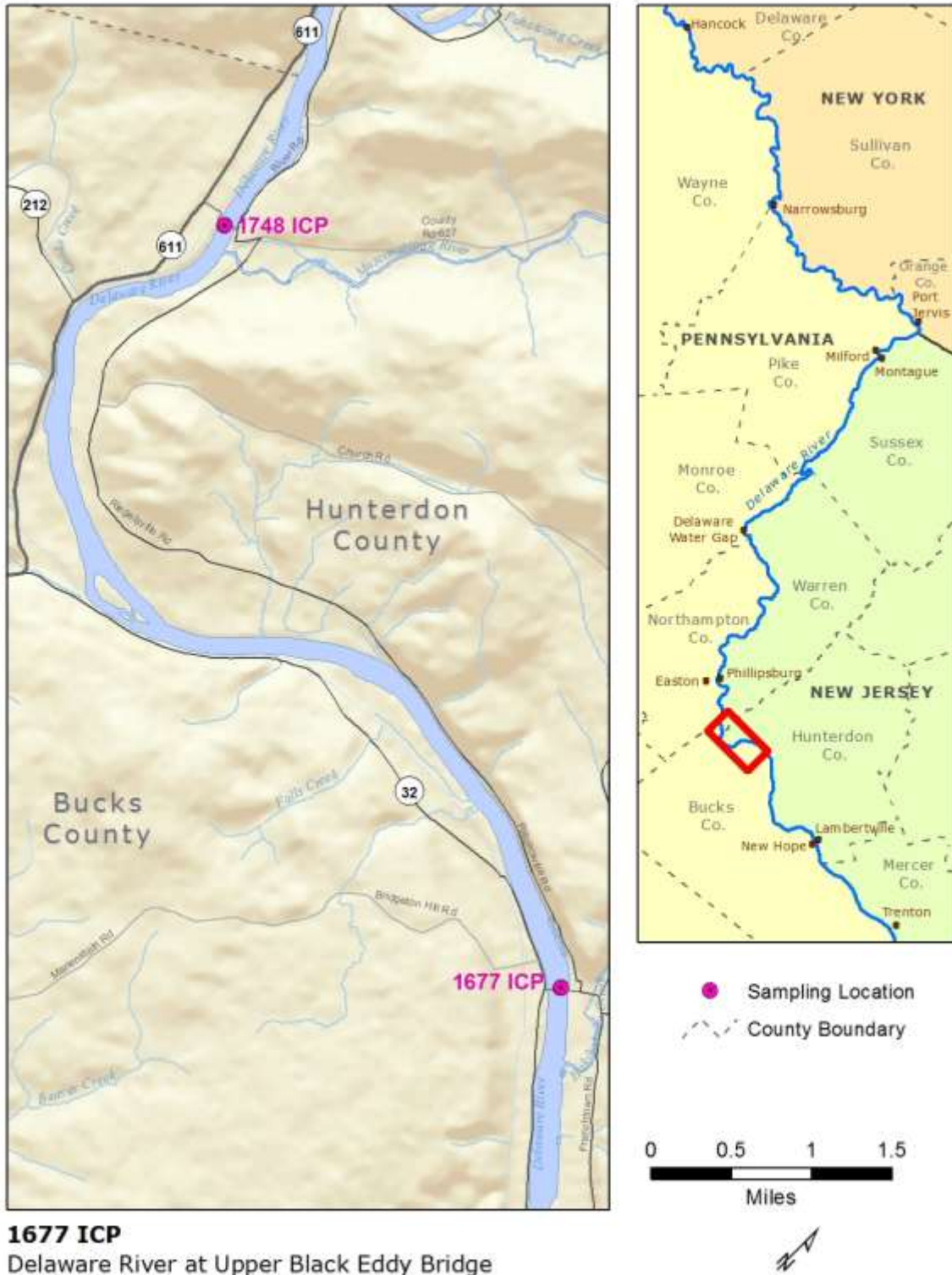
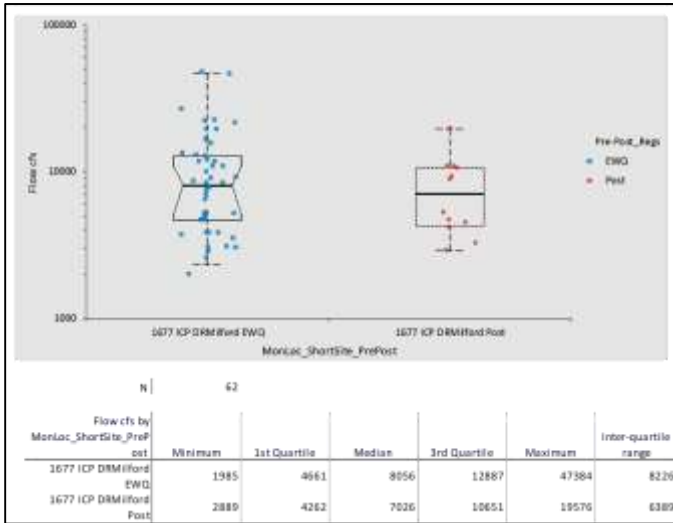


## Chapter 12: 1677 ICP Delaware River at Milford/Upper Black Eddy



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



Flow was roughly the same between the EWQ and post-EWQ periods. Fewer samples were collected in the post-EWQ period, and the range of flow conditions sampled was narrower. Flow is plotted on a logarithmic scale.

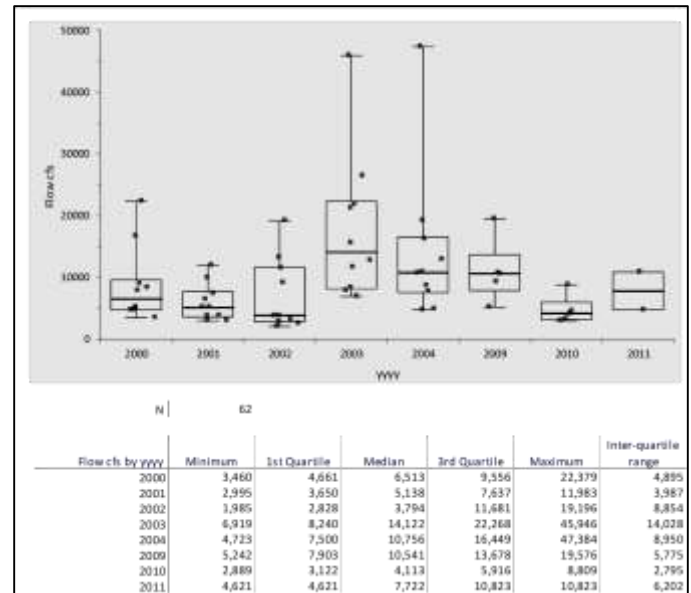
Kruskal-Wallis test

Flow cfs by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	50	33.6	0.67
1677 ICP DRMilford Post	12	140.1	11.67

H statistic: 0.53  
 X<sup>2</sup> approximation: 0.53  
 DF: 1  
 p-value: 0.4651

H0:  $\theta_1 = \theta_2 = \theta_3$ .  
 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.  
 † Do not reject the null hypothesis at the 5% significance level.

For many of the water quality parameters to follow, there were an insufficient number of samples taken to set up a good statistical comparison between the two periods. For the next assessment round biweekly instead of monthly sampling is recommended.



Annual flow statistics are plotted above. These are May to September flow measurements associated with the time of each water quality sample. Flow is interpolated at this location using drainage area weighting based on the USGS continuous stream gage at Trenton, NJ. “Normal” flow is about 9,000 cfs at this location on the Delaware River, but median summer flows are typically around 5,000 cfs.

Upstream ICP: Delaware River at Riegelsville 1748 ICP  
 Downstream ICP: Del. River at Bulls Island 1554 ICP

Tributary BCP Watersheds in Upstream Reach:

Musconetcong River, NJ – 1746 BCP  
 Cooks Creek, PA – 1737 BCP

All other tributary watersheds are less than 20 square miles and have little effect upon the Delaware River.

Chapter 12: 1677 ICP

Delaware River at Milford/Upper Black Eddy NJ/PA

Alkalinity as CaCO<sub>3</sub>, Total mg/l

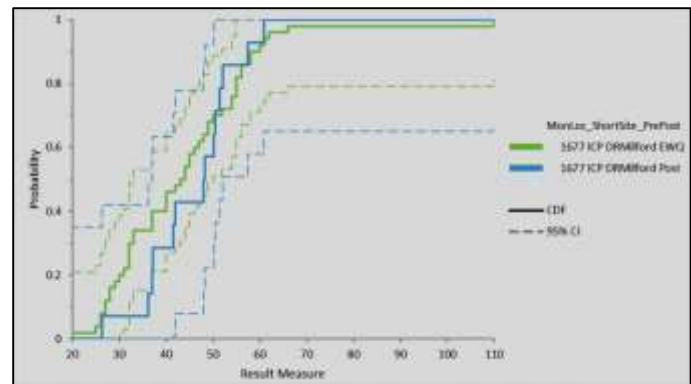
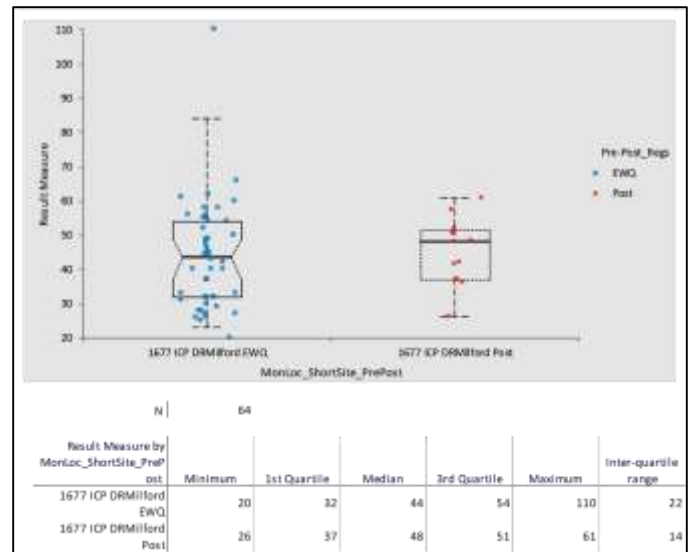
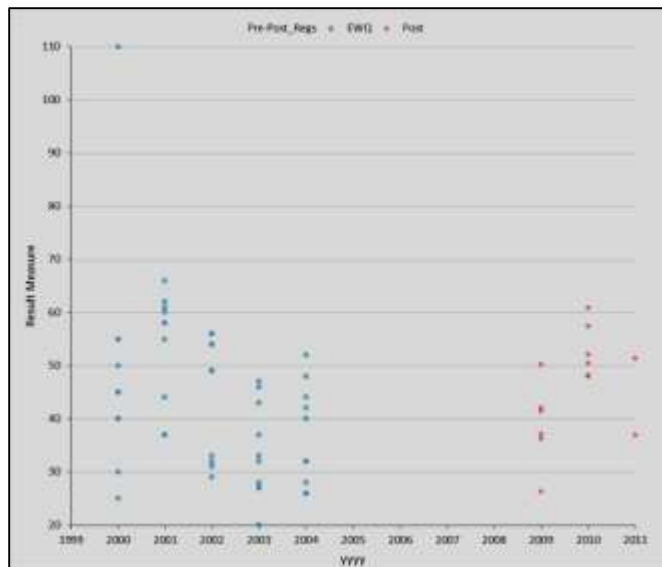
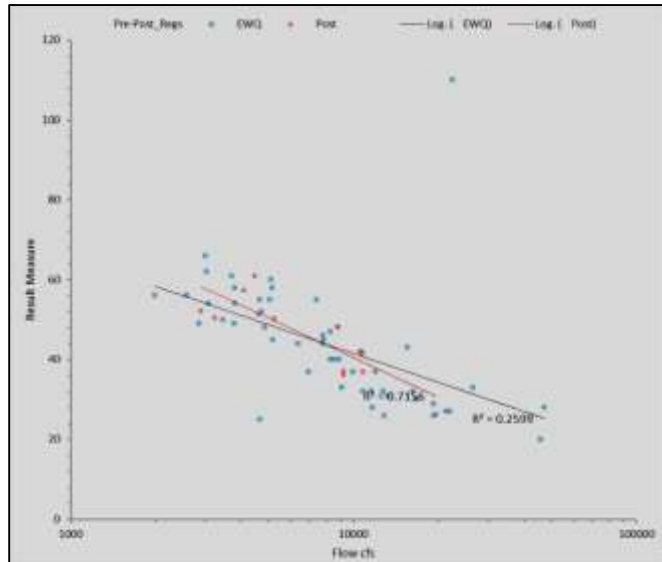
Existing Water Quality (Table 20):

Median 44 mg/l

Lower 95% Confidence Interval 37 mg/l

Upper 95% Confidence Interval 49 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRM Milford EWQ	50	49.0	0.98
1677 ICP DRM Milford Post	14	175.0	12.50

H statistic 0.65  
 X<sup>2</sup> approximation 0.65  
 DF 1  
 p-value 0.4213<sup>1</sup>

H<sub>0</sub>: θ<sub>1</sub> = θ<sub>2</sub> = 0...  
 The median of the populations are all equal.  
 H<sub>1</sub>: θ<sub>i</sub> ≠ θ<sub>j</sub> for at least one i, j  
 The median of the populations are not all equal.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

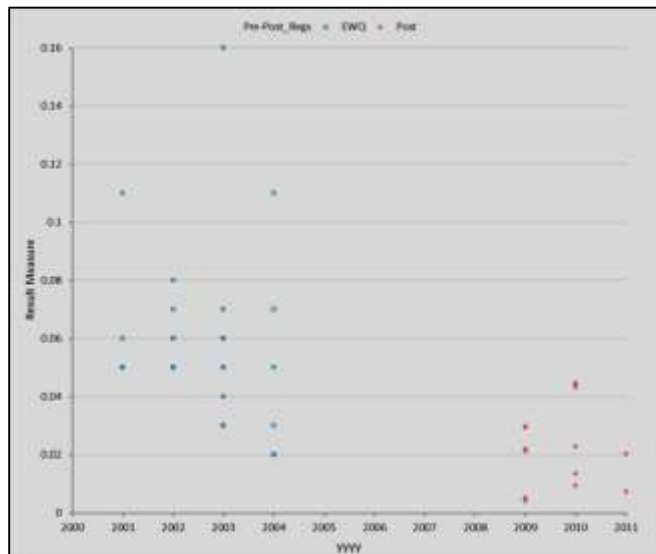
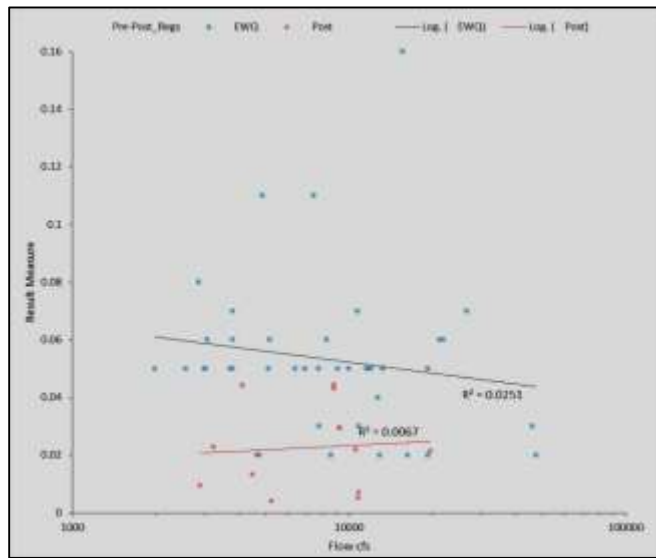
No water quality degradation is evident here. Alkalinity apparently did not measurably change between the EWQ and post-EWQ periods. Potential laboratory artifacts and insufficient post-EWQ sampling introduced analytical uncertainty. Alkalinity is inversely related to flow in both data sets. Post-EWQ median alkalinity fell within EWQ 95% confidence intervals. Flow is plotted on a logarithmic scale.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

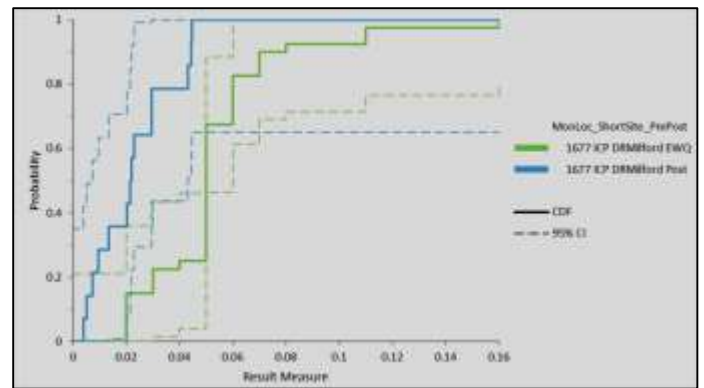
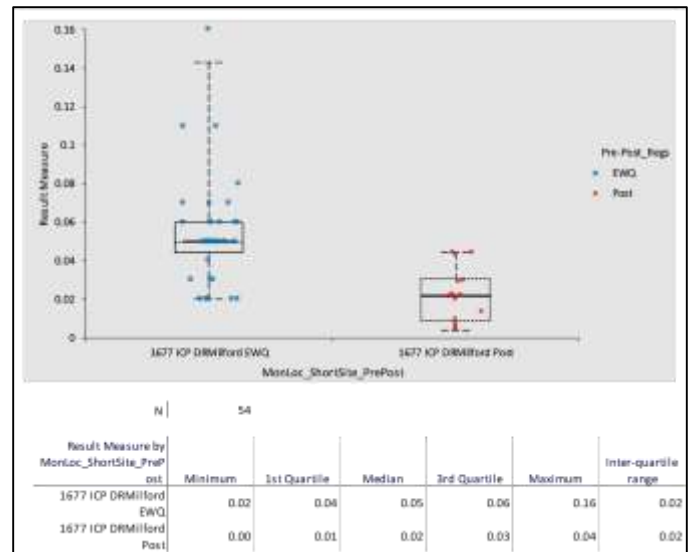
Ammonia Nitrogen as N, Total mg/l

Existing Water Quality (Table 20):

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 here. Ammonia concentrations apparently declined. However, potential laboratory artifacts, detection limit differences, and insufficient post-EWQ sampling frequency (n=14) introduced analytical uncertainty.



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	40	1144.9	28.62
1677 ICP DRMilford Post	14	327.1	233.65

H statistic: 18.47  
 X<sup>2</sup> approximation: 18.47  
 DF: 1  
 p-value: <0.0001<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \dots$   
 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.  
<sup>1</sup> 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 available to validate results. EWQ data possessed 25/40 undetected results which interfered with calculation of the median value. Thus EWQ was established as <0.05 mg/l. Under 2009-2011 lower detection levels there was only one undetected result, revealing actual low-level ammonia concentrations. Some evidence for water quality improvement exists as post-EWQ data contained no concentrations above 0.04 mg/l. Flow is plotted on a logarithmic scale.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Chloride, Total mg/l

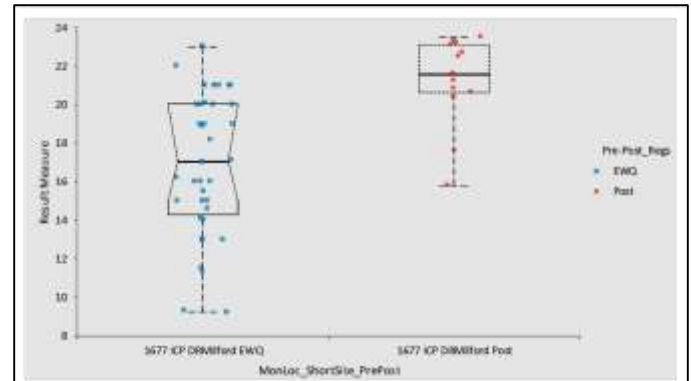
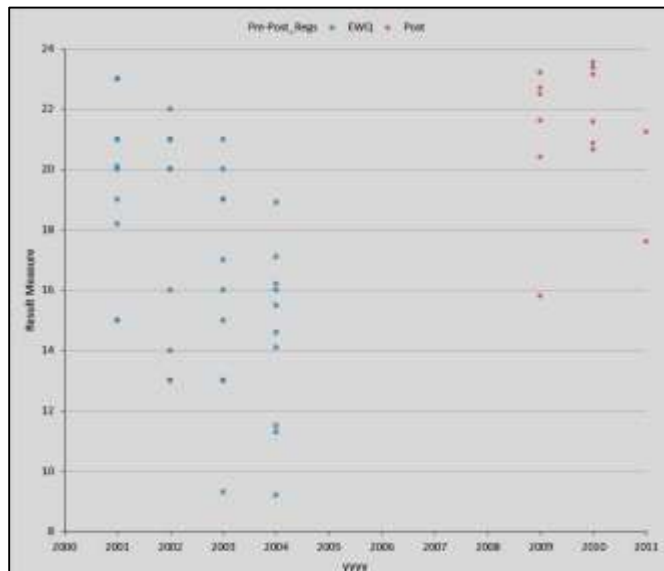
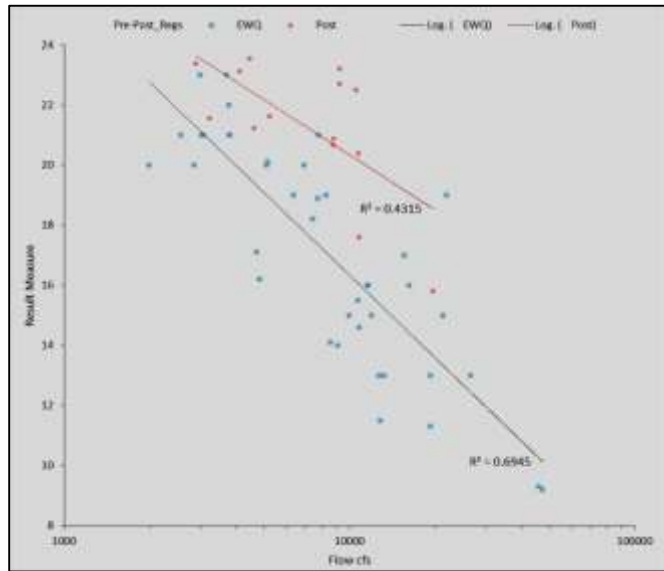
Existing Water Quality (Table 20):

Median 17 mg/l

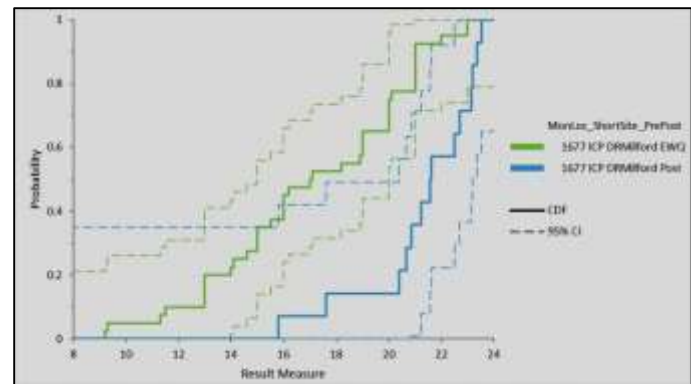
Lower 95% Confidence Interval 15 mg/l

Upper 95% Confidence Interval 20 mg/l

Defined in regulations as a flow-related parameter



Result Measure by MonLoc_ShortSite_PrePost	N	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1677 ICP DRMilford EWQ	54	9	14	17	20	23	6
1677 ICP DRMilford Post	14	16	21	22	23	24	2



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	40	960.4	24.01
1677 ICP DRMilford Post	14	2744.0	196.00

H statistic: 15.01  
 X<sup>2</sup> approximation: 15.01  
 DF: 1  
 p-value: 0.0001<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 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.  
<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

Water quality degradation is evident here. Chloride concentrations apparently rose by about 5 mg/l between the two periods. Potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=14) introduced analytical uncertainty. Post-EWQ median concentration rose above the EWQ upper 95% confidence interval. Both data sets are inversely flow-related. The post-EWQ data are not fully representative of flow conditions, as few samples were collected under high flow conditions. Bi-weekly instead of monthly sampling is recommended for the next assessment.



Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

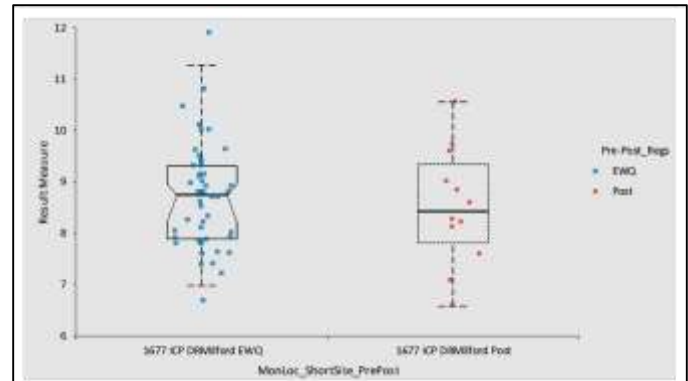
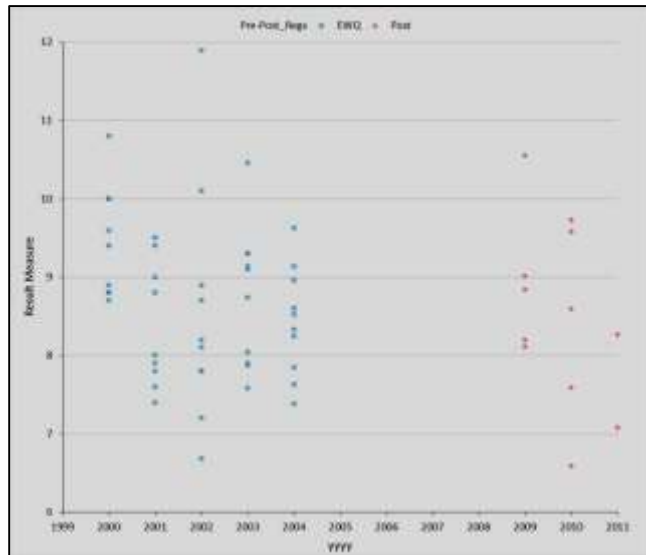
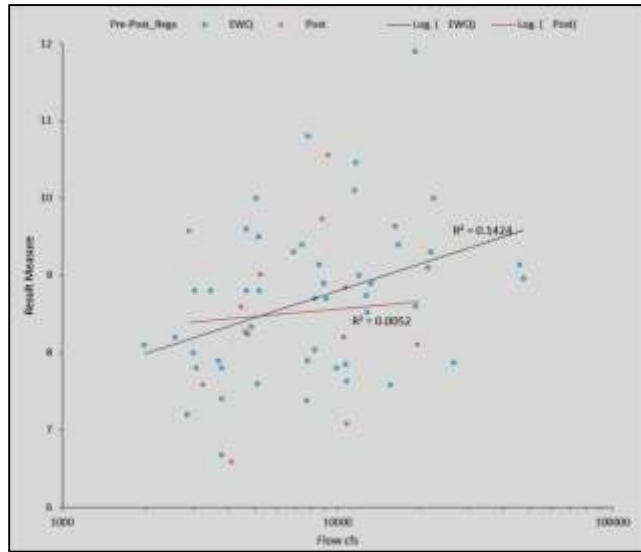
Dissolved Oxygen (DO) mg/l

Existing Water Quality (Table 20):

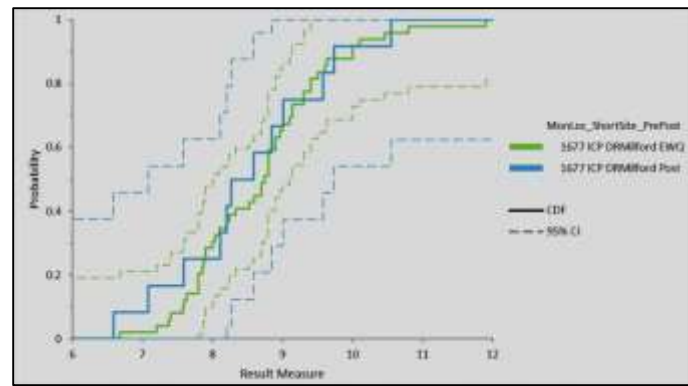
Median 8.74 mg/l

Lower 95% Confidence Interval 8.20 mg/l

Upper 95% Confidence Interval 8.96 mg/l



Result Measure by MonLoc_ShortSite_PrePost	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1677 ICP DRMilford EWQ	6.68	7.89	8.74	9.30	11.90	1.41
1677 ICP DRMilford Post	6.59	7.81	8.43	9.34	10.55	1.54



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	49	8.6	0.18
1677 ICP DRMilford Post	12	35.0	2.92

H statistic	0.14
X <sup>2</sup> approximation	0.14
DF	1
p-value	0.7099 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \dots$   
 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.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. No measurable change took place between the EWQ and Post-EWQ periods. There were too few post-EWQ samples (n=12). Post-EWQ median DO concentration fell within the EWQ 95% confidence intervals. Flow is plotted on a logarithmic scale. DO concentration is unrelated to flow in both data sets.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

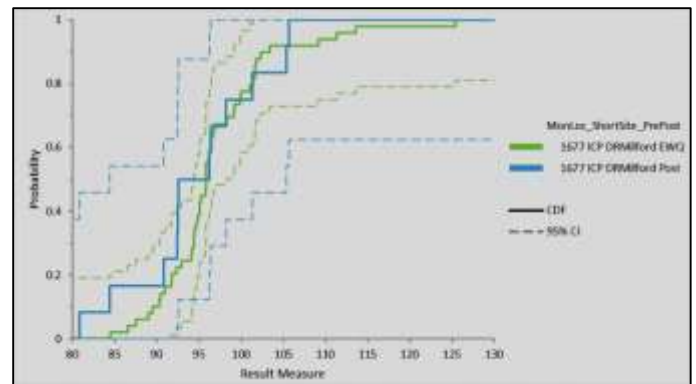
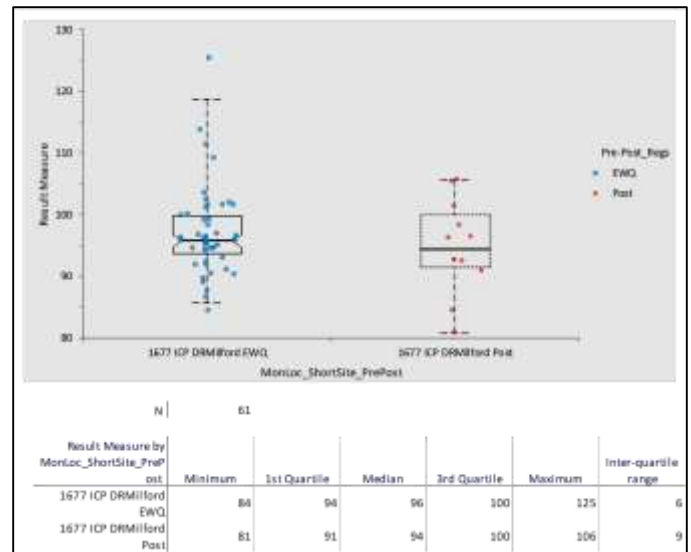
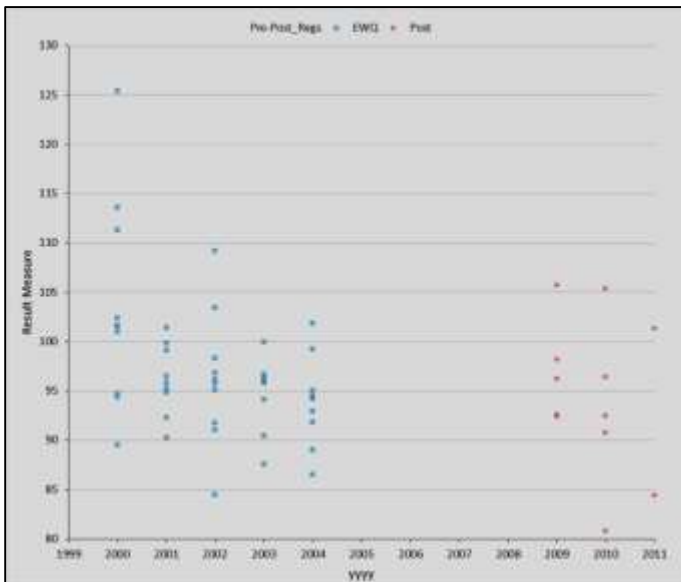
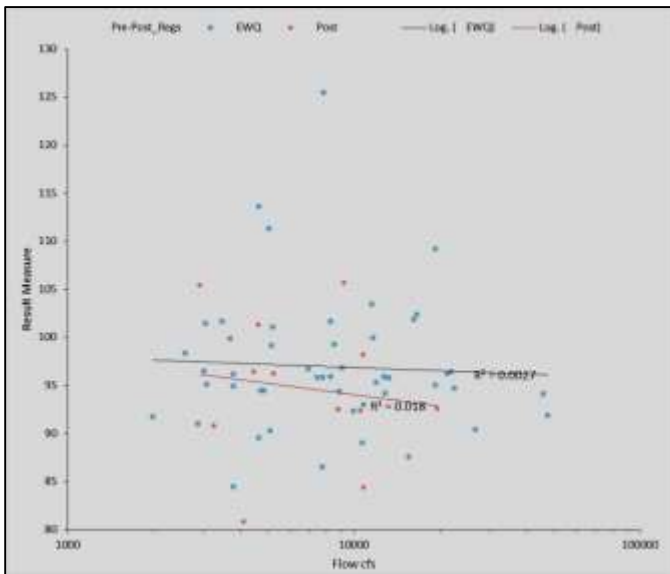
Dissolved Oxygen Saturation %

Existing Water Quality (Table 20):

Median 96%

Lower 95% Confidence Interval 95%

Upper 95% Confidence Interval 97%



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	49	25.0	0.51
1677 ICP DRMilford Post	12	102.1	8.51

H statistic	0.40
$\chi^2$ approximation	0.40
DF	1
p-value	0.5254 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 \dots$   
 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.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

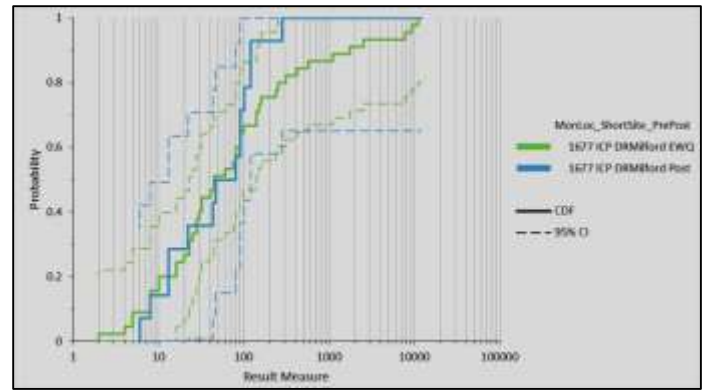
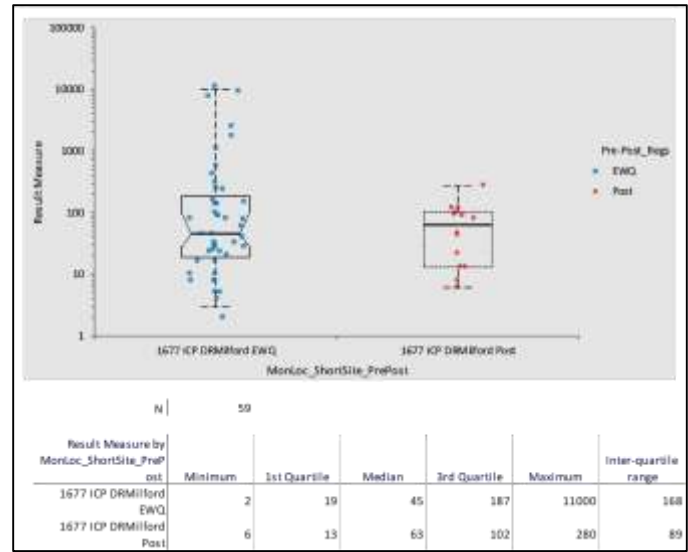
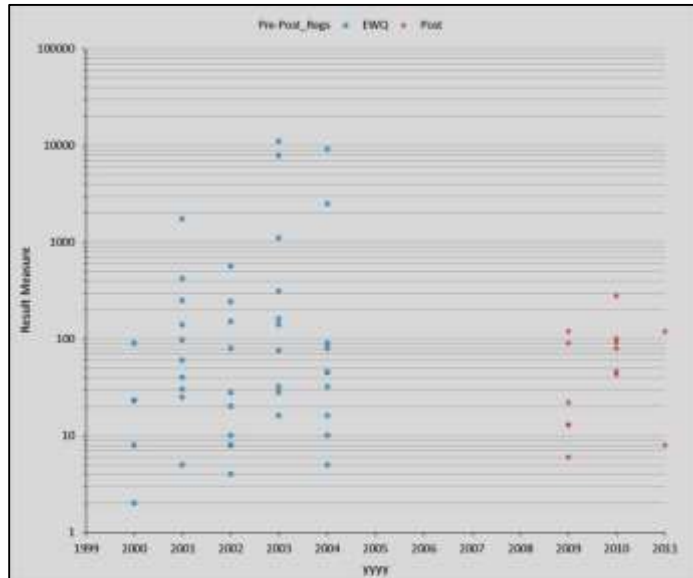
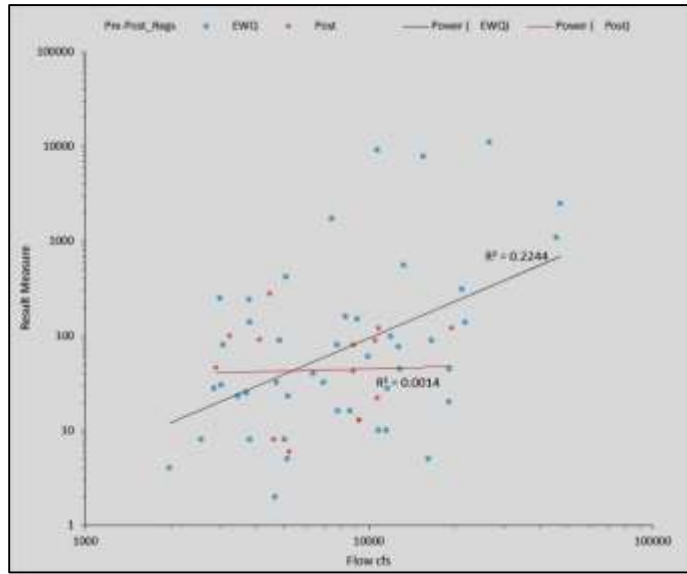
No water quality degradation is evident here. Dissolved Oxygen Saturation is unrelated to flow, and did not measurably change between the EWQ and post-EWQ periods. Post-EWQ median DO saturation fell below the lower EWQ 95% confidence interval, though the difference was not significant due to insufficient post-EWQ sampling (n=12). Flow is plotted on a logarithmic scale.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Enterococcus colonies/100 ml

Existing Water Quality (Table 2O):

- Median 45/100 ml
- Lower 95% Confidence Interval 28/100 ml
- Upper 95% Confidence Interval 98/100 ml



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	45	11.3	0.25
1677 ICP DRMilford Post	14	36.2	2.58

H statistic	0.16
X <sup>2</sup> approximation	0.16
DF	1
p-value	0.6884 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \dots$   
 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.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. Enterococci did not measurably change between the EWQ and Post-EWQ periods. Uncertainty is introduced into comparisons by potential laboratory artifacts and insufficient post-EWQ sampling frequency. Both data sets are unrelated to flow. Post-EWQ samples were not representative of the full range of flow conditions. Note that concentrations and flows are plotted on a logarithmic scale. Post-EWQ median enterococcus concentrations fell within the EWQ 95% confidence intervals.



Chapter 12: 1677 ICP

Delaware River at Milford/Upper Black Eddy NJ/PA

Escherichia coli colonies/100 ml

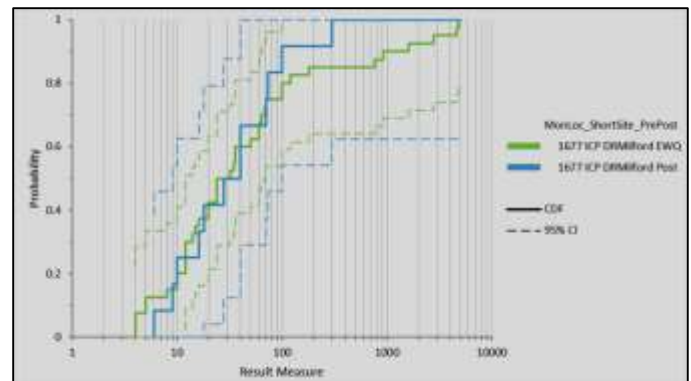
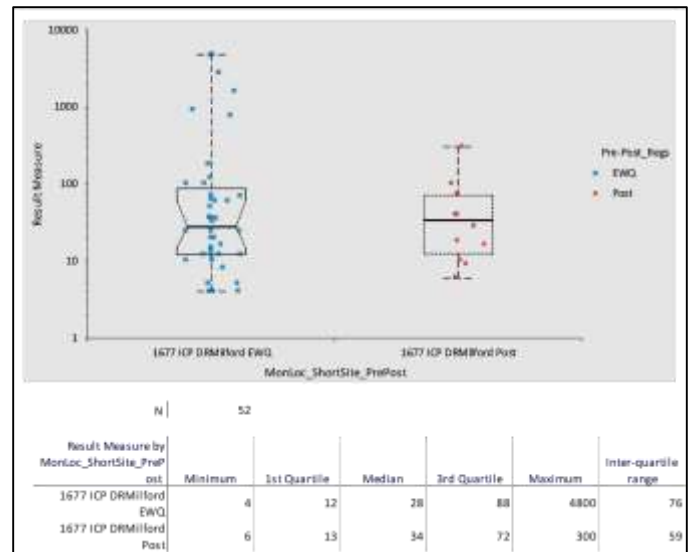
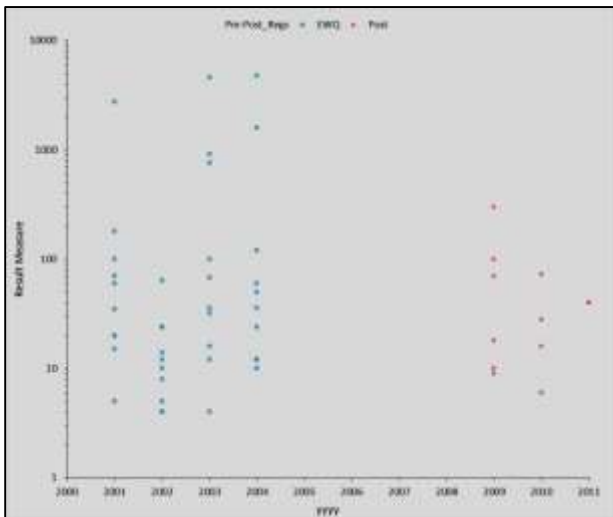
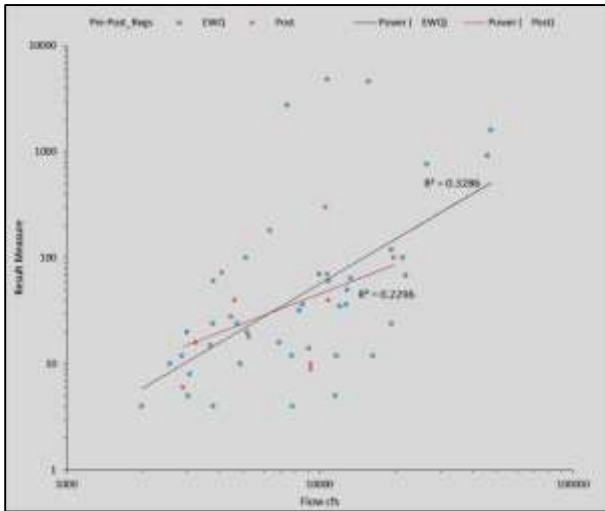
Existing Water Quality (Table 20):

Median 28/100 ml

Lower 95% Confidence Interval 15/100 ml

Upper 95% Confidence Interval 60/100 ml

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	40	0.0	0.00
1677 ICP DRMilford Post	12	0.0	0.00

H statistic: 0.00  
 X<sup>2</sup> approximation: 0.00  
 DF: 1  
 p-value: 1.0000<sup>1</sup>

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.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. E. coli concentrations apparently did not change between the EWQ and Post-EWQ periods. Uncertainty is introduced into comparisons by potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=12). Post-EWQ median E. coli fell within the EWQ 95% confidence intervals. Note that concentrations and flows are plotted on a logarithmic scale.

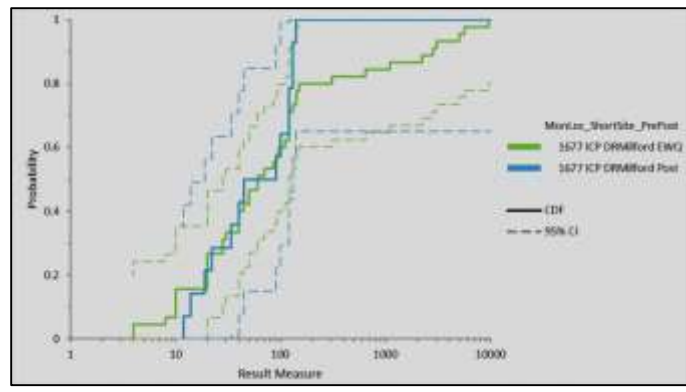
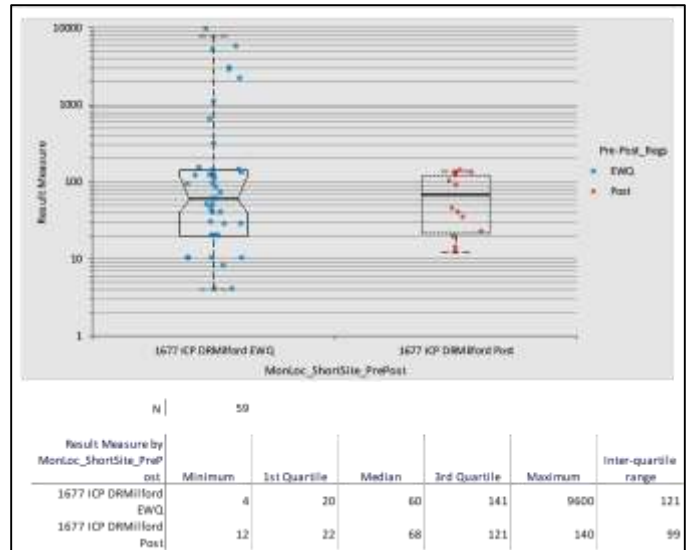
E. coli concentrations were positively but weakly related to flow in the EWQ data set, but unrelated to flow in the post-EWQ data set. Post-EWQ data were not fully representative of flow conditions. No independent data were available for validation.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Fecal coliform colonies/100 ml

Existing Water Quality (Table 2O):

- Median 60/100 ml
- Lower 95% Confidence Interval 40/100 ml
- Upper 95% Confidence Interval 120/100 ml
- Defined in regulations as a flow-related parameter



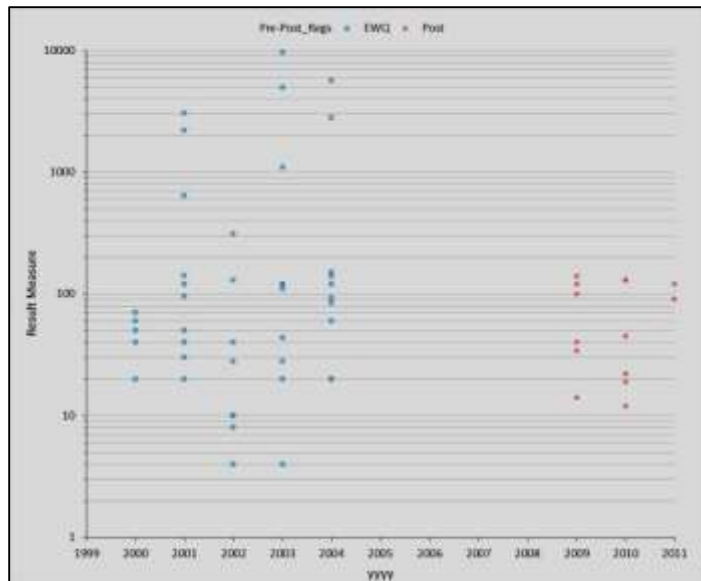
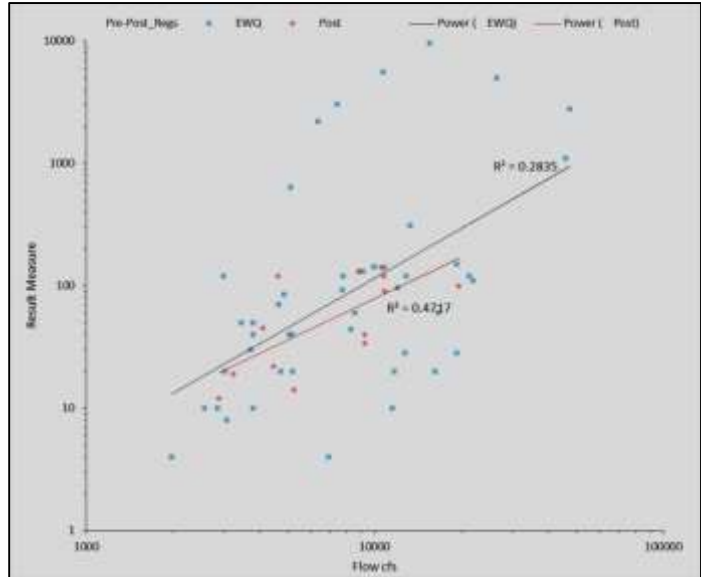
Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	45	9.8	0.22
1677 ICP DRMilford Post	14	31.5	2.25

H statistic	0.14
X <sup>2</sup> approximation	0.14
DF	1
p-value	0.7079 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 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.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.



No water quality degradation is evident here. Fecal coliform concentrations apparently did not measurably change between the EWQ and post-EWQ periods. Uncertainty is introduced into comparisons by potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=14). Fecal coliform concentrations are weakly related to flow in the EWQ data set, and positively related to flow in the post-EWQ data set. Post-EWQ median concentrations were within the EWQ 95% confidence intervals. Note that concentrations and flows are plotted on a logarithmic scale.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Hardness as CaCO<sub>3</sub>, Total mg/l

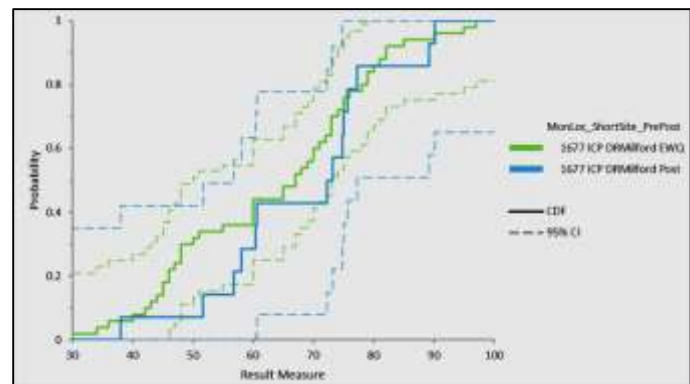
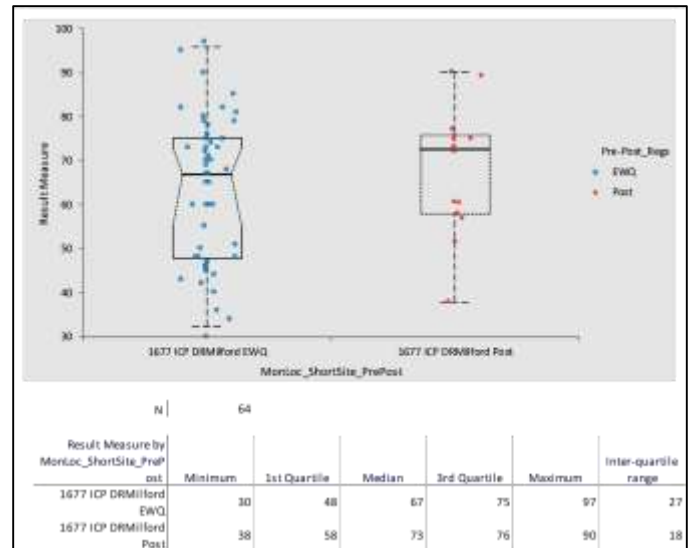
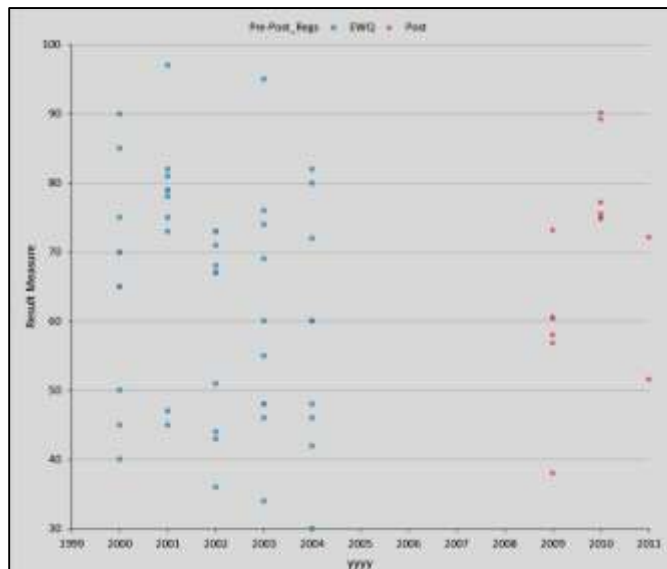
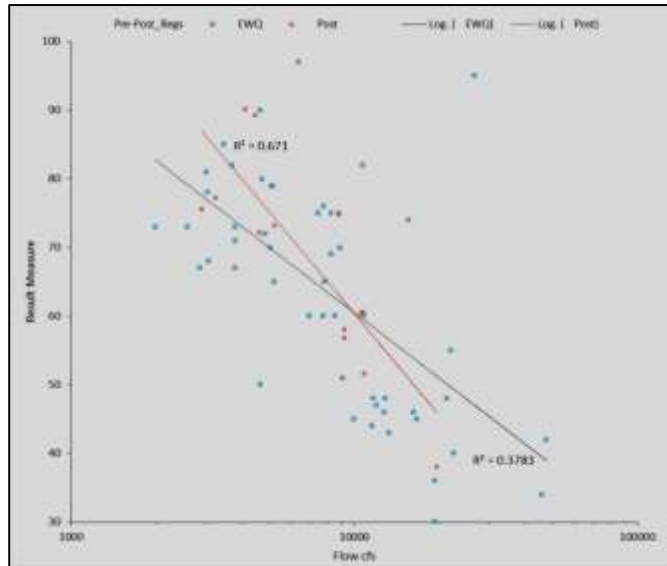
Existing Water Quality (Table 20):

Median 67 mg/l

Lower 95% Confidence Interval 55 mg/l

Upper 95% Confidence Interval 73 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by Monitor_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMillford EWQ	50	76.9	1.54
1677 ICP DRMillford Post	14	274.6	19.61

H statistic | 1.01

$\chi^2$  approximation | 1.01

DF | 1

p-value | 0.3138<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3$   
 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.

<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. Hardness apparently did not measurably change between the EWQ and post-EWQ periods. Uncertainty is introduced into comparisons by potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=14). Hardness is inversely related to flow in both data sets. Post-EWQ median hardness was at the EWQ upper 95% confidence interval, but the increase was not significant. Flows are plotted on a logarithmic scale.

Chapter 12: 1677 ICP

Delaware River at Milford/Upper Black Eddy NJ/PA

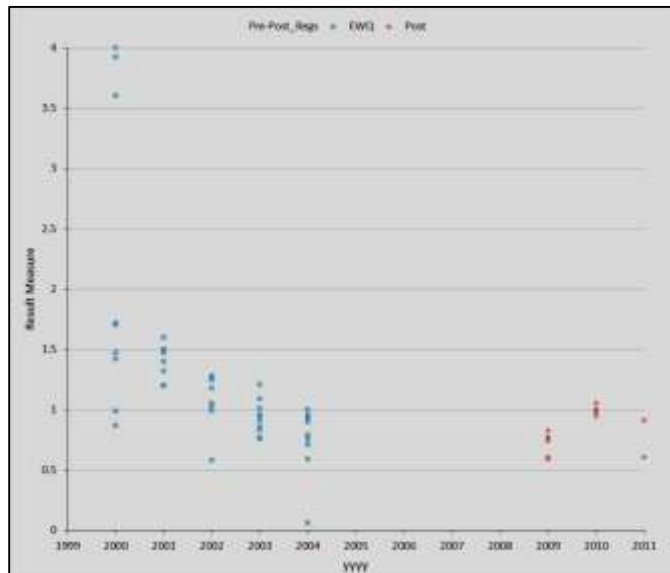
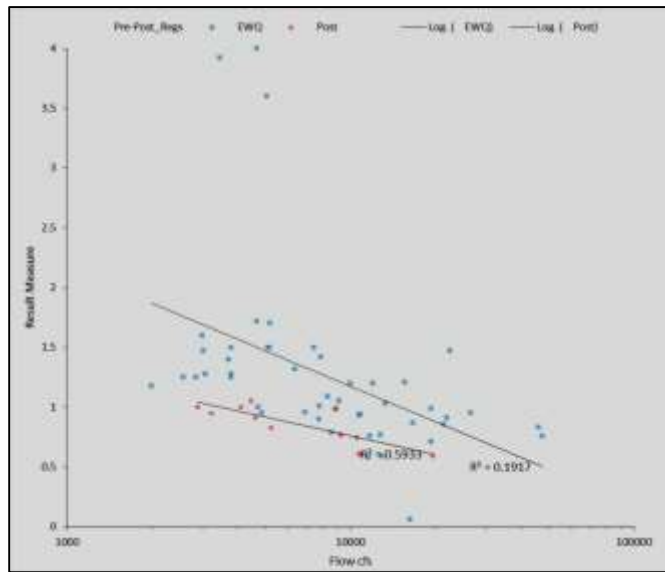
Nitrate + Nitrite as N, Total mg/l

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

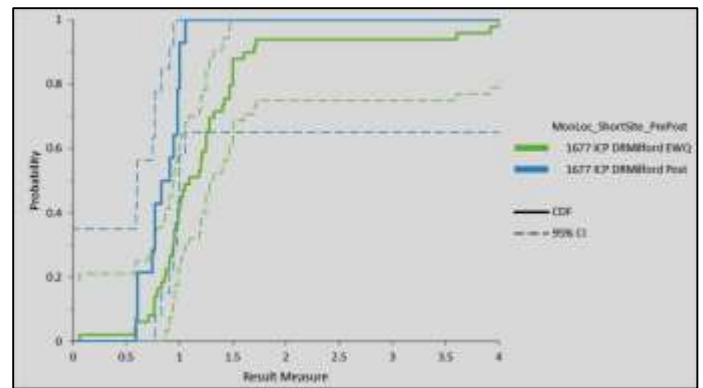
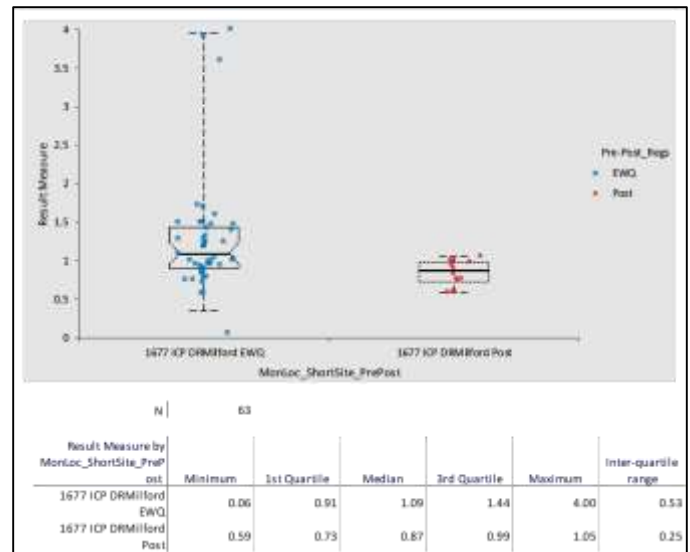
Median 1.09 mg/l

Lower 95% Confidence Interval 0.96 mg/l

Upper 95% Confidence Interval 1.25 mg/l



No water quality degradation is evident here. Nitrate concentrations apparently declined between the EWQ and post-EWQ periods. Uncertainty is introduced into comparisons by potential laboratory artifacts, different detection limits and insufficient post-EWQ sampling frequency (n=14).



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	49	668.6	13.64
1677 ICP DRMilford Post	14	2340.1	167.15

H statistic	8.96
X <sup>2</sup> approximation	8.96
DF	1
p-value	0.0028 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$

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.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

Nitrate is unrelated related to flow in the EWQ data set, but inversely related to flow in the post-EWQ data set. Post-EWQ concentrations fell below the EWQ lower 95% confidence interval. Post-EWQ nitrate + nitrite concentrations were assumed equivalent for comparison with EWQ nitrate concentrations since EWQ nitrite concentrations were never detected. Flow is plotted on a logarithmic scale. Independent data were not available for validation of DRBC data.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

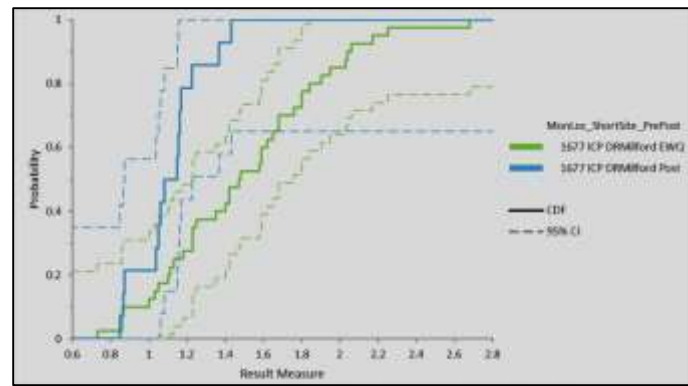
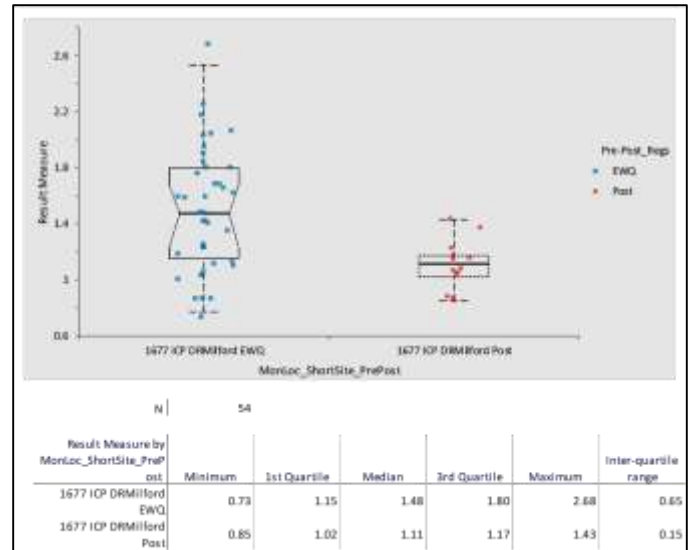
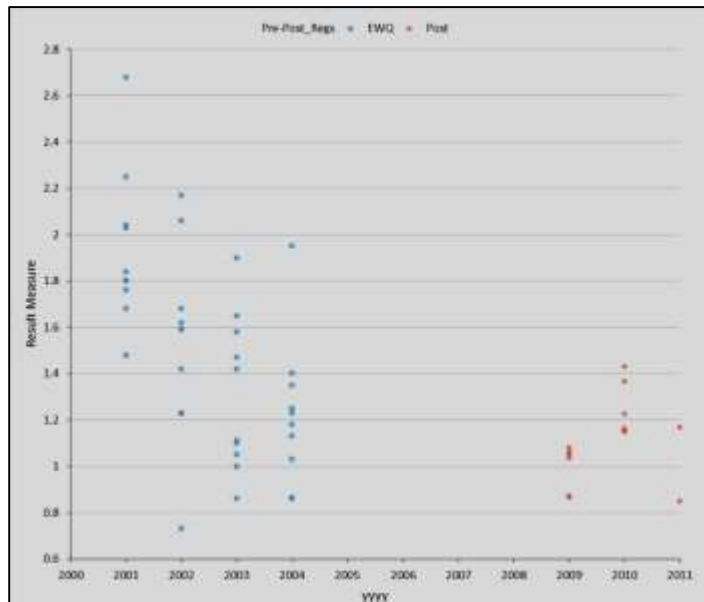
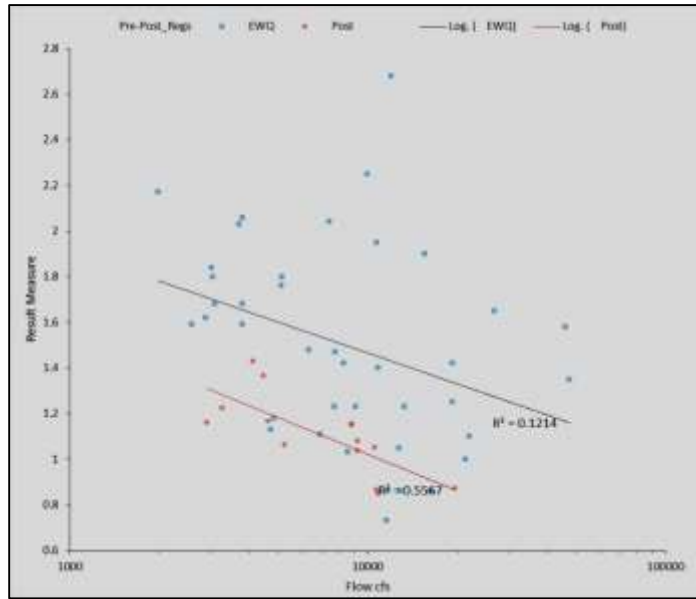
Nitrogen as N, Total (TN) mg/l

Existing Water Quality (Table 20):

Median 1.48 mg/l

Lower 95% Confidence Interval 1.23 mg/l

Upper 95% Confidence Interval 1.68 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	40	624.1	15.60
1677 ICP DRMilford Post	14	1783.1	127.37

H statistic	9.73
X <sup>2</sup> approximation	9.73
DF	1
p-value	0.0018 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 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.  
<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. Total Nitrogen concentrations apparently declined between the EWQ and post-EWQ periods. Uncertainty is introduced into comparisons by potential laboratory artifacts, different detection limits and insufficient post-EWQ sampling frequency (n=14). TN is inversely related to flow in the post-EWQ data set, but unrelated to flow in the EWQ data set. Flow is 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 12: 1677 ICP

Delaware River at Milford/Upper Black Eddy NJ/PA

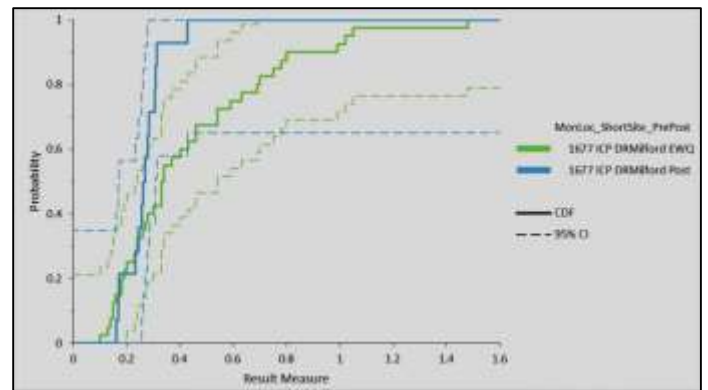
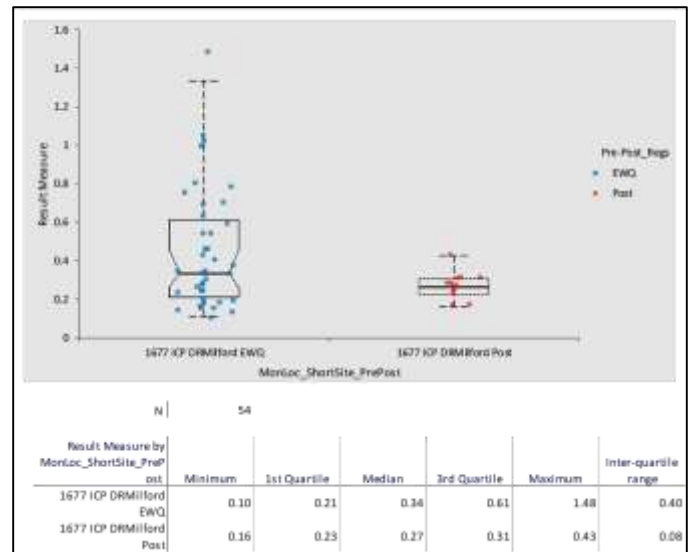
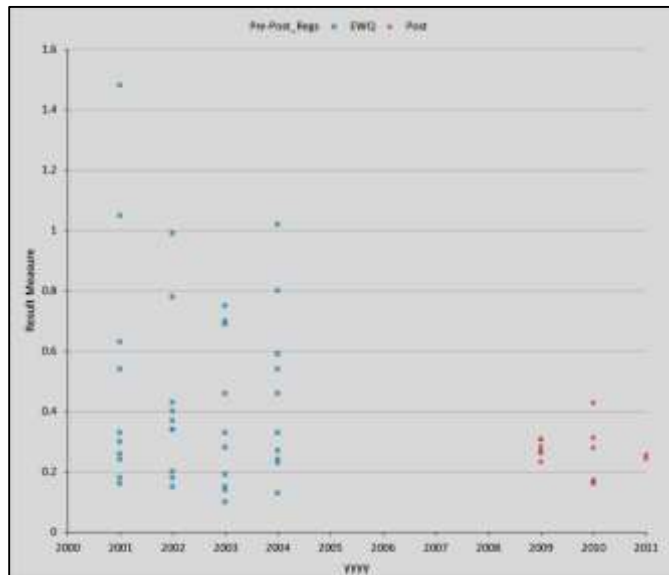
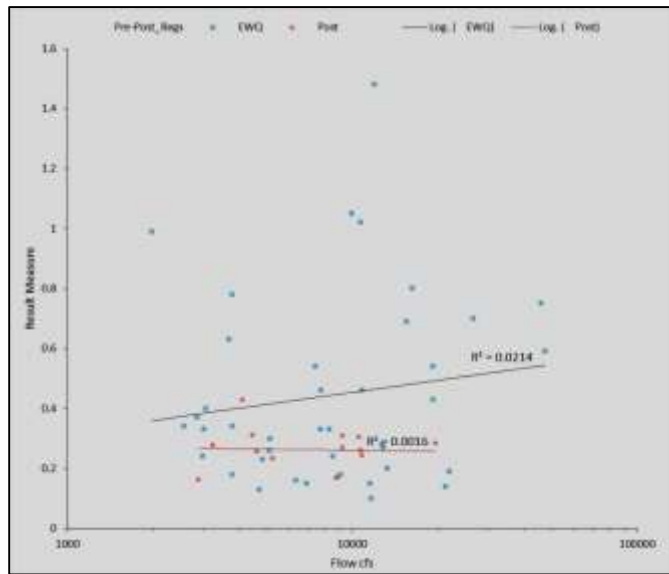
Nitrogen, Kjeldahl as N, Total (TKN) mg/l

Existing Water Quality (Table 20):

Median 0.34 mg/l

Lower 95% Confidence Interval 0.26 mg/l

Upper 95% Confidence Interval 0.46 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	40	207.0	5.18
1677 ICP DRMilford Post	14	591.5	42.25

H statistic 3.23  
 X<sup>2</sup> approximation 3.23  
 DF 1  
 p-value 0.0724<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \dots$   
 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.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. TKN concentrations apparently did not measurably change between the EWQ and post-EWQ periods, though the post-EWQ range was far narrower and all concentrations were less than 0.5 mg/l. Uncertainty is introduced into comparisons by potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=14). TKN concentration is unrelated to flow in both data sets. Flow is plotted on a logarithmic scale. Post-EWQ median TKN was within the EWQ 95% confidence intervals but very near the lower interval.

Chapter 12: 1677 ICP

Delaware River at Milford/Upper Black Eddy NJ/PA

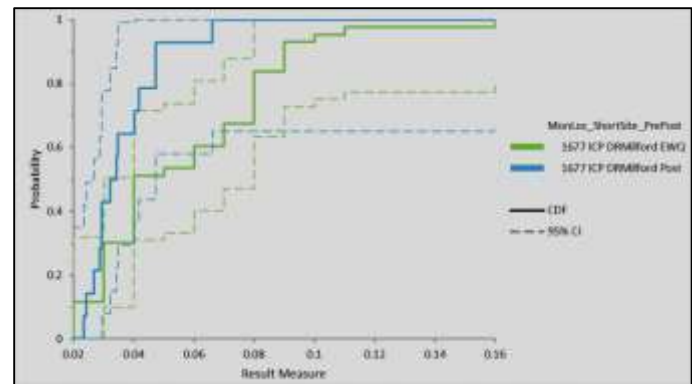
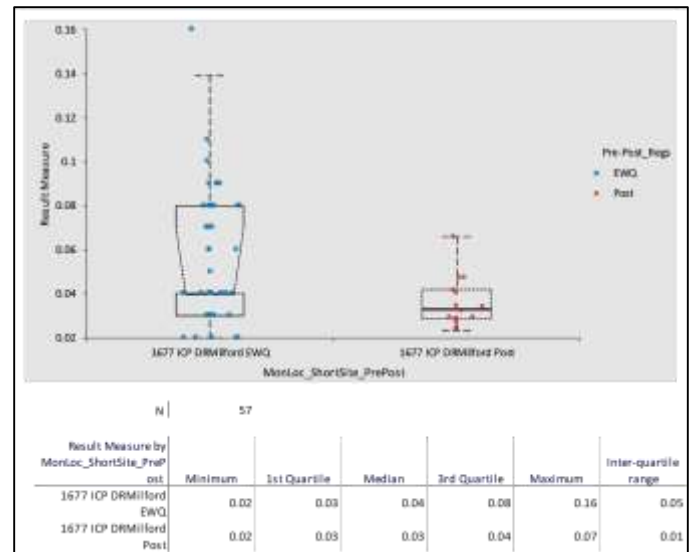
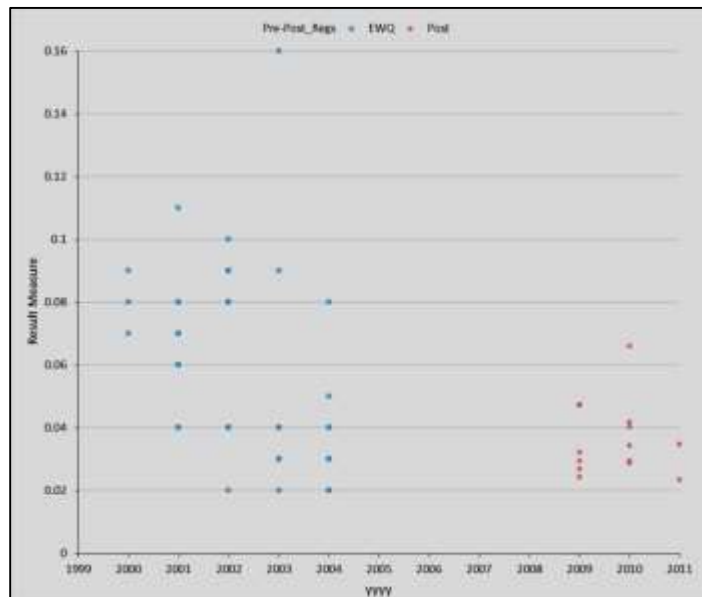
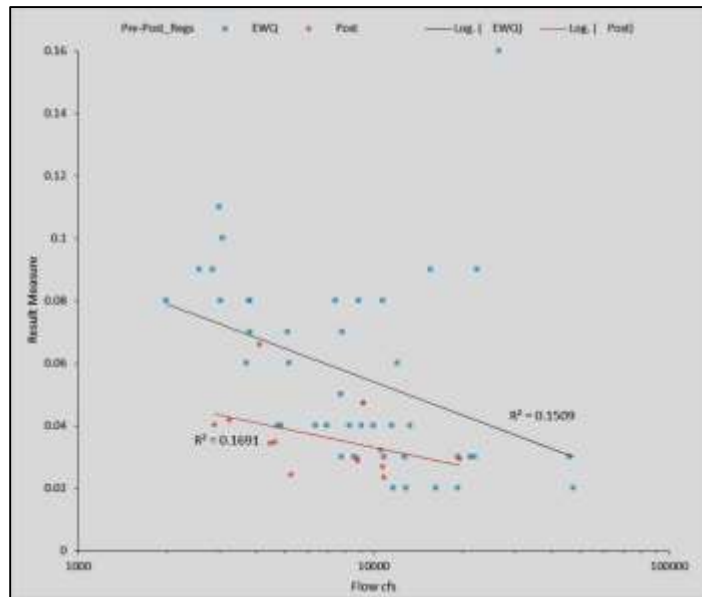
Orthophosphate as P, Total mg/l

Existing Water Quality (Table 2O):

Median 0.04 mg/l

Lower 95% Confidence Interval 0.04 mg/l

Upper 95% Confidence Interval 0.07 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	43	323.8	7.53
1677 ICP DRMilford Post	14	994.6	71.04

H statistic	4.83
X <sup>2</sup> approximation	4.83
DF	1
p-value	0.0279 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3$   
 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.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

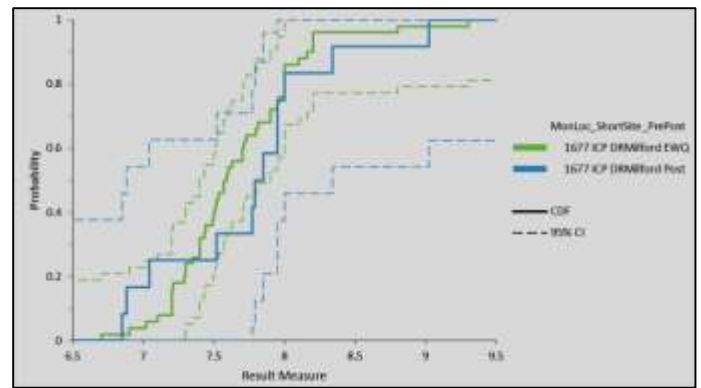
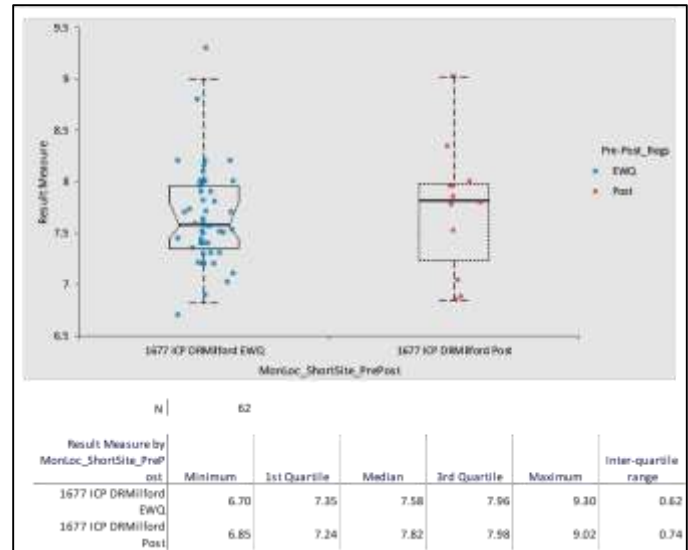
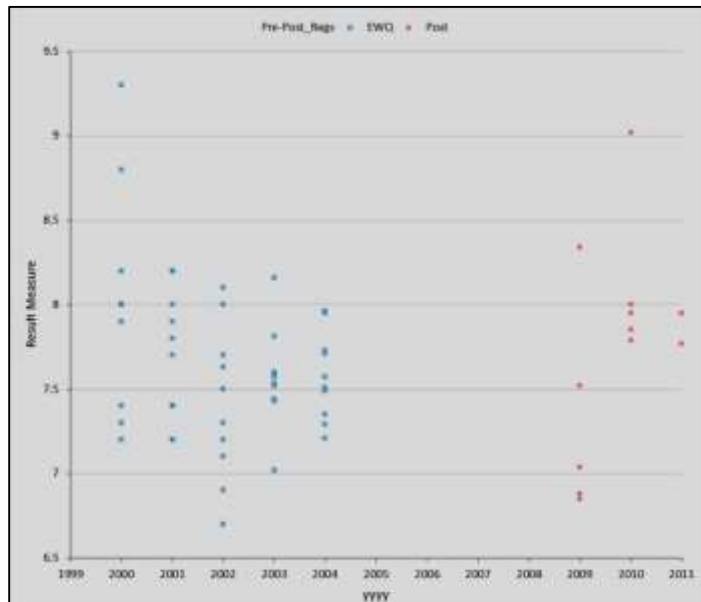
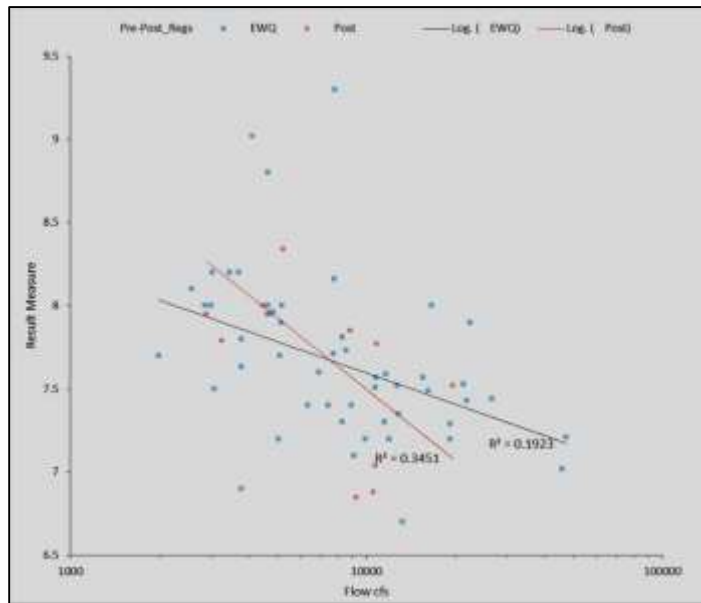
No water quality degradation is evident here. Orthophosphate concentrations apparently declined. Uncertainty in comparisons was introduced by potential laboratory artifacts, declining detection limits and insufficient post-EWQ sampling frequency. Both data sets are weakly and inversely related to flow. Post-EWQ median orthophosphate fell below the EWQ lower 95% confidence interval. A water quality improvement is evidenced in that there were no post-EWQ concentrations higher than 0.07 mg/l. There were no independent data to confirm DRBC results.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

pH

Existing Water Quality (Table 20):

Median 7.58 standard units  
 Lower 95% Confidence Interval 7.44 standard units  
 Upper 95% Confidence Interval 7.80 standard units



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	50	24.5	0.49
1677 ICP DRMilford Post	12	102.1	8.51

H statistic	0.39
X <sup>2</sup> approximation	0.39
DF	1
p-value	0.5326 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 \dots$   
 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.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. pH did not measurably change between the EWQ and post-EWQ periods. pH is weakly related to flow in both data sets. Note that flows are plotted on a logarithmic scale. Post-EWQ median pH was just above the EWQ upper 95% confidence interval, but the increase was statistically insignificant. There were too few samples collected in the post-EWQ period. This is a wide, shallow reach of the Delaware, where primary productivity is high – indicated by occasional spikes above pH 9.

Chapter 12: 1677 ICP

Delaware River at Milford/Upper Black Eddy NJ/PA

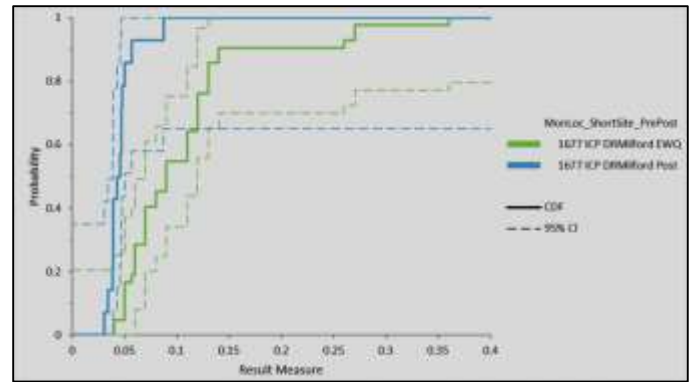
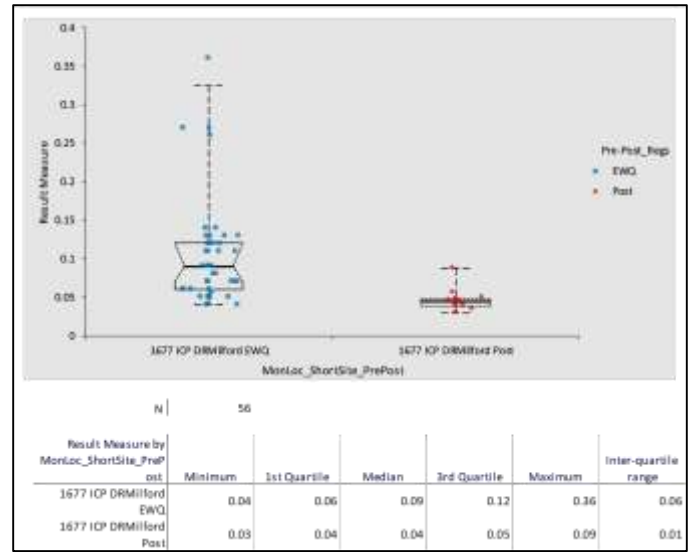
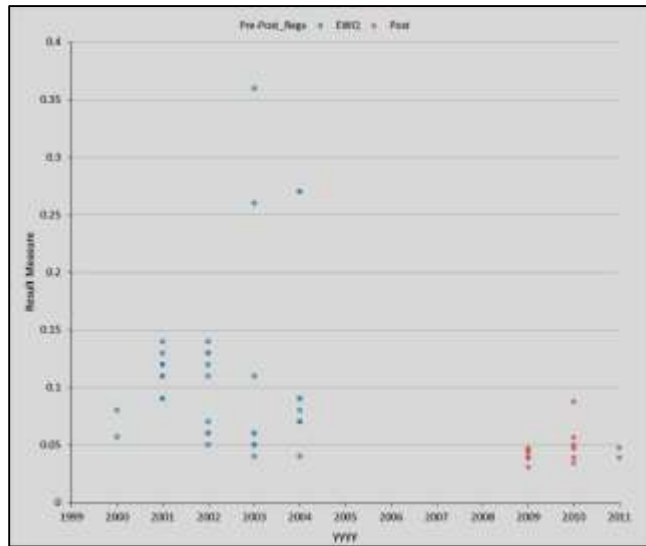
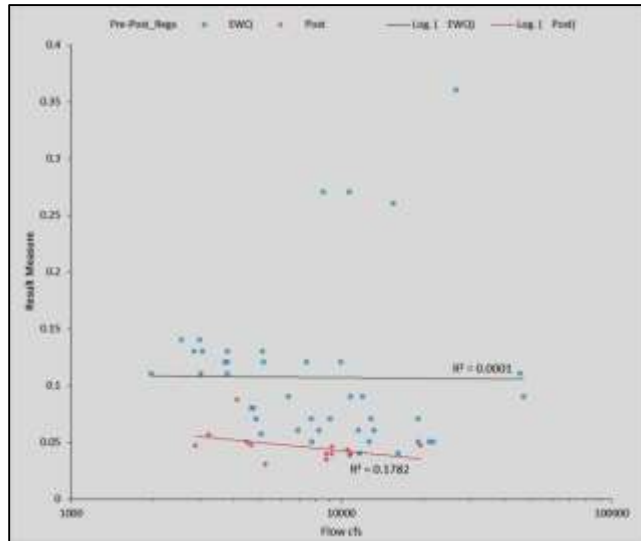
Phosphorus as P, Total (TP) mg/l

Existing Water Quality (Table 20):

Median 0.09 mg/l

Lower 95% Confidence Interval 0.07 mg/l

Upper 95% Confidence Interval 0.12 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	42	1530.1	36.43
1677 ICP DRMilford Post	14	4590.2	327.87

H statistic	23.10
X <sup>2</sup> approximation	23.10
DF	1
p-value	<0.0001 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 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.  
<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

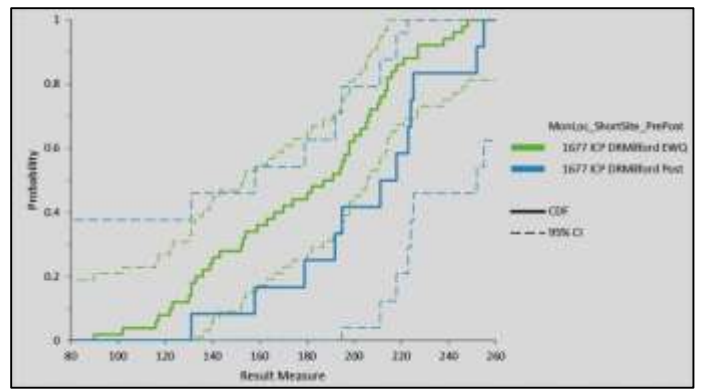
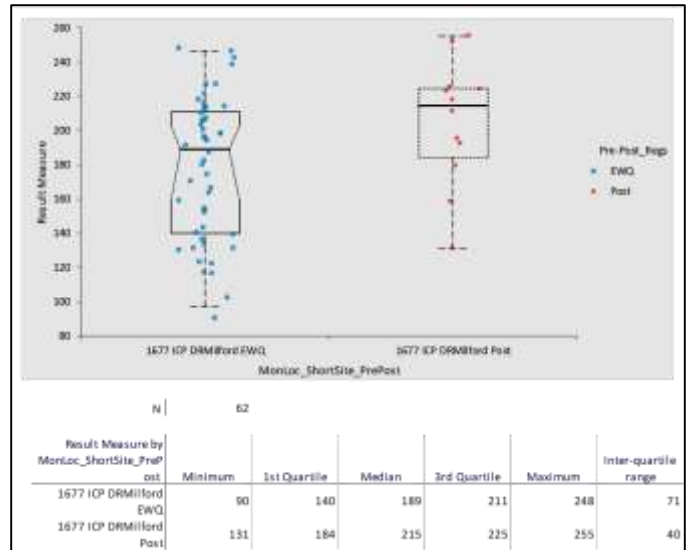
No water quality degradation is evident here. Total Phosphorus (TP) concentrations apparently declined between the EWQ and post-EWQ periods. Uncertainty in comparisons was introduced by potential laboratory artifacts, declining detection limits and insufficient post-EWQ sampling frequency (n=14). Post-EWQ median total phosphorus fell below the EWQ lower 95% confidence interval. TP is unrelated to flow in both data sets. Flow is plotted on a logarithmic scale. No independent data were available to confirm these results.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Specific Conductance  $\mu\text{mho/cm}$

Existing Water Quality (Table 20):

Median 189  $\mu\text{mho/cm}$   
 Lower 95% Confidence Interval 159  $\mu\text{mho/cm}$   
 Upper 95% Confidence Interval 203  $\mu\text{mho/cm}$   
 Defined in regulations as a flow-related parameter

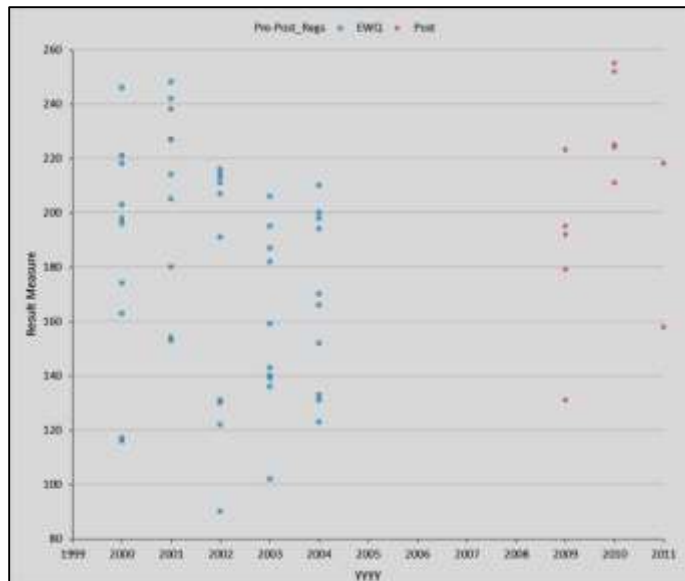
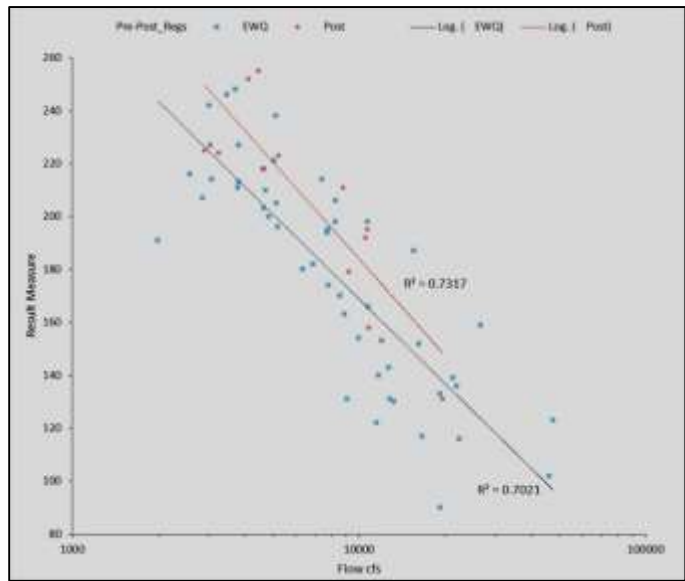


Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	50	253.1	5.06
1677 ICP DRMilford Post	12	1054.7	87.89

H statistic: 4.02  
 X<sup>2</sup> approximation: 4.02  
 DF: 1  
 p-value: 0.0450<sup>1</sup>

H<sub>0</sub>:  $\theta_1 = \theta_2 = \dots$   
 The median of the populations are all equal.  
 H<sub>1</sub>:  $\theta_i \neq \theta_j$  for at least one i, j  
 The median of the populations are not all equal.  
<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.



Water quality degradation is evident here. Specific conductance rose by 26  $\mu\text{mhos/cm}$ ; above the EWQ upper 95% confidence interval. However, uncertainty is introduced by insufficient post-EWQ sampling frequency and under-sampling of the full range of flow conditions. Specific conductance is inversely related to flow in both data sets. Flow is plotted on logarithmic scale. The rise in specific conductance may be associated with the concurrent rise in chloride concentrations. Median specific conductance has risen from 189 to 215  $\mu\text{mhos/cm}$ ; a 14% increase.



Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Total Dissolved Solids (TDS) mg/l

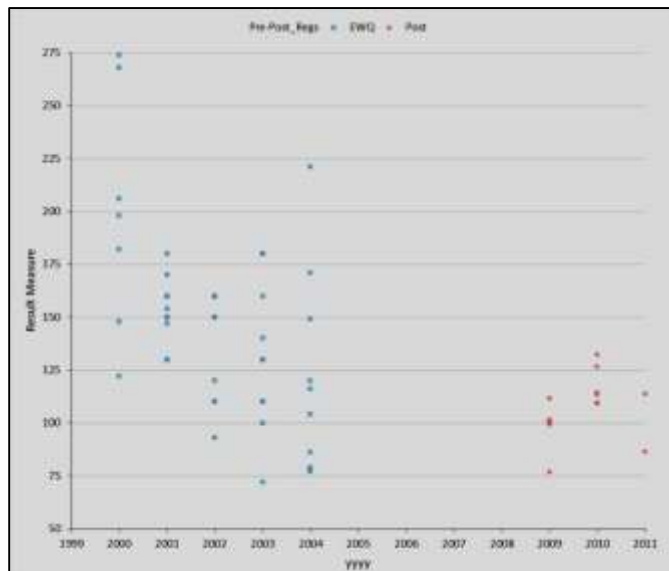
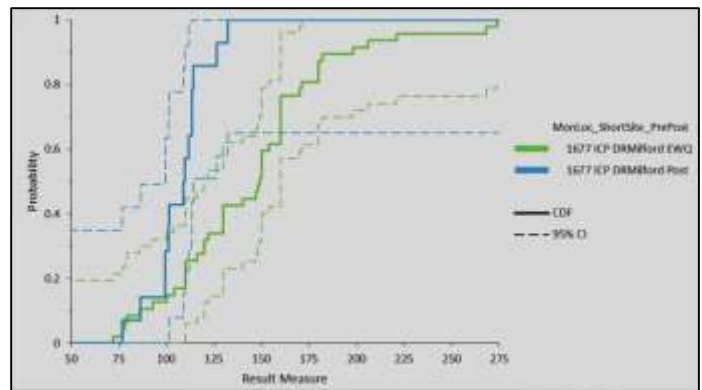
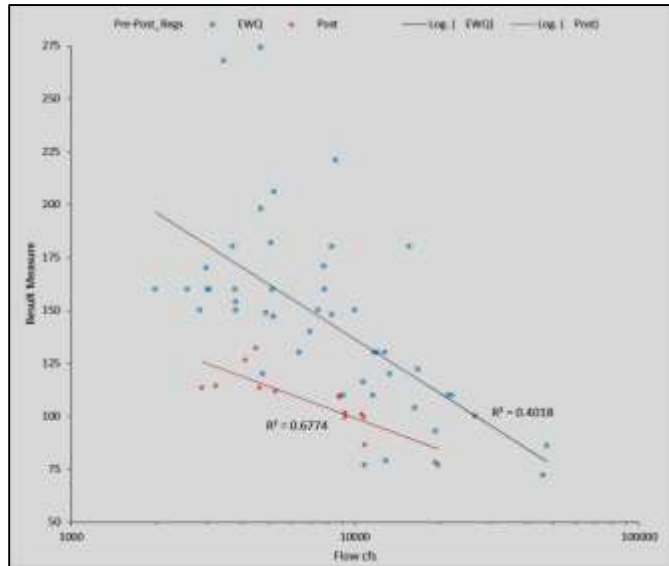
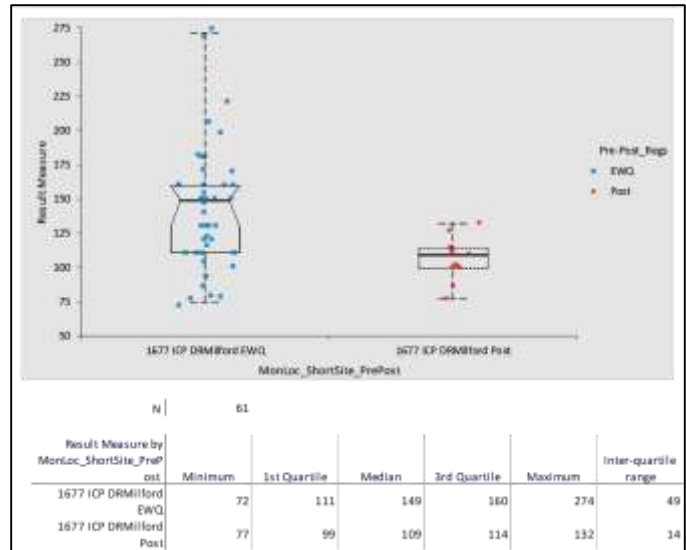
Existing Water Quality (Table 2O):

Median 149 mg/l

Lower 95% Confidence Interval 130 mg/l

Upper 95% Confidence Interval 160 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	47	825.7	17.57
1677 ICP DRMilford Post	14	277.1	198.01

H statistic 11.44  
 X<sup>2</sup> approximation 11.44  
 DF 1  
 p-value 0.0007<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$

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.

<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is evident here. TDS apparently declined between the EWQ and post-EWQ periods. Uncertainty in comparisons was introduced by potential laboratory artifacts and insufficient post-EWQ sampling frequency (n=14). TDS is inversely related to flow in both data sets. Post-EWQ median TDS fell below the EWQ lower 95% lower confidence interval. Post-EWQ TDS was much less variable than the baseline samples as well. There were no undetected results at any time. Flow is plotted on a logarithmic scale.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Total Suspended Solids (TSS) mg/l

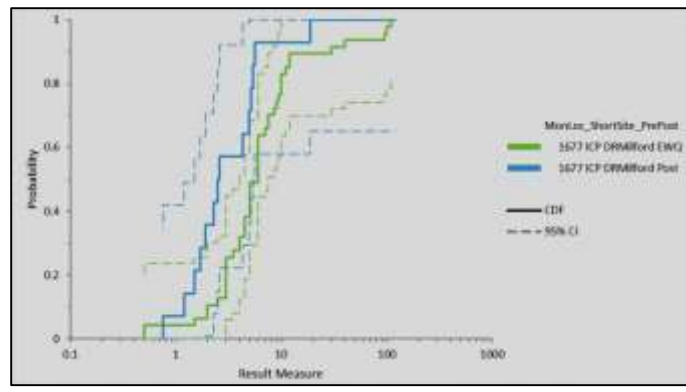
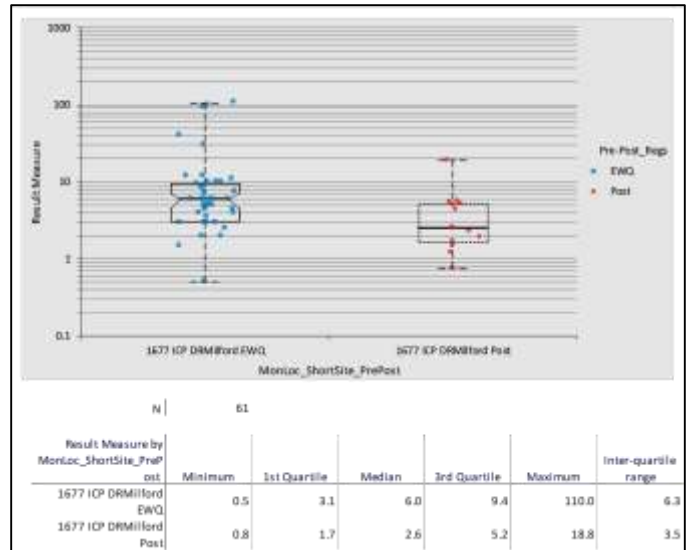
Existing Water Quality (Table 20):

Median 6.0 mg/l

Lower 95% Confidence Interval 4.5 mg/l

Upper 95% Confidence Interval 7.0 mg/l

Defined in regulations as a flow-related parameter

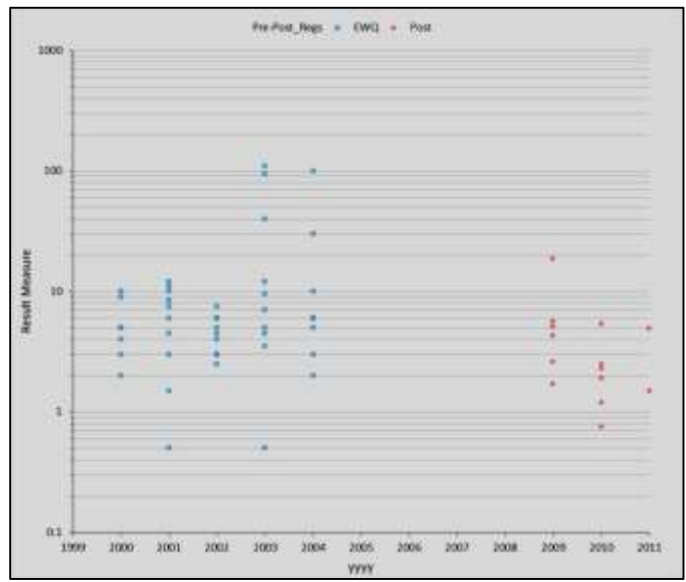
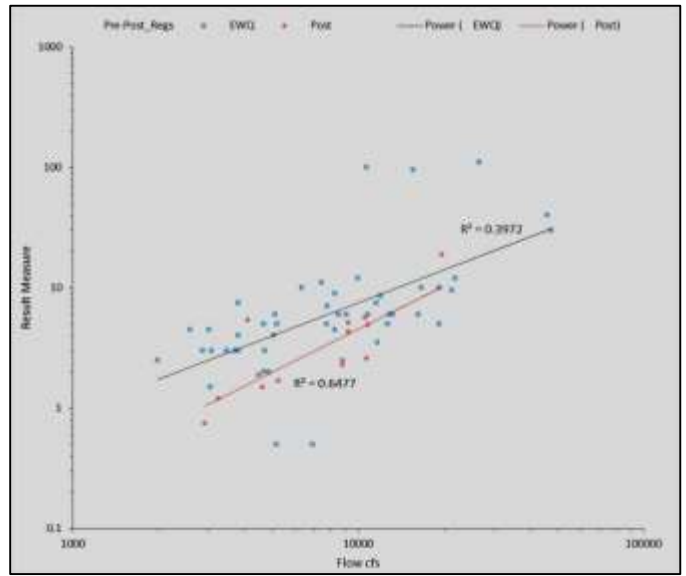


Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	47	511.2	10.88
1677 ICP DRMilford Post	14	1716.1	122.58

H statistic: 7.09  
 X<sup>2</sup> approximation: 7.09  
 DF: 1  
 p-value: 0.0078<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 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.  
<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.



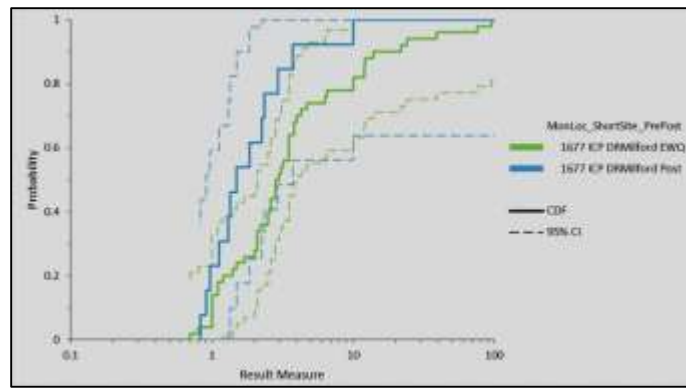
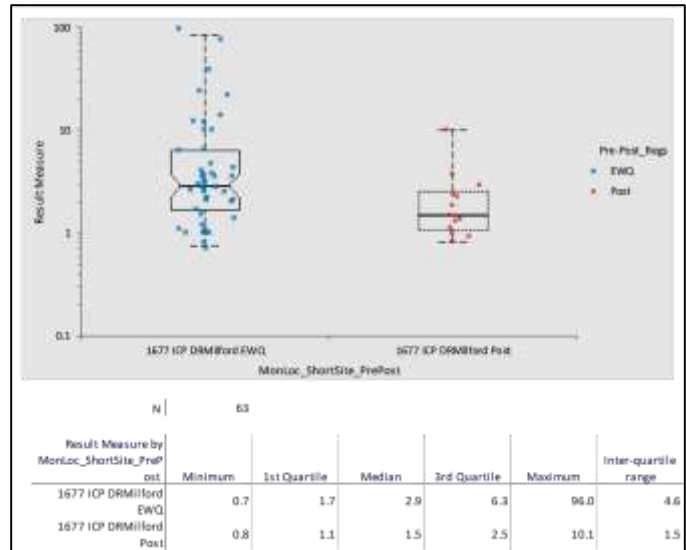
No water quality degradation is evident here. TSS apparently declined between EWQ and post-EWQ periods. Uncertainty in comparisons was introduced by potential laboratory artifacts, insufficient post-EWQ sampling frequency, and under-representation of post-EWQ flow conditions. TSS is positively related to flow in both data sets. Post-EWQ median TSS fell below the lower EWQ 95% confidence interval. Both flow and concentration are plotted on a logarithmic scale.

Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Turbidity NTU

Existing Water Quality (Table 20):

Median 2.9 NTU  
 Lower 95% Confidence Interval 2.2 NTU  
 Upper 95% Confidence Interval 3.8 NTU  
 Defined in regulations as a flow-related parameter



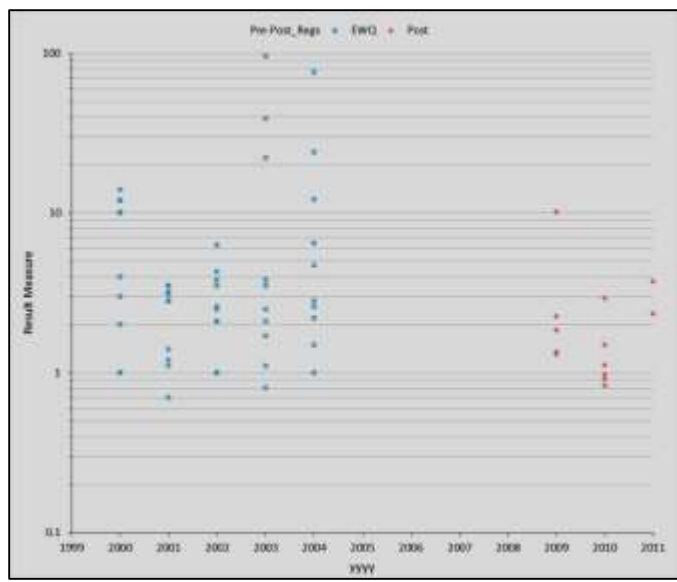
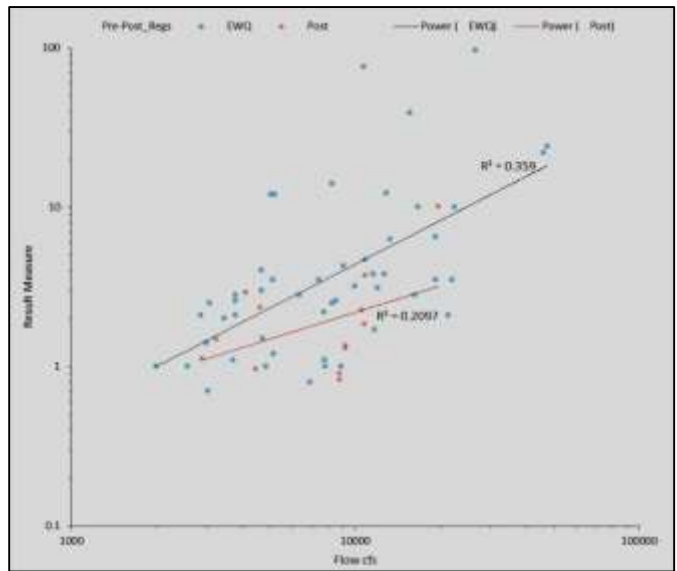
Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	50	348.5	6.97
1677 ICP DRMilford Post	13	1340.3	103.10

H statistic: 5.03  
 X<sup>2</sup> approximation: 5.03  
 DF: 1  
 p-value: 0.0249<sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3$ ...  
 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.  
<sup>1</sup> Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

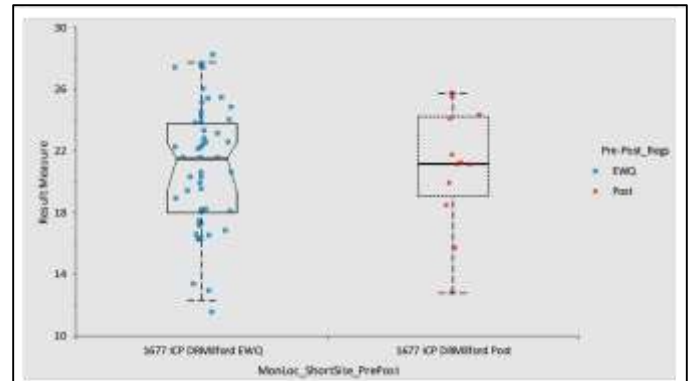
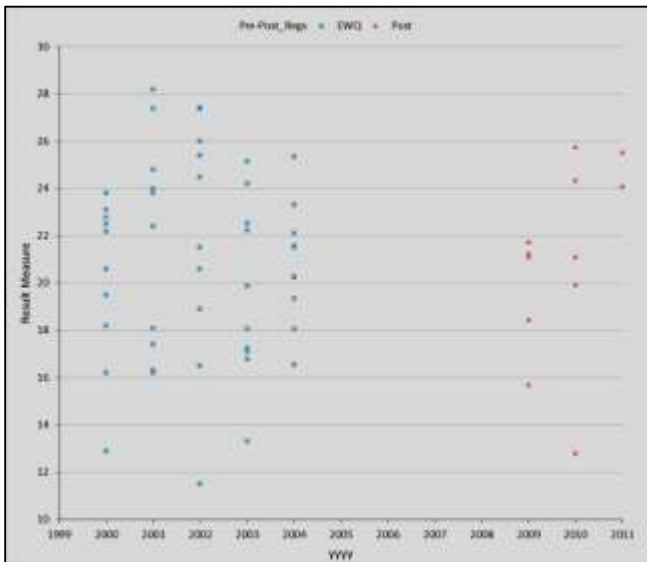
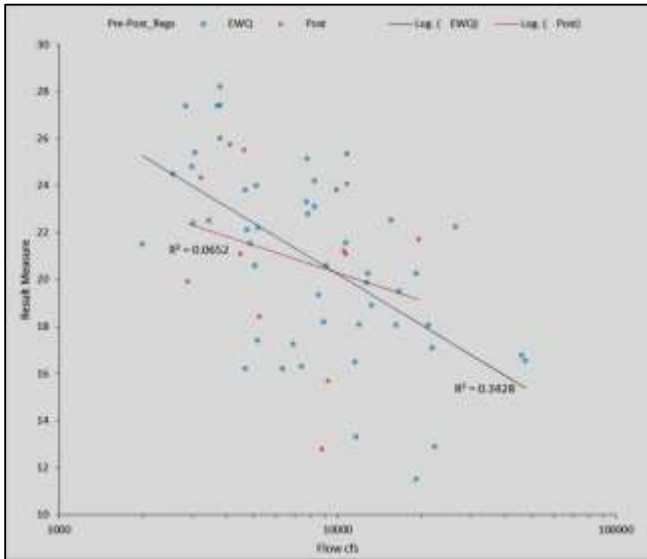
No water quality degradation is evident here. Turbidity appeared to decline between the EWQ and post-EWQ periods. Uncertainty in comparisons was introduced by insufficient post-EWQ sampling frequency (n=13). Post-EWQ median turbidity fell below the EWQ 95% confidence interval. Turbidity is weakly related to flow in both data sets. Both concentration and flow are represented on logarithmic scales.



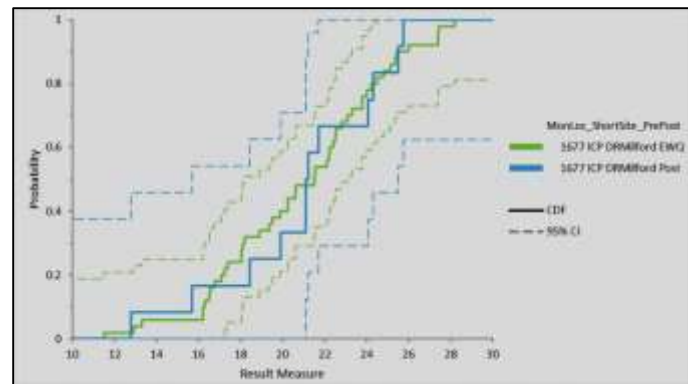
Chapter 12: 1677 ICP  
 Delaware River at Milford/Upper Black Eddy NJ/PA

Water Temperature, degrees C

Not included in DRBC Existing Water Quality rules



Result Measure by MonLoc_ShortSite_PrePost	N   62					
	Minimum	1st Quartile	Median	3rd Quartile	Maximum	Inter-quartile range
1677 ICP DRMilford EWQ	11.5	18.0	21.5	23.8	28.2	5.8
1677 ICP DRMilford Post	12.8	19.0	21.2	24.2	25.8	5.2



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1677 ICP DRMilford EWQ	50	1.3	0.03
1677 ICP DRMilford Post	12	5.3	0.44

H statistic	0.02
$\chi^2$ approximation	0.02
DF	1
p-value	0.8866 <sup>1</sup>

H0:  $\theta_1 = \theta_2 = \theta_3 = \dots$   
 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.  
<sup>1</sup> Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is evident here. Water temperature did not measurably change between the EWQ and post-EWQ periods. Uncertainty in comparisons was introduced by insufficient post-EWQ sampling frequency (n=12). Water temperature is weakly related to flow in both data sets. Flow is plotted on a logarithmic scale.