SCENIC RIVERS MONITORING PROGRAM: WATER QUALITY MONITORING OF THE NON-TIDAL DELAWARE RIVER. QUALITY ASSURANCE PROJECT PLAN 2013

DELAWARE RIVER BASIN COMMISSION

Delaware River Basin Commission
DELAWARE • NEW JERSEY
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UNITED STATES OF AMERICA

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List of Abbreviations and Acronyms

BASE	Baseline Streamflow Estimator (USGS computer application)
BBL	Bottle Blank
BCP	Boundary Control Point (tributary to Delaware River)
DAW	Drainage Area Weighting
DEWA	National Park Service, Delaware Water Gap National Recreation Area
DO	Dissolved Oxygen
DRBC	Delaware River Basin Commission
EDD	Electronic Data Deliverable
EWQ	Existing Water Quality
FMO	Field Measurement / Observation
ICP	Interstate Control Point (Interstate Waters Site)
LDEL	Lower Delaware Scenic and Recreational River
MCP	Modeling Control Point (alternative tributary monitoring location for modeling)
NJDEP	New Jersey Department of Environmental Protection
NJDOH-ECLS	New Jersey Department of Health, Environmental and Chemical Laboratory Services
NPS	National Park Service
NWIS	National Water Information System (USGS water quality data system)
NYSDEC	New York State Department of Environmental Conservation
PADEP	Pennsylvania Department of Environmental Protection
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
REP	Replicate Sample
RIN	Sampling Equipment Rinsate Blank
ROU	Routine Sample
RPD	Relative Percent Difference
SM	Standard Methods for Examination of Water and Wastewater, 21st ed.
SOP	Standard Operating Procedure
SPC	Specific Conductance
SPW	Special Protection Waters
SRMP	DRBC / NPS Scenic Rivers Monitoring Program
TDS	Total Dissolved Solids
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UPDE	National Park Service, Upper Delaware Scenic and Recreational River
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WQDE	Water Quality Data Exchange (NJDEP water quality data system)
WQX	Water Quality Exchange (USEPA water quality data system)

1 Project Management Elements

The elements in this section address project management, including project history and objectives, roles and responsibilities of the participants. These elements document that the project has a defined goal and the approach to be used, and that the planning outputs have been documented.

1.1 *Distribution List*

Signed copies of this Quality Assurance Project Plan (QAPP) and all subsequent revisions will be sent to the following individuals by *electronic mail*:

Table 1. QAPP Distribution List

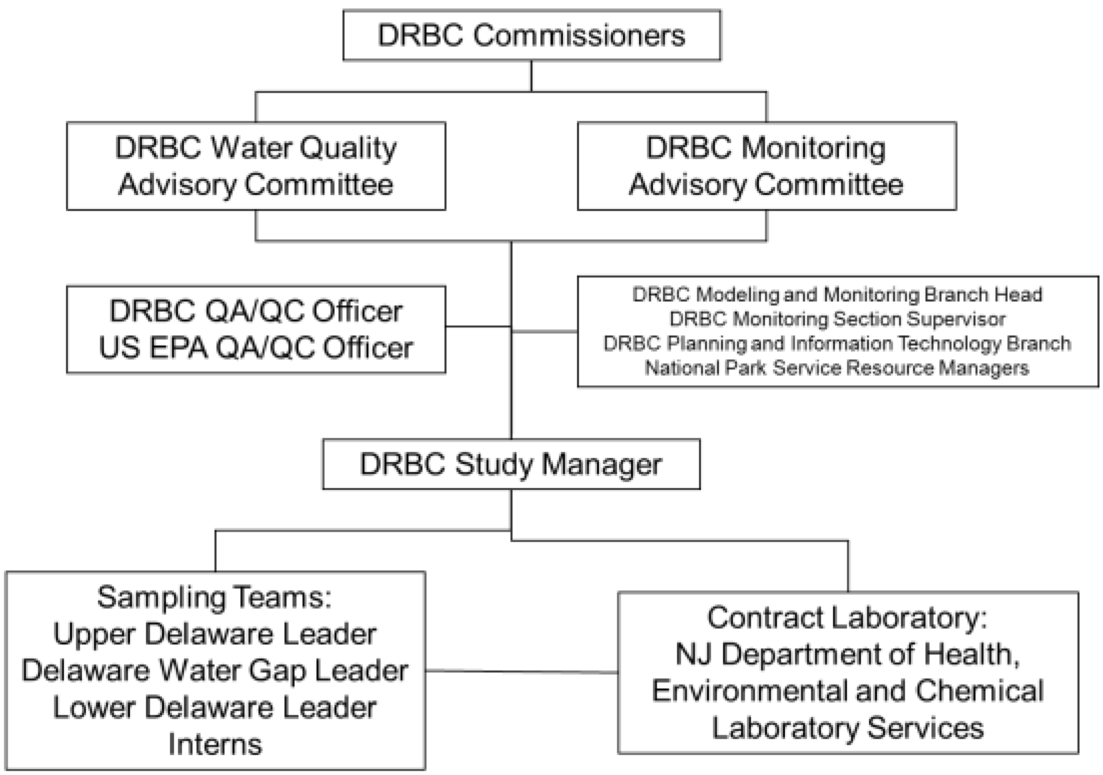
Individual	Organization
Dr. Thomas Fikslin	Delaware River Basin Commission
Mr. John Yagecic	Delaware River Basin Commission
Dr. Erik Silldorff	Delaware River Basin Commission
Mr. Robert Limbeck	Delaware River Basin Commission
Mr. Eric Wentz	Delaware River Basin Commission
Mr. Chad Pindar	Delaware River Basin Commission
Ms. Pamela V'Combe	Delaware River Basin Commission
Dr. Kenneth Najjar	Delaware River Basin Commission
Dr. Ronald MacGillivray	Delaware River Basin Commission
Mr. Allan Ambler	National Park Service
Mr. Donald Hamilton	National Park Service
Ms. Jamie Myers	National Park Service
Ms. Margaret Novak	New York State Department of Environmental Conservation
Mr. Rodney Kime	Pennsylvania Department of Environmental Protection
Ms. Leslie McGeorge	New Jersey Department of Environmental Protection
Ms. Terry Simpson	USEPA, Region 3, QA Manager
Mr. Charlie Jones	USEPA, Region 3, QA Staff
Ms. Kimberly Scharl	USEPA, Region 3, DRBC 106 Grant Coordinator
Mr. Douglas Haltmeier	NJ Dept. of Health, Environmental and Chemical Laboratory Services

Printed copies will be available upon request. Furthermore, signed copies of this QAPP and all subsequent revisions will be available from the Delaware River Basin Commission (DRBC) web site at http://www.state.nj.us/drbc/

1.2 *Project / Task Organization*

Figure 1 below identifies the individuals and organizations participating in the project and outlines the formal lines of responsibility.

Figure 1. Lines of Responsibility and Authority



For the purposes of this QAPP, the Project Team consists of all federal and state personnel and contracted personnel actively involved in the development, coordination, and completion of the sampling program. Table 2 below briefly describes the duties and responsibilities of the members of the Project Team.

Table 2. Description of Responsibility

Key Individual	Title	Phone	Responsibility
Robert Limbeck, DRBC	Study Manager	609-883-9500 x230	Provide overall project coordination, including the preparation of a quality assurance project plan, the scheduling of project tasks to ensure timely completion, coordination and oversight of sampling and analyses, the review of the data to determine compliance with QA/QC requirements and the overall quality of the data, and preparation of a final report.
John Yagecic, P.E.	Monitoring Supervisor	609-883-9500 x271	Provide monitoring supervision; coordination with DRBC modeling section.
Dr. Thomas Fikslin	DRBC QA/QC Officer; Branch Head	609-883-9500 x253	Ensure that the overall quality assurance of the project is achieved; and ensure that activities are coordinated between DRBC, National Park Service; U.S. EPA and the analytical laboratories to meet project schedule.
Donald Hamilton and Jamie Myers, NPS	NPS Sample Collection Team Leaders, Upper Delaware Scenic and Recreational River (UPDE)	570-729-7842	Oversee sample collection from the Delaware River and tributaries in the Upper Delaware Scenic and Recreational River; ensure sample collection in accordance with QAPP procedures; ensure sampling equipment decontamination between sampling locations; ensure proper sampling containers and preservation procedures; QA coordinator for field activities; and ensure response action implementation during sampling operations, if needed. Transmittal of field data to DRBC.
Allan Ambler, NPS	NPS Sample Collection Team Leader, Delaware Water Gap National Park (DEWA)	570-296-6952 x22	Oversee sample collection from the Delaware River and tributaries in the Delaware Water Gap National Park; ensure sample collection in accordance with QAPP procedures; ensure sampling equipment decontamination between sampling locations; ensure proper sampling containers and preservation procedures; QA coordinator for field activities; and ensure response action implementation during sampling operations, if needed. Transmittal of field data to DRBC.
Robert Limbeck, DRBC	DRBC Sampling Team Leader, Lower Delaware Scenic and Recreational River (LDEL)	609-883-9500 x230	Oversee collection of water samples from the Delaware River and tributaries in the Lower Delaware Scenic and Recreational River; ensure sample collection in accordance with QAPP procedures; ensure sampling equipment decontamination between sampling locations; ensure proper sampling containers and preservation procedures; QA coordinator for field activities; and ensure response action implementation during sampling operations, if needed.
Douglas Haltmeier	Laboratory Manager NJ Dept. of Health, Environmental and Chemical Laboratory Services (NJDOH-ELCS)	609-530-2801	Ensure that sample container preparation and analysis of samples specified in the project plan are coordinated with the DRBC, and that contractual obligations are met in a timely fashion. Schedule staff and allocate laboratory time to prepare and analyze samples within required holding time; ensure that all analytical QA/QC requirements are met; prepare analytical data package including precision and accuracy data; serve as QA coordinator for laboratory activities; ensure that response actions are implemented, if needed; and transmit analytical results to DRBC in a timely manner.

1.3 *Problem Definition and Background*

The Scenic Rivers Monitoring Program (SRMP), a long-standing partnership between the Delaware River Basin Commission (DRBC) and the National Park Service (NPS), is responsible for monitoring and management of water quality in the Special Protection Waters of the Upper Delaware Scenic and Recreational River (UPDE), the Delaware Water Gap National Recreation Area (DEWA), and the Lower Delaware Scenic and Recreational River (LDEL). These regions cover approximately 200 miles of the non-tidal Delaware River and selected boundary locations within the 6,780 square mile drainage area (see Figures 2 and 3).

The Delaware River Basin Commission in partnership with the National Park Service is continuing work on a three-pronged approach to implementing and improving the DRBC's Special Protection Waters (SPW) program; 1) monitoring, 2) modeling, and 3) stakeholder organization.

Since the inception of Upper and Middle Delaware River Special Protection Waters antidegradation rules in 1992, DRBC and NPS have encountered problems with applied assessment of water quality changes versus reach-wide existing water quality (EWQ) targets. Data from this study will be used to convert UPDE and DEWA reach-wide existing water quality targets so that site-specific concentration and loading targets can be created for project review applications and statistical comparison of new data to baseline EWQ. This "Control Point Approach" was applied successfully in the Lower Delaware, where rules approved in 2008 include EWQ defined on a site specific basis. In addition, this study also includes a Lower Delaware component. Baseline Lower Delaware data were collected in 2000-2004, and it is necessary to revisit those sites to determine whether or not existing water quality has changed relative to the baseline water quality established in the rules. In the control point approach, Delaware River sites are known as Interstate Control Points (ICP) and tributary boundary sites are known as Boundary Control Points (BCP).

Data collected under this QAPP will serve a variety of purposes:

1. To develop site specific EWQ for UPDE and DEWA project review applications.
2. To define baseline water quality for assessment of water quality changes over time.
3. To provide antidegradation objectives for planning sustainable development.
4. To provide data in support of DRBC and state integrated listing decisions.
5. To determine whether Lower Delaware EWQ has measurably changed since 2004.
6. To provide data for development and use of water quality models.

Figure 2. Upper and Middle Delaware River Special Protection Waters.

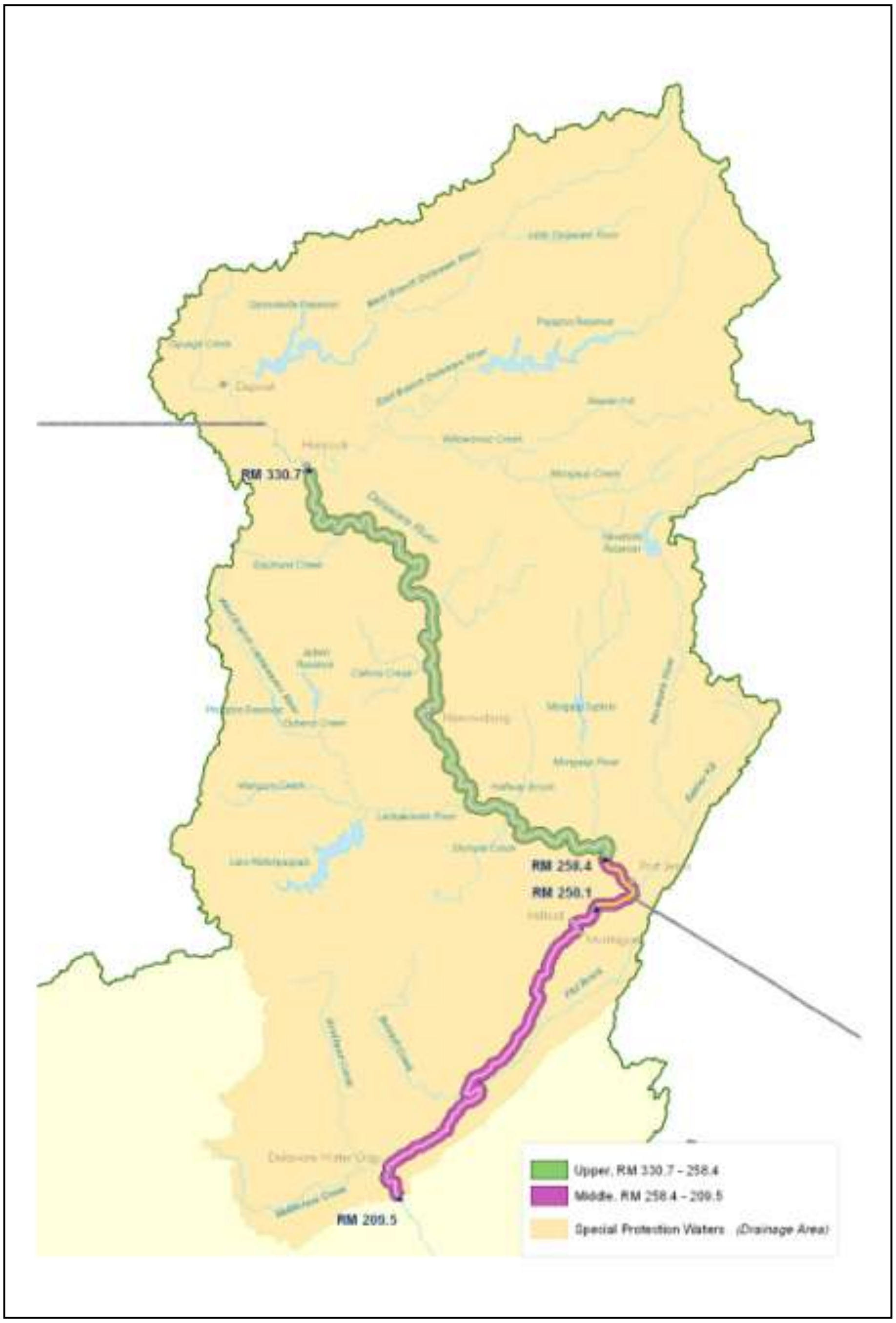
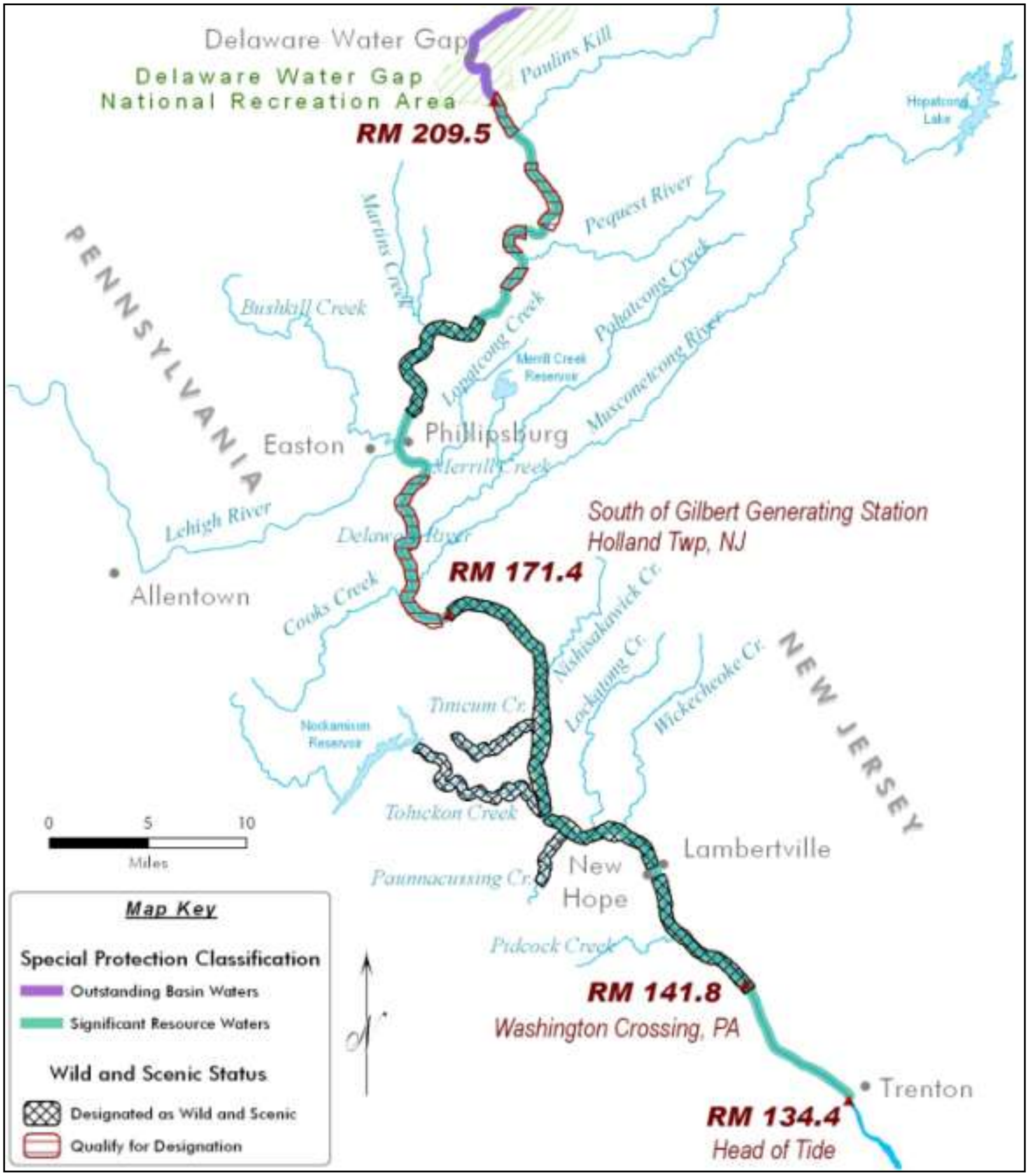


Figure 3. Lower Delaware River Special Protection Waters.



1.4 *Project / Task Description*

DRBC will collect water quality measurements beginning May 2013 to:

1) gather data necessary to convert reach-wide EWQ targets to ICP and BCP targets in UPDE and DEWA;
2) prepare hydrologic and water quality information for longitudinal water quality models for SPW implementation in the Delaware, Lehigh and Neversink Rivers;
3) gather sufficient water quality information to implement DRBC SPW regulations using a site-specific statistical approach to definition and assessment of changes to existing water quality; and
4) determine whether Lower Delaware EWQ has measurably changed since 2004.

Sufficient historical water quality data exist to develop a preliminary water quality model, but not to completely convert reach-wide EWQ targets to site-specific EWQ targets. As of 2013, sufficient data have been gathered to define site-specific EWQ at 44 Upper and Middle Delaware control points. Nine (9) sites still require further data to define site-specific EWQ. Additional data also are needed to refine models and to fully and evenly populate most BCP and ICP nodes along the river with water quality data. This QAPP is intended to address SRMP water quality data needs through 2015, though annual editions will reflect slight changes as new information becomes available.

1.5 *Quality Objectives and Criteria*

The purpose of this investigation is to characterize loadings and ambient concentrations of specific water column parameters in the Upper, Middle, and Lower Delaware River and tributaries to support DRBC Special Protection Waters rules.

1.5.1 Precision

Precision is the measure of the degree to which two or more measurements are in agreement. Precision is assessed through the collection and measurement of field replicates. Relative Percent Difference (RPD) shall be calculated for each of the replicates collected for all the parameters analyzed. Precision in the laboratory is assessed through the calculation of RPD for matrix spikes and matrix spike duplicates and of the field split samples.

RPD is calculated using the equation $RPD = \frac{S - D}{0.5(S + D)} \times 100$

Where:

S = Amount in Spike 1 **<u>or</u>** concentration of parameter in original
D = Amount in Spike 2 **<u>or</u>** concentration of parameter in replicate

1.5.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy in the field is assessed through the use of rinsate (field) and trip blanks and through the adherence to all sample handling, preservation and holding times. The field accuracy objective is to have no quantifiable concentrations of any of the analytical parameters in either the rinsate or the trip blanks, and to adhere to all sample handling, preservation and holding times. Laboratory accuracy and matrix interference is assessed through the analysis of matrix spikes and the determination of percent recoveries.

1.5.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the sampling and analysis plan is followed and that proper sampling techniques are used. Representativeness in the laboratory is ensured by using the proper analytical procedure, meeting sample holding times and analyzing and assessing field duplicate samples.

1.5.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data that was expected to be obtained under normal conditions. Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the field. Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project.

Completeness is the ratio of the number of sample results to the total number of samples analyzed with a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$Completeness = \frac{V}{P} \times 100$$

Where:
V = Number of valid measurements.
P = Number of planned measurements.

Funding derived from EPA Grants will only be applied toward collection and analysis of complete, valid samples.

1.5.5 Comparability

Comparability is an expression of the confidence with which one data set can be compared with another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the field sampling plan is followed and that proper sampling techniques are used. Planned analytical data will be comparable when similar sampling and analytical methods are used and documented in the QAPP. Comparability is also dependent on similar QA objectives.

1.6 *Special Training / Certification*

Sample collection must be performed by personnel who have experience in the collection of samples for chemical and physical analysis. All members of the sampling team must review and be familiar with this QAPP, and its references.

Chemical and physical analysis will be performed by individuals familiar with the analytical techniques described by this plan. These analyses will be conducted by contract laboratories using EPA-approved methods: the New Jersey Department of Health Environmental and Chemical Laboratory Services facility will provide conventional and nutrient analyses.

No other specific training or certification is required.

1.7 *Documents and Records*

The Study Manager will be responsible for maintaining all documents and records associated with this project. Documents and records associated with this project will be kept and maintained in the project file at the Delaware River Basin Commission (DRBC) offices in West Trenton, New Jersey. Records will be maintained for a minimum of 5 years after completion of sampling and analysis.

Revisions to this QAPP which are made after signature will be provided to the individuals listed in Table 1 by electronic mail. If revisions are made after signature, the Revision No. at the top of the page will be changed to reflect the current Revision number. Changes made to this QAPP prior to signature will not result in a change in Revision number. The study manager will provide revisions to this QAPP to all the recipients listed in Table 1, after each revision, by electronic mail.

All electronic files associated with this project, including this QAPP and all electronic data deliverables, will be backed up onto compact disks (CDs) at a minimum of once per month and after each significant revision or update.

1.7.1 Standard Data Reporting Format

Data will be reported to DRBC from the selected analytical laboratory in electronic data deliverable (EDD) form. Figure 4 below shows the data elements contained in the SRMP water quality database. The database is patterned upon WQX-Web formatting, and mapped to the NJDEP WQDE system which flows into STORET. Domain values of the WQDE system are applied to these files and data elements. In addition to records generated by the SRMP, the database also contains all STORET and NWIS records associated with SRMP sites from 1980 to present.

Figure 4. Data Elements of the SRMP Water Quality Data File

Project file

Organization Code	Project ID	Project Name	Project Description
31DRBCSP	SRMP	DRBC/NPS Scenic Rivers Monitoring Program	Antidegradation water quality network for 200 miles of non-tidal portion of Delaware River and tributaries

Locations File

Monitoring Location ID
Monitoring Location Name
Monitoring Location Type
HUC Eight-Digit Code
Tribal Land Indicator
Tribal Land Name
Monitoring Location Latitude
Monitoring Location Longitude

Monitoring Location Source Map Scale
Monitoring Location Horizontal Collection Method
Monitoring Location Horizontal Coordinate Reference System
State Code
County Code
Drainage Area sq mi
Who samples 2013

Results File

Program
Primary Station ID
Site Name
Activity ID
Activity Type
Activity Media Name
Activity Start Date
Activity Start Time
Activity Start Time Zone
Activity Depth/Height Measure
Activity Depth/Height Unit
Sample Collection Method ID
Sample Collection Equipment Name
Sample Collection Equipment Comment
Data Logger Line
Characteristic Name
Method Speciation Name
Result Detection Condition
Result Measure
Result Unit
Result Sample Fraction
Result Status ID
Statistical Base Code
Result Value Type
Result Analytical Method ID
Result Analytical Method Context
Analysis Start Date

Result Detection/Quantitation Limit Type
Result Detection/Quantitation Limit Measure
Result Detection/Quantitation Limit Unit
Result Comment
SRMPUNIT
Season
Baseline EWQ
Pre-Post Regs
Flow cfs
Mo
Dd
Yyyy
Hh
Mm
Short Act Type
Short Char
Loading lbs/d
Log result
Log loading
Loading Rate lbs/d/mi2
Usgs parm cd
Usgs parmname
Lab Sample ID
Lab Batch ID
Lab

2 Data Generation and Acquisition Elements

The elements in this section address all aspects of data generation and acquisition to ensure that appropriate methods for sampling, measurement, analysis, data collection or generation, data handling, and QC activities are employed and documented.

2.1 *Sampling Process Design (Experimental Design)*

Starting in May 2013, 11 stations indicated in Table 3 will be sampled up to 10 times on a biweekly schedule from May through September. Sampling events will be staggered to capture a representative range of flow conditions, seasonal, and daily variability in order to develop representative seasonal (May to September) Existing Water Quality targets. All Upper, Middle and Lower Delaware ICP and BCP concentrations and loadings will be included in a time variable water quality model for Special Protection Waters implementation.

In cooperation with the SRMP, six (6) new Upper Delaware stations indicated in Table 3 are included in a joint USGS/NPS 2012-2014 study to define EWQ on small, previously un-monitored tributaries to the Delaware River. This study is not covered by this QAPP, but will provide additional data to support DRBC water quality management objectives. These tributaries are located in expected natural gas development areas, and require baseline EWQ definition of conventional and natural gas parameters.

As of 2013, most SRMP sites possess sufficient data for statistical definition of Existing Water Quality. 2013 is a reduced sampling year, as most DRBC staff efforts are being devoted in 2013 to analysis and reporting of EWQ conditions in preparation for designation of site-specific EWQ in the Upper and Middle Delaware; and assessment of measurable changes to EWQ in the Lower Delaware. Only 9 sites require additional data for EWQ definition: 3 in the Upper Delaware; 3 in the Middle Delaware; and 3 in the Lower Delaware. Annual monitoring also provides continuity at two important Lower Delaware River sites: Portland and Trenton. Only these 11 sites will be sampled for all field and laboratory parameters. These sites will be sampled bi-weekly for field parameters (DO, pH, water and air temperature, specific conductance, and gage height); in-house laboratory parameters (fecal coliform at Upper and Middle Delaware SRMP units, and turbidity at all SRMP units); and contract laboratory parameters (see Table 5, top).

2.2 *Sampling Methods*

This project involves collection of measurements and water samples from the Delaware River and tributaries. Sampling locations and frequencies are listed in Table 3. EPA-approved field measurement methods are shown in Table 4. EPA-approved laboratory analytical methods are shown in Table 5.

Table 3. Sample Locations and Frequency

Note: FUTURE indicates that site is not sampled in 2013, but may be developed as a control point in the future.

ICP or BCP	Site Name	River Mile	Longitude	Latitude	Site No	Number of Samples 2013 or Task Status as of 2013
Upper Delaware SRR						
BCP	Ocquaga Creek, NY	344.75	Need	Need	3448 BCP	USGS/NPS sampling for EWQ 2012-2014
ICP	West Branch Delaware River Hale Eddy	339.80	-75.38387	42.00279	3398 ICP	10
BCP	Roods Ck, NY	338.50	-75.36240	42.00420	-----	Future
BCP	Balls Creek, PA	335.00	Need	Need	3350 BCP	USGS/NPS sampling for EWQ 2012-2014
BCP	Sands Creek, NY	331.90	Need	Need	3319 BCP	USGS/NPS sampling for EWQ 2012-2014
ICP	West Branch Delaware River Hancock	331.20	-75.29121	41.95250	3312 ICP	Analyze data, Develop EWQ
BCP	Shehawken Ck, PA	330.80	-75.28928	41.94009	3308 BCP	USGS/NPS EWQ 2012-2014; DRBC HOBO
BCP	East Branch Delaware River, NY	330.70	-75.28016	41.95199	3307 BCP	Analyze data, Develop EWQ
BCP	Stockport Ck, PA	327.00	-75.27372	41.89523	-----	Future
BCP	Equinunk Ck, PA	322.50	-75.22528	41.85333	3225 BCP	Analyze data, Develop EWQ
BCP	Factory Ck, PA	322.00	-75.22833	41.85528	-----	Future
ICP	Delaware River at Lordville Bridge	321.60	-75.21444	41.86917	3216 ICP	Analyze data, Develop EWQ, install continuous
BCP	Bouchoux Brook, NY	318.30	-75.17910	41.87180	-----	Future
---	Pea Brook, NY	316.00	-75.13910	41.85140	-----	Future
BCP	Hoolihan Brook, NY	314.30	-75.13590	41.84980	-----	Future
---	Basket Ck, NY	314.10	-75.10139	41.84444	3141 BCP	USGS/NPS sampling for EWQ 2012-2014
BCP	Little Equinunk Ck, PA	312.70	-75.12083	41.82583	3127 BCP	USGS/NPS sampling for EWQ 2012-2014
ICP	Delaware River at Kellams Bridge	312.59	-75.11417	41.82333	3126 ICP	Analyze data, Develop EWQ
---	Hankins Ck, NY	311.20	-75.09010	41.81190	-----	Future
BCP	Cooley Ck, PA	311.10	-75.10083	41.81361	-----	Future
---	Hollister Ck, PA	305.20	-75.08600	41.76980	-----	Future
ICP	Delaware River at Callicoon Bridge	303.70	-75.06167	41.76472	3037 ICP	Analyze data, Develop EWQ
BCP	Callicoon Ck, NY	303.60	-75.03278	41.76444	3036 BCP	Analyze data, Develop EWQ
ICP	Delaware River at Damascus Bridge	298.40	-75.06750	41.70500	2984 ICP	Analyze data, Develop EWQ
BCP	Calkins Ck, PA	295.60	-75.06528	41.67361	2956 BCP	Analyze data, Develop EWQ
ICP	Delaware River at Narrowsburg Bridge	289.90	-75.06222	41.60944	2899 ICP	Analyze data, Develop EWQ
BCP	Tenmile River, NY	284.20	-75.00111	41.57083	2842 BCP	Analyze data, Develop EWQ
BCP	Masthope Ck, PA	282.50	-75.02778	41.53806	2825 BCP	Analyze data, Develop EWQ
ICP	Delaware River at USGS Gage 01428500	279.21	-74.98611	41.50889	2792 ICP	Analyze data, Develop EWQ, install continuous
BCP	Lackawaxen River, PA	277.71	-74.99222	41.48639	2777 BCP	Analyze data, Develop EWQ, install continuous
ICP	Delaware River at Barryville Bridge	273.50	-74.91389	41.47694	2735 ICP	Analyze data, Develop EWQ
BCP	Halfway Brook, NY	273.40	-74.91056	41.47708	2734 BCP	10
BCP	Shohola Ck, PA	273.20	-74.91319	41.47222	2732 BCP	Analyze data, Develop EWQ
BCP	Mill Brook, NY	265.60	-74.82167	41.43889	2656 BCP	10
ICP	Delaware River at Pond Eddy Bridge	265.50	-74.82028	41.43944	2655 ICP	Analyze data, Develop EWQ
BCP	Mongaup River, NY	261.10	-74.75611	41.42694	2611 BCP	Analyze data, Develop EWQ
ICP	Delaware River at Millrift RR Bridge	258.40	-74.73917	41.40639	2584 ICP	Analyze data, Develop EWQ

ICP or BCP	Site Name	River Mile	Longitude	Latitude	Site No	Number of Samples 2013 or Task Status as of 2013
Delaware Water Gap NRA						
ICP	Delaware River at Port Jervis Bridge	254.75	-74.69778	41.37167	2548 ICP	10
BCP	Neversink River, NY	253.64	-74.68556	41.36111	2536 BCP	10
ICP	Delaware River at DEWA Boundary **	250.20	-74.75778	41.34361	2502 ICP	Analyze data, Develop EWQ, Field samples 2013
BCP	Vandermark Ck, PA	247.30	-74.79694	41.32500	2473 BCP	Analyze data, Develop EWQ
BCP	Sawkill Ck, PA	247.00	-74.80000	41.31722	2470 BCP	Analyze data, Develop EWQ
BCP	Shimers Brook, NJ	246.60	-74.78125	41.31305	2466 BCP	Analyze data, Develop EWQ
ICP	Delaware River at Montague, NJ **	246.38	-74.79556	41.30917	2464 ICP	Analyze data, Develop EWQ, install continuous
BCP	Raymondskill Ck DEWA bdy PA	243.90	-74.85167	41.30556	2439 BCP	Analyze data, Develop EWQ
BCP	Adams Ck DEWA boundary, PA	240.30	-74.88250	41.25250	2403 BCP	Analyze data, Develop EWQ
BCP	Dingmans Ck DEWA bdy, PA	239.20	-74.92000	41.23806	2392 BCP	Analyze data, Develop EWQ
ICP	Delaware River at Dingmans Access **	238.67	-74.86194	41.21528	2387 ICP	Analyze data, Develop EWQ, Field samples 2013
BCP	Hornbecks Ck DEWA bdy, PA	236.40	-74.90972	41.19555	2364 BCP	Analyze data, Develop EWQ
BCP	Toms Ck DEWA boundary, PA	230.40	-74.95528	41.15195	2304 BCP	Analyze data, Develop EWQ
ICP	Delaware River at Bushkill Access **	228.11	-74.98194	41.10833	2281 ICP	Analyze data, Develop EWQ, Field samples 2013
BCP	Bushkill Ck DEWA bdy, PA	226.90	-75.03833	41.08861	2269 BCP	Analyze data, Develop EWQ
MCP	Bushkill Ck below WWTP, PA	226.90	-75.00283	41.09166	2269 MCP	10 (Modeling Control Point, data for model)
BCP	Little Bushkill Ck DEWA bdy PA	226.90	-75.00417	41.09778	2269A BCP	Analyze data, Develop EWQ
BCP	Sand Hill Ck DEWA bdy, PA	226.90	-75.00888	41.08500	2269B BCP	Future
BCP	Big Flatbrook DEWA bdy, NJ	225.30	-74.84583	41.19000	2253 BCP	Analyze data, Develop EWQ
BCP	Little Flatbrook DEWA bdy, NJ	225.30	-74.84694	41.19028	2253A BCP	Analyze data, Develop EWQ
BCP	Van Campens Bk DEWA bdy NJ	219.90	-75.00333	41.05778	2199 BCP	Analyze data, Develop EWQ
ICP	Delaware River at Smithfield Access **	218.36	-75.05972	41.02444	2184 ICP	Analyze data, Develop EWQ, Field samples 2013
BCP	Brodhead Ck, PA	213.00	-75.14306	40.99792	2130 BCP	Analyze data, Develop EWQ
BCP	Marshalls Ck, PA	213.00	-75.13833	40.99861	2130A BCP	Analyze data, Develop EWQ
BCP	Cherry Ck, PA	212.60	-75.13750	40.98611	2126 BCP	Future
ICP	Delaware River at Kittatinny Access **	211.50	-75.13750	40.97000	2115 ICP	Analyze data, Develop EWQ, Field samples 2013
BCP	Dunnfield Ck DEWA bdy, NJ	211.40	-75.12695	40.97056	2114 BCP	Analyze data, Develop EWQ
Lower Delaware Scenic and Recreational River						
BCP	Slateford Ck, PA	209.50	-75.11507	40.94674	2095 BCP	10
ICP	Delaware River at Portland Foot Bridge	207.40	-75.09611	40.92417	2074 ICP	10
BCP	Paulins Kill, NJ	207.00	-75.08833	40.92083	2070 BCP	Analyze data, Assess EWQ
ICP	Delaware River at Belvidere Bridge	197.84	-75.08500	40.82889	1978 ICP	Analyze data, Assess EWQ
BCP	Pequest River, NJ	197.80	-75.06111	40.83417	1978 BCP	Analyze data, Assess EWQ
BCP	Martins Ck, PA	190.65	-75.18472	40.78472	1907 BCP	Analyze data, Assess EWQ
ICP	Delaware River at Sandt's Eddy Access**	189.20	-75.18772	40.75825	1892 ICP	10
BCP	Bushkill Ck, PA	184.10	-75.20611	40.69528	1841 BCP	Analyze data, Assess EWQ
ICP	Delaware River at Northampton St Bridge	183.82	-75.20417	40.69111	1838 ICP	Analyze data, Assess EWQ
BCP	Lehigh River, PA	183.66	-75.23667	40.66917	1837 BCP	Analyze data, Assess EWQ
BCP	Lopatcong Ck, NJ	182.00	-75.17499	40.67949	1820 BCP	10
BCP	Pohatcong Ck, NJ	177.40	-75.18611	40.62472	1774 BCP	Analyze data, Assess EWQ

ICP or BCP	Site Name	River Mile	Longitude	Latitude	Site No	Number of Samples 2013 or Task Status as of 2013
ICP	Delaware River at Riegelsville Bridge	174.80	-75.19111	40.59389	1748 ICP	Analyze data, Assess EWQ
BCP	Musconetcong River, NJ	174.60	-75.18667	40.59250	1746 BCP	Analyze data, Assess EWQ
BCP	Cooks Ck, PA	173.70	-75.21157	40.58737	1737 BCP	Analyze data, Assess EWQ
ICP	Delaware River at Upper Black Eddy	167.70	-75.93222	40.56639	1677 ICP	Analyze data, Assess EWQ
BCP	Nishisakawick Ck, NJ	164.10	-75.06028	40.52639	1641 BCP	Analyze data, Assess EWQ
BCP	Tinicum Ck, PA	161.60	-75.05583	40.48528	1616 BCP	Analyze data, Assess EWQ
BCP	Tohickon Ck, PA	157.00	-75.06667	40.42306	1570 BCP	Analyze data, Assess EWQ
BCP	Paunnacussing Ck, PA	155.60	-75.04167	40.39889	1556 BCP	Analyze data, Assess EWQ
ICP	Delaware River at Bulls Island Footbridge	155.40	-75.03778	40.40750	1554 ICP	Analyze data, Assess EWQ
BCP	Lockatong Ck, NJ	154.00	-75.01806	40.41583	1540 BCP	Analyze data, Assess EWQ
BCP	Wickecheoke Ck, NJ	152.50	-74.98694	40.41167	1525 BCP	Analyze data, Assess EWQ
ICP	Delaware River at Lambertville Bridge	148.70	-74.94917	40.36583	1487 ICP	Analyze data, Assess EWQ
BCP	Pidcock Ck, PA	146.30	-74.94525	40.32873	1463 BCP	Analyze data, Assess EWQ
ICP	Delaware River at Washington Crossing	141.80	-74.86889	40.29528	1418 ICP	Analyze data, Assess EWQ
ICP	Delaware River at Calhoun St Bridge	134.34	-74.77833	40.21972	1343 ICP	10

** These locations are grab-sampled by wading as far from shore as possible into the Delaware River. All other Delaware River locations are composite-sampled from bridges. If bacteria are sampled, such grab-samples are taken from center-channel only. If conditions are unsafe for wading from access area sites, samples are taken by wading nearer to the shore if possible or cancelled temporarily. Such side channel samples shall be clearly marked in all records. Specific locations have been identified by global positioning system.

If a sampling site is temporarily inaccessible, the sampling team will return to the sampling site as soon as the site becomes accessible. Reasons for inaccessibility usually include road or bridge construction; flooding; and backwater conditions at near-river tributary locations. If a sampling site is inaccessible for the entire monitoring season, the Study Manager and Sample Collection Team leader will select an alternate site from a prioritized site list and document the change and rationale in a memorandum for the record.

At each sample location, the field measurements shown in Table 4 will be collected. All water column field measurements will be collected using a Measurement Specialties Manta2 multi-parameter sonde. Occasional conductivity longitudinal profiles of river reaches are conducted using a YSI 30 meter. Measurements are taken by lowering the sonde directly into the water body to a depth approximately 1/3 of the total depth at that location and allowing it to stabilize prior to recording of data. For each sampling location, field measurements are approximately made at the thalweg (where the channel is deepest). Between sites, meter probes are rinsed and stored in tap- or site-water as recommended by the manufacturer. While on-site, weather and site observations are also recorded.

Table 4. Field Measurements at Each Sample Location

Parameter	Meter	Unit	Method
Water Temp.	Measurement Specialties Manta2	°C	SM 2550 Thermometric
Dissolved Oxygen	Measurement Specialties Manta2	mg/L	NFM 6.2.1-Lum
pH	Measurement Specialties Manta2	Units	SM 4500 H+ Electrometric
Conductivity	Measurement Specialties Manta2	µS/cm	EPA 120.1
Air Temp.	Bulb Thermometer	°C	SM 2550 Thermometric
Conductivity	YSI 30 Conductivity Meter	µS/cm	EPA 120.1
Turbidity	Hach 2100P turbidimeter	NTU	EPA 180.1
Gage Height	Wire weight cable	0.01 feet	USGS TWRI 3, A7-A8

At each sample location, water samples are collected and submitted to the analytical laboratory for the analyses indicated in Table 5. At Delaware River bridge sites and in large streams, samples are collected at predetermined points near the thalweg, 1/3 channel width, and 2/3 channel width of the water body to be sampled. At small streams, samples are taken only from the thalweg. The bottle is lowered into the water to a depth approximately 1/3 of the total depth at the location and the subsequent retrievals are poured into sample bottles prepared by laboratory prior to sampling. Once all bottles are filled, they are returned to the labeled bag from which they were removed and placed in an iced cooler for transportation to the laboratory.

As of 2011, DRBC became NJDEP-Certified for its field parameters. Please refer to the following documents for calibration, usage and QAQC methods for the following field meter procedures:

DRBC SOP #110.01 – Standard Operating Procedure. pH Using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance.

DRBC SOP #120.01 – Standard Operating Procedure. Conductivity Using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance.

DRBC SOP #130.01 - Standard Operating Procedure. Dissolved Oxygen Using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance.

DRBC SOP #140.01 - Standard Operating Procedure. Temperature Using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance.

These standard operating procedures are attached in Appendix B.

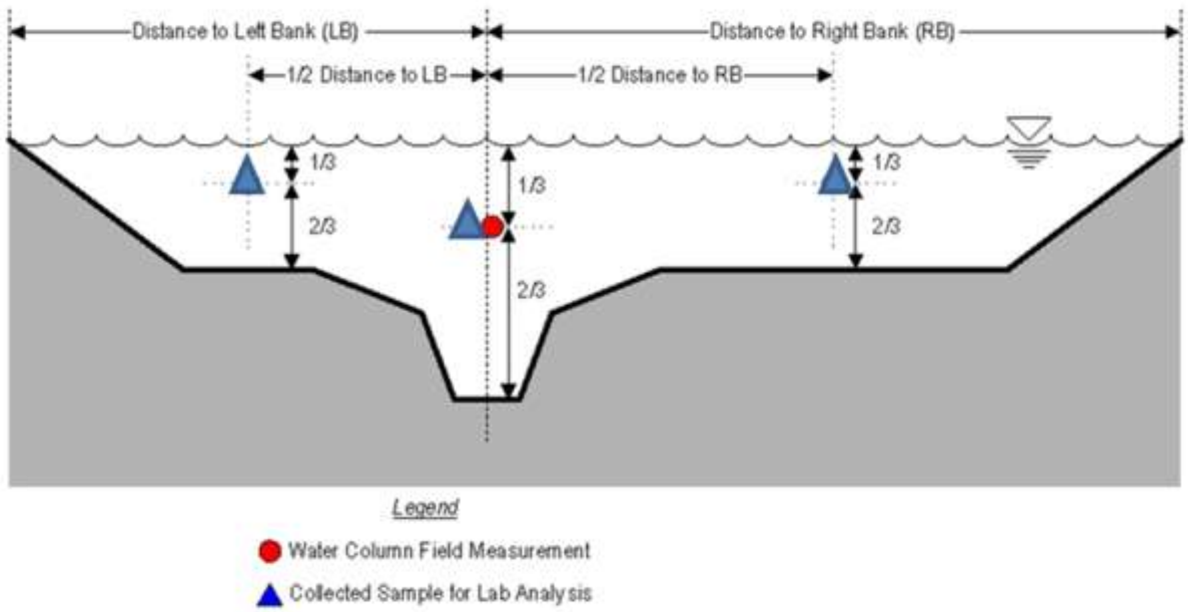
Table 5. Laboratory Sample Analysis for Each Sample Location

Parameter	Method	Detection Limit
Alkalinity as CaCO3, Total	SM 2320B	0.39 mg/l
Chloride, Total	EPA 300.0 rev 2.1 & 300.1 rev 1.0	0.37 mg/L
Dissolved Oxygen Saturation %	Calculated	n/a
Hardness as CaCO3, Total	SM 2340C Hard	1.01 mg/l
Nitrate + Nitrite as N, Total	EPA 353.2 rev 2.0	0.007 mg/L
Ammonia as N, Total	EPA 350.1 rev 2.0*	0.005 mg/L
TKN as N, Total	EPA 351.2 rev 2.0	0.038 mg/L
Phosphorus, Total as P	EPA 365.1 rev 2.0	0.002 mg/L
Orthophosphate as P, Total	EPA 365.1 rev 2.0	0.002 mg/L
Total Dissolved Solids (TDS)	SM 2540C	3.10 mg/l
Total Suspended Solids (TSS)	SM 2540D	0.43 mg/l
Turbidity NTU**	EPA 180.1	0.80 NTU
Nitrogen as N, Total	Calculated	n/a
Bacterial Parameters (optional – none in 2013)		
E. coli	EPA 1103.1	1 #/100ml
Enterococcus	EPA 1106.1	1 #/100ml
Fecal coliform***	SM 9222D	1 #/100ml
Natural Gas Monitoring Parameters (optional – none in 2013)		
Aluminum, Dissolved	EPA 200.7	2 µg/l
Sodium, Dissolved	EPA 200.7	30 µg/l
Calcium, Dissolved	EPA 200.7	10 µg/l
Iron, Dissolved	EPA 200.7	2 µg/l
Strontium, Dissolved	EPA 200.7	0.3 µg/l
Barium, Dissolved	EPA 200.7	1 µg/l
Magnesium, Dissolved	EPA 200.7	20 µg/l
Manganese, Dissolved	EPA 200.7	0.8 µg/l
Potassium, Dissolved	EPA 200.7	300 µg/l
Bromide, Dissolved	EPA 300	10 µg/l
Sulfate, Total as SO4	EPA 300	20 µg/l

* Ammonia samples are normally processed without distillation due to low turbidity environment. If field turbidity is greater than 10 NTU, the distillation step will be used.
** Processed by DRBC and each NPS unit using Hach 2100P and LaMotte 2020 turbidimeters
*** Processed by National Park Service laboratories in Milford and Milanville, PA

Figure 5 shows relative depth and distance from the thalweg where analytical samples are collected. At Delaware River sites, all parameters are composited except for bacteria samples, which are grab-sampled from center channel locations, and wading-access sites (see Table 3) which are grab-sampled at the relative limit of safe wading into the river channel.

Figure 5. Water Sample Collection Schematic



2.2.1 Sampling Equipment

All samples are collected using a rope and bottle apparatus lowered from predetermined points from bridges or transects across each of the water bodies to be sampled. The contract laboratory provides a packaged, labeled set of bottles for each of the samples to be collected. Each package contains all bottles necessary for collection of the correct volume for analysis. The bottles contain preservatives required for proper analysis as described in the analytical methods for each of the parameters to be measured. This ensures proper fixation of appropriate samples and limits improper preservation and possible accidents associated with chemical preservation methods.

2.2.2 Discharge Measurement

A discharge value is associated with each of the field measurements and samples collected by the Scenic Rivers Monitoring Program. A gage height measurement is taken at all sites where there is no USGS continuous monitor present. This measurement is taken from a marked point using a weighted fiberglass surveyor's tape or wire weight cable. The weighted tape is lowered until the weight just touches the water's surface. The measurement is then recorded at the point marked. This point was determined prior to sampling and surveyed so that its location is known in case the channel cross section changes. These gage heights are then associated with a flow rating curve that is specific to each water body. The rating curve is developed using the incremental velocity-area method (Wahl et al. 1995). A series of discharge measurements ($n \geq 5$) are taken over the expected range of flows using a Marsh-McBirney flow meter and wading rod for use in development of the rating curve. With each of the discharge measurements, a gage height is recorded so that the measurement can be related to a point on the curve. Table 6 lists sites and methods of discharge determination. If discharge measurements are not numerous enough for development of a rating curve, or if other problems prevent maintenance of the rating curve (such as too-frequent channel alterations from storms or insufficient staffing levels), DRBC may estimate flow associated with the sample by using two USGS programs: StreamStats (http://streamstats.usgs.gov/) and BaSE (Stuckey et. al. 2012).

A pair of Design Analysis Associates, Inc. DH-21 water level loggers may also be used for rating curve development. These monitors are continuous, pressure gages that monitor gage height on a set increment. These monitors are placed in selected streams as needed for the monitoring season. The monitors are set to take readings at 30 minute intervals until the water level raises 0.04 ft. and then the frequency increases to every 10 minutes until the level no longer fluctuates more than 0.04 ft in the 30 minute time period. Data are downloaded from the data logger monthly to conserve usage of memory on the unit and minimize the possibility of breaks in the data set as a result of expended memory or failure of equipment.

The discharge values generated by the United States Department of the Interior, United States Geological Survey (USGS) are used for the Delaware River and gaged tributaries. For sites where a USGS gage is not located at sampling point but does exist in the watershed or in a geologically, land use, and hydrological similar watershed, a discharge value is calculated based on drainage area weighting (DAW). The formulas used are as follows;

Using 2 known discharge values: $Q_x = Q_d – [((Q_d – Q_u)/(DA_d – DA_u)) \times (DA_d – DA_x)]$
Where:
Q_x = Discharge of Unknown
Q_d = Discharge of Downstream Point
Q_u = Discharge of Upstream Point
DA_x = Drainage Area of Unknown Point
DA_d = Drainage Area of Downstream Point
DA_u = Drainage Area of Upstream Point

Using 1 known discharge value: $Q_x = Q_d – [(Q_d / DA_d) \times (DA_x – DA_d)]$
Where:
Q_x = Discharge of Unknown
Q_d = Discharge at Downstream Gage
DA_x = Drainage Area of Unknown
DA_d = Drainage Area at Downstream Gage

The calculations are computed using instantaneous frequent time interval measurement data. Values selected are those closest to the actual sampling time.

Table 6. Determination of Discharge Values for the Scenic Rivers Monitoring Program

Site Number	Site Name	Drainage Area Square Miles	Gage Type	USGS Gage No. or Discharge Est. Method*
3398 ICP	West Branch at Hale Eddy (**WBR**)	595.6	USGS Continuous	01426500
3312 ICP	West Branch at Hancock	650.2	Calculated	Use WBR DAW
USGS gage	East Branch at Fish Eddy (**EBR**)	784	USGS Continuous	01421000
3307 BCP	East Branch at Hancock	839.3	Calculated	Use EBR DAW
3225 BCP	Equinunk Ck, PA	57.7	Calculated	BaSE & StreamStats
3216 ICP	Delaware River at Lordville Bridge	1,590	Calculated	use WBR+EBR & CAL
3126 ICP	Delaware River at Kellams Bridge	1,670	Calculated	use WBR+EBR & CAL
3035 ICP	Delaware River at Callicoon Bridge (**CAL**)	1,820	USGS Continuous	01427510
3036 BCP	Callicoon Ck, NY	111	USGS Continuous	01427500
2984 ICP	Delaware River at Damascus Bridge	1,840	Calculated	use CAL & BAR
2956 BCP	Calkins Ck, PA	44.0	Calculated	BaSE & StreamStats
2899 ICP	Delaware River at Narrowsburg Bridge	1,910	Calculated	use CAL & BAR
2842 BCP	Tenmile River, NY	48.8	Calculated	BaSE & StreamStats
2825 BCP	Masthope Ck, PA	32.0	Calculated	BaSE & StreamStats
2792 ICP	Delaware River above Lackawaxen (**BAR**)	2,020	USGS Continuous	01428500
2777 BCP	Lackawaxen River at Rowland, PA	597	Calculated	USGS Rating Table
2735 ICP	Delaware River at Barryville Bridge	2,660	Calculated	Use BAR & POJ
2732 BCP	Shohola Ck, PA	85.2	Calculated	BaSE & StreamStats
2656 BCP	Mill Brook, NY		Calculated	BaSE & StreamStats
2655 ICP	Delaware River at Pond Eddy Bridge	2,820	Calculated	Use BAR & POJ
2611 BCP	Mongaup River, NY	207	Calculated	Rio System Report
2584 ICP	Delaware River at Millrift RR Bridge	3,045	Calculated	Use BAR & POJ
2548 ICP	Delaware River at Port Jervis (**POJ**)	3,070	USGS Continuous	01434000
2536 BCP	Neversink River, NY	349	Calculated	01437500 DAW
2502 ICP	Delaware River at DEWA N Boundary	3,420	Calculated	Use POJ & MON
2473 BCP	Vandermark Ck, PA	5.19	Calculated	BaSE & StreamStats
2470 BCP	Sawkill Ck, PA	24.7	Calculated	BaSE & StreamStats
2466 BCP	Shimers Brook, NJ	7.5	Calculated	BaSE & StreamStats
2464 ICP	Delaware River at Montague (**MON**)	3,480	USGS Continuous	01438500
2439 BCP	Raymondskill Ck, PA	24.3	Calculated	BaSE & StreamStats
2403 BCP	Adams Ck, PA	8.0	Calculated	BaSE & StreamStats
2392 BCP	Dingmans Ck, PA	16.5	Calculated	BaSE & StreamStats
2387 ICP	Delaware River at Dingmans Access	3,542	Calculated	Use MON & BEL
2364 BCP	Hornbecks Ck, PA	9.5	Calculated	BaSE & StreamStats
2304 BCP	Toms Ck, PA	9.4	Calculated	BaSE & StreamStats
2281 ICP	Delaware River at Bushkill Access	3,625	Calculated	Use MON & BEL
2269A BCP	Bushkill Ck, PA	117	Calculated	01439500 DAW
2269A2 MCP	Bushkill Ck, PA at Rt. 209 below WWTP	174.9	Calculated	01439500 DAW
2269B BCP	Little Bushkill Ck, PA (trib to Bushkill)	33.0	Calculated	01439500 DAW
2253A BCP	Flatbrook, NJ	32.7	Calculated	01440000 DAW
2253B BCP	Little Flatbrook, NJ (trib to Flatbrook)	16.0	Calculated	01440000 DAW
2199 BCP	Van Campens Brook, NJ	8.0	Calculated	BaSE & StreamStats
2184 ICP	Delaware River at Smithfield Access	3,850	Calculated	Use MON & BEL
2130 BCP	Brodhead Ck, PA	259	USGS Continuous	01442500
2130A BCP	Marshalls Ck, PA	27.1	Calculated	Brodhead DAW
2115 ICP	Delaware River at Kittatinny Access	4,150	Calculated	Use MON & BEL
2095 BCP	Slateford Ck, PA	2.97	Instantaneous	DRBC Rating
2074 ICP	Delaware River at Portland Foot Bridge	4,165	Calculated	Use MON & BEL
2070 BCP	Paulins Kill, NJ	177	Calculated	01443500 DAW
1978 ICP	Delaware River at Belvidere, NJ (**BEL**)	4,535	USGS Continuous	01446500
1978 BCP	Pequest River, NJ	157	Calculated	01445500 DAW
1907 BCP	Martins Ck, PA	44.5	Instantaneous	DRBC Rating
1891 ICP	Delaware River at Sandt's Eddy Access	4,670	Calculated	Use BEL & RGL
1841 BCP	Bushkill Ck, PA	80.0	Calculated	01446776 DAW
1838 ICP	Delaware River at Northampton St	4,717	Calculated	Use BEL & RGL

Site Number	Site Name	Drainage Area Square Miles	Gage Type	USGS Gage No. or Discharge Est. Method*
1837 BCP	Lehigh River, PA	1,361	USGS Continuous	01454700
1820 BCP	Lopatcong Ck, NJ	14.7	Instantaneous	DRBC Rating
1774 BCP	Pohatcong Ck, NJ	57.1	Instantaneous	DRBC Rating
1748 ICP	Delaware River at Riegelsville Bridge (**RGL**)	6,328	USGS Continuous	01457500
1746 BCP	Musconetcong River, NJ	156	Calculated	01457000 DAW
1737 BCP	Cooks Ck, PA	29.5	Instantaneous	DRBC Rating
1677 ICP	Delaware River at Upper Black Eddy	6,381	Calculated	Use RGL & TRN
1641 BCP	Nishisakawick Ck, NJ	11.1	Instantaneous	DRBC Rating
1616 BCP	Tinicum Ck, PA	24.0	Instantaneous	DRBC Rating
1570 BCP	Tohickon Ck, PA	112	Calculated	01459500 DAW
1556 BCP	Paunnacussing Ck, PA	7.9	Instantaneous	DRBC Rating
1554 ICP	Delaware River at Bulls Island Foot Bridge	6,598	Calculated	Use RGL & TRN
1540 BCP	Lockatong Ck, NJ	23.2	Instantaneous	DRBC Rating
1525 BCP	Wickecheoke Ck, NJ	26.6	Instantaneous	DRBC Rating
1487 ICP	Delaware River at Lambertville Bridge	6,680	Calculated	Use TRN
1463 BCP	Pidcock Ck, PA	12.7	Instantaneous	DRBC Rating
1418 ICP	Delaware River at Washington Crossing	6,735	Calculated	Use TRN
1343 ICP	Delaware River at Calhoun St Bridge (**TRN**)	6,780	USGS Continuous	01463500

*DAW stands for Drainage Area Weighting flow estimation at ungaged site.
**If DRBC Rating is problematic or unable to be maintained, the USGS BaSE mean daily streamflow is calculated.

2.3 *Sample Handling and Custody*

2.3.1 Decontamination of Field Sampling Equipment

Each item of field sampling equipment which comes into direct contact with an analytical sample is triple rinsed with distilled de-ionized water between sites. At each site, the sampling equipment is also triple-rinsed in ambient water before sampling. The distilled de-ionized water rinses minimize cross contamination between sites, while the sample water rinses minimize dilution of the sample associated with residual distilled de-ionized water.

2.3.2 Sample ID and Labeling

A unique ID is assigned to each sample and database record. The sample ID incorporates the body of water where the sample was collected and sample collection data as shown below:

Figure 6. Sample Identification Key

```
aaaa-bbbb bbb-ccc-YYYY-M-DD-HH-MM-dd
LDEL-1343 ICP-FMO-2013-5-14-12-05-DO
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Where:
a = SRMP unit responsible for sampling; b = site number combination derived from river mile and ICP or BCP site type; c = activity type abbreviation; dd = parameter abbreviation; date as yyyy-m(m)-d(d); and military time as hh-mm. Underlined portion is the unique Sample ID; and the entire record is the unique database ID which includes the sample ID plus time (in case a parameter is measured multiple times from a sample)

All bottles are labeled with sample numbers and locations. Bottle blank (BBL), equipment rinsate blank (RIN) or replicate (REP) samples should be labeled with times that are different from primary routine (ROU) samples and field measurements / observations (FMO). The field data sheet should indicate that primary, blank or replicate samples were taken, by recording each sample number with the notation ROUTINE, BLANK or REPLICATE. Sample labels are to be completed for each sample using waterproof ink.

2.3.3 Sample Preservation, Holding, and Transportation

The sample collection team places samples into pre-preserved sample jars and maintains samples at or below 6 °C without freezing on site, during transport, and until receipt by the lab. The sample collection team also places a temperature blank in the cooler for later measurement at the Laboratory during sample check-in. The Laboratory maintains the samples and any sample extracts, without freezing, at or below 6 °C until analysis. Each filled labeled sample bottle is sealed inside a sealable plastic bag, to prevent direct contact with melt water from the ice. Containers are supplied by the lab, certified clean, and preserved with the appropriate preservative for the analysis requested. Table 7 shows the sample bottle material, maximum holding time, and preservative requirements for each analysis under this QAPP.

Table 7. Sample Preservation and Holding Time Requirements

Parameter	Sample Container	Preservative	Transport/Storage	Holding Time
Alkalinity as CaCO3, Total	500 ml plastic	Unpreserved No Headspace	Ice (Temp<4 ±2C)	14 days
Hardness as CaCO3, Total	250 ml plastic	HNO_3 (pH<2)	Ice (Temp<4 ±2C)	6 months
Orthophosphate as P, Total	250 ml plastic	Unpreserved	Ice (Temp<4 ±2C)	48 hours
Chloride, Total	1 L Plastic	Unpreserved	Ice (Temp<4 ±2C)	28 days
TDS				7 days
TSS				7 days
Phosphorus, Total as P	1 Liter plastic	H_2SO_4 (pH<2)	Ice (Temp<4 ±2C)	28 days
Ammonia as N, Total				28 days
Nitrate+Nitrite as N, Total				28 days
TKN as N				28 days
Turbidity	250 ml plastic	Unpreserved	Dark, Ice (Temp<4 ±2C)	24 hours
Fecal Coliform	Sterilized 125 ml plastic	$Na_2S_2O_3$ dechlorination	Ice (Temp<4 ±2C)	6 hours
E. coli	Sterilized 125 ml plastic	Unpreserved	Ice (Temp<4 ±2C)	6 hours
Enterococcus	Sterilized 125 ml plastic	Unpreserved	Ice (Temp<4 ±2C)	6 hours
Aluminum	1 L Plastic	Unpreserved	Ice (Temp<4 ±2C)	28 days
Sodium				
Calcium				
Iron				
Strontium				
Barium				
Magnesium				
Manganese				
Potassium				
Bromide				
Sulfate				

2.3.4 Chain of Custody Documentation

The sample packaging and shipment procedures summarized below insure that the samples arrive at the Laboratory with the chain of custody intact.

The sample collection team is responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples. The sample collection team must complete a NJDOH chain of custody form documenting the custody of each sample as soon as the samples are collected. Samples must be accompanied by a properly completed chain of custody form. The sample numbers and locations are listed on the chain of custody form. When transferring the possession of samples, the individuals relinquishing and receiving should sign, date, and note the time on the record. This record documents transfer of custody from the sampler to another person, to a mobile laboratory, or to/from secure storage.

Samples should be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody, record enclosed in each sample box or cooler. The completed chain of custody documentation shall accompany the samples at all times.

Given the short holding time for several parameters, a courier may be used to transport analytical samples to the laboratory. In this case, custody seals are generally not used. However, the cooler being delivered should be well-sealed and placed in a stable location in the delivery vehicle. Samples within the cooler should be in closed Ziploc bags. The bags should be generously iced. The courier must sign the chain of custody form documenting his receipt of the samples and again when he relinquishes the samples to the lab.

2.3.5 Field Log Books and Field Data Forms

The sample collection team may record important field information in a project field log book or upon field data sheets. Field logbooks should be bound field survey books or notebooks, with printed page numbers.

The title page of each logbook should contain the following: person to whom the logbook is assigned; logbook number; project name; project start date; project end date.

Logbook entries may contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present and the signature of the person making the entry should be entered. The date and time that each sample is collected should be recorded in the logbook. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit should be recorded in the field logbook. Measurements made and samples collected should be recorded. All entries should be made in ink and no erasures made. If an incorrect entry is made, the information should be crossed out with a single strike mark. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station shall be recorded.

2.3.6 Laboratory Custody Procedures

Upon receipt of the sample cooler(s), the Laboratory shall initiate a documentation procedure to verify the custody and condition of the samples. On a standard check-in sheet, notebook, or sample receiving system, the Laboratory shall note the presence and number of sample custody seals, including seal number and condition of seals.

Immediately upon opening the cooler, the Lab shall measure and record the internal temperature of the cooler using the enclosed temperature blank sample. Also, the receiving Lab shall record the number and condition of the samples received. The log-in sheet shall be signed and dated by the log-in personnel, who shall provide a copy for the study manager.

2.4 *Analytical Methods*

Samples are analyzed for the parameters shown in Table 8 below:

Table 8. Analytical Methods

Parameter	Method	Detection Limit
Alkalinity as CaCO3, Total	SM 2320B	0.39 mg/l
Chloride, Total	EPA 300.0 rev 2.1 & 300.1 rev 1.0	0.37 mg/L
Hardness as CaCO3, Total	SM 2340C Hard	1.01 mg/l
Nitrate + Nitrite as N, Total	EPA 353.2 rev 2.0	0.007 mg/L
Ammonia as N, Total	EPA 350.1 rev 2.0	0.005 mg/L
Kjeldahl Nitrogen as N, Total (TKN)	EPA 351.2 rev 2.0	0.038 mg/L
Phosphorus as P, Total (TP)	EPA 365.1 rev 2.0	0.002 mg/L
Orthophosphate as P, Total	EPA 365.1 rev 2.0	0.002 mg/L
Total Dissolved Solids (TDS)	SM 2540C	3.10 mg/l
Total Suspended Solids (TSS)	SM 2540D	0.43 mg/l
E. coli – none 2013	EPA 1103.2	1 col/100ml
Enterococcus – none 2013	SM 9230C	10 col/100ml
Fecal coliform (UPDE and DEWA labs)	SM 9222D	1 col/100ml
Sodium – none 2013	EPA 200.7	30 µg/l
Calcium – none 2013	EPA 200.7	10 µg/l
Strontium – none 2013	EPA 200.7	0.3 µg/l
Barium – none 2013	EPA 200.7	1 µg/l
Magnesium – none 2013	EPA 200.7	20 µg/l
Potassium – none 2013	EPA 200.7	300 µg/l
Bromide – none 2013	EPA 300	10 µg/l
Sulfate – none 2013	EPA 300	20 µg/l

2.5 *Quality Control*

Field QA/QC procedures and criteria are presented in Table 9 below.

Laboratory QA/QC procedures and criteria are fully defined in the analytical methods. A summary of project required QA/QC procedures is provided in Table 9 below, but for a full discussion of the Laboratory QA/QC requirements, the assessment method, and the acceptance criteria, the reader is directed to the analytical methods listed in Table 8. Distilled de-ionized water, for the performance of bottle blanks and rinsate blanks, is provided by the analytical laboratory or DRBC.

Table 9. QA/QC Assessments and Goals

QC Sample	Rate	Assessment	QC Goals
Field QA/QC Samples			
Bottle Blanks	once per team every sampling day	detection	Below Detection Limits
Rinsate Blanks	once per team every sampling day	detection	Below Detection Limits
Field Replicate	10%: at least one duplicate for each sampling site per year, time of day varies	RPD to duplicated sample	≤30%
Split Samples	None Specified Available to 3rd party upon written request	None specified	None specified
Laboratory QA/QC Samples			
Lab Duplicates	1 or more per 20 samples analyzed	RPD	As defined by the analytical methods
Method Blanks	≥ 1 per batch, where applicable	detection	Below Detection Limits
Surrogate Spikes	*all samples, where applicable*	%R	As defined by the analytical methods
Lab Control Sample	≥ 1 per batch	As defined by analytical Methods	As defined by the analytical methods

Notes:
1. %R = % recovery
2. RPD = relative percent difference
3. N/A = not applicable

2.5.1 Bottle Blank

A bottle blank is a controlled water sample, free from the contaminants of concern, which is placed into the sample bottles used to contain the analytical samples. The bottle blank is intended to determine if extraneous contaminants associated with the sample bottles are impacting the analytical samples. *For this project, one bottle blank shall be collected by each of the 3 teams on each day of sampling.*

2.5.2 Rinsate Blank

Rinsate blanks are samples collected from a final rinse of sampling equipment with analyte-free water after the decontamination procedure has been performed. In this instance, rinsate blanks should be collected after the distilled de-ionized water rinse, but before the site water rinse. The purpose of rinsate blanks is to document adequate decontamination and to determine whether the sampling equipment is causing cross contamination of samples. *For this project, one rinsate blank will be collected by each of the 3 teams during each sampling day.*

2.5.3 Field Replicate Samples

Replicate Samples are analytical samples that are collected as a single sample, divided into two or more equal parts, and placed into separate containers. The replicate sample is given a different sample ID time to distinguish it from the primary sample, and submitted to the laboratory accompanying the remainder of the analytical samples. *For this project, one field replicate will be submitted for each sampling site. Each station will be replicate-sampled at least once per year during this project.*

2.5.4 Field Split Samples

Field split samples are analytical samples that are collected as a single sample, divided into two or more equal parts, and placed into separate containers. Field split samples differ from field replicate samples in that they are delivered into the custody of an independent third party at the sampling site, and are typically analyzed by a different laboratory. Field split samples are sometimes utilized to assess the precision and accuracy of sample results. *For this project, no split samples are specifically required. However, a third party may make a written request to DRBC for a split sample. In order to be considered, the request must be made at least 1 week prior to sample collection. The third party requesting the split sample must be prepared to take custody of the sample at the sampling site, and must provide appropriate sample bottles, labels, forms, and coolers. DRBC will not pay for the analysis of any split sample.*

2.6 *Equipment Testing, Inspection, and Maintenance*

To ensure that all data collected under this project are of sufficient quality, all instruments and equipment used are maintained on a regular basis. Records of all maintenance activities are documented in an Equipment Service Logbook that is stored in the DRBC laboratory, near the equipment preparatory area. A kit, which includes replacement parts for each of the pieces of equipment to be used as well as tools to conduct this maintenance, is present at time of sampling.

Measurement Specialties Manta2 Meters

These are subject to daily, routine maintenance as well as annual maintenance. The daily maintenance includes both lab and field procedures to ensure that all measurements taken are both accurate and precise. Between sites, the sonde is rinsed with deionized water to prevent fouling by accumulation of contaminants found in the waters samples. The storage cup, used to store the sonde while transporting from site to site, is filled with fresh, deionized water after each site, according to manufacturer’s recommendations. After daily sampling is complete, the sonde is disinfected with an Alconox Soap Solution (4%) to prevent accumulation of bacteria or other biological contaminants. The soap is applied to all parts of the sonde using a cotton swab and then rinsed with deionized water to remove soap residues. For long-term storage, the storage cup is filled with pH 4 standard solution to prevent colonization of bacteria and other biological contaminants on the sonde. Upon completion of the sampling season, the entire unit is sent to the manufacturer for annual maintenance as prescribed by the manufacturer. All service performed on the units is documented in the Equipment Service Logbook.

Marsh-McBirney Flow Meter

Due to the fragile nature of this equipment, all storage, transport, and usage instructions described by manufacturer are explicitly followed. All wiring and other electrical equipment associated with the meter is frequently inspected. All services conducted on the flow meter is documented in the Equipment Service Logbooks.

2.7 *Instrument / Equipment Calibration and Frequency*

Measurement Specialties Manta2 Meters

All calibrations are conducted as recommended by manufacturer. Calibration procedures and frequency of calibration can be found in Table 10. If during the time of collection any values seem to fall outside of the expected range, these values are noted and a calibration occurs upon completion of sampling to verify measurements taken. Where possible, such as for verification of conductivity and pH, complete the following procedure:

1. Immediately following calibration, a blank is analyzed and recorded in the field logbook followed by;
2. Analysis of a mid-level Quality Control (QC) calibration check standard. The QC calibration check standard should be from a different batch of standard than those used for calibration, to verify quality of the initial calibration standard and ensuring accuracy of the calibration results of the field equipment. Followed by;
3. Analysis of another blank and then;
4. Analyze the next ten samples.
5. Repeat 1-4.

This sequence shall be repeated after every tenth sample run and after the end of the sample run sequence. An annual factory calibration occurs prior to each sampling season. All calibrations are documented in the Calibration Logbooks. See Appendix B for multi-meter Standard Operating Procedures.

Table 10. Measurement Specialties Manta2 Calibration Summary

Parameter	Unit	Lab Preparation	Lab Frequency	Field Preparation	Field Frequency
Air Temperature	Deg. C	Factory Calibration	Annual	None	N/A
Water Temperature	Deg. C	Factory Calibration	Annual	None	N/A
Dissolved Oxygen (DO)	Mg/l	Air Calibration	Daily	Air Calibration	Upon barometric or elevation changes
Conductivity	mS/cm	100 & 500 mS standards	Daily	DI rinse	Per site
pH	units	3 point: 4, 7 and 10 standards	Daily	DI rinse, check 7 standard	Mid-day and end of day

2.8 *Inspection / Acceptance of Supplies and Consumables*

All field supplies and consumables are inspected by the sample collection team for defects and obvious signs of improper handling before use. Supplies and consumables which show signs of defects or improper handling are not used by the sample collection team. All laboratory supplies and consumables are the responsibility of the analytical laboratory. Requirements for the inspection and acceptance of supplies and consumables are defined in the analytical methods. The reader is directed to the methods in Table 8 for a complete discussion of these requirements.

2.9 *Non-direct Measurements*

In the context of this QAPP, non-direct measurements refer to pre-existing data and estimates of values generated by mathematical models. The only non-direct measurements associated with this program include: 1) Discharge drainage-area-weighting calculations at selected ungaged sites using nearby USGS gage sites; 2) Estimation of mean daily discharge at ungaged sites using Stream Stats and BaSE, if necessary; 3) Calculation of Total Nitrogen as N by summing individual component concentrations; and 4) Calculation of dissolved oxygen percent saturation from field-measured water temperature and dissolved oxygen concentration.

2.10 Data Management

The Delaware River Basin Commission manages all data generated from this work. EDD files and transcribed field notes are stored electronically on DRBC computers with backup copies on external backup drives attached to each computer; on network storage drives that are themselves backed up in an off-site secure location; and on DVD media maintained in the branch project files. Dr. Fikslin has ultimate responsibility for ensuring that data is maintained and secured. Compatibility of hardware / software configurations is determined through observations associated with routine usage. Hardware / software compatibility problems are referred to the Information Services branch of DRBC for correction.

3 Assessment and Oversight Elements

The elements in this section address the activities for assessing the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAPP is implemented as described.

3.1 *Assessments and Response Actions*

When errors, deficiencies, or aberrant situations occur during sample collection, the sample collection team contacts the Study Manager for guidance and clarification. If appropriate response actions can not be implemented in the field, sample collection is terminated and resumes as soon as response actions have been implemented and field conditions are appropriate.

When errors, deficiencies, or aberrant situations occur in the Laboratory, the Laboratory's QA program provides systematic procedures, called "response actions," to resolve problems and restore proper functioning to the analytical system(s). Laboratory personnel are alerted that response actions are necessary if:

- QC data are outside the acceptable windows for precision and accuracy;
- Blanks, duplicate control samples, or single control samples contain contaminants above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- There are unusual changes in method detection limits; or
- Deficiencies are detected by the Laboratory QA department during internal or external audits or during performance evaluations.

Response action procedures may be handled by the analyst, who reviews the preparation and extraction procedure for possible errors, checks the instrument calibration, spike, and calibration mixes, and instrument sensitivity. If the problem persists or can not be identified, the matter is referred to the Laboratory supervisor, manager, and/or QA department for further investigation. Once resolved, full documentation of the response action procedure shall be included with the Laboratory report.

The following response actions and/or procedures are required as part of this QAPP.

3.1.1 Incoming Samples

Problems noted during sample receipt shall be documented on an appropriate sample log-in form. The DRBC Study Manager shall be contacted immediately for consultation regarding problem resolution. All response actions taken shall be thoroughly documented and submitted to the DRBC Study Manager.

3.1.2 Sample Holding Times

If samples can not be extracted and/or analyzed within the appropriate method required holding times, the DRBC Study Manager shall be immediately notified, such that an appropriate response action plan can be generated. All response actions taken shall be thoroughly documented.

3.1.3 Detection Limits

Appropriate sample cleanup procedures shall be employed to attempt to achieve the required detection limits. Cleanup methods employed are left to the discretion of the analyst or other appropriate Laboratory personnel, in accordance with the specified analytical method. Cleanup methods and dilutions shall be documented, with the rationale, along with revised method detection limits for those analytes directly affected.

3.1.4 Method QC

All method QC, including blanks, matrix duplicates, matrix spikes, matrix spike duplicates, surrogate spikes, laboratory control samples, and other method specified QC, shall meet the requirements as specified in this QAPP. Failure of the method required QC shall result in the review of all affected data. If no errors can be noted, the affected samples shall be reanalyzed and/or re-extracted then reanalyzed within method holding times to verify the presence or absence of a matrix effect. If the matrix effect is confirmed, the corresponding data shall be flagged accordingly using the EPA flagging symbols and criteria.

3.2 *Reports to Management*

Reports from the Laboratory are to be submitted to the Study Manager within 30 days after receipt of samples. These will serve as Laboratory Quality Assurance Reports to management. The reports from the Laboratory must include all the items specified in this QAPP. At a minimum, the laboratory deliverables must include items to support reconciliation with user requirements described in Section 4.3.

4 Data Validation and Usability Elements

Data validation and usability procedures will include, as the minimum, the elements described below:

4.1 *Data Review, Verification, and Validation*

All analytical data generated by the Laboratory shall be reviewed prior to report generation to assure the validity of the reported data. This internal laboratory data validation process shall consist of data generation, reduction, and a minimum three levels of documented review. In each stage, the review process shall be documented using an appropriate check list form that is signed and dated by the reviewer. The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data of high quality are generated consistently. All data generated and reduced shall follow well documented in house protocols. Data outside the quality objectives and criteria will be flagged, so that data recipients can exercise discretion in determining appropriate data uses and limitations.

4.2 *Verification and Validation Methods*

Each analyst reviews the quality of their work based on an established set of guidelines. This review shall, at a minimum, ensure the following:

- Sample preparation information is correct and complete;
- Analysis information is correct and complete;
- The appropriate SOPs have been followed;
- Analytical results are correct and complete;
- QC samples are within established control limits;
- Blanks and laboratory control samples are within appropriate QC limits;
- Special sample preparation and analytical requirements have been met;
- Documentation is complete (i.e., all anomalies in the preparation and analysis have been documented; anomaly forms are complete, holding times are documented, etc.).

Level 1 data review shall be documented using a check list form and by signature and date of the reviewer.

Level 2 reviews shall be performed by a supervisor or data review specialist whose function is to provide an independent review of the data package. This review shall also be conducted according to an established set of guidelines and is structured to ensure that:

- All appropriate Laboratory SOPs have been followed;
- Calibration data are scientifically sound, appropriate to the method, and completely documented;
- QC samples are within established guidelines;
- Qualitative identification of sample components is correct;
- Quantitative results are correct;

- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented, anomaly forms are complete, holding times are documented, etc.);
- The data are ready for incorporation into the final report;
- The data package is complete and ready for data archive.

Level 2 reviews shall be structured so that all calibration data and QC sample results are reviewed and all the analytical results from at least 10% of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional 10% of the sample results shall be checked back to the bench sheet. This cycle repeats until either no errors are found in the data set checked or all the data has been checked. All errors and corrections noted shall also be documented on a check list with the signature and date of the reviewer.

Level 3 reviews are performed by the quality assurance officer or the program administrator at the Laboratory. This review should be similar to the review as provided in Level 2 except that it should provide a total overview of the data package to ensure its consistency and compliance with this contract. All errors noted shall be corrected and documented. Level 3 data review shall also be documented on a check list with the signature and date of the reviewer.

4.3 *Reconciliation with User Requirements*

In order to ensure that all the data is consistent with the project requirements, DRBC performs a Data Quality Assessment on the completed data set. All data quality assessment results are documented in a memorandum by DRBC or a contractor.

DRBC reviews the entire data set (100% of the data) and performs each of the following checks:

- Determine if all the requested data is present. Document any missing data. If there are no deficiencies, document that the data set is complete.

- Check the analyte-specific holding times. Document any holding times which were exceeded. If there are no deficiencies, document that all holding times were met.

- Check the detection limits against those specified in the QAPP. Document any detection limits which exceeded the detection limits required by the QAPP. Where detection limits were higher than expected, document any explanation included in the laboratory report, such as “matrix interferences.” If there are no deficiencies, document that all detection limits were met.

- Check the field and method blanks to determine if blanks were run at the frequency required in the QAPP. Document any deficiency in blanks. Document any blank in which a quantifiable concentration of the analyte was detected. If there are no deficiencies, document that sufficient blanks were analyzed and none had quantifiable concentrations of any analyte.

- Check the initial and continuing calibration information to determine whether or not calibration was achieved and maintained. Document any deficiencies. If there are no deficiencies, document that the initial and continuing calibration information is complete and acceptable.

- Check the documented quantitation processes against the process requirements described in the analytical method. Document any deficiencies. If there are no deficiencies, document that the quantitation process is complete and acceptable.

- Check the Matrix Spike results (MS) to determine if they were run at the required frequency. Check the % recoveries and the relative percent differences (RPD) against the acceptance criteria listed in the QAPP. Document any deficiencies in frequency of MS or any % recoveries or RPDs that exceeded the acceptance criteria. If there are no deficiencies, document that the MS are complete and acceptable.

- Check all field and laboratory duplicates to determine if duplicates were performed at the frequency required by the QAPP. Check the RPD against the acceptance criteria listed in the QAPP. Document any deficiencies in the frequency of duplicates, or any RPDs outside the acceptance criteria. If there are no deficiencies, document that the duplicates are complete and acceptable.

- Check the laboratory control samples to determine if they were analyzed at the frequency, and for the parameters specified in the QAPP. Check the % recovery (or other measures such as Response Factor, where appropriate) against the acceptance criteria listed in the QAPP. Document any deficiencies in frequency or any % recoveries outside the detection limits. If there are no deficiencies, document that the laboratory control samples are complete and acceptable.

- Check the surrogate recoveries to determine if they were performed at the frequency and for the parameters specified in the QAPP. Check the % recoveries against the acceptance criteria specified in the QAPP. Document any deficiencies in frequency or any % recoveries outside the detection limits. If there are no deficiencies, document that the surrogates are complete and acceptable.

- Check for the presence and content of response action forms where any deficiencies in any of the above categories exist. Document the existence and content of response action forms.

- Check related laboratory data to determine if the results are logical and reasonable. For example, if a sample is analyzed for a total and dissolved fraction of a given parameter, the results for the total fraction should be greater than (or at least equal to) the dissolved fraction. Document any deficiencies or any data which appears to be illogical or incorrect.

If data deficiencies should occur, DRBC will prepare a memorandum outlining all the documented deficiencies. The last paragraph of the memo should state the reviewer's recommendation for accepting or not accepting the data package. Based on the review of the data package, DRBC will determine if (1) the data package is acceptable based on the QAPP; and (2) the data is sufficient for its intended purpose. It should be noted that DRBC may accept the data package even if minor deficiencies exist, provided that the data can still be used for its intended purposes.

5 References

American Public Health Association, American Water Works Association, Water Environment Federation. 2005. Standard Methods for the Examination of Water and Wastewater. 21st Ed. American Public Health Association, Washington, DC.

Buchanan, T.J. and Somers, W.P. 1968. Stage measurement at gaging stations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A7. 1968.

Buchanan, T.J. and Somers, W.P. 1969. Buchanan, T.J., and Somers, W.P., 1969, Discharge measurements at gaging stations: U.S. Geological Survey Techniques of Water-Resources Investigations, book 3, chap A8, 65 p.

Delaware River Basin Commission. 2004. Lower Delaware Monitoring Program: 2000-2003 Results and Water Quality Management Recommendations. Delaware River Basin Commission, West Trenton, NJ. 46 pp + 5 Appendices.

Stuckey, M.H., Koerkle, E.H., and Ulrich, J.E. 2012. Estimation of baseline daily mean streamflows for ungaged locations on Pennsylvania streams, water years 1960–2008. U.S. Geological Survey Scientific Investigations Report 2012–5142, 61 p.

U.S. Environmental Protection Agency. 2001. EPA Requirements for Quality Assurance Project Plans: EPA QA/R-5. EPA/240/B-01/003. U.S. Environmental Protection Agency, Washington, DC.

U.S. Environmental Protection Agency. 2000. Guidance for the Data Quality Objectives Process: EPA QA/G-4. EPA/600/R-96/055. U.S. Environmental Protection Agency, Washington, DC.

U.S. Geological Survey. Baseline Streamflow Estimator (BaSE) application. http://pubs.usgs.gov/sir/2012/5142/support/BaSE_v.1.0.zip Downloaded October 2012, frequently used 2012-2013.

U.S. Geological Survey. StreamStats web application. http://streamstats.usgs.gov. Repeatedly accessed 2011-2013.

Wahl, K.L., W.O. Thomas, Jr., and R. M. Hirsch. 1995. Stream-gaging Program of the U.S. Geological Survey. U.S. Geological Survey Circular 1123. Reston, VA.

APPENDIX A

Forms

SCENIC RIVERS MONITORING PROGRAM
CHAIN-OF-CUSTODY RECORD

CoCR No.: 042706A — Page: of

Project Manager:	Return completed form to Robert L. Limbeck	Agency: Delaware River Basin Commission
Address & Phone:	PO Box 7360, W. Trenton NJ 08628 609-883-9500 x 230	Project: Scenic Rivers Monitoring Program

Date Collected (YYYYMMDD)	Time Collected (Mil. HHMM)	Site No. Location	# jars	Check if all samples taken (note if set incomplete)	Preserv-ation (see below)	Collect. Method (Grab / Composite)	Log Number (Seq+)

Sampled by (signature):					
Received by (signature):		Date		Time	
Received by (signature):		Date		Time	
Received by (signature):		Date		Time	

Instructions/Notes:

Instructions: Record all information concerning samples.
Check log numbers against containers to assure all samples are present, then sign in appropriate spaces.
Keep original Chain-of-Custody Record with samples.
Person relinguishing samples should receive a photocopy of this form.
Notify Project Manager immediately of any damaged or missing samples.

Scenic Rivers Monitoring Program

Water Quality Monitoring Form

1.) River Mile (RM/ Trib 1/ Trib 2/ State) ________________

Station Name: ________________

Station Number: ________________

2.) Date (YYYY/MM/DD) and **Time** (Military) ________ ____:____

3.) Dissolved Oxygen Method: ________ ________ mg/l

4.) Air Temperature Method: ________ ________ ^{o}C

5.) Water Temperature Method: ________ ________ ^{o}C

6.) Specific Conductance Method: ________ ________ µmhos/cm

7.) pH Method: ________ ________ pH units

9.) Gage Height ________ (measurement) + ________ (leader) = ________ ft.

10.) Weather Conditions: ________________

____

Dates of Last Rain: ________ and ________

11.) Water and Site Conditions: ________________

____

12.) Personnel

Name	Role
________	________
________	________
________	________

SCENIC RIVERS MONITORING PROGRAM
STREAMFLOW DATA SHEET

Station Name __________
River Mile ____.___
Station Number
Date (MM/DD/YYYY) __________ **Time (HHMM):**
Party________________________ **Agency:**
Location of Test Site From Gage Station:
Weather Conditions
Dates Last Rain ___/___/___ _______**inches**
___/___/___ _______**inches**

Gage Readings		Time	Tape Reading		Leader Length		Total Gage
	Before			+		=	
	After			+		=	

Gage Height at Substrate	
Meter Type	Pygmy
Spin Test (sec)	
Interval Width Chosen	
Total Number of Intervals	

Tape Reading @ Near Bank	
Tape Reading @ Far Bank	
Total Width of Stream	

Flow Width = (total width)-(zero flow intervals)	
Flow Area = Sum(incremental width X incremental depth)	
Average Depth = flow area / flow width	
Average Velocity = total discharge / total flow area	

VELOCITY BASED ON REGRESSION:

INCREMENTAL VELOCITY = 0.977 (REVOLUTIONS/SEC) + 0.028

USE ADDITIONAL SHEET IF NECESSARY

Mark REF, REW, LEF and LEW

Inter-vals	Tape Reading[1]	Dist. From stream edge[2]	Interval Width (tenths)	Interval Depth (tenths)	Observ. Depth[3] (tenths)	Revolutions[4]	Time (sec)	rev/sec	Velocity @ point	Interval Area (W X D)	Interval Discharge (A X V)
1											
2											
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36											
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38											
39											
40											
Totals			0.00						Totals	0	0.000

APPENDIX B

Standard Operating Procedures: Multi-Parameter Water Quality Meters

Refer to attached files:

DRBC SOP #110.01_pH – Standard Operating Procedure. pH Using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance.

DRBC SOP #120.01_Conductivity – Standard Operating Procedure. Conductivity Using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance.

DRBC SOP #130.01_DO - Standard Operating Procedure. Dissolved Oxygen Using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance.

DRBC SOP #140.01_Temperature - Standard Operating Procedure. Temperature Using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance.

Note: Procedures were developed for meters no longer used by DRBC, and are out of date. Procedures apply generally to newer meters, but SOP's are undergoing revision at this time for re-certification by NJDEP.

Note: SOP #110.01_pH states that 2 point calibrations of pH 4 and pH 10 standards be followed by a check with pH 7 standard. The statement is untrue here. All pH calibrations associated with this QAPP shall be 3-point calibrations of pH 4, pH 7 and pH 10 standards. Mid-day and end-of-day checks are made using pH 7 standard, as usual.