11.2.5 Place the top-set wading rod upstream with the sensor facing into the flow.
11.2.6 Measure depth of water column with the foot of the top-set wading rod resting firmly on the bottom.
11.2.7 Record section midpoint number and depth on form.

If water column of stream is <2.5 ft.

11.2.8 Set wading rod to 60% of depth of water column (See below).
11.2.9 Turn FLOW-MATE on.
11.2.10 Press <STO> to store reading, or record readings directly on Stream Flow Discharge Measurement Form.
11.2.11 Move to next division and repeat. (Note, unit will only hold 19 readings). Be sure to press the 'ON/C' button to clear any noise reading from movement of the sensor from one section to the next.
11.2.12 If necessary, after measurements are stored, transfer observational depth and velocity (flow) readings to stream flow measurement form.

If water column of stream is >2.5 ft.

11.2.13 Set wading rod to 20% of depth of water column (See Below).
11.2.14 Follow steps 11.2.9-11.2.12.
11.2.15 Set wading rod to 80% of depth of water column (See Below).
11.2.16 Repeat steps 11.2.9-11.2.12.

Setting the top-set wading rod

To set to 60% of water column depth:
Line up the foot scale on the sliding rod with the tenth scale to the top of the depth gauge rod. If for example the total depth is 1.3 ft., then line up the 1 on the foot scale with the 3 on the tenth scale.

To set to 20% of water column depth:
Multiply the total water column depth by 2. For example, if the total depth is 2.7 ft., then 2.7 x 2 = 5.4. Line up the 5 on the foot scale with the 4 on the tenth scale.

To set to 80% of water column depth:
Divide the total water column depth by 2. For example, if the total depth is 2.7 ft., then 2.7 / 2 = 1.33. Line up the 1 on the foot scale with the 0.33 on the tenth scale.

11.3 Calculations:

11.3.1 Calculate average velocity when stream depth is >2.5 ft. Average velocity readings collected at 20% and 80% of depth of water column. Record on form.
11.3.2 Calculate cross-sectional area of stream flow = width x depth. Record on form.
11.3.3 Calculate flow = velocity x area. Record on form.

12.0 Troubleshooting

12.1 The flow meter should be inspected prior to leaving the laboratory on a sample event and the battery voltage should be verified.

13.0 Data Acquisition, Calculations, and Data Reduction

13.1 Flow data is subject to a quality control/quality assurance examination and is recorded on hardcopies and electronically in a storm water database.

14.0 Computer Hardware and Software

14.1 Microsoft Excel spreadsheets are used to calculate flow.

15.0 Data Management and Record Management

15.1 The Authority keeps hardcopies of all data. Data is also stored in an electronic database.

16.0 Quality Control and Quality Assurance

16.1 There is no specific procedure for Quality Control and Quality Assurance techniques involving flow data collection. Authority personnel should make all reasonable efforts for accuracy and completeness labeling. Flow data will be rejected if at least ten transects are not conducted during field sampling.

17.0 References

17.1 FLOW-MATE Model 2000 Portable Water Flowmeter Instruction Manual. Marsh-McBirney, Inc., December 1990. Revised January 1995.

17.2 Surface Water Quality Monitoring Procedures Manual. TNRCC. Volume 1, December 2003 and Volume 2, August 2005.

18.0 Attachments

18.1 Stream Flow (Discharge) Measurement Form.

18.2 Top-set wading rod diagram. Marsh-McBirney, Inc., December 1990.

18.3 General Maintenance Form.

18.4 Field Activity Form.

SOP-012
BMP Effectiveness Monitoring Project
Bottle Washing

1.0 Applicability

This procedure applies to washing sample collection (ISCO) bottles and other equipment that comes in contact with sample water.

2.0 Purpose

This procedure details steps necessary for properly washing sample bottles to ensure that no sample contamination occurs.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 Bottle Washing Form – forms documenting date and quantity of bottles washed. They are kept on a clipboard at the Texas Forest Service FRD/BMP Laboratory.
3.3 DI and Acid Rinse Preparation Form - forms documenting the date of DI and Acid Rinse preparation and discarding. They are kept on a clipboard at the Texas Forest Service FRD/BMP Laboratory.

4.0 Equipment, Reagents, and Standards

4.1 Bottle washing brushes.
4.2 Phosphate-free laboratory grade dishwashing soap.
4.3 Technical Grade 22°Baume or equivalent normality HCL.
4.4 30-gallon tubs.
4.5 Clean washrags.
4.6 Bottle drying racks.

5.0 Procedure

5.1 Preparation of Acid and DI Rinse water:
- 5.1.1 Fill the 30 gallon tub marked "DI WATER" approximately ¾ full of distilled water (22.5 gallons).
- 5.1.2 Fill the 30 gallon tub marked "ACID RINSE" approximately ¾ full of distilled water (22.5 gallons).
- 5.1.3 Pour approximately 600 ml of HCL (Technical Grade 22°Baume or equivalent normality) into tub marked "ACID RINSE" and allow to mix.
- 5.1.4 Document on the DI and Acid Rinse Preparation and the Bottle Washing Form the date on which the DI Water and Acid Rinse were prepared.

5.2 Washing Bottles
- 5.2.12 Fill sink with warm tap water, add 3-6 tbsp of dishwashing soap (see soap bottle for proper measured amounts per gallon of water used).

5.2.13 Scrub each bottle until all dirt is removed.
5.2.14 Rinse soap off each bottle with tap water.
5.2.15 Place bottle into Acid Rinse, completely immerse, and allow to soak at least 5 minutes.
5.2.16 Remove bottle from Acid Rinse, shake off excess rinse, and fully immerse in DI Water for at least 5 minutes.
5.2.17 Remove from DI Water and shake off excess water. Place upside down on bottle drying rack until fully dry.
5.2.18 After dry replace clean lids.

5.3 Washing Lids
5.3.1 Remove marking from lids, as necessary, with acetone.
5.3.2 Wash in soapy water thoroughly, removing any dirt or other foreign material.
5.3.3 Rinse with tap water.
5.3.4 Soak in Acid Rinse for at least 5 minutes.
5.3.5 Soak in DI Rinse for at least 5 minutes.
5.3.6 Place lids on drying area until dry.
5.3.7 Place lids back on bottles.

5.4 Washing Bases (if necessary)
5.4.1 Bases should be wiped down with clean, damp rag to remove any accumulated dirt.
5.4.2 If bases are very dirty, fill with warm soapy water and scrub any dirt out.
5.4.3 Rinse with tap water.
5.4.4 Place upside down in drying area until dry.
5.4.5 Fill with clean bottles.

6.0 Quality Control and Safety Aspects

6.1 All bottles should be thoroughly washed and free of dirt. Any deviation from this standard will result in the bottle being rewashed.

6.2 DI Water and Acid Rinse should be used for only 3 batches of samples (Max 936 bottles, depending on how dirty) or 3 months, which ever comes first. Rinse will be changed after this time period before any more bottles will be washed.

6.3 Date and activity of bottle washing will be noted on the General Maintenance Form, as well as the initials of the person washing the bottles. Date and approximate number of bottles washed will be recorded on the Bottle Washing Tracking Form, as well as the initials of the person washing the bottles.

6.4 Completed forms (DI/Acid Rinse Preparation and Bottle Washing Tracking) will be archived every six months to a binder located at the Texas Forest Service FRD/BMP Laboratory.

7.0 Attachments

7.1 Bottle Washing Tracking Form.
7.2 DI and Acid Rinse Preparation Form.
7.3 General Maintenance Form.

SOP-013
BMP Effectiveness Monitoring Project
Battery Changing

1.0 Applicability

This procedure applies to changing and charging 12-volt deep cycle marine/rv batteries for use at the BMP Effectiveness Monitoring Project sites.

2.0 Purpose

This procedure details steps necessary to change and charge the batteries, which are the main power source for samplers and dataloggers at the BMP Effectiveness Monitoring Project sites.

3.0 Definitions

3.1 BMP – Best Management Practices.
3.2 Battery Maintenance and Tracking Form – form documenting date, battery number, charging information and initials of person(s) charging the batteries for field use.

4.0 Equipment, Reagents, and Standards

4.1 12 volt deep-cycle marine/RV batteries.
4.2 Battery Charger.
4.3 Jumper cables for battery series connections.
4.4 Terminal cleaners, wire brush, protectant.

5.0 Procedures

5.1 Changing Batteries
- 5.1.1 Batteries should be changed on a 3-6 week schedule, depending on usage and drain potential.
- 5.1.2 Ensure batteries are fully charged and ready for deployment (See 5.2).
- 5.1.3 Write down all display data from the Isco 4230 Flow Meter and the Isco 3700 Auto Sampler on Field Activity Form.
- 5.1.4 Before powering down a flow meter, data must be downloaded (see SOP-004 Data Downloading). Battery changing is typically done at the same time as normal data downloading.
- 5.1.5 Remove the alligator clips (autosampler) and the wing nuts (solar panel) from the battery power supply.
- 5.1.6 Remove the battery from the sampler housing and replace it with a fully charged battery.
- 5.1.7 Reconnect the alligator clips and the wing nuts to the new battery. **DO NOT CROSS POLARITY OR THE MONITORING EQUIPMENT COULD BE RUINED.** Even brief brushes of the black across the positive terminal or

vice-versa could cause damage to equipment. Extreme caution must be employed.

5.1.8 Verify that the Isco 4230 Flow Meter and Isco 3700 Auto Sampler have powered back up and are functioning properly. Verify display data with the information that was written down in step 5.1.3. Any problems or major discrepancies must be corrected before leaving the site.

5.1.9 The time must be checked on the monitoring equipment to ensure it is correct. Change the time to the correct time either using the laptop (See SOP-004 Data Downloading) or the numeric interface pad.

5.1.10 Record the battery change on the Field Activity Form, Monthly Maintenance Form and in the Battery Changing Tracking three-ring binder.

5.2 Charging Batteries

All battery charging, installing (deploying) and retrieving activities must be noted on the Field Activity Form, Monthly Maintenance Form and the Battery Maintenance and Tracking Form.

Note: Once batteries have been retrieved, they need to be charged ASAP. Up to 10 batteries can be placed on the series charger.

5.2.1 Charge batteries in series, with a jumper from the positive terminal of one battery to the negative terminal of another. The charger should be hooked up to the first and last batteries in the series, with the positive (red) clip hooked to the positive (+) battery terminal on one end of the series and the negative (black) clip hooked to negative (-) terminal on the battery at the other end of the series. **USE EXTREME CAUTION! DO NOT CROSS POLARITY OR THE TERMINALS WILL ARC AND MAY RESULT IN BATTERY EXPLOSION.**

Never hook up two positive terminals or two negative terminals. Even accidentally brushing the jumpers across the wrong terminal can result in arcing and possible explosion.

5.2.2 Once batteries are inter-connected, plug the charger in to a power outlet and flip

the power switch to the "On" position. Note charging date, charging time, battery number and technician initials on the Battery Maintenance and Tracking Form.

Note: Batteries should be charged at a rate of about 4-5 amps for no more than 24 hours or until the indicator indicate full charge.

5.2.3 Remaining batteries are to be charged on the individual chargers.

Plug the individual chargers in and charge at the 10 amp rate for about 24 hours or until the indicator indicates full charge.

Note: Once batteries are finished charging, note the date and time of when charging was completed and technician initials on the Battery Maintenance and Tracking Form.

5.2.4 Batteries are to be stored in a fully charged condition.

5.2.5 Prior to installation (re-deployment), charge batteries for 24 hours to bring batteries up to full charge. Charge batteries until indicators indicate full charge. Note activity on Battery Maintenance and Tracking Form.

5.3 Battery Maintenance

5.3.1 Battery electrolyte level must be periodically checked. Add distilled water to cells when level is below normal.

5.3.2 Battery terminals should be cleaned with a terminal cleaner and wire brush periodically to prevent corrosion.

5.3.3 Terminals should be sprayed with an appropriate protectant to prevent corrosion.

6.0 Quality Control and Safety

6.1 Problems that result in the loss of a collected sample or could compromise sample integrity will be noted on a Corrective Action Report to document and rectify the problem.

6.2.1 Batteries are filled with sulfuric acid, which is very dangerous. Always use extreme caution, avoid spillage of electrolyte, and never cross polarity.

7.0 Attachments

7.1 Field Activity Form.

7.2 Corrective Action Report.

7.3 Monthly Maintenance Form.

7.4 Battery Maintenance and Tracking Form.

SOP-014
BMP Effectiveness Monitoring Project
Benthic Macroinvertebrate Sampling

1.0 Applicability

Physical and chemical characteristics of water bodies affect the abundance, species composition, stability productivity, and physiological condition of aquatic organism populations. Biological methods used for assessing water quality include the collection, counting, and identification of aquatic organisms.

2.0 Purpose

Whenever practical, biologists should collect their own samples. Much of the value of an experienced biologist lies in personal observations of conditions in the field and in the ability to recognize signs of environmental changes as reflected in the various aquatic communities.

Samples are to be collected with a kick net, screened, and preserved. Sorting and identification may occur in the field or the lab. Data should be recorded on a Field Activity Form containing the following information: site ID, site location, date, time, collectors names, and space for scientific names and number of individuals, if identified in the field.

3.0 Definitions

3.1 Kick Net- most versatile collecting devices for shallow, flowing water, and are useful for shoreline collecting in lakes. When combined with a standardized kicking technique, these nets are appropriate for quantitatively sampling macroinvertebrates.

4.0 Health and Safety Warnings

4.1 Collect samples safely, avoiding situations that may lead to accidents. When in doubt as to the level of safety precautions needed, consult a knowledgeable industrial hygienist or safety professional.

4.2 Cautions – None of note

5.0 Personnel Qualifications

5.1 Whenever practical, biologists should collect their own samples. Much of the value of an experienced biologist lies in personal observations of conditions in the field and in the ability to recognize signs of environmental changes as reflected in the various aquatic communities.

6.0 Equipment, Reagents, and Standards

6.1 "D" frame kick net
6.2 Chest Waders
6.3 Glass Jars for Specimens
6.4 Linesman Gloves
6.5 5-Gallon Plastic Buckets
6.6 Ethyl Alcohol
6.7 Formalin
6.8 Isopropyl Alcohol
6.9 Forceps
6.10 Pipettes
6.11 Sorting Sieves
6.12 Hand Counters

7.0 Instrument Method or Calibration

Not Applicable

8.0 Sample Collection

8.1 Benthic macroinvertebrate sample collection procedures are documented in the TNRCC Surface Water Quality Monitoring Procedures Manual, Volume 2 (August 2005).

9.0 Handling and Preservation

9.1 Fix samples in a solution of 10% buffered formalin or 70% ethanol. If ethanol is used, do not fill more than one-half the container with screened material.
9.2 Preserve and store animals with calcareous shells, i.e. mussels, snails, and ostracods, in 70% ethanol.

10.0 Sample Preparation and Analysis

10.1 Sample sorting procedures are documented in the TNRCC Surface Water Quality Monitoring Procedures Manual, Volume 2 (August 2005).

10.2 Specimen identification can be accomplished using the macroinvertebrate key by Merritt and Cummins (1996).

11.0 Data Acquisition, Calculations, and Data Reduction

Data calculations and reduction procedures are documented in the U.S. EPA Rapid Bioassessment Protocols for Use in Streams and Rivers (1989).

12.0 Data Management and Records

The Authority keeps copies of data sheets and data analysis results. In addition, any other entities are given copies of all forms for their records as needed.

13.0 Quality Control and Quality Assurance

There is no specific procedure for Quality Control and Quality Assurance techniques involving benthic macroinvertebrate sampling. Authority personnel should make all reasonable efforts for accuracy and completeness labeling.

14.0 References

14.1 Surface Water Quality Monitoring Procedures Manual. TNRCC. Volume 1, December 2003 and Volume 2, August 2005.

14.2 Rapid Bioassessment Protocols for Use in Streams and Rivers. United States Environmental Protection Agency, 1989.

14.3 An Introduction to the Aquatic Insects of North America. Merritt, R.W. and K.W. Cummins, Third Edition, 1996.

15.0 Attachments

15.1 Field Activity Form

SOP-015
BMP Effectiveness Monitoring Project
Fish Community Sampling

1.0 Applicability

Physical and chemical characteristics of water bodies affect the abundance, species composition, stability productivity, and physiological condition of aquatic organism populations. Biological methods used for assessing water quality include the collection, counting, and identification of aquatic organisms.

2.0 Purpose

All methods of collecting and observing fish are selective and, therefore, biased. No one method of collection will completely portray the composition of a fish assemblage. The Authority has determined that the use of seines and electrofishing during the study will meet goals of Authority fish community studies.

3.0 Definitions

3.1 Seine - a seine is a simple panel of netting pulled by a bridle at each end. The upper line of the seine is equipped with floats and the lower with weights.

3.2 Electrofisher - portable backpack unit powered by a battery used to stun fish and allow them to be collected.

3.3 Field Activity Form – Field Activity Forms are kept to record activities and problems with any activity for each operation done on a particular site. They are kept in three-ring binders at the Texas Forest Service FRD/BMP Laboratory.

4.0 Health and Safety Warnings

4.1 Sampling with electricity requires that the collector be aware of the special dangers associated with this technique. Specially trained staff in the proper uses of protective equipment and carefully monitor the sampling area before and during the operation.

5.0 Interferences

5.1 Excessively high and low conductivity levels and large algae populations in a stream can negatively affect electrofisher function.

6.0 Personnel Qualifications

6.1 Whenever practical, biologists should collect their own samples. Much of the value of an experienced biologist lies in personal observations of conditions in the field and in the ability to recognize signs of environmental changes as reflected in the various aquatic communities.

6.2 Personnel conducting this analysis should be trained in-house on proper technique and safety.
6.3 No unauthorized personnel should be allowed to conduct this work.
6.4 At least one member of sampling crew should be educated in CPR.

7.0 Equipment, Reagents, and Standards

7.1 Seines
7.2 Backpack Electrofisher w/extra battery
7.3 Chest Waders
7.4 Glass or Plastic Jars for Specimens
7.5 Linesman Gloves
7.6 5-Gallon Plastic Buckets
7.7 Nets
7.8 Portable Aerator
7.9 10% Formalin
7.10 Fish Measuring Board
7.11 Fish Identification Book(s)
7.12 Field Activity Form
7.13 Field ID of Fish Species Caught Form
7.14 Seining Form
7.15 Pencil
7.16 Polarized Sunglasses

8.0 Instruments or Method Calibration

Not Applicable.

9.0 Sample Collection

Fish sample collection procedures are documented in the TNRCC Surface Water Quality Monitoring Procedures Manual, Volume 2 (August 2005).

10.0 Handling and Preservation

10.1 For fish samples, when possible, identify and list the species of fish collected and number of individual of each species and release fish. Document samples on the Field ID of Fish Species Caught During Electrofishing and Seining Form.
10.2 If it is not possible to release the fish, preserve specimens in 10% formalin. Leave in formalin for a minimum of two weeks, rinse in water for one week, and then transfer to 70% ethyl alcohol for long-term storage.

11.0 Sample Preparation and Analysis

Sample preparation and analysis procedures are documented in the TNRCC Surface Water Quality Monitoring Procedures Manual, Volume 2 (August 2005).

12.0 Troubleshooting

None of note

13.0 Data Acquisition, Calculations, and Data Reduction

Data calculations and reduction procedures are documented in the U.S. EPA Rapid Bioassessment Protocols for Use in Streams and Rivers (1989).

14.0 Data Management and Records Management

The Authority keeps copies of data sheets and data analysis results. In addition, any other entities are given copies of all forms for their records as needed.

15.0 Quality Control and Quality Assurance

There is no specific procedure for Quality Control and Quality Assurance techniques involving benthic macroinvertebrate sampling. Authority personnel should make all reasonable efforts for accuracy and completeness labeling.

16.0 References

16.1 Surface Water Quality Monitoring Procedures Manual. TNRCC. Volume 1, December 2003 and Volume 2, August 2005.

16.2 Rapid Bioassessment Protocols for Use in Streams and Rivers. United States Environmental Protection Agency, 1989.

17.0 Attachments

17.1 Field Activity Form
17.2 Field ID of Fish Species Caught Form
17.3 Seining Form

SOP-016
BMP Effectiveness Monitoring Project
Habitat Assessment

1.0 Applicability

Habitat, as affected by instream and surrounding topographical features, is a major determinant of aquatic community potential. Both the quality and quantity of available habitat affect the structure and composition of resident biological communities. Final conclusions from biological studies should always include an evaluation of habitat quality to determine the extent that habitat may be a limiting factor.

2.0 Purpose

Because the habitat assessment is intended to support biosurvey analysis, the various habitat parameters are weighted to emphasize the most biologically significant parameters. All parameters are evaluated for each station studied. The ratings are then totaled and compared to a reference to provide a final habitat ranking. Scores increase as habitat quality increases.

3.0 Definitions

3.1 Bottom Substrate - refers to the availability of habitat for support of aquatic organisms. A variety of substrate materials and habitat types are desirable.

3.2 Embeddedness - The degree to which boulders, rubble, or gravel are surrounded by fine sediment.

3.3 Channel Alteration - The character of sediment deposits from upstream is an indication of the severity of watershed and bank erosion and stability of the stream system.

3.4 Bottom Scouring and Deposition - These parameters relate to the destruction of instream habitat resulting from the problems of channel alteration.

4.0 Health and Safety Warnings

Collect data safely, avoiding situations that may lead to accidents. When in doubt as to the level of safety precautions needed, consult a knowledgeable industrial hygienist or safety professional.

5.0 Personnel Qualifications

Whenever practical, biologists should collect their own assessments. Much of the value of an experienced biologist lies in personal observations of conditions in the field and in the ability to recognize signs of environmental changes as reflected in the various aquatic communities.

6.0 Equipment, Reagents, and Standards

6.1 Clinometer
6.2 Densiometer
6.3 Long Tape (100 meters)
6.5 Waders or Rubber Boots
6.6 Habitat Assessment Form
6.7 Field Activity Form
6.8 Pens or Pencils
6.9 Compass
6.10 Clipboard(s)
6.11 Yard Stick

7.0 Instrument or Method Calibration

7.1 See SOP-009, Stream Flow Measurement, for related calibration method for Flow-Mate flow meter.

8.0 Data Collection and Procedures

Habitat assessment procedures are documented in the TNRCC Surface Water Quality Monitoring Procedures Manual, Volume 1 (December 2003) and Volume 2 (August 2005).

9.0 Data Acquisition, Calculations, and Data Reduction

Data calculations and reduction procedures are documented in the U.S. EPA Rapid Bioassessment Protocols for Use in Streams and Rivers (1989).

10.0 Data Management and Records Management

The Authority keeps copies of data sheets and data analysis results. In addition, any other entities are given copies of all forms for their records as needed.

11.0 Quality Control and Quality Assurance

There is no specific procedure for Quality Control and Quality Assurance techniques involving benthic macroinvertebrate sampling. Authority personnel should make all reasonable efforts for accuracy and completeness labeling.

12.0 Reference Section

12.1 Surface Water Quality Monitoring Procedures Manual. TNRCC. Volume 1, December 2003 and Volume 2, August 2005.

12.2 Rapid Bioassessment Protocols for Use in Streams and Rivers. United States Environmental Protection Agency, 1989.

13.0 Attachments

13.1 Field Activity Form

13.2 Habitat Assessment Forms