



C I T Y O F  
**RENO**  
Memorandum

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**DATE:** September 26, 2024

**TO:** Mayor and City Council

**THROUGH:** Jackie Bryant, Interim City Manager

**Electronically Approved**

**FROM:** Trina Magoon, Utility Services Director

Chris Holman, Senior Civil Engineer

**DEPT:** Utility Services

**SUBJECT:** Virginia Lake Water Quality Memo

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This memo provides a summary of previous work completed regarding Virginia Lake water quality; current water quality monitoring results, a detailed history of water quality monitoring and modeling efforts, improvement projects previously completed at Virginia Lake, potential future management strategies and/or proposed capital improvement solutions for further improved water quality.

Current Water Quality and proposed listing on NDEP's 2024 Nevada Water Quality Integrated Report

Staff typically collect monthly water quality samples at Virginia Lake during the summer months at the Virginia Lake dock. This year, collection began on May 17, 2024. Per Nevada Administrative Code (NAC) 445A.1726, Standards of Water Quality Steamboat Creek at the Truckee River (the nearest downstream water quality standards that could be considered applicable to the lake), water quality sampling parameters include the concentrations of nutrients, fecal coliforms, pH, and dissolved oxygen. Late spring lab results show Virginia Lake water quality met the Water Quality Criteria to Protect Beneficial Uses listed in NAC 445A.1726, but by mid-summer various water quality standards were not met. These standards include Recreation Involving Contact with Water and Recreation Not Involving Contact with Water. Good to fair water quality values for late spring and early summer are likely due to the continuous flows in Cochran Ditch, from the Truckee River, and the resulting flushing of water through Virginia Lake to multiple outlets.

In accordance with the Federal Clean Water Act, the Nevada Division of Environmental Protection, NDEP, is required to develop a list of waterbodies which do not meet water quality standards, known as the Water Quality Integrated Report, 303(d) list. This list can designate waterbodies not meeting standards using either numeric or narrative methods. Numeric water quality standards for Virginia Lake have not been developed. Because Virginia Lake is tributary to Steamboat Creek, water quality standards for Steamboat Creek at the Truckee River are applied. Notably, the standards in NAC 445A.1726, do not include thresholds for toxins from harmful algae blooms (HABs), or the reoccurring presence of Avian Botulism. Data gathered by the Department of Wildlife show the reoccurring presence of Avian Botulism, and data gathered by the City show algal blooms at harmful levels. On account of this, NDEP notified the City that “on the forthcoming Draft 2024 [Surface] Water Quality Integrated Report [aka the 303(d) list], Virginia Lake will be listed as impaired for recreation involving contact with the water, aquatic life, and the propagation of wildlife beneficial uses under our narrative criteria.” As a result of this, quoting again from NDEP, “Having a waterbody appear on the 303(d) list of impaired waters does have some implications. EPA requires that NDEP prioritize waterbodies on the list and work on a plan to bring those waterbodies back to meeting water quality standards. Due to other high priority waters, Virginia Lake will likely be assigned a lower priority.”

### Water Quality Background

Virginia Lake water quality varies throughout the year and from year to year due to variations in Cochran Ditch flows, ambient air temperature, water temperature and oxygen levels, bird populations, and the spatial and temporal variability of rainfall in the Truckee Meadows. The lake’s overall water quality tends to improve during late winter through spring and declines during summer and fall months as water temperatures rise and Ditch flows usually decrease. Furthermore, in mid- to late summer months, typically July through October, Virginia Lake experiences dense blue-green algae blooms, also known as cyanobacteria blooms, which can produce harmful toxins to animals and humans. These blooms are common to urban ponds throughout the country and occur due to nutrients in the water and warmer water temperatures.

### Potential Solutions

Water quality management strategies for Virginia Lake have focused on two separate but related concerns: reduction of high nutrient concentrations within the lake, and elimination of cyanobacteria blooms that occur during the summer and early fall.

Several completed studies have investigated various solutions to reducing the lake’s nutrient concentrations, detailed in the attachment to this memo, including dosing with nutrient locking chemicals, advanced water aeration, and installing a constructed wetlands on the west shore of the lake, which involves engineered water circulation through the wetlands. Additionally, dosing with algacide has been considered for a targeted approach to prevent algal blooms.

Notably, the City has already made a significant improvement to the lake’s water circulation: The 2015 Virginia Lake Circulation Project routes water by gravity, via a submerged 24” pipe, from the southern outlet structure back to the existing outlet in the northeast. Prior to this, during low

flows from Cochran Ditch, water would flow directly towards the northeast primary outlet, leaving the rest of the lake stagnant. This circulation project has effectively reduced stagnant water in the central, south, and eastern areas of the lake, reducing odors and likely improving general water quality.

While previously completed studies and past input from various interested parties have helped to form a path forward for both seasonal algal bloom mitigation and potential capital improvements projects designed to benefit overall water quality, further investigation is needed.

#### Seasonal Algal Bloom Mitigation:

- o Seasonal application of algaecides (sodium percarbonate) and or nutrient locking chemicals to reduce both the prevalence of algal blooms and the associated cyanotoxins. If viable, algaecides and nutrient locking chemicals would be applied multiple times per year as needed dependent on yearly climatic, hydrologic and biologic conditions of the lake.
- o Further evaluation is needed to determine potential impacts to aquatic and avian wildlife, impacts to downstream water rights users, appropriate application schedule, required permitting and public noticing.
- o Cost: \$30k-\$100k per year depending on climatic/hydrologic/biologic conditions.
- o Anticipated Implementation (Sewer Fund)
  - o Fall 2024-Spring 2025: Further investigation of algaecides and their potential impacts.
  - o Spring 2025: Public Outreach
  - o Summer 2025: Seasonal algal bloom mitigation pilot study.

#### Capital Improvements:

- Staff has evaluated multiple alternatives which have been determined to be unsuitable, such as: in-channel upstream wetlands, island removal, and floating wetlands. These alternatives were rejected for various reasons including impacts to flood conveyance capacity and impacts to avian wildlife populations.
- The most viable capital improvement is an in-lake constructed wetlands. This concept would both filter and uptake nutrients through filter media and aquatic vegetation. A jet pump circulation system would increase circulation between the treatment area and the deeper zones of the lake.
- Further evaluation of impacts to the flood control detention basin function of the lake will be required to ensure the proposed improvements do not reduce mitigation volume. Freeboard, storage capacity requirements and long-term maintenance and replacement costs must also be evaluated.
- Cost: \$3M (Estimate from 2020, to be re-evaluated, and expected to be significantly higher).
- Anticipated implementation: (funding to be determined)
  - o Fall 2024-Summer 2025: Further evaluation of in-lake constructed wetlands impacts, required permitting and costs.

- Winter 2025: Preliminary design of in-lake constructed wetlands.
- Summer 2026: Final design of in-lake constructed wetlands.
- Construction to be determined based on funding availability, grant opportunities, and resolution of impacts.

As mitigation alternatives continue to be evaluated, monthly water quality monitoring will continue. The following attachment provides a timeline and brief synopsis of the history of Virginia Lake, water quality monitoring and modeling efforts, and improvement projects.

## Attachment:

### Timeline of Water Quality Investigations, Projects, Funding for Virginia Lake

This attachment provides a timeline and brief synopsis of the history of Virginia Lake, water quality monitoring and modeling efforts, and improvement projects.

- **1938 – 1939:** Virginia Lake constructed by the Works Progress Administration. Design documents and plans are unavailable. A fish hatchery was operated at the current site of Virginia Lake Dog Park until 1965.
- **1960s – 1990s:** Storm drain systems built and upsized have discharged into Virginia Lake turning the recreational lake into a stormwater detention basin and forever changing the water quality characteristics of the lake.
- **2002:** UNR's Mark Walker & Laurel Saito led UNR Class investigation – Total Phosphorous (TP) was recorded from 0.003 to 0.12 mg/L. Recommendations included construction of detention/retention ponds, engineered treatment systems, and diverting point sources of nutrients.
- **2002:** Three fountains installed in Virginia Lake. Aeration effectiveness is considered minimal.
- **December 2008:** Master's Thesis: Nutrients, Cormorants, and Rainbow Trout in an Urban Lake, Reno NV – findings showed that birds were a large source of TP to the lake, exceeding the amount contributed by the Truckee River inflow. It was found that 100% fish predation by double-crested cormorants on rainbow trout stocked at Virginia Lake. Thesis recommended stocking trout in the fall, well after nesting season. Suggested management options included surface water treatment with aluminum sulfate, or draining and dredging the lake to remove TP-saturated sediment (not feasible as Virginia Lake has a clay lining).
- **Spring 2014:** City of Reno water quality monitoring begins at Virginia Lake. NDOW stocks the lake with fish for the last time, refraining from stocking lake again until 2017.
- **June 2014:** City of Reno Staff completes Virginia Lake Dam Emergency Action Plan, which outlines risks associated with damage or potential failure of the dam embankment, models downstream flooding effects, and provides an Action Plan and notification chart in the case of emergency. The notification chart is updated regularly, most recently in April 2024.
- **January 2015:** Scientific Panel established to guide efforts in developing a lake management and monitoring plan. Panel discusses pros and cons of a multi-phase and comprehensive approach for improving water quality, including some or all of the following:
  1. Improve water circulation in the lake;
  2. Halt fish stocking (trout specifically) or delay until after cormorant nesting season;
  3. Remove the Virginia Lake Island which provides the only suitable habitat for nesting cormorants;
  4. Increase public education to reduce bird feeding at the lake and fertilizer runoff into local storm drains.
- **June 2015:** First of several Virginia lake Public Meetings to -solicit citizen input about issues and potential solutions. Citizens overwhelmingly support Virginia Lake

Circulation Project. Resistance to removing Virginia Lake Island was expressed here or at subsequent meetings.

- **September 2015:** Truckee River Fund Grant awarded for \$100,000, for “Virginia Lake Water Quality Improvement Project Monitoring and Public Education.” The funding provided for pre-project water quality monitoring and public education and outreach programming.
- **Fall 2015:** Construction of the Virginia Lake Circulation Project, which improved circulation by re-routing water by gravity from the southern outlet structure back to the existing outlet in the northeast. This circulation project has effectively reduced stagnant water in the central, south, and eastern areas of the lake, reducing odors and likely improving overall water quality. Design by Manhard Consulting, Constructed by RTC Construction, total cost: \$391,000. Project was completed in December 2015.
- **2015:** One of driest years on record at Reno-Tahoe Airport. Flows from Truckee River did not enter Cochran Ditch from late March 2015 through December 2015 – Important because it highlights the variability in monitoring results and the difficulty in setting up a short-term monitoring study to determine an average lake condition.
- **January 2016:** Developer of new condominiums adjacent to Virginia Lake, SWD-NVL LLC, donates \$116,316.92 to the City to support the Virginia Lake Water Quality Improvement Project, acting as reimbursement for the FY14/15 Capital Improvement Program (CIP) which originally funded the project.
- **May 2016:** Virginia Lake Stormwater and Baseflow Water Quality to Virginia Lake, Balance Hydrologics. Includes recommendations to evaluate Dant and Rosewood Wash drainages, measure continuous streamflow at Dant drainage and Cochran Ditch.
- **December 2016:** Dant Drainage Perennial Flow Source & Water Quality Investigation, Balance Hydrologics. Investigated flows into VL from Dant drainage. Flows ranged from 0.01 cfs to 1.5 cfs, lowest during winter, highest during irrigation season, no pesticides, no geothermal flows, TP at 0.07 mg/L (relative to irrigation ditches (TP 0.012 mg/L), and Thomas Creek (TP 0.085 mg/L)). Recommendations include educating upstream irrigators to reduce runoff, and vegetating lined concrete channels to provide passive treatment.
- **2017:** One of wettest years on record, important because it highlights the spatial and temporal variability of precipitation in the Truckee Meadows and effects to monitoring results and the difficulty in setting up a short-term monitoring study.
- **March 2017:** Virginia Lake Water Quality Assessment, MaxDepth Aquatics, is delivered to Scientific Panel. Report provides several treatment types including improved circulation, dilution and flushing, aeration, Sodium percarbonate algaecide, constructed wetlands, and several less practical alternatives. Nutrient inputs include surface water flows from Cochran, Dant, stormwater runoff, waterfowl, and nitrogen-fixing cyanobacteria.
- **April 2017:** Briefing meeting conducted with CM Naomi Duerr with Balance Hydrologics and MaxDepth Aquatics, discussing recent water quality monitoring results and future water quality improvements.

- **May 2017:** NDOW begins stocking fish in the lake, including stocking trout in both June and October. NDOW determined that stocking was suitable to continue after the completion of the 2015 Circulation Project. Why trout were stocked in June (during nesting season) is unknown at this time.
- **July – September 2018:** City staff works with UNR to conduct a pilot wetlands plant filter project in Virginia Lake, with insufficient results.
- **2019:** Pilot Barley Straw experiment conducted at Lake Park to determine effectiveness of straw degradation, which releases Hydrogen Peroxide and can inhibit new algae growth. Results inconclusive, but technology has been proven useful in small ponds.
- **May 2023:** Virginia Lake Water Quality Report 2014-2022, MaxDepth Aquatics, Inc. Summarizes that water quality has generally improved since 2015, likely due to increased precipitation and longer periods of Cochran Ditch flowing, and the new circulation improvements.
- **December 2023:** Water Quality Modeling of Virginia Lake to Evaluate Treatment Options, MaxDepth Aquatics. Provides an update to the March 2017 report, detailing potential treatment options including constructed wetlands with active circulation and aeration. An initial quote of ~\$3 million was determined for the construction of an advanced engineered wetlands, provided in 2020.
- **Spring 2024:** City of Reno offers Pilot Pedal Boat Program to the public.
- **Spring 2024:** The Nevada Division of Environmental Protection initiates the Nevada Cyanobacterial Harmful Algal Bloom (HAB) Strategic Response Plan that details a methodology for monitoring and responding to HAB events in the state. One important element of this plan is issuing recreational advisories for waterbodies accessible to the public with the stated purpose of protecting public health.
  
- **Summary of Historical Investments/Costs associated with Water Quality:**
  - Total Consultant Research Costs for Virginia Lake: ~ \$225K
  - Design & Construction of Circulation Project: \$391K
  - Total Research and Project Efforts to date: ~ \$630K
  
- **Summary of Estimated Costs for Various Mitigation Measures:**
  - Constructed Wetlands with active circulation and aeration.: \$3M (Estimate from 2020, to be re-evaluated)
  - Full lake application of algaecide and nutrient locking to bind free reactive phosphorus (~\$250k)
  - Seasonal implementation of algaecide, phosphorus mitigation or dyes (~\$30k-\$100k annually)
  - Acquisition of additional water rights to promote nutrient flushing year-round (subject to Truckee River flow rate, costs TBD)
  - Per Max Depth Report, nutrient concentrations have improved considerably since 2015 primarily due to increase flows from the Cochran Ditch.