

Work/Quality Assurance Project Plan
Lockatong and Wickecheoke Creek Watersheds
Restoration and Protection Project

319(h) Grant

Contract: RP05-082

QAPP was organized according to NJDEP specifications:
Appendix D, Quality Assurance Project Plan (QAPP)
Guidance for 319(h) Nonpoint Source Projects

New Jersey Water Supply Authority
Watershed Protection Programs Unit

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(Response to NJDEP comments italicized and bold in narrative)

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Contract RP05-082

Approved By:

Date

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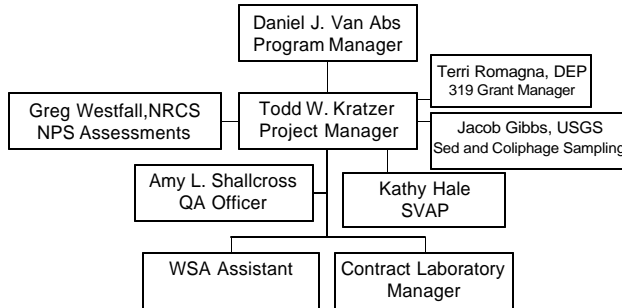
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PROJECT ORGANIZATION



Daniel J. Van Abs, PhD, PP/AICP

Program Manager: Coordinates resources (staff and funding) to facilitate the success of the program. Provides overall review of program progress and schedules.

Todd W. Kratzer, PE

Project Manager: Oversees the project schedule and assignments (monitoring and reporting) for project tasks. Supervises field duties; assists with sample collections and training; and provides data analyses, interpretation, management, and reporting. Coordinates efforts with USGS for sampling schedules and collections, and data management.

Amy L. Shallcross, PE

QA Officer: Provides review of field and laboratory QA/QC procedures and manages the implementation of correction measures, if necessary. Provides technical review of field and laboratory data management, validation, and reporting. Assists with sample collections and the associated training.

Kathy Hale

SVAP Specialist: Coordinates and manages field assessment work for segments of the stream channel. Provides training for field assistant(s).

Jacob Gibbs, PhD

Manager for USGS sampling and data management. Coordinates all sampling procedures, efforts, and QA/QC with Project Manager and QA Officer.

Terri Romagna

NJDEP WMA11 319(h) Grant Manager. Reviews and assesses progress and outputs from project, via quarterly progress reports.

Greg Westfall

Manager for NRCS Erosion Assessments. Coordinates phosphorus and sediment loading assessments and RUSLE2 modeling efforts with NRCS personnel and Project Manager.

Tara Petti

Field Scientist: Assists with sample collections, QA/QC, data management, maintenance and calibration of monitoring equipment, and other duties as necessary.

Thomas Hines, President QC Laboratories, Inc.

Laboratory contact for analytical processing. Oversees proper techniques for sample preservation, transport of samples from field to laboratory, and all laboratory QA/QC procedures for sample analysis and data reporting, as well as assuring supplies of sampling containers, labels, and coolers.

PROBLEM DEFINITION AND BACKGROUND

The Delaware and Raritan Canal transfers water from the Delaware River Basin to the Raritan River Basin, where the raw water is treated to become drinking water for approximately 600,000 people living in and outside of the Raritan Basin, including customers of NJ American (Elizabethtown) Water Company, Middlesex Water Company, the Townships of East Brunswick and North Brunswick, and the City of New Brunswick. The entire length of the Delaware and Raritan Canal (D&R Canal) is classified as FW2-NT; Category 1 status is under consideration by the New Jersey Department of Environmental Protection (NJDEP) but has not been proposed. Since 1997, several of the Canal's water purveyors reported increased concentrations of total suspended solids and total organic carbon in the raw water during and immediately after precipitation events, requiring increased chemical use for removal and increasing sludge generation from residuals. The New Jersey Water Supply Authority (NJWSA) has sponsored three studies to assess pollutant contributions to the Canal; one in the late 1980's by Ebasco; another in the late 1990's by USGS and a third in 2006 by the NJWSA. The Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Program 319(h) proposal provides additional background information and is presented in Attachment 1.

The Lockatong and Wickecheoke Creek Watersheds drain a significant section of western Hunterdon County, in areas predominated by very poor aquifers in the Lockatong and Stockton formations. These watersheds flow into the D&R Canal. NJDEP has identified a variety of water quality problems in the two watersheds including impairments for fecal coliform, phosphorus and temperature, plus impaired benthic macroinvertebrate communities. Table 1 shows the 2004 Integrated List results for the Lockatong and Wickecheoke Creek Watersheds, including changes presented in the draft 2006 Integrated List.

The watersheds are primarily rural in nature, with scattered farms, homes, county and local roads, etc. Soils tend to be thin, and water resources minimal, due to their location on the Hunterdon (or Croton) Plateau with its hard argillite bedrock. Approximately 48% of the watershed is forested or wetlands, 40% is agricultural and 10% is urban, according to NJDEP 1995/97 GIS land use information. Development within the watersheds relies primarily on on-site well water and wastewater discharge through septic systems. The Delaware Township MUA is the only permitted WWTP discharge, on a tributary to the

Wickecheoke Creek. This tributary is known locally as Rose Brook. The agricultural lands are primarily used for crops: sunflowers, sorghum, corn, hay and some pasture.

Streams are “flashy” due to the poor ground water recharge and storage capacity – stormwater moves quickly to streams, and dry periods result in very low or no stream flows. NRCS has noted stream bank erosion and soil erosion from surrounding lands. NJWSA has documented major sediment loading to the Delaware & Raritan Canal during storms. Phosphorus can be contributed to streams by erosion, agricultural and lawn fertilizers, livestock, pets, and wildlife. Fecal coliform bacteria can contribute to stream degradation by septic system failure; and/or livestock, pets and wildlife feces. Temperature violations can be caused by the loss of natural riparian areas, stormwater runoff from impervious surfaces near streams, and the periodic low flows that typify the streams. NJDEP has prepared fecal coliform and phosphorus TMDLs for the Lockatong and Wickecheoke Creeks. This project will provide vital information to support TMDL implementation, along with management approaches to address current problems. The two watersheds were part of the Central Delaware Tributaries (WMA 11) Watershed Management Project (see www.planningpartners.org/projects/past/wma11.html) conducted by the Regional Planning Partnership, which developed information that can be used in this project. The watersheds represent nearly 60 percent of the total drainage into the Delaware and Raritan Canal (Figure 1, downstream of the Delaware River intake). Therefore, these watersheds are very important to the Canal water quality and for the amount of sediment loads that must be dredged from the Canal at the location of discharge. Both watersheds have been granted Category 1 status.

PROJECT/TASK DESCRIPTION

The objectives of this study are to:

- ?? Collect water quality and flow data to define the existing conditions within 20 selected subbasins of the Lockatong and Wickecheoke Creek Watersheds (Phase 1, see Figure 2);*
- ?? Isolate and target subbasins contributing the largest loadings (Phase 2);*
- ?? Provide recommendations to Hunterdon County Health Department and County Soil Conservation Division for on-site source tracking*
- ?? Apply results from this project to an appropriate sediment transport and/or water quality model(s) to assist in source-tracking , and to simulate loadings based on existing and future land uses and zoning.*
- ?? Supplement the implementation of a watershed management plan to restore and protect water quality and flows, using the modeling results as a water quality/quantity management tool.*

There are 4 components, described below, to the project for defining water quality and identifying loading sources within the mainstem and tributaries of the Lockatong and Wickecheoke watersheds.

1. Water Quality Monitoring - Phase 1

NJWSA will conduct water quality monitoring at 9 sites in the Lockatong watershed and at 11 sites in the Wickecheoke watershed as shown in Figure 2. A synoptic water quality

Table 1. 2004 Integrated Listings for Lockatong and Wickecheoke Creek Watersheds (includes changes presented in the draft 2006 Integrated Listings)

Sublist	Station Name/Waterbody	Site ID	Parameters	Data Source
1	Lockatong Creek at Oak Grove Rd in Franklin	AN0086	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBCNJ0013	Fecal Coliform, Dissolved Oxygen, pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	DRBC
5	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBCNJ0013	Phosphorus*, Temperature ^d	DRBC
1	Lockatong Creek at Rt 12 in Kingwood	AN0087	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rt 29 in Delaware	AN0089	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rt 519 in Kingwood	AN0088	Benthic Macroinvertebrates	NJDEP AMNET
3	Plum Brook at Rt 579 in Raritan	AN0092	Benthic Macroinvertebrates	NJDEP AMNET
5	Plum Brook near Locktown	01461262	Fecal Coliform*	NJDEP/USGS Data
3	Plum Brook near Locktown	01461262	Phosphorus*	NJDEP/USGS Data
1	Plum Brook near Locktown	01461262	Temperature*, pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
3	Wickecheoke Creek at Croton	01461220	Phosphorus*, Dissolved Oxygen	NJDEP/USGS Data
1	Wickecheoke Creek at Croton	01461220	Temperature ^d , pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
5	Wickecheoke Creek at Croton	01461220	Fecal Coliform*	NJDEP/USGS Data
5	Wickecheoke Creek at Locktown - Sergeantsville Rd in Delaware	AN0091	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Rt 29 in Stockton	AN0095	Benthic Macroinvertebrates	NJDEP AMNET
3	Wickecheoke Creek at Rt 579 in Raritan	AN0090	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Sergeantsville Rd in Delaware	AN0094	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Stockton	01461300, DRBCNJ0012	pH, Dissolved Oxygen, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data, DRBC
5	Wickecheoke Creek at Stockton	01461300, DRBCNJ0012	Phosphorus*, Fecal Coliform*, Temperature*	NJDEP/USGS Data, DRBC
3	Wickecheoke Creek near Sergeantsville	01461282	Phosphorus*	NJDEP/USGS Data
1	Wickecheoke Creek near Sergeantsville	01461282	Temperature*, pH, Dissolved Oxygen, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
5	Wickecheoke Creek near Sergeantsville	01461282	Fecal Coliform*	NJDEP/USGS Data

Moved to sublist 4 on the Draft 2006 Integrated List

^d Delisted on the Draft 2006 Integrated List

Figure 1. Direct Drainage to the Delaware & Raritan Canal
(Downstream of the Delaware River Intake)

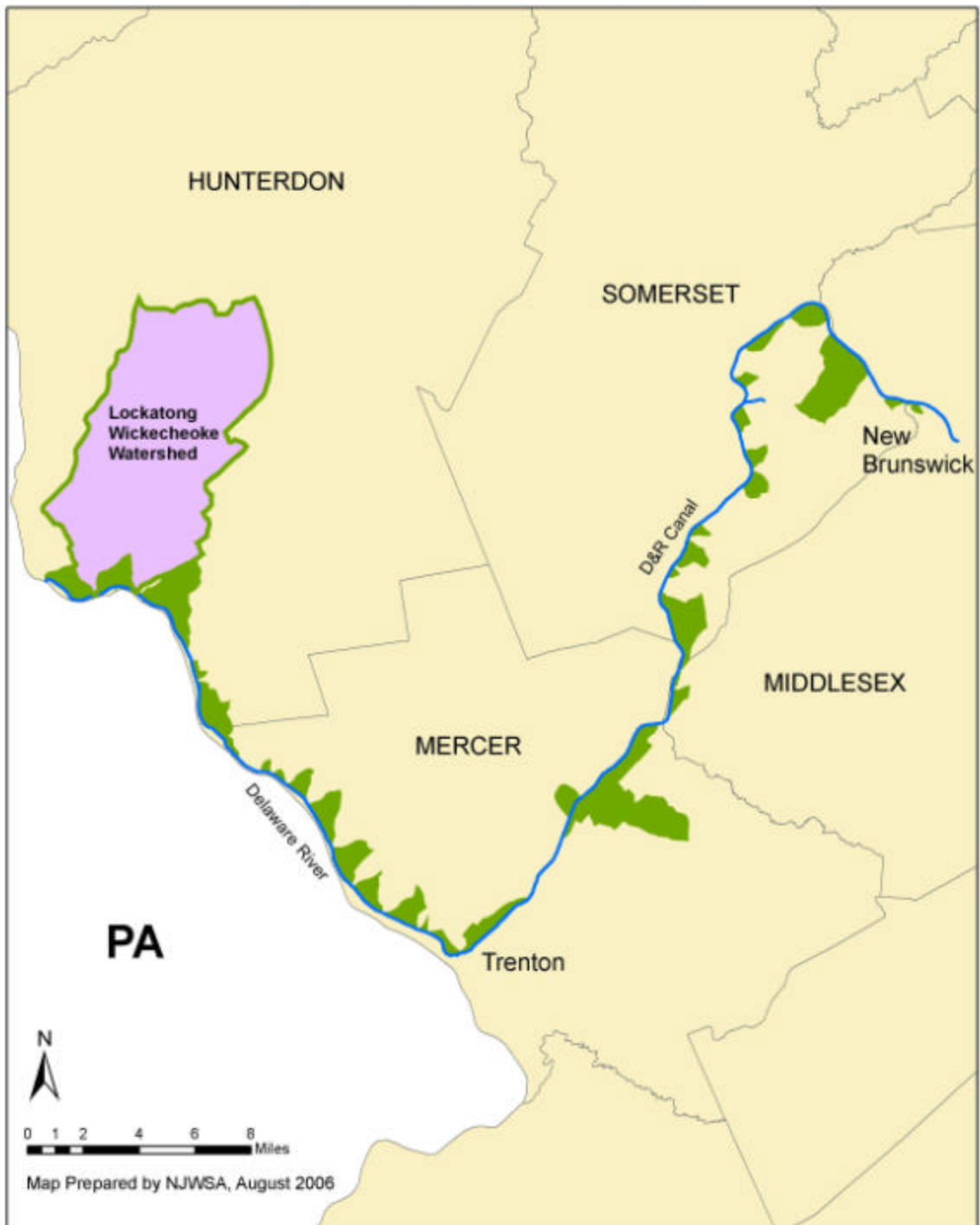
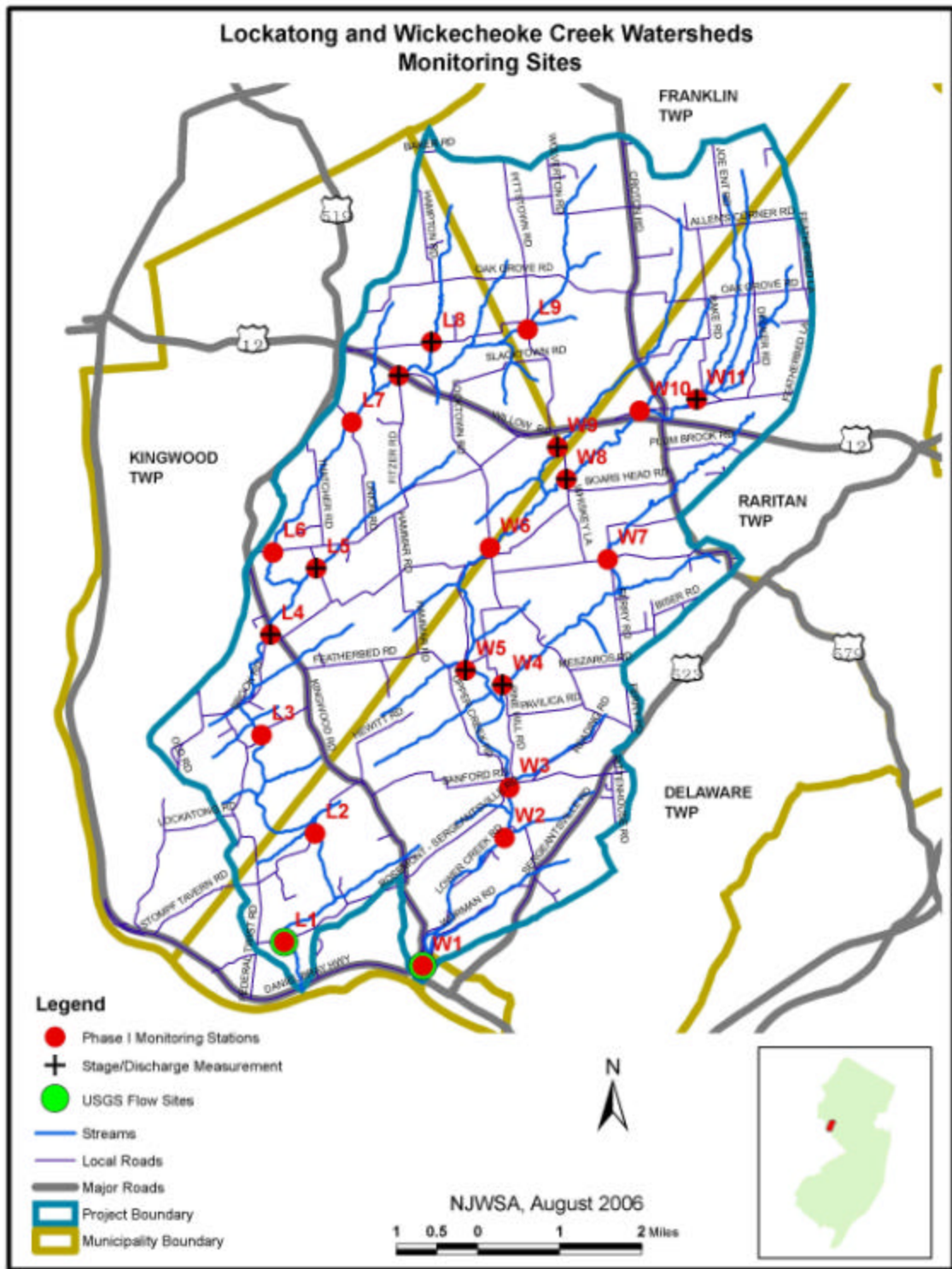


Figure 2. Sampling site locations within the Lockatong and Wickecheoke Watersheds for Phase 1 of the monitoring program.



and flow-monitoring program (Phase 1) will be performed at all 20 sites for 3 storm-induced flows and 3 baseflow conditions. ***Storm flows, or higher flows are represented by an abrupt increase in flow from runoff after the onset of a precipitation event. Lower flow is equivalent to baseflows, or flows unaffected by stormwater.*** USGS flow-monitoring stations, one located near the mouth of each stream, will be used to determine when runoff has commenced from storm events and at what point on the discharge hydrograph the samples were actually collected.

The 20 sampling sites are listed in Table 2, including the type of flow monitoring associated with selected sites. Water quality concentrations during storm-runoff events are dominated by non-point source loadings, whereas point-source/ground water loadings are more prevalent during baseflows. Total phosphorus, total suspended solids (TSS), fecal coliform, nitrite+nitrate, total Kjeldahl nitrogen (TKN), ammonia, boron, and turbidity will be analyzed by QC Laboratories as specified in the Request for Laboratory Services (Attachment 2). QC Laboratories is preparing to analyze E. coliform samples in 2007. Specific-conductivity, pH, and water and air temperature data will be monitored by the field crew at each sampling site using a YSI 63 field meter. The Standard Operating Procedure (SOP) for the YSI meter is presented in Attachment 3. Table 3 presents the sampling schedule and number of samples collected at each site. Flow data will be collected continuously at USGS flow monitoring stations that have been installed as part of this study near the mouth of each watershed. ***The collected data will provide*** a better evaluation of pollutant loadings within the full range of flows experienced during the project period.

Stage/discharge relationships, based on instantaneous flow measurements, will be developed at selected sites upstream of the USGS stations to determine whether flow versus drainage area is proportional throughout the watersheds. ***Sites are initially selected to partition the watershed into subsections representing the lower, middle, and upper watershed areas. Tributaries that contribute flow during summertime baseflows are also selected. Visual inspections of channel characteristics and instantaneous flow measurements are used to determine areas of stream reaches that gain or lose flow and those reaches or tributaries that provide a more constant baseflow from springs. Water quality monitoring sites that do not have a flow-to-drainage-area ratio consistent with the continuous USGS flow-measurement stations, near the mouth of the streams, are selected for the development of a stage/discharge relationship. Instantaneous flow measurements are conducted according to "USGS Measurement and Computation of Streamflow, Water Supply Paper 2175" at selected sites (see Table 2), usually near bridges for establishing an accessible elevation datum on the bridge deck.*** Associations between flow and drainage area can be established to determine if there are stream segments that are gaining or losing flow, thus providing more accurate loading estimates at the upstream sites. Water quality data combined with flow from the first phase will provide a summary of subreaches exhibiting greater loadings of the measured parameters.

2. Water Quality Monitoring - Phase 2

The monitoring sites will be reevaluated, based on results from Phase 1, and relocated where necessary, to focus on the subreaches with the greater loadings, or where the concentration of fecal coliform or total phosphorus exceed the Standards. ***Each parameter can be associated with specific sources (see LOADINGS AND WATER QUALITY INDICATORS section).***

Table 2. Monitoring site locations and flow monitoring for Phase 1 of the monitoring program.

Site Code ¹	Other Site Codes	Location	Flow-measurement
Lockatong Watershed (sites ordered from downstream to upstream)			
L1	DRBCNJ0013	Rosemont-Raven Rock Rd Bridge	USGS, Continuous
L2		Stompf Tavern Rd Bridge	
L3		Milltown Rd Bridge	
L4	AN0088, 8869600629, 8869600622	Route 519 Bridge	WSA, Instantaneous
L5		Muddy Run, Muddy Run Rd Bridge	WSA, Instantaneous
L6		Barbertown-Point Breeze Rd Bridge	
L7		Union Rd Bridge (Kingwood Park)	
Rt 12 Bridge	AN0087, 01460860, 6969601069	Route 12 Bridge	WSA, Instantaneous
L8		Middle Trib, Lower Oak Grove Rd Bridge (#K131)	WSA, Instantaneous
L9		Rt 615 (Pittstown Rd) Bridge	
Wickecheoke Watershed (sites ordered from downstream to upstream)			
W1	DRBCNJ0012, 01461300, 8853600031, AN0095	Rt 29 Bridge	USGS, Continuous
W2		Just Downstream of WWTP Trib	
W3	01461282	Rosemont-Sergeantsville Rd (Rt 604 at Covered Bridge)	
W4	8857600022, 8857600019	Plum Brook, Pinehill Rd Bridge	WSA, Instantaneous
W5		Old Mill Rd Bridge	WSA, Instantaneous
W6	8853600715	Locktown Rd Bridge	
W7		Plum Brook, Locktown-Flemington Rd Bridge	
W8		Whiskey Lane Bridge	WSA, Instantaneous
W9		Trib - Whiskey Lane Bridge	WSA, Instantaneous
W10		Trib – Old Croton Rd Bridge	
W11		Rake Rd Bridge	WSA, Instantaneous

¹ Sampling sites are located in Figure 1.

Table 3. Number of water quality and QA/QC samples analyzed for each parameter per month.

Year/ Month	Monitoring Phase	Number of sites	Number of Samples/Site					SVAP	Cross-section survey	QA/QC
			Routine	TKN & Ammonia	NO ₂ +NO ₃	Coliphage	Sediment total P			
2006										
August	1	20	2	2	2					2 Blank, 4 Dupl
September	1	20	2	2	2					2 Blank, 4 Dupl
October	1	20	1	1	1			v		1 Blank, 2 Dupl
November	1							v		
December	1	20	1	1	1					1 Blank, 2 Dupl
2007										
February	2	14	1	pending	pending					1 Blank, 1 Dupl
April	2	14	1	pending	pending					1 Blank, 1 Dupl
May	2	14	2*	pending	pending			v		2 Blank, 2 Dupl
June	2	14	2	pending	pending			v		2 Blank, 2 Dupl
July	2	14	2	pending	pending			v	v	2 Blank, 4 Dupl
Coliphage		6				6				3 Blank, 0 Dupl
Sed TP		4					4			
Routine		6	1							1 Blank, 1 Dupl
Aug - Sept	2								v	Missed samples

Schedule subject to change due to unanticipated weather or flow conditions.

Routine parameters are: fecal coliform, E. coliform (only during 2007), TSS, total P, turbidity, boron, specific conductivity, pH, and air and water temperature.

* In addition to the routine sampling events, two or three additional sampling events for only fecal coliform and E. coliform analyses will be conducted during May through July 2007, if necessary, to satisfy the DEP data density of 5 samples in 30 days. **Only conductivity, pH, and air and water temperature monitoring will accommodate any additional bacterial samplings.**

Land use and land cover will be partitioned in the drainage area from each sampling site to determine relationships between land use and loadings. If land use does not indicate potential sources for elevated loadings, then further investigation will be conducted in Phase 2 for those stream reaches that may be prone to direct discharges, livestock, or other potential sources of loadings. Sites having constant or prevalent greater loadings of solids, nutrients, and/or bacteria than neighboring sites will continue to be monitored in Phase 2. When access is possible, subbasins upstream of sites with greater loadings will be monitored to further isolate the source(s) of contamination.

During Phase 2, the total number of monitoring sites is anticipated to be 14 or fewer. Each of these sites will be sampled 9 times for most of the water quality parameters listed in Phase 1. Ammonia, TKN, and nitrite+nitrate will not be monitored during the second phase, unless the results from Phase 1 show that these water quality parameters are good indicators for the existing loadings (see “Loadings and Water Quality Indicators” section). ***If nitrate parallels the boron***

results, then this will depict loadings emanating mainly from human sources and only boron will be necessary to further track these sources. Total Kjeldahl nitrogen (TKN) and ammonia concentrations at or near the detection limits will be basis for discontinuing these parameters. However, TKN loadings directly associated with flow may indicate that these loadings can be directly associated with stormwater runoff, a basis for continuing the sampling for this parameter. Due to the change in the 2007 DEP standards for using E. Coli as the ambient bacteria standard, both E. Coli and fecal coliform will be included in each sampling event during Phase 2. If required, there will be additional samplings for the bacteria parameters to fulfill the DEP requirement of 5 samples within a 30 day period.

3. Sediment and Coliphage sampling

The USGS will *collect and* analyze sediment samples at 4 sites for total phosphorus. There are approximately 4 sites that exhibit fine-grained sediments for this type of sampling: 3 within the Lockatong Creek and 1 within the Wickecheoke Creek. Water column samples may be analyzed for coliphage at up to 6 sites. *USGS, or private laboratory that uses the EPA-approved protocols will perform the analyses. If a private laboratory is selected for the coliphage analysis, the analytical technique will be submitted to the NJDEP for review.* Samples for *sediment phosphorus and coliphage*, processed by the USGS, will be subject to their field and laboratory QA/QC and protocol: *U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, available online at <http://pubs.water.usgs.gov/twri9A>.* Sampling sites will be selected based on the results from both Phase 1 and Phase 2. Coliphage are viruses that can infect E. coliform bacteria. By determining the genetic grouping of the viruses, the bacteria can be associated with either human or animal fecal contamination.

4. Land Use and Stream Channel Erosion

The NRCS has been contracted to perform sediment erosion and transport estimates for both watersheds based on land use, including road drainage, construction, and agricultural practices. Using the RUSLE2 model, sediment loads will be estimated from subbasins in the watersheds. Stream channel erosion and bank stability will be assessed using a modification of the “USDA Stream Visual Assessment Protocol,” photo-documentation, and possibly transect surveys of the channel geometry at selected sites by Authority personnel. All land-use erosion assessments and modeling performed by the NRCS will follow their standard protocol. Low-altitude photoreconnaissance is also being considered for determining the location and extent of channel erosion that is not visible from the sampling sites. A Scope of Work for the NRCS effort is included in Attachment 1.

SAMPLING SITE SELECTION

Sampling sites were selected based on accessibility; representation of land uses/covers within the watersheds; and to isolate smaller watershed areas for further assessment of potential “hot spots.” The site locations will be relocated, as appropriate, to further “zero in” on sediment, bacterial, and phosphorus loading sources in Phase 2, after the initial synoptic assessment of water quality during Phase 1.

LOADINGS AND WATER QUALITY INDICATORS

There are many sources of solids, nutrients, and bacterial loadings to the Locketong and Wickecheoke watersheds. Specific water quality parameters: total phosphorus, total suspended solids (TSS), fecal coliform, E. coliform, nitrite+nitrate, total Kjeldahl nitrogen (TKN), ammonia, boron, turbidity, specific conductivity, pH, water and air temperature, and flow will be used to refine the location of the loads, as related to the following loading sources.

Point-source loadings

The Delaware Township MUA is the only permitted wastewater treatment plant (WWTP) discharge, located on a tributary to the Wickecheoke Creek (locally known as Rose Brook). A site on this tributary, near the confluence with the mainstem, will be sampled for all of the parameters listed above. All of these parameters are by-products of the bacterial and chemical decomposition of human wastes. Properly maintained and fully-functional WWTPs discharge these components at levels within their permitted limits. Malfunctioning, or mechanical bypass of treatment systems will convey elevated concentrations of these parameters in the effluent.

Septic-system non-point source loadings

Malfunctioning septic systems can be traced with fecal coliform, E. coliform, nitrite+nitrate, and boron analyses. This loading occurs during both storm-induced and baseflows, with higher concentrations usually occurring during the lower flows (less dilution). Fecal coliform and E. coliform can originate from human and animal feces, and can also be present naturally in ponded stream reaches having a silty/mucky anoxic bed material.

Nitrate and boron are very conservative and do not normally become attached to soil particles. Therefore, both of these will be present at stream locations where septic-system problems are encountered. Boron is more indicative of septic discharge, since laundry whiteners are the primary, or in many instances the sole source of this contaminant, whereas nitrate can also enter a stream from agricultural and natural sources. Livestock and wildlife manure, leaf litter, and detritus all produce nitrate. Both of these constituents will be measured during Phase 1 to determine their association and effectiveness for source tracking.

Agricultural/Residential non-point source loadings

Both animal and crop farming can add loads of nutrients, solids, and bacteria to surface and ground water. Application of fertilizers for lawn maintenance can also introduce high levels of nutrients to these water systems. Total phosphorus, nitrite+nitrate, ammonia, TKN, TSS, fecal coliform, E. coliform, and turbidity are good indicators for these loading sources.

Road runoff and drainage non-point source loadings

There are many gravel and dirt roads within the project watersheds, and dirt drainage ditches along both unpaved and paved roads. Runoff from roads occurs quickly, carrying sediment and other road debris into either drainage ravines along the roads or directly into adjacent streams. When roads are positioned on steep slopes, runoff from the surface is quickly concentrated and fast, deeply scouring drainage ravines and carrying large volumes of sediments into the receiving

stream. Sediments conveyed from steep roads and ravines contain a mixture of sediment sizes, ranging from fine silt to boulders. Runoff flows carrying this material enhances the scouring and erosion of the roadways and stream channels. Turbidity and TSS, and possibly TKN and total phosphorus will provide the best indication of rill and gully erosion.

Internal stream loadings

Stream channels displaying incised/undercut and eroding banks, and scouring and deposition of the channel substrate, can contribute large loads of sediments and nutrients during higher flows. Sediments contain bacteria, nutrients, and solids. Deposits of sediments can be resuspended during storm flows, putting these loads back into the water column. Pooled reaches usually contain a larger supply of deposited sediments. Of the water quality parameters being measured in this project, TKN, TSS, total phosphorus, and turbidity will provide the best indication of suspended sediments. Nitrite+nitrate, fecal coliform, and E. coliform may also prove to be good secondary indicators.

QUALITY OBJECTIVES AND CRITERIA

The project QA is guided by the *NJDEP Field Sampling and Procedures Manual, August 2005*.

Both internal and external quality control will be used in the project. Internally, field sampling and measurement personnel will be trained prior to executing water quality and quantity monitoring. Field blanks will be collected during each sampling event to determine possible sample contamination from collection, preservation, and transport processes. Duplicate samples will be collected from the same water sample, by pouring half of the collected water into each of two containers for laboratory analyses. All monitoring equipment will be calibrated, using the manufacturers' recommended procedure and the Standard Operating Procedures (SOP) in Attachment 3, before sampling and checked during sampling, as necessary. Erratic readings, those at levels beyond the normal range, or those that have problems stabilizing, are considered suspect and reviewed immediately with an in-field calibration check. The Authority's QA Officer will report any data anomalies to the Project Manager and reviews/corrections will be implemented immediately.

External quality controls will be performed by the contract laboratory by using methods blanks, spikes, duplicate samples, maintenance of holding times, and records of analytical equipment calibration. All laboratory QA/QC reports will be reported to the Authority for each sampling event. These reports will be reviewed by the Authority's QA Officer and the Project Manager for possible errors and omissions. Any uncertainty relating to the laboratory data and/or QA report will immediately be presented to the laboratory manager for verification or, if necessary and possible, for reprocessing of the sample.

TRAINING REQUIREMENTS

Field crews will be trained prior to the first sampling event. ***NJDEP does not employ a certification for personnel collecting water quality samples (communications with Marc Ferko). All personnel involved with sample collections are trained prior to the actual sampling event on proper techniques for collecting representative samples, avoidance of sample contamination, and preservation as specified in the NJDEP Field Sampling and***

Procedures Manual, August 2005. Techniques for collecting samples by wading and from bridge samplers will be presented and performed, and flow measurement techniques will be demonstrated and applied. The Authority has qualified staff with years of experience in both teaching and performing sample collection and handling techniques, sampling equipment calibration, and visual assessment protocol. Todd Kratzer and Amy Shallcross will provide training to field staff for grab sampling, flow measurements, and calibration and use of a Yellow Springs Instrument (YSI) hand meter; and Kathy Hale will present visual assessment protocol techniques.

LABORATORY CERTIFICATION

The contract laboratories: QC laboratories, Inc, and USGS, are certified for the laboratory analyses to be used in this program. ***QC Laboratories, NJ certification ID# PA166, is certified for the TSS, turbidity, nitrite+nitrate, TKN, ammonia, fecal coliform, boron, and total phosphorus analyses. They are also certified for E. Coli analysis, using the EPA 1103.1 E. Coli technique, NJ certification ID# PA001.*** USGS uses techniques accepted by DEP for coliphage and sediment total phosphorus analyses. The Authority has obtained certification for “analyze immediately” conductivity, pH, and temperature to be measured with a YSI hand meter. The SOP and certification are presented in Attachments 3 and 4, respectively.

DOCUMENTATION AND RECORDS

The final QAPP will be available on the Authority’s Web site with any addendums attached. Those listed on the “Distribution List” will be notified to update their files with any changes to the file on the Web. Any addendums that address monitoring or sampling will be submitted to the Office of Quality Assurance at DEP.

Reports on the monitoring program will be submitted in the quarterly report to the 319(h) grant manager for review. The reports will include copies of field data sheets, chain-of-custody, meter calibration records, and laboratory QC reports for that portion of the sampling program. The collected data will be provided in the report and available on the Authority’s Web site. Any QC problems will be submitted to the Office of Quality Assurance and the 319(h) grant manager for evaluation.

The final report will include an Appendix containing all field and laboratory results, laboratory reporting limits for each parameter, and any noted QC discrepancies. The report will be formatted as a Word® document. All field data will be provided as an Excel® spreadsheet.

SAMPLING PROCESS DESIGN

Ambient Samples

Samples will be collected by trained field personnel at selected locations that best represent the existing water quality and flow conditions at each sampling site. Samples will be collected from either a bridge, by wading into the channel, or by use of an extension rod from the stream bank. Personnel wading to collect samples will enter the stream at a location downstream from the sample-collection site and move upstream to the site to prevent disturbance of sediments. Samples will always be collected upstream from the wader’s location. At most sites, a single

location that visually represents the average flow will be sampled. Average flow is the location within the channel where the width and depth of the flow volume represents an approximate average condition. At sites having water depths of 2 or more feet, samples will be collected at approximately 1 foot below the water surface. When a channel has a split flow, or a tributary enters at the site and there is no access to a more representative site, the sample will contain a visual flow-weighted volume of sample from the individual flow channels. Whenever possible, the samples will be collected at a downstream location that best represents the mixed volume of flow.

All samples will be collected from ambient stream sites with a collection bottle. The collection bottle will be either a 500ml or 1 liter capacity. This bottle will be used to fill all of the routine, duplicate, and blank sample bottles. The bottle will be filled and purged 2 times at the site before the actual sample is collected. As each sample bottle is filled, an air space will be left to allow the sample to be shaken for mixing the contents prior to analysis. All sample containers will be pre-labeled and grouped for individual sites prior to the sampling event. Site code, date, and the collection time will be written on the label with an indelible ink pen and also entered onto the field data sheet. As samples are collected, they will be immediately transferred to an enclosed ice chest and stored at 4°C until processed for analysis. Bacteria samples will be sealed in zip-lock bags to add additional prevention against possible contamination from ice water. Samples requiring special preservatives will be put into bottles that were prepared with the proper preservatives and transported in the iced coolers. TSS and turbidity do not require any preservatives. Boron will be preserved with nitric acid. Ammonia, TKN, NO₂+NO₃, and total phosphorus will be preserved with sulfuric acid. Fecal coliform and E. coliform samples will be collected in sterile containers with a sodium thiosulfate (dechlorination) tablet. All samples will be cooled in sealed ice chests, transported to the laboratory, and processed within the required holding time.

Tables 4 and 5 show the water quality parameters to be analyzed by the laboratory and in the field, and the expected detection limit for each parameter, respectively. Field monitoring for pH, specific conductivity, and air and water temperature will accompany the sample collections, in addition to flow measurements at selected sites. A Yellow Springs Instrument (YSI) hand meter will be used to measure pH, specific conductivity, and air and water temperature. The meter probe will be totally submersed in the water column, suspended above the channel bottom at sites with fine-grained sediments. At sites having water depths of 2 feet, or more, the probe will be positioned approximately 1 foot below the water surface. During low flows, it may be necessary to gently position the probe on available rock substrate in shallow water. The probe will always be oriented so that the sensors on the probe will not be in direct contact with the substrates.

When the streams are not wadeable due to higher flows, or during very low flows that create shallow, pooled stream reaches with silty sediments, the collection bottle will be strapped to a weighted harness that is suspended from a line, and lowered from a bridge deck. The harness submerges the sampling bottle horizontally into the water, thus not disturbing the sediment, and tips upward as it is withdrawn from the water to collect the sample. The weighted harness design was based on an adaptation of the design illustrated in *Chapter 5A of the NJDEP Field Sampling Procedures Manual, August 2005*. The collection harness can also be connected to an extension pole to fill the collection bottle from the channel bank during higher flows at sites where a bridge is not present.

Table 4. Water quality parameters, analytical and preservation methods, and holding time.

Parameter	Container	Method	Preservation	Holding Time
Water and air temperature	N/A	SM 2550B	N/A	Analyzed at site
Specific conductivity	N/A	SM 2510B	N/A	Analyzed at site
pH	N/A	SM 4500-H B	N/A	Analyzed at site
Fecal coliform	Plastic	SM 9222D	Cool 4°C, 0.008% Na ₂ S ₂ O ₃	6 hours
E. Coli.	Plastic	EPA 1103.1	Cool 4°C, 0.008% Na ₂ S ₂ O ₃	6 hours
Total phosphorus	Plastic	EPA 365.1 & 365.2	Cool 4°C, H ₂ SO ₄ to pH<2	28 days
Nitrite+Nitrate - N	Plastic	EPA 300 and SM 4500 NO ₃ F	Cool 4°C, H ₂ SO ₄ to pH<2	28 days
Total Kjeldahl Nitrogen	Plastic	EPA 350.2 and 350.3	Cool 4°C, H ₂ SO ₄ to pH<2	28 days
Ammonia - N	Plastic	EPA 350.2	Cool 4°C, H ₂ SO ₄ to pH<2	28 days
Boron - total	Plastic	EPA 200.7	HNO ₃ to pH<2	6 months
Turbidity (NTU)	Plastic	EPA 180.1	Cool 4°C	48 hours
Total Suspended Solids	Plastic	SM 2540D	Cool 4°C	7 days
Sediment Total P	Plastic	USGS ¹	Cool 4°C	7 days
Coliphage	Plastic	EPA Coliphage method or USGS ²	Cool 4°C, 0.008% Na ₂ S ₂ O ₃	48 hours

¹ Modification of EPA methods 365.1 and 365.2. Sampling methods are described in *USGS Water Quality Information, Field Procedures*.

² Application of EPA 1601 or 1602 technique.

Duplicate Samples

Duplicate samples will be collected by equally dividing the water in the collection bottle between 2 identical sample containers for each parameter. The collection bottle is refilled as necessary to fill all of the regular and duplicate containers.

Field/Method Blanks

The sampling container will be rinsed twice with distilled water and then used to transfer distilled water into a group of the same bottles used for the ambient samples. These bottles will be labeled the same as the ambient samples and undergo the same preservation, transport, and analytical processes.

SAMPLING METHOD REQUIREMENTS

Samples will be collected, preserved, and transported within recommended holding times to the contract laboratory (QC Laboratories) as prescribed in the *NJDEP Field Sampling Procedures Manual, August 2005*.

Table 5. Field and laboratory analyses and detection limits.

Parameter	Field/Lab Measurement	Detection Limit
Water Temperature	Field	0.1 °C
Air Temperature	Field	0.1 °C
Specific Conductivity	Field	0.1 us/cm
pH	Field	0.1 Standard Unit
Fecal coliform & E. coliform*	Laboratory	1 colony/100 ml
Total Phosphorus	Laboratory	0.02 mg/l
Nitrite+Nitrate	Laboratory	0.04 mg/l
Ammonia	Laboratory	0.02 mg/l
TKN	Laboratory	0.05 mg/l
TSS	Laboratory	1 mg/l
Turbidity	Laboratory	0.1 mg/l
Boron	Laboratory	5 µg/l
Coliphage	Private Laboratory or USGS	Not applicable
Sediment Total Phosphorus	USGS	0.8 mg/kg for a 100 mg sample

* E. Coliform will be included for analyses during the 2007 sampling events.

Specific analytical method and holding time for each parameter are listed in Table 4.

The sampling crew will meet at a designated site for each sampling event. Arrangements for sample pick-up, and replacement of ice chests and sample containers, will be made with QC Laboratories prior to initiating the sample collection. Water-quality monitors will be calibrated prior to embarking for the first sampling site, and as necessary during the sampling event, according to the manufacturer's recommended technique. Calibration notes will be recorded and filed for each calibration. The following equipment will be loaded into the field vehicle for each day of sampling:

- ?? Hip boots
- ?? Clip board, pencils, and waterproof marker
- ?? Site-Visit Data sheets (Appendix A)

- ?? Equipment Calibration Log sheets (Appendix B)
- ?? Chain-Of-Custody sheets (Appendix C)
- ?? Streamflow Data sheets (Appendix D)
- ?? Labeled sample-collection containers for each site, preservatives included
- ?? Coolers with ice
- ?? Zip-lock bags for storing bacteria-sample containers
- ?? Bridge and shoreline sampler
- ?? Flow-measurement equipment and spare parts
- ?? Rain gear
- ?? First-Aid kit
- ?? Emergency and personnel phone numbers
- ?? Cell phone
- ?? Vehicle communication radio
- ?? Field water quality meters
- ?? Calibration equipment for the field meters
- ?? Distilled/deionized water in squirt bottles
- ?? Sun screen and insect repellent
- ?? Spare clothes
- ?? Drinking water
- ?? Antibacterial cleanser for hands

Each sampling crew will consist of a minimum of 2 staff for sampling efficiency and safety. Samples will be collected consecutively in an upstream direction for half of the sampling events and in a downstream direction for the other half of the sampling events. This will determine if water quality has temporal variability during the day. Collection of samples will commence between 6 and 11 a.m. for low-flow samples. Storm-flow samples will be collected at times commensurate with the runoff hydrograph at the USGS gaging sites. Appropriate sample bottles will be filled at each site, using a collection bottle. Samples will be collected, preserved and transported to the laboratory as specified in the “Sampling Process Design” section.

SAMPLE HANDLING AND CUSTODY PROCEDURES

All samples will be packed into a dark cooler for preservation at 4 °C. Specific preservation requirements and holding times are listed in Table 4. A chain-of-custody form will be attached to the cooler and signed by the sample collector and then by the laboratory analyst as he/she receives the samples. The chain-of-custody form will be similar to that presented in Chapter 10 of the NJDEP Field Sampling Procedures Manual, “New Jersey Department of Environmental Protection External Chain of Custody and Sample Analysis Request Form.” An example is presented in Appendix C.

ANALYTICAL METHODS REQUIREMENTS

A contract has been awarded to QC Laboratories for the “Laboratory” analyses presented in Table 5. “Field” measurements will be conducted at the site by NJWSA staff, using a Yellow Springs Instrument (YSI) 63 conductivity, pH, and temperature meter. The meter will be

calibrated just before the start of each sampling run, and during the sampling run, as required. The detection limits listed in Table 5 are anticipated.

QUALITY CONTROL REQUIREMENTS

Field and laboratory audits, and field orientation and training, will be performed by the QA Officer and Project Manager prior to initiation of the sampling program, and semi-annually, or more frequent as necessary, thereafter. Field monitoring equipment will be calibrated the morning of each sampling run; rechecked in the field if erratic or unstable readings occur; and as directed in the SOP (Attachment 3). All calibrations and field checks are recorded in the Equipment Calibration Log. A field blank will be collected during each sampling event. Duplicate samples will be collected at a frequency of one per every 10 samples.

The Authority has obtained certification for the YSI hand meter for “analyze immediately” conductivity, pH, and temperature.

All laboratory instrument and process blanks, control samples, calibrations, and duplicates will conform to the laboratory’s NELAP or ELCP requirements for QC.

INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Field equipment, including the YSI pH/conductivity/temperature instrument and flow meter, will be inspected and tested prior to the commencement of sampling. Spare parts will be kept with the equipment at all times. Damaged, and/or malfunctioning equipment will be reported to the Project Manager immediately for repair or replacement. Field crews are trained in equipment handling and maintenance to provide remedy for most problems while in the field. Any equipment damage or malfunction is recorded on the data sheet at the time of the incident. After each use, the pH/conductivity probes are rinsed with distilled deionized (DI) water. If the pH probe is not to be used for more than a week, it will be stored in pH 4 buffer. Prior to its next use, it will be placed in pH 7 buffer for a minimum of 5 minutes to stabilize, and then calibrated.

INSTRUMENT CALIBRATION AND FREQUENCY

The YSI pH/conductivity/temperature meter will be calibrated using standard solutions that are traceable to N.I.S.T. (National Institute of Standards and Technology) standards. A 2- or 3-point calibration will be used to bracket the pH range that is normally encountered at the sampling sites. Conductivity will be calibrated using a buffer that is within the normal levels expected in the field. If ambient stream pH and/or conductivity is outside the calibration range, a field calibration will be performed to adjust the range. All calibration data are recorded on the Equipment Calibration Log. Calibration solutions are poured into polypropylene containers that were rinsed twice with DI water and once with the solution. After calibration, the solutions are discarded. Calibration standards are dated for when they were received, opened, and a 6-month expiration time. These solutions are replaced every 6 months to provide accurate calibrations.

The velocity/flow-measurement equipment is calibrated using a “spin-test” as described by Rantz and others in the *USGS Measurement and Computation of Streamflow, Water Supply Paper 2175*. The vertical shaft is inspected and rid of any debris, and lubricated with a light oil prior to use. Protected from the wind, the cups are spun and timed until they stop. The duration

should not be less than 1 minute. If the test fails, then the appropriate maintenance will be conducted according to the manufacturer's specifications, the shaft inspected, oiled, and the test repeated. Spin-test results and flow measurements will be recorded on the Streamflow Data Sheet (Appendix D). The mechanical setup and disassembly will be performed according to the manufacturer's instructions.

INSPECTION/ACCEPTANCE REQUIREMENTS

Field equipment calibration aliquots will be used once and discarded. All solutions will be replaced every 6 months to maintain accuracy in calibrations. Meter readings are noted after stabilization during each calibration. If the meter is within the known accuracy range of both the equipment and standard solution, the calibration is complete. If the meter is not providing an accurate reading, the calibration process will be repeated. The electronic equipment is not used unless calibrations are within the manufacturer's accuracy range.

Field and laboratory blanks that are not providing data below the laboratory reporting limits, and duplicate data outside the acceptable range of precision, will be investigated immediately by the QA Officer and reported to the Project Manager. Data collected during these sampling events are noted as suspect with STORET remark codes. The codes that may be associated with data are:

- B Results based upon colony counts outside the acceptable range.
- C Value calculated (used for flow estimates related to stage/discharge ratings).
- D Field measurement (i.e., conductivity, pH, temperature, and flow).
- J Estimated value.
- K Actual value is known to be less than the value given.
- L Actual value is known to be greater than the value given.
- Q Sample held beyond normal holding time.
- T Value reported is less than criteria of detection.
- U Indicates material was analyzed but not detected.
- Z Too many colonies were present to count (TNTC), numeric value is filtration volume.

DATA ACQUISITION REQUIREMENTS

Data used in this program will be compiled from the following sources: USDA, NRCS, USGS, DRBC, NJDEP, Hunterdon County, NJWSA, and Delaware, Raritan, Kingwood, and Franklin Townships.

NRCS has obtained Farm Service Agency data for cropland, used in the analysis for sheet and rill erosion and ephemeral gully erosion. NRCS data from their 1986 Sediment, Erosion and Animal Waste (SESAW) Study has been applied to the Locketong and Wickecheoke Creek watersheds to estimate the annual soil loss per acre of cropland.

NJDEP GIS data will be used for historical changes in land use. Their water quality data, combined with USGS, DRBC, and municipal data, will be used to supplement the NJWSA database. County Parcel GIS data, in combination with municipal zoning data and all pertinent ordinances, will be used to estimate build-out and the anticipated affect on water quality. Municipal Environmental/Natural Resource Inventories and Hydrogeology reports, when

available, and NJDEP TMDLs will supplement the Watershed Characterization and Assessment Report. The combined water quality database will facilitate the targeting and magnitude of contaminant source contributions. Phase 1 of the Authority's water quality monitoring program will provide a screening of problem stream reaches in the watersheds and Phase 2 will focus on the possible source(s) within the 20 subwatersheds, as related to point and non-point contributions. The water quality data characterization of various subreaches will be compared to the appropriate land-use/cover and ortho-photo GIS layers, and supplemented with Google Earth[®] images for locating potential contaminant sources.

Graphical presentation of temporal and spatial trends in water quality, and flow-integrated statistical analyses will provide information on the location and magnitude of pollutant loadings during baseflow and stormflow conditions. Water quality targets will be developed as part of the Lockatong and Wickecheoke Watershed Restoration and Protection Plan.

USDA Stream Visual Assessment Protocol (SVAP) will be used to assess sections of the watershed for reference conditions and levels of anthropogenic impact. This level of assessment is vital for characterizing the aquatic ecosystems, and for restoration efforts in areas experiencing channel destabilization from modifications to the watershed hydrology and/or land uses.

All data used in this project will be collected and analyzed under the guidance of this QC program and the QC programs of the cooperating water quality collection agencies.

DATA MANAGEMENT

Historical water quality, GIS, and flow data will be stored in both personal computers and a network computer at the Authority for use and backup. All Site-Visit and Streamflow data will be entered into an Excel spreadsheet, including site attribute data. Data collected with a YSI hand meter will be reported on the Site-Visit Data Sheet and entered into the Excel spreadsheet. Calibration data for the YSI meter will be recorded in the Equipment Calibration Log. Data analyzed by the contract laboratory will be entered into a spreadsheet by the laboratory and sent, via email attachment or disk, to the Authority for entry into the database. The laboratory is expected to provide the data within 2 weeks after each sampling event. Original data sheets and digital databases will be stored at the NJWSA Watershed Protection Programs office in Somerville, NJ.

Data will be compared to the original field data sheets for verification by Authority personnel, prior to release of the database for public distribution. Data from QC tests will be stored in a separate file. STORET remark codes will be used, when necessary, for the water quality and flow data. The Authority is considering the possibility of entering their data into the EPA STORET database. Otherwise, all numerical field and laboratory data will be delivered to DEP as digital files (e.g., Excel[®]).

Data exceeding two standard deviations may be labeled as outliers and disregarded, pending the number of samples and skewness of the distribution.

Data collected as part of the SVAP effort will be stored as a separate Excel database.

ASSESSMENT AND RESPONSE ACTIONS

Field sample collections and laboratory processes will be audited by the QA Officer before the start of the sampling program and semi-annually, or as needed, during the program. Data will be reviewed and assessed for the field collections after each sampling event. Data received from the laboratory are reviewed immediately upon arrival at the Authority by the QA Officer and the Project Manager. Any discrepancies or uncertainties in either the field or laboratory data will be presented to the Project Manager. If the discrepancy(ies) cannot be resolved by the Project Manager, through discussions with field or laboratory personnel, or changes in sample collection protocol, a memo will be routed to the Program Manager to explain the problem, possible causes, and recommended solution(s). Pending the severity of the problem, contacts on the Distribution List may be notified.

Changes in sample collection or analysis protocols will be sent to contacts on the Distribution List for approval, prior to implementation, as an amendment to this QAPP.

REPORTS

Quarterly progress reports and a final report will be submitted to the 319(h) grant manager during the duration of this program. A monitoring program report, with a comprehensive data summary, will be submitted at the conclusion of the monitoring program to the program members on the Distribution List and will be available on the Authority's Web site. The monitoring program report is anticipated to be completed by Spring 2008. The Locketong and Wickecheoke Watershed Restoration and Protection Plan is anticipated to be completed, and submitted for NJDEP approval, by Summer 2008. The final Plan will be submitted to the contacts on the Distribution List and available on the Authority's Web site.

DATA REVIEW, VERIFICATION, AND VALIDATION

Data exceeding the established range of water quality that has been historically collected at several of the monitoring sites will be scrutinized for cross-contamination, interferences, and reporting errors to verify the accuracy. Duplicate analyses should match within the established laboratory variance for the specific parameters. Data uncertainties will be reported to the Project Manager by either the QA Officer or the Authority's Field Scientist. Discrepancies in data collected in the field will be checked against the Equipment Calibration Log and the Site-Visit Data Sheet. Laboratory data inconsistencies (i.e., ammonia greater than TKN, or extreme variation in any data) will be presented to the Project Manager who will contact the contract laboratory for their internal review of blanks, calibrations, duplicates, and possible reporting errors. Data showing inconsistencies will also be compared to meteorological and flow data, and seasonal variation, to determine possible causes.

One Authority staff person will review and verify all of the field data as it is entered into the Excel database. The Excel database will then be reviewed for correct data entries and validated by a second Authority staff. Questionable data will be highlighted for review, followed by a final review by the QA Officer and/or Project Manager prior to approval.

VALIDATION AND VERIFICATION METHODS

Data passing the verification and validation reviews by Authority personnel will be entered into the “Validated” Excel database. Any data anomalies will be referenced with the proper STORET remark code that will be located in the spreadsheet column next to the data value. Validated data will be put on the Authority’s Web page and available for public distribution.

RECONCILIATION WITH DATA QUALITY OBJECTIVES

Validated data will be analyzed statistically and graphically to determine temporal and spatial relationships. The database will present a minimum of 4 storm-runoff events. Data density and grouping should be adequate to meet the intended uses of the dataset. The six samples collected in Phase 1 will be sufficient to determine a screening level of differences in water quality. Phase 2 will include selected sites from Phase 1 with some relocations, pending results from Phase 1. Therefore, the resulting database will contain 6 to 15 data at each site for the selected parameters at the end of the sampling program. Most sites will have 8 to 15 data per parameter that will provide reliable statistical and graphical interpretations for defining the variation of water quality over a range of stream flows and for tracking potential sources of contamination within the subbasins. Fecal coliform and E. coliform will be sampled 6 to 16 times per site, including the additional samples for meeting the DEP criteria of 5 samples within 30 days.

Data collected during the SVAP will include a distribution of sites to provide a valid interpretation between those with and without impacts to the aquatic system from anthropogenic activities.

Note: Italicized and bolded text represents placement of a response to a DEP comment(s). Attachment 4 presents comments from DEP and our associated responses.

Appendix B Equipment Calibration Log

pH (YSI 63)

Date	Time	Initials/ Name	Initial Meter Value	Standard Solution Temp (°C)	Standard Solution Value	Difference	AutoCal Final Value [#]

[#] Automatically temperature-compensated by meter.

Specific Conductivity (YSI 63)

Date	Time	Initials/ Name	Initial Meter Value [*]	Standard Solution Temp (°C)	Standard Solution Value (us/cm)	Difference	Final Value [*] (us/cm)	Temp Coeff	Cell Constant Pre/Post

^{*} Automatically compensated for variation from 25°C . Note: $SC = C_T / (1 + (0.0191 \times (T - 25)))$
 SC = Specific Conductivity, C_T = Conductivity at measured temperature, and T = Measured temperature.

Water Temperature (YSI 63)

Date	Time	Initials/ Name	Meter Value (°C)	NIST- Calibrated Thermometer Value (°C)	Difference

Analyst signature: _____

Date: _____

Appendix D

LOCKWICK MONITORING PROGRAM STREAMFLOW DATA SHEET

River Mile (RM) (Tab 1/Tab 2/State) _____
 Station Name _____
 Station Number _____
 Date (Yr/Mo/Day) _____ Time (HH:MM) _____
 Party _____ Agency _____
 Location of Test Site From Gage Station _____
 Weather Conditions _____
 Date of Last Rain _____
 Water Temperature _____
 Air Temperature _____

Gage Readings	Time	Tape Reading	Leader Length	Total Gage
Before				
After				

Gage Height at Zero Flow _____
 Type of Meter _____
 Spin Test in Seconds _____
 Tape Reading at Near Bank _____
 Tape Reading at Far Bank _____
 Total Width of Stream _____
 Interval Width Chosen _____
 Total Number of Intervals _____ (minimum 15)

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 _____

CONVERSIONS

Inches	feet
1	= 0.083
2	= 0.167
3	= 0.250
4	= 0.333
5	= 0.417
6	= 0.500

Inches	feet
7	= 0.583
8	= 0.667
9	= 0.750
10	= 0.833
11	= 0.917
12	= 1.000

Inches	feet
1 1/8	= 0.0652
1 3/8	= 0.104
1 5/8	= 0.0208
1 7/8	= 0.0417

Interval #	Tape reading	Dist from stream edge ²	Interval Width (tenths)	Interval Depth (tenths)	Observ. Depth ³ (tenths)	Revolutions ⁴	Time (sec)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Calculations completed by _____
 Remarks: _____
 Checked by: *ky*

¹ Tape reading is the actual reading that the tape shows at the edge of the stream actual reading where testing is completed is at the opposite edge, and all interval r

² The stream edge for our purposes is the point where the water presently meets one edge to begin measurement and the opposite edge to terminate, giving the st

³ The Observation Depth is 0.6 of the depth if the depth is less than 2'. If the dep must be taken at 0.2 and 0.5 of the depth. The two velocities will be averaged, the give the Interval Discharge.

⁴ Start the stopwatch on a click but do not count that click as a revolution.

Attachment 1

319(h) Grant Proposal: Watershed Restoration and Protection Plan for the Lockatong and Wickecheoke Creek Watersheds, Hunterdon County, New Jersey

Attachment 2

Request for Laboratory Services

Attachment 3

Standard Operating Procedure For “Analyze Immediately” Conductivity, pH, and Temperature Monitoring

Attachment 4

“Analyze-Immediately” Certification

State of New Jersey
Department of Environmental Protection

Certifies That

New Jersey Water Supply Authority
Laboratory Certification ID # 18014


having duly met the requirements of the

Regulations Governing The Certification Of
Laboratories And Environmental Measurements N.J.A.C. 7:18 et. seq.

is hereby approved as a

State Certified Environmental Laboratory
to perform the analyses as indicated on the Annual Certified Parameter List
which must accompany this certificate to be valid

Expiration Date June 30, 2007



Joseph E. Aiello
for Joseph E. Aiello, Chief
Office of Quality Assurance

THIS CERTIFICATE IS TO BE CONSIDERED NULL AND VOID IF THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST IS A LOCATED IN THE PERMITS LIST FOR THE BUREAU.

Attachment 4 (Continued)

New Jersey Department of Environmental Protection
 Environmental Laboratory Certification Program
ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS
 Effective as of 03/29/2007 until 06/30/2007

Laboratory Name: NEW JERSEY WATER SUPPLY AUTHORITY Laboratory Number: 18014 Activity ID: SLC0600004
 74 E MAIN ST
 Somerville, NJ 08876

Category:	WPP02 -- Inorganic Parameters, Nutrients and Dema	Approved Method	Parameter Description
Status	Code Matrix Technique Description		
Certified	WPP02.45500 NPW Wheatstone Bridge	[SM 2510 B]	Specific conductance
Category:	WPP03 -- Analyze-Immediately Inorganic Parameters	Approved Method	Parameter Description
Status	Code Matrix Technique Description		
Certified	WPP03.09000 NPW Electrometric	[SM 4500-H B]	pH
Certified	WPP03.14000 NPW Thermometric	[SM 2530 B]	Temperature


 for Joseph F. Aiello, Chief

KEY: AE = Air and Emissions, BT = Biological Tissues, DW = Drinking Water, NPW = Non-Potable Water, SCM = Solid and Chemical Materials

Attachment 5

Responses to Comments From NJDEP

From: Todd W. Kratzer, P.E.

Date: September 1, 2006

To: Beth Torpey

Subject: Responses to-

**Waterhshed Restoration and Protection Plan for the Lockatong and
Wickecheoke Watersheds**

QAPP Review

August 7, 2006

Beth Torpey

Responses italicized beneath each item.

☞☞Need cover page with RP number

Revisions applied

**☞☞Spell out items such as NJDEP, NJWSA, the first time mentioned in
the body of the document**

Revisions applied

☞☞What laboratory is being used?

QC Laboratories, Inc. has been contracted for analyzing total suspended solids, turbidity, nitrite+nitrate, total Kjeldahl nitrogen, ammonia, total phosphorus, fecal coliform, and boron. A contract amendment is anticipated in 2007 to include analyses for E. Coliform. Sediment total phosphorus will be analyzed by USGS. Coliphage will either be analyzed by USGS or a private laboratory that uses the EPA approved protocols.

☞☞Lab certification Number.

QC Laboratories, Inc - NJ Certification ID# PA166

**☞☞Are the methods listed in Table three the same as the laboratory
uses?**

Yes, analytical methods listed in Table 3(now Table 4) for total suspended solids, turbidity, nitrite+nitrate, total Kjeldahl nitrogen, ammonia, total phosphorus, fecal coliform, and boron are used by QC Laboratories

**☞☞Please submit overall location map - particularly indicating the 60
percent of the total drainage area into the D&R Canal.**

Maps included as Figures 1 and 2.

☞☞The goals for Phases one and two aren't stated until page 20.

Goals are presented in Project/Task Description section, page 8.

Part 1. - Page 10 - Water Quality Monitoring - Phase I :

**☞☞Will fecal and E. coliform samples be collected during the first six
high and low flow events or only during the "two to three additional
sampling events" for those parameters?**

Fecal coliform will be collected during each sampling event. Both fecal coliform and E. coliform will be analyzed for all samples collected in 2007. Two to three additional

sampling runs will be necessary if DEP requires 5 samples to be collected within a 30-day period. If necessary, this will be performed from May through July in 2007.

Will the other parameters be sampled for during the two to three additional sampling events?

Only conductivity, pH, and air and water temperature will be monitored during the bacteria sampling.

Define "higher" flow and "lower" flow.

Higher flow is represented by a stormwater runoff hydrograph, the abrupt increase in flow from runoff just following the initiation of a precipitation event. Lower flow is equivalent to baseflows, or flows unaffected by stormwater.

Table 2 does not present the sampling schedule and number of samples collected at each site. Please coordinate table descriptions with what is actually on them.

Revisions applied.

The data collected, not "The two stations" will allow for better evaluation.

Revisions applied.

Instantaneous flow measurement from where?

Instantaneous flow measurements are those that are performed to associate flow with water surface elevation, also known as the development of a stage/discharge relationship. The measurements are conducted at selected sites, usually near bridges for establishing an accessible datum on the bridge deck.

How will you determine "up to 8 stations" to "associate" water depth with flow?

Sites are initially selected to partition the watershed into subsections representing the lower, middle, and upper watershed areas. Tributaries that contribute flow during summertime baseflows are also selected. Visual inspections of channel and flow characteristics are used to determine areas of stream reaches that gain or lose flow and those reaches or tributaries that provide a more constant baseflow from artesian wells. Water quality monitoring sites that do not have a flow-to-drainage-area ratio consistent with the continuous USGS flow-measurement stations, near the mouth of the streams, are selected for the development of a stage/discharge relationship.

Part 2. - Phase II -

what is the rationale behind the re-evaluation. Page 20 says that you're going to focus on sources. How will you use the data from Phase one to do this?

Data obtained from Phase I of the program will be analyzed to determine which monitoring sites are contributing the greatest loadings of each water quality constituent. Each parameter can be associated with specific sources (see LOADINGS AND WATER QUALITY INDICATORS section). Land use and land cover will be partitioned in the drainage area from each sampling site to determine relationships between land use and loadings. If land use does not indicate potential sources for elevated loadings, then

further investigation will be conducted in Phase 2 for those stream reaches that may be prone to direct discharges, livestock, or other potential sources of loadings.

~~☞☞~~ **What is the rationale for excepting ammonia, TKN and nitrite+nitrate?**

The omission of ammonia, TKN, and nitrite+nitrate from further analyses in Phase 2 will be based on the results from Phase 1 (see PROJECT/TASK DESCRIPTION, Water Quality Monitoring - Phase 2).

Part 3:

~~☞☞~~ **Sediment - Who is collecting the samples? Are they certified for this parameter? What lab? Are they certified for this parameter?**

USGS will be collecting these samples and conducting the analytical procedures, subject to their field and laboratory QA/QC and protocols that are accepted by NJDEP.

~~☞☞~~ **What medium will be sampled for coliphage - sediment? Water? Who is collecting the samples? Are they certified for this parameter? What lab? Are they certified for this parameter? Certification number?**

Water column samples will be processed for coliphage (see Project/Task Description, Sediment and Coliphage sampling). NJWSA staff will be collecting the samples. Either the USGS or a private laboratory that uses the EPA approved methodology will be performing the analyses. If a private laboratory is selected for this procedure, NJDEP will be provided the analytical method(s) for their review.

Quality Objectives and Criteria:

~~☞☞~~ **Are personnel certified - not trained - for all of the water quality parameters?**

NJDEP does not require NJWSA personnel to be certified for collecting water quality samples (communications with Marc Ferko). All personnel involved with sample collections are trained prior to the actual sampling event on proper techniques for collecting representative samples, avoidance of sample contamination, and preservation as specified in the NJDEP Field Sampling and Procedures Manual, August 2005..

Table 4:

~~☞☞~~ **Please make the top of this table easily readable**
Revision applied.

From Beth Torpey

Notes:

?? L and W Creeks drain into D&R Canal from western Hunterdon Co.

?? Impaired for fecal , P, Temp and benthic on integrated list

?? Fecal and P TMDLs done

?? Both watersheds = C-1

?? Parameters:

Phase I: Temp, conductivity, pH, fecal coliform and E. coliform, TP,
Nitrite+nitrate, total Kjeldahl, Ammonia, Boron, Turbidity, TSS
Sediment TP, Coliphage - 20 locations

~~2/2~~ 3 hi flow, 3 lo flow,

~~2/2~~ 2 to 3 additional for fecal and e-coliform

Phase II: Temp, conductivity, pH, fecal coliform and E. coliform, TP, Boron,
Turbidity, TSS - 14 locations or fewer - 9 events