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FINAL REPORT

CHESAPEAKE BAY PROGRAM BLIND AUDIT

Fiscal Year 2011 Final Report

PREPARED FOR:

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INTRODUCTION

The purpose of this Blind Audit Program is to provide samples of specific nutrient analytes at concentrations commonly found in estuarine systems for analysis by laboratories that analyze water samples collected from the Chesapeake Bay and its tributaries. The concentrations of these samples, which are unknown to the recipient analysts, are compared to their prepared concentrations.

In the early years of the Chesapeake Bay Program, U.S. EPA provided blind audit samples on an irregular basis to laboratories analyzing Chesapeake Bay water samples. However, these audit samples were designed for waste water/drinking water applications rather than for estuarine water applications. Consequently, the concentrations were much higher than normally occur in the Bay and did not provide a reasonable estimate of accuracy for low level nutrient concentrations. For example, a blind audit concentration of 1.0 mg NH4-N/L would be comparable to NPDES water samples, but would be at least an order of magnitude greater than concentrations normally occurring in most parts of Chesapeake Bay.

The only continuous program providing an estimate of laboratory performance has been the Chesapeake Bay Coordinated Split Sample Program (CSSP). Data generated from this program provide the only long term QA/QC data base to compare nutrient measurements provided by laboratories analyzing water samples collected from Chesapeake Bay and its tributaries. Samples for CSSP are natural water samples collected from Chesapeake Bay or a tributary. Briefly, a common unfiltered water sample is distributed to the various field/laboratory personnel who, in turn, subsample into dissolved and particulate fractions. These are analyzed and the results compared to those of other participating laboratories. Resulting data analysis can show how field filtration techniques and/or laboratory practices affect data variability. CSSP samples are each subject to cumulative errors of analytical determinations from variation in both field and laboratory procedures. Also, these data sets cannot definitively determine the accuracy of laboratory analyses.

The current Blind Audit Program has been designed to complement the CSSP. Blind Audit particulate samples distributed to participants have few cumulative errors associated with field filtering and subsampling procedures. Prepared concentrates of dissolved substances, whose concentrations are unknown to the analysts, are provided so that laboratory accuracy can be assessed.

This is the thirteenth year of the Blind Audit Program and it is the continued intent of this program to provide unknown, low level dissolved and particulate nutrient samples to laboratories analyzing Chesapeake Bay Program nutrients, as well as to other laboratories interested in participating in the Blind Audit Program.

MATERIALS AND METHODS

Blind Audit samples were sent to participating laboratories on 13 September 2010 and 1 February 2011. Participating laboratories and contact personnel are found in Table 1.

Parameters measured were: total dissolved nitrogen (organic N), total dissolved phosphorus (organic P), nitrate+nitrite, ammonium, phosphate and dissolved organic carbon. High and low concentration samples were provided for each analyte. Particulate carbon, nitrogen and phosphorus, chlorophyll and total suspended solids, were also provided for those laboratories that routinely analyze these parameters. Chlorophyll samples were natural population samples collected from the mouth of the Patuxent River.

Dissolved Blind Audit concentrates were prepared by careful dilution of high quality standards using 18.3 megohm deionized water. The concentrates were sealed in 20 mL ampoules for shipment to participants. One ampoule contained a concentrate of an organic nitrogen compound and an organic phosphorus compound to be diluted for the analysis of low level total dissolved nitrogen and total dissolved phosphorus. A second ampoule contained a concentrate of an organic nitrogen compound and an organic phosphorus compound to be diluted for the analysis of higher level total dissolved nitrogen and total dissolved phosphorus. A third ampoule contained a concentrate to be diluted for the analysis of low level inorganic nutrients (ammonium, nitrate and phosphate). A fourth ampoule contained a concentrate to be diluted for the analysis of higher level inorganic nutrients. The fifth and sixth ampoules contained a low and high concentration of dissolved organic carbon (Potassium hydrogen phthalate), respectively. At each participating laboratory, an aliquot from each ampoule was diluted and analyzed according to accompanying instructions for preparation and dilution. These Blind Audit samples were then inserted randomly in a typical estuarine sample set. Final concentrations were reported for each diluted concentrate according to the dilution instructions provided.

Particulate analytes are measured by analyzing suspended material concentrated on filter pads. There are no commercially available suspensions of pure carbon, nitrogen or phosphorus compounds, so a natural sample was subsampled onto filter pads for analysis by participating laboratories. A batch water sample was collected from the CBL pier, and subsampled for particulate samples of carbon, nitrogen and phosphorus. Particulate C/N samples were filtered from the batch sample with care taken to shake the batch before each filtration to ensure homogeneity. Vacuum filtration was used to process the filters. Samples were dried completely (overnight at 47EC) before shipment. Two samples on 25 mm GF/F pads were sent to each laboratory for analysis.

The same general procedure was followed for particulate phosphorus samples in which they were concentrated by vacuum filtration on 47 mm GF/F pads.

Filter pads were sent to each laboratory for the analysis of particulate C, N, and P. The volume of sample filtered was noted in the instructions so that each laboratory could report concentrations in mg/L. Samples for chlorophyll analysis were filtered from natural population samples onto 47 mm GF/F filter pads. Replicate pads were provided to participating laboratories.

Total suspended solids blind audits were prepared as follows: A suspension of a known mass of infusorial earth in deionized water was stirred with a magnetic stirrer. While stirring continued, an aliquot was subsampled by pipette into a screw cap vial for each participating laboratory. Detailed instructions explaining how to prepare this concentrate for total suspended solids analysis, were also provided.

Samples were sent in coolers via next day carrier to the participating laboratories. A cold temperature was required for chlorophyll samples, so frozen cold packs were packed in those participants= coolers.

RESULTS

Tables and figures summarizing results from the summer 2010 and winter 2011 audit are found at the end of the report. Shortly after the completion of the study, a brief data report, including the concentrations of the prepared samples, was sent to each participant for them to check their data. These data reviews served as a final check of data before preparing this final report.

Concentrations were assessed statistically by calculating the mean and standard deviation of each sample set, then calculating how many standard deviations separated each laboratory=s reported concentration from that mean (Table 2). The percent recovery of each laboratory=s reported concentration relative to the prepared concentration was also calculated for the dissolved analytes (Table 3 and Appendix 1).

DISSOLVED FRACTION

Total Dissolved Nitrogen: For the prepared high level concentrations, most participants reported approximately the same concentration. For the low level concentration, there was slightly more variability between participants and from the prepared concentration. One participant's reported summer 2010 low level concentration was about two times higher than the other reported values and the prepared concentration.

Total Dissolved Phosphorus: For the prepared high level concentrations, most participants reported approximately the same concentration. One participant's reported summer 2010 high level concentration was about 60% higher than the other reported values and the prepared concentration. For the low level concentration, there was slightly more variability between participants and from the prepared concentration. There was less variability between participants and from the prepared concentration for the low level winter 2011 audit than for the summer 2010 audit.

Ammonium: For the prepared high level concentrations, most participants reported approximately the same concentration. There was considerable divergence between participants for the summer 2010 low level ammonium sample. One participant's reported summer 2010 low level concentration was about two times higher than the other reported values and the prepared concentration. There was more moderate divergence between participants for the winter 2011 low level ammonium sample.

Nitrate + Nitrite: For the prepared high level concentrations, most participants reported approximately the same concentration. For the low level concentration, there was slightly more variability between participants and from the prepared concentration.

Orthophosphate: For the prepared high level concentrations of both audits, most participants reported approximately the same concentration with little variability from the prepared concentration. For the low level orthophosphate concentration summer 2010 audit, there also was considerable variance in reported concentrations. Seven out of the eleven participants reported concentrations that were 20% greater than the prepared concentration. For the low level orthophosphate concentration winter 2011 audit, there also was considerable variance in reported concentrations. Eight out of the ten participants reported concentrations that were 20% greater than the prepared concentration.

Dissolved Organic Carbon: For all the prepared concentrations, most participants reported approximately the same concentration. The exception was the summer 2010 high level concentration where one participant reported a concentration that was about half the other reported values and the prepared concentration.

PARTICULATE FRACTION

Again, it should be noted that particulate carbon, nitrogen and phosphorus samples were filtered from a common estuarine water sample and, consequently, are not true blind audit samples produced from pure constituents. Particulate results are graphically presented in Figures 1 and 5.

<u>Particulate Carbon:</u> Particulate C results for both audits revealed close agreement between all participating laboratories (Table 2). Again, this is remarkably close agreement for multi-laboratory comparison of samples of a natural population!

<u>Particulate Nitrogen:</u> For particulate N results, one laboratory's reported concentration was about 90% higher than the mean of the other participants' data for the summer 2010 audit (Table 2). Particulate N results for the winter 2010 audit revealed close agreement between all participating laboratories. This is remarkably close agreement for multi-laboratory comparison of samples of a natural population!

<u>Particulate Phosphorus:</u> Particulate P results for both audits revealed fairly close agreement between all participating laboratories (Table 2). Again, this is remarkably close agreement for multi-laboratory comparison of samples of a natural population!

<u>Chlorophyll:</u> Most of the chlorophyll *a* results for the summer 2010 audit displayed the usual close agreement that was remarkable for multi-laboratory comparison of low concentrations of an environmentally transitory compound, with the exception of two laboratories that reported concentrations about half the mean of the other participants' data for the summer 2010 sample. In accordance with usual seasonal chlorophyll *a* patterns, the winter 2011 reported concentrations were lower, but not particularly variable between participants.

<u>Total Suspended Solids:</u> The concentrate of infusorial earth suspended in deionized water was suspended further in deionized water by each laboratory, then concentrated on a filter pad and weighed. For the summer 2010 sample, 10.0 mg/L was prepared, and there was a consistent slight negative bias reported by most participants; however, one laboratory reported a concentration that was about half of the prepared value. For the winter 2011 sample, 13.0 mg/L was prepared but, there was, again, a consistent negative bias reported by most participants. The slight negative bias reported by most participants for these two audits was about the same as last year.

DISCUSSION

Several important issues should be considered when assessing whether individual Blind Audit results are within acceptable limits.

<u>Variation Associated With An Analytical Method:</u> As we have noted in previous Blind Audit Reports, analytical variability is associated with any quantitative determination. The method detection limit (three times the standard deviation of seven low level replicate natural samples) is often used to express that level of variation. Total dissolved nitrogen data provide a good example. The detection limit at CBL has been determined to be 0.02 mg N/L. <u>Any</u> total dissolved nitrogen measurement has a potential 0.02 mg N/L variability associated with it. This variability, when expressed as a percent of the Atrue@ concentration, can be extremely large for low level concentrations and fairly low for higher concentrations. For example, a 0.20 mg N/L

concentration has an analytical variability of 10% associated with it; whereas, a 1.20 mg N/L concentration has an analytical variability of 2%.

<u>Acceptance Limits of Provided Dissolved Samples:</u> Companies that prepare large quantities of performance evaluation samples assign acceptable confidence limits around the Atrue@ value. In one case (SPEX, CertiPrep), the mean recovery and standard deviation are later reported along with the true concentration and the 95% confidence interval (CI). The 95% CI is the mean recovery ∀ 2 standard deviations and is developed from regression equations from Water Pollution Performance Evaluation Studies. A recently purchased set of these standards gave a true total P value of 3.00 mg P/L with a 95% CI of 2.47-3.42 mg P/L. The lower end of the 95% CI recovery allows 82% recovery of the true concentration. This type of statistical analysis was not performed on the Blind Audit Program samples prepared for this study prior to their distribution to the participants.

Parameters assessed in the Blind Audit do not have predetermined acceptance limits, so we are following the statistical procedure of ERA, an approved source of wastewater and drinking water proficiency samples, and the State of Wisconsin Proficiency Testing program. They average the results for each parameter and at each concentration, then calculate the standard deviation from the mean. Results that are within 2 standard deviations Apass@, and those greater than 3 standard deviations Afail@. Results between 2 and 3 standard deviations are in the Awarning@ category.

Most of the data comparisons based on standard deviations showed similar characteristics (Table 2); that is, the reported concentrations were similar, and one or two concentrations fell slightly beyond one standard deviation from the mean of all data for that portion of the study. Apparently, it is a statistical Areality@ in small sample sets with little variability between individual values, that at least one value will lie just beyond one standard deviation from the mean. Thus, for most of the data sets compared by means and standard deviations, all the reported concentrations Apassed.@ It should also be noted that approximately the same number were in the Awarning@ category as in most of the previous studies, and that only one value in the entire study fell in the Afail@ category.

Data sets with relatively small standard deviations yielded more potentially extraneous Awarning@ points. For example, in the winter 2011 blind audit of high level nitrate + nitrite concentration, the mean reported concentration was 0.740 mg N/L and reported concentrations ranged from 0.675-0.830 mg N/L. The coefficient of variation was ONLY 4.7%! Ten laboratories reported results for this high level sample that were within two standard deviations (S.D. ∀ 0.0349 mg C/L) of the mean. Since the standard deviation was so small, two laboratories' reported results for this sample were between one and two standard deviations of the mean, so were labeled Awarn,@ although <u>all</u> of the reported data were within ∀11% of the prepared concentration. Thus, by that measure of accuracy, most of the data Apassed@ and one was "warned." This nitrate + nitrite data comparison points toward a form of circular reasoning in these statistical assessments. The data being evaluated are also the data that were used to calculate the mean and standard deviation to which the data are being compared.

Data were also assessed by comparing reported concentrations to those that had been prepared (Table 3). Groupings of data in Apass, warn and fail@ categories were arbitrarily set. Reported data that were within ∀10% of the prepared concentration were listed as Apass.@ Reported data that were 80-90% or 110 -120% of the prepared concentration were listed as Awarn.@ Reported data that were <80% or >120% of the prepared concentration were listed as Afail.@

When comparing reported concentrations to those prepared, the lower concentration ranges had more data that fell in Awarn@ and Afail@ categories than the higher level concentrations, i.e., there was less accuracy at the lower concentration ranges (Table 3). The acceptance criteria for low concentration samples are quite narrow. For example, for winter 2011 blind audit of 0.0026 mg P/L prepared for orthophosphate has a Apass@ category (∀10%) of only 0.0020 - 0.0032 mg P/L. For the winter 2011 blind audit, nine out of eleven participating laboratories reported results that fell in the Afail@ category, indicating that their reported concentrations were greater than ∀20% of the prepared concentration in this low range. These results could be interpreted as an inability for all participants to accurately measure low level orthophosphate from concentrates provided to them. It would be important to know if there is also a difficulty in measuring natural low level samples. An alternative interpretation would be that it may be appropriate to broaden the acceptance boundaries for very low concentrations of prepared samples. There was also a broad range in percentage recovery of low level orthophosphate reported values in past audits; however, when comparing with other participants, the coefficient of variation remains remarkably small. For example, winter 2011 reported data based on comparisons with other participants was mean 0.0039, S.D. 0.0012, C.V. 31%.

There was considerable divergence between participants for the summer 2010 low level ammonium sample. One participant's reported summer 2010 low level concentration was about two times higher than the other reported values and the prepared concentration. As with all past blind audits, the standard deviations for the low level ammonium samples were less than those for the higher level ammonium samples for the winter 2011 audit. The proportions of the standard deviations to the means for the low level ammonium samples were about as large as they have been for the last few years. For the winter 2011 audit, the coefficient of variation for 0.042 mg NH4-N/L was 21%. The coefficient of variation was 16% for 0.042 mg NH4-N/L (Summer 2006) and 39% for 0.036 mg NH4-N/L (Winter 2007). The slightly reduced variation in reported concentrations of low level ammonium for these blind audits probably indicates that inter-laboratory comparisons of any ammonium data prepared by laboratories from concentrates below 0.042 mg N/L, although somewhat unreliable, had improved over the past few years. The concentration reported by one laboratory for the summer 2010 low level concentration failed to fit the pattern of less divergence of reported ammonium data.

There were thirteen instances where concentrations reported for dissolved constituents or total suspended solids fell in the Awarn@ or Afail@ category based on the standard deviation of all participants= reported concentrations and also in the Awarn@ or Afail@ category based on percent recovery. These are listed for the individual laboratories in Appendix 1.

<u>Acceptance Limits of Provided Particulate Samples:</u> For each study, particulate samples were filtered from a common estuarine water sample and, consequently, are not true blind audit samples made from pure constituents. There is no Atrue@ or prepared concentration with which to compare. The standard deviation was less than 13% of the mean reported concentration for particulate carbon and phosphorus for both the summer 2010 and winter 2011 audits. The standard deviation was 27% of the mean reported concentration for particulate nitrogen for the summer 2010 audit; 6% for the winter 2011 audit. For particulate nitrogen, one laboratory's reported concentration was about 90% higher than the mean of the other participants' data for the summer 2010 audit

Over the years, the concentration of particulate constituents provided to the participants has varied randomly over approximately a five-fold range. For example, particulate carbon in winter 1998 was approximately 0.45 mg C/L, and in summer 2007 was approximately 2.35 mg C/L.

Reporting Data Accurately: Most data originally reported by all participants for both these blind audits appeared, on casual inspection, to be reported accurately. A few of the results for both these blind audits were miscalculated (and later corrected), or had Aslipped a decimal@ or exhibited some other obvious entry error that could have been easily avoided. As in past years, contacting the participants resolved these reporting discrepancies, but has not always improved their subsequent reporting practices. Other subtle entry or calculation errors may have gone undetected.

The summer 2007 and winter 2008 audits were the only pair of audits in which no participant noted any discrepancies when all were contacted to review their data. No results were miscalculated (and later corrected), or had Aslipped a decimal@ or exhibited some other obvious entry error that could have been easily avoided. After years of reporting “difficulties,” participants had improved their reporting practices! Sadly, this improvement in reporting did not extend to the summer 2008 through summer 2010 audits. At last, for the winter 2011 audit, no participant noted any discrepancies when all were contacted to review their data. WE HAVE RETURNED TO THAT GREAT CONDITION where no results were miscalculated (and later corrected), or had Aslipped a decimal@ or exhibited some other obvious entry error that could have been easily avoided.

The number of significant figures reported in analytical results can significantly affect data comparability in a blind audit study. If a laboratory reports only two significant figures (for whatever reasons) and an audit sample has a prepared concentration expressed in three significant figures, then substantial under or over estimates of the comparative concentration can be reported. For example, if a 0.032 mg P/L sample has been prepared and a laboratory only reports two significant figures, i.e., 0.03 mg P/L, then the results expressed are 86% of the prepared value. During the 2000 study, all participants reported three significant digits for most parameters. It is noteworthy that the 2000 study's coefficients of variation were, generally, smaller than in the previous two years, probably a result of comparisons of data containing the appropriate number of significant digits. Unfortunately, some 2001 through winter 2011 participants reported only two significant digits for some analytes, thus potentially giving substantial under or over estimates for the comparisons.

CONCLUSION

Now that twenty seven rounds of the Blind Audit Program have been completed, some consistent patterns have been observed that warrant action or further investigation:

1. Reported concentrations of particulate analytes were usually similar between laboratories participating in the Blind Audit Program. With the exception of chlorophyll *a*, particulate nitrogen and total suspended solids for the summer 2010 audit; no laboratory reported concentrations for individual analytes that were widely different from the range of the other reported concentrations. This indicates that most participating laboratories usually execute and report these measurements with accuracy and precision, reporting the appropriate number of significant digits.

2. Reported concentrations of dissolved analytes were usually similar between laboratories participating in the Blind Audit Program. No laboratory reported concentrations for individual analytes that were widely different from the range of the other reported concentrations for both blind audits. This indicates that most participating laboratories usually execute and report these measurements with accuracy and precision, reporting the appropriate number of significant digits.

3. When comparing reported concentrations to those prepared, the lower concentration ranges had more data that fell beyond ∀10% of the prepared sample than the higher level concentration ranges, i.e., there was less accuracy at the lower concentration ranges. This was particularly apparent for ammonium, orthophosphate and total dissolved phosphorus. The categories for Apass, warn and fail@ for low concentration samples are quite narrow. Therefore, for very low concentrations of prepared samples, it may be appropriate to broaden the acceptance boundaries.

4. The variation in reported concentrations of low level ammonium for both these blind audits, and several previous audits, probably indicates that inter-laboratory comparisons of any ammonium data prepared from concentrates with resultant concentrations below 0.042 mg N/L would be unreliable. It would be important to know if there is also a difficulty in measuring natural low level samples.

5. For most participating laboratories, there was remarkable consistency in the measurement of total suspended solids from suspensions of infusorial earth; however, there was consistent, slight negative bias in the measurements, when compared to the prepared concentrations. This occurred in past years as well.

6. The proportion of the standard deviation to the mean was small for particulate phosphorus for the winter 2003 through winter 2008 blind audits, so inter-laboratory comparison of particulate phosphorus data should have been valid. The proportion of the standard deviation to the mean was higher for particulate phosphorus in the blind audits of summer 2008 through winter 2010. This contrasted to all three previous years, in which the coefficient of variation for particulate phosphorus was usually the lowest of the particulate fractions. For the summer 2010 and winter 2011 audits the proportion of the standard deviation to the mean was again small for particulate phosphorus, so inter-laboratory comparison of particulate phosphorus data should be valid.

7. The proportion of the standard deviation to the mean for particulate nitrogen was higher for the summer 2010 blind audit than for most previous audits. For particulate nitrogen, one laboratory's reported concentration was about 90% higher than the mean of the other participants' data for the summer 2010 audit. The proportion of the standard deviation to the mean was in its usual range for all participants for the winter 2011 blind audit.

8. Care should continue to be taken when completing report forms. For the summer 2010 and winter 2011 blind audits, some results were AGAIN (!) reported with insufficient significant digits. For the summer 2010 and winter 2011 blind audits, results were AGAIN (!) reported and then later corrected. Results were miscalculated (and later corrected), or had Aslipped a decimal@ or been entered on the wrong parts of the results form. Over the course of the years, a few laboratories repeatedly have made calculation or entry errors that were later corrected. It is hoped that corrections of these lapses serve as reminders of the importance to continuously check many aspects of data management to ensure overall data quality.

Table 1. Participants in the Summer 2010 and Winter 2011 Blind Audit Program.

Institution	Contact Person	Phone	Dissolved	Particulate	Chlorophyll a	DOC	TSS
Old Dominion University, Water Quality Lab, (**ODU**)	Suzanne Doughton	757-451-3043	X	X	X	X	X
University of MD, Horn Point Laboratory (**HPL**)	Jennifer O'Keefe	410-221-8276	X	X	X	X	X
Virginia Institute of Marine Science (**VIMS**)	Carol Pollard	804-684-7213	X	X	X		X
Virginia Div, Consolidated Lab Services (**DCLS**)	Jay Armstrong	804-648-4480 x328	X	X	X	X	X
MD Dept Health and Mental Hygiene (**DHMH**)	Shala Ameli	410-767-6190	X	X	X	X	X
Univ. of MD Chesapeake Bio Lab (**CBL**)	Carl Zimmermann	410-326-7252	X	X	X	X	X
Delaware Dept. of Natural Resources (**DNREC**)	Ben Pressly	302-739-9942	X	X	X	X	X
Academy of Natural Science of Philadelphia (**PAACAD**)	Paul Kiry	215-299-1076	X	X	X		X
PA DEP, Bureau of Laboratories (**PADEP**)	James Yoder	717-346-8232	X			X	X
MWRA, Water Quality Laboratory (**MWRA**)	Jennifer Prasse	617-660-7808	X	X	X	X	X
Hampton Roads Sanitation District (**HRSD**)	Stacie Metzler	757-460-4217	X		X	X	X
Occoquan Watershed Monitoring Lab (**OCC**)	Dongmei Wang	703-361-5606 x118	X	X	X	X	X
U of Connecticut Center for Environmental Sci. & Engineering (**UCONN)**	Chris Perkins	860-486-2668	X	X	X	X	X
Solomons Waste Water Treatment Lab (**SOLWWT**)	Bonnie Mattingly	410-326-4702	X				X

Table 2. Summary of Mean Concentration and Standard Deviation for Each Group of Analytes in the Summer 2010 and the Winter 2011 Blind Audit, Including Distribution of Reported Concentrations from the Mean.

Parameter	Concentration in mg/L		**Number of Laboratories**			
			Standard Deviations from Mean			
			<1	1-2	2-3	>3
	Mean	S.D.	**PASS**	**PASS**	**WARN**	**FAIL**
Summer 2010						
Total Dissolved Nitrogen	0.294	0.0699	10		1	
Total Dissolved Nitrogen	0.648	0.0611	10	3	1	
Total Dissolved Phosphorus	0.0134	0.0024	7	4		
Total Dissolved Phosphorus	0.0452	0.0074	13			1
Ammonium	0.0343	0.0166	9	1	1	
Ammonium	0.115	0.0064	12	1	1	
Nitrate + Nitrite	0.0379	0.0054	8	3		
Nitrate + Nitrite	0.850	0.0600	12		2	
Orthophosphate	0.0058	0.0037	9	2		
Orthophosphate	0.0268	0.0035	12	1	1	
Dissolved Organic Carbon	1.90	0.100	8	2		
Dissolved Organic Carbon	4.17	0.663	9		1	
Particulate Carbon	1.22	0.140	9		1	
Particulate Nitrogen	0.255	0.0685	9	1		
Particulate Phosphorus	0.0298	0.0036	6	3		
Total Suspended Solids	8.74	1.48	12	1	1	
Winter 2011						
Total Dissolved Nitrogen	0.371	0.0378	7	4		
Total Dissolved Nitrogen	0.924	0.0561	8	4		
Total Dissolved Phosphorus	0.0170	0.0018	8	3		
Total Dissolved Phosphorus	0.0461	0.0033	7	5		
Ammonium	0.0362	0.0076	8	2	1	
Ammonium	0.218	0.0158	8	3	1	
Nitrate + Nitrite	0.0283	0.0046	10	1		
Nitrate + Nitrite	0.740	0.0349	10	1	1	
Orthophosphate	0.0039	0.0012	7	3		
Orthophosphate	0.0443	0.0027	8	4		
Dissolved Organic Carbon	2.38	0.184	4	4		
Dissolved Organic Carbon	4.56	0.304	6	2		
Particulate Carbon	1.76	0.074	7	3		
Particulate Nitrogen	0.221	0.0131	7	3		
Particulate Phosphorus	0.0197	0.0026	7	3		
Total Suspended Solids	11.59	0.78	7	4	1	

Table 3. Summary of Prepared and Reported Concentrations for Each Analyte and Percent Recovery of the Prepared Concentration by Participating Laboratories

			Number of Laboratories		
Parameter	Prepared Concentration mg/L	Reported Concentration Range mg/L	Within 90% - 110% of Prepared Concentration	Within 80 -90%, or 110-120% of Prepared Concentration	<80%, or >120% of Prepared Concentration
			PASS	**WARN**	**FAIL**
Summer 2010					
Total Dissolved Nitrogen	0.270	0.25-0.4988	9	1	1
Total Dissolved Nitrogen	0.667	0.5-0.73	12	1	1
Total Dissolved Phosphorus	0.0115	0.01-0.0175	4	2	5
Total Dissolved Phosphorus	0.0422	0.04-0.069	11	2	1
Ammonium	0.038	0.068-0.077	2	2	7
Ammonium	0.118	0.10-0.123	13	1	
Nitrate + Nitrite	0.0350	0.0321-0.049	8	1	2
Nitrate + Nitrite	0.868	0.700-0.981	12	2	
Orthophosphate	0.0037**	0.0015-0.0157	1	3	7
Orthophosphate	0.0259	0.020-0.036	11	2	1
Dissolved Organic Carbon	1.80	1.71-2.06	8	2	
Dissolved Organic Carbon	4.30	2.31-4.56	9		1
Total Suspended Solids	10.0	5.3-10.0	8	3	3
Winter 2011					
Total Dissolved Nitrogen	0.341	0.310-0.430	6	3	2
Total Dissolved Nitrogen	0.923	0.820-0.995	11	1	
Total Dissolved Phosphorus	0.0154	0.0146-0.02	7	2	2
Total Dissolved Phosphorus	0.0422	0.0402-0.050	6	6	
Ammonium	0.042	0.0205-0.050	3	5	3
Ammonium	0.210	0.2-0.251	10	2	
Nitrate + Nitrite	0.0250	0.0239-0.04	7	1	3
Nitrate + Nitrite	0.756	0.675-0.830	11	1	
Orthophosphate	0.0026**	0.0019-0.0054	2		9
Orthophosphate	0.0444	0.040-0.0492	11	1	
Dissolved Organic Carbon	2.20	2.18-2.67	7	1	1
Dissolved Organic Carbon	4.30	4.17-5.14	7	2	
Total Suspended Solids	13.0	9.9-12.4	9	2	1

**For very low concentrations of prepared samples, it may be appropriate to broaden the acceptance boundaries.

Appendix 1. Summer 2010 and Winter 2011
Reported Data, Prepared Concentrations and Percent
Recoveries
Warnings based on Standard Deviation of the mean of reported concentrations are listed.

Virginia Institute of Marine Science

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27	0.2797	103.6	0.341	0.3523	103.3
TDN (mg N/L)	0.677	0.6818	100.7	0.923	0.9094	98.5
TDP (mg P/L)	0.0115	0.0114	99.1	0.0154	0.0184	119.5
TDP (mg P/L)	0.0422	0.0416	98.6	0.0422	0.0467	110.7
NH4 (mg N/L)	0.038	0.0179	47.1	0.042	0.0205	48.8
NH4 (mg N/L)	0.118	0.1125	95.3	0.21	0.2177	103.7
NO3+NO2 (mg N/L)	0.035	0.0347	99.1	0.025	0.0326	130.4
NO3+NO2 (mg N/L)	0.868	0.89	102.5	0.756	0.7438	98.4
PO4 (mg P/L)	0.0037	0.0015	40.5	0.0026	0.0019	73.1
PO4 (mg P/L)	0.0259	0.0237	91.5	0.0444	0.0422	95.0
Part. C (mg C/L)					1.91	
Part. N (mg N/L)					0.2235	
Part. P (mg P/L)		0.0342			0.0238	
DOC (mg C/L)	1.8			2.2		
DOC (mg C/L)	4.3			4.3		
Chlorophyll (µg/L)		10.4			8.7	
Total Susp. S (mg/L)	10	8.9	89.0	13	12.4	95.4

Old Dominion University WQL

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27	0.268	99.3	0.341	0.385	112.9
TDN (mg N/L)	0.677	0.65	96.0	0.923	0.922	99.9
TDP (mg P/L)	0.0115	0.013	113.0	0.0154	0.0172	111.7
TDP (mg P/L)	0.0422	0.0435	103.1	0.0422	0.0449	106.4
NH4 (mg N/L)	0.038	0.0358	94.2	0.042	0.0351	83.6
NH4 (mg N/L)	0.118	0.123	104.2	0.21	0.2142	102.0
NO3+NO2 (mg N/L)	0.035	0.0355	101.4	0.025	0.0255	102.0
NO3+NO2 (mg N/L)	0.868	0.8728	100.6	0.756	0.7428	98.3
PO4 (mg P/L)	0.0037	0.0054	145.9	0.0026	0.0046	176.9
PO4 (mg P/L)	0.0259	0.0269	103.9	0.0444	0.0446	100.5
Part. C (mg C/L)		1.198			1.7	
Part. N (mg N/L)		0.226			0.213	
Part. P (mg P/L)		0.0274			0.01635	
DOC (mg C/L)	1.8	1.816	100.9	2.2	2.194	99.7
DOC (mg C/L)	4.3	4.344	101.0	4.3	4.402	102.4
Chlorophyll (µg/L)		13.35			10.5	
Total Susp. S (mg/L)	10	9.58	95.8	13	11.68	89.8

Virginia Tech Occoquan Watershed Monitoring Laboratory

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27	0.25	92.6	0.341	0.43	126.1
TDN (mg N/L)	0.677	0.555	82.0	0.923	0.99	107.3
TDP (mg P/L)	0.0115	0.01	87.0	0.0154	0.02	129.9
TDP (mg P/L)	0.0422	0.042	99.5	0.0422	0.05	118.5
NH4 (mg N/L)	0.038	0.028	73.7	0.042	0.05	119.0
NH4 (mg N/L)	0.118	0.118	100.0	0.21	0.23	109.5
NO3+NO2 (mg N/L)	0.035	0.049	140.0	0.025	0.04	160.0
NO3+NO2 (mg N/L)	0.868	0.89	102.5	0.756	0.72	95.2
PO4 (mg P/L)	0.0037	0.008	216.2	0.0026	<0.01	
PO4 (mg P/L)	0.0259	0.028	108.1	0.0444	0.04	90.1
Part. C (mg C/L)		1.57**				
Part. N (mg N/L)		0.448**				
Part. P (mg P/L)						
DOC (mg C/L)	1.8	1.951	108.4	2.2	2.28	103.6
DOC (mg C/L)	4.3	4.257	99.0	4.3	4.17	97.0
Chlorophyll (µg/L)		10.5			8.6	
Total Susp. S (mg/L)	10	8.7	87.0	13	12	92.3

**WARN based on Standard Deviation of all participants' reported concentrations

Virginia Division of Consolidated Laboratory Services

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27	0.278	103.0	0.341	0.328	96.2
TDN (mg N/L)	0.677	0.647	95.6	0.923	0.87	94.3
TDP (mg P/L)	0.0115	0.0142	123.5	0.0154	0.016	103.9
TDP (mg P/L)	0.0422	0.0435	103.1	0.0422	0.046	109.0
NH4 (mg N/L)	0.038	0.0242	63.7	0.042	0.032	76.2
NH4 (mg N/L)	0.118	0.116	98.3	0.21	0.205	97.6
NO3+NO2 (mg N/L)	0.035	0.0358	102.3	0.025	0.026	104.0
NO3+NO2 (mg N/L)	0.868	0.834	96.1	0.756	0.734	97.1
PO4 (mg P/L)	0.0037	0.0041	110.8	0.0026	0.0039	150.0
PO4 (mg P/L)	0.0259	0.0265	102.3	0.0444	0.0432	97.3
Part. C (mg C/L)		1.165			1.83	
Part. N (mg N/L)		0.225			0.221	
Part. P (mg P/L)		0.0299			0.0221	
DOC (mg C/L)	1.8	1.84	102.2	2.2	2.33	105.9
DOC (mg C/L)	4.3	4.38	101.9	4.3	4.54	105.6
Chlorophyll (µg/L)		11.79			8.66	
Total Susp. S (mg/L)	10	10	100.0	13	12	92.3

Hampton Roads Sanitation District

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27			0.341		
TDN (mg N/L)	0.677	0.73	107.8	0.923	0.97	105.1
TDP (mg P/L)	0.0115			0.0154		
TDP (mg P/L)	0.0422	0.05	118.5	0.0422	0.05	118.5
NH4 (mg N/L)	0.038			0.042		
NH4 (mg N/L)	0.118	0.11	93.2	0.21	0.2	95.2
NO3+NO2 (mg N/L)	0.035			0.025		
NO3+NO2 (mg N/L)	0.868	0.85	97.9	0.756	0.74	97.9
PO4 (mg P/L)	0.0037			0.0026		
PO4 (mg P/L)	0.0259	0.028	108.1	0.0444	0.045	101.4
Part. C (mg C/L)						
Part. N (mg N/L)						
Part. P (mg P/L)						
DOC (mg C/L)	1.8	1.89	105.0	2.2	2.67	121.4
DOC (mg C/L)	4.3	4.53	105.3	4.3	4.8	111.6
Chlorophyll (µg/L)		6.3			8.05	
Total Susp. S (mg/L)	10	10	100.0	13	11.9	91.5

Delaware DNREC-Division of Water, Environmental Laboratory Section

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27	0.4988**	184.7	0.341	0.3817	111.9
TDN (mg N/L)	0.677	0.7205	106.4	0.923	0.9348	101.3
TDP (mg P/L)	0.0115	0.0165	143.5	0.0154	0.0163	105.8
TDP (mg P/L)	0.0422	0.0452	107.1	0.0422	0.0435	103.1
NH4 (mg N/L)	0.038	0.0468	123.2	0.042	0.0454	108.1
NH4 (mg N/L)	0.118	0.1264	107.1	0.21	0.2399	114.2
NO3+NO2 (mg N/L)	0.035	0.0468	133.7	0.025	0.027	108.0
NO3+NO2 (mg N/L)	0.868	0.827	95.3	0.756	0.7519	99.5
PO4 (mg P/L)	0.0037	0.0064	173.0	0.0026	0.0049	188.5
PO4 (mg P/L)	0.0259	0.0289	111.6	0.0444	0.0475	107.0
Part. C (mg C/L)		1.226			1.77	
Part. N (mg N/L)		0.228			0.235	
Part. P (mg P/L)		0.0247			0.01785	
DOC (mg C/L)	1.8	1.995	110.8	2.2	2.634	119.7
DOC (mg C/L)	4.3	4.313	100.3	4.3	5.136	119.4
Chlorophyll (µg/L)		10.59			11	
Total Susp. S (mg/L)	10	9.59	95.9	13	9.9	76.2

**WARN based on Standard Deviation of all participants' reported concentrations

Academy of Natural Sciences of Philadelphia

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered

TDN (mg N/L)	0.27	0.256	94.8	0.341	0.31	90.9
TDN (mg N/L)	0.677	0.618	91.3	0.923	0.82	88.8
TDP (mg P/L)	0.0115	0.0124	107.8	0.0154	0.0153	99.4
TDP (mg P/L)	0.0422	0.0422	100.0	0.0422	0.0402	95.3
NH4 (mg N/L)	0.038	0.077**	202.6	0.042	0.0314	74.8
NH4 (mg N/L)	0.118	0.118	100.0	0.21	0.209	99.5
NO3+NO2 (mg N/L)	0.035	0.0342	97.7	0.025	0.024	96.0
NO3+NO2 (mg N/L)	0.868	0.84	96.8	0.756	0.723	95.6
PO4 (mg P/L)	0.0037	0.0157	424.3	0.0026	0.00191	73.5
PO4 (mg P/L)	0.0259	0.0266	102.7	0.0444	0.043	96.8
Part. C (mg C/L)		1.33			1.66	
Part. N (mg N/L)		0.256			0.198	
Part. P (mg P/L)		0.0273			0.0202	
DOC (mg C/L)	1.8			2.2		
DOC (mg C/L)	4.3			4.3		
Chlorophyll (µg/L)					8.07	
Total Susp. S (mg/L)	10	10	100.0	13	10.8	83.1

**WARN based on Standard Deviation of all participants' reported concentrations

PADEP Water Quality Laboratory

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27					
TDN (mg N/L)	0.677	0.65	96.0			
TDP (mg P/L)	0.0115					
TDP (mg P/L)	0.0422	0.069**	163.5			
NH4 (mg N/L)	0.038					
NH4 (mg N/L)	0.118	0.11	93.2			
NO3+NO2 (mg N/L)	0.035					
NO3+NO2 (mg N/L)	0.868	0.84	96.8			
PO4 (mg P/L)	0.0037					
PO4 (mg P/L)	0.0259	0.027	104.2			
Part. C (mg C/L)						
Part. N (mg N/L)						
Part. P (mg P/L)						
DOC (mg C/L)	1.8	1.93	107.2			
DOC (mg C/L)	4.3	4.39	102.1			
Chlorophyll (µg/L)						
Total Susp. S (mg/L)	10	6	60.0			

**FAIL based on Standard Deviation of all participants' reported concentrations

UMCES Horn Point Laboratory

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27	0.255	94.4	0.341	0.426	124.9
TDN (mg N/L)	0.677	0.643	95.0	0.923	0.995	107.8
TDP (mg P/L)	0.0115	0.0118	102.6	0.0154	0.0167	108.4

TDP (mg P/L)	0.0422	0.0428	101.4	0.0422	0.0473	112.1
NH4 (mg N/L)	0.038	0.0285	75.0	0.042	0.0391	93.1
NH4 (mg N/L)	0.118	0.116	98.3	0.21	0.251	119.5
NO3+NO2 (mg N/L)	0.035	0.0351	100.3	0.025	0.0268	107.2
NO3+NO2 (mg N/L)	0.868	0.88	101.4	0.756	0.745	98.5
PO4 (mg P/L)	0.0037	0.0043	116.2	0.0026	0.0042	161.5
PO4 (mg P/L)	0.0259	0.0264	101.9	0.0444	0.0476	107.2
Part. C (mg C/L)		1.114			1.68	
Part. N (mg N/L)		0.231			0.222	
Part. P (mg P/L)		0.0349			0.0212	
DOC (mg C/L)	1.8	1.71	95.0	2.2	2.18	99.1
DOC (mg C/L)	4.3	4.2	97.7	4.3	4.3	100.0
Chlorophyll (µg/L)		11.275			9.98	
Total Susp. S (mg/L)	10	9.28	92.8	13	12	92.3

UMCES Chesapeake Biological Laboratory

Parameter	Summer 2010	Summer 2010	Summer 2010	Winter 2011	Winter 2011	Winter 2011
	Prepared	Reported	% Recovered	Prepared	Reported	% Recovered
TDN (mg N/L)	0.27	0.308	114.1	0.341	0.361	105.9
TDN (mg N/L)	0.677	0.686	101.3	0.923	0.875	94.8
TDP (mg P/L)	0.0115	0.0109	94.8	0.0154	0.0166	107.8
TDP (mg P/L)	0.0422	0.0403	95.5	0.0422	0.0434	102.8
NH4 (mg N/L)	0.038	0.034	89.5	0.042	0.038	90.5
NH4 (mg N/L)	0.118	0.119	100.8	0.21	0.211	100.5
NO3+NO2 (mg N/L)	0.035	0.041	117.1	0.025	0.0304	121.6
NO3+NO2 (mg N/L)	0.868	0.981**	113.0	0.756	0.8301	109.8
PO4 (mg P/L)	0.0037	0.0037	100.0	0.0026	0.0039	150.0
PO4 (mg P/L)	0.0259	0.0244	94.2	0.0444	0.0432	97.3
Part. C (mg C/L)		1.15			1.78	
Part. N (mg N/L)		0.235			0.217	
Part. P (mg P/L)		0.0334			0.0175	
DOC (mg C/L)	1.8	1.97	109.4	2.2	2.41	109.5
DOC (mg C/L)	4.3	4.56	106.0	4.3	4.66	108.4
Chlorophyll (µg/L)		13.29			9.97	
Total Susp. S (mg/L)	10	8.6	86.0	13	11.7	90.0

**WARN based on Standard Deviation of all participants' reported concentrations

MD DHMH Division of Environmental Chemistry Nutrients Laboratory

Parameter	Summer 2010	Summer 2010	Summer 2010	Winter 2011	Winter 2011	Winter 2011
	Prepared	Reported	% Recovered	Prepared	Reported	% Recovered
TDN (mg N/L)	0.27	0.295	109.3	0.341	0.341	100.0
TDN (mg N/L)	0.677	0.696	102.8	0.923	0.927	100.4
TDP (mg P/L)	0.0115	0.0175	152.2	0.0154	0.0146	94.8
TDP (mg P/L)	0.0422	0.0431	102.1	0.0422	0.0421	99.8
NH4 (mg N/L)	0.038	0.0168	44.2	0.042	0.0343	81.7
NH4 (mg N/L)	0.118	0.112	94.9	0.21	0.201	95.7

NO3+NO2 (mg N/L)	0.035	0.0375	107.1	0.025	0.0289	115.6
NO3+NO2 (mg N/L)	0.868	0.839	96.7	0.756	0.748	98.9
PO4 (mg P/L)	0.0037	0.00488	131.9	0.0026	0.00412	158.5
PO4 (mg P/L)	0.0259	0.0276	106.6	0.0444	0.0438	98.6
Part. C (mg C/L)		1.117			1.79	
Part. N (mg N/L)		0.243			0.247	
Part. P (mg P/L)		0.0272			0.0189	
DOC (mg C/L)	1.8	2.06	114.4	2.2	2.35	106.8
DOC (mg C/L)	4.3	4.42	102.8	4.3	4.51	104.9
Chlorophyll (µg/L)		11.401			8.6	
Total Susp. S (mg/L)	10	9.2	92.0	13	11.8	90.8

Solomons WWTP Laboratory

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27					
TDN (mg N/L)	0.677	0.5**	73.9			
TDP (mg P/L)	0.0115					
TDP (mg P/L)	0.0422	0.04	94.8			
NH4 (mg N/L)	0.038					
NH4 (mg N/L)	0.118	0.1**	84.7			
NO3+NO2 (mg N/L)	0.035					
NO3+NO2 (mg N/L)	0.868	0.7**	80.6			
PO4 (mg P/L)	0.0037					
PO4 (mg P/L)	0.0259	0.02	77.2			
Part. C (mg C/L)						
Part. N (mg N/L)						
Part. P (mg P/L)						
DOC (mg C/L)	1.8					
DOC (mg C/L)	4.3					
Chlorophyll (µg/L)						
Total Susp. S (mg/L)	10	5.3**	53.0			

**WARN based on Standard Deviation of all participants' reported concentrations

MWRA Water Quality Laboratory

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27	0.281	104.1	0.341	0.371	108.8
TDN (mg N/L)	0.677	0.658	97.2	0.923	0.884	95.8
TDP (mg P/L)	0.0115	0.0156	135.7	0.0154	0.02	129.9
TDP (mg P/L)	0.0422	0.0489	115.9	0.0422	0.049	116.1
NH4 (mg N/L)	0.038	0.0312	82.1	0.042	0.0364	86.7
NH4 (mg N/L)	0.118	0.117	99.2	0.21	0.223	106.2
NO3+NO2 (mg N/L)	0.035	0.0321	91.7	0.025	0.0239	95.6
NO3+NO2 (mg N/L)	0.868	0.813	93.7	0.756	0.675	89.3

PO4 (mg P/L)	0.0037	0.00459	124.1	0.0026	0.00354	136.2
PO4 (mg P/L)	0.0259	0.0253	97.7	0.0444	0.0492	110.8
Part. C (mg C/L)		1.09			1.74	
Part. N (mg N/L)		0.225			0.2175	
Part. P (mg P/L)		0.0296			0.0222	
DOC (mg C/L)	1.8	1.87	103.9	2.2		
DOC (mg C/L)	4.3	2.31**	53.7	4.3		
Chlorophyll (µg/L)		12.65			11	
Total Susp. S (mg/L)	10	7.52	75.2	13	10.5	80.8

**WARN based on Standard Deviation of all participants' reported concentrations

U Conn Center for Environmental Sciences & Engineering

Parameter	Summer 2010 Prepared	Summer 2010 Reported	Summer 2010 % Recovered	Winter 2011 Prepared	Winter 2011 Reported	Winter 2011 % Recovered
TDN (mg N/L)	0.27	0.27	100.0	0.341	0.395	115.8
TDN (mg N/L)	0.677	0.642	94.8	0.923	0.995	107.8
TDP (mg P/L)	0.0115	0.014	121.7	0.0154	0.031	201.3
TDP (mg P/L)	0.0422	0.041	97.2	0.0422	0.05	118.5
NH4 (mg N/L)	0.038	0.037	97.4	0.042	0.036	85.7
NH4 (mg N/L)	0.118	0.117	99.2	0.21	0.209	99.5
NO3+NO2 (mg N/L)	0.035	0.035	100.0	0.025	0.027	108.0
NO3+NO2 (mg N/L)	0.868	0.844	97.2	0.756	0.73	96.6
PO4 (mg P/L)	0.0037	0.005	135.1	0.0026	0.0054	207.7
PO4 (mg P/L)	0.0259	0.036	139.0	0.0444	0.042	94.6
Part. C (mg C/L)		1.213			1.77	
Part. N (mg N/L)		0.233			0.2145	
Part. P (mg P/L)					0.017	
DOC (mg C/L)	1.8			2.2		
DOC (mg C/L)	4.3			4.3		
Chlorophyll (µg/L)		4.07			3.3	
Total Susp. S (mg/L)	10	9.7	97.0	13	12.4	95.4

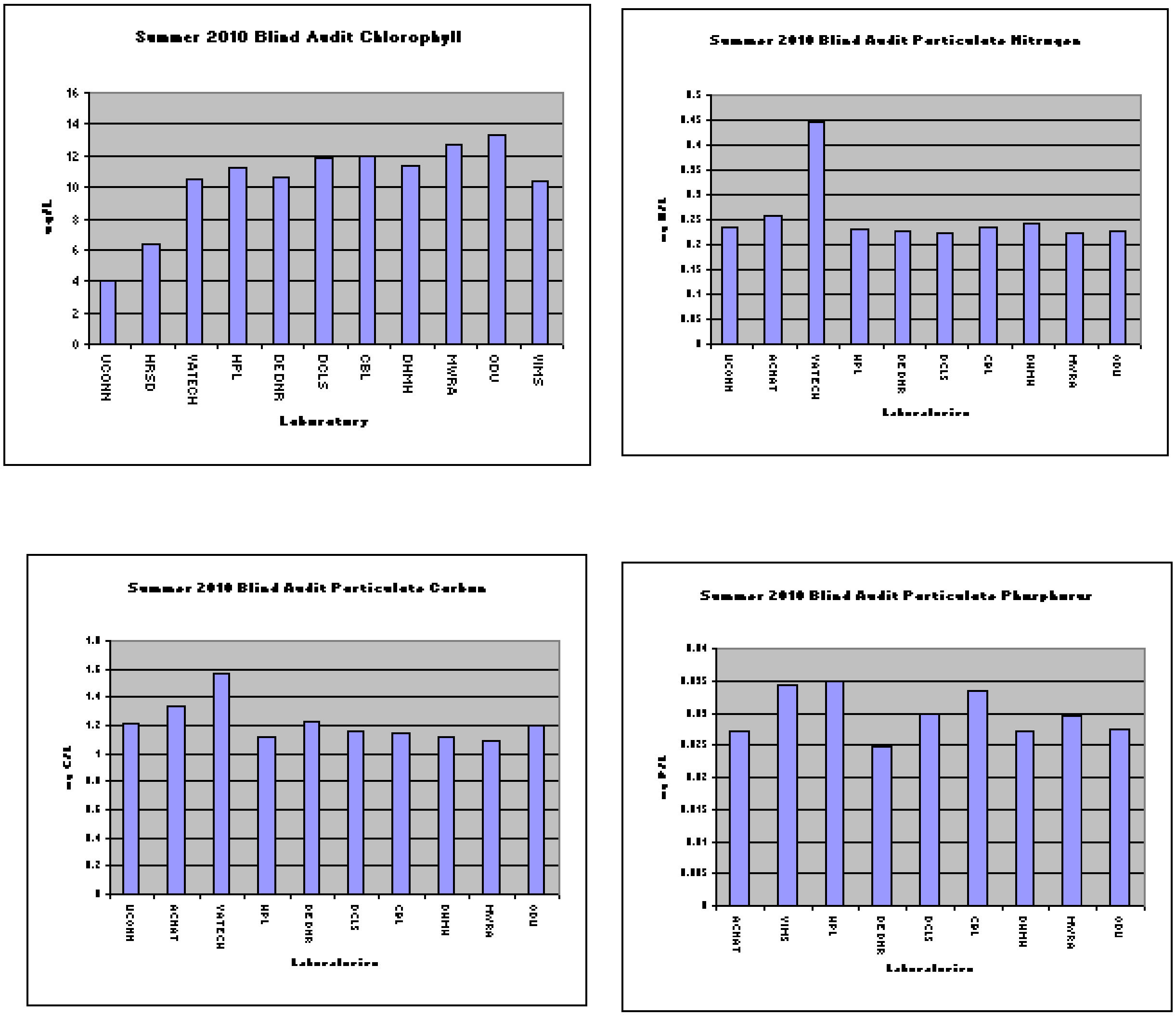


Figure 1. Particulate carbon, nitrogen and phosphorus; chlorophyll, Summer 2010

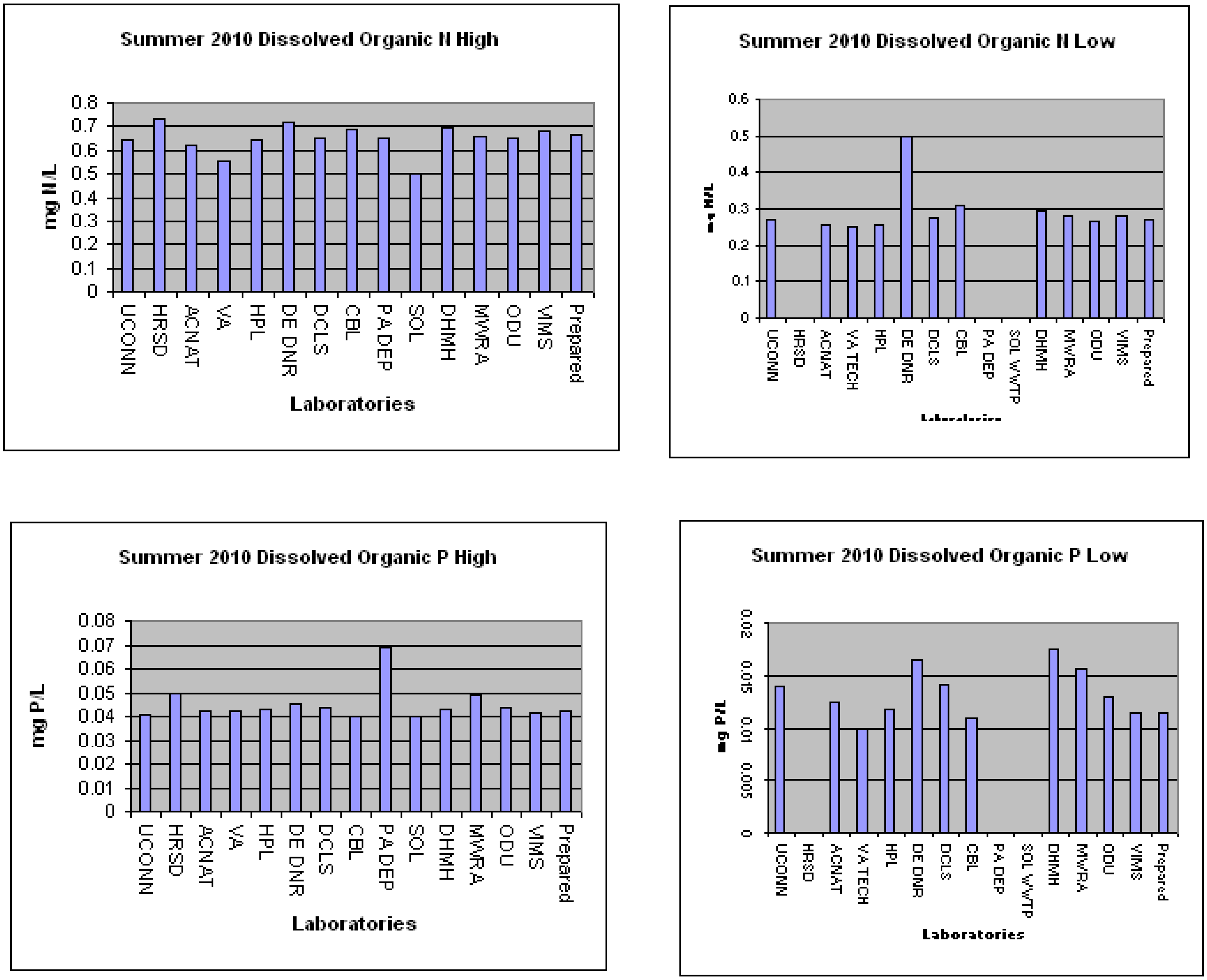
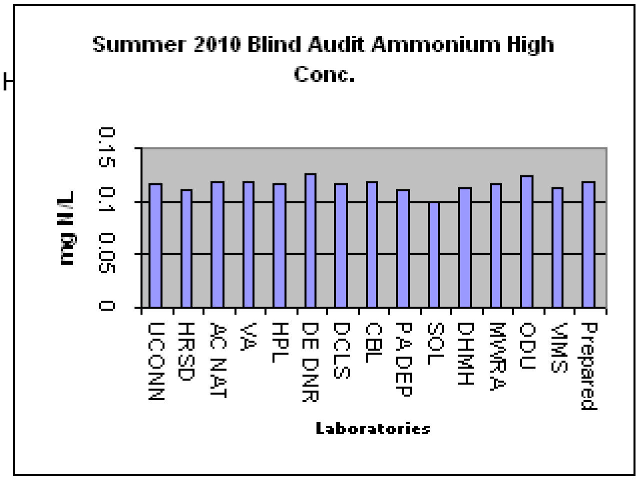


Figure 2. Total dissolved nitrogen and phosphorus, Summer 2010.

HHH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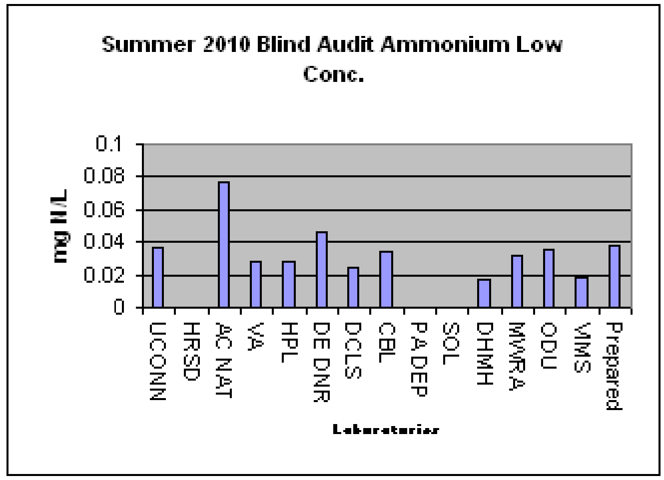
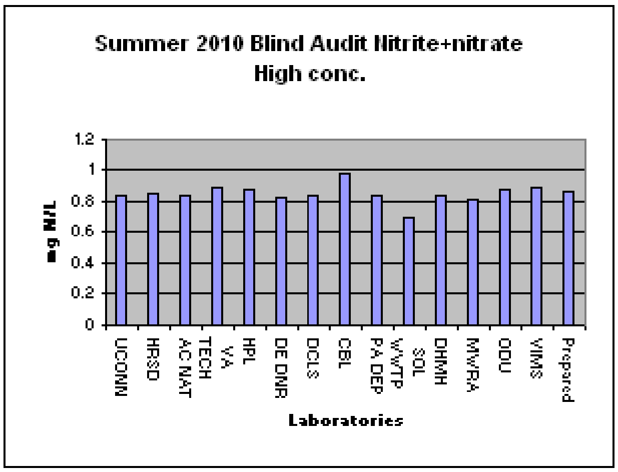
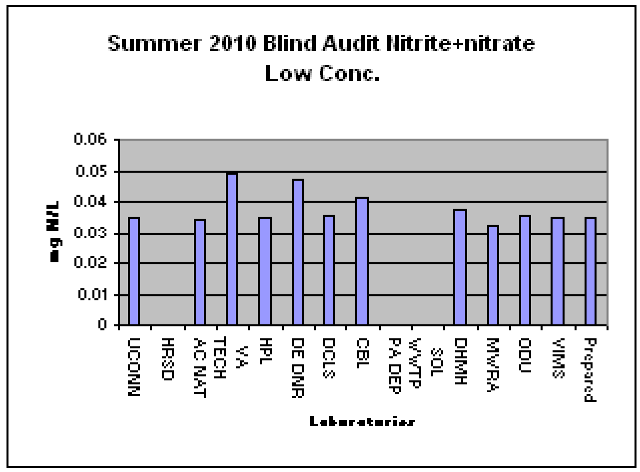
UCONN HRSD AC NAT VA HPL DE DNR DCLS CBL PA DEP SOL DHMH MWRA ODU VIMS Prepared
Laboratories


Summer 2010 Blind Audit Ammonium Low Conc.
mg N/L
0 0.02 0.04 0.06 0.08 0.1
UCONN HRSD AC NAT VA HPL DE DNR DCLS CBL PA DEP SOL DHMH MWRA ODU VIMS Prepared
Laboratories


Summer 2010 Blind Audit Nitrite+nitrate High conc.
mg N/L
0 0.2 0.4 0.6 0.8 1 1.2
UCONN HRSD AC NAT TECH VA HPL DE DNR DCLS CBL PA DEP WWTP SOL DHMH MWRA ODU VIMS Prepared
Laboratories


Summer 2010 Blind Audit Nitrite+nitrate Low Conc.
mg N/L
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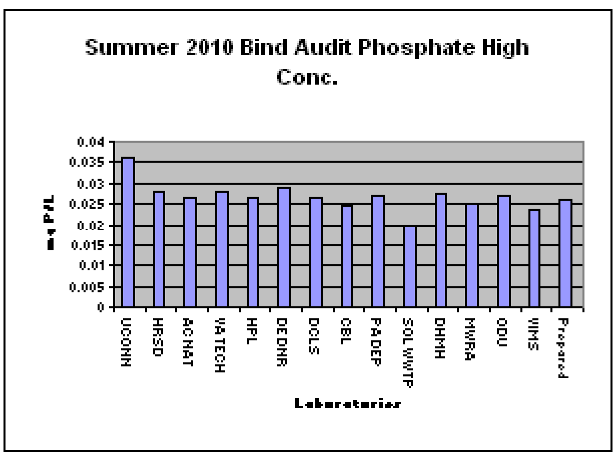
Laboratories


Summer 2010 Bind Audit Phosphate High Conc.
mg P/L
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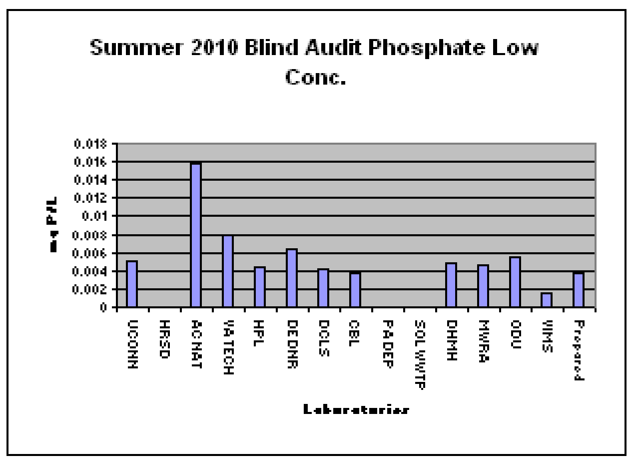
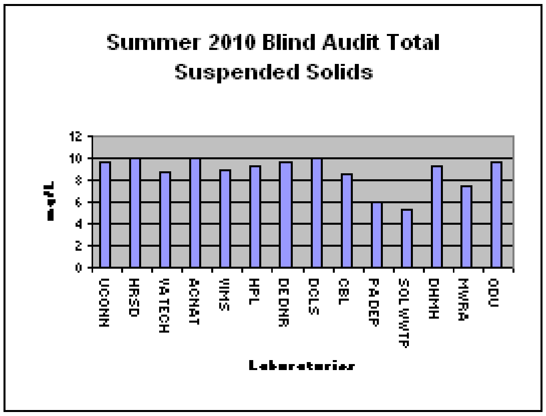
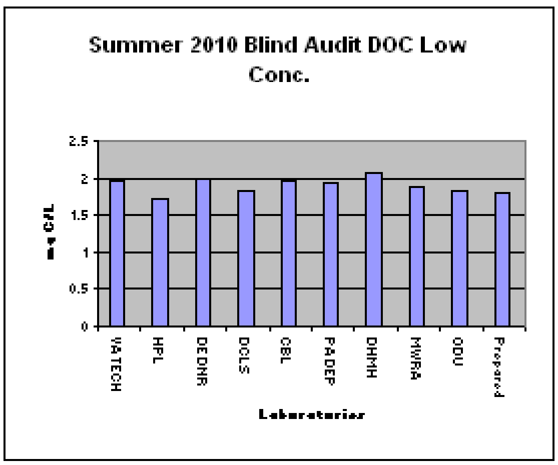
Laboratories


Summer 2010 Blind Audit Phosphate Low Conc.
mg P/L
0 0.002 0.004 0.006 0.008 0.01 0.012 0.014 0.016 0.018
UCONN HRSD AC NAT VA TECH HPL DE DNR DCLS CBL PA DEP SOL WWTP DHMH MWRA ODU VIMS Prepared
Laboratories





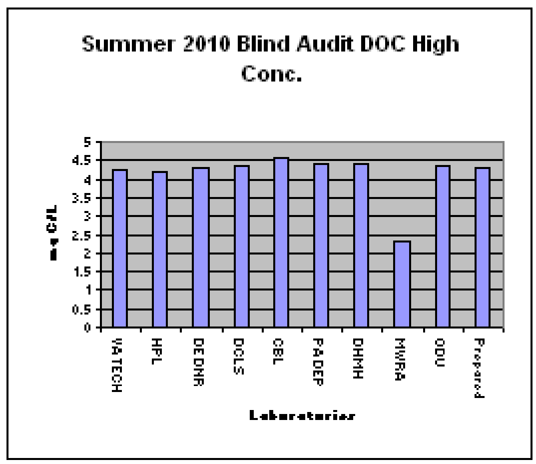
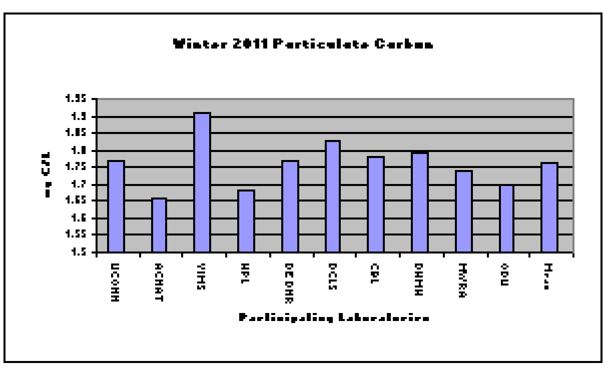
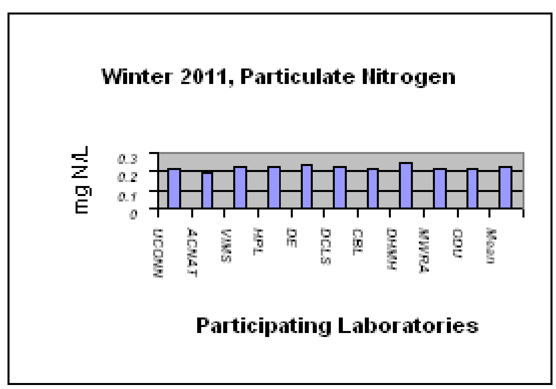


Figure 4. Dissolved organic carbon and total suspended solids, Summer 2010





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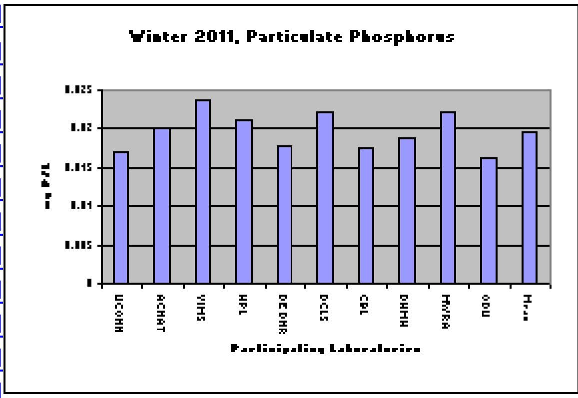

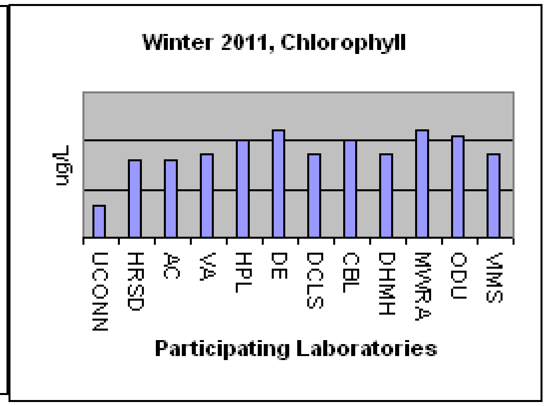

HFigure 5. Particulate carbon, nitrogen and phosphorus, Winter 2011
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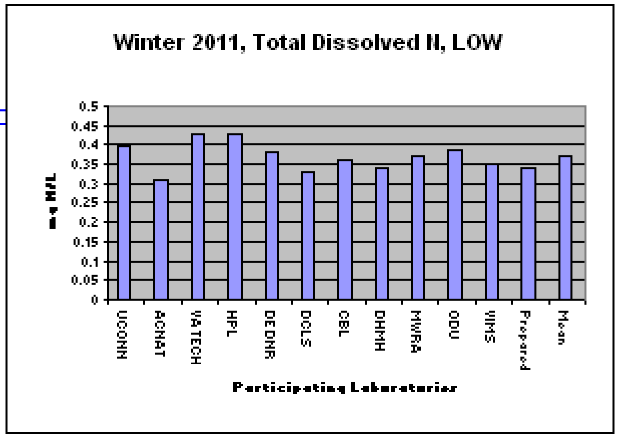

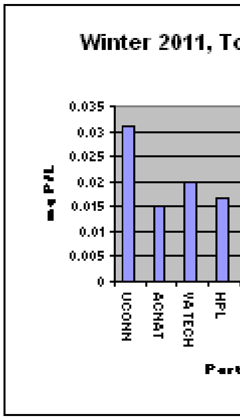

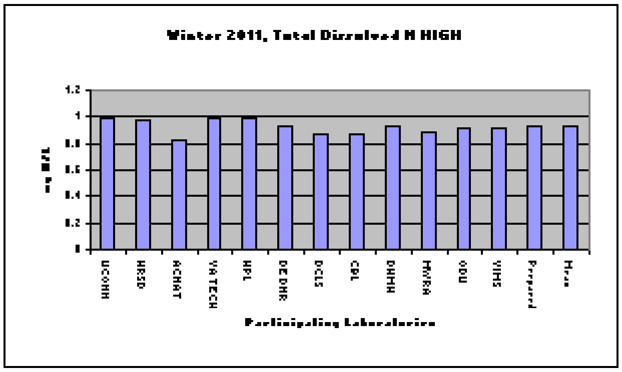

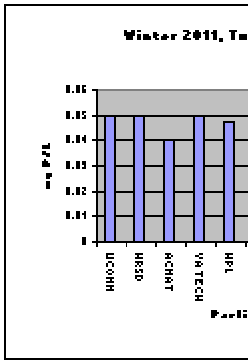

Figure 6. Total dissolved nitrogen and phsophorus, Winter 2011

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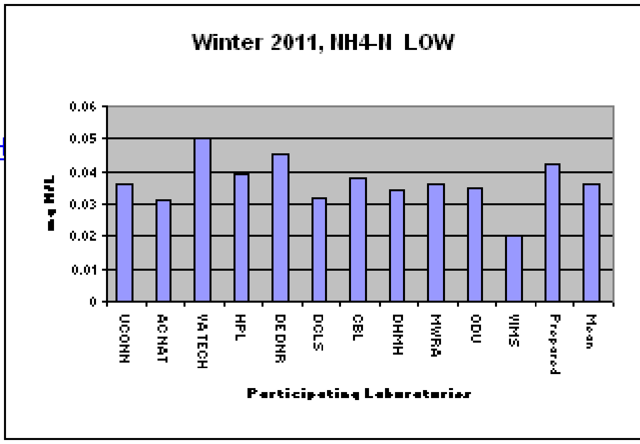

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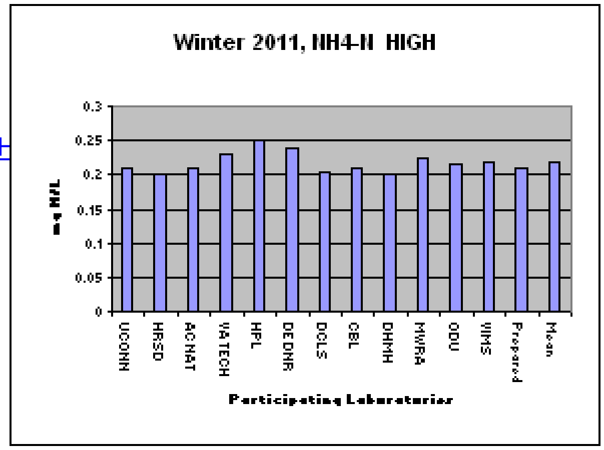
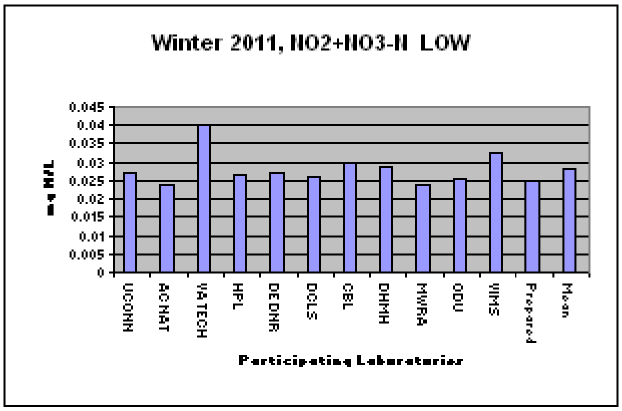




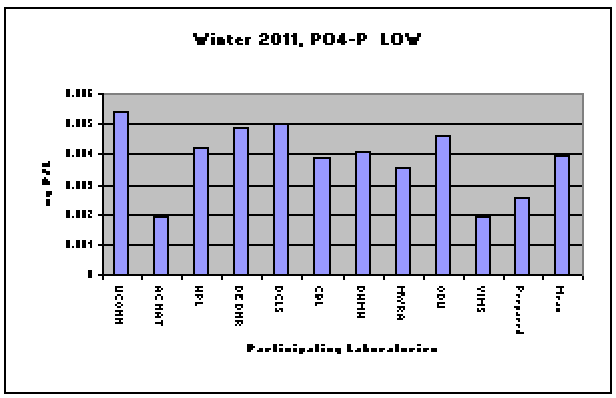
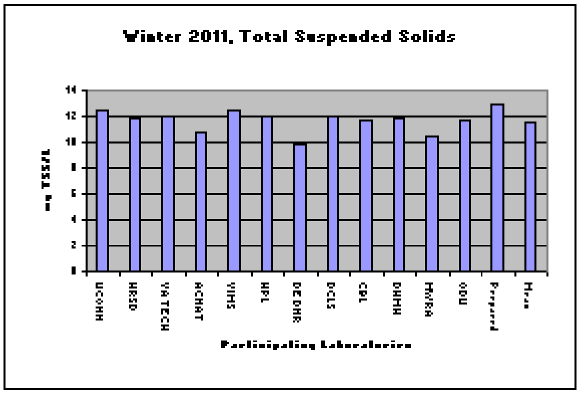
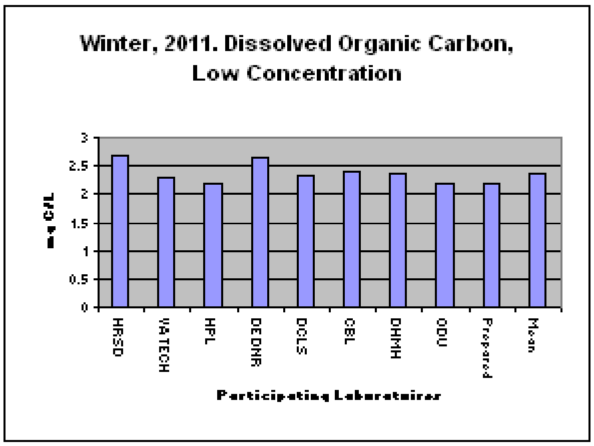


Figure 7. Dissolved inc





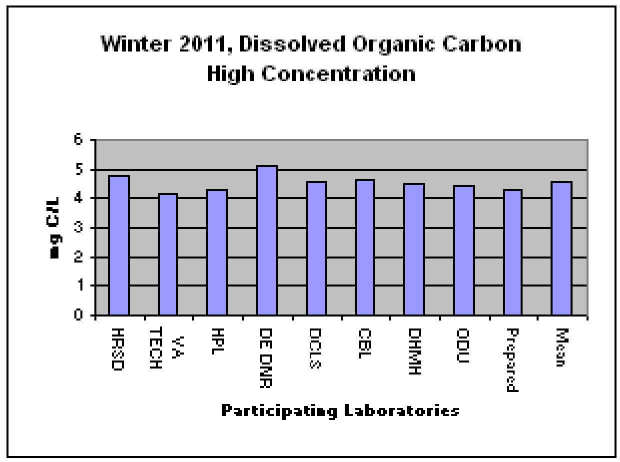


Figure 8. Dissolved organic carbon and total suspended solids, Winter 2011