9A1. Title and Approval Page

QUALITY ASSURANCE PROJECT PLAN
Fecal Coliform Bacteria Monitoring for the Warm Springs Watershed Project

Prepared for: USEPA

Prepared by:
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PO Box 68
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Participating Agencies and Organizations
Warm Springs Watershed Association
WV Department of Environmental Protection, Div. of Water and Wastewater Mgt.
Cacapon Institute

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A3. Distribution List

Timothy Craddock – WVDEP, Coordinator, Nonpoint Source Program
Neil Gillies – Cacapon Institute Science Director/Project Leader
Kate Lehman – Warm Springs Watershed Association (WSWA) President/Project Manager
Leo Essenthier – EPA Project Officer for WV

A4. Project/Task Organization

The individuals participating in the project and their specific roles and responsibilities are discussed below:

Leo Essenthier, EPA Project Officer for WV – Responsible for EPA review and submittal to the QAPP section for final review and approval of the QAPP.

Kate Lehman, WSWA Project Manager – The primary decision maker for the project and the primary user of the data to determine whether or not further action is required. Ms. Lehman's duties are:

- Overall responsibility for the investigation.
- Reviewing and approving the QAPP and subsequent revisions in terms of program.
- Reviewing reports and ensuring plans are implemented according to schedule
- Making final project decisions, with the authority to commit the necessary resources to conduct the project.

Timothy Craddock, WVDEP – Responsible for compliance with applicable regulations.

W. Neil Gillies, Science Director/Project Leader, Cacapon Institute – Coordinates the project activities. His specific responsibilities include:

- Assist WSWA in developing the QAPP.
- Coordinating field, laboratory, and data analysis activities.
- Conducting project activities in accordance with the QAPP and work order.
- Validating field data.
- Reporting to the WSWA Project Manager regarding the project status, per the work order, and preparing a final report to WSWA.

A5. Problem Definition/Background

Warm Springs Run (WSR) is located in Morgan County, West Virginia. It flows 10.8 miles north into the Potomac River. Warm Springs Run was listed by WVDEP on the

2012 303(d) list as impaired for fecal coliform bacteria, based on data collected by WVDEP in 2007 and 2009.

A Comprehensive Watershed Based Management Plan for Warm Springs Run was prepared by GeoConcepts Engineering Inc, in 2012: The report noted: "As can be seen from the data shown on Table 4, wide variation in values for fecal coliform colonies was observed throughout the sampling period. The data for August 16, 2007 showed a consistent high spike in the coliform data, starting well upstream at Mile Point 8.2, and extending along the entire length of the run. Historical meteorological data records show there was approximately 0.5 inches of rain the day the June 21, 2012 12018 Page 20 samples were collected; however, it is unknown whether this may have affected the reported fecal coliform test result." (Denton Jr, 2012)

The WSWA asked Cacapon Institute (CI) to conduct 'pre-TMDL monitoring' for fecal coliform bacteria. The purpose of monitoring is to gather additional data that will lead to a better understanding of the problem and the ability to make more informed decisions on areas that require particular attention for remediation. The monitoring and sampling project will also be used to improve the accuracy of the upcoming TMDL.

A6. Project/Task Description and Schedule

The purpose of this study is to augment the 2007/2009 WVDEP data that led to WSR being identified as impaired on the 2012 303(d) list for fecal coliform bacteria. Such information will provide a better understanding of the problem and also inform the pending TMDL source tracking study.

Exceedences of the fecal coliform standard -- (400 cfu/100ml), and the caution level of 200 cfu/100ml -- during the pre-303(d) monitoring period, which was done at five sites in WSR, were frequent. CI will sample seven (7) locations, in WSR and one tributary (Yellow Springs Run). These include the five original sites plus two additional sites in an effort to locate regions with consistent fecal coliform contamination.

Sampling locations will be based on results of previous sampling and local knowledge of conditions on the ground. Quarterly sampling will be done at these sites for one year, plus two episodically conducted storm-event sampling trips. Sampling will help determine if fecal coliform contamination remains an issue in WSR and, if so, may help find the source(s). One duplicate sample will be collected on each sampling trip. The working group may decide to add sites for source tracking and conduct less storm sampling.

Samples will be collected only at sites with public access and/or landowner permission.

A7. Data Quality Objectives for Measurement Data

The quality of field and laboratory data is extremely important for assessment of project impacts. Cacapon Institute is a West Virginia Certified Laboratory. They will perform field collections and laboratory analysis as laid out in the attached SOPs.

Comparability: The QAPP will help standardize the protocol for data measurement and collection, and will help ensure that the data collection is repeatable and comparable over time, in the event of personnel changes, or against data from similar projects.

Completeness: Cacapon Institute will perform field collections and laboratory analysis as laid out in the attached SOPs.

Quantitation Limits: Detection limits for fecal coliform bacteria are based on recovery of a single "colony forming unit" at the largest filtration volume.

A8 – Special Training/Certification

Cacapon Institute is a West Virginia Certified Laboratory, and will perform field collections and laboratory analysis as laid out in the attached SOPs. The project leader, trained in stream survey, data collection, laboratory analysis, and interpretation techniques, is responsible for assuring that the field assistants are trained to perform fieldwork. The project leader will conduct the training, and/or supplement and fine-tune any prior training the field assistant has had. This training includes the operation and appropriate use of field sampling equipment and laboratory equipment, and understanding the appropriate need for accuracy and quality control in data collection. Field assistants are required to be familiar with the QAPP and SSP. Assistants must demonstrate proficiency in performing laboratory analyses.

A9. Documents and Records

All documents will be stored electronically on the project leader's computer system, in project specific folders. Files are to be backed up daily. Project files are archived and kept indefinitely. Hard copies of field data, field notes, second-hand data, or print outs of on-going work will be stored in a file located on the CI premises. A copy of the approved QAPP will be electronically stored in CI's, WVDEP's, and WSWA's premises, and a hard copy will be retained in the project file. Major changes to the QAPP will be submitted to WVDEP for approval.

All field notes will be maintained by the project leader and field assistants. Copies will be kept with the file folder. Team members will retain the original copies. Field notes must be completed on-site at the time the data collection occurs. The minimum required information to be included is as follows:

- Project Name

- Company
- Sample Collector/Transporter
- Date
- Location of measurement
- Time of Day
- Weather conditions
- Any necessary notes or supplemental forms used

The records for this project will include miscellaneous correspondence, field data worksheets, laboratory analytical reports, and a final report. All reports will be submitted to the WSWA Project Manager. Field data worksheets will be prepared specifically for this project, and include space for the field data noted above. Any other pertinent observations or deviations from the procedures in this QAPP, deemed noteworthy by any member of the field team, will also be recorded in the field data worksheets. Field data worksheets will be used to record all field measurements. Each page of the field data worksheets will be dated and signed by the person making the entries.

B1. Sampling Process Design

The objective for this investigation is to collect fecal coliform bacterial water quality data for Warm Springs Run that will lead to a better understanding of the impairment and more informed decisions on areas that require particular attention for remediation. Sampling locations will be based on results of previous sampling during the pre-303(d) impairment monitoring period and local knowledge of conditions on the ground by the Project Team. The budget covers the costs of a total of four quarterly sampling trips, plus two storm sampling trips, with eight (8) samples (including one duplicate) per trip.

B2. Sampling Methods Requirements

Cacapon Institute is a West Virginia Certified Laboratory, and will perform field collections and laboratory analysis as laid out in the attached SOPs.

B3. Sample Handling and Custody Requirements

Cacapon Institute is a West Virginia Certified Laboratory, and will perform field collections and laboratory analysis as laid out in the attached SOPs.

B4. Analytical Methods Requirements

Cacapon Institute is a West Virginia Certified Laboratory, and will perform field collections and laboratory analysis as laid out in the attached SOPs.

B5. Quality Control Requirements

Cacapon Institute is a West Virginia Certified Laboratory, and will perform field collections, laboratory analysis, and associated QA/QC as laid out in the attached SOPs.

B6. Instrument/Equipment Testing, Inspection, & Maintenance Requirements

Cacapon Institute is a West Virginia Certified Laboratory, and will maintain instruments and equipment as laid out in the attached SOPs.

B7. Instrument Calibration and Frequency

Cacapon Institute is a West Virginia Certified Laboratory, and will maintain instruments and equipment as laid out in the attached SOPs.

B8. Inspection/Acceptance Requirements for Supplies and Consumables

Cacapon Institute is a West Virginia Certified Laboratory, and will treat supplies and consumables as laid out in the attached SOPs.

B9. Data Acquisition Requirements for Non-direct Measurements

Not applicable.

B10. Data Management

Field data sheets will be checked for completeness after each survey and at the end of each day. Field data sheets will be reviewed by the project leader each day. Any omissions or discrepancies will be handled immediately. Original field data sheets will be placed in the project file, along with any other pertinent site information. Refer to Section A9 for a more in-depth discussion on documentation and record keeping. Any secondary data will be stored in the project file, in either hardcopy or electronic format.

All data will be entered into a computerized spreadsheet program, designed for project needs. Basic computations (calculating the number of cfu/100 ml) will be done by hand. More complex calculations will be performed using Excel or a statistical program such as

SAS-JMP. All computer-generated documents will be inspected for validity, completeness, and accuracy by the quality control manager and project leader.

All project files will have a unique file name including the project number and name. Paper files will be maintained in a secure filing cabinet. Electronic files will not be modified without proper authorization. Inactive files are archived, and once archived they are changed to read-only status.

C1. Assessment and Response Actions

The project leader will monitor and address all activities of the data collection process. Field assistants review field techniques as needed and have a review performed by the project leader annually. Data collection methods are standardized and the reporting method is consistent. The quality assurance manager will ensure that field team members are performing all data collection as prescribed by the quality assurance project plan. All field activities may be reviewed and project sites may be visited by EPA quality assurance officers as requested.

C2. Reports to Management

The following documentation, as applicable to the project, will be presented at the end of data collection and analysis: sampling site locations and a final project report will be submitted when the project is finished.

D1. Data Validation and Usability

The project QA manager will review all data collected as well as subsequent calculations to evaluate whether QC requirements have been met and whether data are usable to obtain the stated objectives of the project based on criteria contained in the QAPP. Subsequent final review and approval will be made by the project leader.

Data will be accepted if they meet the following criteria:

1. Field data sheets are complete.
2. Field data and laboratory data were validated
3. Actual sample locations and collection procedures match the proposed sample locations and collection procedures identified in sections B1 and B2, respectively.
4. Any deviations from the QAPP are to be reported in the field activity report or analytical data report and the analytical data report will include the information described in section A9. The CI project leader will verify the content of these reports.

If the data fails to meet the criteria, they will be flagged by the WSWA project manager.

D2. Data Validation and Verification

Field data are submitted to the project leader and QA officer. The QA officer reviews all field data for completeness. The project leader makes sure that any questionable data are verified by speaking to the sampling personnel, and noting any unusual or anomalous data in the project files. Any decisions made regarding the usability of data will be ultimately left to the project leader, however the project leader may consult with the QA officer, project personnel, WSWA, and WVDEP QA staff.

When it is found that data do not meet the quality objectives from Section A7, or do not adhere to the quality control measures from Section B5, the project leader manager may determine what corrective action must be taken.
In the case of incomplete data, or if data quality is poor, the project leader will apply one of the following actions.
1. Systems audit for measurements in question;
2. Immediate on-site re-survey of the measurements in question; or
3. Rejection of data with a written explanation.

The Cacapon Institute project leader will validate the field data. Any problems identified during this process will be reported to the WSWA project manager in the field activity report.

D3. Reconciliation with Data Quality Objectives

Data will be generated based on the quality objectives defined in Section A-7 and verified according to Section D2. Limitations in the data will be clearly defined for potential end users in all reports produced. If the project objectives from Section A7 are met, the user requirements have been met. If the project objectives have not been met, corrective action as discussed in Section D2 will be established by the project leader(?).

Literature Citations

Denton Jr,.Robert K. 2012. Comprehensive Watershed Based Management Plan for Warm Springs Run. A Potomac Direct Drains Watershed. Morgan County, WV. Prepared by GeoConcepts Engineering Inc. for Warm Springs Watershed Association on June 21, 2012.

PCREL SAMPLING AND LABORATORY

STANDARD OPERATING PROCEDURES

QUALITY ASSURANCE PLAN
AND OPERATOR INSTRUCTIONS

Cacapon Institute
High View, West Virginia 26808

I. COVER SHEET

Quality Assurance (QA) is a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and defensible quality. It specifies the measures used to produce data of known precision and bias. That is, the accuracy of the analytical result can be stated with a high level of confidence.

A laboratory (QA) program is the orderly application of the practices necessary to remove or reduce errors that may occur in laboratory operations, as caused by personnel, equipment, supplies, sampling procedures, and analytical methodology.

For additional guidance and technical information see Standard Methods, 18th ed., 1992 and Hach's Water Analysis Handbook, 2nd ed.

Plan Approval:

W. Neil Gillies, Director: _____

Date: _____

II. STAFF ORGANIZATION AND RESPONSIBILITIES

Personnel, Title, Job Description, Tenure and Qualifications

I. A. W. Neil Gillies

B. Science Director, Lab Supervisor

C. Oversee scientific activities of lab, verify systems, check work periodically, help when problems arise

D. Nine years tenure

E. 1. Educational Degrees -- M.S. Environmental Systems, Florida International University, B.S. Biology University of Miami

2. Training for job -- extensive work as Research and Consulting Scientist, as well as Lab courses in Biology, Physiology, Chemistry thru Organic and statistics

3. Experience at Job -13+ years experience in turbidity analysis, 9 years experience at microbiological and nutrient chemistries.

Organizational Chart:

W. Neil Gillies, Science Director, Laboratory Manager, Sampler/Analyst

III. SAMPLE CONTROL AND DOCUMENTATION PROCEDURES.

Permits tracing a sample and derivatives through all steps from collection to analysis and reporting of results. Sample control and documentation procedures are presented here and integrated with Standard Operating Procedures (Part IV).

A Chemical and Physical Analysis Bench Sheet is prepared for each water sample and each QC sample. For field programs requiring more than two daily samples, a single daily sheet may be prepared for that days multiple samples - required data fields are the same. Each separate project has a distinct series of sampling number sequences, recorded in separate project Sampling Log Books. Data fields to complete are:

A. Sample number
B. Date and time
C. Analysis result for specific test (see SOP manual for each parameter)
D. Reagent Lot #, equipment utilized, or Scale used as appropriate
E. Analyst name/initials.

When complete, each Chemical and Physical Analysis Bench Sheet is filed in Bench Sheet File.

To track the number of samples processed for each certified method (for QA/QC purposes), each certified method analysis is recorded in a "virtual" Procedure Log Sheet in the appropriate computer QA/QC file, in which the unique site name, date and time of collection are recorded sequentially each time the procedure is performed; this log sheet is in a computer data file.

IV. STANDARD OPERATING PROCEDURES

A. Sample Collection

1. Sample containers are 200-250 ml plastic bottles for water chemistry samples, and sterile Whirl-Pacs tablet for microbiological samples. Water chemstry sample bottles are washed in the laboratory using tap water, followed by one distilled water rinse. Bottles are stored at least ¼ filled with distilled water.

2. Wash and rinse hands prior to handling any sample containers. If this is not possible, wash hands in river immediately downstream of sampling site.

3. Record sample number and data on Site Data Sheet. The sample number indicates river, kilometer and date, e.g. the sample number for Cacapon River at kilometer 75.3 on August 11, 1993 was CRkm75.3-081193.
   a. Time.
   b. Exact sampling site and depth, e.g. 5 meters upstream of Rt. 259 bridge. River monitoring samples are collected midstream in a riffle, 6 inches below surface when possible.
   c. Number of sample bottle.
   d. Collector's name, e.g. "G. Constantz, collector".

4. For a water column sample, walk or boat to site, facing into current to avoid collection of disturbed water. Exact site should be in current, not an eddy. If the site is not wadeable due to depth or turbidity (or some other restraint), the sample may be collected using a sampling device that extends from shore or a bridge as far into the stream flow as possible.

5. Water Chemistry Samples.

   a. Open collection bottle without touching bottle mouth or inside of cap and so that water dripping off hands cannot land near bottle mouth or cap.

   b. Rinse out bottle and cap 3 times with water from exact sampling site as follows:
      1. Plunge inverted bottle and cap to desired depth (6 inches for routine river sampling, without disturbing bottom). Neither surface water nor bottom sediments are desired.

2. Turn bottle and cap upright under water and allow to fill. Bottle and cap should be held upstream of hands. Bring both out of water and empty downstream.
3. Rinse a total of three times before collecting sample.

c. Using procedure in step 6, immerse bottle and cap to desired depth and allow to fill with no air bubbles. Cap bottle firmly while immersed at filling depth.

d. Place bottle into an insulated container with ice in bottom. This cooler is to be cleaned prior to starting field work.

6. Fecal Coliform Bacteria samples are collected in sterile Whirl-Pacs. See Fecal Coliform Bacteria procedures manual for details.

B. Transport sample to Laboratory stored on ice. Chemistry samples must be analyzed within 24 hours of collection, or preserved as required by the USEPA to extend the holding time to the maximum allowed for the procedure. Fecal coliform bacteria samples must be processed within 6 hours of collection.

C. Lab documentation and activity log. See Chemical and Physical Analyses Bench Sheet, Figure 2.

D. **Basic Lab procedures**. The following narrative describes general laboratory procedures. Parameter specific procedures discussed in each Parameter QA/QC manual.

1. Use sterile technique throughout. Wash benchtop with either soap solution or 3% bleach solution, and wipe dry. Wash and dry hands.

2. Record lot/batch numbers of reagent packets on bench sheet. Use packets from same batch for blank and sample.

3. Order of procedures: 1. turn on turbidimeter and spectrophotometer for at least a 15 minute warmup period. Procedures may be conducted in any order consistent with maximum holding times for each method. As a practical matter, bacterial analyses will usually be performed first due to the short method holding time. Of the chemical procedures, reactive phosphorus is the parameter most likely to change with time and should be done first.

4. Glassware washing techniques for spectrophotometer procedures.
   a. Prior to beginning each procedure, rinse spectrophotometer cuvettes and reaction vessels (if other than cuvette) with hydrochloric acid, followed by two rinses using commercial grade distilled water, one rinse using laboratory grade demineralized water, and a final rinse using a small amount of sample water.

5. Clean the outside of cuvettes by first wiping with a damp KimWipe, followed by a dry KimWipe. (Kimwipes are dust-free non-abrasive absorbent wipes.) Visually check the outside for smudges or any sign of visual distortion. It is imperative that the cuvettes be absolutely clean prior to inserting them into the spectrophotometer. Never touch front or back of a cuvette except with a Kimwipe.

6. Place cuvettes into spectrophotometer with numbers facing left, then close the light shield.

7. Record result on bench sheet.

8. If an analysis exceeds detection range of analytical method, dispose of waste solution, clean glassware, and repeat analysis with a dilution of the sample in laboratory grade deionized water. Suggested first dilution is 1/10 (1 part sample: 9 parts deionized water). Analyze as dilute a solution as is necessary to obtain a result within the detection range of the analytical method, and multiply by appropriate dilution factor to obtain test results in undiluted sample. (For example, if sample was diluted to 10%, to convert to actual concentration multiply result by 10.)

9. Dispose of waste. See section XII.

10. Clean glassware.

11. Store bench sheet in Bench Sheet File.

V. TECHNICAL COMPLAINTS

If a client or regulatory personnel informs the Lab that a result is questionable, the Lab will check the data paper trail as follows: data on computer file (if applicable), data on worksheet, calculations for that test, QC history for that test and the operator in question.

If no error can be found and the client or regulatory personnel still have reason for concern, the lab will re-run the test on a newly acquired sampled. The new sample must be collected at a time when the field conditions are comparable to the field conditions at the time the original sample was collected.

VI. RECORD KEEPING AND RECORD STORAGE

All recordkeeping will be done in ink.

Laboratory supplies are dated on receipt, and dated of opening if the contents of the package are not completely utilized on the date opened. The date will be recorded on the supply container and each procedure's QA/QC Log.

Field data and raw test data are recorded in ink on the field and laboratory worksheets by each operator. Any corrections made on the worksheets will be made as follows: 1. incorrect entry is marked out with a single line that does not obscure the original notation; and 2) the new entry is recorded in ink as close as possible to the original entry. These worksheets are kept on permanent file and can be rechecked.

If dilutions of the sample are required, note dilution factor on the bench sheet and arithmetic operations to obtain correct measurement. As noted in the SOP, this result is recorded in ink on the benchsheet.

Final reports to clients are typed in duplicate, with one copy for the client and one to be kept on permanent file at the Laboratory. Reports will be mailed at the interval requested by the client. Clients will be informed of their results by phone on completion of the test, if requested. Separate laboratory files will be kept for each calendar year.

Records will be stored so that they can be easily retrieved upon request by clients or regulators. The Lab may archive results more than five years old, at the discretion of the Lab Manager.

VII. INTERNAL QUALITY CONTROL ACTIVITIES (QC)

A. Maintain Quality Control records for each Certified Procedure as a component of the Procedure Log Sheet. The "Logbook" is in a computer database with appropriate fields of information. Each QC sample and QC action is logged. The following information is recorded:

1. Date and time.

2. QC sample number. If the QC sample is collected as part of an ongoing project, the sample number will be the unique site name plus the date and time stamp of collection. Otherwise, the number will be source of water plus the unique date and time stamp of collection.

3. Nature of QC sample.
   a. Sterile distilled water (blank or known negative).
   b. Known addition (spike).
   c. Duplicate or split sample.
   d. Multiple analysts, parallel known nitrate spikes.

4. Source of QC sample, such as river sample number or manufacturer, stock number, description, batch number and expiration date. Examples:
   a. Hach nitrate spike solution, including batch # and known concentration.
   b. Duplicate river sample.
   c. Commercial distilled water, brand name, packing date.

5. Record result of QC procedure in QC Logbook/computer database. If QC indicates a problem, so note and notify Science Director. The Science Director will interpret QC result and make corrective actions.

B. Blank Analysis.

1. Analyze a **Trip Blank** once during the cool/wet season and once during the warm/dry season. Trip blank procedure is as follows:
   a. Use the same techniques and supplies and apparatus for the blank as are used for all other samples.
   b. Rinse a sample bottle twice with commercial distilled water, and once with lab grade deionized water. Fill sample bottle with lab grade deionized water (HACH Deionized water (Cat#272-56)). Assign a QC sample number from the Quality Control Log.
   c. Insert the bottle into the usual transport container and transport the sample to the lab, leaving the sample in the container for a typical amount of time (1 to 6 hours).
   d. Analyze the trip blank using the same techniques, supplies and apparatus for the blank as are used for all other samples (Procedure IV-D).
   e. Result should equal the analytical result of a sample prepared in the laboratory from the same deionized water source.
   f. Record results (NTU) in Quality Control Log.

2. Analyze a **Field Blank** once during the cool/wet season and once during the warm/dry season. Field blank procedure is identical to the above Trip Blank procedure, except the field blank sample bag or bottle is filled while standing in the river, while the trip blank sample bag can be filled at the car. Record results in Quality Control Log.

C. Procedure specific blank analysis. Refer to QA/QC manual for each procedure

D. Analyze a known addition (spike) for at least 5% (≥1 out of 20) of the samples analyzed for each certified parameter. Procedure is identical to each parameter's basic SOP except that the sample is "split" for dual analysis. The first split is run as always to determine the existing concentration of the parameter in the sample. The second split is analyzed after adding a known amount of the parameter, using a standard concentration traceable to NIST standards, is added to split. Spike procedure is as follows:
   a. Use same techniques, supplies, and apparatus for spikes as used for all other samples.
   b. Using the Hach 0.1 to 1.0 ml TenSette Pipette (or other pipetting device with comparable accuracy), transfer a known volume of Standard Solution to a properly cleaned (See each parameter QA/QC Manual) dilution vessel. Fill the dilution vessel to the required volume with sample, and mix well. Refer to each parameters QA/QC manual for specific information.
   f. Record results in Quality Control Log, indicating source of sample, date collected, analyst, sample size, concentration of parameter in unspiked sample, measured

concentration increase in spiked sample, expected concentration increase, and percent difference between the expected and actual increase. Splits are labeled S1, S2, S3, etc.

g. Results should be 80 to 120 % of known concentrations, as described in Standard Methods 1020.B.2, Table 1020:I. If results are less than 80% or greater than 120%, notify Laboratory Manager, determine source of error, and take necessary corrective current and retroactive action.

E. Multiple analysts, parallel known additions (spikes). When multiple analysts are working, both should process samples with known concentrations of the parameter being measured on the same sample biannually, independently and within a few hours of each other. Procedure is identical to V.B.2 (complete) except that each known addition is prepared in a volume of 100 ml in a Class A volumetric flask so that each analyst analyzes an aliquot of the same solution.

a. Record results in Quality Control Log for each analyst. Splits are labeled S1, S2, S3, etc.

b. Results should be 80 to 120 % of known concentrations, as described in Standard Methods 1020.B.2, Table 1020:I. If results are less than 80% or greater than 120%, or if the two operators' results vary by more than 25%, notify Director, determine source of error, and take necessary corrective current and retroactive action.

F. Analyze duplicates of $\geq$ 5% of samples (at least 1 out of 20 samples) for assessment of precision. Analyze splits annually for assessment of precision. ("Splits" and "duplicates" are similar, differing only in that for a split, one sample is collected and then processed in duplicate [split] in the lab, whereas for a duplicate, two samples are collected at the same site under as identical conditions as possible. The two terms are used interchangeably in Standard Methods, but not in this document. Another term for duplicate is replicate.) Duplicates are analyzed to determine precision, variability in Parameter concentrations in the field and because sampling technique is included. Each parameter's SOP from Section IV-D is followed independently for each duplicate sample.

a. Record results in each procedure's Quality Control Logbook to determine method precision. Duplicates are labeled D1 and D2. Splits are labeled S1, S2, S3, etc. If multiple analysts are performing splits, add each analyst's initials to the QC record.

b. Compare results of duplicate analysis against precision control charts (Section VII). If results exceed the control limits, refer to the Laboratory Manager for further instructions.

G. The spectrophotometer shall be calibrated yearly using manufacturer's field calibration filter.

H. Turbidimeter is to be kept covered at all times when not in use. Perform complete calibration of Turbidimeter twice per year, or when readings on Gelex Secondary Standards vary by more than 5% from recorded value. For more information refer to Turbidity QA/QC Manual.

I. All laboratory and field thermometers must be checked annually against a NIST Certified thermometer. Digital thermometers must be calibrated at least quarterly against a NIST Certified thermometer or a glass mercury thermomter that has been checked against a NIST Certified thermometer in the past year.

J. Cuvette matching. Compare matched cuvette pairs biannually. Cuvettes are purchased in factory-matched pairs, identified by large identical numbers on their collars. Cuvettes can become mismatched due to nicks and scratches during handling. Use following procedure to check for optical matching.[1]

1. Select spectrophotometer constant-on (absorbance) mode. Allow 5 minutes warm-up time. Press 0, then Read/Enter. The display will read "Abs".

2. Set wavelength to 400 nm.

3. Pour 25 ml distilled water into each matched cuvette.

4. Clean and dry cuvettes with Kimwipes.

5. Place first cuvette into spectrophotometer with numbers facing left. Close cover and press Zero. Display will show 0.000.

6. Place second cuvette into spectrophotometer with numbers facing left. Close cover at wait at least 3 seconds for reading to stabilize.

7. If second cuvette reads zero, repeat, zeroing second cuvette first and then reading first cuvette.

8. Record cuvette numbers and result in Quality Control Logbook.

9. The two cuvettes should match within $\pm$ 0.002 Abs. If they do not, rotate them 180 degrees and re-read.

10. If the two cuvettes do not match within 0.002 Abs, they may still be used by compensating for the difference.
    a. Label lower-absorbance cuvette "B", and higher one "S".

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1 . Hach Water Analysis Handbook, 2nd ed., 1992, Hach Co., Loveland, Colorado, p27.

b. Always use "B" cuvette for blanks and "S" cuvette for samples.
c. To determine effect of mis-match on nitrate readings, set spectrophotometer on nitrate MR program (press 353 and Read/Enter).
d. Press Shift/Timer 7 just as though you were running a sample. Wait the 1-minute period, press Shift/Timer 7 again and wait through 5-minute period.
e. Insert "B" cuvette and press Zero.
f. Insert "S" cuvette and press Read/Enter. The display will show cuvette absorbance mis-match converted to content of nitrogen N (14) as NO_3^- in mg/L H_2O. This value should be subtracted from future sample readings.
g. Although this compensation procedure is technically correct, it is recommended that a new pair of matched cuvettes be purchased if current pair exceed 0.002 Abs difference.

VIII. CORRECTIVE ACTIONS

If QC indicates a problem, so note and notify Director. The Director will interpret QC result and make corrective actions. Such actions may include training in sterile technique, invalidation of current sample or a range of previously-analyzed samples, replacement of media, or other actions appropriate to specific QC indications.

IX. DATA ASSESSMENT FOR BIAS AND PRECISION: CONTROL CHARTS

Prepare control charts to assess sampling and laboratory procedures for variability and precision (using duplicate samples), accuracy (using spiked samples), and bias according to Standard Methods, 18th Edition.

X. DATA REDUCTION

Refer to each parameter's QA/QC Manual for information.

XI. DATA REPORTING STANDARD UNITS

Report data using standard units. Refer to each parameter's QA/QC Manual for further information.

XII. ANALYST TRAINING REQUIREMENTS AND CERTIFICATION OF OPERATOR COMPETENCE.

A. Operator should demonstrate acceptable single-operator precision and bias on a minimum of 4 check sample analyses run in duplicate as a "split" (one sample container with

sufficient sample volume for two separate analyses, as in section V.B.3) with the Director or other certified operator. See specific methods for details

B. The operator's results should be 80 to 120 % recovery of known concentrations, and ± 25 % of certified operator's results, as described in Standard Methods 1020.B.1, Table 1020:I.

XIII. EQUIPMENT PREVENTIVE MAINTENANCE (PM) PROCEDURES.

A. Clean incubators and COD Reactor monthly.

B. Cover turbidimeter, spectrophotometer. Clean if necessary.

XIV. WASTE DISPOSAL

A. Excess (unreacted) river water sample may be disposed of in sink or outdoors.

B. Refer to each parameter's QA/QC Manual for further information. The Lab will periodically dispose of regulated wastes through an authorized waste handling facility.

XV. PERFORMANCE AUDITS.

Unscheduled performance audits are conducted at discretion of the Director, and use a checklist to document the manner in which a sample is treated from time of collection to reporting of final result, with the goal of detecting any deviation from standard operational procedures, to enable corrective action. See Figure 3.

XVI. EXTERNAL QUALITY CONTROL (QUALITY ASSESSMENT)

Cacapon Institute is periodically inspected and certified by the West Virginia Division of Environmental Protection for acceptable laboratory procedures.

QUALITY ASSURANCE PLAN
AND OPERATOR INSTRUCTIONS
DETERMINATION OF FECAL COLIFORM BACTERIA
MEMBRANE FILTRATION TECHNIQUE
Cacapon Institute
High View, West Virginia 26808

I. COVER SHEET

Quality Assurance (QA) is a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and defensible quality. It specifies the measures used to produce data of known precision and bias. That is, the accuracy of the analytical result can be stated with a high level of confidence.

A laboratory (QA) program is the orderly application of the practices necessary to remove or reduce errors that may occur in laboratory operations, as caused by personnel, equipment, supplies, sampling procedures, and analytical methodology.

For additional guidance and technical information see Standard Methods, 18th ed. (Section 9000), 1992, Hach's Water Analysis Handbook, 2nd ed. P. 254, and Cacapon Institute's Sampling and Laboratory Standard Operating Procedures.

Plan Approval:

W. Neil Gillies Director : _____

Date: _____

II. STAFF ORGANIZATION AND RESPONSIBILITIES

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures

III. SAMPLE CONTROL AND DOCUMENTATION PROCEDURES.

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures. Method specific procedures follow:

A. Laboratory bench sheet, specific to this method, is used to record laboratory data. The result of analysis is then transfered to the project bench sheet.
B. Record lot numbers for m-FC with Rosalic Acid growth medium, and lot or batch numbers for dilution/rinse water.
C. Record temperature of incubator on the incubator temperature log daily when in use.
D. To track the number of samples processed using this procedure for QA/QC purposes, record the unique sampling site name, date and time of collection in the Procedure Log Sheet in the appropriate computer QA/QC file..

IV. STANDARD OPERATING PROCEDURES for Determination of Fecal Coliform Bacteria using the Membrane Filtration Method

Fecal Coliform Bacteria are determined using the Membrane Filtration Method by filtering a known volume of sample through a 0.45 micrometter filter, transfering the filter to a petri dish containing a selective growth medium, incubating the petri dish at a selective temperature, and counting the number of resulting colonies.

A. Sample Collection. See Cacapon Institute Sampling and Laboratory Standard Operating Procedures. Method specific procedures follow:
    1. Sample containers are 207 mL Sterile Whirl-Pak Bagswater sampling for collecting non-chlorinated water for bacteriological analysis.
    2. When possible, wash and rinse hands prior to handling sample bags, or wipe hands with an alcohol swab. If this is not possible, wash hands in river immediately downstream of sample collection site.
    3. For a water column sample, walk or boat to the site facing into the current to avoid collection of disturbed water. (If water conditions do not allow wading, collect water sample from the shore or a bridge using a sterilized collected bottle mounted on a remote sampling device. Transfer the water sample to the Whirl Pak sampling bag as below.)
    4. Tear off the bag's top strip, but do not yet open the mouth of the bag.
        a. Be careful not to touch the to-be-opened edge of bag.
        b. If your hands are wet, hold the bag so that water dripping off your hands cannot land near the to-be-opened edge.
        c. Grasp the two short white opening tabs at the center of the bag's to-be-opened edge, one tab in each hand.
        2d. Immerse the bag, upright, passing promptly through the surface to the desired depth (6 inches for routine river sampling, without disturbing the bottom).

Surface water is not desired.

e. Point the bag opening into the current and pull the bag open with the opening tabs.
f. Fill the bag. In slow current this may require pulling the bag through the water.
g. Close the bag mouth and remove it from the water.
h. The bag should be full to the fill line, with about 1" of air at the top. Squeeze out excess water.
I. Twirl the bag to seal it and bend each tab over once.
j. Place the sample bag on ice in a wide-mouth Thermos or other insulated container to lower temperature and protect it from puncture.

B. Transport the sample on ice to the Laboratory. Samples should be protected from severe agitation and chilled on ice to 4 ºC until ready for processing. Processing of samples must begin within 6 hours of collection.

C. Lab documentation and activity log. See Chemical and Physical Analyses Bench Sheet, Figure 2, and Cacapon Institute Sampling and Laboratory Standard Operating Procedures.

D. Perform membrane filtration for fecal coliform bacteria technique (Standard Methods and Hach Water Analysis Handbook page 254-264).

1. Membrane Filtration for fecal coliform bacteria analysis apparatus and supplies:
   a. Millepore Dual Chamber Incubator, Cat# XX63 LK1 15, , capable of providing a constant incubation temperature of 44.5 oC $\pm$ 0.2 oC
   b. 1. Hach buffered dilution water, APHA sterile, 99ml, Cat#14305-72/98, or
   2. Sterile buffered water prepared in laboratory using reagent grade water (Hach Cat #272-56) and Magnesium Chloride Pillows and Potassium Dihydrogen Phosphate Pillows (Hach Cat# 21431-66).
   c. All American Electric Pressure Steam Sterilizer Model #25X
   d. Growth medium, PourRite m-FC/Rosalic Acid Broth Ampules (Hach Cat# 24285-20)
   e. Petri Dish, 50 x 9 mm (Hach Cat#14852-99)
   f. Pure Cellulose Fiber Filter Pads, Sterile, 47mm, (Gelman Cat#66025)
   g. 47 mm, 0.45 micron white gridded, sterile filters, (Gelman #66278)
   h. Magnetic Filter Holder, (Hach Cat# 13529-00)
   i. Hach Tensette Pipette 1.0 to 10.0 ml with disposable, sterile pipette tips or, alternatly, Hach Sterile Serological Polystyrene Pipette Cat#2097-98.
   j. Hach Tensette Pipette 0.1 to 1.0 ml with disposable, sterile pipette tips.
   k. Binocular dissecting microscope, 10-20X, with light source.
   l. Dilution/rinse water bottles, 200 ml. Transparent, autoclavable, polysulfone wih linerless polypropylene cap, molded in 90- and 99-mL marks for serial dilutions.
   m. Vacuum Pump, Hand Operated (Hach cat#14283-00)

   NOTE: The following supplies are used for colony confirmation

   n. Laurel tryptose liquid medium MPN tubes, concentrated, APHA sterile, for potable water and wastewater testing, Hach catalog number 21014-15, 15 per pack.
   o. E.C. Medium MPN tubes, APHA sterile, for potable and wastewater testing,

Hach number 14104-15, 15 per pack.

p. Hach bacterial incubator models 45900-00 and 15320-00, 115 v AC.

q. Hach wire innoculating loop #21121-0

r. Equivalent alternate supplies may be used with Director's approval. Such use must be noted on the Bench Sheet.

2. Preparation of sterile dilution/rinse water (if not using Hach Cat#14305-72/9):
   a. Add one Magnesium Chloride Pillow and one Potassium Dihydrogen Phosphate Pillow (Hach Ca# 21431-66) to 1000 ml of laboratory reagent grade water (Hach Cat #272-56)
   b. Pour above solution into a series of dilution bottles. Cap loosely. If to be used for rinse water, fill to within 1/2" of top. If to be used for serial dilutions, fill to either 90 or 99 ml mark (according to needs).
   c. Attach sterilization indicator tape to each dilution bottle, write the current date on the tape, and sterilize at 121 ^{o}C for 30 minutes for each 1000 ml to be sterilized. Record date, time and temperature of sterilization on Sterilizer Log Sheet.
   d. After cooling, tighten caps and store in cool, dark location.

3. Sterlization of filter apparatus. Attach sterilization indicator tape to filter apparatus, write the current date on the tape. Sterilize at 121 ^{o}C for at least 15 minutes. Record date, time and temperature of sterlization on Sterilizer Log Sheet.

4. Turn on Millepore Dual Chamber Incubator at least 24 hours prior to test, to allow temperatures to stabilize.

5. Prepare data sheet and mark filtration volumes of each sample (see attached bench sheet for further information).

6. Use sterile technique throughout. Wash benchtop prior to analysis with 2% chlorine solution or soap and water, and wipe dry. Wash and dry hands.

7. Record lot/batch numbers of growth medium and rinse/dilution water on bench sheet.

8. Layout a small beaker of ethyl or isopropyl alcohol to flame forceps.

9. Layout a minimum of 3 petri dishes per sample station (for 3 different filtration volumes) unless it is a preliminary survey station, in which case set out one or two, as necessary. In addition, beginning in the year 2001, following a prolonged period of time where the bacteria counts at regular sites were consistently below 20 cfu from a 30 ml volume filtration, the decision was made to begin “screening level” filtration at 30 ml only at all sites with a history of low numbers. The regular 3 filtration volumes would be used for all contract work, or for regular sites when conditions warrant. Set out one petri dish each for a preliminary and finishing sterile control check (blanks) using sterile rinse water for each filtration series. This check is to determine the sterility of the media, rinse water, supplies, equipment and technique.

10. Mark culture dishes for each sample and the control blanks, with sampling site and filtration

volume. Preliminary blank to be marked B1, finishing blank B2.

11. Remove petri dish cover. Place one filter pad in petri dish using the pad dispenser. Dispense the first pad out of the dispenser each day into the garbage.

12. Using an ampule breaker, break the top off a m-FC/Rosalic Acid broth ampule, and dispense into one petri dish. Pour off any excess broth. Replace petri dish cover.

13. Set up filtration apparatus. Use a flamed forceps to place a pre-sterilized membrane filter on the filter support. Attach magnetic funnel to filter support. (Note: if this equipment has been used for a series of filtrations and left unattended for 30 minutes or more, the filter assembly must be resterilized in boiling waer for at least 5 minutes.)

14. First filter a control sample using 100 ml of rinse water. Label this B1. Follow procedure in 17,18,19 below, then place new filter into filtration assembly prior to starting sample series.

15. Shake sample container up and down vigorously 25 times.

16. Add 10 ml of rinse water to funnel (if filtering less than 20 ml of sample). Using a sterile pipette, pipette the desired sample size and add to funnel. Swirl the funnel assembly to distribute the sample throughout and apply vacuum. Provide three 20 ml rinses, washing the funnel wall thoroughly. Turn vacuum off completely beween rinses.

17. Remove funnel assembly.

18. Flame forceps and, after releasing vacuum, remove membrane filter.

19. Remove cover from petri dish and, holding dish labeled for the correct sampling site and filtration volume at an angle, roll the filter onto the pad preventing wrinkles or air bubbles from occuring under the membrane filter. Replace cover.

20. Repeat steps 15 - 19 for each sample filtration volume and each sample until all samples have been plated.

21. Complete series by filtering 100 ml of sterile rinse water as the final control blank. Label this B2.

22. Invert dishes and place in incubator. All prepared cultures are to be placed in the incubator within 30 minutes after filtration.

23. Leave inverted dishes in incubator for 24 $\pm$ 2 hours.

24. Afer 24 $\pm$ 2 hours, remove dishes from incubator. Count within 20 minutes.

25. Remove lid and place dish under microscope and examine at 10X to 20X magnification.

26. Count all characteristic blue colonies whether they are entirely blue or partly blue. (Cream or grey colonies are not fecal coliform.) Colonies are counted individually, even if they are in

contact with each other.

27. Proper dilutions should produce counts of 20-60 fecal colonies per filter. See membrane filtration bench sheet for suggested dilutions.

28. Record results in the proper columns.

29. Check the controls for fecal growth. Equipment or media contamination would be indicated by at least one blue colony on the before control. Incomplete rinsing contamination would be indicated by at least one blue colony on the after control.

30. Calculations. Indicator organism levels in water samples are expressed as the number per 100 ml. See the membrane filtration bench sheet for calculations.

31. Dispose of waste material per Section XIV below

32. Wipe counter top and any other areas that came in contact with the bacteria sample.

33. Wash used dilution bottles and filter funnel apparatus in preparation for future reuse after sterilization.

34. Store bench sheet in Bench Sheet File.

V. TECHNICAL COMPLAINTS

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures

VI. RECORD KEEPING AND RECORD STORAGE

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures

VII. INTERNAL QUALITY CONTROL ACTIVITIES (QC)

A. Maintain Quality Control Logbook for Membrane Filtration Method of determining fecal coliform bacteria. Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures. Method specific procedures follow:
   1. Medium vitality, known positive.
   2. Routine analysis of sterility of rinse water, media, and equipment (see Section IV.D.9.

B. Blank Analysis. Trip and Field Blanks. Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures. Method specific procedures follow:

   1. Use the same techniques and supplies and apparatus for the blank as are used for all other samples.
   2. Fill sample bag with sterile dilution water prepared in the laboratory according to Section IV.D.2. Assign a QC sample number from the Quality Control Log.

C. Known negatives are processed as part of the daily sampling routine. Only note in QC

Logbook when a batch fails this test. Otherwise, the notation on the daily bench sheet will serve as documentation.

D. Analysis of known addition (spike). Due to the biological nature of fecal coliform bacteria, there are no "known additions". However, each batch number of medium received from Hach should be tested with known positive fecal coliform bacteria.

1. For known positive, obtain a water sample highly contaminated with fresh animal fecal matter. Domesticated animal feces are acceptable contamination. Assign a QC sample number from the Quality Control Log and prepare a bench sheet. Process the known positive sample by filtering two volumes of the sample, 10 ml and 1 ml. Record results (colonies /100 ml or TNTC - too numerous to count) in Quality Control Log. If no contamination is indicated (fecal count zero), reject analytical data from samples tested with that batch, re-sample, and request replacement of entire batch by Hach.

F. Analyze field duplicates of $\geq$ 5% of samples (every 20th sample) for assessment of precision. Analyze splits annually for assessment of precision. ("Splits" and "duplicates" are similar, differing only in that for a split, one sample is collected and then processed in duplicate (split) in the lab, whereas for a duplicate, two samples are collected at the site under as identical conditions as possible.)

Procedure:

1. When collecting field QC duplicate samples, collect two regularly filled whirl-paks at the site under conditions as identical as possible. Thus, sampling technique is included in the QC, but normal field variation may occur in the samples.
2. Prepare two bench sheets using sample numbers with suffixes D1 and D2, e.g. 93-060-D1 and 93-060-D2. Log these sample numbers into the Quality Control Log.
3. Analyze each sample per methods outlined in Section IV.D. above.
4. Record results on the bench sheets and in the Quality Control Log. If D1 and D2 results exceed the method control limits (see Section IX below), report results to Director.

G. Analysis of splits for assessment of precision. This process follows the same procedure as analysis of duplicates (D.1-6, above) except that one over-filled sample bag is collected at the site, and this sample water will be used for both D1 and D2 analyses. Fill whirl-pak collection bag 1.5 cm past the fill line, being sure that when whirled closed the bag still has at least 1 cm of air pocket. Splits will be analyzed annually or every 100 samples, and should be done on a sample expected to have at least 50 fecal coliforms per 100 ml. If D1 and D2 results exceed the method control limits (see Section IX below), report results to Director.

H. Confirmation of fecal coliform colonies. At the same time as splits are performed (VII G above), confirm a minimum of two characteristic blue colonies from each of the two "split" samples (for a total of four colony confirmations) as follows:

1. Prepare bench sheet for fecal coliform bacteria, Membrane Filtration confirmation using Multiple Tube Fermentation technique.
2. Set out four tubes of Lauryl Tryptose presumptive growth medium.
3. Fill Lauryl Tryptose tubes to within 1 cm of top with sterile buffered dilution water.

Recap.

4. Flame sterilize wire innoculating loop
5. Using the sterilized wire loop, transfer one characteristic blue colony from a completed membrane filtration split to the first Lauryl Tryptose tube. Label this S1-C1 (for split 1, confirmation 1).
6. Repeat c. and d. until two characteristic blue colonies from each of the two "split" samples (for a total of four colony confirmations) have been transfered to lauryl tryptose tubes.
7. Place tubes into preheated incubators at 35.0 ^{o}C + 0.5 ^{o}C. Follow procedures set out in Multiple Tube Fermentation QA/QC Procedures Manual, through the completion of the EC Medium confirmation phase.
8. Record results in QC Logbook as presence/absence for each tube.

I. Analysis of externally supplied standards. There are no "externally supplied standards" or "certified reference standards" for fecal coliform bacteria due to perishability.

J. When more than one analyst is working, each analyst will make parallel analyses of a split of at least one positive sample once during the cool/wet season, and once during the warm/dry season. Log S1 and S2 sample numbers into the Quality Control Log and prepare bench sheets. Record results in Quality Control Log.

K. Each batch of sterile buffered dilution water must be tested for parameters such as pH, conductivity, chlorine, and metals. Obtain factory water quality testing results from Hach if ordering their prepared sterile water solution and when ordering the laboratory grade demineralized water used to make rinse/dilution water in the laboratory. Total chlorine analysis is required prior to making each laboratory prepared batch. In addition, one bottle of this water must be submitted annually to a certified laboratory for a Heterotrophic Plate Count (HPC) procedure, as specified in State regulations for laboratory certification.

VIII. CORRECTIVE ACTIONS

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures.

IX. DATA ASSESSMENT FOR BIAS AND PRECISION: CONTROL CHARTS

Prepare control charts to assess sampling and laboratory procedures for variability, bias and precision, according to Standard Methods 18th Edition (Section 9020).

X. DATA REDUCTION

Data reporting standard unit is number of colonies per 100 ml. Each individual colony has developed from a single bacterial cell inthe original sample. Use the following formula to determine the number of indicator organisms in the water tested and remember to report results from the filtration volume resulting in the number of colonies closest to the method target range (20 - 60 colonies per plate).

1. Select the membrane filter with the number of colonies in the Acceptable Range (20 -

60 colonies) and calculate count per 100 ml:

a/b x 100 = colonies per 100 ml where:
a= number of colonies counted
b= sample volume filtered, in ml.

2. If all membrane filter counts are Below the Acceptable Range, select the most nearly acceptable count and perform the calculation from X.1. above. If two plates have counts below the acceptable limit, the counts can be averaged to give an estimated count - Reported as "Estimated Count is X colonies / 100ml"
3. If the count from all the membranbe filters is ZERO, calculate a less than range using a count of 1 from largest filtration volume and Report as "less than (<) X colonies / 100 ml". For example, if the largest filtration volume was 25 ml and zero colonies appeared on the plate, calculate as follows:

1/25 x 100 = 4 colonies/100 ml Reported as < 4 colonies

4. If all membrane counts are above the Acceptable Range (20-60 colonies), colonies are Too Numerous To Count (TNTC). Calculate a greater than range using a count of 60 from the smallest filtration volume and Report as "TNTC - Greater than (>) X colonies / 100 ml". For example, if the smallest filtration volume was 0.01 ml and the count on that plate exceeded 60 colonies, calculate as follows:

60/0.01 x 100 = 600,000 colonies/100 ml Reported as > 600,000

XI. DATA REPORTING STANDARD UNITS

Data reporting standard unit is colonies per 100 ml.

XII. ANALYST TRAINING REQUIREMENTS AND CERTIFICATION OF OPERATOR COMPETENCE.

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures.

XIII. EQUIPMENT PREVENTIVE MAINTENANCE (PM) PROCEDURES.

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures.

A. Clean incubators monthly.
B. Calibration: check thermometers annually against a precision thermometer certified by the National Institute of Standards and Technology (NIST). Record the date and result of calibration on the Thermometer Calibration Record Sheet.
    1. If any thermometer varies from the tested temperature, note in QC Logbook and notify Director. Make note of any correction factors required for each thermometer, and attach this information to the thermometer so that the correction factor will be applied whenever the thermometer is in use.

XIV. WASTE DISPOSAL

A. River water sample may be disposed of in sink or outdoors.

B. Dispose of used culture dishes, tops removed, in a container with 1/2 cup of bleach solution. Alternately, remove culure dish tops, sprinkle bleach or Ajax into dish, replace cover. Dispose as regular waste.

XV. PERFORMANCE AUDITS.

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures.

XVI. EXTERNAL QUALITY CONTROL (QUALITY ASSESSMENT)

Refer to Cacapon Institute Sampling and Laboratory Standard Operating Procedures.