2024 Annual Report on Activities

Cherry Creek Basin Water Quality Authority

Accessible Version

Interactive webpage report available at:

https://ccbwqportal.org/annual-report/2024/key-takeaways

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Acronyms

Acronym	Definition
Board	Board of Directors
CCBWQA	Cherry Creek Basin Water Quality Authority
CCSP	The Cherry State Park
CDPHE	Colorado Department of Public Health and Environment
CEI	Concrete Express Inc.
CIP	Capital Improvement Projects
Commission	Colorado Water Quality Control Commission
CPN	Castle Pines North Metropolitan District
CPW	Colorado Parks and Wildlife
DIKW	The Data-Information- Knowledge-Wisdom
Division	The Colorado Water Quality Control Division
DM	Daily maximum
DO	dissolved oxygen
HFLMS	High Function Low Maintenance Stream
MBR	Membrane Biological Reactors
mg/L	Milligrams Per Liter
MS4	Municipal Separate Storm Sewer System
MWAT	Maximum Weekly Average Temperature
NOAA	National Ocean and Atmospheric Administration
OWTS	Onsite Wastewater Treatment Systems
PAPs	Pollution Abatement Projects
Partners	Cherry Creek Stewardship Partners
PRFs	Pollutant Reduction Facilities (PRFs)
RDS	Reservoir destratification system
Reservoir	Cherry Creek Reservoir
SEMSWA	The Southeast Metro Stormwater Authority
SRP	soluble reactive phosphorus
SWQMP	Statewide Water Quality Management Plan
TAC	Technical Advisory Committee
TDP	total dissolved phosphorus
TIN	total inorganic nitrogen
TP	Total phosphorus
TSI	Trophic State Index
TSS	total suspended solids
ug/L	Micrograms Per Liter
WWTFs	Wastewater treatment facilities

Key Takeaways from Water Year 2024 (10/1/2023– 9/30/2024)

During 2024, the Cherry Creek Basin Water Quality Authority worked with its partners to preserve and protect water quality in Cherry Creek Reservoir (Reservoir). This work includes an extensive reservoir and watershed monitoring program, stream reclamation projects, operation and maintenance of Pollutant Reduction Facilities (PRFs), operation of the Reservoir Destratification System (RDS), special studies and modeling efforts, public education and outreach, and other efforts. Local governments and entities operating wastewater reclamation facilities use advanced treatment technology to maintain total phosphorus (TP) in treated effluent at 30-day average concentrations below 0.05 milligrams per liter (mg/L). Municipal stormwater managers implemented stormwater management programs in accordance with Regulation 72 requirements to minimize the adverse effects of stormwater runoff on streams and the Reservoir.

Highlights of our 2024 activities are briefly summarized below.

How is the Reservoir?

Cherry Creek State Park (CCSP) has a record number of visitors every year, and the Reservoir continues to provide space where people enjoy recreating and connecting. There were over 1.5 million visitors to Cherry Creek Park in 2024, and Colorado Parks and Wildlife (CPW) biologists reported that the walleye fishery is doing well.

Due in part to on-going efforts to reduce nutrient loading to the Reservoir, the Reservoir attained its chlorophyll-a standard of 18 micrograms per liter (ug/L) during 2024. The average chlorophyll-a concentration was 16.4 ug/L for the growing season of July through September. The Reservoir has exceeded the standard for four of the past five years; however, the average chlorophyll-a concentrations were the lowest they’ve been in the last five years. One undesirable blue-green algae bloom occurred in late July and was responsible for closure to human contact due to the detection of toxins. The bloom dissipated in a few days.

Seasonal phosphorus concentrations in the Reservoir were higher than they have been relative to the past 20 years but were significantly lower than last year. The Reservoir attained the Regulation 38 water quality standards for temperature, pH, and dissolved oxygen.

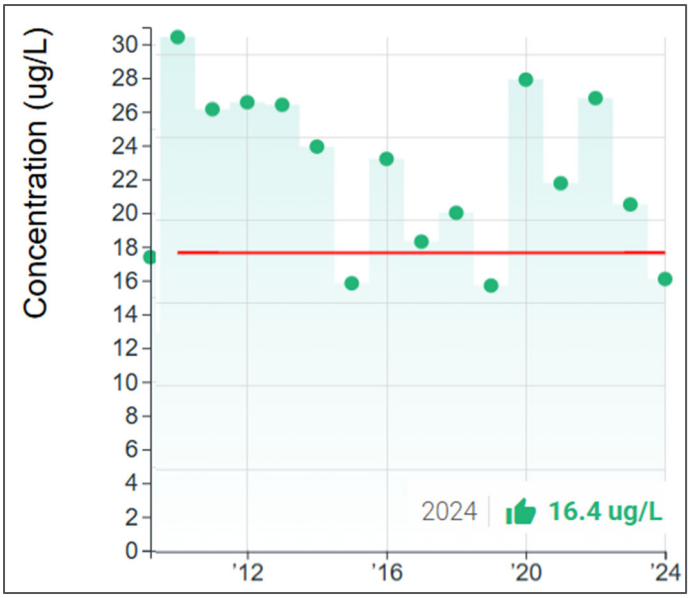

Figure 1. Seasonal average Chlorophyll-a concentrations

Some of the factors affecting conditions in the Reservoir are challenging or impossible to control and result in year-to-year variations in water quality and environmental conditions. Some of these factors include weather conditions such as temperature, wind, and precipitation patterns. The Reservoir received close to average annual precipitation in 2024, with significantly lower rain than average from May through July.

Other factors include natural sources of phosphorus loading from the watershed and alluvial groundwater and the release of stored nutrients from Reservoir sediments (internal loading). CCBWQA operates a RDS from April through October to help mitigate some of these influences.

How is the watershed?

The 386 square mile watershed has experienced significant growth since Control Regulation 72 was implemented. Baseline loading of phosphorus from wastewater reclamation facilities is well controlled, with these point sources contributing less than three percent of the phosphorus load to the Reservoir.

CCBWQA monitors phosphorus and nitrogen concentrations in Cherry Creek and Cottonwood Creek since they are the two main inflows to the Reservoir.

Key findings from 2024 include:

- Median TP concentrations in baseflows and storm flows were lower than long term medians for both Cherry Creek and Cottonwood Creek

- Phosphorus concentrations in Cottonwood Creek are ~ 60% lower than concentrations in Cherry Creek.
- Total nitrogen concentrations in both Cherry Creek and Cottonwood Creek were slightly higher than the long-term historical median.
- Median nitrogen concentrations in Cherry Creek were 50% lower than concentrations in Cottonwood Creek in base flows.
- The CCBWQA PRFs on Cottonwood Creek are effectively reducing phosphorus and suspended solids during storm flows.
- Conductivity in the watershed is increasing in both streams and groundwater.
- Median nutrient concentrations are lower downstream of the stream reclamation project on McMurdo Gulch

What did we do to preserve water quality?

CCBWQA and its partners continue to implement pollutant reduction facilities and stormwater control measures, construct stream reclamation projects and conduct other activities to reduce nutrient loading throughout the watershed.

Key 2024 capital improvement projects in the watershed include:

Completed in 2024:

- Dove Creek Phase II Chambers Road to Pond D-1: In 2024, Phase II of the Dove Creek stream restoration project was completed. The project included step pool structures for grade control, bank protection (void-filled riprap, soil lifts, and vegetation), and grading to create overbanks providing a wider stream corridor which stabilizes the stream and reduces erosion potential. The Southeast Metro Stormwater Authority (SEMSWA) is a project partner.

Under Construction in 2024:

- Cherry Creek at Dransfeldt: Design was completed in 2024, and construction began in April 2024 and is expected to be completed in April 2025.
- Cherry Creek upstream of Scott Avenue: Construction began in September 2024 and is expected to be completed in May 2025.

What we learned from studies and special projects conducted in 2024

During 2024, CCBWQA conducted several special studies including:

Wetlands Harvesting Project: In 2024, CCBWQA completed year four of a six-year pilot project to cut and dispose of wetland vegetation to reduce phosphorus and nitrogen from being carried to Cherry Creek Reservoir after the plants decay.

Stormwater Best Management Practice (BMP) Effectiveness Study: CCBWQA continued a study to synthesize the most current information on the expected effectiveness of stormwater BMPs (also known as stormwater control measures). A draft report was submitted in 2024 and will be finalized in 2025.

Receiving Pervious Area Study: CCBWQA partnered with SEMSWA and the Mile High Flood District to develop a more quantitative understanding of volume reduction benefits of receiving pervious areas such as grass buffers, grass swales and other landscape areas. Reducing runoff volumes through green infrastructure can reduce pollutant loads and channel erosion. The final report was completed in 2024.

What are our plans for 2025?

CCBWQA will continue its routine activities along with some new activities in 2025.

Highlights include:

- Continue the extensive long-term monitoring program that includes: weather and stream flow conditions; water quality in the Reservoir, groundwater, Cherry Creek and Cottonwood Creek, and other tributaries; PRF performance; and phytoplankton and zooplankton dynamics in the Reservoir.
- Finalize a major update to the 2012 Watershed Plan, including joint TAC and Board workshops and subcommittee participation. The updated Watershed Plan includes a significant effort to integrate geospatial data from multiple partners into the CCBWQA's Data Portal.
- Invest $3.5 million in stream reclamation projects in the watershed. These include projects on Cherry Creek, Lone Tree Creek, Happy Canyon Peak, Piney Creek and the Reservoir shoreline.
- Complete extension of a drainage master plan on Lone Tree Creek, Windmill Creek and Cottonwood Creek from the Park boundary to the Reservoir, collaborating with SEMSWA and Mile High Flood District.
- Operate the RDS from April through October.
- Continue the wetland harvesting pilot project for the Pollutant Reduction Facility on Cottonwood Creek and evaluate if we can quantify the benefit through water quality analysis.
- Continue to host the Cherry Creek Stewardship Partners annual watershed conference in the fall of 2025.

- Participate with MHFD, Parker and Douglas County to support a Sulphur Gulch, Sara Gulch, Tallman Gulch & Tall Tributary Master Drainage Plan.
- Support the USACE's pilot project to evaluate if there is a water quality benefit of change of storage and release timing in the Reservoir.
- Communicate and share information and data with sister watersheds on the front range, including Bear Creek, Chatfield, and Barr-Milton Watershed Authorities.
- Conduct the conceptual design of Cherry Creek Reach 1 just upstream of the Reservoir to determine feasibility of restoration staging, timing and funding.
- Finalize a Capital Improvement Plan project identification and prioritization process to implement for future projects and funding allocation in the basin.

Thank you to Our Partners

- Colorado Parks and Wildlife
- Cherry Creek Stewardship Partners
- MS4s: City of Lone Tree, City of Castle Pines, Southwest Metro Stormwater Authority, Arapahoe County, Town of Castle Rock, Parker, Greenwood Village Colorado, Douglas County, City of Aurora, CDOT
- WWTFs: Pinery Water and Wastewater District, Plum Creek Water Reclamation Authority, Meridian Service Metropolitan District, ACWWA, Stonegate, Parker Water and Sanitation District

1. Cherry Creek Basin Water Quality Authority

1.1 What is the CCBWQA?

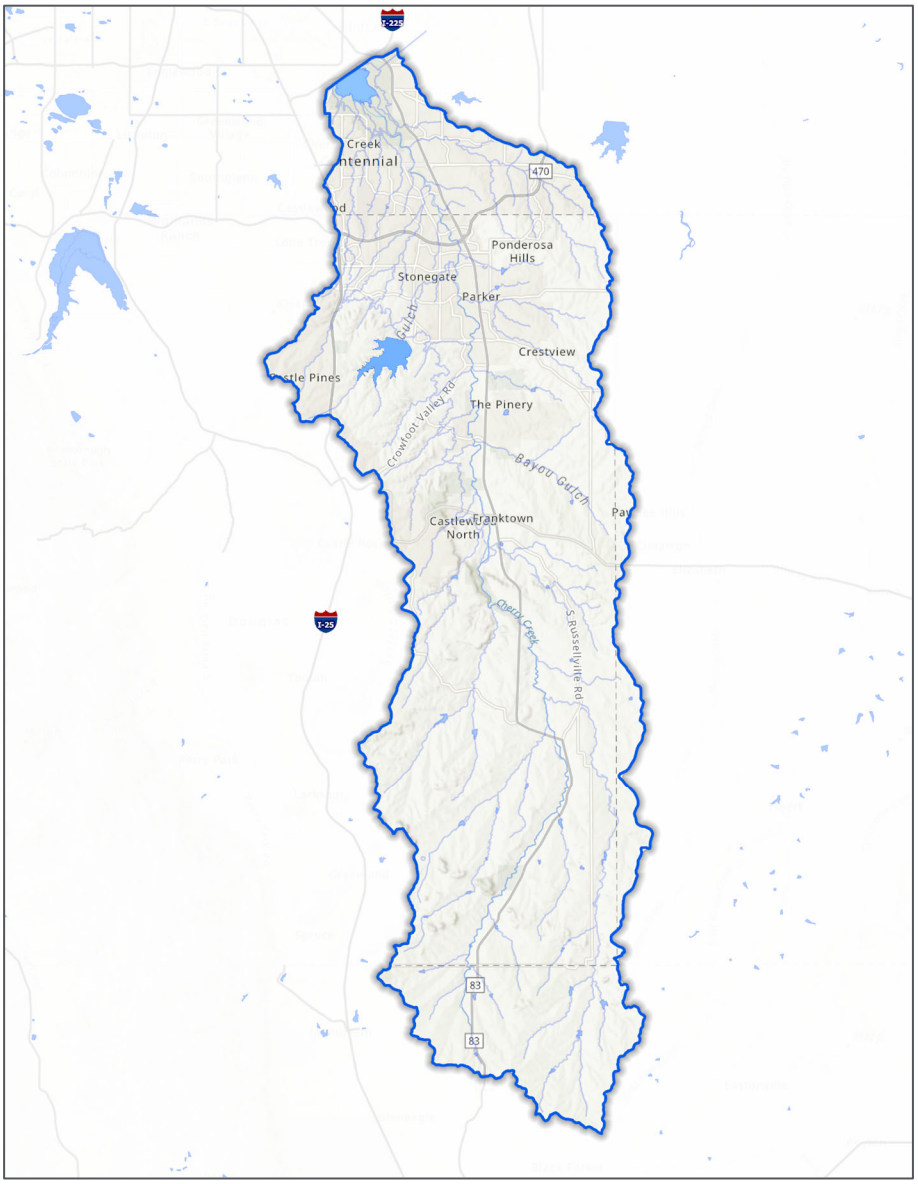

Figure 2. CCBWQA boundary

The Cherry Creek Basin Water Quality Authority (CCBWQA) was formed following the completion of a Clean Lakes Study in 1984, which led to the development of our first Master Plan in 1985. After the adoption of the Master Plan, the local governments in the Cherry Creek Basin formed an Authority by intergovernmental agreement and worked diligently to gain State approval of legislation to create the Cherry Creek Basin Water Quality Authority. That goal was accomplished during the 1988 General Assembly with Governor Roy Romer signing the Cherry Creek Basin Water Quality Authority Statute, House Bill 1029, on April 28, 1988 (C.R.S. 25-8.5-101 et seq.). The Statute was amended in 2002; this is the current version.

CCBWQA is tasked with improving, protecting, and preserving water quality in the Reservoir and Cherry Creek for beneficial uses. CCBWQA is directed by a 17-member Board of Directors (Board) who are supported by a Technical Advisory Committee (TAC), and other technical experts contracted by CCBWQA. The Board includes representatives of local governments in the watershed and Governor-appointed members.

1.1.1 Beneficial Uses

CCBWQA's Statute calls for the Authority to benefit the inhabitants and landowners within its boundaries by preserving water quality in Cherry Creek and Cherry Creek Reservoir, and to benefit the people of the State of Colorado by preserving waters for recreation, fisheries, water supplies, and other beneficial uses. Regulation 38 establishes water quality standards to protect designated beneficial uses including warm water aquatic life, recreation, agriculture, and water supply. CCBWQA continues to work diligently to protect beneficial uses as population growth and development increase and park visitation increases.

While some of the beneficial uses of the Reservoir are evident, some are less known. Each spring, Cherry Creek Reservoir is one of three Front Range waters that are used to provide fertilized walleye and saugeye eggs to the CPW hatchery system. Saugeyes are a hatchery hybrid cross between walleye and sauger. "This is an annual event for us, where we take more than 100 million walleye eggs and fertilize them, then grow walleye to a very small size and then replant those back into our waters in Colorado and make more fish," explained Kara Van Hoose, a CPW spokeswoman. "Walleye would do this one their own but they can't do it in numbers like this," she said. "I mean, this is our version of March Madness, from Day One to when we end, we will have fertilized over 119 million walleye eggs." The healthy walleye population is evidence that the beneficial uses of the fishery are being protected. In 2024, the Reservoir supplied almost 40 million eggs for rearing in the hatcheries to be used in the state stocking program. These eggs contributed to the over 66 million walleye and walleye hybrids stocked across the state in 2024. In addition, over 4.5 million juvenile fish were re-stocked in Cherry Creek Reservoir to maintain healthy populations.

1.1.2 CCBWQA Board

The governing body of CCBWQA is its Board. Our Statute requires that CCBWQA Board includes representatives from each member county and municipality, and one for the special districts within the watershed, as well as seven governor appointees.

2024 Board Members

- Joshua Rivero, Chair, (Town of Parker)
- Christopher Lewis, Vice Chair, (Governor's Appointee)
- John McCarty, Secretary, (Governor's Appointee)
- Bill Ruzzo, Assistant Secretary, (Governor's Appointee)
- Mike Sutherland (City of Centennial)
- Leslie Summey (Arapahoe County)
- Abe Laydon (Douglas County)
- Steve Sundberg (City of Aurora)
- Mike Anderson (City of Lone Tree)
- Tom Stahl (City of Greenwood Village)
- Max Brooks (Town of Castle Rock)
- Roger Hudson (City of Castle Pines)
- Luis Tovar (January-May) (Special Districts)
- Rebecca Tejada (May-December) (Special Districts)
- John Woodling (Governor's Appointee)
- Margaret Medellin (Governor's Appointee)
- Tom Downing (Governor's Appointee)
- Aditi Bhaskar (Governor's Appointee)

1.1.3 Technical Advisory Committee (TAC)

The role of the TAC is to consider and report to the Board on matters of a scientific or technical nature. CCBWQA's Bylaws allow each entity member (all municipalities, counties, and the wastewater district member) to appoint one representative to serve on the TAC. The Board has also appointed other individuals who represent CDOT, E-470 Authority, public health, educational or public interest groups having an interest in stormwater drainage and water quality in the Cherry Creek Basin, and any governmental or quasi-governmental agencies that are not members of CCBWQA, but have an interest in stormwater drainage or water quality in the Basin.

2024 TAC Members

- Lisa Knerr, Arapahoe County, TAC Chair

- Ashley Byerley, SEMSWA, Representation for the City of Centennial, TAC Vice Chair
- Jacob James, City of Lone Tree
- Ryan Adrian, Douglas County
- Jessica La Pierre, City of Aurora
- David Van Dellen, Town of Castle Rock
- Alex Mestdagh, Town of Parker
- Cayla Cappello, Greenwood Village
- Joseph Marencik, City of Castle Pines
- Rebecca Tejada, Board Appointee, Special Districts, Parker Water and Sanitation District (January-May)
- Ben Emerson, Board Appointee, Special Districts, Parker Water and Sanitation District (May-December)
- Casey Davenhill, Board Appointee, Cherry Creek Stewardship Partners
- Rick Gonçalves, Board Appointee, RG Engineers
- Diana Rashash, Board Appointee, Arapahoe County Public Health
- Caitlin Gappa, Board Appointee, Douglas County Health Department (January-May
- Jacob Deitz, Board Appointee, Douglas County Health Department (May-September)
- Shania McCain, Board Appointee, Douglas County Health Department (September-December)
- Michelle Seubert, Board Appointee, Cherry Creek State Park
- Jeremiah Unger, Board Appointee, CDOT
- Gene Seagle, Board Appointee, USACE
- Wanda DeVargas, Board Appointee, E-470
- Jim Watt, Board Appointee, Mile High Flood District
- Jon Erickson, Board Appointee, Colorado Parks & Wildlife

1.2 Our Regulation 72 Responsibilities

The Colorado Water Quality Control Commission (Commission) establishes water quality standards and designated beneficial uses for Cherry Creek Reservoir in Regulation 38, which includes a chlorophyll-a standard of 18 ug/L and other standards. The Commission also established the Cherry Creek Reservoir Control Regulation in "Regulation 72". A control regulation can contain limitations on pollutants that are discharged, management requirements, and/or precautionary measures to prevent or minimize pollutants entering the water. The Cherry Creek Reservoir Control Regulation 72 prescribes activities necessary to reduce the inflow of total phosphorus concentrations to Cherry Creek Reservoir to attain the chlorophyll-α standard.

Regulation 72 requires:

- Construction of nonpoint source projects, called Pollutant Reduction Facilities (PRFs)

- Inclusion of stringent phosphorus effluent limits in point source discharge permits
- Stormwater control measures (CMs, also known as best management practices) in stormwater permits and projects that add 500 square feet or more of impervious area
- Collaboration in pursuing incentives, grants, and cooperative programs for agricultural sources
- Implementation of a public information and education program
- Limitations on the construction of new Onsite Wastewater Treatment Systems (OWTS)
- Consideration of floodplain, riparian corridor, and wetlands projects
- Nutrient monitoring
- Submission of an Annual Report to the Commission on these activities

The activities under Regulation 72 are assigned to different entities.

CCBWQA: CCBWQA is to construct Pollutant Reduction Facilities, implement a public information and education program, and conduct water quality monitoring. CCBWQA may collaborate on floodplain, riparian corridor, conservation easements, and wetlands projects. CCBWQA must report annually to the Commission and Division on activities required under Regulation 72.

Colorado Water Quality Control Division: The Colorado Water Quality Control Division (Division) must include phosphorus effluent limits in discharge permits issued to wastewater facilities, industrial process wastewater facilities, drinking water treatment facilities, and reclaimed water Notices of Authorization. In addition, special Regulation 72 requirements must be included in all Municipal Separate Storm Sewer System (MS4) permits in the basin. The Division is also directed to collaborate with agricultural and silvicultural owners/operators in pursuing incentives, grants, and cooperative programs to study and control nonpoint sources, as well as collaborate with local governments to encourage connection of existing OWTS and new development to centralized wastewater facilities.

Arapahoe County Public Health and Douglas County Public Health: The Douglas and Arapahoe County Health Departments maintain regulations (DCHD OWTS Regulations, Proposed ACPH OWTS Regulations) regarding OWTSs within their respective county limits. Each department reviews designs for new systems and inspects the installation of and repairs to OWTS to ensure they meet the requirements of the state and county regulations. As part of the design review process, these departments also prohibit the construction of new OWTS within the 100-year floodplain of the Cherry Creek Basin per the requirements of Regulation 72.

Partners: Many partners work together to protect water quality in the Cherry Creek Watershed to support designated uses such as a thriving fishery and multiple recreational uses.

Figure 3. The CCBWQA and its partners continue to support beneficial uses of the Cherry Creek Watershed and Reservoir

1.3 Our Section 208 Responsibilities

Key Takeaways: CCBWQA is a Governor-designated Management Agency under Clean Water Act Section 208. As such, it has an important role in the management of water quality in the basin. The Authority's role currently includes review of site location approvals for wastewater treatment plants and lift stations, and providing recommendations to the State regarding approval, denial, or conditional approval of such applications.

Three levels of management agencies are recognized in the federal Clean Water Act. The Statewide Water Quality Management Plan (SWQMP) defines their different roles.

Planning agencies develop regional or statewide water quality management plans (commonly called "Section 208 Plans") that evaluate regional/statewide existing water quality conditions, identify pollutant sources, evaluate the cumulative impacts of multiple point and nonpoint sources in a regional area, and develop appropriate water quality controls, including recommendations for wastewater treatment plant effluent limits. The Division is the designated

208 planning agency for the Cherry Creek Basin. CCBWQA works cooperatively with the Division to support planning activities by monitoring and evaluating water quality, conducting modeling to better understand pollutant loading and pollutant reduction opportunities, and other activities.

Operating agencies carry out day-to-day wastewater treatment plant functions and ensure water quality requirements are met. These are typically wastewater treatment plants.

Management agencies carry out Section 208 Plans. In Colorado, general-purpose local governments and special districts are designated as management agencies; CCBWQA is considered a 208-management agency.

1.4 What Makes Us Unique?

The CCBWQA was formed by Statute and given powers and authorities unique to our basin, such as the ability to establish rates, tolls, fees, and charges for CCBWQA's facilities and programs. No other watershed in the state has a statute specifically designed to protect its reservoir. Although our reservoir is also subject to the Cherry Creek Reservoir Control Regulation 72 (as are many other Colorado reservoirs with similar control regulations), it is the additional powers in our Statute that sets us apart.

Additional Opportunities in Our Statute

- Additional opportunities in our Statute include the ability to:
- Incur debts, liabilities, and obligations
- Enter into contracts and agreements
- Acquire, lease, hold, dispose of and encumber real property
- Establish rates, tolls, fees, charges, penalties, Cherry Creek State Park fees, taxes on property, bonds
- Develop and implement plans for water quality controls for the Reservoir and watershed to achieve and maintain water quality standards
- Acquire, construct, lease, rent, improve, equip, relocate, maintain, and operate water quality control, nonpoint source, and drainage facilities
- Conduct studies concerning the development of water quality solutions
- Develop and implement programs to provide credits, incentives, and rewards for water quality projects
- Recommend erosion controls and urban runoff control standards
- Conduct educational programs
- Recommend septic system maintenance programs

1.5 Funding and Spending

1.5.1 How we Fund Our Activities

Our Statute provides several funding mechanisms that CCBWQA can use in a manner that is consistent with its statutory purpose to improve, protect, and preserve the water quality of Cherry Creek and Cherry Creek Reservoir.

CCBWQA levies property taxes (up to one-half mill) on all taxable property within CCBWQA's boundaries. Current development fees include $60 per single family residence and $0.04 per square foot of impervious area in commercial and multi-family developments; agricultural lands are exempt from the collection of these fees. Wastewater fees are $0.05 per 1,000 gallons of treated wastewater discharged in the Cherry Creek basin.

CCBWQA also receives user fees from CCSP visitors including $3 on annual passes (including the Keep Colorado Wild pass) and $1 on single-day passes.

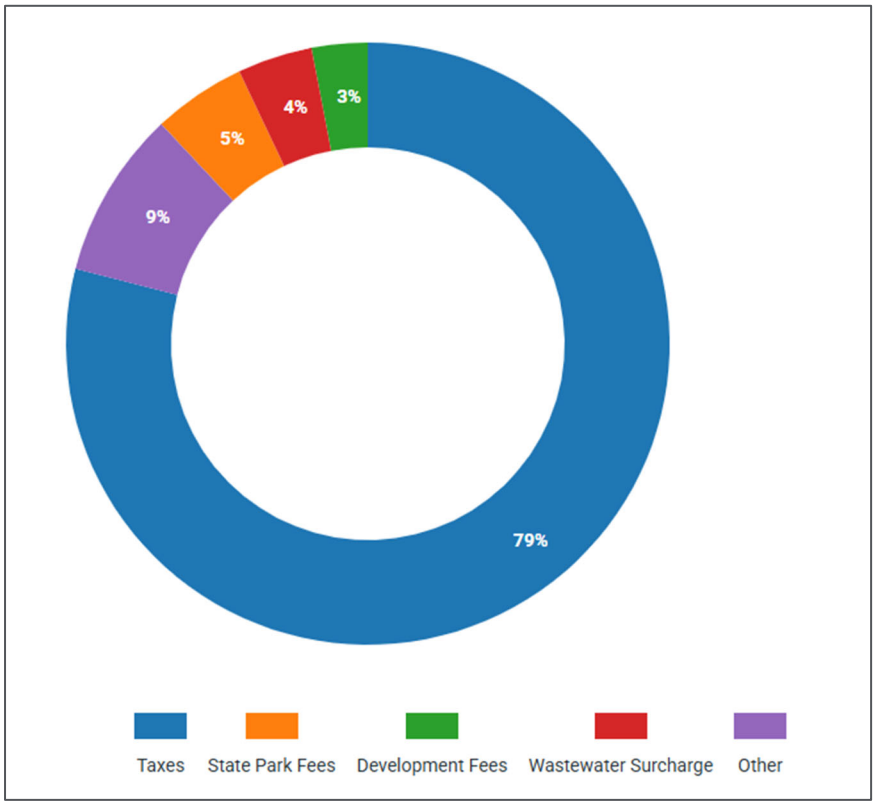

Figure 4. Projected CCBWQA 2025 Revenue

1.5.2 How We Spend Our Funds

The 2025 budget includes over $4.2 million in new revenues and CCBWQA is mandated to spend at least 60% of the annual revenues on Pollution Abatement Projects (PAPs). As expenditures and revenues are often not matched each calendar year (because implementation and timing of project costs can vary significantly from year to year) the CCBWQA Board tracks the 60% funding requirement as a multi-year mandate, as opposed to a single-year requirement. This interpretation allows CCBWQA to fund larger projects – a crucial element to CCBWQA's success. The Board has determined that "Pollution Abatement Projects" include:

- Any physical structure or facility that is planned, designed, and intended to directly reduce nutrients or other pollution in the Reservoir or the Cherry Creek Watershed (colloquially referred to as a Pollution Reduction Facility or PRF);
- The acquisition and/or interest in a property, including easements for the purpose of controlling or reducing nutrient loading or pollution in the Watershed; and
- The development of any new approach, analytical tool, educational approach, or other innovative methods for treating or controlling nutrient loading or pollution in the Watershed.

In 2024, CCBWQA spent over $2.6 million on Pollutant Abatement Projects. In addition to funding capital improvements, CCBWQA conducts operation and maintenance activities for certain PRFs in and near the State Park. Activities include inspections, identification of maintenance needs, and funding maintenance projects to make sure that PRFs continue to provide their intended functions. CPW partners on maintenance in the State Park. In 2024, CCBWQA entered into a multi-party inspection and maintenance agreement for the Peoria Wetland Pond adjacent to the park.

The 2025 budget plans on spending a minimum of 60% of current year revenues on PAPs. The Board's goal is to meet the 60% mandate over a five-year rolling average. As the summary of recommended PRFs shows, $13 million is planned on structures and facilities over the next ten years. The remaining 40% of revenue is allocated towards monitoring, modeling, special studies, planning documents, technical reports or memoranda, and administrative costs.

1.6 Public Education

1.6.1 Cherry Creek Stewardship Partners

CCBWQA is responsible for developing and implementing a public information and education program, which it fulfills by partially funding and utilizing the service of the Cherry Creek Stewardship Partners (Partners).

The Partners promote awareness of the value and function of the many pollution abatement projects that have been constructed in the Cherry Creek Basin with funding from the CCBWQA and their valuable partners: Mile High Flood District, Arapahoe and Douglas County Open Space Programs, the Cities and Towns of Aurora, Castle Rock, Centennial, Denver, Lone Tree, Parker, Parker Jordan Metropolitan District, Colorado State Parks and Great Outdoors Colorado. Activities include outings, sponsorship of the Denver Metro Regional Science and Engineering Fair, stormwater outreach, and the Annual Cherry Creek Watershed Conference.

2024 Outings

Each year the Partners lead excursions along Cherry Creek where interested local residents can see their tax dollars at work. The late January Hawk Walk on Cottonwood Creek is an annual event where Cherry Creek State Park staff, bird fans and 'friends of Cherry Creek' gather to walk the length of Cottonwood Creek for an opportunity to evaluate project benefits, learn about pollution reduction facilities and engage the community. A pond on Lone Tree Creek is a major attraction for waterfowl, especially during the colder months when many ponds are frozen. The pond is a popular spot for birds and birdwatchers. The CCBWQA technical team sought input from the community regarding management priorities on Lone Tree Creek.

Figure 5. Hawk Walk Outing, January 27, 2024

Annual Solstice and Equinox hikes at the Cherry Creek Valley Ecological Park add extra sets of eyes to observe and report on changing conditions in the watershed. Considerable beaver activity was noted at various locations. The Partners helped residents engage with land use agencies and build an understanding of 'tolerable adaptation,' which is a term that refers to land

managers' use of a common framework to assess beaver activity to determine when they can take a 'hands off' approach and when it is necessary to intervene and disrupt the beaver's busy routine.

Cherry Creek Watershed Conference

The 2024 Cherry Creek Watershed Conference was held in November 2024 at the Parker Events Center. The theme was Ways of Knowing - The Data-Information- Knowledge-Wisdom (DIKW) Pyramid. Speakers explored topics which included: results from the Reservoir monitoring program for Water Year 2024, planning for the future, designing for resilience and nature-based solutions, Cyanobacteria monitoring and response as well as presentations from members of the community specifically related to education and public outreach.

1.6.2 Phosphorus-Free Lawn Fertilizer Initiative

In 2022, the CCBWQA joined around 25 other entities in the Phosphorus-Free Lawn Fertilizer Initiative through Colorado WaterWise #LiveLikeYouLoveIt. The goal of the program is to keep phosphorus from getting into our lakes and streams by using phosphorus-free lawn fertilizers. (Additionally, several local governments are actively involved in reducing non-functional turf areas, thereby reducing overall fertilizer and water usage. In 2024, additional public outreach materials were developed to continue to help spread the word!

Figure 6. Public outreach materials for the Phosphorus-Free lawn fertilizer initiative

1.7 Planning

1.7.1 Planning Overview

CCBWQA conducts two general types of planning:

- Strategic planning related to its mission and goals and
- Specific project planning for PAPs.

1.7.2 Vision and Mission

The objective of the Federal Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. CCBWQA's vision is to implement this vision in the Cherry Creek Reservoir Basin. CCBWQA strives to:

- Improve, protect, and preserve water quality in Cherry Creek and Cherry Creek Reservoir for recreation, fisheries, water supplies, and other beneficial uses.
- Provide for effective efforts by counties, municipalities, special districts, and landowners within the basin in the protection of water quality.
- Promote public health, safety, and welfare.

1.7.3 Goals

- Use effective stewardship to implement sustainable Reservoir and watershed water quality management strategies.
- Implement an efficient and effective organization with the expertise to achieve results.
- Work with Member Entities and Stakeholders to enhance partnerships on water quality policies and projects.
- Continue to develop leading edge, innovative water quality solutions.
- Adapt as needed.

1.7.4 Objectives

- Better understand Reservoir and watershed dynamics and linkages.
- Identify the right "mix" of sustainable strategies that will preserve and enhance water quality for beneficial uses and/or prevent negative water quality impacts.
- Ensure that the CCBWQA Board maintains an adaptable organizational structure and expertise so it can efficiently identify, prioritize, and implement Authority initiatives, and respond to requests.

- Enhance partnerships with Member Entities and Stakeholders to leverage resources, resulting in improvement, protection, and/or preservation of water quality beneficial uses, and prevention of negative water quality impacts.
- Effectively and efficiently participate in Regulatory Activities that impact water quality.
- Continue as leader and laboratory.

1.7.5 Pollution Abatement Project Planning

CCBWQA plans for future PAPs. These planning efforts help to identify future projects, estimate water quality benefits, and inform prioritization for inclusion in the 10-year Capital Improvement Program.

Sulphur Gulch, Sara Gulch, Tallman Gulch & Tall Tributary Master Drainage Plan: In 2024, CCBWQA partnered with MHFD, Parker and Douglas County on scoping and consultant selection for an upcoming master drainage plan for several minor tributaries. CCBWQA intends to support and participate in the master planning effort which will start in 2025.

Cherry Creek Mainstem Assessment: Partners within the Cherry Creek basin including CCBWQA, SEMSWA, City of Aurora, Town of Parker, Douglas County, and MHFD (leading the effort) have been developing a Cherry Creek Mainstem Assessment that will incorporate and update the findings of the Cherry Creek Mainstem Assessment by Muller performed in 2020. The goal is to develop a shared GIS tool/map that is accessible to all partners and can be updated annually by each partner for the portion of the channel within their jurisdiction. The tool is expected to go “live” in 2025 showing maintenance or potential CIP project needs, such as: bank damage, beaver activity, debris/tree removal, sediment removal, trail damage, and vegetation management. The living map is intended to serve as an interim assessment until future full-length assessment is required.

1.7.6 Emerging Regulatory Issues

CCBWQA actively participated as a party in the WQCC 2023 Regulation 38 “Lakes Nutrients Criteria'' RMH in April of 2023. At this RMH, the WQCC adopted chlorophyll-a standards in all lakes and reservoirs 25-acres or larger in surface area. Cherry Creek Reservoir already had a chlorophyll-a standard at the time of this 2023 RMH and no changes were made to this standard at this RMH. The WQCC also adopted TP and total nitrogen standards for certain reservoirs in Colorado located upstream of qualified permitted wastewater dischargers, meaning no TP nor TN standards were adopted in Cherry Creek Reservoir at this RMH. It was stated by the WQCC that their intention was to revisit this topic at a RMH in 2027 for adoption of lake nutrient standards statewide. However, recent communication from the WQCD indicates that it is unlikely that a proposal will be brought to the WQCC until 2030 at the earliest. CCBWQA plans to propose site-specific phosphorus and nitrogen standards in Cherry Creek Reservoir at a future

Regulation 38 rulemaking hearing based on unique conditions in the Cherry Creek watershed. In 2023, CCBWQA shared its initial proposal for site-specific phosphorus and nitrogen standards with the WQCD, EPA, and CPW. Due to uncertainties related to how such standards would be implemented in discharge permits, CCBWQA is delaying its proposal at the WQCD's request to allow refinement of feasibility and implementation issues related to nutrients as part of CDPHE's "10-year Water Quality Roadmap."

2. Watershed History

2.1 History

Early History

The current Arapahoe County was the territory of the Arapaho and Cheyenne indigenous people by the early nineteenth century. They formed an alliance in the early 1800's and hunted bison and other wild game in the area. The dense cottonwood trees along Cherry Creek provided seasonal shelter and other food sources. Later, depleting water and grazing lands led to conflict and displacement of the indigenous inhabitants from the area.

Agriculture

Mid 1800s - Early 1900s

For centuries, Cherry Creek was used by Native Americans, trappers, traders, and adventurers. The watershed was also important agriculturally from the late 1800s through the 1930s, due to rich soil and flat land. There were numerous dairy farms, truck farms, orchards, and potato fields from Franktown to downtown Denver. Water was supplied from Castlewood Reservoir, built in 1890. Originally the plan was to provide water to irrigate about 30,000 acres of farmland downstream.

Flooding along Cherry Creek

1864

One of the first recorded large floods in the basin occurred in May 1864. The flash flooding originated in the upper end of the Cherry Creek and Plum Creek watersheds; an estimated 15 to 20 people lost their lives downstream in Auraria, near the confluence with the South Platte.

1933

On August 3, 1933, Castlewood Dam burst after several days of torrential rain. This released a wall of water into Cherry Creek, as high as 20 feet in spots, eventually reaching Denver. Remains of Castlewood dam can still be seen at Castlewood Canyon State Park.

Construction of Cherry Creek Dam and Reservoir

1950

Cherry Creek flooding was the impetus for building the Cherry Creek Dam and Reservoir. Cherry Creek Dam was completed in 1950 to protect downstream areas from catastrophic floods that had plagued the area for more than 100 years. During the 1965 Denver flood, all flow upstream from Cherry Creek was stored in Cherry Creek Reservoir, helping mitigate the flood.

Urbanization and Growth

2020+

Throughout much of the early to mid-1900s, the creek degraded and was lost as a community asset. This began to change when, in 1959, recreational demands on the Reservoir from the growing urban population led to the creation of the Cherry Creek State Recreation Area, Colorado's first state park. Today the park is one of Colorado's busiest, with an estimated 1.5 million visitors per year.

2.2 Population Growth

Population in the basin has grown significantly. The 2020 population in the basin is more than 6.5 times higher than it was in 1980 and over 20% higher than in 2015. Population increases generally impact water quality with increased runoff and point and nonpoint source pollutants. However, through strong partnerships with local, state, and federal stakeholders, CCBWQA has worked to moderate these impacts to the Reservoir.

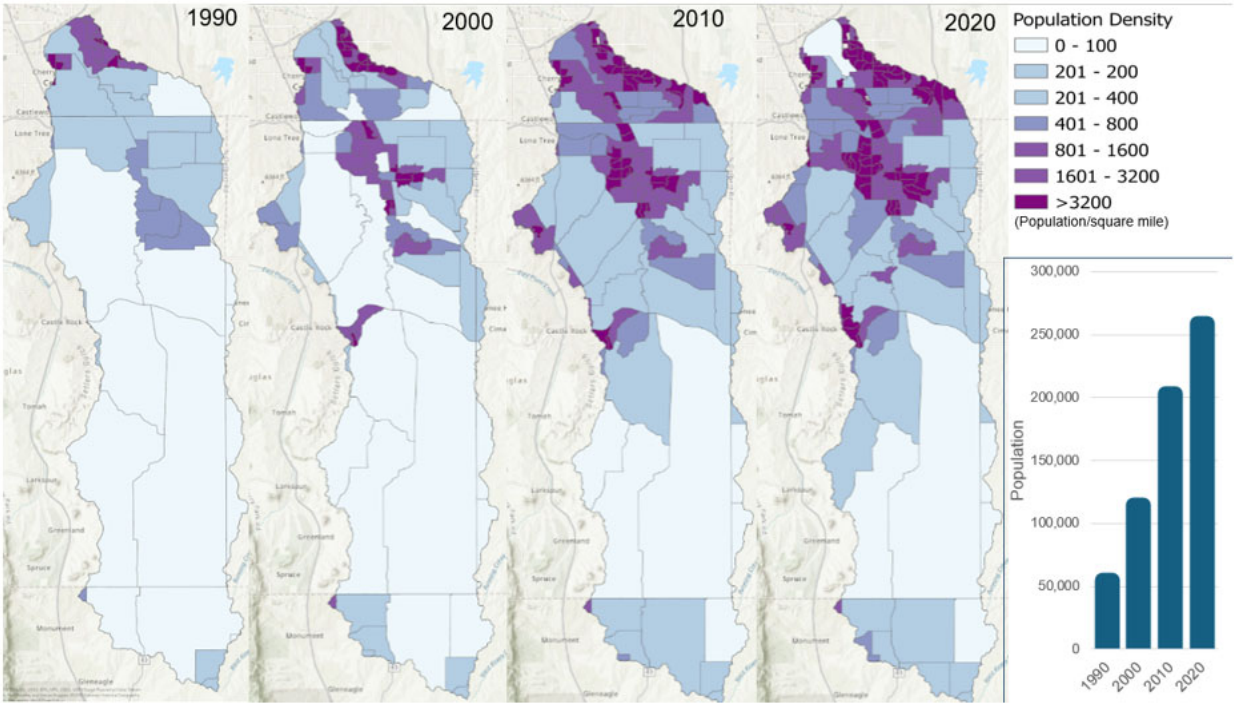

Figure 7. 1990-2020 Cherry Creek Basin population per square mile by census block

2.3 Land Use Referrals

One of the statutory powers given to CCBWQA is the ability to review water quality control projects of any other entity within the watershed. Authority review of land use agency referrals is conducted to support local governments' efforts to implement our special standards. For example, there are additional water quality requirements for areas specifically identified in Regulation 72 as Stream Preservation Areas. These areas include Cherry Creek Reservoir, all of CCSP, surface drainage and discharges to the Park within 100 feet of the Park boundary, lands overlying the Cherry Creek 100-year floodplain, and all lands within the 100-year floodplain of Cherry Creek tributaries. Other unique requirements include construction and post-construction stormwater control measures for developments and redevelopments with less than one acre of disturbance, whereas stormwater requirements are typically triggered at one acre of disturbance or more in other urbanized areas in Colorado.

Beginning in 2023, CCBWQA deferred most of the land use referral reviews to local governments but continues to provide technical support and review if requested by the local government. CCBWQA decided to make this change in 2023 due to the integration of clear, specific and measurable stormwater requirements related to Regulation 72 into applicable MS4 permits in the basin, along with local government experience in implementing these requirements.

In 2024, CCBWQA replied to 176 land use referral reviews with a standard acknowledgement deferring to the local government's review. A technical review was also provided as requested for several of those projects.

3. Point Source Controls

3.1 Permit Compliance

Control requirements for point source dischargers were effective in reducing phosphorus concentrations to the watershed and Reservoir. All of the WWTFs in the basin met their TP and total inorganic nitrogen (TIN) discharge limits in 2024.

Wastewater treatment facilities (WWTFs) in the basin are required to meet stringent TP discharge permit limits of 0.05 mg/L as a 30-day average. These control requirements effectively reduce phosphorus concentrations to the watershed and Reservoir. Point source discharges contribute less than 3% of TP loading to the Reservoir.

WWTFs in the basin provide TP removal through advanced wastewater treatment processes, followed by direct discharge or further treatment through land application. Some WWTFs are also required to remove TIN to meet permit limits. There are currently five permitted WWTFs in the basin that discharge to Cherry Creek waters. Another, Plum Creek Water Reclamation Authority, is located outside the watershed but applies some of its treated effluent as irrigation water within the watershed. All six of these facilities have TP effluent limits of 0.05 mg/L (some of the lowest in the state). Pinery, PWSD, and Stonegate have daily maximum (DM) TIN limits of 10 mg/L with associated compliance schedules that will require even stricter TIN limits be achieved by the end of 2026 (based upon the public-noticed permits for these three facilities that were issued in April 2022, final permits have not yet been issued by the WQCD for these three facilities). Additionally, the Plum Creek facility has a DM nitrate limitation of 10 mg/L, and PWSD has a 30-day average nitrite limitation of 0.05 mg/L, that will also become effective upon the completion of the compliance schedule in 2026.

Wastewater and industrial process wastewater sources, as well as reclaimed water treaters, are limited in the amounts of phosphorus they are allowed to discharge to the Cherry Creek Reservoir watershed. Limits contained in the point source discharge permits in the basin effectively reduce nutrient concentrations in the receiving streams. For example, TP discharge limits for WWTFs, which for most dischargers are less than 0.05 mg/L TP as a 30-day average, are significantly less than the flow-weighted TP concentrations currently entering the Reservoir

from aggregated sources (surface and groundwater inflows, precipitation). Drinking water treatment plant discharges are required to meet a phosphorus effluent limit of 0.2 mg/L.

3.2 Site Location Applications

As the Governor-designated Water Quality Management Agency for the Cherry Creek Reservoir watershed, CCBWQA reviews site applications for domestic wastewater treatment works, including WWTFs, lift stations, and interceptor sewers. CCBWQA reviews address protection of Cherry Creek Reservoir and the watershed with respect to phosphorus and nitrogen, general water quality, protection of downstream water quality to protect water supplies, and adequacy of proposed design processes and capacity to protect water quality. As required by Regulation 72, CCBWQA must report annually on approved site applications.

In 2024, four site location applications were submitted to the CCBWQA for review. After review by Rick Goncalves, CCBWQA Water/Wastewater Manager, CCBWQA determined all four projects met the CCBWQA specific criteria for lift stations as outlined in the Authority's Guidance Document, including differential flowmeters, redundant pumps, overflow storage, a clear maintenance plan and well-defined Emergency Response Plan, all of which will be protective of the water quality in the watershed and the reservoir.

Castle Pines North Lift Station No. 1 Site Location Application

- Status – CCBWQA Board recommended approval on May 16, 2024.
- Applicant – Castle Pines North Metropolitan District
- Owner – Castle Pines North Metropolitan District

Castle Pines North Metropolitan District (CPN) submitted a CDPHE Regulation 22 Lift Station Site Location Application Form Section 22.9 which requires approval or disapproval and signature of CCBWQA as the 208 Management Agency. The project proposed replacing the existing CPN Lift Station 1 with new 872 gpm increased capacity pumps. The increase is necessary because Lift Station 2 will be decommissioned, its flows being added to Lift Station 1. Additionally, the project proposed replacing a portion of existing, aged 10-inch force main, adding overflow storage, adding an emergency power generator and adding differential flow meters.

Cherry Creek Middle School No. 8 Site Location Application

- Status – CCBWQA Board recommended approval on June 20, 2024.
- Applicant – Prairie Point Community Authority Board
- Owner – Aurora Water

The Prairie Point Community Authority Board submitted a CDPHE Regulation 22 Lift Station Site Location Application Form Section 22.9 which requires approval or disapproval and signature of

CCBWQA as the 208 Management Agency. The project proposed replacing existing Cherry Creek Middle School No. 8 with a new lift station with 152 gpm increased capacity pumps to service the larger service area, reconstructing a portion of existing 8-inch force main to a 4-inch force main to increase scour velocities and reduce incidences of force main blockages, providing 10,866 gallons of emergency overflow storage, including a new underground concrete overflow vault-18% more than default minimum, adding an emergency power generator, and adding differential flow meters.

Stonegate Village Metropolitan District WWTF Site Location Application Amendment

- Status – CCBWQA Board recommended approval on August 15, 2024.
- Applicant – Stonegate Village Metropolitan District
- Owner – Stonegate Village Metropolitan District

The Stonegate Village Metropolitan District submitted a CDPHE Regulation 22 Site Location Application Form Section 22.10 – Amendment of Existing Treatment Plant Site Location Approval which requires approval of disapproval and signature of CCBWQA as the 208 Management Agency. The amendment proposed replacing existing, aged and worn-out membrane filters in the Membrane Biological Reactors (MBR) with new, more efficient membrane filters. No increase in hydraulic or organic capacity proposed.

Castle Pines North Lift Station No. 6 Site Location Application

- Status – CCBWQA Board recommended approval on October 17, 2024.
- Applicant – Castle Pines North Metropolitan District
- Owner – Castle Pines North Metropolitan District

The CPN submitted a CDPHE Regulation 22 Site Location Application Form Section 22.9 which requires approval or disapproval and signature of CCBWQA as the 208 Management Agency. The project proposed replacing existing CPN Lift Station No. 6 pumps with new 310 gpm capacity pumps and adding overflow storage.

4. Riparian Areas and Wetlands

4.1 Riparian Areas

Riparian areas in the urbanized sections of Cherry Creek’s mainstem and some of its tributaries have improved over the past several years because of collaborative efforts by CCBWQA, CCBWQA's member entities, Mile High Flood District, and others.

Stream reclamation projects that reconnect the stream channel and floodplain enable storm flows to spill out of the channel onto the riparian and floodplain area and increase

filtration/infiltration in the overflow banks. Revegetation along the corridor with wetland plants, grasses, shrubs, and trees provides an aesthetic buffer and promotes enhanced riparian habitat. All of this creates a healthier stream and reduces nutrients and sediments entering the Reservoir.

4.1.1 Stream Preservation Areas Defined in Regulation 72

- Cherry Creek Reservoir
- All of Cherry Creek State Park
- Discharges to the Park within 100 Feet of Boundary
- Lands Overlying the Cherry Creek 100-Year Floodplain
- All Lands withing the 100-Year Floodplain of its Tributaries

4.1.2 Benefits of a Healthy Riparian Vegetation Area

A healthy riparian vegetation area:

- Reduces stream bank erosion, which maintains stable stream channel geomorphology and reduces velocity of flow.
- Provides support of sediment deposition on floodplains during periods of overbank flow, which removes suspended sediment and attached phosphorus that can degrade water quality.
- Provides shade, which works to lower water temperatures (lower water temperatures support higher dissolved oxygen (DO) levels which are important to maintain fisheries); and
- Removes phosphorus, nitrogen, and sediment from surface runoff (through plant uptake and filtering and biogeochemical interactions between surface and ground water).

4.2 Wetland Harvesting Project

The pilot wetland harvesting project on Cottonwood Creek within CCSP continued in 2024 (4th year of the 6 proposed). The purpose of the project is to cut and dispose of wetland plants (primarily cattails) but leave the roots so the vegetation can regrow and regenerate the following year. The objective of the wetland harvesting project is to benefit water quality by reducing phosphorus and nitrogen from being carried downstream into Cherry Creek Reservoir after the plants decay.

2024 Wetland Harvesting: 3.3 Acres, 120,600 pounds of plant material removed, 127 pounds of phosphorus and 845 pounds of nitrogen.

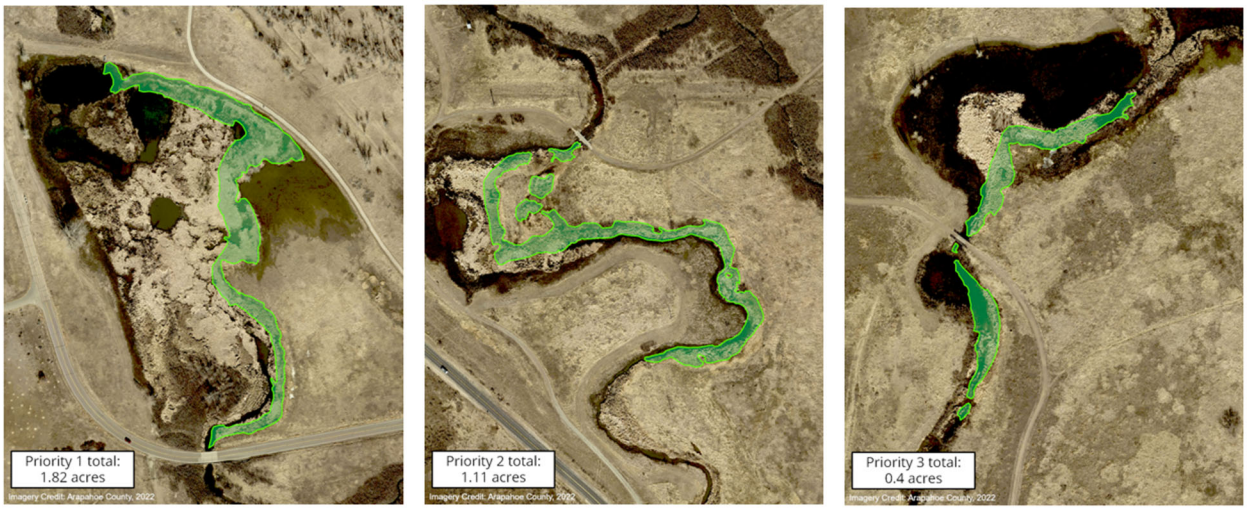

Figure 8. Wetland harvesting areas: east side of Perimeter Road (Priority 1), east side of channel south of Lakeview (Priority 2), and East of Peoria Rd. in CCSP (Priority 3)

5. Pollutant Reduction Facilities and Pollution Abatement Projects

5.1 PRF/PAP Activities

Pollutant Reduction Facilities (PRFs) and Pollution Abatement Projects (PAPs) are structural measures and pollution reducing activities (projects) that include but are not limited to, stream reclamation, detention/water quality pond and retrofits, wetlands, filtration, infiltration, and other technologies with the primary purpose of reducing pollutant concentrations entering the Reservoir and protecting the beneficial uses of the Reservoir. Like an MS4-required stormwater control measure, a PRF reduces pollutants in stormwater runoff; however, the term PRF is used because a PRF does not discriminate as to the source of the stormwater. PRFs remove pollutants from all upstream stormwater, whether regulated by an MS4 or not. In-channel PRFs effectively treat runoff from recent as well as past development.

5.1.1 Stormwater Controls

PRFs are stormwater controls constructed by CCBWQA. CCBWQA's PRFs include stream reclamation, shoreline stabilization, detention, wetlands, and other activities that provide water quality benefits for the Reservoir by reducing pollutants carried by stormwater from existing and future land disturbances. Similar projects constructed by local governments are also stormwater controls.

5.1.2 Funding of PRFs

The costs and benefits of all potential PRFs are evaluated at the conceptual level prior to design and construction. If costs and benefits appear to be reasonable, the PRF is added to the master list of Capital Improvement Projects (CIP) planned by CCBWQA. Each year CCBWQA updates its 10-year CIP plan to identify projects to fund in the coming years. Annually, the Board selects projects from the 10-year CIP for implementation, based on recommendations from the TAC and subject to available funds.

CCBWQA also works with Cherry Creek State Park to maintain PRFs in the park. As part of this effort, CCBWQA staff conduct an annual inspection of PRFs to identify routine maintenance requirements (e.g., mowing, weed control), as well as repairs and anticipated rehabilitation needs.

5.1.3 CIP Identification and Prioritization

Beginning in June of 2024 and with input from the CCBWQA TAC CIP Subcommittee future guidance has been developed for identification and prioritization of potential CIP projects and future CIP projects. It's the goal of the process that future CIP projects will be evaluated by the proponent with assistance from the CCBWQA and prioritized by the CCBWQA with the help of the TAC CIP Subcommittee. The basis of prioritization has focused on four (key categories which have been identified by members of the subcommittee and CCBWQA contractors.

- 1.0 Project Water Quality Benefit
  - 1.1 Overall Immobilization of Phosphorus (lbs/year)
  - 1.2 Cost/Water Quality Benefit ($/lb)*
  - 1.3 Proximity to Cherry Creek and Cherry Creek Reservoir
  - 1.4 Risk of No Action
- 2.0 Maintainability & Sustainability
  - 2.1 Sustainable Design Approach
  - 2.2 Assurance of Future Maintenance
- 3.0 Project Partner Support
  - 3.1 Partner Support Level
  - 3.2 Availability/Timeline of Partner Funding
- 4.0 Other Project Factors
  - 4.1 Project Co-Benefits

The prioritization categories were selected to align with CCBWQA’s mission to improve, protect and preserve water quality in Cherry Creek and Cherry Creek Reservoir.

Summary of the progress made in 2024 and the Looking ahead in 2025

The TAC CIP subcommittee met in June, August and December of 2024. A draft of the CIP Prioritization was presented in the December 2024 subcommittee meeting and comments were requested by January 17, 2025. Upon receipt of comments provided the CIP prioritization draft will be revised for the next meeting in Q1 of 2025 with the goal to have a process in place by 2026.

5.2 Pollution Abatement Project Highlights

In 2024, CCBWQA contributed over $2.32 million towards PAPs and PRFs in the watershed. In 2024 work was performed on three key PAPs.

5.2.1 Completed Construction Projects in 2024

Dove Creek Phase II - Chambers Road to Pond D-1

- Total Project Cost: $2,641,000
- Authority's Share: $540,000
- Project Partner: SEMSWA
- Engineer: RESPEC
- Contractor: Concrete Express, Inc. (CEI)

In 2021, the SEMSWA and CCBWQA began design of the stream reclamation improvements on Dove Creek from Otero Avenue to Pond D-1, which is located approximately 5 miles upstream of the reservoir; RESPEC was the selected consultant for the design. CEI was the selected contractor that was brought into the project development in 2021 as part of the project team. Based on project cost estimates, the project was split into two phases in 2022; Phase I included Dove Creek improvements from East Otero Avenue to South Chambers Road (constructed in 2023) and Phase II (This Project) included Dove Creek improvements from Chambers Road to Regional Pond D-1 at East Broncos Parkway.

Figure 9. Before photo of the Dove Creek Phase II – Chambers Road to Pond D-1 project

Figure 10. Completed project photos from the Dove Creek Phase II – Chambers Road to Pond D-1 (Photos Courtesy of SEMSWA)

The goals of the project stakeholders were to create a healthy stream corridor with floodplain connectivity to improve the vegetation (wetland, riparian and upland). The design approach utilized the High Function Low Maintenance Stream (HFLMS) concept, an industry standard that targets design to improve the functionality of the stream and allow for adaptation of the stream to the surrounding environment. The project included increased sinuosity of the channel with riffle-pool sequences throughout the reach and reconnection to the floodplain and improvement of wetland and riparian vegetation. The project also constructed two forebay structures; one at the outfall from the adjacent development and one just upstream of pond D-1 to allow sediment removal from the channel prior to entering the regional water quality facility. Another key component of the area was construction and improvement to existing maintenance access to the channel and new forebay structures to allow for more frequent maintenance and sediment removal.

Dove Valley Phase II began construction in February 2024 and was completed in May 2024 by CEI.

5.2.2 Projects Under Construction in 2024

Cherry Creek at Dransfeldt Project

- Total Project Cost: $8,049,031
- Authority's Share: $837,070
- Engineer: Muller Engineering Company
- Contractor: CEI

In 2021, the Mile High Flood District, Town of Parker and the Authority began the planning efforts to improve the reach of Cherry Creek near the proposed new Dransfeldt overpass, known as Cherry Creek at Dransfeldt or “Reach A”. Design was completed in 2024 and construction began in April 2024 and is expected to be completed in April 2025.

Figure 11. Before photo of the Cherry Creek at Dransfeldt project

Figure 12. Construction progress photos of the Cherry Creek at Dransfeldt project
(Courtesy of Mueller Engineering, November 2024)

5.2.3 Cherry Creek at Scott Avenue Project

- Total Estimated Project Cost: $5,477,011
- Authority's Share: $1,309,000

- Engineer: Muller Engineering Company
- Contractor: Naranjo Civil Constructors

In 2020, the Mile High Flood District, Douglas County and the Authority began the planning efforts to improve the reach of Cherry Creek upstream of Scott Avenue in Douglas County. Design was completed in 2023 and construction began in September 2024 and is expected to be completed in May 2025.

Figure 13. Before photo of the Cherry Creek at Scott Avenue project

Figure 14. Construction progress photos of the Cherry Creek at Scott Avenue project (Courtesy of Mueller Engineering, November, 2024)

5.3 PRF Monitoring

5.3.1 Highlights

The PRF ponds continue to function well as designed to reduce suspended solids and phosphorus.

During 2024:

- PRF effectiveness was evaluated for significant changes over time and geospatially using the PRF statistical analysis tool available on the data portal.
- The Cottonwood Creek "treatment train" and both PRF ponds have effectively reduced phosphorus (TP) and total suspended solids (TSS) in storm flow conditions as designed for the last 10 years or more.
- The Perimeter Pond also demonstrated lower median TP and TSS concentrations downstream during base flows in WY 2024.
- All monitored nutrients were reduced upstream to downstream of the stream reclamation projects that have been completed on McMurdo Gulch.

5.3.2 Summary

The Cherry Creek Basin has multiple PRFs in various locations through the watershed, most notably in Cottonwood Creek. Together, stream reclamation and wetland detention systems comprise a passive treatment train approach to reduce nutrients and sediments, especially during storm events.

These PRFs are monitored on an ongoing basis to assess water quality benefits upstream to downstream annually and overtime.

While the limited results from each water year are often not sufficient to complete a robust statistical analysis, annual calculations are included for reference. This analysis leverages the "PRF Statistics Tool" from the data portal to evaluate the statistical significance of changes above and below PRFs during WY 2024. During WY 2024, there were no significant trends observed up to downstream on Cottonwood Treatment Train as a whole. Since there were minimal storm samples collected, the same trends that can often be observed under storm flow, were not apparent in WY 2024.

Cottonwood Treatment Train as a whole (Peoria Pond, Phases 1 and 2 of stream reclamation completed on Cottonwood Creek downstream, and the Perimeter Pond), Peoria Pond and Perimeter Pond all showed statistically significant reductions of TP and TSS during stormflow conditions over the last 10 years. Additionally, the Perimeter Pond PRF demonstrated statistically

significant reductions in median TP, TN, and TSS concentrations in baseflow conditions during the last 10 years and WY 2024.

The McMurdo Gulch upstream to downstream concentration analysis demonstrated a statistically significant reduction of all nutrients in WY 2024 and all nutrients except for nitrogen, since monitoring began at those sites.

6. Regulated Stormwater MS4 Permittees

All municipalities with MS4s permits from the Colorado Department of Public Health and Environment (CDPHE) in the watershed have adopted stormwater programs consistent with Regulation 72 for development and redevelopment projects within their jurisdictions. Both construction-phase and permanent stormwater control measures are required. Regulation 72 requirements are more stringent than MS4 Permit requirements in Regulation 61 Colorado Discharge Permit System Regulations.

6.1.1 Permittee Activities

In 2024, the MS4 permittees conducted over 11,300 inspections of over 2080 construction sites. In addition, the MS4 permittees required that construction site owners/operators install 49 new permanent control measures that are designed to reduce or eliminate pollutants in stormwater before it enters Cherry Creek or its tributaries.

6.1.2 MS4 Public Education

In addition to regulating development and redevelopment sites in the Cherry Creek Reservoir basin, MS4 permittees also have programs to educate the public, respond to and eliminate illicit discharges, and reduce or eliminate pollutants in stormwater from municipal operations. Examples of these efforts include:

- **One thing is Clear:** (Douglas County, Town of Castle Rock, Town of Parker, City of Lone Tree, Highlands Ranch Metro District, Castle Pines Metro District, Castle Pines North Metro District, Stonegate and Lincoln Park Metro Districts)
- **Splash:** (Arapahoe County, City of Cherry Hills Village, City of Centennial, Cherry Creek State Parks, City of Sheridan, Greenwood Village)
- **Colorado Stormwater Council** (CSC)
- **Cherry Creek Stewardship Partners**

6.1.3 MS4s: Above & Beyond

Splash & Douglas County Clear Outreach and Education

The Douglas County Cooperative for Local Environmental Awareness and Responsibility-CLEAR brings together 14 regional stakeholders including Douglas County, Town of Castle Rock, Town of Parker, City of Castle Pines, and Lone Tree. CLEAR revamped 12 monthly public education ads which run full-page, and in color in Colorado Community Media Newspapers covering portions of Douglas, Arapahoe, and Elbert Counties. The ads run in the Castle Pines News-Press, Castle Rock News-Press, Douglas County News-Press, Highlands Ranch Herald, Lone Tree Voice, Elbert County News, Parker Chronicle, Centennial Citizen, Englewood Herald, Littleton Independent and South Platte Independent, and reached nearly 80,000 households in 2024.

CLEAR also launched a social media campaign on LinkedIn https://www.linkedin.com/company/dc-clear/ and Facebook which focuses on providing awareness around stormwater pollution prevention practices.

CLEAR partnered with the Douglas County Health Department in 2024 to create targeted outreach documents for restaurant and food truck operators. The outreach focuses on best practices for food service operators to prevent stormwater pollution.

Colorado Department of Transportation, CSC and Keep it Clean Spreading the Word on Bustang

CDOT, in partnership with CSC and Keep it Clean, posted water quality messages on Bustang buses. These messages focused on fertilizer, pesticide, and pet waste impacts to water quality including nutrients. The outreach campaign started on July 15, 2024 and ran through September 15, 2024. The posters went on all three Bustang routes including the south line which intersects with the Cherry Creek Basin.

7. Monitoring Program

In accordance with Regulation 72, CCBWQA has implemented a long-term water quality monitoring program in both the watershed and the Reservoir to characterize water quality of Reservoir inflows and the Reservoir to determine compliance with selected water quality standards, particularly those related to the chlorophyll-a standard.

- Surface water, groundwater, Reservoir, and precipitation are monitored at 26 locations.
- Over 2,700 lab analyses are completed annually.

- The monitoring data and lab results are used to evaluate the attainment of water quality goals, compliance with water quality standards, and to characterize water quality trends.

CCBWQA's monitoring program is conducted in accordance with Cherry Creek Reservoir Control Regulation No. 72 and the Cherry Creek Sampling and Analysis Program and Quality Assurance Procedures and Protocols.

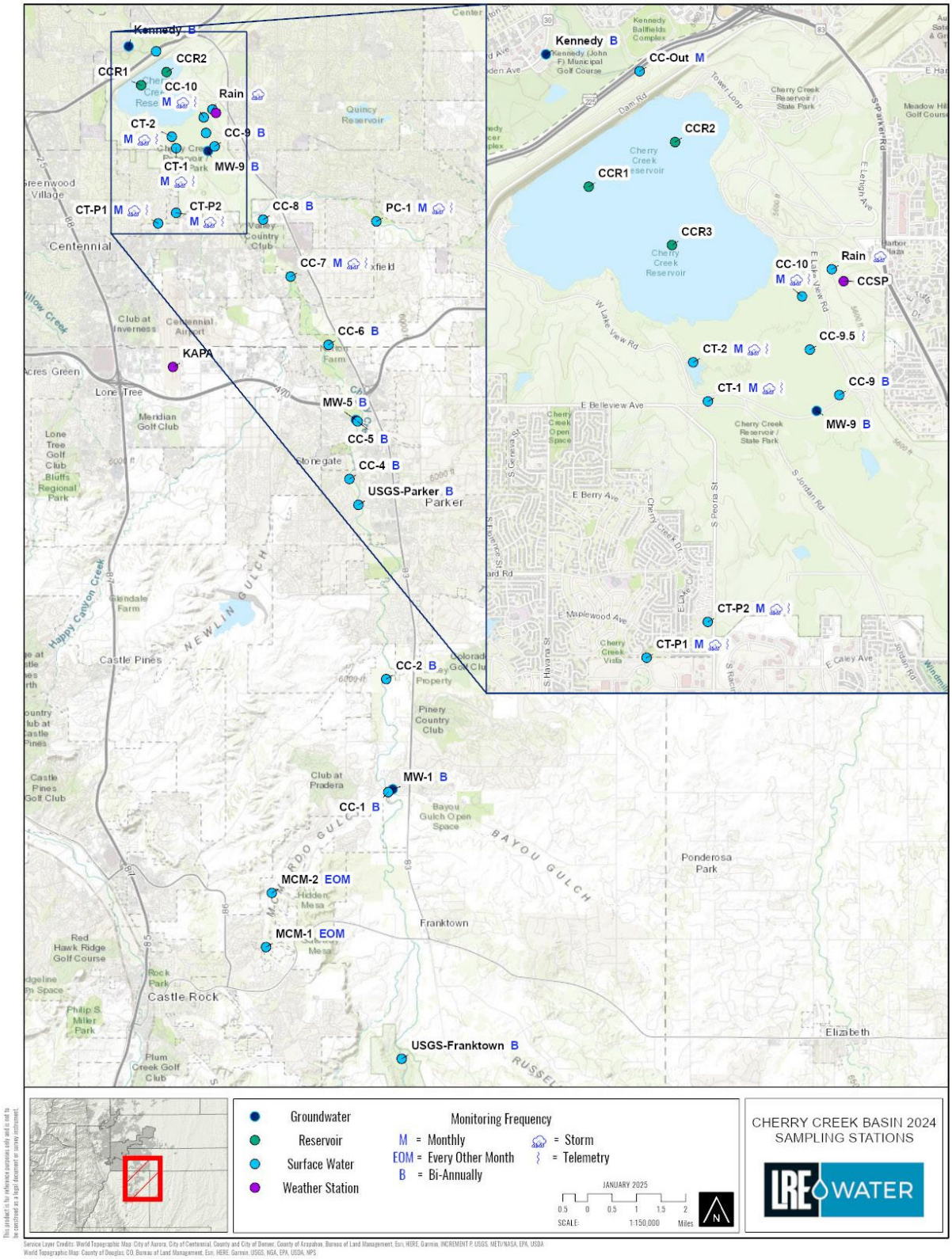

Figure 15. Cherry Creek Basin 2024 monitoring sites and details

8. Watershed Monitoring

8.1 Precipitation

8.1.1 Precipitation Highlights

- Precipitation patterns are a factor in the Reservoir's water quality due to impacts on inflows, water temperature, exchange rates, and overall Reservoir dynamics.
- The National Ocean and Atmospheric Administration (NOAA) at Centennial Airport Station (KAPA) weather station (NCDC) received close to average annual precipitation during WY 2024 (96%) with significantly lower than average precipitation in May through and July.
- The Cherry Ck MET Station/MHFD 10091 (CCSP) is used to measure precipitation on the Reservoir surface due to the closer proximity.
- The Cherry Creek watershed received an average of 139% of the 30-year PRISM average (1991-2020), while areas around the Reservoir generally received less precipitation than the rest of the watershed.

8.1.2 Precipitation Summary

The CCSP MET Station (MHFD 10091) went online in June 2022. This local weather better captures localized precipitation impacts and was used for the Reservoir water balance in WY 2024. Although March and April had above average precipitation; May, June, and July totals were all well below the monthly average . WY 2024 received 64% of the historical average (9.7 inches) at the CCSP station. The NOAA station received 92% of the historical average (13.4 inches).

Total WY 2024 precipitation at the KAPA station was over 3 inches higher than at the CCSP meteorological station. Total precipitation at the CCSP meteorological station was higher than the KAPA site in April but was lower in May, which helps demonstrate the spatial variability of storms in the watershed.

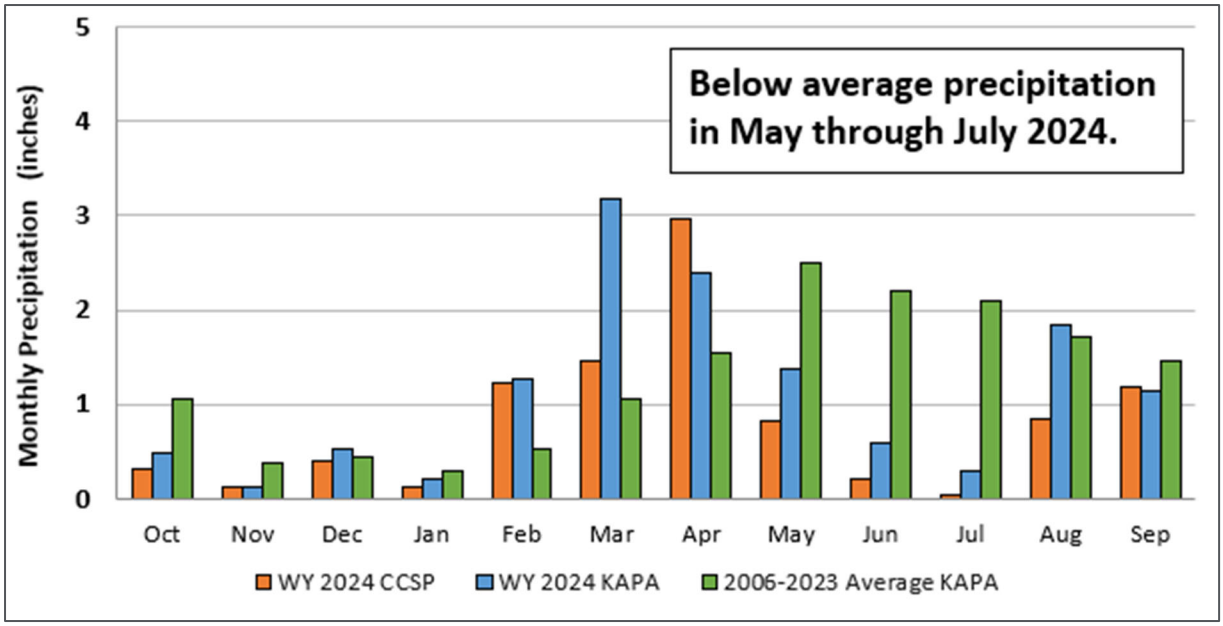

Figure 16. WY 2024 monthly precipitation at Centennial Airport (KAPA) and Cherry Creek State Park (CCSP) and historical average

Precipitation also varied across the watershed and ranged from approximately 88% to 163% of the 30-year (1991-2020) PRISM average precipitation data generated by NOAA/National Weather Service. The watershed received approximately 139% of the 30-year average, while areas just around Cherry Creek Reservoir generally received less precipitation than the rest of the watershed.

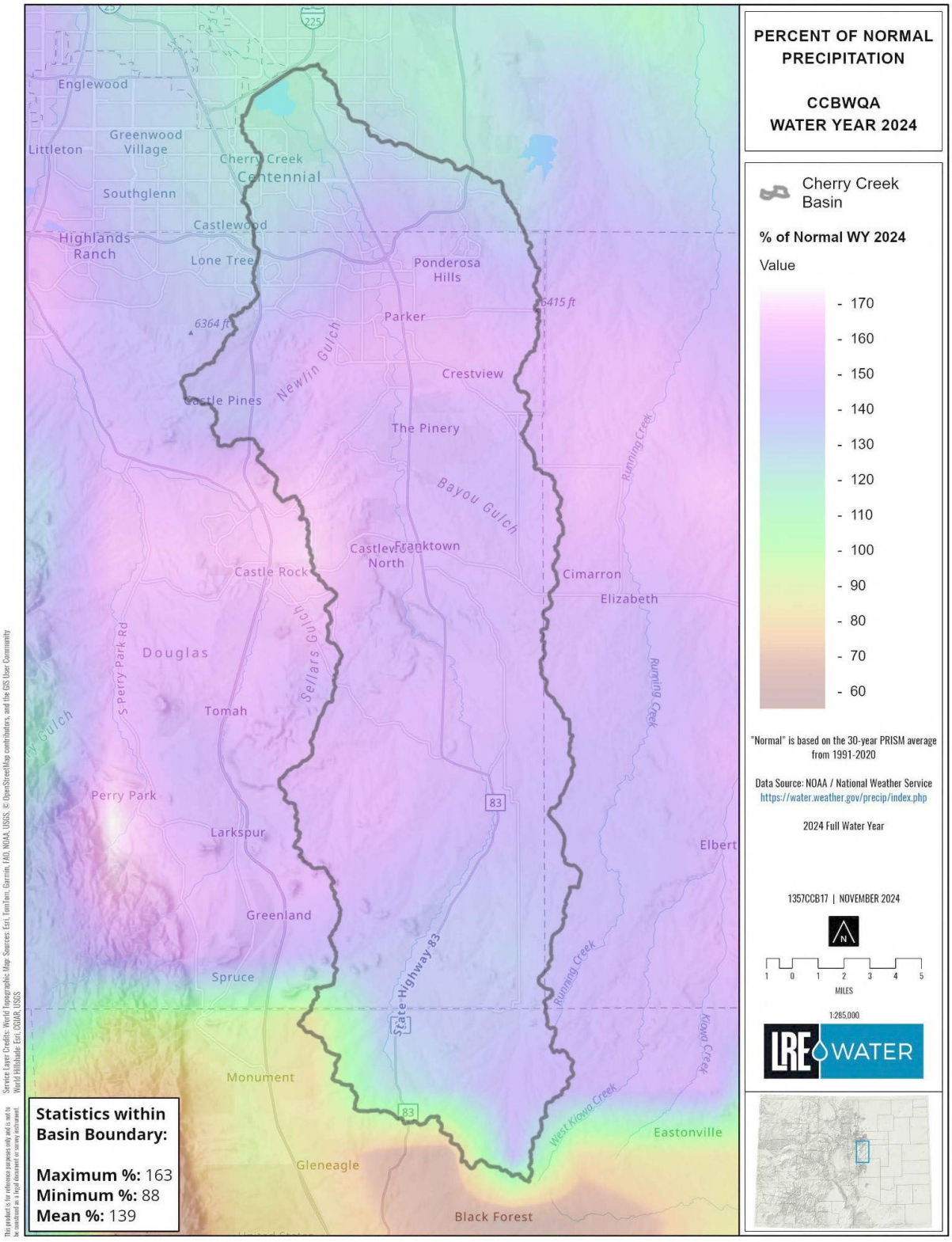

Figure 17. WY 2024 Percent of normal precipitation throughout the Cherry Creek Basin

8.2 USGS Stream Flows

In WY 2024, flows measured at the USGS gage near Franktown (located near the center of the watershed) were 62% of the 33-year (1992-2024) historical average and flows at the USGS gage near Parker (located in the lower third of the watershed) were 144% of the 33-year average which demonstrates the impacts of urban development and runoff on streamflow.

USGS Gage: Cherry Creek near Franktown WY 2024 Statistics

- Drainage Area: 169 square miles
- Total Annual Flow: 3,987 AF/Year
- Annual Daily Mean Flow Rate: 5.5 cfs (10.9 AF/day)
- Percent of 32-year (1992-2024) Average Discharge: 73%

USGS Gage: Cherry Creek near Parker WY 2024 Statistics

- Drainage Area: 287 square miles
- Total Annual Flow: 12,198 AF
- Annual Daily Mean Flow Rate: 16.8 cfs (33.3 AF/day)
- Percent of 32-year (1992-2024) Average Discharge: 146 %

8.3 Surface Water Inflow

8.3.1 Surface Water Inflow Highlights

The Cherry Creek sub-basin is the largest in the watershed (234,000 acres) and contributes the majority of streamflow into the Reservoir. Cottonwood Creek, the next largest source of inflows into the Reservoir, has a sub-basin of 9,050 acres, approximately 4% of the total watershed.

The equipment at Cherry Creek upstream of the Reservoir that has historically been used to measure inflows to the Reservoir was damaged in large storm events in WY 2023 and again in the early spring of 2024. A new site, CC-9.5, upstream near the section of Cherry Creek in the stabilized area where the Aurora waterline crosses was installed in the fall of 2024, which will be used in the future measurements.

CT-2, the site upstream of the Reservoir on Cottonwood Creek is used to measure the inflow contribution from Cottonwood Creek. Inflow and storage information and relative inflows were used in WY 2024 to inform the water balance.

8.3.2 Surface Water Inflow Summary

The damage from the storms in 2023 damaged the monitoring equipment at the site historically used to calculate inflow from Cherry Creek into Cherry Creek Reservoir. As an alternative and similar to WY 2023, the inflow values provided by the USACE, precipitation, and groundwater, were used to estimate surface water inflow based on the mean five-year relative contributions, 71% for Cherry Creek and 29% for Cottonwood Creek. This method appears to be representative based on the information available.

A new site, CC-9.5, upstream near the section of Cherry Creek in the stabilized where the Aurora waterline crosses was installed in 2024 to collect stream level on telemetry. Manual flow measurements were completed to develop the rating curve at this site so continuous flow can be calculated and used to represent Cherry Creek inflows in future years.

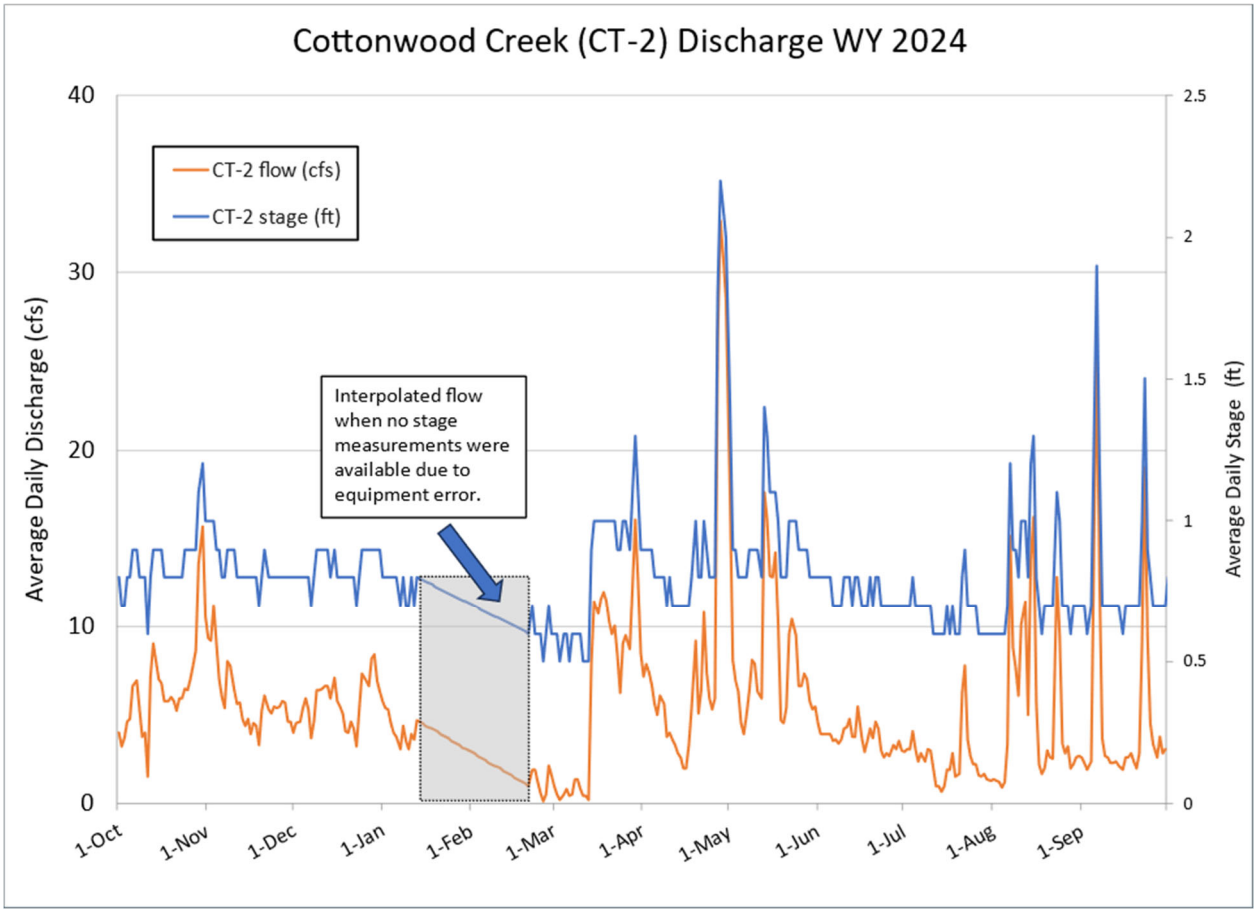

Figure 18. Cottonwood Creek discharge at CT-2 upstream of Cherry Creek Reservoir

8.3.3 Surface Water Inflow Concentrations

In WY 2024, TP concentrations in Cherry Creek were below the baseline median during base and storm flow conditions. Median TP concentrations in Cottonwood Creek were approximately 60% lower than concentrations in Cherry Creek.

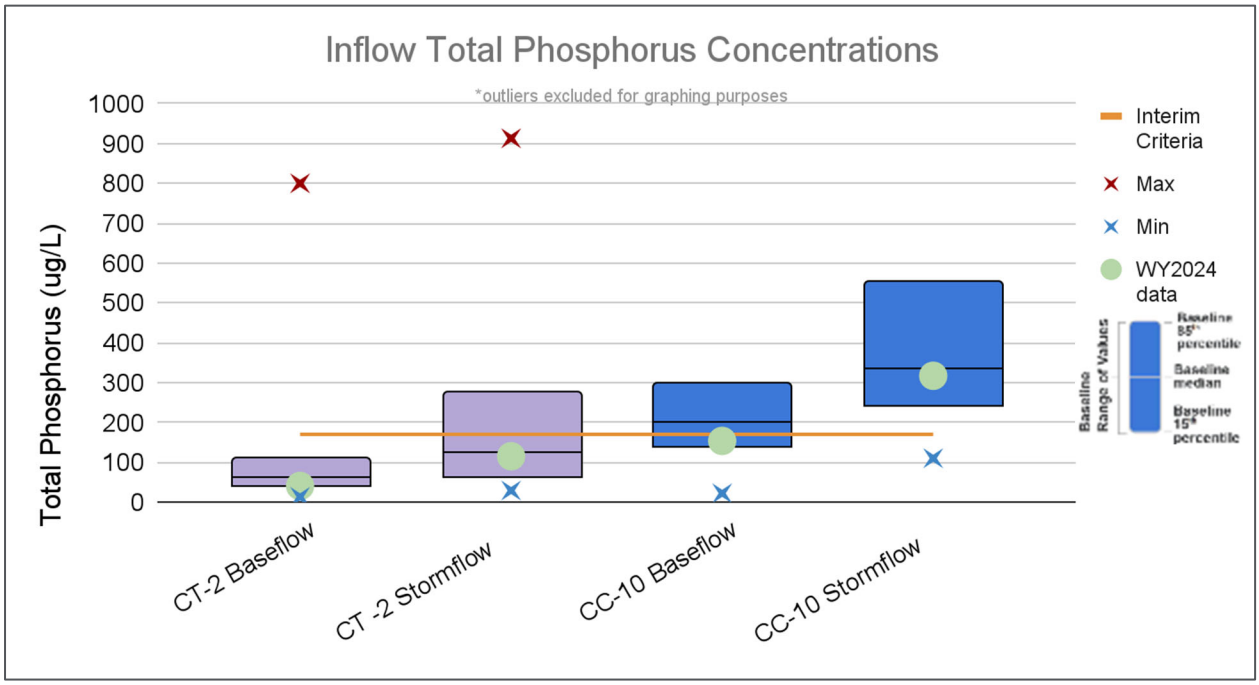

Figure 19. Inflow Total Phosphorus concentrations

In WY 2024, median TN concentrations in both Cherry Creek and Cottonwood Creek were slightly higher than the baseline median for base conditions and near the median for storm flow conditions. TN concentrations were approximately 50% lower in Cherry Creek than Cottonwood Creek in baseflow samples analyzed.

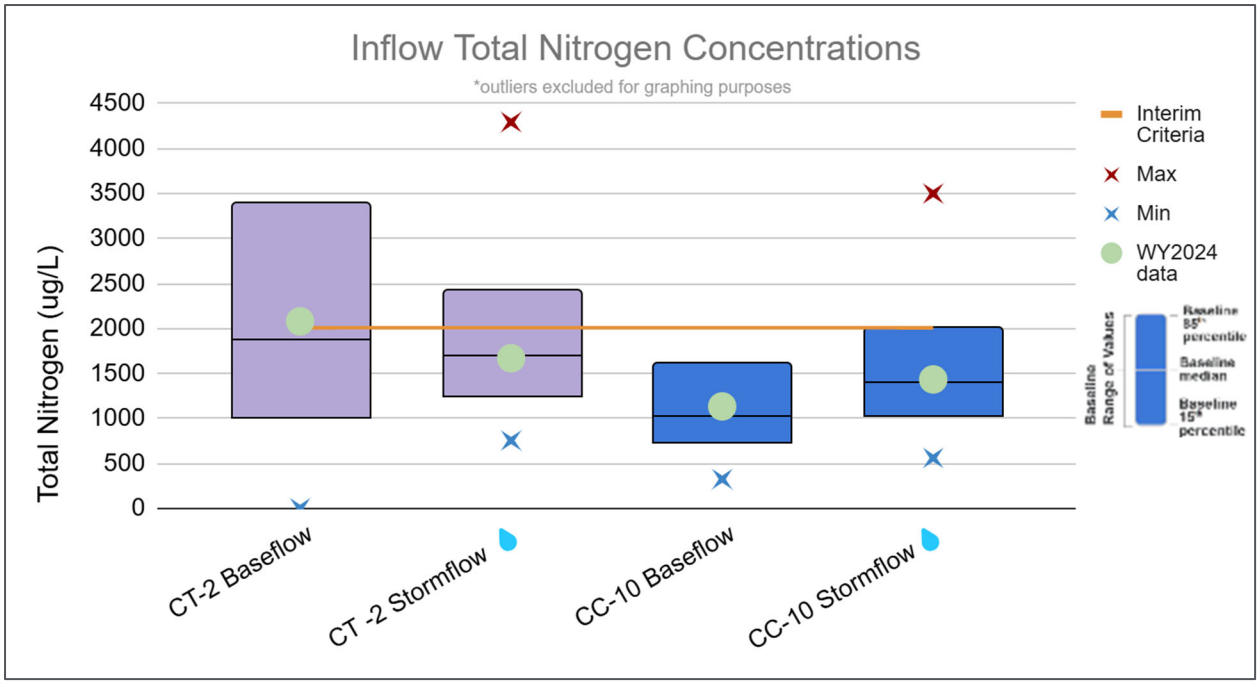

Figure 20. Inflow Total Nitrogen concentrations

Cherry Creek flows from south to north to the Reservoir through a 245,000-acre drainage basin. The basin includes various types of land use, including both undeveloped and urbanized areas, with the urbanized areas located closer to the Reservoir. Cottonwood Creek is the other major surface water input to Cherry Creek Reservoir. Overall, land in the smaller Cottonwood Creek watershed is more fully developed than the Cherry Creek watershed, which extends above the El Paso County line. Both creeks receive permitted discharges from wastewater treatment facilities.

8.4 Alluvial Water Quality

Alluvial (groundwater) contributes approximately 9% of the total annual yearly inflow to the Reservoir. Phosphorus concentrations in groundwater are similar to concentrations in Cherry Creek and higher than the average of all surface water inflows concentrations.

Alluvial water quality is important because groundwater travels more slowly than surface water to the Reservoir. CCBWQA samples groundwater to characterize the contribution and timing of past and current pollutant loads that originate underground.

Concentrations of total dissolved phosphorus (TDP) or soluble reactive phosphorus (SRP) are used for long-term evaluation of phosphorus because dissolved fractions are the main chemical forms found in groundwater and a longer period of record is available. In WY 2024, TDP concentrations were lower than the median, except for MW-9 just upstream of the Reservoir in November 2023 which was above the 85th percentile.

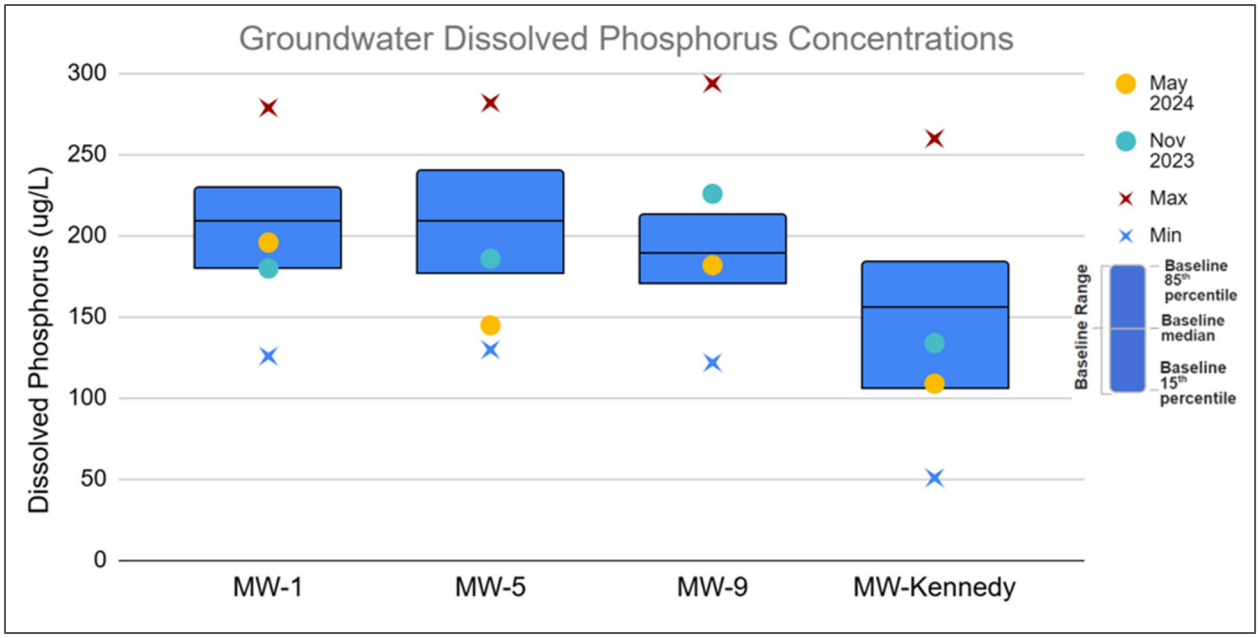

Figure 21. Groundwater Dissolved Phosphorus Concentrations

A Mann Kendall trend analysis identified a statistically significant increasing trend of the annual median dissolved phosphorus in the groundwater upstream of the Reservoir (MW-9).

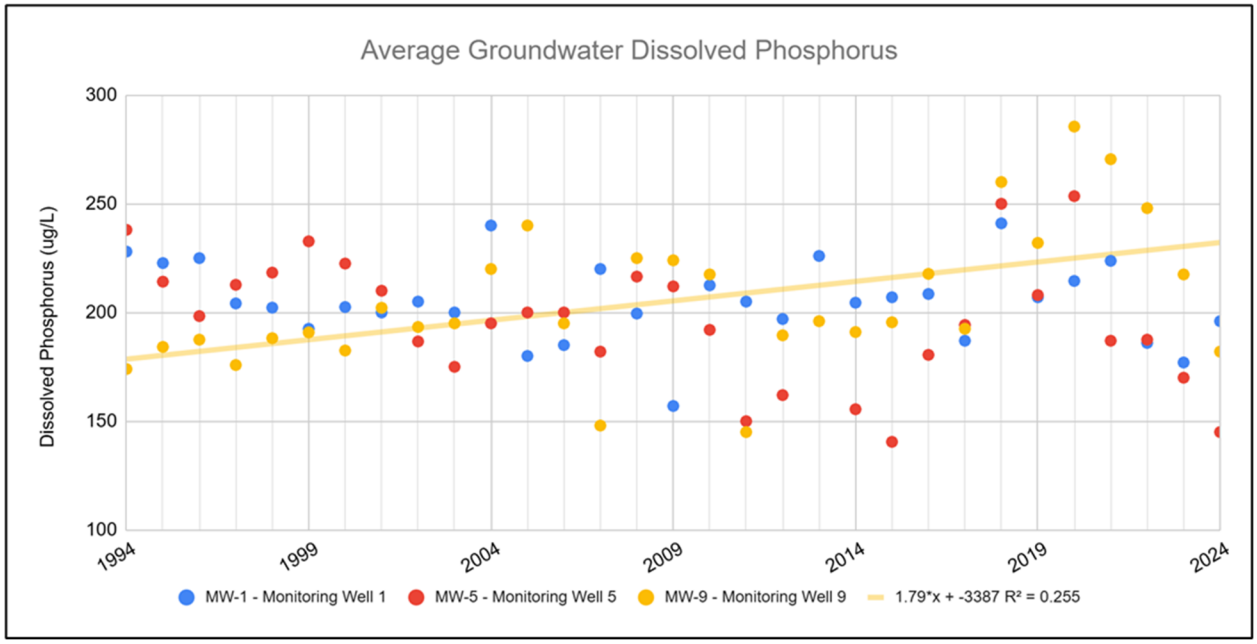

Figure 22. Average Groundwater Dissolved Phosphorus

In addition to natural sources, conductivity in groundwater can be impacted due to interactions with surface water. A Mann Kendall trend analysis identified a statistically significant increasing

trend of the annual median conductivity of all monitoring wells upstream of the Reservoir as well as MW-Kennedy below the Reservoir.

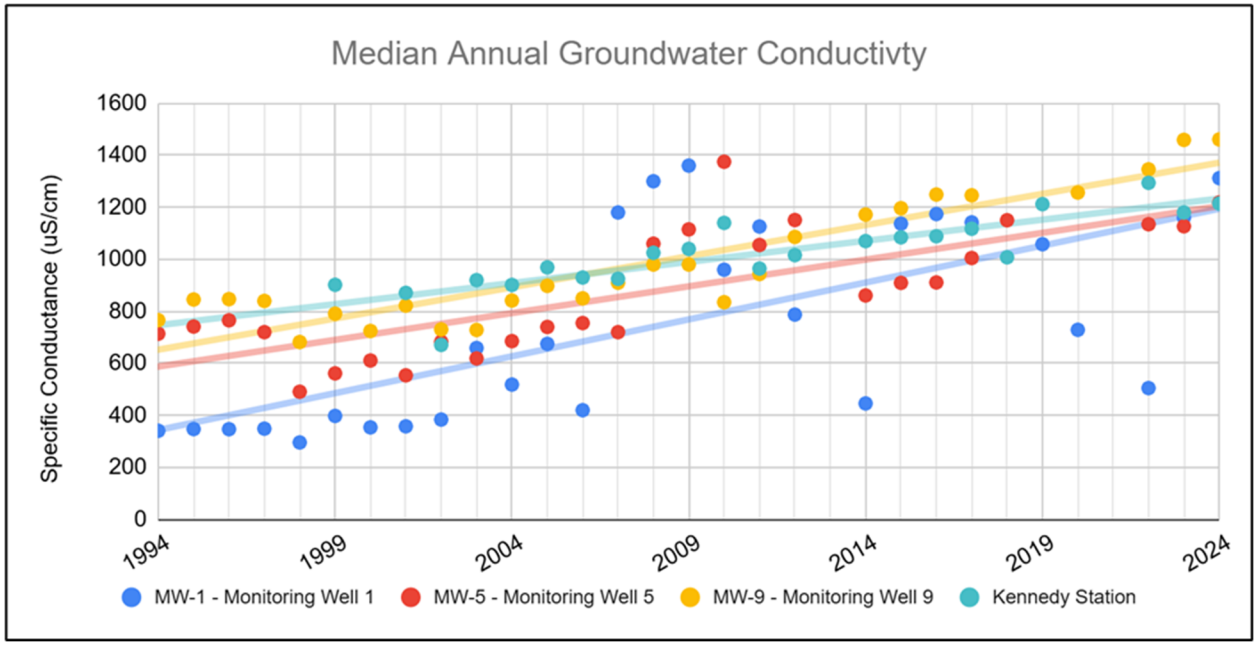

Figure 23. Median annual groundwater conductivity

9. Reservoir Modeling

9.1 Chlorophyll-α

The chlorophyll-α concentrations in the Reservoir met the seasonal standard for WY 2024 but is not meeting the requirement of attainment under Reg 38. The Reservoir chlorophyll-α seasonal (July through September) concentration was 16.4 ug/L, which is below the 18 ug/L standard. The seasonal mean concentration is measured from the upper three meters of the water column (photic zone), with an allowable exceedance frequency of once in five years. The Reservoir has exceeded the chlorophyll-α standard in four of the last five years, and seven of the last ten years.

CCBWQA samples for chlorophyll-α because it can tell us about the amount of algae in the Reservoir, and high levels of algae may impact the Reservoir's beneficial uses. Chlorophyll-α is also an enforceable water quality standard that the Division uses in its biennial assessment of water quality in the Reservoir.

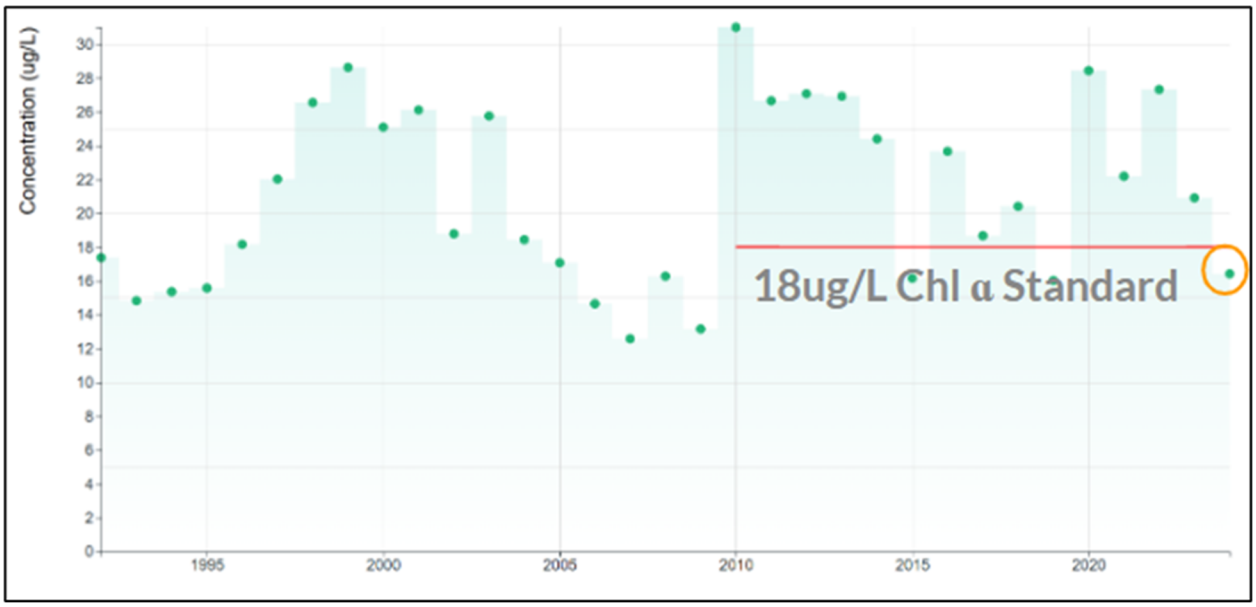

Figure 24. Seasonal Mean Chlorophyll *a* in Cherry Creek Reservoir WY 1991-2024.

9.2 Field Measurements

The Reservoir met the aquatic life standards for temperature, pH, and DO in WY 2024.

9.2.1 Temperature

The Reservoir met the temperature standards established for the Class I Warm Water Aquatic Life classification established by the Water Quality Control Commission (WQCC) in Regulation No. 31 (Reg 31) of 26.2 ˚C Maximum Weekly Average Temperature (MWAT) and 29.3 ˚C DM, as adopted in Regulation 38 for the Reservoir.

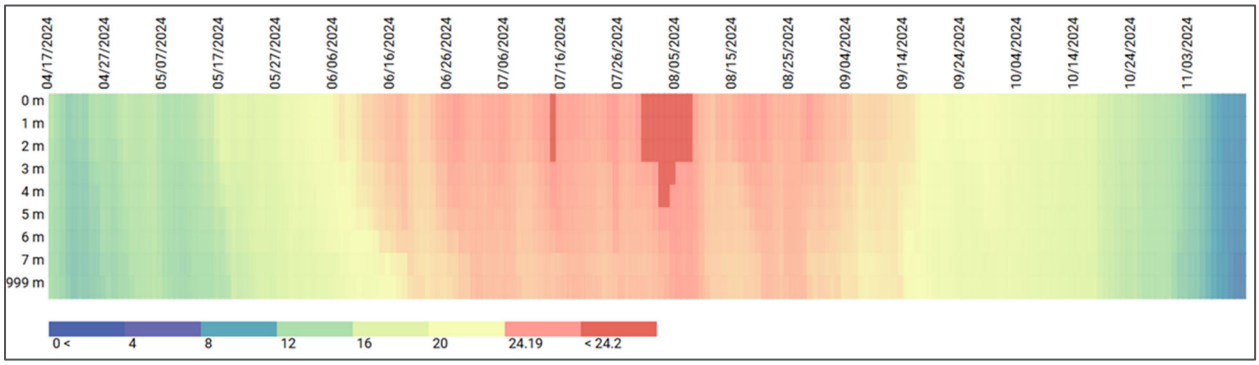

Figure 25. Daily Temperature Profile (˚C) on monitoring buoy, Cherry Creek Reservoir, WY 2024.

9.2.2 Dissolved Oxygen

Regulation 31 states that in the upper portion of a lake or Reservoir, DO shall not be less than 5.0 mg/L. There needs to be adequate refuge for aquatic life with DO levels greater than 5.0 mg/L available at other depths or locations in the Reservoir at the same time period. Although there were low DO concentrations at depth during the summer months of WY 2024, the DO standard was met since concentrations in the mid and upper portions of the water column were sufficient during the monitoring events. It is common that high microbial activity or decomposition in the hypolimnion and sediments reduces DO concentrations in the bottom of the Reservoir during the warmer months.

9.2.3 pH

During WY 2024, the pH met the minimum and maximum standards of 6.5 and 9.0, based on the annual 15th and 85th percentiles. Higher pH values are usually correlated with higher productivity and elevated chlorophyll-a in the Reservoir.

9.3 Nutrient Depth Profiles

9.3.1 Nutrient Depth Profiles Highlights

In WY 2024, the average seasonal (July- Sept) TP in the photic zone (top three meters of the Reservoir) was 113 ug/L, which is higher than the long-term median of 93 ug/L, but more than 15% lower than the average seasonal concentration in WY 2023.

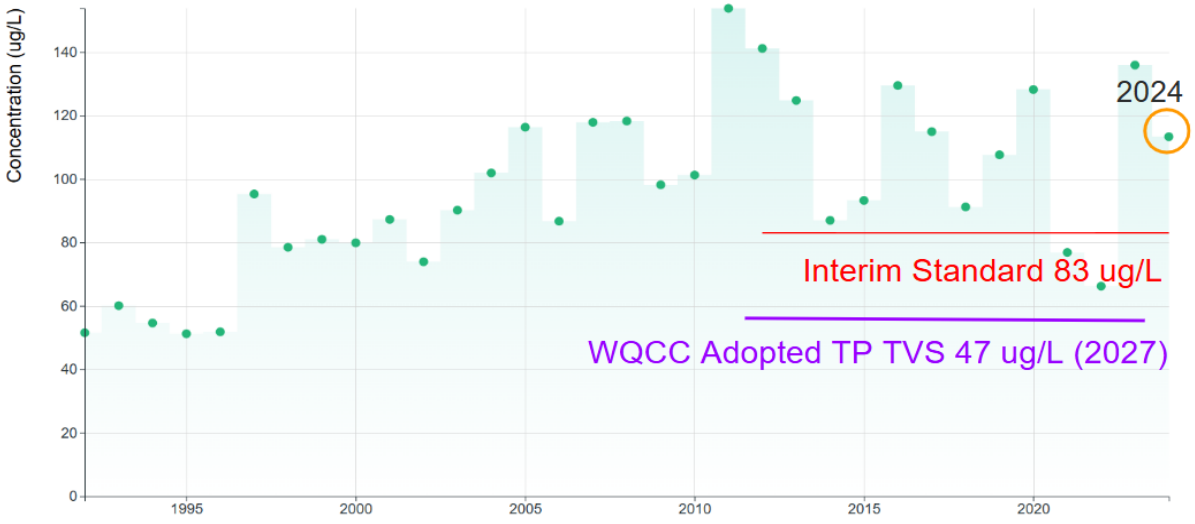

Figure 26. Seasonal Mean Concentration of Total Phosphorus Measured in Cherry Creek Reservoir

The average seasonal total nitrogen, 748 ug/L, was lower than the long-term median of 859 ug/L and below the 2012 interim criteria goal of 870 ug/L set in 2012.

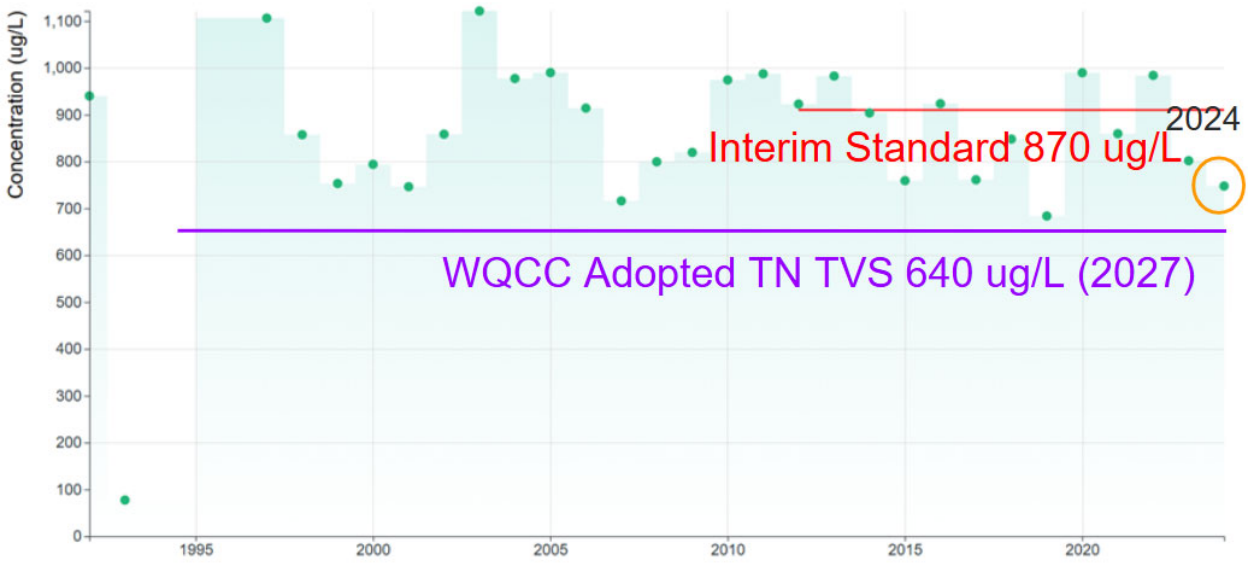

Figure 27. Seasonal Mean Concentration of Total Nitrogen Measured in Cherry Creek Reservoir

The bioavailable forms of nitrogen (nitrate, nitrite, and ammonia) were the limiting nutrients in the Reservoir for much of the year. Nitrogen-limited conditions give cyanobacteria a competitive advantage because they can fix nitrogen from the atmosphere. All forms of nitrogen were at or near limitation during the growing season in WY 2024.

9.3.2 Nutrient Depth Profiles Summary

TP concentrations generally increase with depth. As usual, TP concentrations were elevated in the hypolimnion (lower layer of water in a stratified lake) from early spring through summer. Phosphorus increases in the hypolimnion can be caused by internal loading or result from the decomposition of algal cells and other organic matter settling from higher levels in the water column. Inflows of cold runoff water, which have a higher density than warmer surface waters and sink to the bottom as they enter a lake, can also directly increase hypolimnetic nutrient concentrations, especially in reservoirs.

TP is made up of both particulate and dissolved phosphorus. Particulate phosphorus includes both inorganic material, such as soil particles and clay minerals, and organic phosphorus, which includes particulate forms such as algal cells and plant fragments. TDP includes dissolved organic and inorganic material. Dissolved inorganic phosphorus is usually reported as SRP, which represents the bioavailable form of phosphorus. Reactive or bioavailable forms of nutrients are readily available for uptake by algae or cyanobacteria and increases in these concentrations are likely to drive chlorophyll-α production.

Nitrogen and phosphorus are the nutrients that limit algal growth in natural waters. However, in nutrient-enriched lakes and reservoirs and during periods of nitrogen limitation, cyanobacteria populations have an advantage over other types of algae and can easily dominate populations and limit diversity. N:P ratios calculated during WY 2024 demonstrated that the bioavailable forms of nitrogen were frequently limited.

The epilimnion of a lake or reservoir is the mixed layer near the surface where the most phytoplankton algae reside because of its higher relative temperature and sunlight penetration for photosynthesis. The hypolimnion, or bottom layer, is cooler and denser and is where suspended materials settle to the bottom to decompose.

During bacterial decomposition, DO levels decline in the hypolimnion which lead to internal loading of phosphorus from the sediments. A recent study confirmed that the concentrations of phosphorus in the sediments of Cherry Creek Reservoir play a significant role in internal phosphorus loading. When the reservoir mixes, this phosphorus reaches the epilimnion where it can drive additional algae growth.

The RDS at Cherry Creek Reservoir, which pumps air to the bottom of the Reservoir through diffusers, helps to mix the water column and is most effective in the spring and fall when there is less thermal stratification.

9.4 Trophic State Index

In WY 2024, the Reservoir's trophic state was classified as eutrophic to hypereutrophic. Higher TSI values are associated with higher nutrients and more primary productivity (algal growth).

The Trophic State Index (TSI) is a measure of the biological productivity of a water body. The most common TSI uses three water quality parameters to determine the trophic state: TP, Secchi depth (a measure of water transparency), and chlorophyll α. There are four main levels of biological productivity: Oligotrophic (Low), Mesotrophic (Moderate), Eutrophic (High), and Hypereutrophic (Excessive). Higher TSI numbers are associated with increased probabilities of encountering nuisance conditions, such as algal scums. Based on the historical Carlson TSI, Cherry Creek Reservoir has been considered eutrophic for Secchi depth and chlorophyll α, and

ranges between eutrophic and hypereutrophic based on total phosphorus concentrations since 2002. Although year-to-year variability is present in the TSI, an increasing (declining water quality) trend is not present, despite significant increases in population and development within the watershed.

Table 1. Trophic State Classifications and WY 2024 Ranges (May- September)

Trophic State	Total P (mg/L)	Chlorophyll a (µg/L)	Secchi Depth (m)	Relative Productivity
Oligotrophic	< 0.005	< 2.0	> 8	Low
Mesotrophic	0.005 -0.030	2.0 - 6.0	4 – 8	Moderate
Eutrophic	0.030 - 0.100	6.0 - 40.0	2 – 4	High
Hypereutrophic	> 0.100	> 40.0	< 2	Excessive
Cherry Creek Reservoir	0.103	17.3	1.73	High

9.5 Phytoplankton

9.5.1 Phytoplankton Highlights

The phytoplankton populations (algae) in Cherry Creek Reservoir represent the "primary productivity" and are responsible for chl α production. Density and biovolume were low in the early spring and summer but there was a major diatom and cyanobacteria bloom in late July.

The elevated phytoplankton biovolume coincided with the detection of cyanotoxin which led to a temporary recreational closure.

9.5.2 Phytoplankton Summary

Phytoplankton are photosynthetic organisms that are the primary producers in aquatic systems. They form the base of aquatic food chains and are grazed upon by zooplankton and herbivorous fish. A healthy lake should support a diverse assemblage of phytoplankton, in which many algal groups are represented.

Phytoplankton and zooplankton continued to exhibit characteristics of an over-productive and nutrient-rich Reservoir, as indicated by WY 2024 planktonic communities. The most abundant phytoplankton taxa present in Cherry Creek are Cyanophyta, commonly referred to as "blue-green algae" (or cyanobacteria, depicted in red), which are of concern, but also many Chlorophyta ("green algae", depicted in green), and Bacillariophyta (diatoms, shown in blue) are present which are both considered to be good or beneficial algae.

Cyanophytes may be responsible for the majority of algal blooms that occur in freshwater ecosystems based on competitive advantage over other groups of phytoplankton. Although

cyanobacteria (blue-green algae) represented the highest populations during WY2024, they normally represent a small percentage of the total biovolume, except during bloom conditions. Although there was not a monitoring event that aligned with the exact timing, the Reservoir was closed to contact by CPW during the bloom in late July due to cyanotoxin detection above the recreational threshold.

Cyanobacteria represented a high percentage of the total algae on most all dates but only 64% which was less than recent years. Diatoms represented the highest biovolume on most dates reaching almost 95% of the total in July which is the highest biovolume observed since a severe cyanobacteria bloom in 2014.

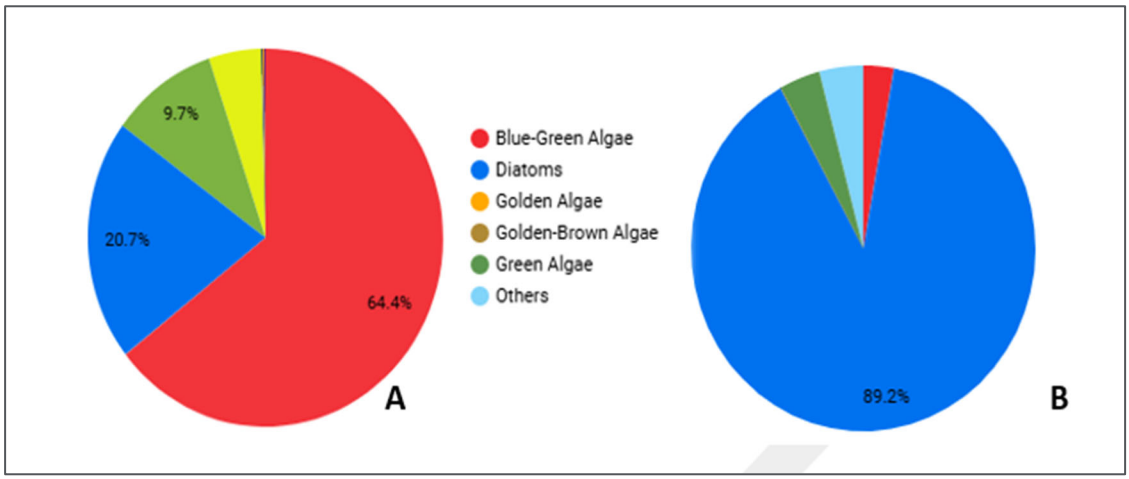

Figure 28. WY 2024 Cherry Creek Reservoir Relative Reservoir Phytoplankton Concentration (A) and Biovolume (B)

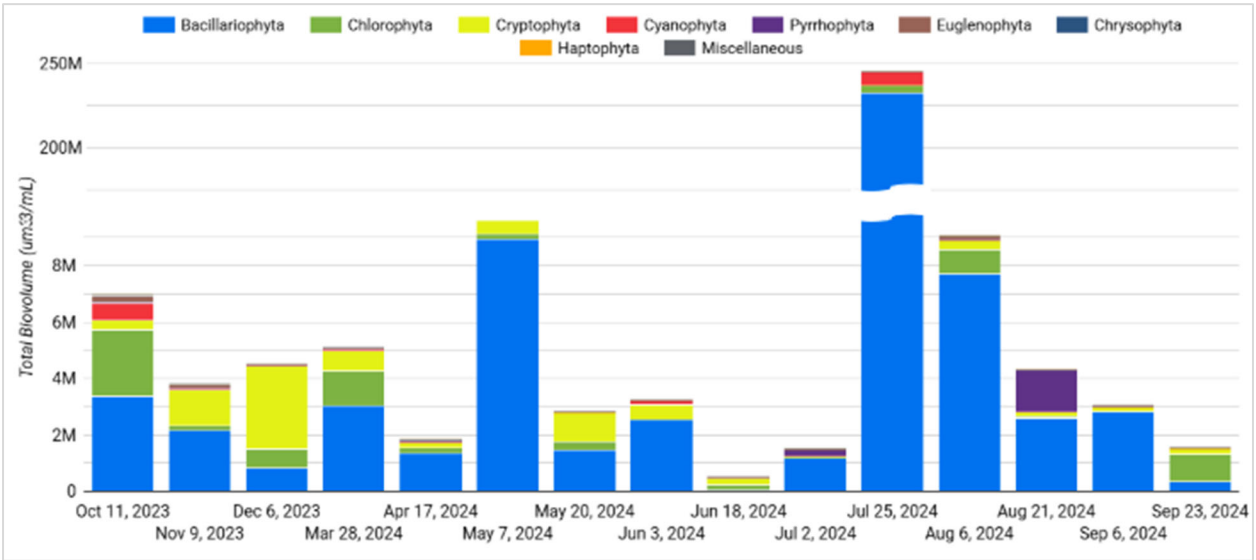

Figure 29. WY 2024 Cherry Creek Reservoir Phytoplankton Biovolume. (Late July - Major diatom and toxic cyanobacteria bloom)

9.6 Zooplankton

9.6.1 Zooplankton Highlights

High zooplankton numbers and biomass in mid June coincided with very low phytoplankton abundance and biovolume and conversely low zooplankton populations in late July coincided with peak phytoplankton populations, supporting that zooplankton grazing impacts phytoplankton abundance in Cherry Creek Reservoir.

9.6.2 Zooplankton Summary

Zooplankton are important in the biological balance of Cherry Creek Reservoir as they serve as the primary food source for small fish and many feed on algae. Zooplankton population dynamics and activity are also affected by water quality and the water clarity can impact ability to feed.

Larger zooplankton can exert significant grazing pressure on algal cells; however, they are also subject to predation as they are a food source for larger crustaceans, aquatic insects and fish.

Most freshwater zooplankton are part of only three phyla: amphipods, which include both cladocerans (shown in green) and copepods (shown in orange); rotifers (shown in yellow); and protozoa (shown in blue). Cladocerans and copepods are microscopic crustaceans that feed primarily on phytoplankton. These organisms can be an important food source for fish and can also exert grazing pressure on phytoplankton populations when present in high enough numbers. Rotifers are microscopic animals that feed on detritus and smaller organisms, such as bacteria. They can also serve as a food source for larger zooplankton. Protozoans are single-celled organisms that feed on other microorganisms, organic matter, and debris.

There was a major zooplankton bloom in early June that was primarily made up of daphnia which are large bodied cladocerans which are not frequently observed in Cherry Creek Reservoir but provide a great food source for small fish. During this unusual bloom, dense populations of daphnia could be observed with the naked eye in the marina and common carp were observed feeding on them.

Both the elevated zooplankton and corresponding low phytoplankton in June and the notable drop in zooplankton which coincided with peak phytoplankton in late July, suggests zooplankton grazing can reduced phytoplankton abundance in Cherry Creek Reservoir.

The invasive water flea, daphnia lumholtzi, a type of cladoceran, competes with native species and isis less palatable to fish due to its spines. and has been detected in samples 2011. These

species are less desirable than other large body daphnia which are an important food source for fish and has been observed since 2011.

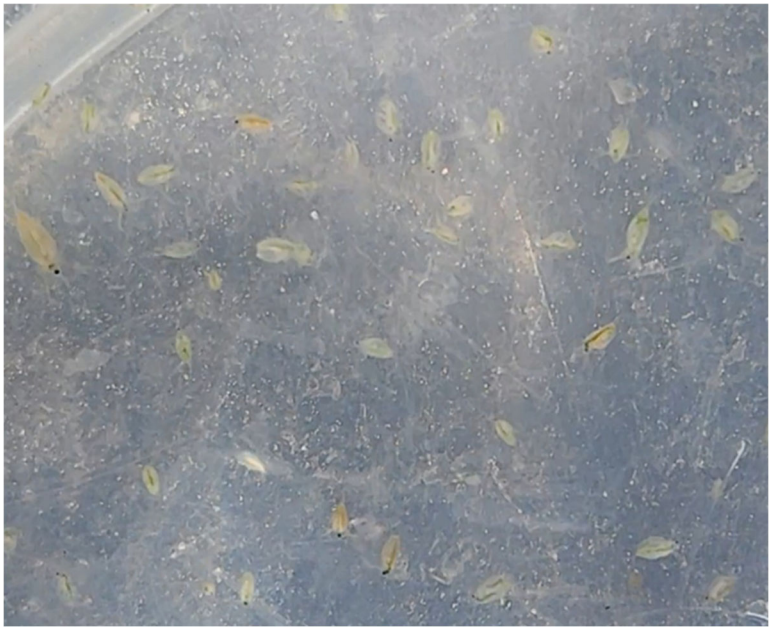

Figure 30. Zooplankton bloom observed in marina, June 18, 2024

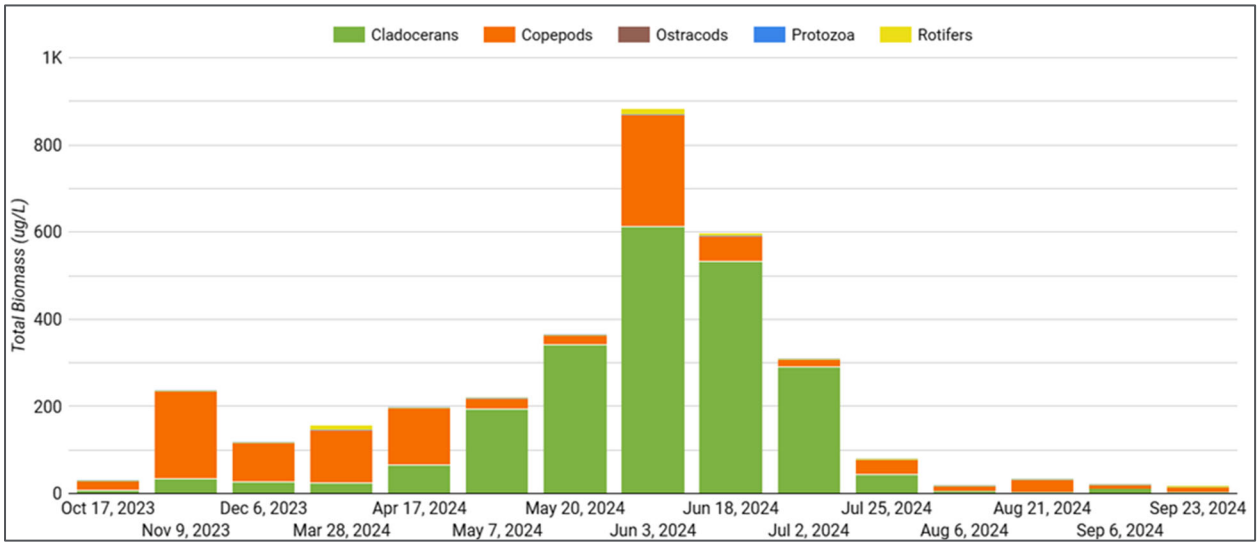

Figure 31. Total Zooplankton Biomass WY 2024 (elevated biomass in early June was when the bloom was observed in the marina - picture above)

10. Special Studies

In 2024, CCBWQA completed and embarked on several special studies to better understand conditions in the watershed and opportunities to reduce pollutant loading to the Reservoir.

Special studies included:

- **Watershed Plan Update:** In 2024 CCBWQA continued working on an update of its 2012 Watershed Plan. This effort integrated findings from the HSPF watershed modeling scenarios linked to the Reservoir model, and will be completed in 2025. CCBWQA held two workshops with the CCBWQA Board and TAC members in 2024 to integrate feedback for the plan.
- **Wetlands Harvesting Pilot Project:** In 2024, CCBWQA completed year four of a six-year project to cut and dispose of wetland vegetation to reduce phosphorus and nitrogen from being carried to Cherry Creek Reservoir after the plants decay.
- **BMP Effectiveness Study:** In 2022, Regulation 72 stormwater requirements were "modernized" to be consistent with the current state of the practice for reducing pollutant loads from stormwater. As a companion effort, CCBWQA began a study to synthesize the most current information on the expected effectiveness of stormwater BMPs (also known as stormwater control measures). Wright Water Engineers submitted a draft report to the TAC MS4 Subcommittee in December 2024; the report will be finalized in the spring of 2025 after input from CCBWQA.
- **Receiving Pervious Area Study:** CCBWQA partnered with SEMSWA and the Mile High Flood District to develop a more quantitative understanding of volume reduction benefits of receiving pervious areas such as grass buffers, grass swales and other landscape areas. By reducing runoff volumes through use of receiving pervious areas, pollutant loads can be reduced, as well as channel erosion. Use of receiving pervious areas is a key principle of low-impact development and green infrastructure approaches to development. Wright Water Engineers completed a final report summarizing the results of this study in 2024.
- **USACE Water Level Management Pilot Study:** CCBWQA provided a letter of support to the USACE related to a pilot project beginning in 2024 that the USACE is undertaking to strategically manage water levels in the Reservoir to improve water quality during the summer months. CCBWQA will also provide data sharing to support this effort.

11. CCR Nutrient Balance

In WY 2024, phosphorus and nitrogen in the Reservoir increased by approximately 3,200 and 57,000 pounds, respectively, similar to previous Water Years and significantly less than the high precipitation WY 2023.

11.1 Nutrient Loading

The differences in flow and nutrient concentrations between Cherry Creek and Cottonwood Creek are apparent when evaluating the relative nutrient loading from each source. Cherry Creek contributed 77% of the phosphorus and 53% of the nitrogen loading to the Reservoir in WY 2024. In comparison, Cottonwood Creek was responsible for 8% of the phosphorus but 37% of the nitrogen.

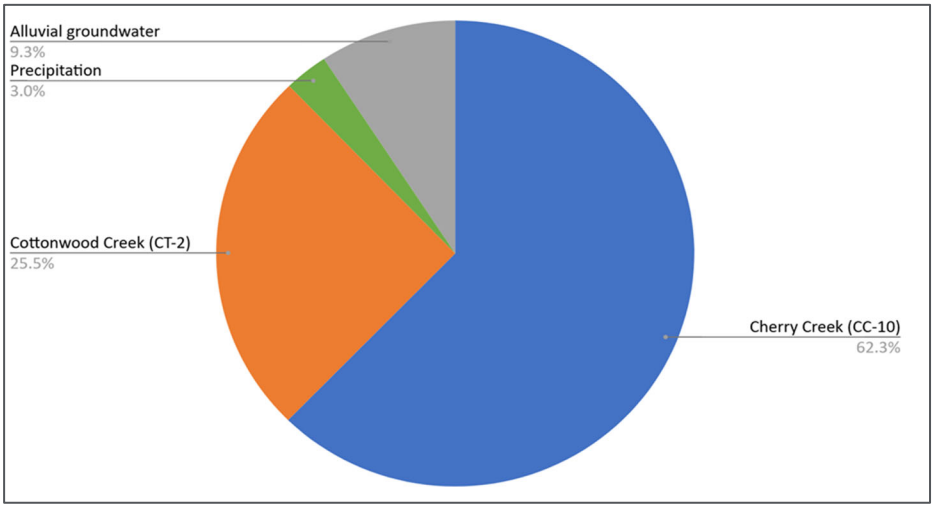

Figure 32. Relative inflows to Cherry Creek Reservoir WY 2024

The nutrient concentrations of all inflows and the outflow of Cherry Creek Reservoir are used to calculate the mass storage on an annual basis. Phosphorus and nitrogen loading to the Reservoir results from surface water from Cherry and Cottonwood Creeks, precipitation and alluvial groundwater. The concentrations and inflows of each source are used to determine loading.

Table 2. Flow-weighted Nutrient concentrations (µg/L) for sources to Cherry Creek Reservoir WY 2024

Nutrient	Cherry Creek	Cottonwood Creek	Alluvial Groundwater	Precipitation	Weighted Total
Total Phosphorus	115	13	18	4	**149**
Total Nitrogen	863	609	96	60	**1,626**

Flow weighted nutrient concentrations are calculated based on relative flow and concentrations from samples collected at surface water sites upstream of Cherry Creek Reservoir during base and storm flow conditions and long-term medians for precipitation and groundwater.

The flow-weighted influent phosphorus goal, derived as part of the 2009 Regulation 38 rulemaking process to achieve the 18 ug/L chlorophyll α standard is 200 µg/L. The flow-weighted TP concentration for all inflows (149 µg/L) and TN concentration (1,626 µg/L) in WY 2024 were approximately half of the values recorded in WY 2023 and lower than the 5-year and historical averages. Following the high flow events and multiple storms in WY 2023 which resulted in high concentrations, the WY 2024 flow weighted nutrient concentrations were in line with those of a more average year.

Table 3. Total Flow-Weighted Nutrient Concentrations Over Time

Median	**Total Phosphorus (µg/L)**	**Total Nitrogen (µg/L)**
WY 2000-2018	201	1,401
WY 2019-2023	176	1,401
WY 2023	351	1,964
WY 2024	149	1,626

11.2 Nutrient Balance

The nutrient loading calculations are used based on daily inflow from each source and the representative nutrient concentrations. The annual storage is based on a mass balance approach represented in the table below.

Table 4. Total Phosphorus and Nitrogen mass balance in Cherry Creek Reservoir WY2024

Water Source	**Total Phosphorus Mass (pounds)**	**Total Nitrogen Mass (pounds)**
Inflows		
Cherry Creek (CC-10)	7,425	55,749
Cottonwood Creek (CT-2)	816	39,328
Precipitation	249	3,821
Alluvial groundwater	1,137	6,102
Total Inflows	9,627	100,500
Outflows		
Evaporation	0	0
Reservoir releases	-5,916	-47,605
Total Outflows	-5,916	-47,605
WY 2024 Storage	3,711	57,395

12. Modeling

Cherry Creek Reservoir has periodic blue-green algae blooms and high chlorophyll-α concentrations. The conditions that cause these algae blooms are complex; therefore, CCBWQA uses two models to help make management decisions: one for the Reservoir and one for the Watershed. A method to link the two models was completed in 2020 and was implemented in 2024 by Hydros Consulting.

CCBWQA uses the two models to better understand how watershed and in-Reservoir processes interact and affect water quality. The models help CCBWQA ask "what if" questions that can be used to identify and prioritize actions to improve water quality in the Reservoir.

12.1 Reservoir Model

A water quality model of the Reservoir was developed by Hydros Consulting to:

- Better understand the causes of chlorophyll-α standard exceedances and cyanobacteria blooms;
- Determine the impacts of the destratification system;
- Provide a tool to help predict the effects of future management strategies.

CCBWQA chose a two-dimensional hydrodynamic and water quality model of the Cherry Creek Reservoir that simulated in-Reservoir water quality for 2003-2017. To further investigate the findings of Model Scenario 2 (Increased Destratification System Mixing), a Bubble Plume model was coupled with the Reservoir model to mechanistically simulate the effects of the destratification system on mixing in Cherry Creek Reservoir.

Concurrent with, although separate from the Bubble Plume Model, CCBWQA contracted with Wright Water Engineers to study the RDS. WWE's study led to discussion of many in-Reservoir treatment options that CCBWQA can consider. As CCBWQA began to consider these options, our meetings and interactions were disrupted by a different organism (SARS-CoV-2).

12.1.1 Reservoir Model: Some Things We Have Learned

1) The primary factors that cause high algal growth in Cherry Creek Reservoir are:
   a) High external nutrient loading;
   b) High internal nutrient loading; and
   c) The Reservoir's shallow depth and wind mixing ensure plenty of nutrients near the surface for algae to grow.

2) Reducing nitrogen and phosphorus by 50% in Cherry Creek Reservoir inflows does not result in attaining the existing chlorophyll-a standard in all years.
3) Since some cyanobacteria can fix nitrogen, they can gain an advantage if other important factors are in place (such as warm temperatures and calm conditions).
1. The Bubble Plume Model showed that the existing RDS provides some benefits; however, the benefits are limited.

12.2 Watershed Model

During 2023, watershed modeling scenarios were developed that included assumptions such as land-use and precipitation patterns, changes in wastewater flows, and types of stormwater quality control measures implemented during development and redevelopment. These assumptions were then input into the model to simulate water quality responses from the watershed for some scenarios that could occur through the year 2030. In 2024, several of the watershed scenarios were linked to the Reservoir model to estimate Reservoir responses to these scenarios.

RESPEC developed the watershed model for CCBWQA to:

- Provide detailed information on hydrologic, sediment and nutrient loading as inputs to the Cherry Creek Reservoir and as boundary conditions for the Reservoir model;
- Represent and quantify loadings from multiple land uses, pollutant sources, along with impacts of water quality controls, and instream processes that affect the pollutant loadings to the Reservoir

In addition to the hydrology and water quality, the HSPF model simulation incorporates segmentation and characteristics of the Cherry Creek Watershed. Watershed segmentation is based on spatial characteristics of the watershed which include:

- Topography
- Drainage Patterns
- Land Uses and Distribution
- Meteorological Variability
- Soils Conditions

The Model Report describes the details of the watershed model development efforts, including model setup procedures and assumptions, available data to support the model, calibration and validation time periods, constituents to be simulated, model scales and resolution, model performance targets, and a discussion of the results. In 2023, RESPEC prepared a memorandum summarizing multiple scenarios through 2030. Several of these model scenarios were further refined in 2024 prior to running the linked watershed-reservoir model.

13. Additional Information

Cherry Creek Basin Water Quality Authority Website
https://www.cherrycreekbasin.org/

WY 2024 Monitoring Program Annual Report
https://ccbwqportal.org/sites/default/files/annual_report_files/2024/WY%202023%20CCBWQA%20Monitoring%20Report.pdf

CCBWQA 2024 Capital Improvement Program Supporting Data
https://ccbwqportal.org/sites/default/files/annual_report_files/2024/10-Year%20Capital%20Improvement%20Program%20(CIP)%20Budget.pdf

Cherry Creek Basin Water Quality Authority Annual Budget for the Year Ending December 31, 2025
https://ccbwqportal.org/sites/default/files/annual_report_files/2024/2025FinalBudgetCCBWQA.pdf

Cherry Creek Stewardship Partners Website
https://www.cherry-creek.org/

CCBWQA Data Portal
https://ccbwqportal.org/

CCBWQA Historical Annual and Monitoring Reports
https://www.cherrycreekbasin.org/annual-reports

5 CCR 1002-72 Regulation No. 72 – Cherry Creek Reservoir Control Regulation
https://www.coloradosos.gov/CCR/DisplayRule.do?action=ruleinfo&ruleId=2383&deptID=16&agencyID=132&deptName=Department%20of%20Public%20Health%20and%20Environment&agencyName=Water%20Quality%20Control%20Commission&seriesNum=5%20CCR%201002-72

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