

Lake Okeechobee Basin Management Action Plan (BMAP)
Technical Webinar
March 27, 2019 1:00 PM

Handout

Water Quality Analysis DRAFT Results

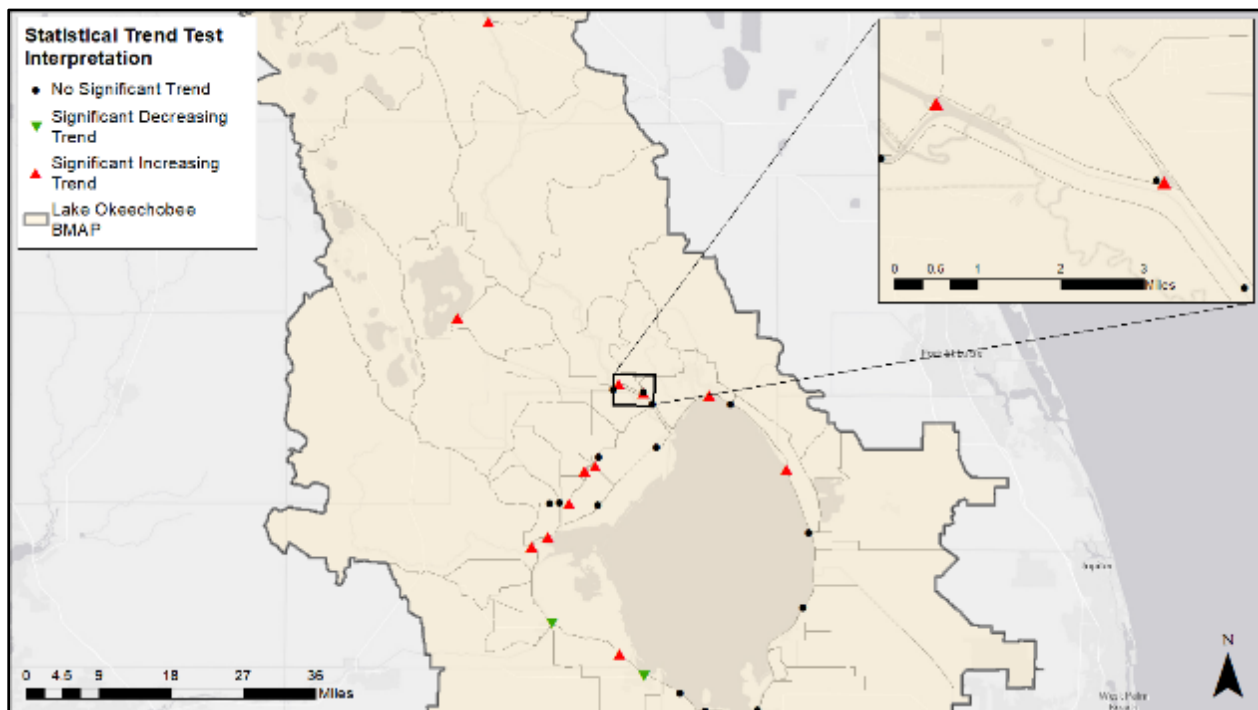
Time Series, Seasonal Kendall Analysis,
and Serial Correlation Results

Times Series and Seasonal Kendall Trend Analysis Methods

- The South Florida Water Management District (SFWMD) provided pre-processed data.
- For Tier 1 Stations:
 - Removed total phosphorus (TP) outliers.
 - Analyzed trends in loads and flow weighed means (FWMs):
 - Only analyzed stations with greater than 50% of data for water year (WY) 2009 - WY2018.
- For Tier 2 Stations:
 - Appended Watershed Information Network (WIN) data for last four months of WY2018 when necessary.
 - Analyzed trends in TP concentrations:
 - Only analyzed stations with greater than 50% of data for WY2009 - WY2018.
- Statistical significance is indicated by a p-value ≤ 0.05 .
- Note: Even if the p-value is statistically significant, the result may not be ecologically significant.

Tier 1 Monthly TP Loads

- Station Locations and Trend Results



**TP Load Trend Analysis and Serial Correlation Results
(Stations with MORE than 50 percent of data)**

Station	Tau	P-Value	Adjusted P-Value	¹ Slope	² Selected P-value	Serial Correlation	³ Trend
C10A	0.009	0.9109	0.9458	0.0000	0.911		No Significant Trend
FECSR78	0.248	0.0006	0.0708	44.2000	0.001		Significant Increasing
INDUSCAN	-0.169	0.0192	0.0086	-1.3920	0.019		Significant Decreasing
L59W	0.091	0.2117	0.4382	3.8870	0.438	Yes	No Significant Trend
L60E	0.176	0.0131	0.1134	0.4175	0.013		Significant Increasing
L60W	0.231	0.0014	0.0065	1.4160	0.001		Significant Increasing
L61E	0.001	0.9556	0.9685	0.0000	0.956		No Significant Trend
S127	0.133	0.0575	0.2777	0.4762	0.058		No Significant Trend
S129	0.002	1.0000	1.0000	0.0000	1.000		No Significant Trend
S131	0.165	0.0204	0.2017	0.8327	0.020		Significant Increasing
S133	0.291	0.0000	0.0554	15.2800	0.000		Significant Increasing
S135	0.380	0.0000	0.0137	20.7900	0.014	Yes	Significant Increasing
S154	0.187	0.0072	0.1408	0.0270	0.007		Significant Increasing
S154C	0.017	0.8353	0.8972	0.0000	0.835		No Significant Trend
S191	0.083	0.2465	0.4680	0.0427	0.468	Yes	No Significant Trend
S308C	-0.033	0.6597	0.7983	-3.1330	0.660		No Significant Trend
S4	0.178	0.0139	0.0470	6.3680	0.014		Significant Increasing
S65	0.244	0.0007	0.0345	197.8000	0.001		Significant Increasing
S65E	0.293	0.0001	0.0192	595.2000	0.000		Significant Increasing
S68	0.183	0.0114	0.2363	174.7000	0.011		Significant Increasing
S71	0.115	0.1153	0.4178	89.2500	0.418	Yes	No Significant Trend
S72	0.163	0.0247	0.2663	138.3000	0.025		Significant Increasing
S84	0.170	0.0188	0.2255	160.8000	0.019		Significant Increasing

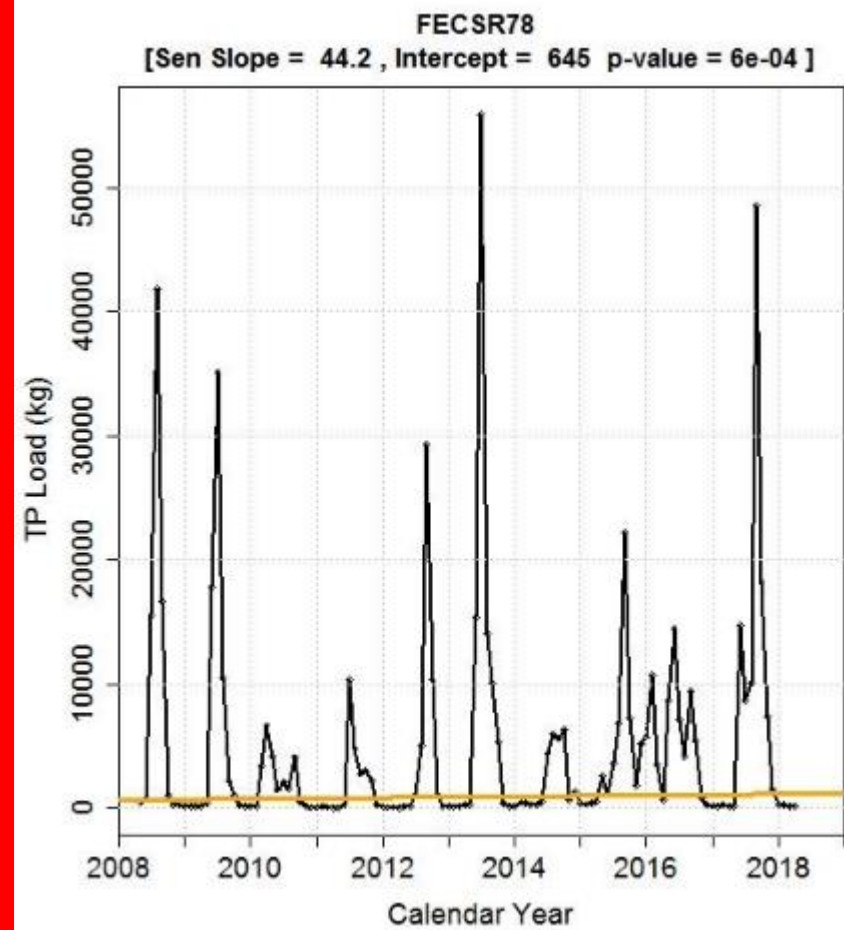
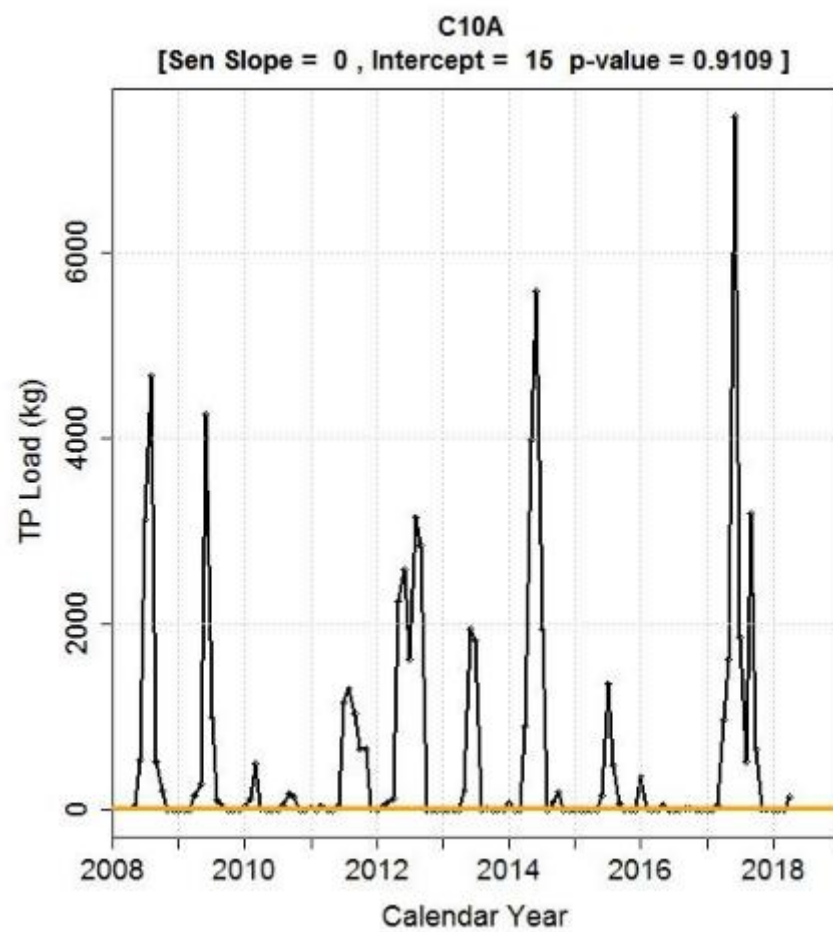
Notes:

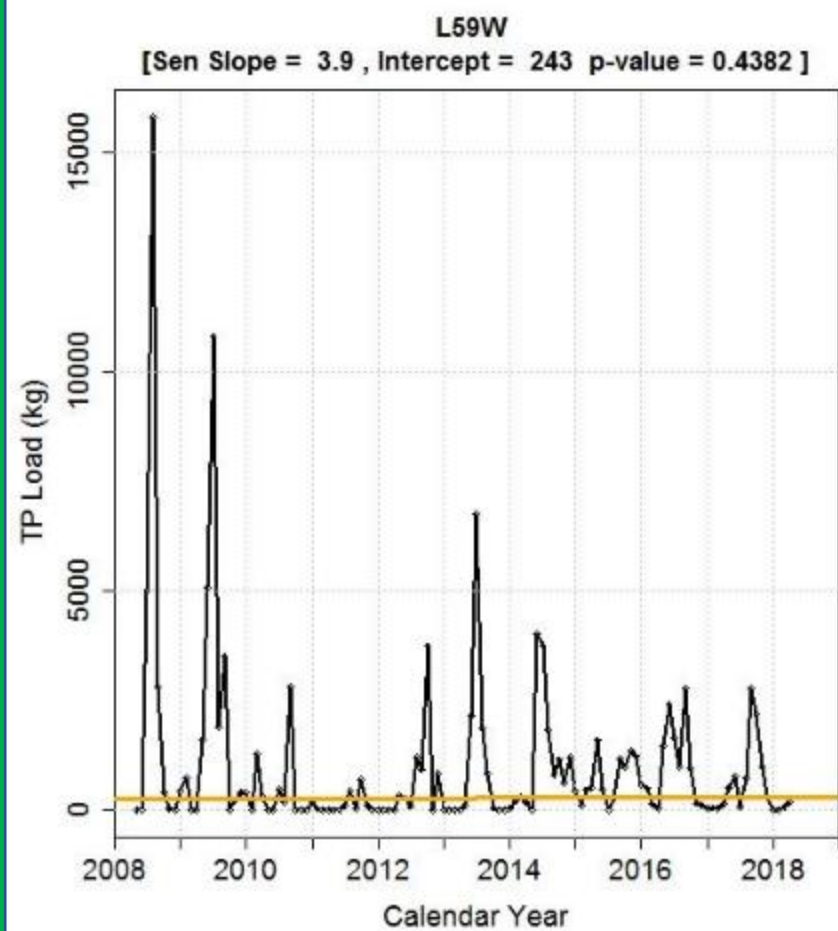
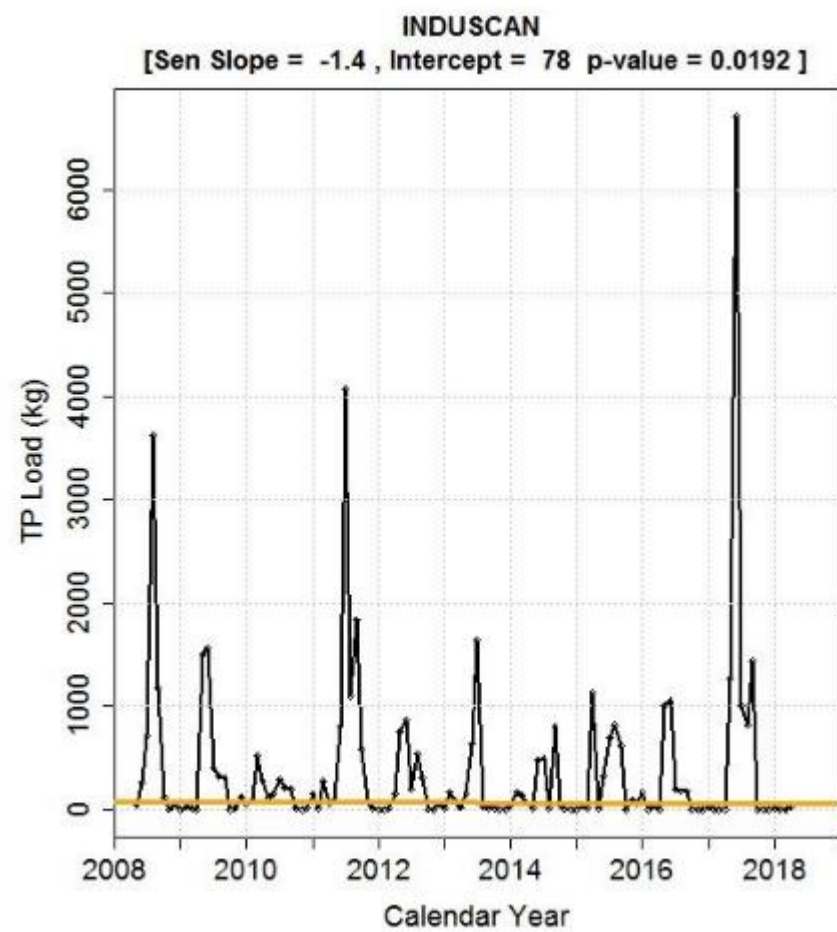
1: Even if the *p*-value is statistically significant, the result may not be ecologically significant. For example, if a trend is statistically significantly declining (negative trend) but the slope is near zero, then it may not be realistic to assume that an improvement in water quality by reductions in TP may positively impact the ecological system in a measurable way.

2: Series with serial correlation (as per autocorrelation analysis results) used the adjusted *P*-value for serial correlation.

3: A decreasing trend may suggest an improvement in water quality. An increasing trend may suggest a decline in water quality.

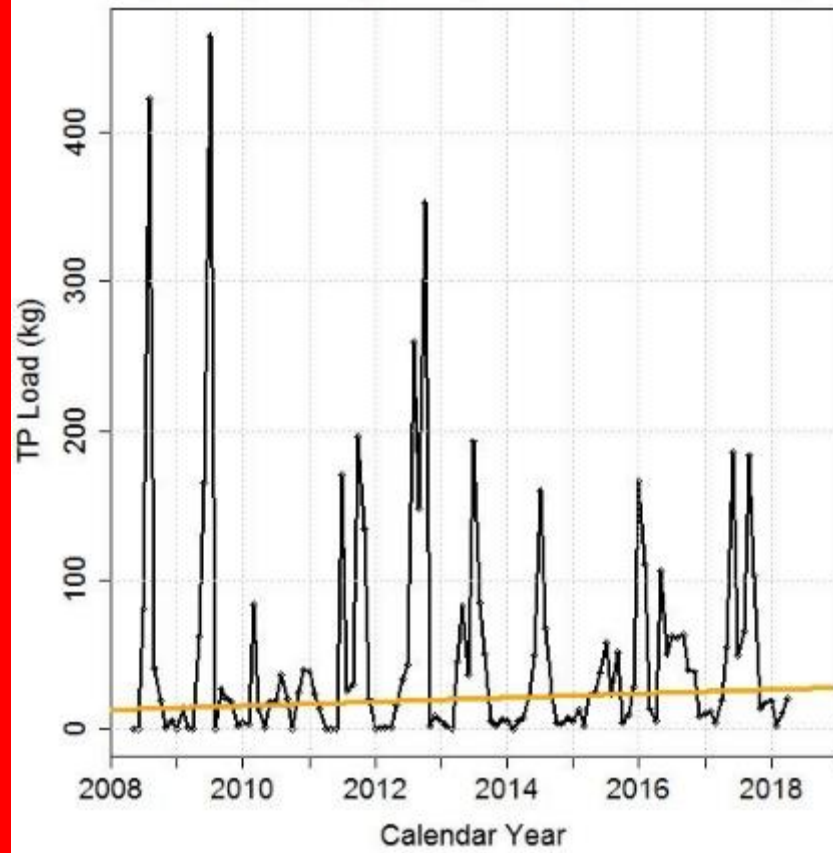
- Tier 1 TP Loads Results Graphs
 - The period of record (POR) plotted on the graphs is WY2009 through WY2018.
 - The x-axis tick marks represent the beginning of the calendar year.
 - Time-series data are plotted in black.
 - Orange line indicates linear trend in the data using Sen-Slope.





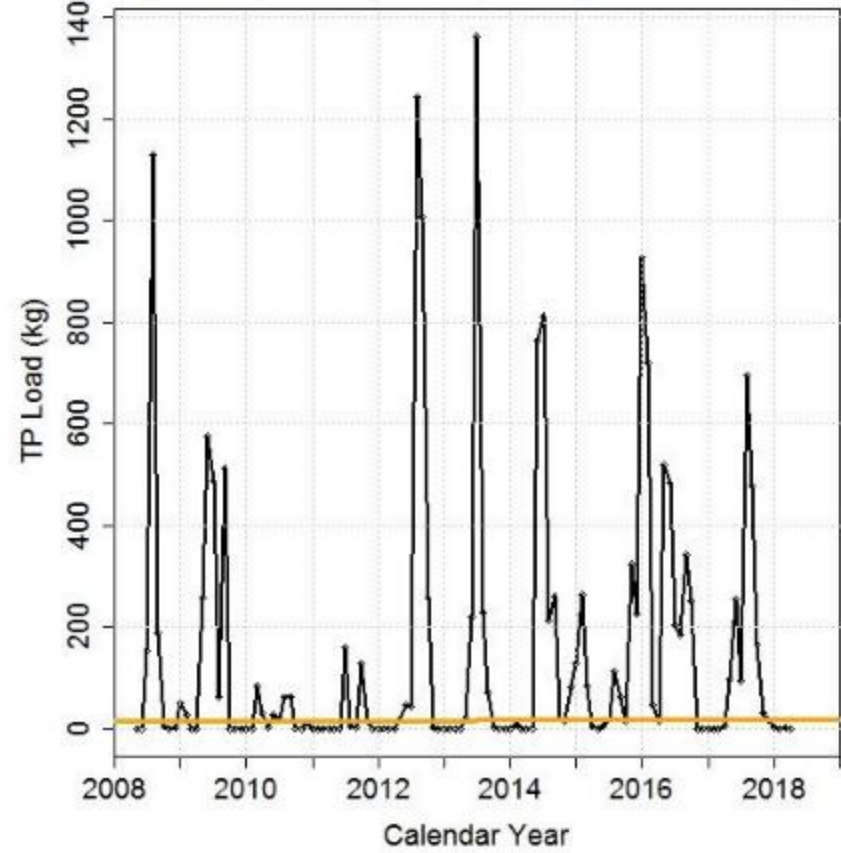
L60W

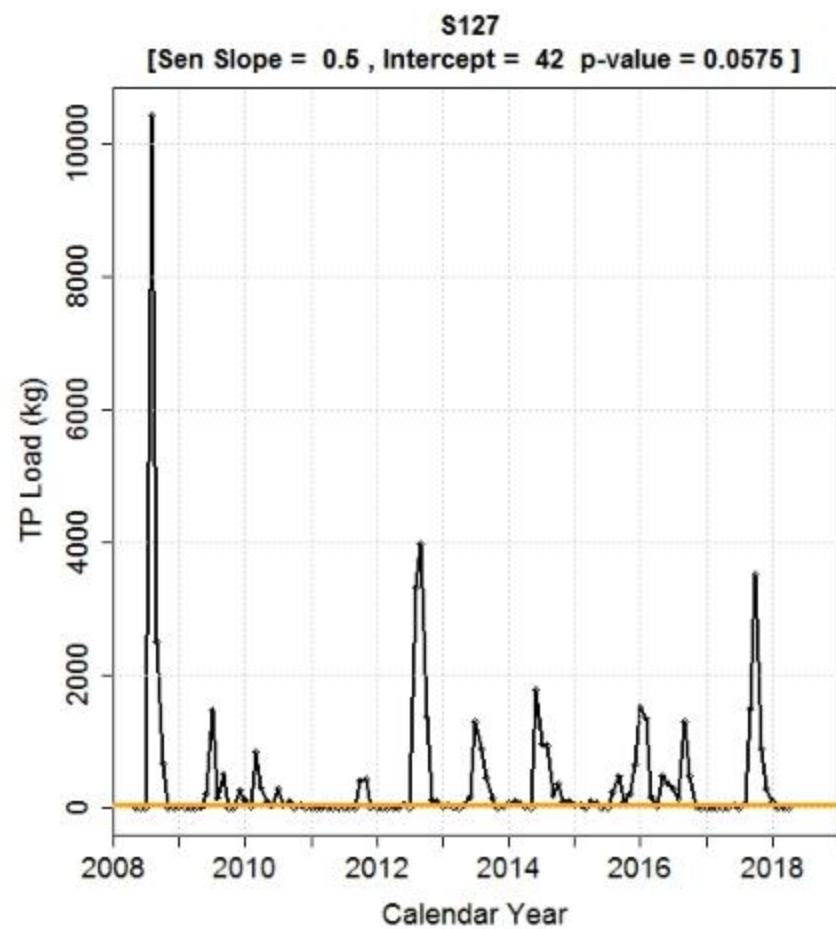
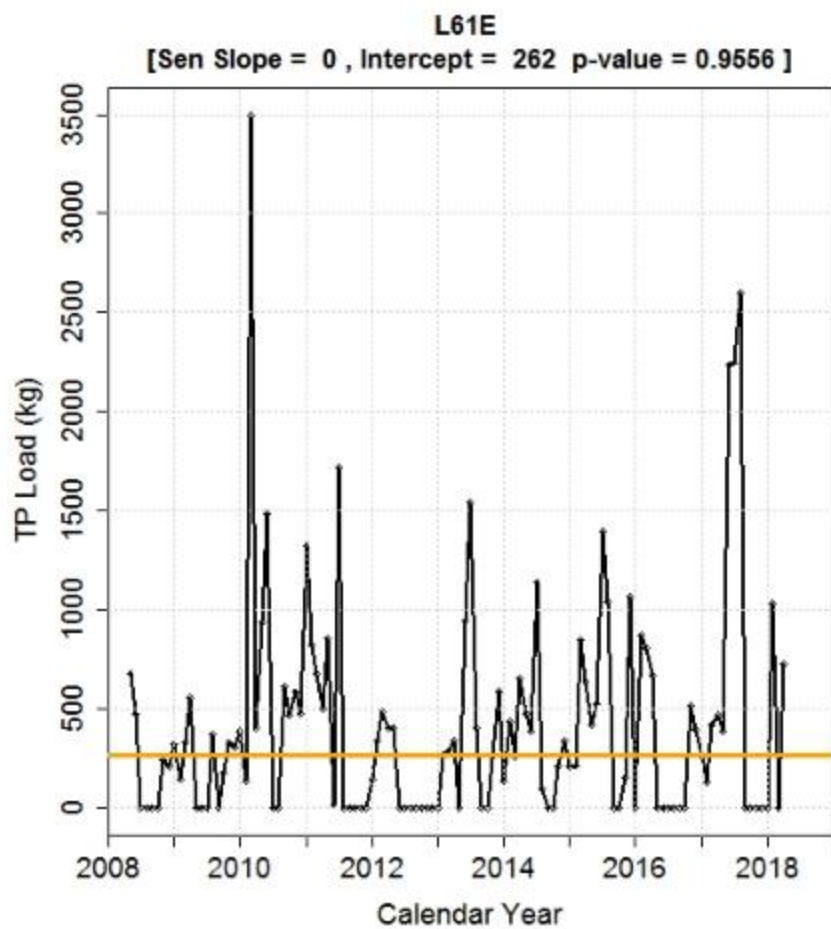
[Sen Slope = 1.4 , Intercept = 12 p-value = 0.0014]

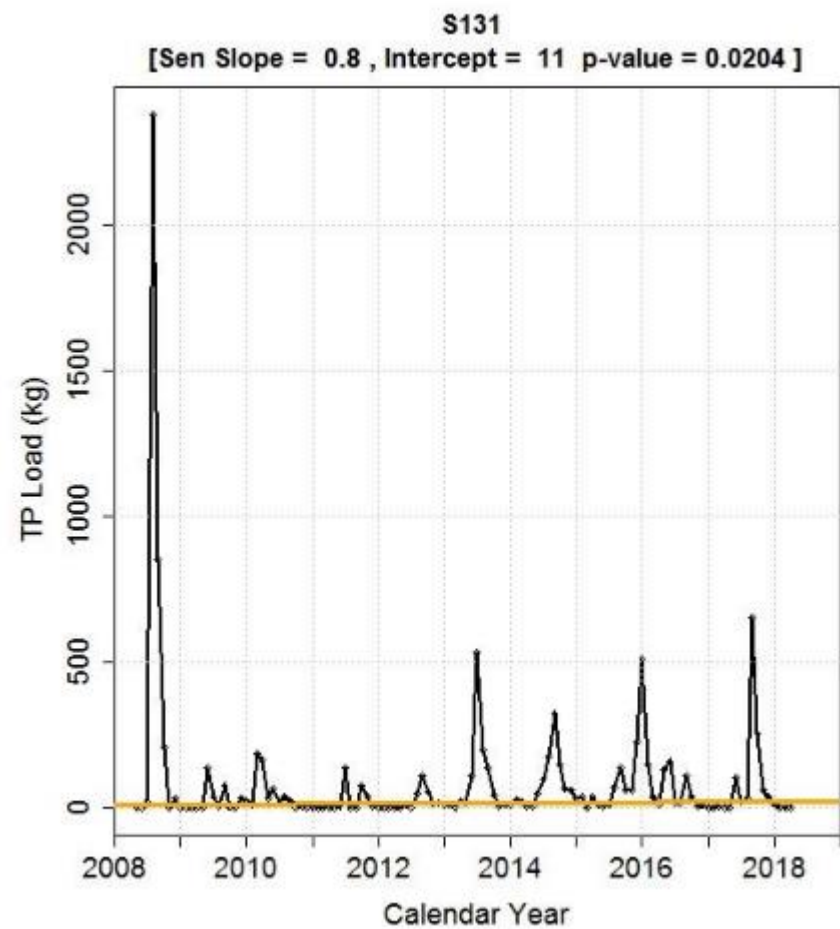
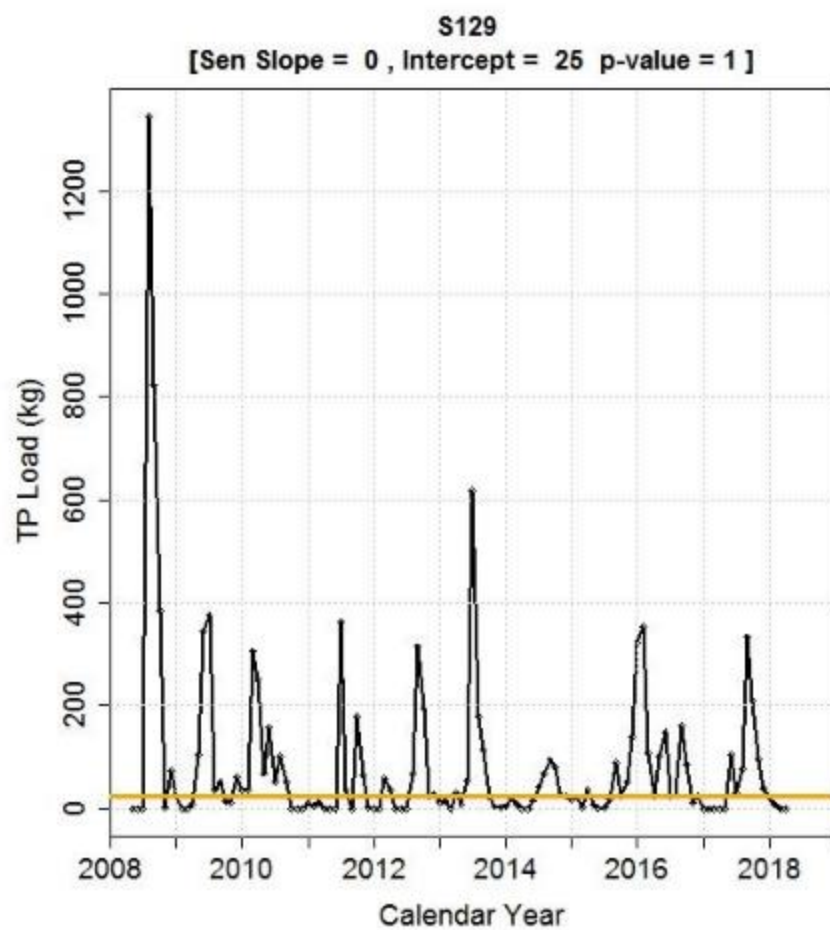


L60E

[Sen Slope = 0.4 , Intercept = 14 p-value = 0.0131]

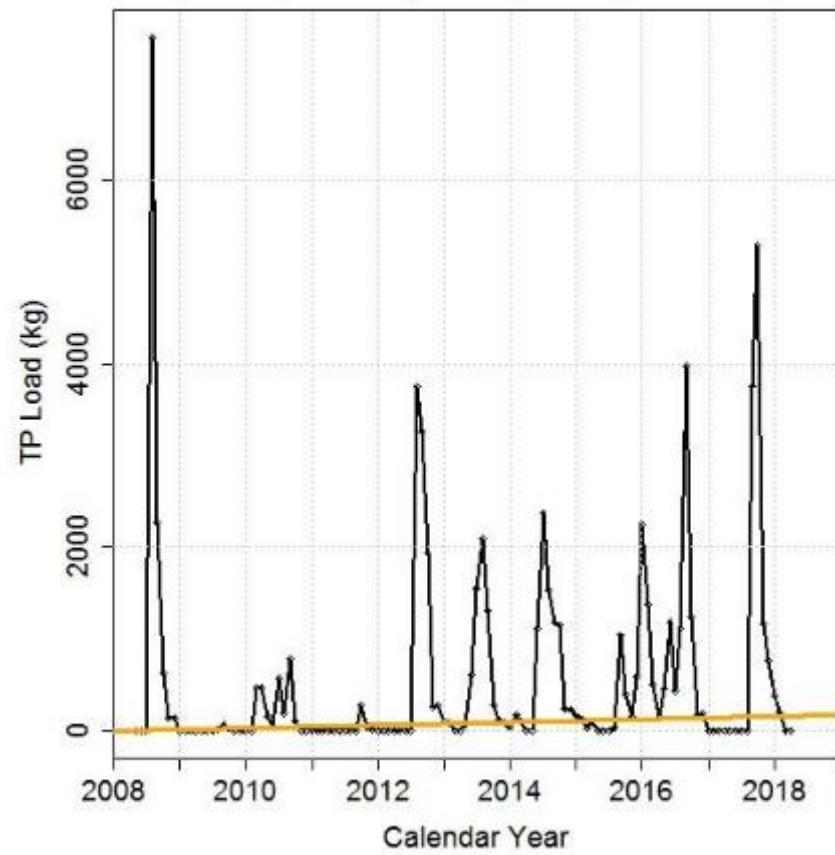






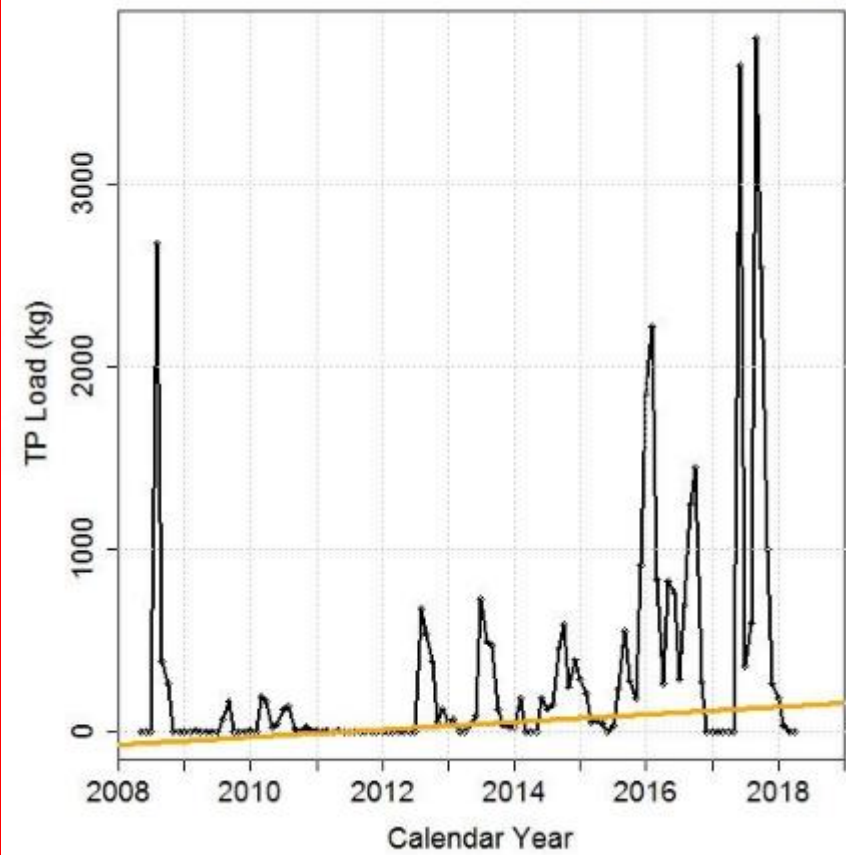
S133

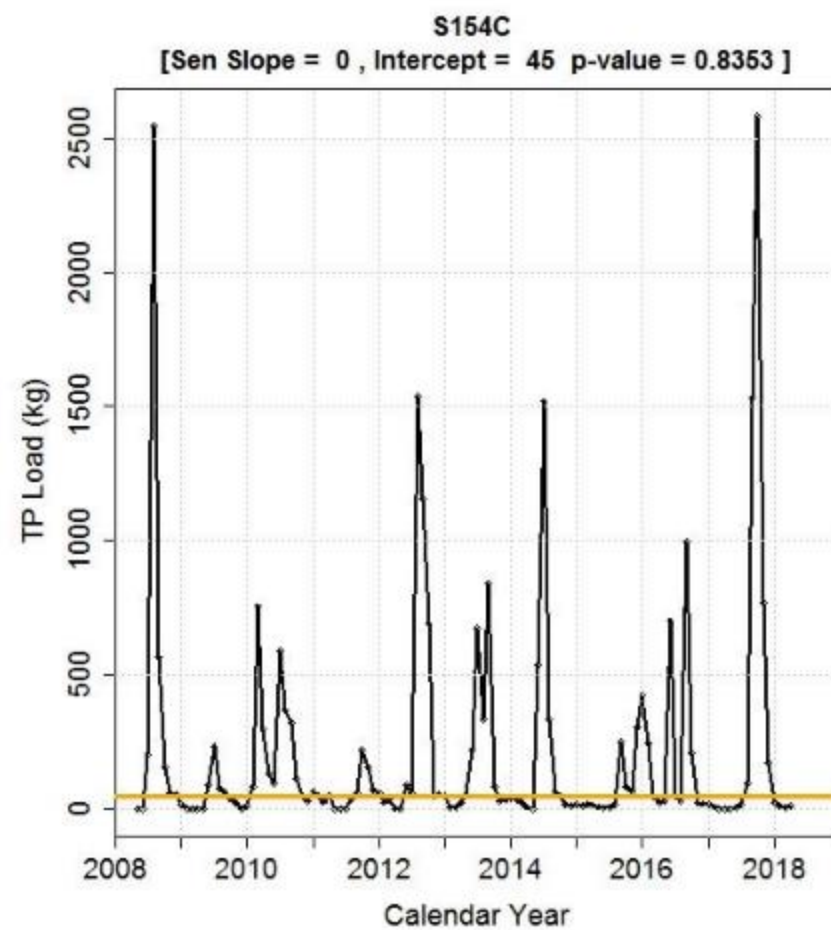
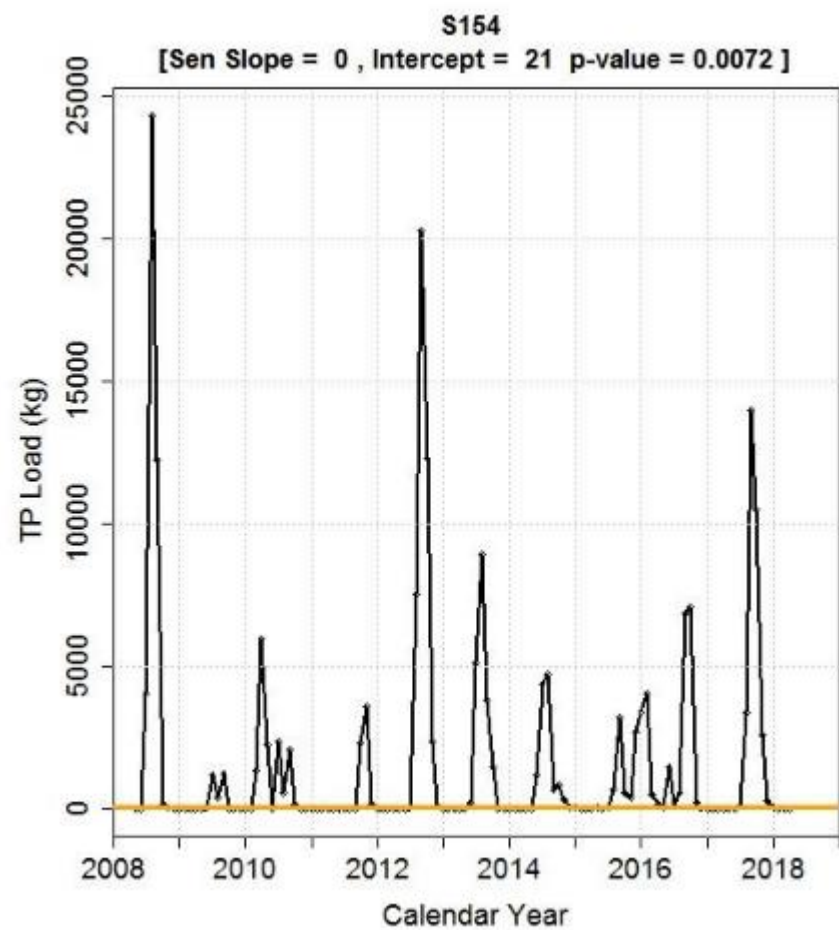
[Sen Slope = 15.3 , Intercept = -1 p-value = 0]

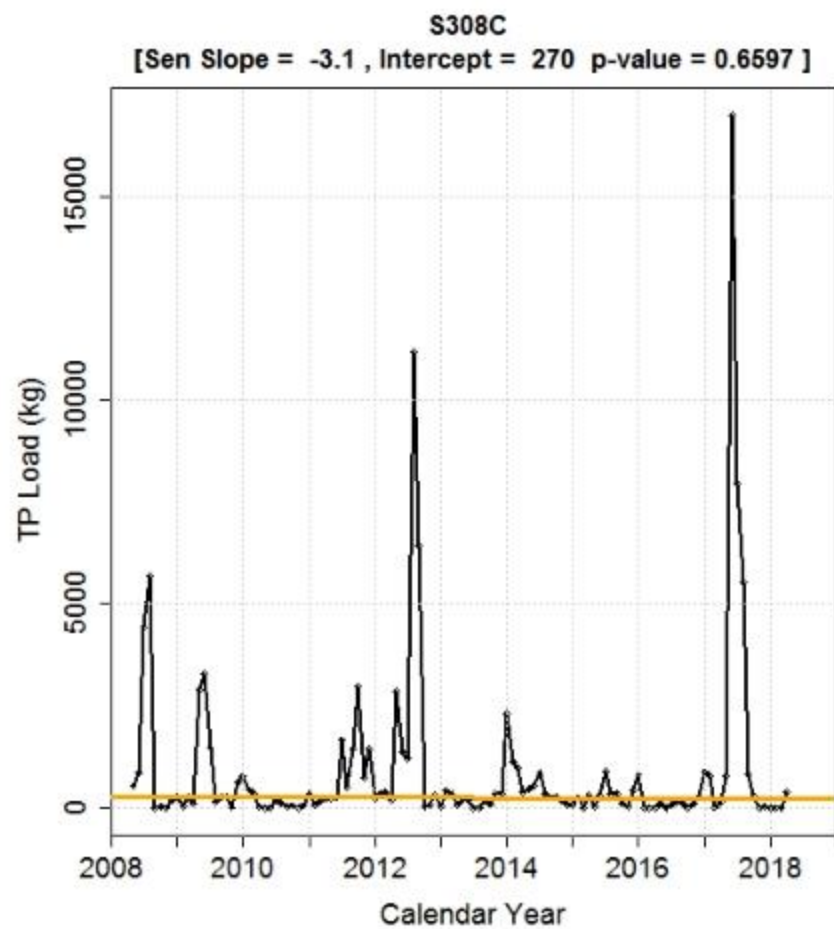
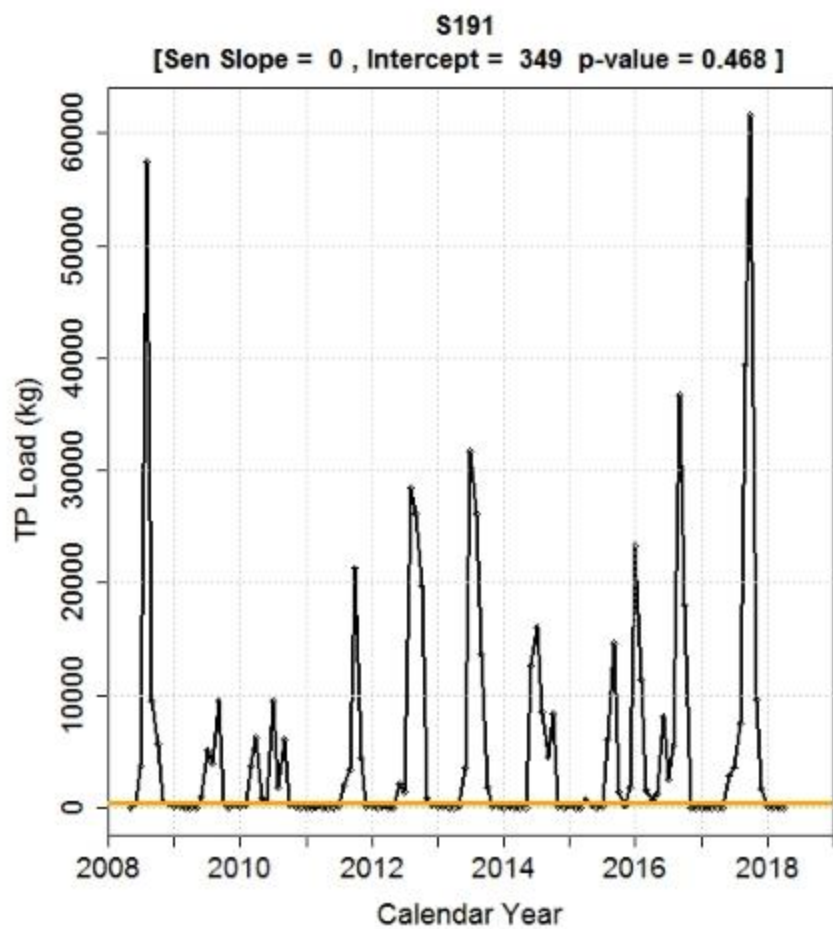


S135

[Sen Slope = 20.8 , Intercept = -80 p-value = 0.0137]

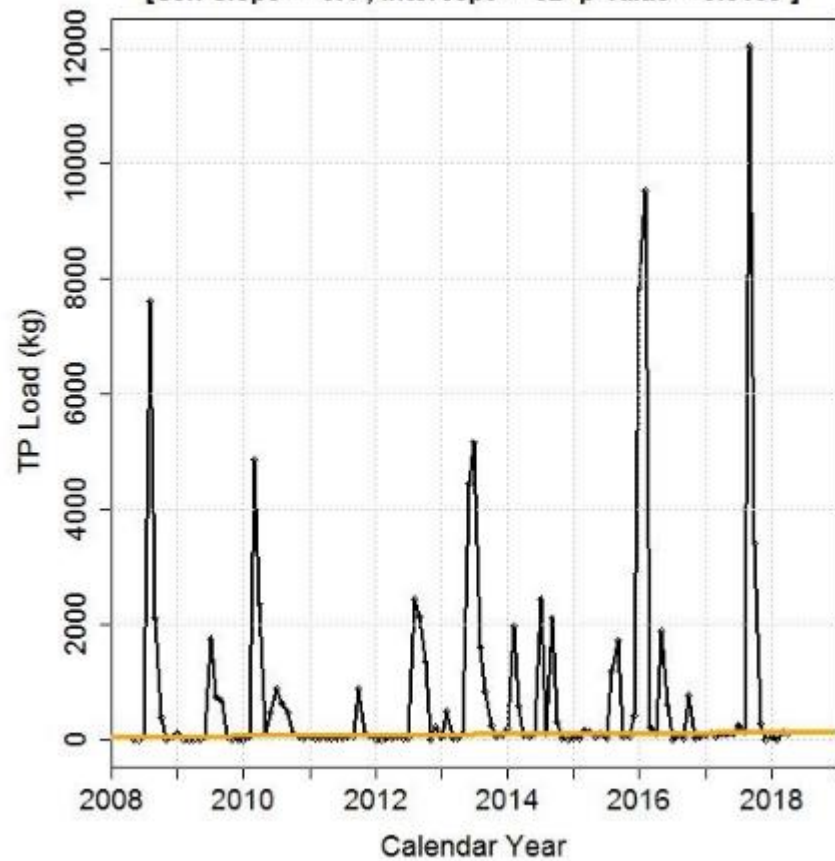






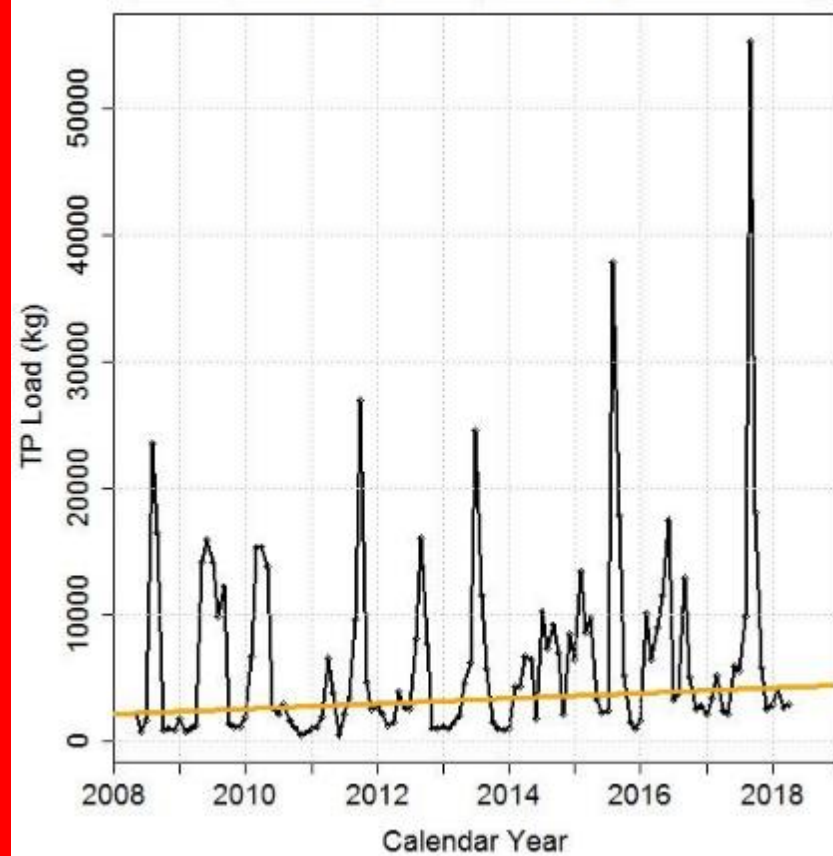
S4

[Sen Slope = 6.4 , Intercept = 52 p-value = 0.0139]



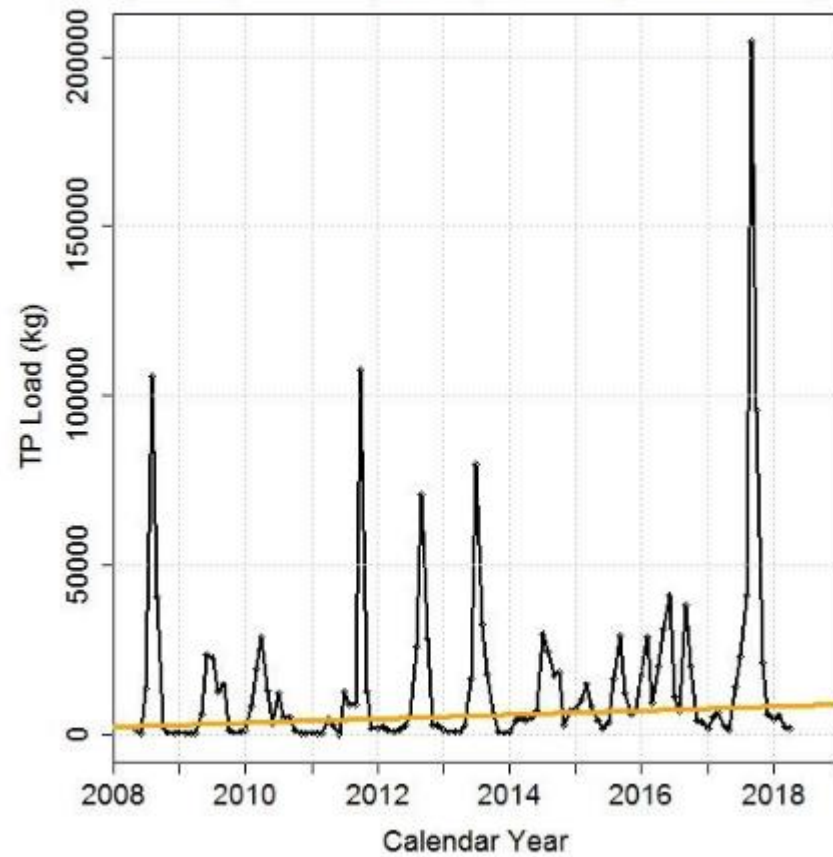
S65

[Sen Slope = 197.8 , Intercept = 2167 p-value = 7e-04]



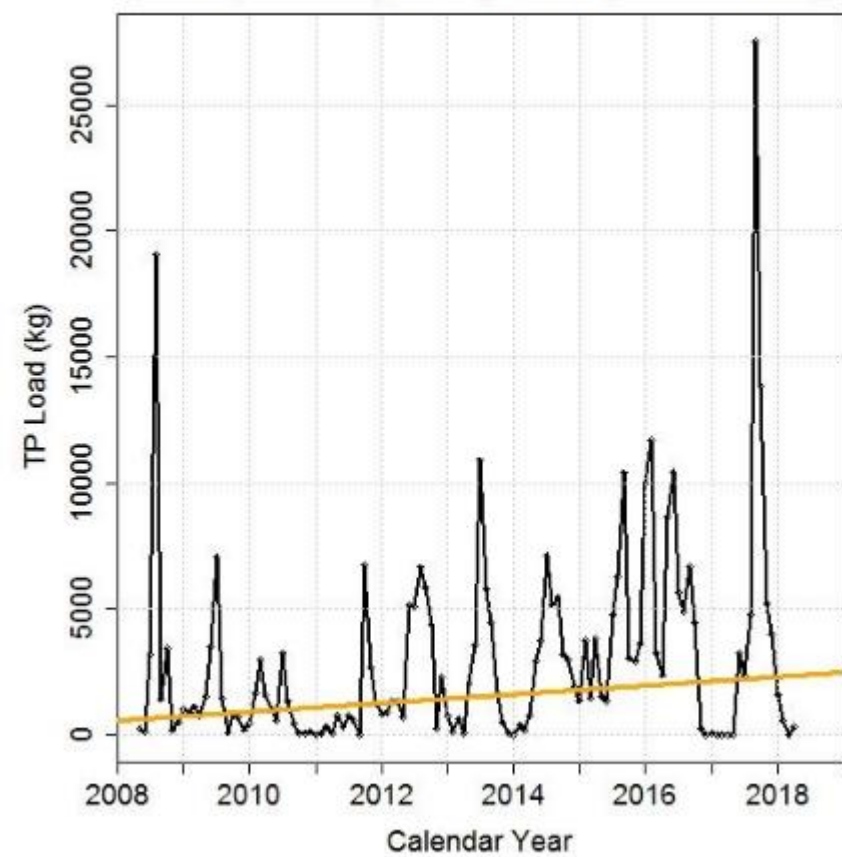
S65E

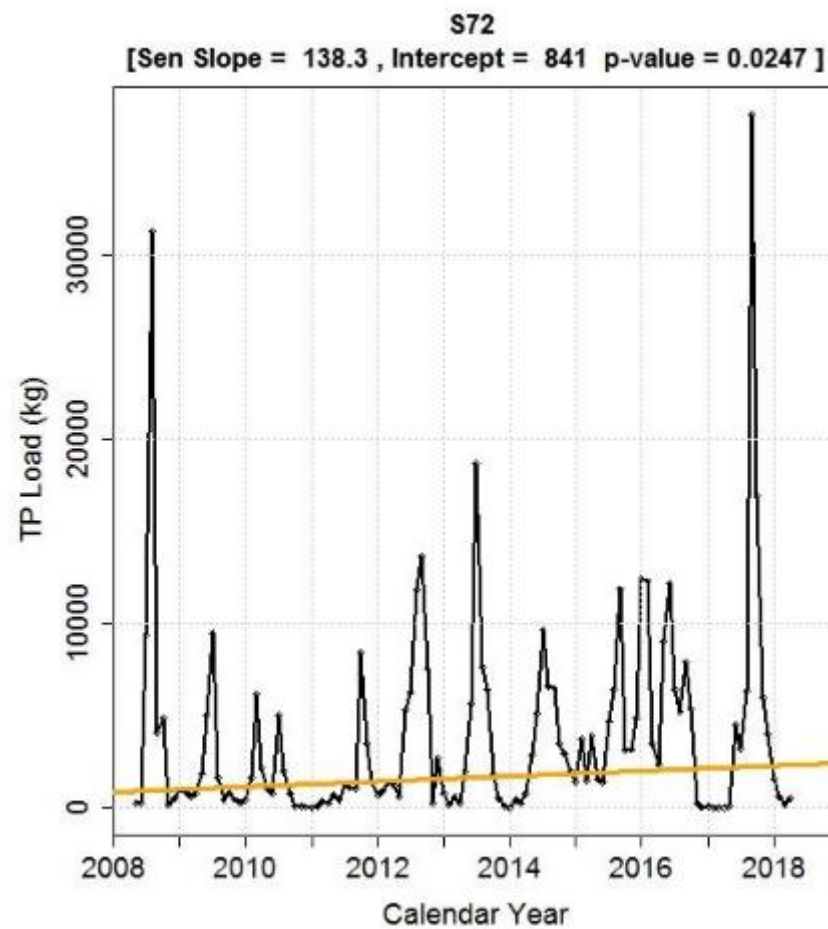
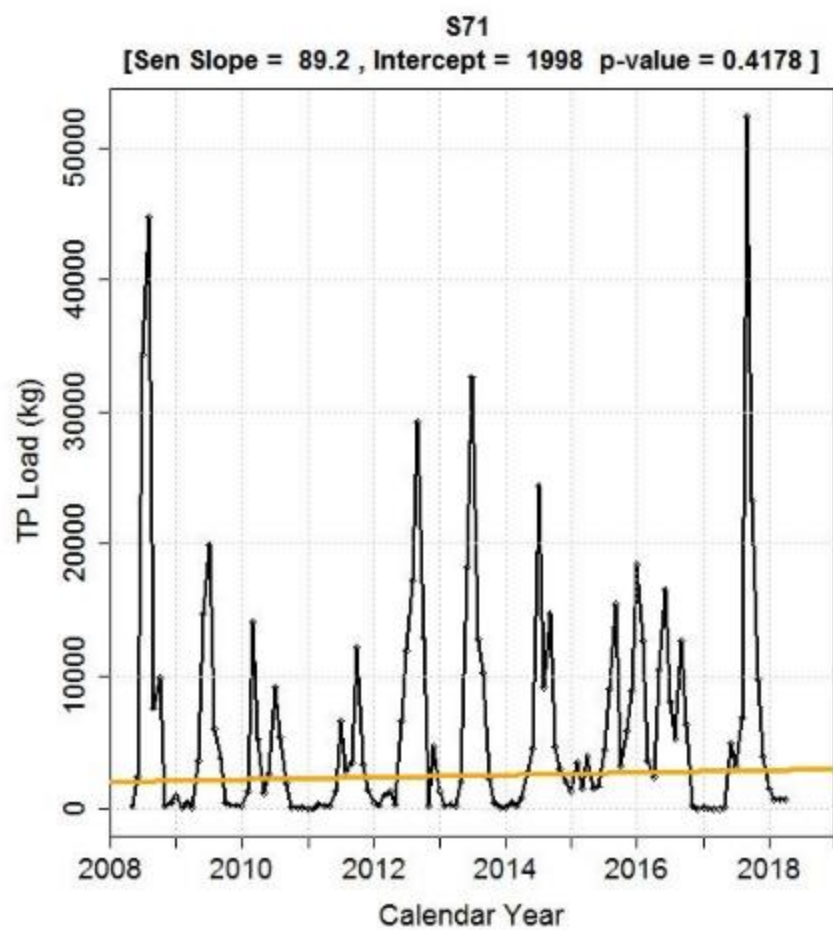
[Sen Slope = 595.2 , Intercept = 2409 p-value = 1e-04]

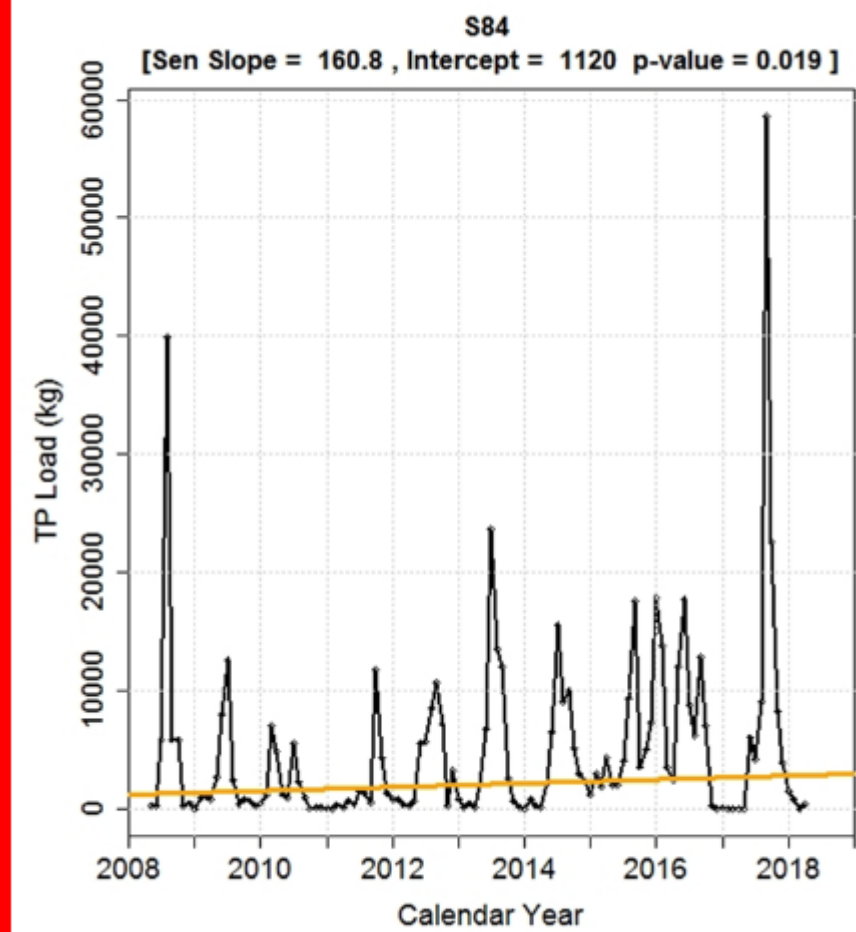


S68

[Sen Slope = 174.7 , Intercept = 493 p-value = 0.0114]

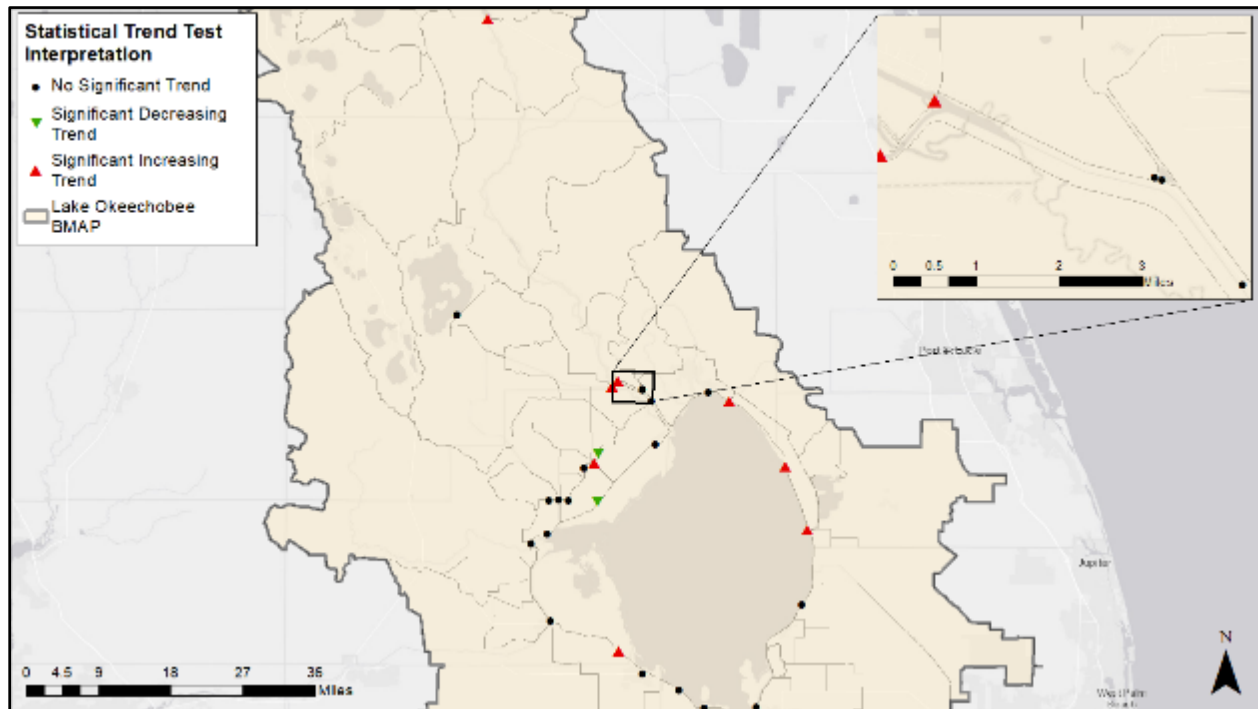






Tier 1 Monthly TP FWM

- Station Location and Trend Results



**Flow Weighted Mean Trend Analysis and Serial Correlation Results
(Stations with MORE than 50 percent of data)**

Station	Tau	P-Value	Adjusted P-Value	¹ Slope	² Selected P-value	Serial Correlation	³ Trend
C10A	0.253	0.0150	0.1683	0.0043	0.015		Significant Increasing
FECSR78	0.085	0.2453	0.4692	0.0025	0.245		No Significant Trend
INDUSCAN	-0.010	0.9277	0.9518	-0.0002	0.928		No Significant Trend
L59W	-0.241	0.0039	0.1456	-0.0156	0.004		Significant Decreasing
L60E	-0.052	0.5612	0.7368	-0.0021	0.561		No Significant Trend
L60W	0.019	0.8204	0.8585	0.0004	0.859	Yes	No Significant Trend
L61E	-0.167	0.0936	0.3040	-0.0030	0.094		No Significant Trend
S127	-0.161	0.0907	0.3922	-0.0081	0.091		No Significant Trend
S129	-0.407	0.0000	0.0476	-0.0048	0.048	Yes	Significant Decreasing
S131	-0.070	0.4372	0.6523	-0.0008	0.652	Yes	No Significant Trend
S133	-0.137	0.1789	0.4760	-0.0047	0.179		No Significant Trend
S135	0.346	0.0002	0.0817	0.0093	0.000		Significant Increasing
S154	0.137	0.1366	0.3377	0.0107	0.137		No Significant Trend
S154C	-0.124	0.1175	0.3789	-0.0114	0.118		No Significant Trend
S191	0.391	0.0000	0.0086	0.0243	0.009	Yes	Significant Increasing
S308C	0.233	0.0036	0.1338	0.0071	0.004		Significant Increasing
S4	0.303	0.0001	0.0856	0.0177	0.000		Significant Increasing
S65	0.237	0.0010	0.0544	0.0021	0.001		Significant Increasing
S65E	0.293	0.0001	0.0139	0.0074	0.000		Significant Increasing
S68	0.266	0.0003	0.0785	0.0040	0.079	Yes	No Significant Trend
S71	0.107	0.1464	0.2646	0.0051	0.146		No Significant Trend
S72	0.202	0.0056	0.0560	0.0105	0.006		Significant Increasing
S84	0.190	0.0090	0.1120	0.0067	0.009		Significant Increasing

Notes:

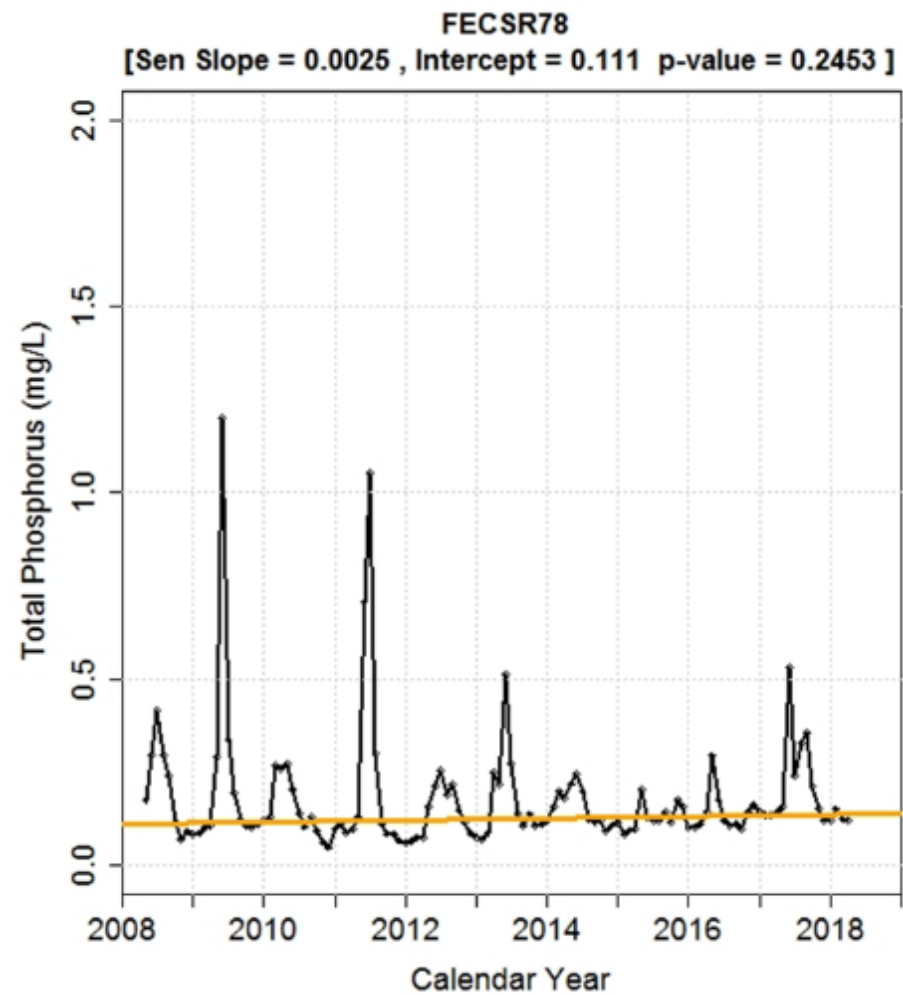
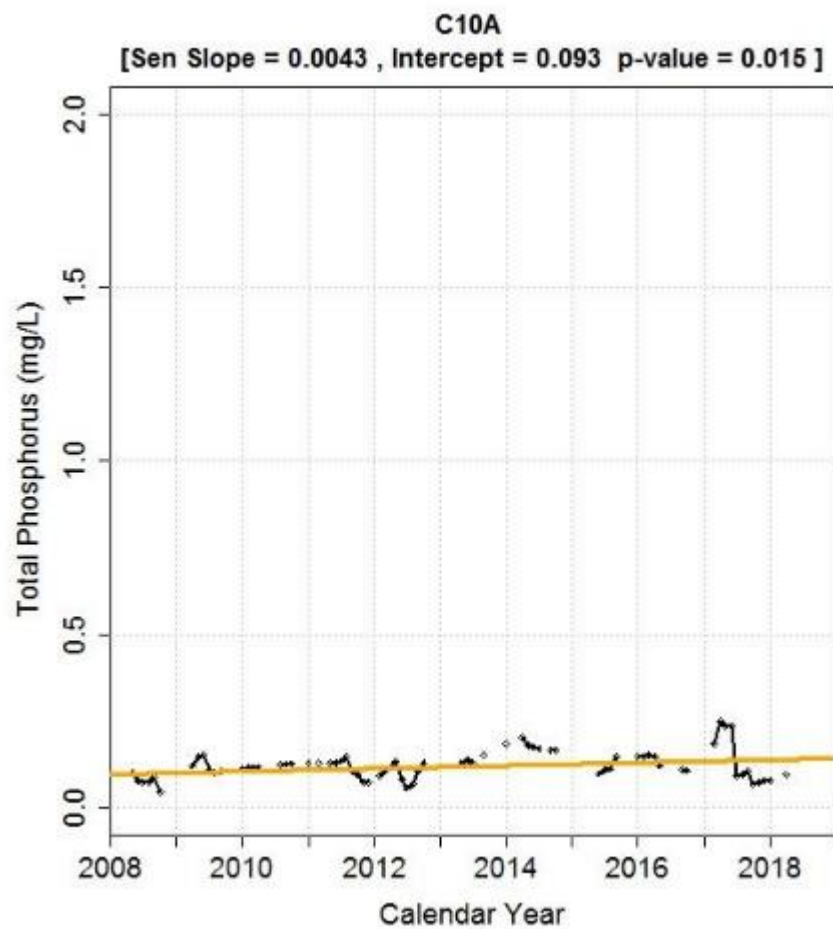
1: Even if the p-value is statistically significant, the result may not be ecologically significant. For example, if a trend is statistically significantly declining (negative trend) but the slope is near zero, then it may not be realistic to assume that an improvement in water quality by reductions in TP may positively impact the ecological system in a measurable way.

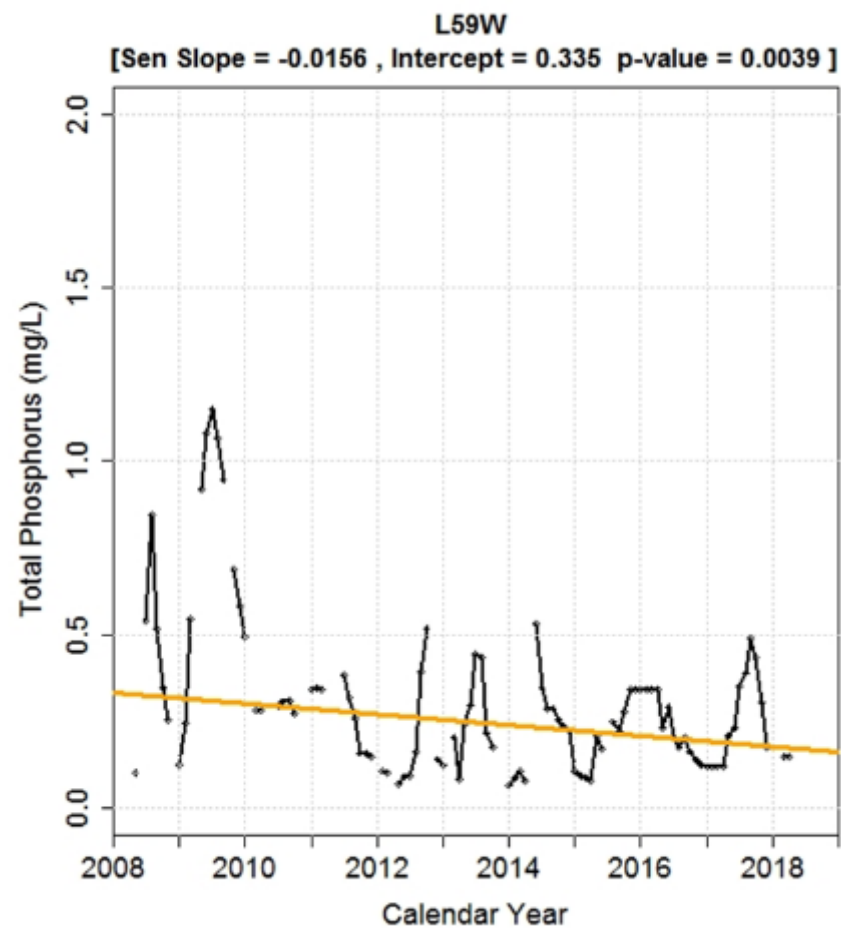
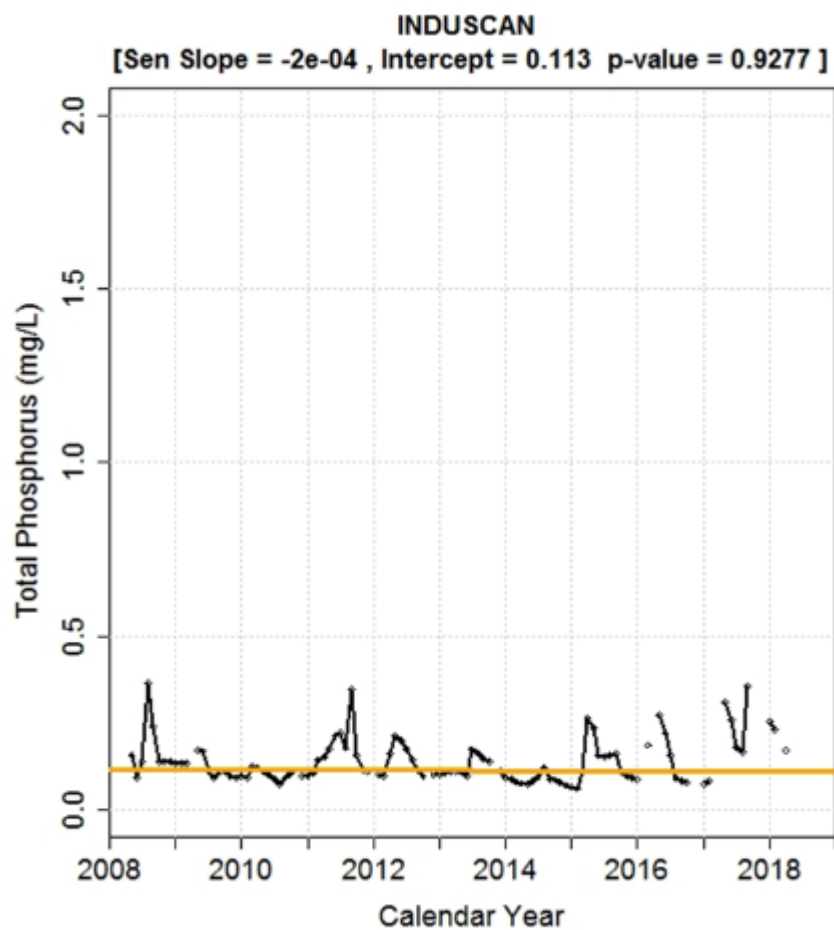
2: Series with serial correlation (as per autocorrelation analysis results) used the adjusted P-value for serial correlation.

3: A decreasing trend may suggest an improvement in water quality. An increasing trend may suggest a decline in water quality.

- **TP FWM Results Graphs**

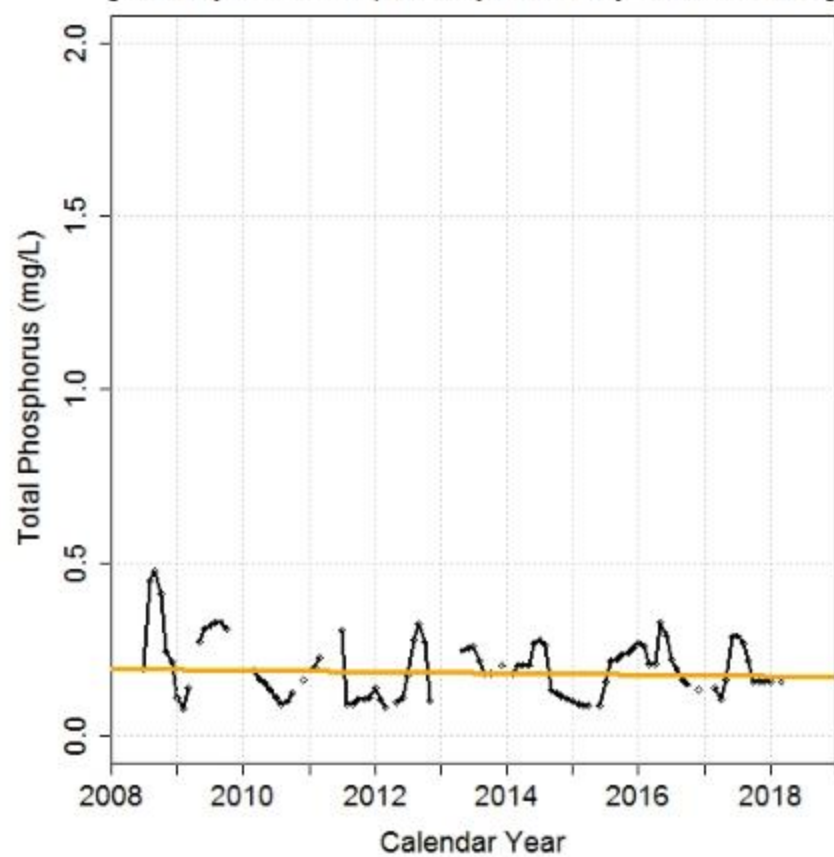
- The POR plotted on graphs is WY2009 through WY2018.
- The x-axis tick marks represent the beginning of the calendar year.
- Time-series data are plotted in black.
- Orange line indicates linear trend in the data using Sen-Slope.
- The Y-axis scale was fixed between 0 and 2 milligrams per liter (mg/l).
 - o Data points outside the limits were added as footnote.





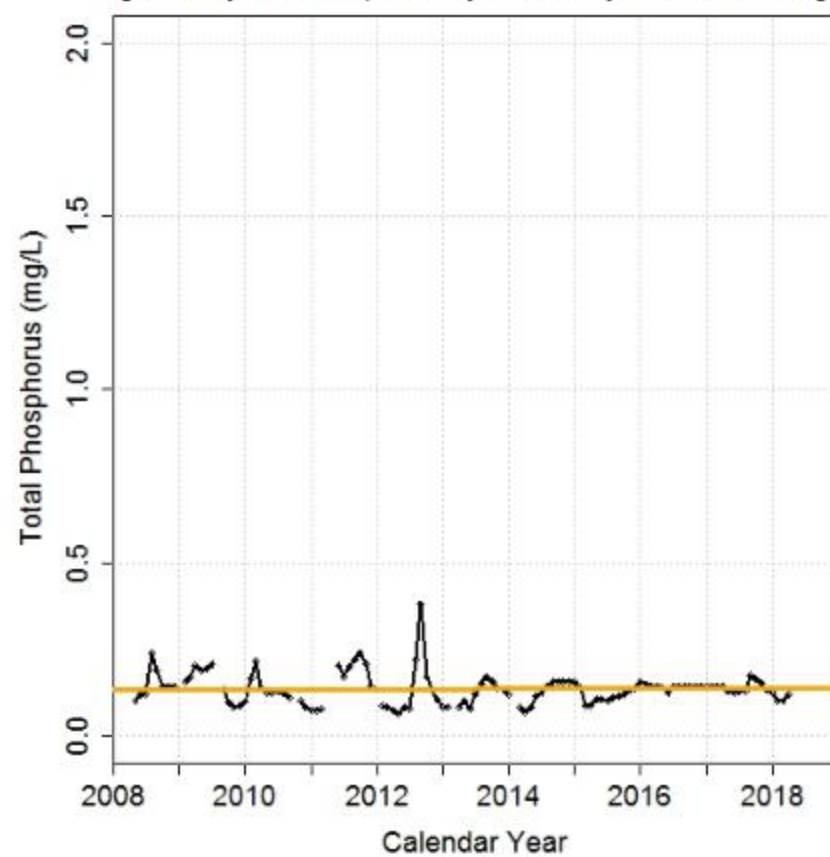
L60E

[Sen Slope = -0.0021 , Intercept = 0.195 p-value = 0.5612]



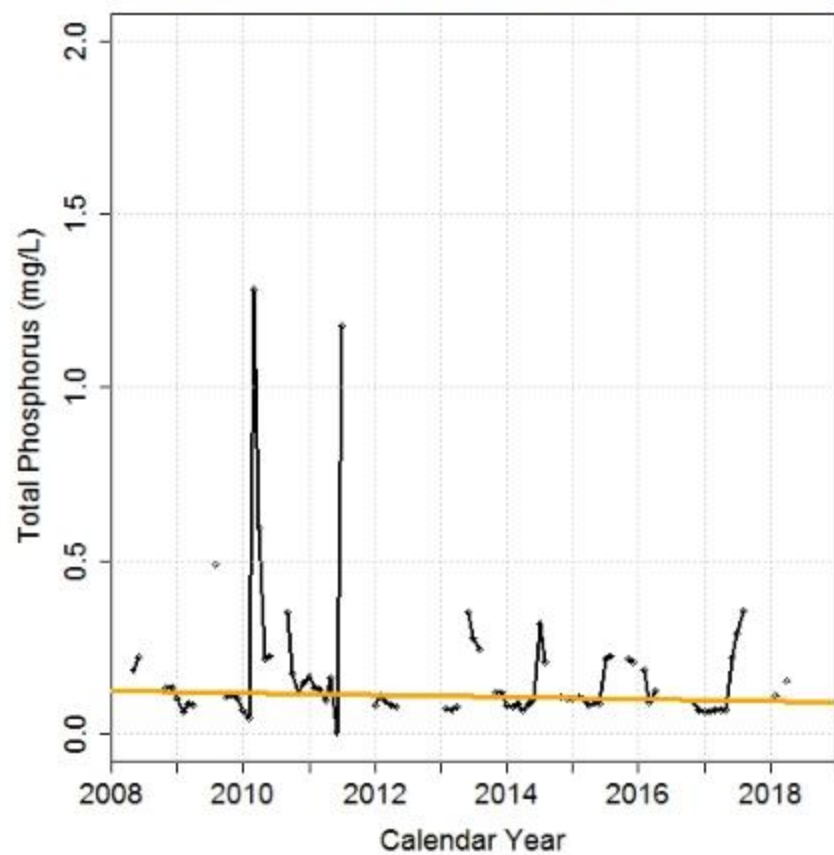
L60W

[Sen Slope = 4e-04 , Intercept = 0.131 p-value = 0.8585]



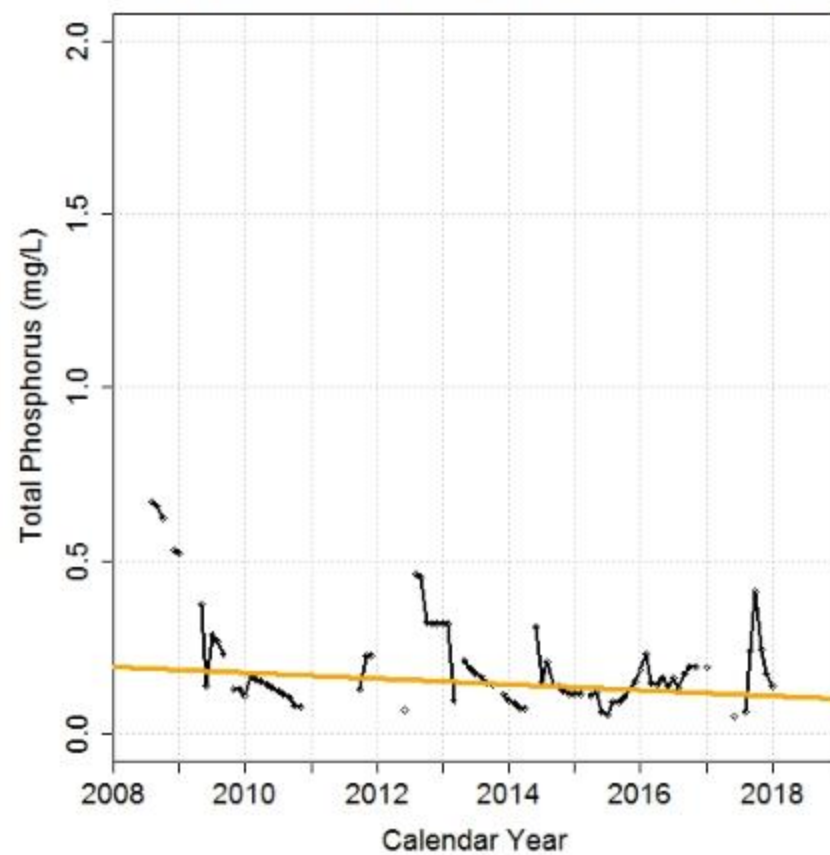
L61E

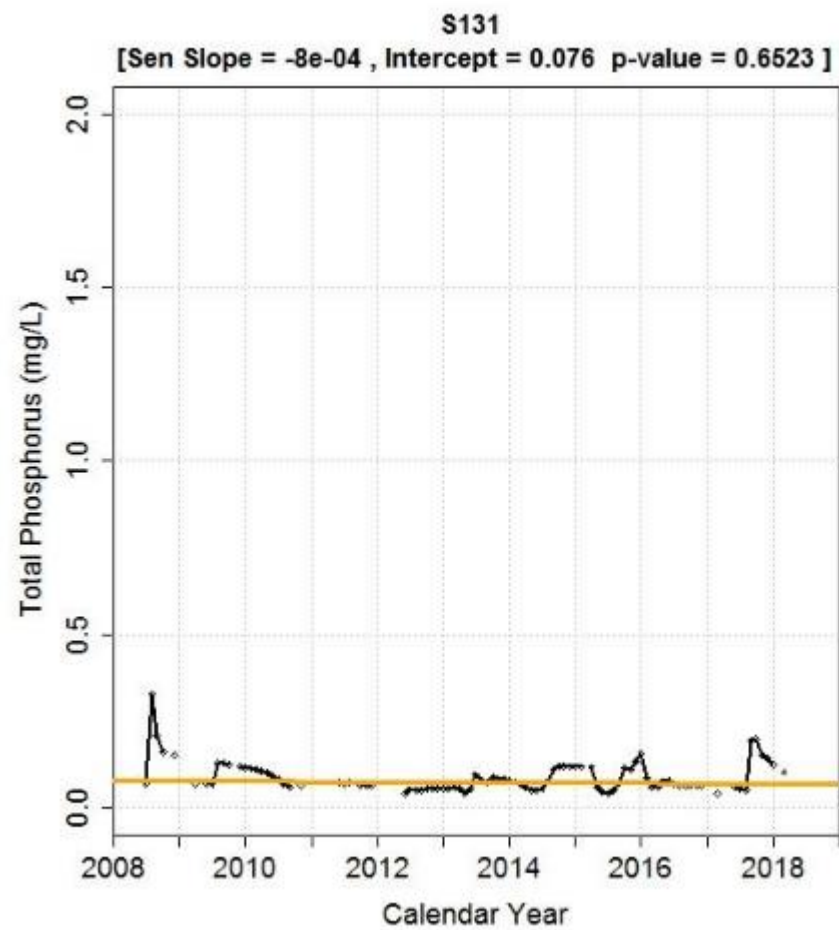
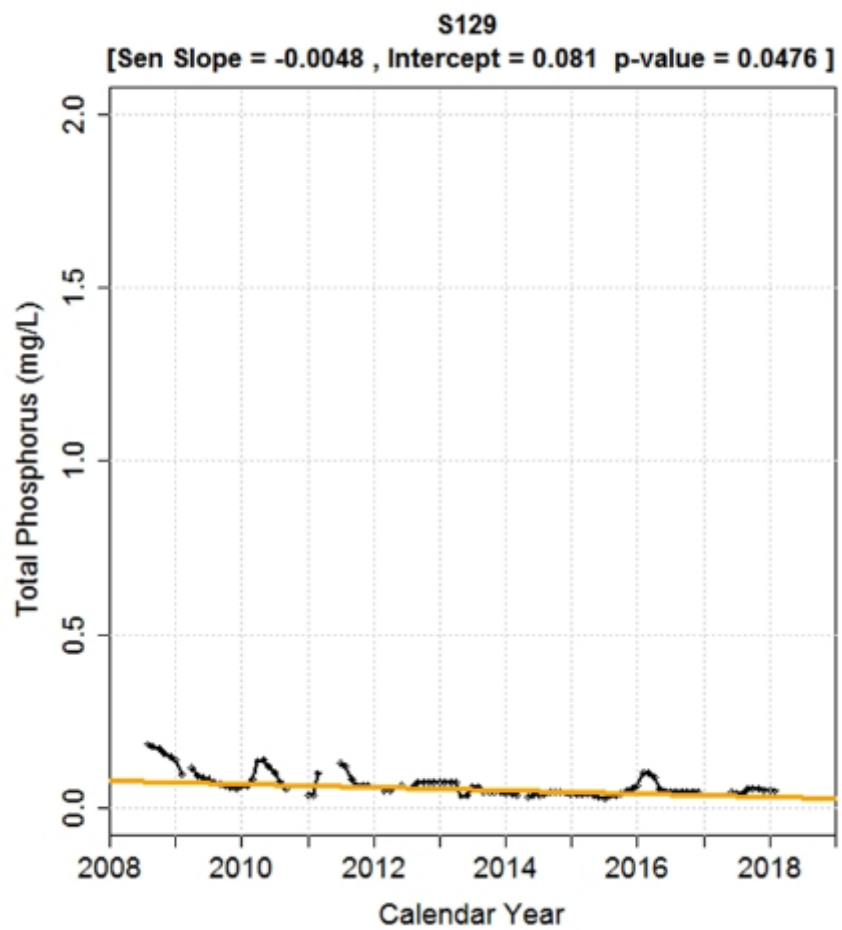
[Sen Slope = -0.003 , Intercept = 0.124 p-value = 0.0936]

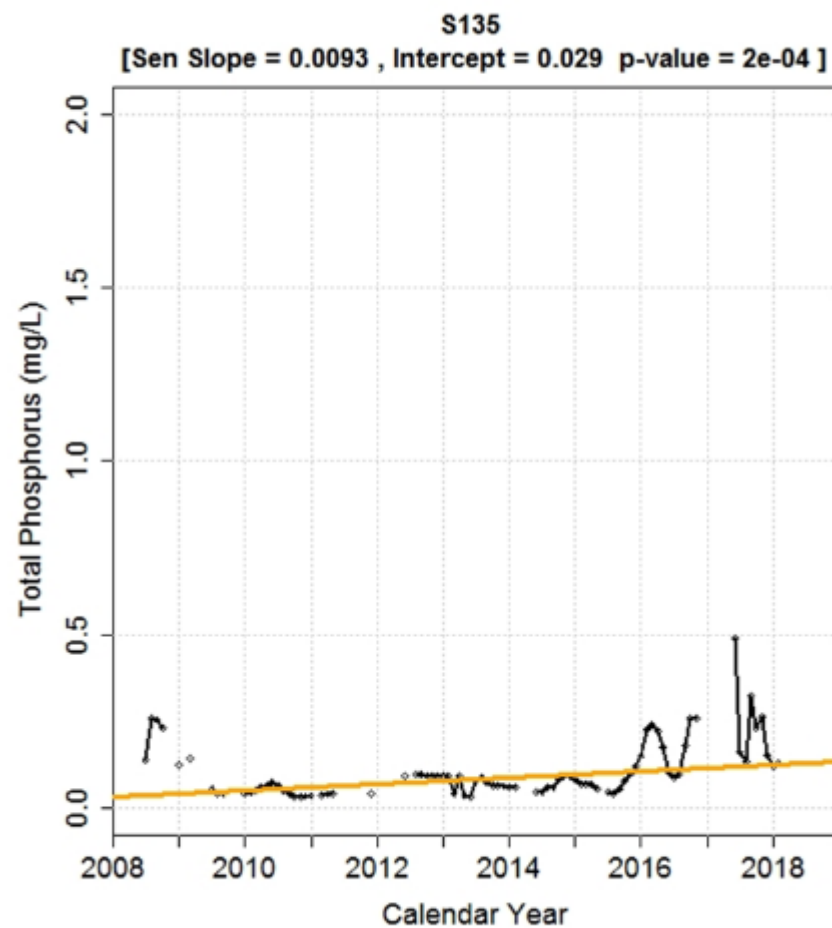
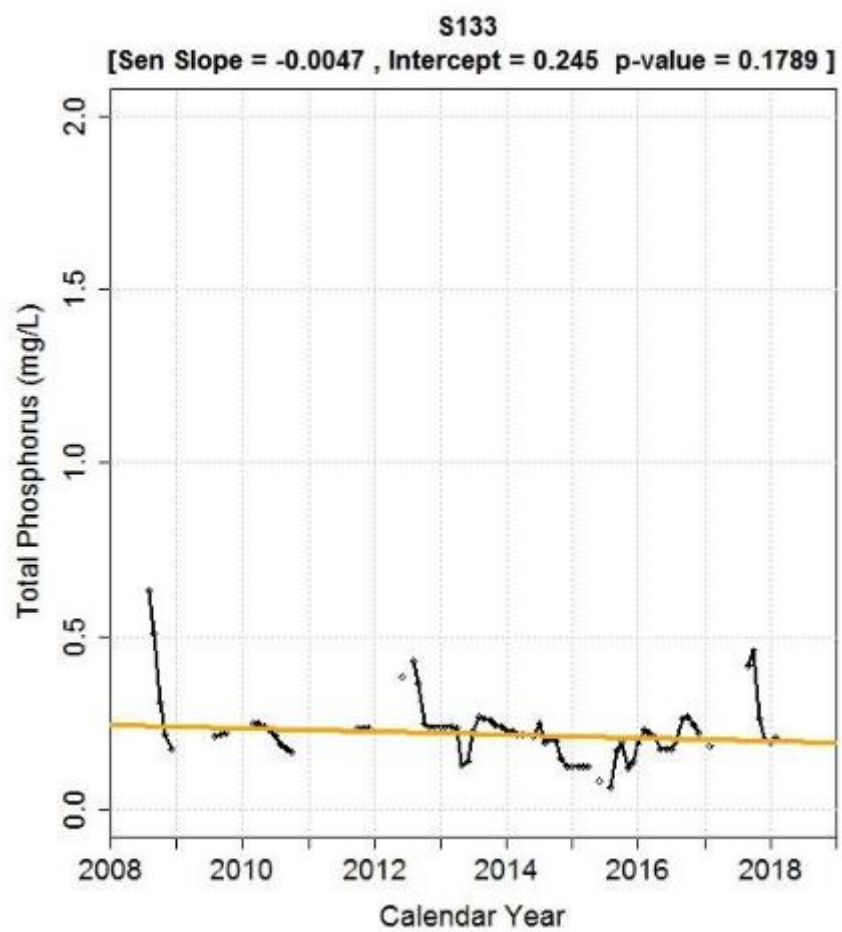


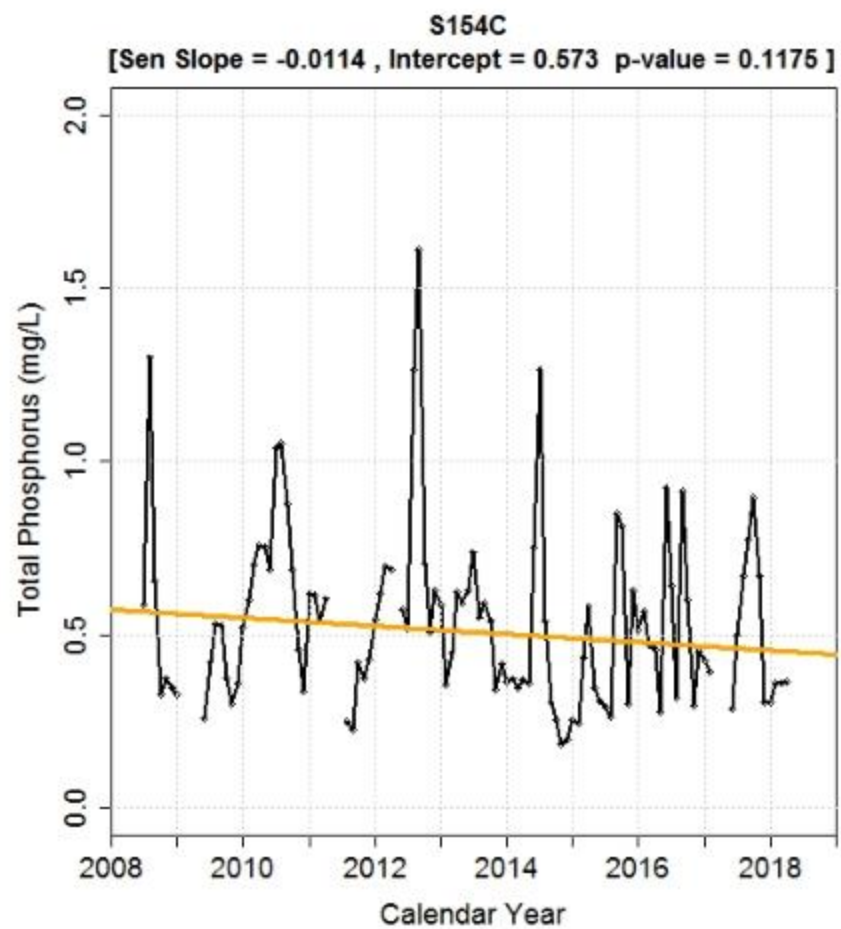
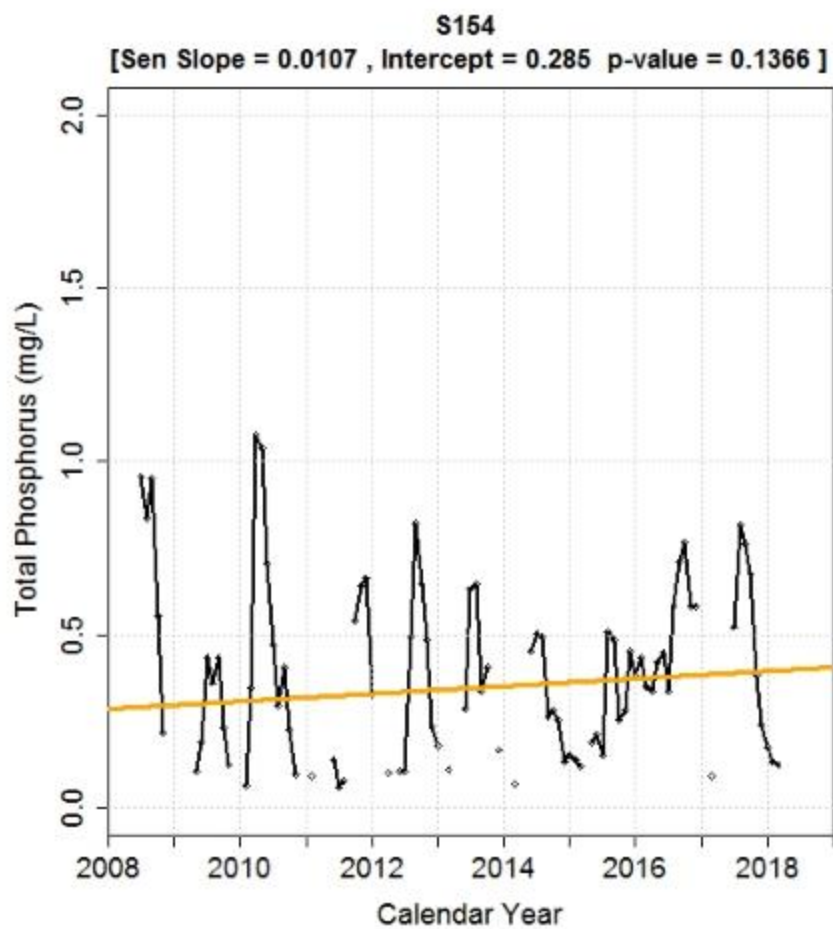
S127

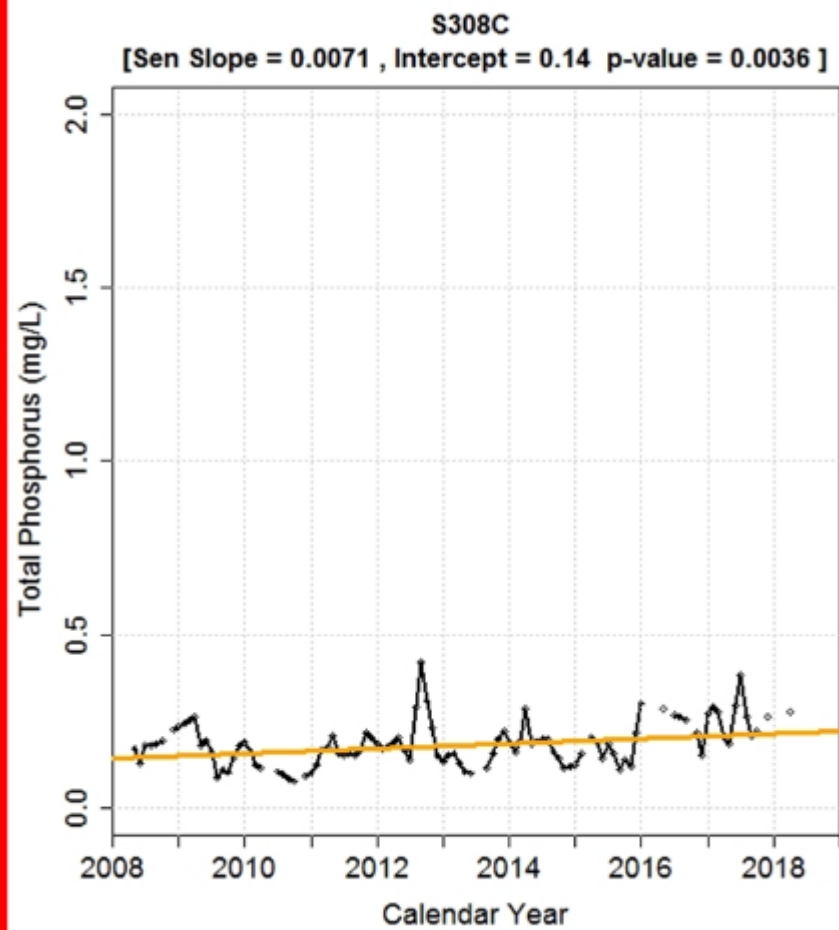
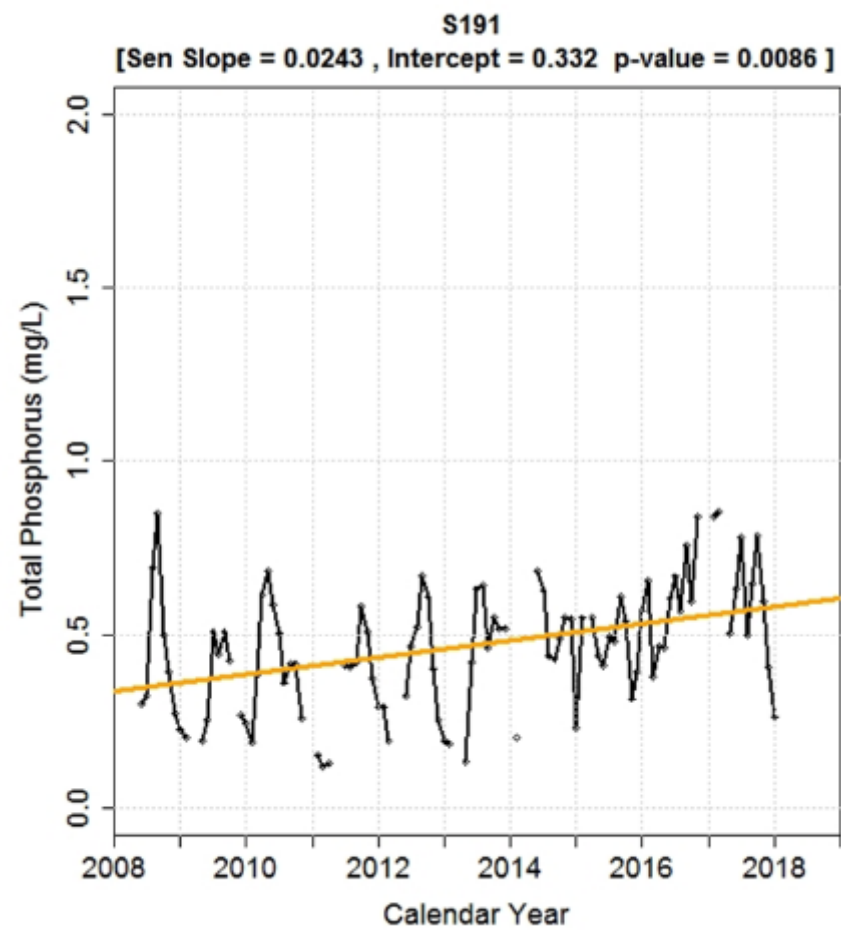
[Sen Slope = -0.0081 , Intercept = 0.193 p-value = 0.0907]





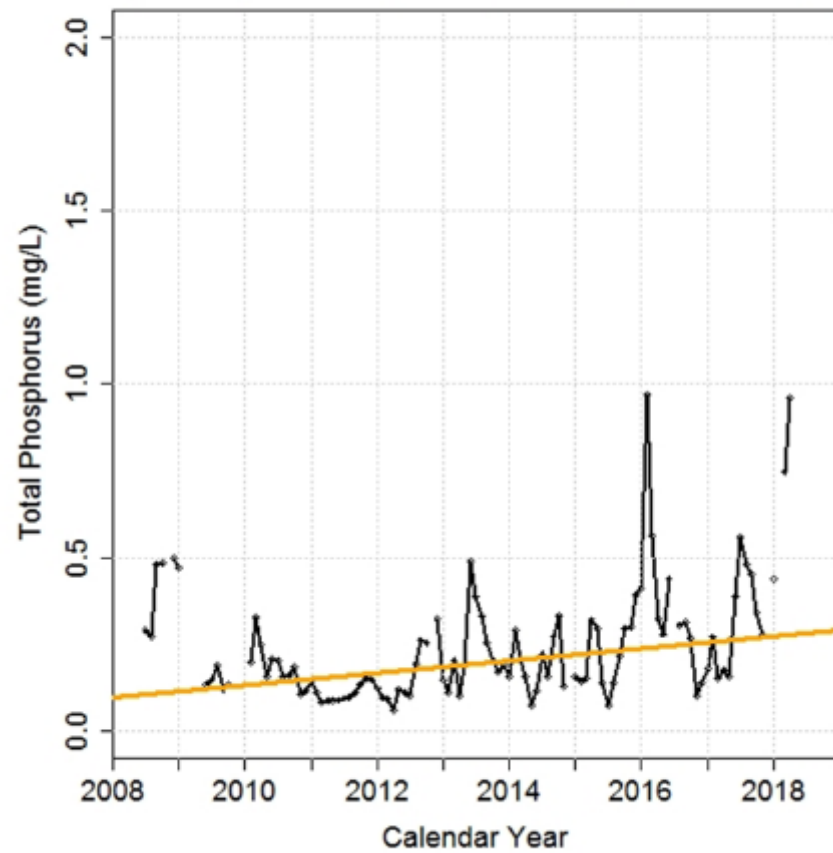






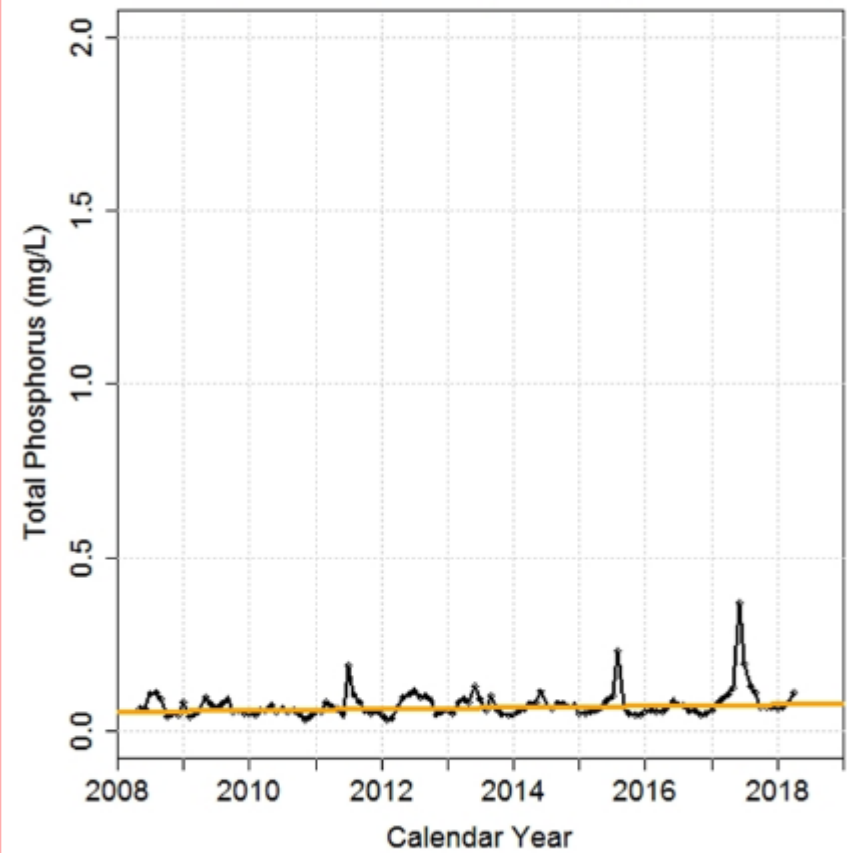
S4

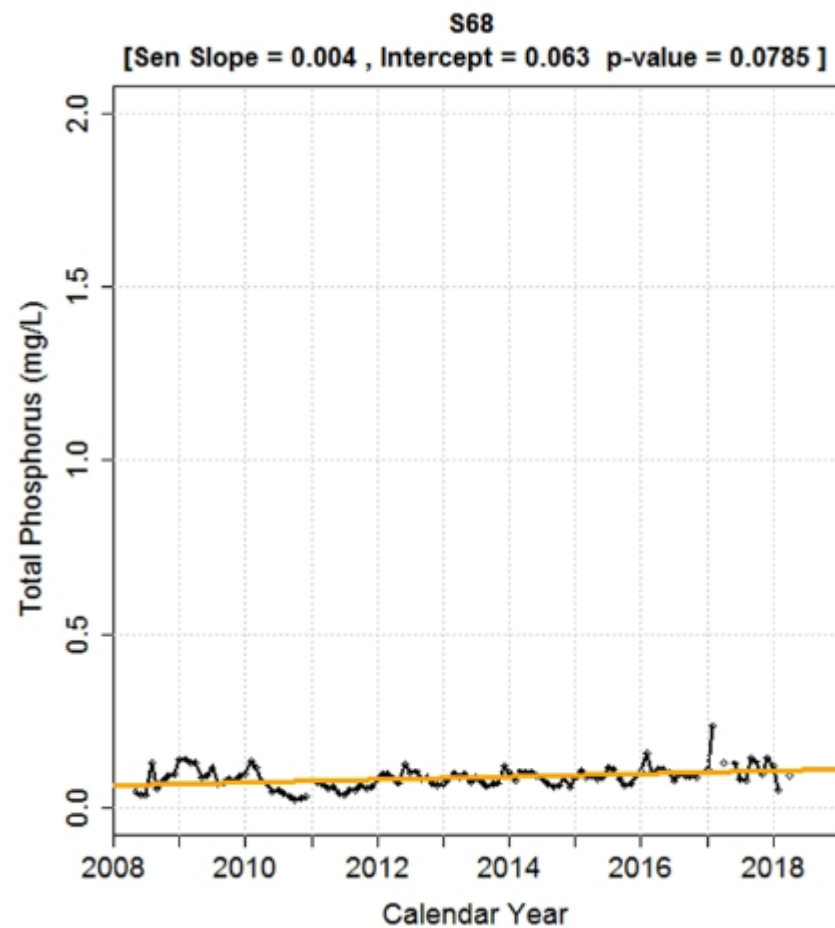
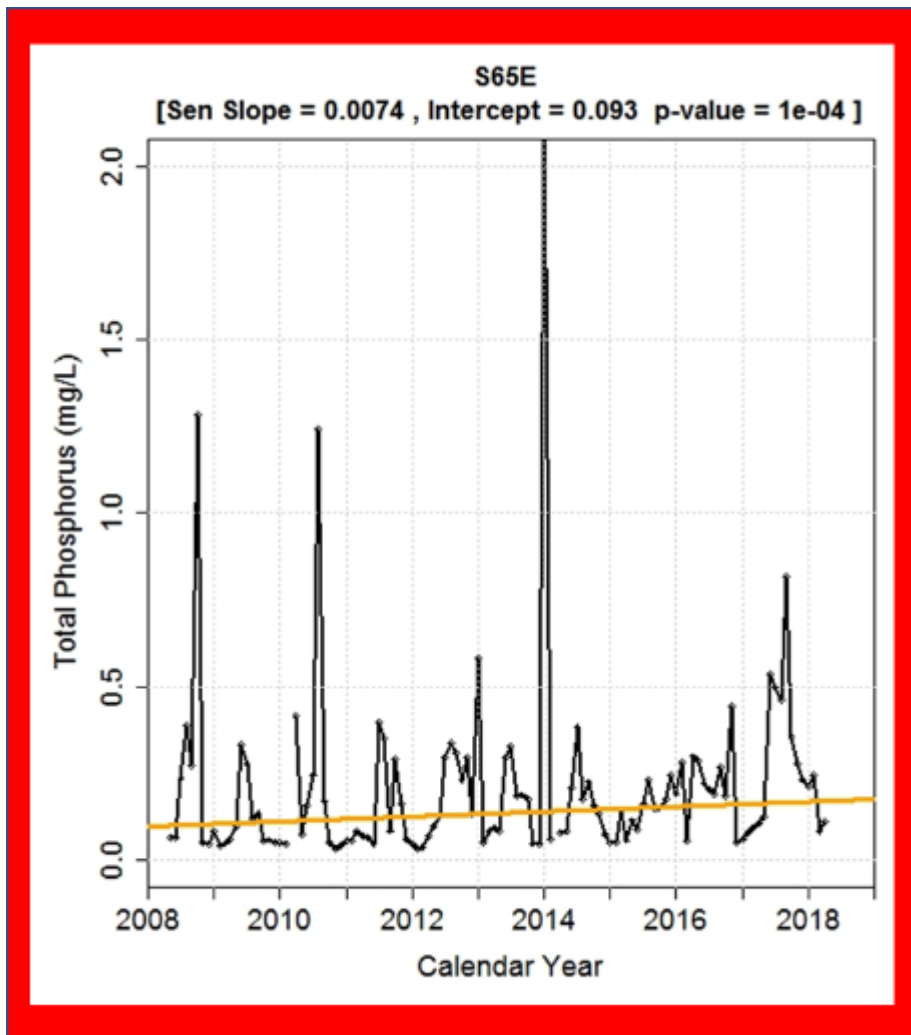
[Sen Slope = 0.0177 , Intercept = 0.09 p-value = 1e-04]



S65

[Sen Slope = 0.0021 , Intercept = 0.053 p-value = 0.001]



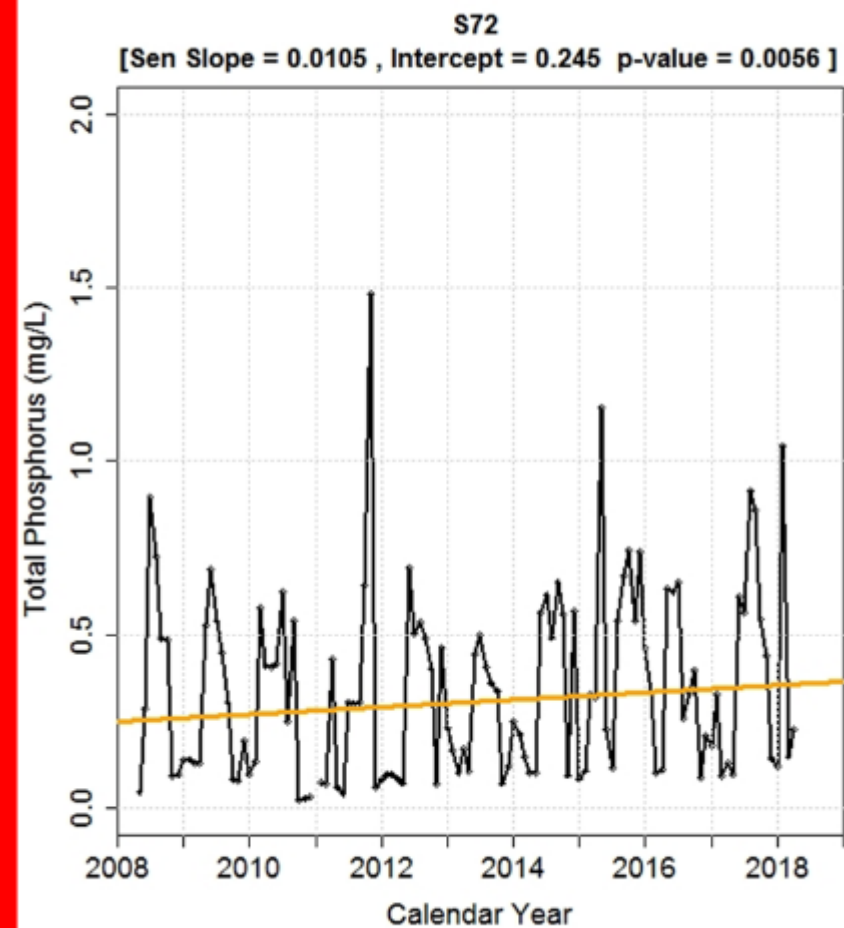
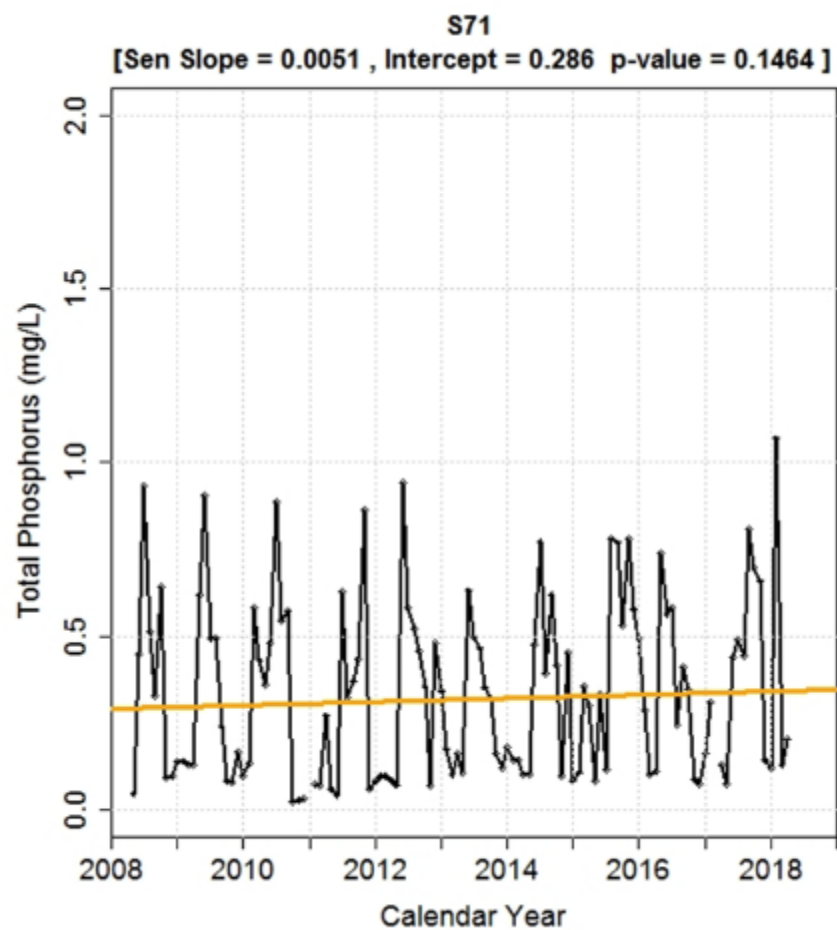


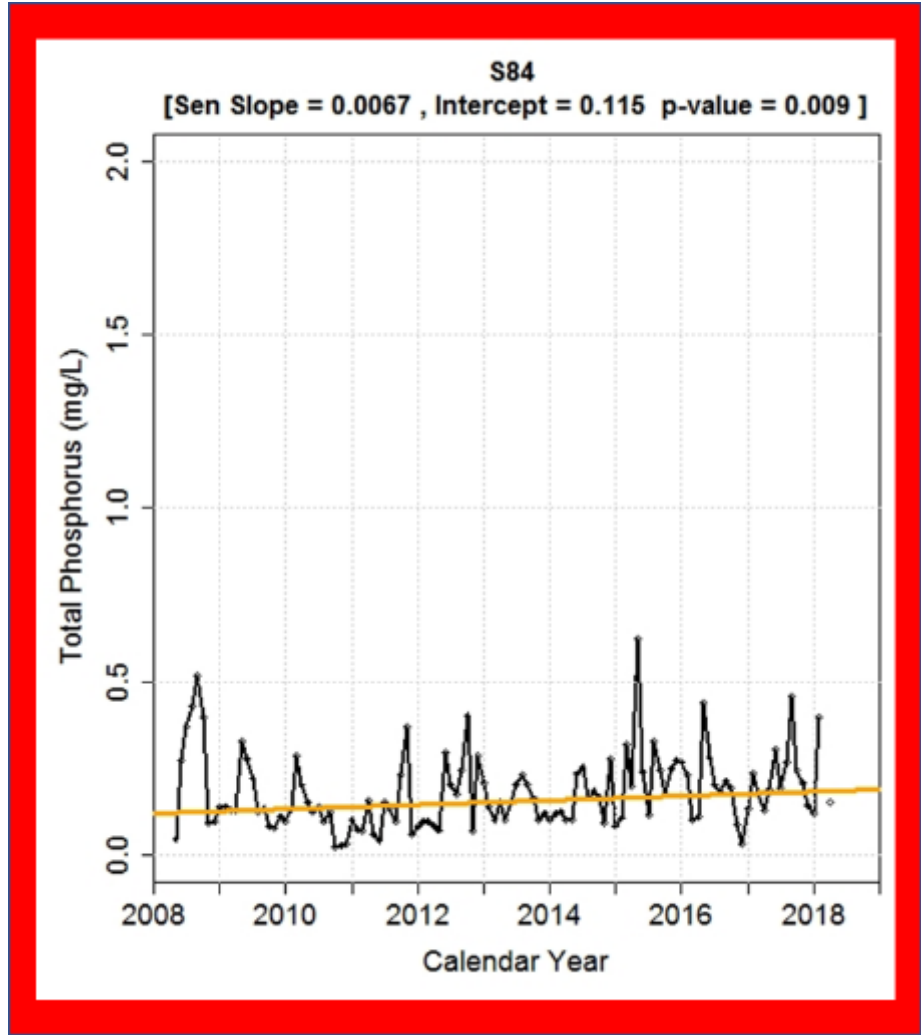
Notes:

Point not shown for S65E: 1/1/2014 – 2.26 mg/L.

Two outlier data points were removed from the analysis:

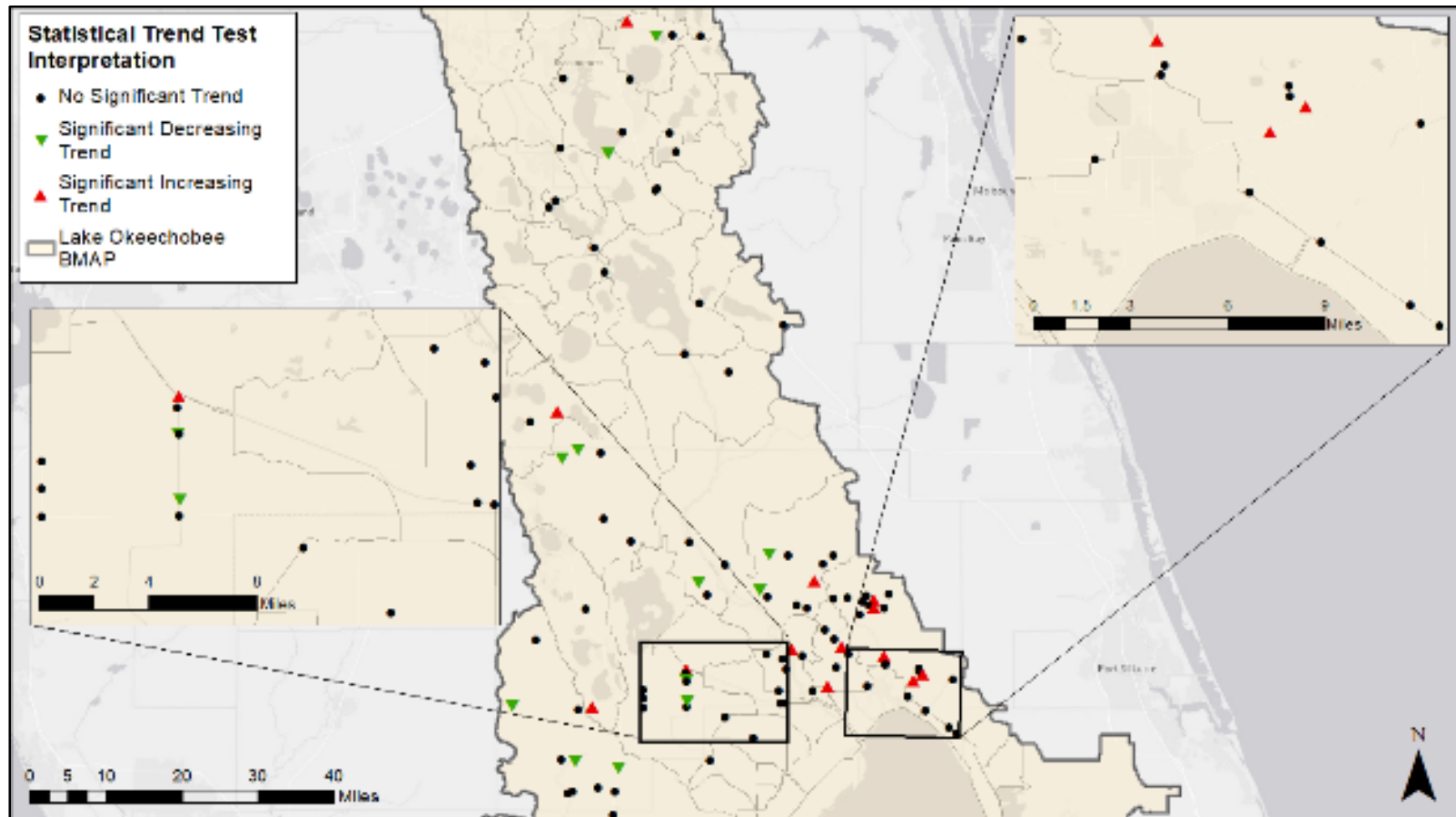
Station	Date	Value (mg/L)
S65E	3/1/2010	16.16
S65E	3/1/2014	5.66





Tier 2 Monthly TP Concentrations

- Station Location and Trend Results



TP Concentration Trend Analysis and Serial Correlation Results
(Stations with MORE than 50 percent of data)

Station	Tau	P-Value	Adjusted P-Value	¹ Slope	² Selected P-value	Serial Correlation	³ Trend
AB27343014	0.096	0.2168	0.3458	0.0030	0.346	Yes	No Significant Trend
ABOGGN	0.251	0.0064	0.0302	0.0007	0.006		Significant Increasing
AR06333013	-0.058	0.4380	0.7287	-0.0005	0.729	Yes	No Significant Trend
AR18343012	0.114	0.1583	0.2549	0.0021	0.255	Yes	No Significant Trend
BH04392912	-0.413	0.0000	0.0118	-0.0285	0.012	Yes	Significant Decreasing
BN03332911	-0.291	0.0001	0.0226	-0.0392	0.023	Yes	Significant Decreasing
BN08332912	-0.226	0.0037	0.1545	-0.0798	0.004		Significant Decreasing
BNSHINGLE	-0.157	0.0556	0.2949	-0.0013	0.295	Yes	No Significant Trend
BS-59	-0.098	0.4080	0.6328	-0.0002	0.408		No Significant Trend
CL18273011	-0.255	0.0321	0.1305	-0.0015	0.032		Significant Decreasing
CREEDYBR	-0.196	0.0670	0.2630	-0.0030	0.263	Yes	No Significant Trend
CY05353444	-0.026	0.7678	0.7829	-0.0022	0.783	Yes	No Significant Trend
DLMARNCR	-0.050	0.6841	0.7923	-0.0005	0.684		No Significant Trend
ET05253114	-0.262	0.0133	0.1262	-0.0009	0.126	Yes	No Significant Trend
ET06253113	-0.196	0.0113	0.0617	-0.0028	0.011		Significant Decreasing
FE20393013	0.144	0.1781	0.3790	0.0146	0.178		No Significant Trend
FE21392913	-0.311	0.0050	0.0616	-0.0124	0.062	Yes	No Significant Trend
FE26362812	-0.069	0.4703	0.6584	-0.0013	0.470		No Significant Trend
GA09393011	-0.398	0.0000	0.0251	-0.0326	0.025	Yes	Significant Decreasing
HP06393242	0.155	0.1928	0.1979	0.0086	0.198	Yes	No Significant Trend
HP11373132	0.424	0.0004	0.0451	0.0053	0.045	Yes	Significant Increasing
HP15373112	0.224	0.0350	0.1408	0.0194	0.141	Yes	No Significant Trend
HP22373112	-0.321	0.0015	0.0076	-0.0218	0.008	Yes	Significant Decreasing
HP25373013	-0.037	0.6375	0.7282	-0.0011	0.728	Yes	No Significant Trend
IP09383232	0.180	0.1339	0.0894	0.0095	0.134		No Significant Trend
KR05373311	0.168	0.1534	0.1248	0.0193	0.153		No Significant Trend
KR16373414	0.294	0.0019	0.0361	0.0200	0.036	Yes	Significant Increasing
KR17373513	0.203	0.0255	0.1766	0.0095	0.177	Yes	No Significant Trend
KR24353114	-0.326	0.0012	0.0475	-0.0139	0.048	Yes	Significant Decreasing
KREA 01	-0.037	0.7771	0.7797	-0.0030	0.780	Yes	No Significant Trend
KREA 04	-0.061	0.6129	0.7429	-0.0019	0.743	Yes	No Significant Trend
KREA 14	0.026	0.8684	0.8953	0.0024	0.868		No Significant Trend
KREA 17A	0.232	0.0139	0.1324	0.0163	0.014		Significant Increasing
KREA 22	-0.043	0.6448	0.7214	-0.0003	0.645		No Significant Trend
KREA 23	-0.276	0.0038	0.0511	-0.0050	0.004		Significant Decreasing
*KREA91	-0.224	0.0024	0.0874	-0.0035	0.002		Significant Decreasing
*KREA92	0.248	0.0010	0.0423	0.0020	0.001		Significant Increasing
*KREA93	0.066	0.3902	0.5585	0.0008	0.559	Yes	No Significant Trend
*KREA94	0.086	0.2574	0.4369	0.0010	0.437	Yes	No Significant Trend
*KREA97	-0.206	0.0060	0.1370	-0.0022	0.137	Yes	No Significant Trend
KREA98	0.084	0.2555	0.5383	0.0005	0.538	Yes	No Significant Trend

Station	Tau	P-Value	Adjusted P-Value	¹ Slope	² Selected P-value	Serial Correlation	³ Trend
LB29353513	0.079	0.3974	0.5749	0.0131	0.397		No Significant Trend
LI02362923	0.094	0.3378	0.3580	0.0005	0.338		No Significant Trend
LV14322813	-0.043	0.7122	0.7604	-0.0033	0.760	Yes	No Significant Trend
MS08373611	0.257	0.0156	0.1978	0.0660	0.198	Yes	No Significant Trend
OK09353212	-0.167	0.0830	0.2218	-0.0067	0.083		No Significant Trend
OT34353513	0.167	0.1309	0.2019	0.0218	0.202	Yes	No Significant Trend
PA10313112	0.137	0.1338	0.3620	0.0026	0.362		No Significant Trend
PB24392912	0.113	0.1467	0.2500	0.0062	0.250		No Significant Trend
PL01382911	0.346	0.0000	0.0058	0.0336	0.006	Yes	Significant Increasing
RD08322913	0.454	0.0000	0.0026	0.0050	0.003	Yes	Significant Increasing
TCNS 204	0.016	0.9010	0.9236	0.0032	0.901		No Significant Trend
TCNS 207	0.060	0.6268	0.6732	0.0025	0.673	Yes	No Significant Trend
TCNS 213	0.047	0.6155	0.6843	0.0018	0.616		No Significant Trend
TCNS 214	0.500	0.0000	0.0015	0.0426	0.000		Significant Increasing
TCNS 217	0.116	0.1418	0.3598	0.0060	0.142		No Significant Trend
TCNS 220	0.239	0.0275	0.1118	0.0331	0.028		Significant Increasing
TCNS 222	0.109	0.2146	0.3497	0.0073	0.350	Yes	No Significant Trend

Notes:

1: Even if the p-value is statistically significant, the result may not be ecologically significant. For example, if a trend is statistically significantly declining (negative trend) but the slope is near zero, then it may not be realistic to assume that an improvement in water quality by reductions in TP may positively impact the ecological system in a measurable way.

2: Series with serial correlation (as per autocorrelation analysis results) used the adjusted P-value for serial correlation.

3: A decreasing trend may suggest an improvement in water quality. An increasing trend may suggest a decline in water quality.

4: * = data from DEP STORET/WIN Databases was appended due to calendar year sampling

- Results TP Concentrations Graphs
 - The POR plotted on graphs is WY2009 through WY2018.
 - The x-axis tick marks represent the beginning of the calendar year.
 - Time-series data are plotted in black.
 - Orange line indicates linear trend in the data using Sen-Slope.
 - The Y-axis scale was fixed between 0 and 2 mg/l.
 - Data points outside the limits were added as footnote.

