

New Hampshire Department of Environmental Services

Volunteer River Assessment Program

2009 Programmatic Report & QA/QC Audit Overview

Program Summary

In 2009, VRAP supported 29 volunteer groups and 185 volunteers who monitored 354 stations on numerous rivers and watersheds throughout the state (Table 1, Figures 1 through 4). These volunteers contributed approximately 1,659 hours of time solely collecting in-situ data (Figure 3). VRAP volunteers conduct water quality monitoring on an ongoing basis. Each year VRAP has continued to grow both in terms of the number of groups participating and the amount of useable data that is collected.

2009 QA/QC Summary (Table 1)

- VRAP volunteers collected **8,180** field parameters. Of these, **96%** were valid and usable for the 2010 NH Surface Water Quality Assessments.
- VRAP volunteers collected **921** laboratory samples. Of these, **99%** were valid and usable for the 2010 NH Surface Water Quality Assessments.
- The total number of samples (field parameters and laboratory samples) collected by VRAP volunteers was **9,101**. Of these, **96%** were valid and usable for the 2010 NH Surface Water Quality Assessments.

Table 1: 2009 QA/QC Data Summary Statistics

| Type of Sample | Number of Samples Collected | Number of Invalid Samples | Percent (%) Invalid Samples | % Valid Samples Usable for 2010 NH Surface Water Quality Assessments |
|--|-----------------------------|---------------------------|-----------------------------|--|
| Number of Field Parameters | 8,180 | 346 | 4.23% | 95.77% |
| Number of Laboratory Parameters | 921 | 003 | 0.36% | 99.64% |
| Total Number of Samples (Field + Lab) | 9,101 | 349 | 3.83% | 96.17% |

Table 2. VRAP Group and Number of Stations Monitored - 2009

| Group | Number of Stations Monitored |
|--|-------------------------------------|
| 1. Ammonoosuc River Local Advisory Committee | 16 |
| 2. Ashuelot River Local Advisory Committee | 24 |
| 3. Baker River Watershed Association | 13 |
| 4. Bellamy River Watershed Association | 08 |
| 5. Black Brook | 03 |
| 6. Blackwater River VRAP Group | 04 |
| 7. Cains Brook VRAP Group | 08 |
| 8. Cochecho River Watershed Coalition | 41 |
| 9. Cold River Local Advisory Committee | 64 |
| 10. Contoocook River Local Advisory Committee | 15 |
| 11. Dalton Conservation Commission <i>(Connecticut & Johns River)</i> | 05 |
| 12. Exeter Conservation Commission | 08 |
| 13. Sharon Conservation Commission <i>(Gridley River)</i> | 04 |
| 14. Gunnison Brook VRAP Group | 04 |
| 15. Hodgson Brook Advisory Committee | 09 |
| 16. Israel River VRAP Group | 11 |
| 17. Isinglass River Local Advisory Committee | 17 |
| 18. Lamprey River Watershed Association | 15 |
| 19. Mascoma River VRAP Group | 05 |
| 20. Oyster River Watershed Association | 24 |
| 21. Pemigewasset River Local Advisory Committee | 08 |
| 22. Powwow River VRAP Group | 07 |
| 23. Bartlett Conservation Commission <i>(Saco River)</i> | 03 |
| 24. Salmon Falls River VRAP Group | 03 |
| 25. Sucker Brook VRAP Group | 05 |
| 26. Sugar River VRAP Group | 04 |
| 27. Waterville Valley VRAP Group <i>(Mad River & Snow's Brook)</i> | 04 |
| 28. Wolfboro Conservation Commission <i>(Smith River)</i> | 02 |
| 29. Lake Winnepesaukee Tributaries VRAP Group | 20 |
| TOTAL NUMBER OF STATIONS MONITORED IN 2009 | 354 |

Figure 1:

Number of VRAP Groups 1998-2009

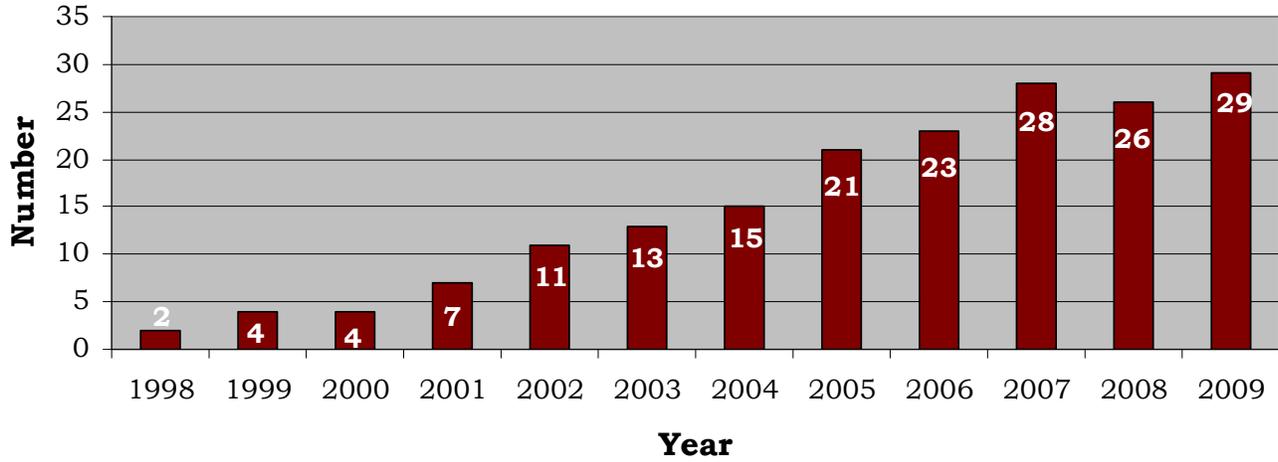


Figure 2:

Number of VRAP Volunteers 2003 - 2009

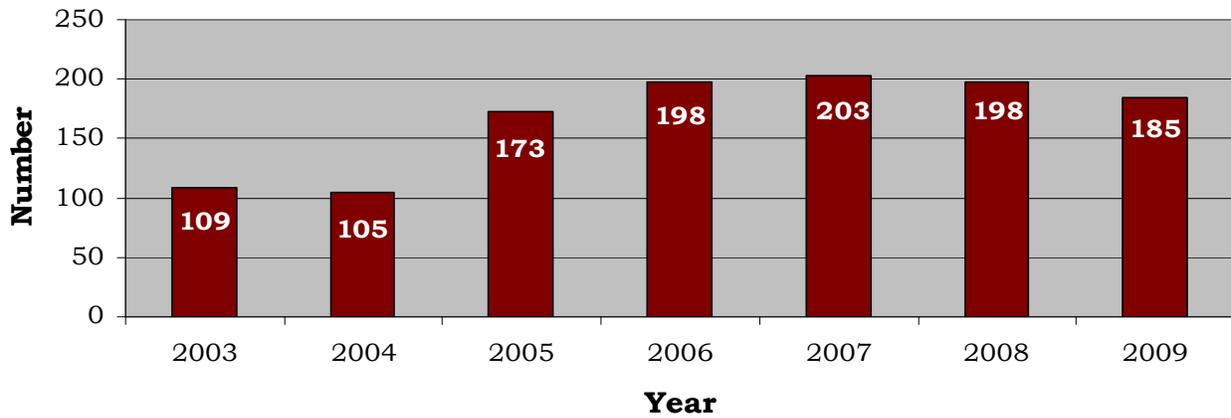


Figure 3:

Number of VRAP Volunteer Hours 2003 - 2009

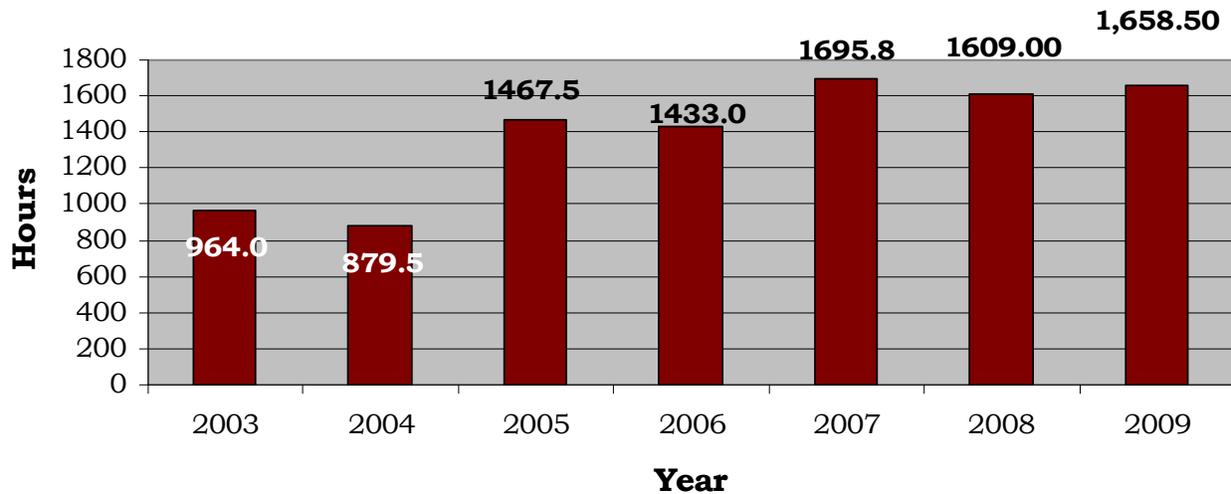


Figure 4:

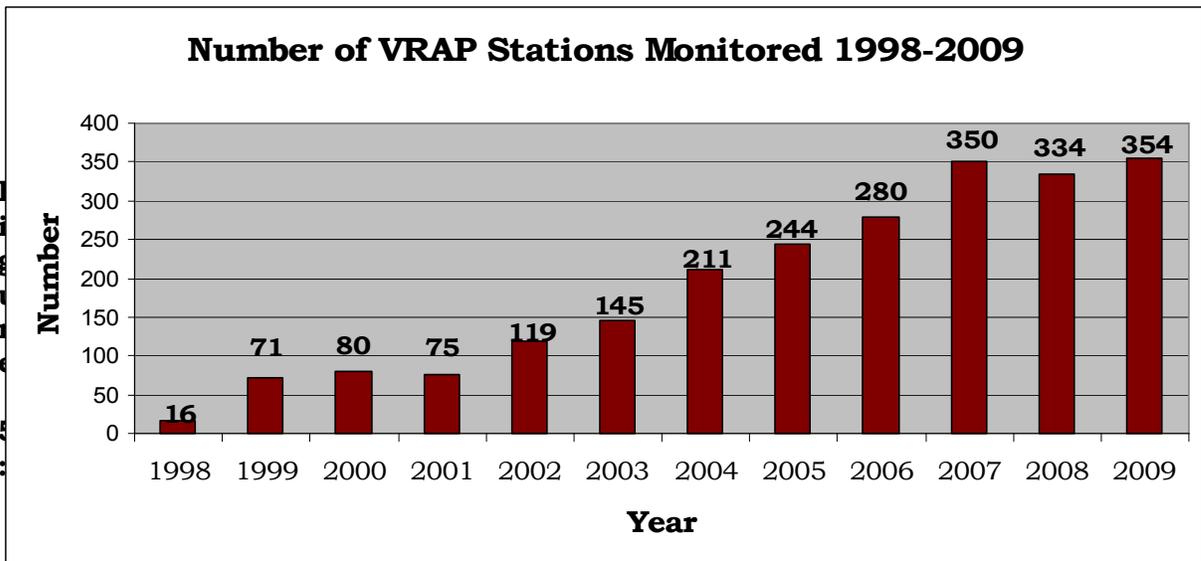


Figure 5:

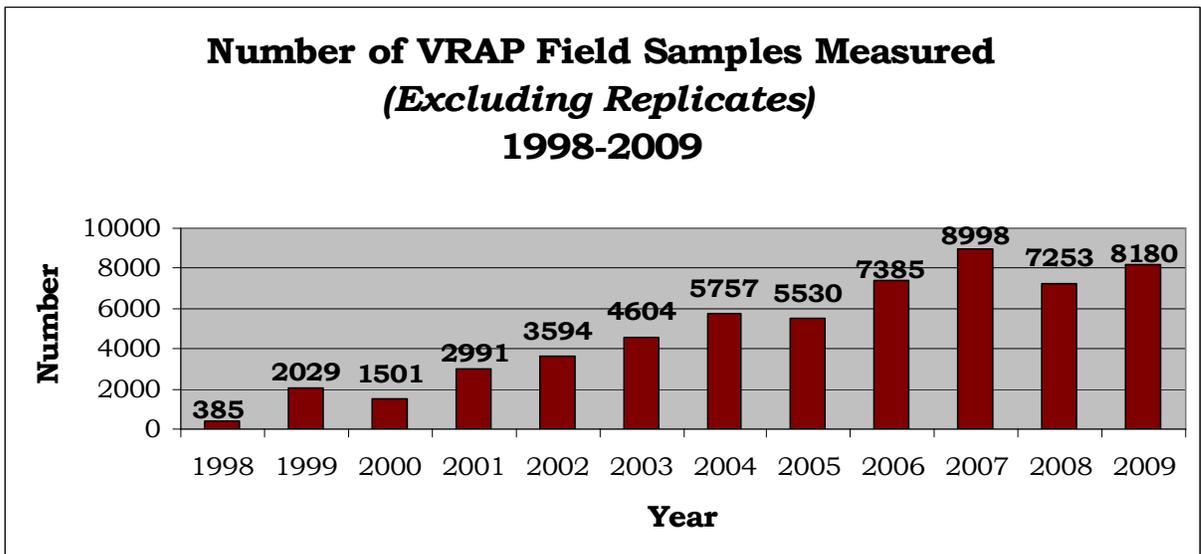


Figure 6:

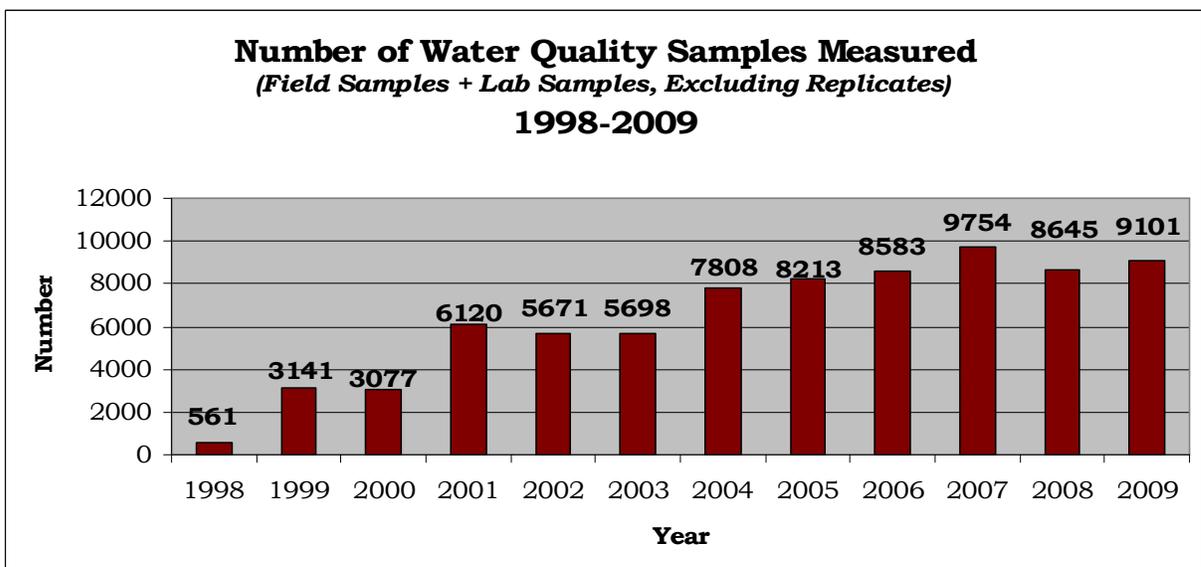


Table 3. Summary of Parameter Count for VRAP - 2009

| Parameter | Parameter Count for Routine Samples Only | Parameter Count Including Replicate Samples |
|---|--|---|
| Field Parameters | | |
| ■ Dissolved Oxygen (% Sat.) | 1167 | 1404 |
| ■ Dissolved Oxygen (mg/L) | 1166 | 1402 |
| ■ pH (std. units) | 1304 | 1558 |
| ■ Specific Conductance (uS/cm) | 1559 | 1845 |
| ■ Turbidity (NTU) | 1432 | 1702 |
| ■ Water Temperature (C) | 1552 | 1838 |
| Total | 8,180 | 9749 |
| Laboratory Parameters | | |
| ■ Chloride (mg/L) | 267 | 282 |
| ■ <i>E.coli</i> (#/100mL) | 332 | 359 |
| ■ Nitrogen, Ammonium (NH ₄) | 001 | 001 |
| ■ Nitrogen, Kjeldahl (mg/L) | 005 | 005 |
| ■ Nitrogen, Nitrate (NO ₃) as N (mg/L) | 003 | 003 |
| ■ Nitrogen, Nitrite (NO ₂) + Nitrate (NO ₃) as N (mg/L) | 055 | 058 |
| ■ Total Phosphorous (mg/L) | 258 | 279 |
| Total | 921 | 987 |
| TOTALS | 9,101 | 10,736 |

II. 2009 QA/QC VRAP SUMMARY

The QA/QC procedures incorporated into the VRAP QAPP are designed to generate data that is of sufficient quality to be useable in NHDES's 305(b) 303(d) reports. Field SOPs and protocols are written to translate the QA/QC requirements of the QAPP into terms and explanations useable by volunteer monitors. Frequent QA/QC checks by VRAP staff, field audits, and open communication lines with the VRAP groups are to ensure that proper QA/QC procedures are being followed and that a maximum of data collected is useable for assessment purposes.

Documentation/Data Verification

Upon submission of VRAP field data sheets to NHDES, VRAP staff go through a detailed QA/QC check to determine what status the data should be flagged with in the Environmental Monitoring Database (EMD).

1. Data is manually entered into the EMD. Templates already exist in the EMD to ensure the proper scientific methods and parameter specific units are documented.
2. Data from the EMD is proofed against the original VRAP field data sheets. Any errors are corrected. If necessary VRAP staff will contact the appropriate volunteer coordinator to verify the data.
3. The data is then checked against the QAPP requirements documented in Table 4. Data that is invalidated is flagged as such in the EMD with an explanation of why the data was invalidated. (For example, "RPD of sample/replicate 23% exceeds QAPP requirements of less than 10 percent and would be flagged.) Data that is invalidated are also documented in the annual VRAP reports to each group.

The VRAP Quality Assurance/Quality Control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in volunteer sampling efforts.

- **Calibration:** Prior to each measurement, the pH and DO meters must be calibrated. Conductivity and turbidity meters are checked against a known standard before the first measurement and after the last one.
- **Replicate Analysis:** A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the replicate analysis should be conducted at different stations. Replicates should be measured within 15 minutes of the original measurements.
- **6.0 pH Standard:** A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.
- **Zero Oxygen Solution:** A reading of a zero oxygen solution is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the zero oxygen standard check should be conducted at different stations.
- **DI (De-Ionized) Turbidity Blank:** A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.
- **End of the Day Conductivity and Turbidity Meter Check:** At the conclusion of each sampling day, the conductivity and turbidity meters are re-checked against a known standard.

Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through measurement replicates (instrumental variability) and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables. Table 4 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \%$$

where x_1 is the original sample and x_2 is the replicate sample

Table 4. Field Analytical Quality Controls

| Water Quality Parameter | QC Check | QC Acceptance Limit | Corrective Action | Person Responsible for Corrective Action | Data Quality Indicator |
|-------------------------|---|---|--|--|------------------------|
| Temperature | Measurement Replicate | RPD < 10% or Absolute Difference <0.8 C. | Repeat Measurement | Volunteer Monitors | Precision |
| Dissolved Oxygen | Measurement Replicate | RPD < 10% | Recalibrate Instrument Repeat Measurement | Volunteer Monitors | Precision |
| | Known Buffer (Zero O ₂ Sol.) | RPD < 10% or Absolute Difference <0.4 mg/L | Recalibrate Instrument Repeat Measurement | Volunteer Monitors | Relative Accuracy |
| pH | Measurement Replicate | Absolute Difference <0.3 pH units | Recalibrate Instrument Repeat Measurement | Volunteer Monitors | Precision |
| | Known Buffer (pH = 6.0) | ± 0.1 std units | Recalibrate Instrument Repeat Measurement | Volunteer Monitors | Accuracy |
| Specific Conductance | Measurement Replicate | RPD < 10% or Absolute Difference <5µS/cm | Recalibrate Instrument Repeat Measurement | Volunteer Monitors | Precision |
| | Method Blank (Zero Air Reading) | ± 5.0 µS/cm | Recalibrate Instrument Repeat Measurement | Volunteer Monitors | Accuracy |
| Turbidity | Measurement Replicate | RPD < 10% or Absolute Difference <1.0 NTU | Recalibrate Instrument Repeat Measurement | Volunteer Monitors | Precision |
| | Method Blank (DI Water) | ± 0.1 NTU | Recalibrate Instrument Repeat Measurement | Volunteer Monitors | Accuracy |
| Laboratory Parameters | Measurement Replicate | RPD < 20% or Absolute Difference less than ½ the mean value of the parameter in NHDES's Environmental Monitoring Database | Repeat Measurement | Volunteer Monitors | Precision |

III. SUMMARY OF 2009 QA/QC RESULTS

A. Description of Training Activities

For Volunteers:

- From April through June 2009, VRAP organized 12 training workshops. Training workshops were held in Meredith, Keene, Bethlehem, Goshen, Rochester, Bennington, Portsmouth, Lee, Concord, Dover, Enfield, and Bristol. One hundred thirty five volunteers attended the events. Topics included: calibration and meter checks, quality assurance and quality control, sample collection for field and laboratory analysis, order of field tests, sampling techniques, and instruction on water quality parameters and state standards.
- From May through October 2009, 14 field audits were conducted by VRAP staff. To facilitate this process, the “*Field Sampling Procedures Assessment*” data sheet was revised and used to assess sampling procedures during the field audit.

For the VRAP Intern:

The VRAP intern hired for the 2009 season was new to the program.

- The VRAP intern was trained on proper use of hand-held water quality sampling equipment and in-situ multiparameter dataloggers according to the approved SOPs. This instruction was given both in the “classroom” (NHDES office and laboratories in Concord) as well as in the field.
- The VRAP intern was trained on proper laboratory sampling techniques, collection methods, sample volumes, container sizes/types, as well as preservative requirements and holding times at the NHDES office and laboratories in Concord as well as in the field.
- The VRAP intern also accompanied other NHDES Watershed Management Bureau staff and experienced interns on several field days for additional training. Additional trainings would have occurred if the VRAP intern had not been comfortable with the instrumentation or procedures.

B. Documentation of Usable Data Versus Actual Data Collected

Field Measurements and Grab Sampling

VRAP staff reviewed all results from field sampling and laboratory analysis. Comments relative to the field data were written directly on the field data sheets, whereas comments relative to laboratory data were written directly on the laboratory results sheets. Table 5 summarizes the number of data points collected for each parameter and the corresponding number and percent of invalid data. During 2009, 9,101 instantaneous data points were collected via the VRAP. Of these, 353 or 3.88 percent were ruled invalid (Table 5).

Data was classified as invalid if calibrations were not conducted, replicates did not meet the requirements in Table 4, or the program manager had other reasons to question the validity of the data. The invalid data were input to the Environmental Monitoring Database (EMD), but will not be used for surface water quality assessment purposes. Invalid data is specifically flagged in the EMD as such.

Table 5. Summary of Data Verification - 2009

| Parameter | Parameter Count for Routine Samples Only | Invalid Count | % Invalid |
|---|--|---------------|--------------|
| Field Parameters | | | |
| ■ Dissolved Oxygen (% Sat.) | 1167 | 075 | 6.43 |
| ■ Dissolved Oxygen (mg/L) | 1166 | 072 | 6.17 |
| ■ pH (std. units) | 1304 | 028 | 2.15 |
| ■ Specific Conductance (uS/cm) | 1559 | 059 | 3.78 |
| ■ Turbidity (NTU) | 1432 | 039 | 2.72 |
| ■ Water Temperature (C) | 1552 | 073 | 4.70 |
| Total | 8,180 | 346 | 4.23% |
| | | | |
| ■ Chloride (mg/L) | 267 | 001 | 0.00 |
| ■ <i>E.coli</i> (#/100mL) | 332 | 002 | 0.01 |
| ■ Nitrogen, Ammonium (NH4) | 001 | 000 | 0.00 |
| ■ Nitrogen, Kjeldahl (mg/L) | 005 | 000 | 0.00 |
| ■ Nitrogen, Nitrate (NO3) as N (mg/L) | 003 | 000 | 0.00 |
| ■ Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N (mg/L) | 055 | 000 | 0.00 |
| ■ Total Phosphorous (mg/L) | 258 | 000 | 0.00 |
| Total | 921 | 003 | 0.36% |
| TOTALS | 9,101 | 349 | 3.83% |

C. Use and Effectiveness of Corrective Actions

Corrective actions were rarely necessary during the sampling season. VRAP staff remained in contact with VRAP group leaders and volunteers throughout the year and immediately communicated any problems with the data or sampling techniques. When questions or problems did arise they were quickly corrected.

D. Conformance to QAPP Requirements/Descriptions of Deviations

Table 8 shows the inconsistencies with the approved VRAP QAPP during the 2009 monitoring season.

Table 6: Non-Conformances with the Approved NHDES VRAP QAPP Identified Following the 2009 VRAP Monitoring Season

| QAPP Inconsistency Number | QAPP Section | Description | QAPP/SOP Inconsistency | Reconciliation of QAPP Inconsistency |
|---------------------------|--------------|----------------------------------|---|--|
| 2009-01 | 4.4 | Training Certification Form | The VRAP QAPP indicates that each volunteer and volunteer group coordinator must participate in an annual training workshop and this training must be documented. Given that some of the group coordinators have been monitoring for over 5 annual training workshops have been established whereby the volunteer group coordinator can attend the annual training workshop and then retrain veteran volunteers and train new recruits. This also allows for the recruitment of new volunteer monitors during the monitoring season when the training sessions have been completed. | The current VRAP QAPP will be revised accordingly. Those coordinators who have participated in the annual training workshops have been documented. |
| 2009-02 | 5.1 | Project Planning Meetings | QAPP indicates that formal planning meeting should be held with each group annually to discuss monitoring plan. In 2009, each group was required to complete and submit an “Individual Group Monitoring Plan”. Only one group failed to submit the form. | The current VRAP QAPP will be revised accordingly. “Individual Group Monitoring Plan” forms from each VRAP group are kept on record, both electronically, and as hard copy. |
| 2009-03 | 7.2 | Measurement Performance Criteria | <u>Precision – Turbidity</u> : If replicate pairs had turbidity values of >10 NTU, an RPD of <10% was used to validate or invalidate data. Similarly, if replicate pairs had turbidity values of ≤ 10 NTU, an absolute difference of 1.0 NTU was used to validate or invalidate data. | The current VRAP QAPP will be revised accordingly. This change is consistent with the ARMP program. QAQC checked and data validation adjusted to accommodate new precision standard. |
| 2009-04 | 7.2 | Measurement Performance Criteria | <u>Precision – E. coli</u> : The approved RPD for <i>E. coli</i> bacteria was exceeded on a number of occasions, but the data were flagged as “Valid” in the EMD. This will not reduce the quality of the data. | The RPD was changed from 50% and 20% to 100% for all replicate samples. The current VRAP QAPP will be revised accordingly. |

| QAPP Inconsistency Number | QAPP Section | Description | QAPP/SOP Inconsistency | Reconciliation of QAPP Inconsistency |
|---------------------------|--------------|----------------------------------|--|--|
| 2009-05 | 7.2 | Measurement performance criteria | <u>Relative percent difference (RPD) and absolute difference between replicate samples:</u> Acceptance limits were revised for water temperature, dissolved oxygen, pH, specific conductance, turbidity, nitrate+nitrite, total Kjeldahl nitrogen, ammonia, BOD ₅ , hardness, alkalinity, total solids, total suspended solids, <i>E. coli</i> , aluminum, and chlorophyll <i>a</i> . | <p>Alternative acceptance limits were used and were based on a statistical analysis of existing VRAP/ARMP data. This will not reduce the quality of the data.</p> <p>The current VRAP QAPP will be revised accordingly.</p> |
| 2009-06 | 13.1 | Sampling Quality Control | <u>Field Duplicates:</u> During the 2009 season VRAP groups were not required to collect duplicate samples as they had in the past. This decision was made due to the inability to determine if any variability between the duplicate and sample was due to instrument issues or true environmental variability. | <p>The current VRAP QAPP will be revised accordingly. This will not reduce the quality of the data or its ability to be flagged as valid.</p> |
| 2009-07 | 13.1 | Sampling Quality Control | <u>Frequency of Replicates:</u> VRAP groups are instructed to conduct a replicate on each sampling day for field parameters. In cases where there was no field replicate conducted, the 10% replicate requirement was used and the replicate for the previous or next sampling event was used for QA/QC purposes on the date without a replicate. | <p>The current VRAP QAPP will be revised accordingly. This will not reduce the quality of the data or its ability to be flagged as valid.</p> |
| 2009-08 | 16.1 | Technical System Audits | <p>Technical system audits were conducted for 50.0% of VRAP groups whereas the QAPP requires that all groups be audited. In addition some audits were conducted in conjunction with field visits to groups for other purposes. All of the groups that did not receive audits are experienced in sampling techniques and QA/QC procedures and have experienced group leaders. This did not reduce the quality of the data collected as all data was still subject to the QA/QC procedures described in the VRAP QAPP.</p> | <p>An effort will be made to audit all VRAP groups during the 2009 season regardless of the number of years they have been participating. If this is not possible a priority will be given to new groups and those deemed by the Program Manager and Program Coordinator as in need of an audit.</p> |

| QAPP Inconsistency Number | QAPP Section | Description | QAPP/SOP Inconsistency | Reconciliation of QAPP Inconsistency |
|----------------------------------|---------------------|--|---|---|
| 2009-09 | 17.0 | QA Management Reports | The prescribed QA Memorandum will not be completed. | The NHDES QA System Annual Program Self-Audit will be completed instead of the prescribed QA Memorandum. The current VRAP QAPP will be revised to state that the self-audits will be conducted annually. |
| 2009-10 | Appendix A | Field Sampling Protocols | The field sampling protocols in the approved QAPP were not used during 2009 | The field sampling protocols were modified to reflect changes in QA/QC procedures listed above. The use of the revised field protocols will not reduce the quality of the data. |
| 2009-11 | Appendix B | VRAP Sampling Plan and Analysis Template | The sampling template in the approved QAPP was not used in 2009. | VRAP staff allowed for flexibility in how a sampling plan was documented as long as sampling QA/QC requirements were met. This will not reduce the quality of the data. |
| 2009-12 | Appendix C | VRAP Field Data Sheet | The Field Data Sheet in the approved QAPP was not used in 2009. This will not reduce the quality of the data. | Field data sheet updated and improved to reflect changes in QA/QC requirements and to reflect minor changes requested by VRAP groups. |