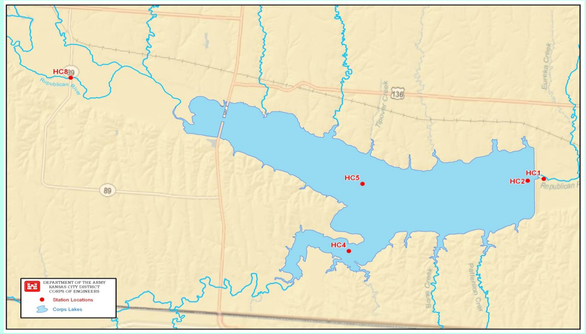
Harlan County Lake Water Quality Data

2005-2014

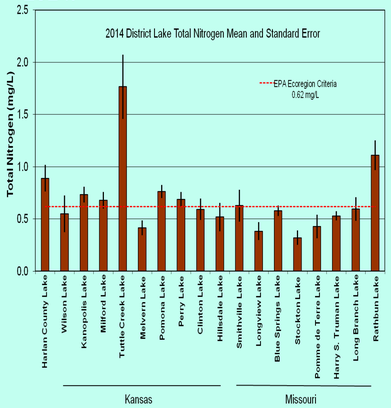


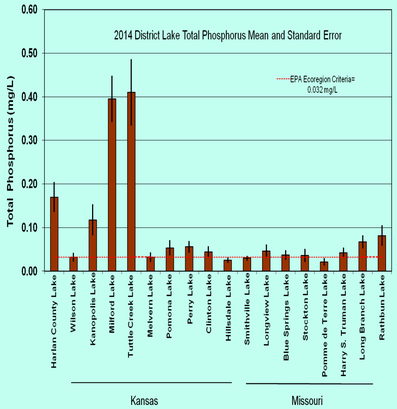
Harlan County Lake

- Built on Republican River at RM 232 reaching full pool in 1951.
- **Watershed** = 7,169 square miles/ 4,588,160 Surface Acres (SA)
- **Capacity**:
  - Flood Control: 500,000 Acre-feet (AF) / 23,431 SA
  - Multipurpose: 150,000 AF / 13,305 SA / 54 miles of shoreline
  - Avg. annual inflow (2005-2014)=127,558 AF; 2014 inflow=92,204 AF
- **Operating project purposes**: flood control, irrigation, recreation, fish and wildlife
- **Water Quality** at Harlan County Lake in 2014 was beneficial to USACE operating purposes listed above. Measured nutrients exceeded 2012 NEDEQ criteria for benefits to aquatic life. Water quality at Harlan County Lake 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 productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging or eutrophication process in lakes. This can alter plant and aquatic life in lakes and water bodies, cause algal blooms, create low dissolved oxygen affecting fish survival, and lead to taste and odor issues in drinking water. Harlan County Lake is listed in the 2014 Nebraska 303(d) list of impaired waters due to excessive total phosphorus and total nitrogen concentrations. Nebraska Department of Environmental Quality (NEDEQ) and U.S. Environmental Protection Agency are working with water quality partners to reduce nutrient inflow into Harlan County Lake in efforts to improve water quality. In 2014, Harlan County Lake ranked above averages among District Lakes for average total phosphorus (0.094 mg/L) and total nitrogen (0.68 mg/L) measured at the site nearest the dam. Both nutrient measures exceeded nutrient criteria set by NEDEQ in efforts to reduce impairments to Harlan County Lake. Standard error bars in the graphs below illustrate the variation in sample results from each site in 2014.



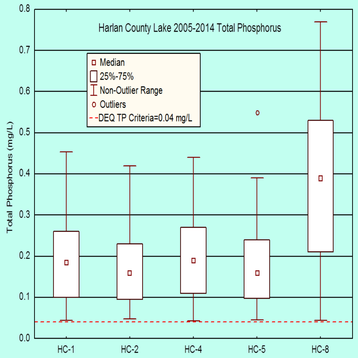


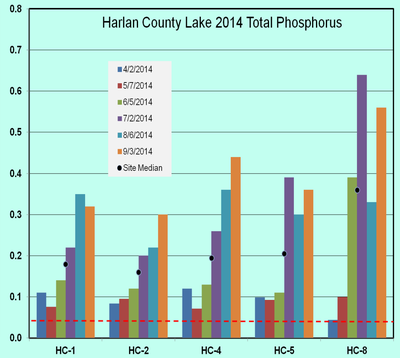
The US Army Corps of Engineers (USACE) Water Quality Program collects monthly water samples at Harlan County Lake* from April through September. These figures present data collected between 2005-2014 from inflow (#8), lake sites (#2,4,5), and the outflow (#1) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe water quality history, conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.

*Note: The term "lake" is substituted for technically correct "reservoir" throughout this document for consistency.

Total Phosphorus

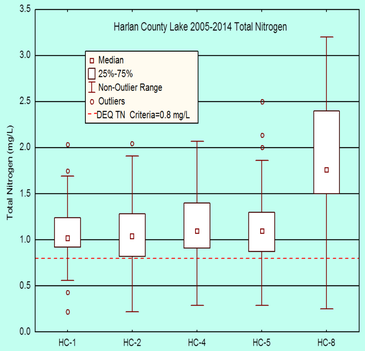
Physical conditions and excessive nutrients in Harlan County Lake led to infrequent toxic blue-green algae blooms. Median phosphorus concentrations at all sites in 2014 were similar (i.e. between 25%-75% quartile) to 10-year trends. Total phosphorus medians from all sites in 2014 exceeded hypereutrophic thresholds and were 2-4 times higher than NEDEQ criteria 0.062 mg/L. Low inflows and increasing water clarity combine with increases in phosphorus during the hottest part of the summer to create optimum conditions for blue green algae. Internal sources of total phosphorus including orthophosphate released by bottom sediments are apparent as TP concentrations increase exponentially from July-Sept unrelated to inflow volume or timing. Wind action, invertebrates, bottom feeding fish and bacteria cause the re-suspension of sediment bound phosphorus.

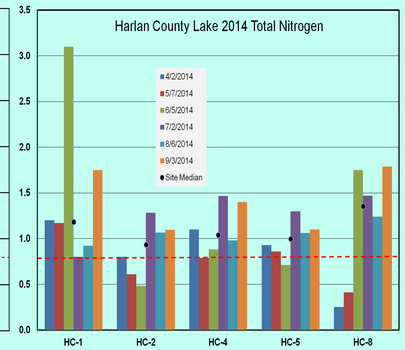




Total Nitrogen

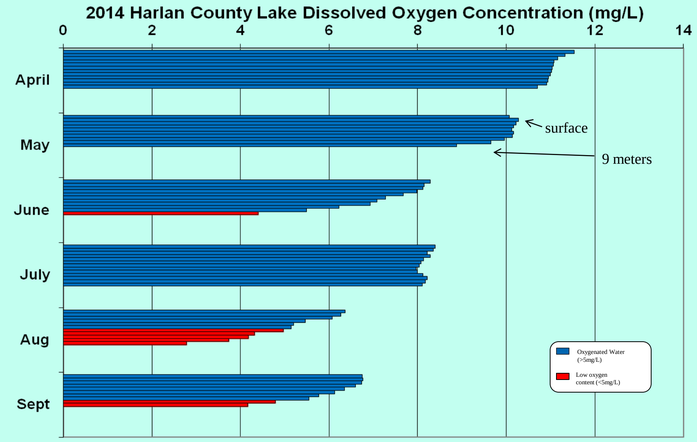
Total nitrogen (TN) calculated from Harlan County Lake are typically rank high compared to other District Lakes. Similar to phosphorus, the highest concentrations of TN are typically found in the inflow HC-8 (Republican River). However, lower than average inflows lead to significantly lower TN values for HC-8. Total nitrogen concentrations are two times higher than NEDEQ TN criteria at all sites from 2005 to 2014. A spike in TN at HC-1 was related to high ammonia content in a period of low flow. Nitrogen concentrations are highly variable between sites and years mostly related to inflow discharge and upstream land use.





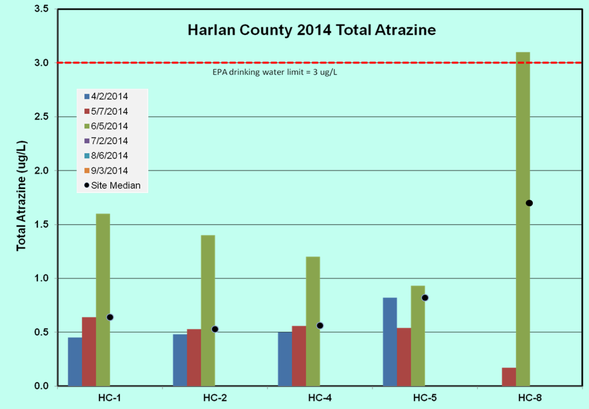
Dissolved Oxygen

Dissolved oxygen is a factor in aquatic species location, growth, and ultimately survival in lakes. The figure below shows 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 through September. Harlan County Lake typically stratifies for a short period of the summer, however adequate (>5 mg/L) dissolved oxygen is typically available in the lake. In 2014, Harlan County Lake was oxygenated in the top 8 meters during the worst conditions in August.



Atrazine

Atrazine is a widely used and frequently detected herbicide throughout the Midwest. Measured concentrations in the Republican River (HC-8) occasionally exceed EPA water quality criteria (3 ug/L) during spring sampling, which coincides with application and runoff. 2014 sampling indicates that under normal inflow conditions, lake and inflow atrazine concentrations had only one exceedance of EPA total atrazine criteria measured from the Republican River site in June.



Water Quality Concerns:

- Eutrophication
- Nutrients
- Herbicides

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