

*New River Water Watchers, Volunteer Water Quality Monitoring Program*  
**Quality Assurance Project Plan**

**Program Administered and Plan Prepared by:**  
**National Committee for the New River**

**December 2010**

# **SECTION A:**

# **PROJECT MANAGEMENT**

## A1. Signature and Approval Sheet

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### **A3. Distribution List**

#### **I. *National Committee for the New River***

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- Courtney Wait, NCNR Advocacy Coordinator, New River Water Watcher Program Coordinator and QA Officer, 336-982-6267

#### **II. *North Carolina Department of Environment and Natural Resources Division of Water Quality***

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#### A4. Project Organization

Personnel for the National Committee for the New River (NCNR) program, *New River Water Watchers*, will vary. The Program Coordinator is a position to be held by National Committee for the New River staff. The other positions may be held by representatives from other organizations or individuals, if those groups or individuals are working under the NCNR's QAPP. The number of positions and the persons filling the various roles change depending on the watershed organization.

**Table A4.1:** Summary of potential project personnel for citizen monitoring projects sponsored by NCNR

<b>Name</b>	<b>Project Title</b>
NCNR Staff	Program Coordinator
NCNR Staff / Volunteer	QA Officer
NCNR Staff / Volunteer	Field Coordinator
Volunteers	Primary Monitors
Volunteers	Back-up Monitors

## ***Project Management and Oversight***

### *Program Coordinator*

- Seeks funding to support the citizen monitoring program
- Makes initial contact with groups/ individuals interested in participating in the program
- Researches methods and supplies used for the citizen monitoring program
- Manages monitor documents
- Does analysis of water quality data and determines viability and uses
- Works on billing and budgetary items
- Writes manuals and revisions
- Manages NCNR on-line database for citizen volunteer water quality data
- Assigns sites to volunteers
- Trains and recertifies citizen water quality monitors

### *QA Officer*

- Responsible for quality control of data submitted to NCNR including spot checking of data sheets
- Reports citizen volunteer water quality data to DWQ
- Does analysis of water quality data and determines viability and uses
- Manages equipment and chemicals
- Trains citizen monitors and manages monitor documents
- Trains and recertifies citizen water quality monitors

### *Field Coordinator*

- Discusses site selection with NCNR staff and assigns sites to volunteers
- Recruits and manages citizen monitoring volunteers
- Collects datasheets from monitors and sends them to NCNR
- Receives datasheets from volunteer monitors
- Spot-checks datasheets and data submitted to NCNR online database for errors
- Notifies either the Program Coordinator or QA Officer of questionable values on the datasheet or in the database

### *Primary Monitor*

- Responsible for monitoring for a duration set by the Program Coordinator and QA Officer
- Records data on datasheets and enters data into the online database unless arrangements have been made for NCNR staff to input the data

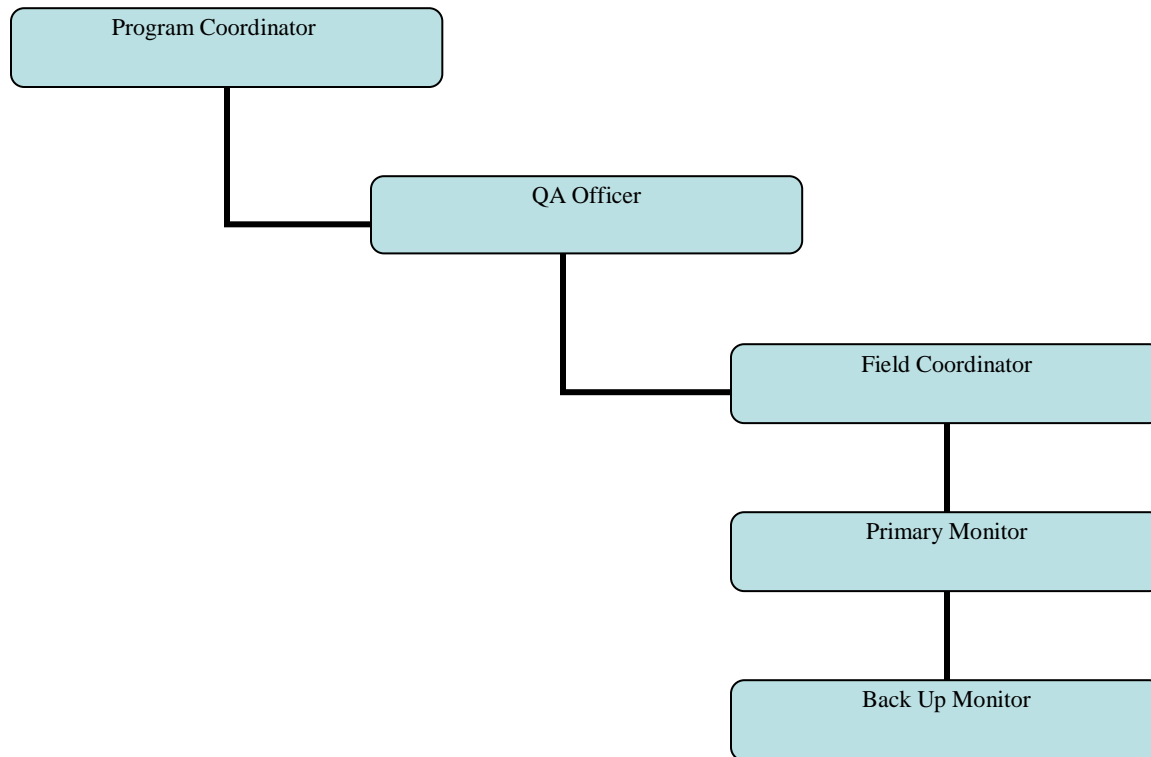
### *Back-up Monitor*

- Trained as a backup/replacement volunteer for a primary volunteer and their site.



Data obtained by NCNR's trained monitors are used in a number of different ways. NCNR will submit data collected to NC Department of Environment and Natural Resources Division of Water Quality to use in any way that they see fit. Other audiences include other New River and New River tributary watershed groups for use in establishing baselines, monitoring local changes, and providing information to local officials and groups. NCNR will also use the data for evaluation of long-term trends in the health of the New River and its tributaries. NCNR will maintain a web-based database at the link [http://www.ncnr.org/data\\_entry.php](http://www.ncnr.org/data_entry.php). At this database, volunteer monitors and field coordinators will input data for their sites on a weekly to monthly basis. In addition, this database will be accessible by the general public wishing information about specific locations, and is not meant to exclude any interested party.

**Figure A4.1:** Program organization chart with the relationship between different personnel members responsible for quality control of data submitted to NCNR.



## **A5. Problem Definition and Background**

### ***Introduction***

The health of the New River, like many of North Carolina's water bodies, is in constant jeopardy as the population of people living, working, and recreating in the watershed continues to rise.

According to the October 2005 New River Basinwide Water Quality Plan:

DWQ identifies the stressors of water quality impact as specifically as possible depending on the amount of information available in a watershed. Most often, the source of the stressor is based on the predominant land use in a watershed. In the New River basin, new development/construction activities, land clearing, agriculture and one point source were all identified as possible stressors. Water quality decline can often be attributed to a combination of many stressors that lead to habitat and water quality degradation. In some way, every person, industry, landowner and municipality in the basin impacts water quality. Therefore, every resident of the basin should play a role in management strategies designed to protect and restore the streams, lakes and rivers of the basin.

Submitted citizen information will be considered in assessing the health of the waters in the basin. This information is relevant to the development of the Basinwide Water Quality Plans and as a reporting requirement to the US EPA under Section 303(d) of the Federal Clean Water Act. NCDENR-DWQ staff will evaluate submissions to determine if they are applicable and useful to the basinwide planning process or 303(d) reporting requirements.

### ***Submission Criteria:***

- Letters, including photographs and other information, may be submitted regarding the uses of surface waters for boating, drinking water, swimming, aesthetics, and fishing.
- Summary reports and memos including distribution statistics will be accepted. If information includes summaries of chemical or biological sampling data, maps showing sampling locations must be included. All information must be scientifically valid and verifiable by NCDENR-DWQ staff.
- Raw data should be submitted electronically and must be accompanied by the methods used to collect and analyze the samples. Documentation of applicable quality assurance/quality control programs in a Quality Assurance Project Plan (QAPP) is required.
- Qualifiers must be in separate fields and must be defined (e.g. < is non-detected value).

- Pollutant name, with units, must be defined. STORET codes may also be used.
- All sampling locations must be referenced on maps and with latitude and longitude. Electronic maps will be accepted in Adobe Acrobat, ArcView shapefile, tif, gif, jpg, and bmp image format. For co-located samples at multiple depths, depths must be specified in a separate field in the database.
- Electronic data will be accepted in delimited ASCII, spreadsheet (e.g., Excel, Quattro Pro, Lotus 1-2-3), or database (e.g., Access, dBase, or SAS) platforms.

If citizen water quality monitors are to obtain the best data for the intended use, good methodology must be used and, where applicable, a quality assurance project plan utilized to assure quality data. This document outlines the project plan for the National Committee for the New River's pilot program, *New River Water Watchers*.

***Intended Usage of Data:***

Data collected by volunteer citizen monitors will be used to supplement data gathered by federal, state, and local entities. The following groups will use these data:

Federal. The data can be used for watershed assessment reporting conducted by the U.S. Environmental Protection Agency.

State. NCDENR-DWQ, after evaluating submissions to determine if they are applicable and useful, can use the volunteer-acquired monitoring information in the development of the Basinwide Water Quality Plans and as a reporting requirement to the US EPA under Section 303(d) of the Federal Clean Water Act.

Local. Volunteer citizen monitoring data can be used to provide baseline data for planning and zoning and other land use decisions.

River and Watershed Organizations. Many volunteer monitoring organizations will have their own intended usage of the data, including educational and stewardship purposes.

National Committee for the New River. NCNR will use the data to assess areas in need of restoration or conservation. Also, this data collected can be used for educational or stewardship purposes.

Overall, the collection of data by volunteers can help foster good stewardship of environmental resources while providing early warnings of problems resulting from inadequate storm water management, sedimentation, sewage contamination, and other potential water quality problems.

## A6. Project/ Task Description and Schedule

### *Overview*

This document outlines the project plan for the National Committee for the New River's pilot program called *New River Water Watchers*.

NCNR will train volunteers in methods to test the following standard water quality parameters in the non-tidal waters of the New River and its tributaries:

- pH using color comparators
- Water temperature using verified armored thermometers
- Dissolved oxygen using modified Winkler method
- Water clarity using a turbidity tube

NCNR has chosen these parameters because they provide a basic assessment of water quality and water clarity and the techniques are easy to master, making them ideal for volunteer monitors. Obtaining data from the listed parameters requires minimal and/or inexpensive equipment, making the process accessible for watershed groups and individual volunteer water quality monitors. Monitors perform a visual assessment of their site and record any observations or changes when monitoring in the field including physical characterization of immediate surrounding land use, width, stream depth, water odor, bank height, bank angle, channel flow status, weather conditions, channel modification, instream habitat, bottom substrate, pool variety, riffle habitat, bank stability and vegetation, light penetration, and riparian vegetative zone width.

In the future other groups working with NCNR may elect to perform secondary water quality parameters. While these parameters may not be the basic parameters used by NCNR, they are very important in assessing the overall health of the New River.

The use of secondary parameters by other groups or individuals typically depends on participation of members, interest in the parameter, and cost of the equipment, training, and sample processing. Examples of secondary parameters include:

- Water Clarity using a Secchi disk
- Nutrient sampling for nitrates and phosphates using LaMotte kits
- Daily precipitation using a rain gauge

NCNR recommends sampling at a minimum of at least month, with some volunteers monitoring as frequently as weekly, and others bi-monthly intervals. Volunteer monitors use protocols, supplies, and equipment provided by NCNR.

**Table A6.1.** Project Timetable for the *New River Water Watchers* program through NCNR

<b>Activity</b>	<b>Project Start Date</b>	<b>Anticipated Date of Completion</b>
New River Water Watchers	August 2008	Ongoing

**Table A6.2.** Citizen Monitor Project Timetable

<b>Activity</b>	<b>Project Start Date</b>	<b>Anticipated Date of Completion</b>
<ul style="list-style-type: none"> <li>▪ Training</li> </ul>	July 7, 2008	July 19, 2008
<ul style="list-style-type: none"> <li>▪ Water Quality Monitoring</li> </ul>	Monthly; August 2008	September 2009
<ul style="list-style-type: none"> <li>▪ Data Entry</li> </ul>		
<ul style="list-style-type: none"> <li>▪ Recertification</li> </ul>	June 2009	Annual event

**Table A6.3.** Example project timetable for citizen monitoring data management

<b>Activity</b>	<b>Project Dates</b>	<b>Anticipated Date of Completion</b>
Data Management by the NCNR QA Officer	July 17, 2008 through July 18, 2009	Data query forwarded to DWQ and Watershed Organizations August 1, 2009

## A7. Quality Objectives and Criteria

### *Precision, Accuracy and Measurement Range*

NCNR trains volunteer monitors in basic water quality parameters. Table A7.1. lists the parameters to be used by *New River Water Watchers*.

**Table A7.1.** Measurement ranges for water quality parameters measured in the *New River Water Watchers* program.

<b>Matrix</b>	<b>Parameter</b>	<b>Measurement Range</b>	<b>Resolution</b>
Air	Temperature	0°C - 35°C	0.5°C
Water	Temperature	0°C - 35°C	0.5°C
Water	Dissolved Oxygen	0 – 15 mg/L	0.2 mg/L
Water	Wide Range pH	3 – 10.5 SU	0.5 S.U.
Water	Water Clarity	0 – 4 m	0.1m
Water	Water Depth	0 – 4 m	0.1m

### *Representativeness*

Selection of Sampling Sites. *New River Water Watchers* work with individual monitors, watershed and river groups, and government agencies to select sites. A site is chosen with the expectation that it will provide an adequate representation of what is occurring in the water body being sampled, whether it being a stream reach, larger tributary, or portion of the New River proper.

*New River Water Watchers* work with DWQ staff to identify stream reaches as well as tributary sections that are appropriate for volunteer citizen monitoring and will best augment and complement data gathered by DWQ staff and contractors as well as choosing sites that are of interest to other governmental agencies and potential data users.

Final site selection occurs after a discussion between the Program Coordinator, QA Officer, Field Coordinator and/or Primary Monitor(s). Because site selection may be based on proximal land use with considerations for spatial and temporal variations, it is invaluable to have the local knowledge provided by Field Coordinators and/or Primary Monitors to help locate sampling sites that will yield data that are of most value to the local organization as well as government agencies. Monitoring sites must be accessible to volunteers (either open to the public or through permission of the private landowner). Often this is resolved by choosing monitoring sites that are actually on the monitor's private property or is on public property, such as a public pier or bridge to ensure that no volunteers are trespassing on private property. Site selection also takes into consideration safety of the volunteers during access to the site as well as during sampling operations.

Number of Sampling Sites. *New River Water Watchers* will start with at least 10 volunteer citizen monitors in three North Carolina counties of the New River watershed. The number of sampling sites will increase each year.

Sampling Time Requirements. The time needed to sample an individual site varies with accessibility and type of site. For the basic suite of parameters (pH, temperature, DO, and transparency), NCNR suggests that monitors allow at least 2 hours (travel time to site may vary) to check and prepare equipment; conduct all necessary monitoring; record results; clean up; and data entry.

Duration and Frequency. Volunteer monitors who are trained and recertified under NCNR's *New River Water Watchers* program are asked to commit to sample at their designated site for a minimum of one year. A primary monitor is assigned to a site or sites that he or she continually monitors for the duration of the project. Depending upon the location and parameter, the monitor may sample weekly, biweekly, monthly or bi-monthly. Monitors are required to note on the data sheet the time and date of each monitoring event. If a monitor cannot safely perform the monitoring due to inclement weather, high tides, health reasons, or an environmental hazard, the monitor may not be able to provide results on the "normal" schedule.

### ***Comparability***

NCNR currently uses the following federally accepted standard methods:

1. Water and air temperature are most often measured using **Method 170.1 EPA/NERL**, in which the *New River Water Watchers'* master thermometer (Fisher Scientific #15-000A) is annually verified against a NIST-traceable thermometer. All volunteer monitors are required to verify their alcohol thermometers (LaMotte #1066) against NCNR's NIST verified master precision thermometer. A description of Method 170.1 EPA/NERL can be obtained at [www.nemi.gov](http://www.nemi.gov).

2. **Method 360.2 EPA/NERL**, a modified Winkler titration, is used for measuring dissolved oxygen. NCNR uses LaMotte's Winkler titration Dissolved Oxygen Kit #5858 and follows the Environmental Protection Agency's (EPA) compliance for checking the sodium thiosulfate solution.

A description of EPA/NERL methods is available at [www.nemi.gov](http://www.nemi.gov).

*New River Water Watcher* volunteer monitors measure other basic water quality parameters without probes, including pH, and water clarity, but do not use the standardized federal methods for these parameters. NCNR researches methods for each parameter before determining the appropriate methods for use in its volunteer program, basing its decision on the sensitivity of the test, volunteer safety, cost, the appropriateness for the given volunteer group, and requirements for disposal of the materials.

## ***Completeness***

NCNR anticipates that with monitors collecting samples generally once a month there will be a total of 12 samples per monitor per year. Some participants in *New River Water Watchers* may decide with the Program Coordinator to monitor more frequently and due to unforeseen circumstances, some monitors may not be able to monitor every month. The Program Coordinator will set a maximum and minimum limit for the number samples collected per monitor. The percent complete will be the percentage of valid samples per parameter monitors collected on their particular sampling schedule.

**Table A7.2.** Summary table for organization of the anticipated number of samples collected on a monthly sampling schedule.

<b>Parameter</b>	<b>Percent of Completeness</b>
Dissolved Oxygen	80 – 100%
pH	80 – 100%
Water Temperature	80 – 100%
Air Temperature	80 – 100%
Water Clarity	80 – 100%



## **A8. Special Training/Certifications**

### ***Training Arrangements***

NCNR's *New River Water Watchers* program training contains two components: initial trainings, and annual recertification sessions.

NCNR will schedule an initial training once a year for beginning monitors and on an as-needed basis throughout the year. These trainings are designed to provide information and methods appropriate to the parameters being monitored. All citizen monitoring groups are trained on the same basic water quality procedures: pH, dissolved oxygen, temperature, and water clarity. These initial trainings, coupled with a follow-up validation that the new monitor understands proper monitoring procedures, result in "certification" of a NCNR volunteer water quality monitors. Each new monitor's sampling techniques can be validated by the Program Coordinator and/or QA Officer either in the field or in a lab/classroom setting. Any data submitted by a new monitor prior to his/her being officially "certified" must be flagged in the online database so that it will not be submitted to DWQ. This entails entering the phrase, "pre-certified," in the Comments field. Monitor qualification is valid for one year, at which time all monitors are required to be "recertified".

An initial training will start with an introduction to the science of water quality monitoring, information on the importance of water quality monitoring, commitment agreements, and liability waivers. Most training sessions will be held on the weekend to accommodate work schedules. The location of trainings will vary and will be selected based on the volunteers receiving the training.

NCNR will host recertification sessions annually for monitors that have passed the initial training. Recertification sessions are conducted in a fashion that is similar to a lab practical. Monitors are checked to assure that: they remain proficient in methodology and understanding of basic water quality parameters, their equipment is operational and properly calibrated / verified, and they have an adequate supply of viable chemicals.

**Table A8.1.** Individual basic parameters, the frequency of training and recertification, and the procedural items that are emphasized during the various training sessions and workshops that NCNR conducts.

<b>Parameter</b>	<b>Frequency</b>	<b>Procedural Items Emphasized in Training</b>
Air Temperature	Yearly	<ul style="list-style-type: none"> <li>• Keep the thermometer out of direct sunlight</li> <li>• Wait a few minutes for equilibration</li> <li>• Do not touch the bulb when reading the temperature</li> </ul>
Water Clarity	Yearly	<ul style="list-style-type: none"> <li>• Turbidity Tube               <ul style="list-style-type: none"> <li>○ How to read the turbidity tube</li> </ul> </li> </ul>
Water Temperature	Yearly	<ul style="list-style-type: none"> <li>• Emphasize allowing thermometer to equilibrate</li> <li>• How to accurately read the thermometer</li> </ul>
Dissolved Oxygen (Winkler Titration method)	Yearly	<ul style="list-style-type: none"> <li>• Check sodium thiosulfate before testing in the field</li> <li>• Perform duplicate sample for comparison</li> <li>• Understanding the meniscus and how to properly read one</li> <li>• How to read and use titrating syringe</li> <li>• Rinsing sample bottles and test tubes with the sample water</li> <li>• How to properly dispense drops of solution</li> </ul>
pH (Wide range kits)	Yearly	<ul style="list-style-type: none"> <li>• How to properly dispense drops of solution</li> <li>• How to interpret readings using the color comparator box</li> <li>• The importance of rinsing glassware with the sample water before beginning the pH test</li> </ul>

***Description of Training and Trainer Qualifications***

This section describes those who perform the training of volunteers, what the trainings cover, and how volunteers demonstrate proficiency in the techniques.

***Initial Volunteer Training***

The Program Coordinator and/or QA Officer will train new volunteers. The trainings cover material including an introduction to the science of water quality monitoring, information on the importance of water quality monitoring, and water quality monitoring techniques. Training sessions are conducted like an actual sampling session, with water samples obtained in the proper manner followed by water quality tests performed in the order in which they would be performed in the field (i.e. air temperature, general observations, dissolved oxygen, water temperature, pH, and water clarity). During these trainings, new volunteers are given manuals, “cheat sheets” (the complete step-by-step instructions of the procedures for all parameters), and samples of the datasheets they will use.

NCNR will guide the trainees through each test and then requests that they repeat the procedure. The trainers work with each individual until the volunteer demonstrates an understanding of, and proficiency with, each testing method. Trainers circulate through the room while the monitors are practicing the test to answer questions and verify that monitors are using proper technique.

If a volunteer cannot adequately perform any procedure, Trainers will work with the volunteer after the training session to help that volunteer gain proficiency. If proficiency is not achieved, that monitor will be informed that his/her data cannot be submitted to the online database, but the volunteer is welcome to continue monitoring. Written data sheets submitted by that monitor are marked by NCNR as “questionable data.” All documentation including monitor contact information, site documentation and assignments, liability waivers, commitment statements, and participant evaluations from initial trainings, are held at NCNR’s Jefferson, North Carolina, office where they are retained for five years.

### ***Recertification Sessions***

The Program Coordinator and/or QA Officer provide recertification sessions for volunteer monitors who have passed the initial training. These trainings are conducted like a lab practical, providing monitors with a review of procedures, equipment verification/check, and updated information about monitoring. The recertification session is set up with a “station” for each water quality parameter. Volunteer monitors perform the test and compare their results to a known or controlled result. Trainers observe the volunteer monitors’ methods and ensure that monitors correctly perform the tests and accurately record the data. After completing and “passing” one parameter, the monitor moves through each of the other stations while completing a datasheet that serves as documentation of recertification. Replacement equipment, datasheets, information, and chemicals are given if needed. NCNR retains documentation of recertification sessions at its Jefferson, North Carolina, office for five years.

## **A9. Documentation and Records**

### ***Original Water Quality Monitoring Filed Datasheets***

NCNR will maintain original hardcopy records (datasheets) of water quality data submitted by all *New River Water Watchers* volunteers at NCNR's Jefferson, North Carolina, office for five years after submission. In addition, NCNR will maintain electronic (digital) records of the data. The online datasheets are to be stored in the citizen-monitoring database located at [http://www.ncnr.org/data\\_entry.php](http://www.ncnr.org/data_entry.php).

Using a standard data sheet, volunteer monitors record the date and time, physical conditions, and all measured water quality parameters. Standardized datasheets prevent confusion among volunteers and trainers. The Program Coordinator, QA Officer and Field Coordinator refer to the original datasheets if there are any questionable entries in the citizen-monitoring database. A sample datasheet is included as Appendix D to this document. *New River Water Watchers* does not use any additional field sampling sheets or field logs.

### ***Volunteer Reporting***

Reporting procedures vary for each organization or individual monitor depending on participation and monitor accessibility to Internet. Most *New River Water Watchers* certified water quality monitors input their data on a monthly basis to the web-based database and then copy the datasheets before forwarding them to the QA Officer and/or directly to NCNR. Once the QA Officer receives the datasheet, she or he performs a “spot-check”, copies the form, and forwards the original to NCNR's office for filing where it will be retained for five years.

### ***Verification Logs***

Verification logs for *New River Water Watchers'* master thermometer and armored thermometers given to monitors will be stored at National Committee's Jefferson, North Carolina, office for five years. *New River Water Watchers'* QA Officer must copy their verification logs and forward originals to NCNR. Verification logs for thermometers are included in Appendix C to this document.

In addition, other volunteer monitoring records will be kept on file at NCNR's Jefferson, North Carolina, office. *New River Water Watchers* maintain a separate file for each volunteer monitoring group or individual with whom it works. This file contains information about that monitor (contact information, assigned site(s), and sampling frequency).

### ***Site Data Forms***

*New River Water Watchers'* will maintain site data forms that record the latitude and longitude of the site, site description and designation (name), physical characteristics of the site, detailed directions to the site, and a site map and/or photograph. See Appendix E for a sample of a site data form.

## ***Volunteer Certification***

*New River Water Watchers'* will maintain documentation on all initial training and recertification sessions held by the QA Officer and/or Program Coordinator. The following documentation is kept for each session, training, or workshop: monitor site designation, sign in sheets (attendees), monitor contact information, liability and commitment forms, and training datasheets. See Appendix C for an example of documentation package that will be kept at NCNR after each training or workshop.

## **SECTION B:**

# **DATA GENERATION AND ACQUISITION**

## B1. Sampling Process Design

### *Sampling Sites*

While NCNR will strive to maintain monitoring sites through its volunteers that provide an accurate representation of water quality of the New River and its tributaries, the extent and coverage of sampling locations vary based on the organization, or group partnering with NCNR. In addition, some monitoring sites have been added due to individual volunteer monitoring interest and are not part of a larger group's monitoring program. To the degree practical, the following criteria will be used when selecting sites or groups of sites for volunteer monitoring:

- Monitoring sites should be located, as often as practical, both immediately above the mouth of any tributary and immediately below on the mainstem of the receiving water body or river.
- Monitoring sites should be located above and below major construction sites and point discharges (although below permitted 'mixing zones').
- Monitoring sites should be proximal to a farm or animal holding facility that is instituting best management practices.
- Monitoring sites may be located opposite a state monitoring site to allow for comparison of data sets.
- Monitoring sites should be located in accessible and safe areas.

As discussed in Section A5 Intended Usage of Data, sites increasingly will be chosen with respect to complementing or augmenting data obtained by DWQ and other government agencies as well as to provide data that allows monitoring of changes resulting from best management practices, TMDL implementation plans, and other restoration activities.

In addition, focus for some NRWAs will be on New River streams that are in pristine condition. Not only will this give a better understanding of the watershed's overall health but help identify waters that should be actively protected.

Safety is an issue strongly emphasized by NCNR. During training sessions, safety is emphasized and is discussed before training begins. Most sampling locations are on the monitor's property or on public property to prevent safety issues resulting from a lack of landowner permission. NCNR emphasizes the importance of using "the buddy system" when possible or alerting someone when a monitor will be in the field sampling. Inclement weather, monitor health issues, or environmental hazards are reasons not to conduct monitoring. Monitors sample either using a bucket off a bridge or pier or by wading into the stream channel. For safety reasons, NCNR encourages monitors to use a bucket as a precaution in case of extreme flow rate or unsafe substrate. Please see Appendix A (the *New River Water Watchers Volunteer Water Quality Monitoring Program Manual*) for detailed monitoring instructions and procedures.

***Indicators measured and sampling frequency***

Table B1.1 describes the number of samples, sampling frequency, and sampling period of NCNR's monitoring program.

**Table B1.1.** Sampling logistics for *New River Water Watchers* Program.

	<b>Type of Sample/Parameter</b>	<b>Sampling Frequency</b>	<b>Sampling Period</b>
Physical	Temperature	Monthly	1 Year
	Water Clarity		
	Water Depth		
Chemical	Dissolved Oxygen		
	pH		



## B2. Sampling Methods

**Table B2.1.** Sampling methods that will be used by the *New River Water Watchers*.

<b>Monitoring Parameter</b>	<b>Monitoring Equipment</b>	<b>Sampling Method</b>
Water Temperature	Armored Thermometer	Collect in bucket; direct stream reading
Air Temperature	Armored Thermometer	Reading from air
Water Clarity	Turbidity Tube	Collect in bucket; direct stream reading
Dissolved Oxygen	LaMotte Kit 5860	Collect in bucket; direct stream collection
pH	LaMotte Kits 5858	Collect in bucket; direct stream collection

Please see Appendix A (the *New River Water Watchers* Volunteer Water Quality Monitoring Program Manual) for detailed monitoring instructions for each parameter including any storage equipment, sample preservative and holding times.

## B3. Sample Handling and Custody

NCNR is not currently working with any groups or individuals that send samples out for laboratory analysis. All testing procedures are performed in the field and recorded on field datasheets.

## B4. Analytical Methods

Table B4.1 shows the test methods and equipment that will be used by NCNR and its volunteer monitors. Specifics of the test methods for each parameter are outlined in Appendix A, the *New River Water Watchers* Volunteer Water Quality Monitoring Program Manual.

**Table B4.1.** Test methods and equipment currently used by *New River Water Watchers* monitors.

Monitoring Parameter	Monitoring Equipment	Test Method
Water Temperature	Armored Thermometer	*EPA/NERL 170.1
Air Temperature	Armored Thermometer	See Appendix A
Water Clarity	Turbidity Tube	See Appendix A
Dissolved Oxygen	LaMotte Kit 5860	*EPA/NERL 360.2
pH	LaMotte Kits 5858	Color comparator: See Appendix A

\*Please refer to the National Environmental Methods Index at [www.nemi.gov](http://www.nemi.gov)

## B5. Quality Control

### *Field QC Checks*

Volunteer monitors check the viability of their sodium thiosulfate solution prior to each monitoring event and record the results on the field datasheet. Sodium thiosulfate is used for monitoring dissolved oxygen. By using a standard solution of iodate-iodide, with 10mg/L dissolved oxygen value, the monitor must record a value of 9.4 – 10mg/L with their sodium thiosulfate measurement. If results of the first check are above or below these intended values, a second check is performed. If the second check yields unacceptable values or if the two checks are greater than 0.4 mg/L apart from each other, the monitor is instructed to abandon the dissolved oxygen test because the sodium thiosulfate is no longer viable. The monitor must contact *New River Water Watchers'* Program Coordinator or QA Officer for assistance and/or chemical replacement.

Monitors perform the dissolved oxygen test on the actual water sample in duplicate. Monitors are instructed to do a third titration if their two initial titrations differ by more than 0.6mg/L. The two closest values are recorded on the datasheet. If the Program Coordinator or QA Officer discovers through “spot-checking” of the datasheets that a monitor reported values in two consecutive weeks exceeding NCNR's quality control requirements, the monitor is contacted to resolve the problem.

Specifics of the test methods for each parameter are outlined in Appendix A, the *New River Water Watchers* Volunteer Water Quality Monitoring Program Manual.

### ***Laboratory QC Checks***

*New River Water Watchers* are not currently working with any groups, organizations or individuals that send samples out for laboratory analysis.

### ***Data Analysis and QC Checks***

Site Metadata Check. Any new monitoring site that is established will be documented on a site data form. Among other things, this form documents a description of the site, its location, and coordinates for the site. See Appendix E for a sample of a site data form. Staff will confirm the accuracy of the latitudes and longitudes of new sites using a GPS unit. Coordinates are recorded in decimal degrees. Photographs, topographic maps and other useful metadata are kept on file at the NCNR office in Jefferson.

Data Analysis. Reporting procedures vary for each organization, or individual working with NCNR depending on participation, and monitor accessibility to Internet. Most volunteer monitors input their data on a monthly basis to NCNR's web-based database and then copy the datasheets before forwarding to the QA Officer. The database allows values within “acceptable” ranges for each parameter, further ensuring that suspect data or data entry mistakes are flagged, first by the monitor and then by the Field Coordinator and/or NCNR staff.

Data is also checked for outliers that may have been missed through random spot-checking. Outlier checks are performed by staff and consist of the following steps.

- a) Check performed prior to submitting data to DWQ.
- b) Staff sorts the online data using Microsoft Excel or Access based on the following parameters: DO, pH, and temperature.
- c) Staff look for unusually high or low values and confirms them to raw data sheets using the following table:

<b>DO (mg/L)</b>	<b>Temp. (°C)</b>	<b>pH (S.U.)</b>
<4, >15	>32	<6.0, 9.0>

- d) If errors are found in any parameter, the entire record is checked to the field data sheet

Any inconsistencies in data entry found in the database are corrected and a note is put on the datasheet and in the “Comments” field of the database indicating that an error was made. Repeated entry errors (i.e. recording transposed values in database), out of range results, incomplete datasheets, and written notes by monitors are examples of signals to the Field Coordinator and staff of possibility of “questionable data.” Under these circumstances, the

monitor is contacted by the Program Coordinator and/or QA Officer for a conversation on what if any problems the monitor is experiencing, to answer any questions the monitor may have, and to schedule a retraining if necessary.

Questionable data are determined by *New River Water Watchers'* Program Coordinator with assistance from the QA Officer, and is deleted from the online database and field datasheets are marked as such. Questionable data are investigated and not reported to the Department of Environmental Quality in annual data queries of NCNR's online database. Examples of questionable data are:

- Absence of metadata including chemical viability checks for sodium thiosulfate
- Out of range results due to:
  - Equipment issues (i.e. monitor alerting on datasheet that syringe broke during testing)
  - Monitor not performing test correctly (i.e. determined by monitor comments on datasheet or investigation by Program Coordinator and/or QA Officer resulting in retraining of monitor)
  - Chemical expiration or contamination (i.e. determined by monitor comments on datasheet, investigation by Program Coordinator and/or QA Officer resulting in chemical replacement or recall of reagent)
- Required samples not taken (i.e. two dissolved oxygen samples are required to be taken at each monitoring event, only one sample taken)

Chemical Storage and Usage Procedures. Monitors are trained from the beginning of their *New River Water Watchers* commitment on the proper use and storage of chemicals. Please see Appendix A, the *New River Water Watchers* Volunteer Water Quality Monitoring Program Manual.

Monitors are encouraged to store their kits in a cool dark location because some of the chemicals used for the various water quality tests can become degraded in extreme heat or cold and by direct sunlight. Monitors are supplied with explicit directions on chemical storage and disposal and encouraged to keep chemicals away from small children and pets.

NCNR emphasizes proper handling procedures (such as holding bottles completely vertical when dispensing drops) during training sessions. Trainers discuss sample contamination in all trainings and recertification. Monitors are trained to use sterile procedures when dispensing a reagent. For example, monitors are trained to dispense leftover sodium thiosulfate into a waste container rather than back into its original container.

Chemical Integrity/Replacement. When staff provides chemicals and reagents to volunteers and volunteer monitoring organizations, these supplies are clearly labeled with an expiration date. If Trainers observe any questionable data input to the database, they will specifically check with the monitor or monitoring organization about the chemical integrity and the expiration date(s) of chemicals and/or reagents. If the chemical is expired or was stored improperly, the chemical is replaced. If the data discrepancy occurs for dissolved oxygen, the

numbers reported on the datasheet for the sodium thiosulfate are checked. If the sodium thiosulfate does not meet calibration values (i.e. 9.4 – 10 mg/L with iodate-iodide standard solution), it is replaced with a new bottle.

Equipment Replacement. If data appears questionable (such as missing or out of range metadata), the QA Officer investigates the cause of the data anomaly. If this investigation yields information that the data is due to equipment malfunction, the equipment is replaced promptly and the data collected with faulty equipment is discarded.

Volunteer Monitoring Methods and Procedures. If a problem is repeatedly occurring and the chemicals and monitoring supplies have been checked and/ or replaced, staff contact the Field Coordinator or the volunteer monitor directly to ascertain if there may be a problem with how the monitor is obtaining the suspect data. If necessary, the volunteer is retrained on the procedures for obtaining data for the parameter that the monitor is having difficulties with. If this does not remedy the problem, the monitor is still allowed to continue sampling; however, his or her data are not used in the database, but their datasheets will still be retained at the NCNR Jefferson, North Carolina, office, but will be marked as “questionable data.”

## **B6. Instrument/Equipment Testing, Inspection and Maintenance**

Water quality sampling supplies are stored in secured cabinets at NCNR's Jefferson, North Carolina, office before they are distributed to volunteer monitors. The following supplies and equipment are stored in the secure areas (which allow chemicals to be stored at room temperature and be out of reach of animals and small children): thermometers, chemicals and reagents, turbidity tubes, and glassware.

NCNR keeps an adequate supply of chemicals to restock volunteer kits as needed. All chemical restocks are clearly labeled with the expiration date. Staff checks chemical expiration dates of stored chemicals on a regular basis for inventory and chemical resupply needs. Staff thoroughly inspects all equipment before use in the field or at training events to verify it is in working order. Staff clearly labels and segregates expired chemicals and damaged equipment and only uses these for demonstrations, trainings, and educational purposes if appropriate.

Volunteers have a variety of equipment and supplies that they keep at their house or workplace. Volunteers are trained to perform periodic inspections of their equipment. Volunteers contact the QA Officer or Program Coordinator to request resupply if equipment or chemicals have been damaged, lost, or has expired.

Thermometer Maintenance. Staff keeps and maintains thermometers for use in water quality monitoring. These thermometers are stored upright and are clearly labeled as either a verified or a non-verified thermometer. Volunteer monitors are instructed to keep their thermometers stored in an upright position or hanging from the lip of their bucket to reduce damage or column separation. Staff train volunteer monitors to periodically inspect thermometers for separation of the liquid inside the column, which may result from improper storage. To reunite the column, the volunteer places the thermometer in boiling water until the column rises into the bulb. When the column enters the bulb, the thermometer is tapped gently on a soft surface to reunite the column. Volunteers are instructed to wear protective eyewear and take care not to shatter the bulb. Thermometers belonging to volunteer monitors are verified once a year at a recertification session to insure accuracy within 1<sup>0</sup>C of a verified control thermometer. If thermometers are out of range, staff replaces them with verified equipment.

Chemical Kits (pH, DO). NCNR staff keeps all extra glassware for the chemical kits in a secure cabinet in NCNR's Jefferson, North Carolina, office or at a secure area at an organization's office. Chemical reagents for kits are stored and clearly labeled with the expiration date. Color comparators are stored in the appropriate kit boxes to prevent breakage. Color comparators in use by monitors are checked once a year at a recertification session by NCNR staff to assure they are not damaged, and are replaced if necessary.

Glassware. NCNR trains all monitors to use tap water to clean glassware and to allow the glassware to dry thoroughly before each use. The *New River Water Watchers* Volunteer Water Quality Monitoring Program Manual (Appendix A) provides detailed instructions and requirements for equipment cleaning and storage. Glassware used by volunteer monitors is checked once a year at a recertification session by NCNR Trainers to assure it is not damaged. Defective glassware is replaced if needed.

Turbidity Tube. NCNR Trainers instruct volunteer monitors to periodically inspect their Turbidity tube to ensure that they have not been distorted, thus misrepresenting the marked graduations. To inspect the turbidity tube, verify the tube's centimeter markings against a tape measure. If distortions or other inaccuracies are found with the turbidity tube, monitors are to contact the QA Officer to have it replaced. Turbidity tubes used by volunteer monitors are checked once a year at a recertification session by NCNR Trainers to assure they are correctly calibrated. If needed, they are replaced.

### **B7. Instrument Verification/ Calibration and Frequency**

Table B7.1 describes the frequency and standards of equipment verification / calibration currently used in the volunteer monitoring program.

**Table B7.1.** Monitoring equipment verification / calibration standards and frequency.

<b>Equipment Type</b>	<b>Verification / Calibration Frequency</b>	<b>Standard or Calibration Instrument Used</b>
Master thermometer	Yearly. Before use/training by NCNR Trainers	NIST-traceable thermometer
Armored thermometers	Before use/training by NCNR Trainers	Master thermometer verified to NIST thermometer
Turbidity Tube	Before use/training by trainers and monitors	Tube gauge is checked against a tape measure

Master Thermometer Verification. NCNR owns a master precision thermometer that is verified annually against a NIST-traceable thermometer. If NCNR's master thermometer is not found to be within the acceptable range of within 1<sup>0</sup>C, NCNR obtains a new thermometer, which is then verified. It is this verified thermometers that is used by staff to assure proper verification of the thermometers used by the volunteers. Verification logs are retained by NCNR staff that forward their original verification logs to the NCNR Jefferson, North Carolina, office to be retained for five years.

Volunteer Thermometer Verification. At the beginning of this monitoring project, NCNR will purchase armored thermometers (LaMotte Model #1066), which will be given serial numbers and verified against the NCNR's master verified NIST-traceable thermometer. The thermometers are verified in three water baths: room temperature, approximately 35°C, and an ice bath. If the thermometer does not read within 1°C of the verified NIST-traceable thermometer, it cannot be used for monitoring purposes and is clearly labeled as a demonstration or non-verified thermometer.

## **B8. Inspection/Acceptance Requirements for Supplies and Consumables**

NCNR obtains equipment and chemicals from reputable supply companies including: LaMotte Chemical, and the HACH Company.

Upon receipt of equipment, staff inspects all supplies. Items that are broken or appear defective are immediately sent back to the supplier. Staff clearly marks the expiration dates in permanent marker on all chemicals and reagents (based on the lot number or manufacture expiration date).

Supplies are then organized for both training and recertification sessions. Staff ships replacement supplies to monitors as needed. Monitors return expired chemicals and defective equipment to NCNR which then either disposes of them or uses them for training and educational purposes only. All defective equipment and expired chemicals are clearly labeled to prevent accidental use in a water quality sampling session.

## **B9. Non-direct Measurements**

All data will be generated through field activities with the exception of precipitation. Volunteers that do not use a gauge can collect rainfall information quickly by going to [www.weatherunderground.com](http://www.weatherunderground.com) or [www.weatherchannel.com](http://www.weatherchannel.com). These websites will provide accurate weather information from the closest weather station.

## **B10. Data Management**

Trained volunteer monitors will be provided with a website link [http://www.ncnr.org/data\\_entry.php](http://www.ncnr.org/data_entry.php), so that they can enter their own data online. After monitors enter their data, they are instructed to send their datasheets to the Field Coordinator to be “spot-checked”. The Field Coordinator photocopies the datasheets and highlights any area of concern on the datasheet. After the initial “spot-checking” is completed, the Field Coordinator will send the original datasheets to NCNR so that the QA Officer can perform an additional “spot-check” before forms are filed.

Spot-checking involves checking the written field datasheet against the online database. At least 20% of each datasheet received is “spot-checked” by the QA Officer. Only the QA Officer has data altering abilities and administrative permission to change incorrectly entered data. NCNR submits data from this database to the NCDENR-DWQ according to reporting requirements.

## **B11. Data Acquisition**

The Alliance for the Chesapeake Bay's 2006 *RiverTrends* program's Quality Assurance Project Plan was relied on heavily for procedures, supplies, and overall organization of the *New River Water Watchers* volunteer monitoring group.



## **SECTION C:**

# **ASSESSMENT AND OVERSIGHT**

## **C1. Assessments and Response Actions**

The Program Coordinator and QA Officer are responsible for insuring that all monitors attend a recertification session each year. These sessions serve as audits or “tests” for the monitors and their equipment.

NCNR retrain any monitor who demonstrates a faulty sampling technique. If the problems persist data from this monitor is flagged and not entered into the database or deleted if already entered. NCNR uses recertification sessions to identify faulty equipment so that it can be immediately replaced.

Monitors can be recertified at a scheduled recertification session, during a site visit by the Program Coordinator or QA Officer, or during a visit to the NCNR office for individual recertification. Staff analyzes the datasheets from recertification sessions to determine if the data quality objectives (i.e. correct values for parameters compared to controls) are met and if the monitor had any questions about the procedures. These objectives include:

- pH measurement within range of control value
- thermometer verified; able to read thermometer
- correct procedure for dissolved oxygen witnessed by Trainer
- accurate reading of turbidity tube
- equipment replaced if damaged

If the monitor does not meet the objectives, NCNR will decide on corrective action (i.e. training monitors to use an alternate method of sampling, requiring that equipment be more frequently verified, or the monitor ceases measuring the parameter in question.)

## **C2. Reports to Management**

NCNR provides water quality data obtained by trained monitors to the Division of Water Quality on an annual basis for inclusion in water quality assessment reports. The reports submitted to DWQ include the following information and data:

- total number of sites
- data collected at each site
- number of samples collected at each site
- site locations

NCNR provides similar reports to other organizations with which it works. These reports may vary in content and timing. These individual monitoring organizations working with the NCNR may also analyze and compile data for their own purposes, using NCNR's online database. This access to NCNR's data gives local and regional organizations the opportunity to perform statistical analysis for their own reporting purposes. NCNR will receive funding from state and federal grant sources, which require progress and/or final reports, some of which may require the following information, depending on the program or project:

- total number of sites
- data collected at each site
- number of samples collected at each site
- site locations
- QA schedule and training events
- adjustments made in technique or equipment

## **SECTION D:**

# **DATA VALIDATION AND USABILITY**

## **D1. Data Review, Verification, and Validation**

The initial review of field data takes place in the field by the individual monitor when samples are collected. The monitor is trained to look for discrepancies in readings or data that appear unusual. If the monitor finds such a data abnormality, the monitor may perform the test again and make a note in the comments section on the datasheet.

Monitors input data into NCNR's online database and then submit original paper datasheets to their Field Coordinator. In some cases, the Field Coordinator will input the data directly to the online database, checking to see if values are within acceptable ranges and there are no anomalies that might warrant review. Once NCNR receives the original datasheet (typically within a month of the sampling event) the QA Officer conducts a final "spot check" of each datasheet received.

Extensive crosschecking is conducted on the database before it is submitted to any agency for use. The QA Officer queries the database for possible outliers and cross checks the datasheets with the information entered in the online database for each outlier. The Program Coordinator makes the final decision about whether to accept or reject any data. After the data is thoroughly checked, it is submitted to the requesting agency.

## **D2. Validation and Verification Methods**

Staff works with the volunteer monitoring organization to ensure that all data are validated and verified before submittal through "spot-checking" methods. The Program Coordinator, QA Officer, the Field Coordinator, and monitors are in constant contact throughout the duration of the monitoring project. Staff provides advice and technical assistance to ensure that procedures are properly followed and that submitted data has been checked thoroughly.

The monitor, and/or Field Coordinator forward the original datasheet to the QA Officer. "Spot-checking" of raw datasheets is used for quality control. Common mistakes involve monitors entering data into the database in the wrong space or transposing numbers. If data is incorrect or unusable, the QA Officer contacts the Field Coordinator for more information. If the Field Coordinator cannot explain the anomaly, the monitor is contacted to investigate possible errors. If errors are easily identifiable, the monitor is informed of errors and is retrained if necessary to ensure proper data collection.

Through yearly recertification sessions, Trainers work with monitors to ensure that equipment and reagents are still in good condition and monitors are performing the testing methods correctly. Trainers log verifications of thermometers. NCNR keeps calibration log sheets at the NCNR Jefferson, North Carolina, office and are checked and referenced if any questionable data arise to confirm proper equipment verification. Verification of master thermometers occurs yearly. Thermometers for new monitors are verified as needed. Monitor thermometers are checked yearly at recertification sessions and are replaced if needed with new verified equipment.

### **D3. Reconciliation with Data Quality Objectives (DQO)**

The results of all recertification sessions are immediately analyzed to determine if monitors have met quality assurance objectives within each parameter. If an individual monitor does not meet DQO's, his or her equipment will be reverified, checked, and replaced if it is determined to be faulty. If a monitor's technique is incorrect, he or she is retrained. If the monitor continues to use incorrect technique, his or her data are flagged by the Program Coordinator or QA Officer and not entered into the database (or deleted if previously entered) nor used in reporting.

Duplicate dissolved oxygen results are recorded and the average is calculated by the online database. The Program Coordinator or QA Officer reviews each sheet for decimal point errors, site/monitor entry, or any questionable results.

Field and laboratory data that does not meet DQO's will be rejected. Data correction information will be supplied to the monitoring group as well as the Department of Environmental Quality or other report requiring body.

#### ***References***

Alliance for the Chesapeake Bay Quality Assurance Project Plan, December 2007.

Virginia Citizen Water Quality Monitoring Program Methods Manual, October 2007.