

The Twenty Four Steps to Develop a Quality Assurance Project Plan

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Purpose: Following the directions below will allow users to develop a Virginia Department of Environmental Quality (DEQ) approved Quality Assurance Project Plan (QAPP). A template to fill out the QAPP is available at www.deq.state.va.us/cmonitor/grant.html or by contacting James Beckley at jebeckley@deq.virginia.gov. A QAPP is important to show that the group followed acceptable sample collection and test procedures. A QAPP also serves as a troubleshooting guide to identify and correct quality assurance problems.

Background: Prior to beginning to develop a QAPP, it is best to know the goals that the group wants to achieve through monitoring. Completing a monitoring plan prior to starting a QAPP is extremely helpful in planning the monitoring project. The Citizen Monitoring Plan template found at www.deq.state.va.us/cmonitor/grant.html is an excellent resource.

Procedure : Developing a QAPP can require several revisions due to missing or incorrect information. To prevent the need for unnecessary revisions, please follow the directions below. Contact James Beckley at (804) 698-4025 or at jebeckley@deq.virginia.gov if you have any questions.

Step 1- Title and Approval Page:

This is the first page of the QAPP. Congratulations on beginning the process to develop a scientifically based QAPP. Much like a book cover, the title and approval pages identify the project, the name of the monitoring group, and the date of the QAPP submission.

Under the heading is a section to place the name of the various people involved with conducting and reviewing the QAPP. Usually, there are four people involved with developing a QAPP. These people are the project manager for the group, the Quality Assurance (QA) officer of the group, DEQ data liaison (James Beckley), and DEQ QA officer.

Step 2- Table of Contents:

Please provide the page numbers for each section covered in the QAPP template. Please include a list of appendices for tables, figures, pictures, reference page(s), and similar items.

Step 3- Distribution List:

In this part, the group will list the people who will receive a copy of the QAPP. Unlike *Step 1- Title and Approval Page*, this section covers people not directly involved in the development of the QAPP but is involved in the monitoring project.

Step 4- Project/ Task Organization:

In this step, please identify the key personnel in your project and their duties. These can include such positions as:

- The project manager (usually the leader of the group)
- A QA officer (ensures that samples and tests are being done correctly)
- Field leader (oversees sample collection teams)
- Field monitors (volunteers who collect and/or test samples in the field)
- Laboratory manager (oversees the lab where samples are being analyzed)
- Laboratory technicians (laboratory staff who may be actually testing the samples)

Next to each position should be a brief description of that position's responsibility in the project. In addition, please mention who the intended audience is who will look at the monitoring data.

To help organize this information, it may be wide to develop an organizational chart. This chart can clearly show the structure of the group and identify which person is the best to answer a specific question. Computer programs like Microsoft® Word offer tools to help make these charts.

Step 5- Problem Definition/ Project Background:

This step is composed of two sections. The purpose is to describe why the group is doing monitoring at the selected sites and includes background information for people not familiar with the project.

Section A. Problem Statement:

In this section, describe the reason why the group is doing this project. If you have already completed a monitoring plan worksheet, you can take this directly from Step 1 of the worksheet. If not, simply state the reasons why you wish to do this project.

Example:

Previous monitoring in Bob's Creek in Smith County has shown high levels of E. coli bacteria. By setting up additional sampling stations along the creek, we will be able to identify the source of the E. coli bacteria. We believe the source is due to failing septic tanks and runoff from a nearby cattle farm.

Section B. Intended Usage of Data:

In this part, the group will describe how they intend to use the data. Again, you can pull this directly from the monitoring plan worksheet under Step 3. If not, list how you will use the data and who the intended users of the data are.

Example:

We intend to use the data to identify possible pollution sources in Bobs Creek. We will share our findings with the local government, soil and water conservation district, DEQ, and local citizens.

Step 6- Project/ Task Description:

As the title implies, this step of the QAPP process deals with developing an outline concerning when performing each task and what the tasks are.

Section A. General Overview of Project:

This section helps give a brief overview of the project. It is important to include such items as the water quality parameters the group is testing for and the methods to collect samples. In addition, it is good to identify which tests are the most critical and which are of secondary importance. You can obtain most of this information from Steps 5 and 6 of a completed Monitoring Plan.

Section B. Project Timetable:

This section deals with the timetable for the project. A well-planned timeline can help prevent bottlenecks from conflicting project tasks. The group should consider expected weather conditions and other events that could delay completing certain project tasks. For the timeline, include important tasks such as planned sampling dates (i.e. 2ed Tuesday of every month), data entry and report deadlines.

There are many different formats for developing a project timeline. The QAPP template uses a table-based timeline. In the first column, you would list the project task. The second column is where you would place the start date for the task. The third column would then list the expected completion date for that task. Please note that by overlapping two activities start and/or ending dates, you may experience scheduling problems.

Another popular method used by volunteer groups is to make a project timeline. The timeline format can graphically show the lifespan of each project task. This may make it easier to see overlapping tasks and project bottlenecks. Using this method, place each project tasks along the timeline according to the start and end dates for each task. Be sure to identify these dates on the timeline.

Step 7- Measurement Quality Objectives: (AKA Data Quality Objectives)

Now we are starting to move past the introductory and planning phases of the QAPP. The following steps are where most volunteer groups have trouble in getting the QAPP approved by DEQ. It is important to receive input from laboratory and sample teams when writing the remainder of the QAPP. You will refer back to this section when you are completing *Step 24- Reconciliation with Data Quality Objectives*

Section A. Data precision, Accuracy, and Measurement Range:

For the first section, the group must list each water quality parameter that the group plans to test for. For most water quality parameters (pH, DO, E. coli, etc), it is best to use a table format

Example:

Matrix	Parameter	Measurement Range	Accuracy	Precision
Water	TKN	0.5 mg/L- 25 mg/L	+/- 0.5 mg/L	+/- 10%
Water	pH	6.0 – 8.0 S.U.	0.2 S.U.	+/- 10%
Sediment	Lead	5.0 ug/L-10,000 ug/L	0.02 ug/L	+/- 10%

In filling out section 7A, it is important to know some basic definitions. Below are definitions for matrix, parameter, measurement range, accuracy, and precision.

Matrix- Is defined as where you are taking samples from. Most groups will list 'water' as the matrix for sampling most chemical parameters. A group would use list 'sediment' as the matrix when sampling for benthic macroinvertebrates because the animals live in the rocks and sediment of a streambed.

Parameter- Is defined as the actual substance that you are testing for (i.e. pH, DO, E. coli, etc.)

Measurement Range- shows the range that a test method can detect. The manufacturer of the test equipment, test procedure, or the laboratory that will test samples can supply this information.

Accuracy- shows how close a sample result is to the actual value. Think of it as aiming for the bull's eye of a dartboard. Like in darts, it is impossible to have perfect accuracy in testing water samples.

Most laboratories and probe manufacturers can provide the level of accuracy for their tests and equipment. In some cases, this level of accuracy may be so poor that the data is unreliable. The DEQ QA officer can give advice on acceptable levels of accuracy.

Precision- is the degree of agreement between taking repeated measurements of the same sample. A high level of precision will show consistent results. Again, think of throwing three darts at the dart board and they hit next to each other. With water sampling, as in darts, it is impossible to get perfect precision.

Usually the equipment manufacturer or laboratory can give the precision for the test method. In some cases, the group must develop their own levels of precision. If this is true, a good rule of thumb is that repeated measurements of the same sample must be within 10% or one (1) standard deviation of each other. The QA officer of the group and the DEQ QA officer can help define acceptable limits.

Section B. Data Representativeness:

When collecting water samples, it is important to collect a sample that represents the actual stream conditions. In this section, the group must state how they selected their sample sites. The group should note such items as number of sample sites, location of the sites, time needed to sample each site, safety factors, and similar items.

It is highly recommended when planning your sampling schedule, to have the group sample at multiple sites at the same time. This will give a snapshot for the entire study area to show water quality at each sample site. This is a great sampling methodology but it may require multiple sample teams.

Section C. Data Comparability:

In this section, the group should state the methods for testing water samples. You can provide a summary of the test methods in this section. If you decide to do so, please include a full description of the methods as an attachment.

For DEQ to approve a QAPP the group should use EPA and/or DEQ approved methods. The website www.nemi.gov offers free downloads of EPA approved methods. You can also contact local laboratories, college science departments, or your local EPA and DEQ offices.

Section D. Data Completeness:

The volunteer group must determine how much data they need to get accurate results. A good QAPP should include extra samples to act as a buffer in the event such as bad weather or if a sample is lost.

The best way to address this is to make a data completeness table. Here you will list the number of samples that you plan to collect and test for at each site. At the end of the sample year, you will compare the actual number of tested samples to the number you planned for. Since the group does not know the final tally of samples during the project is completed, you can leave the number of valid collections blank.

For the sample completeness percentage, the group should have a goal in mind. This will help determine the minimum number of samples you need to meet this goal. Depending on the sample size, most groups have a goal of 80 to 95% completeness. The volunteer group QA officer and the DEQ QA officer can help set this goal.

Step 8- Training Requirements and Certification:

For most groups, volunteers may not have a lot of knowledge of EPA or DEQ approved methods. Therefore, it is important for volunteers to receive training and certification. Even groups that have seasoned volunteers occasionally need retaining to reinforce sampling and test methods.

You can use the information from Step 10, Part A of a completed Monitoring Plan. Normally, most groups do training or recertification once each year. Include a brief summary of what the training session will include.

Example:

Every year, volunteers meet to receive training and recertification. Volunteers bring in their sampling equipment to check for wear. The QA officer calibrates sample team thermometers with an NIST certified thermometer. Sample team volunteers are tested, and if necessary, retrained to collect temperature, pH, and DO samples following the DEQ approved SOP. Sample teams properly dispose of expired reagents and given fresh reagents.

If you are unsure about the frequency and type of recertification you will need, please contact James Beckley at jebeckley@deq.virginia.gov or at (804) 698-4025.

Section A. Training Logistical Arrangements:

The purpose of this section of the QAPP is to outline the training necessary for various group members. Most training and certification should occur at least an annual basis. Some tests may require more frequent retraining or supervision.

For this section of the QAPP, the training schedule can be in a table format. In some cases, the volunteer group may wish to write out a description of the training. The group should include items such as what the training involves and how frequent the training should occur.

Section B. Description of Training and Trainer Qualifications:

This section is where the group will write out what the training program will involve. Please include who will do the training, what the training will cover, and how to demonstrate that volunteers learned from the training.

Example:

The group leader and QA officer will lead the training and recertification. Group volunteers will observe how to do the tests for pH, DO, and temperature and record the information correctly on the calibration sheet. Volunteers will then perform each test while being observed by the group leader or QA officer. If the volunteer makes a mistake, the observer will bring it to their attention and explain the problem. Once the volunteer is able to do the test correctly, the observer will sign off that they have passed training.

Step 9- Documentation and Records:

This step deals with how the volunteer group will record and store their data. Please also note the amount of time that the group will hold onto the data (usually 3 or more years) and who is responsible for keeping the data. In addition, please include a blank copy of the data forms mentioned below as an attachment.

- Raw data sheets
- Field sampling sheets or field logs
- Laboratory datasheets
- Calibration logs for probes and other calibrated equipment
- Chain of custody forms (normally used when sending samples to a lab)
- Any other quality control or data reporting sheets

Step 10- Sampling Process Design:

This deals with the actual monitoring project and pulls some information from earlier sections of the QAPP and the Monitoring Plan.

Section A. Rationale for Selection for Sampling Sites:

Here the volunteer group will identify sample site locations, and state why these are good sample sites. It is important to list any safety considerations for the sample sites. The group does not need to go into detail about how the samples are collected but they should reference a developed Standard Operational Procedure (SOP). A copy of the SOP should be included when submitting the QAPP.

It is helpful but not necessary to include a map showing the locations of the sample sites. If a map is not available, please be sure to include the latitude and longitude of the sample sites in a table. You can access a free mapping service by going to www.topozone.com to find latitude and longitude of sample sites. Please record the latitude and longitude from each site in a table and include this table as an attachment.

Section B. Sample Design Logistics:

This section is where the volunteer group will describe the details of their monitoring project. Some items covered under this section are the following.

- Monitoring parameters (Example: DO; pH; etc)
- Number of anticipated samples
- Frequency of sampling (Example: 1 sample per month, quarterly, etc.)
- Planned end date of sampling (Example: ongoing, December of 2007, etc.)

The best way to show this information is in a table format provided in the QAPP template. The table has separate sections to show physical, chemical, and biological parameters.

Step 11- Sampling Method Requirements:

Here the volunteer group will list specific details of the type of monitoring equipment or test procedures. If you are working with a laboratory, they can help you prepare this section.

The table provided in the QAPP template has three sections.

- Monitoring Parameters (DO; pH; etc.)
- Monitoring equipment used (YSI® DO 200 meter; etc)
- Test method used (EPA method 360.1; Virginia SOS; etc.) **Hint:** Visit www.nemi.gov to find methods for each parameter.

If you cannot find a method from www.nemi.gov or are using a method not familiar with DEQ, you will need to provide a description of the method in the QAPP. You can either list this under Step 11 or as an attachment. You should include the following:

- How a volunteer collects the samples
- What (if any) storage equipment is used to collect the samples
- Sample preservative (if any)
- Holding times for samples prior to analysis
- Any decontamination of sampling equipment necessary prior to collecting the next sample

Step 12- Sample Handling and Custody Procedures:

Note: If the group running the tests at the sample site, this section may not be necessary.

Volunteers that collect samples in the field to ship to a laboratory or given to another volunteer for analysis will need to develop a chain of custody procedure. This helps track down any shipping or storage problems with a sample. In addition, when using a laboratory, the lab needs to identify your samples from other samples they may receive at the same time. Many laboratories have their own chain of custody forms and can help you when preparing this part of the QAPP.

To develop your own chain of custody, you will need to write the shipping procedures for samples going to a laboratory. It is important to cover every step of the process from sample collection to arriving at the laboratory. These steps include sample collection, transport, storing, analyzing, and disposing of samples. There should be clear labels for each sample bottle and should, at a minimum, include the following:

Sample date/time:	Sample Location:	Sample number:
Preservative used (if any):	Sample collector:	Sample type:

In addition, a chain of custody should be on file. The volunteer can make the chain of custody form if the laboratory performing the analysis does not have one available. The chain of custody form should include at a minimum:

- The date/time of sample collection
- Who collected the sample?
- Date/Time sample was relinquished along with signature of both the sample collector and the shipping party
- A date/time of sample arrival to the laboratory along with the signature of the shipping party and the laboratory worker who received the sample.

Please include a blank copy of this form in the final copy of the QAPP.

Step 13-Analytical Methods Requirements :

In this step, please write out the test methods and specific equipment used to conduct the study. You can go to www.nemi.gov to find approved methods for water sampling. Please list these methods (i.e. EPA method 351.4).

If you are using a non-standard method, please describe the method or site and attach the procedure from the SOP of the volunteer group.

Step 14- Quality Control Requirements :

This is a critical section of any sound QAPP. Here, the volunteer group should describe they will ensure data reliability from using field equipment and laboratory procedures. The term Quality Control (QC) describes these steps. You can complete the following sections using a table or with a written description.

Section A. Field QC checks:

Under this section, the group must describe the methods used to test and/or collect field samples. Such descriptions include but are not limited to: taking multiple samples at the same location, field blanks, and split samples. Please refer to www.epa.gov/owow/monitoring/volunteer/qapp/qappch3.pdf for other field QC methods. If the group is using a non-standardized method, please write out the procedure.

Section B. Laboratory QC Checks:

Note: This section is not necessary for volunteer groups who are running tests only in the field.

Laboratories that test the group's field samples should be able to provide this information. You can attach this to the QAPP. If the group does not use a laboratory but runs tests away from the field, the group will have to complete this section. The group must write out the entire QC protocols in either a narrative or table form in this section. Again, refer to the web address listed in the section above for more information.

Section C. Data Analysis QC Checks:

If there is a problem in sample analysis or incorrect sampling procedures, it is important show how the group will correct the problem. In this section, please write out what steps the group will take to correct any problems.

Such examples include retraining of samplers, and rerunning tests with new reagents. Many other methods are available based on the problem you encounter. For the purposes of a draft QAPP to DEQ, general details for this section are acceptable.

Step 15- Instrument/Equipment Testing, Inspection, and Maintenance Requirements :

It is important to identify and fix equipment when it fails. To prevent equipment failure, there needs to be a regular maintenance and inspection schedule. The schedule should cover field and laboratory equipment, and sample sites.

In a narrative or table based format, the monitoring group must describe the following steps.

- Type of sampling or test equipment/instruments used
- Frequency of inspection for defects or damage
- Who will do the inspection and the inspection procedure
- How the equipment will be maintained during and after sample runs

For instruments such as pH probes, most instrument suppliers provide this information in the instrument manual. Please include a copy of this information when submitting the QAPP and in your SOP.

Step 16- Instrument calibration and Frequency:

Over time, the equipment used to take and test water samples will lose their accuracy. Regular calibrations will prevent this from occurring. For equipment such as pH probes, the user's manual should have this information. If a laboratory is testing samples, they should be able to provide their calibration information.

In a narrative or table format, describe the following:

- What equipment needs calibration
- How often the equipment needs calibration
- What standards or other instruments used to perform the calibration
- How and where calibration records will be stored for future review and reference

Step 17- Inspection/Acceptance Requirements for Supplies:

Data is only as good as the supplies used in collecting and running of the samples. These include sample bottles, reagents, and other items. Please write a brief description on how to inspect the sampling equipment. In addition, state what the group will do if they receive damaged equipment or other unacceptable equipment. For example, if there is expired pH buffer, the group can use the buffer for training purposes.

Step 18- Data Acquisition Requirements :

It is important to list any outside data sources used in developing the monitoring project. This will give credit for other groups work and help separate your data from another source. Such examples include:

- Use of USGS topographic maps
- Data from other monitoring groups
- Historical information
- Any other similar sources of data.

Step 19- Data Management:

This part of the QAPP deals with how the group will manage the collected data. In this step, please describe the resources that group used to record the data. Such items include the following:

- Type of data storage media (Example: CD R/RW)
- Computer operating system (Example: Windows® 2000)
- Data management programs (Example: Microsoft® Excel)
- Plan to check raw data sheets to the final database to ensure accurate and complete data entry

Step 20- Assessments and Response Actions :

In this step, describe how the group will evaluate field and laboratory sampling, data management, and group members. Here you would include some of the following procedures:

- Visits of sample teams in the field and laboratory members
- Sampling and testing review sessions with field and laboratory members
- Audits of test procedures and methods

The sample team leader and/or QA officer should lead all reviews under this step. In addition, there should be a mention on what the group will do if there are problems found with a sample team or testing procedure such as retraining. This should include who will administer the corrective actions.

Step 21- Reports :

Describe the types of reports, frequency of reporting, and to who will receive the reports. These reports include such things as quarterly progress reports, monthly sample results, internal assessments, audits, and the final report. Other reports are also possible based on the scope of the project.

Step 22- Data Review, Validation, and Verification:

Based on collecting and assessing the data, it is time to see if the data would be valid or rejected based on meeting the objectives set out by the QAPP. Please describe who is responsible in reviewing the data. Please include brief summary on how the person will do the review.

Example:

The QA officer and sample team leader review the data collected by the sample volunteers. Any questions with the data will be asked to the stream sampler and/or laboratory manager. If data is in need of correction, the QA officer and sample team leader will flag and document the data for future review. Decisions to reject data not meeting quality assurance will be done through agreement of the QA officer and sample team leader.

Step 23- Validation and Verification Methods :

The previous step of the QAPP dealt with who will be responsible for reviewing the data. This step covers the methods that the person will review and validate the data. Such examples include:

- Use of sample spikes and other QC steps as mentioned in *Part 14- Quality Control Requirement*
- Confirming computer-entered data with actual field sheets
- Ensuring proper filling out of chain of custody forms
- Equipment calibration frequency

Also, include a section discussing if the person finds errors in the data, how they plan to correct the errors.

Step 24- Reconciliation with Data Quality Objectives (DQO):

After completing the previous 23 steps, we are now at the last step in the QAPP. We are now at the final step of the QAPP development process!

In this final step, the group should describe if the data generated by the project met with the objectives of the project. The best way to do this is to compare and analyze the project data for completeness, accuracy, precision, representativeness, and comparability. Compare these items to those outlined in the preceding parts of the QAPP. If the data does not meet with the planned goals, describe how the group will correct the problem and why it occurred. Discarding of some data, revising the project DQO, or setting limits on how unusable data is acceptable in these situations. Please also state who will receive any data corrections.

Congratulations for completing the QAPP process! Remember that you can modify the QAPP at any time to adapt to new situations. If you wish to change your QAPP, please notify everyone in Step 1 and 3 to these changes.