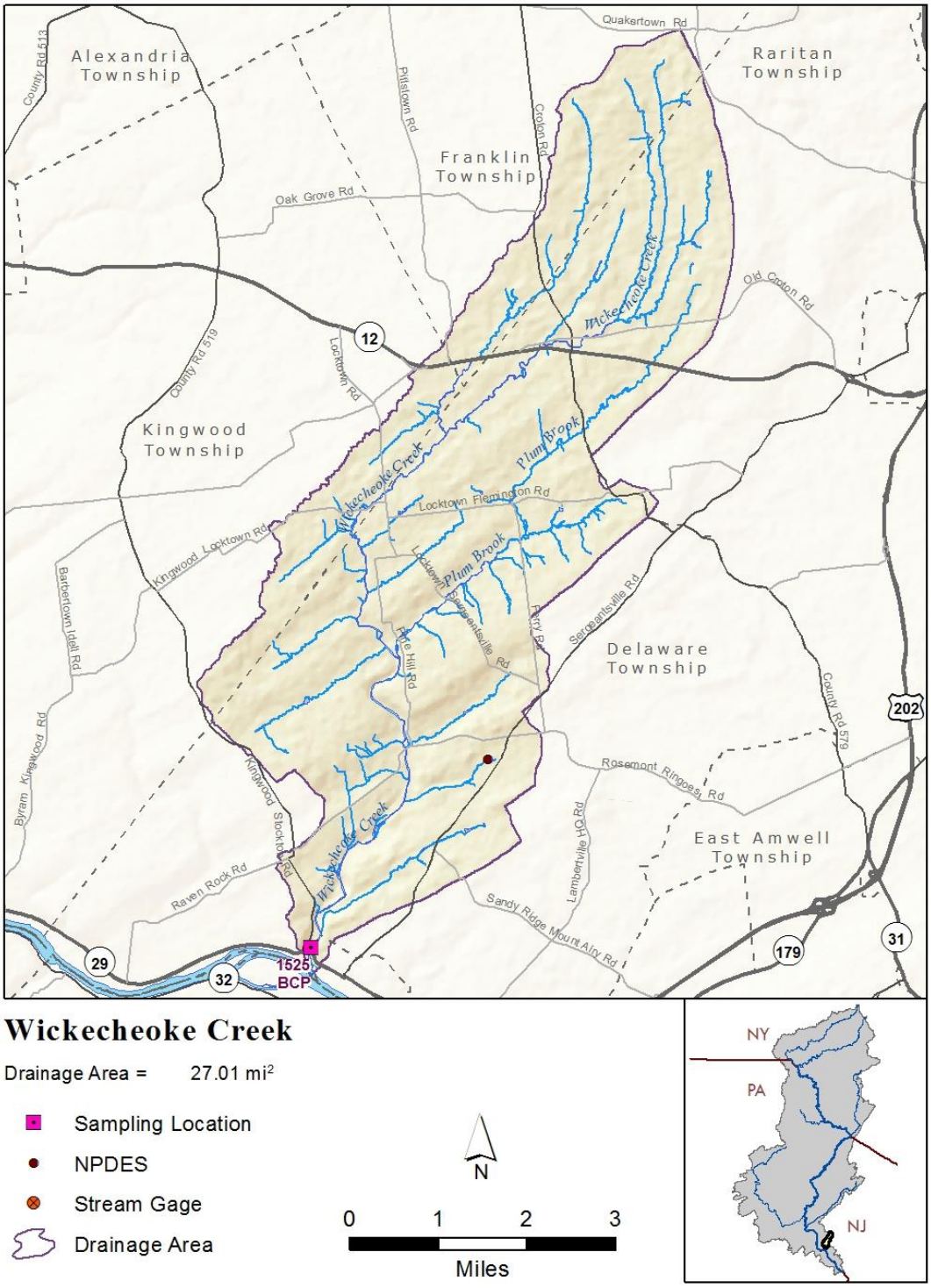
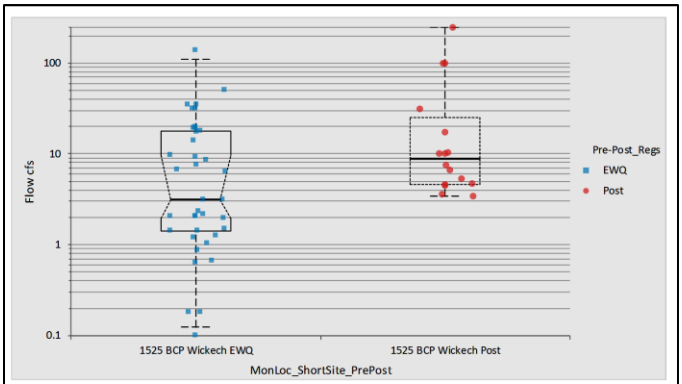
Chapter 5: 1525 BCP Wickecheoke Creek, Hunterdon County, NJ



Analysis of flow differences between the EWQ and post-EWQ periods:



N	54					
Flow cfs by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.10	1.40	3.12	17.98	135.33	16.58
1525 BCP Wickech Post	3.40	4.64	8.75	25.33	250.00	20.69

Kruskal-Wallis test

Flow cfs by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	318.4	8.38
1525 BCP Wickech Post	16	756.3	47.27

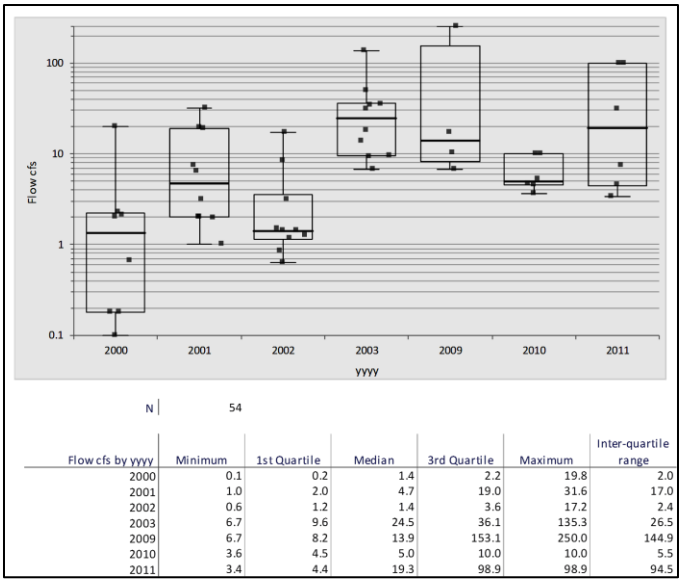
H statistic	4.34
X^2 approximation	4.34
DF	1
p-value	0.0372[1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

Flow was higher during the post-EWQ period. Numerous samples were collected in the EWQ period when the flow was less than 3 cfs. The minimum flow sampled in the post-EWQ period was 3.4 cfs. This has a major effect upon analysis of within-site water quality changes between the two periods, especially for those parameters that are flow-related.

The 27 square mile watershed is about 48% forested, with less than 1% urban land cover. There is no carbonate bedrock in the watershed.

Wickecheoke Creek is captured by the Delaware and Raritan Canal and is used as public water supply, exported outside the Delaware River Basin via the New Jersey Water Supply Authority. Its water quality influence upon the Delaware River is minimal except during high-flow conditions.



N	54					
Flow cfs by yyyy	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
2000	0.1	0.2	1.4	2.2	19.8	2.0
2001	1.0	2.0	4.7	19.0	31.6	17.0
2002	0.6	1.2	1.4	3.6	17.2	2.4
2003	6.7	9.6	24.5	36.1	135.3	26.5
2009	6.7	8.2	13.9	153.1	250.0	144.9
2010	3.6	4.5	5.0	10.0	10.0	5.5
2011	3.4	4.4	19.3	98.9	98.9	94.5

Annual May to September flow statistics are plotted above. Flow is plotted on a logarithmic scale. These are flow measurements or sometimes estimates associated with the time of each water quality sample. "Normal" annual median flow is about 29 cfs at this location, but the summer seasonal flow is much less. The geology of this watershed is such that almost all rainfall runs off almost immediately. Very little water infiltrates into groundwater to be held back as baseflow to the stream. Like several other Piedmont streams of the Lower Delaware, this "flashy" condition means that for most of the summer there is very little water in what appears to be an over-sized channel. When it rains, the channel fills quickly but not for a long duration. Unless it rains frequently, normal flow conditions are not sustained. Thus in the figure above, only during the relatively wet summers of 2003, 2009 and 2011 were near-normal flow conditions represented by these samples.

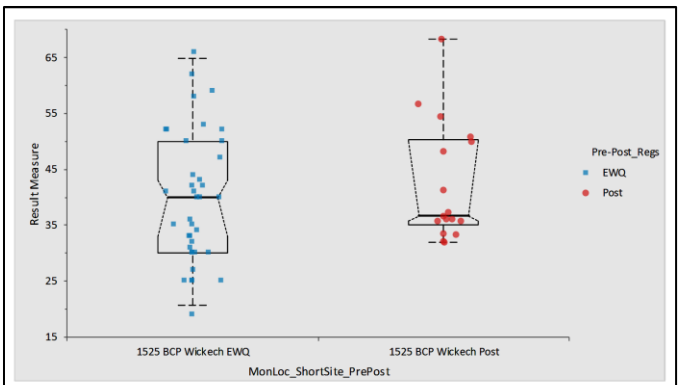
Upstream ICP: Delaware River at Bulls Island 1554 ICP
Downstream ICP: Delaware River at Lambertville 1487 ICP

Chapter 5: 1525 BCP Wickecheoke Creek, NJ

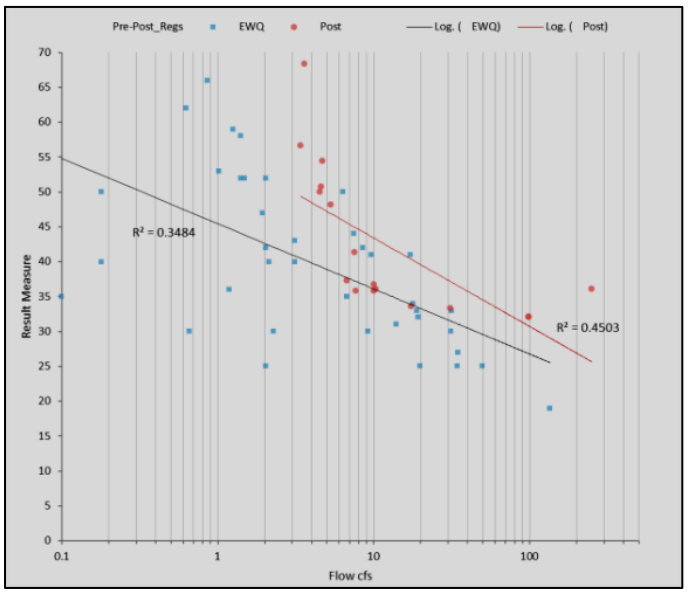
Alkalinity as CaCO3, Total mg/l

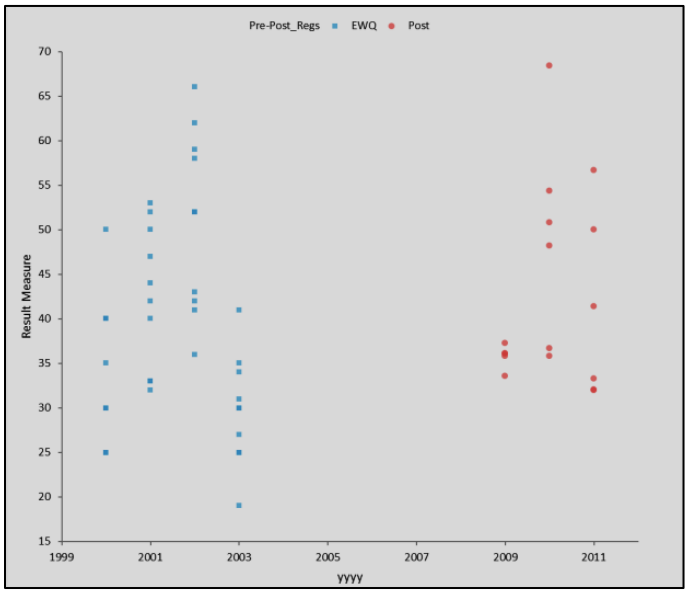
Existing Water Quality (Table 2V):

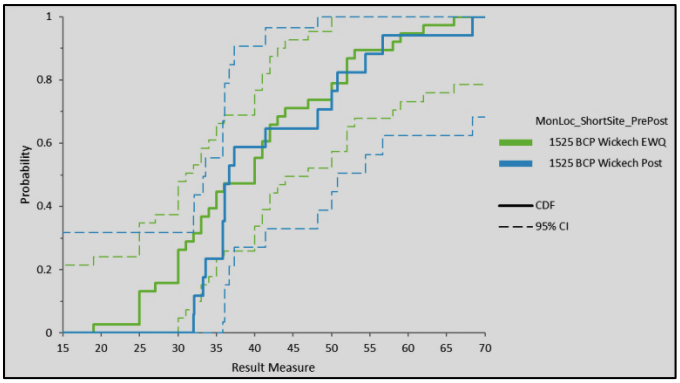
Median 40 mg/l
Lower 95% Confidence Interval 33 mg/l
Upper 95% Confidence Interval 43 mg/l
Defined in regulations as a flow-related parameter



N	55					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	19.0	30.0	40.0	50.0	66.0	20.0
1525 BCP Wickech Post	32.0	35.1	36.7	50.3	68.4	15.2







Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	67.1	1.77
1525 BCP Wickech Post	17	150.0	8.82

H statistic	0.85
X^2 approximation	0.85
DF	1
p-value	0.3574 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

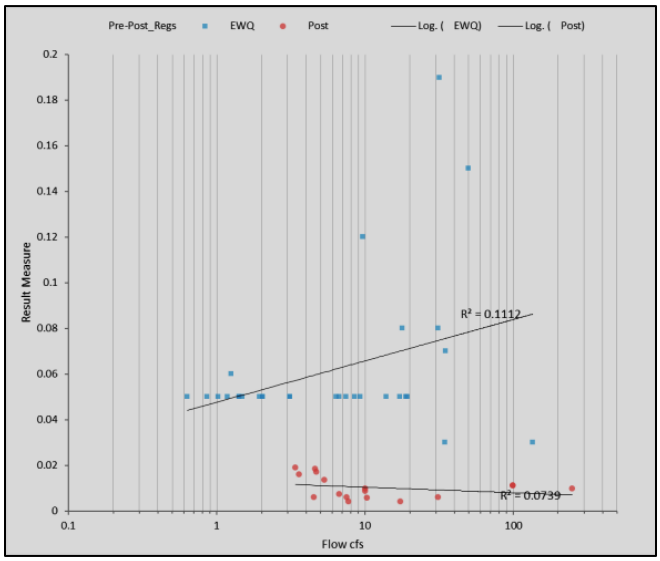
No water quality degradation is evident. Alkalinity did not measurably change between the EWQ and post-EWQ periods. Alkalinity is inversely related to flow in both data sets. Post-EWQ median alkalinity fell within EWQ 95% confidence intervals, and the post-EWQ data were under-represented by dry weather samples. Flow is plotted on a logarithmic axis.

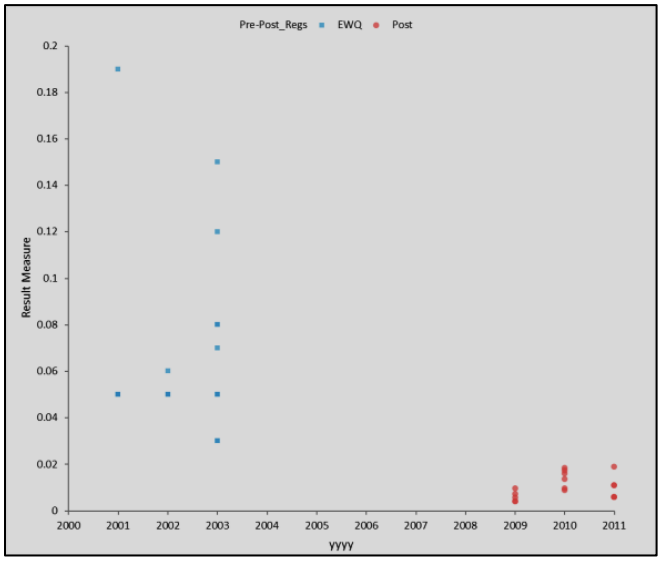
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

Ammonia Nitrogen as N, Total mg/l

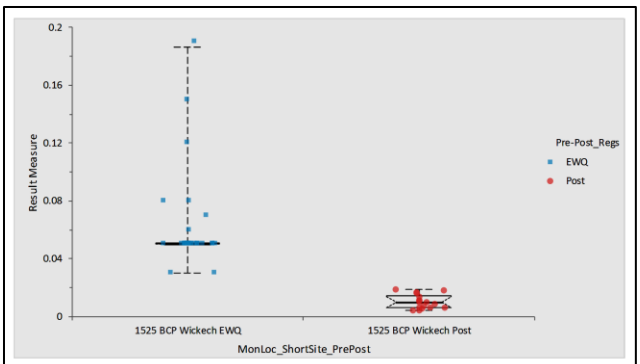
Existing Water Quality (Table 2V):

Median <0.05 mg/l
Lower 95% Confidence Interval <0.05 mg/l
Upper 95% Confidence Interval <0.05 mg/l



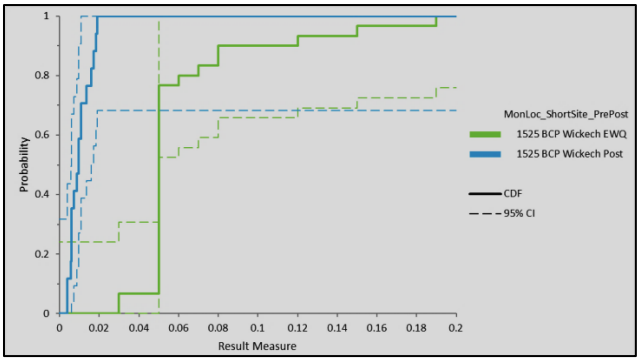


No water quality degradation is evident. Ammonia concentrations apparently declined. However, differences in flow conditions, detection limits, potential laboratory artifacts and too few post-EWQ samples introduced uncertainty to conclusions.



N	47

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.030	0.050	0.050	0.051	0.190	0.001
1525 BCP Wickech Post	0.004	0.006	0.010	0.014	0.019	0.008



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	30	2167.5	72.25
1525 BCP Wickech Post	17	3825.0	225.00

H statistic	35.01
X^2 approximation	35.01
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

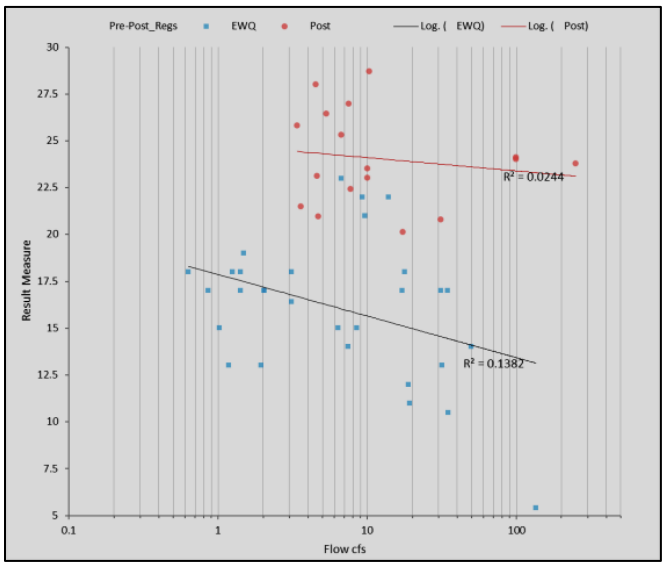
Post-EWQ median ammonia concentration was below the EWQ lower 95% confidence interval. No independent data were readily available to validate the decline. DRBC's post-EWQ detection limit was lower than during the EWQ period. EWQ data possessed high frequencies of non-detect results (23 of 30 samples). Thus EWQ was established as "less than" 0.05 mg/l, which was the detection limit at the time. Even with lower detection levels for post-EWQ samples, there were still 5 out of 17 non-detect results. The decline in concentration at least partially is due to adoption of more sensitive laboratory methods rather than a real change in ambient Wickecheoke Creek concentrations.

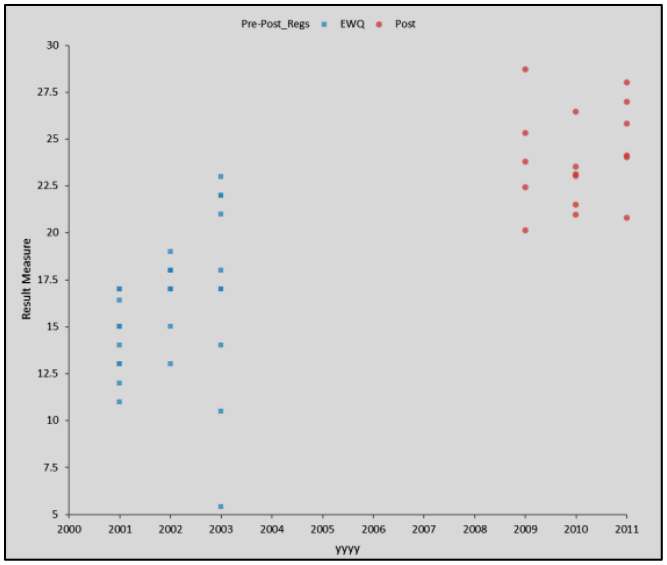
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

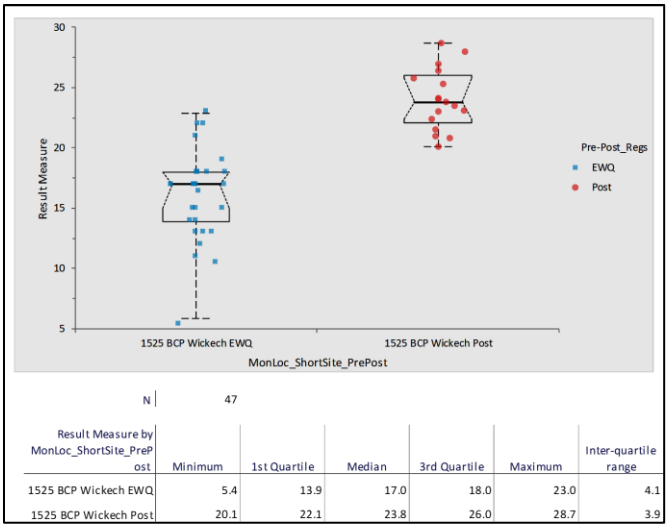
Chloride, Total mg/l

Existing Water Quality (Table 2V):

Median 17 mg/l
Lower 95% Confidence Interval 15 mg/l
Upper 95% Confidence Interval 18 mg/l
Defined in regulations as a flow-related parameter

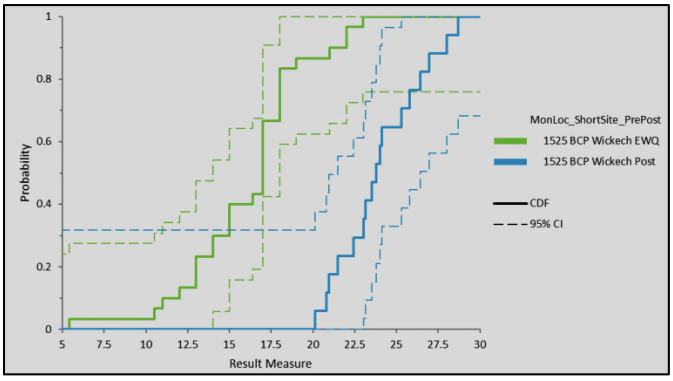






N	47

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	5.4	13.9	17.0	18.0	23.0	4.1
1525 BCP Wickech Post	20.1	22.1	23.8	26.0	28.7	3.9



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	30	1904.0	63.47
1525 BCP Wickech Post	17	3360.1	197.65

H statistic	28.14
X^2 approximation	28.14
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

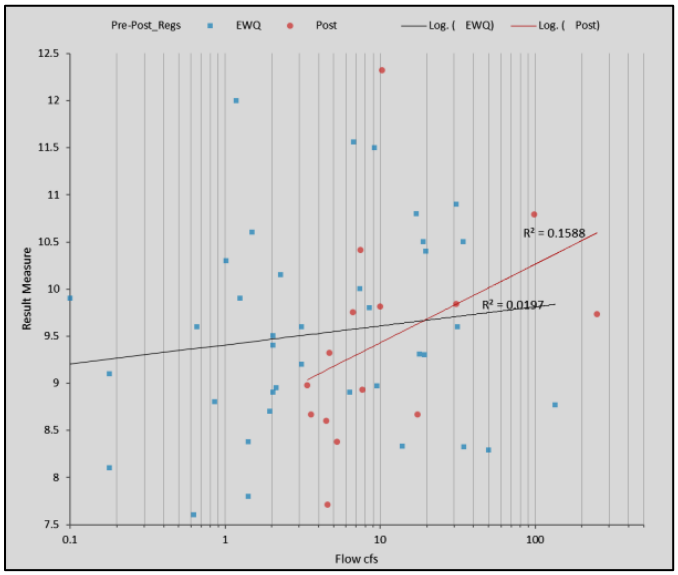
Water quality degradation is evident. Chloride concentrations increased by 6.8 mg/l (40%) between the two periods. Post-EWQ median concentration rose above the EWQ upper 95% confidence interval. Flow is plotted on a logarithmic scale. With no new discharge permits issued in the watershed, we suspect that other sources such as winter road salting may be the main reason for the increase.

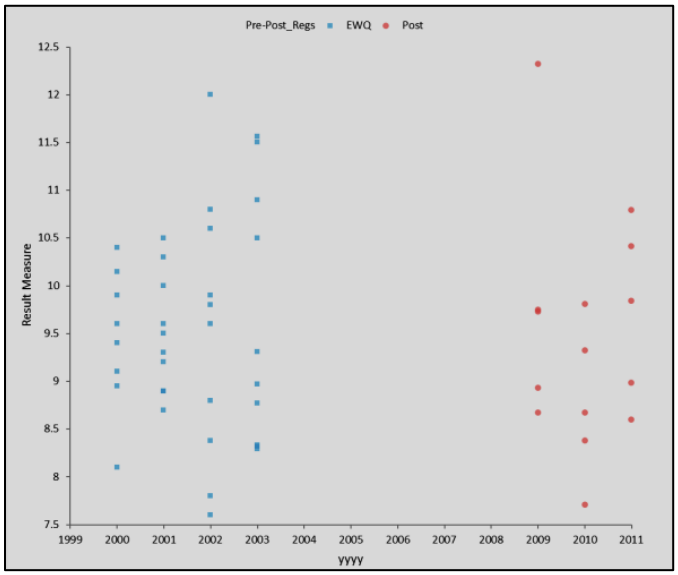
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

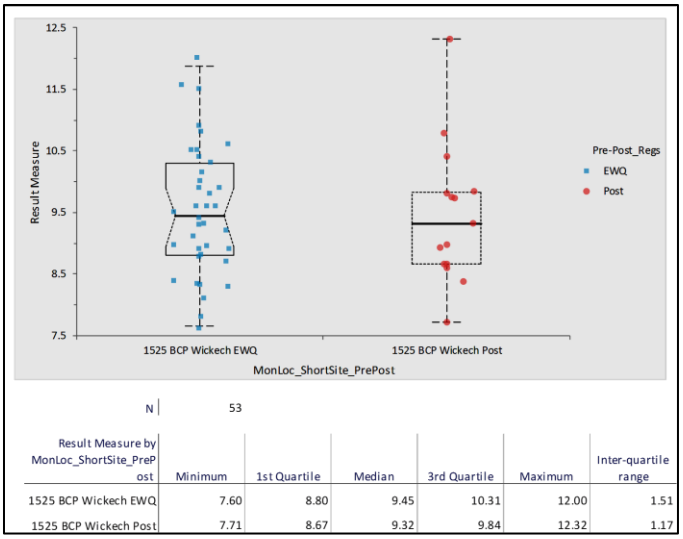
Dissolved Oxygen (DO) mg/l

Existing Water Quality (Table 2V):

Median 9.45 mg/l
Lower 95% Confidence Interval 8.95 mg/l
Upper 95% Confidence Interval 9.90 mg/l

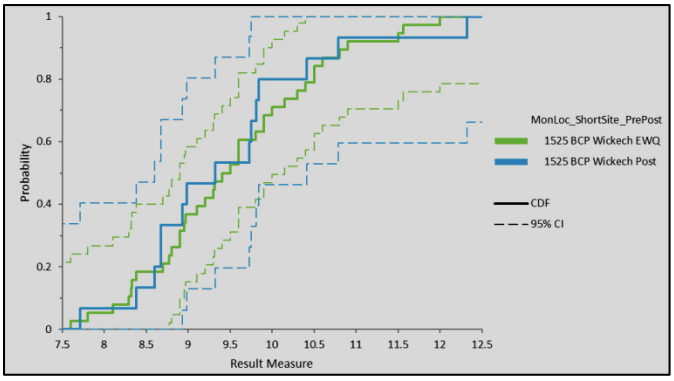






N	53

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	7.60	8.80	9.45	10.31	12.00	1.51
1525 BCP Wickech Post	7.71	8.67	9.32	9.84	12.32	1.17



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	8.1	0.21
1525 BCP Wickech Post	15	20.4	1.36

H statistic	0.12
X^2 approximation	0.12
DF	1
p-value	0.7296 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

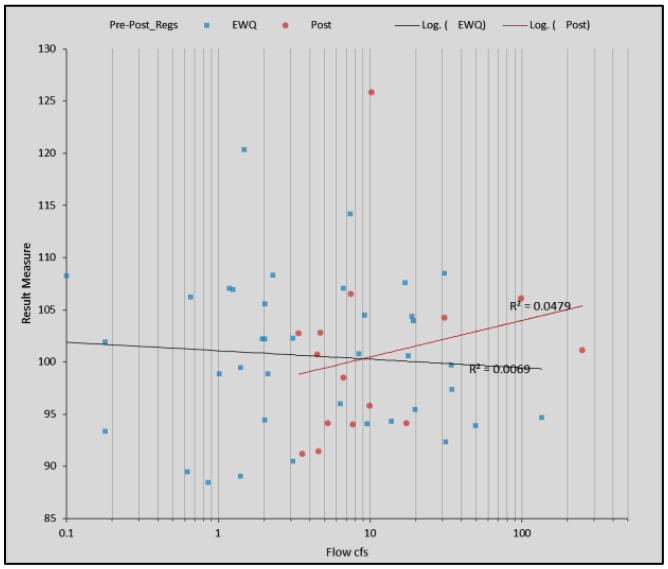
No water quality degradation is evident. No measurable change took place between the EWQ and Post-EWQ periods. Post-EWQ median DO concentration was within the EWQ 95% confidence intervals. Flow is plotted on a logarithmic scale. DO concentration is unrelated to flow in both data sets.

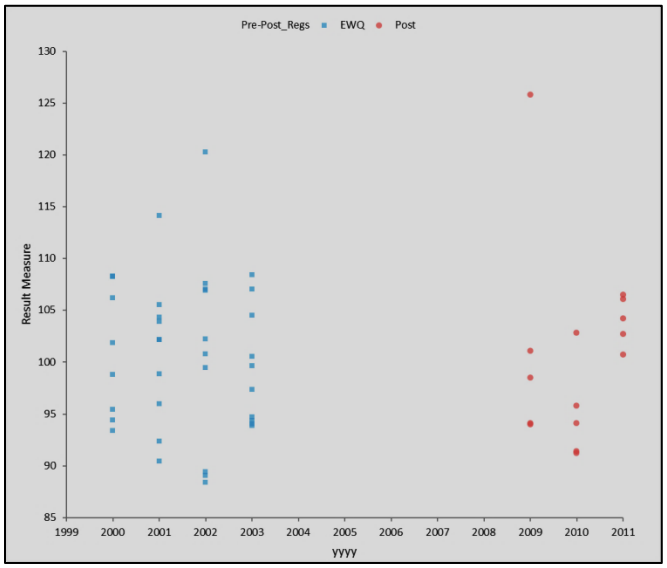
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

Dissolved Oxygen Saturation %

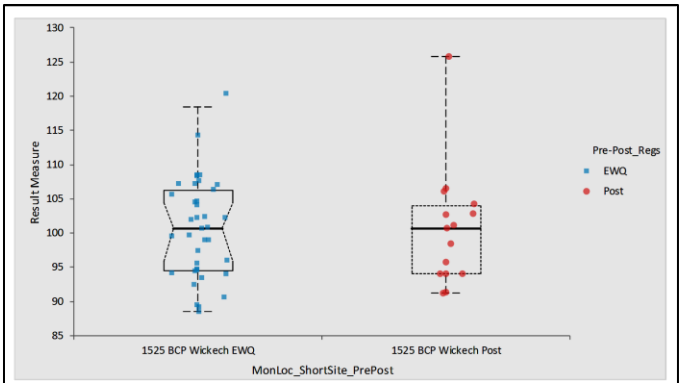
Existing Water Quality (Table 2V):

Median 101%
Lower 95% Confidence Interval 96%
Upper 95% Confidence Interval 104%



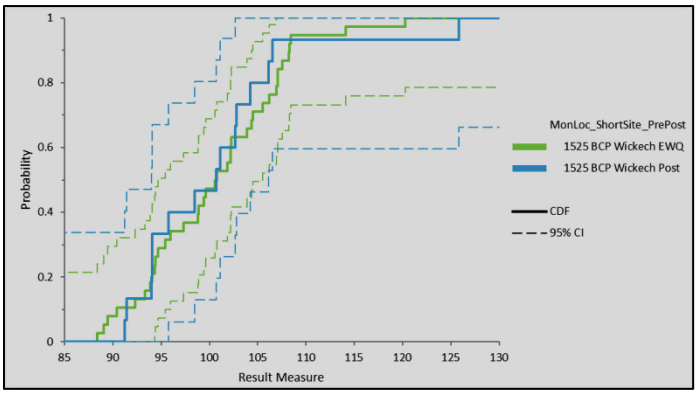


No water quality degradation is evident. Dissolved Oxygen Saturation is unrelated to flow, and did not measurably change between the EWQ and post-EWQ periods. Flow is plotted on a logarithmic scale.



N	53

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	88.4	94.4	100.7	106.3	120.3	11.9
1525 BCP Wickech Post	91.2	94.1	100.7	104.0	125.8	9.9



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	11.6	0.31
1525 BCP Wickech Post	15	29.4	1.96

H statistic	0.17
X^2 approximation	0.17
DF	1
p-value	0.6784 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

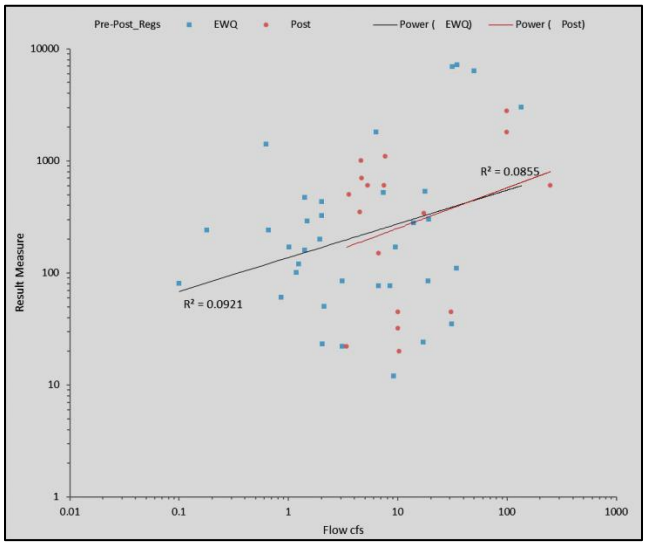
Dissolved oxygen saturation is nicely balanced in Wickecheoke Creek, rarely dipping below 90% or rising above 120%. There are some algae blooms, as indicated by the highest saturation levels, but the blooms never appear to last long. The short duration of algae blooms is probably due to washout by storms. Even a small rain event can scour the Wickecheoke Creek stream bottom of excess algal growth.

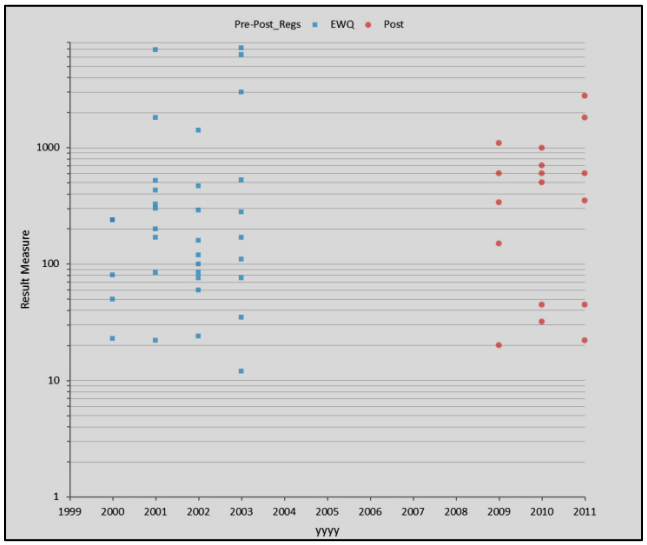
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

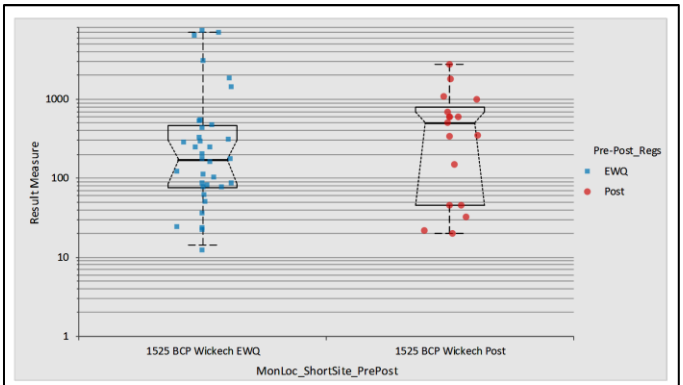
Enterococcus colonies/100 ml

Existing Water Quality (Table 2V):

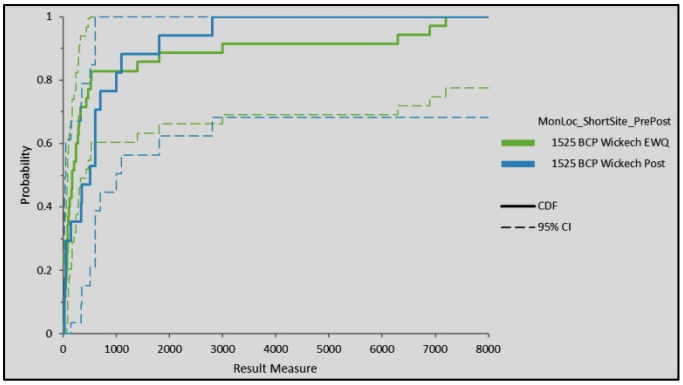
Median 170/100 ml
Lower 95% Confidence Interval 84/100 ml
Upper 95% Confidence Interval 300/100 ml







N	52					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	12	77	170	463	7,200	387
1525 BCP Wickech Post	20	45	500	800	2,800	755



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	35	61.8	1.77
1525 BCP Wickech Post	17	127.2	7.48

H statistic	0.82
X^2 approximation	0.82
DF	1
p-value	0.3643 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. Enterococci did not measurably change between the EWQ and Post-EWQ periods. Sources of analytical uncertainty included potential laboratory artifacts, insufficient post-EWQ sampling (n=17), and poor post-EWQ representation of the flow regime. Enterococcus concentrations are very weakly related to flow in both data sets, but results are highly variable.

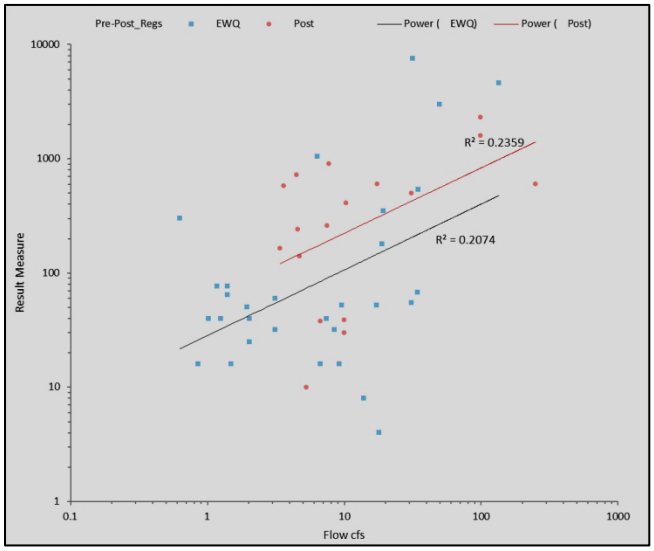
Post-EWQ median enterococcus concentrations were well above the EWQ upper 95% confidence interval, but variability is so high that the rise is statistically meaningless.

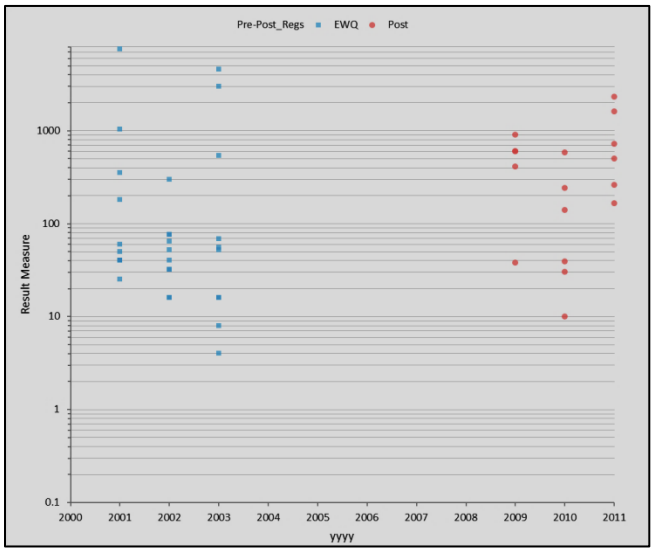
Chapter 5: 1525 BCP
Wickecheoke Creek, NJ

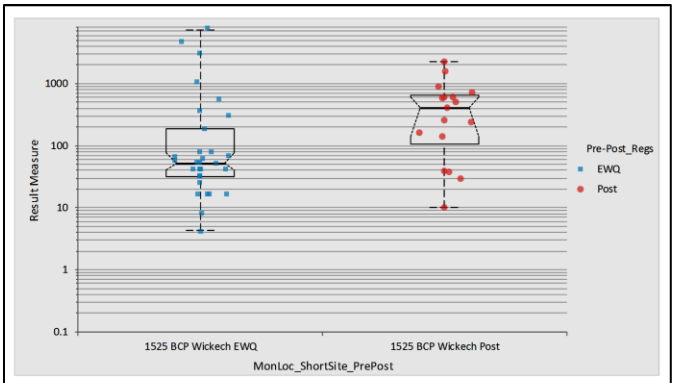
Escherichia coli colonies/100 ml

Existing Water Quality (Table 2V):

Median 52/100 ml
Lower 95% Confidence Interval 40/100 ml
Upper 95% Confidence Interval 76/100 ml

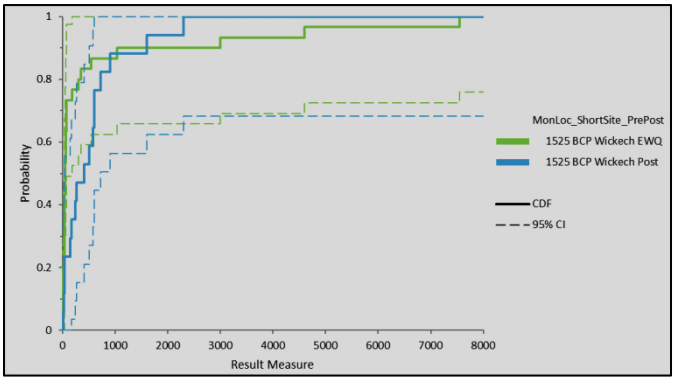






N	47

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	4	31	52	190	7544	159
1525 BCP Wickech Post	10	106	410	640	2300	534



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	30	307.2	10.24
1525 BCP Wickech Post	17	542.1	31.89

H statistic	4.52
X^2 approximation	4.52
DF	1
p-value	0.0334 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

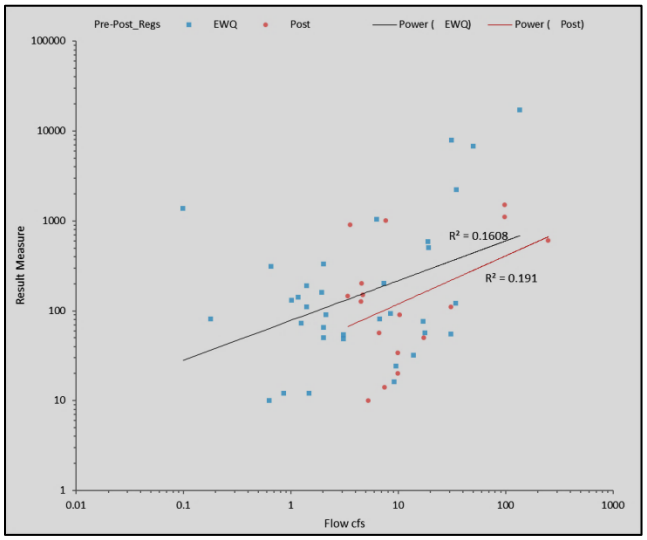
Some evidence of water quality degradation is indicated. E. coli concentrations apparently rose between the EWQ and Post-EWQ periods. Sources of analytical uncertainty included potential laboratory artifacts, insufficient post-EWQ sampling (n=17), and poor post-EWQ representation of the flow regime. No independent data were available at this site to validate DRBC results. The increase is reported as such in the summary matrix, but confidence in the conclusion is low because of low N and high variability.

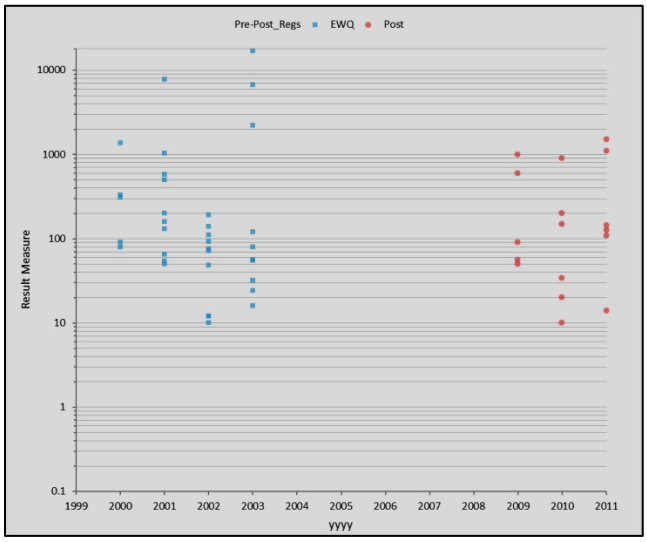
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

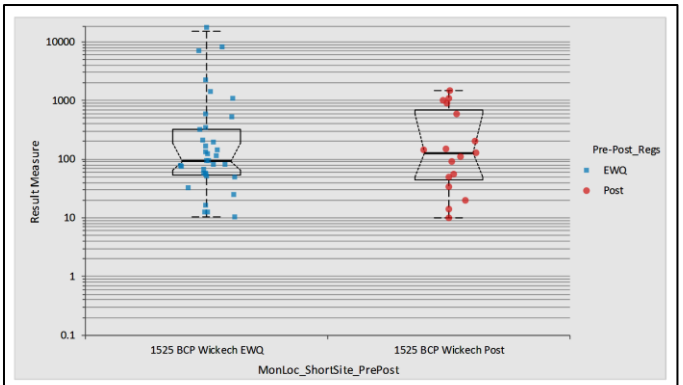
Fecal coliform colonies/100 ml

Existing Water Quality (Table 2V):

Median 92/100 ml
Lower 95% Confidence Interval 65/100 ml
Upper 95% Confidence Interval 190/100 ml

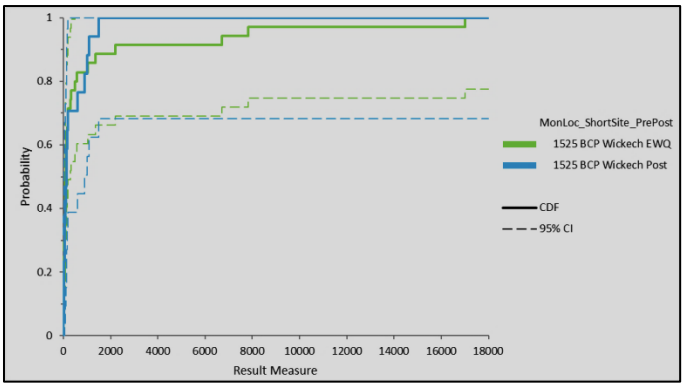






N	52

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	10	54	92	327	17000	273
1525 BCP Wickech Post	10	45	127	700	1500	655



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	35	0.7	0.02
1525 BCP Wickech Post	17	1.5	0.09

H statistic	0.01
X^2 approximation	0.01
DF	1
p-value	0.9223 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

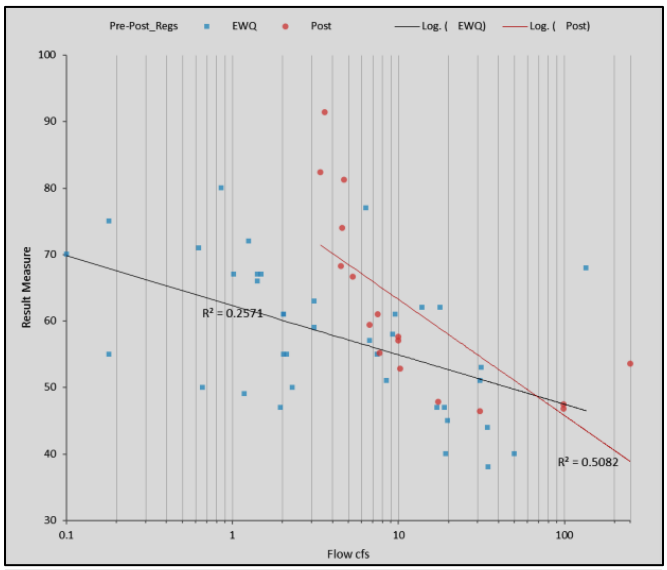
No water quality degradation is indicated. Fecal coliform concentrations did not measurably change between the EWQ and post-EWQ periods. Sources of analytical uncertainty included potential laboratory artifacts, insufficient post-EWQ sampling (n=17), and poor post-EWQ representation of the flow regime. Fecal coliform concentrations are positively but weakly related to flow. Post-EWQ median concentrations fell within the EWQ 95% confidence intervals, but the data were naturally variable and N was low. Note that concentrations and flows are plotted on a logarithmic scale.

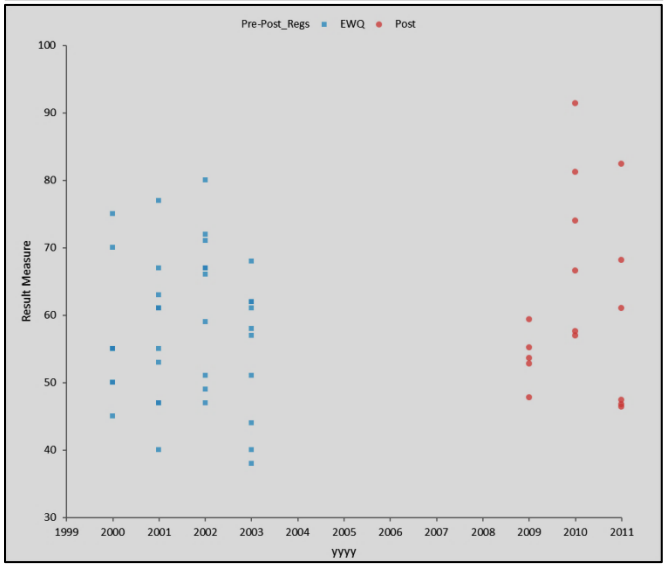
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

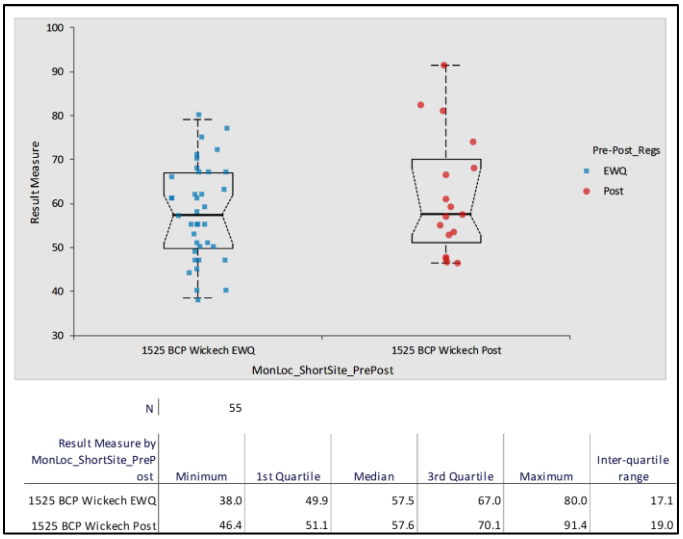
Hardness as CaCO3, Total mg/l

Existing Water Quality (Table 2V):

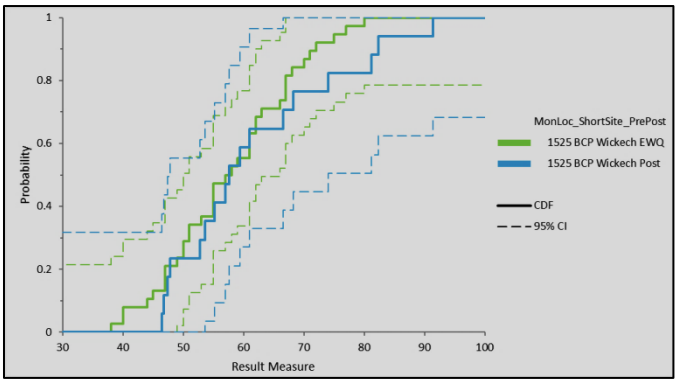
Median 58 mg/l
Lower 95% Confidence Interval 51 mg/l
Upper 95% Confidence Interval 62 mg/l
Defined in regulations as a flow-related parameter







N	55					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	38.0	49.9	57.5	67.0	80.0	17.1
1525 BCP Wickech Post	46.4	51.1	57.6	70.1	91.4	19.0



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	38.0	1.00
1525 BCP Wickech Post	17	84.9	5.00

H statistic	0.48
X^2 approximation	0.48
DF	1
p-value	0.4886 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

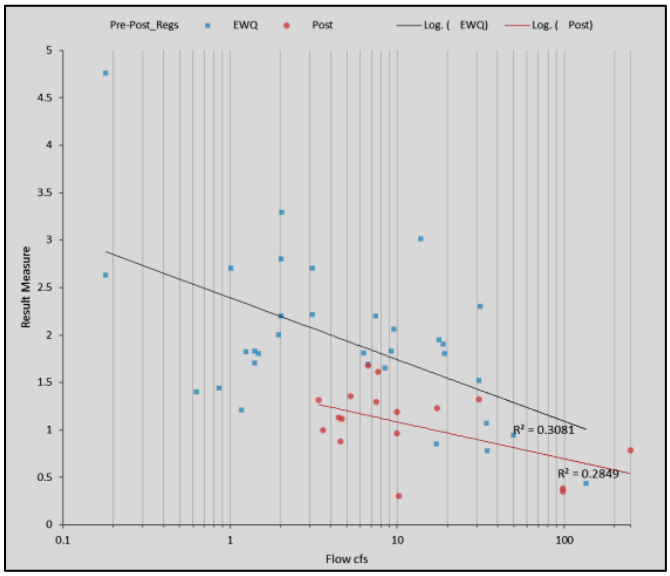
No water quality degradation is indicated. Hardness did not measurably change between the EWQ and post-EWQ periods. Sources of analytical uncertainty included potential laboratory artifacts, insufficient post-EWQ sampling (n=17), and poor post-EWQ representation of the flow regime. Hardness is inversely related to flow. Post-EWQ median hardness fell within the EWQ 95% confidence intervals. Note that flows are plotted on a logarithmic scale.

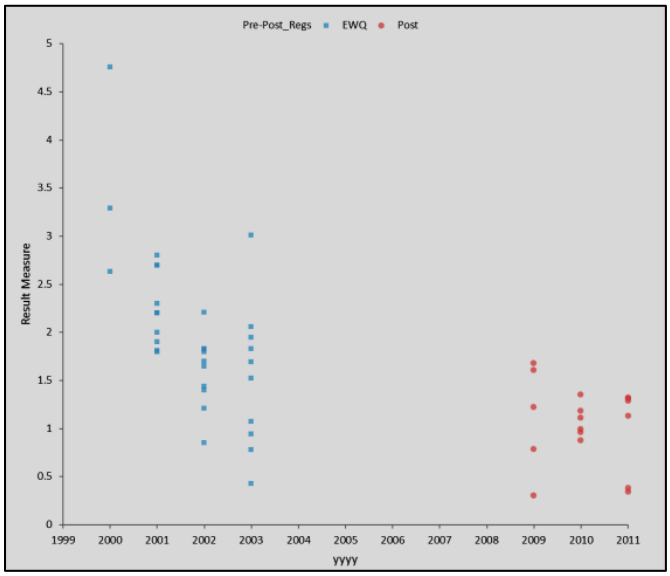
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

Nitrate + Nitrite as N, Total mg/l

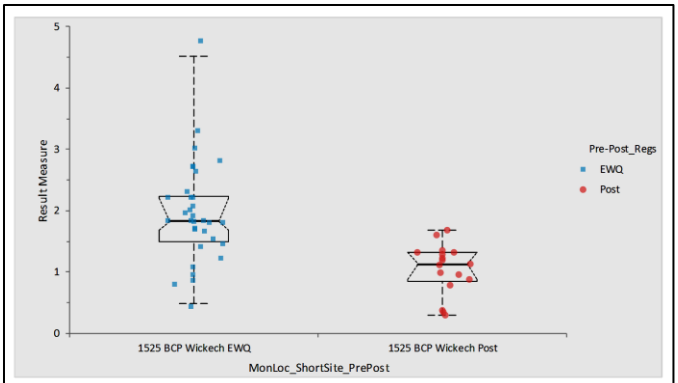
Existing Water Quality (Table 2V, as Nitrate only):

Median 1.83 mg/l
Lower 95% Confidence Interval 1.69 mg/l
Upper 95% Confidence Interval 2.20 mg/l



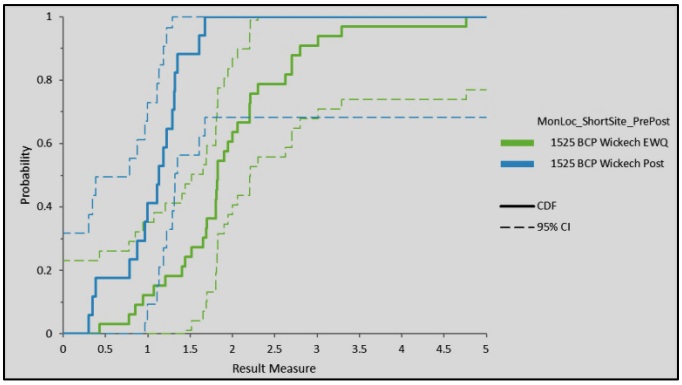


No water quality degradation is indicated. Nitrate concentrations apparently declined between the EWQ and post-EWQ periods. However, differences in flow conditions and potential laboratory artifacts introduced uncertainty. In both data sets, nitrate is inversely but weakly related to flow. On the annual plot, 2002-2003 EWQ nitrates appear to match well with post-EWQ nitrate + nitrite for 2009.



N	50

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.430	1.493	1.830	2.240	4.760	0.747
1525 BCP Wickech Post	0.303	0.845	1.129	1.316	1.678	0.471



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	33	1254.9	38.03
1525 BCP Wickech Post	17	2436.0	143.29

H statistic	17.37
X^2 approximation	17.37
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

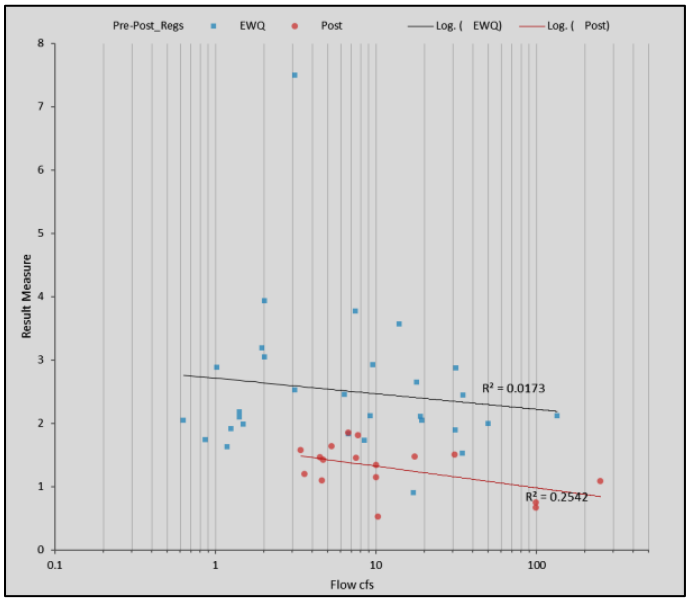
Nitrate + Nitrite concentrations are assumed to be equivalent for comparison with EWQ nitrate concentrations, since EWQ nitrite concentrations were never detected. Note that flows are plotted on a logarithmic scale. Independent data were not available for validation of the apparent decline in concentrations shown by DRBC. Post-EWQ median nitrate + nitrite concentrations fell below the EWQ lower 95% confidence interval. There was no interference by undetected values in either data set.

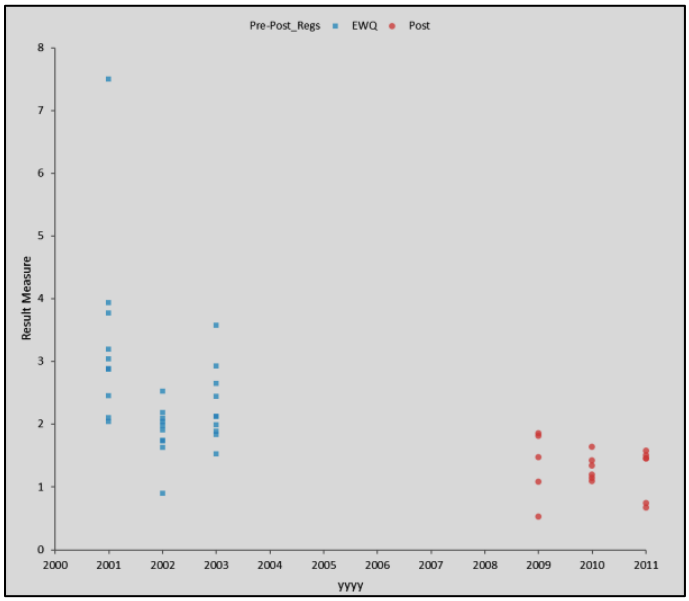
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

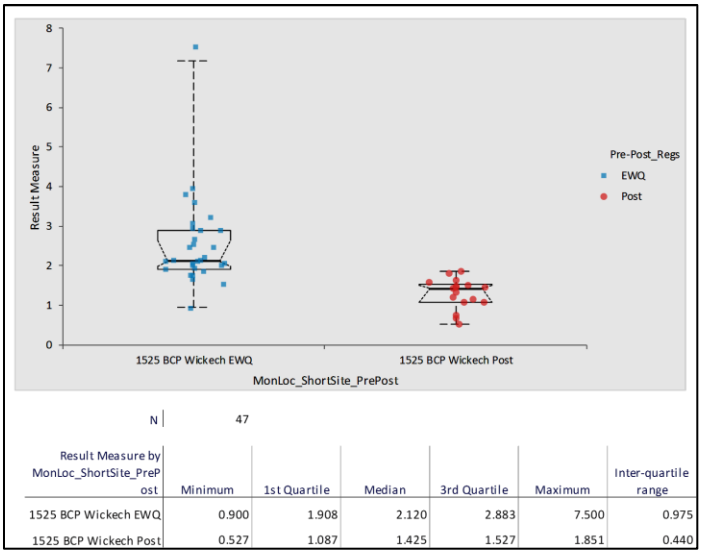
Nitrogen as N, Total (TN) mg/l

Existing Water Quality (Table 2V):

Median 2.12 mg/l
Lower 95% Confidence Interval 1.99 mg/l
Upper 95% Confidence Interval 2.65 mg/l

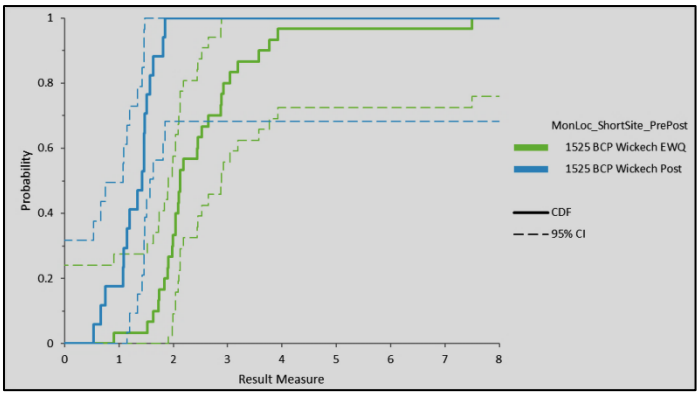






N	47

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.900	1.908	2.120	2.883	7.500	0.975
1525 BCP Wickech Post	0.527	1.087	1.425	1.527	1.851	0.440



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	30	1748.0	58.27
1525 BCP Wickech Post	17	3084.8	181.46

H statistic	25.71
X^2 approximation	25.71
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

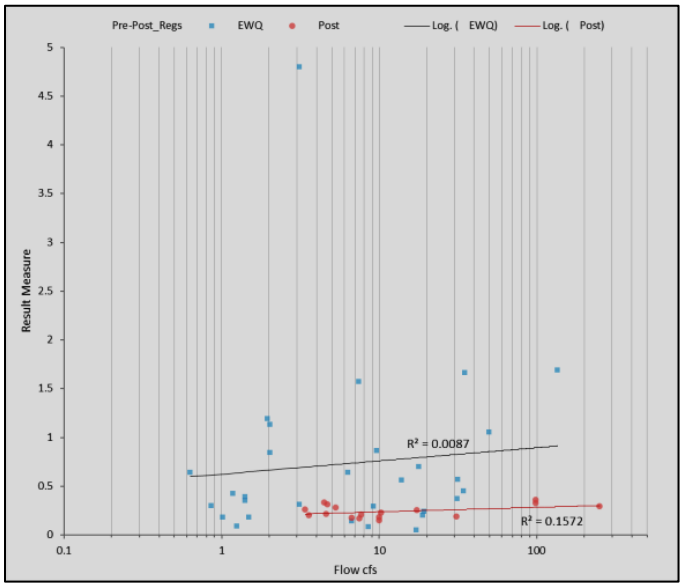
No water quality degradation is indicated. TN apparently declined between the EWQ and post-EWQ periods. However, flow differences and potential laboratory artifacts introduced uncertainty in conclusions. TN is weakly related to flow in the post-EWQ period, but unrelated to flow in the EWQ period due to skewing of the regression by an outlier sample. Note that flows are plotted on a logarithmic scale. DRBC results could not be independently validated. Post-EWQ median TN concentrations fell below the EWQ lower 95% confidence interval.

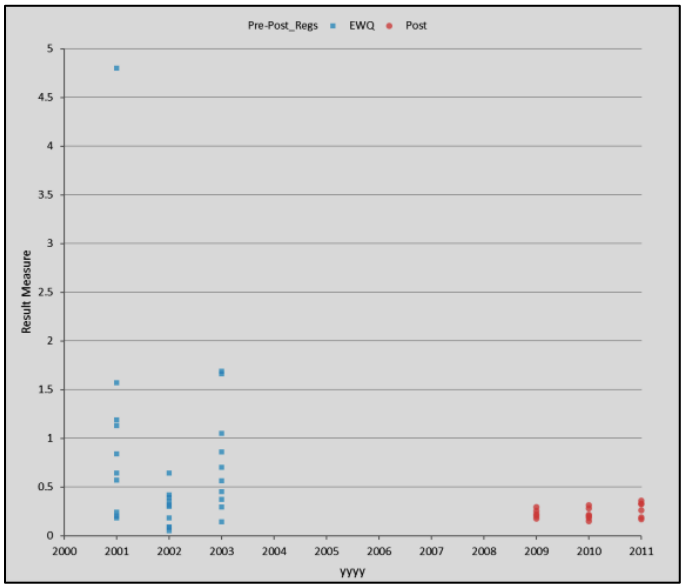
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

Nitrogen, Kjeldahl as N, Total (TKN) mg/l

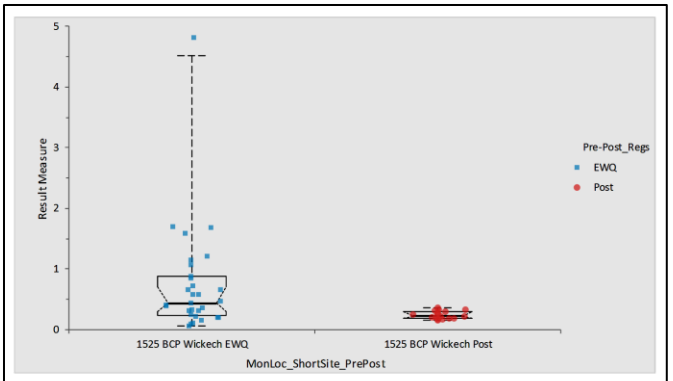
Existing Water Quality (Table 2V):

Median 0.44 mg/l
Lower 95% Confidence Interval 0.30 mg/l
Upper 95% Confidence Interval 0.70 mg/l



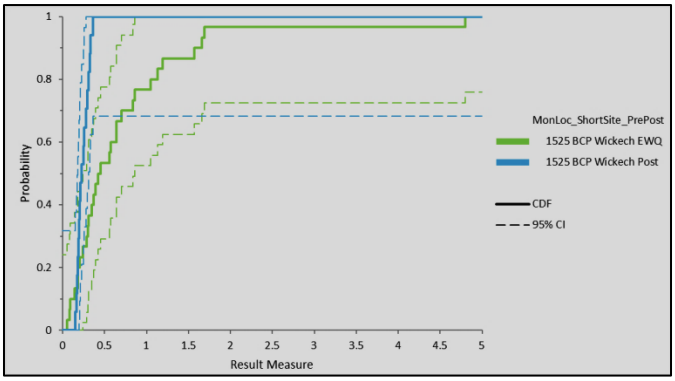


No water quality degradation is indicated. TKN concentrations apparently declined between the EWQ and post-EWQ periods. However, flow differences and potential laboratory artifacts introduced uncertainty in conclusions. TKN concentration is unrelated to flow in both data sets.



N	47

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.050	0.237	0.435	0.876	4.800	0.639
1525 BCP Wickech Post	0.149	0.184	0.223	0.300	0.360	0.116



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	30	546.1	18.20
1525 BCP Wickech Post	17	963.8	56.69

H statistic	8.03
X^2 approximation	8.03
DF	1
p-value	0.0046 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

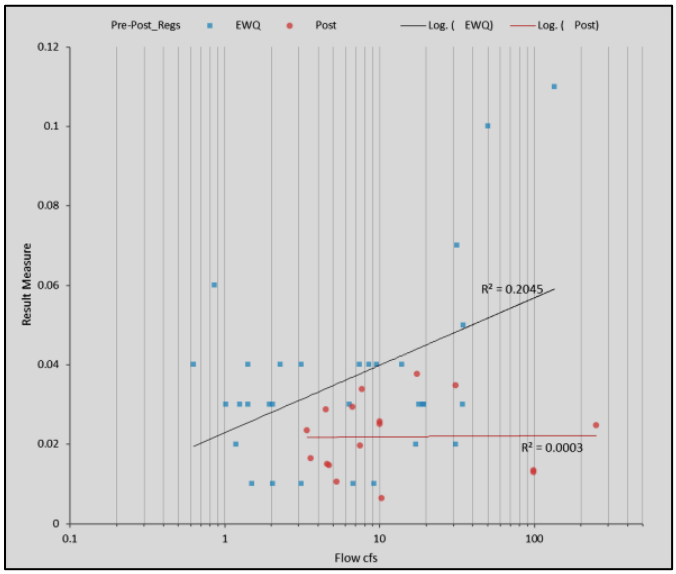
TKN ranges less widely and is less variable in the post-EWQ data set. Post-EWQ median TKN fell below the EWQ lower 95% confidence interval. Unlike nitrate + nitrite and other parameters, the TKN data sets are more directly comparable since there are no discrepancies in detection limits throughout the two periods. The main difference was that there were less dry weather post-EWQ TKN samples. Because of method stability, the decrease in concentrations may indicate a real improvement in water quality.

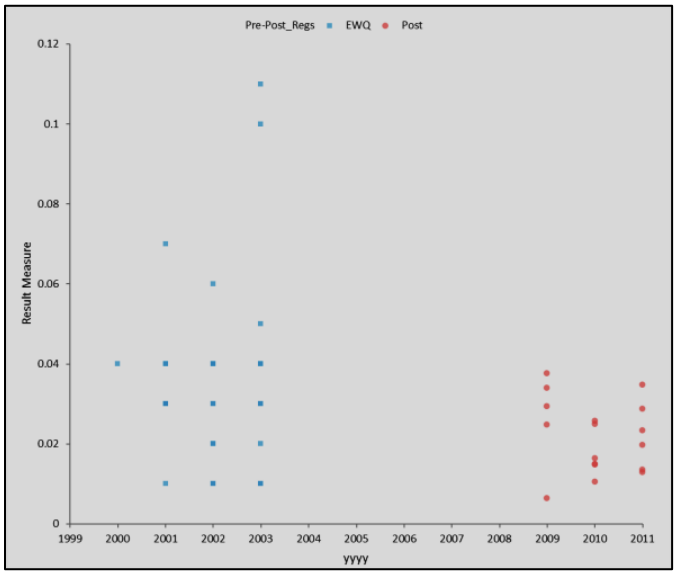
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

Orthophosphate as P, Total mg/l

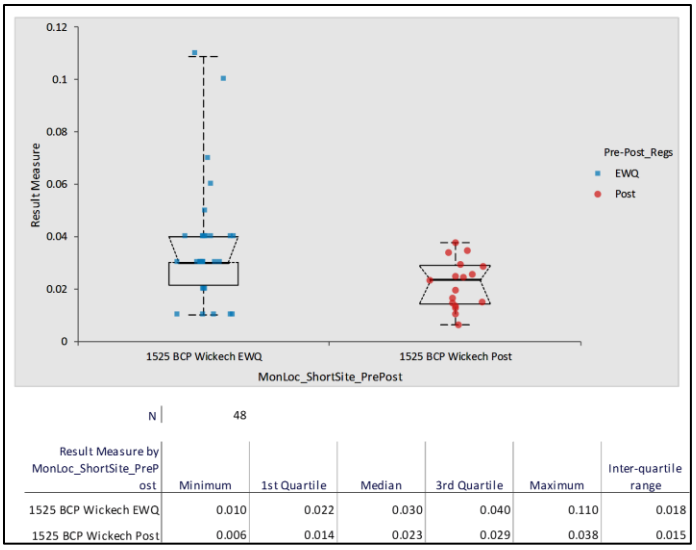
Existing Water Quality (Table 2V):

Median 0.03 mg/l
Lower 95% Confidence Interval 0.03 mg/l
Upper 95% Confidence Interval 0.04 mg/l



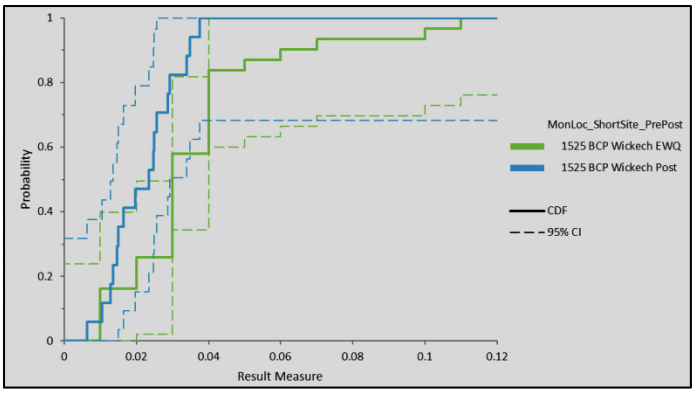


No water quality degradation is indicated. Orthophosphate concentrations apparently declined between the EWQ and post-EWQ periods. However, flow differences and potential laboratory artifacts introduced uncertainty in conclusions.



N	48

Result Measure by MonLoc_ShortSite_PreP ost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.010	0.022	0.030	0.040	0.110	0.018
1525 BCP Wickech Post	0.006	0.014	0.023	0.029	0.038	0.015



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PreP ost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	31	516.2	16.65
1525 BCP Wickech Post	17	941.3	55.37

H statistic	7.55
X^2 approximation	7.55
DF	1
p-value	0.0060 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

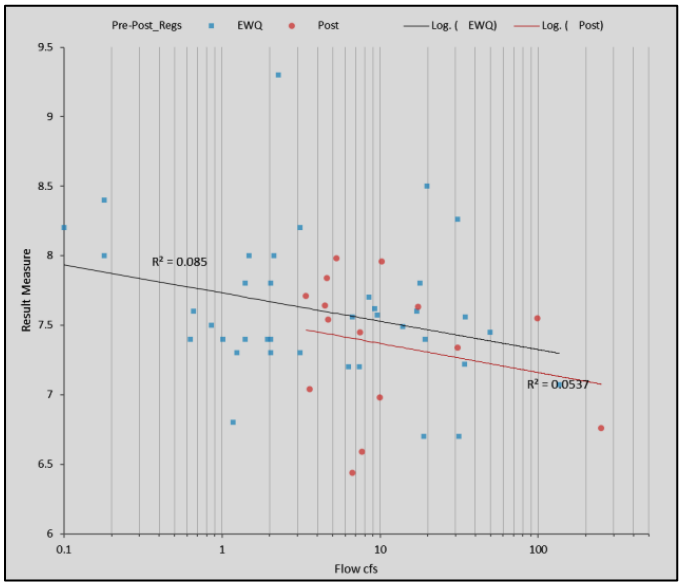
Orthophosphate is weakly related to flow in the EWQ data set, but unrelated to flow in the post-EWQ data set. Note that flows are plotted on a logarithmic scale. Post-EWQ median orthophosphate fell below the EWQ lower 95% confidence interval. There were no independent data to confirm DRBC results. DRBC detection limits improved between the two periods, but there was no interference in calculation of the median by non-detect results. Some improvement in water quality may be evident in that there are no values above 0.04 mg/l in the post-EWQ data set.

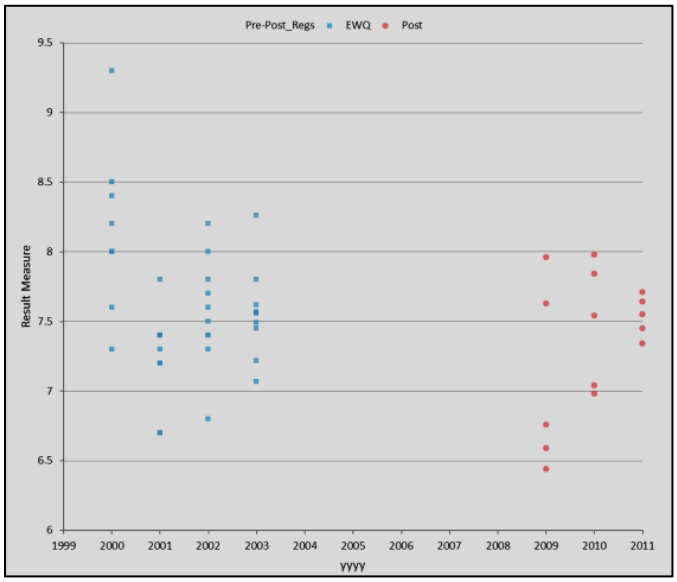
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

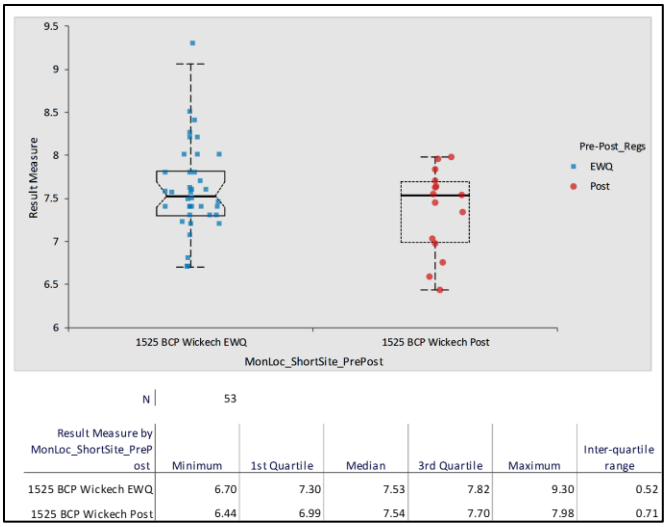
pH, units

Existing Water Quality (Table 2V):

Median 7.53 standard units
Lower 95% Confidence Interval 7.40 standard units
Upper 95% Confidence Interval 7.70 standard units

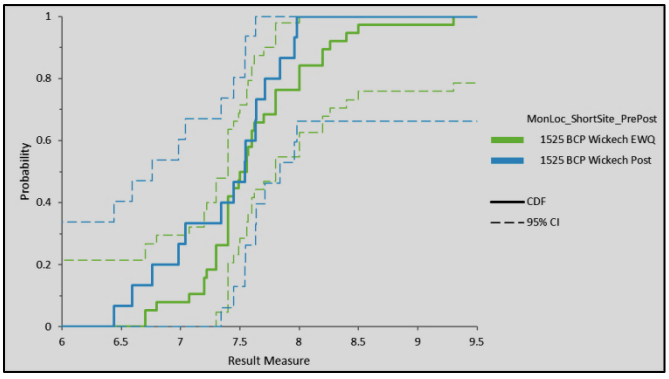






N	53

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	6.70	7.30	7.53	7.82	9.30	0.52
1525 BCP Wickech Post	6.44	6.99	7.54	7.70	7.98	0.71



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	64.5	1.70
1525 BCP Wickech Post	15	163.4	10.89

H statistic	0.96
X^2 approximation	0.96
DF	1
p-value	0.3279 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

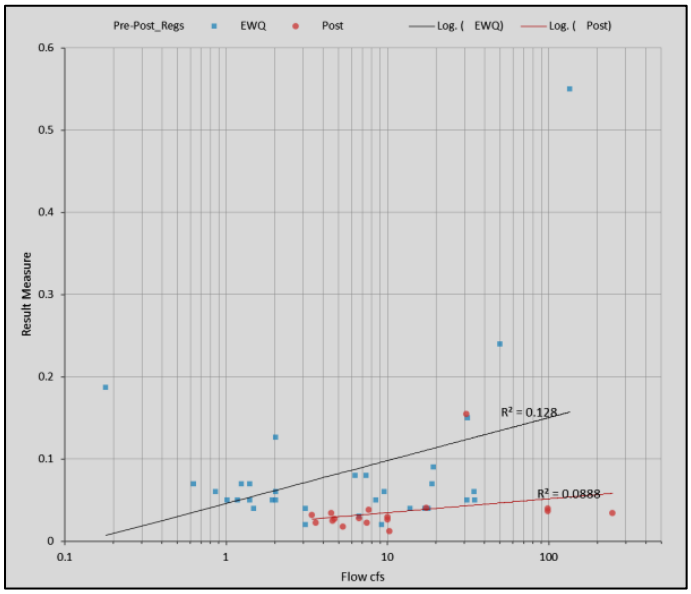
No water quality degradation is indicated. pH did not measurably change between the EWQ and post-EWQ periods. Under higher flow conditions, pH tends toward neutral, though pH is unrelated to flow in both data sets. Post-EWQ median pH fell within the EWQ 95% confidence intervals. Note that flows are plotted on a logarithmic scale.

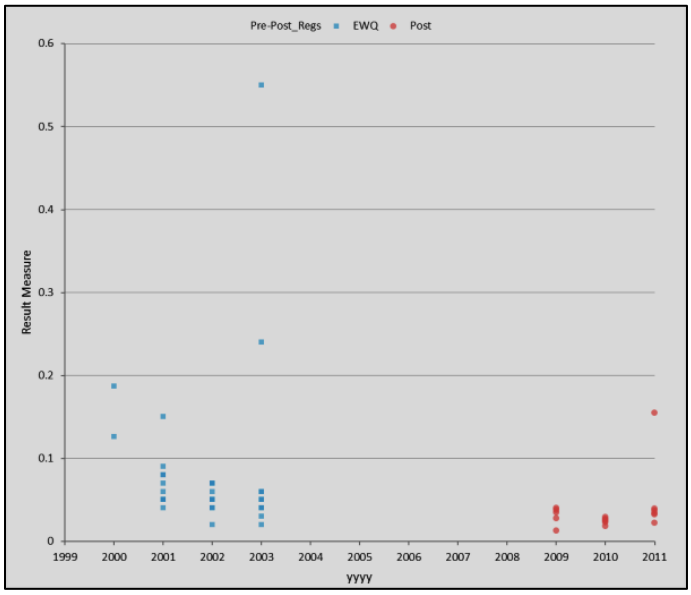
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

Phosphorus as P, Total (TP) mg/l

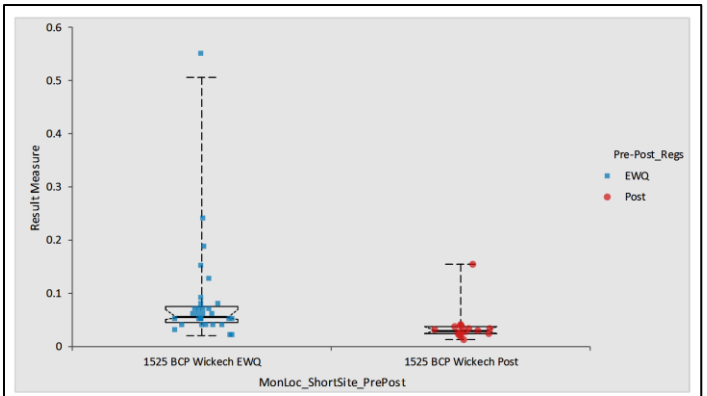
Existing Water Quality (Table 2V):

Median 0.06 mg/l
Lower 95% Confidence Interval 0.05 mg/l
Upper 95% Confidence Interval 0.07 mg/l



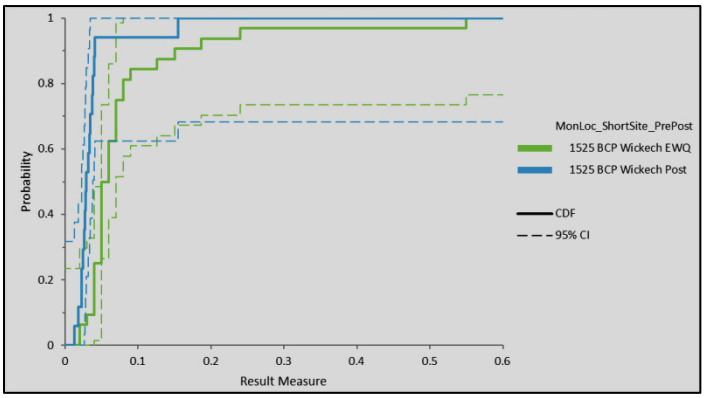


No water quality degradation is indicated. Total Phosphorus (TP) concentrations apparently declined between the EWQ and post-EWQ periods. However, flow differences and potential laboratory artifacts introduced uncertainty in conclusions.



N	49

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.020	0.044	0.055	0.076	0.550	0.032
1525 BCP Wickech Post	0.013	0.024	0.029	0.037	0.155	0.013



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	32	1287.8	40.24
1525 BCP Wickech Post	17	2424.1	142.59

H statistic	18.30
X^2 approximation	18.30
DF	1
p-value	<0.0001 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

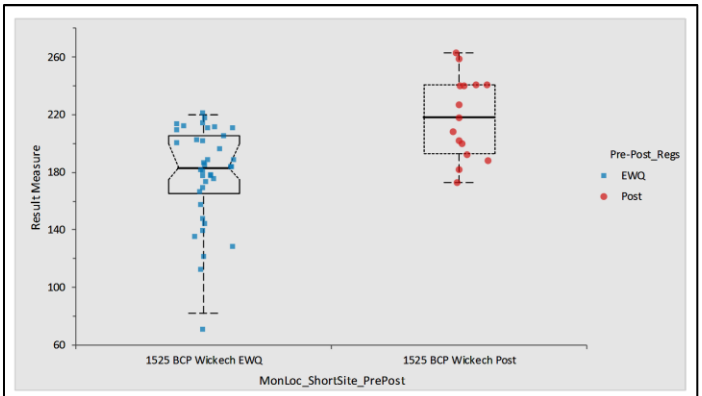
Post-EWQ median total phosphorus fell below the EWQ lower 95% confidence interval. TP is unrelated to flow in both data sets. Note that flows are plotted on a logarithmic scale. No independent data were available to confirm these results. The compressed appearance of data on these graphs is caused by a single high outlier value from a sample taken in September 2003 (0.55 mg/l). The cause for the high value is unknown.

Chapter 5: 1525 BCP Wickecheoke Creek, NJ

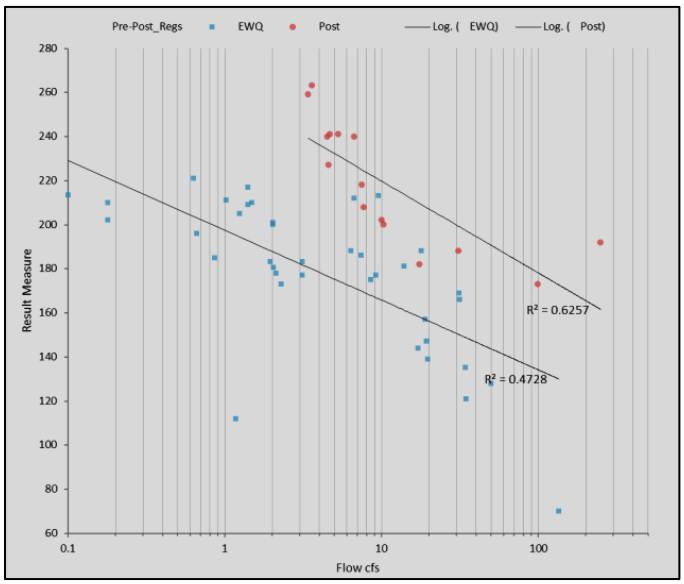
Specific Conductance µmho/cm

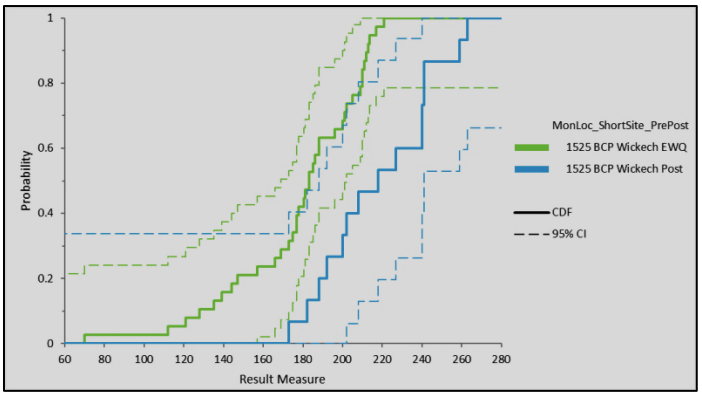
Existing Water Quality (Table 2V):

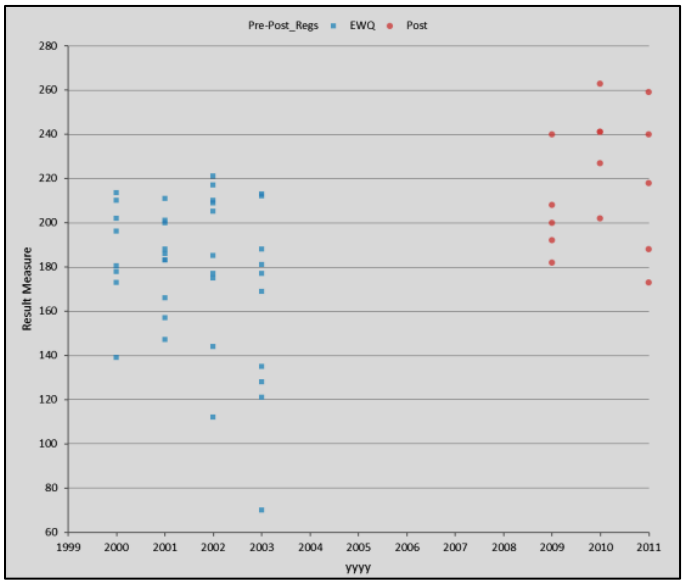
Median 183 µmho/cm
Lower 95% Confidence Interval 175 µmho/cm
Upper 95% Confidence Interval 200 µmho/cm
Defined in regulations as a flow-related parameter



N	53					
Result Measure by MonLoc_ShortSite_PreP ost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	70.0	165.3	183.0	205.3	221.0	40.1
1525 BCP Wickech Post	173.0	193.3	218.0	240.8	263.0	47.5







Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PreP ost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	819.8	21.57
1525 BCP Wickech Post	15	2076.8	138.45

H statistic	12.15
X^2 approximation	12.15
DF	1
p-value	0.0005 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

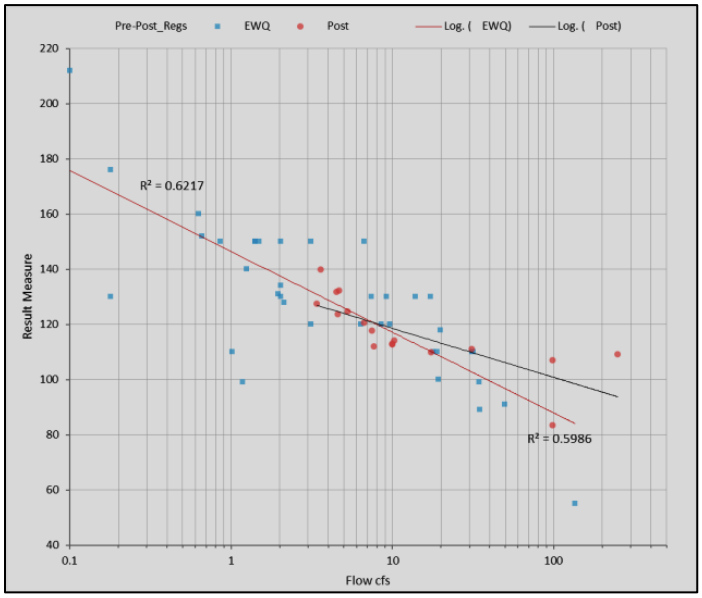
Water quality degradation is evident. Specific conductance rose above the EWQ upper 95% confidence interval between the EWQ and post-EWQ periods. In both data sets, specific conductance is inversely related to flow. Note that flows are plotted on a logarithmic scale. The rise in specific conductance may be attributable to the concurrent rise in chloride concentrations. No new dischargers are present in the watershed. Specific conductance has risen from a median of 183 µmho/cm to 218 µmho/cm, a 19% increase in a short time span.

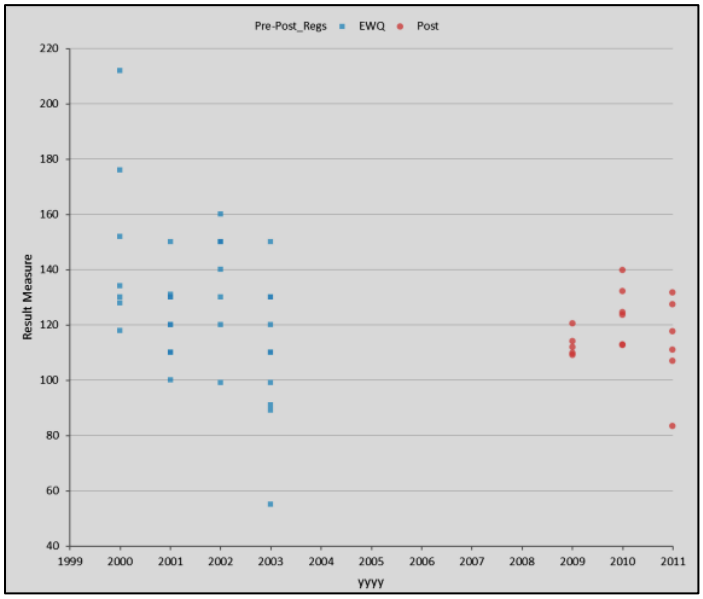
Chapter 5: 1525 BCP
Wickecheoke Creek, NJ

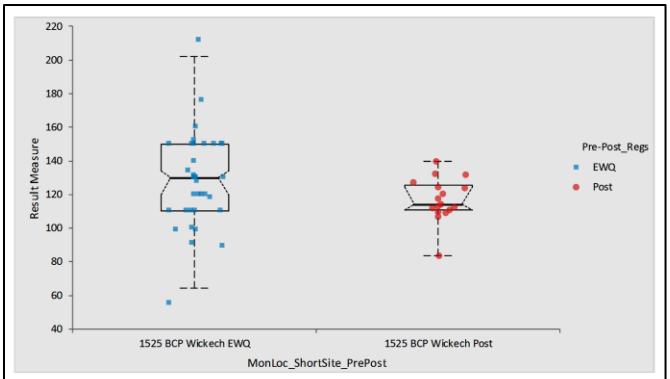
Total Dissolved Solids (TDS) mg/l

Existing Water Quality (Table 2V):

Median 130 mg/l
Lower 95% Confidence Interval 120 mg/l
Upper 95% Confidence Interval 134 mg/l
Defined in regulations as a flow-related parameter

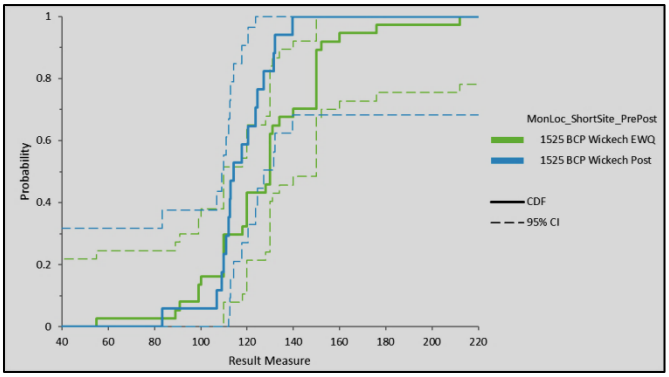






N	54

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	55	110	130	150	212	40
1525 BCP Wickech Post	83	111	114	126	140	15



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	37	231.3	6.25
1525 BCP Wickech Post	17	503.3	29.61

H statistic	2.98
X^2 approximation	2.98
DF	1
p-value	0.0842 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

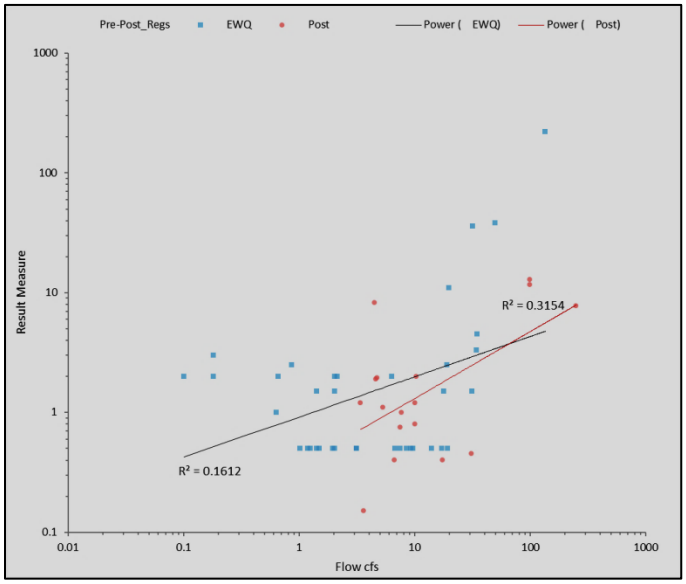
No water quality degradation is evident. TDS did not measurably change between the EWQ and post-EWQ periods. TDS is inversely and strongly related to flow in both data sets. Stream flows were different between the two periods, so flow accounts for some of the apparent decline in TDS even though the decline was not statistically significant. Post-EWQ median TDS was below the EWQ 95% lower confidence interval. Post-EWQ detection limits were lower than EWQ detection limits, though there were no non-detect results at any time. Note that flows are plotted on a logarithmic scale.

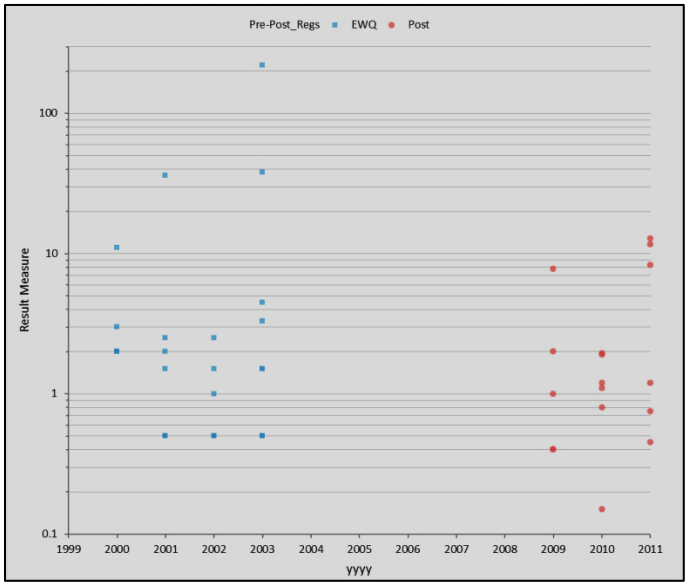
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

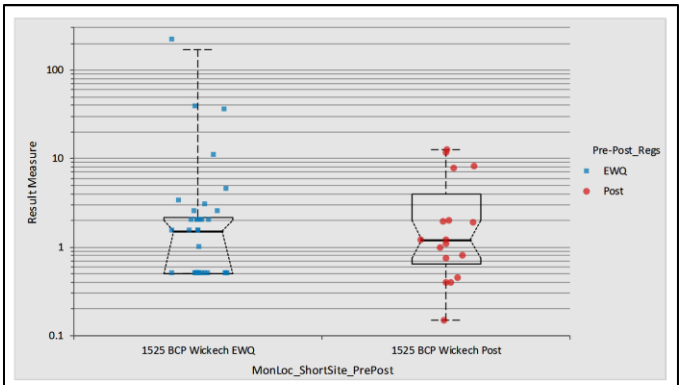
Total Suspended Solids (TSS) mg/l

Existing Water Quality (Table 2V):

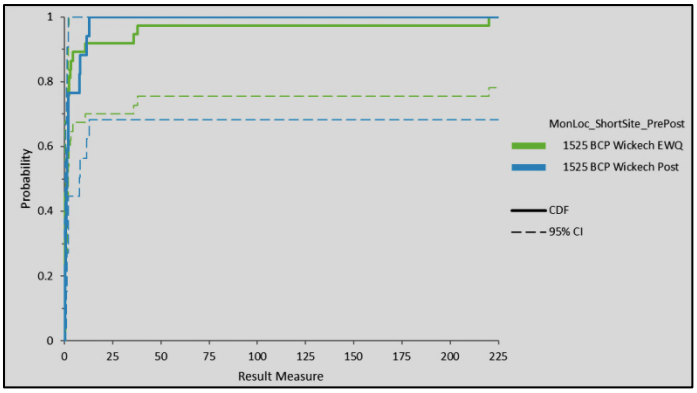
Median 1.0 mg/l
Lower 95% Confidence Interval <0.5 mg/l
Upper 95% Confidence Interval 1.5 mg/l
Defined in regulations as a flow-related parameter







N	54					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.5	0.5	1.5	2.2	220.0	1.7
1525 BCP Wickech Post	0.2	0.6	1.2	3.9	12.8	3.3



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	37	1.1	0.03
1525 BCP Wickech Post	17	2.5	0.15

H statistic	0.02
X^2 approximation	0.02
DF	1
p-value	0.9020 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

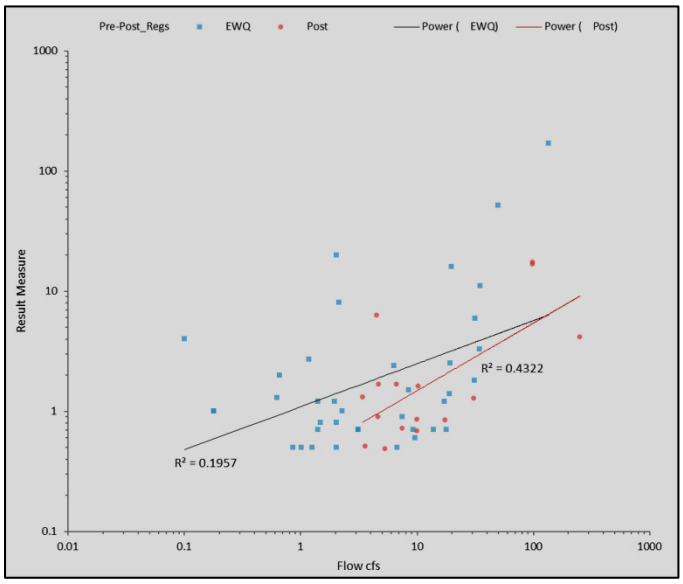
No water quality degradation is evident. TSS did not measurably change between the EWQ and post-EWQ periods. TSS is positively related to flow in both data sets, though the relationship is weaker in the EWQ data because of numerous non-detect results in the data that were estimated at the detection limit concentration (22 of 39 samples). Post-EWQ median TSS was within the EWQ 95% confidence intervals. Note that both flow and concentration are plotted on a logarithmic scale.

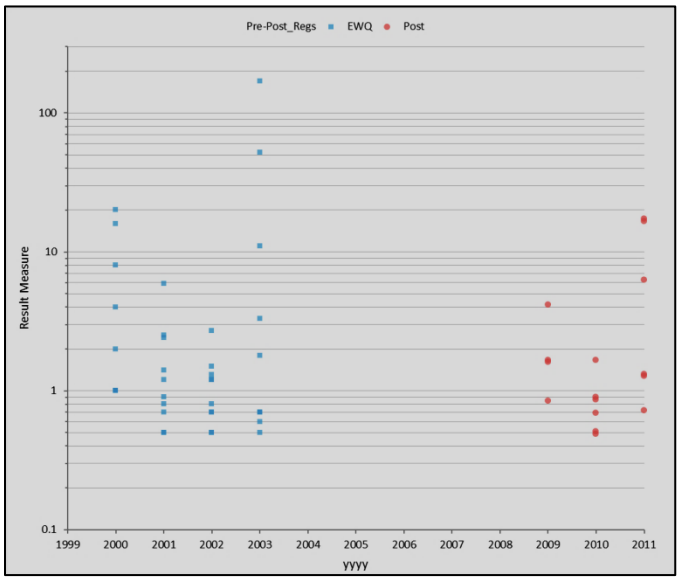
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

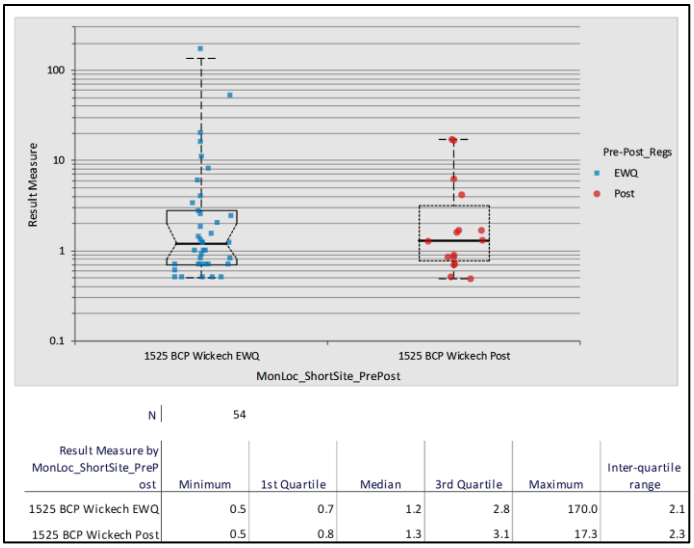
Turbidity NTU

Existing Water Quality (Table 2V):

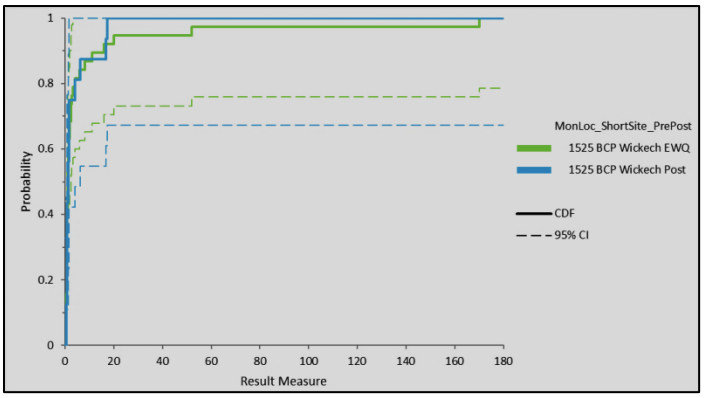
Median 1.2 NTU
Lower 95% Confidence Interval 0.7 NTU
Upper 95% Confidence Interval 2.0 NTU
Defined in regulations as a flow-related parameter







N	54					
Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	0.5	0.7	1.2	2.8	170.0	2.1
1525 BCP Wickech Post	0.5	0.8	1.3	3.1	17.3	2.3



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	2.4	0.06
1525 BCP Wickech Post	16	5.6	0.35

H statistic	0.03
X^2 approximation	0.03
DF	1
p-value	0.8570 [1]

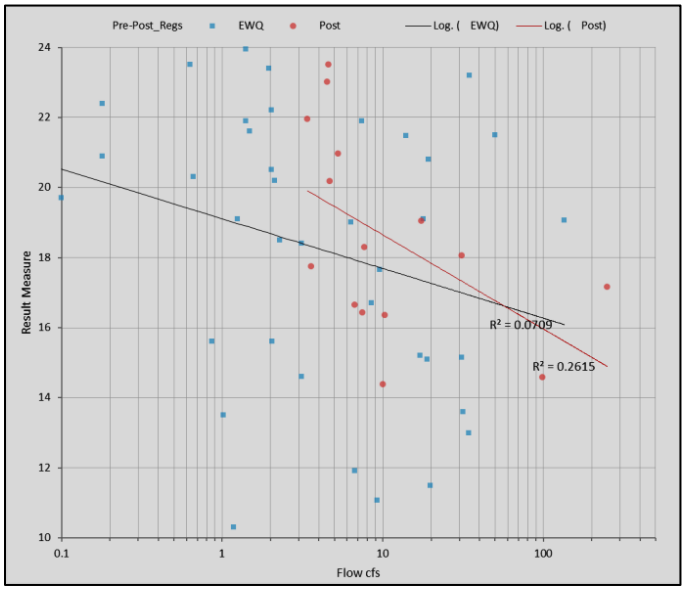
H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

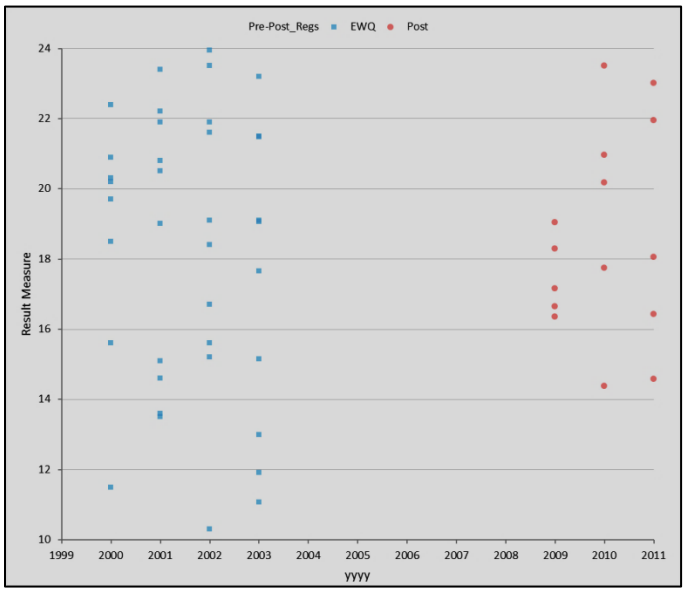
No water quality degradation is evident. Turbidity did not measurably change between the EWQ and post-EWQ periods. The post-EWQ median turbidity fell within the EWQ 95% confidence intervals of the median. In both data sets, the turbidity vs. flow relationship is positive, though the EWQ relationship is weak. Note that both concentration and flow are represented on logarithmic scales.

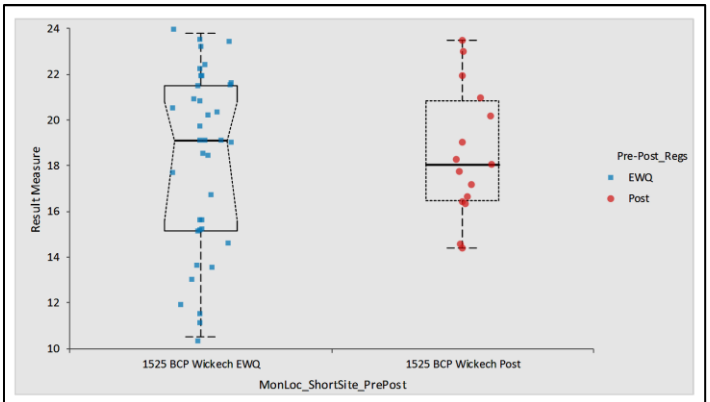
Chapter 5: 1525 BCP Wickecheoke Creek, NJ

Water Temperature, degrees C

Not included in DRBC Existing Water Quality rules

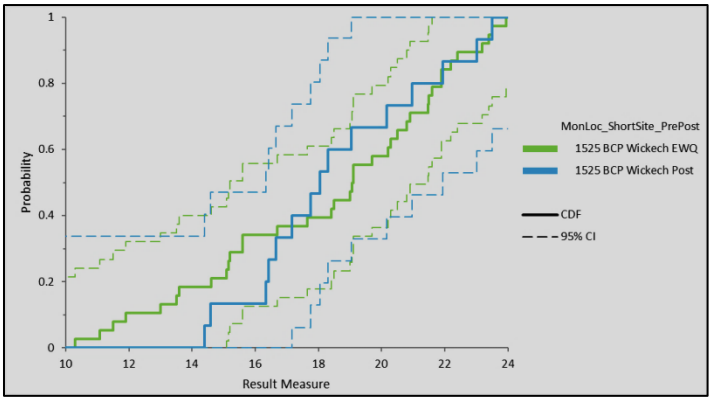






N	53

Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1525 BCP Wickech EWQ	10.3	15.1	19.1	21.5	23.9	6.4
1525 BCP Wickech Post	14.4	16.5	18.1	20.8	23.5	4.4



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1525 BCP Wickech EWQ	38	0.2	0.01
1525 BCP Wickech Post	15	0.6	0.04

H statistic	0.00
X² approximation	0.00
DF	1
p-value	0.9528 [1]

H0: $\theta_1 = \theta_2 = \theta...$
The median of the populations are all equal.
H1: $\theta_i \neq \theta_j$ for at least one i,j
The median of the populations are not all equal.
[1] Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident. Water temperature did not measurably change between the EWQ and post-EWQ periods. Water temperature is not related to flow in the EWQ data set, but inversely and weakly related to flow in the post-EWQ data set. There were less cool temperatures in the post-EWQ data set. Note that flows are plotted on a logarithmic scale.