Phosphorus Load of Hangman Creek, Washington

Larissa Severance
EWU Biology

Background

Phosphorus is a key element for plant growth but can cause great harm when it enters into waterways. Agricultural run off and soil erosion are sources of excessive phosphorus that can cause eutrophication - a reduction in dissolved oxygen in water bodies resulting from high nutrient availability. Eutrophication can include algal blooms toxic to aquatic and human life.

Phosphorus is of critical importance to dissolved oxygen levels, especially in Lake Spokane (Long Lake). Hangman Creek, a tributary of the Spokane River, is a significant contributor of phosphorus, impacting the health of the ecosystem and preventing compliance with Total Maximum Daily Load (TMDL) pollution limits set by the US EPA.

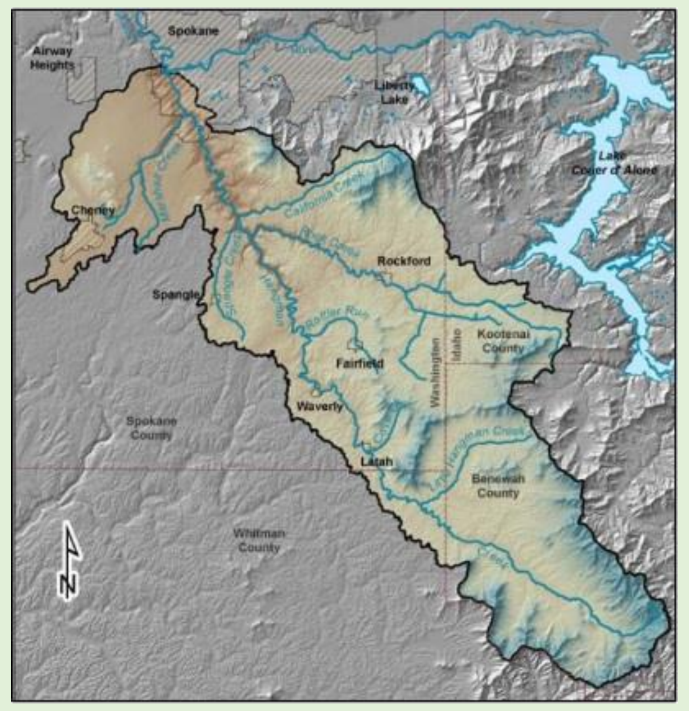

Figure 1: Hangman Creek watershed

The Clean Water Act sets standards to protect and restore water bodies. For polluted water bodies this includes a TMDL, which represents the highest pollution load a waterbody can receive and still meet water quality standards. Amounts in excess of this value violate water quality standards and must legally be mitigated. Table 1 displays the TMDL for Hangman Creek total phosphorus based on seasonal creek discharge.

Water Body and Season	2001 Flow (cfs)	Total Phosphorus: Allocation Concentration (mg/L)[1]	Total Phosphorus: 2001 Load Allocation (lbs/day)
Hangman Creek			
March–May Average	229	0.113	140.2
June	31	0.044	7.5
July – October Average	9	0.030	1.4

Table 1: TMDL load allocations for Hangman Creek

In partnership with the Spokane Riverkeeper, water samples from Hangman Creek were collected during winter and spring 2017 to determine phosphorus concentration and loads. I will compare phosphorus concentrations to discharge and turbidity to determine if there is a possible relationship. I will compare phosphorus loads to the Hangman Creek TMDL for March-May.

Data from this project can be used by the Spokane Riverkeeper to advocate for changes in pollution management for this watershed.

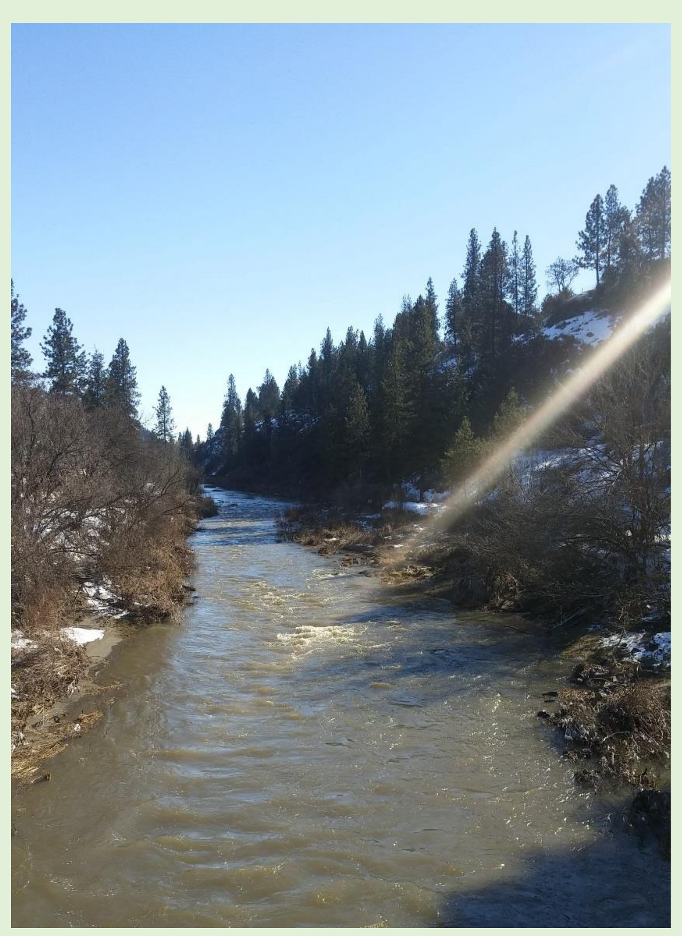

Figure 2: Hangman Creek as seen from the 11th street bridge

Study Area

Hangman Creek phosphorus loads fluctuate with yearly and seasonal variation in run-off. Current data suggest that the amount of phosphorus that Hangman Creek contributes to the Spokane River is dropping, but those reductions may be due to low flows and not improvements in land use. The headwaters of Hangman Creek are in the foothills of the Rocky Mountains in Idaho. About 60% of this watershed is located in Washington State Palouse farming regions. The creek's close association with agriculture gives it plenty of access to nutrient run off and stream bank erosion, increasing the phosphorus load.

The 11th street bridge, near High Bridge Park, was chosen as a study site due to its close proximity to the mouth of Hangman Creek and the ease of water accessibility. Figure 3 shows Hangman Creek entering the Spokane River as a ribbon of brown muddy water. The creek water will eventually mix with the Spokane River as it flows towards Lake Spokane.

Figure 3: Hangman Creek entering the blue Spokane River

Photo Credit: Cutboard Studio

Materials and Methods

Sampling: On each collection date, two bottles of filtered and two bottles of unfiltered creek water were collected. Figure 4 shows all field tools used for sampling. Samples were filtered in the field using a 0.7 micron mesh glass fiber filter. Turbidity readings were taken using an EcoSense 9500 photometer. During transport, samples were kept cold, then frozen until the day of lab analysis.

Figure 4: Field equipment used for water sampling

Figure 5: To collect less than 50 mL of filtered water, 11 filters were needed

Analysis: Water from each sampling date was used to determine total phosphorus (**TP**). TP includes phosphorus associated with particles as well as dissolved forms. Chemical analysis of the samples was performed using the molybdate method, on an Alpkem 3 flow analyzer (Figure 6). An alkaline persulfate digest was used to convert all forms of phosphorus to soluble reactive phosphorus (Patton and Kryskalla 2003). Daily loads were determined by multiplying measured concentrations by Hangman Creek daily discharge obtained from the U.S. Geological Survey.

Figure 6: Alpkem 3 flow analyzer used to analyze water samples

Results and Conclusions

There was a significant positive linear relationship between total phosphorus concentration and turbidity (Figure 7).

There was an exponential increase in total phosphorus concentration with discharge of Hangman Creek (Figure 8). High discharge results in higher transport through increase in concentration as well as volume transported.

Daily loads exceeded the TMDL of 140 lbs per day for most dates sampled (Figure 9).

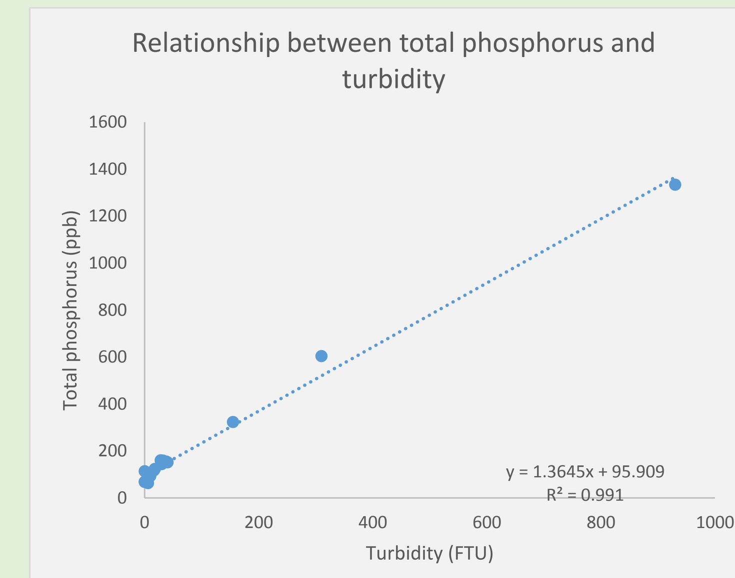

Figure 7: Total Phosphorus vs turbidity

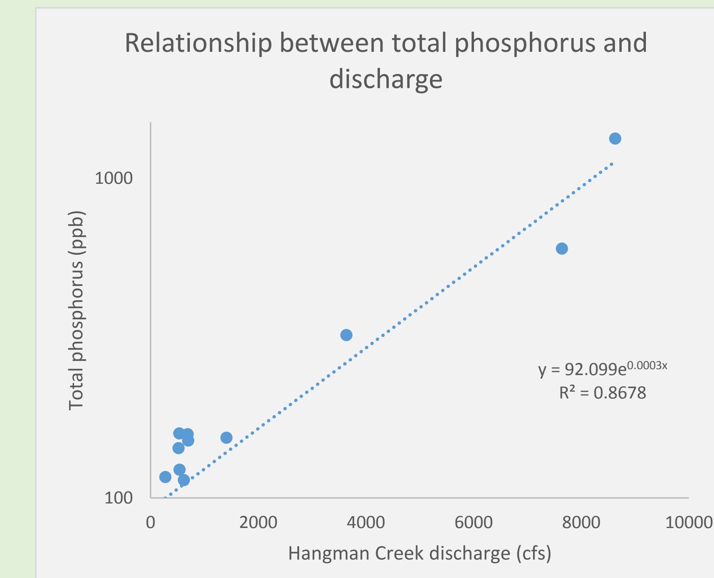

Figure 8: Total phosphorus vs discharge

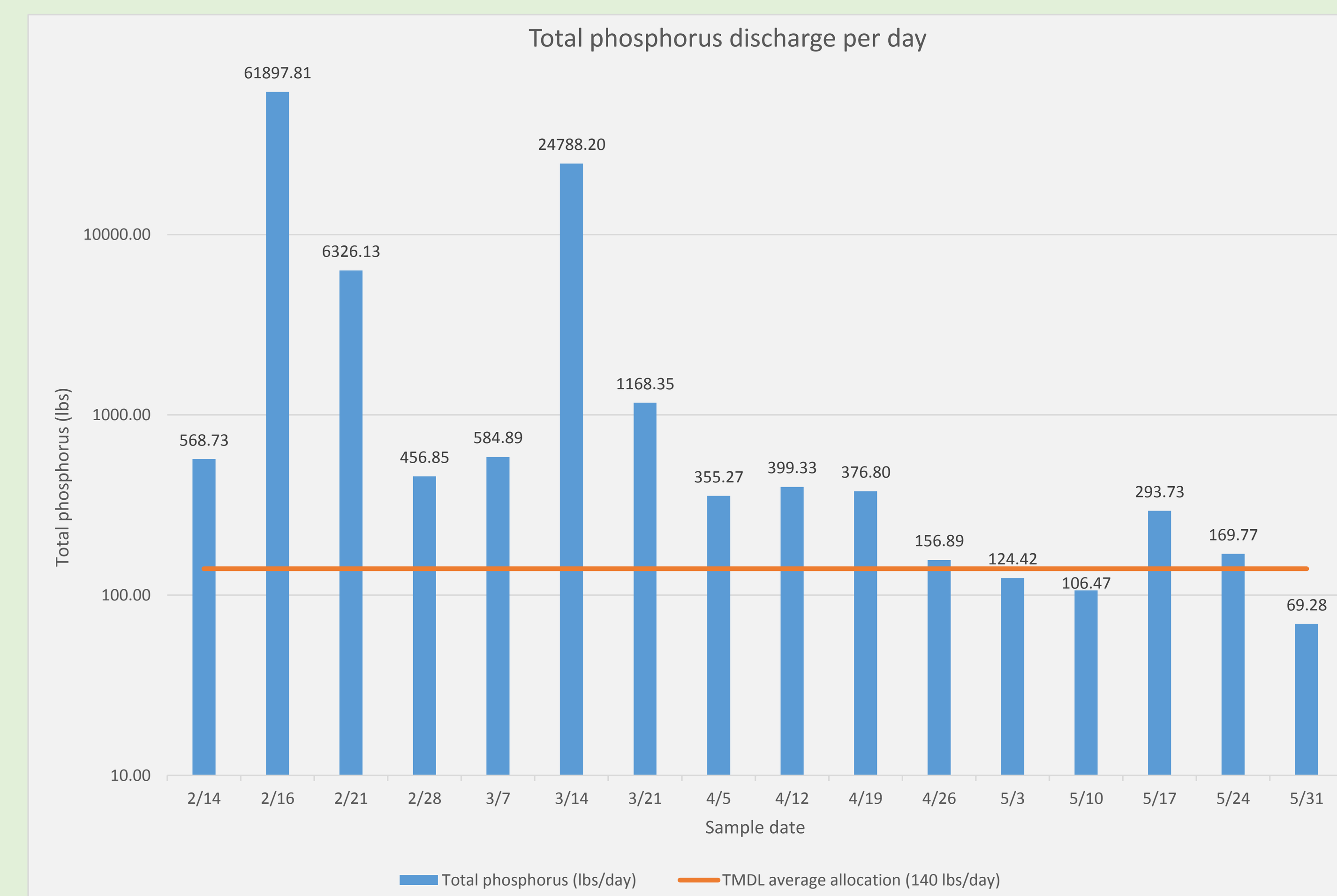

Figure 9: Total phosphorus discharge per day

Future work

In addition to monitoring phosphorus in Hangman Creek at the 11th street bridge site, increasing the sample area may yield more information regarding causal agents for increases in phosphorus.

Hangman Creek is in desperate need of rehabilitation. Data from this project can be used by the Spokane Riverkeeper to advocate for changes in pollution management for this watershed.

Acknowledgements

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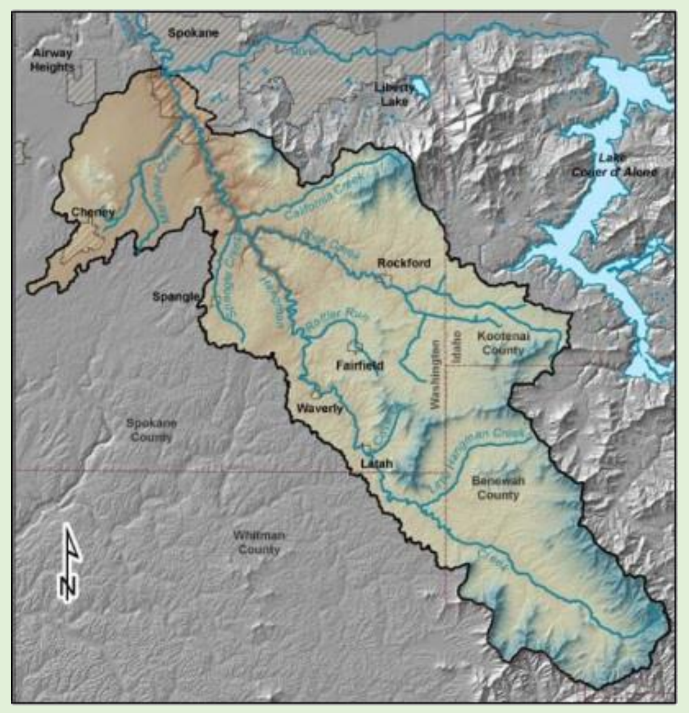

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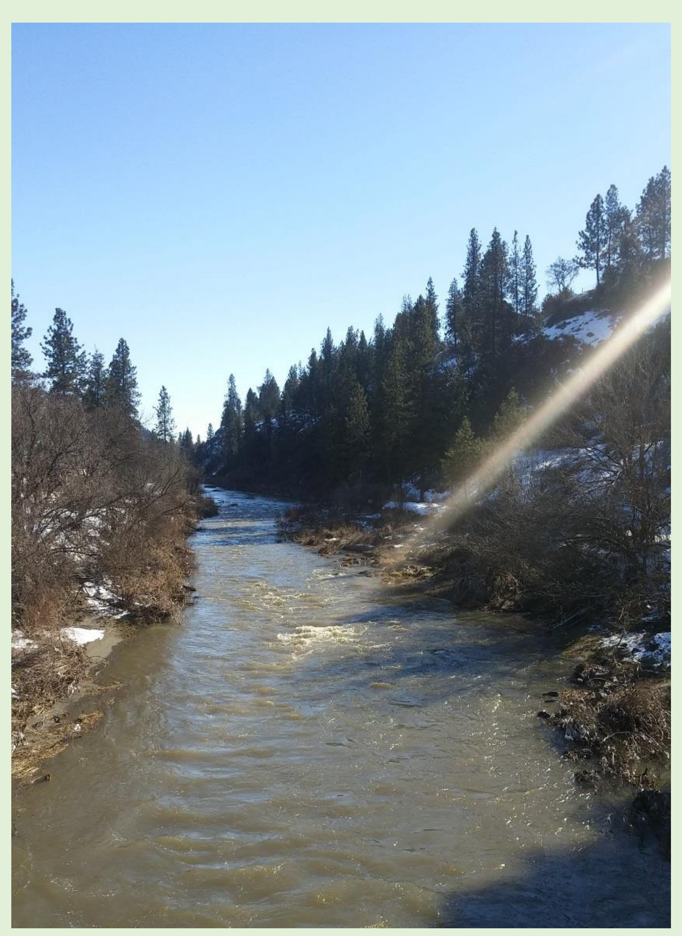

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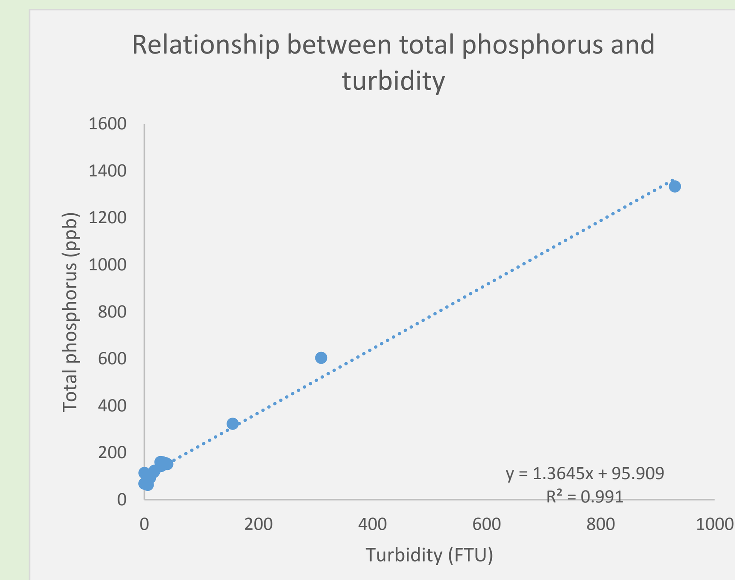

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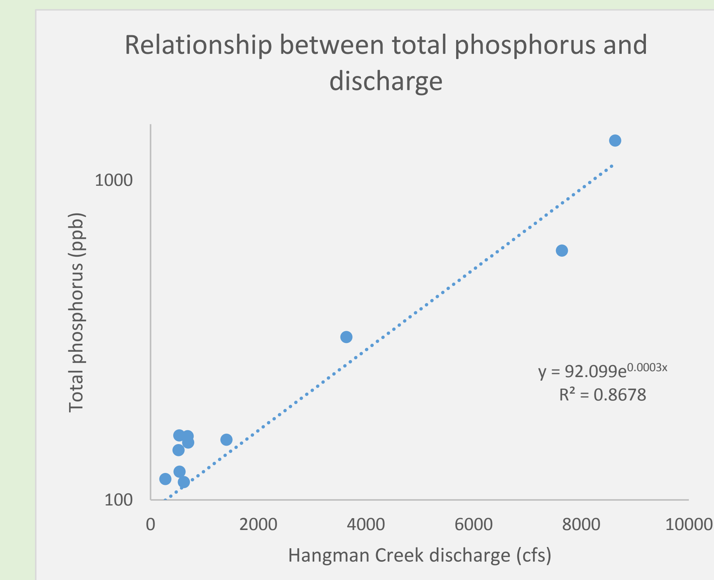

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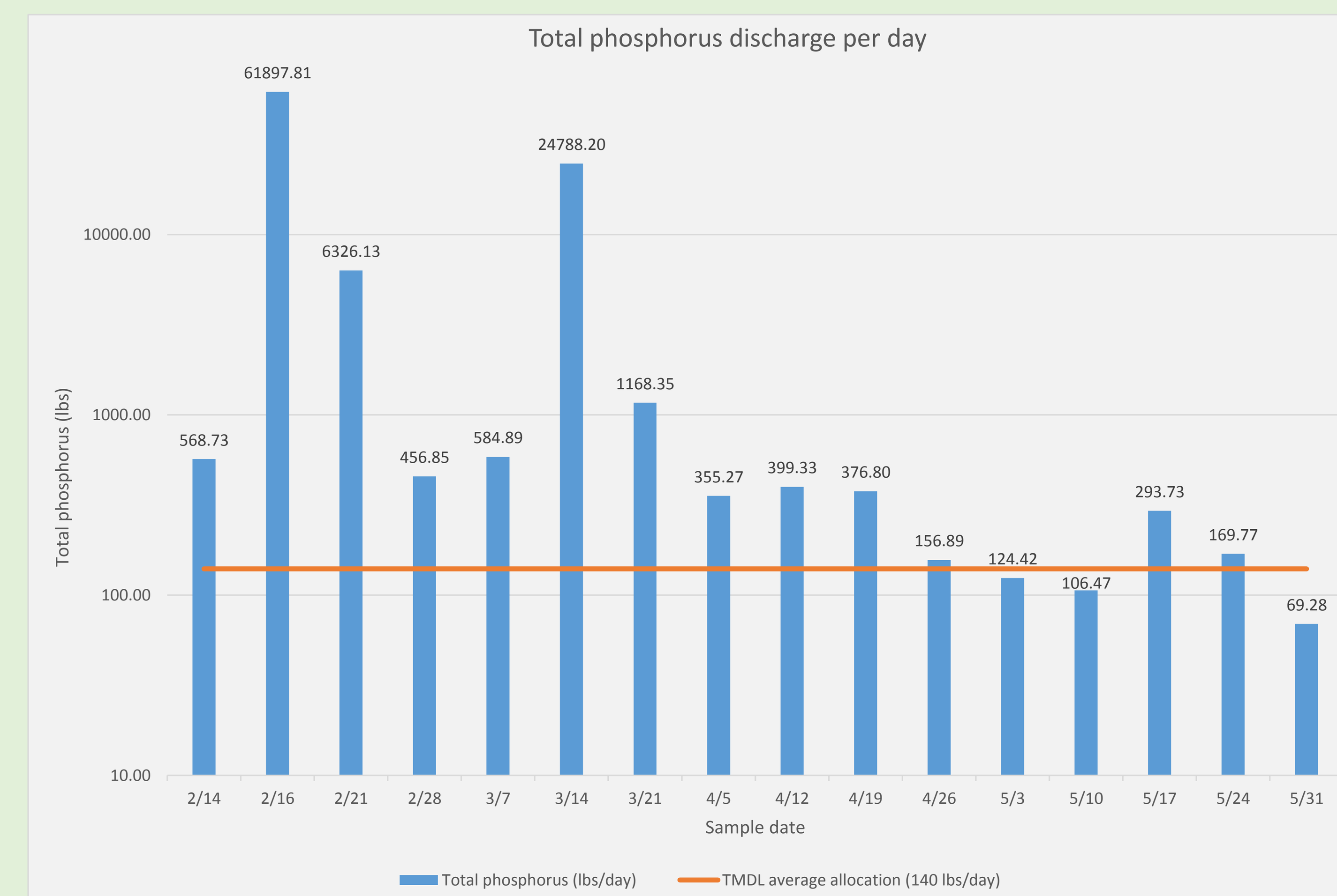

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