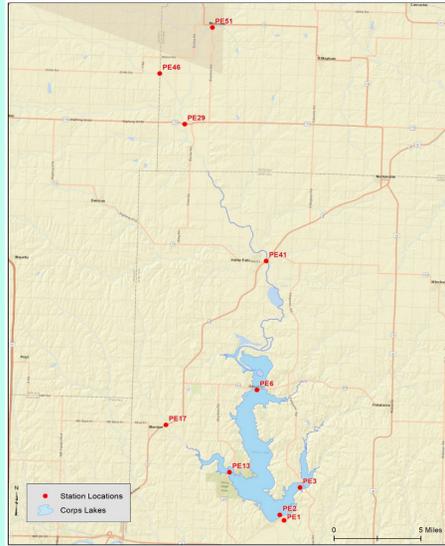


# Perry Lake Water Quality Summary

## 2010-2019

The US Army Corps of Engineers (USACE) Water Quality Program collects monthly water samples at Perry Lake from the beginning of April through September. These figures present data collected between 2010-2019 from four inflow sites on Delaware River (PE-29, PE-41, PE-46, PE-51), lake sites (PE-2, PE-3, PE-6, PE-13) and the outflow (PE-1) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.



### Perry Lake:

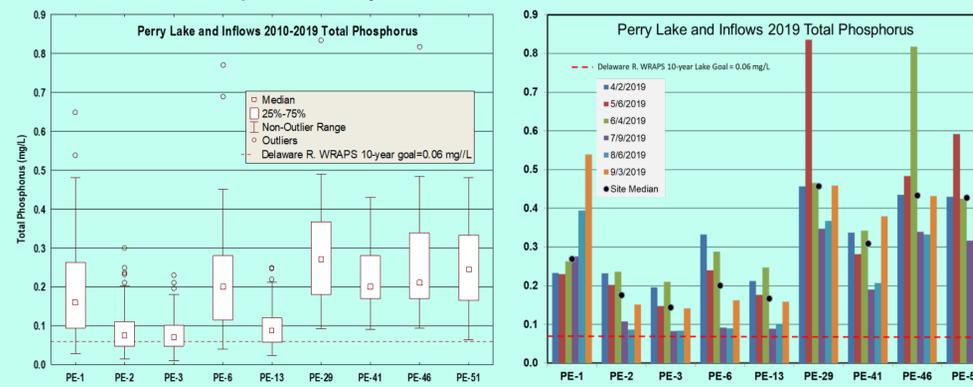
- Built on Delaware River reaching full pool in 1970
- **Watershed** = 1,117 sq miles; 714,880 Acres (A)
- **Capacity:** Flood Control: 515,795 Acre-Feet (AF); 25,347 Surface-Acre (SA)
- **Multipurpose Pool:** 209,513 AF; 11,146 SA; 160 miles of shoreline
- **Avg. annual inflow:** (2010-2019) = 473,073 AF; 2019 inflow = 1,188,551 AF
- **Operating project purposes:** flood control, recreation, water supply, navigation support, water quality, and fish and wildlife habitat.
- **Water Quality** at Perry Lake in 2019 was beneficial to operating purposes listed above while measured parameters did not exceed Kansas State WQ Standards for designated uses. Water quality generally improves as nutrients, herbicides and sediments are removed by settling, dilution, and biological processes as water moves from inflow streams to the dam.

### Nutrient Enrichment

Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life and are the primary factor driving fish and aquatic plant growth rates and biological productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging process in lakes. This rapid aging process, called eutrophication, is responsible for changes in plant and aquatic life in lakes and water bodies including algal blooms, low dissolved oxygen that affect fish survival, and taste and odor issues in drinking water. Perry Lake is listed on the 2020 Kansas 303(d) list of impaired waters for accelerated eutrophication. The U.S. Environmental Protection Agency (EPA) and the Kansas Department of Health and Environment (KDHE) are working with WQ partners, landowners and an active Delaware River Watershed Restoration and Protection Strategy (WRAPS) group in the watershed to reduce nutrient and sediment runoff. Slowing the eutrophication process improves water quality and increases the life span of Perry Lake. Perry Lake 2019 mean Total Nitrogen (TN) exceeded District lake average of 1.0 mg/L while Total Phosphorus (TP) concentrations were below District mean of 0.19 mg/L. Both Perry Lake average TN and TP exceeded the EPA Ecoregion Recommended Criteria as illustrated below.

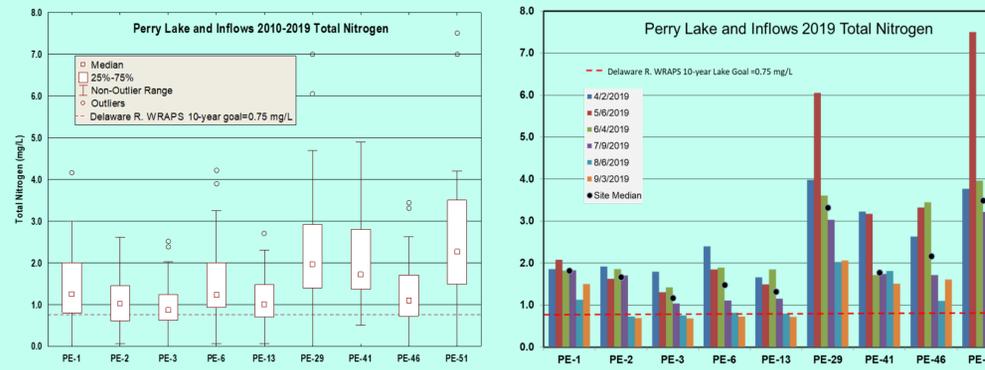
### Total Phosphorus

Perry Lake inflows in 2019 measured 600% of the 10-year average. Increased phosphorus load from frequent runoff led to high phosphorus concentrations in Perry Lake in 2019. Median Total phosphorus (TP) in 2019 exceeded 75% of the sample results from 2010-2019, except at site PE-6. June and July had peak inflow phosphorus from the Delaware River inflow sites while August and September samples had high concentrations of phosphorus evacuated through the outlet (PE-1). Median TP from lake sites exceeded EPA approved 10-year goals set by Delaware River WRAPS. Phosphorus released by bottom sediments or other internal loading mechanisms was not apparent as high nutrient inflows influenced the phosphorus cycle. In 2019, flood elevation and increased water residency time allowed for significant settling of sediment bound phosphorus as well as biological uptake by algae to remove soluble phosphorus from water column. Increased algae density at lower lake sites led to a proportional increase in TP compared most years.



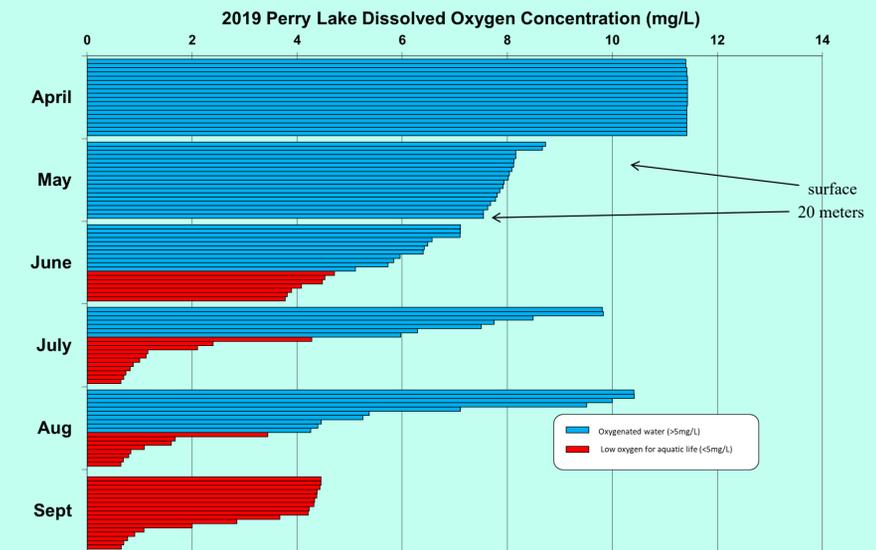
### Total Nitrogen

In 2019, median total nitrogen (TN) exceeded 75% of the sample results from 2010-2019, except at site PE-6 and inflow site PE-41. Median TN concentrations from lake sites exceeded the 10-year milestones set by Delaware River WRAPS and EPA recommended criteria. Nitrogen concentrations at upper lake sites and inflows were highly variable related to runoff events. Nitrogen cycling and denitrification from biological process was apparent as TN steadily decreased June-September. Bottom withdrawal during stratified conditions typically leads to significant nitrogen concentrations in the outflow which did not occur in relation to sampling events in 2019.



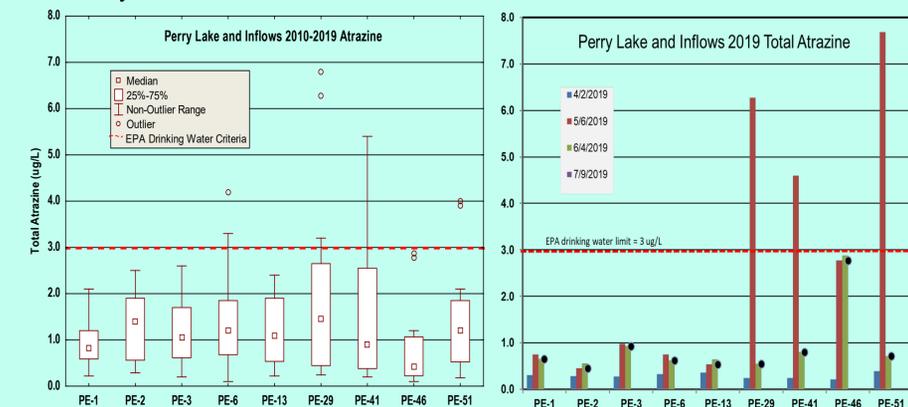
### Dissolved Oxygen

Dissolved oxygen is a key factor in aquatic species location, growth, and survival in lakes. Some lakes undergo a process called stratification (develop layers based on temperature and oxygen). This process typically begins in late spring, remains throughout the summer, and breaks apart (de-stratifies or 'turns over') in the fall. The figure below illustrates dissolved oxygen measured in the water column in one-meter intervals (e.g. each row in each month represents one meter of depth) from April-September at the dam (PE-2). In 2019, stratification occurred June-September. September sampling occurred after a flood release (i.e. 20,000 cfs) in which low oxygen water mixed through the water column at the site near dam. The top 6 meters at other lake sites were well oxygenated for fish and aquatic life April-September. Fish mortality or reports of low oxygen stress were not reported.



### Atrazine

Atrazine is the most widely used and most frequently detected herbicide throughout the Midwest. Measured concentrations occasionally exceed water quality criteria (3 ug/L) during spring sampling, which coincides with application and runoff as observed in May water quality samples. The ten-year atrazine box plot below shows that percentage exceed the EPA criteria in the inflows and only one exceedance at lake sites. Atrazine management in the Perry Lake watershed is a success story. The Delaware River Watershed became the first inland Pesticide Management Area (PMA) in 1992 to address high levels of atrazine. The Delaware River WRAPS program has been very successful at improving water quality with education and BMPs to reduce runoff of sediment nutrients and chemicals flowing into Perry Lake.



### Water Quality Concerns:

- Eutrophication
- Sediment inputs
- Herbicides
- Algae Blooms



US Army Corps of Engineers  
Environmental Resources Section  
Kansas City, MO

