

# **Analysis of Phosphorus Concentrations in the Maumee River**

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**ENVIRONMENTAL LAW  
& POLICY CENTER**



# 1. Data & Methodology

**This document presents a basic analysis of the temporal fluctuation of Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP) concentrations at Ohio monitoring stations in the Maumee River basin.**

The data for both TP and SRP were obtained from nine United States Geological Survey (USGS) stations located in Ohio’s Maumee River basin over the course of seven years, from January 1, 2015, through December 31, 2021. The measured concentration unit is milligrams of phosphorus per liter (mg-P/L). The station names are: Blanchard River, Lost, Maumee, Potato Run, S. Turkeyfoot, Shallow Run, Tiffin River, West, and Wolf. Figure 1.1 presents the location of each station. Monitoring of the parameters is conducted by National Center for Water Quality Research (NCWQR) under the Heidelberg Tributary Loading Program (HTLP) . It is important to note that some stations’ time intervals for monitoring are shorter than seven years.

Because the purpose of this analysis is to understand the temporal variability of phosphorus, and flag times in which concentrations are higher than usual, we can use a simple but robust method of comparison by finding the central tendency of the data. By looking at the distribution of data for each station’s TP and SRP values (Figures 1.2 and 1.3) over seven years, we can conclude that they don’t follow a symmetric normal distribution,

and tend to skew to the right (i.e., long right tail). Figures 1.2 and 1.3 below are histograms showing this distribution.

In such circumstances, the median is a more appropriate measure of central tendency than the mean, as it is not sensitive to the outlier or extreme values. Therefore, a station-by-station historical observations analysis of median values will best illustrate the temporal variability of phosphorus at monthly intervals in the Maumee basin. To do that, we first calculated the medians of TP and SRP values of each station’s entire data set (Table 1).

Table 1 shows the median values for TP and SRP at each station from 2015 to 2021. The numbers in the table can be considered as the baseline values of TP and SRP concentrations at each station.

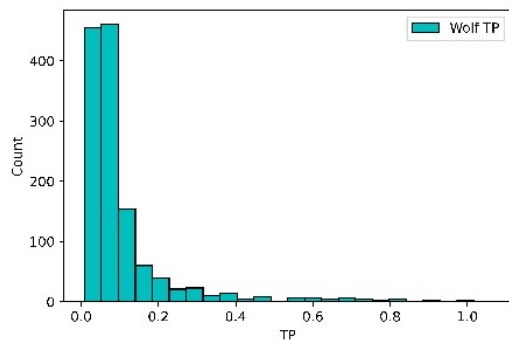
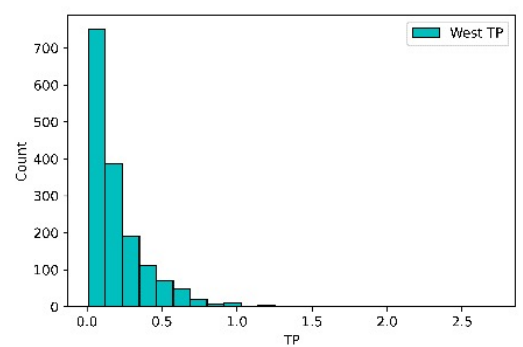
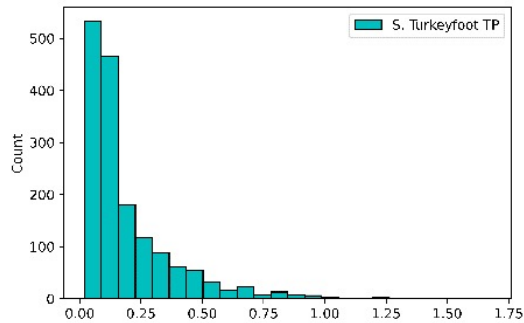
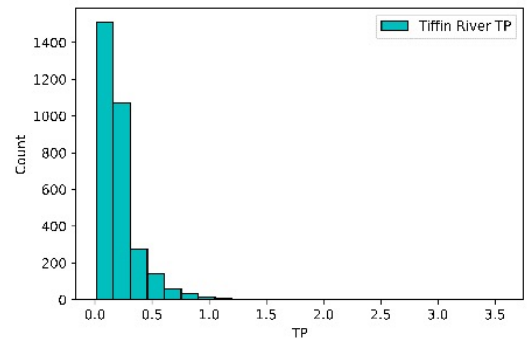
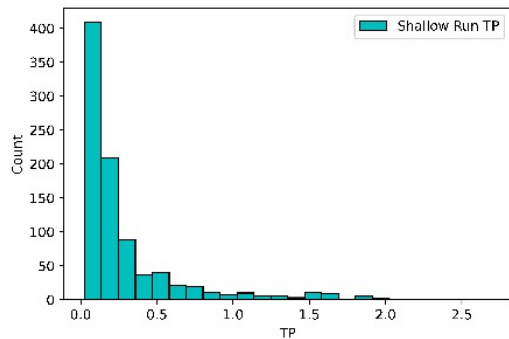
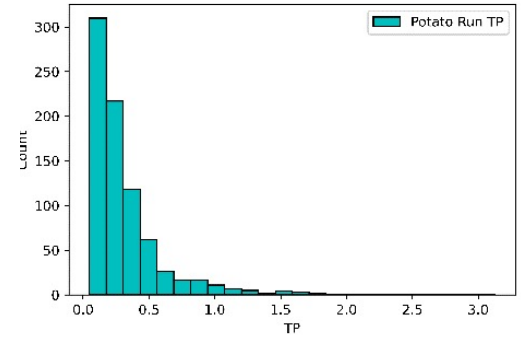
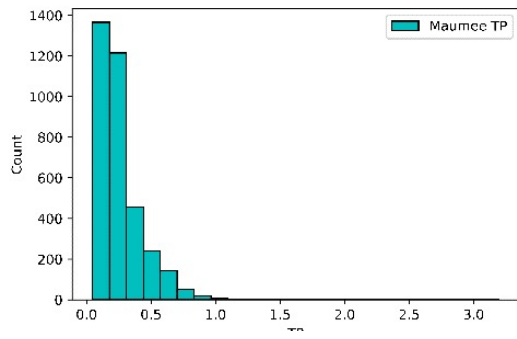
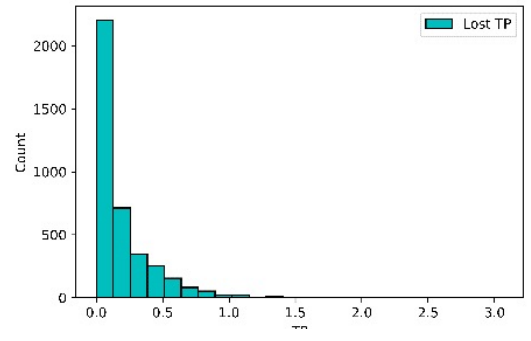
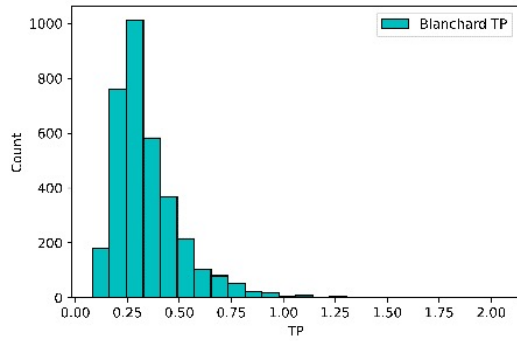
In Section 2, we compare each station’s monthly median values to the median value of the station’s data in its entirety. The comparison facilitates evaluation of monthly phosphorus concentration variations to the baseline.

**Figure 1.1 - Location of monitoring stations in Maumee River Basin**

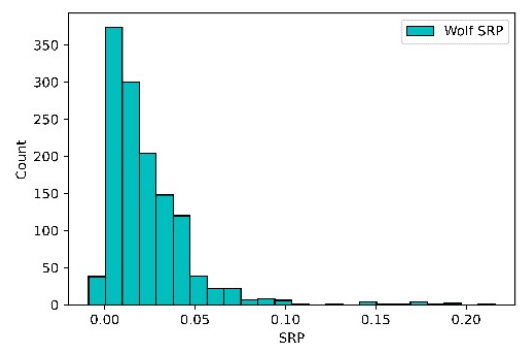
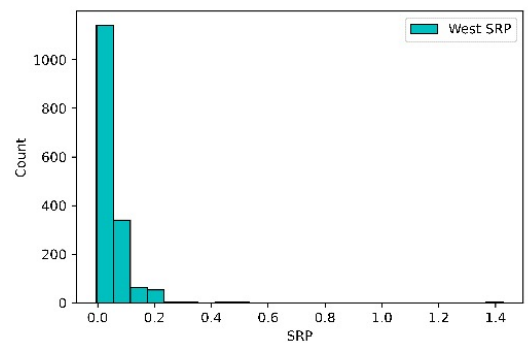
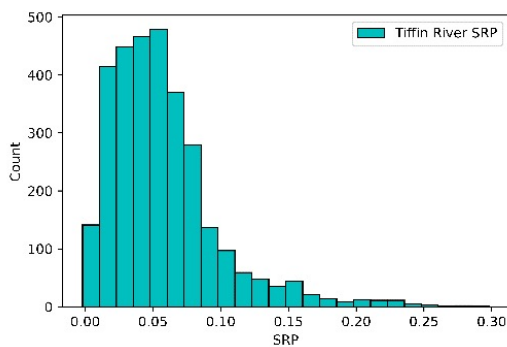
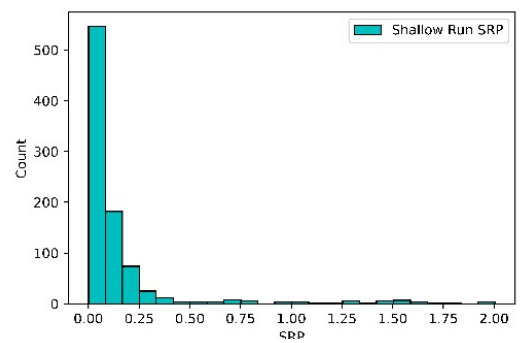
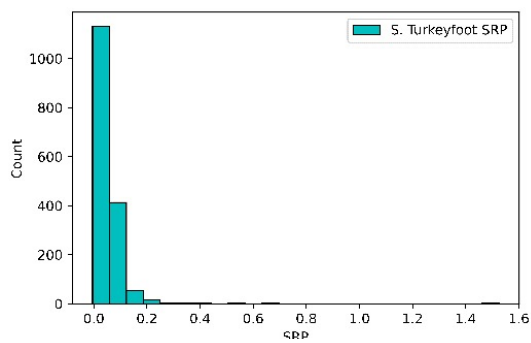
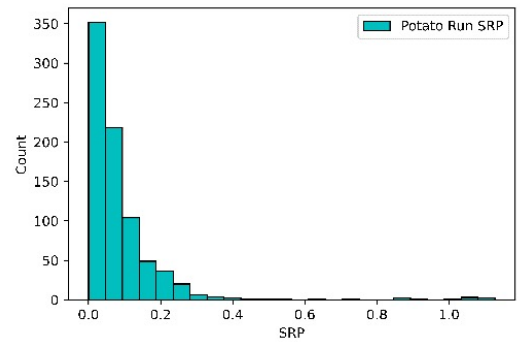
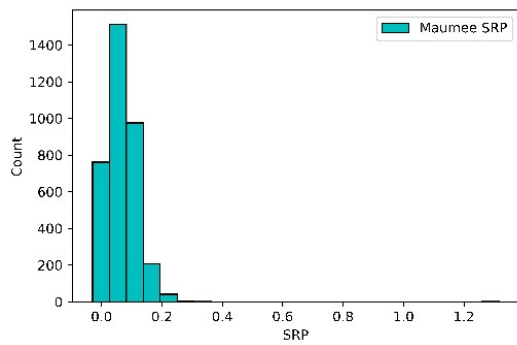
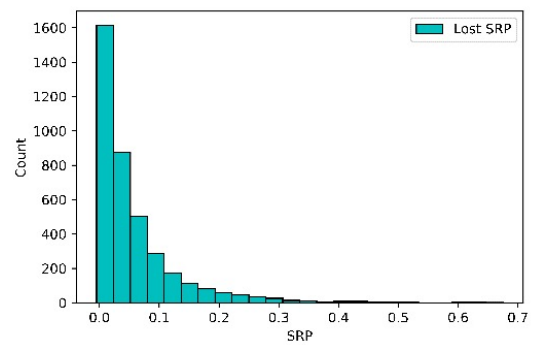
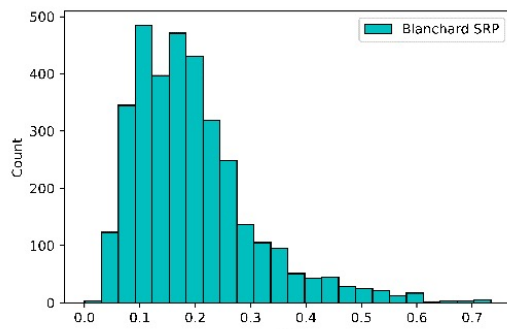


**Table 1 - Median values of TP and SRP observed at all nine stations**

Station	TP Median (mg-P/L)	SRP Median (mg-P/L)
Blanchard River	0.305	0.175
Lost	0.099	0.032
Maumee	0.206	0.065
Potato Run	0.225	0.055
S. Turkeyfoot	0.120	0.041
Shallow Run	0.151	0.062
Tiffin River	0.166	0.050
West	0.132	0.036
Wolf	0.071	0.017



**Figure 1.2 - Histograms of seven years TP observations at each station**



**Figure 1.3 - Histograms of seven years SRP observations at each station**

## 2. Station Historical Observations

This section presents two heatmaps for each station showing the monthly median values of both Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP) concentrations, with green indicating lower concentration and red indicating higher concentration. The “total” column at the end of each year shows the median value for the entire year and “total” row at the bottom of each month shows the median for all values in that month for all observed years. This section then presents a graph for each station portraying the total monthly median values as compared to the overall median values that were shown in Table 1 and then presents highlights for each station in bullets.

### Blanchard River Station

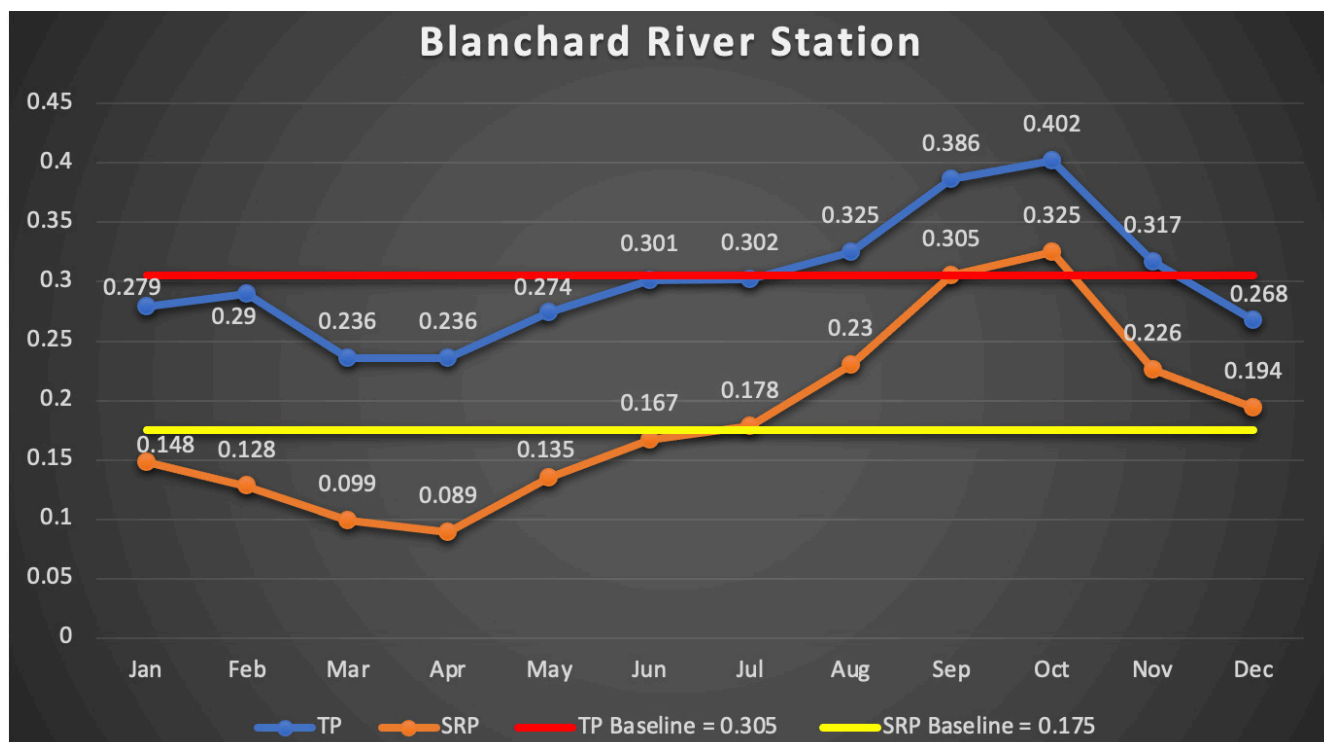
Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	0.283	0.311	0.334	0.214	0.266	0.306	0.211	0.262	0.351	0.503	0.292	0.248	0.289
2016	0.222	0.240	0.182	0.182	0.208	0.268	0.295	0.378	0.463	0.391	0.450	0.301	0.290
2017	0.338	0.289	0.227	0.206	0.484	0.343	0.333	0.328	0.415	0.351	0.293	0.263	0.318
2018	0.243	0.282	0.217	0.217	0.266	0.287	0.290	0.335	0.363	0.383	0.350	0.265	0.305
2019	0.278	0.296	0.208	0.336	0.310	0.462	0.291	0.294	0.336	0.384	0.263	0.293	0.303
2020	0.325	0.268	0.375	0.194	0.272	0.283	0.364	0.385	0.404	0.504	0.327	0.260	0.332
2021	0.240	0.332	0.256	0.299	0.240	0.293	0.276	0.372	0.492	0.498			0.302
Total	0.279	0.290	0.236	0.236	0.274	0.301	0.302	0.325	0.386	0.402	0.317	0.268	0.305

**Table 2 - Heatmap of monthly TP median values**

**Table 3 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	0.193	0.242	0.127	0.093	0.170	0.134	0.114	0.185	0.282	0.455	0.254	0.189	0.179
2016	0.115	0.122	0.079	0.069	0.107	0.163	0.217	0.298	0.401	0.321	0.366	0.221	0.169
2017	0.139	0.125	0.128	0.104	0.146	0.226	0.137	0.264	0.338	0.313	0.208	0.226	0.173
2018	0.126	0.118	0.121	0.089	0.172	0.187	0.210	0.211	0.295	0.292	0.184	0.167	0.175
2019	0.169	0.104	0.076	0.075	0.105	0.135	0.168	0.186	0.271	0.315	0.199	0.200	0.163
2020	0.127	0.095	0.078	0.158	0.145	0.203	0.266	0.239	0.309	0.417	0.227	0.169	0.185
2021	0.166	0.245	0.133	0.205	0.152	0.165	0.164	0.298	0.378	0.416			0.181
<b>Total</b>	<b>0.148</b>	<b>0.128</b>	<b>0.099</b>	<b>0.089</b>	<b>0.135</b>	<b>0.167</b>	<b>0.178</b>	<b>0.230</b>	<b>0.305</b>	<b>0.325</b>	<b>0.226</b>	<b>0.194</b>	<b>0.175</b>

**Figure 2.1 - Blanchard River station total median monthly values against their corresponding baselines**



**Highlights:**

- October has the highest TP and SRP values, followed by September.
- Months TP above the baseline: August, September, October, and November.
- Months SRP above the baseline: July, August, September, October, November, and December.



# Lost Station

**Table 4 - Heatmap of monthly TP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	0.186	0.038	0.150	0.092	0.146	0.244	0.177	0.031	0.026	0.023	0.022	0.170	0.110
2016	0.110	0.158	0.123	0.106	0.123	0.118	0.044	0.063	0.066	0.044	0.344	0.105	0.105
2017	0.304	0.128	0.206	0.246	0.262	0.172	0.152	0.027	0.030	0.033	0.236	0.026	0.147
2018	0.130	0.309	0.119	0.081	0.262	0.078	0.043	0.106	0.057	0.034	0.191	0.100	0.092
2019	0.057	0.221	0.104	0.129	0.207	0.219	0.071	0.112	0.070	0.058	0.057	0.078	0.107
2020	0.163	0.103		0.080	0.133	0.064	0.058	0.075	0.033	0.044	0.026	0.022	0.058
2021	0.020	0.010	0.039	0.042	0.059	0.153	0.159	0.082	0.083	0.209	0.121		0.091
<b>Total</b>	<b>0.138</b>	<b>0.121</b>	<b>0.129</b>	<b>0.109</b>	<b>0.171</b>	<b>0.162</b>	<b>0.100</b>	<b>0.064</b>	<b>0.056</b>	<b>0.042</b>	<b>0.104</b>	<b>0.064</b>	<b>0.099</b>

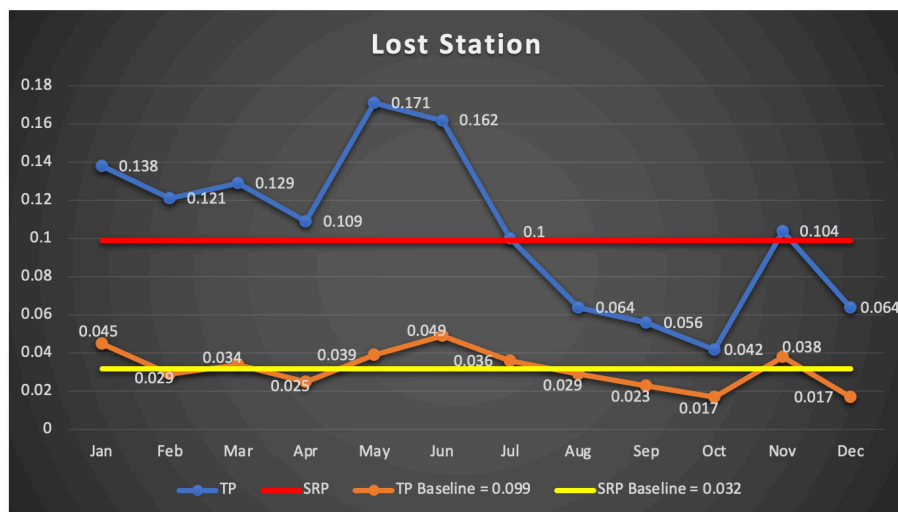
**Table 5 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	0.089	0.010	0.058	0.020	0.031	0.069	0.074	0.009	0.011	0.007	0.007	0.050	0.027
2016	0.032	0.034	0.029	0.028	0.029	0.041	0.016	0.024	0.037	0.017	0.128	0.033	0.030
2017	0.093	0.042	0.045	0.050	0.063	0.039	0.050	0.010	0.010	0.013	0.089	0.009	0.037
2018	0.062	0.095	0.026	0.020	0.053	0.029	0.017	0.048	0.026	0.017	0.095	0.038	0.034
2019	0.015	0.064	0.030	0.026	0.044	0.060	0.027	0.063	0.041	0.024	0.017	0.021	0.038
2020	0.045	0.016		0.016	0.053	0.027	0.022	0.037	0.005	0.014	0.006	0.006	0.017
2021	0.006	0.003	0.015	0.010	0.018	0.063	0.073	0.042	0.038	0.082	0.030		0.040
<b>Total</b>	<b>0.045</b>	<b>0.029</b>	<b>0.034</b>	<b>0.025</b>	<b>0.039</b>	<b>0.049</b>	<b>0.036</b>	<b>0.029</b>	<b>0.023</b>	<b>0.017</b>	<b>0.038</b>	<b>0.017</b>	<b>0.032</b>

**Figure 2.2 - Lost station total median monthly values against their corresponding baselines**

Highlights:

- May has the highest TP value.
- June has the highest SRP value
- Months TP above the baseline: January through July, and November.
- Months SRP above the baseline: January, March, May, June, July, and November.





# Maumee Station

**Table 6 - Heatmap of monthly TP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	0.273	0.184	0.220	0.209	0.141	0.344	0.252	0.198	0.157	0.091	0.094	0.064	0.194
2016	0.249	0.151	0.340	0.234	0.192	0.113	0.115	0.123	0.127	0.153	0.161	0.190	0.160
2017	0.512	0.199	0.145	0.237	0.459	0.205	0.310	0.164	0.132	0.117	0.451	0.145	0.237
2018	0.196	0.348	0.158	0.400	0.245	0.235	0.187	0.246	0.198	0.219	0.412	0.357	0.234
2019	0.325	0.270	0.351	0.429	0.318	0.342	0.236	0.202	0.157	0.186	0.176	0.185	0.237
2020	0.352	0.248	0.427	0.282	0.111	0.164	0.177	0.138	0.126	0.118	0.191	0.181	0.180
2021	0.196	0.077	0.314	0.137	0.295	0.181	0.257	0.165	0.185	0.279	0.162	0.344	0.206
<b>Total</b>	<b>0.282</b>	<b>0.199</b>	<b>0.288</b>	<b>0.253</b>	<b>0.246</b>	<b>0.219</b>	<b>0.220</b>	<b>0.165</b>	<b>0.149</b>	<b>0.151</b>	<b>0.203</b>	<b>0.198</b>	<b>0.206</b>

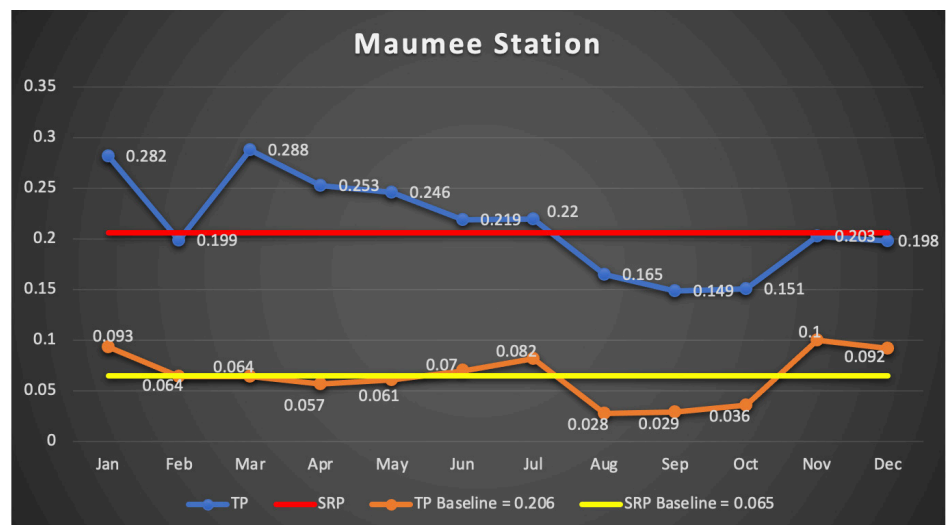
**Table 7 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	0.171	0.128	0.101	0.057	0.016	0.116	0.120	0.026	0.042	0.011	0.005	0.015	0.070
2016	0.076	0.056	0.061	0.048	0.066	0.029	0.023	0.021	0.027	0.043	0.083	0.101	0.054
2017	0.099	0.068	0.040	0.063	0.117	0.047	0.102	0.031	0.025	0.015	0.147	0.082	0.079
2018	0.071	0.068	0.049	0.072	0.057	0.074	0.018	0.052	0.051	0.086	0.160	0.111	0.072
2019	0.104	0.082	0.079	0.058	0.051	0.077	0.054	0.027	0.024	0.060	0.084	0.062	0.065
2020	0.094	0.057	0.058	0.066	0.007	0.014	0.059	0.028	0.004	0.003	0.095	0.092	0.054
2021	0.082	0.003	0.082	0.003	0.107	0.059	0.098	0.013	0.040	0.117	0.093	0.103	0.073
<b>Total</b>	<b>0.093</b>	<b>0.064</b>	<b>0.064</b>	<b>0.057</b>	<b>0.061</b>	<b>0.070</b>	<b>0.082</b>	<b>0.028</b>	<b>0.029</b>	<b>0.036</b>	<b>0.100</b>	<b>0.092</b>	<b>0.065</b>

**Figure 2.3 - Maumee station total median monthly values against their corresponding baselines**

Highlights:

- March has the highest TP value.
- November has the highest SRP value followed by December and January.
- Months TP above the baseline: January, March, April, May, June, and July.
- Months SRP above the baseline: January, June, July, November, and December.



# Potato Run Station

**Table 8 - Heatmap of monthly TP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2019											0.118	0.135	0.122
2020	0.331	0.281	0.340	0.194	0.234	0.156	0.240	0.238	0.233	0.693	0.304	0.217	0.277
2021	0.090	0.082	0.096	0.102	0.138	0.186	0.225	0.373	0.361				0.184
<b>Total</b>	<b>0.252</b>	<b>0.167</b>	<b>0.140</b>	<b>0.109</b>	<b>0.157</b>	<b>0.173</b>	<b>0.228</b>	<b>0.337</b>	<b>0.311</b>	<b>0.693</b>	<b>0.237</b>	<b>0.189</b>	<b>0.225</b>

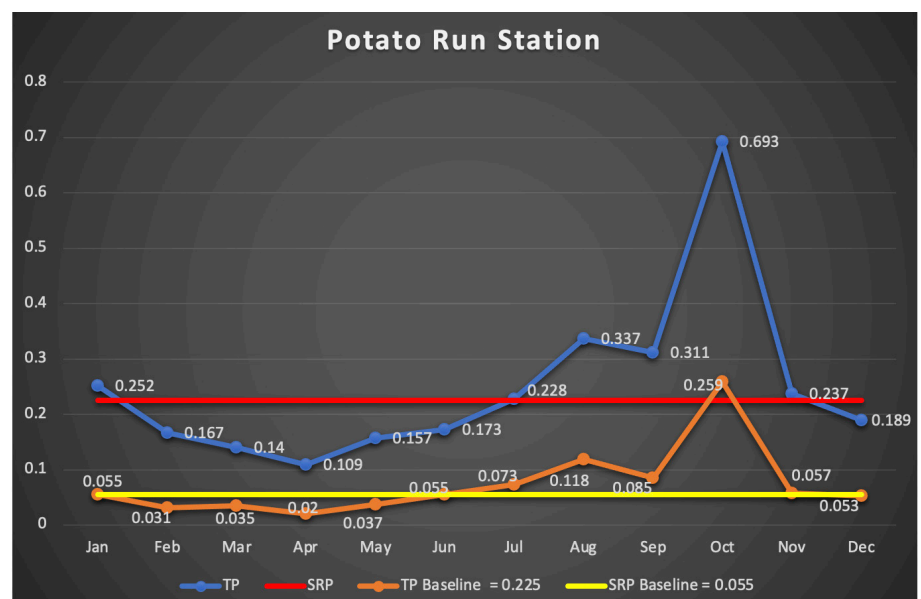
**Table 9 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2019											0.042	0.053	0.043
2020	0.079	0.044	0.050	0.025	0.028	0.039	0.055	0.052	0.030	0.259	0.075	0.053	0.055
2021	0.028	0.014	0.018	0.020	0.043	0.067	0.087	0.154	0.174				0.060
<b>Total</b>	<b>0.055</b>	<b>0.031</b>	<b>0.035</b>	<b>0.020</b>	<b>0.037</b>	<b>0.055</b>	<b>0.073</b>	<b>0.118</b>	<b>0.085</b>	<b>0.259</b>	<b>0.057</b>	<b>0.053</b>	<b>0.055</b>

**Figure 2.4 - Potato Run station total median monthly values against their corresponding baselines**

Highlights:

- October has the highest TP and SRP values.
- Months above the TP baseline: January, July, August, September, October, and November.
- Months above or equal to the SRP baseline: January, June, July, August, September, October, and November.



# S. Turkeyfoot Station

**Table 10 - Heatmap of monthly TP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018	0.106	0.229	0.069	0.057	0.176	0.199	0.076	0.220	0.157	0.150	0.186	0.124	0.150
2019	0.087	0.262	0.120	0.220	0.290	0.219	0.114	0.129	0.130	0.090	0.063	0.083	0.147
2020	0.281	0.109	0.087	0.054	0.150	0.104	0.136	0.111	0.076	0.148	0.074	0.058	0.109
2021	0.041	0.052	0.078	0.041	0.083	0.112	0.224	0.091	0.088				0.091
<b>Total</b>	<b>0.112</b>	<b>0.163</b>	<b>0.093</b>	<b>0.082</b>	<b>0.184</b>	<b>0.135</b>	<b>0.126</b>	<b>0.114</b>	<b>0.117</b>	<b>0.132</b>	<b>0.095</b>	<b>0.088</b>	<b>0.120</b>

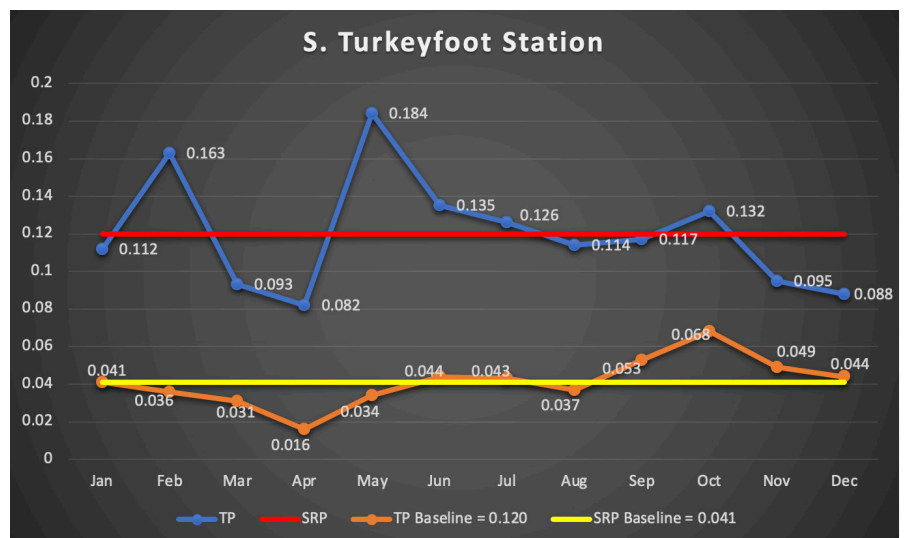
**Table 11 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018	0.046	0.045	0.022	0.009	0.036	0.067	0.016	0.091	0.075	0.083	0.069	0.058	0.061
2019	0.040	0.068	0.032	0.031	0.033	0.042	0.038	0.052	0.061	0.036	0.021	0.028	0.040
2020	0.057	0.025	0.020	0.009	0.047	0.047	0.040	0.027	0.010	0.072	0.021	0.026	0.035
2021	0.020	0.017	0.027	0.006	0.022	0.032	0.075	0.041	0.028				0.030
<b>Total</b>	<b>0.041</b>	<b>0.036</b>	<b>0.031</b>	<b>0.016</b>	<b>0.034</b>	<b>0.044</b>	<b>0.043</b>	<b>0.037</b>	<b>0.053</b>	<b>0.068</b>	<b>0.049</b>	<b>0.044</b>	<b>0.041</b>

**Figure 2.5 - S. Turkeyfoot station total median monthly values against their corresponding baselines**

Highlights:

- May has the highest TP followed by February.
- October has the highest SRP values.
- Months above the TP baseline: February, May, June, July, and October.
- Months above the SRP baseline: June, July, September, October, November, and December.





# Tiffin River Station

**Table 12 - Heatmap of monthly TP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	0.170		0.073	0.057	0.104	0.243	0.148	0.146	0.157	0.110	0.065	0.068	0.077
2016	0.080	0.053	0.123	0.088	0.135	0.181	0.228	0.229	0.213	0.198	0.155	0.070	0.172
2017	0.203	0.103	0.155	0.226	0.193	0.162	0.206	0.176	0.155	0.152	0.376	0.057	0.176
2018	0.146	0.184	0.089	0.148	0.208	0.170	0.189	0.216	0.161	0.113	0.201	0.118	0.173
2019	0.086	0.210	0.207	0.204	0.218	0.300	0.214	0.186	0.165	0.161	0.128	0.094	0.183
2020	0.180	0.081	0.122	0.165	0.184	0.183	0.198	0.180	0.132	0.100	0.090	0.036	0.148
2021	0.030	0.021	0.078	0.078	0.112	0.202	0.255	0.164	0.155	0.215	0.177		0.145
<b>Total</b>	<b>0.122</b>	<b>0.091</b>	<b>0.122</b>	<b>0.131</b>	<b>0.175</b>	<b>0.187</b>	<b>0.206</b>	<b>0.187</b>	<b>0.166</b>	<b>0.156</b>	<b>0.120</b>	<b>0.074</b>	<b>0.166</b>

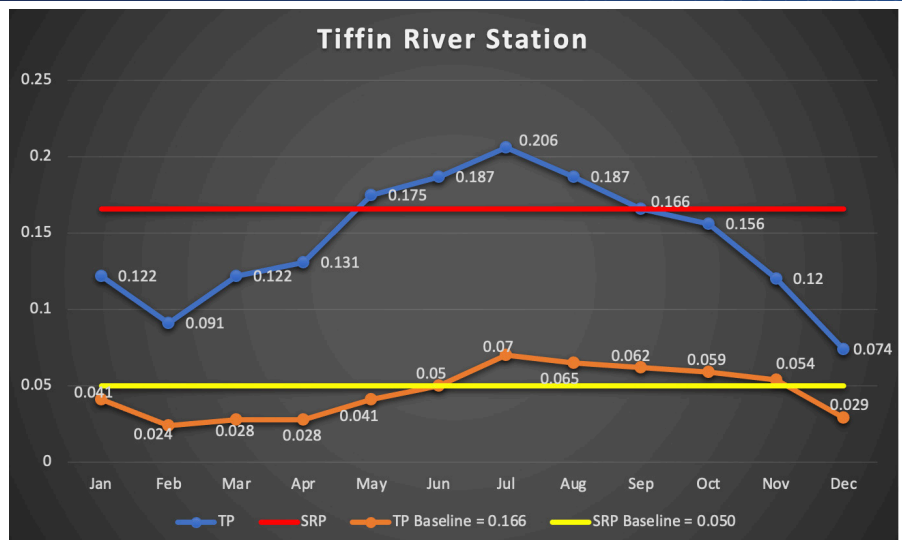
**Table 13 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	0.113		0.020	0.018	0.015	0.095	0.054	0.067	0.081	0.063	0.030	0.028	0.035
2016	0.034	0.021	0.026	0.022	0.033	0.046	0.067	0.073	0.078	0.066	0.060	0.031	0.045
2017	0.081	0.026	0.031	0.050	0.046	0.043	0.072	0.061	0.058	0.062	0.129	0.022	0.055
2018	0.061	0.066	0.030	0.035	0.059	0.051	0.068	0.078	0.063	0.045	0.086	0.043	0.059
2019	0.029	0.059	0.047	0.044	0.038	0.061	0.059	0.053	0.066	0.051	0.056	0.031	0.051
2020	0.052	0.018	0.022	0.024	0.055	0.045	0.077	0.067	0.049	0.046	0.033	0.009	0.046
2021	0.010	0.006	0.017	0.015	0.025	0.050	0.083	0.055	0.062	0.080	0.083		0.046
<b>Total</b>	<b>0.041</b>	<b>0.024</b>	<b>0.028</b>	<b>0.028</b>	<b>0.041</b>	<b>0.050</b>	<b>0.070</b>	<b>0.065</b>	<b>0.062</b>	<b>0.059</b>	<b>0.054</b>	<b>0.029</b>	<b>0.050</b>

**Figure 2.6 - Tiffin River station total median monthly values against their corresponding baselines**

Highlights:

- July has the highest TP and SRP values.
- Months above or equal to the TP baseline: May, June, July, August, and September.
- Months above or equal to the SRP baseline: June, July, August, September, October, and November.



# Shallow Run Station

**Table 14 - Heatmap of monthly TP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018									0.193	0.100	0.193	0.321	0.193
2019	0.065	0.408	0.084	0.235	0.197	0.232	0.256	0.201	0.173	0.117	0.096	0.371	0.152
2020	0.293	0.388	0.376	0.074	0.145	0.059	0.082	0.098	0.124	0.172	0.134	0.126	0.135
2021	0.076	0.612	0.077	0.111	0.054	0.171	0.266	0.220	0.168				0.164
<b>Total</b>	<b>0.163</b>	<b>0.429</b>	<b>0.134</b>	<b>0.133</b>	<b>0.073</b>	<b>0.090</b>	<b>0.108</b>	<b>0.175</b>	<b>0.157</b>	<b>0.143</b>	<b>0.117</b>	<b>0.248</b>	<b>0.151</b>

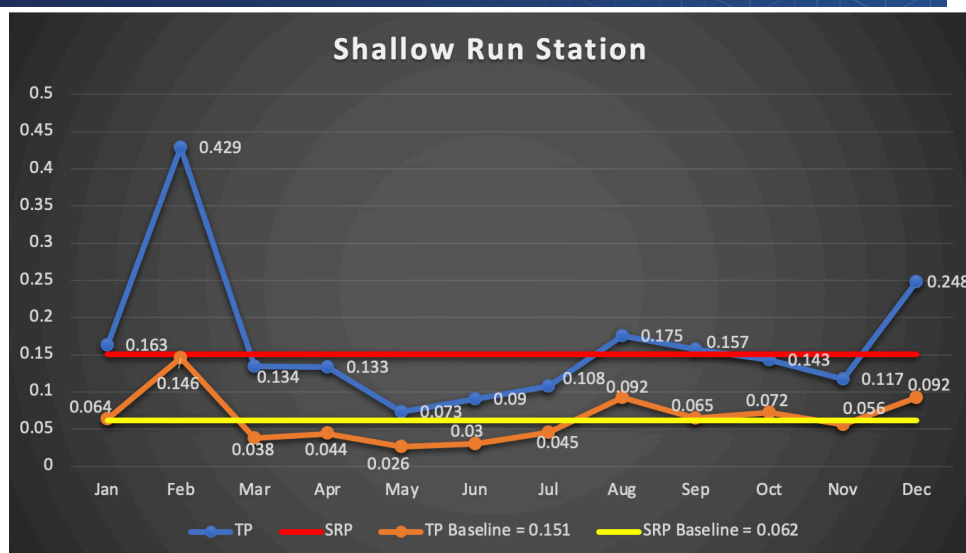
**Table 15 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018									0.186	0.050	0.086	0.177	0.105
2019	0.023	0.257	0.023	0.059	0.046	0.134	0.101	0.099	0.053	0.034	0.048	0.190	0.056
2020	0.077	0.074	0.085	0.016	0.057	0.015	0.027	0.037	0.060	0.093	0.073	0.044	0.055
2021	0.037	0.291	0.017	0.040	0.015	0.092	0.141	0.108	0.070				0.076
<b>Total</b>	<b>0.064</b>	<b>0.146</b>	<b>0.038</b>	<b>0.044</b>	<b>0.026</b>	<b>0.030</b>	<b>0.045</b>	<b>0.092</b>	<b>0.065</b>	<b>0.072</b>	<b>0.056</b>	<b>0.092</b>	<b>0.062</b>

**Figure 2.7 - Maumee station total median monthly values against their corresponding baselines**

Highlights:

- February has the highest TP and SRP values.
- Months above the TP baseline: January, February, August, September, and December.
- Months above the SRP baseline: January, February, August, September, October, and December.



# West Station

**Table 15 - Heatmap of monthly TP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018	0.089	0.384	0.053	0.048	0.153	0.184	0.367	0.209	0.125	0.099	0.162	0.114	0.157
2019	0.071	0.255	0.129	0.200	0.280	0.202	0.128	0.146	0.100	0.092	0.057	0.073	0.141
2020	0.283	0.087	0.067	0.044	0.115	0.150	0.282	0.366	0.194	0.528	0.075	0.055	0.155
2021	0.042	0.014	0.047	0.037	0.050	0.045	0.179	0.180	0.111				0.056
<b>Total</b>	<b>0.081</b>	<b>0.138</b>	<b>0.077</b>	<b>0.060</b>	<b>0.156</b>	<b>0.140</b>	<b>0.185</b>	<b>0.174</b>	<b>0.127</b>	<b>0.131</b>	<b>0.089</b>	<b>0.083</b>	<b>0.132</b>

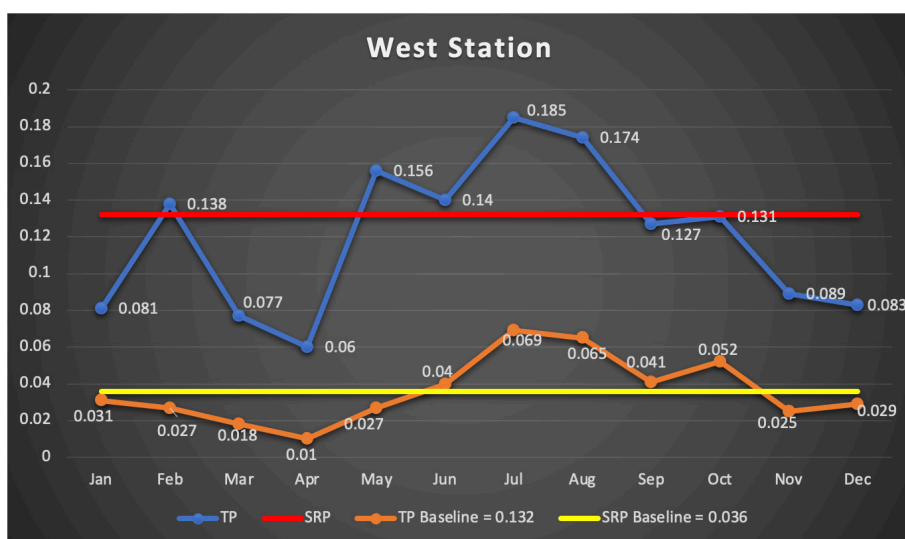
**Table 16 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018	0.032	0.048	0.022	0.007	0.042	0.055	0.188	0.089	0.044	0.039	0.034	0.038	0.049
2019	0.028	0.058	0.021	0.023	0.027	0.031	0.050	0.045	0.036	0.031	0.018	0.028	0.033
2020	0.043	0.021	0.014	0.007	0.029	0.061	0.124	0.176	0.044	0.080	0.022	0.020	0.037
2021	0.019	0.002	0.017	0.003	0.012	0.007	0.058	0.068	0.042				0.017
<b>Total</b>	<b>0.031</b>	<b>0.027</b>	<b>0.018</b>	<b>0.010</b>	<b>0.027</b>	<b>0.040</b>	<b>0.069</b>	<b>0.065</b>	<b>0.041</b>	<b>0.052</b>	<b>0.025</b>	<b>0.029</b>	<b>0.036</b>

**Figure 2.8 - West station total median monthly values against their corresponding baselines**

Highlights:

- July has the highest TP and SRP values.
- Months above the TP baseline: February, May, June, July, and August.
- Months above the SRP baseline: June, July, August, September, and October.





# Wolf Station

**Table 18 - Heatmap of monthly TP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018			0.039	0.037	0.085	0.084	0.093	0.081	0.061	0.059	0.059	0.054	0.061
2019	0.037	0.056	0.057	0.077	0.091	0.155	0.317	0.528	0.099	0.053	0.032	0.030	0.085
2020	0.060	0.039	0.036	0.040	0.101	0.095	0.157	0.086	0.070	0.077	0.070	0.028	0.071
2021	0.023	0.017	0.029	0.034	0.065	0.099	0.086	0.083	0.078				0.066
<b>Total</b>	<b>0.043</b>	<b>0.038</b>	<b>0.044</b>	<b>0.049</b>	<b>0.085</b>	<b>0.107</b>	<b>0.162</b>	<b>0.098</b>	<b>0.076</b>	<b>0.067</b>	<b>0.053</b>	<b>0.035</b>	<b>0.071</b>

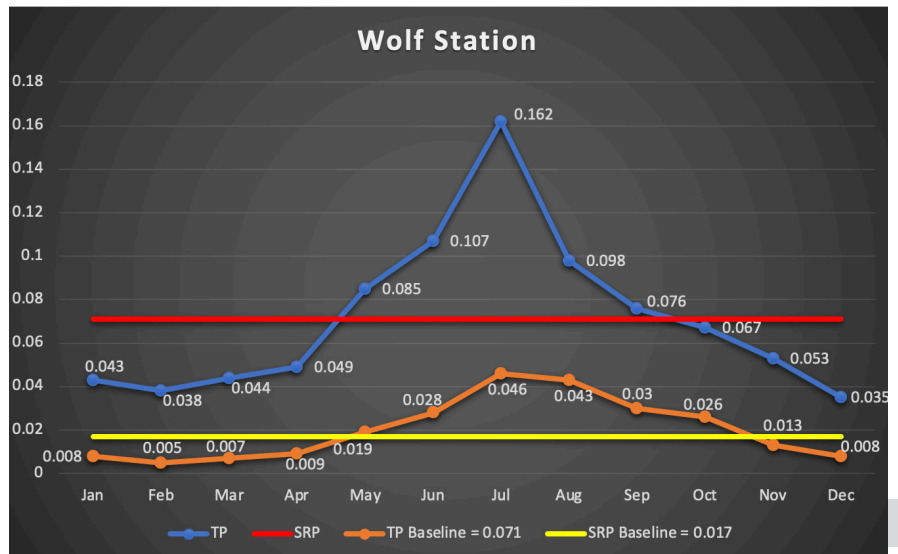
**Table 19 - Heatmap of monthly SRP median values**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018			0.006	0.009	0.012	0.030	0.044	0.033	0.021	0.022	0.016	0.013	0.018
2019	0.009	0.012	0.014	0.015	0.019	0.025	0.061	0.072	0.028	0.017	0.004	0.007	0.018
2020	0.008	0.003	0.002	0.004	0.023	0.036	0.054	0.041	0.029	0.035	0.025	0.007	0.020
2021	0.007	0.005	0.005	0.006	0.015	0.022	0.027	0.038	0.038				0.013
<b>Total</b>	<b>0.008</b>	<b>0.005</b>	<b>0.007</b>	<b>0.009</b>	<b>0.019</b>	<b>0.028</b>	<b>0.046</b>	<b>0.043</b>	<b>0.030</b>	<b>0.026</b>	<b>0.013</b>	<b>0.008</b>	<b>0.017</b>

**Figure 2.3 - Wolf station total median monthly values against their corresponding baselines**

Highlights:

- July has the highest TP and SRP values
- Months above the TP value: May, June, July, August, and September.
- Months above the SRP baseline: May, June, July, August, September, and October.



### 3. Final Thoughts

Another way to understand these data is to consider how many times Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP) concentrations exceeded or were below the baseline in a particular month across the nine monitoring stations. To this end, we calculated the difference ( $\Delta$ ) between the total median values of the entire observations recorded in each month during the study time span (i.e., 2015 through 2021) and the station's baseline value for both TP and SRP. Formulas 1 and 2 show how the differences are calculated in which a negative  $\Delta$  value indicates the total monthly median is less than the baseline and a positive  $\Delta$  number indicates a greater median value than baseline.

$$\Delta_{TP} = \text{Month}_{Total\ Median\ TP} - \text{Baseline}_{TP} \quad (1)$$

$$\Delta_{SRP} = \text{Month}_{Total\ Median\ SRP} - \text{Baseline}_{SRP} \quad (2)$$

For example, at Blanchard River station, the total TP median value for January is equal to 0.279 mg-P/L with a TP baseline equal to 0.305 mg-P/L (recall from Table 2). The calculated  $\Delta_{TP}$  is equal to -0.026 which suggests that the TP concentration in January is generally lower than the baseline. Tables 20 and 21 show the calculated  $\Delta_{TP}$  and  $\Delta_{SRP}$ , respectively and demonstrate that six out of nine ( $\approx 67\%$ ) stations had SRP concentrations above the baseline in September, October, and November; the only month with a greater number of stations exceeding the baseline is July, in which seven stations exceeded. These results underscore that September-November is regularly a time of relatively high SRP concentration in the basin.

**These results underscore that September-November is regularly a time of relatively high Soluble Reactive Phosphorus (SRP) concentration in the Maumee River basin.**

	Blanchard River	Lost	Maumee	Potato Run	S. Turkeyfoot	Tiffin River	Shallow Run	West	Wolf	# Of stations above their baselines
Jan	-0.026	0.039	0.076	0.027	-0.008	-0.044	0.012	-0.051	-0.028	4
Feb	-0.015	0.022	-0.007	-0.058	0.043	-0.075	0.278	0.006	-0.033	4
Mar	-0.069	0.03	0.082	-0.085	-0.027	-0.044	-0.017	-0.055	-0.027	2
Apr	-0.069	0.01	0.047	-0.116	-0.038	-0.035	-0.018	-0.072	-0.022	2
May	-0.031	0.072	0.04	-0.068	0.064	0.009	-0.078	0.024	0.014	5
Jun	-0.004	0.063	0.013	-0.052	0.015	0.021	-0.061	0.008	0.036	5
Jul	-0.003	0.001	0.014	0.003	0.006	0.04	-0.043	0.053	0.091	6
Aug	0.02	-0.035	-0.041	0.112	-0.006	0.021	0.024	0.042	0.027	5
Sep	0.081	-0.043	-0.057	0.086	-0.003	0	0.006	-0.005	0.005	3
Oct	0.097	-0.057	-0.055	0.468	0.012	-0.01	-0.008	-0.001	-0.004	3
Nov	0.012	0.005	-0.003	0.012	-0.025	-0.046	-0.034	-0.043	-0.018	3
Dec	-0.037	-0.035	-0.008	-0.036	-0.032	-0.092	0.097	-0.049	-0.036	1

**Table 20 - Monthly  $\Delta_{TP}$  at each monitoring station**

	Blanchard River	Lost	Maumee	Potato Run	S. Turkeyfoot	Tiffin River	Shallow Run	West	Wolf	# Of stations above their baselines
Jan	-0.027	0.013	0.028	0	0	-0.009	0.002	-0.005	-0.009	3
Feb	-0.047	-0.003	-0.001	-0.024	-0.005	-0.026	0.084	-0.009	-0.012	1
Mar	-0.076	0.002	-0.001	-0.02	-0.01	-0.022	-0.024	-0.018	-0.01	1
Apr	-0.086	-0.007	-0.008	-0.035	-0.025	-0.022	-0.018	-0.026	-0.008	0
May	-0.04	0.007	-0.004	-0.018	-0.007	-0.009	-0.036	-0.009	0.002	1
Jun	-0.008	0.017	0.005	0	0.003	0	-0.032	0.004	0.011	4
Jul	0.003	0.004	0.017	0.018	0.002	0.02	-0.017	0.033	0.029	7
Aug	0.055	-0.003	-0.037	0.063	-0.004	0.015	0.03	0.029	0.026	5
Sep	0.13	-0.009	-0.036	0.03	0.012	0.012	0.003	0.005	0.013	6
Oct	0.15	-0.015	-0.029	0.204	0.027	0.009	0.01	0.016	0.009	6
Nov	0.051	0.006	0.035	0.002	0.008	0.004	-0.006	-0.011	-0.004	6
Dec	0.019	-0.015	0.027	-0.002	0.003	-0.021	0.03	-0.007	-0.009	4

**Table 21 - Monthly  $\Delta_{SRP}$  at each monitoring station**





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