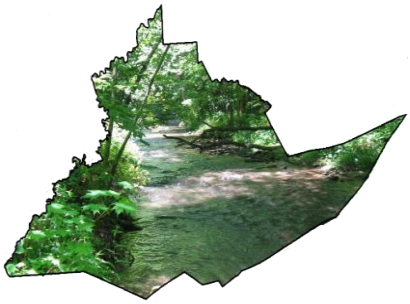


Centre County, Pennsylvania

Senior Environmental Corps

2018 Quality Report

The mission of the Centre County Pennsylvania Senior Environmental Corps (CCPaSEC) is to develop and to support teams of senior citizens who gather and publish data on the quality of water in the streams of Centre County. Through public outreach, with the assistance of the ClearWater Conservancy, the Centre County Conservation District, Nature Abounds™ and other environmentally concerned organizations, CCPaSEC seeks to keep the public informed of the importance of clean water and how the management of our civil and natural resources affects the quality of streams in the county.

CCPaSEC Quality Team
January 2019kj

We value the Quality of our data published on our website

CCPaSEC implemented a Quality Assurance Plan in preparation for the Nature Abounds™ quality plan distributed at the May 2016 training session. Basically, our plan calls for our quality team to conduct Team field reviews, perform duplicate test to determine our collective Relative Average Deviation (RAD). The average team RAD is expressed as a percentage (RPD) is one measure of the quality of our posted data on our website at CCPaSEC.org.

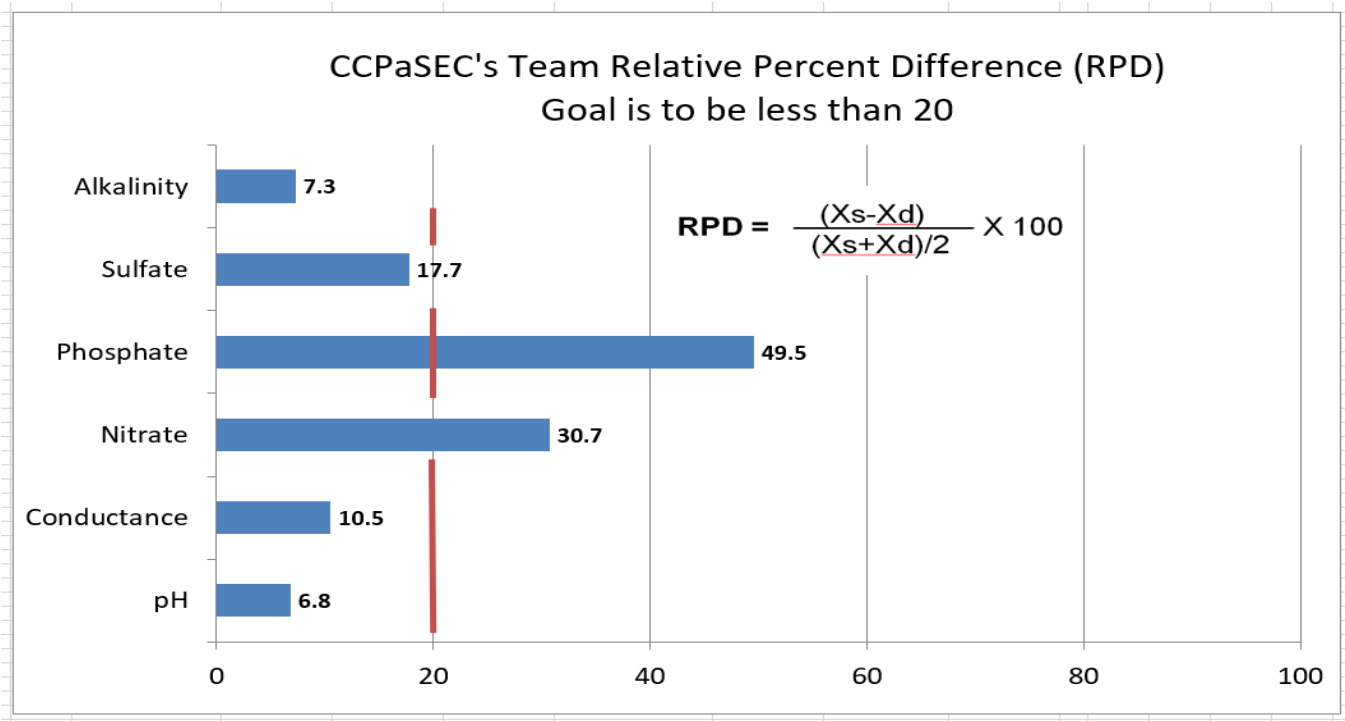
It is incumbent upon us to provide the RPD to users of our data for them to understand its significance.

Duplicate tests

The CCPaSEC RPD is determined by duplicate testing of our Field teams and the Quality team.

Relative Percent Deviation (RPD) 2018

Nature Abounds™ Quality Plan set a goal for the RAD to be less than 20%.



* *Note*: Nitrate. Since we use mixed lots of reagents during the year, we used the NitraVer-5 correction factor of 0.6 (reagent blank value) that was determined for our 2017 equipment check NitraVer-5 reagent to correct for the cadmium reduction test method *(Appendix I).*

Equipment

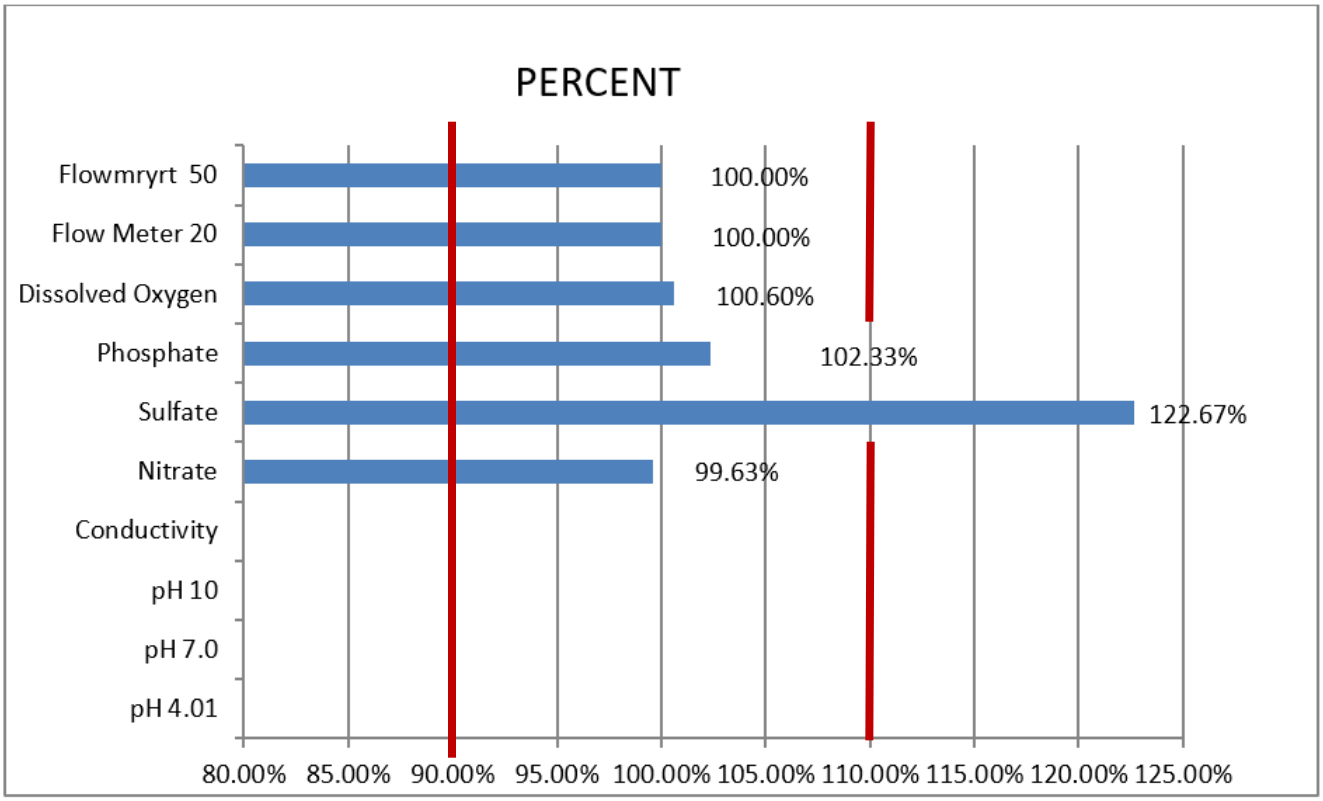
Percent Standard deviation (PD) 2018

Nature Abounds™ Quality Plan set a goal to be between 90% and 110%

We are not using Laboratory certified equipment and we cannot expect Laboratory level results. We perform a yearly evaluation of our equipment percent deviation from a known Standard. The relative standard deviation is widely used in analytical chemistry to express the precision and repeatability of an assay.

Percent Standard deviation (PD) is a measure of the capability of the data measurements of our equipment. Our Quality Control plan calls for testing all of our equipment each year. The Nature Abounds™ Quality Plan established PD goal is to be between 90% and 110% is used to quantify the amount of variation or dispersion of a set of data values.

The equipment tests are performed against standards for pH, nitrate, sulfate and phosphate. We use a common tap water sample for dissolved oxygen.



Conclusions & Results:

Relative Percent Deviation (RPD) 2018 (duplicate tests)

We feel our data is useful for seasonal and yearly comparisons. Although our duplicate phosphate RPD results are poor, the previous year (2017) was 20.7 %. The quality team only conducts duplicate tests once a year. This year the comparison phosphate tests with three teams exceed the goal by a large margin. We cannot determine which – the field team or the quality team – measurement or both resulted in the large RPD. All duplicate tests used the same lot of reagent. Efforts were made to completely empty the reagent packets. However, the tests use different sample cells. Please see page 5 for an explanation.

Percent Standard deviation (PD) 2018 (equipment tests)

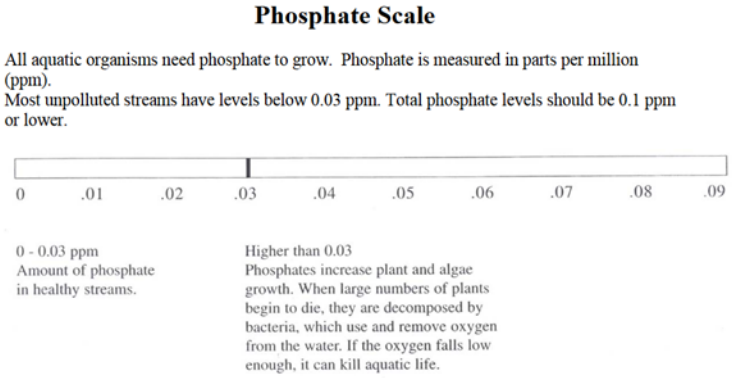
Sulfate exceeded our goal by 22.67%. The equipment percent standard deviation (PD) result for sulfate last year (2017) was 107.4% well within the goal.

Our Quality team noticed that it was difficult to completely empty the nitrate powder packets and there were indications of nitrate reagent residue (see Appendix II). The amount left behind varied greatly between the field teams and the Quality team. The tests are sensitive to the quantity of reagent. Using less than needed would produce a lower mg/L value and is one likely cause of the disparity in our duplicate tests.

Factors that may bias our Phosphate RPD duplicate test results

Our Quality team noticed that it was difficult to completely empty the phosphate powder packets.

The measured phosphate levels are all below 1.0 mg/L. Our test equipment may be a limiting factor in the calculations. Phosphate levels are typically shown:



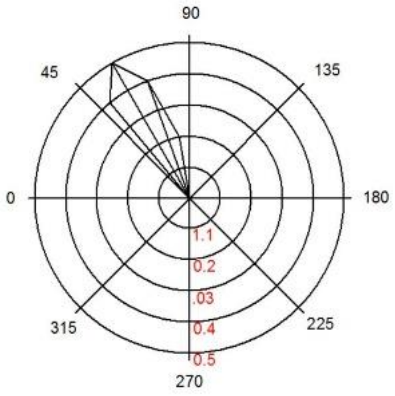
What's happening?

One possibility is that we do not use the same sample cell for the field team and QC team duplicate tests. We found that sample cell orientation can have a large effect on results, especially on small numbers.

Teams have been instructed to use, identify and dedicate a sample cell for each chemical test and to orient the sample cells in the colorimeter using the diamond for consistency of results, so that comparisons over a time period can be made.

However, no two sample cells are the same and the orientation effects can be very different. The effect would be more pronounced in comparison of small numeric values.

Previous tests using 4 different sample cells for nitrate had variations of 0 to 0.5 mg/L as the cells were rotated through 180 degrees.



The reason for this may be subtle differences in transparency of the glass or variations in curvature and in wall thickness causing variation in refraction. The light source and photo cell are located directly opposite one another so it may be that the light beam is dispersed or refracted in a way that reduces the intensity when measured by the photocell.

Recommendations

We do not recommend any changes in our test procedures. Nature Abounds™ recognizes the capability of the equipment they have provided us. By maintaining our procedures our published data is consistent and can be compared over time.

Our report provides users a measure of the quality of the data. If there is a sudden or profound change in a stream, we can notify the proper authorities. Nature Abounds™ encourages and approves using the diamond marker for placement of the sample cells in the colorimeter.

Practices

We need to continue to segregate the sample cells, sample cell lids, and clean them and the colorimeter per our procedures.

We may improve our RPD results by assuring we completely empty the powder packets per the instructions. To assure all the reagent is used we should carefully tear open the powder packs and empty any residue into the sample ceII.

Calibration of the Oakton meter for ambient temperature is not needed as the Oakton meter is compensated for temperature.

We have no control over the sample cells. We could see an improvement in our RPD if the Quality Team performs the duplicate tests with the teams' sample cells. The results would be more representative of the team's RPD performance. This will extend the onsite time but we would only need to do this once a year.

Use the same sample cell for the duplicate tests?

Performing duplicate tests with the same sample cell should improve the results and would be a fairer comparison but may be too time consuming. The Quality team could consider performing duplicate tests using the same sample cell as the field team when the comparison exceeds a difference factor of 1.5 (RPD of 40).

Appendix I

HACH Technical Support

Nitrate Percent Recovery (PR): The HACH Technical service was contacted as to why our initial PR equipment tests of the nitrate standard resulted in in the mean of 7.86 (above the standard).

The Support Tech's answer: "When testing the standard, you can get higher results on DR-850s using the Cadmium Reduction method."

The HACH Tech said the powder packets contain reagents for cadmium reduction that influence our data. These powders assume a concentration of cadmium in the sample that may not be in the general range of our field sample. Many of our Centre County streams have very low levels of Nitrate. The cadmium reduction method may account for some of the apparent increase in nitrate as measured with the colorimeter.

We cut our nitrogen standard in half to 5.0 mg/L for the 2016 Equipment Check, but recorded an average reading of 7.68 mg/L. The HACH recommended correction method (*see Appendix III*) implies that our website colorimeter nitrate data is skewed Hi (overstated).

A correction factor was determined for our current NitaVer-5 powder packets as 0.6 for our 2017 Equipment Check. The true NO3-N concentration of the field sample is the field reading times the correction factor. This indicates that our published colorimeter nitrate data is higher than the true values.

Our comparison of previous Color Wheel NO3 results correct for with our Colorimeter NO3-N results supports this conclusion.

We suspect all PaSEC users of the DR-800 series colorimeter will have the same issue.

Appendix II

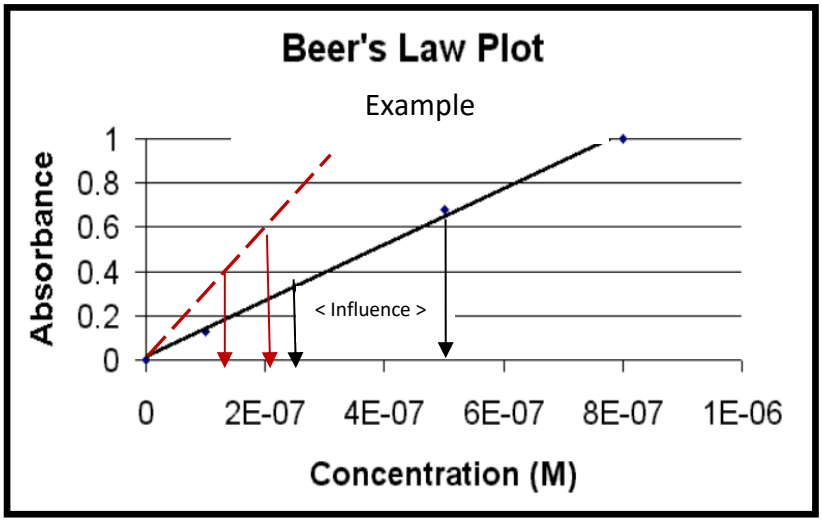
Why it is important that we completely empty the reagent powder packs

Not emptying the reagent powder pack would affect colorimeter reading. The influence of the amount of reagent used for our tests for phosphate and sulfate may be less critical than nitrate if the absorbance line for nitrate is greater than those chemicals.

Illustration:

If we use less than the prescribed amount of reagent, the field sample will absorb less light.

The slope of the absorbance line is different for each chemical. If the slope for the nitrate line is less than those for sulfate or phosphate; the proportion of reagent used would have a greater effect on the derived concentration.



Indicators of unused reagent:

Please tear open the powder pack and empty the remains into the field test sample cell before performing the colorimeter test.

Appendix III

HACH *recommended Formula for Correction of Differences for Cadmium Reduction Method of Nitrate Analysis;*

A=True Concentration of the Sample
B=Concentration of the Reagent Blank (what you get when you run Deionized water as a sample).
C=Observed Concentration of the Sample
D=True Concentration of the standard
E=Observed Concentration of the standard
*A = (C - B) * [D / (E - B)]*
So, when you get your new lot of NitraVer 5 Nitrate Powder packs, you should run a test on deionized water, to see what color the powder powders read as. This is your reagent blank (B). If you get a result of .5 mg/L, then B would be equal to .5 mg/L.

When you test your samples, you will also test a standard solution at the same time. Be sure to shake the sample cells all the same. Take a Hach standardized solution of Nitrate and run it through the test. The number you get is your (E) in this equation. Let's presume you got 12 mg/L. on a 10 mg/L standard. Because your standard is supposed to be 10 mg/L (that's what it says on the box), the true concentration of your standard (D) is 10 mg/L. This is your D value.

With all that in mind, run your sample (C). Imagine that you get a result of 15 mg/L. This is your C, or the Observed Concentration of your sample. So,

*A = (15 - .5) * [10 / (12 - .5)]*
*A = (14.5) * [10/11.5]*
*A = 14.5 * .87*
A = 12.6 mg/L

And THAT is the true concentration of the sample that initially read 15 mg/L.

If you decide not to determine the reagent blank value, then the formula is simply: $A = C \times D \div E$