



COLORADO

Water Quality Control Division

Department of Public Health & Environment

2023 Nutrients Regulatory Analysis

Lakes Nutrient Criteria

Regulation 31 - Basic Standards and Methodologies for Surface Water

Regulations 32-38 - Basin Regulations

Water Quality Control Division

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Regulatory Analysis

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Regulation 31 - Basic Standards and Methodologies for Surface Water

Regulations 32-38 - Basin Regulations

Regulation 85 - Nutrients Management Control Regulation



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I. INTRODUCTION

The Water Quality Control Division (division), serving as staff to the Water Quality Control Commission (commission), is proposing revisions to Regulation No. 31 (Basic Standards and Methodologies), Regulation Nos. 32-38 (the Basin Regulations)¹, and Regulation No. 85 (Nutrient Management Control Regulation)^{2,3} in order to continue to protect lakes, reservoirs, rivers, and streams from nutrient pollution. The specifics of the division's proposal are available in its rebuttal⁴ and in the consolidated proposal that will be submitted to the commission by March 30, 2023. In brief, the proposed revisions would amend Regulation No. 31.17 to extend the application of the existing chlorophyll *a* standard from specific upstream segments to all segments with aquatic life, recreation, and/or direct use water supply (DUWS) uses. The division also proposes adopting revised total nitrogen (TN) and total phosphorus (TP) table value criteria to address comments from EPA recommending additional considerations.

Sections 24-4-103(2.5) and (4.5), C.R.S., of the State Administrative Procedure Act (APA), require the rulemaking agency to develop a cost benefit analysis (CBA) and/or regulatory analysis (RA) when requested. On July 29, 2022, two parties to the rulemaking requested the division develop both a CBA and an RA for the Nutrients Rulemaking. The requested RA is presented herein. The requested CBA is in a separate document that was sent to the parties on March 21, 2023 and linked below.⁵

The details of the proposed revisions to the regulations and a history of nutrient controls in Colorado are explained in more detail in the CBA. But, in short, Colorado has been working on adopting and implementing nutrients regulations for decades. The commission and division have considered costs along the way, starting with the adoption of control regulations for specific reservoirs in the 1980s and 1990s⁶ and continuing through the *Cost/Benefit Study of the Impacts of Potential Nutrient Controls for Colorado Point Source Discharges* (2012 CBA)^{7,8} and the recently completed 2023 CBA. All of these documents have quantified impacts and found that there will be significant costs and benefits from

¹ Changes to Regs. 31-38 are collectively referred to as the "Lakes Nutrients Rulemaking".

² Changes to Regs. 31-38 and 85 are collectively referred to as the "Nutrients Rulemaking".

³ The division is not proposing significant edits to Regulation No. 85. Therefore, there are no costs or benefits associated with these changes for analysis, and Regulation No. 85 is not analyzed further in this RA.

⁴ The division's 2023 rebuttal is available here:

https://drive.google.com/drive/folders/1MscDBGXT5hLgvis-q56X69JWaT2-pZKb?usp=share_link.

⁵ The 2023 CBA is available online here:

https://drive.google.com/drive/folders/1_Oo-vaBFDRXd0rWizrtGZt3yY9xTzRZz?usp=share_link.

⁶ See, e.g., Reg. 71.8, Fiscal Impact Statement for Dillon Reservoir, ("[T]he economic value of Dillon Reservoir is quite substantial as is indicated by the best available evidence. . . . The Commission notes that the potential losses which could result from less stringent [nutrient] controls could seriously impact this value.").

⁷ The 2012 CBA is available online at the Secretary of State's website here:

<https://www.sos.state.co.us/CCR/Upload/AGORequest/RegulatoryAnalysisAttachment2011-00832.PDF>.

It was also submitted by parties to the 2023 rulemaking. See, e.g., Exhibit 4 to Colorado Wastewater Utility Council's (CWWUC) Responsive Prehearing Statement.

⁸ The commission discussed costs throughout its deliberations during the 2012 Rulemaking Hearing. See, e.g., Mar. 14, 2012, Nutrients Rulemaking, Deliberations Transcript,

https://drive.google.com/drive/folders/1kMhrhcZel-yHPYdLwzpsJw44g7-LvKEN?usp=share_link.



implementing nutrient standards. However, the quantified numbers in these CBAs and this RA must be considered along with the qualitative costs and benefits in order to fully understand the impact of these regulations. Thus, as required by the APA, this RA identifies classes of people who may be impacted by the regulations and presents an analysis of both the qualitative and quantitative benefits and costs these classes may experience as well as potential alternatives to the division's proposal.

II. RA REQUIREMENTS AND APPROACH

A. Regulatory requirements for an RA

According to commission Regulation 21.3.J, and consistent with APA section 24-4-103(4.5)(a), C.R.S., an RA must include an analysis of the following six factors:

1. A description of classes of persons who bear the costs and/or benefits from the proposed rule;
2. To the extent practicable, a description of the probable quantitative and qualitative impact of the proposed rule, economic or otherwise, upon affected classes;
3. The probable costs to the commission, the division, or any other state agency of the implementation and enforcement of the proposed rule and any anticipated effect on state revenues;
4. A comparison of the probable costs and benefits of the proposed rule to the probable costs and benefits of inaction;
5. A determination of whether there are less costly methods or less intrusive methods for achieving the purpose of the proposed rule; and
6. A description of any alternative methods for achieving the purpose of the proposed rule that were seriously considered by the commission or petitioner and the reasons the alternative methods were rejected in favor of the proposed rule.

Once complete, the RA "shall be available for inspection at the Commission Office at least five days before the hearing on the proposed rule." Reg. 21.3.J. And, "[i]f the agency has made a good faith effort to comply with the requirements of paragraphs (a) to (c) of this subsection (4.5), the rule shall not be invalidated on the ground that the contents of the regulatory analysis are insufficient or inaccurate." § 24-4-103(4.5)(d), C.R.S.

B. Approach: use of 2012 RA and 2012 CBA as starting points, summary and reorganization of parts of the 2023 CBA into this RA

As with the 2023 CBA, the division relied on the 2012 CBA as a starting point for this RA. The 2012 CBA included the framework for the 2012 RA in section 6. The division submitted the full 2012 RA as an exhibit during the 2012 rulemaking.⁹

⁹ 2012 Rulemaking, WQCD Exhibit 31, 2012 RA, available at: <https://drive.google.com/drive/folders/19kNygYaPJNbhQy8gW-8tFDYkFBNOXrAY>.



III. FACTOR 1: A DESCRIPTION OF CLASSES OF PERSONS WHO WILL BENEFIT FROM AND/OR BEAR THE COSTS FROM THE PROPOSED RULE

The following are classes of persons who will benefit or bear costs from the proposed Lakes Nutrients Rulemaking.

A. Classes who may benefit from the proposed rule

- Drinking water utilities: Drinking water utilities may experience benefits from the proposed rules due to decreased source water treatment costs as a result of reduced phosphorus and nitrogen. Lower concentrations of phosphorus and nitrogen may make it easier for drinking water utilities to meet current federal and state finished drinking water maximum contaminant limits and will reduce taste and odor issues.
- Drinking water utility customers: Drinking water utility customers in certain Colorado communities where source waters will have reduced phosphorus and nitrogen concentrations may also benefit. Specifically, customers may have reduced bills or smaller increases in utility bills due to reduced potable water treatment costs.
- Aquatic life: Aquatic life may benefit from the proposed rules due to a reduction in algal blooms and better water quality generally. This would then benefit those that fish or otherwise value a healthy aquatic ecosystem.
- Residents: Those residents who recreate in Colorado on lakes, reservoirs, streams and rivers (fishing, boating, swimming) may benefit due to a reduction in algal blooms and increased recreational opportunities. Also, residents who recreate near lakes, reservoirs, streams, and rivers (picnicking, scenic drivers, wildlife viewing, hunting) may benefit for the same reasons.
- Tourists: Out-of-state visitors who recreate in Colorado and on lakes, reservoirs, streams and rivers (fishing, boating, swimming) may benefit due to a reduction in algal blooms and increased recreational opportunities. Also, out of state visitors who recreate near lakes, reservoirs, streams, and rivers (picnicking, scenic drivers, wildlife viewing, hunting) may benefit for the same reasons.
- Businesses
 - Tourism-based businesses: Recreational businesses like rafting companies, fishing supply stores, guide services, businesses that sell goods and services to boaters and swimmers in Colorado, and hotels, restaurants, and gasoline service stations may benefit due to increased recreation.
 - Engineering and construction companies: Companies in Colorado and elsewhere that design, build, and maintain wastewater treatment facilities (WWTFs) may benefit due to increased job opportunities.



- Environmental management firms: Firms that design and conduct water quality monitoring, sampling, and analysis programs may also benefit due to increased job opportunities.
- Agriculture: Farmers and ranches may benefit from the proposed rules due to increases in the quality of water available for livestock watering and crop irrigation.
- Disproportionately impacted communities: Disproportionately impacted communities or environmental justice communities may benefit from the proposed regulations due to increased access to recreational opportunities nearer their homes.
- Waterfront private property holders: Private property holders on lakes, reservoirs, streams, and rivers subject to the proposed rule may experience benefits due to increased water quality (taste, odor) and reductions in algae.
- Water rights holders: Water rights holders may experience benefits from cleaner water, such as being able to use the water for additional uses or reduced treatment and maintenance of water conveyances.

B. Classes who may bear costs from the proposed rule

- Dischargers: Wastewater dischargers and certain industries that discharge phosphorus and inorganic nitrogen at levels that will require additional treatment to meet the standards set under Regulation No. 31.17 will primarily bear the cost of these rules. Wastewater dischargers include municipalities, other governmental entities, and private companies. Industries which discharge phosphorus and inorganic nitrogen at levels that will require additional treatment include certain types of power plants, food processing plants, and other water-intensive industries.
- Wastewater system customers: Wastewater system customers served by the above dischargers, typically households and businesses and including disproportionately impacted communities, will bear the cost of the proposed rule through higher wastewater rates. These costs will vary among ratepayer groups because of variability in current levels of nutrient removal and physical infrastructure among existing wastewater facilities. This variability will directly affect the cost of treatment upgrades and the need to raise rates to fund these upgrades.
- Water rights holders: Water rights holders may experience limited increases in costs from obtaining and defending water rights approvals from the State Engineer's Office (SEO) and decrees from water court. However, these costs, if any, should be limited because the purpose of the proposed regulations is to increase water quality, and the SEO has stated that it will not deny approvals, open up previous approvals, or seek to challenge water rights applications as a result of the new rules.¹⁰

¹⁰ March 13, 2023, SEO Consultation Letter:
<https://drive.google.com/drive/folders/1RxUt9OrehtydWLL0Dj7ruv8e3UOrK3GY>.



IV. FACTOR 2: TO THE EXTENT PRACTICABLE, A DESCRIPTION OF PROBABLE QUALITATIVE AND QUANTITATIVE IMPACTS OF THE PROPOSED RULE, ECONOMIC OR OTHERWISE, ON AFFECTED CLASSES

A. Benefits and costs studied in the 2023 CBA and applicable to the RA¹¹

The 2023 CBA analyzed both quantitative and qualitative benefits and costs, all of which are relevant to this RA as well. In particular, Section VI of the 2023 CBA analyzed the benefits of the rule; Section VII analyzed the direct costs of the nutrients regulations on the government and private sector; and Section VIII analyzed indirect costs to the broader economy. The findings of these sections are summarized below and reframed as appropriate to fit the RA factors. Because costs to state agencies are covered in Factor 3 of the RA, they are not discussed in this section.

1. Quantitative or semi-quantified benefits

Quantified and semi-quantified benefits include avoided capital and operation/maintenance costs for drinking water facilities, increased direct recreational benefits (fishing, swimming, boating), increased indirect recreational benefits (hiking, picnicking, and wildlife watching), and increased waterfront property values. These benefits are discussed individually and summarized in Table 1 below.

Reduced drinking water treatment costs: Drinking water utilities may be able to reduce their future water treatment capital investment costs and operating and maintenance costs as a result of reduced nutrients. Or, if drinking water utilities do not have plans for future investments, reduced nutrients in the drinking water supply might improve public health and improve the market attributes of drinking water, (i.e., appearance, odor and taste). The quantified benefits for drinking water providers in 2012 were \$11,966,000 in avoided capital costs and \$46,317,000 in avoided operating and maintenance costs. In 2023 dollars, these benefits amount to \$16,513,080 in avoided capital costs and \$63,917,460 in avoided operating and maintenance costs. If reduced to fit the scope of the proposed rulemaking (the subset of lakes/reservoirs¹² with new nutrient standards applied), these benefits were estimated to amount to \$3,302,616 in avoided capital costs and \$12,783,492 in avoided operating and maintenance costs. Aesthetic and marketing benefits are not able to be quantified.

Recreational: Recreational interests will also benefit as a result of decreased algal blooms and cleaner water. Colorado total travel spending for overnight and day travel in 2021 was \$21.1 billion,¹³ and 60% of overnight person trips included

¹¹ As noted in the 2023 CBA, Section III.B.2., the 2023 CBA used the 2012 CBA as a starting point for analysis but adjusted benefits and costs to reflect 2023 dollars using the U.S. Bureau of Labor Statistics' Consumer Price Index (CPI), https://www.bls.gov/data/inflation_calculator.htm, adjusted benefits and costs to fit the scope of the 2023 rulemaking, and added new information where available.

¹² The "subset of lakes and reservoirs" refers to high priority lakes (DUWS/Swim Beaches) 35 miles downstream of qualified dischargers.

¹³ Colo. Tourism Office, Longwoods Travel USA, Colorado Report (2021), <https://oedit.colorado.gov/about/oedit-reports#ctoresearch>.



outdoor activities and 48% of day person trips included outdoor activities.¹⁴ Tax revenue generated through travel and tourism can contribute to state and local governments by providing revenue and by reducing the amount of revenue that must be collected by local residents. State and local tax revenue generated from tourism saved households approximately \$690 per household in taxes in 2021.¹⁵ However, connecting and quantifying these benefits to a specific rule or action is very difficult. Therefore, these benefits are considered semi-quantitative.

Private property: Better water quality has the potential to increase the values of private property near and adjacent to lakes and reservoirs. Excess algae causes reduced clarity, inhibits recreational opportunities, and harms aquatic life, and decaying plants produce unpleasant odors or diminish scenic views, thereby impacting nearby properties. For this rulemaking, there are approximately 387 miles of private property¹⁶ shoreline on lakes and reservoirs designated as direct use water supply (DUWS) or swim beaches. Thus, this rule may improve water quality and benefit private property owners by increasing their property values. Because this increase is difficult to tie to a specific action, these benefits are considered semi-quantitative.

Passive benefits: The active benefits of nutrient reduction described above are directly related to human activities and human use of lake resources. Beyond this, there are a number of ecosystem functions that benefit from nutrient reduction which are not active, but for which people do have a value. These may include increased biodiversity, protection of species, and wetland functions.

¹⁴ Colo. Tourism Office, Dean Runyan Associates, The Economic Impact of Travel on Colorado (2021), <https://oedit.colorado.gov/about/oedit-reports#ctoresearch>.

¹⁵ Colo. Tourism Office, Colorado Dashboard, <https://www.travelstats.com/impacts/colorado> (last visited Mar. 23, 2023).

¹⁶ March 9, 2023, Communication with WQCD GIS Specialist, Andy Witt.



Table 1. Quantitative and Semi-Quantitative Benefits, based on 2012 CBA Data Adjusted to Account for Inflation and the Scope of the Lakes Nutrients Rulemaking			
	Statewide benefits, as shown in 2012 CBA Table 5-15	Adjusted for Inflation (2010 to 2023 dollars)	Scaled for Rulemaking Hearing (x80/400 wastewater facilities)
Avoided Treatment Costs to Drinking Water Facilities to Meet SWDA Regulations for Disinfection Byproducts (DBP)			
Capital	\$11,966,000	\$16,513,080	\$3,302,616
Operating	\$46,317,000	\$63,917,460	\$12,783,492
Recreation Benefits			
Angling	\$630,168,000	\$869,631,840	\$173,926,368
Boating	\$1,147,713,000	\$1,583,843,940	\$316,768,788
Swimming	\$243,217,000	\$335,639,460	\$67,127,892
Other Quantified Benefits			
Property Value Benefits	\$58,119,000 ¹⁷	\$80,204,220	\$16,040,844
Passive Benefits (i.e., increased biodiversity, protection of species, and wetland functions)	\$1,222,770,000	\$1,687,422,600	\$337,484,520
Total Quantified Benefits	\$3,360,270,000 ¹⁸	\$4,637,172,600	\$927,434,520

2. Quantitative costs

Quantified costs include permittees' (i.e., municipalities, special districts, utilities, industrial dischargers, etc.) costs to comply with new effluent limits resulting from the proposed rule, such as capital costs and annual costs for labor, chemical, electrical, and repair and replacement. These costs may be passed on to consumers as well.

Outside of the initial costs of upgrading or constructing new infrastructure for facilities, the costs will also increase for operations and maintenance. Facilities may need to hire higher level certified operators and increase staffing. These administrative costs may be significant.

In the 2023 CBA, the division assumed that approximately 80 domestic wastewater treatment facilities and industrial facilities (SIC Code 20) would have

¹⁷ The 2012 CBA estimated impacts to property values only for one Manageable Unit, Arkansas-03. 2012 CBA, page 4-22. Therefore, this number is likely significantly underestimated.

¹⁸ Note, Table 5-15 of the 2012 CBA shows a total of \$3,360,269,000, but the sum of the individual benefits listed equals \$3,360,270,000, so this latter number is used. This decision does not affect the benefit to cost ratio.



to comply with the nutrients regulations for the subset of lakes and reservoirs covered in the rulemaking based on the proximity of these facilities to DUWS and swim beaches.¹⁹ These costs were compared to two EPA life cycle studies²⁰ on nutrient treatment removal options, information submitted by the parties to the rulemaking, and the 2012 CBA to determine accuracy. The total costs for these facilities to comply is \$7,863,644,604, as shown in Table 2 below.

Table 2. Quantitative Costs, based on 2012 CBA Data Adjusted to Account for Inflation and the Scope of the Lakes Nutrients Rulemaking	
Statewide Costs (from 2012 CBA, 2010 dollars)	\$24,898,025,000
Statewide Costs (Adjusted for inflation, 2023 dollars)	\$34,359,274,500
Costs Adjusted for Inflation, New Treatment Information, and Scaled Down for Lakes Nutrients Proposal (2023 dollars)	\$7,863,644,604

Although these estimated costs are significant, they may not be realized by these facilities due to existing regulatory flexibilities.²¹ The division and commission have access to standards-focused tools such as criteria or use-based site-specific standards, feasibility-based or natural ambient site-specific standards, temporary modifications, and discharger specific variances (DSVs). For example, for DSVs, the division can conduct an economic analysis and derive an appropriate cost cap for any public facility in Colorado, and the results of that analysis can then be used to inform various regulatory flexibilities that exist within the Clean Water framework. Permitting-focused tools include special studies to evaluate appropriate mixing zones and potential impacts to downstream waters to ensure appropriate limits to protect the beneficial uses are included in permits, as well as compliance schedules to provide facilities time to install source control and/or treatment to meet limits. The division routinely works with facilities to help evaluate available regulatory tools and make progress on an appropriate path forward.

Consumers may experience increased costs due to the costs of compliance described above, which water utilities may pass on to them. These costs may be limited somewhat because there is some state funding available to help impacted consumers with their water services through the Colorado Low Income Household Water Assistance Program.²² There is also federal funding available for

¹⁹ 2023 CBA, page 49.

²⁰ EPA, Life Cycle and Cost Assessments of Nutrient Removal Technologies in Wastewater Treatment Plants (2021), <https://www.epa.gov/system/files/documents/2021-08/life-cycle-nutrient-removal.pdf> (hereinafter “2021 EPA LCCA”); EPA, Life Cycle Assessment of Upgrade Options to Improve Nutrient Removal for the City of Santa Fe, NM, Paseo Real Wastewater Treatment Plant (2023): <https://www.epa.gov/system/files/documents/2023-01/life-cycle-assessment-santafe-2023.pdf> (hereinafter “2023 EPA LCA - Santa Fe”).

²¹ 2023 CBA at 57-60.

²² CDPHE, Colorado Low-income Energy Assistance Program (LEAP), <https://cdhs.colorado.gov/leap> (last visited Mar. 17, 2023).



disproportionately impacted communities for water system upgrades, including additional funding through the Bipartisan Infrastructure Law.²³

3. Qualitative benefits

Qualitative benefits evaluated in the 2023 CBA include fewer closures to public waterbodies and reduced risks to public health from harmful algal blooms, increased uses for agriculture and environmental justice communities, and job creation from facility construction to meet increased treatment and operation requirements (Table 3).

Qualitative benefits are important to consider. As the 2012 CBA found:

“The qualitative effects identified below are no less important than the quantified benefits and costs described earlier. These qualitative effects simply mean that the project team was not able to obtain sufficient data or derive sufficient supportable assumptions in order to quantify these benefits. The lack of quantification of a particular cost or benefit element does not diminish the importance of the element. Instead, the findings of this Study should be viewed within the following context: Quantified costs and benefits, presented in the form of a benefit-cost ratio, represent a subset of the larger universe of combined quantitative and qualitative benefits.”

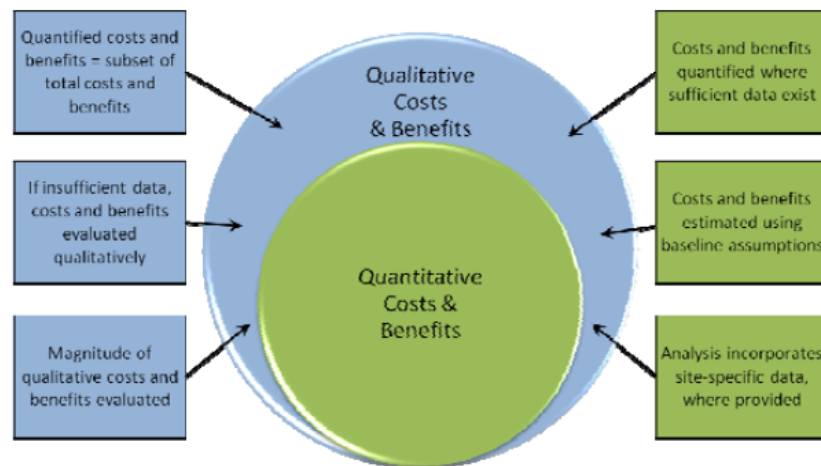


Figure 1. Overlap of quantitative and qualitative costs and benefits from 2012 CBA.

²³ EPA, Factsheet, Bipartisan Infrastructure Law: State Revolving Funds Implementation Memorandum March 2022, <https://www.epa.gov/system/files/documents/2022-03/bil-srf-memo-fact-sheet-final.pdf> (“The Bipartisan Infrastructure Law mandates that 49 percent of funds provided through the DWSRF [Drinking Water State Revolving Funds] General Supplemental Funding and the DWSRF Lead Service Line Replacement Funding must be provided as grants and forgivable loans to disadvantaged communities. . . . For the CWSRF [Clean Water State Revolving Funds], the law mandates that 49 percent of funds provided through the CWSRF General Supplemental Funding must be provided as grants and forgivable loans to communities that meet the state’s affordability criteria or certain project types, consistent with the Clean Water Act”).



Reduction in algal blooms: Cyanobacteria, commonly known as blue-green algae, are a photosynthetic bacteria that naturally occur in waters around the world, including in Colorado. These organisms become a nuisance and health risk when they rapidly reproduce and cause a dense concentration or “bloom.” Excessive nutrient loading in waterbodies is a key driver that can lead to harmful algae blooms. Harmful algae blooms negatively impact recreational activities in a variety of ways. Some algae blooms produce toxins that are harmful to people and pets, and many are not aesthetically pleasing. The toxic blooms are cause for lake closures, which impact revenue from recreation and may affect future revenue by giving the public a negative impression of the lake or reservoir. For example, twelve Colorado Parks & Wildlife (CPW) lakes were closed (or partially closed) to contact recreation for more than 40 weeks from June 2020 to September 2022. Caution advisories (toxic algae blooms present but toxin concentrations below the safety threshold) were posted at approximately 30 CPW lakes for 60 weeks over the last three years.²⁴ The division spends approximately \$10,000 each year to support analytical testing to measure toxins where algae blooms have been reported. Another \$5,000 to \$10,000 is also spent on monitoring efforts. Nutrients regulations will reduce these costs and the risks to public health.

Agriculture: Agriculture may benefit from reductions in nutrients as well. Agricultural uses of water include irrigation and animal watering. Nutrient concentrations in agricultural water may increase drinking water quality for livestock, and reduce nutrient concentrations in water used for crop irrigation and maintenance of conveyance systems.

Environmental justice benefits: The proposed nutrient standards may have benefits for environmental justice (EJ) communities, mostly in the form of increased access to recreational opportunities within EJ communities. For example, of the approximately 34 lakes and reservoirs with DUWS and swim beaches proposed for this rulemaking, 27 are within counties with EnviroScreen scores above 60, which means that 75% of the lakes and reservoirs prioritized for proposed protection in the Lakes Nutrients Rulemaking are in disproportionately impacted communities. There are studies which have found a strong connection between park use by disproportionately impacted communities and proximity to the park.²⁵ Thus, it is logical to assume that cleaner water in the various lakes and reservoirs proposed for greater protections in the 2023 Lakes Nutrients Rulemaking could benefit EJ communities.

Job creation: The regulations may result in more job opportunities for environmental consultants and the engineering and construction industries. The 2012 CBA recognized that “[e]ngineering and construction industry companies and their employees could experience higher revenues and more job opportunities as a result of the proposed rule. However, the potential for higher

²⁴ CPW Rebuttal Statement at 8.

²⁵ Vaughan, C.A., et al., Park Use in Low-Income Urban Neighborhoods: Who Uses the Parks and Why? 95 J Urban Health 222-31 at 222 (2018), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5906381/> (“Residential proximity to parks has been shown to be a robust predictor of park use.”).



revenues and more job opportunities is dependent upon many factors.”²⁶
Therefore, these benefits are not able to be quantified.

Intrinsic benefits: Finally, people may place values on improving Colorado's water resources for reasons other than direct use of the water. For example, a person may value the environment for use by future generations or find a value in just knowing that the resource exists in the world. These types of non-use benefits are commonly estimated via willingness to pay studies. However, such studies were not possible for this RA. As a consequence, such benefits are recognized but not quantified.

Table 3. Summary of Qualitative Benefits	
Benefit	Relative Benefit Contribution
Potable Drinking Water (protection of public health, increased customer satisfaction from improved taste and odor, and decreased likelihood of DBP formation)	Substantial ²⁷
Reduction in public water body closures and risks to public health from mitigation of harmful algal blooms	Moderate
Additional recreation benefits (hiking, picnicking, wildlife watching)	Moderate ²⁸
Agriculture	Minimal ²⁹ for both, TP less
Environmental Justice	Unknown
Job Creation	Unknown
Intrinsic Value Benefits	Unknown ³⁰

4. Qualitative costs

Finally, there are qualitative costs that may arise as well. Qualitative costs evaluated in this RA and 2023 CBA include costs from water loss associated with reverse osmosis (RO), energy costs, and greenhouse gas emissions. A summary of qualitative costs is below (Table 4).

Reverse osmosis: The EPA life cycle and cost assessment from 2021 (2021 EPA LCCA) studied the impacts of RO, a treatment option that will likely be necessary for some facilities to meet nutrients standards and subsequent effluent limits. The 2021 EPA LCCA found that RO treatment increased energy consumption, air

²⁶ 2012 CBA, page 6-3.

²⁷ 2012 CBA, Table 5-17.

²⁸ 2012 CBA, Table 5-17.

²⁹ 2012 CBA, Table 5-17.

³⁰ 2012 CBA, Table 5-17.



pollutants, and water depletions.³¹ These impacts from RO will result in additional costs.

Further, RO has a notable amount of water loss (on average 10%) that is created by the concentrated liquid waste stream. It also generates brine. Colorado has limited options to deal with this RO waste stream. For landlocked states, the brine is either evaporated or pumped into deep aquifers for permanent disposal. Evaporative techniques either require substantial energy (e.g., distillers) not accounted for in this report or large ponds that may require significant land (~46 acres for the example of a 1 MGD facility) to evaporate the brine. For evaporation, the water remains in the global water cycle but does not immediately return to the stream. Alternately, deep well injection removes this water from the global water cycle. Both waste techniques could require augmentation, purchase of water rights, and the possible water court costs to move water between basins. This capital cost is exacerbated by social concerns about the immediate loss of water in an arid state.

Energy costs and greenhouse gas emissions: For both RO and other treatment upgrades, the treatment infrastructure needed to meet the proposed nutrient limits are expected to be more complex and energy intensive than the current treatment systems based on the technology currently available. Higher energy use translates to higher costs. Upgraded treatment facilities may result in higher energy costs and therefore increased greenhouse gas emissions. Although the current push to green the power generating systems³² has the potential to reduce these emissions and costs, these changes may be regional depending on the timing of local efforts.³³

Table 4. Summary of Qualitative Costs	
Cost	Relative Cost Contribution
Water Loss with RO	Unknown/Variable
Energy costs and GHG emissions	Substantial

³¹ 2012 CBA, page 9-22.

³² See Colo. Energy Office, Summary Overview: Colorado GHG Pollution Reduction Roadmap: <https://drive.google.com/file/d/1dYf94kx95WzSyco6mjMJYRaYA6ljmSOK/view>.

³³ See 2023 EPA LCA - Santa Fe at 5.3, <https://www.epa.gov/system/files/documents/2023-01/life-cycle-assessment-santafe-2023.pdf>.



B. Total quantitative benefits and costs, benefit:cost ratio from 2023 CBA

The total quantitative benefits and costs are summarized below (Table 5).

Adjusted Statewide Benefits	\$927,434,520
Adjusted Statewide Costs	\$7,863,644,604
Adjusted Statewide Benefit to Cost Ratio	0.12:1

The benefit to cost ratio in the table above is very close to the aggregated statewide benefit to cost ratio as reported in the 2012 CBA of 0.13:1.³⁴ It is also aligned with other cost-benefit assessments for similar policies. For example, Keiser et al., 2018³⁵ found the benefit-cost ratio from the median study is 0.37. Keiser et al. also found that similar policy benefits are often much smaller than their costs. This is largely because the existing evidence to quantify benefits is limited and thus benefit/cost ratios often undercount many types of benefits.

V. FACTOR 3: THE PROBABLE COSTS TO THE COMMISSION, THE DIVISION, OR ANY OTHER STATE AGENCY OF THE IMPLEMENTATION AND ENFORCEMENT OF THE PROPOSED RULE, AND ANY ANTICIPATED IMPACTS ON STATE REVENUE

A. Costs to the commission

The direct costs to the commission may include costs from future requests for site-specific standards, DSVs, and temporary modifications as a result of the nutrients standards. Because the division is recommending delayed implementation of the proposed rules, any costs to the commission from these potential requests will likely not be realized until sometime after 2027.

B. Costs to the division

The direct costs to the division will include the workload associated with implementing the amended standards, such as development and issuance of engineering reviews of site applications and revised permits. The division will not incur any additional costs with regards to the number of permit applications requiring review (in terms of both volume and frequency). However, while the division already has technical staff dedicated to conducting permit application reviews, it is expected that a percentage of

³⁴ 2012 CBA, page 1-16.

³⁵ Keiser, D.A. et al., Proceedings of the Nat'l Academy of Sciences, The low but uncertain measured benefits of US water quality policy (2018), <https://www.researchgate.net/publication/328157879> The low but uncertain measured benefits of US water quality policy.



these staff will require additional training to ensure understanding of nutrient treatment technology. This training need is consistent with general ongoing training needs associated with changes in treatment practices and is not an additional incurred cost.

There will be an added need for the development of restoration plans once impairments are assessed and identified; however, the division will not incur any additional costs as a result of this rule with regards to the number of plans actually developed since this rule will not require an increased rate of plan development.

Likewise, because the decrease in costs to regulated entities' interest in, and need for, the use of regulatory flexibilities such as DSVs was not considered in the 2023 CBA, this RA also does not assume an increased cost for the division to implement these regulatory flexibilities.

There may also be an increase in loan demand under the Water Pollution Control Revolving Fund (WPCRF). However, the amount of funding provided will not change because of this rule and there will only be a minimal increase in cost to the division.³⁶

C. Costs to other state agencies:

Other state agencies may also experience costs to implement and enforce the changes proposed through the Lakes Nutrients Rulemaking.

1. State agencies that own WWTFs

State agencies, such as CPW and the Department of Corrections, operate WWTFs, some of which may become subject to the proposed regulations. New, state-owned WWTFs would also have to meet the proposed regulations, which may increase the capital and operation and maintenance (O&M) costs associated with these facilities.

2. CPW

CPW may experience some costs to implement the rule. CPW manages state parks and the lakes and reservoirs present at those parks for wildlife and recreational uses. CPW would likely be involved in the development of site-specific standards for, and DSVs that may impact, these lakes and reservoirs should such regulatory flexibilities be needed, and will likely experience increased costs as a result.

3. State Engineer's Office

As identified in the SEO's consultation letter,³⁷ the SEO has a role in implementing water quality standards adopted by the commission. In particular, the SEO considers water quality standards when deciding whether to approve nondecreed exchanges and/or to engage in water court on decreed exchanges and plans for augmentation. However, as the SEO notes, the proposed rules are

³⁶ 2012 CBA, page 2-1.

³⁷ The SEO consultation letter is available here:

<https://drive.google.com/drive/folders/1RxUt9OrehtydWLL0Dj7ruv8e3UOrK3GY>.



intended to improve water quality and therefore increase the quality of substitute supplies in exchanges and plans for augmentation. Thus, the SEO likely will not experience significant increased implementation costs as a result of the nutrients rules.

D. Impacts on State Revenue

The division does not anticipate there will be any effect on state revenues caused by the implementation of this proposed regulatory action, and was not able to directly identify any such effect.

VI. FACTOR 4: A COMPARISON OF THE PROBABLE COSTS AND BENEFITS OF THE PROPOSED RULE TO THE COSTS AND BENEFITS OF INACTION

As shown above in Table 5, there are both significant benefits and costs to the Lakes Nutrients Rulemaking. Quantified benefits include the avoided costs for drinking water utilities, active benefits to recreation (i.e., angling, boating, and swimming), increases of waterfront property values, and passive benefits from increased biodiversity, protection of species, and wetland functions. Quantified costs include the costs to facilities to comply with new effluent limits resulting from the proposed rule and include capital costs, as well as annual costs for labor, chemical, electrical, and repair and replacement.

In contrast, the costs and benefits of inaction are hard to quantify. The 2012 CBA described the costs of inaction at that time before the adoption of Regulation No. 85 and adoption of the Voluntary Incentive Program as follows³⁸:

- The probable capital and O&M costs will be avoided, or deferred.
- Avoidance or deferral of the need for capital financing and funding for O&M would reduce or delay the need for increased wastewater rates and lower the financial burden on households and businesses.
- The anticipated impact to the WPCRF or other funding sources for WWTFs would not occur, or be delayed.
- The described additional regulatory burden on state agencies and cost burden to state-owned and operated WWTFs would not occur or would be delayed.

The probable costs from inaction at that time also included:

- Public water supply facilities that draw their water from sources downstream of WWTF discharges may incur higher long-term treatment costs as the nutrient loads from upstream wastewater effluent discharges increase along with population growth. In addition, specific industrial facilities (SIC Code 20) may have avoided costs as a result of regulation implementation. These avoided costs may be incurred, however, if the regulations are not implemented.

In contrast, the potential impacts from increased nutrient loading include:

³⁸ 2012 CBA, page 6-9.



- Lakes and reservoirs - enriching nutrient supplies to lakes and reservoirs increases algal abundance, which can have a broad range of impacts to water quality. Impacts include, but are not limited to, elevated pH, decreased oxygen and clarity, algal blooms, toxin formation, shifts in the nature of the fishery, and decline in property values. These impacts have the potential to impair uses for aquatic life, recreation, agriculture, and water supply. No dollar amount has been attached to the complete set of impacts.
- Rivers and streams - increased pH and low dissolved oxygen, a common byproduct of excess algal growth, could occur, which is detrimental to other aquatic organisms. In addition, excessive abundance of attached algae could diminish the recreational use of state waters.

These factors were considered for this RA, and resulted in similar conclusions. In sum, while inflation rates and construction costs vary year to year, the costs for wastewater treatment plants may continue to grow as inflation increases. The impacts to lakes and reservoirs from inaction now will be continued harmful algal blooms impacting recreation, park closures, and the resulting impacts to tourism.

VII. FACTOR 5: A DETERMINATION OF WHETHER THERE ARE LESS COSTLY METHODS OR LESS INTRUSIVE METHODS FOR ACHIEVING THE PURPOSE OF THE PROPOSED RULE

The commission and division are required to protect beneficial uses by law. § 25-8-102(2), C.R.S. (“It is [] declared to be the public policy of this state . . . [that] no pollutant be released into any state waters without first receiving the treatment or other corrective action necessary to reasonably protect the legitimate and beneficial uses of such waters[.]”)³⁹. Here, there are no less costly or less intrusive methods to achieve nutrients reductions in Colorado that would conform with existing science and provide the requisite level of protection for beneficial uses. Put another way, any less costly or less intrusive methods would result in fewer benefits with a risk of not protecting the uses that are the focus of the Lakes Nutrients Rulemaking. The division’s rebuttal addresses its concerns with less costly and less intrusive (less stringent) standards at length in Section XI, B.1; these arguments are not repeated here.⁴⁰

The commission adopted less intrusive methods through Regulation Nos. 85 and 31.17 in 2012. Although Regulation No. 85 has resulted in nutrient reductions,⁴¹ more progress needs to be made to protect public health and aquatic life, as shown by continued algal blooms and other impacts from excess nutrients.

³⁹ See also Reg. 31.6 (“Waters shall be classified for the present beneficial uses of the water, or the beneficial uses that may be reasonably expected in the future for which the water is suitable in its present condition or the beneficial uses for which it is to become suitable as a goal.”), Reg. 31.5 (defining “beneficial use” as “those uses of state surface waters to be protected such as those identified in the classification system”).

⁴⁰ The division’s rebuttal and accompanying exhibits are available online at: https://drive.google.com/drive/folders/1Ql-3i565_lIDlwGPDDrFghzCdC_43q8h?usp=share_link.

⁴¹ See, e.g., 2022 WQCD PPHS at Section IV, https://drive.google.com/file/d/1TiDo-poz5XzdLrPKupPs5alNecxql83Q/view?usp=share_link.



There are potential voluntary measures that can reduce nutrients through nonpoint source reductions, but those are already being worked on through state 319 funding. No additional funding is available to support those efforts at this time. Additional options include mandatory controls on very specific nutrient sources (e.g., implementation of a ban on phosphate fertilizers or detergents) and/or watershed-based nutrient trading through point source to point source trades or nonpoint source to point source trades. Such trades are recognized in Regulation No. 85.

Finally, as explained above in Section IV.A.2, existing regulatory outlets may provide some cost relief to facilities subject to the nutrients regulations. These flexibilities work in conjunction with the proposed rule and not as an alternative to the rule.

VIII. FACTOR 6: A DESCRIPTION OF ANY ALTERNATIVE METHODS FOR ACHIEVING THE PURPOSE OF THE RULE THAT WERE SERIOUSLY CONSIDERED BY THE COMMISSION OR PETITIONER AND THE REASONS THE ALTERNATIVE METHODS WERE REJECTED IN FAVOR OF THE PROPOSED RULE

A. Alternative methods proposed by parties to the rulemaking

The division initially proposed lakes nutrients table value standards to be adopted into Regulation No. 31 with adoption into specific lakes and reservoirs across the state. Stakeholders proposed different regulatory pathways (i.e., less stringent standards), requested the commission delay promulgation of the criteria, and requested the commission adopt language to address water rights concerns. Although the division does not believe these methods would achieve the purpose of the rule and protect DUWS and swim beach uses, the three alternative methods offered in responsive prehearing statements for this rulemaking hearing are summarized below.

- CWWUC suggested the commission delay the Lakes Nutrients Rulemaking hearing. The costs and benefits of this option are captured through Alternative 2, below.
- Northern Colorado Water Conservancy District (Northern) proposed less stringent standards for both total nitrogen (TN) and total phosphorus (TP), as summarized in the table below (Table 6). Northern did not provide any information as to how its proposal would impact costs. Regardless, as noted above in the discussion on Factor 5, the division believes Northern’s proposal would not protect beneficial uses and therefore does not achieve the purpose of the Lakes Nutrients Rulemaking. The division's rebuttal also addresses its evaluation of Northern’s proposal at length in Section XI, B.1; these arguments are not repeated here.



Table 6. Comparison of the lake nutrients standards proposed by the division and in Northern’s alternative proposal.				
	Cold Lakes		Warm Lakes	
	TP (µg/L)	TN (µg/L)	TP (µg/L)	TN (µg/L)
Division Proposal	21	380	47	670
Northern Alternative Proposal - “HY”	25	400	59	690
Northern Alternative Proposal - “nonHY”	44	650	109	1300

- Various parties proposed alternate language to address concerns about water rights. Because the SEO has found the Lakes Nutrients Rulemaking will not cause material injury to water rights, the division finds that no significant costs or benefits are likely to occur from the rulemaking on water rights. Therefore, the division does not believe it is necessary to assess the costs and benefits of this alternative language.

B. Alternatives methods considered in 2023 CBA and relevant to this RA

The 2023 CBA considered three alternatives as listed in the table below (Table 7). All of these are relevant to this RA as well. Alternative 1 is the division’s proposal included in rebuttal; Alternative 2 is the division’s proposal included in rebuttal, but with a five-year delayed effective date for total phosphorus and total nitrogen on lakes and reservoirs below qualified dischargers; and Alternative 3 is a “no action” alternative, where adoption of the division’s entire proposal is delayed to 2027. Alternatives 2 and 3 would result in less progress in controlling nutrients in the immediate years after the adoption of this rule than Alternative 1.



Table 7. Costs and Benefits of Alternatives to the Proposed Rule		
Alternative	Quantitative Benefit/Cost Ratio	Impact to Nutrients Control
1. Adopt the proposal as described in the division’s rebuttal. This proposal includes adoption of chlorophyll <i>a</i> statewide, adoption of revised total phosphorus and total nitrogen standards for lakes and reservoirs in Reg. 31, and adoption of total phosphorus and total nitrogen standards for lakes and reservoirs that are DUWS, swim beach reservoirs, or upstream of qualified dischargers. No delayed effective date.	0.12:1	No delay in incremental progress for nutrient reductions.
2. Adopt the proposal as modified since rebuttal. This proposal includes adoption of chlorophyll <i>a</i> statewide, adoption of revised total phosphorus and total nitrogen standards for lakes and reservoirs in Reg. 31, and adoption of total phosphorus and total nitrogen standards for lakes and reservoirs that are upstream of qualified dischargers. Delayed effective date of 12/31/2027 for DUWS and swim beaches downstream of qualified discharges.	Next five years: No ratio calculated because there is not an increase in cost or benefits as of the date of this RA. After 2027: Costs and benefits will be substantially higher based on statewide application and inflation.	Delays progress for nutrients reduction by five years. The cost of inaction may be seen in reduced benefits.
3. No Action, i.e., delay all statewide action on chlorophyll <i>a</i> , total phosphorus, and total nitrogen to 2027.	No ratio calculated because there is not an increase in cost or benefits.	Delays progress for nutrients reduction.

Alternative 1: Adopt the proposal as described in the division’s rebuttal

Summary: This alternative was the alternative primarily evaluated in the 2023 CBA. This proposal would result in immediate adoption of total phosphorus and total nitrogen standards for lakes and reservoirs with swim beaches, DUWS, and upstream of qualified dischargers. This proposal also includes statewide adoption of chlorophyll *a* standards for lakes, reservoirs, rivers, and streams to protect Aquatic Life, Recreation, and/or DUWS uses. This alternative may be less costly to implement for some facilities today compared to 2027 costs due to inflation. The maps below represent the segments where standards would have been adopted (Figures 2 and 3).

Assumptions and Unknowns: The quantitative analysis for this alternative largely relied on the quantitative analysis in the 2012 CBA adjusted based on inflation. This analysis assumes that the costs and benefits would scale at the same rate. It is unknown at this time how many facilities would have actually received nutrient permit limits based on the adoption of standards on these lakes and reservoirs. In both the 2012 and 2023 CBAs, there are some costs and benefits that can only be qualitatively described. It is unknown how many facilities which may have been subject to the lakes standards



would have pursued other regulatory flexibilities such as site-specific standards, DSVs, or the evaluation of available assimilative capacity/dilution.

Comparison to the 2012 CBA Costs and Benefits: For the 2023 CBA, the costs and benefits are adjusted based on an inflation rate of 1.38 based on CPI and on the limited scope of the rulemaking to a subset of facilities. The benefit to cost ratio for this alternative would be 0.12:1, which is slightly less than that calculated in the 2012 CBA of 0.13:1.

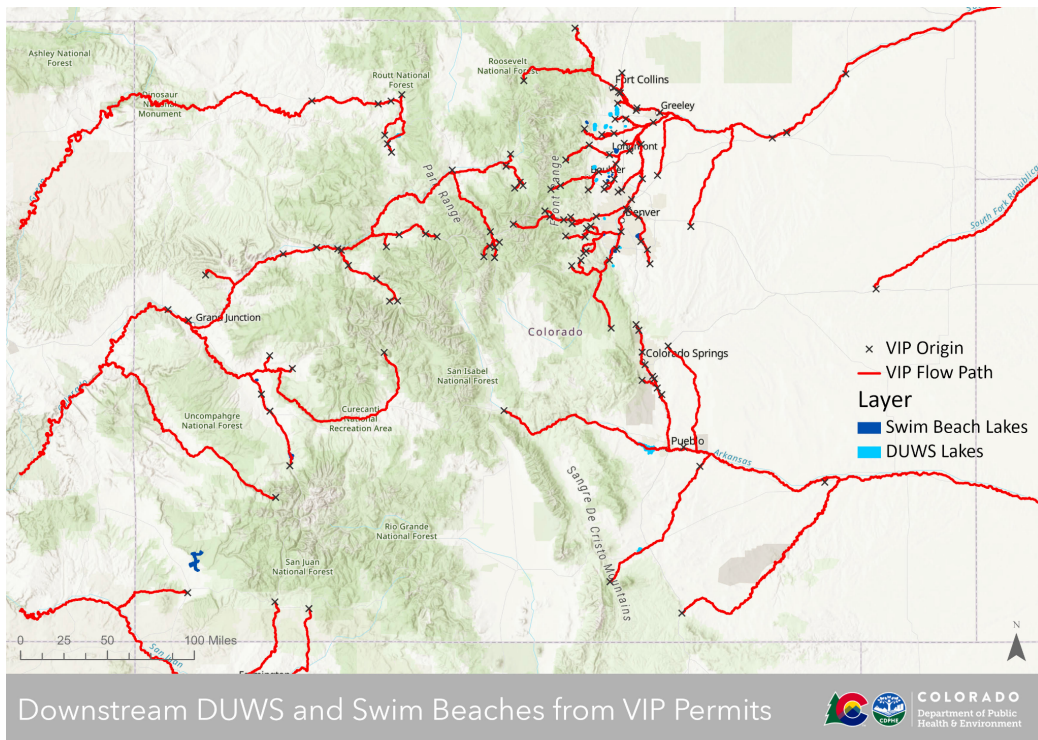


Figure 2. Downstream Flowpaths of Facilities Participating in the Voluntary Incentive Program in Relation to DUWS and Swim Beach Lakes and Reservoirs

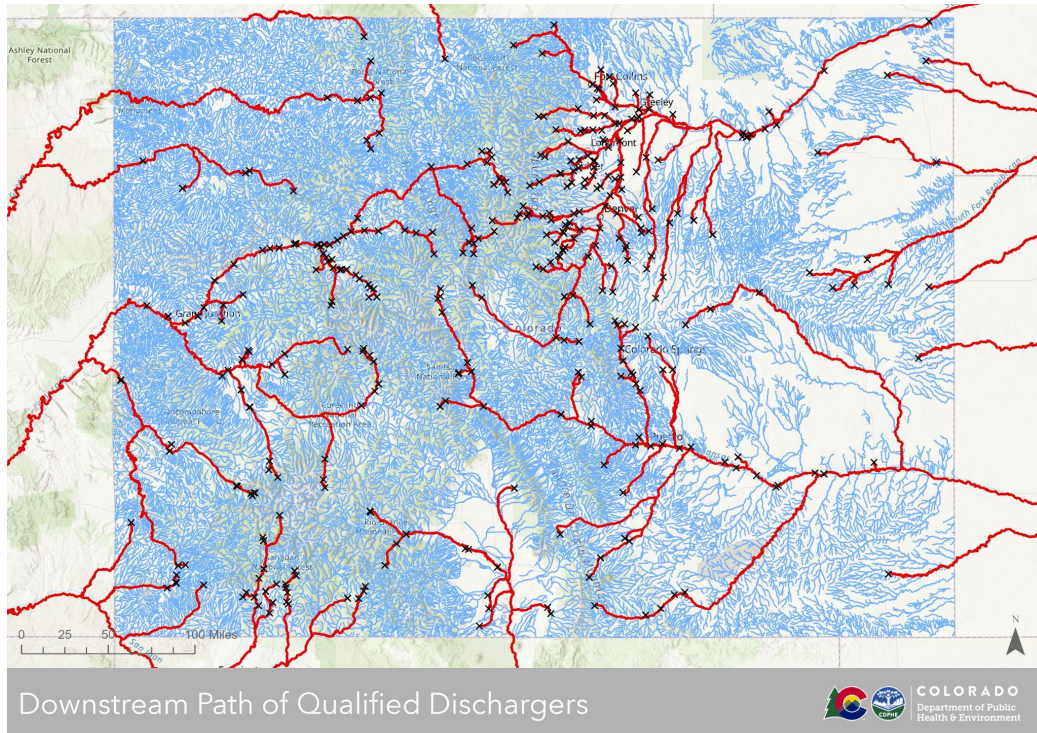


Figure 3. Downstream Flowpaths of Qualified Discharger Facilities

Alternative 2: Delayed implementation – adopt the division’s proposal as modified since rebuttal

Summary: This alternative was presented after the division received rebuttal statements relating implementation concerns. This alternative includes:

1. Adoption of the proposed lakes nutrients criteria for total phosphorus and total nitrogen in Regulation No. 31 as initially proposed and described in the 2023 CBA.
2. The revised total phosphorus and total nitrogen standards for lakes and reservoirs would not go into effect until 12/31/2027 in Regulation Nos. 32-38 for any new segments (i.e., those below qualified dischargers). For the segments above qualified dischargers that already have total phosphorus standards, the total phosphorus standards would be updated and total nitrogen standards be applied in 2023. Beginning 12/31/2027, the revised total phosphorus and total nitrogen standards will be effective statewide on all lakes and reservoirs with Aquatic Life and/or Recreation uses.
3. Statewide adoption of chlorophyll *a* standards for lakes, reservoirs, rivers, and streams to protect Aquatic Life, Recreation, and/or DUWS uses.
4. Prior to 2027, there would be an informational hearing regarding implementation of nutrient standards for both lakes/reservoirs and streams/rivers to discuss results of a stakeholders process to explore regulatory and feasibility options for implementation of nutrient and other standards.

This alternative would potentially harm upstream waters that would otherwise be protected by the revised total phosphorus and total nitrogen standards. This



alternative could also harm existing uses by allowing algae blooms to continue and/or worsen. However, the delay could allow regulated entities to defer capital and operation and maintenance costs for an additional five years.

Assumptions and Unknowns: This alternative assumes that all facilities would delay costs associated with an immediate upgrade in treatment until after 2027, when the standards become effective. While some facilities may begin planning and treatment upgrades prior to 2027, it will not be required per this alternative. After 2027, once the lakes nutrients standards are effective, the costs and benefits would likely be adjusted based on inflation statewide. It is unknown at this time how many facilities would have actually received nutrient permit limits based on the adoption of standards to these lakes and reservoirs.

Comparison to the 2012 CBA Costs and Benefits: There would be no immediate costs or benefits from this alternative. Facilities could defer capital and operation and maintenance costs. But, costs and benefits will likely increase due to inflation between now and 2027.

Alternative 3: No action, i.e., delay adoption of chlorophyll a standards statewide and application of total phosphorus and total nitrogen values for all lakes and reservoirs to 2027

Summary: This alternative is a “no action” alternative where the commission would not adopt the division’s initial proposal and would delay all statewide action on chlorophyll *a*, total phosphorus, and total nitrogen to 2027. This alternative would potentially harm upstream waters that would otherwise be protected by the revised total phosphorus and total nitrogen standards. This alternative could harm existing uses by allowing algae blooms to continue and/or worsen. No action risks increasing harm to existing Recreation, DUWS, and Aquatic Life uses. The impacts of no action are also discussed in Section VI, above.

Drinking water supply treatment costs are expected to increase with rising inflation, but adopting nutrients standards could reduce these treatment costs or slow increases. Based on the 2012 CBA, drinking water treatment providers would save 58 million dollars in treatment costs if the wastewater discharges were protective of drinking water standards. In today’s dollars, this value is estimated to be 75.4 million dollars based on inflation indices for construction, operations and maintenance, and labor costs.⁴²

However, the delay could allow regulated entities to defer capital and operation and maintenance costs for an additional five years.

Assumptions and Unknowns: This analysis assumes that the costs and benefits would scale at the same rate. It is unknown at this time how many facilities would have actually received nutrient permit limits based on the adoption of standards on these lakes and reservoirs.

⁴² This number is calculated using the U.S. Bureau of Reclamation’s Operation and Maintenance Cost Index, <https://www.usbr.gov/assetmanagement/O&M%20Cost%20Index/Att1-Historical-Indexes.pdf>, and the CPI Inflation Calculator, https://www.bls.gov/data/inflation_calculator.htm, and assumes that costs increased by 1.38 times from 2012.



Comparison to the 2012 CBA Costs and Benefits: There would be no immediate costs or benefits from this alternative. Facilities could defer capital and operation and maintenance costs. But, costs and benefits will likely increase due to inflation between now and 2027.

IX. CONCLUSION

As noted at the start of both this RA and the 2023 CBA, both the benefits and costs of the Lakes Nutrients Rulemaking will be significant. The division is proposing the Lakes Nutrients Rulemaking in order to make progress protecting Colorado's waters and beneficial uses from nutrient pollution. Nutrient pollution is a statewide issue and has been a recognized statewide issue for over 40 years. It is a difficult issue to tackle and will continue to remain a difficult issue to tackle.

But, progress must be made to protect the uses of the waters of Colorado and the health of residents and visitors. The division hopes that this RA will help guide the commission's decisionmaking on this difficult issue and result in action which will benefit Colorado for years to come.

