ASSESSMENT OF NUTRIENT SOURCES FROM MAINSTEM AND SELECTED WATERSHEDS IN THE SUSQUEHANNA RIVER BASIN

Quality Assurance/Quality Control Plan
July 2007 – September 2008

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TABLE OF CONTENTS

1.0 PROJECT DESCRIPTION 1
- 1.1 Background 1
- 1.2 Objective and Scope 1
- 1.3 Data Usage 4
- 1.4 Monitoring Network Design and Rationale 5
- 1.5 Monitoring Parameters and Frequency of Collection 8

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY 11
- 2.1 Data Collection and Analysis 11
- 2.2 Project Coordination and Overview 12

3.0 QUALITY ASSURANCE OBJECTIVES 14
- 3.1 Detection Limits 14
- 3.2 Representativeness-Site Representation 15
- 3.3 Data Comparability 16
- 3.4 Precision and Accuracy 16

4.0 SAMPLING PROCEDURES 17

5.0 SAMPLE CUSTODY PROCEDURES 19

6.0 CALIBRATION PROCEDURES AND PREVENTIVE MAINTENANCE 19
- 6.1 Specific Conductance Meter 20
- 6.2 pH Meter 20
- 6.3 Thermometer 21
- 6.4 Dissolved Oxygen Meter 21
- 6.5 Maintenance of Calibration Records 21
- 6.6 Preventative Maintenance 22
- 6.7 Backup Instruments and Equipment 22

7.0 DOCUMENTATION, DATA REDUCTION, AND REPORTING 22

8.0 DATA ANALYSIS 23

9.0 INTERNAL QUALITY-CONTROL CHECKS 24

10.0 ANALYTICAL PROCEDURES 24

11.0 PERFORMANCE AND SYSTEM AUDITS 24
- 11.1 Laboratory 24
- 11.2 Field 25
- 11.3 System Audit 25

12.0 PREVENTIVE MAINTENANCE 27

13.0 ROUTINE PROCEDURES FOR DATA PRECISION, ACCURACY, AND COMPLETENESS 27

14.0 CORRECTIVE ACTION 28

15.0 REPORTS 28

16.0 REFERENCES 30

TABLES

Table 1. Parameters for Physical Characteristics and Other Constituents 10
Table 2. Detection Limits 15

APPENDICES

Appendix A Location Data 30
Appendix B Forms 31

1.0 PROJECT DESCRIPTION

1.1 Background

In 1987, the Commonwealth of Pennsylvania entered into an agreement with the federal government and the states that surround the Chesapeake Bay (Bay) to reduce nutrient loading to the Bay by 40 percent by the year 2000 at the fall line, which, for the Susquehanna River watershed, is located at the Conowingo Dam in Maryland. In 1992, the Commonwealth of Pennsylvania committed to tributary-specific reduction strategies to achieve this reduction and agreed to stay at or below the nutrient loads once the reduction is attained. Although measurable reductions in pollutant loadings have been made despite continuing growth and development, additional reductions will have to be achieved. In the draft Chesapeake 2000 Agreement, the Commonwealth of Pennsylvania and signatories to the Chesapeake Bay Agreement proposed to continue efforts to achieve and maintain the 40 percent nutrient reduction goal in order to achieve water quality conditions necessary to protect aquatic living resources and assign load reductions for nitrogen, phosphorus, and sediment to each major tributary. Tributary strategies are being developed and implemented to achieve these reductions. Consequently, it is very important that the premises upon which current and planned management programs are based be supported by data from long-term nutrient monitoring.

1.2 Objective and Scope

A) Existing Monitoring

The Susquehanna River Basin Commission (SRBC) completed an intensive 5-year study (concluded December 31, 1990) to provide nutrient and suspended-sediment loading data for the mainstem Susquehanna River and its major tributaries, and nutrient and suspended-sediment runoff data from selected small watersheds representative of the land uses found in the central and lower Susquehanna River Basin.

This sampling effort is the continuation of the 5-year study for the mainstem Susquehanna River, its major tributaries, and other selected tributaries. The scope of the monitoring program includes the following objectives:

1.2.1 To measure concentrations and estimate nutrient and suspended-sediment loads in the Susquehanna River at Towanda, Danville, and Marietta, Pa.; the West Branch Susquehanna River at Lewisburg, Pa.; the Juniata River at Newport, Pa.; and the Conestoga River at Conestoga, Pa.

1.2.2 To establish a sound database for government, agriculture, industry, and the public to most effectively plan and implement immediate and long-range nutrient reduction efforts.

B) Enhanced Monitoring

The CBP and signatories to the Bay Agreement have commitments to meet water quality criteria (dissolved oxygen, chlorophyll, and water clarity) in the Bay and its tidal tributaries by 2010. Collectively, this group is working to reduce loads of nutrients and sediment to achieve these criteria. An enhanced tidal water quality network has been developed for measuring attainment of the criteria in the Bay and tidal tributaries. While watershed model runs are used to predict the effectiveness of management actions to reduce loads, a nontidal water quality network is critical to measure and assess the actual nutrient and sediment concentration and load reductions in the tributary strategy basins across the watershed. Therefore, a nontidal water quality network has been designed for the Bay watershed, building from and integrating existing state and federal (United States Geological Survey (USGS) and U.S. Environmental Protection Agency (USEPA) monitoring programs, by the CBP Non-Tidal Water Quality Workgroup. The scope of the project includes the following objectives:

1.2.3 To measure and assess the actual nutrient and sediment concentration and load reductions in the tributary strategy basins across the watershed.

1.2.4 To improve calibration and verification of the partners' watershed models.

1.2.5 To help assess the factors affecting nutrient and sediment distributions and trends.

C) Status and Trends Analysis

This project will provide a trend update for the six long-term SRBC monitoring stations. This update supports a cooperative effort by the Maryland Department of Natural Resources (MDNR), USGS, Virginia Department of Environmental Quality (VADEQ), and SRBC for a comprehensive analysis of trends in water quality habitat and living resources for the Bay tidal and nontidal tributaries. The analyses will use the latest statistical protocols developed by the investigators in dialogue through the Monitoring and Analysis Subcommittee's Non-Tidal Workgroup, including adjustments for variations in flow, where appropriate, and selected application of nonlinear trend techniques. The trend analyses for water quality will include, at a minimum, where available, the following parameters: total and dissolved nitrogen; total and dissolved phosphorus; total and dissolved kjeldahl nitrogen; total and dissolved nitrate + nitrite; total and dissolved ammonia; dissolved orthophosphate; total organic carbon; total suspended solids; and suspended sediment. The scope of work for the project includes the following objectives:

1.2.6 To compile water quality data sets into a single database using Chesapeake Information Management System (CIMS) format for trend analysis.

1.2.7 To process compiled data sets using USGS approved regression techniques to generate all trend statistics including flow corrected trends.

1.3 Data Usage

The environmental measurements and analysis will provide baseline nutrient loading data for the mainstem and the selected major tributaries in sufficient detail to:

1.3.1 Allow model refinement and verification;

1.3.2 Track and better define nutrient loading dynamics;

1.3.3 Relate measured load fluctuations to changes in water discharge due to precipitation events of varying intensities, durations, and seasons; and

1.3.4 Evaluate nutrient loading trends.

1.4 Monitoring Network Design and Rationale

This section provides the rationale for establishing the sampling network that includes a series of mainstem and major tributary sites. All sites have been co-located with USGS stream gauging stations to obtain discharge data. The latitude and longitude of these sites and location map can be found in Appendix A. Existing long-term SRBC monitoring sites are listed under Group A, and enhanced monitoring sites are listed under Group B.

1.4.1 **Group A**

Susquehanna River at Towanda, Pa.

The Susquehanna River at Towanda was selected because it represents the contribution from New York State, although the drainage area does include a part of the Tioga River Basin in northern Pennsylvania and an area along the northern tier counties of north-eastern Pennsylvania. The drainage area at Towanda is 7,797 square miles.

Susquehanna River at Danville, Pa.

The Susquehanna River at Danville has a drainage area of 11,220 square miles and includes part of northcentral Pennsylvania and much of southcentral New York. Data collected at Danville represent the loadings from the mainstem Susquehanna River.

West Branch Susquehanna River at Lewisburg, Pa.

Data collected from the West Branch Susquehanna River at Lewisburg represent the loadings from a major tributary to the mainstem. The West Branch Susquehanna River includes much of northcentral

Pennsylvania and has a drainage area of 6,847 square miles. This watershed is predominantly forested (81 percent). The combined drainage area at Lewisburg and Danville represents 65.7 percent of the total Susquehanna River Basin.

Juniata River at Newport, Pa.

The Juniata River at Newport, another major tributary to the mainstem Susquehanna River, drains much of the southcentral area of Pennsylvania and has a drainage area of 3,354 square miles. The combined drainage area at Newport, Lewisburg, and Danville represents 77 percent of the total Susquehanna River Basin and 88.9 percent of the watershed above Harrisburg, Pa.

Susquehanna River at Marietta, Pa.

The Susquehanna River at Marietta is the southern-most sampling site upstream from the reservoirs on the lower Susquehanna River and represents the inflow to the reservoirs from its 25,900-square-mile drainage area. This drainage area represents 94.5 percent of the total Susquehanna River Basin.

Conestoga River at Conestoga, Pa.

Data collected from the Conestoga River at Conestoga provide loadings from a major tributary watershed that is actively farmed and is experiencing an increase in agricultural nutrient management programs. Additionally, this watershed is experiencing an increase in urban and suburban development. The drainage area of this basin at the sampling site is 470 square miles.

1.4.2 Group B

The following rationale was considered and stations meeting the conditions below were given priority status when selecting sites for Group B:

a. Sites that are located at outlets of major streams draining the tributary strategy basins.
b. Sites that are located in areas within the tributary strategy basins that have the highest nutrient delivery to the Bay.
c. Sites that represent the overall range of conditions in the Bay watershed. This would include ranges of loads from different land cover types (urban, agriculture, and forestland covers), diverse physiographic/geologic settings, and different watershed sizes.

The initial selection of sites was designed to support a network for the tributary basins. These sites will be evaluated for representativeness of watershed characteristics, which is important for model calibration and simulation. In the future, the network may be modified to ensure that these objectives are met.

Group B sites in Pennsylvania, Maryland, and New York include:

Susquehanna River at Smithboro, N.Y.
Chemung River at Chemung, N.Y.
Cohocton River near Campbell, N.Y.
Unadilla River at Rockdale, N.Y.
Susquehanna River at Conklin, N.Y.
Susquehanna River near Wilkes-Barre, Pa.
West Branch Susquehanna River near Karthaus, Pa.
West Branch Susquehanna River near Jersey Shore, Pa.
Penns Creek at Penns Creek, Pa.
Raystown Branch Juniata River at Saxton, Pa.

Shermans Creek near Dromgold, Pa.
Conodoguinet Creek near Hogestown, Pa.
Swatara Creek near Hershey, Pa.
West Conewago Creek near Manchester, Pa.
Pequea Creek near Martic Forge, Pa.
Bald Eagle Creek near Castanea, Pa.
Octoraro Creek at Richardsmere, Md.

Samples collected at these sites will be used for load and trend determination. Therefore, the criteria for determining sampling frequency are based on loads, which have more stringent requirements. To effectively capture the loads being transported, 20 samples will be collected per year, consisting of 12 monthly samples and eight storm samples. Two storm samples will be collected on different days during each of four storms per year (one per season), targeting the rising and peak flow of the storm.

1.5 Monitoring Parameters and Frequency of Collection

Filtered and unfiltered samples will be analyzed for physical characteristics and constituents listed in Table 1.

Samples from base flow conditions will be collected manually once a month at Group A stations. Samples will be collected from at least four verticals, based on the width of stream, across the section, and composited using the equal-width sampling procedure. All samples will be depth-integrated, using USGS standard equipment and techniques.

An additional date-based random flow sample will be collected at all sites around the twelfth of each month, plus or minus two days if it falls on the weekend, regardless of the stream discharge. If a base flow sample cannot be collected at Group A sites because of fluctuating discharges, a sample will be collected in its place at a discharge that is different from that of the random sample. If a storm sample is collected on the random sample date, it will be considered the random sample.

Storm runoff samples for all sites will be collected during four high flow events per year, targeting one storm per season. Two discreet samples will be collected per storm, targeting one sample during the rise and one during the peak of flow on different days.

Table 1. Parameters for Physical Characteristics and Other Constituents

Parameter	Number of Samples	Sample Matrix	Analytical Method Reference	Sample Preservation	Holding Time
Dissolved Oxygen	550	Water/sediment	Instream field measurement at each vertical	N/A	None
pH	550	Water/sediment	Instream field measurement at each vertical	N/A	None
Temperature	550	Water/sediment	Instream field measurement at each vertical	N/A	None
Specific Conductance	550	Water/sediment	Instream field measurement at each vertical	N/A	None
Suspended Sediment	550	Water/sediment	USGS*	N/A	N/A
Sand-Fine Splits	184	Water/Sediment	USGS*	N/A	N/A
Total Nitrogen	450	Water/sediment	Std. Meth. 4500-Norg-D**	Chill at 4^{o}C	None
Dissolved Nitrogen	450	Water	Std. Meth. 4500-Norg-D**	Chill at 4^{o}C	None
Total Kjeldahl Nitrogen +	100	Water/sediment	USEPA 351.2	Chill at 4 ^{o}C	28 Days
Dissolved Kjeldahl Nitrogen +	100	Water	USEPA 351.2	Chill at 4 ^{o}C	28 Days
Total Ammonia	550	Water/sediment	USEPA 350.1	Chill at 4^{o}C H_2SO_4 to pH<2	28 Days
Dissolved Ammonia	550	Water	USEPA 350.1	Chill at 4^{o}C H_2SO_4 to pH<2	28 Days
Total Nitrate + Nitrite	550	Water/sediment	USEPA 353.2	Chill at 4^{o}C	48 Hours
Dissolved Nitrate + Nitrite	550	Water	USEPA 353.2	Chill at 4^{o}C	48 Hours
Total Phosphorus-TP	550	Water/sediment	USEPA 365.1	Chill at 4^{o}C H_2SO_4 to pH<2	28 Days
Dissolved Phosphorus-DP	550	Water	USEPA 365.1	Chill at 4^{o}C H_2SO_4 to pH<2	28 Days
Dissolved Orthophosphate	550	Water	USEPA 365.1	Chill at 4^{o}C	48 Hours
Total Suspended Solids	450	Water/sediment	USGS-I-3765	N/A	7 Days
Total Suspended Solids	100	Water/Sediment	GEN 160.2 +	N/A	7 Days
Total Organic Carbon	450	Water/sediment	SM 5310C	Chill at 4^{o}C H_2SO_4 to pH<2	28 Days
Total Organic Carbon	100	Water/sediment	GEN 415.1/9060 +	Chill at 4^{o}C H_2SO_4 to pH<2	28 Days

*TWRI Book 3, Chapter C2 and Book 5, Chapter C1, Laboratory Theory and Methods for Sediment Analysis (Guy and others, 1969)
**Standard Methods, 19th Edition
+ New York analysis

Additional storm runoff samples will be collected for Group A sites, including a fifth storm event targeted for the spring. In addition to the two discreet samples mentioned above, a minimum of four discreet samples over the hydrograph (two on the rising and two on the falling stage) will be sent to the laboratory for analysis for Group A sites. Storm samples for the Conestoga River will be collected with an automatic pumping sampler. In the event that field personnel are at the site while the automatic sampler is still collecting, an additional manual sample will be collected in conjunction with the automatic samplers to check the representativeness of samples collected using the automatic sampler.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Data collection will be conducted by the SRBC with cooperation from the Pennsylvania Department of Environmental Protection (PADEP), Bureau of Laboratories (PADEP Lab) and the Bureau of Watershed Management (BWM), Division of Conservation Districts and Nutrient Management. New York sites will be sampled by the New York State Department of Environmental Conservation (NYSDEC) during the months of April through September.

2.1 Data Collection and Analysis

2.1.1 SRBC

Project Officer: Kevin H. McGonigal

Quality Assurance Officer: David W. Heicher

Data Analysis: Kevin H. McGonigal

2.1.2 PADEP Lab

Director: Dr. Roger Carlson

Inorganic Section: Ted Lyter

Quality Assurance Officer: James Yoder

2.1.3 NYSDEC

Contact: Ron Entringer

2.2 Project Coordination and Overview

2.2.1 PADEP, BWM, Division of Conservation Districts & Nutrient Management

Project Officer: Steven W. Taglang

Overall Project Responsibility: Steven W. Taglang

2.2.2 USEPA Chesapeake Bay Program Office

Project Officer: Rich Batuik, Kyle Zieba

Quality Assurance Officer: Rich Batuik

Data collection and data analysis will be performed by SRBC. Compliance with the Quality Assurance/Quality Control Plan will be the responsibility of each agency Quality Assurance Officer. Quarterly reports documenting data collection activities will be sent to the PADEP BWM Project Manager.

All Pennsylvania water samples will be taken to the PADEP Lab. Appropriate quality assurance measures for sample analyses and lab procedures, as established by the PADEP Lab, will be the responsibility of the Inorganic

Section Chief and the Quality Assurance Officer for the lab. Resolution of problems will be the responsibility of the Inorganic Section Chief and the respective Quality Assurance officers.

Project coordination and review will be the responsibility of the PADEP BWM Project Officer. Appropriate quarterly progress reports will be sent to the USEPA Project Officer by the PADEP BWM. Any problems that occur that cannot be solved by the project officers of each agency will be resolved by the identified PADEP BWM responsible individual.

New York samples will be collected by SRBC during October to March and by NYSDEC from April to September. Quality assurance of sample collection will be insured by both following the sample procedure listed in section 4.0. Water samples and duplicates collected at New York sites will be sent to Columbia Analytical Services for analysis. Samples will be analyzed according to the lab's approved Quality Assurance Project Plan (QAPP). Contact information for Columbia Analytical Services is as follows:

Columbia Analytical Services, Inc.
1 Mustard Street, Suite 250
Rochester, NY 14609-6925
Phone: (585) 288-5380
Mike Perry, Laboratory Director
MPerry@rochester.caslab.com

Sand/fine particle analysis and sediment analysis for storm samples will be conducted at the USGS Sediment Lab in Kentucky. Contact information for the USGS Sediment Lab is as follows:

Elizabeth A Shreve, Laboratory Chief

KY Water Science Center Sediment Laboratory

U.S. Geological Survey

9818 Bluegrass Parkway

Louisville, KY 40299

eashreve@usgs.gov

Phone: (502) 493-1916

Fax: (502) 493-1909

Suspended-sediment analysis for routine sampling at Group A sites will be conducted at SRBC.

3.0 QUALITY ASSURANCE OBJECTIVES

Data collected during this study will be used to help define magnitude, timing, and severity of nutrient and suspended-sediment inputs to the Bay and to provide a comparison with data collected from the Susquehanna River at Conowingo, Md. For this reason, several quality assurance objectives must be met.

3.1 Detection Limits

Analytical methods and detection limits must be compatible with those used by other data collection agencies.

The analytical methods and detection limits selected for the constituents of concern were determined by consultation with the USGS and the PADEP Lab to assure compatibility of the results. Detection limits, accuracy, and precision data contained in the Quality Assurance Plan for the PADEP Lab have been found acceptable for this project. A list of the constituents and their detection limits are presented in Table 2.

Table 2. Detection Limits

Parameter	Detection Limits for Columbia Analytical Services (mg/l)	Detection Limits for PADEP Labs (mg/l)
Total Nitrogen	N/A	0.040
Dissolved Nitrogen	N/A	0.040
Total Kjeldahl Nitrogen	0.050	N/A
Dissolved Kjeldahl Nitrogen	0.050	N/A
Total Ammonia	0.05	0.020
Dissolved Ammonia	0.05	0.020
Total Nitrite + Nitrate	0.002	0.040
Dissolved Nitrite + Nitrate	0.002	0.040
Total Phosphorus-TP	0.002	0.020
Dissolved Phosphorus-DP	0.002	0.020
Orthophosphate-P	0.001	0.002
Total Suspended Solids	1.0	2.000*
Total Organic Carbon	1.0	0.500

* Reporting limit

3.2 Representativeness-Site Representation

The collection of water quality samples representative of river conditions is essential for the program to be successful. Spatial variability inherent to a sampling site is addressed by taking depth-integrated, discharge-weighted water samples across the cross section at the sampling site; the sample thus reflects the composite effect of occurrences upstream from the site. Data will be collected within the same time frame at all locations. Therefore, data collected at all sites should be representative of conditions in the Susquehanna River Basin within a specified timeframe. Collection of greater than 90 percent of the programmed samples will be considered as fulfilling the program objective. Any samples short of the allotted goal will be applied to the following sample year.

3.3 Data Comparability

Use of USEPA-approved laboratory methods and USGS field techniques provide a uniform methodology for both field and laboratory analysis. Data from this project are intended to be comparable with data collected for the Chesapeake Bay River Input Monitoring Program. To ensure data are comparable with the River Input Program, similar data collection methods and analysis are used. The PADEP Lab routinely analyzes CBP split samples and USGS reference samples to check the comparability of the field and laboratory data.

3.4 Precision and Accuracy

Variability within the PADEP Lab will be quantified with field-split samples. Field blanks will be used to determine total measurement error due to contamination. If contamination of the blank is found, additional field blanks will be submitted, along with samples from the same volume of distilled water poured directly into the precleaned sample bottle. This procedure will help to determine the source of contamination. Samples sent to the laboratory for analyses will include five percent field-split samples and five percent field blanks. Duplicate sample results with greater than 20 percent error from the split sample will be discarded. Field blank results should be less than five percent of the lowest value in the sample batch. Variability among laboratories will be quantified through the use of field-split duplicate samples that will be sent to the USGS and the PADEP laboratories. This activity is being conducted in cooperation with the USGS in

Towson, Md., which has the responsibility for interlaboratory quality assurance. Detection limits, accuracy, and precision of data are included in each lab's individual Quality Assurance Plan and are acceptable for this project. Data analysis methods will be based on approved USEPA and USGS techniques.

4.0 SAMPLING PROCEDURES

A complete description of the sampling procedures used for this study can be found in Brown and others (1970) and in Guy and Norman (1970).

Descriptions of sampling devices are found in the National Handbook of Recommended Methods for Water-Data Acquisition, Chapter 3, pp. 3-18 to 3-24.

A copy of the sample identification and lab request form is found in Appendix B. Information on the form includes the collector's name and telephone number, date, time, sample number, and stream name. The first four digits of the sample number identify the collecting agency (SRBC) and the last three digits identify the sample in sequential order.

All water quality parameters including; temperature, dissolved oxygen, conductivity, and pH, will be taken instream at each vertical, and the median value will be recorded. During times when this is not possible due to high flow, all water quality will be taken from the composite sample after the water quality sample has been collected.

Whole-water (unfiltered) samples will be collected to ensure that the samples are representative of stream conditions. Samples will be collected by compositing depth-integrated samples from equal increments of discharge along the cross section in a precleaned churn splitter. Sample bottles will be filled while gently churning the water. Field-split samples will be collected by filling sample bottles from the same volume of water in the churn splitter. Samples will be filtered in the field. All automatically collected samples are composited on a time-weighted basis.

Field-blank samples will be processed in the field. Water for blank samples will be transported to the sampling site and processed through the pre-cleaned sampling equipment and churn splitter before filling the sample bottle provided by the lab.

Appropriate labels with the sample number, location, date, time, and fixative (where appropriate) will be affixed to each sample container. Samples will be stored on ice and transported to the lab within 24 hours of collection.

The standard USGS depth-integrating sampler, USDH-59 with epoxy coating, will be used on the larger river and stream sites when stream flows are low and velocities do not exceed 1.5 meters per second (m/s). The depth-integrating sampler, USDH-74 with epoxy coating and Teflon nozzle, will be used for higher flows when velocities are 1.5 to 2.0 m/s. Cleaned glass bottles will be used with the samplers.

The USGS PS-69 pumping sampler will be used at the Conestoga River sampling site for collection of storm samples since the rapid rise and fall of the Conestoga River hydrograph precludes adequate manual sampling. Samples will be collected and composited on a time-weighted basis.

All equipment will be cleaned with 0.1 percent v/v ratio of Liquinox: tap water and rinsed with tap water after each sampling trip. The equipment will be rinsed with distilled water and river water at the site before the initial sample is collected.

5.0 SAMPLE CUSTODY PROCEDURES

Immediately upon collection, samples will be chilled on ice and transported to the lab within 24 hours. The lab will perform the necessary analyses within the holding time limits specified in its Quality Assurance Plan.

All samples will be submitted with the appropriate analysis request form (Appendix B), as provided by the PADEP Lab and Columbia Analytical Services. This form includes the site location, name of person collecting the sample, and the standard analysis code, as well as any other pertinent information the lab or the sampler needs for future reference.

Field-tracking forms are not needed, since only one person will be handling and transmitting samples to the lab. A field notebook will be kept by personnel collecting the samples. A copy of the note sheet is included in Appendix B. Data to be recorded in the field notebook include the date, time, weather, field data collected, and any comments the collector has concerning the conditions at the site or problems encountered while collecting the sample.

Custody of samples at the lab will follow procedures as established by each labs individual Quality Assurance Plan, with appropriate documentation.

6.0 CALIBRATION PROCEDURES AND PREVENTIVE MAINTENANCE

Every instrument used to collect water quality data will be checked for accuracy as follows.

6.1 Specific Conductance Meter

Primary Meter: YSI 650 MDS with 600R sonde and Cole Parmer model 1481-61 conductance meters with 500 series cell probe will be used. SRBC personnel will keep meters in working order and check weekly against one specific conductance standard (usually 447 umhos/cm), obtained within six months from Oakton Calibration Solutions.

Acceptance Criteria:

Standards (<1,000 umhos/cm) ± 4 percent

(>1,000 umhos/cm) ± 3 percent

Backup Meter: Cole Parmer model 1481-61 conductance meter with 500 series cell probe will be used. Lab personnel will keep meters in working order and check weekly against three specific conductance standards, obtained within six months from the USGS Central Laboratories to insure they are working properly.

6.2 pH Meter

Primary Meter: YSI 650 MDS with 600R sonde and Cole Parmer model 5996-70 pH meters will be used. SRBC personnel will keep the meters in working order and check weekly against two pH buffer standards (7 and 10), purchased within six months from Beckman Instruments, to insure the meters are working properly. The pH meter is checked with at least two buffers, prior to sample collection, and the results are recorded in the instrument calibration log.

Backup Meter: Cole Parmer model 5996-70 pH meter will be used. Lab personnel will keep the meters in working order and check weekly against three pH buffer standards (4, 7, and 10), purchased within six months of its use to insure they are working properly. The pH meter is to be checked with at least two buffers once in the morning and once in the afternoon during each day's use. This check is always to be done, and recorded in the instrument calibration log.

6.3 Thermometer

YSI models 650 MDS with 600R sonde will be used. The sondes utilize a thermistor of sintered metallic oxide that changes predictably in resistance with temperature variation. The algorithm for conversion of resistence to temperature is built into the sonde, software, and accurate temperature readings in degrees Celsius, Kelvin, or Fahrenheit are provided automatically. No calibration or maintenance of the temperature sensor is required.

Acceptance Criteria:

Temperature +0.2^{o}

6.4 Dissolved Oxygen Meter

Primary Meter: YSI models 650 MDS with 600R sonde will be used. Meters will be calibrated daily prior to sample collection using the air calibration chamber in water method.

Backup Meter: YSI model 95. Meters will be calibrated daily prior to sample collection using the air calibration chamber in water method.

6.5 Maintenance of Calibration Records

Staff will maintain records of instrument calibrations, repairs, and maintenance in the "Water Quality Field Instrument Calibration Log," and will report any abuse or neglect of equipment or calibration schedules to the Project Officer.

6.6 Preventative Maintenance

6.6.1 Conductivity–dip cell

Staff will wash the conductivity cell with distilled water and river water. The cell will be shaken dry and stored.

6.6.2 pH–combination electrode

The electrode will be stored according to operating manual instructions.

6.6.3 Dissolved oxygen meter

Meters will be stored according to operating manual instructions.

6.6.4 Churn splitter

SRBC staff will churn with distilled water and river water before collecting a sample at each site. SRBC staff also will rinse and scrub the churn splitter and filter with liquinox detergent and tap water at the end of each sampling day.

6.7 Backup Instruments and Equipment

Backup instruments and equipment also will be maintained, as described above.

7.0 DOCUMENTATION, DATA REDUCTION, AND REPORTING

Samples collected in the field will be labeled at the time of collection. Sample bottles are labeled with a seven-digit identification number, sampling date, and time. The seven-digit identification number consists of a four-digit collector identification number and a three-digit sample number. This identification information also is recorded on a laboratory submission sheet. One form is submitted with each set of samples and also includes an analysis code that designates the laboratory analyses to be conducted. Laboratory results from PADEP will be received by electronic transfer. Columbia Analytical Services will submit hard copies of data from New York.

All project data will be entered into the SRBC computer-data files. On completion of data entry, they will be retrieved, and visually checked by project personnel to insure that data was entered correctly. All verified data will be submitted, as electronic-data files, to the USEPA CBP Project Officer. The data will be served on SRBC's website (www.srbc.net) in accordance with the format, documentation requirements, data dictionary standards, and procedures described in the most recent version of the CBP Data-Management Plan for Water-Quality Data. Data that are not described in the water quality data management plan will be submitted in accordance with the most recent version of the CBP's Data Submissions Guidelines document. All parameters will be reported in mg/l.

8.0 DATA ANALYSIS

Loads and flow-adjusted trends are estimated using the USGS 7-parameter, log-linear regression model (ESTIMATOR) developed by Cohn and others (1989) and described in Langland and others (1999). This estimator relates the constituent concentration to water discharge, seasonal effects, and long-term trends, and computes the best-fit regression equation. Daily loads of the constituents then are calculated from the daily mean water discharge records. Loads and trends are calculated using S-Plus with the USGS ESTREND library addition and SLOAD (Schertz and others, 1991).

9.0 INTERNAL QUALITY-CONTROL CHECKS

SRBC personnel will receive results of analyses, and will submit copies of the analyses and "primary printouts" to project personnel. Personnel will review results for accuracy and acceptability within five to ten days after receipt, using their analytical experience and knowledge of water quality of streams in the basin. The data will be verified by comparing values with ranges of values from prior sampling and by review of data plots.

If an error in an analysis is detected or suspected, the questionable value will be noted and a rerun will be requested. Rerun data will be reviewed by the project personnel, and appropriate changes will be made in the computer files. If results of field-split duplicate samples are different but are within quality assurance specifications, the average of the two values will be reported.

10.0 ANALYTICAL PROCEDURES

Pennsylvania samples will be analyzed by PADEP Lab and New York samples will be analyzed by Columbia Analytical Services. The methods used by the laboratory are listed in Table 1. Laboratory quality assurance procedures, including use of standard reference materials, are documented in the specific labs Standard Operating Procedures.

11.0 PERFORMANCE AND SYSTEM AUDITS

11.1 <u>Laboratory</u>

Analytical and quality assurance procedures for each laboratory are detailed in the Labs Quality Assurance Plan. Duplicate samples will be submitted to the PADEP, CAS, and USGS laboratories by the field personnel, as directed above. The total number of quality assurance samples submitted will be at least ten percent of the samples analyzed. The appropriate Quality Assurance Office and Project Officer will review results for necessary action. Any problems, which cannot be resolved by SRBC personnel, will be deferred to the PADEP BWM Project Officer for solution.

Chesapeake Bay Tributary Split Samples (Blue Plains) are delivered to PADEP Lab, and the results are compared to other Bay laboratories. USGS nutrient reference samples are analyzed once or twice a year.

11.2 Field

Field personnel will be subjected to performance audits for pH and specific conductance. USGS will schedule audits annually using standard samples provided by the USGS Central Lab. Results will be verified by the USGS Central Lab. The appropriate Quality Assurance Officer is responsible for verifying that all field personnel are competent in the collection techniques before participation in any fieldwork. Any unsatisfactory results will be cause for a repeat audit, at the discretion of the Project Officer.

11.3 System Audit

This audit is made by the appropriate agency Quality Assurance Officer as a qualitative and quantitative inspection and review of the total measurement system. Audits include reviews of the following:

11.3.1 Organization and responsibility--Is the quality-control organization operational? Are quality-control and system audits properly made and documented?

11.3.2 Data collection--Are written data collection procedures available and followed? Are personnel completing all record forms and identification labels?

11.3.3 Sample collection--Are written sample collection procedures available and followed? Do personnel use the required containers? Are containers clean to prevent contamination?

11.3.4 Sample analysis--Are written analysis procedures available and followed?

11.3.5 Human errors--Are data checks made and actions taken to control human errors? Is the program of pass-fail checks for operations in use? Does checking show that the desired quality assurance level is met?

11.3.6 Measurement comparisons--Are results from measurements-comparison testing reviewed and used?

The role of audits in the overall measurement program is one of verification. While audits do not improve data quality, if all work is correctly performed, they do provide assurance that the work prescribed for the measurement program has been conducted properly. A summary of all audit results will be submitted to SRBC and PADEP BWM, and will include: the purpose of the audit; personnel audited; activities audited; tests observed;

documents and data reviewed; work performance and errors in procedures observed; corrective actions recommended, a deadline for completion of corrective actions, and a provision for verification of completion of corrective actions.

12.0 PREVENTIVE MAINTENANCE

All lab equipment will be maintained as specified in each lab's individual Quality Assurance and Work Plans.

The appropriate Quality Assurance Officer will keep maintenance records of all equipment and calibration procedures. The Project Officer will review these records periodically.

All field equipment will be maintained as described in Section 6.0.

13.0 ROUTINE PROCEDURES FOR DATA PRECISION, ACCURACY, AND COMPLETENESS

Assessment of data precision and accuracy for the monitoring program will consist of collecting and analyzing duplicate, field-split duplicate, and blank samples. The purpose of these quality assurance practices is to check the precision of the laboratories that provide water analyses and data for the program's use and to verify that the laboratories are producing comparable results. These criteria will be evaluated in terms of the standard deviation(s) and the coefficient of variation (cv) for each of the constituents analyzed. The number of QA samples is described in Section 3.3.

All data will be verified and submitted to the USEPA CBP office according to procedures established in the latest Data Submission Guidelines and Water Quality Data Management Plan.

Load calculations will be made using an established method that is consistent with the methods used by the Harrisburg division of USGS, SRBC, and USGS in Maryland.

14.0 CORRECTIVE ACTION

Corrective action is taken immediately upon discovery of a problem. Project personnel will interact constantly to coordinate project activities. Additionally, meetings with personnel from all agencies will be held at the discretion of the PADEP BWM Project Officer. Data and data-collection activities are discussed constantly and evaluated. Corrective action is taken immediately by the appropriate agency Project Officer, if evaluation indicates action is necessary. Laboratory corrective action is the responsibility of the Lab Quality Assurance Officer. Any issues that cannot be resolved by the Lab Officer and the SRBC Officer, will be referred to the PADEP BWM Project Officer or his/her supervisor for action.

15.0 REPORTS

Quarterly reports will be submitted by SRBC to the PADEP BWM Project Officer. These quarterly reports will include a description of activities completed during the quarter, as well as any problems encountered. Data analysis results will be summarized. A description of activities planned for the next quarter also will be included.

A quarterly report will be submitted to USEPA, CBP Office Project Officer by the PADEP BWM Project Officer as part of the quarterly grant report.

A final report also will be submitted by SRBC annually that summarizes the results to the PADEP BWM Project Officer.

For the enhanced Group B sites and trends work, a semi-annual progress report and final report will be completed and submitted to the CBP Office.

16.0 REFERENCES

Brown, E., M.W. Skougstad, and M. Fishman. 1970. Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases. U.S. Geological Survey Techniques of Water Resources Investigation, Book 5, Chapter A1.

Cohn, T.A., L.L DeLong, E.J. Gilroy, R.M. Hirsch, and D.E Wells. 1989. Estimating Constituent Loads. Water Resources Research, 25(5), pp. 937-942.

Guy, H. P., and V.W. Norman. 1969. Field Methods for Measurement of Fluvial Sediment. U.S. Geological Survey Techniques of Water Resources Investigation, Book 3, Chapter C2 and Book 5, Chapter C1.

Langland, M.J., J.D. Bloomquist, L.A. Sprague, and R.E. Edwards. 1999. Summary of Trends and Status for Flow, Nutrients, Sediments at selected Nontidal Sites, Chesapeake Bay Basin, 1985-99. U.S. Geological Survey (Open-File Report 01-73), 20 pp.

Schertz, T.L., Alexander, R.B, and Ohe, D.J. 1991. The computer program EStimate TREND (ESTREND), a system for the detection of trends in water quality data: U.S. Geological Survey Water-Resources Investigations Report 91-4040, 63 pp.

APPENDIX A

LOCATION DATA

TABLE A1. LATITUDE AND LONGITUDE OF SAMPLING SITES

Existing SRBC sites (Group A sites)	Latitude	Longitude
Susquehanna River at Towanda, Pa. (James Street Bridge)	41°47'27"	76°26'40"
Susquehanna River at Danville, Pa.	40°57'29"	76°37'10"
Susquehanna River at Lewisburg, Pa.	40°58'05"	76°52'25"
Juniata River at Newport, Pa.	40°28'42"	77°07'46"
Susquehanna River at Marietta, Pa. (Rt. 30 Bridge)	40°02'08"	75°31'23"
Conestoga River at Conestoga, Pa.	39°56'20"	76°23'15"
Enhanced Sites (Group B sites)	**Latitude**	**Longitude**
Susquehanna River at Smithboro, N.Y.	42°02'02"	76°24'02"
Cohocton River near Campbell, N.Y.	42°15'09"	77°13'01"
Chemung River at Chemung, N.Y.	42°00'10"	76°38'06"
Susquehanna River at Conklin, N.Y.	42°02'07"	75°48'12"
Unadilla River at Rockdale, N.Y.	42°22'40"	75°24'23"
Susquehanna River near Wilkes-Barre, Pa.	41°15'03"	75°52'52"
West Branch Susquehanna River near Jersey Shore, Pa.	41°12'08"	77°15'05"
Penns Creek at Penns Creek, Pa.	40°52'00"	77°02'55"
Bald Eagle Creek near Castanea, Pa.	41°07'36"	77°25'60"
Shermans Creek near Dromgold, Pa.	40°20'46"	77°11'31"
Conodoquinet Creek near Hogestown, Pa.	40°15'08"	77°01'17"
Swatara Creek near Hershey, Pa.	40°17'54"	76°40'05"
West Conewago Creek near Manchester, Pa.	40°04'56"	76°43'13"
Pequea Creek near Martic Forge, Pa.	39°53'53"	76°20'32"
West Branch Susquehanna River near Karthaus, Pa.	41°07'03"	78°06'33"
Raystown Branch Juniata River at Saxton, Pa.	40°12'57"	78°15'56"
Octoraro Creek at Richardsmere, Md.	39°41'25"	76°07'41"

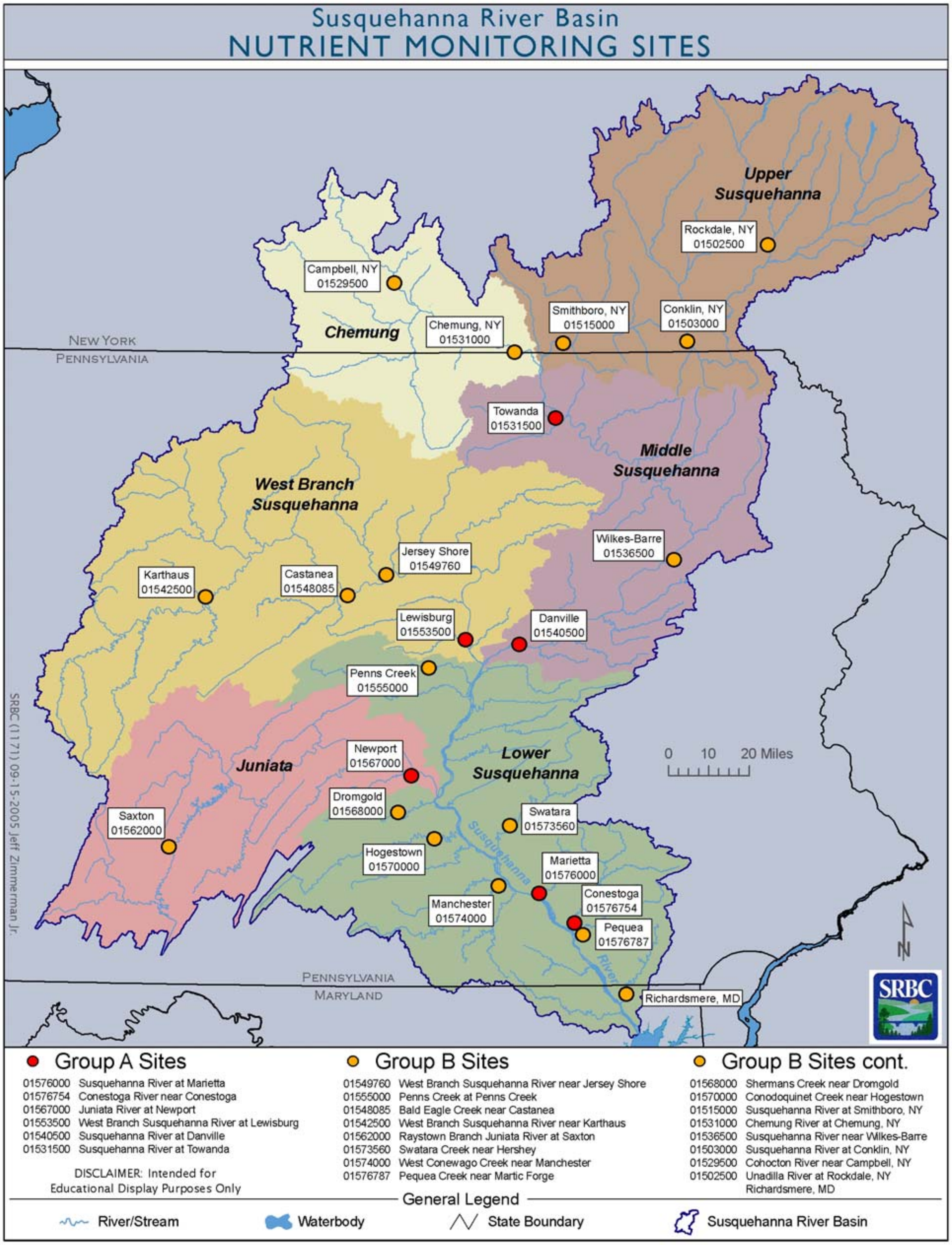

Figure A1. Sampling Site Locations

Appendix B

Forms

FIELD NOTES Group A

SITE

Station No.______________________________ Location ______________________________________

Date ______________ Time ____________ Investigators ______________________________________

STAGE CONDITION

Stable ____________________ Rising ____________________ Falling _________________________

Gage Ht. _______/________ Inside ______/______ Inside __________ Outside _______________

No. Verticals Sampled ____________

FIELD CHEMISTRY

Temp. ____________________ pH ____________________ Sp. Cond. _________________________

STAGE CONDITION

Stable ____________________ Rising ____________________ Falling _________________________

Gage Ht. _______/________ Inside ______/______ Inside __________ Outside _______________

SITE

Station No.______________________________ Location ______________________________________

Date ______________ Time ____________ Investigators ______________________________________

STAGE CONDITION

Stable ____________________ Rising ____________________ Falling _________________________

Gage Ht. _______/________ Inside ______/______ Inside __________ Outside _______________

No. Verticals Sampled ____________

FIELD CHEMISTRY

Temp. ____________________ pH ____________________ Sp. Cond. _________________________

STAGE CONDITION

Stable ____________________ Rising ____________________ Falling _________________________

Gage Ht. _______/________ Inside ______/______ Inside __________ Outside _______________

FIELD NOTES Group B

SAMPLE NUMBER ____________________ **LOCATION** ____________________
DATE ____________________ **FLOW** ____________________
TIME ____________________
pH ____________________
COND. ____________________
TEMP. ____________________
D.O. ____________________
ACID. ____________________
ALK. ____________________

SAMPLE NUMBER ____________________ **LOCATION** ____________________
DATE ____________________ **FLOW** ____________________
TIME ____________________
pH ____________________
COND. ____________________
TEMP. ____________________
D.O. ____________________
ACID. ____________________
ALK. ____________________

SAMPLE NUMBER ____________________ **LOCATION** ____________________
DATE ____________________ **FLOW** ____________________
TIME ____________________
pH ____________________
COND. ____________________
TEMP. ____________________
D.O. ____________________
ACID. ____________________
ALK. ____________________

SAMPLE NUMBER ____________________ **LOCATION** ____________________
DATE ____________________ **FLOW** ____________________
TIME ____________________
pH ____________________
COND. ____________________
TEMP. ____________________
D.O. ____________________
ACID. ____________________
ALK. ____________________

Fixed:

DEP Laboratory
Sample Submission Sheet

LAB USE ONLY
Lab Number:
Date Received:

Collector ID: | Seq. No.: | Date Collected: (MM-DD-YY) | Time Collected:

SAC or Suite Code: 874

Reason: 01 | Cost Center: 049 | Program: 0044 | SPN:

Matrix Code: 001

Residual Chlorine: YES NO (circled: NO)

pH less than 2.0? YES NO (circled: YES)

Legal Seal Number

Check If Broken:

Custody Log
How Shipped:
Date:
Received by:

Additional Information:

Addressee : jhoffman@srbc.net
Address 1 :
Address 2 :
City : State: Zip:

Sampling Location:

Field Results:

Flow	
Gage Height	
Temp	
pH	
Cond.	
D.O.	
Alkalinity	
Acidity	

Collector Name (Please PRINT) :

Signature: Date: Phone: 238-0426

☐ = Required Information

One Copy of This Sheet Goes To: a) 625 Broadway, 4th Floor, Albany, New York 12233-3502
b) With sample to contract lab c) Retain for your records

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Print Legibly

Clear Form

CAUTION (check if applicable)

☐ Lab personnel are expected to use caution when handling DEC samples, however, please use special caution when handling this sample since it is believed to contain significant concentrations of hazardous and/or toxic material(s).

CHECK THE BOX PRECEDING THE REQUESTED ANALYSIS

PRIORITY POLLUTANTS (Water and Wastewater Title 40 Part 136)—SPDES

☐ 1. 13PP Metals	☐ 10. Sulfate	☐ 19. Halogenated Volatiles (USEPA 601 GC)
☐ 2. Cyanide	☐ 11. Reactive Phosphorus	☐ 20. Aromatic Volatiles (USEPA 602 GC)
☐ 3. BOD	☑ 12. Total Phosphorus + Dissolved	☐ 21. Volatiles (USEPA 624 GC/MS)
☐ 4. CBOD	☑ 13. Nitrate/Nitrite Total + Dissolved	☐ 22. Low-Level Volatiles (USEPA 524.2 GC/MS)
☐ 5. COD	☑ 14. Ammonia Total + Dissolved	☐ 23. Acids/Base/Neutrals (USEPA 625 GC/MS)
☐ 6. pH	☐ 15. TKN	☐ 24. Pesticides/PCBs (USEPA 608 GC)
☐ 7. Settleable Solids	☐ 16. Total Phenols	☐ 25. PCBs at 0.065 µg/L (USEPA 608 GC)
☐ 8. Total Solids	☑ 17. TOC	☐ 26. PCBs congener method (1668A HRGC/HRMS)
☑ 9. TSS	☐ 18. Oil/Grease	☐ 27. Other TPO4, DPO4, TN, DN

CONTRACT LABORATORY PROTOCOLS

☐ 28. (ALL) - Water - Includes 29-33	☐ 35. (ALL) - Soil/Sediments - Includes 36-40
☐ 29. Base/Neutral/Acid (B/N/A) Water (GC/MS)	☐ 36. Base/Neutral/Acid (B/N/A) Soil/Sediments (GC/MS)
☐ 30. Volatile Organic Analysis (VOA) Water (GC/MS)	☐ 37. Volatile Organic Analysis (VOA) Soil/Sediments (GC/MS)
☐ 31. Pesticides/PCBs Water (GC/MS)	☐ 38. Pesticides/PCBs Soil/Sediments (GC)
☐ 32. 23 Metals in Water	☐ 39. 23 Metals in Soil/Sediments
☐ 33. Cyanide in Water	☐ 40. Cyanide in Soil/Sediments
☐ 34. Dioxin - Water (1613B GC/MS)	☐ 41. Doixin - Soil/Sediments (1613B GC/MS)
☐ 42. Other ______	

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

☐ 43. EP Toxicity	☐ 48. EP Toxicity (Metals Only)	☐ 53. BNA (USEPA 8270 GC/MS)
☐ 44. Corrosivity	☐ 49. TCLP (Metals Only)	☐ 54. Pesticides (USEPA 8081GC/ECD)
☐ 45. Ignitability	☐ 50. Metals—17 Hazardous	☐ 55. PCBs (USEPA 8082 GC/ECD)
☐ 46. Reactivity	☐ 51. Percent Solids	☐ 56. Dioxin (USEPA 8280 GC/MS)
☐ 47. TCLP	☐ 52. VOA (USEPA 8260 GC/MS)	☐ 57. Other ______

MUNICIPAL SLUDGE

☐ 58. RS-01 ☐ 59. RS-02 ☐ 60. Other ______

COLLECTED BY: Darryl Sitlinger
TELEPHONE NUMBER: (717) 238-0426 x 111
REGION NO.:

CONTRACT LABORATORY: CAS
COUNTY: Stuben
SAMPLING DATE: 10/12/05
MILITARY TIME: 0900

SAMPLE MATRIX:
☐ Air ☐ Soil/Sediment ☐ Groundwater ☑ Surface Water ☐ Wastewater ☐ Other ______

CASE NO.	SDG NO.	SAMPLE NO.	CHECK FOR MS/MD	TYPE OF SAMPLE
R11B04	101125	75000 3	☐ This Sample	☐ Grab ☑ Composite ☐ Term ____

☐ Check if there will be more samples with this SDG sent in this calendar week.

Report via Category B, unless checked ☐

SAMPLING POINT:

Cohocton River @ Campbell

G - 0.63 Q - 166

Check if field duplicate ☐

Outfall Number

Check if sampling is part of inspection ☐

FLOW: ________ GPD ________ MGD

SPDES NUMBER/REGISTRY NUMBER

Revised 10/24/06