

Northwest Colorado Council of Governments Regional Water Quality Management Plan

**Northwest Colorado Council of Governments
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Section 1. NWCCOG Regional Water Quality Management

In 1972, the Clean Water Act (the Act or CWA) was enacted. In Section 208 of the Act, Congress delegated express authority to state and local governments to develop and implement Regional Water Quality Management Plans, also referred to as 208 Plans.¹ The primary goal of this 208 Plan is to maintain and enhance water quality of waterbodies in the planning area. A crosswalk of 208 Plan requirements and sections of this 208 Plan are included in Appendix A.

1.1. NWCCOG, the Regional Designated Planning Agency

Northwest Colorado Council of Governments (NWCCOG) is the designated regional water quality management agency responsible for water quality planning in Colorado Planning Region 12: Eagle, Grand, Jackson, Pitkin, Routt, and Summit Counties (Figure 1). The Region is the top of the Colorado River and North Platte River watersheds.

NWCCOG is an association of local governments made up of municipalities and counties in Region 12 (Figure 1).

¹ 33 U.S.C. § 1288.

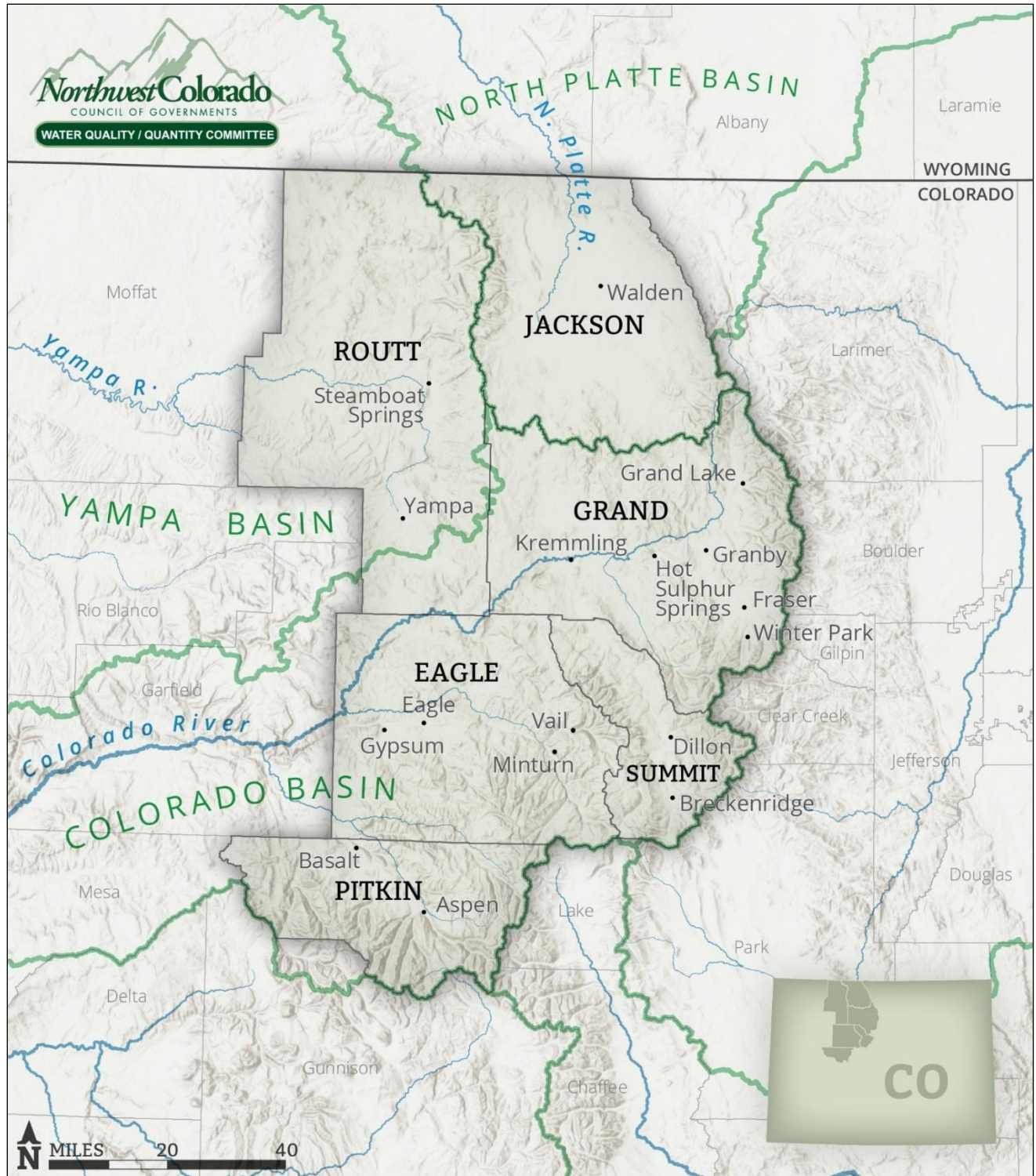


Figure 1: Counties and Watersheds in the NWCCOG Region

1.2. NWCCOG Water Quality/ Quantity Committee

The NWCCOG Water Quality/ Quantity Committee (QQ) is a separate organization that includes counties, municipalities, water and wastewater special districts, and governmental agencies. QQ is responsible for carrying out the 208 Plan as part of its mission to protect and enhance the Region's water resources. In that capacity, QQ provides legal, technical, and policy advice on matters affecting water quality and quantity in the Region.

1.2.1. Management Agencies²

Diffuse "nonpoint sources" of pollution such as runoff from urban development, agriculture, or abandoned mines are not regulated through a federal or state permit system, but are instead left to state, regional, and local governments to address, including through 208 planning.³ Nonpoint source (NPS) pollution is "the leading remaining cause of water quality problems," both nationally and in the NWCCOG Region, and is difficult to regulate.⁴ Section 208 requires a Regional Water Quality Management Plan to "identify procedures and methods (*including land use requirements*) to control to the extent feasible such sources" of nonpoint source pollution.⁵

Nonpoint sources are the leading cause of water quality degradation in the Region. Because the CWA and the Colorado Water Quality Control Act (CWQCA) do not directly regulate nonpoint sources of pollution, local government land use controls are the primary regulatory tool to address nonpoint source pollution.⁶

In this 208 Plan, counties and municipalities are designated as Management Agencies⁷ that can address nonpoint source pollution through their land use authority. Appendix B identifies Management Agencies in the NWCCOG Region.

The 208 Plan calls for NWCCOG local governments to implement the 208 Plan in large part by adopting, strengthening, enforcing, and protecting their regulatory authority to address

² 40 CFR § 130.6 208 Plans shall identify the "agencies necessary to carry out the plan and provision for adequate authority for intergovernmental cooperation in accordance with § 208(b)(2)(D) and 303(e)(3)(E) of the Act. Management agencies must demonstrate the legal, institutional, managerial and financial capability and specific activities necessary to carry out their responsibilities in accordance with § 208(c)(2)(A) through (I) of the Act."

³ *Defenders of Wildlife v. EPA*, 415 F.3d 1121, 1124 (10th Cir. 2005); *Oregon Natural Desert Ass'n v. Dombeck*, 172 F.3d 1092, 1096-97 (9th Cir. 1998).

⁴ EPA, *Basic Information About Nonpoint Source (NPS) Pollution*, <https://www.epa.gov/nps/basic-information-about-nonpoint-source-nps-pollution> (accessed 10/29/2024).

⁵ 33 U.S.C. § 1288(b)(2)(F-I) (emphasis added).

⁶ 33 U.S.C. § 1288(b)(2)(F-I).

⁷ Between 1987 and 1989, NWCCOG signed intergovernmental agreements (IGAs) designating management agencies within each county. There are more management agencies that implement the 208 Plan than those listed in the IGAs but the IGAs create policy and enforcement commitments among signatory local governments that may still be useful. Appendix B includes these IGAs.

nonpoint source water quality issues associated with development. Implementation Measures are provided in Section 2.2.

1.2.2. Operating Agencies⁸

Operating agencies in Region 12 are those organizations that carry out day-to-day wastewater treatment functions and ensure that operational and financial capacity is adequate to protect the waters receiving their wastewater discharges. For example, sanitation districts, industrial dischargers, and municipalities providing wastewater treatment are operating agencies. In addition, counties and municipalities must approve the service plans of special districts within their boundaries who provide wastewater treatment.⁹ Homeowner associations and private owners of wastewater treatment facilities are designated as operating agencies for their own facilities.¹⁰ Operating agencies in the Region are listed in Appendix C.

⁸ Per [WQCC Policy 98-2](#) Operating Agencies as the “agencies necessary to construct, operate, and maintain all facilities required by the plan and otherwise to carry out the plan.”

⁹ C.R.S. 32-1-203 for counties; C.R.S. 32-1-204.5 for municipalities.

¹⁰ *Id.*

Section 2. Policies and Implementation Measures

These policies guide regional water quality planning, implementation of the 208 Plan, and overall water quality protection in the NWCCOG Region.

As the Designated Planning Agency, NWCCOG relies on these policies to evaluate whether applications for land use approvals submitted to counties and municipalities are consistent with the 208 Plan. These policies also guide NWCCOG in determining whether applications for site location and design of domestic wastewater treatment works are consistent with the 208 Plan as discussed in more detail in Section 5.7.

2.1. [Policies](#)¹¹

- Policy 1. Water Quality Protection and Mitigation.** Land use and water project development shall not significantly degrade water quality or the health of the affected watershed(s) within the Region. The developer is responsible for mitigating adverse impacts to water quality and the watershed.
- Policy 2. Transmountain Diversions.** No person shall conduct transmountain diversions of water for use outside the Region without the prior approval of NWCCOG, the local governments and conservancy districts affected by the proposed diversion, and the Colorado River District (CRD).
- Policy 3. Local Government Land Use Regulations.** Local governments in the Region will implement land use regulations that require an applicant for approval of a project to demonstrate that the project is consistent with this 208 Plan. The local government will refer such applications to the NWCCOG Water Quality Administrator for a determination of consistency with the 208 Plan.¹²
- Policy 4. Water Smart Land Use and Development.** Land use and development in the Region shall be planned, designed, and conducted in accordance with best practices including but not limited to Sonoran Institute Growing Water Smart recommendations, NWCCOG Water Quality Protection Standards, and other practices that further water use efficiency, conservation, and water quality protection or enhancement.
- Policy 5. Nonproliferation of Wastewater Treatment Facilities (WWTF).** New wastewater treatment facilities shall not be approved in the Region if existing

¹¹ On November 15, 2024, QQ recommended that NWCCOG adopt the updated policies. On January 23, 2025 NWCCOG adopted these policies for use during consistency reviews until the updated 208 Plan is approved by the WQCC.

¹² The language adopted by local governments may vary (e.g., comply). The intent is the same, projects must be consistent with the 208 Plan.

facilities have the legal and physical capacity or can be expanded or consolidated to provide additional wastewater treatment service.

Policy 6. Private Wastewater Treatment Facility Operation. The ownership and/or management of wastewater treatment facilities by homeowner associations or private wastewater operators shall not be allowed in the Region unless there is no other practicable alternative.

Policy 7. Onsite Wastewater Treatment Systems (OWTS). OWTS shall comply with the regulations of the jurisdiction in which they are planned to be located and should not be allowed in the Region unless developing or connecting to an existing or new consolidated wastewater treatment facility or system is not technically or legally practicable. Where no other alternatives are available, OWTS should be designed, installed, inspected, and maintained to assure effective wastewater treatment and to protect watershed health.

Policy 8. Climate Change. The assessment of the water quality impacts of land use and water development will apply regional climate change predictions.

Policy 9. Chemical Management. The uses of pesticides, fertilizers, algaecides, and other hazardous substances; and road maintenance materials, including deicing and sanding, shall not degrade water quality or the health of the watershed.

2.2. Implementation Measures

These implementation measures are intended to support the 208 Plan policies and maintain and enhance water quality in the Region. Measures will be implemented by NWCCOG, QQ, Management Agencies (counties and municipalities), and Operating Agencies who discharge into waters in the NWCCOG Region.

IM 1. Advocacy for Strong State and Federal Water Quality Protection. During Colorado Water Quality Control Commission (WQCC) proceedings and Water Quality Control Division (WQCD or Division) decision making, federal rulemakings and policy formulation, National Environmental Policy Act (NEPA) processes, and state and federal permit decisions affecting water quality, NWCCOG and/or individual members will advocate for the Region's water quality, including without limitation:

- the protection of classified uses.
- water quality standards that are fully protective of existing water quality.
- antidegradation provisions that take into account impacts to the Region associated with the operation of projects.
- the designation and protection of high-quality waters when conditions justify such designation.
- consideration of projected impacts of climate change to water quality.

- environmental justice.

IM 2. Instream Environmental and Recreational Flows. NWCCOG and its members will seek to preserve stream flows by requesting that the Colorado Water Conservation Board (CWCB) establish, increase, or accept water rights acquisitions for instream flow water rights in the Region. NWCCOG and its members will support efforts to preserve or increase flows that support the aquatic environment and the recreational use of waterbodies in the Region.

IM 3. Local Regulatory Controls to Protect Water Quality. Municipalities and counties will adopt, strengthen, and enforce regulations designed to address water quality impacts of land use and water development. Examples of these controls include without limitation:

- Pursuant to C.R.S. § 31-15-707(1)(b), municipalities have the authority to construct municipal water facilities outside their boundaries and protect them from injury and the water supply from pollution by adopting regulations that apply to development in those areas.
- Municipal and county land use regulations that require compliance with this 208 Plan before a land or water development project can be approved.
- Municipal and county land use regulations that require an applicant to analyze impacts from a project considering future conditions based on climate change.
- County regulations that address the environmental impacts of private use of federal lands as confirmed by the United States Supreme Court in *California Coastal Comm'n v. Granite Rock Co.*, 480 U.S. 572 (1987), which include provisions that address the water quality impacts of these uses.
- Municipal and county land use regulations to protect important waterbodies such as wetlands from the nonpoint source impacts of land use and water development regardless of whether the waterbodies are subject to federal jurisdiction as “waters of the United States.”
- Municipal and county “1041 Regulations” to protect quality for designated areas and activities of state interest under C.R.S. 24-65.1-101 et seq.
- Municipal and county land use regulations requiring the most efficient use of water, including recycling and reuse methods, landscaping requirements, water metering and budgeting, and other water conservation best practices. See, e.g., Sonoran Institute Growing Water Smart materials and NWCCOG’s Water Savings Resource Guide and Model Code Provisions for the Colorado Headwaters.
- County OWTS regulations requiring best practices to protect water quality beyond requirements established in WQCD Regulation 43 (5 CCR 1002-43). Best practices include, for example, establishing minimum lot size for OWTS,

limiting OWTS to one per parcel, establishing certification requirements for OWTS installers and inspectors, and establishing OWTS inspection requirements upon pumping, transfer of title, or annually.

- IM 4. Other Water Quality Protection Tools.** QQ will work with local watershed groups, conservation organizations, and similar organizations to protect waterbodies, floodplains, wetlands, riparian areas, and shorelines through tools such as conservation easements, land exchanges, transfer of development rights, setbacks, and similar techniques.
- IM 5. Monitoring, Assessment, and Planning.** NWCCOG and QQ will conduct and/or provide technical support for water quality monitoring, assessment, and planning efforts led by federal, state, and local organizations, as appropriate.
- IM 6. Federal and State Permitting.** NWCCOG and/or its members will obtain cooperating agency status under NEPA for major federal actions that will affect the Region's water quality. QQ and/or NWCCOG members will review and submit comments on proposed federal permits and as appropriate for projects that impact the Region's water quality to ensure that federal and state agencies require water quality mitigation as a condition of approval.
- IM 7. Voluntary Improvement Projects.** NWCCOG and QQ will facilitate voluntary water quality improvement and stream restoration projects within the NWCCOG Region based on regional water quality priorities.
- IM 8. Stream Management Plans.** NWCCOG and/or QQ will provide technical assistance to municipalities and counties engaged in preparation and implementation of stream management plans and integrated water management plans that identify existing water quality conditions and needs for restoration of streams and watersheds.
- IM 9. Hazardous Materials.** NWCCOG will assist members to encourage responsible management of hazardous household wastes such as pharmaceuticals, oil, paint, acids, and pesticides.
- IM 10. Water Quality/ Quantity Committee (QQ).** NWCCOG will rely on QQ to spearhead regional water quality protection and 208 Plan updates and implementation.

Section 3. Attainment of State Water Quality Standards and Use Classifications

This section describes to what degree waterbodies in the NWCCOG Region attain State water quality standards and classified uses.

The WQCC adopts water quality use classifications and standards that apply to groups or sections of waterbodies called segments.¹³

Water quality use classifications identify the type of water uses in a segment. The current use classifications include agriculture, aquatic life, recreation, water supply, and wetlands. The majority of waterbodies in the Region have agriculture, aquatic life, recreation, and water supply use classifications.

For each stream segment, the WQCC adopts water quality standards to maintain water quality at a level sufficient to protect the classified use. The water quality standard that is most sensitive to a given pollutant is the “effective standard.” This practice assures that all classified uses are protected when the water quality standard for the most sensitive use is attained. The WQCC adopts water quality standards either statewide in [Regulation 31](#) (5 C.C.R. 1002-31) and for specific waterbodies in basin-specific regulations, namely [Regulation 33](#) (5 C.C.R. 1002-31) for the Upper Colorado and Yampa River Basins.

3.1. Attainment of Water Quality Standards in the Region

The WQCC maintains an [Integrated Water Quality Monitoring and Assessment Report](#) (Integrated Report) to comply with the CWA. The Integrated Report identifies the attainment status for each classified use for all segments in the State. The WQCD maintains a [map](#) and [dashboard](#) to help stakeholders more easily access this information. The following terms are used to describe the attainment statuses in this report:

- **Attaining:** attaining the water quality standards for all classified uses (i.e., categories 1a, 1b, and 2¹⁴).
- **Impaired:** The water quality standard for one or more classified uses was exceeded and the segment appears on the 303(d) List as an impaired waterbody (i.e., categories 4 and 5)
- **Potentially Impaired:** refers to waterbodies that appear on the Monitoring and Evaluation List (M&E List), which is incorporated into Regulation 93,¹⁵ where there is

¹³ The WQCD maintains an [Arc GIS online map of stream segments](#); the WQCD updates the GIS resources following changes to the related water quality standards or segmentation.

¹⁴ The categories are reported based on the information included in the 2024 Integrated Report.

¹⁵ [5 CCR 1002-93](#), effective 9/14/2023.

a reason to suspect that the water quality standard for one or more classified uses may be exceeded, but there is uncertainty and/or insufficient data to make a final determination regarding impairment (i.e., category 3b).

- **Lacks Data:** refers to waterbodies that do not have data to evaluate attainment with water quality standards (i.e., category 3a). In the NWCCOG Region many of the segments that lack data are located in wilderness areas or very remote areas.

There are approximately **10,254 miles of Streams and Rivers** in the NWCCOG Region. As illustrated in Figure 2:^{16,17}

- **4,405 miles of streams and rivers (43%) attain the water quality standards applied to protect all classified uses.** In most instances, the streams and rivers have agricultural, aquatic life, recreational, and water supply use classifications.
- **2,677 miles of streams and rivers (26%) are potentially impaired.** The most common causes of potential impairment are total arsenic, dissolved oxygen, and dissolved iron.
- **2,466 miles of streams and rivers (24%) are impaired for at least one classified use due to one or more pollutants.** The causes of impairment are total arsenic, temperature, dissolved oxygen,¹⁸ dissolved iron, and dissolved zinc.
- **Collectively, 5,143 miles of streams and rivers (50%) in the NWCCOG Region are impaired or potentially impaired for one or more pollutants.**
- **705 miles of streams and rivers (7%) lacked water quality data to assess attainment with water quality standards.** A considerable portion of the streams and rivers without current water quality data are located within wilderness or very remote areas; addressing this data gap may not be critical to regional water quality.

¹⁶ The Integrated Report was developed in 2024 from readily available water quality data collected in the NWCCOG Region between 2017 and 2022.

¹⁷ [WRAP](#) data downloaded on November 15, 2025. WRAP uses information reported by WQCD in the 2024 Integrated Report.

¹⁸ Most of the dissolved oxygen impairments are on segments over 100 miles in length with a few sample locations. The data set used to establish the listing tends to be small (<20), outdated, and newer data indicate attainment. Given the data sets, these “impairments” are better characterized as data gaps.

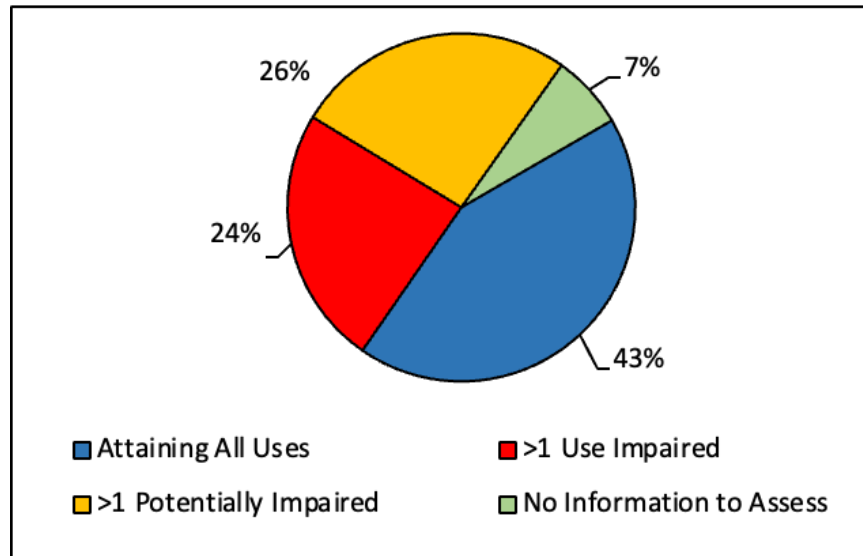


Figure 2. Attainment Status of Streams and Rivers in the NWCCOG Region.

There are approximately **34,622 acres of Reservoirs and Lakes** in the NWCCOG Region. As illustrated in Figure 3:^{19,20}

- **14,433 acres of reservoirs and lakes (42%) attain the water quality standards applied to protect all classified uses.** In most instances, the waterbodies have agricultural, aquatic life use, recreational use, and water supply use classifications.
- **1,349 acres of reservoirs and lakes (4%) are potentially impaired.** The most common pollutants identified as causing potential impairments are total arsenic and dissolved iron.
- **15,764 acres of reservoirs and lakes (45%) are impaired for at least one classified use due to one or more pollutants.** The most common pollutants causing impairments are total arsenic, dissolved iron, and mercury-fish tissue.
- **Collectively, 17,113 acres of reservoirs and lakes (49%) in the NWCCOG Region are impaired or potentially impaired for one or more pollutants.**
- **3,076 acres of reservoirs and lakes (9%) lacked water quality data to assess attainment with water quality standards.** A portion of the streams and rivers without current water quality data are located within wilderness or very remote areas; addressing this data gap may not be critical to regional water quality.

¹⁹ The Integrated Report was developed in 2024 from readily available water quality data collected in the NWCCOG Region between 2017 and 2022.

²⁰ [WRAP](#) data downloaded on November 15, 2025. WRAP uses information reported by WQCD in the 2024 Integrated Report.

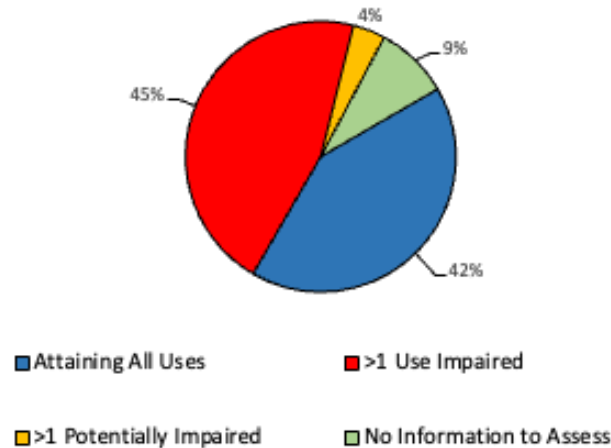


Figure 3. Attainment Status of Lakes and Reservoirs in the NWCCOG Region.

Several watershed groups in the Region collect, analyze, and maintain extensive water quality data sets. These programs are critical to characterizing water quality at the watershed scale and should be relied upon when developing projects to protect and restore water quality or to understand the potential water quality impacts of a proposed development.

3.2. Total Maximum Daily Loads

After a segment has been listed as impaired for exceeding a water quality standard, the CWA requires the WQCD to develop a Total Maximum Daily Load (TMDL) for the waterbody and pollutant(s) of concern.²¹ The TMDL identifies existing rates of pollution from both point and nonpoint sources and then calculates the reduction in loading from each source necessary to attain the water quality standard(s) for each pollutant(s), plus a margin of safety.

These calculations are referred to as waste load allocations for point sources and load allocations for nonpoint sources. Typically, waste load allocations are used to establish permit limitations in the next permit renewal. TMDLs may identify voluntary implementation measures for load allocations.

WQCD has completed eight TMDL reports in the Region that address approximately 55 miles of streams and rivers and over 20 waterbody-parameter combinations.²² This accounts for 2 percent of the impaired streams and rivers in the NWCCOG Region. The TMDLs are summarized by watershed below.

3.2.1. Upper Colorado Watershed

COUCUC06b²³: Unnamed Tributary to Willow Creek for ammonia. This TMDL was completed in 2000. The ammonia standard and the segment boundaries have changed since

²¹ 33 U.S.C. §1313(d)(1)(C).

²² The TMDLs are available [here](#).

²³ Segment COUCUC06b and COUCUC06c were combined into COUCUC06c by the WQCC in 2019.

2000. The current ammonia standard is more stringent than the ammonia standard in effect when the TMDL was developed.

Because the ammonia standard and segment boundary have changed since the TMDL was prepared, the waste load allocation assigned to the Table Mountain Reclamation Facility, operated by Three Lakes Water and Sanitation District, has not been implemented.

The draft renewal permit²⁴ includes ammonia limitations developed from the current ammonia standard, increased monitoring frequencies, and a compliance schedule for ammonia. When finalized, the permit may help reduce the degree of ammonia impairment in the receiving waters.

The ammonia standard was exceeded in 3 samples collected between July 2017 and July 2020 (n= 57). Northern Water routinely collects water quality data in the Willow Creek Watershed. These data should be evaluated further to evaluate potential projects and anticipated water quality benefits.

The East Troublesome Fire burned the Willow Creek Watershed in late 2020. Multiple organizations are addressing post-fire recovery and restoration. Restoration activities on this segment and in the Willow Creek Watershed may support adaptive management efforts to improve clarity in Grand Lake.²⁵ These efforts may address nonpoint source pollution identified in the Willow Creek TMDL.

3.2.2. Blue River Watershed

COUCBL07 and COUCBL06: Mainstem of Peru Creek and all tributaries, Saints John Creek, and Snake River from its Source to Dillon Reservoir for pH, cadmium, copper, lead, manganese, and zinc. The TMDL, approved in 2008, attributes elevated metal concentrations and acidic pH to natural mineralized geology and historic mining activities within the watershed. Multiple mine reclamation projects have occurred since the TMDL was completed; the degree of water quality improvement following implementation was not as large as anticipated. The projects are briefly summarized below:

- **Pennsylvania Mine:** The mine has six levels and is located up-gradient of Peru Creek, a tributary to the upper Snake River. The Environmental Protection Agency (EPA), the Colorado Division of Reclamation, Mining and Safety (DRMS), and other partners installed two bulkheads in the underground mine workings; the work was completed in 2014 and 2015.²⁶ The bulkheads are intended to create a mine pool with anoxic conditions, which typically reduces metal concentrations. Water from the mine pool flows into the surrounding groundwater system and may reach surface waters through diffuse flows, as opposed to a concentrated source at the adit. Together,

²⁴ The draft permit was sent to public notice by WQCD on November 13, 2025.

²⁵ This tributary flows to Willow Creek Reservoir water stored in this reservoir is pumped through Grand Lake as part of the Colorado-Big Thompson Project.

²⁶ [EPA Pennsylvania Mine Website](#).

these factors reduce the impact of water draining from the Pennsylvania Mine, although the benefits were not as large as some parties anticipated.

- **Saints John Mine:** Generally, the site consists of mine workings in the northwest flank of Glacier Mountain, perennially draining adits, multiple waste rock piles near the adits, and smelter and mill tailings on the valley floor immediately adjacent to Saints John Creek, a relatively large tributary to the Snake River near Montezuma. Reclamation activities occurred in two stages- first to address the tailings in the Saints John Creek floodplain and second on the mountainside to control adit flows and stabilize waste rock piles.

First, DRMS removed over 23,000 cubic yards of tailings and placed them in an on-site consolidation area. The removal and consolidation areas were capped and covered with on-site cover material, amendments, and native seed. The removal area was restored to support approximately 3 acres of wetlands.²⁷ This work was completed in 2013.

In 2025, EPA completed a time-critical removal action to reroute the adit discharge away from waste rock piles and reduce runoff and erosion from the waste rock piles.²⁸

COUCBL12: Illinois Gulch and Fredonia Gulch for Zinc and Cadmium. The WQCD prepared the zinc TMDL in 2009 and completed the cadmium TMDL in 2011; the data and analyses are similar and will be summarized together. Based on the TMDL, the Puzzle Mine²⁹, an inactive mine adjacent to Boreas Pass Road outside of Breckenridge, is the primary source of cadmium and zinc in Illinois Gulch. In 2020, EPA required the owner of the Puzzle Mine to reduce flow to the mine workings, move water away from waste piles, install a passive treatment system, consolidate and cap mine waste, and sample nearby residential properties. Some work was completed in 2021, and monitoring was scheduled for 2022. Additional details are not provided on the project website.³⁰

COUCBL18: Straight Creek for Sediment. WQCD prepared a TMDL to attain the narrative sediment standard for the portion of Straight Creek downstream of Interstate 70 (I-70). The TMDL identified the cut and fill slopes of I-70 and the application of traction sand as the primary causes of impairment. The TMDL identified several control measures including revegetation and appropriate application and subsequent removal of traction sand, and several other best management practices (BMPs) to control sediment and attain the narrative water quality standard for sediment. In 2017, aquatic life use-based sediment criteria were met in Straight Creek, and the Creek was reported as attaining the standard in

²⁷ [Project Summary: Saints John Mine and Mill Complex.](#)

²⁸ [EPA Saints John Mine Project Website.](#)

²⁹ Also known as the Puzzle-Ouray Mine. EPA refers to the mine site as the Illinois Gulch Site.

³⁰ [EPA Illinois Gulch Project Website.](#)

2018.³¹ Macroinvertebrates collected from Straight Creek in September 2016 had low multimetric index scores and the segment is provisionally listed for macroinvertebrates.³²

3.2.3. Eagle River Watershed

COUCEA05a, 5b, and 5c and COUCEA07: Eagle River and Cross Creek for copper and zinc.

In 2009, the TMDL identified the Eagle Mine and other abandoned mine sites as the primary sources of copper and zinc. The Eagle Mine is an EPA Superfund site. Metal concentrations have declined due to reclamation and improved treatment at the Eagle Mine. In the most recent assessment period, zinc concentrations attained the site-specific standard in COUCEA05b and exceeded the site-specific standard in COUCEA05a and COUCEA05c. Additionally, the Eagle River exceeds the arsenic, iron, and cadmium water quality standards in these segments. In the most recent assessment, the lower portion of Cross Creek attained the copper and zinc standards but is potentially impaired for arsenic.

Aside from Cross Creek, water quality standards have not been attained on the segments with TMDLs in the Eagle River Watershed.

There are no approved TMDLs in the Roaring Fork, Upper Yampa, Colorado River from the Blue River to Roaring Fork River, and the North Platte watersheds.

3.2.4. Future Total Maximum Daily Loads in the Region

Arsenic. Approximately 1,778 miles of rivers and streams, which equates to 72 percent of the impairments in the NWCCOG Region, are listed as impaired for arsenic concentrations that exceed the water supply use standard. Like the rest of Colorado, arsenic impairments are widespread throughout the NWCCOG Region, most likely caused by arsenic from naturally occurring geologic sources. Activities that expose sediment or accelerate erosion such as mining or construction activities may increase arsenic concentrations. The WQCD plans to revise the arsenic standard prior to 12/31/2034. Therefore, the WQCD has decided that it is not practical to develop arsenic TMDLs at this time.

Metals. A substantial number of segments in the NWCCOG Region are listed as impaired for metal concentrations (e.g., cadmium, copper, zinc) that exceed the water quality standards used to protect aquatic life. In many cases, natural geology and historic abandoned mines cause the pollution responsible for these impairments in the NWCCOG Region. As these are considered nonpoint sources, they would be addressed by load allocations in the TMDL but mechanisms to improve water quality are limited because funding to address nonpoint source pollution from legacy mine features is minimal due to liability concerns (see Section 4.6).

³¹ https://www.epa.gov/sites/default/files/2020-12/documents/co_straight_creek_1934_508.pdf

³² The rationale for the provisional macroinvertebrate listing is provided on pages 74-76 of the Regulation 33 Rationales (WQCD Exhibit 4) provided in the 2024 Regulation 93 Rulemaking Hearing.

WQCD TMDL Prioritization. In 2024, the WQCD published a prioritization framework³³ and a list of segments where TMDLs or advanced restoration plans, a near-term plan or description of actions that is more immediately beneficial or practicable to achieving the water quality standard(s), are currently in development.³⁴ WQCD identified nutrients, sediment, selenium, uranium, and *E. coli* as the priority pollutants for the current cycle (2024 to 2032). The current prioritization does not include any segments in the NWCCOG Region.

Given the number of impaired waters in the NWCCOG Region, an efficient and effective approach to develop TMDLs is needed. TMDL development in the Region is complicated by the impacts of TMDs. Where the TMD is subject to a 401 Certification, the certification instructs the applicant, affected parties, and the Division to develop alternative restoration plans.

3.3. Waterbodies Subject to Antidegradation Review in the NWCCOG Region

The Colorado regulatory scheme, consistent with the CWA, includes a system for protecting existing quality and preventing incremental degradation of water quality, called the “antidegradation policy,” along with the use-based water quality standards.³⁵ Colorado's antidegradation review requirements apply before any new or increased water quality impacts are permitted in reviewable waters.

The WQCC designates waterbodies into one of three antidegradation designations as an element of the water quality use classifications and standards.³⁶

Within the NWCCOG Region, the designations are as follows:

1. **Reviewable waters.** Reviewable waters are waters that are of high quality. If a segment is not designated as outstanding or use-protected, it is reviewable. There are 8,813 miles of “reviewable” waters in the NWCCOG Region.

“Antidegradation review procedures shall apply to the review of regulated activities with new or increased water quality impacts that may degrade the quality of ... reviewable waters.”³⁷ Regulated activities are any activity that requires a discharge permit, water quality certification, or which are subject to state control regulations.

A significance determination is the first step in an antidegradation review and the purpose is to determine whether the regulated activity is likely to cause significant degradation of water quality. If the regulated activity is likely to cause significant degradation, it may only be authorized if the regulated activity is “necessary to accommodate important economic or social development in the area in which the

³³ [Colorado TMDL Prioritization Framework](#).

³⁴ <https://cdphe.colorado.gov/tmdl-prioritization>.

³⁵ 33 U.S.C. § 1313(4)(B).

³⁶ 5 CCR 1002-31.8.

³⁷ 5 CCR 1002-31 31.8(3)(a).

waters are located” and there are no reasonable alternatives that result in less or no water quality degradation.³⁸ The antidegradation review process provides significant water quality protections.

2. **Outstanding waters.** Outstanding waters are provided the highest possible level of protection: no degradation is allowed.³⁹ There are 19 segments, totaling 1,220 miles, designated as “Outstanding Waters” in the NWCCOG Region. These Outstanding Waters are generally within federal lands with special protections, such as Wilderness Areas and National Parks, or immediately downstream of such areas. No permitted facilities discharge to Outstanding Waters in the NWCCOG Region.
3. **Use protected waters.** Regulated activities may degrade water quality up to the water quality standards in use protected waters. There are seven “use protected” segments, totaling 221 miles, in the NWCCOG Region. These segments are located in Routt County (186 miles) and Summit County (35 miles). Six permitted facilities discharge to use-protected segments in the NWCCOG Region, including one publicly-owned treatment works (POTW) in Summit County and five industrial facilities in Routt County.

Antidegradation review is particularly important in the NWCCOG Region for three primary reasons:

1. Eighty-six of the waters in the NWCCOG Region are high quality waters designated as “reviewable waters,” subject to anti-degradation review. As part of antidegradation review, the WQCD must notify “any regional council of governments, county, local health departments, and cities and towns that the WQCD believes may be affected by the proposed activity,” and must consider comments by such entities.⁴⁰ NWCCOG provides comments during these anti-degradation reviews.
2. Any regulated activity that may result in a discharge into “Waters of the United States” and for which a federal 404 Permit or Federal Energy Regulatory Commission (FERC)

Figure 4. Antidegradation Designations in the NWCCOG Region.

³⁸ 5 CCR 1002-31 31.8(3)(d).

³⁹ Regulations allow for very limited “[s]hort-term degradation . . . for activities that result in long-term ecological or water quality benefit or clear public interest.” 5 CCR 1002-31.8(1).

⁴⁰ 5 CCR 1002-21.16(B).

license is required, must obtain a 401 Certification issued by WQCD pursuant to the CWA § 401 and CCR 1002-82. A 401 Certification must include antidegradation review for reviewable waters.⁴¹ “Any certification issued by the Division pursuant to these regulations shall apply to **both the construction and operation** of the project for which a federal license or permit is required, and shall apply to the water quality impacts associated with the project.”⁴² “Operation” includes all waters that are impacted by the project, so if a 404 Permit is required for reservoir construction on the eastern side of the Continental Divide for a TMD system, the 401 Certification must take into account the impacts to water quality associated with construction of the reservoir and the water quality impacts caused by changes in the amount and timing of flows on the West Slope, even if no construction occurs in the headwaters.⁴³

Colorado also regulates the discharge of dredged and fill materials in state waters where activities do not require a federal 404 Permit through a discharge authorization program that generally parallels the federal 404 Permit process.⁴⁴

3. WQCD staff conduct antidegradation reviews when discharge permit limitations are established for facilities that discharge to reviewable waters. Where existing water quality in the reviewable water is of higher quality than the applicable water quality standard, discharge permit limits must ensure pollutant concentrations in the receiving waters do not exceed the baseline water quality. Baseline water quality was defined by the WQCC in 2000 and is equal to the “low-flow pollutant concentration as of September 30, 2000⁴⁵ and in ideal circumstances includes data collected from 1995-2000.”^{46,47} The antidegradation review process provides a “second layer of protection beyond the water quality standards for reviewable waters.”⁴⁸

⁴¹ 5 C.C.R. 1002-82.5(A)(1)(a).

⁴² 5 CCR 1002-82.2(5) (emphasis added).

⁴³ 5 CCR 1002-82.5(A)(1)(a).

⁴⁴ 5 CCR 1002-87.6(7)(e).

⁴⁵ 5 CCR 1002-31.8(3)(c)(ii)(B).

⁴⁶ *Id* at page 27.

⁴⁷ In limited instances, the typical antidegradation period (1995-2000) is inappropriate. In the NWCCOG Region, the antidegradation period for portions of the Eagle River (Segment COUCEA05a, b, and c) was redefined due to water quality improvements that occurred following remediation of the Eagle Mine.

⁴⁸ Antidegradation Significance Determination for New or Increased Water Quality Impacts Procedural Guidance, December 2001 at page 2. Also known as the “AD Guidance” and available [here](#).

3.4. Groundwater in the NWCCOG Region

Groundwater, which is water stored beneath the earth's surface and typically accessed via wells or springs, is an important part of the Region's water supply, especially for domestic use in unincorporated areas of counties.

The NWCCOG Region includes seven tributary groundwater aquifers⁴⁹:

- Alluvial aquifers primarily near the towns of Eagle and Gypsum and along the Roaring Fork and Fraser Rivers.
- Piceance Basin, which includes portions of Pitkin County, and also Moffat, Rio Blanco, Garfield, Mesa, Delta, Gunnison and Montrose Counties.
- Eagle Basin, primarily in Eagle and southern Routt Counties.
- Dakota-Cheyenne group is found on the lower Blue River north of I-70 in Summit and Grand Counties, on both sides of I-70 just west of Glenwood Springs,
- Middle Park Basin, comprising a large swath of Grand County.
- North Park alluvial aquifers in Jackson County.

The WQCC has adopted use classifications and standards for tributary groundwater and requires permits for discharges into tributary groundwater.⁵⁰

The quality of groundwater in the NWCCOG Region can vary widely, especially groundwater that originates from deep formations. Alluvial aquifers, typically used for domestic and agricultural purposes in the Region, tend to have water quality characteristics similar to the adjacent waterbody.

Groundwater contamination has occurred in the NWCCOG Region (e.g., the Town of Frisco abandoned a well due to PFAS contamination). Pollutants have also been detected, on occasion in shallow alluvial aquifers in urban settings throughout the NWCCOG Region.⁵¹ Proper siting, design, and maintenance of OWTS is critical to protecting shallow alluvial aquifers and is discussed further in Section 4.5.

None of the groundwater aquifers in the NWCCOG Region have been designated as a [Sole Source Aquifer](#).

⁴⁹ As reported in the [Statewide Water Quality Management Plan \(2011\) Chapter 7](#) and [Chapter 11](#).

⁵⁰ WQCC [Regulation 41](#) establishes the basic standards for groundwater to protect existing and potential future beneficial uses of groundwater. WQCC [Regulation 42](#) establishes site-specific groundwater standards, including standards for five areas in the NWCCOG Region. Discharges to groundwater, like surface water, are controlled by WQCC [Regulation 61](#).

⁵¹ USGS, Water Quality in alluvial Aquifers of the Southern Rocky Mountains Physiographic Province, Upper Colorado River Basin, Colorado 1997, WRIR 99-4222.

Section 4. Nonpoint Source Pollution Management and Control

This section examines the principal sources of NPS pollution in the NWCCOG Region and concludes by identifying strategies, programs, and processes to address NPS pollution.

NPS pollution is “the leading remaining cause of water quality problems,” both nationally and in the NWCCOG Region.⁵²

As discussed below, TMDs that export water to the Front Range from the headwaters of the NWCCOG Region by tunnels through the Continental Divide. TMDs have created substantial water quality problems because they cause significant reductions in the amount of flow and alter the natural hydrograph in many streams and rivers in the NWCCOG Region. The primary sources of NPS pollution in the NWCCOG Region include:

- Urban Development and Runoff
- Runoff from Roadways
- Onsite Wastewater Treatment Systems⁵³

This section discusses these top sources of NPS pollution as well as a host of other sources of NPS pollution including abandoned mine lands, in-basin diversions, agricultural grazing and irrigation, wildlife, silviculture, impacts from recreation runoff, and invasive species. Climate change exacerbates the water quality impacts of NPS pollution as discussed in Section 6.0.

Several types of NPS pollution are directly related to development and land uses associated with increasing urbanization. Because the NWCCOG Region continues to grow rapidly, there is an increased need to prevent and reduce NPS pollution attributed to activities in the Region. NWCCOG members address these impacts through land use regulations.

4.1. Transmountain Diversions

TMDs that export water from the headwaters of the NWCCOG Region to the Front Range are 100% consumptive to the basin of origin. Basin of origin is the term used to describe the watershed where the diverted water originates. Many TMDs rely upon collection systems that gather water from the upper reaches of several tributaries. For example, the Homestake

⁵² US EPA, Basic Information About NPS Pollution, <https://www.epa.gov/nps/basic-information-about-nonpoint-source-nps-pollution> (accessed 4/18/2023).

⁵³ As identified by QQ members in 2022, see [Nonpoint Source Pollution Assessment for the NWCCOG Region](#). The Assessment primarily consisted of interviews with NWCCOG members and partners. NWCCOG conducted 27 interviews with 4 counties, 16 municipalities, 3 water and sanitation districts, and 4 watershed groups. Many interviews included 3-5 people representing a local government, while others were one-on-one conversations.

Project diverts water from Homestake Creek and five of its tributaries, in the headwaters of the Eagle River Watershed.⁵⁴ TMD collection systems may divert all water in these small creeks. On a larger scale, TMDs remove water from the basin of origin and water quality impacts are observed many miles downstream. The magnitude of TMDs in the NWCCOG Region are discussed in Section 4.2.6

TMDs have created substantial water quality problems because they cause significant reductions in the amount of flow and alter the natural hydrograph in many streams and rivers in the NWCCOG Region. Moreover, most TMDs in the Region were constructed before there were any regulatory requirements to mitigate such impacts.

4.2. Existing TMDs

There are eight major TMDs in the NWCCOG Region.⁵⁵ Over the last thirty years, TMDs removed water from the NWCCOG Region at the following rates during various year types:^{56,57}

4.2.1. Grand County- Headwaters of the Colorado River

- The Moffat Tunnel TMD removed 33 percent of the native flow in the Fraser River below Crooked and Ranch Creeks.
- TMDs removed 62 percent of the flows from the Colorado River below Windy Gap Reservoir. Flows in this portion of the Colorado River are diverted in the Grand River Ditch, Colorado Big-Thompson Project, and Moffat Tunnel TMDs.
- The Moffat Tunnel Collection System⁵⁸ diverts 6 percent of the Williams Fork River.
- Flow in the Colorado River downstream of the confluence with the Blue River, near Kremmling, is reduced due to TMD projects in Grand and Summit Counties.
- Under drought conditions,⁵⁹ TMD diversions in Grand County removed up to 80 percent of native flows in the Colorado River Watershed downstream of Windy Gap Reservoir.

⁵⁴ [Citizen's Guide to Colorado's Transbasin Diversions](#) at page 11.

⁵⁵ [Colorado Division of Water Resources](#).

⁵⁶ In an average year gauge flows in the basin of origin ranged from the 25th to 75th percentile.

⁵⁷ Estimated Transmountain Diversion Impacts to West Slope Headwaters Subbasins. Lotic Hydrological, December, 2025. See Appendix E.

⁵⁸ Water is moved via the Gumlick, Jones Pass, and Vasquez Tunnels from the Williams Fork to the Fraser River Watershed and ultimately diverted into the Moffat Tunnel.

⁵⁹ In drought conditions flow in the basin of origin gauges ranged from the 0 to 5th percentile.

4.2.2. Summit County- Blue River Watershed

- The Continental Hoosier TMD removed approximately 31 percent of the flow in Blue River at Blue River.
- TMDs removed 30 percent of the flow in the Blue River at Dillon Reservoir Dam. The TMDs include the Roberts Tunnel, Continental Hoosier System, Vidler Tunnel, and Straight Creek Tunnel.
- Flows in the Blue River downstream of Dillon Reservoir are reduced by 30 percent and further altered by reservoir releases from Dillon and Green Mountain Reservoirs.
- Under drought conditions, TMD diversions in Summit County removed up to 55 percent of native flows in the Blue River Watershed at Dillon Reservoir.

4.2.3. Eagle County- Eagle River Watershed

- TMDs removed about 53 percent of the flow in Homestake Creek at Gold Park. The TMDs include the Homestake Project, Wurtz, Ewing, and Columbine ditches.
- TMDs removed approximately 24 percent of the flow in the Eagle River near Minturn.
- Under drought conditions, TMD diversions in Eagle County removed approximately 44 percent of the native flows of the Eagle River near Minturn.

4.2.4. Pitkin County- Roaring Fork Watershed

- The Fryingpan Arkansas TMD removed approximately 37 percent of the flow in the Fryingpan River upstream of Ruedi Reservoir.
- Flows in the Frying Pan River downstream of Ruedi Reservoir were reduced by 37 and further altered by reservoir releases.
- The Twin Lakes Tunnel diverted approximately 54 percent of the flow in the Roaring Fork River near Aspen.

Table 1 reports TMD diversions as a percentage of native flow by location and year type and is an excerpt of the technical brief prepared by Lotic Hydrological in 2025.

Watershed	Location	Drought	Dry	Average	Wet	Flood	All Years
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	48	41	33	29	20	33
	Colorado River blw Windy Gap	80	77	62	48	38	61
	Williams Fork near Leal	22	11	6	3	2	7
Blue	Blue River at Blue River	36	38	31	20	8	29
	Straight Creek nr Dillon (Laskey Gulch)	6	3	2	2	2	3
	Blue River at Dillon Dam (all major reservoir tribs.)	55	42	30	14	18	30
Eagle	Homestake Creek at Gold Park	70	64	53	46	48	54
	Eagle River near Minturn	44	30	24	18	20	25
Roaring Fork	Fryingpan River at Meredith (above Ruedi Res.)	22	33	37	35	37	35
	Roaring Fork abv Difficult Creek nr Aspen	55	60	54	47	26	52

Table 1. Estimated Annual TMD Diversions as a percentage of Native Flow at Selected Gauges in the NWCCOG Region During Various Year Types (modified from Lotic Hydrological, 2025).

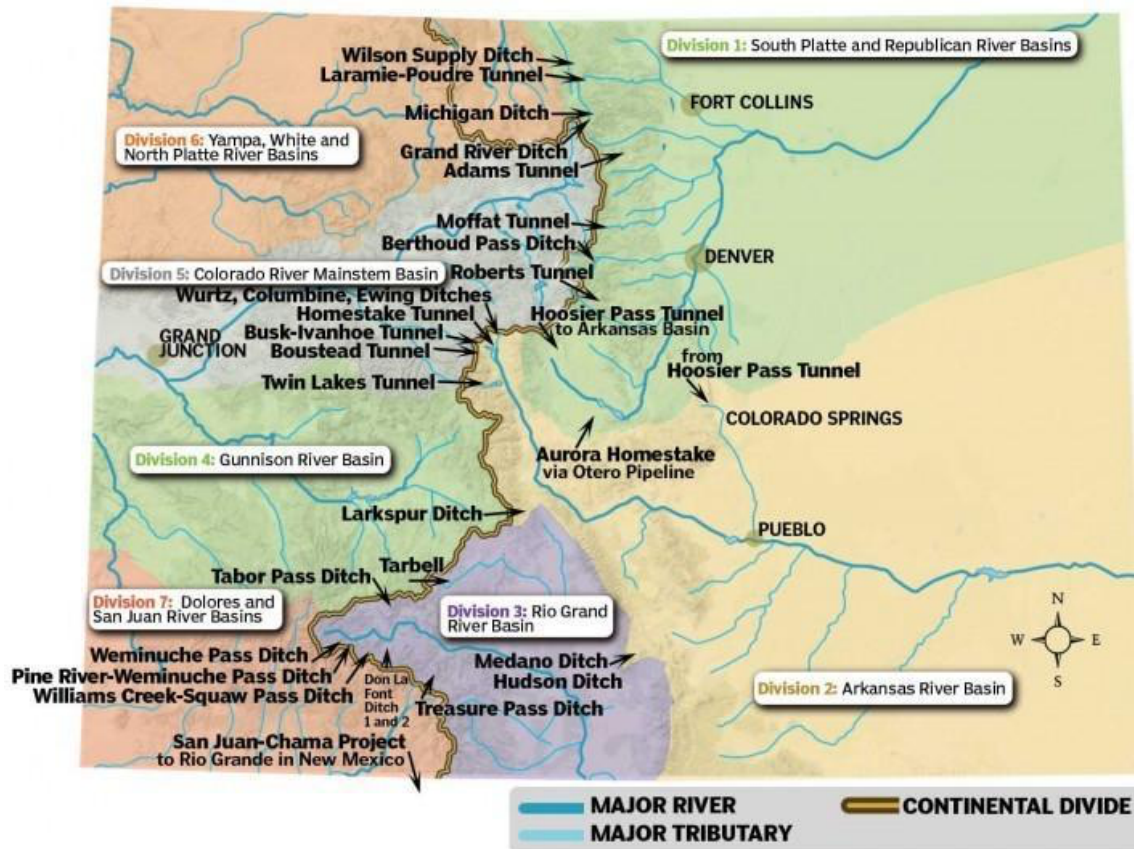


Figure 6: NWCCOG Region Watersheds and Transmountain Diversions

Source: Colorado River District, <https://www.coloradoriverdistrict.org/map-gallery/>

4.2.5. Future Transmountain Diversions

The NWCCOG Region has been dealing with the impacts of TMDs since the first project to divert water to the Front Range went on-line in 1880. Currently, there are a handful of TMD-related projects either under construction or contemplated for the next 20 years.

If the planned and proposed TMDs are developed, additional water will be diverted from the NWCCOG Region and existing impacts to water quality and quantity would become more severe. Due to legal and physical water availability, the proposed and pending TMD projects are expected to divert water from the NWCCOG Region during wet and average years. Currently, wet years provide some degree of relief from the on-going impacts of existing TMD projects. This relief will be reduced by pending and proposed TMDs and the on-going impacts of climate change.

Continued and improved collaboration is necessary to prevent the collapse of the rivers and ecosystems that the NWCCOG Region relies upon. Water smart development and increased water conservation throughout the state, including in Front Range communities, is beneficial to water quality and watershed health in the NWCCOG Region. Section 4.14 discusses

adaptive management measures that are critical to maintaining water quality in the NWCCOG Region.

Windy Gap Firming Project (WGFP). WGFP will be using existing infrastructure in the Upper Colorado Watershed to deliver a firm yield of approximately 30,000 acre-feet/year (AF/yr) to municipalities and agricultural water users on the northern Front Range. To accomplish this, Northern Water is constructing a new storage reservoir on the Front Range, Chimney Hollow Reservoir, that would store water from the existing Windy Gap portion of the Federal Colorado-Big Thompson TMD system. Water quality and environmental enhancements are captured in the WGFP 404 Permit, Final Environmental Impact Statement, Fish and Wildlife Mitigation Plan, 401 Certification, 2012 Intergovernmental Agreement for the Learning by Doing Cooperative Effort⁶⁰, and 1041 permit issued by Grand County. As of 2026, Northern Water is constructing Chimney Hollow Reservoir.

Moffat Collection System. Denver Water will expand [Gross Reservoir](#) to provide storage for additional water diversions from the Fraser and Williams Fork Rivers and their tributaries. The project will use existing infrastructure in the NWCCOG Region to provide an additional 18,000 AF/yr for use on the Front Range. These diversions will occur in average to wet years when water is legally and physically available.⁶¹

Gross Reservoir is currently under construction and is expected to be completed by 2027; the permit is in litigation. Mitigation and environmental enhancements are captured in the 2012 [Colorado River Cooperative Agreement](#) (CRCA) and the Records of Decision for the Moffat Collection System Project 404 Permit and Army Corps of Engineers (USACE) approval.

Continental-Hoosier System Project. Colorado Springs Utilities plans to expand Montgomery Reservoir, located in Park County, to deliver an additional 4,000 AF/year, on average, from the headwaters of the Blue River in Summit County. Currently project development and negotiations are underway. Colorado Springs Utilities reports that reservoir construction activities could be completed as soon as 2032.

Wildhorse Reservoir. Aurora Water proposes to construct a new off-channel reservoir in Park County that would, in part, store additional TMD water. The increased diversions rely upon existing water rights and infrastructure⁶² that remove water from the headwaters of the Roaring Fork, Fryingpan, and Eagle rivers. Additional storage would allow for increased diversions from the NWCCOG Region in wet and average years. Aurora Water's goal is to begin construction around 2030, pending receipt of all required permits.

Homestake Partners Project. The long-contemplated potential TMD project that would provide for the diversion and storage of conditional water rights of the "Homestake Partners"

⁶⁰ The 2012 Intergovernmental Agreement between the Northern Water Conservancy District, Grand County, Middle Park Water Conservancy District, and the CRD is available [here](#).

⁶¹ Moffat Collection System Record of Decision at page 1.

⁶² Aurora Water diverts water from the NWCCOG Region through the Columbine Ditch, Homestake Tunnel, Busk-Ivanhoe System, and Independence Tunnel.

(Colorado Springs and Aurora Water) in the Eagle River watershed. This conceptual TMD project, spearheaded by the “Homestake Partners” of Colorado Springs and Aurora, would consist of a new reservoir near the headwaters of Homestake Creek (Eagle River Watershed) to deliver water to Turquoise Lake into the Arkansas Basin via the Homestake Tunnel.⁶³ Total incremental depletions from the project are estimated at 17,900 acre-feet per year.⁶⁴ In 1998 Colorado Springs Utilities and Aurora Water signed an MOU with west slope entities, called the “[Eagle River MOU](#),” which outlines a joint TMD and in-basin water storage project. At this point, it is unclear whether a future TMD proposal would include any in-basin water storage.

Box Creek Reservoir (Aurora & Lake County). Development of Box Creek Reservoir in Lake County would increase storage in the Arkansas Basin for use by the City of Aurora and Lake County. The project may enable increased TMDs from Headwaters Counties.⁶⁵

Arkansas Basin Reservoir Enlargements TBD. Enlargement of existing East Slope storage associated with the Fry-Ark project may include Pueblo Reservoir in Pueblo County and Turquoise Reservoir in Lake County. Enlargement of these reservoirs may enable increased TMDs from Headwaters Counties.⁶⁶

4.2.6. Water Quality Impacts of Transmountain Diversions

TMDs are detrimental to water quality because they do not return any water to the basin of origin, and result in a substantial loss of flow for many streams and rivers in the NWCCOG Region. Some headwaters streams experience a complete loss of flow during certain times of the year. Decreased stream flow impacts several water quality characteristics, including, but not limited to:

- Increased stream temperatures, larger variability in stream temperatures, and unnatural temperature regimes downstream of dams.
- Decreased dilution, which can increase the overall impact of pollutants introduced in downstream waters.
- Loss or reduced scale, duration, and frequency of high flow events which over time alters sediment transport dynamics, and has an array of site-specific consequences (e.g., increased fine sediment deposition in critical spawning habitat).
- Water quality changes attributed to hydrologic modification affect aquatic and riparian habitat and wildlife that rely upon those habitats.

⁶³ <https://www.csu.org/blog/homestake-water-project-decision>.

⁶⁴ Colorado River Risk Study Phase IV Final Report, 2023, https://crwcd.wpenginepowered.com/wp-content/uploads/2024/05/2024_03_29-Phase-4-WaterSmart-CRD-TRANSMITTAL-multiple-deliverables.pdf

⁶⁵ South Platte Basin Implementation Plan Volume II, Appendix C

⁶⁶ <https://www.secwcd.org/content/enlargement>. Accessed on 6/4/2024

- Altered flows due to channel and habitat modifications can cause erosion, the loss of riparian and in-channel habitat, loss of connection with floodplains, and increased sediment deposition, which can also be harmful to aquatic life and habitat.
- Reduced flows decrease the assimilative capacity (i.e., ability to accept pollutants without exceeding water quality standards) that would otherwise be available to wastewater treatment facilities which creates on-going and complex permit compliance challenges.
- Low flow impacts are compounded by drought and climate change. Climate change increases evapotranspiration and increases outdoor water demand on the Front Range in the TMD service area. Both factors reduce flows in the basin of origin.

The following table further presents some direct, indirect, and secondary impacts attributed to TMDs.

Table 2: Examples of Environmental Impacts from TMDs

Direct Impact	Indirect Impact	Secondary Impacts
Increased pollutant concentrations	Loss of assimilative capacity	Loss of dilution flows that offset pollutant discharges from WWTFs and acid mine drainage Negative impacts to members' ability to treat water and wastewater
Loss of natural hydrograph	Lower base, flushing, and channel maintenance flows	Impacts to terrestrial fauna; freezing of exposed fish spawning beds; aquatic species impacts
Increased temperatures, sediment	Degradation of aquatic life- decreased abundance and diversity	Algal blooms, other extreme reactions to temperature increases Low dissolved oxygen levels
Loss of wetland values, functions	Increased flooding Loss of pollution filtering	Loss of aquatic, wildlife, and bird habitat
CBT pumping	Loss of clarity in Grand Lake	Reduction of recreation/ tourism; Adverse economic impact
Reductions in stream flows, generally	Harm to water-based recreation	Adverse economic impact

4.3. Urban Development and Runoff

Runoff from urban areas can increase pollutant loading to adjacent waterbodies and groundwater. Urban runoff can substantially alter the timing and quantity of water delivered

to adjacent waterbodies and groundwater. This occurs as urban development replaces native landscapes with impervious areas (e.g., roads, parking lots, houses, etc.) and compacted soils (e.g., parks, trails, etc.).

An increase in impervious surface area affects water quality in two primary ways. First, it eliminates water infiltration, pollutant filtration, and energy dissipation that would have occurred on an undisturbed landscape, and second, impervious areas facilitate pollutant transport and increase water velocity which can cause additional erosion when urban runoff reaches native soils. These altered runoff characteristics can increase sediment transport, pollutant loading, and in many cases increase the likelihood of flooding.

Generally, NPS pollution from urban runoff occurs during and following precipitation and snowmelt events. Urban runoff frequently delivers the following pollutants into waterbodies, wetlands, and groundwater:

- Sediment
- Pathogens including viruses and bacteria
- Nutrients
- Dissolved solids (salts)
- Metals
- Pesticides
- Oil, grease, road salts, and other chemicals
- Thermal pollution⁶⁷
- Trash

While most of the land in the NWCCOG Region is undevelopable mountainous terrain, rural, or minimally developed natural landscapes, the Region includes many small areas of relatively concentrated urban development. Due to continued population growth and tourism, urban areas are expected to increase in size and density. Because many of the NPS pollution issues discussed in this section have a direct link to the use of land for urban development, careful land use planning is necessary to reduce the impacts of urban runoff.

Until an urban area exceeds specific criteria, urban runoff is not subject to regulation as a point source. Urban runoff typically becomes regulated as a Municipal Separate Storm Sewer System (MS4) when the population exceeds 10,000 and the population density exceeds 1,000 people per square mile. Stormwater as a point source is discussed further in Section 5.0.

Urban development can also directly impact waterbodies through construction and siting of development. Municipal and county land use controls regulate siting and construction practices can impact water quality. These regulations also use stream, wetland, and riparian

⁶⁷ US EPA, Nonpoint Source: Urban Areas, <https://www.epa.gov/nps/nonpoint-source-urban-areas> (accessed April 18, 2023).

buffers to protect waterbodies from adverse impacts of development. Surface disturbance from new development is restricted within buffers, and local governments may enforce against a property owner who infringes on the established buffer. NWCCOG's [Model Water Quality Protection Standards for the Headwaters](#) (2019) recommends an absolute inner buffer of 25 feet from streams, wetlands and other waterbodies, and a variable outer buffer of up to 100 feet based on site-specific conditions that warrant extra protections.

4.4. Roadway Runoff

Runoff from roadways causes water quality problems similar to those described for urban runoff. Unlike urban runoff, roadway runoff, which occurs along all roads, occurs in both heavily and minimally developed areas. Rural and forest roads often parallel waterways and in some cases are not paved. Unpaved roads typically require increased maintenance, dust suppression, and may invite more off-road traffic than paved roads.

Roadway runoff accumulates sediment, salts, and nutrients as it flows over impervious road surfaces and adjacent cut or fill slopes. To a lesser degree, metals, petroleum products, and hazardous materials spilled along roadways have also been documented to impact water quality in nearby waterbodies. These pollutants can negatively impact aquatic life, especially macroinvertebrates.

The Colorado Department of Transportation (CDOT)⁶⁸, US Forest Service (USFS), Bureau of Land Management (BLM), counties, and municipalities are responsible for managing roads in the NWCCOG Region. A wide variety of erosion and sediment control measures are used for new projects as well as on-going maintenance.

Runoff from many state highways and county roads continue to deliver pollutants to adjacent waterbodies. As development increases in further-afield areas of the Region, new roads have potential to increase pollution in waterbodies that have not been previously impacted by roadway runoff. Proper local regulation and standards for siting and construction of roadways should always address and mitigate these impacts. Road maintenance, snow removal, and dust suppression should provide for public safety while protecting water quality and watershed health. Likewise, road construction and maintenance activities on public lands should consider the water quality impacts of roads, particularly in areas tributary to public water supplies. Colorado law gives local governments authority to regulate within five miles upstream of its drinking water intakes to protect its waterworks from pollution or other injury.⁶⁹ NWCCOG strongly recommends the use of watershed protection ordinances.

4.5. Onsite Wastewater Treatment Systems (OWTS)

NWCCOG strongly encourages the use of centralized wastewater treatment for development wherever possible. OWTS, also known as septic systems, are often necessary in rural areas

⁶⁸ CDOT is an MS4 Phase 1 stormwater permittee.

⁶⁹ C.R.S. § 31-15-707(b).

where centralized wastewater treatment is not available or impracticable. OWTS are most frequently used in unincorporated areas that lack consolidated wastewater services provided by municipalities, special districts or homeowners associations. When properly designed, installed, and maintained, OWTS effectively treat wastewater and maintain water quality conditions. But when improperly designed, installed, sited, or poorly maintained, OWTS are a well-documented water quality problem.⁷⁰ In these circumstances, OWTS can be a substantial source of pathogens, nutrients, and other pollutants.

WQCC Regulation 43 establishes the minimum requirements for OWTS in Colorado and delegates authority to permit, inspect, test, supervise, maintain and clean, dispose of waste material, and to issue cease and desist orders to local public health authorities (LPHAs). In the NWCCOG Region, county governments serve as the LPHAs. As of 2024, NWCCOG counties have adopted the majority of the "opt-in" criteria in Regulation 43 including: OWTS inspections, OWTS certifications to assure maintenance is performed by qualified personnel, inspection upon transfer of title, and replacement of failing systems.

During interviews conducted in late 2022, some respondents reported that OWTS regulations are working very well to protect water quality, but also flagged that many systems are aging and could lead to problems in the future. Many residents that live in homes that are served by OWTS do not have the funds to maintain or fix failed systems. Respondents reported a gap in available state funding to help, especially individual homeowners that are not associated with a homeowners association or other larger entity that could apply for government grants.

4.6. Abandoned Mine Lands

There are an estimated 23,000 abandoned mine sites on both public and private land in Colorado, many of which are in the NWCCOG Region. Many historic abandoned mines predate any regulatory controls and have left behind serious water quality issues. Runoff accrues metal and/or acidity after interacting mine tailings, waste rock or other mineralized features. Some abandoned mine sites include adits or other features that deliver contaminated water to local waterways.

These remnants of mining activities typically contain multiple metals, and sulfide minerals which form sulfuric acid when exposed to water. Many metals are toxic to aquatic life at low concentrations and act as "stressors" at sub-lethal concentrations. Acidity can also cause aquatic life mortality and act as a stressor to aquatic life.

In the NWCCOG Region, local governments have been leaders in remediation efforts, often in partnership with the EPA and the DRMS, local watershed groups, and others. [Summit](#)

⁷⁰ Robertson, William, 2021, [Septic System Impacts on Groundwater Quality](#). The Groundwater Project, Guelph, Ontario, Canada.

[County](#) partnered with Summit Water Quality Committee and various groups to clean up a host of mine sites and miles of river restoration in the Blue River Watershed (Figure 6).

In interviews with NWCCOG members in 2022, respondents did not rate metals or pollution from abandoned mine lands as a top concern. This is surprising because metals from inactive mines continue to be a common cause of degradation to the Region's water quality, and NWCCOG local governments together with the state Abandoned Mine Land (AML) Program,

Blue River Before Restoration



Blue River After Restoration and "Naturalization"



Figure 6: Blue River Before and After Restoration

Source: Summit County, Colorado Mines to open space: <https://www.summitcountyco.gov/1184/Mines-to-Open-Space>

Summit Water Quality Committee, and many other partners have long invested in remediation of AML lands and discharges to restore water quality. The 2015 Gold King mine spill, which released approximately 3 million gallons of toxic water into the Animas River watershed, has also drawn attention to the potential liability of "Good Samaritans" and may explain why addressing metals pollution from AML was not a top priority for members who were interviewed.⁷¹

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The EPA designates severely contaminated sites for clean up under CERCLA, which is informally called Superfund. There are two Superfund sites in the NWCCOG Region:

- [Eagle Mine](#) in Eagle County, one mile south of Minturn.
- [Smuggler Mountain](#) in Aspen, Pitkin County.

⁷¹ Wood, Jonathan, [Prospecting for Pollution: The Need for Better Incentives to Clean Up Abandoned Mines](#), Property and Environmental Research Center (PERC), February 2020.

4.7. In-Basin Diversions

In-basin diversions, where the diverted water is used within the basin of origin, can also cause adverse impacts on the Region's water quality. In general, that impact is more limited than the impacts of TMDs because in-basin diversions generally tend to impact smaller stretches of river and a portion of the diverted water returns to the system at downstream locations.



Figure 7. Low Flows on the Crystal River in Oct. 2020

Source: Heather Sackett, Aspen Journalism. <https://aspenjournalism.org/studies-tackle-water-replacement-options-for-shortages-on-crystal-river/>

Agricultural uses account for most of the in-basin water use in the Region. Depending on the watershed, between 88% and 98% of water usage is for agriculture.⁷² Municipal and industrial uses account for the remaining 2 to 12%.

The Crystal River, a major tributary to the Roaring Fork River, has extreme low flows during average and dry years. Water is diverted for both agricultural and municipal uses in this reach.

4.8. Agricultural Grazing and Irrigation

Agricultural grazing and runoff from agricultural irrigation can mobilize sediment, nutrients, pesticides, and dissolved solids to waterbodies and/or groundwater from associated land disturbance and fertilizer application. In addition, crop and forage production is responsible for large water withdrawals for irrigation, as well as riparian and wetland disturbance and loss which has secondary impacts on water quality. Runoff from agriculture including

⁷² Colorado Basin Implementation Plan (Colo BIP), Volume 1 at 30:
https://dnrweblink.state.co.us/cwcbsearch/0/edoc/216707/Colorado_BIP_Volume1_2022.pdf.

irrigation return flows are not considered point sources under the CWA⁷³ and Colorado Water Quality Control Act,⁷⁴ and thus are nonpoint sources of pollution in waterbodies.

Return flows from irrigation may sustain late season streamflow for fisheries and recreation, and agricultural land can provide wildlife habitat.⁷⁵ The effect and magnitude of irrigation return flows are dependent upon numerous site-specific factors including irrigation method, soil characteristics, geology, crop type, and topography. In the NWCCOG Region, pasture grass and alfalfa, supported by flood irrigation, are the most common crops.

In the NWCCOG Region, a number of initiatives have begun to use agricultural water more efficiently, reduce water quality impacts, and improve soil health. Often these initiatives also improve the long-term sustainability of agricultural operations.

4.9. Wildfire

Wildfires have acute and long-term negative water quality impacts. While wildfires have always been a part of the Colorado landscape, climate change-driven aridification has increased the severity and number of wildfires in Colorado.⁷⁶ After wildfire, loss of canopy vegetation and changes to soil properties can result in more water flowing over the land surface during storms, leading to flooding, erosion, and delivery of sediment, ash, pollutants, and debris to surface water. This can result in decreased water quality, loss of reservoir storage capacity, stream habitat degradation, and increased treatment costs for drinking water providers.⁷⁷

In the past two decades the extent and severity of forest disease have increased throughout the NWCCOG Region. Common forest diseases include mountain pine beetle, spruce beetle, western spruce budworm, Douglas-fir beetle, and others. While there are multiple factors contributing to the increased incidence of forest disease, climate change and fire suppression practices are primary causes. Water quality impacts from wildfire events can include sedimentation resulting from flash flooding and debris flow events and long-term loss of wetlands and riparian areas that were naturally filtering pollutants from up-gradient areas.

In the NWCCOG Region, development occurs in the wild-urban interface and wildfire mitigation strategies are critical to protecting human life, infrastructure, and public water supplies.

⁷³ 33 U.S.C. § 1361(14).

⁷⁴ C.R.S. § 25-8-103(14).

⁷⁵ Coley/Forrest, Inc., [Water and Its Relationship to the Economies of the Headwaters Counties](#), December 2011, at 30-31.

⁷⁶ J. T. Overpeck and B. Udall, [Climate Change and the aridification of North America](#). PNAS, Vol. 117. No. 22. 11856-11858. (2020).

⁷⁷ USGS, [Water Quality After Wildfires](#), accessed May 25, 2023.

In 2020, Colorado experienced many of its largest and costliest wildfires in history. In **Grand County**, the 193,000-acre East Troublesome Fire (Oct. 2020) continues to impact water quality, and Grand County and partners continue restoration efforts.⁷⁸

In **Eagle County**, the Grizzly Creek Fire burned more than 32,000 acres in the Colorado River watershed in Glenwood Canyon in 2020. Subsequent debris and ash wreaked havoc on the Colorado River and I-70 as it runs along the river. Water supplies downstream were also impacted by the level of debris, and recovery is ongoing.



Figure 8. Debris flows in Glenwood Canyon, 2021. Source: Colorado Department of Transportation.

Strategic logging, with appropriate best management practices, and other vegetation management techniques may be necessary to protect water supplies, limit fire severity and extent, and encourage regrowth. Currently, several organizations in the NWCCOG Region are

⁷⁸ For more information on the fire and watershed recovery efforts in Grand County, visit their [website](#).

developing Wildfire Ready Action Plans (WRAPs).^{79,80} These plans are intended to help communities identify and mitigate fire and post-fire risks such as debris flows, hillslope erosion, water quality degradation, and flooding. Vegetation management may be included as a wildfire mitigation technique.

Much of the areas impacted by the wildfires is managed by federal agencies, so federal agencies conduct much of the recovery work in partnership with counties and other local governments.

4.10. Silviculture

Silviculture (logging) tends to occur on lands managed by the USFS and BLM. Some silviculture occurs on private land primarily to reduce wildfire risk. Logging and other vegetation management practices (e.g., controlled burns) are necessary to maintain and improve forest health and mitigate wildfire risk. In the NWCCOG Region, development occurs in the wild-urban interface and wildfire mitigation strategies are critical to protecting human life, infrastructure, and public water supplies.

Silviculture activities can increase sediment, nutrient, and dissolved solid loading in local waterbodies by increasing soil compaction and removing vegetation. Logging operations often require construction of temporary or permanent roads. Minimizing new road construction, reducing water crossings and proximity to waterbodies, decreasing the severity and extent of soil compaction, and assuring the roads are properly decommissioned is critical to minimizing watershed health and water quality impacts attributed to logging activities. Several counties in the Region regulate the environmental impact of silviculture by private parties on federal lands.

4.11. Pesticides

The application of pesticides near waterbodies can lead to water quality degradation, especially in smaller waterbodies or with increased exposure to pesticides. For example, Gore Creek through the Town of Vail experiences both; it's a small creek with significant development up to, and sometimes within, the riparian area through the Town. Gore Creek is identified as impaired for aquatic life (i.e., a lack of healthy macroinvertebrates), and evidence points to pesticide application as a significant cause of impairment.

Municipalities and counties in the Region continue to address pesticide pollution but are currently limited to adopting regulations "pursuant to a stormwater management program .

⁷⁹ [Blue River WRAP](#), Grand County WRAP, Steamboat Front WRAP, Roaring Fork WRAP, Twin Lakes WRAP, [Bear River WRAP](#)

⁸⁰ CWCB maintains a map of [WRAP areas](#) on the [Wildfire Ready Watersheds website](#).

. . . or to protect surface and groundwater drinking water supplies” under the Pesticide Applicators Act.⁸¹

4.12. Recreation Activities

Recreation is a major year-round activity in the NWCCOG Region. Recreation can impact water quality and watershed health in a myriad of ways, including:

- Social trails used to access waterways disturb vegetation, native soils, and habitat and may reduce bank stability.
- Introduction of *E. coli* and other pollutants through improper disposal of human and pet waste due to lack of facilities.
- Introduction of pesticides and other pollutants from irrigation of golf courses, parks, and other recreational amenities.
- Reduction of flows due to water diversions for irrigation of golf courses, parks, and other recreational amenities or snowmaking.
- Increased population density generally results in greater demand for recreational opportunities, which are often centered around water, especially in mountain communities.

Many NWCCOG Members have invested in improved recreational facilities including installing and maintaining boat put-ins and takeouts, permanent and portable toilets, designated parking areas, and similar infrastructure implementation to improve recreational experience and to protect water quality and watershed health.

4.13. Invasive Species

Invasive Species are non-native aquatic and terrestrial plants, animals, and pathogens that have a harmful impact on natural resources and the human use of those resources. Top invasive species with a water quality nexus in Colorado (aquatic nuisance species, noxious weeds, and non-native phreatophytes) are discussed below.

4.13.1. Aquatic Nuisance Species

Aquatic Nuisance Species (ANS) are invasive plants and animals that are transported and released, intentionally or unintentionally, into waterbodies outside of their historic range. ANS can completely alter aquatic systems by destroying native plant and animal habitats; threatening the diversity and abundance of native species; and damaging industrial, agricultural, and recreational activities dependent on surface waters.⁸²

⁸¹ C.R.S. § 35-10-112.5(3)(a)(I).

⁸² Colorado Parks and Wildlife (CPW), [State of Colorado Aquatic Nuisance Species Management Plan](#) (Dec. 2022) at 7, accessed June 8, 2023.

There are four primary ANS threats to Colorado: zebra and quagga mussels, New Zealand Mudsnail, Rusty Crayfish, and Eurasian Watermilfoil. Mysis shrimp were introduced to several lakes in the Region as a food source to increase lake trout production. However, there is increasing evidence that Mysis shrimp may create more issues than benefits. Several partners involved in managing Grand Lake's clarity are conducting studies to better understand the potential benefits of eradicating non-native Mysis shrimp (see Section 4.14 Grand Lake for additional discussion).

The most concerning ANS are **quagga and zebra mussels**, which have infested lakes, reservoirs, and water infrastructure in almost every state in the West. In July 2025, Colorado Parks and Wildlife (CPW) officials confirmed the presence of zebra mussels at Highline Lake State Park, outside of Grand Junction, the Colorado River near New Castle, and in Eagle County. The Colorado River from the confluence of the Roaring Fork River in Glenwood Springs to the Colorado-Utah border is now considered "positive" for zebra mussels.⁸³ To date, quagga mussels have not been found in Colorado waterbodies, but ANS inspection programs routinely intercept them.

Once present in a waterbody, zebra and quagga mussels pose environmental and economic concerns, including:

- Owners and managers of dams and reservoirs pay astronomically and perpetually to keep water infrastructure open enough to let water flow through them to homes, farms, and power plants.
- Zebra and quagga mussels can filter up to one liter of water per day per mussel to consume phytoplankton in the water column. This can have serious impacts on fish and aquatic life because phytoplankton form the base of the food web in most aquatic ecosystems.
- By altering the population dynamics of plankton, zebra and quagga mussels can allow blue-green algae (a type of plankton) to flourish and increase the probability of



⁸³ <https://www.cpr.org/2025/07/22/colorado-river-positive-zebra-mussels/>.

harmful algal blooms that can result in beach or waterbody closures to protect human health.⁸⁴

New Zealand Mudsnaills are present in the NWCCOG Region. The Eagle River (from the confluence with Milk Creek to the confluence with the Colorado River) and Brush Creek (from the Eagle River to its east and west forks) have been infected with New Zealand Mudsnaills since 2023. According to CPW, New Zealand Mudsnaills are “voracious eaters that reproduce rapidly,” and thus “they deplete aquatic habitats of food for native species, damaging ecosystems in the process. Aquatic insect larvae, native snails and fish are all affected. These mudsnaills are also able to pass through a fish's digestive system unharmed, leaving the fish malnourished — and the mud snail free to eat, reproduce and do more damage to the surrounding habitat”.⁸⁵

The **Rusty Crayfish** are present in the NWCCOG Region as well, including in Granby Reservoir, Catamount Reservoir, Stagecoach Reservoir, and the Yampa River. “Rusty Crayfish are native to the Ohio River Basin, and may have been introduced to Colorado by anglers using them as bait. Being larger and more aggressive, they outcompete native crayfish for food and habitat. These crayfish will eat aquatic insects, small fish and fish eggs. They also eat aquatic vegetation, which native fish rely on for spawning, cover and food.”⁸⁶

There are no **Eurasian Watermilfoil** present in the NWCCOG Region as of 2025.⁸⁷

The primary method for preventing ANS infestations is through Colorado’s Watercraft Inspection and Decontamination (WID) Program. CPW has 72 boat inspection and decontamination stations that are operated collaboratively by state, local, federal, and private entities. The stations conduct over 450,000 inspections annually and have decontaminated over 280 boats with mussel infestations coming into Colorado from out-of-state.⁸⁸

Local governments in the NWCCOG Region contribute annually to ensure local reservoirs and lakes have fully-operational decontamination stations. In 2018, the Colorado General Assembly established an invasive species sticker that both in-state and out-of-state boats are required to purchase to fund the WID program.⁸⁹ This funding source greatly contributed to sustainable funding that relieved pressure from local governments.

⁸⁴ CPW, State of Colorado Aquatic Nuisance Species Management Plan (Dec. 2022), [CO-ANS-Management-Plan.pdf](#), at 27, accessed Nov. 28, 2025.

⁸⁵ CPW, Aquatic Nuisance Species webpage, <https://cpw.state.co.us/aquatic-nuisance-species>, accessed Nov. 28, 2025.

⁸⁶ *Id.*

⁸⁷ *Id.*

⁸⁸ CPW, Aquatic Nuisance Species webpage, <https://cpw.state.co.us/aquatic-nuisance-species-program#230548828-3356024224>, accessed Nov. 28, 2025.

⁸⁹ See [HB 18-1008](#), the Mussel-Free Colorado Act.

4.13.2. Noxious Weeds

Noxious Weeds are terrestrial or aquatic exotic plants that out-compete native plants for light, space, and nutrients. By displacing native plants, weeds eliminate necessary forage, shelter, and habitat for wildlife. Noxious weeds can be particularly harmful in ecologically-sensitive riparian areas, wetlands, fens, and smaller ephemeral streams. The Colorado Department of Agriculture develops and maintains [lists of various categories of noxious weeds](#).

Counties must conduct weed control and management within their jurisdictions. County weed management also generally includes partnerships with municipalities, federal land management agencies, and other large landowners to address noxious weeds on other properties. Counties also conduct education and outreach to reduce the spread and prevalence of noxious weeds on private properties.

4.13.3. Non-native Phreatophytes

Phreatophytes are deep rooted plants that acquire water from a constant source such as along streams or in areas with a shallow water table. Non-native invasive plant species can negatively impact water quality and displace native plant species that provide habitat, stream shading, stream bank stabilization and organic material that serves as the basis of the food chain in aquatic ecosystems. Tamarisk (also known as salt cedar) and Russian Olive are two plant species presently replacing the native cottonwood/willow riparian habitats in the lower elevations of the Region. Certain terrestrial noxious weeds also negatively impact water quality through increased soil erosion.

4.14. Recommended Strategies, Projects, and Programs to Address Nonpoint Source Pollution

In addition to the policies and implementation measures in Section 2.0, NWCCOG and members will take the following actions to manage and control nonpoint source pollution. Additional or alternative actions may also be appropriate; this list is not exhaustive and the strategies, projects, and programs should be tailored to the specific nature and location of the nonpoint source pollution.

Local Land Use Regulation. Recall that, because the CWA does not regulate nonpoint sources of pollution, local government land use regulations aimed at water quality protection is the key way to address NPS pollution in the Region.

NWCCOG/QQ has developed guidance for NPS pollution reduction measures through the [Model Water Quality Protection Standards](#) and [Water Savings Resource Guide and Model Provisions for the Colorado Headwaters Region](#). QQ members generally report that construction, revegetation, and snow storage regulations designed to minimize NPS pollution are all working well.⁹⁰ Several jurisdictions are reducing runoff from daily activities,

⁹⁰ [2022 NWCCOG NPS Survey](#)

such as landscape watering, by requiring additional water efficiency measures in new development, such as requiring the installation of drought resistant landscaping and water-efficient irrigation technology.

Stream Restoration Projects. Local nonprofits and state, federal, and local agencies implement stream restoration projects that address nonpoint source issues.

Local watershed groups are often leaders in developing and identifying partners for these types of projects, along with local, state, and federal agencies. These nonprofits are citizen-led and often focus on stream restoration projects. See the Colorado Watershed Assembly's [list of watershed plans](#), to identify watershed groups and other local partners.

For example, the stakeholder group Learning By Doing (LBD), formed by groups negotiating expansions of TMDs in Grand County, completed the [Fraser Flats Restoration Project](#) on 0.9 miles of the Fraser River to create a smaller stream channel that is more appropriate for current stream flows, which are significantly reduced from natural levels because of TMDs.

Local governments may enter into IGAs to share stream restoration responsibilities to address water quality issues. For example, the [Colorado River Cooperative Agreement](#) established LBD and required the signatories to acknowledge LBD in the 404 Permit applications for Denver Water's Moffat Project and Northern Water Subdistrict's Windy Gap FIRMING Project. The LBD IGAs establish a long-term partnership of cooperation, not conflict, among the groups.⁹¹

⁹¹ LBD webpage, <https://www.grandcountylearningbydoing.org/>, accessed Nov. 25, 2025. IGAs are available here: <https://www.grandcountylearningbydoing.org/about.html>.



Figure 10. Stakeholders from Learning By Doing tour the Fraser Flats Restoration Project (Sept. 2017).

Source: Torie Jarvis

Instream Flow Leases/ Loans/ Acquisitions. Water rights holders may loan, lease, gift, bequeath, or sell water rights to the [Colorado Water Conservation Board](#) to meet instream flows in stream reaches. This technique has been helpful to addressing low flows on the Crystal River, for example. Local governments may, in some instances, use water rights to boost stream flows.

The [Colorado Water Trust](#) serves as a facilitator for water rights owners who want to use some or all of their water to benefit rivers and streams, similar to a land trust that works with landowners to protect natural habitat.

Shoshone Water Rights Preservation. The Shoshone Power Plant in Glenwood Canyon diverts water from the Colorado River to produce electricity. The Shoshone Power Plant water rights total 1408 cfs and are among the most senior water rights in the Colorado River (Shoshone Water Rights).⁹² Because of their seniority, the “call” of Shoshone Water Rights sends water from the headwaters to the Colorado River in Glenwood Canyon on a year-round basis.

The Shoshone Water Rights increase flows and reduce stream temperatures in the Upper Colorado River Basin upstream of the power plant, particularly during late summer in dry years. These environmental benefits of the Shoshone Water Rights’ operation are so substantial that they are referenced in several important permits and processes including the 404 permits authorizing WGFP and Moffat System Project, the 15-Mile Reach

⁹² 1250 cfs in a 1902 water right and 158 cfs under a 1929 water right.

Programmatic Biological Opinion used to protect four endangered fish species, and the USFS-BLM Report Biological and Recreational Resources Dependent on Colorado River Flows through Glenwood Canyon, which is critical to the Upper Colorado Wild and Scenic Alternative Management Plan.

In 2023, the Colorado River District entered into a Purchase and Sale Agreement with Public Service Company of Colorado (PSCo) to permanently acquire the Shoshone Water Rights.⁹³ There are several critical steps required for permanent acquisition:

- **Instream Flow Water Right:** In November 2025, the CWCB voted unanimously to accept the River District and PSCo's proposal that the CWCB acquire an interest in the Shoshone water rights for an instream flow use on the Colorado River. QQ and several members supported the proposal jointly as the "Headwaters Parties" because of the region's reliance on the Shoshone flow regime to support its environment and economy.
- **Water Court Decree for Instream Flow Use:** in 2026, the Colorado River District, PSCo, and CWCB filed an application before the Colorado Water Court in Garfield County to add an instream flow use to the Shoshone Water Rights. The case is still pending before the state court.
- **Secure Financing:** The Purchase and Sale Agreement, signed by PSCo and the CRD in 2023, requires \$99 million for the transaction. To date, the financial commitments total approximately \$97 million and include contributions from many QQ members.
- **Approval of the transaction from Colorado's Public Utility Commission.**

Grand Lake Adaptive Management (GLAM). In April 2016, the WQCC established Goal Qualifiers as a measure to guide an adaptive management process to improve clarity in Grand Lake. This adaptive management process is formalized and embodied in an MOU among Reclamation, Grand County, Northern Water, River District, and NWCCOG.⁹⁴ In August 2026, the parties agreed to a 30-year extension to the MOU. The MOU also contemplates many nonpoint source control projects, restoration activities, and related initiatives. The MOU includes a permanent funding source.

For example, Northern Water in partnership with Colorado State University, BOR, CPW, and the Three Lakes Watershed Association are conducting a detailed study, referenced above, to identify the impacts of Mysis shrimp on the ecosystem of Grand Lake and its impact on water clarity. Mysis shrimp were introduced to the Three Lakes System in the 1960s and 70s as a food source for lake trout. Subsequent ecological studies indicate that Mysis shrimp consume daphnia and other planktonic filter feeders which severely reduce their populations. Daphnia and similar organisms consume particulates in the water column

⁹³ <https://www.coloradoriverdistrict.org/shoshone-permanency-takes-a-step-forward-with-historic-water-deal/>

⁹⁴ <https://www.co.grand.co.us/?bidId=>

which tends to improve water clarity. Mysis shrimp also consume and redistribute nutrients found on the lake bottom, which further alters the natural water clarity regime.

Water Conservation and Efficiency Measures. Reducing the amount of water used for urban development and agriculture can help supplement flows that have been reduced because of TMDs and in-basin diversions. These reductions could be from more efficient infrastructure, local regulation requiring more efficient water use, or other measures.

NWCCOG encourages communities across the state to use water conservation and efficiency measures. This includes on-going support of the Sonoran Institute's Growing Water Smart program. Additionally, NWCCOG advocates for water conservation and efficiency in the legislature, during WQCC rulemaking hearings, and during updates to the Colorado Water Plan. Water conservation on the Front Range may reduce the rate of TMD diversions.

Participation in Federal Permitting Processes. Projects that involve a "major federal action," such as projects occurring on federal land or that require a federal permit, also require environmental review under NEPA. NWCCOG and local governments often serve as cooperating agencies during NEPA and the process that may accompany a federal permit process, providing important local input on the environmental and socioeconomic impacts of the project that should be mitigated.

Project Mitigation through Adaptive Management. Local, state, and federal permitting may integrate adaptive management, which commits parties to participate in an ongoing, iterative, and flexible process to respond to on-the-ground impacts of projects such as TMDs or large-scale urban development. Adaptive management allows parties to ensure that the mitigation actions agreed to address the real impacts over a long-term planning horizon. Note that the term "adaptive management" in this context is not related to the federal process also termed "Adaptive Management."

The Learning By Doing Cooperative Effort is an adaptive management process in Grand County resulting from two water diversion projects, both impacting rivers in Grand County: Denver Water's Moffat Project and the Northern's WGFP. The adaptive management process outlined in the LBD IGAs, cited above, was integrated into approval documents for the Moffat and WGFP.⁹⁵

Educate Growth Areas about Potential Future MS4 Permitting. Help educate urban areas that may become MS4 Permittees in the future.

Explore whether improved runoff management and NPS pollution control would help dischargers with compliance schedules comply with permit limitations more quickly. Research potential intersections between NPS pollutants, infiltration and inflow, and pollutants identified in permit compliance schedules. Determine whether there are any efficiencies to support reductions in point source and NPS pollution.

⁹⁵ Sonoran Institute, Bridging the Gap, at 7-8.

Watershed Assessments. The [Blue River Watershed Group](#) developed an [Integrated Water Management Plan](#) (IWMP) in partnership with Trout Unlimited and many Summit County local governments. The IWMP examined how runoff from roadways, in particular I-70 and Highway 9, may be degrading aquatic life in the Blue River, including from the application of chlorides used for deicing. A restoration plan was published in 2023; project design, funding, and implementation are underway.

Sediment Capture. Local governments along I-70 and state highways have long worked in partnership with the CDOT to address sediment from traction sand entering water bodies, particularly in winter months. Eagle, Summit, and Grand Counties have addressed sediment deposition from I-70 and state highway systems through the construction of sediment capture areas along I-70 in Summit and Eagle Counties and on Highway 40 over Berthoud Pass (with funding contribution from Denver Water) in Grand County. Respondents cited the ongoing need to track proper maintenance of these sediment capture areas to ensure continued water quality benefits.

Adopting 1041 Regulations for Highways. Local governments may require a permit for the “site selection of arterial highways and interchanges and collector highways”. NWCCOG local governments should consider adopting or revising 1041 regulations for water quality protection from roadway runoff.

4.14.1. Strategies to Address OWTS

Consider Maintaining Existing Affordable Housing Stock. Many of the homes with failing OWTS are generally some of the most affordable homes in the NWCCOG Region. While there is funding to address aging public wastewater treatment systems, OWTS are often privately-owned and may not be eligible for state or federal funding. Further, the OWTS owners may lack experience and capacity to apply for such funding.⁹⁶ NWCCOG and its members should consider approaches to address failing OWTS and maintaining affordable housing stock whenever possible. The [State Revolving Fund Loan Program](#) includes options for local governments to administer and manage funding to repair or replace failing OWTS in coordination with homeowners.

Technical and Financial Assistance. Local governments or nonprofit entities in the NWCCOG Region could take a leadership role in assisting homeowners in updating OWTS where homeowners need financial or technical support, especially when such assistance would ensure homes remain affordable. Such entities could even offer payment for repairs or replacement in exchange for a deed restriction on such property (likely with a cost threshold that must be exceeded). Counties or NWCCOG may be in a better position to apply for and administer grant funding for a group of systems. NWCCOG should explore and support such efforts.

⁹⁶ Colorado Department of Public Health and Environment (CDPHE) maintains a list of [potential funding options for OWTS](#).

4.14.2. Strategies to Address Abandoned Mine Lands

Liability Reform. Currently, there is not sufficient liability protection to facilitate third-party (aka “Good Samaritan”) clean-up at historic mine sites. Without these protections, there are very limited opportunities to reduce nonpoint source pollution attributed to historic abandoned mine sites.

There is significant need to work toward liability protections to enable AML remediation projects, especially through amendments to the Mining Law of 1872. NWCCOG and its members will continue to advocate for policy solutions to enable further water quality improvements in the NWCCOG Region.

The [Good Samaritan Remediation of Abandoned Hardrock Mines Act of 2024](#) authorized a pilot-project to allow good Samaritans to remediate mine sites. NWCCOG supported this legislation by working with partner organizations and providing comments on draft legislation. While promising, the Good Samaritan Act is not permanent.

Mine Reclamation Projects. Where sufficient liability protection exists, implement comprehensive mine reclamation or restoration projects to reduce water quality impacts and protect watershed health. The DRMS [Inactive Mine Reclamation Program](#) is a critical partner in this work.

4.14.3. Strategies to Address Agricultural Grazing and Irrigation

Preservation of Ecologically Valuable Agricultural Lands. Counties in the NWCCOG Region have instituted or supported the preservation of agricultural lands, such as Routt County’s [Purchase-of-Development-Rights program](#). Pitkin County approved an increase in the sales and use tax rate to raise funds for conservation purposes, specifically including the protection of ranchland. Eagle County imposes a voter-approved property tax mill levy that is used, in part, to purchase agricultural easements and agricultural/open space land such as Brush Creek Ranch.⁹⁷

Virtual Fencing. Eagle County is using virtual fencing to protect restored portions of Brush Creek, which runs upstream of and through the Town of Eagle.⁹⁸ Physical fences can be reduced or demolished when ranchers control livestock distribution by placing collars on livestock that communicate with GPS and reception towers to form a virtual fence. This strategy prevents overgrazing, reduces soil erosion and degradation, which over time will improve the function of riparian areas that provide critical habitat and flood protection.

Updating irrigation systems for public properties. Local governments are investing in updates to irrigation systems for public properties throughout the NWCCOG Region. Updates will create more water-efficient systems and reduce runoff from fields and

⁹⁷ *Id.* at 28.

⁹⁸ Scott Miller, Some Eagle County ranchers are using virtual fences, Vail Daily (Sept. 14, 2022), <https://www.vaildaily.com/news/some-eagle-county-ranchers-are-using-virtual-fences/>.

landscaped areas that could transport sediment, nutrients, and pesticides into nearby waterbodies.

4.14.4. Strategies to Address Silviculture and Wildfire

Pre-Wildfire Planning and Mitigation. NWCCOG members develop and implement [FEMA Hazard Mitigation Plans](#), and utilize the CWCB [Wildfire Ready Watersheds Program](#) to plan and implement locally-selected watershed projects based on wildfire risk. As of late 2025, several planning efforts are underway in the NWCCOG Region.

Adopt and Strengthen Code and Zoning Requirements in Wildland Urban Interface (WUI). Local government land use codes establish where and what type of uses may occur in the WUI. Urban development in the WUI can worsen water quality impacts of wildfire and endanger public safety.

Strengthen Partnerships. Wildfire mitigation and response is an effort filled with partnerships. NWCCOG local governments should continue strengthening relationships with key partners such as federal land management agencies, primarily the USFS, front range water providers such as Denver Water and Northern Water who use headwaters' supply, state agencies such as the Colorado Forest Service and the CWCB, and local watershed groups and other nonprofits.

Section 5. Point Sources in NWCCOG Region

This section examines point sources of pollution in the NWCCOG Region and concludes by identifying strategies, programs, and processes for NWCCOG and its members to help address point source pollution along with the WQCC and WQCD.

The CWA requires discharges from point sources into Waters of the United States to receive a permit. **Point sources** of pollution are defined as

any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.⁹⁹

In Colorado, point source discharges are subject to Colorado Discharge Permit System (CDPS), implemented by the WQCD. The WQCC and the WQCD have the exclusive authority to regulate the discharge of point sources into state waters.¹⁰⁰

5.1. Discharge Permits Issued in the NWCCOG Region

As of February 2026, there were just under 500 CDPS discharge permits in the NWCCOG Region (Figure 11), including:

- **218 construction stormwater permits** which accounts for 45 percent of the discharge permits. During the summer construction season the percentage is likely larger (Figure 11).
- **74 domestic WWTFs** in the Region, which equates to 14 percent of the permits in the Region. The permitted discharges from the domestic WWTFs range from less than 0.01 to 5.0 million gallons per day (MGD). **In general, the 208 Plan focuses on the 52 domestic WWTFs that discharge to surface waters.**
- **54 industrial stormwater permits** that provide coverage to a variety of facilities including mines, railroad yards, solid waste and recycling centers, airports and airfields, and concrete plants. Industrial stormwater accounts for roughly 11 percent of the permits in the Region.
- **47 sand and gravel operations** account for about 10 percent of the permits.

⁹⁹ 33 U.S.C. § 1362 (14) (2023).

¹⁰⁰ C.R.S. §25-8-202(7).

- There are currently **36 dewatering permits**¹⁰¹ in the Region. This category of permits includes both short and long-term activities such as: construction dewatering, well development and pumping, and foundation dewatering. Dewatering permits account for 7 percent of the permits in the NWCCOG Region. Dewatering typically involves pumping or evaporating groundwater or surface water that flows into excavated areas.

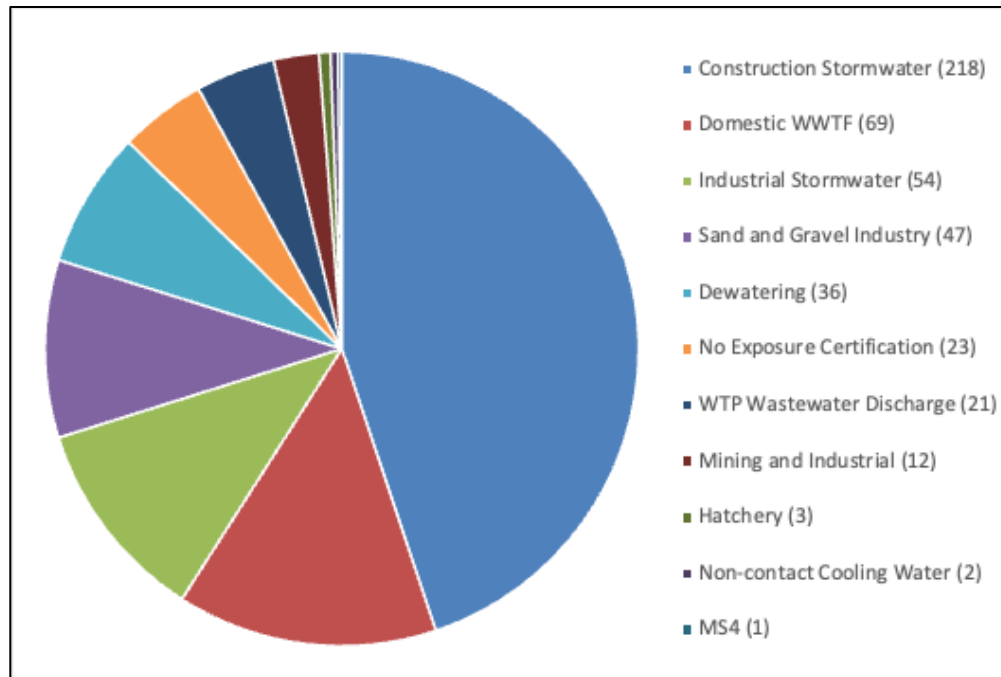


Figure 11. CDPs Permits by Category in the NWCCOG Region as of February 2026.

This remainder of this section focuses on the following five types of discharges which require permits, certifications or authorizations that are common throughout the NWCCOG Region and/or have a clear nexus with local governments (i.e., local government is the permittee or regulates permittee):

- Stormwater for construction activities over one acre
- Domestic wastewater treatment facilities
- Municipal Separate Storm Sewer Systems
- Industrial discharges
- Dredge and Fill authorizations

¹⁰¹ [CDPHE general permits for dewatering.](#)

5.2. Stormwater Permits for Construction Activities

The potential pollutants of concern for construction activities include sediment, nutrients, and spills or releases of hazardous materials such as fuel, pesticides, herbicides, or building materials like concrete, asphalt, or sealant.

Construction activities that disturb more than one acre of land or are part of a common plan of development over an acre require a certification and must comply with the terms of the Statewide General Construction Stormwater Discharge Permit (General Permit), including preparing and maintaining a Stormwater Management Plan. The General Permit also requires “control measures” or best management practices to control the discharge of pollutants off-site and to prevent spills or releases of hazardous materials. Permit coverage is required from initial ground breaking until the site is “finally stabilized.”

The State’s stormwater permit system complements county and municipal land use and development regulations used throughout the NWCCOG Region. The WQCD stormwater permit requires permittees to “comply with the lawful requirements of municipalities, counties, drainage districts, and other local agencies. The permittee must comply with local stormwater management requirements, policies, and guidelines including those for erosion and sediment control.”¹⁰²

Most local governments also regulate construction activities of all sizes as part of land use development review and approval, including to address nonpoint source impacts of construction practices (see Section 4.2). Local regulations focus on erosion and sediment control requirements, and may also include stream and wetland setbacks, revegetation standards, and other measures which reduce water quality impacts from construction sites.

5.3. Domestic Wastewater Treatment Facilities

This section focuses on domestic WWTFs that discharge to surface waters in the NWCCOG Region. In general, pollutants of concern from domestic WWTFs include:

- Pathogens, including bacteria, viruses, and other microorganisms, which create a serious human-health risk if discharged without effective treatment.
- Organic wastes are harmful to aquatic life because as bacteria and other organisms decompose organic wastes, they consume dissolved oxygen in the water column making it unavailable to aquatic life. This is measured by biochemical oxygen demand.
- Toxins such as metals and ammonia that may harm aquatic life or other classified uses; and
- Nutrients, particularly nitrogen and phosphorus, that may contribute to excess algal growth.

¹⁰² WQCD Permit No COR400000 at p. 11.

- Total suspended sediment, pH, and temperature.

Publicly and privately owned domestic wastewater treatment facilities are issued permits that include limitations developed to protect the uses and water quality standards applied to the segments where the discharge is located, along with several other critical requirements.

There are 52 domestic WWTFs that discharge to surface waters in the NWCCOG Region. These WWTFs range from very small private wastewater treatment systems to large publicly-owned WWTFs with advanced tertiary treatment systems. Thirty-three facilities have individual permits and 29 facilities have certifications through one of four general permits. General permit certifications are reserved for WWTFs with design flows of less than 1.0 MGD. Appendix C provides additional information on Domestic WWTFs in the NWCCOG Region.

As of June 2026, 83 percent of domestic WWTF permits in the NWCCOG Region are administratively continued, which means that the permittee submitted a timely application for a permit renewal, but the WQCD has not issued a renewal permit. All of the individual permits are administratively continued. Fifty-five percent of the general permit certifications for domestic WWTFs are administratively continued.

Administratively continued individual permits are not modified, which creates a number of issues for permittees. For example:

- Administratively continued permits do not implement newly adopted water quality standards or policies.
- A permittee with an administratively continued permit may not receive authorization to use a new chemical in its treatment process.
- Administratively continued permits hamper long-term planning for facility upgrades because the new permit limitations and requirements (e.g., the duration of compliance schedules that may be included in the renewal permit) are unknown and the timing for a new permit is unknown.

5.3.1. Expansion Requirements

The CWQCA¹⁰³ requires permittees to initiate engineering and financial planning for expansion of the domestic WWTF when throughput reaches eighty percent of the treatment capacity. When throughput reaches ninety-five percent, the permittee must begin construction to expand the WWTF or stop issuing building permits for projects that would add throughput to the WWTF until construction at the WWTF begins. Historically, all WWTFs in the Region have complied with these requirements and designed facility expansions at the appropriate time.

¹⁰³ C.R.S. 25-8-501 5 d and e

Throughput is hydraulic and organic loading measured prior to treatment and typically reported as a 30-day average.¹⁰⁴ Percent throughput is calculated by dividing throughput by the permitted design capacity. Peak hydraulic throughput often occurs during the snowmelt season (March, April, and May), indicating that infiltration and inflow (I/I) may play a critical role. Outside of this period, some facilities see increased hydraulic and organic throughput during the peak tourism seasons (e.g., Fourth of July, Spring Break). NWCCOG recommends that operating agencies continue I/I control measures as part of routine maintenance.

The expansion requirements serve as a backstop to assure that population growth and commercial or industrial development within a domestic WWTF service area do not outpace the capacity of existing WWTFs. Where possible, WWTFs should include protective throughput requirements in their inclusion policies to accommodate growth adjacent to the service area while avoiding an outsized impact to the existing service area.

5.3.2. Effluent Limitations

Discharge permits issued by WQCD include effluent limitations and other requirements that protect existing water quality, designated uses, and support attainment of applicable water quality standards.

In the NWCCOG Region:

- 21 domestic WWTFs discharge into waterbodies that attain all applicable water quality standards,
- 35 domestic WWTFs discharge into waterbodies that are listed as impaired¹⁰⁵, and
- 10 domestic WWTFs discharge into waterbodies that may be impaired and appear on the monitoring and evaluation list.¹⁰⁶

The paragraphs below summarize the pollutants causing impairments, potential compliance issues, and the processes in place to resolve these issues.

Arsenic

Thirty-seven domestic WWTFs discharge into segments that are impaired or on the M&E List for arsenic. Based on data compiled by the WQCD, total recoverable arsenic concentrations range from <1 to 79 ug/L in treated effluent discharged from 25 domestic WWTFs in the NWCCOG Region.¹⁰⁷ Typically, domestic WWTFs are not designed to remove arsenic, although removal may occur as a by-product of other treatment techniques.

¹⁰⁴ 5 CCR 1002-61.2(108)

¹⁰⁵ When a water quality standard is not met, the stream is considered impaired.

¹⁰⁶ A portion of the waterbodies are impaired and/or on the monitoring and evaluation list for multiple pollutants. Thus, the number of facilities reported for each pollutant will not add to the total number of facilities that discharge into impaired waters.

¹⁰⁷ This citation combines data presented in [WQCD Exhibit F-3 Arsenic Permit Data](#) and [WQCD Exhibit F-4 Arsenic Predicted Non-compliance](#) provided in WQCD proponent's prehearing statement

While the source(s) of arsenic has not been identified in every impaired segment, arsenic is commonly found in soil and sediment. Water infiltration through soil and sediment can create naturally elevated arsenic concentrations in local waterbodies; human activity can exacerbate arsenic mobilization.

The WQCC has adopted a statewide temporary modification of the statewide water quality standard for arsenic. The statewide arsenic temporary modification expires on 12/31/2029. Prior to the expiration of the temporary modification, WQCD is expected to propose a revised arsenic water quality standard for consideration by the WQCC. WQCD plans to share the revised draft arsenic criteria with stakeholders in mid-2027 and schedule a rulemaking hearing to consider the revised criteria in 2029.¹⁰⁸

EPA recently revised the toxicological profile for arsenic. The most recent studies indicate that arsenic is more toxic than previously understood. As a result, the revised water quality standard for arsenic will be at least as stringent as the existing water quality standard (0.02 ug/L). Colorado is conducting additional studies to assure that the EPA's updated toxicological profile is suitable for adoption in Colorado.

During the term of the temporary modification, facilities that discharge into segments impaired for arsenic are obligated to conduct activities as described in their permit. These requirements are known as "Arsenic Terms and Conditions". As permits are renewed additional terms and conditions will be added to the permit depending upon the arsenic concentrations measured in the effluent.

The Arsenic Terms and Conditions were revised and approved by the WQCC in June 2024.¹⁰⁹ All facilities will be required to monitor arsenic during the term of the temporary modification. The Arsenic Terms and Conditions establish three tiers of requirements based upon the arsenic concentrations measured in the effluent and are summarized below:

- **Tier 1:** where arsenic concentrations are less than 1 ug/L the WWTF will be required to monitor the effluent.
- **Tier 2:** Where arsenic concentrations are between 1 and 3 ug/L the WWTF will be required to monitor effluent, influent, conduct a source identification study, and evaluate source control options.
- **Tier 3:** Where arsenic concentrations are greater than 3 ug/L the WWTF will be required to complete the activities identified in the lower tiers and evaluate treatment options. If the existing permit incorporated Arsenic Terms and Conditions there will be additional requirements.

for Regulation 33 Rulemaking Hearing on June 10, 2024.

¹⁰⁸ [WQCD Exhibit F-5 Updated Arsenic Temp Mod PTRU](#) provided in WQCD proponent's prehearing statement for Regulation 33 Rulemaking Hearing on June 10, 2024.

¹⁰⁹ Described in [WQCD Exhibit F-6 \(REVISED\)- Updated Terms and Conditions](#).

NWCCOG reviewed WQCD's Exhibits¹¹⁰ and found arsenic effluent data for twenty-five WWTFs in the Region. Four facilities are classified as Tier 1, twelve facilities are classified as Tier 2, and nine facilities are classified as Tier 3.

Temperature

Seventeen facilities discharge into segments that are impaired for temperature. Nine of the facilities have permits with numeric effluent limitations. Currently 8 of these facilities do not have temperature limitations. Preliminary analysis suggests that point source discharges are not likely to be the primary cause of temperature impairment in these segments. In some instances, the data used to identify the temperature impairment was collected upstream of the domestic WWTF and do not provide information to evaluate the potential effect of the facility.

NWCCOG and several members are exploring options to potentially revise temperature standards (e.g., site-specific standards), definitions, and/or implementation practices (e.g., defining representative data in the 303(d) listing methodology). NWCCOG plans to initiate a Water Quality Forum work group to engage with other stakeholders as part of the process to create a proposal for the WQCC to consider in June 2028.¹¹¹

Nutrients: Nitrogen and Phosphorus

Nitrogen and phosphorus are nutrients required to support aquatic ecosystems. However, excess nutrient concentrations support algal growth that can become detrimental to aquatic life and recreational use in waterbodies. Over the past two decades, Colorado has worked to reduce nutrient pollution from point and nonpoint sources.

In the 1980s, local governments in Summit County and NWCCOG collaborated to adopt a regulation that establishes phosphorus load limitations to protect water quality in Dillon Reservoir.¹¹² In the past 40 years, WWTFs have reduced phosphorus concentrations in their discharges and local governments have adopted regulations to mitigate the impacts of development. As a result of these efforts, the Dillon Reservoir Watershed is a prime example of effective nutrient management and the attendant water quality benefits.

Currently, the primary mechanism to control total nitrogen and total phosphorus concentrations is technology-based effluent limits established in Regulation 85. Currently, technology-based effluent limits only apply to WWTF with permitted flows of 2.0 MGD or greater.

In the NWCCOG Region there are 13 WWTFs, or approximately 20 percent of the domestic WWTFs, permitted to discharge at 2.0 MGD or higher and have individual permits. As of June

¹¹⁰ WQCD Exhibits [F-3](#) and [F-4](#) in the 2024 WQCC Rulemaking Hearing.

¹¹¹ NWCCOG and several members participated in the Triennial Review Informational Hearing in November 2025. The written comments are available [here](#).

¹¹² 5 CCR 1002-71.

2026, all these permits are administratively continued, though the Division's current permit renewal plan includes permits in the Region.

Recall that WQCD does not modify administratively continued individual permits. Depending on the situation, this practice may make it more difficult for facilities to comply with future permit limits for nutrients. For example, characterizing effluent nutrient concentrations, creating an engineered design to remove nutrients, funding and building the designed treatment can easily take years and often exceeds the duration of the compliance schedule (often 2 to 5 years) or the permit itself (5 years). A facility can work diligently during the term of a compliance schedule and find themselves without options to address the pollutant because doing so may require a permit modification. In the NWCCOG Region, these issues are often exacerbated by variable effluent flow and quality, attributed in part to large seasonal fluxes in population, short construction seasons, and competing infrastructure projects.

Technology-based effluent limitations do not protect the underlying classified uses of the waterbody. WQCD is working with stakeholders statewide to develop a proposal to adopt water quality standards for nitrogen, phosphorus, and chlorophyll a (a measure of algal growth, excess algal growth is a by-product of excess nutrients). WQCD expects to propose nutrient criteria in 2030. The proposed nutrient standards, in Regulation 85, will account for technological and economic feasibility.

NWCCOG will continue to engage in WQCC and WQCD processes to adopt protective nutrient standards, understand nutrient loading characteristics in the Region, particularly in areas where TMDs with 401 certifications operate (e.g., Grand County), and support implementation of technologically and economically feasible treatment options.

5.3.3. Compliance Schedules in Domestic WWTF permits

In addition to establishing effluent limitations, discharge permits for domestic WWTFs establish several requirements, including compliance schedules which provide additional time for permittees to attain compliance with permit limitations.

Permits typically include compliance schedules¹¹³ when evidence indicates that a permittee may not be able to immediately comply with a permit limitation. Compliance schedules must include appropriate milestones and a duration to allow the facility to comply with the permit limit "as soon as possible." Compliance schedules may allow time to characterize pollutant sources, design, fund, construct, and implement treatment or other activities that will allow the facility to comply with the permit limit or, in limited circumstances, to revise the permit limit (e.g., an anti-degradation alternatives analysis).

In the NWCCOG Region, the most common compliance schedules are for copper, ammonia, total inorganic nitrogen (TIN), nitrite, pH, and temperature. Special studies to characterize and reduce infiltration and inflow are also common. Improved management of nonpoint

¹¹³ See CW-3 Policy available [here](#)

source pollution, including unregulated stormwater, may help facilities comply more quickly, while protecting regional water quality.

5.3.4. Feasibility and Implementation

Through the [Water Quality Roadmap](#) effort, WQCD is engaging stakeholders to revise nutrient, ammonia, arsenic, and selenium standards. The process will also consider economic and technological feasibility of proposed revisions, including an evaluation of synergies or competition in the pollutant removal process. Because WWTFs frequently have a multitude of compliance challenges, including for arsenic, ammonia, nutrients, and temperature, these considerations are critical to effectively planning for WWTF upgrades and to maintain and improve water quality in the NWCCOG Region. NWCCOG and members are actively engaged in the Water Quality Roadmap and associated WQCD work groups.

5.3.5. Facility Planning

The designated management and operating agencies in the NWCCOG Region have a strong history of successfully navigating the planning process and design and engineering review process.

Each year the WQCC adopts an [Intended Use Plan](#) that identifies projects that can receive financial assistance through Colorado's Water Pollution Control Revolving Fund. This assistance can go to governmental agencies to construct and maintain wastewater infrastructure necessary to protect public health and the environment. The 2026 Intended Use Plan includes 30 projects in the NWCCOG Region.

As of November 2025, 35 WWTF projects in the NWCCOG Region are under active review by the WQCD Engineering Section.¹¹⁴

As resources allow, NWCCOG monitors these processes to assure that facilities in the Region are maintaining existing infrastructure and planning necessary upgrades. When enforcement actions occur in the Region, NWCCOG considers information in the intended use plan to support on-going and future compliance.

5.3.6. Population Growth Projections and Capacity Analysis

Table 3 summarizes past and projected populations by county in the NWCCOG Region. Most counties are projected to grow substantially by 2050, while the populations in Pitkin and Jackson counties are projected to remain stable or decline.

¹¹⁴ <https://cdphe.colorado.gov/designreviews>. Accessed on November 20, 2025.

Metric	Routt	Grand	Summit	Eagle	Pitkin	Jackson
Population in 2000	20,122	12,852	25,708	43,288	15,763	1,574
Population in 2024	25,241	16,202	30,889	54,196	16,593	1,270
Projected Population in 2050	28,775	19,078	34,348	68,442	16,743	1,047
Projected Percent Change	14.0%	17.8%	11.2%	26.3%	0.9%	-17.5%

Table 3. Past, current, and future populations by county in the NWCCOG Region. Source: [Colorado Demographers Office](#) accessed on December 22, 2025.

The population statistics and projections include permanent residents only. Because recreation and tourism are primary economic drivers in the NWCCOG Region (Section 7.1), transient populations, attributed to tourism and recreation, must be accounted for when conducting capacity analyses. For example, Eagle River Water and Sanitation District (ERWSD) operates a single sanitary sewer collection system served by three wastewater treatment facilities located in Vail, Avon, and Edwards. Current service area populations, including both permanent and transient residents, are 15,500, 28,400, and 22,700 for Vail, Avon, and Edwards, respectively.¹¹⁵ The 2020 Census reported permanent populations of 4,835, 5,900, and 10,449 for Vail, Avon, and Edwards, respectively. This discrepancy in permanent and transient populations clearly demonstrates the need to include transient populations (e.g., hotel occupants) in capacity analyses. Based on a review of hydraulic throughput capacity, WWTFs in the NWCCOG Region have effectively managed population and tourism growth over the last several decades.

Recent and pending WWTF site applications, intended use plans, and capital improvement plans from throughout the NWCCOG Region indicate that facility improvements to replace aging infrastructure or to meet existing or projected permit limits are a more pressing need than facility expansions attributed solely to population growth.

Replacing and/or upgrading aging collection system infrastructure provides opportunities to reduce I/I, manage influent flows, and reduce pollution while accommodating a small degree of population growth. WWTFs in the NWCCOG Region face short construction seasons, limited staff or contractor resources, and mountainous terrain as they implement I/I control measures.

5.4. Municipal Separate Storm Sewer Systems (MS4)

An MS4 is “a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) owned or operated by a State, city, town, county, district, association, or other public body.”¹¹⁶ MS4s do not include combined sewers or publicly owned treatment works.¹¹⁷

A conveyance system requires a CDPS MS4 permit when the population and population densities for the system exceed specific regulatory thresholds or if the WQCD designates a

¹¹⁵ ERWSD Renewal Permit Application dated August 8, 2025.

¹¹⁶ 5 CCR 1002-61.2(62).

¹¹⁷ *Id.*

system as regulated based on factors spelled out in regulation.¹¹⁸ The Division may require MS4 permits for small stormwater conveyance systems in areas where the “combined permanent *and seasonal* population” exceeds 10,000 people.¹¹⁹ This 208 Plan refers to areas that may become subject to MS4 permits as “urban areas.”¹²⁰

Currently, Steamboat Springs is the only jurisdiction large enough to require an MS4 discharge permit in the NWCCOG Region. However, several “growth areas” are approaching regulatory thresholds that may require an MS4 permit or could be assigned a permit, at the division’s discretion, where the population is in excess of 10,000. The WQCD may also consider seasonal population and density when determining whether an area becomes a regulated small MS4. When evaluating the need for an MS4 permit, WQCD may consider the existing stormwater management practices and the overall risk that urban runoff may cause or contribute to the exceedance of a water quality standard.¹²¹ In addition to protecting water quality, proactive stormwater management practices may extend the time horizon available to growing communities that may eventually become regulated MS4s.

Generally, urban areas in the NWCCOG Region are within municipalities, but some urban areas such as El Jebel and Edwards are in unincorporated areas of their counties. If an unincorporated area becomes subject to an MS4 permit, it may be necessary for the county or a newly created special district to be the permittee.

I-70 is the largest roadway in the NWCCOG Region and one of the largest in the United States. CDOT is subject to a Phase 1 MS4 permit, which includes I-70. Much of I-70 is lined with sediment catchment basins that were added in the past ten to twenty years. Highway 40 over Berthoud Pass also includes catchment basins. Ongoing maintenance and monitoring of the function of these sediment basins and their ongoing maintenance is critical and needs to be continued and/or expanded.

5.5. Industrial Discharges

Acidity and metals, including arsenic, cadmium, copper, lead, manganese, molybdenum, and zinc, are typically the most problematic pollutants associated with industrial facilities.

There are three major industrial dischargers in the NWCCOG Region, including:

- Henderson Mill facilities owned and operated by Climax Molybdenum Company;

¹¹⁸ 5 CCR 1002-61.3(2)(f)(v)(A)(III). For example, a small MS4 is an urbanized area as determined by the latest decennial census, or a jurisdiction with a population density of at least 1,000 people per square mile and a population of at least 10,000.

¹¹⁹ 5 CCR 1002-61.3(2)(f)(v)(A)(III)(b) (emphasis added).

¹²⁰ CDPHE sometimes uses the “growth area” to describe areas that may become subject to MS4 permits. We feel this term works best at the state level where it may refer to an urban area not previously subject to an MS4 permit or expanding the boundary of an existing MS4 permit area.

¹²¹ 5 CCR 1002-61.3(2)(f)(v)(A)(III).

- Climax Mine facilities owned and operated by Climax Molybdenum Company; and
- Moffat Tunnel West Portal operated by Union Pacific Railroad.

Industrial facilities must operate pursuant to discharge and stormwater permits to control pollution.

Permits for mining operations issued by the Division of Reclamation, Mining, and Safety (DRMS) implement surface water quality and groundwater assessments and monitoring programs that are critical to overall water quality protection in the NWCCOG Region. For example:

- DRMS regulations require that “Disturbances to the prevailing hydrologic balance of the affected land and of the surrounding area and to the quantity or quality of water in surface and groundwater systems both during and after the mining operation and during reclamation shall be minimized.”¹²²
- Applicants for most types of permits from DRMS/the Mined Land Reclamation Board (MLRB) must provide detailed assessments of surface and groundwater quality as part of an application for a Reclamation Permit as well as obtaining any required Division permit.¹²³
- More intensive Designated Mining Operations (DMO) must develop Environmental Protection Plans that require more intensive analysis of surface and groundwater quality and monitoring requirements.¹²⁴

There are many **inactive or abandoned mines** within the Region that discharge water through a point source which do not have permits. Historic and abandoned mine sites are classified as nonpoint sources of pollution and are discussed in Section 4.6.

5.6. Dredge and Fill

The CWA prohibits the discharge of dredge or fill material into “Waters of the US” (WOTUS) without a permit from USACE under Section 404 of the Act, referred to as 404 Permits.

In order for USACE to issue a 404 Permit, the Division must first issue a 401 Certification that the permitted activity will comply with applicable state water quality standards and requirements.¹²⁵ “Any certification issued by the Division pursuant to these regulations shall apply to **both the construction and operation** of the project for which a federal license or permit is required, and shall apply to the water quality impacts associated with the project.”¹²⁶ This is particularly important for TMD projects where the dredging and filling of

¹²² 2 CCR 407-1.3.1.6(1).

¹²³ 2 CCR 407-1.6.4.7 (Exhibit G- Water Information).

¹²⁴ 2 CCR 407-1.6.4.21 (Exhibit U- – Designated Mining Operation Environmental Protection Plan).

¹²⁵ 33 U.S.C. § 1341(a)(1).

¹²⁶ 5 CCR 1002-82.2(5) (emphasis added).

waters may occur in a different watershed than many of the water quality impacts of the project's operations.

On May 26, 2023, the US Supreme Court narrowed the scope of waterbodies that are considered WOTUS in the *Sackett* decision.¹²⁷ Certain wetlands without a continuous surface connection to WOTUS are no longer considered within federal CWA jurisdiction. Other waterbodies may be excluded as well; the ramifications of *Sackett* are evolving.

In response, from 2024-2025, Colorado developed a Dredge and Fill Permit system for "state waters" that are not WOTUS and thus are not regulated by USACE.¹²⁸ This is the first permit system of its kind in the US. Where individual authorizations are required for the discharge of dredged or fill materials into state waters, Regulation 87 requires conditions in the authorization to assure that the "activity as a whole" and the "project operation" comply with applicable state water quality requirements and serves the same purpose as a 401 Certification.¹²⁹ Individual authorizations that include ongoing operations are required to enter into a binding and enforceable "Ongoing Operations Agreement" to assure that the project or activity complies with state water quality requirements throughout the life of its operation.¹³⁰

While local governments cannot regulate point sources, municipal and county authority to apply land use regulations to protect water bodies from adverse impacts has not been affected by the *Sackett* decision. Section 4.2 discusses local regulation of nonpoint source impacts of urban runoff and development.

5.7. 208 Planning and State Approvals

State and federal agencies regulate point source discharges pursuant to the Clean Water Act. NWCCOG and implementing agencies are authorized to participate in many Colorado regulatory review processes at the WQCC and WQCD levels:

1. WQCD Discharge Permits. "No permit under section [402] of this title shall be issued for any point source which is in conflict with a plan approved pursuant to" Section 208.¹³¹

¹²⁷ *Sackett v. EPA*, 598 U.S. ___, (2023) (*Sackett*). For more information, see the June 8, 2023 Update to NWCCOG Water Quality/ Quantity Committee members re: new WOTUS Rule, available at <https://www.dropbox.com/s/8qkurdgro9fwgwgq/2023%2004%2019%20QQ%20WOTUS%20update.pdf?dl=0>.

¹²⁸ C.R.S. 25-8-205.1.

¹²⁹ 5 CCR 1002-87.6(7)(e).

¹³⁰ 5 CCR 1002-87.6(13)(c).

¹³¹ 33 U.S.C. § 1288(d); *see also*, C.R.S. § 25-8-503(2); 5 C.C.R. 1002-61.8(1)(c).

2. WQCD Site Location Approvals and Changes in Design. The WQCD must consider the 208 Plan and local government comprehensive plan for the following applications:¹³²

Site location approvals and changes in design such as new domestic wastewater treatment plans, increase or decrease in design capacity, interceptor sewer site locations, and lift stations.¹³³
3. Federal and State Grants to Publicly-Owned Treatment Works. The WQCC must consider whether grants for construction of publicly-owned treatment works are in conformity with the 208 Plan."¹³⁴
4. WQCD 401 Certification. A project that requires a federal license or permit, including "the construction or operation of facilities," must obtain a certification from the WQCD finding that the federally-regulated discharge will comply with the applicable provisions of the CWA and the CWQCA.¹³⁵
5. Dredge and Fill Authorizations. The WQCD must consult with local governments, including designated planning agencies, when issuing Dredge and Fill Authorizations.¹³⁶
6. Antidegradation Review. For proposed discharges to "reviewable waters" in the Region, as discussed in Section 3.3, the WQCD must notify and consider comments by NWCCOG and the relevant county and municipality.¹³⁷

5.8. Recommended Strategies, Projects, and Programs for Point Source Management

In addition to the policies and implementation measures in Section 2.0, NWCCOG and members will take the following actions to address point source pollution in concert with WQCC and WCQD. Additional or alternative actions may also be appropriate; this list is not exhaustive and the strategies, project, and programs should be tailored to the specific nature and location of the point source pollution.

Increase capacity to facilitate enforcement of existing regulations. Many jurisdictions have enacted regulations to protect water quality from impacts attributed to construction activities. Local jurisdictions may lack the capacity to enforce these requirements. NWCCOG will work with members to identify strategies to enforce existing regulations.

¹³² C.R.S. § 25-8-702(2)(a).

¹³³ 5 C.C.R. 1002-22.5(1)(k); 22.6(1)(e); 22.7(2)(c); 22.8(1)(a)(iii); 22.9(1).

¹³⁴ 33 U.S.C. § 1288(c); *see also* 33 U.S.C. § 1284(a)(1).

¹³⁵ 33 U.S.C §1341(a)(1); C.R.S. § 25-8-302(1)(f); *see also* CCR 5-1002.82.3(c) and 82.5(A)(1)(g).

¹³⁶ 5 C.C.R. 1002-87.5(4).

¹³⁷ 5 C.C.R. 1002-21.16(B).

Stormwater and construction inspections (potentially regional). Inspections of stormwater infrastructure and control measures are important for ensuring that infrastructure is performing as intended to minimize water quality impacts. Construction sites also require inspections to ensure construction staff are installing and maintaining appropriate erosion and sediment control practices. Stormwater management fees can assist in proper inspection of facilities and sites.

Based on members' suggestions, NWCCOG will explore providing a regional stormwater and construction inspection team, akin to the existing NWCCOG regional elevator inspection program, for efficiency, effectiveness, and the ability to staff properly trained inspectors.

Stormwater management fees. Only a few municipalities, for example Silverthorne and Aspen, assess a stormwater management fee to address aging infrastructure, reduce potential property damage from stormwater issues, and maintain local water quality. NWCCOG will promote the use of stormwater fees to fund water quality protection throughout the NWCCOG Region.

Promote participation in WQCD water quality data calls. Increased availability of water quality data may help protect water quality by allowing for more thorough water quality standards assessments (i.e., 303(d) and M&E list) and supporting appropriate permit limitations. NWCCOG will encourage members and other organizations in the NWCCOG Region to participate in data calls.

Review and comment on discharge permits. As time and resources allow, NWCCOG staff will review and, if needed, provide comments on discharge permits issued in the Region. Reviews may be prioritized based on whether the receiving water is classified as impaired, has a temporary modification, site-specific standard, an approved TMDL, or other critical circumstance.

Advocate that penalty funds be used for supplemental environmental projects (SEPs).¹³⁸ In some cases, penalties paid for violations of the CWQCA can be used for SEPs. NWCCOG would like to increase the use of SEPs, particularly third-party SEPs, for water quality improvement projects. To promote this practice, as resources allow, NWCCOG will share potential project ideas with WQCD annually.

Support implementation of feasible nutrient standards in the Region. Facilitate conversations to understand challenges and successes (i.e., Dillon Control Regulation) within the Region as the WQCD and WQCC continue to implement nutrient standards. Develop a comprehensive understanding of feasible treatment options used in and suitable for the Region.

Continue to review site applications for Domestic Wastewater Treatment Works. NWCCOG will continue to review site applications in the Region.

¹³⁸ <https://cdphe.colorado.gov/supplemental-environmental-projects>

Eliminate OWTS within the Three Lakes Water and Sanitation District (TLWSD): There are a number of failing OWTS in the TLWSD service area. Extending centralized wastewater treatment to these residences would have multiple water quality benefits, including the potential to improve clarity in Grand Lake by eliminating nutrient sources that may otherwise reach the lake. TLWSD estimates that eliminating existing OWTS in their service area will cost approximately \$43,500,000. TLWSD identified this project in the 2026 intended use plan and is pursuing funding. NWCCOG will support these efforts, as time allows.

Monitor metal mining permits, and comment as needed. In 2022, WQCD determined that stormwater pollution originating from metal mining facilities would no longer be managed as individual certifications under a general permit. Moving forward, stormwater will be incorporated into the discharge permits for each mine site. As resources allow, NWCCOG will review permits for metal mining facilities to assure the permit terms are protective of water quality in the Region.

Use inclusion policies and service area agreements¹³⁹ to facilitate engineering and financial planning for WWTF expansions and improvements. When considering service area expansions, WWTFs should consider protective throughput and treatment requirements with appropriate financial commitments in their inclusion policies and/or service area agreements to accommodate growth while avoiding an outsized impact to the existing service area. Treatment requirements that could be incorporated into inclusion policies include nitrogen, phosphorus, temperature, or arsenic.

¹³⁹ There are multiple names for the policies and agreements that establish the requirements for new developments to receive water and/or wastewater treatment from an existing utility provider.

Section 6. Climate Change

Climate change impacts water quality, water supply, and water demand worldwide, nationally, and regionally. Climate change impacts are especially acute in the NWCCOG Region because of its elevation and because it is the headwaters of the Colorado River system which relies on snowmelt for most of its water supplies. Climate change exacerbates all the impacts of nonpoint and point source pollution (Sections 4.0 and 5.0, respectively).

Predicted impacts of climate change in the NWCCOG Region include: increased air temperatures, increased water temperatures, decreased snowpack accumulation, accelerated snowmelt runoff, lower flows, increased water demand, and more frequent and prolonged drought. While these factors are discussed individually in the sub-sections that follow, it is critical to understand that each factor is inextricably linked to the others.

6.1. Air Temperature Increases

Increased air temperature is an obvious result of climate change and is the driving force for many of the water and snow impacts. Increased temperatures lead to earlier snowmelt and peak runoff, reduced runoff, increased sublimation (i.e., snow or ice lost as water vapor) and evaporation, higher rates of water use by plants (evapotranspiration), drier soils, more frequent and intense droughts, and more frequent and severe wildfires.¹⁴⁰

In recent decades, fall temperature increases have outpaced other seasons. In the NWCCOG Region, fall temperatures increased 3.1 °F from 1980 to 2022.¹⁴¹ Recent climate projections indicate that summer and fall temperatures will increase slightly more than winter and spring temperatures. Warmer air temperatures are likely to contribute to more frequent and severe drought. By increasing evapotranspiration, increased air temperatures will reduce the benefits of wet years.¹⁴²

The Rocky Mountain Climate Organization studied air temperature extremes in Summit and Eagle Counties, and found that, for example:

- In the Avon/Edwards area of Eagle County, an average summer day in mid-century could be as hot as the single hottest day of the late 20th century.¹⁴³

¹⁴⁰ CWCB, *Colorado Water Plan* (2023), at 34, <https://cwcb.colorado.gov/colorado-water-plan>, accessed Nov. 11, 2025 (“Water Plan”).

¹⁴¹ CWCB, *Climate Change in Colorado Assessment Report Third Edition* (2024), at 6, [climatechange.colostate.edu/downloads/CCC 2024 Climate Assessment Report.pdf](https://climatechange.colostate.edu/downloads/CCC_2024_Climate_Assessment_Report.pdf), accessed April 30, 2026.

¹⁴² *Id.* at 11

¹⁴³ Saunders, Stephen, Tom Easley, and Melissa Mezger, [Climate Projections in Eagle County, Colorado](#), A report by the Rocky Mountain Climate Organization to Eagle County, Town of Vail, and Northwest Colorado Council of Governments Water Quality/Quantity (August 2021).

- By midcentury, the Town of Eagle area could experience 11 days with temperatures above 90° in a typical year, and 39 days above 90° in an extreme year, compared with less than 7 days above 90° even in an extreme year from 1979-1999.¹⁴⁴
- In the Frisco/ Dillon Reservoir area of Summit County, an *average* summer day in mid-century could be three degrees hotter than the single hottest day of the late 20th century.¹⁴⁵

An increasing body of evidence indicates that drier soils, created by higher air temperatures and increased transpiration, in mineralized areas can accelerate chemical weathering and increase metal concentrations in down-gradient waterbodies.^{146,147} In the past five years, this phenomenon has contributed to at least three incidents of fish kills in Grizzly Reservoir in Pitkin County.¹⁴⁸ Because mineralized geology is found in many parts of the NWCCOG Region, this problem could become more widespread in the future.

6.2. Decreased Snowpack Accumulation and Accelerated Snowmelt

The seasonal snowpack in the NWCCOG Region generates about 60 to 80 percent of annual streamflow.¹⁴⁹ As a result, changes in snowpack accumulation and snowmelt patterns have an outsized effect on water supply in the NWCCOG Region.

If greenhouse gas emissions continue at current rates, the share of winter precipitation falling as snow is projected to decrease sharply as shown in Figure 3.¹⁵⁰ Colorado's average statewide snowpack could decline by 13 percent by 2041–2070, and by twice that later in the century.¹⁵¹

Dust-on-snow events, which may become more common, can further accelerate the pace of snowmelt. By reducing the reflectivity of the snow's surface, dust contributes to more rapid snow melt. Multiple studies report that dust loading can make spring runoff occur 3 to 6 weeks earlier.¹⁵²

¹⁴⁴ *Id.*

¹⁴⁵ Saunders, Stephen, Tom Easley, and Melissa Mezger, [Climate Projections in Summit County, Colorado](#), A report by the

Rocky Mountain Climate Organization to Summit County, Town of Breckenridge, Town of Frisco, and Northwest Colorado Council of Governments Water Quality/Quantity (August 2021)

¹⁴⁶ Manning, A.H., Petach, T.N., Runkel, R.L., & McKnight, D.M. (2024) Climate-driven increases in stream metal concentrations in mineralized watersheds throughout the Colorado Rocky Mountains, USA. *Water Resources Research*, 60 e2023WR036062. <https://doi.org/10.1029/2023WR036062>

¹⁴⁷ EPA, 2023. Lincoln Creek and Grizzly Reservoir Study.

¹⁴⁸ Shannon Mulane, The Colorado Sun. 9/12/2025.

¹⁴⁹ *Id.* at 40

¹⁵⁰ Water Plan at 13.

¹⁵¹ *Id.*

¹⁵² Colorado Climate Assessment Report at 77.

Snowfall as Share of Winter Precipitation Projections with high emissions

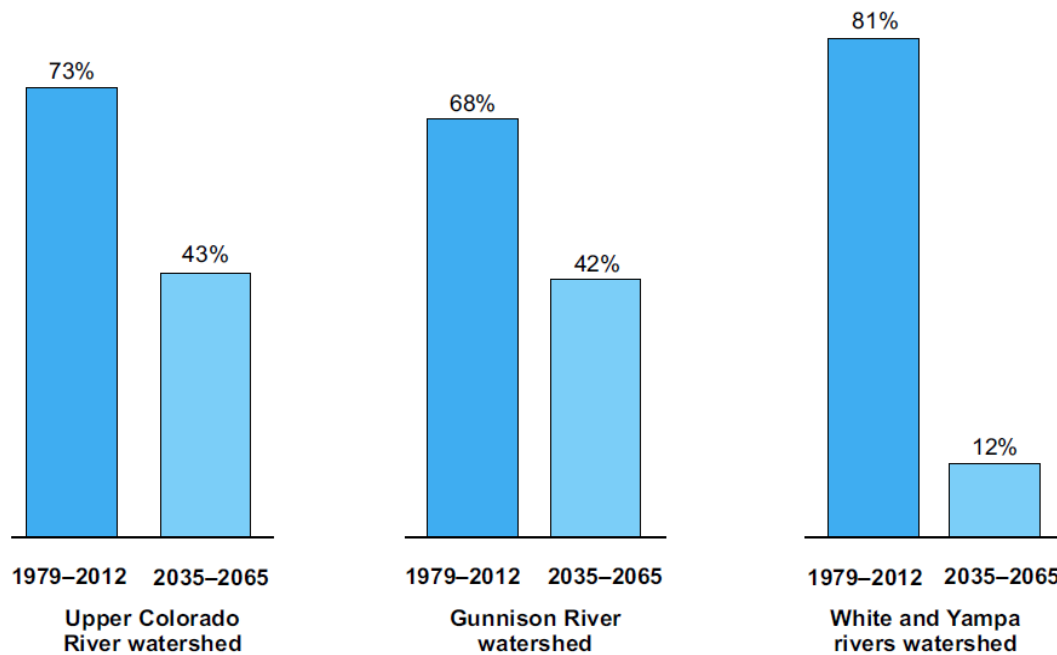


Figure 12: Snowfall as Share of Winter Precipitation (Projections with High Emissions)

Source: Saunders, Stephen and Tom Easley, [Climate Change in the Headwaters: Water and Snow Impacts](#) at 13.

6.2.1. Changes in Ice Formation

As air and water temperatures decline in the fall, ice forms on waterbodies. The annual dynamics of ice formation create consequences for the aquatic ecosystem (e.g., altered fish passage) and to man-made infrastructure (e.g., flooding upstream of ice dams). Due to the high elevations common throughout the NWCCOG Region, ice formation and its impacts remains important despite a warming climate.

Frazil ice, ice particles suspended in the water column, can form in rivers and streams that lack surface ice and have turbulent flows, particularly when air temperatures are below zero. These conditions cause water to become super-cooled, making ice formation in moving water possible. Over time, frazil ice can form anchor ice on the stream bottom. While certain amounts of anchor ice are natural to rivers and streams in the NWCCOG Region, extensive anchor ice can negatively impact macroinvertebrates and fish. An increase in anchor ice may alter the composition of macroinvertebrate communities in the NWCCOG Region, including the Lower Frying Pan River and Blue River. Anchor ice may be a factor for some of the

macroinvertebrate impairments in the NWCCOG Region; additional investigation is warranted.

The frequency and distribution of anchor ice could become more erratic as climate change continues. Warm spells or winter rain may cause additional areas of open water that are vulnerable to frazil and anchor ice in subsequent cold spells.¹⁵³ Other examples may include an increase in winter water releases from dams in the NWCCOG Region create more open water facilitating additional frazil and anchor ice formation, increased surface water diversions for snowmaking or municipal use may have similar but more localized effects. WWTF effluent discharges may create additional open water, particularly when flows in the receiving waters are low.

6.3. Low Flows

Increased air temperatures reduce stream flows in the NWCCOG Region. Multiple studies estimate that for every 1-degree Fahrenheit increase in temperature, streamflow is reduced between 3% to 5.2%.¹⁵⁴ One study estimates that with business-as-usual greenhouse gas emissions, river flows may decline by 20% by mid-century and 35% by end-century due to rising air temperatures.¹⁵⁵

Reductions in stream flows can have significant impacts on water quality. Impacts include:

- Increased concentrations of metals, sediments, nutrients, and other contaminants.
- Production of more organic matter in waterways, which during water treatment may increase disinfection by-products, which must in turn be removed to meet water quality standards.
- Higher water temperatures, which can exceed water quality standards.¹⁵⁶
- Reductions in stream flows also create water supply and demand challenges for the Region's water providers.

As low flows and droughts persist, groundwater will become an increasingly important resource in the NWCCOG Region. New research in mountainous watersheds shows that groundwater is more critical than previously understood. Groundwater provides a

¹⁵³ Barrette, Paul 2024/11/26- On fish in rivers during winter: The challenges posed by ice and a warming climate- 10.13140/RG.2.2.32458.99529.

¹⁵⁴ [Colorado Basin Implementation Plan, Volume 2](#) (2022) at 22.

¹⁵⁵ Udall, B. and J. Overpeck, [The twenty-first century Colorado River hot drought and implications for the future](#), Water Resource. Res., 53, 2404– 2418, doi:10.1002/2016WR019638 (2017).

¹⁵⁶ Saunders, Stephen and Tom Easley, [Climate Change in the Headwaters: Water and Snow Impacts](#), Rocky Mountain Climate Organization commissioned by Northwest Colorado Council of Governments Water Quality/Quantity Committee, 2018.

substantial portion of flows in streams and rivers during late summer and fall and is being depleted due to climate change.¹⁵⁷

6.4. Water Temperature Increases

Increased air temperatures and reductions in stream flows can create significantly warmer rivers and streams. Warmer water temperatures can be harmful or even lethal to aquatic life, especially in high altitude waterbodies with minimal or intermittent flows.

The water quality and environmental impacts of increased stream temperatures have economic consequences in the Region, such as when sections of the Yampa, Colorado, Fraser, Eagle, and Roaring Fork Rivers have been closed to fishing.¹⁵⁸

6.5. Water Demand

With increased air temperatures comes additional demands for nearly all types of water uses. Climate-change-driven impacts on water demand “may be as or more important than changes to water supply,” according to the Western Water Assessment.¹⁵⁹ Higher temperatures increase water consumption by plants, which can increase water demand for crops, yards, landscaping, and native vegetation.¹⁶⁰

The NWCCOG Region already experiences low flows and water temperature increases due to transmountain diversions in the NWCCOG Region.¹⁶¹ Climate change will exacerbate these impacts further.

¹⁵⁷ Carroll, R.W.H et al. 2024 Nature Water. <https://www.nature.com/articles/s44221-024-00239-0>

¹⁵⁸ For examples on fishing closures from 2021 and 2022, see articles from [Channel 7](#), [Fox 31](#), [Summit Daily](#), and [Trout Unlimited](#).

¹⁵⁹ *Id.* at 16, quoting J. Lukas and others, [Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation](#) (Second Edition—August 2014), report by Western Water Assessment, University of Colorado, Boulder, to Colorado Water Conservation Board (Boulder: University of Colorado, Boulder, 2014).

¹⁶⁰ *Id.*

¹⁶¹ Coley/Forrest, Inc., [Water and Its Relationship to the Economies of the Headwaters Counties](#), December 2011, at 46.

Section 7. Water Quality's Relationship to the Region's Economy and Environmental Justice

7.1. Recreation and Tourism Economy

The economy of the NWCCOG Region is focused on recreation and tourism, with \$5.5 million in visitor spending from 18 million visitors in 2024.¹⁶² The bulk of this economic activity is water-based, including snow sports, fishing, and boating. Water quality problems can quickly generate economic challenges.

Because the bulk of the NWCCOG Region's economic sectors are water-dependent, water quality problems can quickly generate economic challenges.

For example, the Region has experienced river closures to protect fish populations in recent years. Many rivers and streams in the Region experience high temperatures due to low flow conditions from TMDs, in-basin diversions, increased air temperatures due to climate change, and varying combinations of these and other factors. Emergency closures, implemented by Colorado Parks and Wildlife, are mainly voluntary in nature and can be triggered when water temperatures rise above 71 degrees or when flows drop below 50 percent of average. In recent years, closures have occurred on the Colorado, Yampa, Fraser, and Crystal rivers, among others.¹⁶³ Such closures, even when voluntary, limit activity and spending related to fishing and boating.

Climate change impacts such as increased air temperatures will exacerbate economic impacts such as shortened ski seasons and threats to fish, boating activity, aquatic species, and aquatic habitat.¹⁶⁴

Agriculture is also adversely impacted by low flows and water quality degradation.

Without a doubt, the Region's economy is inextricably linked to regional water quality conditions that are outlined in this 208 Plan.

7.2. Environmental Justice

Regional water quality issues in this 208 Plan are sometimes related to environmental justice concerns primarily related to affordability of housing in the Region. There is an inadequate supply of affordable housing across the NWCCOG Region, and the options that exist may face disproportionate water quality risks. The Colorado Environmental Justice Act states that:

¹⁶² Harvey Economics, Water & Its Relationship to the Economy of Headwaters Counties Report Update, anticipated 2026 (draft Dec. 2025), at 3-9.

¹⁶³ [Low river flows trigger calls, closures, stressed fish - Colorado Water Trust](#)

¹⁶⁴ Harvey Economics at 4-10.

“Environmental justice recognizes that all people have a right to breathe clean air, drink clean water, participate freely in decisions that affect their environment, live free of dangerous levels of toxic pollution, experience equal protection of environmental policies, and share the benefits of a prosperous and vibrant pollution-free economy.”¹⁶⁵

Many communities in the NWCCOG Region are considered disadvantaged communities primarily because of the disparity between income levels and the cost of living.¹⁶⁶ Residents spend a disproportionate amount of their income on housing. Those residents are referred to as “housing burdened.”

Colorado recently developed a tool for measuring environmental health injustice, called, EnviroScreen, which shows that the NWCCOG Region generally does not contain a significant measure of cumulative health burdens that give rise to environmental justice concern. NWCCOG Counties are in the lowest third of counties when ranked for environmental health injustice by EnviroScreen.¹⁶⁷ When viewed at the census tract level, several tracts within the middle percentile of EnviroScreen scores statewide because of social factors such as the percent of population housing burdened, the percentage of low-income residents, and the percentage of racial and social isolation.¹⁶⁸

The following are considerations for better incorporating Environmental Justice considerations into the Region's water quality management:

Conduct 208 Reviews with an Environmental Justice Lens. NWCCOG should consider the economic ramifications of regional water quality decisions for disadvantaged communities, especially when reviewing development applications for small providers and systems.

Address Environmental Justice in Rate Structures and State Funding

Water and wastewater rates can impact housing affordability, and water quality issues can cause rate increases to fund infrastructure upgrades.

Continue to Consider Environmental Justice in State and Federal Grantmaking. State and federal funding is essential to funding infrastructure projects in a manner that reduces rate impacts to residents, especially in smaller or disadvantaged communities. Colorado continues to integrate environmental justice considerations into its grant processes in a manner that reflects the affordability challenges in the NWCCOG Region.

Funding sources include:

¹⁶⁵ [Colorado Environmental Justice Act](#)

¹⁶⁶ Colorado Department of Local Affairs, [2023 SRF Disadvantaged Community Data](#), accessed June 7, 2023.

¹⁶⁷ Colorado Department of Public Health and Environment, [Colorado EnviroScreen Mapping Tool](#), accessed June 6, 2023.

¹⁶⁸ *Id.* See, e.g., Grand County tract 08049000100 and Eagle County tract 08037000401.

- EPA's Drinking Water State Revolving Fund,
- EPA Water Pollution Control Revolving Fund,
- Colorado Water Quality Improvement Fund,
- Colorado Natural Hazard Grant Fund, and
- Colorado Small Communities Water and Wastewater Grant Fund.

Continue to Advocate for Improved Drinking Water in Mobile Home Parks

Mobile home parks are an effective affordable housing option throughout the NWCCOG Region but can also be vulnerable to water quality issues. Some mobile home parks are not registered public water systems and instead get water from the local water utility. The utility is responsible for water up to the water meter that serves the entire park, rather than individual units. The owner of the mobile home park is responsible for repairing and maintaining the pipes that deliver water to mobile homes past the meter. Depending on the type of metering and where the mobile home park receives its water, the WQCD may not have regulatory authority for drinking water in the mobile home park.¹⁶⁹

Residents in some mobile home parks have complained of taste, odor, or discoloration from water sources in the park.¹⁷⁰ Often such problems do not create a public health issue, but without testing residents may still be concerned about safety and may not wish to consume the water.¹⁷¹

In 2023, Colorado enacted the [Mobile Home Park Water Quality Act](#), which requires water quality testing in mobile home parks, whereas previously the local utility only tested the water before entering the infrastructure in the mobile home park. The bill also requires remediation if a problem is detected and provides significant funding for necessary upgrades to drinking water and wastewater infrastructure to ensure costs will not be passed onto the residents. NWCCOG supports work related to the act and, as resources allow, will work with local jurisdictions to correct any issues identified in the water or wastewater systems in mobile home parks.

¹⁶⁹ WQCD, [Water and Mobile Homes Technical Guide](#), accessed June 8, 2023.

¹⁷⁰ For example, residents in Apple Tree Park in Garfield County have complained of discoloration, as documented in this [Post Independent story from May 16, 2023](#). The Country Meadows mobile home park in Gunnison, CO, has sporadic water availability for its residents as described in [this July 3, 2022 Colorado Sun story](#).

¹⁷¹ WQCD, [Water and Mobile Homes Technical Guide](#), accessed June 8, 2023.

Appendix A: Required Elements Crosswalk

Cross Walk of Required Elements of a V	
Number	Paraphrased Requirement
1	Total Maximum Daily Loads
2	Effluent limitations
3	Municipal and industrial water treatment
4	Nonpoint source management and control
5	Management Agencies
6	Implementation Measures
7	Dredge or fill program
8	Basin Plans
9	Groundwater

Water Quality Management Plan and NWCCOG Plan	
Location in NWCCOG 208 Plan	Comments
Section 3.2, pages 13-18	
Section 5.0, pages 53-70	Section 5.3.2 discusses priority effluent limitations applicable to domestic wastewater treatment facilities.
Section 5.0, pages 53-70	Specifically sections 5.3 and 5.5 for municipal and industrial water treatment facilities, respectively.
Section 4.0, pages 23-52	
Sections 1.2.1 and 1.2.2, pages 3-4 and Appendices B and C	
Section 2.0, pages 5 to 8	NWCCOG staff use the 208 Plan Policies to evaluate whether development applications are consistent with the 208 Plan. See Appendix D for specific examples.
Section 5.6, pages 65-66	
Not applicable	
Section 3.4, pages 21-22 and Section 5.5, page 64.	Section 5.5 summarizes groundwater quality protection implemented by DRMS, which is critical at industrial mines in the Region.

Appendix B: Management Agencies Intergovernmental Agreements (IGA)

INTERGOVERNMENTAL AGREEMENT

An Intergovernmental Agreement establishing management agencies responsible for carrying out the provisions of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties.

WHEREAS, the Colorado Water Quality Control Commission has approved the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties with the following condition:

"Prior to the submission of the current plan to the Governor and EPA, specific management agencies shall be identified for each specific service area. Special districts may serve as management agencies only if acting cooperatively with a general purpose government, pursuant to identified intergovernmental agreements," and

WHEREAS, the Morrison Creek Water and Sanitation District wishes to act as a designated management agency jointly with the Town of Oak Creek to carry out the provisions of the Area Wide Water Quality Plan for the Morrison Creek Water and Sanitation District and

WHEREAS, the Oak Creek Town Council has developed policies and procedures for land use (and/or wastewater management) and

NOW THEREFORE BE IT RESOLVED THAT:

1. The Board of Directors of the Morrison Creek Water and Sanitation District supports and endorses the following policies or most recently adopted revision as developed by the Oak Creek Town Council:
 - a. Town of Oak Creek Land Use Plan
 - b. Town of Oak Creek Zoning Regulation
2. The Morrison Creek Water and Sanitation District will comply with the Town of Oak Creek in the implementation of these policies, and
3. The Morrison Creek Water and Sanitation District shall be identified as the management agency responsible for controlling point source discharges in a manner consistent with recommendations of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties, and
4. For activities related to the operations of the Sanitation District, the Morrison Creek Water and Sanitation District shall act as the management agency responsible for implementing the control of nonpoint sources of water quality degradation (including activities related to stream encroachment, public facilities and services, vegetation management, soil disturbance, impervious cover, stormwater and chemical management) when undertaking activities within the sanitation district. For all other activities that may result in nonpoint sources of water

quality degradation, the Town of Oak Creek will act as the management agency responsible for the control of these nonpoint sources of pollution on private lands within town boundaries, and

5. The Town of Oak Creek agrees to take into consideration the ability of the Morrison Creek Water and Sanitation District to provide wastewater services during the town's land use policy development and decision making, and
6. The Northwest Colorado Council of Governments will continue to be the designated planning agency for the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties and said Counties (and/or municipalities) shall continue to be responsible for local land use planning.

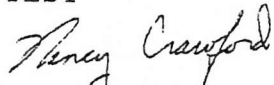
Approved this 21st day of June, 1989.



Mayor
Town of Oak Creek Pro-Tem

President
Morrison Creek Water and Sanitation
District

ATTEST


Town Clerk

46-
JUN 12 1989

INTERGOVERNMENTAL AGREEMENT

NWCCOG

An Intergovernmental Agreement establishing management agencies responsible for carrying out the provisions of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties.

WHEREAS, the Colorado Water Quality Control Commission has approved the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties with the following condition:

"Prior to the submission of the current plan to the Governor and EPA, specific management agencies shall be identified for each specific service area. Special districts may serve as management agencies only if acting cooperatively with a general purpose government, pursuant to identified intergovernmental agreements," and

WHEREAS, the Morrison Creek Metropolitan Water & Sanitation District wishes to act as a designated management agency jointly with Routt County to carry out the provisions of the Area Wide Water Quality Plan for Morrison Creek Metropolitan Water & Sanitation District and

WHEREAS, the Board of County Commissioners has developed policies and procedures for land use (and/or wastewater management) and

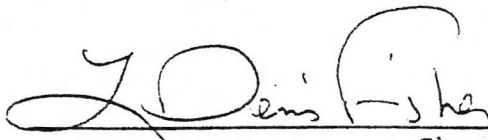
NOW THEREFORE BE IT RESOLVED THAT:

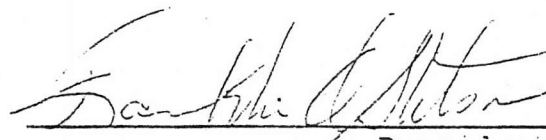
1. The Board of Directors of the Morrison Creek Metropolitan Water & Sanitation District supports and endorses the following policies or most recently adopted revision as developed by the Board of County Commissioners:
 - a. Routt County Land Use Plan
 - b. Routt County Zoning Regulation
2. The Morrison Creek Metropolitan Water & Sanitation District will comply with Routt County in the implementation of these policies, and
3. The Morrison Creek Metropolitan Water & Sanitation District shall be identified as the management agency responsible for controlling point source discharges in a manner consistent with recommendations of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties, and
4. For activities related to the operations of the Sanitation District, the Morrison Creek Metropolitan Water & Sanitation District shall act as the management agency responsible for implementing the control of nonpoint sources of water quality degradation (including activities related to stream encroachment, public facilities and services, vegetation management, soil disturbance, impervious cover, stormwater and chemical management) when undertaking activities within the sanitation district. For all other activities that may result in nonpoint

sources of water quality degradation, Routt County will act as the management agency responsible for the control of these nonpoint sources of pollution on private lands within town boundaries, and

5. Routt County agrees to take into consideration the ability of Morrison Creek Metropolitan Water & Sanitation District to provide wastewater services during the County's land use policy development and decision making, and
6. The Northwest Colorado Council of Governments will continue to be the designated planning agency for the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties and said Counties (and/or municipalities) shall continue to be responsible for local land use planning.

Approved this 5 day of Jan, 1989.


Chairman
Routt County


President
Morrison Creek Metropolitan Water
& Sanitation District

ATTEST


Routt Co. Clerk & Recorder

INTERGOVERNMENTAL AGREEMENT

AN INTERGOVERNMENTAL Agreement establishing management agencies responsible for carrying out the provisions of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties.

WHEREAS, the Colorado Water Quality Control Commission has approved the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties with the following condition:

"Prior to the submission of the current plan to the Governor and EPA, specific management agencies shall be identified for each specific service area. Special Districts may serve as management agencies only if acting cooperatively with a general purpose government pursuant to identified intergovernmental agreements."

WHEREAS, the Kremmling Sanitation District wishes to act as a designated management agency jointly with the Town of Kremmling to carry out the provisions of the Area Wide Water Quality Plan for the Kremmling Sanitation District and

WHEREAS, the Kremmling Town Council has developed policies and procedures for land use and/or wastewater management and

NOW THEREFORE BE IT RESOLVED THAT:

1. The Board of Directors of the Kremmling Sanitation District supports and endorses the following policies or most recently adopted revision as developed by the Kremmling Town Council:
 - a. Town of Kremmling Land Use Policies
 - b. Town of Kremmling Zoning Regulation
2. The Kremmling Sanitation District will comply with the Town of Kremmling in the implementation of these policies, to the best of their ability.
3. The Kremmling Sanitation District shall be identified as the management agency responsible for controlling point source for Kremmling Sanitation District discharges in a manner consistent with recommendations of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties, and
4. For activities related to the operations of the

comprehensive plan for the Fremming Land Use District shall serve as the primary planning instrument for coordinating the control of the Fremming Land Use District's nonpoint sources of water quality degradation (including activities such as stream encroachment, grading facilities and services, vegetation management, soil disturbance, impervious cover, stormwater and chemical management) with underlying activities within the jurisdiction district. For all other activities that may result in nonpoint sources of water quality degradation, the Town of Fremming will act as the ultimate agency responsible for the control of these nonpoint sources as a function on private lands within town boundaries, and

2. The Town of Fremming agrees to take into consideration the policy of the Fremming Land Use District to provide wastewater services during the town's land use policy development and decision making, and

3. The Northwest Colorado Council of Governments will continue to be the designated planning agency for the area with water quality plan for Eagle, Grand, Jackson, Pitkin, Silt and Summit Counties and said Counties (and/or municipalities) shall continue to be responsible for local land use planning.

Approved this 11th day of September 1999.

Ricky Dyer
Mayor
Town of Fremming

Robert C. Sanford
President
Fremming Land Use District

ATTEST:

Sharon K. Cesar
Sharon K. Cesar, Town Clerk

INTERGOVERNMENTAL AGREEMENT

An Intergovernmental Agreement establishing management agencies responsible for carrying out the provisions of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties.

WHEREAS, the Colorado Water Quality Control Commission has approved the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties with the following condition:

"Prior to the submission of the current plan to the Governor and EPA, specific management agencies shall be identified for each specific service area. Special districts may serve as management agencies only if acting cooperatively with a general purpose government, pursuant to identified intergovernmental agreements," and

WHEREAS, the Frisco Sanitation District wishes to act as a designated management agency jointly with the Town of Frisco to carry out the provisions of the Area Wide Water Quality Plan for Frisco Sanitation District, and

WHEREAS, the Frisco Town Council has developed policies and procedures for land use (and/or wastewater management) and

NOW THEREFORE BE IT RESOLVED THAT:

1. The Board of Directors of the Frisco Sanitation District supports and endorses the following policies or most recently adopted revision as developed by the Frisco Town Council:
 - a. Town of Frisco comprehensive land use plan
 - b. Town of Frisco zoning ordinance
 - c. Town of Frisco subdivision ordinance
2. The Frisco Sanitation District will comply with the Town of Frisco in the implementation of these policies, and
3. The Frisco Sanitation District shall be identified as the management agency responsible for controlling point source discharges in a manner consistent with recommendations of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties, and
4. The Frisco Sanitation District shall act as the management agency responsible for implementing the control of nonpoint sources of water quality degradation (including activities related to stream encroachment, public facilities and services, vegetation management, soil disturbance, impervious cover, stormwater and

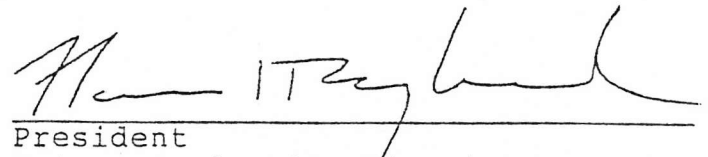
chemical management) when undertaking activities within the sanitation district, otherwise the Town of Frisco will act as the management agency responsible for the control of these nonpoint sources of pollution on private lands within municipal boundaries, and

5. The Town of Frisco agrees to take into consideration the ability of Frisco Sanitation District to provide wastewater services during the Town's land use policy development and decision making, and
6. The Northwest Colorado Council of Governments will continue to be the designated planning agency for the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties and said Counties (and/or municipalities) shall continue to be responsible for local land use planning.

Approved this 21st day of June, 1988.



Mayor
Town of Frisco



President
Frisco Sanitation District

.. . ATTEST

RESOLUTION NO. 86-24

Before the Board of County Commissioners of the
County of Summit
State of Colorado

ADOPTING A POLICY FOR WASTEWATER MANAGEMENT IN THE UPPER BLUE BASIN

WHEREAS, it is the goal of Summit County to:

1. Protect and enhance the water quality in the Upper Blue Basin including Dillon Reservoir.
2. Encourage efficient, economic and reliable delivery of wastewater management services within the Upper Blue Basin; and

WHEREAS, to this end, it is the desire of the Board of County Commissioners to adopt a policy for wastewater management in the Upper Blue Basin; and

WHEREAS, the proposed wastewater management policy was endorsed by the Breckenridge Sanitation District Board of Directors on April 10, 1986; and

WHEREAS, the proposed wastewater management policy has been reviewed by the Summit County Planning Department, Upper Blue Planning Commission and other interested parties.

NOW THEREFORE BE IT RESOLVED that the Board of County Commissioners of Summit County, Colorado hereby adopts the following policy for wastewater management in the Upper Blue Basin:

- I. The Breckenridge Sanitation District's service area includes the entire Upper Blue Basin. Within the area it is assumed that the Breckenridge Sanitation District has declared its intent to provide efficient, economic and reliable delivery of services. Thus the Breckenridge Sanitation District is assumed to be the primary provider of wastewater management services. However, it is recognized that this assumption may not be valid and it may be more efficient or reliable in certain situations to provide wastewater management services inside the Breckenridge Sanitation District's service area through another special district organized pursuant to appropriate Colorado statutes.
- II. A proponent of a new special district for wastewater management must indicate the increased benefit of the new special district over service provided by the Breckenridge Sanitation District. The service plan for the new special district must clearly demonstrate the following:

EXHIBIT 4

1. Compliance with the statutory criteria for action on service plans in C.R.S. 32-1-203, as amended.

2. The inadequacy of the Breckenridge Sanitation District to provide service in the subject area for present and projected needs by demonstrating one or more of the following:

- a. The Breckenridge Sanitation District's facilities do not have the necessary capacity to serve the area.
- b. The Breckenridge Sanitation District refuses to serve the area.
- c. It is impractical based on location, topography, other physical constraints or efficiency of service for the Breckenridge Sanitation District to serve the area.
- d. It is uneconomical (i.e., more expensive) for the Breckenridge Sanitation District to serve the area.

III. It is recognized that several independent wastewater treatment plants are being operated within the Upper Blue Basin. It is the County's intention to apply this policy to these plants if one or more of the following should occur:

1. An independent plant fails to meet its N.P.D.E.S. permit and therefore becomes a threat to the water quality of Summit County's streams, lakes, or groundwater.
2. The independent plant is not owned by a governmental or quasi-governmental entity.
3. The independent plant intends to expand beyond its permitted capacity and it can be shown that service by the Breckenridge Sanitation District would be less expensive and of equal or better reliability than the expanded plant.

ADOPTED this ~~17th~~ day of *May*, 1986.

MAR. 19 1987

BOARD OF COUNTY COMMISSIONERS
OF SUMMIT COUNTY, COLORADO

By: *Dan Ulmer*

Dan Ulmer, Chairman

ATTEST:

Colleen Richmond

Colleen Richmond, Clerk and Recorder

MEMORANDUM OF AGREEMENT

RE: Agreement between the Town of Breckenridge, Summit County and the Breckenridge Sanitation District Establishing a Sewer Tap or Plant Investment Fee (PIF) Policy through December 31, 1987.

June 26, 1985

WHEREAS, the Town of Breckenridge and Summit County are responsible for Land Use Planning in the Upper Blue River Basin; and

WHEREAS, the Breckenridge Sanitation District, the Town of Breckenridge, and Summit County are interested in coordinating planning for the Basin; and

WHEREAS, there presently exists a limit to the sewer treatment capacity in the Upper Blue River; and

WHEREAS, the Town has adopted a master plan and the County is working on a new Master Plan; and

WHEREAS, the Town, County, and District wish to limit or eliminate any speculation on PIFs;

NOW, THEREFORE, IT IS HEREBY mutually agreed for the benefit of the County of Summit, the Town of Breckenridge, and the Breckenridge Sanitation District and for the further orderly and responsible development within the Upper Blue River Valley, that:

1. Building permits will not be issued prior to the approval by the District and prior to purchase of plant investment fees by the Developer. The approval will be in the form of a Building Permit Application signed by the District.

Memorandum of Agreement

Page 2

2. The PIF will be valid for a period of twelve months. If, after the twelve month period substantial construction is not in progress or if after 24 months the building is not complete, then the PIFs will be automatically forfeited with no refund and the PIFs will become available for resale. Substantial construction for this purpose shall mean all foundations in place with additional construction proceeding in a timely manner. The 24 month period may be extended with the approval of both the District and the Town or County planning agency.

3. The Town or County will not approve development proposals which will require service by the District and which are outside existing service areas unless the District has granted approval for the extension of service.

4. The Town, Sanitation District, and Summit County agree to mutually pursue long-term solutions to limited sewer capacity in the Upper Blue.

5. The Town, County, and District agree to consider this agreement in the preparation or modification of the Town and County Master Plans.

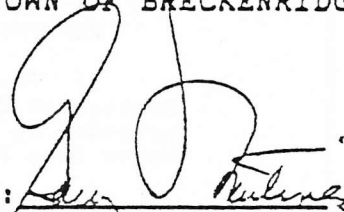
Memorandum of Agreement
Page 3

6. This Agreement will be reviewed at least annually and will terminate on December 31, 1987. A review may be made more frequently at the request of any of the parties. Changes and/or additions may be made at any time with the approval of all of the parties.

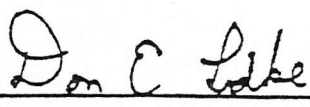
SUMMIT COUNTY

BY: 
DATE: 6/26/85

TOWN OF BRECKENRIDGE

BY: 
DATE: 9/11/85

BRECKENRIDGE SANITATION DISTRICT

BY: 
DATE: 11 July 1985

RESOLUTION 4

SERIES 1986

A RESOLUTION ENDORCING THE COUNTY'S
WASTEWATER MANAGEMENT POLICIES

WHEREAS, the Breckenridge Sanitation District wishes to establish wastewater management policies for the Upper Blue River Basin in cooperation with the County of Summit and the Town of Breckenridge; and

WHEREAS, the Board of County Commissioners has developed proposed policies and procedures for Wastewater Management; and

WHEREAS, these Policies are attached to this Resolution as Exhibit A.

NOW THEREFORE BE IT RESOLVED that

1) The Board of Directors of the Breckenridge Sanitation District supports and endorses the policies as proposed by the BOCC for Wastewater Management in the Upper Blue River Basin; and

2) The Breckenridge Sanitation District will cooperate with the County in the implementation of these policies; and

3) The Breckenridge Sanitation District will continue to work with the County and the Town of Breckenridge to provide efficient, economical and reliable wastewater services.

Approved this 12th day of June, 1986.

Don E. Lidke
Don E. Lidke, President

ATTEST:

B. P. McMenamy
B. P. McMenamy, Secretary

MEMORANDUM OF AGREEMENT

RE: Agreement Between the Town of Breckenridge, Summit County and the Breckenridge Sanitation District Establishing a Sewer Tap or Plant Investment Fee (PIF) Allocation Policy through December 31, 1984

July 13, 1982

WHEREAS, the Town of Breckenridge and Summit County are responsible for Land Use Planning in the Upper Blue River Basin;

WHEREAS, the Breckenridge Sanitation District, the Town of Breckenridge, and Summit County are interested in coordinated planning for the Basin;

WHEREAS, there presently exists a limit to the sewer treatment capacity in the Upper Blue River;

WHEREAS, in November, 1982 there will be an additional treatment capacity on line for approximately 4,000 PIFs;

WHEREAS, both the Town and County are working on new Master Plans and Regulations;

WHEREAS, the Town, County, and District wish to limit or eliminate any speculation on PIFs;

NOW, THEREFORE, IT IS HEREBY mutually agreed for the benefit of the County of Summit, the Town of Breckenridge, and the Breckenridge Sanitation District and for the further orderly and responsible development within the Upper Blue River Valley, that:

1. The District will allocate 1,200 sewer PIFs to the Town of Breckenridge and 600 sewer PIFs to Summit County for distribution and use by new multi-unit and commercial developments through December 31, 1984. The Town or County may reserve some or all of these allocated PIFs for phased-development projects.

2. Single family homes and duplexes will be exempt from allocation restrictions under this agreement. For the purposes of this agreement a single family home shall be a detached living unit designed for occupancy by one or more persons occupying a dwelling as a unit sharing cooking, eating, living, sleeping and sanitary facilities (not including a rooming or boarding house). A duplex shall be two such units physically attached by a common wall or floor/ceiling.

3. The District will not sell PIFs for new multi-family and commercial developments without prior approval by the Town or County. The approval will be in the form of a Building Permit Application signed by the responsible Town or County Planning Authority.

4. The PIF will be valid for a period of ^{TWELVE} ~~six~~ months. If, after the six month period substantial construction is not in progress, then the PIFs will be automatically forfeited with no refund and the PIFs will become available for reallocation. Substantial construction for this purpose shall mean all foundations in place with additional construction proceeding in a timely manner.

5. The Town or County will not allocate taps to new service areas without prior approval of the district.

6. The Town, Sanitation District, and Summit County agree to mutually pursue long-term solutions to limited sewer capacity in the Upper Blue. One solution may be to control the amount and location of growth through Town and County planning efforts and establishing a new sewer tap allocation policy after December 31, 1984.

7. The Town, County, and District agree to consider this agreement in the preparation of the Town and County Master Plans.

8. This Agreement will be reviewed at least annually during the second week in January and will terminate on December 31, 1984. If a review of the taps issued warrants a revision to the allocation numbers, they will be adjusted at that time. A review may be made more frequently at the request of any of the parties. Changes and/or additions may be made at any time with the approval of all of the parties.

SUMMIT COUNTY

BY: *Justin L. McLeod*
DATE: August 19, 1982

TOWN OF BRECKENRIDGE

BY: *[Signature]*
DATE: August 24, 1982

BRECKENRIDGE SANITATION DISTRICT

BY: *[Signature]*
DATE: Sept. 9, 1982

BRECKENRIDGE SANITATION DISTRICT

May 4, 1987

Colorado Water Quality Control Commission
4210 East 11th Avenue
Denver, Colorado 80220

Re: NWCCOG 208 Plan

Dear Members of the Commission:

The Breckenridge Sanitation District wishes to support the Management System Recommendations included in Policy 11 of the NWCCOG Areawide Water Quality Management Plan. Policy 11 specifically includes counties, municipalities and sanitation districts as management agencies. The District requests that the Commission approve Policy 11.

In making this request, The District is aware of the preference to approve general purpose local governments, such as counties and incorporated cities and towns, as management agencies.

First, the District wishes to note that the Continuing Planning Process for Water Quality Management in Colorado specifically allows sanitation districts to be designated as management agencies. Although this document expresses a preference for general purpose governments, sanitation districts are not precluded from being designated as management agencies.

Second, as far as the NWCCOG Plan is concerned, Summit County Sanitation Districts have operated together with Summit County and its towns and management agencies for the last six years. During this time intergovernmental agreements concerning water quality management and planning have been adopted between the County, the towns and sanitation districts. Examples of these agreements follow and are attached as Exhibits 1 through 4:

1. Intergovernmental Agreement for Summit County Water Quality.
2. Memorandum of Agreement Between the Town of Breckenridge, Summit County and the Breckenridge Sanitation District Establishing Sewer Tap or Plant Investment Fee Allocation Policy through December 31, 1984.
3. Memorandum of Agreement Between the Town of Breckenridge, Summit County and the Breckenridge

Sanitation District Establishing Sewer Tap or Plant
Investment Fee Allocation Policy through December 31,
1987.

4. Agreement Between Summit County and the Breckenridge
Sanitation District Adopting a Policy for Wastewater
Management in the Upper Blue River Basin.

This six year course of action has been successful in Summit
County and we urge you not to disturb it.

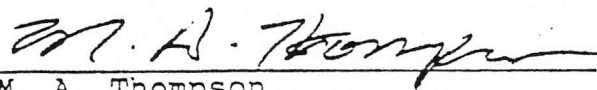
Third, the District is in the process of building sewage
treatment facilities with the benefit of a federal construction
grant. Federal regulations require that grants be made to
management agencies. An awkward and complicated issue will arise
as pointed out to the Commission in 1985 by the Water Quality
Control Division Director, if the District is not designated a
management agency. Therefore, in 1985, Gary Broetzman
recommended that the Breckenridge District be afforded management
agency status.

The District wishes to point out that the construction of
these waste treatment facilities is an example of the kind of
cooperation that has taken place in Summit County between the
County, the towns, and sanitation districts in recent years.

More specifically, these facilities are to replace three old
privately owned sewage treatment facilities in the upper Blue
River basin. The old facilities were sometimes not adequately
maintained and often discharged in excess of permit limitations.
All were subject to enforcement actions by the Division.
Although these facilities and the areas they served were outside
of the Breckenridge Sanitation District boundaries, the District
included them within its boundaries for the sole purpose of
upgrading the facilities and improving water quality in the Blue
River and Lake Dillon. This action was taken in cooperation with
the county and the Town of Breckenridge.

In summary, the District urges the Commission to adopt
Policy 11 and allow sanitation districts to continue to function
as management agencies.

Sincerely yours,

By 
M. A. Thompson
Manager

INTERGOVERNMENTAL AGREEMENT

An Intergovernmental Agreement establishing management agencies responsible for carrying out the provisions of the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Routt and Summit Counties.

WHEREAS, the Colorado Water Quality Control Commission has approved the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties with the following condition:

"Prior to the submission of the current to the Governor and the EPA, specific management agencies shall be identified for each specific service area. Special Districts may serve as management agencies only if acting cooperatively with a general purpose government, pursuant to identified intergovernmental agreements," and

WHEREAS, the Aspen Consolidated Sanitation District wishes to act as a designated management agency to carry out the provisions of the Area Wide Water Quality Plan for the Aspen Consolidated Sanitation District's service area; and

WHEREAS, the Board of County Commissioners of Pitkin County has developed policies and procedures for land use; and

WHEREAS, the Aspen Consolidated Sanitation District has developed a service plan that has been approved by Pitkin County.

NOW THEREFORE BE IT RESOLVED THAT:

1. The Board of Directors of the Aspen Consolidated Sanitation District supports and endorses, as of this date, the following policies or most recently adopted revision as developed by the Board of County Commissioners:
 - a. Pitkin County Land Use Plan
 - b. Pitkin County Zoning Regulation
2. The Board of County Commissioners of Pitkin County supports and endorses the Service Plan developed by the Aspen Consolidated Sanitation District.
3. To the extent allowed by law, Pitkin County and the Aspen Consolidated Sanitation District will act cooperatively in the implementation of the County's policies and the District's service plan.

4. The Aspen Consolidated Sanitation District shall be designated as the management agency responsible for controlling point source discharges within the District's service area, in a manner consistent with the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties.

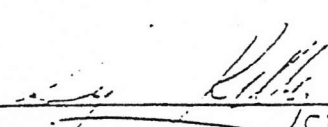
5. Pitkin County will act as the management agency responsible for implementing the control of nonpoint sources of water quality degradation (including activities related to stream encroachment, public facilities and services, vegetation management, soil disturbance, impervious cover, stormwater and chemical management) for all activities on private lands within the County.

6. Pitkin County agrees to take into consideration the ability of the Aspen Consolidated Sanitation District to provide wastewater services during the County's land use development and decision making.

7. The Northwest Colorado Council of Governments will continue to be designated the planning agency for the Area Wide Water Quality Plan for Eagle, Grand, Jackson, Pitkin, Routt and Summit Counties and said Counties (and/or municipalities) shall continue to be responsible for local land use planning.

Approved this _____ day of _____, 1989.

Pitkin County Chairman



Chairman
Aspen Consolidated
Sanitation District

ATTEST

Appendix C: Operating Agencies and WWTF Details

Appendix D: Example Development Reviews

MEMORANDUM



DATE: February 6, 2025

TO: Kristen Manguso, Community Development
Director, Grand County

FROM: Torie Jarvis, Sullivan Green Seavy Jarvis LLC
Ashley Bembenek, Alpine Environmental Consultants LLC
Consultants to the Northwest Colorado Council of Governments

RE: **Review of Henderson Mill Water Treatment Plant Application for Consistency with NWCCOG Regional Water Quality Management Plan**

This memorandum analyzes the Application for the proposed Henderson Mill Water Treatment Plant for consistency with the NWCCOG Regional Water Quality Management Plan, as required in Section 5-306(1)(b) of the Grand County Administrative Regulations for Areas and Activities Designated as Matters of State Interest Regulations ("1041 Regulations").

NWCCOG finds that the Henderson Mill Water Treatment Plant, as proposed in its Application, is consistent with the NWCCOG Regional Water Quality Management Plan as described in the analysis below.

I. Henderson Mill Water Treatment Plant Proposal

Climax Molybdenum Company Henderson Mill Operations ("Henderson" or "the Applicant") submitted its application to Grand County for a permit pursuant to County 1041 Regulations ("Application") to construct a water treatment plant at the Henderson Mill ("WTP" or "Project").

The WTP will treat water during mining operations, while additional water management will be required after mining has been completed.

II. NWCCOG 208 Plan Background

Section 208 of the Clean Water Act provides for the creation of regional water quality management plans for coordinated regional approaches to water quality management.¹ A regional water quality management plan is also referred to as a "208 Plan."

The Northwest Colorado Council of Governments ("NWCCOG") is the designated regional water quality management agency responsible for water quality planning in Region 12 (Eagle, Grand, Jackson, Pitkin, Routt, and Summit Counties). The primary goal of this Regional Water Quality Management Plan is to protect existing water quality and designated uses in the waterbodies of the region. NWCCOG reviews

¹ 33 U.S.C. § 1288.

development Applications for consistency with the 208 Plan when a local government has incorporated such a standard into its regulations.

Grand County requires consistency with the 208 Plan in Section 5-306(1)(b) which states “Assurances of compatibility of the proposed water project with federal, state, regional and county planning policies regarding land use and water resources.” (Emphasis added.)

To be consistent with the 208 Plan, development Applications must be consistent with the 208 Plan, including the policies enumerated in Volume 1 of the 208 Plan.²

III. Henderson Mill Water Treatment Plant Analysis

The following is an analysis of whether and to what degree the Project is consistent with the applicable policy from the 208 Plan, Policy 1, “Protect and Enhance Water Quality,” which reads:

The surface and ground waters of the region shall be protected to minimize degradation of existing water quality and maintain existing and designated uses of those waters; waters not currently supporting designated uses shall be restored as soon as is financially and technically feasible.

The Applicant holds several permits for the Henderson Mill that have been or will be amended to include the proposed WTP which provide information relevant to determining whether the construction and operation of the proposed WTP is protective of surface water and groundwater and maintains existing and designated uses of those waters. Thus, the permits are necessary for determining whether the Project is consistent with Policy 1.

Reclamation Permit from Division of Reclamation, Mining and Safety (DRMS).

The Henderson Mill, together with the Henderson Mine, has operated pursuant to a Mine Reclamation Permit since 1977 and as a Designated Mining Operation since 1994. Henderson integrated the WTP into the permit through Technical Revisions 34 (2021) and 35 (2022), both of which DRMS has approved.³

DRMS regulations require Henderson to meet reclamation performance standards that are protective of surface water quality, which include “minimizing disturbances. . . to the quantity or quality of water in surface and groundwater systems.”⁴ Henderson’s Environmental Protection Plan defines how it will protect those areas that potentially could be affected or impacted by its operations, including water quality impacts. The Plan includes management, monitoring, and response requirements to protect water quality.⁵ Henderson implements a Groundwater Management Plan associated with its Reclamation permit.

Generally, when in operation, the WTP would further ensure the mill facility is operated to prevent groundwater pollution. Because the Applicant cannot forecast the future sitewide water

² NWCCOG Regional Water Quality Management Plan, 2012, Volume 1: Policy Plan, https://www.nwccog.org/wp-content/uploads/2015/04/Vol-1_Policy-Plan-2012-208-Plan.pdf.

³ Application, Attachment 5; Attachment 6.

⁴ 2 C.C.R. § 407-1-3.1.6.(1).

⁵ Application, Attachment 5.

balance to know when the WTP will operate, it is not possible to determine potential water quality benefits attributed to the proposed WTP. According to the Applicant, the proposed WTP “is expected to have no, or a negligible, effect on groundwater quantity and quality.”⁶

The DRMS regulations also provide protections for the region’s aquifers, as the Henderson application explains. Currently, Henderson relies upon a seep water collection and return system and a groundwater extraction system to prevent pollution of local aquifers.⁷ The DRMS Groundwater Management Plan requires that Henderson monitor groundwater at multiple wells, including a well designated as a point of compliance by the Colorado Water Quality Control Commission (WQCC).⁸ This groundwater well is located approximately 5 miles downstream of the Henderson Mill adjacent to the Williams Fork River at Aspen Canyon Ranch. The WQCC adopted the point of compliance at the Aspen Canyon Ranch Well to protect the water supply use of the Williams Fork River, which establishes water quality standards that are far more protective than the groundwater standards that would otherwise apply. The most recent annual water monitoring report demonstrates the Applicant’s on-going compliance with DRMS regulations, including at the Aspen Canyon Ranch well.⁹

Discharge Permit from Water Quality Control Division Pursuant to Colorado Discharge Permit System, Including a Stormwater Permit

Henderson is required to renew the existing permit under the Colorado Discharge Permit System (CDPS) permit for the Mill’s discharge of treated water into the Williams Fork River.¹⁰

On April 14, 2020, Henderson submitted a renewal application to the Colorado Department of Public Health and Environment’s Water Quality Control Division (WQCD).¹¹ The WQCD has provided public notice of two drafts of the Henderson Mill Discharge Permit, both of which NWCCOG commented on jointly with Grand County. The second draft CDPS permit establishes effluent limitations and requirements for the proposed WTP sufficient to protect water quality in the Williams Fork River, aside from a WQCD error resulting in incorrect temperature limitations that NWCCOG understands will be corrected in the final permit.¹² Likewise, the second draft permit establishes limitations and requirements sufficient to control stormwater generated during construction and operation of the proposed WTP, as discussed in more detail below. These provisions are likely largely similar to those that will appear in the final permit.

Stormwater runoff attributed to the proposed WTP will be subject to the stormwater permit which is now combined with the CDPS permit. Stormwater flowing from the WTP building and the surrounding parking areas, as well as stormwater generated during construction of the WTP, will be directed to existing drainage swales which route stormwater flow to the Bear Paw Drainage Pipeline inlet.¹³ Stormwater is conveyed to the TSF through the pipeline where it is

⁶ Application, Attachment 1 at 31.

⁷ Application, Attachment 5 at 22-24.

⁸ 5 C.C.R. 1002-33 at §33.32(F).

⁹ Henderson WTP Application, Attachment 7.

¹⁰ The CDPS discharge permit includes several permitting actions beyond the scope of the County 1041 Application; while the DRMS permit is for the Mine and Mill, the CDPS discharge permit is *only* for the Mill.

¹¹ Henderson Mill Application Attachment 3.

¹² In personal communications, WQCD staff have reported that the final permit provides correct temperature limitations. The first draft permit included the correct temperature limitations.

¹³ Henderson WTP Application, Attachment 1 at 18.

managed as part of the process water system. The Applicant also proposed the following techniques to manage stormwater attributed to the WTP:

The WTP has been designed with sumps to catch overflows and spills. These sumps will return captured water to the treatment process.

The improved area will be graded to route stormwater flow to perimeter stormwater collection swales. These stormwater drainage swales direct drainage to existing drainage swales which route stormwater flow to the Bear Paw Drainage Pipeline inlet.¹⁴

In recent communications with NWCCOG staff, the WQCD indicated that the final CDPS permit will be issued at the end of February 2025.

Onsite Wastewater Treatment System (OWTS) Permit

The proposed WTP includes a septic tank and leach field to treat sanitary water generated in the WTP. The Applicant considered tying into the existing WWTF for the mill building, but technical and financial considerations made this option impractical.¹⁵ Based on the Application and discussion with the Applicant, staff concur with this conclusion. Construction of an OWTS requires a permit with Grand County.

IV. Conclusion

Assuming the final discharge permit issued by WQCD is adequately protective, NWCCOG finds that the Henderson Mill Water Treatment Plant, as proposed in its application, is consistent with the 208 Plan.

¹⁴ *Id.* at 5.

¹⁵ Personal communication with Miguel Hamarat on January 7, 2025.

MEMORANDUM



DATE: January 12, 2026

TO: Alan Goldich, Senior Planner, Routt County

FROM: Ashley Bembenek, Alpine Environmental Consultants LLC
Torie Jarvis, Sullivan Green Seavy Jarvis LLC
On behalf of the Northwest Colorado Council of Governments (NWCCOG)

RE: Second Correctness Review of Sleeping Giant Solar Application for Compliance with NWCCOG Regional Water Quality Management Plan

This memorandum analyzes whether the application for the proposed Sleeping Giant Solar Project (Project) complies with the NWCCOG Regional Water Quality Management Plan (208 Plan), as required in Section 3.1.L. of the Routt County Unified Development Code (UDC). Routt County refers to this phase of review as “correctness review.” NWCCOG finds that the Project **does not comply** with 208 Plan Policy 3 because of potential water quality impacts.

NWCCOG provided comments on the application materials for the proposed Project on November 13, 2024. In the past year, the Applicant submitted revised application materials to Routt County. Most of the comments in this memo address the revised application materials provided to Routt County in late 2024 and throughout 2025, with a focus on the following documents:

- Sleeping Giant Solar Project_SUP_Comment Response_20251111 submitted 11/17/25
- 72166 Trapper CutFillReport 05-28-2024-2 submitted 11/17/25
- Sleeping Giant Solar_Construction Phasing Plan_20250722 submitted 11/17/25
- Sleeping Giant Stormwater Water Quality Plan 2025-11-07 submitted 11/17/25
- Trapper Solar Project_SUP_Comment Response_20250131 submitted 2/6/25

This memo is structured in three parts. Section I provides background on NWCCOG and the 208 Plan. Section II summarizes the findings and recommendations in this memo. In Section III, NWCCOG offers a more detailed technical analysis of the Application. Our questions, comments, and recommendations on the application materials are numbered to facilitate additional discussion. In Section IV, NWCCOG provides recommendations that would allow NWCCOG to reconsider its determination at a later date.

I. NWCCOG 208 Plan Background

NWCCOG is the designated regional water quality management agency responsible for water quality planning in Region 12 (Eagle, Grand, Jackson, Pitkin, Routt, and Summit Counties). The primary goal of the Regional Water Quality Management Plan is to protect existing water quality and designated uses in the Region's waterbodies. NWCCOG reviews development applications for compliance with the 208 Plan when a local government has incorporated such a standard into its regulations.

Routt County requires compliance with the 208 Plan in Section 3.1.L. of the UDC, stating "All development shall demonstrate compliance with the Northwest Colorado Council of Governments' (NWCCOG) Regional Water Quality Management Plan ("208 Plan") . . ."

To demonstrate compliance with the 208 Plan, development applications must comply with the policies enumerated in Volume 1 of the 208 Plan.¹ Policy 3, "Land Use and Disturbance," applies to this Project and reads:

Water quality, including wetlands, floodplains, shorelines, and riparian areas, must be protected from land use and development so that significant degradation of water quality is prevented.

II. Summary Comments and Recommendations

NWCCOG finds that the Project **does not comply** with 208 Plan Policy 3 because of potential water quality impacts. These concerns originate from the soil's limitations and proposed vegetation cover in the Project area, which NWCCOG came to understand more fully from the revised application materials submitted since November 2024.

NWCCOG considers two main categories of information when assessing consistency with Policy 3:

- **Impact Assessment:** Has the Applicant identified all known water quality impacts attributable to the Project?
- **Mitigation and Monitoring:** Does the Applicant mitigate all identified impacts so that there is no significant degradation of water quality? If not, what impacts are not adequately mitigated? Does the Applicant propose monitoring to evaluate whether mitigation measures are performing as expected? Does the monitoring plan include a process for responding to issues identified through monitoring? Is there a process to communicate monitoring activities, results, and responsive measures to the County?

¹ NWCCOG Regional Water Quality Management Plan, 2012, Volume 1: Policy Plan, https://www.nwccog.org/wp-content/uploads/2015/04/Vol-1_Policy-Plan-2012-208-Plan.pdf.

First, NWCCOG identifies many ways in which the applicant should more fully analyze the extent of the impacts of the Project, i.e. the Impact Assessment. Corrections and additions to properly characterize the impacts of the Project should be completed before NWCCOG determines whether the Project is consistent with the 208 Plan. These issues are discussed in Section III. A-D, and Section IV. A.

NWCCOG also identifies deficiencies in the proposed monitoring and mitigation, including the need to develop a comprehensive monitoring and mitigation plan that combines soil, vegetation, stormwater, and water quality monitoring activities (see Section IV.B). If the County agrees, at this time NWCCOG believes the monitoring and mitigation plan could be developed at a later date and NWCCOG could find that the project is consistent with the 208 Plan because of an appropriate permit condition that requires the development of a comprehensive monitoring and mitigation plan, subject to approval by County experts, at the applicant's expense. These issues are discussed in Section III.E. and Section IV. B-D.

III. Technical Comments on Revised Application Materials

NWCCOG's overarching concerns are that the soils in the Project area are marginal for the proposed use and that the primary mitigation measures rely heavily upon improving soil quality and may not be sufficient to overcome the soil's inherent characteristics without substantially more mitigation. Further, the Applicant's analysis to demonstrate that the Project does not cause significant runoff or erosion includes several inappropriate assumptions. For these reasons and at this time, it is not possible for NWCCOG to conclude that the Project as described in the application demonstrates that water quality will not be significantly degraded.

The following comments outline these concerns in more detail.

A. Cut and Fill Report

The Cut and Fill Report includes Solar Fields A and B. Other application materials indicate that Solar Fields A and B have been removed from the proposed Project.²

1. Have Solar Fields A and B been removed? If so, please, revise the application materials, including the plan set, accordingly.

In a recent response to comments, the Applicant reported that the "cut and fill volumes are highly conservative, and most of the earthwork needed for the Project's construction will involve moving earth on-site, rather than taking it off-site. . . Additionally, the Project is expected to use a solar tracker system that will require significantly less earthwork than the

² For example, Sleeping Giant_Project Layout_20251202 and Figure 2 in Sleeping Giant Stormwater Water Quality Plan 2025-11-07 do not include solar fields in the areas previously identified as Solar Fields A and B.

numbers presented in Attachment B.”³ Fine-grained soils, as found throughout the Project area, bulk following excavation, and it is common to use cut factors that range from 1.2 to 1.5 to account for this bulking (i.e., increased volume of soil following excavation). The estimate uses a cut factor of 1.0 and likely underestimates the volume of cut materials. Likewise, the fill factor does not account for soil compaction.

2. How, specifically, are the cut estimates conservative?
3. Due to expansive soils, piles or piers are often necessary to stabilize foundations throughout Routt County. The application proposes a pile depth of 6 to 10 feet. Is this depth sufficient given the soils’ propensity to shrink and swell? How will the array design accommodate the shrink and swell?
4. What type of compaction is necessary to support the solar array piles given the soil textures in the Project area?
5. Is degree of compaction consistent with the reduced soil bulk density necessary to prevent runoff from the Project area?
6. What amount of soil will be moved off-site? To where?
7. What specifically does “significantly less earthwork” mean? Is the Applicant referring to earthwork in a smaller area, at a reduced depth or both?

B. Access Roads that Cross Waterbodies

In November 2024, NWCCOG identified concerns with two access roads that cross streams in the Project area. The Applicant reported that these roads are existing two-track roads with culverts, and that they were selected to avoid additional disturbance with streams and waterbodies in the Project area.⁴ NWCCOG remains concerned about potential impacts to those waterbodies because it is likely that the existing two-track roads were not designed to accommodate traffic associated with the proposed Project (e.g., water trucks). NWCCOG understands that the Applicant will likely have to further evaluate these road crossings as the Project design continues.

8. If the existing roads require improvements, will a federal Dredge and Fill permit or state authorization be required?
9. The application materials should be updated to more fully discuss waterbody crossings. In the alternative, in coordination with Routt County, NWCCOG would consider a condition of approval that could require the Applicant to submit an evaluation of the road capacity and appropriate water quality protection measures before Project construction, including County review and approval by a qualified professional at the Applicant’s expense.

³ Sleeping Giant Project_SUP_Comment Response_20251111 at page 17

⁴ Trapper Solar Project_SUP_Comments Response_20250131 at page 50.

C. Construction Phasing Plan

The construction phasing plan does not identify stormwater management or revegetation activities. The Colorado Department of Public Health and Environment (CDPHE) stormwater permit requires that control measures are installed prior to commencement of construction activities and prior to each phase of construction that introduces new potential pollutant sources.⁵ The UDC requires seeding prior to, during, and after construction (2.79.D.11.b). The Vegetation Establishment and Management Plan requires specific seed mixes depending upon the purpose and time of year that seeding occurs (i.e., Tables 3 to 6).⁶

10. The construction phasing plan should be updated to include stormwater management and revegetation activities.
11. In the alternative, in coordination with Routt County, NWCCOG would consider a condition of approval that could require the Applicant to submit a revised construction phasing plan before Project construction, including County review and approval by a qualified professional at the Applicant's expense.

D. Stormwater and Water Quality Plan

Generally, NWCCOG has several concerns with the Stormwater and Water Quality Plan and the disconnect between the vegetation cover rates presented Stormwater and Water Quality Plan and the vegetation performance standards established in the Vegetation Establishment and Management Plan.

The Stormwater Water Quality Plan uses the following models to assess the potential impacts attributed to the Project:

- Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) estimates runoff response to 24-hour precipitation events at four return intervals (1-yr, 5-yr, 10-yr, and 100-yr). The purpose of this modeling is to demonstrate that the proposed soil bulk densities and revegetation in the Project area provide infiltration capacity sufficient to absorb precipitation at the specified storm sizes without generating excess runoff, erosion, or water quality impacts in down-gradient waterbodies.
- National Renewable Energy Lab's Photovoltaic Stormwater Research and Testing (PV-SMaRT) model calculates Natural Resource Conservation Service (NRCS) Curve numbers. Curve number is an estimate of soil infiltration capacity. PV-SMaRT calculates curve number with inputs that account for solar array systems, including

⁵ CDPS General Permit COR400000 at Part I.B.1.

⁶ Vegetation Establishment and Management Plan pages 13 to 17.

post-Project soil bulk density and vegetation characteristics. Curve number is a critical input into HEC-HMS.

- NRCS Universal Soil Loss Equation (USLE) estimates annual erosion rates in the Project Area. USLE is a coarse but useful tool to evaluate changes in soil erosion based on changes to land use. Annual erosion rates were estimated for pre-Project, during construction, and post-Project conditions to provide evidence that 1) the two primary BMPs, reduced soil bulk density and revegetation, will not increase erosion following construction and 2) that temporary sediment basins are sufficient to capture eroded sediment created during Project construction.

NWCCOG has a number of questions regarding the assumptions used in the models which are organized by model and presented in the sections below.

i. PV-SMaRT

When calculating runoff, PV-SMaRT assumes the soil is free from frost and snow. In the Project area, soils freeze and accumulate snow during the winter. During snowmelt, soils become saturated and convey water to local streams via surface runoff or shallow groundwater flow (i.e., snowmelt driven hydrology).

12. Because PV-SMaRT does not consider snowmelt, it is important to use low initial abstraction values to generate additional runoff in HEC-HMS, as the lower values would more effectively simulate snowmelt conditions in HSG C and D soils.

Antecedent soil moisture is an important variable in curve number calculations. Understanding these assumptions is critical to predicting runoff behavior during snowmelt, rain-on-snow events, and other anomalies that are becoming more common as result of climate change.

13. What assumptions does PV-SMaRT use with respect to antecedent soil moisture?

While soil survey data can be used, the PV SMaRT documentation states that project-specific data are better and should be used when possible.⁷

14. County staff reported that the Applicant has collected soil and sediment samples from the Project area. Can these data be incorporated into the application? Why or why not?
15. Does the Applicant plan to collect data (e.g., soil texture, bulk density, root zone depth, etc.) to refine the curve numbers and HEC-HMS analyses?

The solar array layout is discussed in the Revised Special Use Permit Narrative.⁸ The PV-SMaRT calculations use 21-foot spacing to be conservative based on the proposed spacing

⁷ Stormwater and Water Quality Plan at page 6.

⁸ Trapper Solar Project Special Use Permit Application at page 11.

of 21.5 feet.⁹ However, the application does not appear to consider the soil type and panel spacing as required by the UDC 2.2.13.a.v.

16. How were the low infiltration rates of the HSG C and D soils and existing and projected vegetation cover considered when selecting the proposed solar array spacing?

Regarding slope length calculations, we appreciate that the Applicant used PV SMarT to calculate curve number for on-site and off-site locations, rather than a different method for off-site locations.¹⁰ But the desired continuity is undermined by using a digital elevation model (DEM) for on-site soils and average slope as reported in the soil unit name for off-site soils. Because the DEM uses LiDAR data from the Colorado Water Conservation Board¹¹, LiDAR is likely available for all off-site areas and a DEM could be created to calculate slopes using the same method. Note that the off-site areas are larger than the Project area.¹²

17. Is it possible to use a DEM to determine the slope length for off-site locations? Why or why not?
18. If it is not possible to use a DEM for off-site locations, what type and magnitude of error does this introduce into the runoff and flow calculations provided in the Stormwater and Water Quality Plan?

The post-construction curve numbers were calculated using a bulk density of 1.3 g/cm³.¹³

19. Why was this bulk density selected to characterize post-construction conditions?

Based on soil survey data, existing soil bulk densities on-site range from 1.35 to 1.53 g/cm³.¹⁴ The proposed decompaction reduces existing bulk densities by 4 to 15 percent.

20. Is this reduction in bulk density realistic given the soil properties which include high clay content, shrink-swell clays, and low organic matter content?

The Vegetation Establishment and Management Plan identifies additional soil limitations.¹⁵

21. Were these limitations considered when establishing the targeted bulk density?
22. Soils in the Project area will settle in the months and years following construction. Does the targeted bulk density account for post-construction settling? If so, how?

⁹ Stormwater and Water Quality Plan at page 8.

¹⁰ *Id.* at pages 7-8.

¹¹ *Id.* at page 11

¹² *Id.* see Appendix A figure titled "Pre-Development HEC-HMS Model Schematic" at PDF page 30.

¹³ *Id.* at page 12.

¹⁴ *Id.* at page 9.

¹⁵ Vegetation Establishment and Management Plan at page 9.

Appendix F provides three PV-SMaRT curve number calculations for each on-site soil unit.¹⁶ The text describing post-construction land cover reads “post-construction land cover was assigned either undisturbed, array field, or roads.”¹⁷ The Vegetation Establishment and Management Plan reports that “drive and crush” and “mow-and-go” are the preferred pile installation methods because they limit soil compaction and disturbance and maintain existing vegetation (preferred installation techniques). NWCCOG agrees that these installation methods, which require less traffic and grading, are preferable.

23. Which curve number tables in Appendix 9 are used to represent areas where the preferred installation techniques will be used?

24. Based on our current understanding of the application, areas where preferred installation techniques are used would have the curve number titled “Proposed Conditions with Solar Arrays, No Soil Decomaction” (i.e., second set of tables provided for each soil unit). Is our understanding of the curve numbers correct?

NRCS classifies soils in the Project area as moderately susceptible to compaction due to the high clay and low organic matter content. “The medium ranking indicates that the potential for compaction is significant, but after the initial compaction, the soil should be able to support standard equipment with only minimal increases in soil density.”¹⁸ Despite the benefits of low ground pressure vehicles such as creating less compaction than conventional equipment, it is unreasonable to assume that soil bulk density would remain unchanged following construction of the solar arrays.

25. Please revise the application to account for some degree of soil compaction attributed to the traffic necessary to install the solar arrays and rationale to support the decision.

The PV-SMaRT curve number calculations assume that the rooting zone depths will be maintained throughout the Project area post-construction. The soil survey reports that approximately 80 percent of the on-site soils have a root zone depth of 60”.¹⁹ The Vegetation Establishment and Management Plan calls for 4-12” in of topsoil salvage and, where grading occurs, a minimum of 18” of deep ripping.²⁰ If these recommendations are attained, the decompacted soil depth would likely be about 22 to 30” or roughly half the depth assumed in the PV-SMaRT curve number calculations.

26. Given that the Vegetation Establishment and Management Plan proposes less extensive decompaction than modeled in the Stormwater and Water Quality Plan,

¹⁶ Stormwater and Water Quality Plan at Appendix F

¹⁷ *Id.* at page 12.

¹⁸ Vegetation Management and Establishment Plan at page 9.

¹⁹ Stormwater and Water Quality Plan at page 9, Table 4

²⁰ Vegetation Establishment and Management Plan at pages 11-12

the PV-SMaRT curve number calculations should be revised to reflect the proposed decompacted soil depths.

27. Alternatively, the Applicant could explore additional deep ripping or data collection with a soil penetrometer²¹ or other methods to assure that soil density is maintained at acceptable levels throughout the 60" rooting zone.

The Applicant selected "newly established pollinator" as the vegetation type in the pre- and post-construction PV-SMaRT curve number calculations. NWCCOG appreciates that the Applicant maintained the vegetation cover pre- and post-construction to prevent changes to soil bulk density in the model. However, the "newly established pollinator vegetation" type assumes 50-75 percent cover, which is greater than the existing native vegetation cover of approximately 43.1 percent, and far in excess of the performance standard of 30.2 percent proposed in the Vegetation Establishment and Management Plan.²²

28. What affect does the increased plant cover have on curve number and runoff generation?
29. Are other vegetation types in PV-SMaRT more representative of existing conditions? Why or why not?
30. Are other vegetation types in PV-SMaRT more representative of post-construction conditions? Why or why not?
31. How can the disconnect between proposed vegetation performance standards and modeled vegetation cover be corrected?

For on-site soils, pre- and post-construction²³ PV-SMaRT curve numbers range from 30 to 58 which is far lower than expected for HSG C and D soils with grassland cover which are reported to have curve numbers of 79 and 84, respectively.²⁴ The PV SMaRT curve numbers allow more infiltration in HSG C and D soils than other curve number calculations that results in less runoff in the HEC-HMS model.

32. In your experience, do you find the PV-SMaRT curve numbers typical of HSG C and D soils? Why or why not?

ii. HEC-HMS

Solar Fields A and B have been removed from the Project.

33. Is it necessary to adjust the modeling assumptions in the northwest portion of the Project area?

²¹ *Id.* at page 12.

²² *Id.* at page 3.

²³ Stormwater and Water Quality Management Plan at page 7, see Table 2.

²⁴ SCS HEC-HMS Technical Reference Manual TR-55 Table 2-2c available [here](#). Reported values assume "fair" conditions.

The Applicant said that an initial abstraction of 0.05 would be used to provide higher, conservative runoff rates.²⁵ We agree that initial abstraction should be reduced due to lower infiltration rates characteristic of Hydrologic Soil Group (HSG) C and D soils, which are found throughout the Project area. Additionally, a smaller initial abstraction better accounts for runoff behavior during snowmelt when soils become fully saturated and generate runoff rapidly after reaching saturation. However, the initial abstraction values that appear in Appendix I range from 0.45 to 0.8, approximately.²⁶

34. Please explain, and if necessary, correct the discrepancy in initial abstraction values.

In prior comments, Routt County reported that rapid snowmelt recently caused significant flooding that could affect the Project area.²⁷

35. How do the larger storm events (e.g., 10-yr and 100-yr) included in this analysis compare to recent or probable snowmelt-driven flooding events?

iii. USLE

NWCCOG does not understand the following statement: “Slope length values taken directly from SSURGO based on soil symbol with an assumed slope of 8%.”²⁸ This statement is made less clear by the following statement: “For this analysis . . . LS [Slope Length] . . . remained constant between pre-development, during construction, and post-development scenarios.”²⁹ It is our understanding that the primary purpose of grading is to reduce existing slopes to better accommodate the solar arrays. Thus, it is difficult to understand the benefit of maintaining constant slope length factors.

36. Please, clarify the approach to select slope length factors in USLE pre-, during, and post-construction.

37. Note, NWCCOG recommends using the existing slopes to select the slope length factors during construction as that will generate a larger more conservative estimate of annual soil erosion during construction.

The Applicant relied upon published values (i.e., Wischmeier and Smith, 1978) to select land cover characteristics in the USLE calculation.³⁰ The value selected for vegetated areas is 80 percent cover. This is not consistent with the assumptions made in the PV-SMaRT curve number calculations, where the percent cover for newly established pollinator species is estimated at 50-75 percent. More importantly, the USLE cover is not consistent with existing conditions or the performance standard of 30.2 percent vegetation cover

²⁵ Stormwater and Water Quality Plan at page 11.

²⁶ *Id.* at pages 230-1,496

²⁷ Trapper Solar Project_SUP_Comment Response_20250131 at page 19.

²⁸ Stormwater and Water Quality Management Plan at page 18.

²⁹ *Id.* at page 18

³⁰ *Id.* at page 19, Table 14.

proposed in the Vegetation Establishment and Management Plan.³¹ The USLE calculation grossly overstates pre- and post-construction vegetation cover.³²

38. Please correct the annual sediment loading rates to reflect existing vegetation cover, and post-Project vegetation cover based on existing conditions and the proposed performance criteria.

As noted in the application, NRCS rates erodibility index scores greater than 8 as highly erodible. However, that does not eliminate the need to identify control measures to manage the most erodible soils in the Project area. For example, soil unit 5a, which parallels most drainages in the Project area, has an erodibility index score of 7.3. As noted in the Vegetation Establishment and Management Plan, soil unit 5a has several other limitations as well.³³

39. To what extent did the Applicant consider avoiding these soils entirely?
40. What is the total proposed disturbance area for soil unit 5a by post-construction condition (e.g., road, graded solar array, nongraded solar array, etc.) in each solar field?
41. Table 15 reports that soil unit 10C has a higher erodibility index than 10E, despite 10C having lower slopes. Why?

E. Monitoring Plan

The Stormwater and Water Quality Plan proposes monitoring to “check and track compliance.”³⁴

42. Compliance with what?
43. How will the Project Owner respond if monitoring shows unanticipated outcomes?

The Monitoring Plan should be adequate to understand baseline conditions, the impact of the Project during construction and operation, and the impact of the Project after decommissioning. The Decommissioning/Reclamation Plan states that “surface water conditions will undergo reassessment before decommissioning.”³⁵ NWCCOG agrees that water quality should be sampled prior to, during, and after decommissioning/reclamation to assure that water quality is not degraded. The current monitoring plan does not address monitoring during the decommissioning/ reclamation stage of the Project.

44. Please add monitoring activities prior to, during, and after decommissioning/reclamation for soils, vegetation, stormwater, and water quality to

³¹ Vegetation Establishment and Management Plan at page 3.

³² Concerns related to the vegetation performance criteria are also section III.C and III.D of this memo.

³³ Vegetation Establishment and Management Plan at page 3, 6, 9, and 11.

³⁴ Stormwater and Water Quality Plan at page 21.

³⁵ Decommissioning/Reclamation Plan at page 8.

the Stormwater and Water Quality Monitoring Plan (either in the application or as an update to the Plan that is required as a condition of approval depending on the County's preference).

The Stormwater and Water Quality Plan proposes sampling during significant events with rainfall greater than 0.5 in.³⁶

- 45. Where and how will rainfall be measured?
- 46. Will there be staff or contractors available to collect water quality samples during all events?
- 47. Currently water quality sampling will occur, if practicable. Please establish an annual minimum number of sample events. A minimum of two events each year, one during and or immediately following snowmelt and a second following significant rainfall during the summer or fall is reasonable to NWCCOG.

There are also recommendations regarding the monitoring plans. See Section III.B.

IV. Recommendations for Addressing Consistency with the 208 Plan

The following is an analysis of whether and to what degree the Project complies with Policy 3 of the 208 Plan, "Land Use and Disturbance," which reads:

Water quality, including wetlands, floodplains, shorelines, and riparian areas, must be protected from land use and development so that significant degradation of water quality is prevented.

The following also provides recommended approaches that would allow the Applicant to meet Policy 3, both through a corrected and more detailed Impact Assessment and a comprehensive Mitigation and Monitoring Plan. As discussed in Section II, the applicant should more fully describe the extent of the impacts of the Project before proceeding to a hearing. The Applicant may further develop a mitigation and monitoring plan as a condition of approval, assuming the County agrees with this approach.

The Applicant may identify alternative pathways to meet Policy III; thus, these approaches are characterized as recommendations.

A. Deficiencies with Impact Analyses

i. Soils

The Vegetation Establishment and Management Plan, Biological and Aquatic Resources Inventory, and Stormwater and Water Quality Plan identify several critical limitations with

³⁶ Stormwater and Water Quality Plan at page 22

soils in the Project area, including but not limited to HSG D and C,³⁷ high clay content, low organic matter content, slickensides, clay pans and other restrictive layers, high shrink-swell capacity, moderate susceptibility to erosion, poor reclamation potential, and, in the case of the soil unit 5a, saline-sodic conditions.

NRCS has rating criteria for ground-based solar arrays. The soils in the Project area are rated as “very limited” (the lowest possible ranking) due to the shrink-swell capacity, low strength, and ability to corrode steel. The report is attached for the Applicant’s consideration. Collectively, the soil survey indicates that soils in the Project area are not well-suited for solar arrays.

Recommendation 1. Evaluate the shrink-swell capacity, low strength, and corrosiveness of soils in the Project area. Evaluate whether the soil properties will affect the Project’s design and operation. Soil and geotechnical data collected from the Project area would be extremely helpful to support the evaluation.

The soil characteristics in the Project area create considerable limitations for the proposed Project. The primary techniques to control runoff and prevent erosion identified in the application are limiting compaction and/or reducing soil bulk density through mechanical methods and revegetation to promote infiltration. NWCCOG has numerous concerns regarding assumptions incorporated into the runoff projections presented in the Stormwater and Water Quality Plan. See Section II.D. Currently, NWCCOG is unable to conclude that the Project will not significantly degrade water quality based on the application materials.

Recommendation 2. NWCCOG strongly recommends that the Applicant collect soil and geotechnical data to refine the stormwater runoff and annual erosion rates presented in the Stormwater and Water Quality Plan to demonstrate that the soils in the Project area are capable of infiltrating precipitation following the construction of the solar arrays and associated infrastructure. At a minimum, the models used to estimate stormwater runoff and erosion rates should be revised to address the comments in this document.

ii. Vegetation

The application materials are not internally consistent with respect to vegetation cover. The Stormwater and Water Quality Plan uses unrealistically high vegetation cover estimates to demonstrate that the Project will not generate significant runoff or erosion. The Stormwater and Water Quality Monitoring Plan assumes that post-construction vegetation cover will be 50-75 percent. See Section 2.D.ii. This is not consistent with the existing

³⁷ All soils in the Project area are HSG C and D which indicates low and very low infiltration capacity, respectively.

conditions on site.³⁸ More critically, the Vegetation Establishment and Monitoring Plan proposes a performance standard of 30.2 percent cover. The proposed performance standard, which equates to 70 percent bare ground, is not adequate and will almost certainly result in runoff and erosion that significantly degrades water quality.

Recommendation 3. Given that the Vegetation Establishment and Management Plan identifies lower vegetation cover than modeled in the Stormwater and Water Quality Plan, the models should be revised to reflect the existing and proposed vegetation cover as reported in the Vegetation Establishment and Management Plan.

B. Deficiencies in Monitoring and Mitigation Measures

The Project would benefit from a more comprehensive monitoring and mitigation plan that includes soil, vegetation, stormwater, and water quality monitoring activities. The monitoring plan should address each major stage of the Project: pre-construction, construction, post-construction, operation, decommissioning/reclamation, and final closure. Pre-construction monitoring is used to establish baseline conditions and may include existing data, if appropriate for the Project.

A cohesive and holistic monitoring, analysis, and reporting process is likely to identify and respond to problems that may emerge during the life of the Project in a more effective and timely manner.

Recommendation 4. Create a single monitoring and mitigation plan that includes soil, vegetation, stormwater, and water quality monitoring activities.

The monitoring and mitigation plan should, at a minimum:

- a. Be responsive to the comments and recommendations provided in this document and the final Project design.
- b. Identify and describe key stream segments, waterbodies, groundwater, floodplains, wetlands, riparian area, or aquatic life to be monitored.
- c. Key indicators and threshold levels that will be monitored to detect changes in water quality and watershed health.
- d. Locations for and frequency of sampling and monitoring to establish baseline conditions; the Project's impacts; and effectiveness of, or proposed changes to, mitigation.
- e. Define sample locations, frequencies, and protocols for each type of monitoring and phase of the Project.

³⁸ Average cover for existing native vegetation and agricultural land is approximately 43 and 60 percent, respectively. See Appendix A of the Vegetation Establishment and Management Plan.

- f. Performance standards that establish the duration of routine monitoring activities for each type of monitoring (e.g., routine stormwater monitoring may be concluded when vegetated areas meet final stabilization criteria in the CDPHE stormwater permit) during operation phase
- g. The scale at which each performance standard is applicable (e.g., solar field rather than entire Project area).
- h. A comprehensive strategy for monitoring to determine when final closure has been reached following decommissioning/reclamation.
- i. Include a process to respond to monitoring outcomes that indicate problems or potential problems with the performance of mitigation measures. This may include additional monitoring to better characterize the problem.
- j. Include a process to identify and implement mitigation measures, including communication with Routt County.
- k. Describe a process for reporting to the County when criteria are not met or thresholds are exceeded and the proposed mitigation response.
- l. Identify the minimum required elements of the Annual report and deadline to provide Annual Reports to Routt County.

i. Soils

Roughly 60 percent of the on-site soils are silty clays with slickensides,³⁹ which are evidence of shear stress in the soil profile, claypans, and or natric horizons and soils in the Project area are HSG C or D. These characteristics severely limit water infiltration throughout the soil profile. Expansive soils can reduce seed germination and plant growth as the soils shrink and swell. The Vegetation Establishment and Management Plan states that soil evaluation, deep ripping, and soil amendments are optional.

Recommendation 5. Include a detailed soil sampling program to be implemented before, during, and after construction, operation, and decommissioning/reclamation by a qualified professional. Pre-Project data collection could provide a baseline characterization used to develop soil performance standards, including but not limited to: topsoil salvage depths, total soil depth, soil bulk density, soil strength, and soil organic matter content. The soil performance standards could be used during construction to assure that soil preparation is adequate to establish vegetation cover and promote infiltration. The soil sampling program and soil performance standards could

³⁹ Stormwater and Water Quality Plan at pages 9-10 Table 2 soil units 5a, 10C, and 10E.

also be used to evaluate whether the mitigation measures are performing as anticipated.

Recommendation 6. In coordination with Routt County, NWCCOG would consider a condition of approval that could require the Applicant to submit soil characterization data and soil performance standards before Project construction, including County review and approval by a qualified professional at the Applicant's expense.

Currently, the application materials do not fully address the soil monitoring requirements in the UDC. We understand that it is likely more practical for the Applicant to develop the soil monitoring plan when the Project design is finalized.

Recommendation 7. With respect to UDC 2.2.13.a.vi, the Applicant should provide a rationale for the timing of post-Project bulk density sampling that considers soil settling, the establishment of vegetation cover, and any other relevant factors.

Recommendation 8. Soil monitoring activities could continue some or all of the monitoring activities identified in Recommendation 2.

Recommendation 9. Sample locations could be selected based on solar field, soil unit, or a combination of factors.

Recommendation 10. Provide a rationale regarding the depth at which to collect soil samples, and the use of grab or composite samples.

Recommendation 11. Consider performance standards that link vegetation and soil monitoring. For example, if vegetation monitoring indicates that vegetation was not successfully established, soil sampling will occur to help identify appropriate mitigation measures.

ii. Vegetation

The proposed vegetation performance standard was derived from requirements in the CDPHE stormwater permit.⁴⁰ While this performance standard is required to meet the final stabilization criteria in the stormwater permit, it is not appropriate as a vegetation performance standard for the Project, given the assumptions made in the Stormwater and Water Quality Plan and soil characteristics of the Project area.

Recommendation 12. NWCCOG strongly recommends that the Applicant establish multiple vegetation performance standards. The Applicant should consider the phase of the Project (e.g., release from stormwater permit, operation, post-reclamation), the existing vegetation cover, and the desired post-Project land use.

⁴⁰ *Id* at page 3.

The Decommissioning/Reclamation Plan states that “land within the perimeter fencing is predominantly agricultural land.”⁴¹ Existing cover within those areas is 60 percent, on average.⁴² This is an example of why it would be beneficial establish additional vegetation performance standards, as it would be more likely to support a successful return to agricultural use after the Project.

Recommendation 13. Each vegetation performance standard shall identify an appropriate mitigation measure. For example, if vegetation cover has not attained the appropriate performance standard in two growing seasons, then the area will be re-seeded and, if needed, suitable soil amendments and/or soil decompaction will occur, within one growing season.

The Vegetation Establishment and Management Plan proposes two years of annual monitoring during the growing season or until the Project area meets the final stabilization criteria required by the CDPHE stormwater permit. As previously discussed, this performance standard is not sufficient to control runoff, erosion, and prevent significant water quality degradation. See Section III.A.ii.

Recommendation 14. Additional performance standards are necessary; the vegetation monitoring activities may need to be revised to accommodate additional performance standards.

The existing baseline characterization in the application uses quantitative vegetation monitoring methods. The Vegetation Establishment and Monitoring Plan proposes qualitative vegetation monitoring.

Recommendation 15. Provide a rationale for this decision, and/or supplemental performance standards that require quantitative vegetation monitoring methods under specific circumstances (e.g., where visual monitoring indicates that a vegetation performance standard is met, subsequent monitoring will use quantitative methods to demonstrate that the vegetation performance standard is attained or if visual inspections identify Class A or B noxious weeds, the infested area will be mapped with a GPS).

C. Stormwater Monitoring and Mitigation

The control measures required by the CDPHE stormwater permit are likely sufficient to prevent erosion during the construction and decommissioning/reclamation phases of the Project, but may not be sufficient during the operation of the Project.

⁴¹ Decommissioning/Reclamation Plan at page 2.

⁴² *Id.* at page A-3.

Recommendation 16. The permit certifications, stormwater management plans, and all other correspondence required by the CDPHE stormwater permit shall be included in annual reports submitted to Routt County.

Recommendation 17. The Applicant should consolidate the stormwater and erosion monitoring activities proposed in the Stormwater and Water Quality Plan and Vegetation Establishment and Management Plan into a single description for clarity.

Recommendation 18. The Applicant needs to address stormwater monitoring and mitigation during operation of the Project.

D. Water Quality Monitoring Recommendations

The Stormwater and Water Quality Plan proposes storm sampling during significant storm events with rainfall greater than 0.5 in. Storm sampling is proposed once prior to construction and for the first three years during the Project's operation.

The proposed monitoring program is inadequate for several reasons. It does not include monitoring during the construction period to demonstrate water quality is not significantly degraded. The proposed sampling plan does not appear to include sample locations up and down-gradient of the Project area.⁴³ The plan must collect data sufficient to demonstrate that the Project does not significantly degrade water quality. Additional pre-Project data will be useful to characterize existing conditions.

NWCCOG recommends the several changes to the water quality monitoring program, as discussed below.

Recommendation 19. Add monitoring locations up and down-gradient of the Project area in perennial and/or named waterbodies. It is potentially reasonable to omit selected waterbodies as long as there is acceptable rationale to support the decision.

Recommendation 20. NWCCOG recommends that water quality samples be collected at regular intervals (called routine monitoring) and during storm events. Routine sample collection should collect samples during high and low flow conditions, at a minimum. The Applicant may propose a minimum number of storm sampling events each year. See Comment 40.

Recommendation 21. Establish a minimum sample frequency for each phase of the Project and type of sampling.

Recommendation 22. Selected streams in and near the Project area have site-specific seasonal iron standards as adopted by the Colorado Water Quality Control Commission. The seasonal standards account for increased iron concentrations that occur during and immediately following snowmelt in this

⁴³ Stormwater and Water Quality Plan Figure 7 presents the monitoring locations at a scale that is difficult to interpret.

area. Due to the extensive soil disturbance proposed for this Project, NWCCOG strongly recommends sample collection during snowmelt conditions.

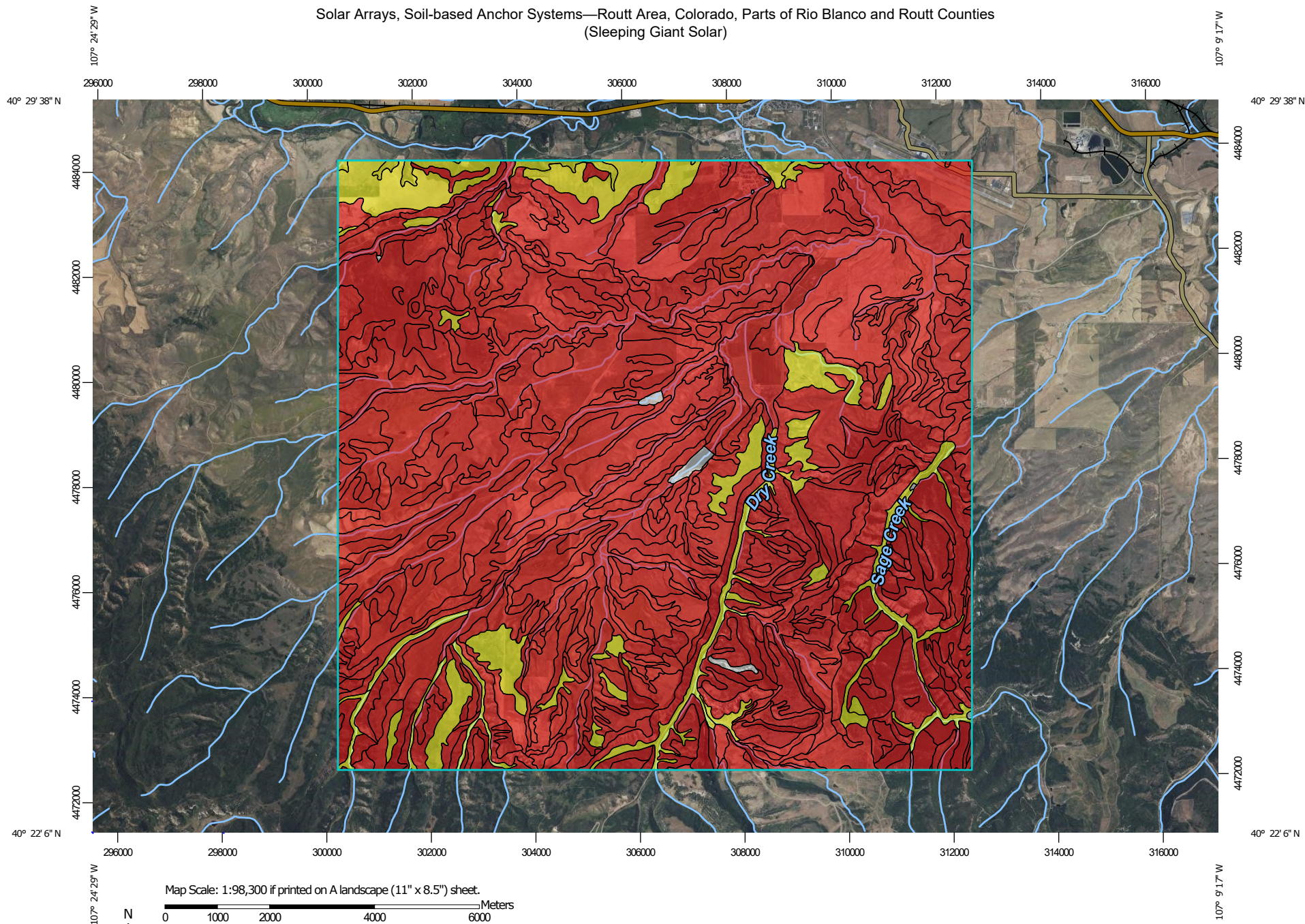
Recommendation 23. The Applicant should consider additional pre-Project sample collection, including during snowmelt conditions. These samples will characterize baseline conditions and allow the Applicant to evaluate whether water quality has changed relative to the baseline during the life of the Project.

Recommendation 24. The monitoring plan should identify when additional water quality monitoring may be necessary in response to other conditions observed on site that may cause significant water quality degradation. For example, if quarterly inspections identify substantial erosion, then water quality samples will be collected from potentially impacted down-gradient waterbodies.

Recommendation 25. Identify the performance standards necessary to conclude water quality monitoring. Consider linking the water quality performance standards to the soil, vegetation, and stormwater performance standards. Consider linking the performance standards to specific solar fields in the Project area. For example, when soil, vegetation, and stormwater performance standards are met in Solar Field X and water quality samples indicate no significant water quality degradation attributed to Solar Field X or the Project as a whole, water quality sampling is considered complete for locations affected only by Solar Field X. Water quality sampling will resume if soil, vegetation, and stormwater performance standards decline beyond their respective performance standards.

In coordination with Routt County, NWCCOG is willing to consider appropriate conditions of approval related to the monitoring and mitigation plan in lieu of completing updates at this time. Such conditions of approval would require County review and approval of the final plan at the Applicant's expense.

Solar Arrays, Soil-based Anchor Systems—Routt Area, Colorado, Parts of Rio Blanco and Routt Counties
(Sleeping Giant Solar)



Map Scale: 1:98,300 if printed on A landscape (11" x 8.5") sheet.

0 1000 2000 4000 6000 Meters

0 4500 9000 18000 27000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

12/22/2025
Page 1 of 33

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Lines

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Points

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Routt Area, Colorado, Parts of Rio Blanco and Routt Counties

Survey Area Data: Version 15, Aug 29, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 9, 2020—Jul 11, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Solar Arrays, Soil-based Anchor Systems

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
2C	Routtskin silty clay loam, 3 to 12 percent slopes	Very limited	Routtskin (90%)	Shrink-swell (1.00)	121.3	0.3%
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.24)		
				Hillslope position (0.13)		
			Lintim (5%)	Shrink-swell (1.00)		
				Steel corrosion (0.75)		
				Low strength (0.55)		
				Slope shape across (0.30)		
				Slope direction and gradient (0.24)		
2E	Routtskin loam, 12 to 25 percent slopes	Very limited	Routtskin (90%)	Slope (1.00)	272.2	0.8%
				Shrink-swell (0.97)		
				Slope direction and gradient (0.56)		
				Low strength (0.31)		
				Steel corrosion (0.25)		
			Lintim (5%)	Shrink-swell (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Low strength (0.55)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
2F	Lintim loam, 25 to 65 percent slopes	Very limited	Jerry (5%)	Slope (1.00)	26.6	0.1%
				Shrink-swell (0.85)		
				Slope direction and gradient (0.56)		
				Low strength (0.28)		
				Steel corrosion (0.25)		
			Lintim (80%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Low strength (0.55)		
			Foidel (5%)	Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Shrink-swell (0.26)		
				Steel corrosion (0.25)		
			Evna (5%)	Large stones (1.00)		
				Slope (1.00)		
				Slope direction and gradient (0.83)		
				Steel corrosion (0.75)		
				Hillslope position (0.13)		
			Venable (5%)	Depth to saturated zone (1.00)		
				Frost action (1.00)		
				Flooding (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Eckmanpark (5%)	Steel corrosion (0.75)		
				Slope shape across (0.30)		
				Slope (1.00)		
				Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
4E	Yampatika silty clay, 12 to 25 percent slopes	Very limited	Yampatika (90%)	Low strength (1.00)	2,404.9	6.9%
				Slope (1.00)		
				Shrink-swell (0.90)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
			Morapos (5%)	Shrink-swell (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Low strength (0.50)		
			Bulkley (5%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
4F	Yampatika silty clay loam, 25	Very limited	Yampatika, warm (95%)	Slope (1.00)	677.9	1.9%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
	to 65 percent slopes, warm			Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Hillslope position (0.13)		
			Morapos (5%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Steel corrosion (0.75)		
				Low strength (0.50)		
				Hillslope position (0.13)		
5A	Dresher very fine sandy loam, 1 to 6 percent	Very limited	Dresher (95%)	Shrink-swell (1.00)	2,035.0	5.8%
				Flooding (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
			Yampatika (5%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
6B	Zoltay loam, 0 to 10 percent slopes	Very limited	Zoltay (90%)	Shrink-swell (1.00)	661.8	1.9%
				Low strength (0.94)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
				Flooding (0.20)		
			Furia (10%)	Shrink-swell (1.00)		
				Frost action (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
7C	Morapos loam, 3 to 12 percent slopes	Very limited		Steel corrosion (0.75)		
				Low strength (0.45)		
				Flooding (0.40)		
			Morapos (85%)	Shrink-swell (1.00)	4,103.0	11.8%
				Steel corrosion (0.75)		
				Low strength (0.55)		
				Slope direction and gradient (0.24)		
				Hillslope position (0.13)		
			Obadia (5%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.24)		
			Morapos, very stony (5%)	Shrink-swell (1.00)		
				Steel corrosion (0.75)		
				Low strength (0.50)		
				Slope direction and gradient (0.24)		
				Slope shape across (0.20)		
			Bulkley (5%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.40)		
				Slope (0.16)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
7E	Morapos loam, 12 to 25 percent slopes	Very limited	Morapos (90%)	Shrink-swell (1.00)	299.6	0.9%
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Low strength (0.51)		
			Bulkley (10%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
8D	Winevada-Splitro complex, 3 to 25 percent slopes	Very limited	Winevada (55%)	Depth to hard bedrock (1.00)	1,446.5	4.1%
				Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
			Splitro (30%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
			Rabbitears (5%)	Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope shape across (0.30)		
				Steel corrosion (0.25)		
			Foidel (5%)	Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Slope shape across (0.30)		
				Steel corrosion (0.25)		
			Coutis (5%)	Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Hillslope position (0.13)		
8F	Dunckley-Skyway complex, 15 to 65 percent slopes	Very limited	Dunckley (45%)	Slope (1.00)	975.3	2.8%
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Slope shape across (0.20)		
			Skyway (40%)	Slope (1.00)		
				Depth to hard bedrock (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
			Rabbitears (5%)	Slope (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Slope shape across (0.20)		
			Foidel (5%)	Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Slope shape across (0.20)		
9C	Shermap loam, 3 to 12 percent slopes	Somewhat limited	Shermap (90%)	Shrink-swell (0.69)	1,449.7	4.2%
				Frost action (0.50)		
				Low strength (0.28)		
				Steel corrosion (0.25)		
				Slope direction and gradient (0.24)		
9E	Shermap loam, 12 to 35 percent slopes	Very limited	Shermap (90%)	Slope (1.00)	869.3	2.5%
				Shrink-swell (0.69)		
				Frost action (0.50)		
				Low strength (0.28)		
				Steel corrosion (0.25)		
			Yampatika (5%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Morapos (5%)	Slope direction and gradient (0.56)		
				Shrink-swell (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Low strength (0.50)		
10C	Bulkley silty clay, 3 to 12 percent slopes	Very limited	Bulkley (100%)	Shrink-swell (1.00)	5,235.0	15.0%
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Hillslope position (0.13)		
10E	Bulkley silty clay, 12 to 25 percent slopes	Very limited	Bulkley (100%)	Shrink-swell (1.00)	5,153.7	14.8%
				Low strength (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
10F	Bulkley silty clay loam, 25 to 40 percent slopes	Very limited	Bulkley (100%)	Slope (1.00)	238.0	0.7%
				Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
15C	Peninsula loam, 0 to 12 percent slopes	Somewhat limited	Peninsula (95%)	Shrink-swell (0.28)	23.4	0.1%
				Steel corrosion (0.25)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
19D	Evanot loam, 1 to 12 percent slopes	Somewhat limited		Slope shape across (0.20)		
				Slope direction and gradient (0.08)		
				Low strength (0.02)		
			Evanot (85%)	Frost action (0.50)	495.0	1.4%
				Steel corrosion (0.25)		
				Shrink-swell (0.25)		
				Low strength (0.20)		
				Slope direction and gradient (0.16)		
				Frost action (0.50)		
				Hillslope position (0.50)		
				Steel corrosion (0.25)		
				Slope shape across (0.20)		
				Slope direction and gradient (0.16)		
19E	Evanot loam, 12 to 25 percent slopes	Very limited	Evanot (85%)	Slope (1.00)	47.1	0.1%
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Shrink-swell (0.17)		
			Zoltay (5%)	Shrink-swell (1.00)		
				Slope (1.00)		
				Low strength (0.94)		
				Steel corrosion (0.75)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Morapos (5%)	Slope direction and gradient (0.56)		
				Shrink-swell (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Low strength (0.50)		
			Coyote flats (5%)	Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Hillslope position (0.50)		
				Steel corrosion (0.25)		
27A	Middlecreek loam, 1 to 5 percent slopes	Somewhat limited	Middlecreek (90%)	Steel corrosion (0.75)	841.6	2.4%
				Depth to saturated zone (0.56)		
				Frost action (0.50)		
				Flooding (0.40)		
				Shrink-swell (0.16)		
34E	Coutis fine sandy loam, 3 to 25 percent slopes	Very limited	Coutis (80%)	Slope (1.00)	197.9	0.6%
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Hillslope position (0.13)		
			Skyway (10%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
			Winevada (5%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
			Foidel (5%)	Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Slope shape across (0.30)		
				Shrink-swell (0.26)		
34F	Coutis fine sandy loam, 25 to 65 percent slopes	Very limited	Coutis (90%)	Slope (1.00)	8.0	0.0%
				Slope direction and gradient (1.00)		
				Frost action (0.50)		
				Slope shape across (0.30)		
				Steel corrosion (0.25)		
			Skyway (5%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Slope direction and gradient (1.00)		
				Frost action (0.50)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Foidel (5%)	Steel corrosion (0.25)		
				Slope (1.00)		
				Slope direction and gradient (1.00)		
				Frost action (0.50)		
				Slope shape across (0.30)		
				Shrink-swell (0.26)		
35D	Eckmanpark silty clay loam, 12 to 25 percent slopes	Very limited	Eckmanpark (90%)	Shrink-swell (1.00)	403.4	1.2%
				Low strength (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
			Impass (10%)	Shrink-swell (1.00)		
				Slope (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
50C	Lintim loam, 3 to 12 percent slopes	Very limited	Lintim (80%)	Shrink-swell (1.00)	248.7	0.7%
				Steel corrosion (0.75)		
				Low strength (0.69)		
			Evna (10%)	Large stones (1.00)		
				Steel corrosion (0.75)		
				Hillslope position (0.13)		
				Low strength (0.03)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Impass (5%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Hillslope position (0.13)		
			Venable (5%)	Depth to saturated zone (1.00)		
				Frost action (1.00)		
				Flooding (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
50E	Lintim loam, 12 to 25 percent slopes	Very limited	Lintim (80%)	Shrink-swell (1.00)	109.5	0.3%
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Low strength (0.55)		
			Impass (5%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
			Routt (5%)	Slope (1.00)		
				Shrink-swell (0.65)		
				Slope direction and gradient (0.56)		
				Steel corrosion (0.25)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Low strength (0.21)		
				Evna (5%)		
				Large stones (1.00)		
				Slope (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Hillslope position (0.13)		
			Venable (5%)	Depth to saturated zone (1.00)		
				Frost action (1.00)		
				Flooding (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
50F	Routt loam, 25 to 65 percent slopes, very stony	Very limited	Routt, very stony (85%)	Slope (1.00)	582.7	1.7%
				Slope direction and gradient (0.56)		
				Shrink-swell (0.53)		
				Steel corrosion (0.25)		
				Low strength (0.21)		
			Impass (5%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
			Venable (5%)	Depth to saturated zone (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Frost action (1.00)		
				Flooding (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
			Slater (5%)	Slope (1.00)		
				Large stones (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Slope shape across (0.30)		
52A	Slocum loam, 0 to 3 percent slopes	Very limited	Slocum (90%)	Frost action (1.00)	25.7	0.1%
				Depth to saturated zone (0.83)		
				Steel corrosion (0.75)		
				Flooding (0.40)		
				Slope shape across (0.30)		
			Venable (10%)	Depth to saturated zone (1.00)		
				Frost action (1.00)		
				Flooding (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
53F	Winevada fine sandy loam, 25 to 65 percent slopes	Very limited	Winevada (85%)	Slope (1.00)	516.0	1.5%
				Depth to hard bedrock (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Steel corrosion (0.25)		
				Foidel (5%) Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Slope shape across (0.30)		
				Shrink-swell (0.26)		
			Coutis (5%)	Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Slope shape across (0.30)		
				Steel corrosion (0.25)		
			Splitro (5%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
66D	Foidel loam, 15 to 25 percent slopes	Very limited	Foidel (85%)	Slope (1.00)	306.2	0.9%
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Hillslope position (0.13)		
			Winevada (5%)	Slope (1.00)		
				Depth to hard bedrock (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Hillslope position (0.50)		
			Routtskin (5%)	Slope (1.00)		
				Shrink-swell (0.97)		
				Slope direction and gradient (0.56)		
				Low strength (0.31)		
				Steel corrosion (0.25)		
			Venable (5%)	Depth to saturated zone (1.00)		
				Frost action (1.00)		
				Flooding (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
66F	Foidel loam, 25 to 65 percent slopes	Very limited	Foidel (90%)	Slope (1.00)	109.6	0.3%
				Slope direction and gradient (0.83)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Hillslope position (0.13)		
			Inchau (5%)	Slope (1.00)		
				Large stones (0.93)		
				Slope direction and gradient (0.83)		
				Frost action (0.50)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Routt (5%)	Steel corrosion (0.25)		
				Slope (1.00)		
				Slope direction and gradient (0.83)		
				Shrink-swell (0.65)		
				Slope shape across (0.30)		
				Steel corrosion (0.25)		
68C	Rabbitears loam, 3 to 12 percent slopes	Somewhat limited	Rabbitears (85%)	Frost action (0.50)	109.1	0.3%
				Steel corrosion (0.25)		
				Slope direction and gradient (0.24)		
				Hillslope position (0.13)		
			Jerry (5%)	Shrink-swell (0.85)		
				Slope shape across (0.30)		
				Low strength (0.28)		
				Steel corrosion (0.25)		
				Slope direction and gradient (0.24)		
68D	Rabbitears loam, 12 to 25 percent slopes	Very limited	Rabbitears (90%)	Slope (1.00)	163.2	0.5%
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Hillslope position (0.13)		
			Routt (5%)	Slope (1.00)		
				Shrink-swell (0.65)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
70F	Skyway sandy loam, 25 to 65 percent slopes	Very limited	Routtskin (5%)	Slope direction and gradient (0.56)	44.5	0.1%
				Steel corrosion (0.25)		
				Low strength (0.21)		
				Slope (1.00)		
				Shrink-swell (0.97)		
				Slope direction and gradient (0.56)		
				Low strength (0.31)		
				Steel corrosion (0.25)		
			Skyway (85%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Slope direction and gradient (1.00)		
				Frost action (0.50)		
				Slope shape across (0.30)		
			Hunchback (5%)	Shrink-swell (1.00)		
				Frost action (1.00)		
				Steel corrosion (0.75)		
				Low strength (0.46)		
				Flooding (0.40)		
			Winevada (5%)	Slope (1.00)		
				Slope direction and gradient (1.00)		
				Depth to hard bedrock (1.00)		
				Frost action (0.50)		
				Slope shape across (0.30)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
80F	Foidel loam, 20 to 50 percent slopes, cool	Very limited	Foidel (5%)	Slope (1.00)	38.9	0.1%
				Slope direction and gradient (1.00)		
				Frost action (0.50)		
				Shrink-swell (0.26)		
				Steel corrosion (0.25)		
			Foidel (85%)	Slope (1.00)		
				Slope direction and gradient (1.00)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Hillslope position (0.13)		
			Winevada (5%)	Slope (1.00)		
				Slope direction and gradient (1.00)		
				Depth to hard bedrock (1.00)		
				Frost action (0.50)		
				Hillslope position (0.50)		
			Rabbitears (5%)	Slope (1.00)		
				Slope direction and gradient (1.00)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Low strength (0.05)		
			Routt (5%)	Slope (1.00)		
				Slope direction and gradient (1.00)		
				Shrink-swell (0.65)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Steel corrosion (0.25)		
				Low strength (0.21)		
92C	Weed loam, 1 to 15 percent slopes	Somewhat limited	Weed (90%)	Shrink-swell (0.63)	121.1	0.3%
				Frost action (0.50)		
				Slope shape across (0.30)		
				Low strength (0.27)		
				Steel corrosion (0.25)		
101	Earsman-Rock outcrop complex, 25 to 65 percent slopes, extremely bouldery	Very limited	Earsman, extremely bouldery (55%)	Depth to hard bedrock (1.00)	904.6	2.6%
				Slope (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
102	Shermap loam, 3 to 25 percent slopes	Somewhat limited	Shermap (100%)	Frost action (0.50)	214.2	0.6%
				Slope direction and gradient (0.40)		
				Steel corrosion (0.25)		
				Slope (0.16)		
				Hillslope position (0.13)		
103	Foidel-Rock outcrop complex, 20 to 60 percent slopes	Very limited	Foidel (70%)	Slope (1.00)	2,126.7	6.1%
				Frost action (0.50)		
				Shrink-swell (0.29)		
				Steel corrosion (0.25)		
				Slope shape across (0.20)		
120	Eckmanpark clay loam, 25 to 65 percent slopes	Very limited	Eckmanpark (95%)	Slope (1.00)	168.2	0.5%
				Shrink-swell (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope direction and gradient (1.00)		
				Low strength (0.99)		
				Steel corrosion (0.75)		
			Routt (5%)	Slope (1.00)		
				Slope direction and gradient (1.00)		
				Shrink-swell (0.65)		
				Steel corrosion (0.25)		
				Low strength (0.21)		
133	Lintim loam, 3 to 25 percent slopes	Very limited	Lintim (90%)	Shrink-swell (1.00)	231.7	0.7%
				Slope (0.96)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
				Low strength (0.40)		
			Venable (5%)	Depth to saturated zone (1.00)		
				Frost action (1.00)		
				Flooding (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
			Slater (5%)	Large stones (1.00)		
				Slope (0.96)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope shape across (0.30)		
149	Rabbitears-Inchou complex, 3 to 25 percent slopes	Very limited	Rabbitears (60%)	Slope (1.00)	76.3	0.2%
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
				Shrink-swell (0.21)		
			Inchou (20%)	Slope (1.00)		
				Large stones (0.93)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
			Winevada (10%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Slope direction and gradient (0.56)		
				Frost action (0.50)		
				Steel corrosion (0.25)		
			Jerry (10%)	Slope (1.00)		
				Shrink-swell (0.85)		
				Slope direction and gradient (0.56)		
				Slope shape across (0.30)		
				Low strength (0.28)		
910F	Yampatika silty clay loam, 25 to 65 percent slopes	Very limited	Yampatika (90%)	Slope (1.00)	355.4	1.0%
				Shrink-swell (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Low strength (0.93)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
			Bulkley (10%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
C10	Impass silty clay loam, 3 to 12 percent slopes	Very limited	Impass (80%)	Shrink-swell (1.00)	11.3	0.0%
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.24)		
				Hillslope position (0.13)		
			Gourley (10%)	Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
				Slope direction and gradient (0.24)		
			Eckmanpark (5%)	Shrink-swell (1.00)		
				Low strength (0.99)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope direction and gradient (0.24)		
D10	Impass silty clay loam, 12 to 25 percent slopes	Very limited	Impass (85%)	Shrink-swell (1.00)	284.3	0.8%
				Slope (1.00)		
				Low strength (0.97)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
			Gourley (5%)	Shrink-swell (1.00)		
				Slope (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
			Routtskin (5%)	Slope (1.00)		
				Shrink-swell (0.97)		
				Slope direction and gradient (0.56)		
				Low strength (0.31)		
				Steel corrosion (0.25)		
			Eckmanpark (5%)	Shrink-swell (1.00)		
				Slope (1.00)		
				Low strength (0.99)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.56)		
F10	Impass silty clay loam, 25 to 40 percent slopes	Very limited	Impass (80%)	Slope (1.00)	22.4	0.1%
				Shrink-swell (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.25)		
			Routtskin (10%)	Slope (1.00)		
				Shrink-swell (0.97)		
				Low strength (0.31)		
				Steel corrosion (0.25)		
				Slope direction and gradient (0.25)		
			Gourley (5%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Low strength (1.00)		
				Steel corrosion (0.75)		
				Slope shape across (0.30)		
			Eckmanpark (5%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Low strength (0.99)		
				Steel corrosion (0.75)		
				Slope direction and gradient (0.25)		
RRS	Rock outcrop-Rubble land complex	Not rated	Rubble land (50%)		28.1	0.1%
			Rock outcrop (45%)			
W	Water	Not rated	Water (100%)		83.8	0.2%
Totals for Area of Interest					34,873.5	100.0%

Rating	Acres in AOI	Percent of AOI
Very limited	31,502.5	90.3%

Rating	Acres in AOI	Percent of AOI
Somewhat limited	3,254.2	9.3%
Null or Not Rated	111.9	0.3%
Totals for Area of Interest	34,873.5	100.0%

Description

ENG - Engineering

Ground-based Solar Arrays, Soil-penetrating Anchor Systems

Ground-based solar arrays are sets of photovoltaic panels that are not situated on a building or pole. These installations consist of a racking system that holds the panel in the desired orientation and the foundation structures that hold the racking system to the ground. Two basic methods are used to hold the systems to the ground, based on site conditions and cost. One method employs driven piles, screw augers, or concrete piers that penetrate into the soil to provide a stable foundation. The ease of installation and general site suitability of soil-penetrating anchoring systems depends on soil characteristics such as rock fragment content, soil depth, soil strength, soil corrosivity, shrink-swell tendencies, and drainage. The other basic anchoring system utilizes precast ballasted footings or ballasted trays on the soil surface to make the arrays too heavy to move. The site considerations that impact both basic systems are slope, slope aspect, wind speed, land surface shape, flooding, and ponding. Other factors that will contribute to the function of a solar power array include daily hours of sunlight and shading from hills, trees or buildings.

Soil-penetrating anchoring systems can be used where the soil conditions are not limited. Installation of these systems requires some power equipment for hauling components and either driving piles, turning helices, or boring holes to install the anchoring apparatus.

Soils can be a non-member, partial member or complete members of the set of soils that are limited for "Ground-based Solar Panel Arrays". If a soil's property within 150 cm (60 inches) of the soil surface has a membership indices greater than zero, then that soil property is limiting and the soil restrictive feature is identified. The overall interpretive rating assigned is the maximum membership indices of each soil interpretive property that comprise the "Ground-based Solar Panel Array" interpretive rule. Minor restrictive soil features are identified but not considered as part of the overall rating process. These restrictive features could be important factors where the major restrictive features are overcome through design application.

Soils are placed into interpretive rating classes per their rating indices. These are not limited (rating index = 0), somewhat limited (rating index greater than 0 and less than 1.0), or very limited (rating index = 1.0).

Numerical ratings indicate the degree of limitation. The ratings are shown in decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil has the least similarity to a good site (1.00) and the point at which the soil feature is very much like known good sites (0).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated

rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

References:

Canada, S. 2012. Corrosion impacts on steel piles. Solarpro. Solarprofessional.com.

Romanoff, Melvin. 1962. Corrosion of Steel Pilings in Soils. Journal of Research of the National Bureau of Standards. (Volume 66C, No. 3). July/September, 1962.

Rating Options

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie. The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Appendix E: TMD Accounting Report

ESTIMATED TRANSMOUNTAIN DIVERSION IMPACTS TO WEST SLOPE HEADWATERS SUBBASINS

Technical Brief Submitted to:

Northwest Colorado Council of Governments
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December, 2025

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APPENDIX A: Supplementary Graphical Summaries

1 Background and Purpose

Streamflow depletions associated with transmountain diversion (TMD) projects result in significant impacts on the health, function, and long-term resiliency of river systems, as well as local economies and quality of life. West Slope headwaters basins face distinct problems associated with significant TMD-driven streamflow depletions, which move water from a basin of origin the east side of the Continental Divide for agricultural and urban uses. All water removed from the West Slope through TMD projects is completely extinguished—no local or regionalized return flow benefits accrue to West Slope water users. Tensions created by the lost opportunities on the West Slope due to TMD water depletions are further exacerbated by ongoing interstate conflict over regional apportionments of Colorado River water sourced from Colorado’s headwaters communities. Conditional water rights for additional or expanded TMD projects exist, but it is not clear that West Slope rivers can sustain additional depletions without significant loss and/or permanent degradation of remaining ecological and social/economic functions. Despite this constrained social and ecological context, many large urban centers in Colorado expect to meet long-term water supply targets with additional TMDs. A critical component of an informed discussion about the current and potential future impact of TMDs on West Slope communities is a regular accounting of the hydrological impacts of TMD projects in the basins they impact.

The proportion of total streamflow exported from headwaters basins relative to the native yields at a given location, as well as the seasonal timing of that removal, has significant importance for river ecosystems, outdoor recreation-based economies and quality of life, West Slope agriculture, and the ability of West Slope residents to support or protect intrinsic properties and community values associated with river health and function. The amount of annual streamflow yield captured by individual TMD projects fluctuates over time due to inter-annual climatic variation, differences in annual storage availability in existing reservoirs on both sides of the Continental Divide, construction of new reservoirs for storing TMD water, and firming of conditional TMD water rights. Although the proportion of basin yield diverted from impacted West Slope headwaters is variously reported in a handful of documents published in recent decades, a set of updated statistics generated by a clear and repeatable methodology is generally lacking. Colorado Division of Water Resources (CDWR) Division reports summarize annual TMD diversions, in the aggregate. CDWR diversion records also allow for the straightforward tabulation of total TMD project yields. However, this type of accounting information typically lacks key context for understanding impacts to headwaters communities and ecosystems.

This technical brief details an accounting of TMD impacts to headwater communities on Colorado’s West Slope. Section 2 outlines a clear and repeatable methodology for tabulating annual and monthly TMD impacts as a percentage of total streamflow yield under different hydrological year types (e.g. dry, average, wet). Summaries of TMD impacts to streamflows in different hydrological year types presented in Section 3 are accompanied by specific geographic context regarding the location, time periods, and variability of the computed impacts. Additional graphical and tabular information is provided in Appendix A.

2 Analysis Approach

Lotic used empirical data, sourced preferentially from real-time streamflow or diversion gauging stations, to calculate the proportion of streamflows in a given West Slope basin captured by TMD diversion infrastructure over a recent 30-year period (1995 – 2024). The general analysis approach involved comparing streamflow gauge and/or diversion structure records recording TMD activity to West Slope stream gauge records at a proximate downstream location within a basin of interest. In some cases, such an analysis was performed at additional downstream West Slope stream gauge locations within a basin in order to take advantage of a more complete period of record. Simple annual and monthly surface mass balance approaches were used to describe the proportional impact of a TMD project in a local basin.

$$P_t = \frac{Y_{TMD,t}}{(Y_{TMD,t} + Y_{WS,t})} * 100$$

Where:

- P_t = The percentage of basin yield captured by the TMD project at time step (t);
- $Y_{TMD,t}$ = TMD yield at time step (t), defined as the water flowing out of basin through the TMD infrastructure; and
- $Y_{WS,t}$ = West Slope streamflow yield at time step (t), calculated at a gauging station downstream of the TMD diversion point

Summarization of results by month helped illustrate the inter-seasonal impacts of TMDs—those most likely to affect ecological, recreational, and social attributes of concern for West Slope communities. At each location, results were binned across five hydrologic year types (Table 4). Reporting by year types reflects upon the natural hydrologic variability inherent to Colorado’s stream systems, and the manner in which that variability impacts TMD operational patterns. This selected approach for binning hydrological year types is similar to other planning efforts such as the Colorado Water Plan, environmental impact studies (EIS) for large water projects, or various local Stream Management Plans. For this work, year types were classified as Drought, Dry, Average, Wet, and Flood using the 5th, 25th, 75th, 95th, and 100th non-exceedance percentiles of annual water yields, computed across a 30-year streamflow dataset from reference gauges identified within each subbasin

Table 1. Annual streamflow exceedance percentile breaks for assigning year type at subbasin reference gauge locations.

Year Type	Annual Streamflow Exceedance Percentile
Flood	0-5%
Wet	5-25%
Average	25-75%
Dry	75-95%
Drought	95-100%

Reference gauges selected for the purpose of year type classification were identified through a review of available gauging sites in each subbasin that gave special consideration to the length and continuity of gauging records and the geographic proximity to the TMD project of interest. A qualitative assessment of watershed characteristics (e.g., elevation, drainage area, aspect, slope, etc.) above each potential reference gauge and the potential impact of upstream water diversions also helped determine suitability. Due to the heavily altered nature of most Colorado watersheds, the quality of reference gauge data for the purpose of year type classification varied somewhat by basin. Year types provide a climate and hydrology-derived disaggregation for TMD impacts. Note that the classification applied here may not map directly to a similar year type classification that does not rely on reference gauges and instead computes annual yield non-exceedance percentiles at the TMD-impacted streamflow gauge of interest within a subbasin.

Results presented here intend to reflect simple real-world snapshots of water yield to TMD projects vs. streamflows in the native basin of origin, aggregated and summarized across a variety of year types. This analysis was not constructed to provide additional insights into detailed administrative and operational patterns related to interannual water storage, out-of-priority exchanges, and other complexities that may be reflected in the records associated with individual TMD projects.

2.1 Primary Datasets

Water mass balance computations relied on daily mean discharge values or water diversion records available over the period of interest. Data were secured from public data repositories maintained by the U.S. Geological Survey (USGS) and CDWR. USGS data were accessed via the *dataRetrieval* software package in R (DeCicco et al., 2025). CDWR stream gauge and diversion structure records stored in the Colorado Decision Support System (CDSS) Hydrobase were similarly accessed using the *cdssr* package in R (Watters, 2023). Data were collated for streamflow gauging stations and diversion structures on both sides of the Continental Divide that reflect TMDs operations (Table 2).

For the subset of locations where either streamflow gauge records (i.e. at the East Slope portal outlet of a TMD tunnel) or water diversion structure records (i.e., at the West Slope point of diversion) may be used to characterize TMD operations, we generally found the administrative water diversion records for diversion structures less reliable than the records from corresponding streamflow gauging stations. Administrative structure records at some locations were sometimes missing entire years or exhibited distinct step changes in reported diversion rates. Decisions on which datasets to use were made on a case-by-case basis for each subbasin. The generalized order of preference for datasets used in this effort was: USGS gauge, CDWR gauge, administrative diversion record for a given structure. In cases where TMD operations were characterized by streamflow gauging records, mass balance computations using administrative water diversion records should be anticipated to produce somewhat different results. For example, using the administrative diversion records for the Colorado-Big Thompson Project's Adams Tunnel (WDID 5104634) will produce a slightly different mass balance result than those computed using the streamflow gauging station at the Adams Tunnel East Slope portal (CDWR ADATUNCO).

Table 2. USGS and CDWR streamflow and diversion record locations used for subbasin analysis.

Site	Name	Basin of Origin	Operator
ROBTUNCO	ROBERTS TUNNEL AT EAST PORTAL NEAR GRANT (8000653)	BLUE	CDWR
HSPTUNCO	HOOSIER PASS TUNNEL AT MONTGOMERY RESERVOIR NEAR ALMA	BLUE	CDWR
09046490	BLUE RIVER AT BLUE RIVER, CO	BLUE	USGS
09050100	TENMILE CREEK BELOW NORTH TENMILE CREEK AT FRISCO, CO	BLUE	USGS
09047500_ext	SNAKE RIVER NEAR MONTEZUMA (extended record)	BLUE	USGS
09046600	BLUE RIVER NEAR DILLON, CO	BLUE	USGS
09047700	KEYSTONE GULCH NEAR DILLON, CO	BLUE	USGS
09051050	STRAIGHT CREEK BELOW LASKEY GULCH NEAR DILLON, CO	BLUE	USGS
BORDITCO	BOREAS PASS DITCH AT BOREAS PASS (BORDITCO)	BLUE	CDWR
STCTUNCO	STRAIGHT CR TUNNEL AT EAST PORTAL OF EISENHOWER	BLUE	CDWR
VIDTUNCO	VIDLER TUNNEL NEAR ARGENTINE PASS (VIDTUNCO)	BLUE	CDWR
WURDITCO	WURTZ DITCH NEAR TENNESSEE PASS (1100501)	EAGLE	CDWR
COLDITCO	COLUMBINE DITCH NEAR FREMONT PASS, CO. (1104616)	EAGLE	CDWR
EWIDITCO	EWING DITCH AT TENNESSEE PASS, CO	EAGLE	CDWR
09064600	EAGLE RIVER NEAR MINTURN, CO	EAGLE	USGS
HOMTUNCO	HOMESTAKE TUNNEL	EAGLE	CDWR
TWITUNCO	TWIN LAKES TUNNEL (1104617)	ROARING FORK	CDWR
BUSTUNCO	BUSK-IVANHOE TUNNEL	ROARING FORK	CDWR
BOUTUNCO	CHARLES H. BOUSTEAD TUNNEL	ROARING FORK	CDWR
09073300	ROARING FORK RIVER AB DIFFICULT CREEK NEAR ASPEN, CO	ROARING FORK	USGS
FRYMERCO	FRYINGPAN RIVER AT MEREDITH, CO	ROARING FORK	CDWR
LARDITCO	LARKSPUR DITCH AT MARSHALL PASS	GUNNISON	CDWR
09115500	TOMICHI CREEK AT SARGENTS, CO	GUNNISON	USGS
TARBELCO	TARBELL DITCH NEAR COCHETOPA PASS (2600702)	GUNNISON	CDWR
MOFTUNCO	MOFFAT WATER TUNNEL AT EAST PORTAL, CO	UPPER COLORADO	CDWR
09033300_ext	FRASER RIVER BELOW CROOKED CR (extended record)	UPPER COLORADO	USGS
5104625	BERTHOUD CANAL AND RESERVOIR TUNNEL	UPPER COLORADO	CDWR
09010500	COLORADO RIVER BELOW BAKER GULCH NEAR GRAND LAKE	UPPER COLORADO	USGS
09034250	COLORADO RIVER AT WINDY GAP	UPPER COLORADO	USGS
ADATUNCO	ALVA B. ADAMS TUNNEL AT EAST PORTAL NEAR ESTES PARK	UPPER COLORADO	CDWR
GRNDRDCO	GRAND RIVER DITCH AT LA POUDRE PASS	UPPER COLORADO	CDWR
5104603	WILLIAMS FORK TUNNEL (5104603)	UPPER COLORADO	CDWR
09036000	WILLIAMS FORK NEAR LEAL, CO	UPPER COLORADO	USGS
5804684	SARVIS DITCH	YAMPA	CDWR
5304716	DOMO CREEK DITCH	YAMPA	CDWR
5304715	STILLWATER DITCH	YAMPA	CDWR
4800573	BOB CREEK DITCH DIVR	NORTH PLATTE	CDWR
CAPDCPCO	CAMERON PASS DITCH NEAR CAMERON PASS (0304602)	NORTH PLATTE	CDWR
DEADDP CO	DEADMAN DITCH NEAR DEADMAN PARK	NORTH PLATTE	CDWR
LAPTUNCO	LARAMIE POUDRE TUNNEL (4800576)	NORTH PLATTE	CDWR
MICDCPCO	MICHIGAN DITCH AT CAMERON PASS	NORTH PLATTE	CDWR
SKYDCLCO	SKYLINE DITCH AT CHAMBERS LAKE	NORTH PLATTE	CDWR
7600600	WILSON SUPPLY DITCH	NORTH PLATTE	CDWR

2.2 Computation Approaches

The stream gauging locations, water diversion structures and mass balance computations used to estimate TMD impacts for locations in each of the affected headwaters subbasins are detailed in the subsections below.

2.2.1 Upper Colorado River Subbasin

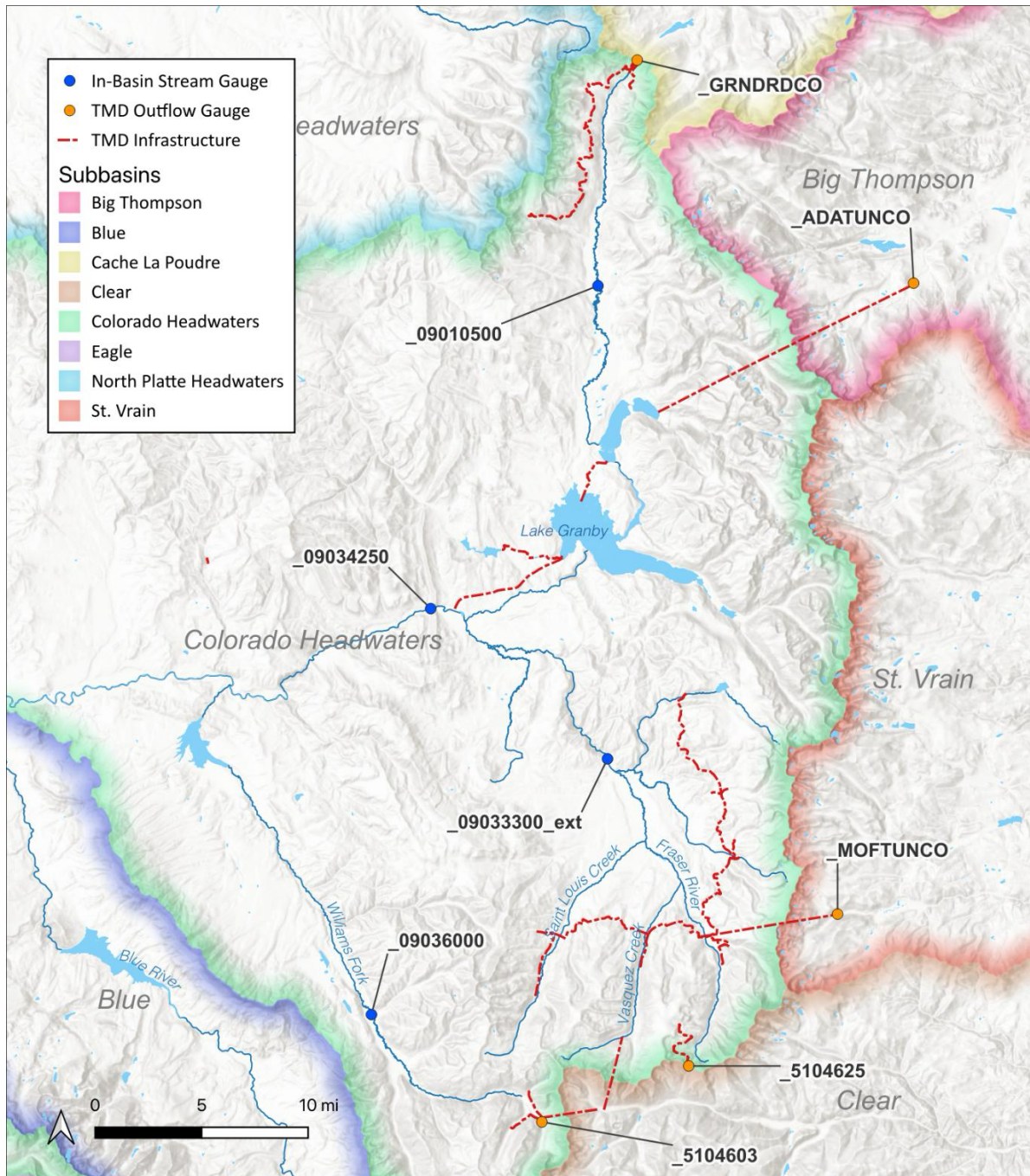


Figure 1. Relevant streamflow gauge and water diversion structure locations in the Upper Colorado Headwaters subbasin.

2.2.1.1 Colorado River at Windy Gap

The Colorado River at Windy Gap USGS-09034250 provides the most reasonable location to compute basin water balances, despite challenges associated with operations of Granby Reservoir and inclusion of streamflow contributions from the Fraser River subbasin. The Fraser River receives import water from the Williams Fork basin which flows through the Gumlick/Jones Pass/Vasquez tunnels into the Moffat Collection System and then into the Moffat Tunnel. Estimating how much of the native Fraser River yield contributes to flows on the Colorado River below Windy Gap thus requires backing out Williams Fork imports to avoid overestimating Moffat Collection System impacts on Fraser River flows.

Streamflow gauge and/or water diversion structure record locations:

- 09034250 - Colorado River below Windy Gap
- ADATUNCO - Adams Tunnel at East Portal near Estes Park
- MOFTUNCO - Moffat Tunnel at East Portal
- GRNDRDCO - Grand River Ditch at La Poudre Pass
- 5104603 - Williams Fork Tunnel

Mass Balance Computation:

- $(\text{GRNDRDCO} + \text{ADATUNCO} + \text{MOFTUNCO} - 5104603) /$
 $(09034250 + \text{GRNDRDCO} + \text{ADATUNCO} + \text{MOFTUNCO} - 5104603)$

2.2.1.2 Fraser River Below Crooked and Ranch Creeks

Estimating proportional impacts of TMDs for the Fraser River remains difficult due to nuances in the locations of available gauges and collection system intakes, as well as the combined nature of water export records in the Moffat Collection System, which includes both native Fraser River diversions that not always recorded at the resolution of individual tributary diversion points, as well as imports from the Williams Fork basin.

The streamflow gauge on the Fraser River below Crooked Creek (USGS-09033300) is sufficiently downstream to capture most influences of the Moffat Collection System, while being subject to only moderate influence from local consumptive uses. However, this location likely under-represents flow impairments in the reaches of the Fraser near the communities of Winter Park and Fraser. Conversely, Fraser River at Tabernash (USGS-09027100) is upstream of the Ranch/Meadow Creek and Crooked/Pole Creek systems, each of which supply significant water to the Moffat Collection system. This means that the proportional impact of the Moffat Tunnel would be over-estimated at the Fraser River at Tabernash (USGS-09027100). Additionally, some diversions from St. Louis Creek provide return flow to the Crooked Creek drainage during the irrigation season, which would not be reflected above the Fraser River below Crooked Creek (USGS-09033300).

The Fraser River basin receives Williams Fork import water from the Gumlick/Jones Pass/Vasquez tunnels. Imported water moves into the Moffat Collection System and then through the Moffat

Tunnel. Estimating how much of the native Fraser River yield is diverted through the Moffat Tunnel thus requires backing out Williams Fork imports.

A more detailed accounting designed to separate the various sources of water to the Moffat Collection System and assign individual impacts to the Fraser Rivers numerous headwaters tributaries is beyond the scope of this analysis and might require more-extensive investigation of individual water rights records or modelling datasets and outputs.

Streamflow gauge and/or water diversion structure record locations:

- 09033300_ext - Fraser River below Crooked Creek (extended record)
- MOFTUNCO - Moffat Tunnel at East Portal
- 5104603 - Williams Fork Tunnel
- 5104625 - Berthoud Canal and Reservoir Tunnel

Mass Balance Computation:

- $(\text{MOFTUNCO} + 5104625 - 5104603) / (09033300_ext + \text{MOFTUNCO} + 5104625 - 5104603)$

2.2.1.3 Williams Fork Near Leal

Estimating impacts of TMD exports from the Williams Fork was straightforward but relied on the assumption that any in-basin uses of water (i.e., Henderson Mine) above the Williams Fork near Leal (USGS-09036000) have only minimal impact on mass balance computations.

Streamflow gauge and/or water diversion structure record locations:

- 09036000 - Williams Fork near Leal
- 5104603 - Williams Fork Tunnel

Mass Balance Computation:

- $(5104603) / (5104603 + 09036000)$

2.2.2 Blue River Subbasin

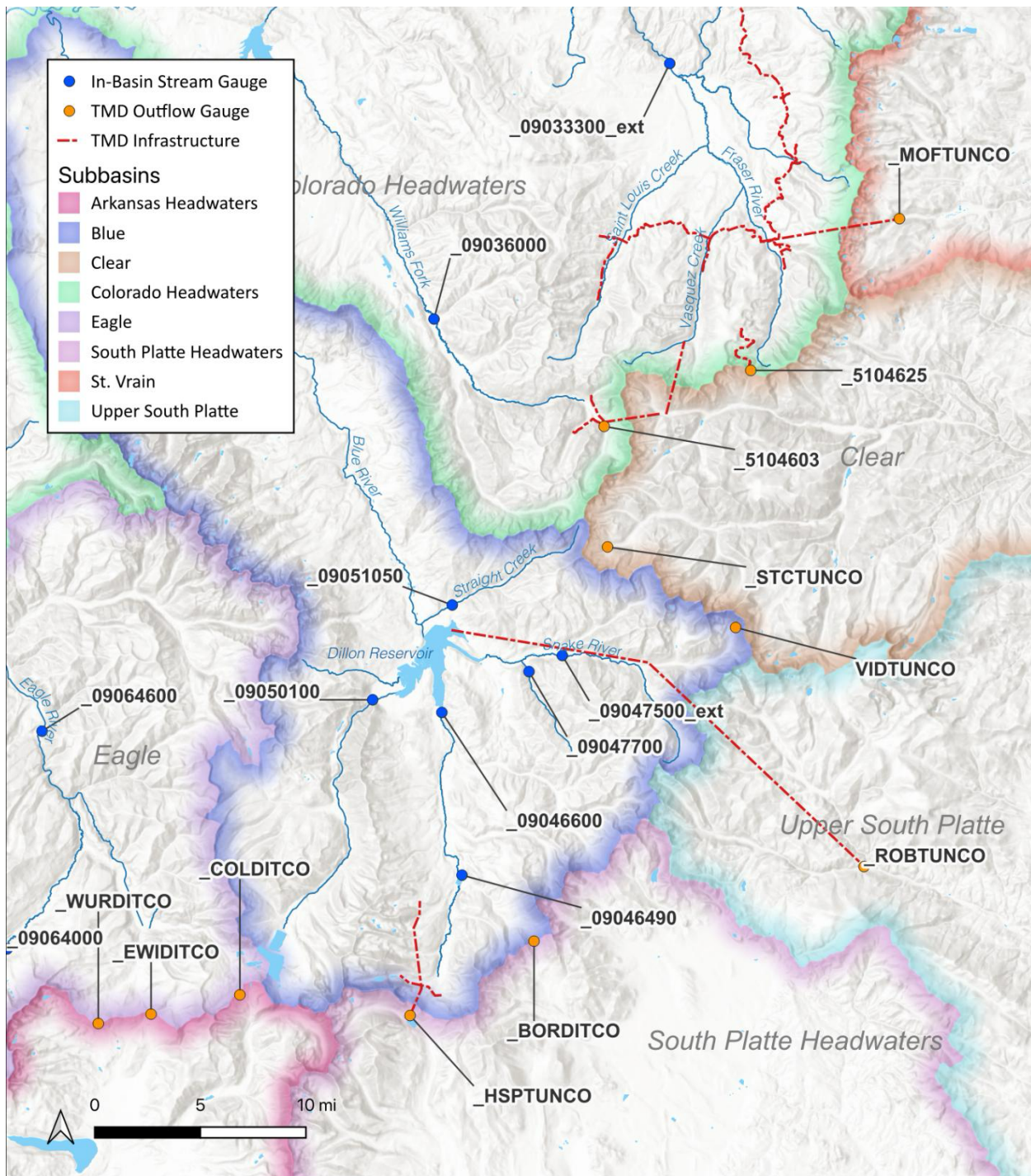


Figure 2. Relevant streamflow gauge and water diversion structure locations in the Blue River subbasin.

2.2.2.1 *Blue River at Dillon Dam*

Computation of Blue River water budgets required a choice regarding use of streamflow gauging data produced either above or below Dillon Dam. We determined that use of gauging stations below the dam would include significant intra- and inter-annual timing distortions due to reservoir operations impacts and elected to estimate a combined watershed inflow above Dillon Reservoir using four streamflow gauges on each of the major tributaries to the reservoir: Blue River, 10-Mile Creek, the Snake River, and Keystone Gulch. These gauges do not reflect a small percentage of upper watershed area that drains directly into the lake itself near the towns of Frisco and Dillon, without flowing past a streamflow gauge.

Streamflow gauge and/or water diversion structure record locations:

- 09046600 - Blue River near Dillon
- 09047700 - Keystone Gulch near Dillon
- 09050100 - North Ten Mile Creek at Frisco
- 09047500_ext - Snake River near Montezuma (extended record)
- ROBTUNCO - Roberts Tunnel at East Portal Near Grant
- HSPTUNCO - Hoosier Pass Tunnel at Montgomery Reservoir
- VIDTUNCO - Vidler Tunnel near Argentine Pass

Mass Balance Computation:

- $(\text{ROBTUNCO} + \text{HSPTUNCO} + \text{VIDTUNCO} + \text{BORDITCO}) / (\text{ROBTUNCO} + \text{HSPTUNCO} + \text{VIDTUNCO} + \text{BORDITCO} + 09046600 + 09047700 + 09050100 + 09047500_ext)$

2.2.2.2 *Blue River above Dillon Reservoir*

The Boreas Pass Ditch and Hoosier Pass Diversion System export water from the headwaters of the Blue River. The impacts of these TMDs were evaluated by comparing records for water exports to a streamflow gauge on the Blue River at Blue River (USGS-09046490) near Breckenridge. Alternate computations performed using data from the Blue River near Dillon (USGS-09046600) would reflect added tributary inputs to the Blue River and would, thus, provide a different perspective on the magnitude of TMD impacts on Blue River streamflows.

Streamflow gauge and/or water diversion structure record locations:

- 09046490 - Blue River at Blue River
- HSPTUNCO - Hoosier Pass Tunnel at Montgomery Reservoir (North Portal)
- BORDITCO - Boreas Pass Ditch

Mass Balance Computation:

- $(\text{HSPTUNCO} + \text{BORDITCO}) / (09046490 + \text{HSPTUNCO} + \text{BORDITCO})$

2.2.2.3 *Straight Creek Near Dillon*

Straight Creek provides water supply to the Dillon / Silverthorne Area. Denver Water has a decree for a conduit to divert water from Straight Creek into Dillon Reservoir. Infrastructure to facilitate this export was not constructed as of 2025. Adolf Coors Company has a right to the water from the Straight Creek Tunnel, which is essentially meltwater in the I-70 bore through Eisenhower Tunnel. Water collected by the tunnel is exported to the Clear Creek side of the Continental Divide and treated before running down Clear Creek to be used in Golden.

Streamflow gauge and/or water diversion structure record locations:

- 09051050 - Straight Creek below Laskey Gulch near Dillon
- STCTUNCO – Straight Creek Tunnel at East Portal of Eisenhower

Mass Balance Computation:

- $(STCTUNCO) / (STCTUNCO + 09051050)$

2.2.3 Eagle River Subbasin

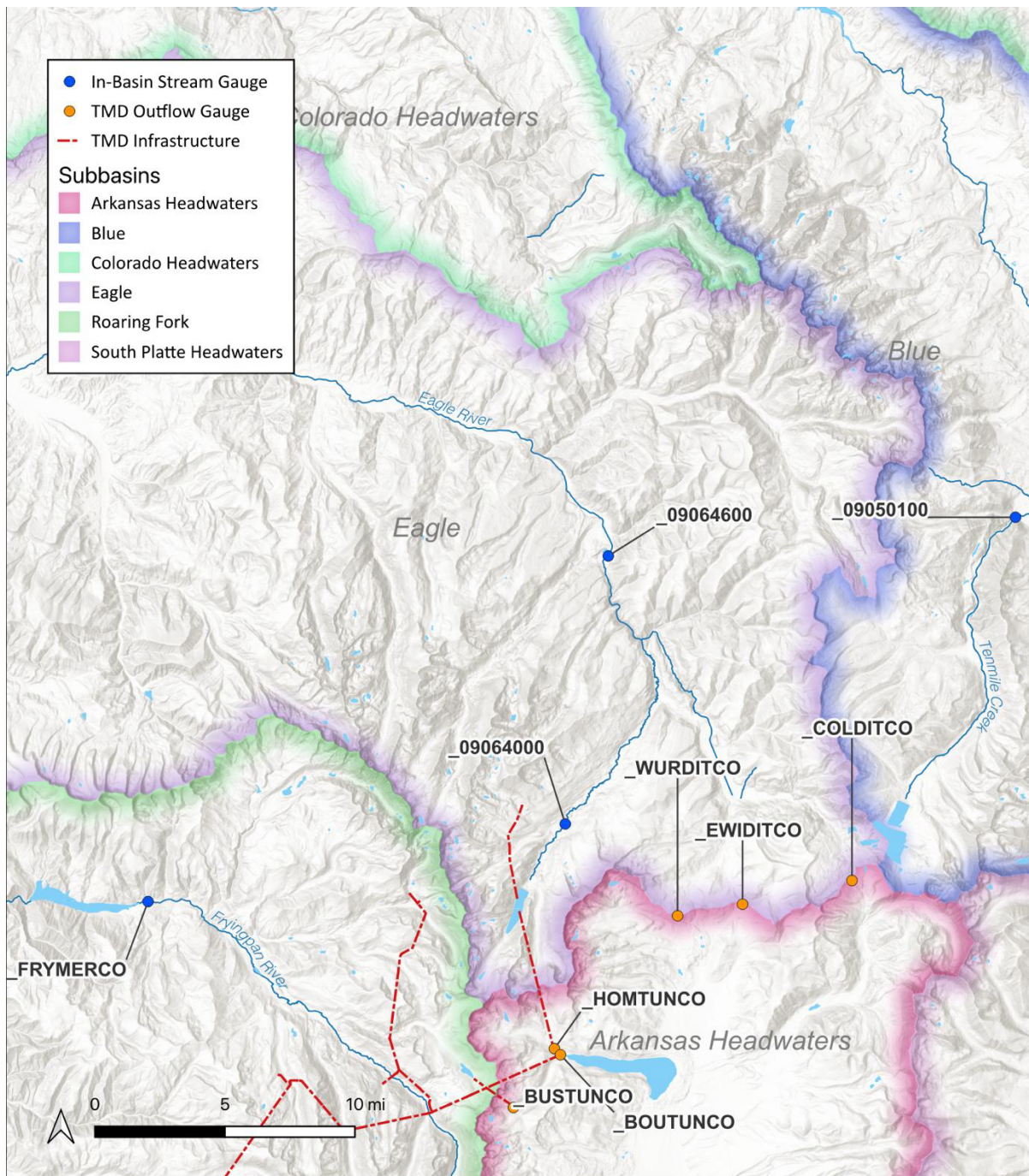


Figure 3. Relevant streamflow gauge and water diversion structure locations in the Eagle River subbasin.

2.2.3.1 Homestake Creek at Gold Park

The primary Eagle River transmountain diversion is the Homestake Project. The Homestake Project system is located in the headwaters of Homestake Creek and includes a collection system and

Homestake Reservoir. The Project diverts water stored in Homestake Reservoir into the Arkansas Headwaters through Homestake Tunnel. The streamflow gauge located at Homestake Creek at Gold Park coupled with the lack of in-basin uses above this point made yield impact estimation relatively uncomplicated.

Streamflow gauge and/or water diversion structure record locations:

- HOMETUNCO - Homestake Tunnel outlet
- 09064000 - Homestake Creek at Gold Park

Mass Balance Computation:

- $HOMETUNCO / (09064000 + HOMETUNCO)$

2.2.3.2 Eagle River Near Minturn

Computing the total impact of TMDs on streamflows on the Eagle River near Minturn required inclusion of both the Homestake Project and a number of small transmountain diversions exist in the upper Eagle River watershed, including the Columbine, Wurtz, and Ewing Ditches.

Streamflow gauge and/or water diversion structure record locations:

- HOMETUNCO - Homestake Tunnel outlet
- WURDITCO - Wurtz Ditch
- COLDITCO - Columbine Ditch
- EWIDITCO - Ewing Ditch
- USGS-09064600 - Eagle River near Minturn (above Cross Creek)

Mass Balance Computation:

- $(HOMETUNCO + WURDITCO + COLDITCO + EWIDITCO) /$
- $(09064600 + HOMETUNCO + WURDITCO + COLDITCO + EWIDITCO)$

2.2.4 Roaring Fork River Subbasin

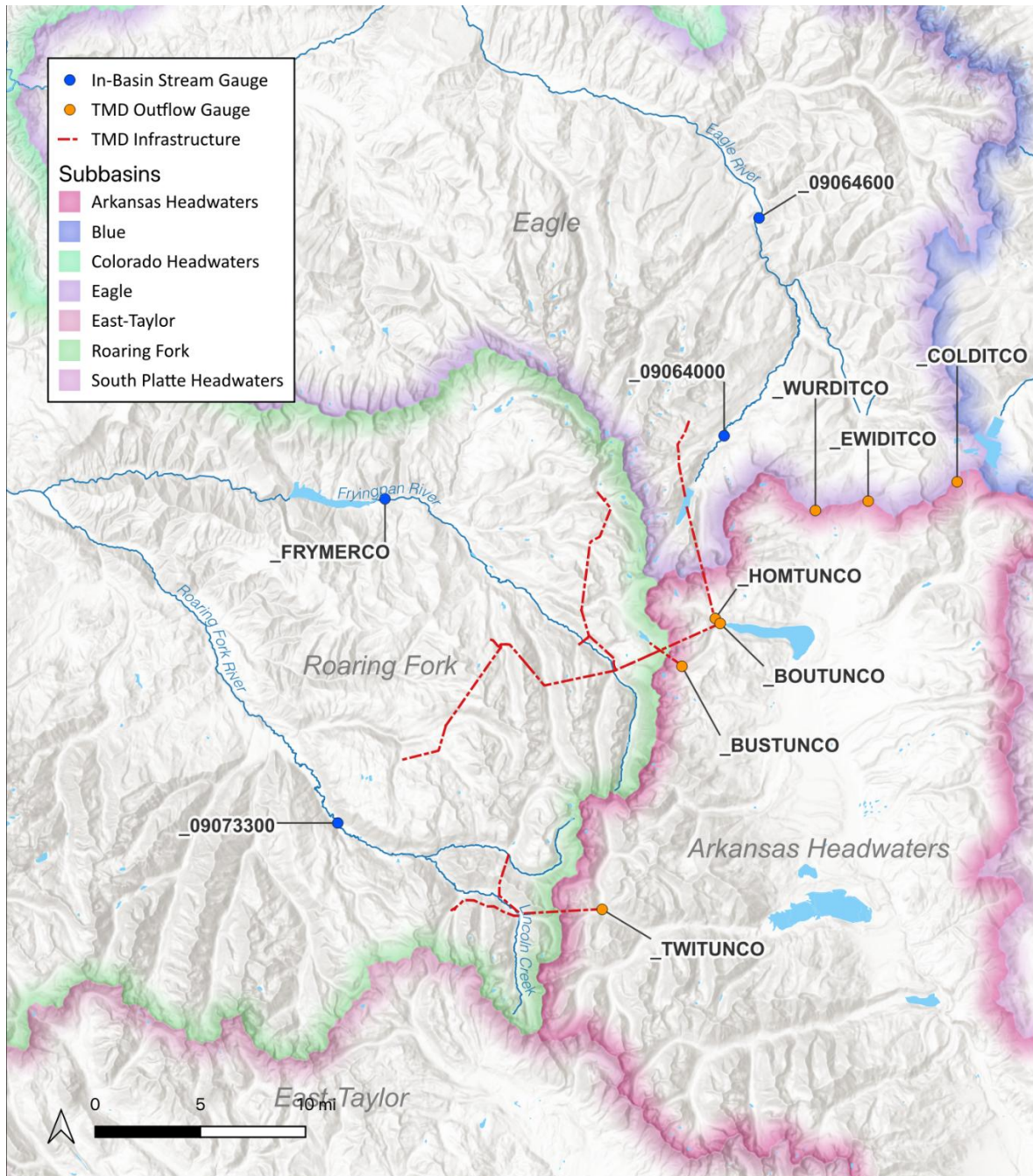


Figure 4. Relevant streamflow gauge and water diversion structure locations in the Roaring Fork River subbasin.

2.2.4.1 Roaring Fork River above Difficult Creek

Convenient streamflow gauge locations in the upper Roaring Fork River coupled with the lack of significant in-basin uses high in the watershed make yield estimates relatively uncomplicated.

Streamflow gauge and/or water diversion structure record locations:

- 09073300 - Roaring Fork River above Difficult Creek
- TWITUNCO - Twin Tunnels / Independence Pass Delivery System outflow

Mass Balance Computation:

- $(TWITUNCO) / (TWITUNCO + 09073300)$

2.2.4.2 Fryingpan River at Meredith

Streamflow gauge locations on the upper Fryingpan River coupled with the lack of significant in-basin uses above this point make for straightforward computations of the impacts of the Fryingpan Arkansas Project on streamflows.

Streamflow gauge and/or water diversion structure record locations:

- FRYMERCO - Fryingpan River near Meredith CO (above Ruedi Reservoir)
- BOUTUNCO - Charles Bousted Tunnel
- BUSTUNCO - Busk-Ivanhoe Tunnel

Mass Balance Computation:

- $(BOUTUNCO + BUSTUNCO) / (FRYMERCO + BOUTUNCO + BUSTUNCO)$

2.2.5 Gunnison River Subbasin

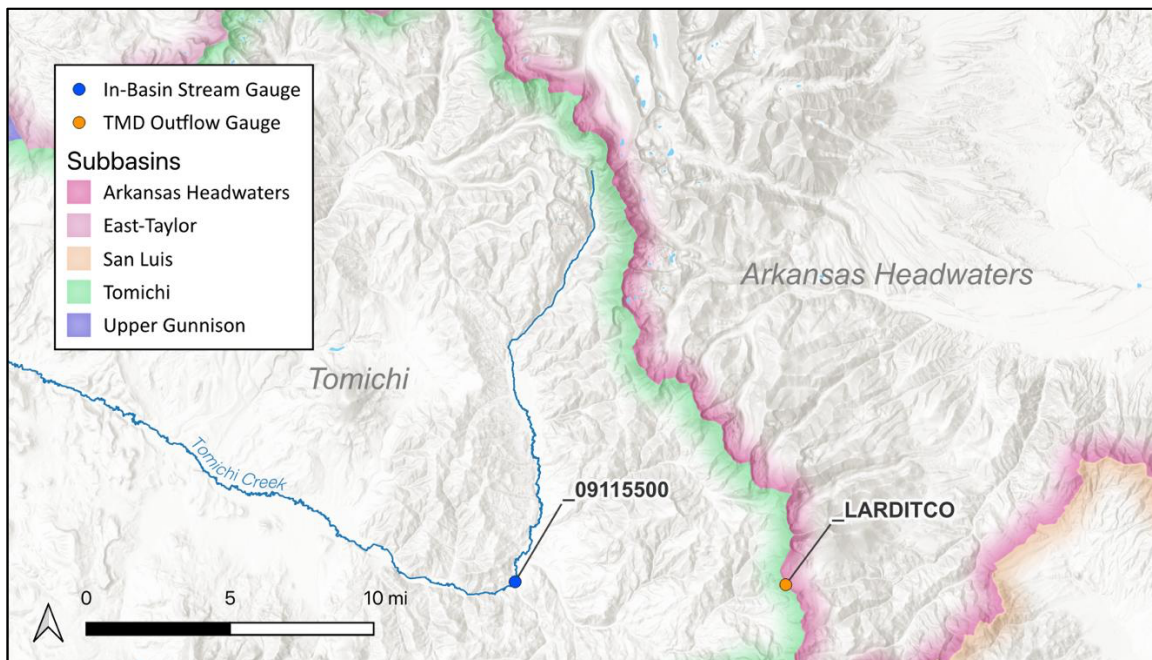


Figure 5. Relevant streamflow gauge and water diversion structure locations in the Gunnison River subbasin.

2.2.5.1 Tomichi Creek at Sargents

The Gunnison Basin is affected by a small number of transbasin diversions with localized impacts to the Tomichi Creek and Cochetopa Creek tributary drainages. The streamflow gauge at Tomichi Creek near Sargent (USGS-09115500) is suitable to capture impacts of the Larkspur Ditch. A streamflow gauge on Tomichi Creek at Gunnison (USGS-09119000) captures diversion impacts from the Tarbell Ditch in the Cochetopa Creek subbasin as well, but this gauge is downstream of significant irrigated lands in the Tomichi Creek drainage. We expect that mass balance computations using this gauge would be significantly distorted by the impact of in-basin consumptive water uses so it was not used to assess TMD impacts.

Streamflow gauge and/or water diversion structure record locations:

- 09115500 - Tomichi Creek near Sargent
- LARDITCO - Larkspur Ditch

Mass Balance Computation:

- $(\text{LARDITCO}) / (09115500 + \text{LARDITCO})$

2.2.6 Yampa River and North Platte River Subbasins

Due to the poor alignment of upper watershed measurement gauges with tributaries hosting TMD infrastructure, as well as the relatively small scale of TMD infrastructure in these areas, basin balances were not calculated in either the upper Yampa River or North Platte River subbasins. However, summaries of annual TMD diversion yields by structure and subbasin were tabulated.

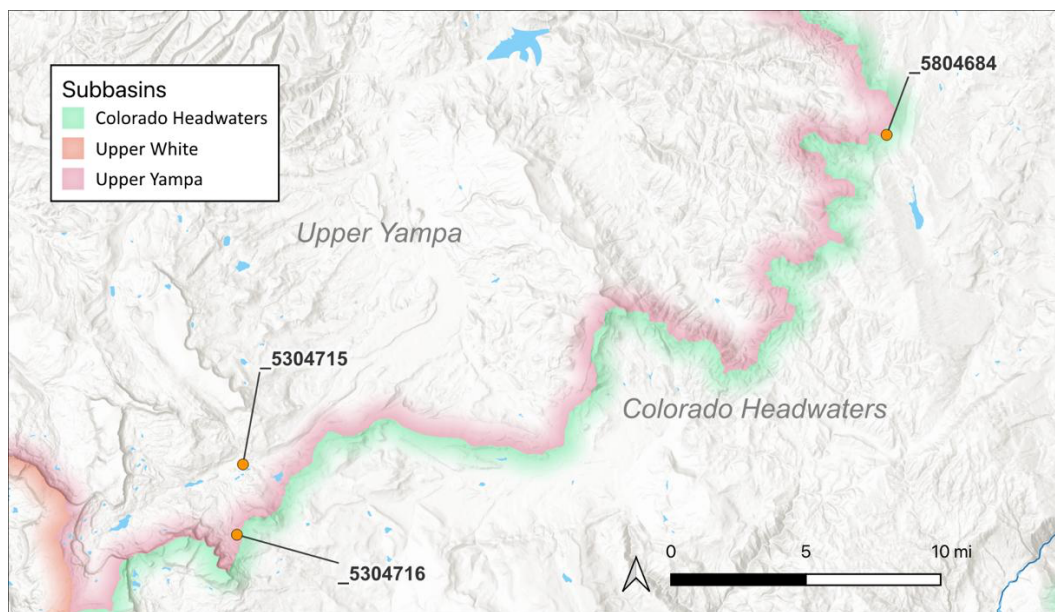


Figure 6. Relevant streamflow gauge and water diversion structure locations in the Upper Yampa subbasin.

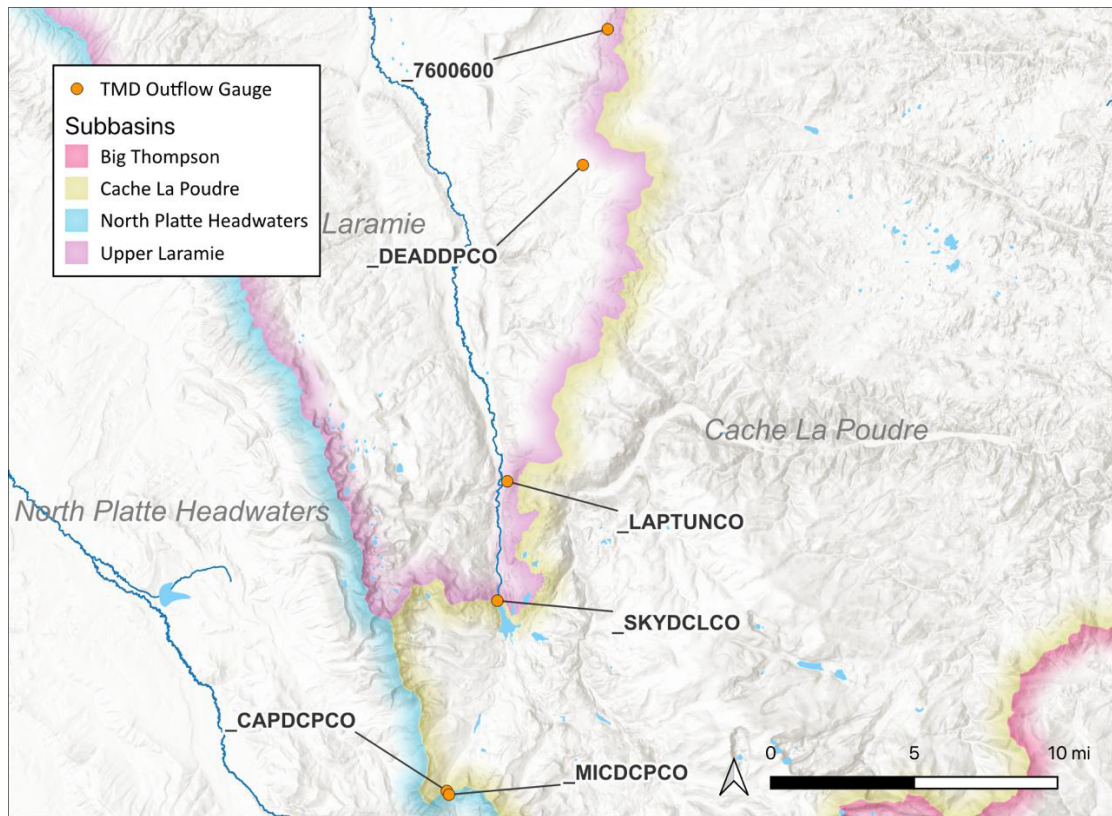


Figure 7. Relevant streamflow gauge and water diversion structure locations in the North Platte Headwaters subbasin.

2.3 Treatment of Incomplete Records

Whenever possible, incomplete streamflow gauging records were avoided for the analysis reported here. However, two locations affected by incomplete records were key to successful basin accounting. Records for the Fraser River below Crooked Creek (USGS-09033300) and Snake River below Montezuma (USGS-09047500) exhibited incomplete or missing data across or within some portion of the period of interest. We used the Maintenance of Variance Extension 2 (MOVE.2) method provided in the *smwrStats* library for R (USGS-R/smwrStats, 2024) to fill missing values in existing records at these two locations. The MOVE.2 method predicts missing data values by constructing correlations in observed seasonal streamflow patterns with other nearby proximal analog streamflow gauge records (Helsel and Hirsch, 2002).

The two gauges of interest are seasonally operated and typically produce data between Mar 1st or April 1st and November 1st of each year. The offline periods in these high-elevation headwaters streams are typically characterized by baseflow or very low flows that contribute little to annual yield totals. For example, the Colorado Climate Center reports that approximately 70-80% of annual runoff volume is produced between April and July (Bolinger et al., 2024). Related studies in Utah demonstrate that the April - July proportion of runoff in snowmelt-dominated headwaters accounts for ~75% of total annual runoff (Julander and Clayton, 2018). Accordingly, this work assumes that potential errors associated with incomplete record filling during the winter baseflow are unlikely to

significantly influence subsequent mass balance calculations at the annual time step. Estimates of monthly TMD impacts calculated during November-April period may be more uncertain.

3 Results and Discussion

Annual TMD yields computed at various water diversion structures and streamflow gauging locations are provided below in Table 3. A brief discussion of notable patterns for each subbasin, as well as caveats regarding datasets or limitations regarding discharge locations in each subbasin are provided in the subsections below. Additional graphical summaries are provided in Appendix A.

Table 3. Statistical summaries of annual diversion volumes (acre feet) from 1995-2024 at select TMD measurement locations. Differences between values reported here and those previously reported by other sources may arise from several factors, in particular: the chosen measurement record source when two or more relevant options exist, the time window of statistical aggregation, and the presence and timing of gaps/missing data in the data record. Incomplete or inconsistent records for some years at ADATUNCO (as well as its counterpart WDID 5104634) suggest the minimum reported value may have higher uncertainty. Data from 2003 are missing from the administrative records for WDIDs 5104634 and 5104655; making assessment of corresponding streamflow gauging station records at MOFTUNCO and ADANTUNCO the only reliable data from those years.

Location ID	Location Name	Subbasin	Minimum	Median	Mean	Max
HSPTUNCO	HOOSIER PASS TUNNEL AT MONTGOMERY RESERVOIR NEAR ALMA	BLUE	3,136	8,486	8,473	8,473
ROBTUNCO	ROBERTS TUNNEL AT EAST PORTAL NEAR GRANT (8000653)	BLUE	8,854	68,934	70,508	70,508
COLDITCO	COLUMBINE DITCH NEAR FREMONT PASS, CO. (1104616)	EAGLE	78	1,506	1,444	1,444
EWIDITCO	EWING DITCH AT TENNESSEE PASS, CO	EAGLE	192	931	924	924
HOMTUNCO	HOMESTAKE TUNNEL	EAGLE	4,185	23,746	24,964	24,964
WURDITCO	WURTZ DITCH NEAR TENNESSEE PASS (1100501)	EAGLE	499	2,235	2,200	2,200
LARDITCO	LARKSPUR DITCH AT MARSHALL PASS	GUNNISON	0	228	335	335
TARBELCO	TARBELL DITCH NEAR COCHETOPA PASS (2600702)	GUNNISON	0	569	569	569
CAPDCPCO	CAMERON PASS DITCH NEAR CAMERON PASS (0304602)	NORTH PLATTE	0	94	108	108
DEADDPCO	DEADMAN DITCH NEAR DEADMAN PARK	NORTH PLATTE	0	912	831	831
LAPTUNCO	LARAMIE POUFRE TUNNEL (4800576)	NORTH PLATTE	5,547	14,360	14,637	14,637
MICDCPCO	MICHIGAN DITCH AT CAMERON PASS	NORTH PLATTE	630	4,270	3,980	3,980
SKYDCLCO	SKYLINE DITCH AT CHAMBERS LAKE ()	NORTH PLATTE	0	0	162	162
4800573	BOB CREEK DITCH DIVR	NORTH PLATTE	17	346	302	302
7600600	WILSON SUPPLY DITCH	NORTH PLATTE	666	1,980	2,107	2,107
BUSTUNCO	BUSK-IVANHOE TUNNEL	ROARING FORK	1,549	4,084	3,813	3,813
BOUTUNCO	CHARLES H. BOUSTEAD TUNNEL	ROARING FORK	13,960	55,516	57,544	57,544
TWITUNCO	TWIN LAKES TUNNEL (1104617)	ROARING FORK	16,580	37,846	40,668	40,668
ADATUNCO	ALVA B. ADAMS TUNNEL AT EAST PORTAL NEAR ESTES PARK	UPPER COLORADO	99,048	236,140	225,273	225,273
5104625	BERTHOUD CANAL AND RESERVOIR TUNNEL	UPPER COLORADO	0	597	662	662
GRNDRDCO	GRAND RIVER DITCH AT LA POUFRE PASS	UPPER COLORADO	5,040	17,575	16,695	16,695
MOFTUNCO	MOFFAT WATER TUNNEL AT EAST PORTAL, CO	UPPER COLORADO	18,495	47,148	47,368	47,368
5304715	STILLWATER DITCH	YAMPA	9	1,632	1,647	1,647
5304716	DOVE CREEK DITCH	YAMPA	0	76	98	98
5804684A	SARVIS DITCH	YAMPA	2,036	2,036	2,036	2,036

Table 4. Estimates of aggregated annual TMD yield from West Slope basins 1995-2024. Basin TMD yield is the sum of daily diversions from any diversion structure recognized as transferring water out of basin. Daily values are summed to annual totals and characterized by summary statistics across the 30-year period.

Basin	Min	Median	Max
Blue	16,406	75,144	134,483
Eagle	6,743	28,328	54,713
Gunnison [†]	0	834	3,195
North Platte	12,567	21,903	28,239
Roaring Fork [†]	39,038	105,070	170,165
Upper Colorado	154,274	290,464	382,145
Yampa [†]	31	1,898	5,342

[†]TMDs to Rio Grande and Arkansas Basins only

[†]Includes Fryingpan River subbasin TMDs

[†]TMDs to Colorado Basin

Table 5. Annual TMD diversions as a percentage of available streamflow at West Slope subbasin locations during different hydrologic year types.

Subbasin	Drought	Dry	Average	Wet	Flood	All Years
Blue River at Blue River	36	38	31	20	8	29
Blue River at Dillon Dam (all major reservoir tribs.)	55	42	30	14	18	30
Straight Creek nr Dillon (Laskey Gulch)	6	3	2	2	2	3
Colorado River blw Windy Gap	80	77	62	48	38	61
Fraser River blw Crooked and Ranch Creeks	48	41	33	29	20	33
Eagle River near Minturn	44	30	24	18	20	25
Homestake Creek at Gold Park	70	64	53	46	48	54
Fryingpan River at Meredith (abv Ruedi Res.)	22	33	37	35	37	35
Roaring Fork abv Difficult Creek nr Aspen	55	60	54	47	26	52
Tomichi Creek at Sargents	0	0	1	1	0	1
Williams Fork near Leal	22	11	6	3	2	7

Table 6. Estimates of monthly TMD yield as a percentage of West Slope subbasin locations by month during different hydrologic year types. Monthly estimates are more likely affected by lags in localized reservoir and storage operations in each subbasin as compared to annual yield estimates and should be treated with caution (see

Critical Caveats).

Subbasin	Location	Year Type	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Blue	Straight Creek near Dillon (Laskey Gulch)	Drought	9	5	3	4	7	7	6	4
		Dry	4	3	2	3	4	4	4	3
		Average	5	3	1	2	4	4	4	4
		Wet	5	3	2	2	3	3	4	3
		Flood	4	4	2	1	2	4	5	4
	Blue River at Blue River (near Breckenridge)	Drought	0	14	54	70	20	3	3	53
		Dry	0	12	40	55	38	13	15	49
		Average	0	11	31	38	35	27	22	35
		Wet	0	9	23	20	19	24	22	33
		Flood	0	0	9	10	1	5	7	53
	Blue River and all major tributaries above Dillon Dam	Drought	69	60	40	49	57	59	53	69
		Dry	40	27	18	30	53	60	59	48
		Average	34	24	13	17	34	45	46	42
		Wet	19	21	3	4	17	15	37	32
		Flood	36	63	29	6	2	21	32	44
Eagle	Eagle River near Minturn	Drought	41	37	13	11	2	31	30	20
		Dry	38	36	14	17	10	2	8	24
		Average	61	41	15	16	11	11	4	1
		Wet	56	43	8	14	17	12	4	2
		Flood	50	73	1	6	14	26	1	43
	Homestake Creek at Gold Park (Eagle headwaters)	Drought	49	56	10	9	0	40	42	38
		Dry	49	53	23	22	9	0	12	36
		Average	75	66	33	23	13	18	7	2
		Wet	73	67	21	31	29	19	8	3
		Flood	72	95	0	0	24	48	0	48
Roaring Fork	Fryingpan River at Meredith (above Ruedi Reservoir)	Drought	7	12	45	25	7	9	6	5
		Dry	5	6	53	52	16	6	5	4
		Average	7	5	40	57	37	10	5	5
		Wet	7	7	28	51	50	21	5	5
		Flood	5	3	18	48	47	37	12	4
	Roaring Fork above Difficult Creek near Aspen	Drought	24	47	73	73	32	2	8	33
		Dry	30	28	69	74	44	18	16	23
		Average	23	26	61	59	57	44	28	39
		Wet	32	26	54	51	47	24	18	44
		Flood	2	5	42	30	20	37	39	12
Upper Colorado	Colorado River below Windy Gap	Drought	81	76	81	80	75	85	84	81
		Dry	81	63	74	73	68	76	81	65
		Average	75	49	49	44	63	64	68	58
		Wet	71	39	37	21	40	66	71	53
		Flood	65	46	30	19	39	31	62	43
	Fraser River below Crooked Creek and Ranch Creek	Drought	14	32	65	75	51	48	62	45
		Dry	13	18	47	42	59	55	46	37
		Average	16	15	33	28	47	47	46	52
		Wet	12	11	35	31	34	40	45	30
		Flood	10	8	32	12	30	32	36	46
	Williams Fork near Leal	Drought	10	14	27	29	26	25	22	18
		Dry	9	7	13	8	13	21	17	10
		Average	4	4	6	2	10	12	10	9
		Wet	5	4	2	1	4	8	9	5
		Flood	5	3	5	1	5	4	8	6
Gunnison	Tomichi Creek at Sargents	Drought	0	0	0	0	1	1	1	1
		Dry	0	0	0	0	0	0	1	1
		Average	0	0	0	1	1	1	1	1
		Wet	0	0	0	1	1	2	2	1
		Flood	0	0	0	1	2	2	2	1

3.1 Alignment with Values Reported Elsewhere

Lotic reviewed a variety of previous publications that include estimates of TMD yield and proportional impacts on West Slope streamflows (Table 6). Although the results produced by this analysis appear well aligned with other estimates reported by others, our estimates for Fraser River impacts were significantly different than values reported elsewhere. Lotic staff was unable to determine where or how the previous estimates for the Fraser River were calculated.

Table 7. Comparison of subbasin impact estimates to previously published values.

Subbasin	Location	Proportion of Annual Streamflow Yield Reduced by TMDs	
		Estimates Reported Here <i>Average (Min - Max)</i>	Previously reported estimate(s)
Fraser	Not specified		60% ^{1,2}
Fraser	Below Crooked Creek	34% (28 - 48%)	
Colorado	Downstream of Windy Gap	62% (38 - 80%)	65% ³
Colorado	Below Kremmling (USGS 09058000)		29% ⁴
Blue	Entire basin yield (Roberts Tunnel only)		18.5%, 25%-30% ⁵
Blue	At Dillon Reservoir	30% (14 - 55%)	
Blue	Entire basin yield (Continental-Hoosier system only)		2.50% ⁶
Blue	At Blue River	31% (8 - 36%)	
Eagle	At confluence with Colorado River		6% ⁷ - 8.2% ⁸
Eagle	Homestake Creek at Gold Park	55% (49 - 70%)	
Eagle	Upper Eagle Headwaters above Minturn	25% (20 - 44%)	21% ⁹
Frying Pan	Above Meredith	34% (22 - 40%)	41% ¹⁰
Roaring Fork	Above Difficult Creek	53% (40 - 60%)	38% ¹¹

3.2 Upper Colorado River Subbasin

Previous reporting by other entities noted that Fraser Basin depletions may represent around 60% of basin flows. Lotic staff could not find a geographic reference point for this number, or an explanation of what water sources and diversion rights were used, making comparison to the estimate arrived at in this work problematic. Transmountain Diversions divert approximately 35% of Fraser River below

¹ <https://www.coheadwaters.org/moffat-diversion>

² <https://coyotegulch.blog/2009/11/01/conservation-organizations-warn-against-denver-waters-moffat-collection-system-projects-ecological-effects-on-the-fraser-river-and-upper-colorado-river/>

³ <https://www.nrcs.usda.gov/programs-initiatives/rcpp-regional-conservation-partnership-program/colorado/colorado-river>

⁴ Beeby and Bledsoe 2013. Colorado River Inventory and Assessment

⁵ Blue River Integrated Water Management Plan, Section 4.1.1 citing Elder 2020, 2021

⁶ Blue River Integrated Water Management Plan, Section 4.1.1

⁷ <https://aspenjournalism.org/homestake-hike-highlights-uncertainties-with-proposed-reservoir-project/>

⁸ <https://nwccog.org/wp-content/uploads/2015/04/Eagle-River-Watershed-2012-208-Plan.pdf>

⁹ Eagle River Community Water Plan, Appendix G, estimated from hydrologic model outputs

¹⁰ <https://www.roaringfork.org/your-watershed/watershed-facts/transmountain-diversions/>

¹¹ <https://www.roaringfork.org/your-watershed/watershed-facts/transmountain-diversions/>

Crooked Creek across the 30-year record assessed here. Impacts are proportionally highest during the summer and early fall (July - October) in most year types. This pattern has implications for fisheries habitat availability, water temperature conditions, and system connectivity. Diversions impacts, as a proportion of native flows, are likely higher above the confluences with Crooked, Pole and Ranch creeks.

Isolating the impacts of TMDs to the Colorado River headwaters (i.e., above the Fraser River confluence) was challenged by the location and record continuity of existing streamflow gauges. Impacts of water releases from Granby Reservoir also mean that annual streamflow and TMD yield patterns across different year types are subject to various lags and alterations tied to reservoir operations. Monthly results should be viewed in this light. For example, water flowing through the Adams Tunnel in late summer will make it appear that a higher proportion of basin yield moves east during that month, even if that water was not native August streamflow but was stored in Granby Reservoir earlier in the season. These subtleties in timing become less relevant at annual timespans.

3.3 Blue River Subbasin

TMD yields in the Blue River basin account for about 30% of the available basin yield above Dillon Reservoir across the major tributary drainages: Blue River, Snake River, and Tenmile Creek. The seasonal timing of TMD impacts, assessed as a proportion of native monthly inflows to Dillon Reservoir, are consistent across year types. Annualized impacts are most significant in Drought and Dry year types. In these year types, the proportional TMD yield increases from 40 to 60%, reflecting the reliance of multiple Front Range municipalities (including Denver Water, Aurora, Colorado Springs, Golden, etc.) on water sourced from the Blue River basin in drier-than-average conditions.

Impacts of the Hoosier Pass system on the mainstem Blue River near Breckenridge are greatest in the May-July period in Dry and Drought year types, approaching 70% of total basin yield in some conditions. In Average and Wet year types, impacts are somewhat lower and more consistent across the May-October period.

A small TMD on Straight Creek reduced yields by approximately 3% across year types. Decreed water rights and a proposed conduit to divert to water to Dillon Reservoir may increase these impacts in the future.

3.4 Eagle River Subbasin

Annual yield comparisons indicate that TMD operations in the Homestake Creek drainage reduce streamflows by ~55% across year types. The timing of water storage and release from Homestake Reservoir impart a distinct influence on observable downstream streamflow patterns between year types. Homestake Reservoir exhibits a somewhat unique operational pattern compared to other headwaters reservoirs. Records indicate that the primary period for transmountain water delivery to the Arkansas Basin and Turquoise Lake Reservoir occurs between late winter and early spring, prior to snowmelt runoff. Winter diversion of water stored in the previous summer season likely gives an exaggerated sense of impact on subbasin streamflows during the winter and spring months.

Impacts of the Homestake Project downstream at the Eagle Basin near Minturn are attenuated by additional tributary inflows. The impact of the Homestake Project and several small TMDs in the Eagle River headwaters average ~25% of basin yield across year types. Previous work by USGS (Williams 2011) estimated those smaller TMDs to account for ~1% of available total Eagle River basin yield. Presumably, this computation was performed at a location on the Eagle River near its confluence with the Colorado River.

3.5 Roaring Fork River Subbasin

TMD impacts to the Roaring Fork subbasin are consistently strongest in May-June when the diversion system captures between ~40-70% of the native streamflow yield, depending on year type. TMD impacts average ~53% across year types. Streamflow impacts hover between ~20-30% from late summer through early spring across year types—a more significant year-round influence than observed in the neighboring Fryingpan River drainage. Diversion impacts typically fall in August when the Cameo Call limits the ability of the Independence Pass system to divert Roaring Fork River water.

TMD impacts to streamflows on the upper Fryingpan River are consistently strongest in the May-June period when the diversion system captures ~30-50% of the subbasin yield, averaging ~35% across year types. Between late summer and early spring, proportional streamflow impacts decline to between 4-7% across year types.

3.6 Critical Caveats

Complex administration of paper and physical water supplies that may occur under many TMD projects in any given year or month complicates the effort to capture a wholly accurate picture of TMD impacts on streamflows via available streamflow gauging records. The analysis results presented here are a simple accounting of TMD impacts that reflects observed streamflows under varying reservoir storage, administrative, and operational conditions. Other approaches for quantifying TMD impacts exist. For example, the impact of TMD projects under different hydrological and administrative conditions may be modeled using the state's hydrologic planning model (StateMod). Such an approach might allow a more nuanced and spatially explicit characterization of TMD impacts, unconstrained by streamflow gauge locations or record completeness. Alternatively, a full water rights engineering exercise could be performed to better track and understand the inter-annual and inter-seasonal role of reservoir storage, out-of-priority exchanges, and other physical or administrative TMD operations. Ultimately, these approaches were discarded due to questions regarding model calibration quality and the limited additional insights that may be increasingly intense investigative approaches may yield.

TMD impacts computed and summarized as monthly percentages are highly impacted by reservoir operations in most subbasins, which can significantly offset the timing of water diversions from a stream versus when it moves through TMD infrastructure. This can create significant distortions in the results produced by the simple water balance methodology applied here. For example, water is frequently moved from Homestake Reservoir out of the Eagle Basin in late winter and early spring, when natural streamflows are very low. Comparing the reservoir storage release through the tunnel

to gauged streamflows during the winter months suggests a large majority of basin flows are going through the tunnel in March and April, when, in reality, much of the water diverted in this period is stored water from the previous year. Monthly outputs should therefore be viewed as a potentially useful aid in understanding intra-year patterns but cannot necessarily be understood as a wholly accurate or fair description of the alteration to local streamflows created by a TMD during the referenced period. **Monthly results for each subbasin should be contextualized with appropriate local knowledge about typical TMD operations before they are used in other reporting or analysis efforts.** Direct consultation with the owners/operators of a given TMD project may be helpful in illuminating the drivers of apparent monthly patterns.

4 References

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Calculate Proportional Basin Yields for TMD Structures

Lotic Hydrological

2025-10-29

Background on Transmountain Diversion (TMD) Basin Balances

Estimates below are for the amount of annual watershed yield at a given location that is extracted by TMD diversions.

Stream and diversion flow records are sourced from USGS and CDWR webservices.

For 09033300 Fraser blw Crooked Creek nr Tabernash and 09047500 Snake River nr Montezuma, the seasonal operation of those gauges means a portion of the year is unaccounted for in yield calculations. At these locations, a synthetic record was created for the winter months (which are relatively less important to annual yield volume) using the Maintenance of Variance Extension 2 method (MOVE.2) published by USGS in the smwrStats v.0.7.6 package for the R computing environment.

These water balances are calculated using a location in each subbasin with a TMD that 1) has a long term year-round record and 2) is unlikely to be affected by significant in-basin consumptive uses.

Calculations do not reflect watershed yield at mouth, they reflect the specific influence of one or more major TMDs at an upper watershed location. Most comparison locations are near the headwaters or higher than at least 50% of the full watershed.

Year Types are calculated using the 5th, 25th, 75th, 95th, and 100th percentile breaks a reference gauge near to the subbasin gauges that is minimally impacted by TMD diversions or local diversions. Year type classifications are then mapped to the annual results in the locations of interest in the subbasin balances for basin hydrologic context across the time period of study.

Eagle River Basin

The primary Eagle River transmountain diversion is the Homestake Project which uses the Homestake Tunnel. A number of smaller transmountain diversions include the Columbine, Wurtz, and Ewing Ditches. Previous work by USGS (Williams 2011) estimated those smaller ditches account for about 1% of available basin yield, which would be a more significant proportion at an upper basin location of measurement such as the Eagle River gauge in Red Cliff or Minturn.

Homestake Creek at Gold Park

Flow record locations include:

HOMTUNCO - Homestake Tunnel outlet

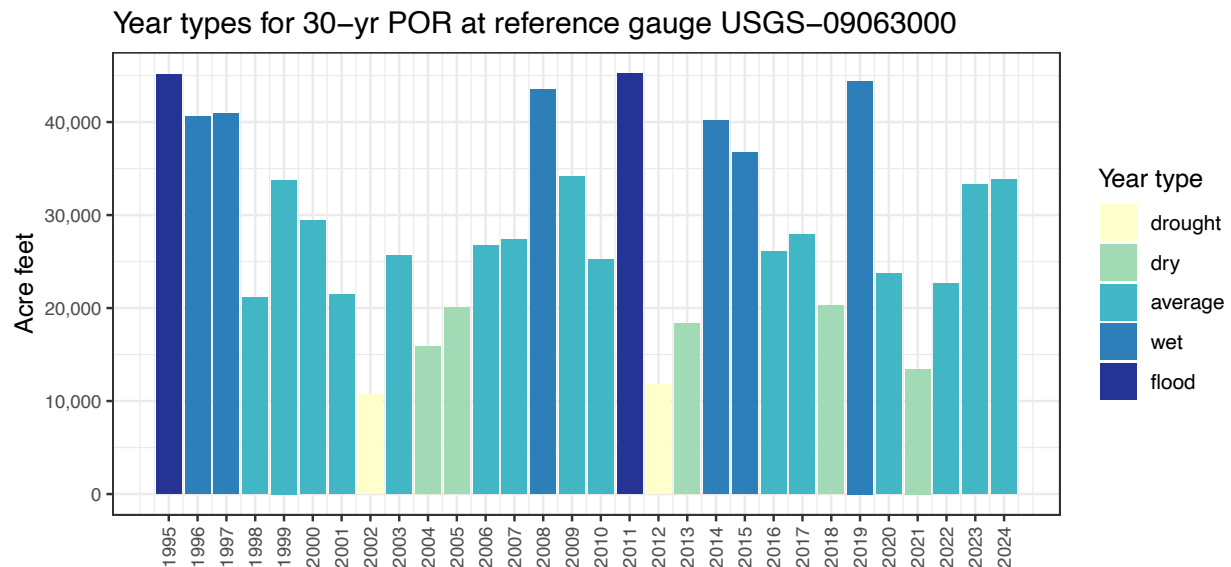
USGS-09064000 - Homestake Creek at Gold Park

Flow balance relies on:

HOMTUNCO / (09064000 + HOMTUNCO)

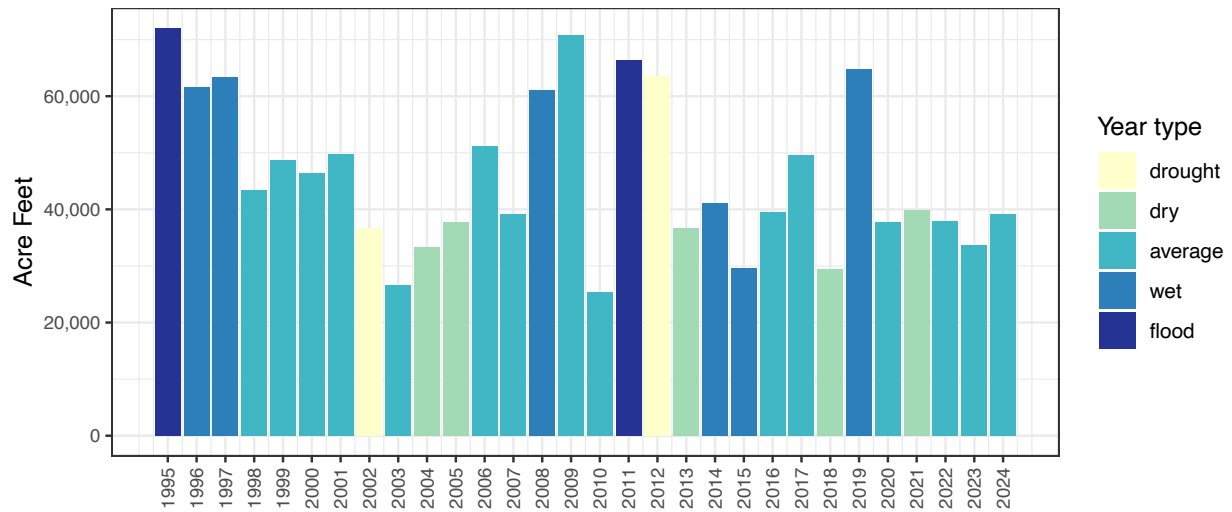
yr_type	mean_yr_type	basin
drought	70	Homestake Creek at Gold Park
dry	64.4	Homestake Creek at Gold Park
average	52.9	Homestake Creek at Gold Park
wet	46	Homestake Creek at Gold Park
flood	48.5	Homestake Creek at Gold Park
all years	54.3	Homestake Creek at Gold Park

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Eagle	Homestake Creek at Gold Park	drought	50	49	48	56	10	9	0	40	42	38	82	49
Eagle	Homestake Creek at Gold Park	dry	0	20	49	53	23	22	9	0	12	36	2	0
Eagle	Homestake Creek at Gold Park	average	0	11	75	66	32	23	12	18	7	2	0	0
Eagle	Homestake Creek at Gold Park	wet	0	16	73	66	21	31	29	19	8	3	10	0
Eagle	Homestake Creek at Gold Park	flood	0	42	72	95	0	0	24	48	0	48	0	0



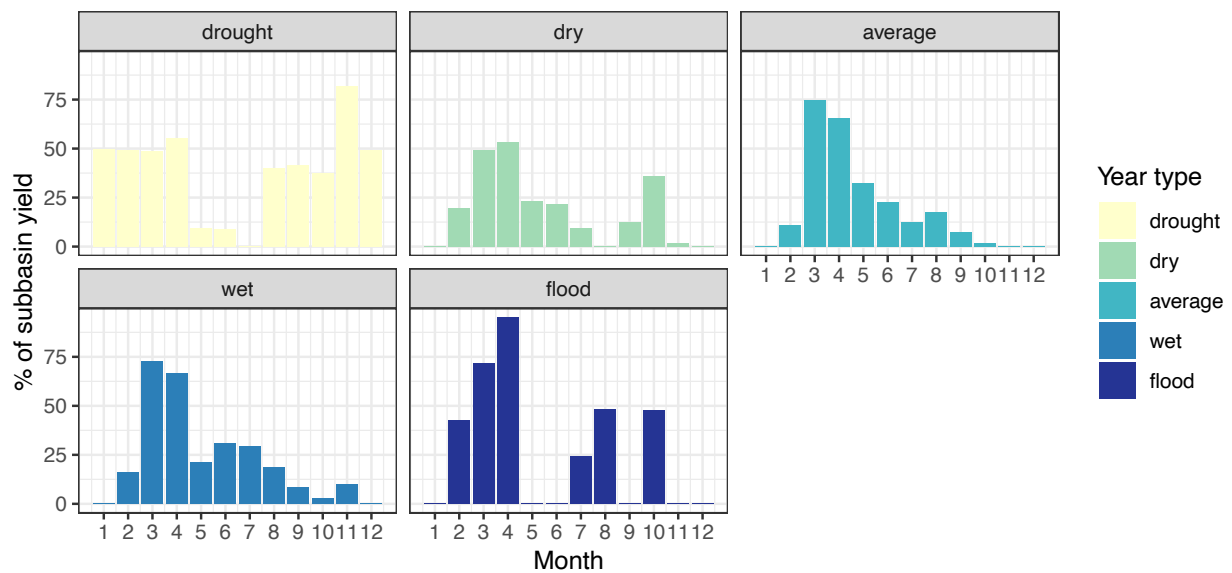
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Homestake Creek at Gold Park



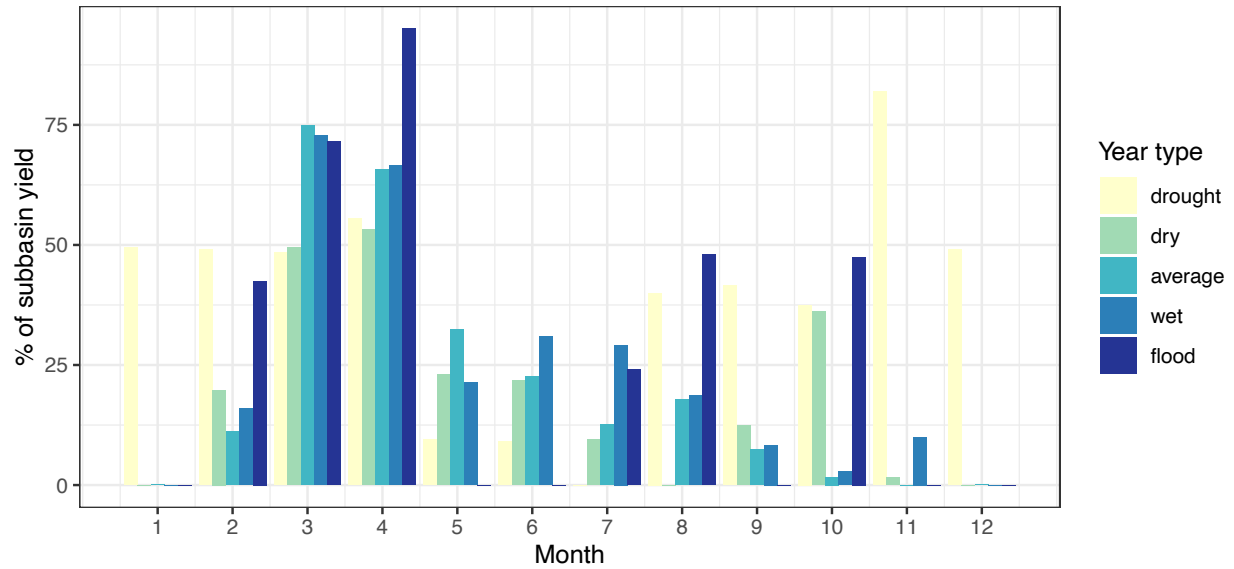
Year types based on annual yield at basin reference gauge USGS-09063000

Percent of watershed yield diverted via TMD by month
Homestake Creek at Gold Park



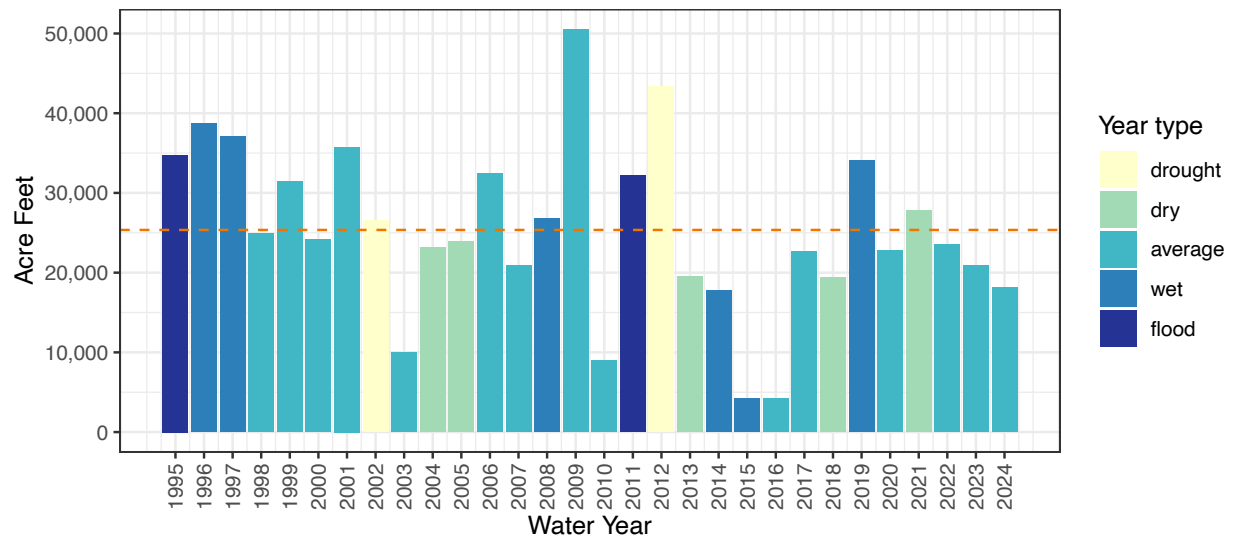
Percent of watershed yield diverted via TMD

Homestake Creek at Gold Park



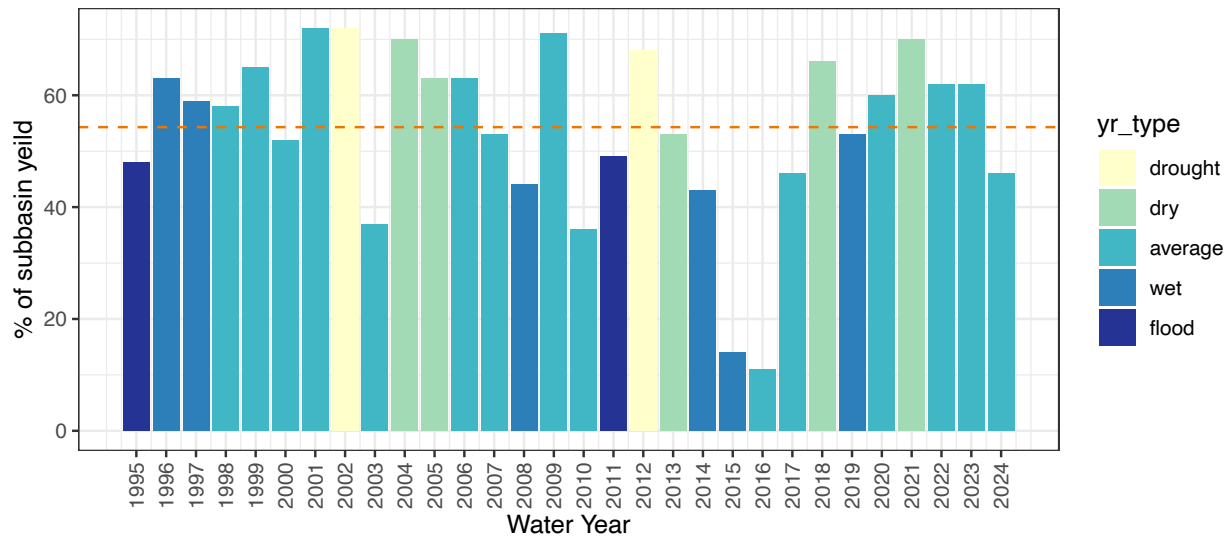
Annual TMD Yield, EAGLE basin

Homestake Creek at Gold Park



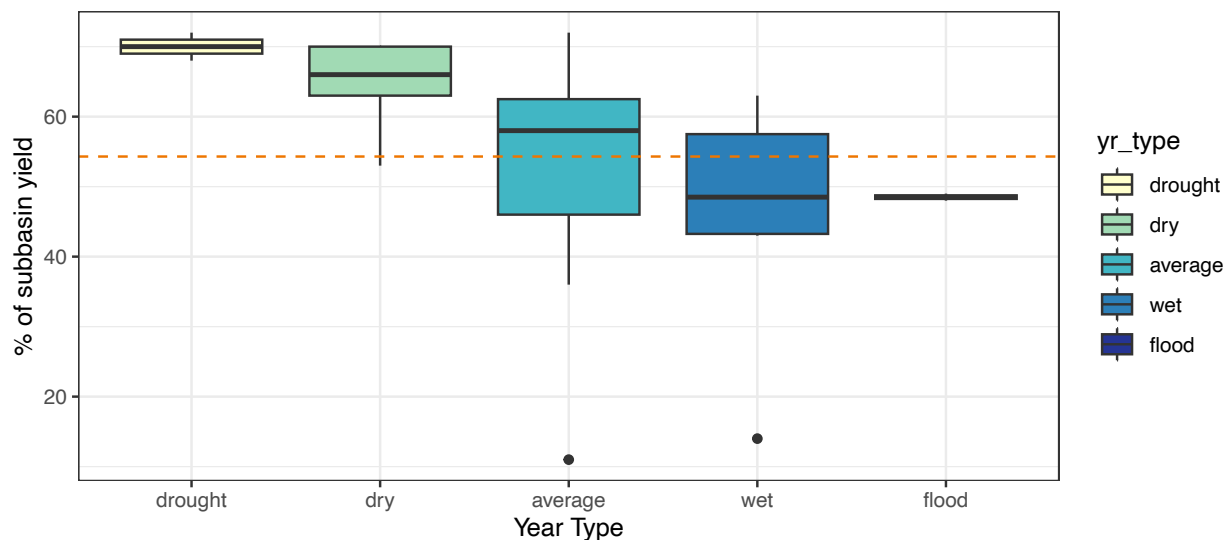
Orange dashed line is mean yield for 30-yr POR.

Percent of annual basin yield diverted by TMD above location
Homestake Creek at Gold Park



Orange dashed line is mean percent for 30-yr POR.

Percent of annual basin yield diverted by TMD, by year type
Homestake Creek at Gold Park



Dashed orange line represents average yield to TMD across all years

Eagle River near Minturn

Flow record locations include:

HOMTUNCO - Homestake Tunnel outlet

WURDITCO - Wurtz Ditch

COLDITCO - Columbine Ditch

EWIDITCO - Ewing Ditch

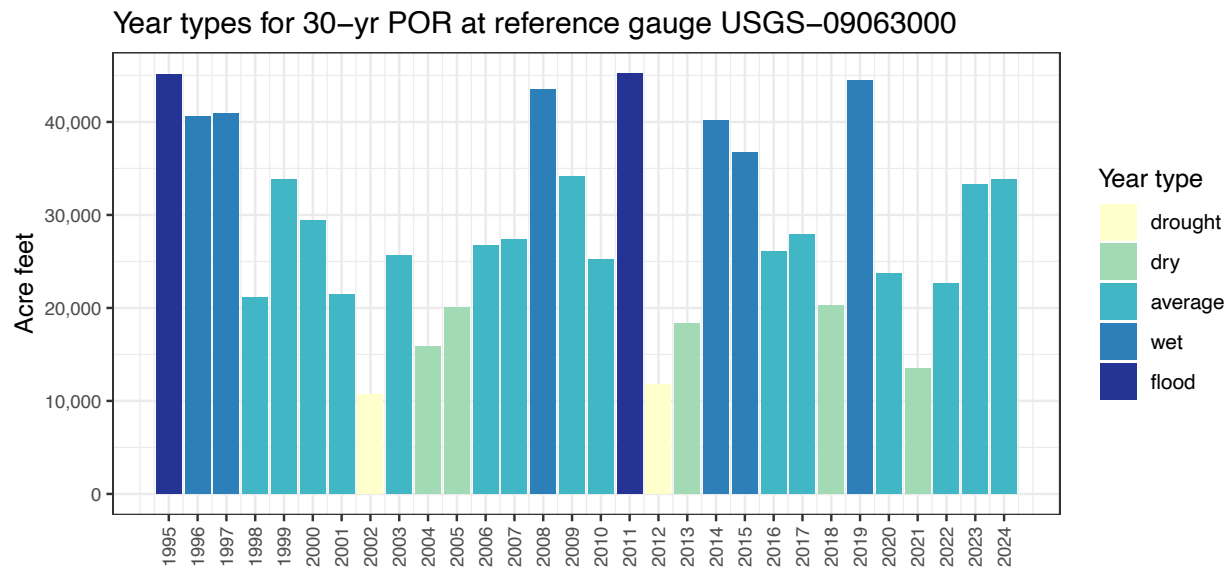
USGS-09064600 - Eagle River near Minturn (abv Cross Creek)

Flow balance relies on:

(HOMTUNCO + WURDITCO + COLDITCO + EWIDITCO) / (09064600 + HOMTUNCO + WURDITCO + COLDITCO + EWIDITCO)

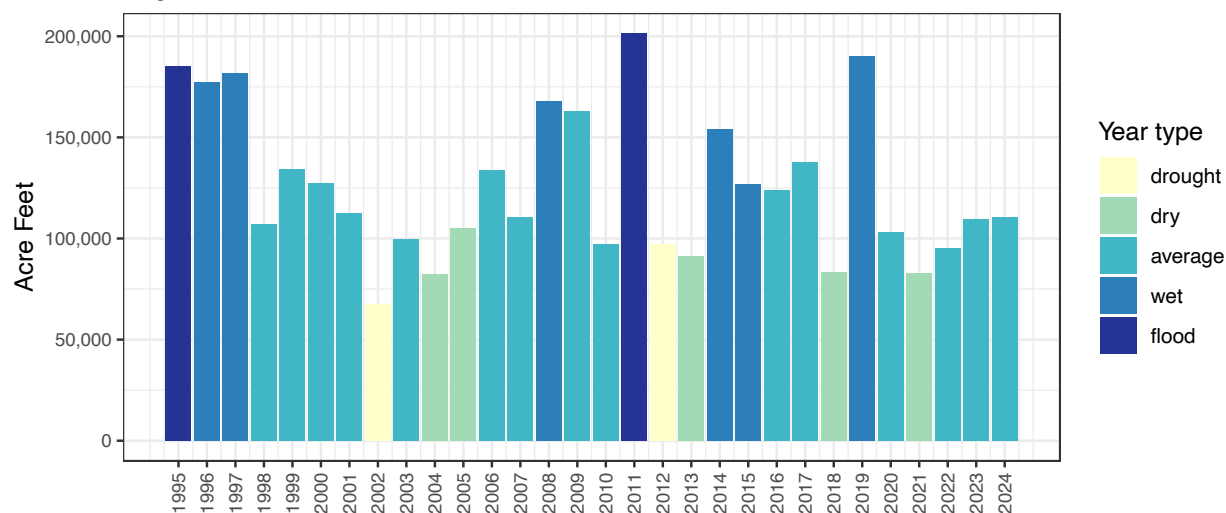
yr_type	mean_yr_type	basin
drought	44	Eagle River near Minturn
dry	29.8	Eagle River near Minturn
average	23.7	Eagle River near Minturn
wet	18.5	Eagle River near Minturn
flood	20.5	Eagle River near Minturn
all years	24.8	Eagle River near Minturn

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Eagle	Eagle River near Minturn	drought	46	43	40	37	13	10	2	31	30	20	52	45
Eagle	Eagle River near Minturn	dry	0	18	38	36	14	17	10	2	8	24	0	0
Eagle	Eagle River near Minturn	average	0	8	61	41	15	16	11	11	4	1	0	0
Eagle	Eagle River near Minturn	wet	0	14	56	43	8	14	17	12	4	2	5	0
Eagle	Eagle River near Minturn	flood	0	26	50	72	0	6	14	26	0	42	0	0



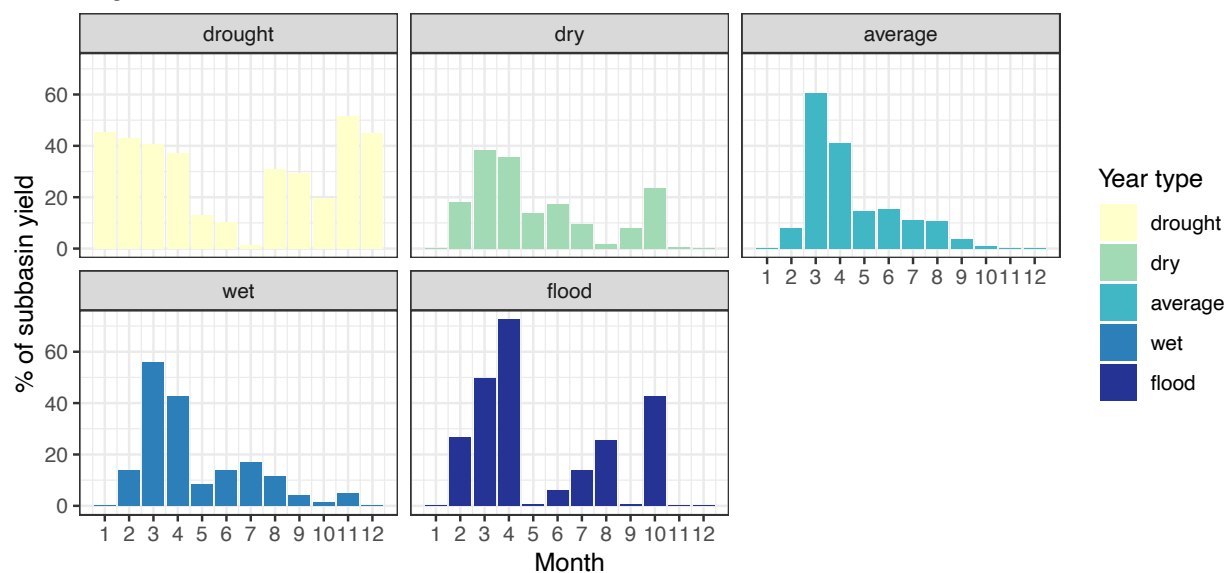
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Eagle River near Minturn



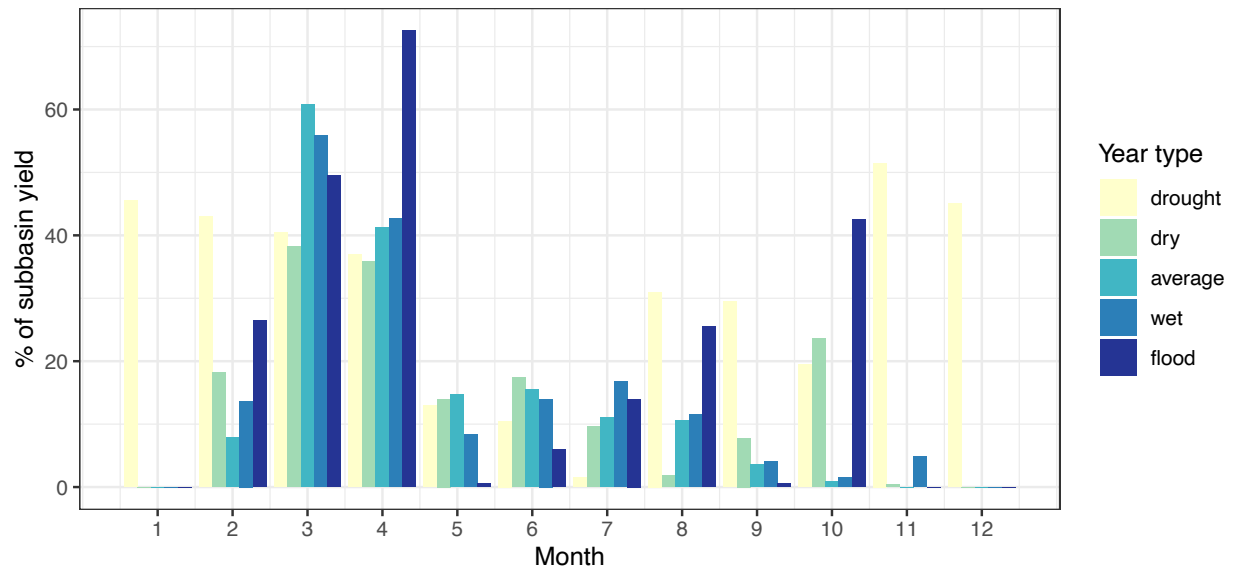
Year types based on annual yield at basin reference gauge USGS-09063000

Percent of watershed yield diverted via TMD by month
Eagle River near Minturn



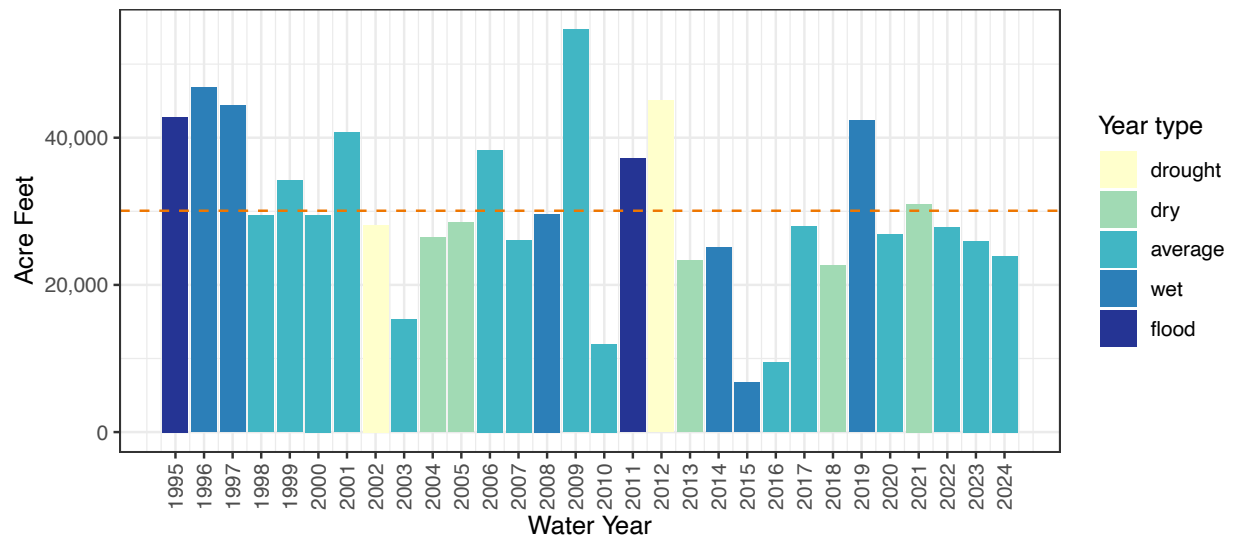
Percent of watershed yield diverted via TMD

Eagle River near Minturn



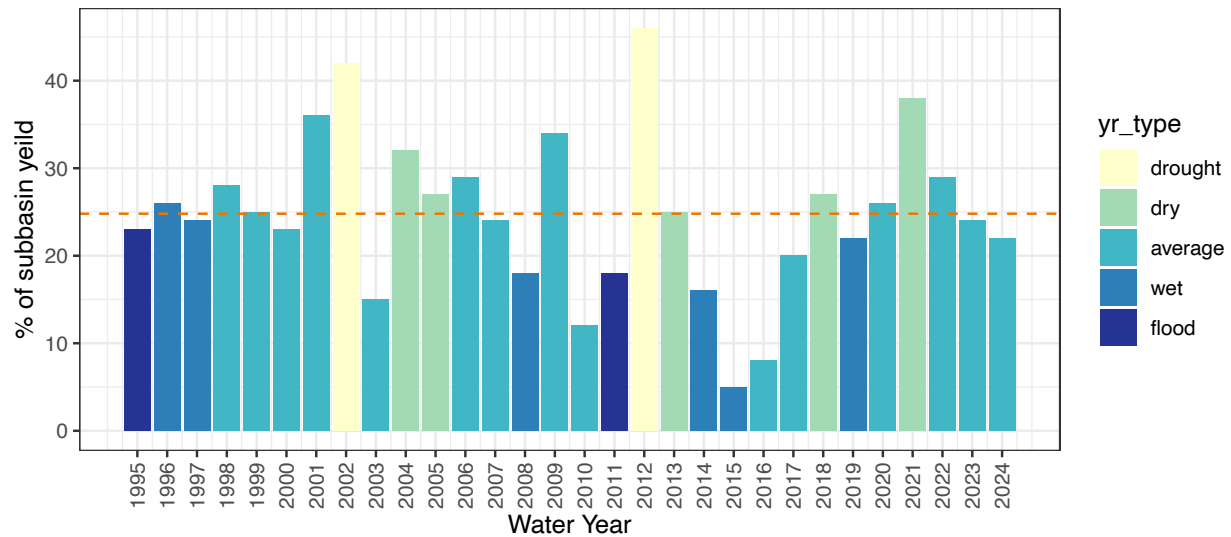
Annual TMD Yield, EAGLE basin

Eagle River near Minturn



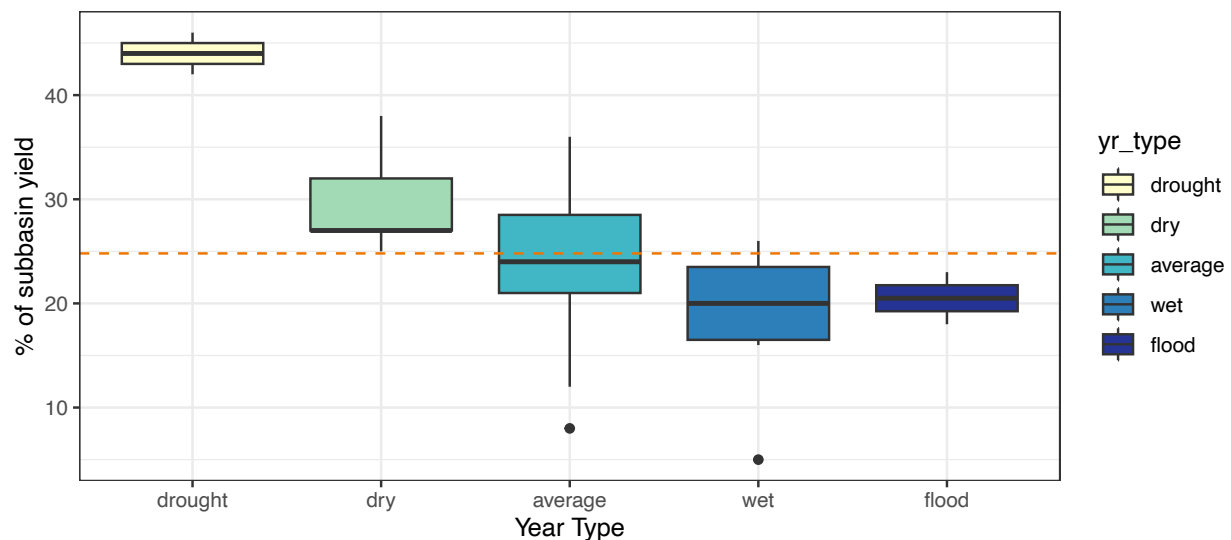
Orange dashed line is mean yield for 30-yr POR.

Percent of annual basin yield diverted by TMD above location
Eagle River near Minturn



Orange dashed line is mean percent for 30-yr POR.

Percent of annual basin yield diverted by TMD, by year type
Eagle River near Minturn



Dashed orange line represents average yield to TMD across all years

Blue River

Blue River at Dillon Reservoir

While a gauge is available at the reservoir outlet works, this gauge is subject to significant lag effects from reservoir storage times. A closer approximation of short-term annual runoff patterns is approximated here using the gauges on the major tributaries to the reservoir, which include the Blue River, 10-Mile Creek, the Snake River, and Keystone Gulch. These gauges will not reflect a small percentage of upper watershed area that drains directly into the lake itself near Frisco and Dillon without flowing past these 4 gauges.

Flow record locations include:

09046600 - Blue River nr Dillon

09047700 - Keystone Gulch nr Dillon

09050100 - North 10mile Cr at Frisco

09047500 - Snake River nr Montezuma (abv Keystone Village) [SEASONAL]

09047500_ext - Snake River nr Montezuma (extended record)

ROBTUNCO - ROBERTS TUNNEL AT EAST PORTAL NEAR GRANT (8000653)

HSPTUNCO - HOOSIER PASS TUNNEL AT MONTGOMERY RESERVOIR

VIDTUNCO - VIDLER TUNNEL NEAR ARGENTINE PASS

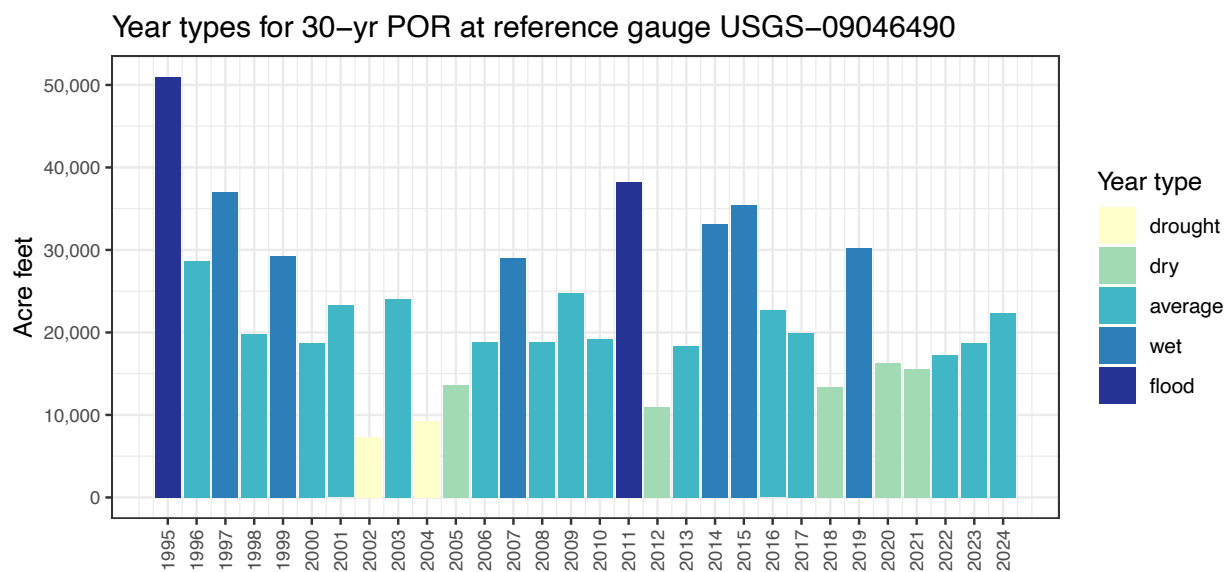
Flow balance relies on:

(ROBTUNCO + HSPTUNCO + VIDTUNCO + BORDITCO) /

(ROBTUNCO + HSPTUNCO + VIDTUNCO + BORDITCO + 09046600 + 09047700 + 09050100 + 09047500_ext)

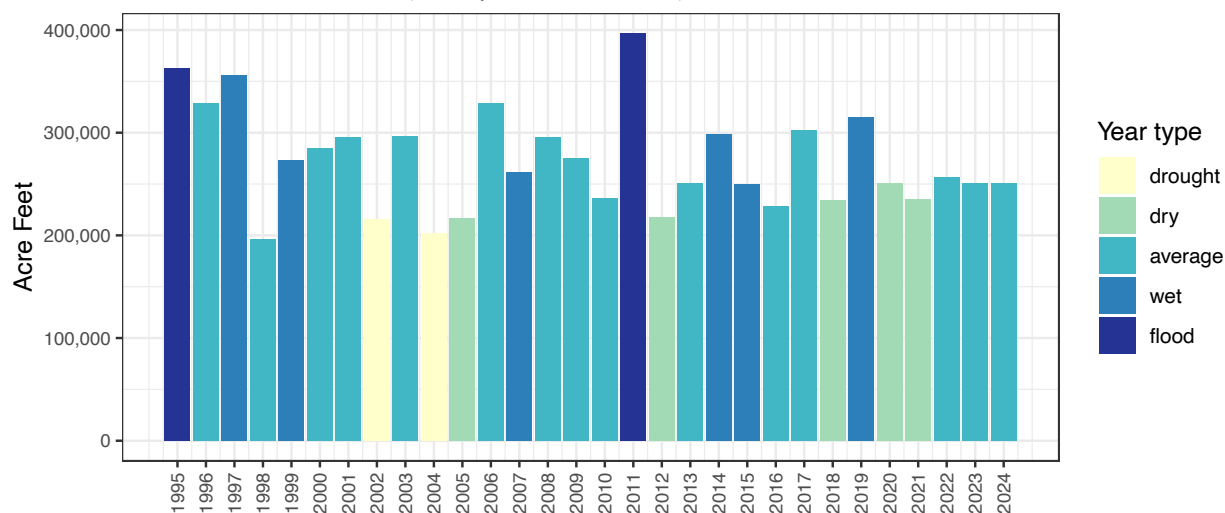
yr_type	mean_yr_type	basin
drought	55	Blue River at Dillon Dam (all major reservoir tribs.)
dry	41.8	Blue River at Dillon Dam (all major reservoir tribs.)
average	29.9	Blue River at Dillon Dam (all major reservoir tribs.)
wet	14.3	Blue River at Dillon Dam (all major reservoir tribs.)
flood	18.5	Blue River at Dillon Dam (all major reservoir tribs.)
all years	29.7	Blue River at Dillon Dam (all major reservoir tribs.)

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	drought	55	66	68	60	40	49	56	58	53	69	54	53
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	dry	24	25	40	27	18	30	53	60	59	48	45	25
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	average	35	35	34	24	13	17	34	45	46	42	39	36
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	wet	23	30	19	20	3	4	17	14	37	32	25	19
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	flood	34	32	36	63	29	6	2	21	32	44	46	44



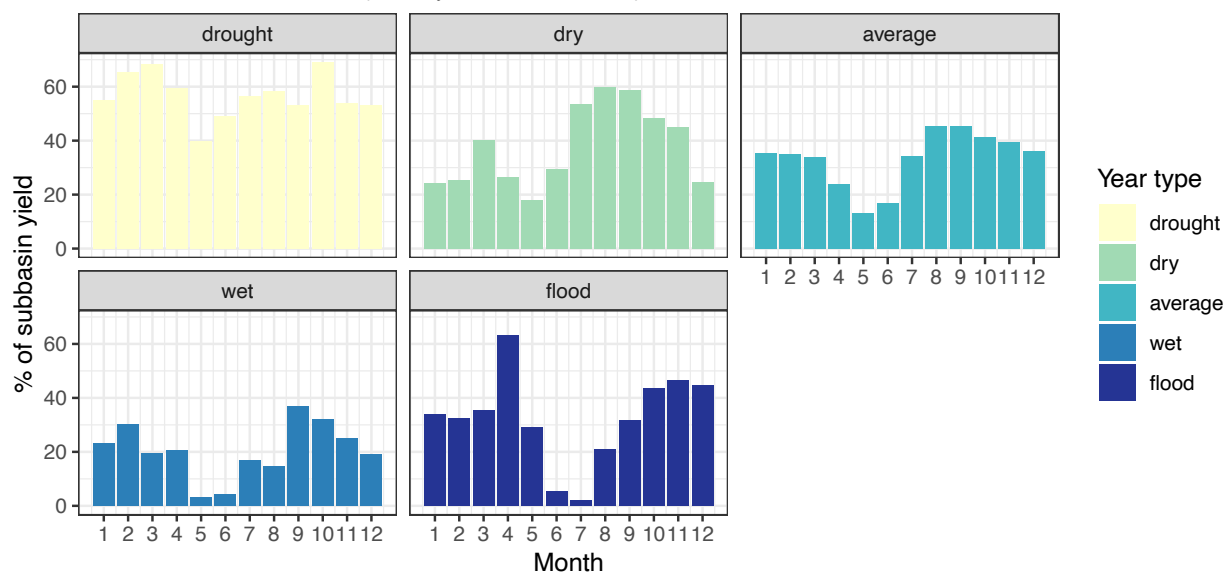
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Blue River at Dillon Dam (all major reservoir tribs.)



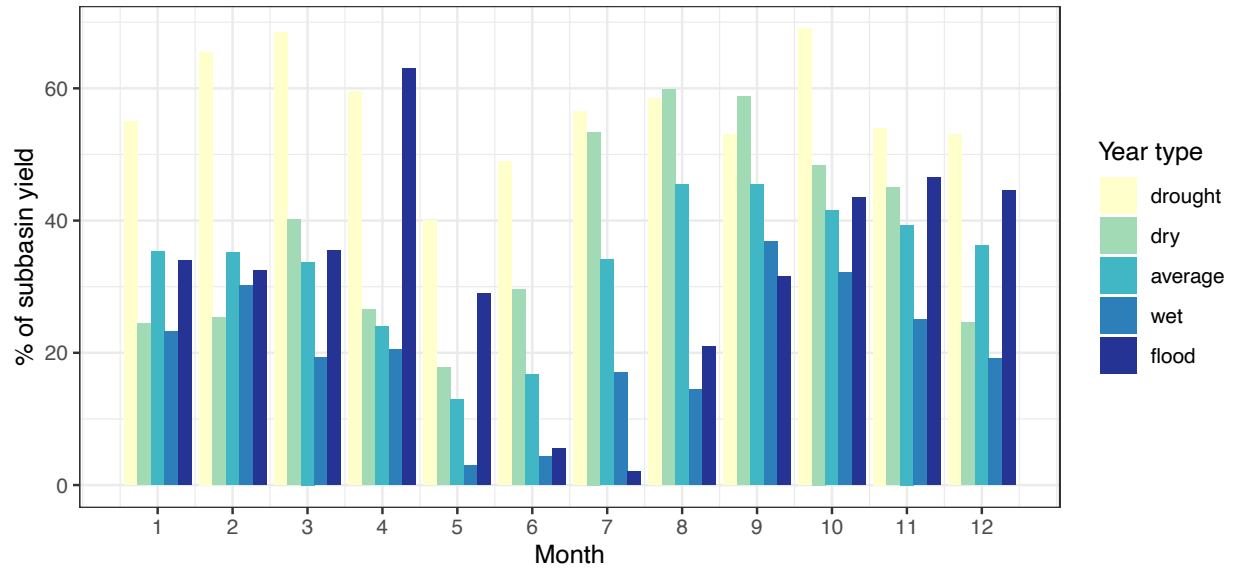
Year types based on annual yield at basin reference gauge USGS-09046490

Percent of watershed yield diverted via TMD by month
Blue River at Dillon Dam (all major reservoir tribs.)



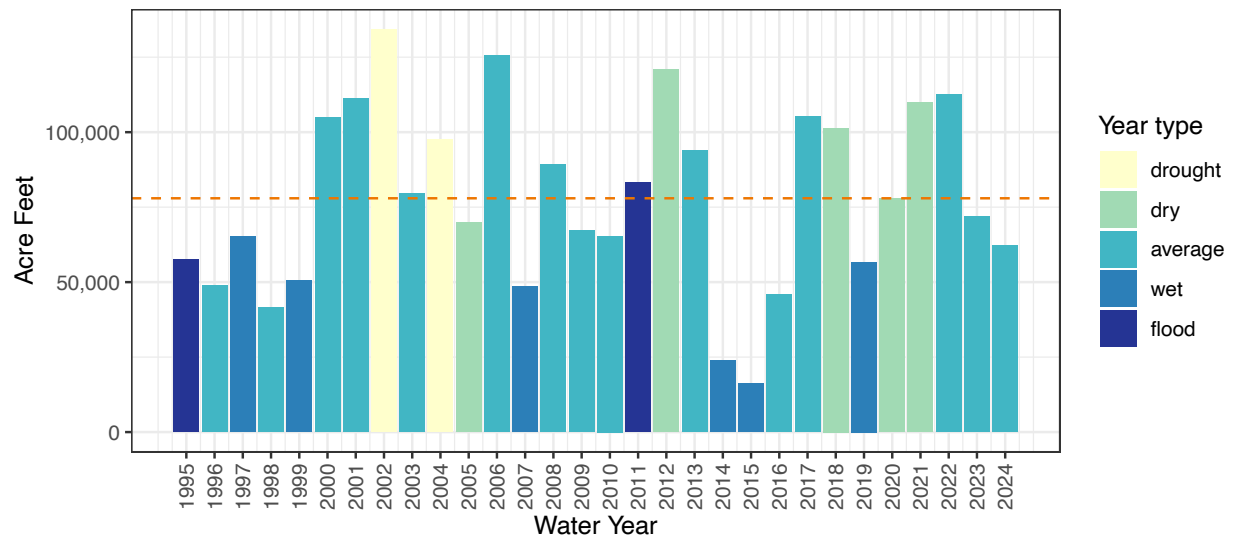
Percent of watershed yield diverted via TMD

Blue River at Dillon Dam (all major reservoir tribs.)



Annual TMD Yield, BLUE basin

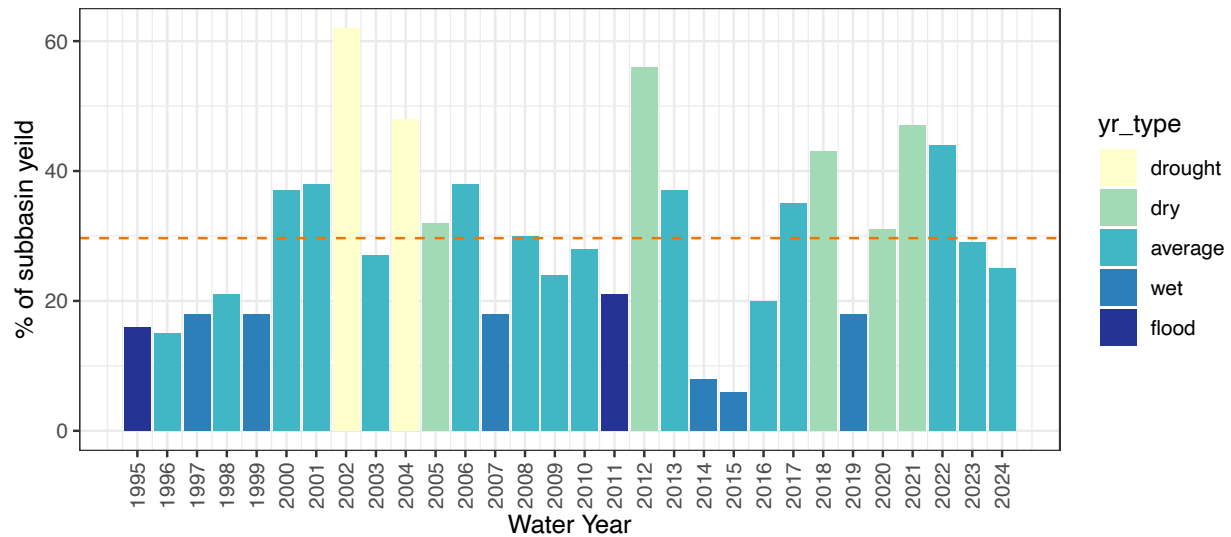
Blue River at Dillon Dam (all major reservoir tribs.)



Orange dashed line is mean yield for 30-yr POR.

Percent of annual basin yield diverted by TMD above location

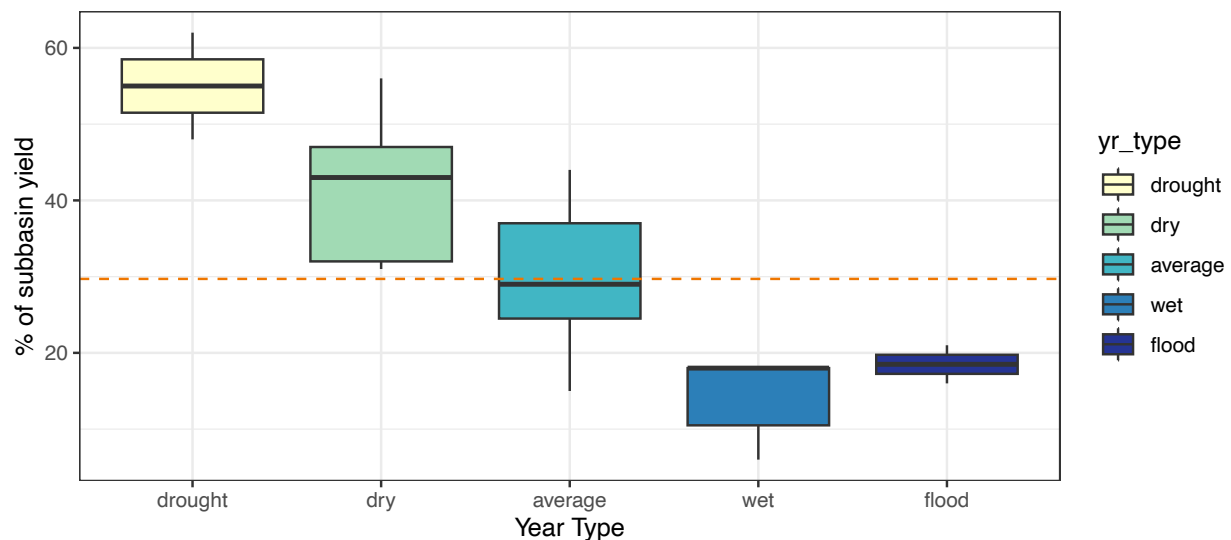
Blue River at Dillon Dam (all major reservoir tribs.)



Orange dashed line is mean percent for 30-yr POR.

Percent of annual basin yield diverted by TMD, by year type

Blue River at Dillon Dam (all major reservoir tribs.)



Dashed orange line represents average yield to TMD across all years

Blue River Headwaters

This balance reflects the mainstem of the upper subwatershed at community of Blue River, below Hoosier Pass Diversion System and abv Town of Breckenridge. It reflects upper Blue headwaters impacts of the HSP system only, no Roberts Tunnel or other major tributaries influence this segment.

Flow record locations include:

09046490 - USGS Blue River at Blue River

HSPTUNCO - Hoosier Pass Tunnel (North Portal)

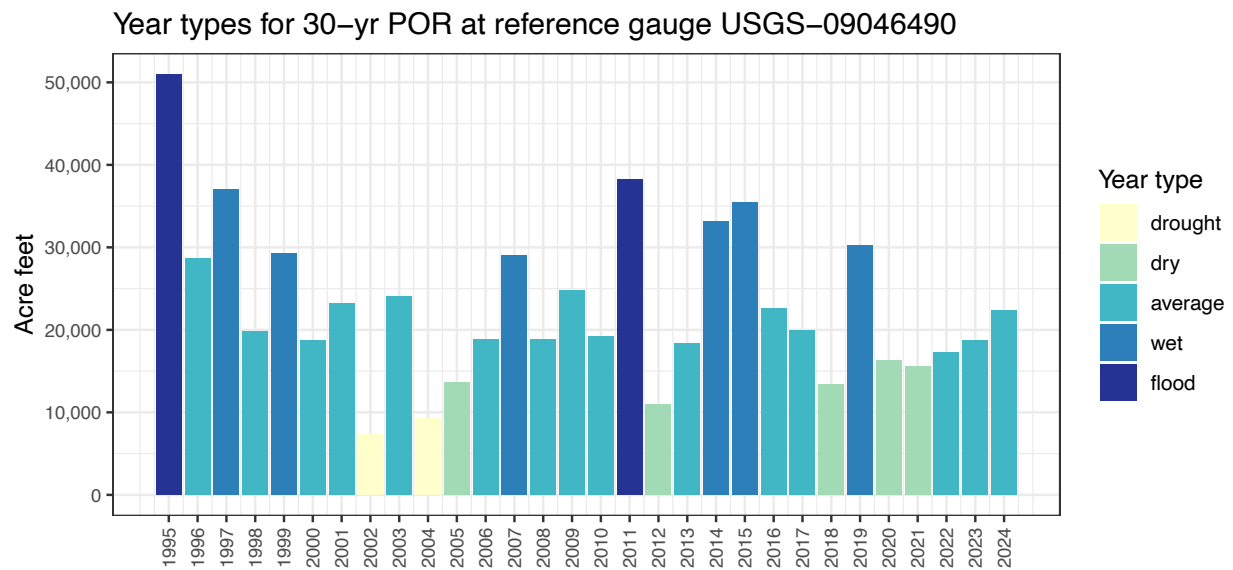
BORDITCO - Boreas Pass Ditch (very minor outflow)

Flow balance relies on:

(HSPTUNCO + BORDITCO) / (09046490 + HSPTUNCO + BORDITCO)

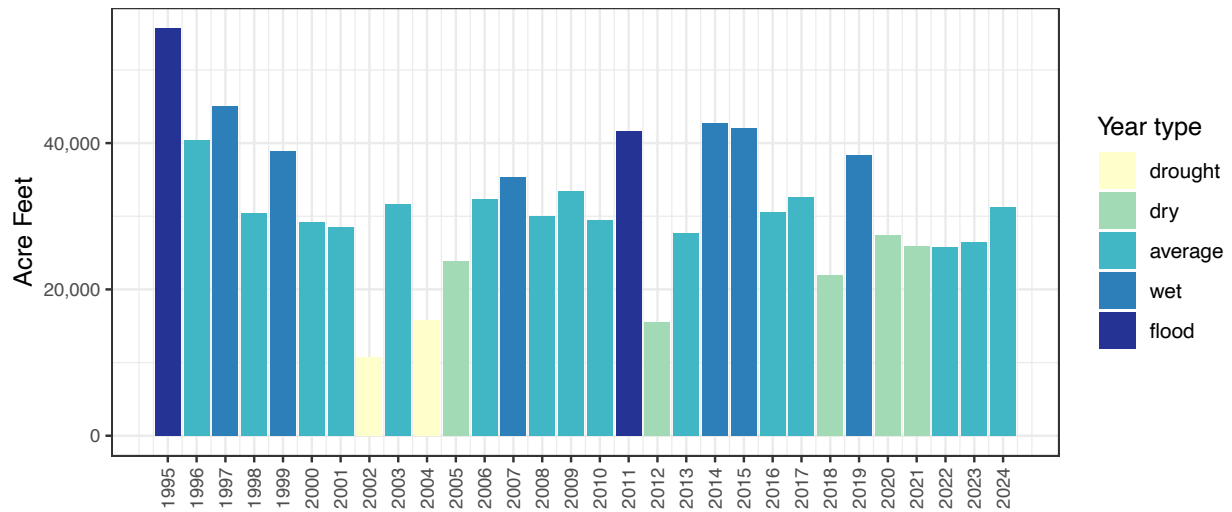
yr_type	mean_yr_type	basin
drought	36.5	Blue River at Blue River
dry	38.4	Blue River at Blue River
average	31.4	Blue River at Blue River
wet	20	Blue River at Blue River
flood	8	Blue River at Blue River
all years	29.1	Blue River at Blue River

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Blue	Blue River at Blue River	drought	0	0	0	14	54	70	20	2	2	52	7	0
Blue	Blue River at Blue River	dry	0	0	0	12	40	55	38	13	15	49	25	0
Blue	Blue River at Blue River	average	0	0	0	11	31	38	35	27	22	34	14	0
Blue	Blue River at Blue River	wet	0	0	0	9	23	20	18	24	22	32	7	0
Blue	Blue River at Blue River	flood	0	0	0	0	8	10	1	5	6	52	26	0



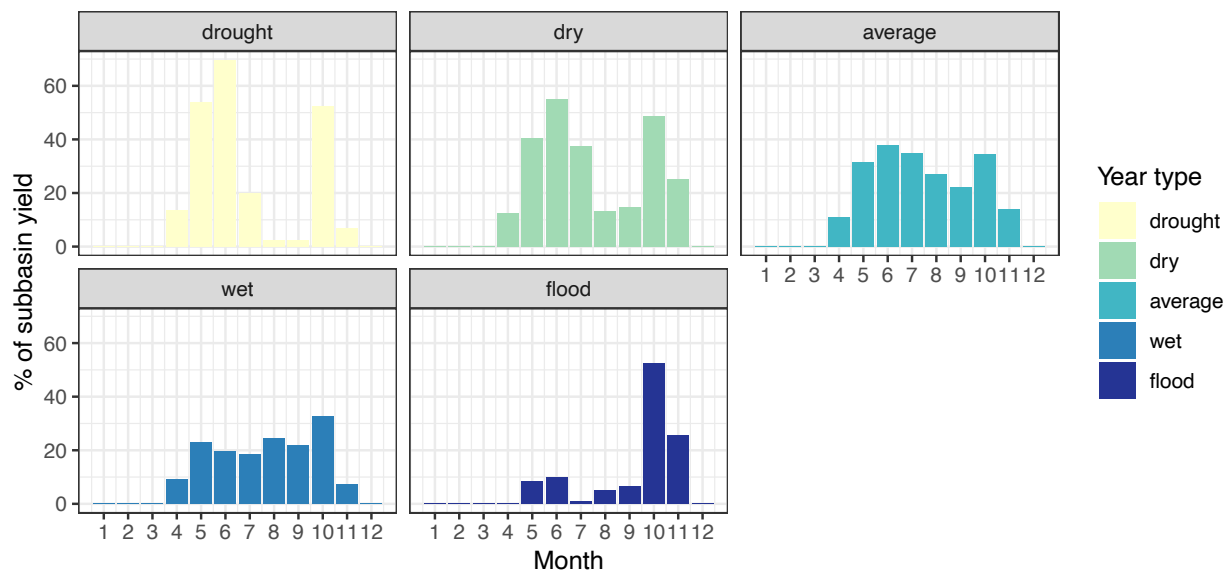
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Blue River at Blue River



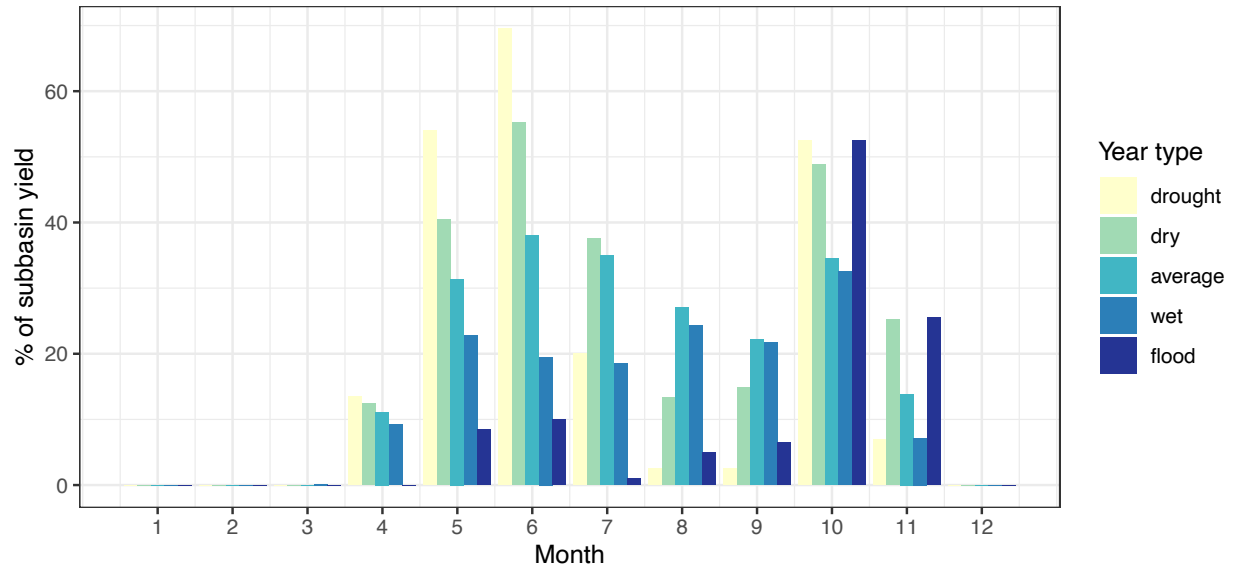
Year types based on annual yield at basin reference gauge USGS-09046490

Percent of watershed yield diverted via TMD by month
Blue River at Blue River



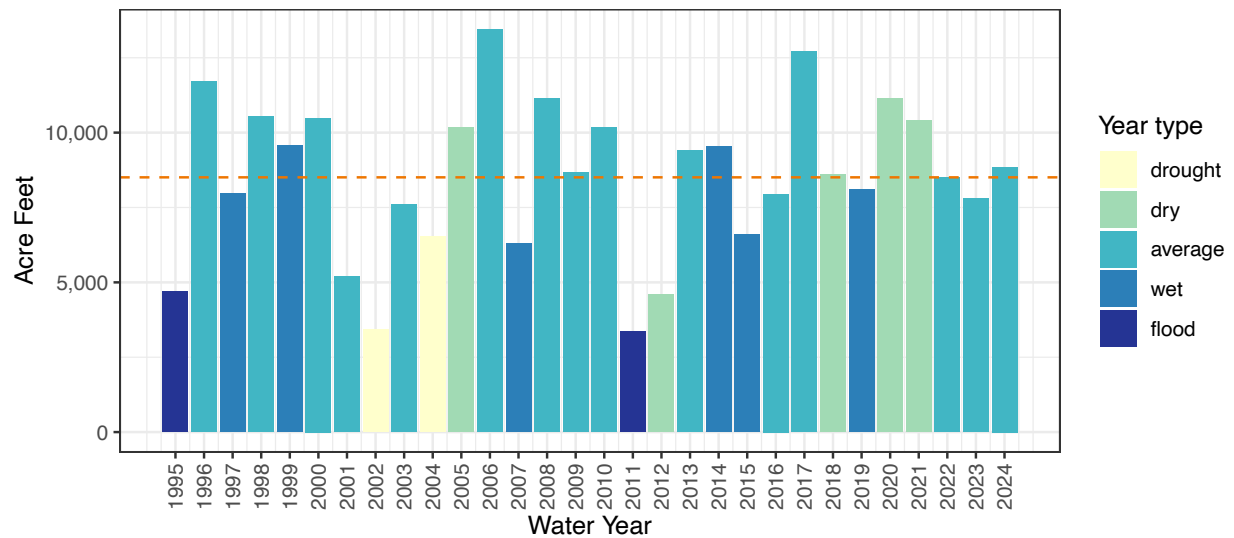
Percent of watershed yield diverted via TMD

Blue River at Blue River



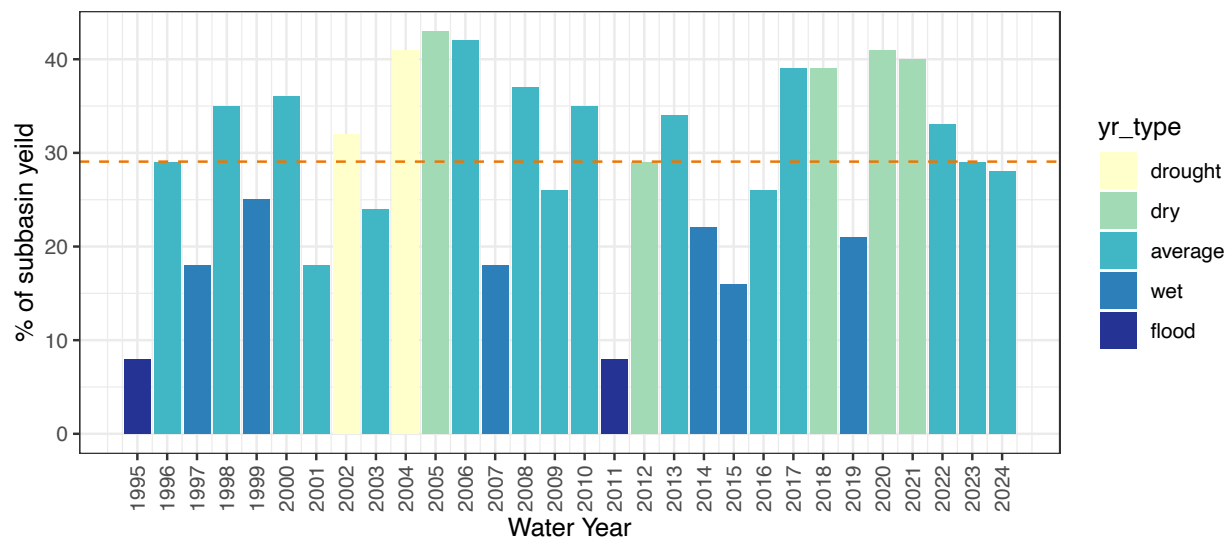
Annual TMD Yield, BLUE basin

Blue River at Blue River



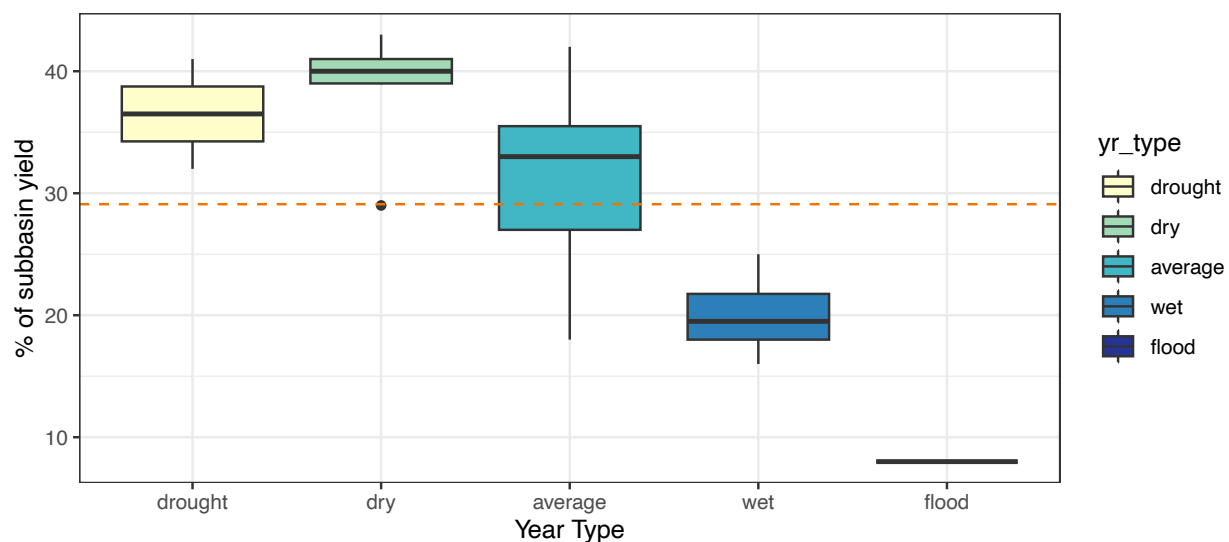
Orange dashed line is mean yield for 30-yr POR.

Percent of annual basin yield diverted by TMD above location
Blue River at Blue River



Orange dashed line is mean percent for 30-yr POR.

Percent of annual basin yield diverted by TMD, by year type
Blue River at Blue River



Dashed orange line represents average yield to TMD across all years

Straight Creek subwatershed

Straight Creek provides water supply to the Dillon / Silverthorne Area. Denver Water has a decree for a conduit to divert water into Dillon Reservoir that has not been built as of 2025. Adolf Coors Company has a right to the water from the Straight Creek Tunnel, which is essentially meltwater in the I70 bore through Eisenhower Tunnel that is collected to the Clear Creek side of the divide and treated before running down Clear Creek to be used in Golden.

Flow record locations include:

09051050 - USGS STRAIGHT CREEK BLW LASKEY GULCH NR DILLON CO

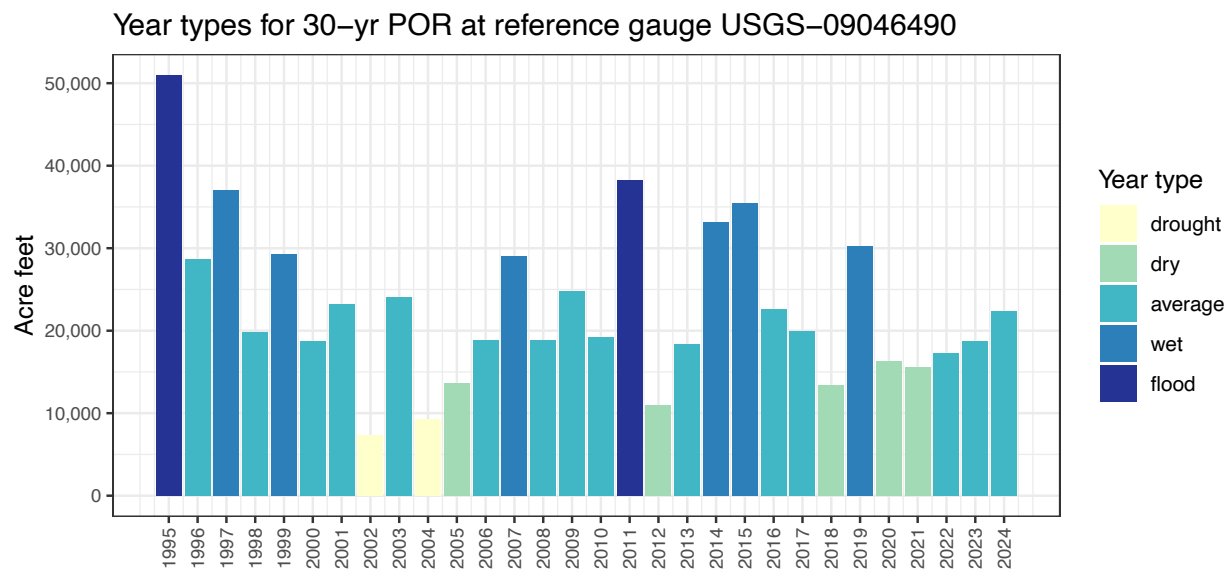
STCTUNCO - STRAIGHT CR. TUNNEL AT EAST PORTAL OF EISENHOWER

Flow balance relies on:

(STCTUNCO)/ (STCTUNCO + 09051050)

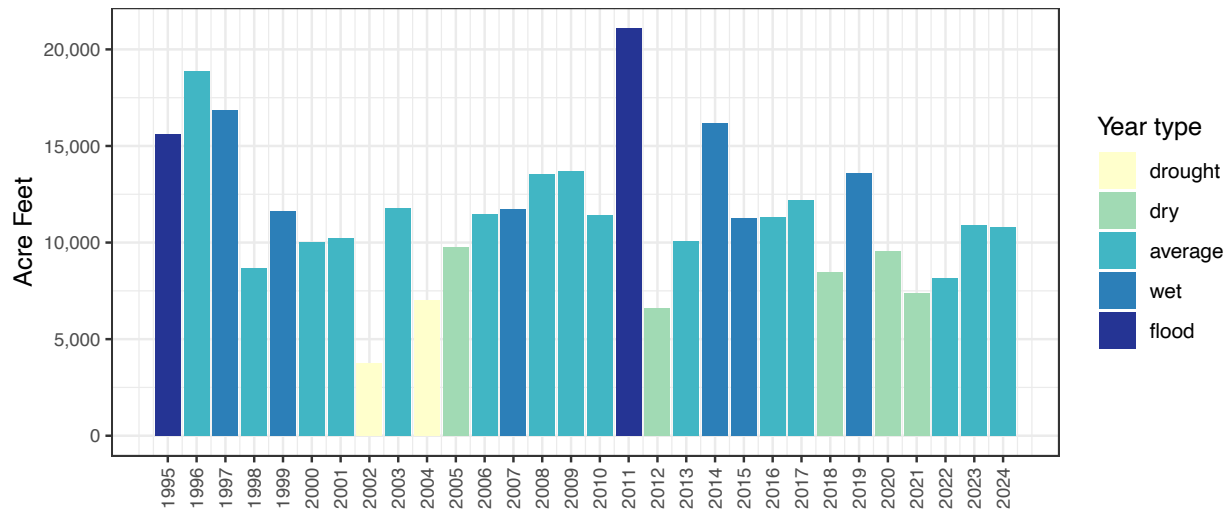
yr_type	mean_yr_type	basin
drought	5.5	Straight Creek nr Dillon (Laskey Gulch)
dry	2.6	Straight Creek nr Dillon (Laskey Gulch)
average	2.5	Straight Creek nr Dillon (Laskey Gulch)
wet	2.3	Straight Creek nr Dillon (Laskey Gulch)
flood	2	Straight Creek nr Dillon (Laskey Gulch)
all years	2.6	Straight Creek nr Dillon (Laskey Gulch)

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Blue	Straight Creek nr Dillon (Laskey Gulch)	drought	8	8	8	5	3	4	7	6	6	4	5	7
Blue	Straight Creek nr Dillon (Laskey Gulch)	dry	4	4	4	3	2	3	4	4	4	3	3	4
Blue	Straight Creek nr Dillon (Laskey Gulch)	average	5	5	5	3	1	2	4	4	4	4	4	4
Blue	Straight Creek nr Dillon (Laskey Gulch)	wet	4	5	5	3	2	2	3	3	4	3	3	4
Blue	Straight Creek nr Dillon (Laskey Gulch)	flood	4	2	4	4	2	0	2	4	5	4	3	4



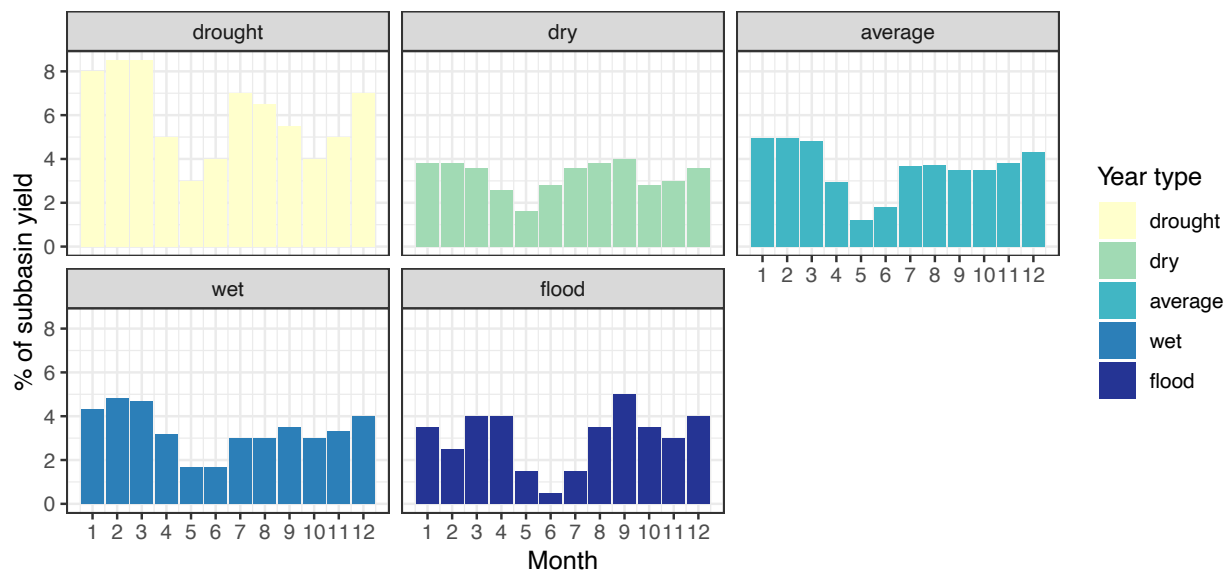
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s) Straight Creek nr Dillon (Laskey Gulch)



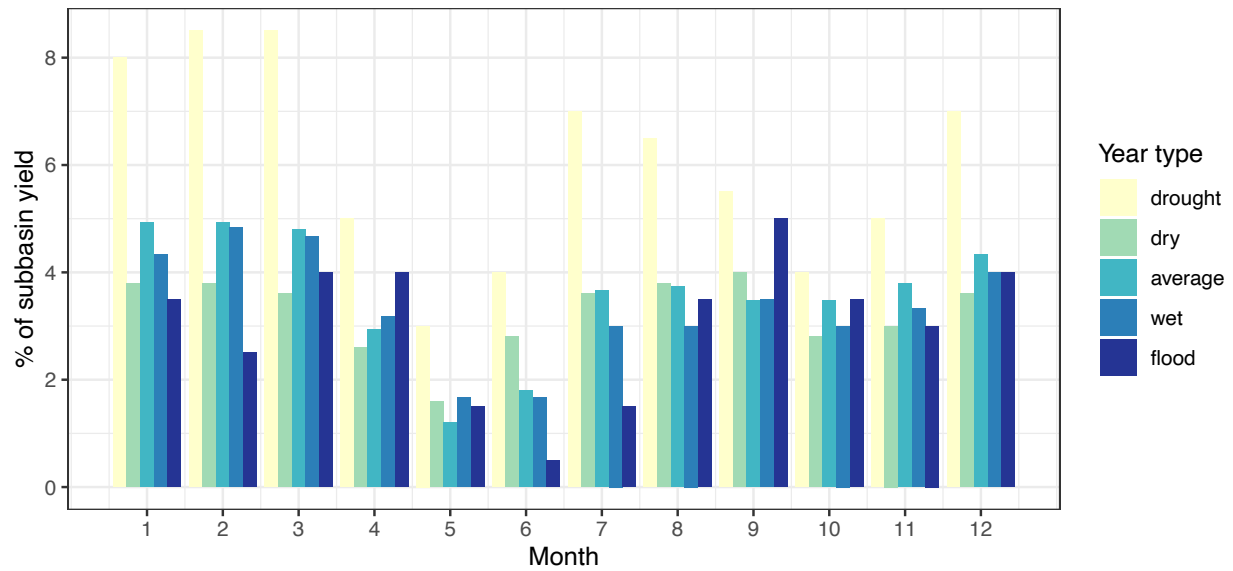
Year types based on annual yield at basin reference gauge USGS-09046490

Percent of watershed yield diverted via TMD by month Straight Creek nr Dillon (Laskey Gulch)



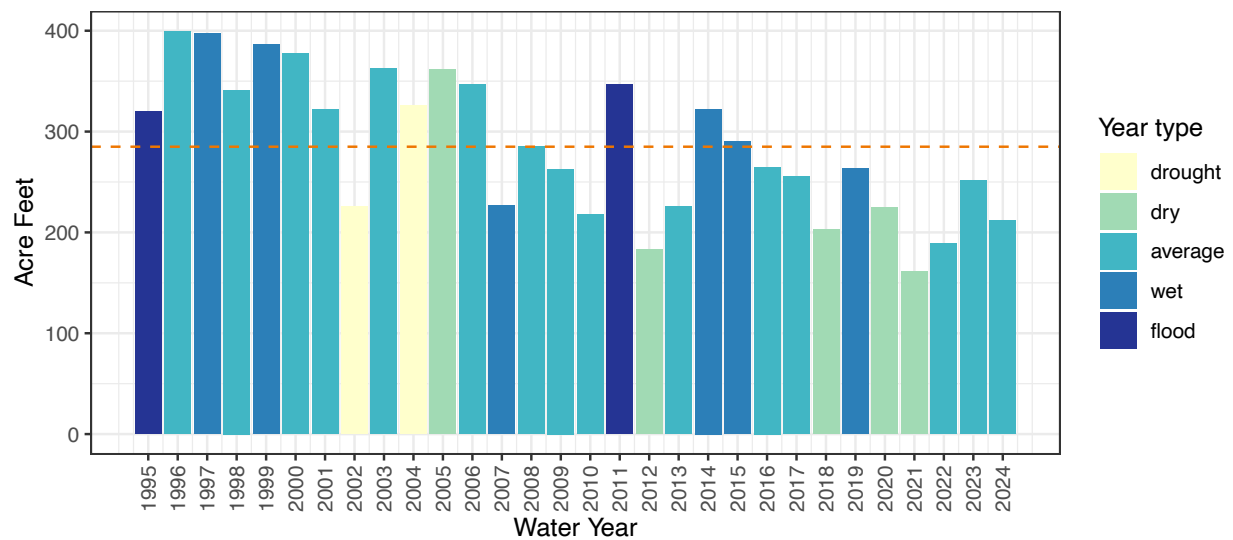
Percent of watershed yield diverted via TMD

Straight Creek nr Dillon (Laskey Gulch)



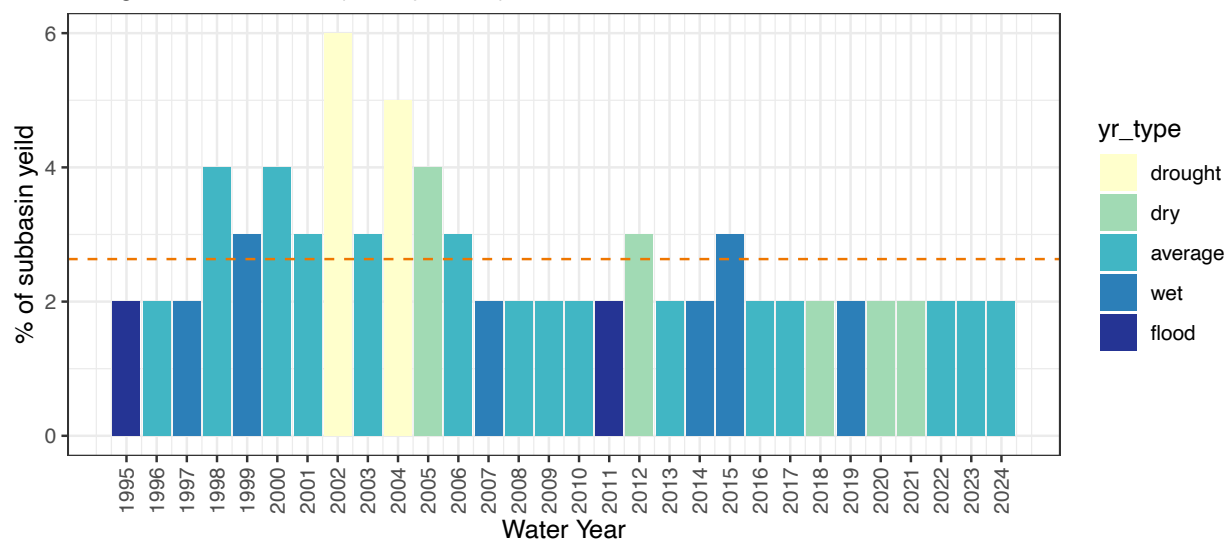
Annual TMD Yield, BLUE basin

Straight Creek nr Dillon (Laskey Gulch)



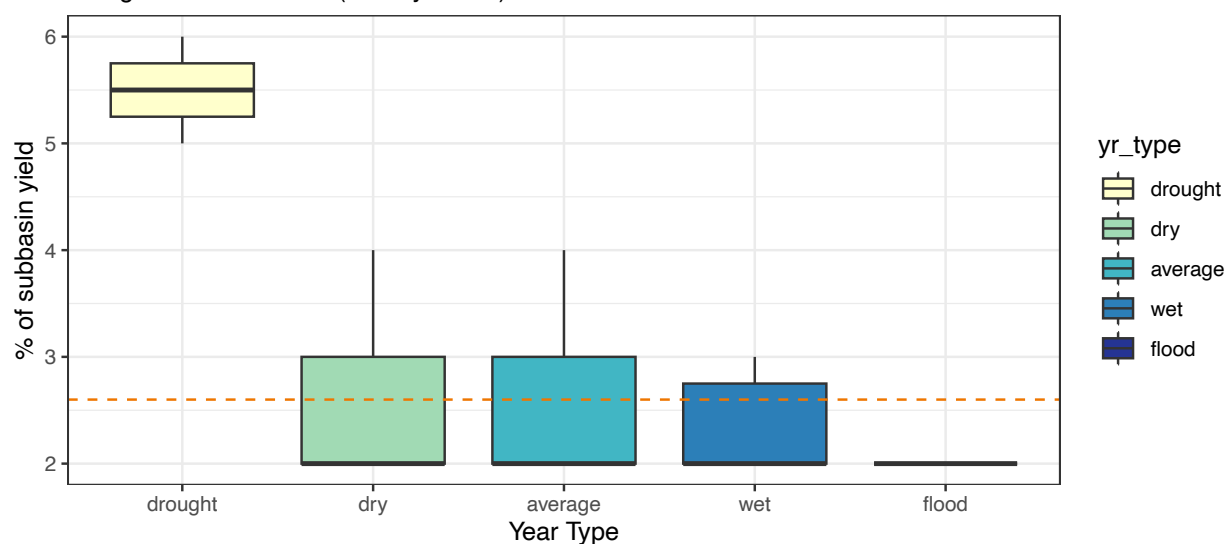
Orange dashed line is mean yield for 30-yr POR.

Percent of annual basin yield diverted by TMD above location
Straight Creek nr Dillon (Laskey Gulch)



Orange dashed line is mean percent for 30-yr POR.

Percent of annual basin yield diverted by TMD, by year type
Straight Creek nr Dillon (Laskey Gulch)



Dashed orange line represents average yield to TMD across all years

Roaring Fork Basin

Roaring Fork River abv Aspen

Flow record locations include:

09073300 - USGS Roaring Fork River abv Difficult Creek

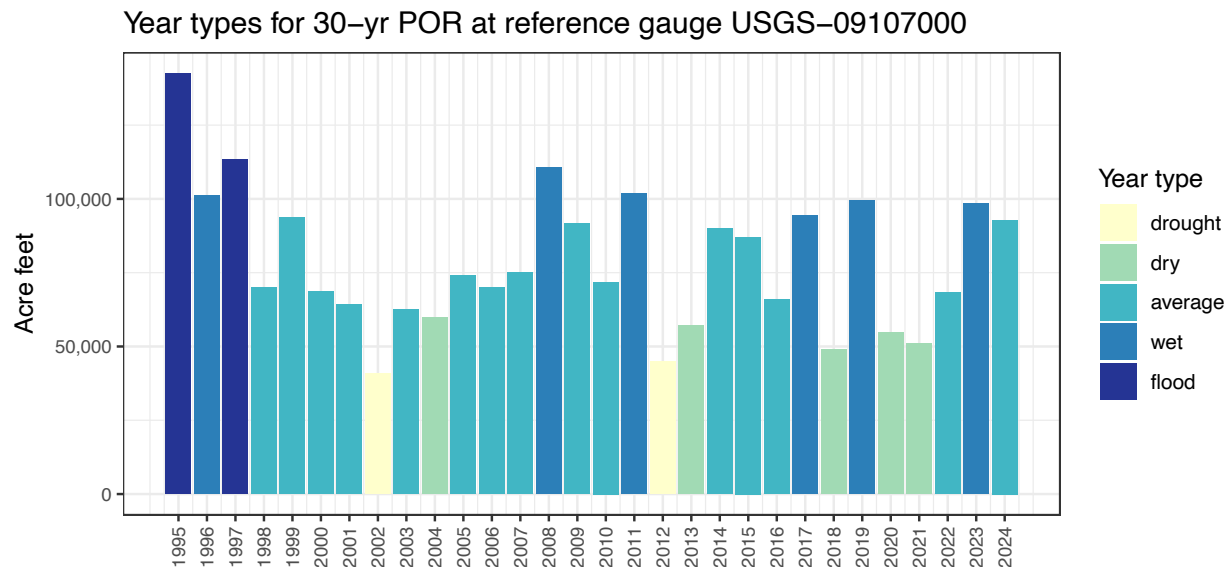
TWITUNCO - Twin Tunnels / Independence Pass Delivery System outflow

Flow balance relies on:

(TWITUNCO) / (TWITUNCO + 09073300)

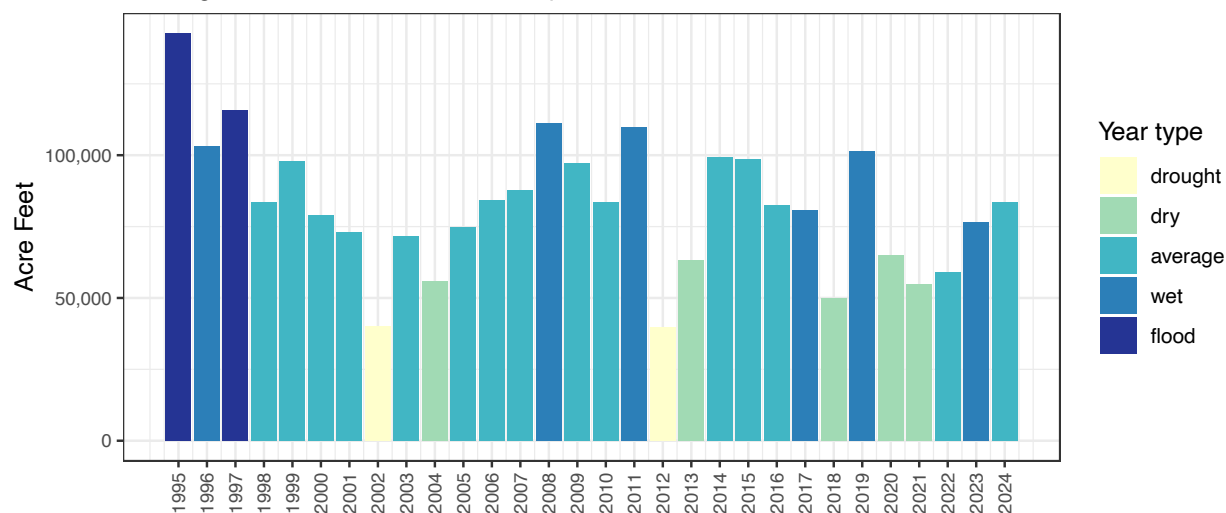
yr_type	mean_yr_type	basin
drought	55	Roaring Fork abv Difficult Creek nr Aspen
dry	60.2	Roaring Fork abv Difficult Creek nr Aspen
average	53.5	Roaring Fork abv Difficult Creek nr Aspen
wet	47	Roaring Fork abv Difficult Creek nr Aspen
flood	26.5	Roaring Fork abv Difficult Creek nr Aspen
all years	51.6	Roaring Fork abv Difficult Creek nr Aspen

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	drought	22	24	24	46	73	73	32	2	8	33	39	34
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	dry	33	30	30	28	69	74	44	18	16	23	40	34
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	average	29	26	23	26	61	59	57	44	28	39	43	35
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	wet	38	34	32	26	54	51	47	24	18	44	47	42
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	flood	2	2	2	4	42	30	20	36	39	12	12	7



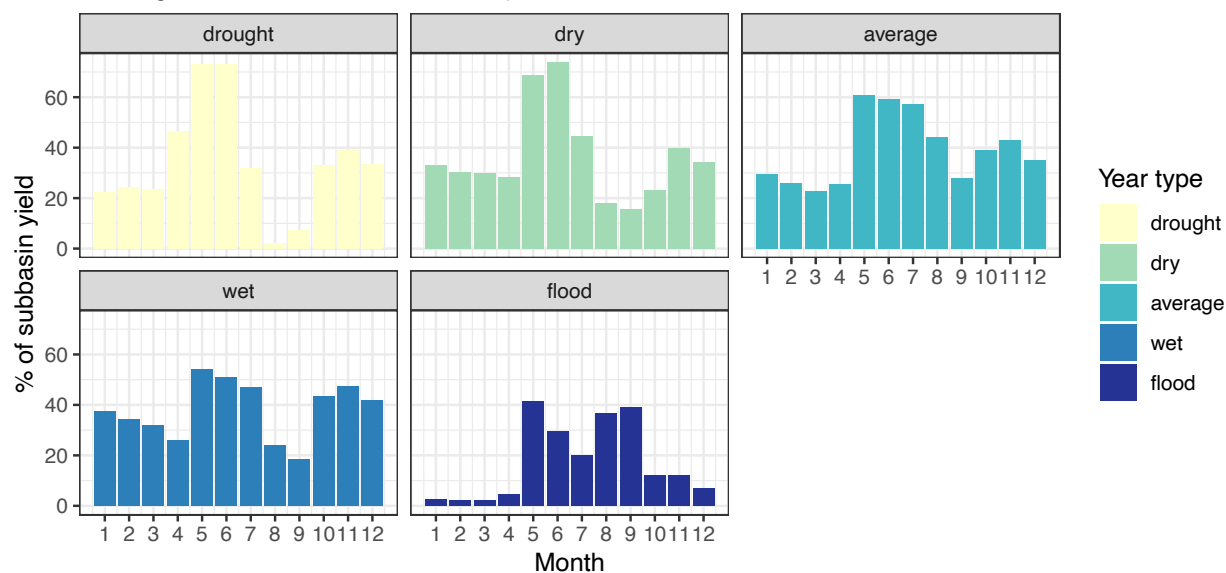
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Roaring Fork abv Difficult Creek nr Aspen



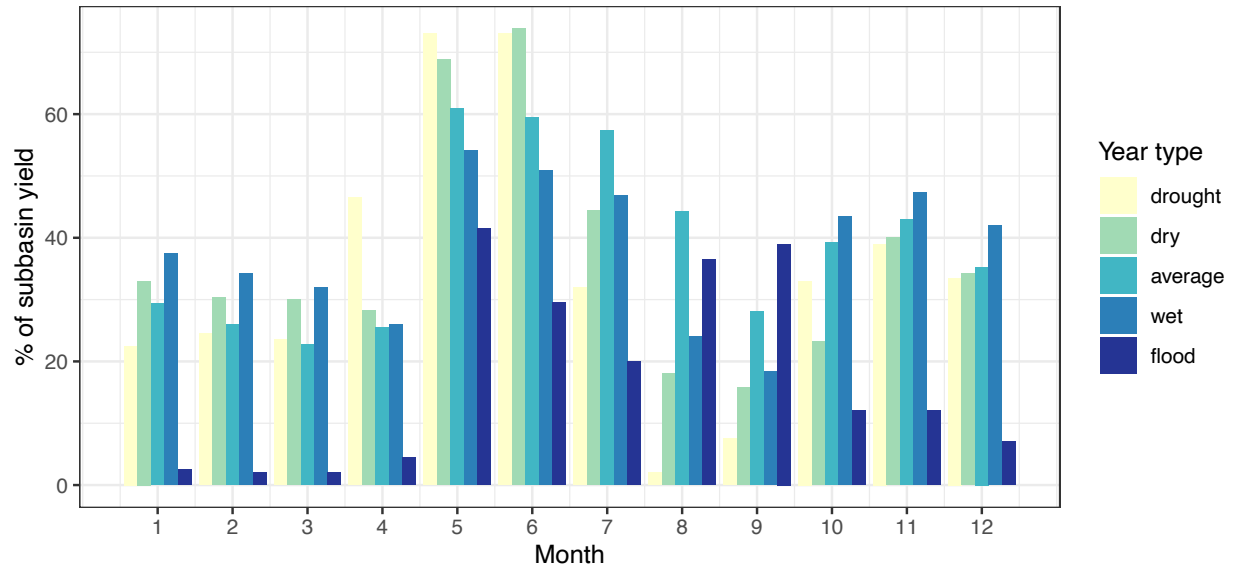
Year types based on annual yield at basin reference gauge USGS-09107000

Percent of watershed yield diverted via TMD by month
Roaring Fork abv Difficult Creek nr Aspen



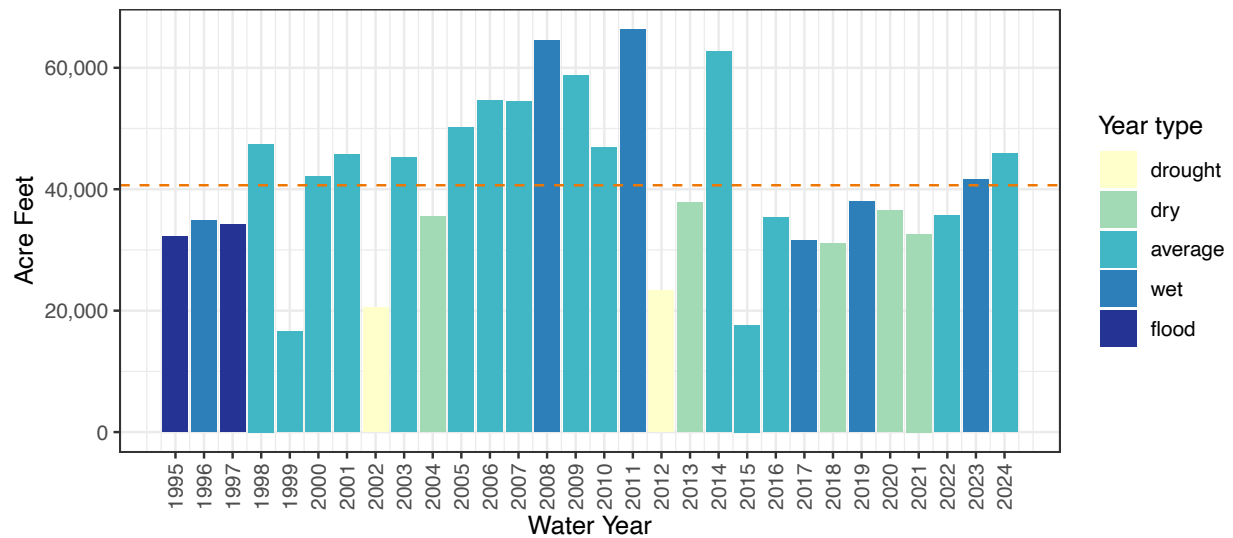
Percent of watershed yield diverted via TMD

Roaring Fork abv Difficult Creek nr Aspen

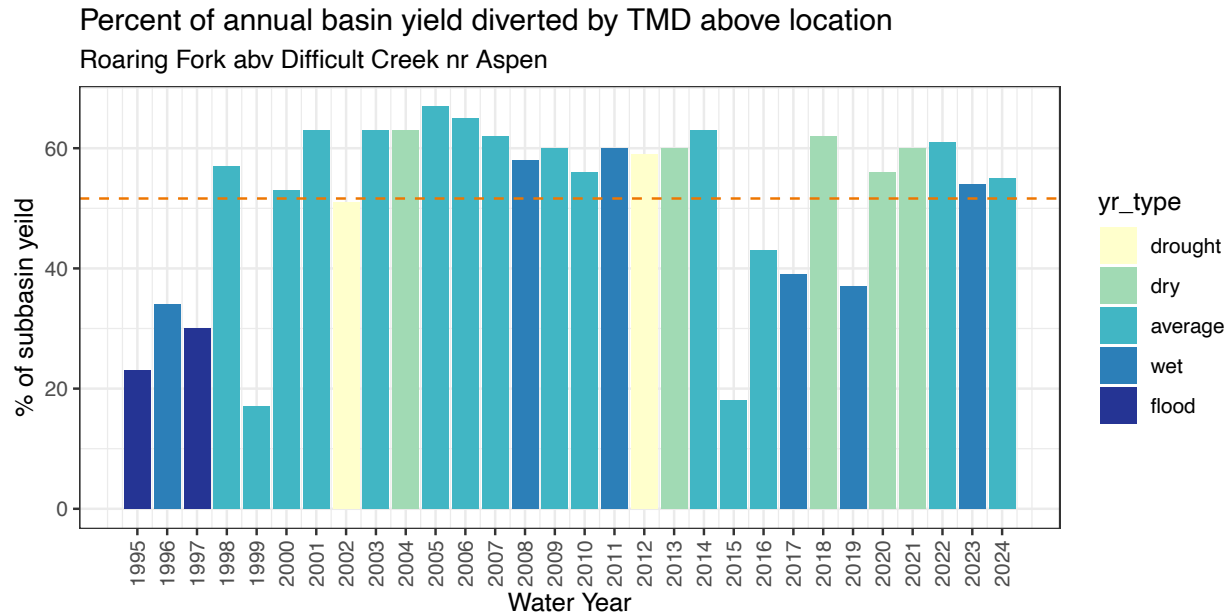


Annual TMD Yield, ROARING FORK basin

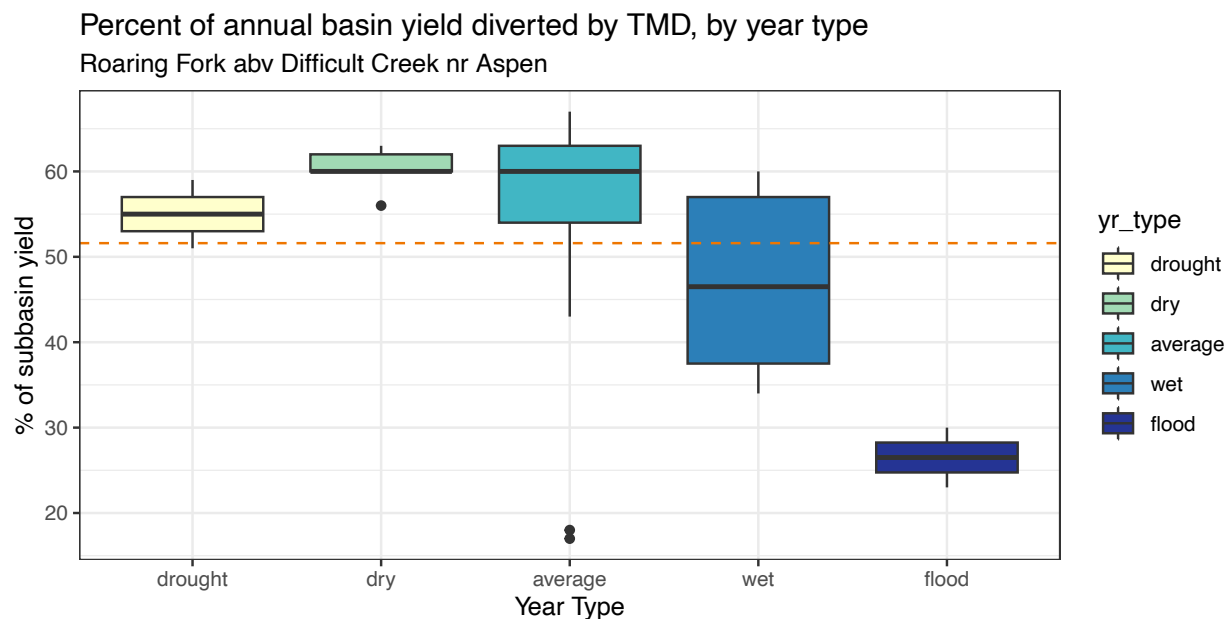
Roaring Fork abv Difficult Creek nr Aspen



Orange dashed line is mean yield for 30-yr POR.



Orange dashed line is mean percent for 30-yr POR.



Dashed orange line represents average yield to TMD across all years

Fryingpan River at Meredith (above Ruedi Reservoir)

Flow record locations include:

FRYMERCO - Fryingpan River near Meredith CO (abv Ruedi Reservoir)

BOUTUNCO - Charles Bousted Tunnel

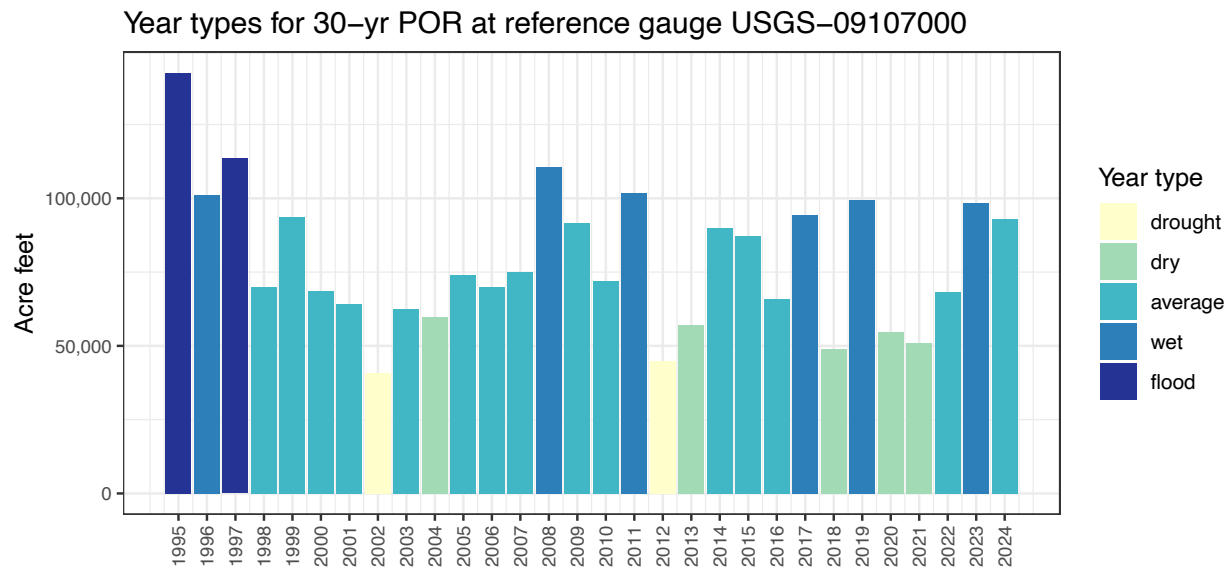
BUSTUNCO - Busk-Ivanhoe Tunnel

Flow balance relies on:

$$(BOUTUNCO + BUSTUNCO) / (FRYMERCO + BOUTUNCO + BUSTUNCO)$$

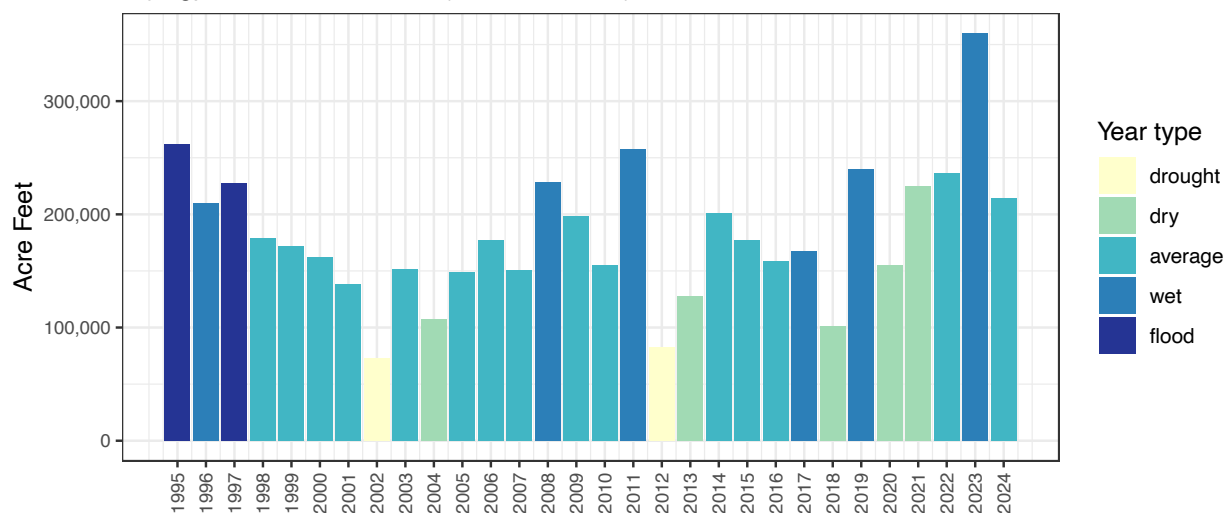
yr_type	mean_yr_type	basin
drought	22.5	Fryingpan River at Meredith (abv Ruedi Res.)
dry	33.4	Fryingpan River at Meredith (abv Ruedi Res.)
average	37.4	Fryingpan River at Meredith (abv Ruedi Res.)
wet	34.7	Fryingpan River at Meredith (abv Ruedi Res.)
flood	37	Fryingpan River at Meredith (abv Ruedi Res.)
all years	35.2	Fryingpan River at Meredith (abv Ruedi Res.)

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	drought	7	8	6	12	45	25	6	9	6	5	4	5
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	dry	5	6	5	6	53	52	16	6	5	4	5	5
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	average	7	8	6	5	40	57	36	10	5	5	5	6
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	wet	6	6	7	6	28	51	50	21	5	5	4	5
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	flood	7	7	5	2	18	48	46	37	12	4	6	6



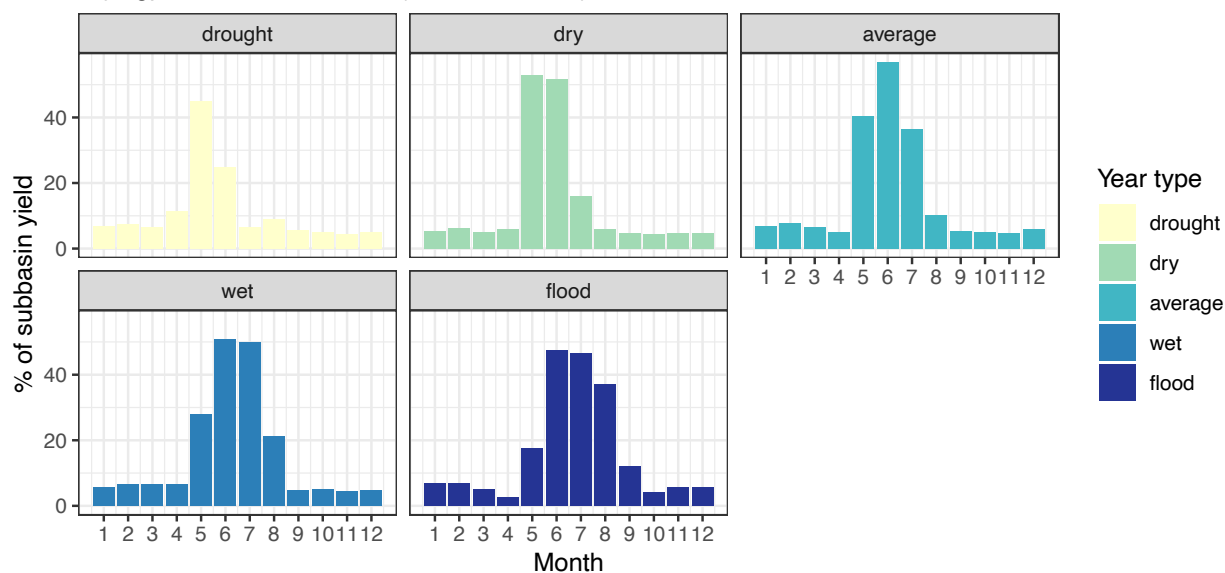
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Fryingpan River at Meredith (abv Ruedi Res.)

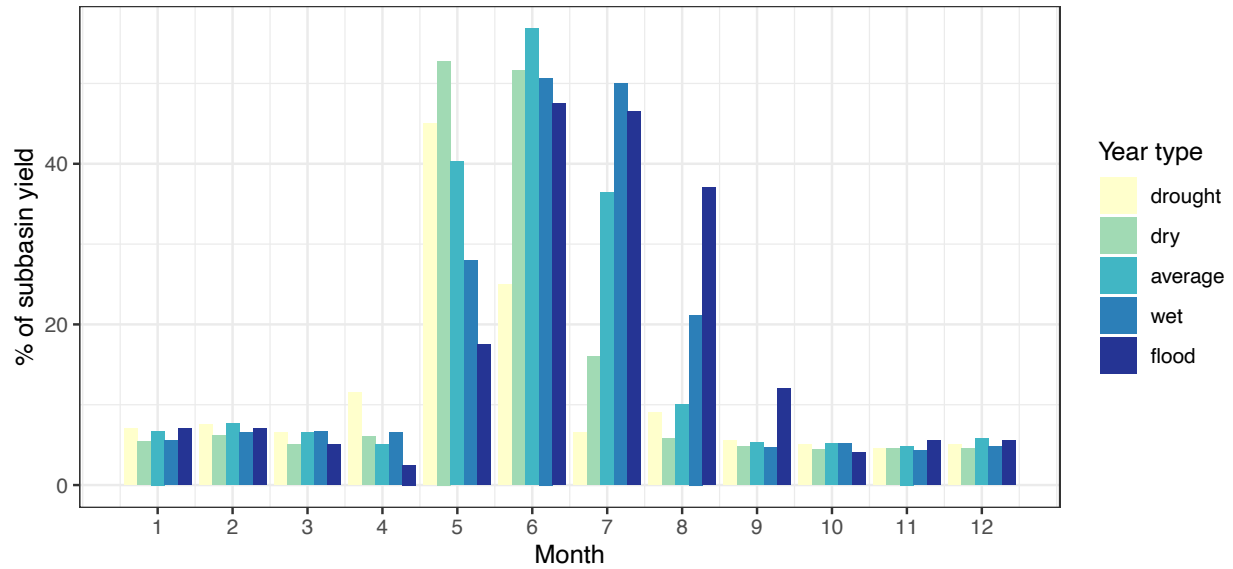


Year types based on annual yield at basin reference gauge USGS-09107000

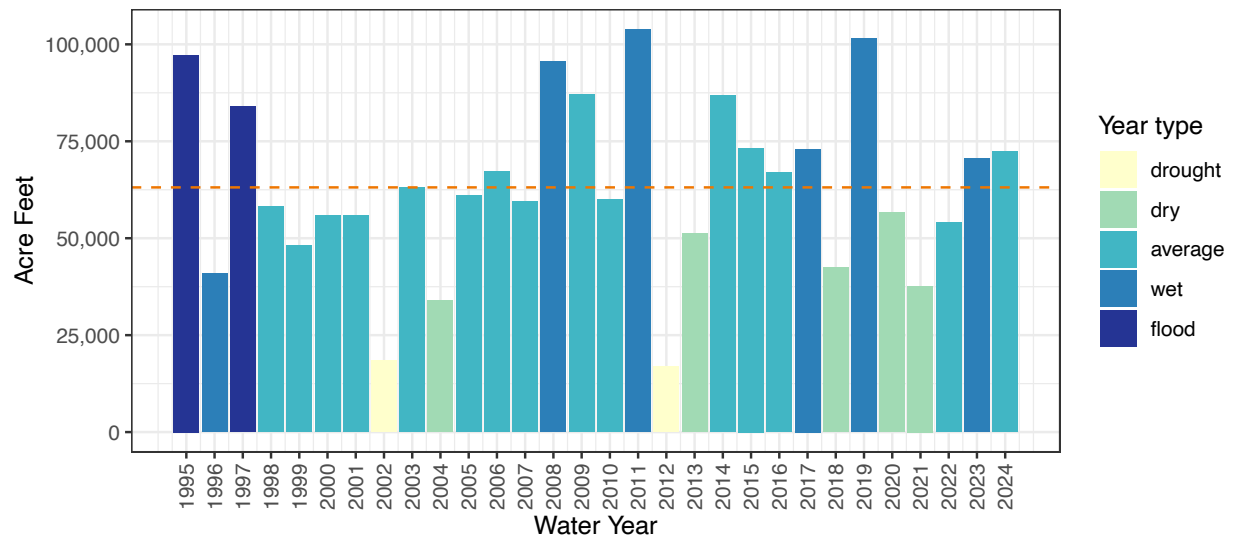
Percent of watershed yield diverted via TMD by month
Fryingpan River at Meredith (abv Ruedi Res.)



Percent of watershed yield diverted via TMD
Fryingpan River at Meredith (abv Ruedi Res.)

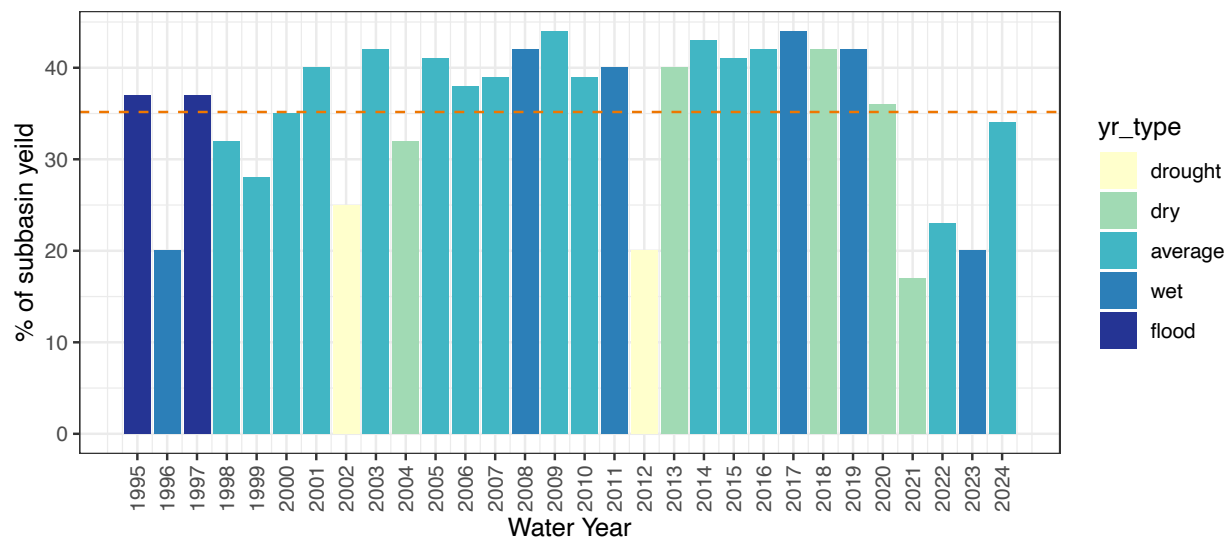


Annual TMD Yield, ROARING FORK basin
Fryingpan River at Meredith (abv Ruedi Res.)



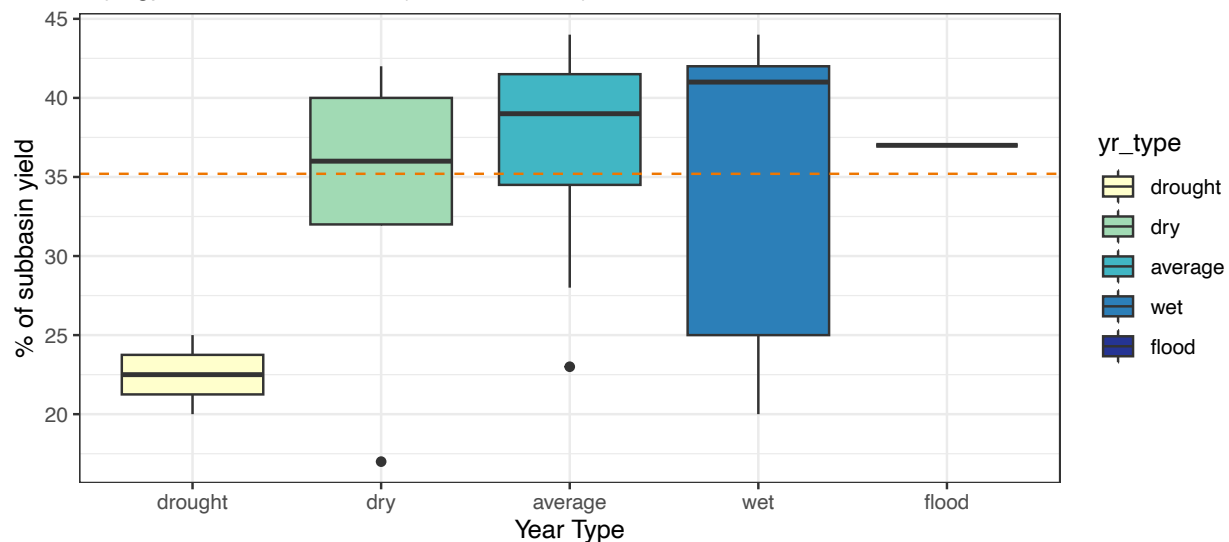
Orange dashed line is mean yield for 30-yr POR.

Percent of annual basin yield diverted by TMD above location
Fryingpan River at Meredith (abv Ruedi Res.)



Orange dashed line is mean percent for 30-yr POR.

Percent of annual basin yield diverted by TMD, by year type
Fryingpan River at Meredith (abv Ruedi Res.)



Dashed orange line represents average yield to TMD across all years

Upper Colorado Basin

Fraser River blw Crooked and Ranch Creeks (near Tabernash)

The Fraser River receives import water from the Williams Fork basin which flows through the Gumlick/Jones Pass/Vasquez tunnels into the Moffat Collection System and then into the Moffat Tunnel. Estimating how much of the native Fraser yield is diverted through the Moffat thus requires backing out Williams Fork imports in order to not overestimate how much the Moffat system yields solely from the Fraser watershed.

Flow record locations include:

09033300_ext - Fraser River below Crooked Creek (extended record)

MOFTUNCO - Moffat Tunnel

5104603 - Williams Fork Tunnel

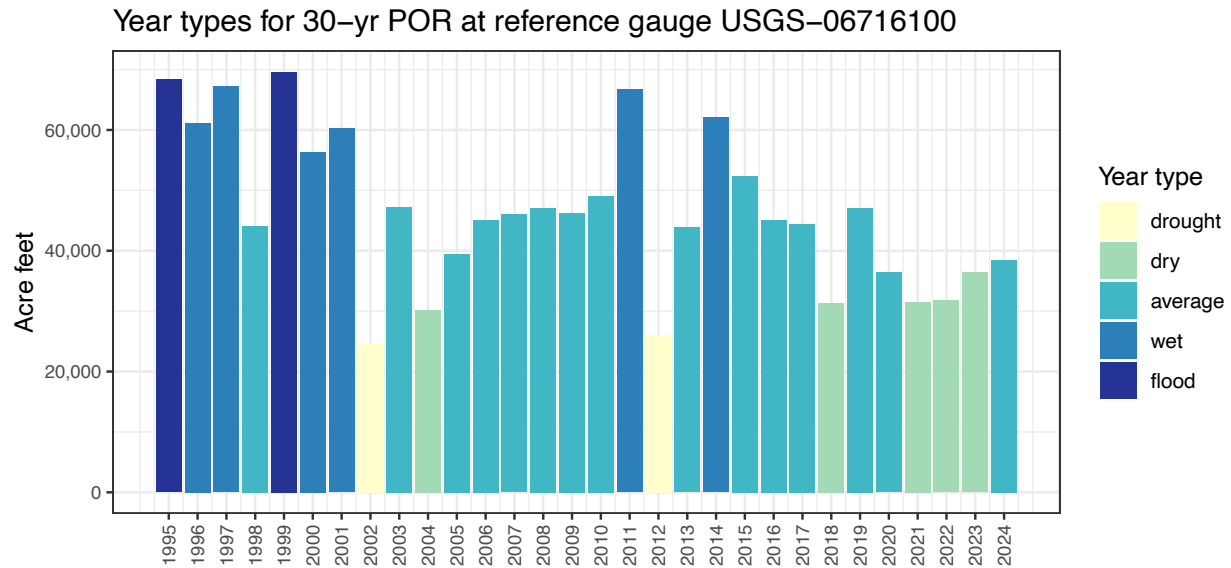
5104625 - Berthoud Canal and Reservoir Tunnel

Flow balance relies on:

$(\text{MOFTUNCO} + 5104625 - 5104603) / (09033300_ext + \text{MOFTUNCO} + 5104625 - 5104603)$

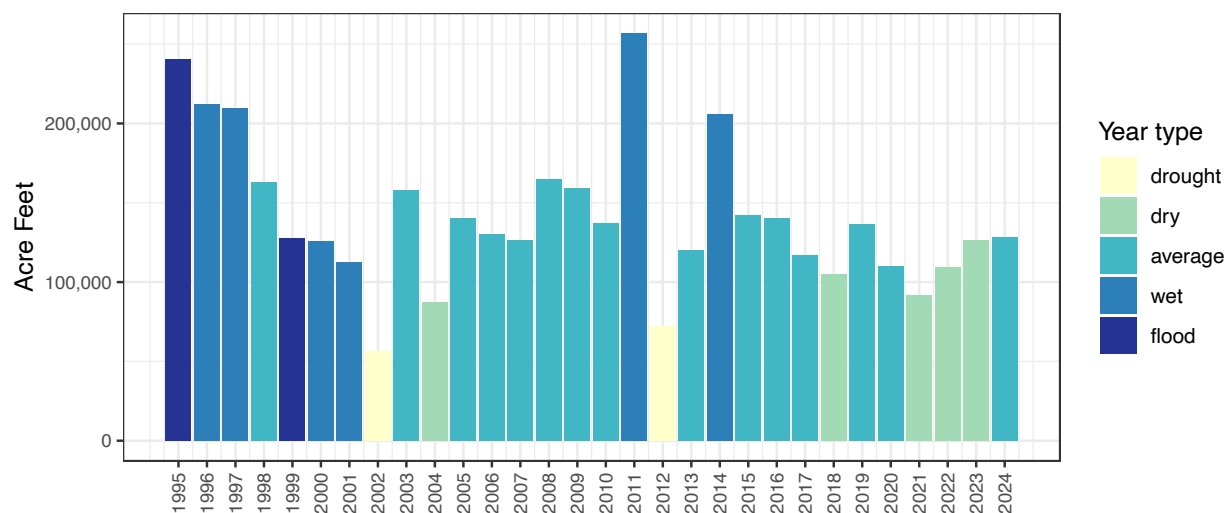
yr_type	mean_yr_type	basin
drought	48	Fraser River blw Crooked and Ranch Creeks
dry	40.6	Fraser River blw Crooked and Ranch Creeks
average	32.6	Fraser River blw Crooked and Ranch Creeks
wet	29	Fraser River blw Crooked and Ranch Creeks
flood	20	Fraser River blw Crooked and Ranch Creeks
all years	33.4	Fraser River blw Crooked and Ranch Creeks

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	drought	22	15	14	32	64	74	50	48	62	45	33	24
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	dry	18	16	13	18	47	42	59	55	46	37	26	20
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	average	22	18	16	15	33	28	47	47	46	52	36	27
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	wet	20	17	12	11	35	31	34	40	45	30	28	22
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	flood	18	14	10	8	32	12	30	32	36	46	42	26



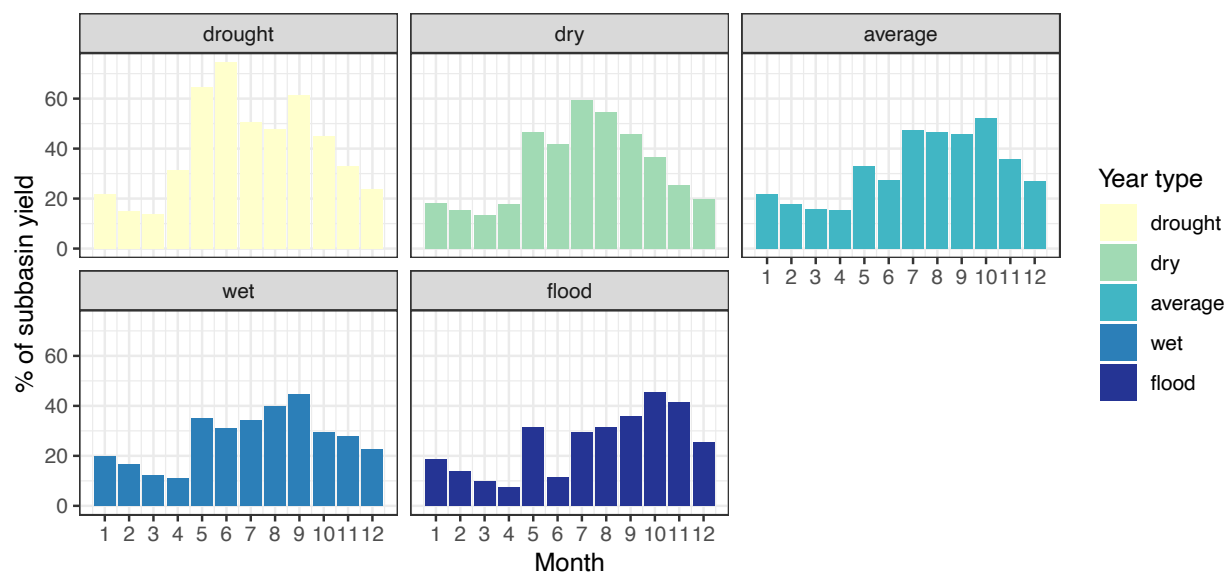
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Fraser River blw Crooked and Ranch Creeks



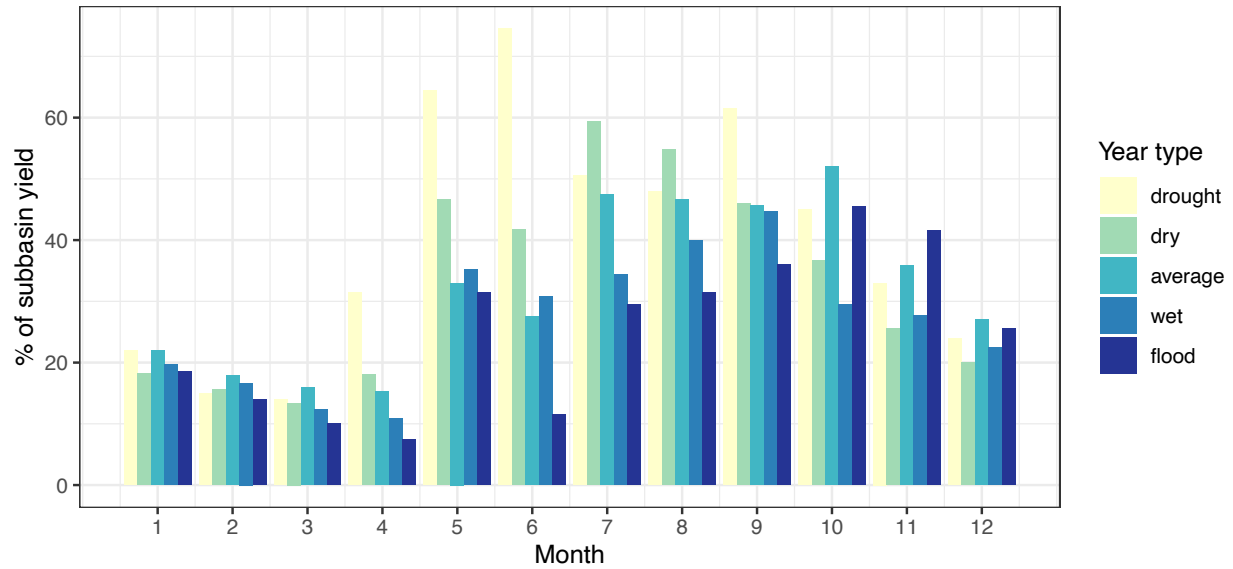
Year types based on annual yield at basin reference gauge USGS-06716100

Percent of watershed yield diverted via TMD by month
Fraser River blw Crooked and Ranch Creeks



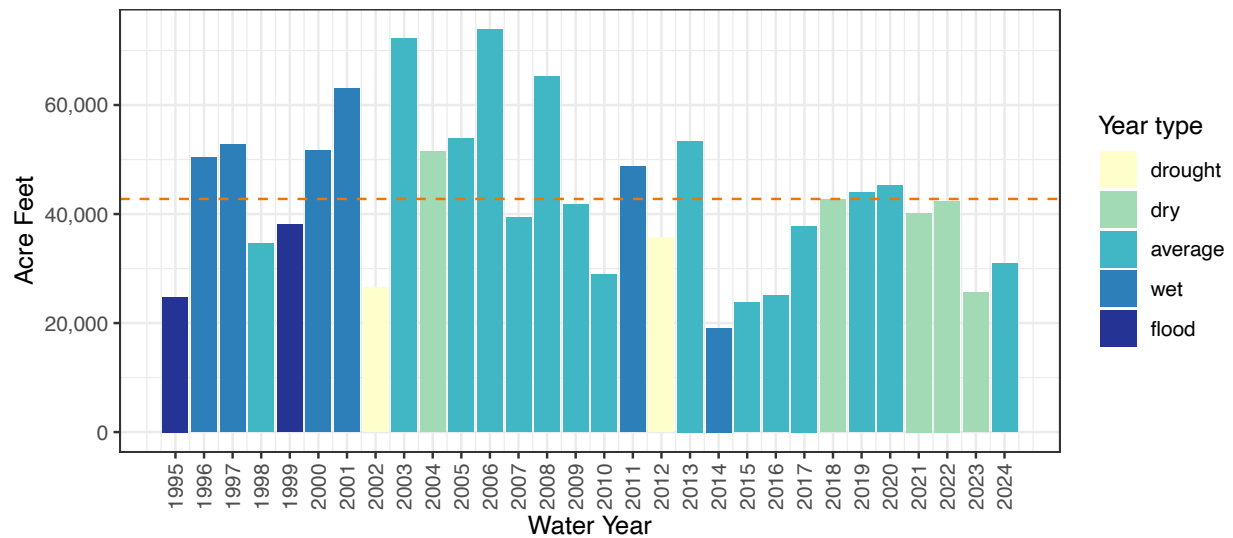
Percent of watershed yield diverted via TMD

Fraser River blw Crooked and Ranch Creeks

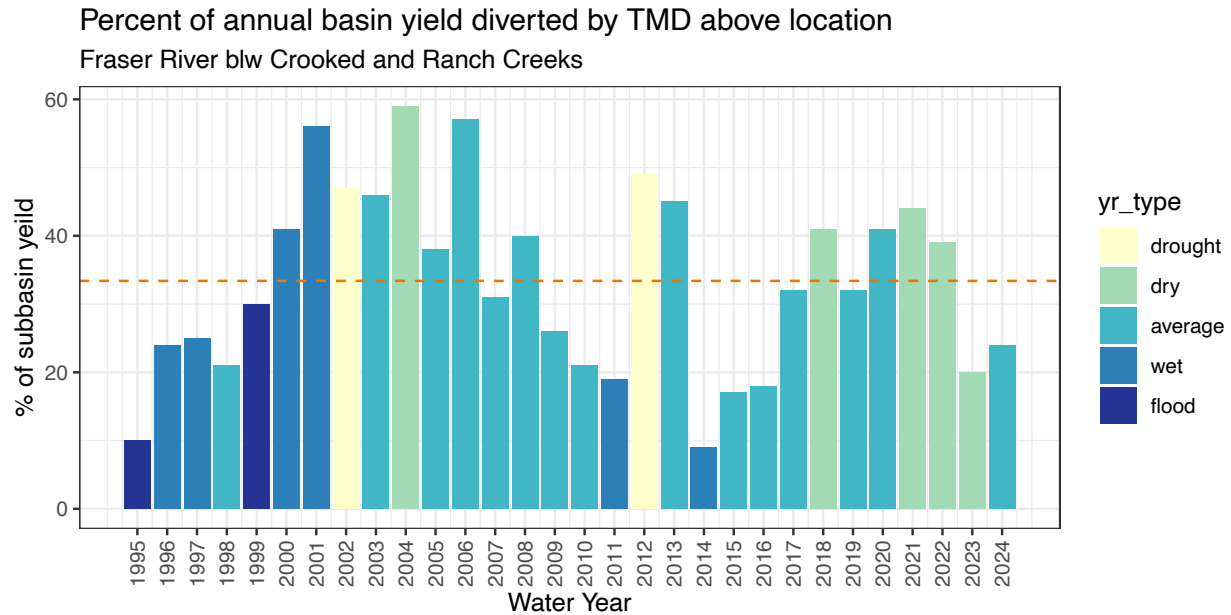


Annual TMD Yield, UPPER COLORADO basin

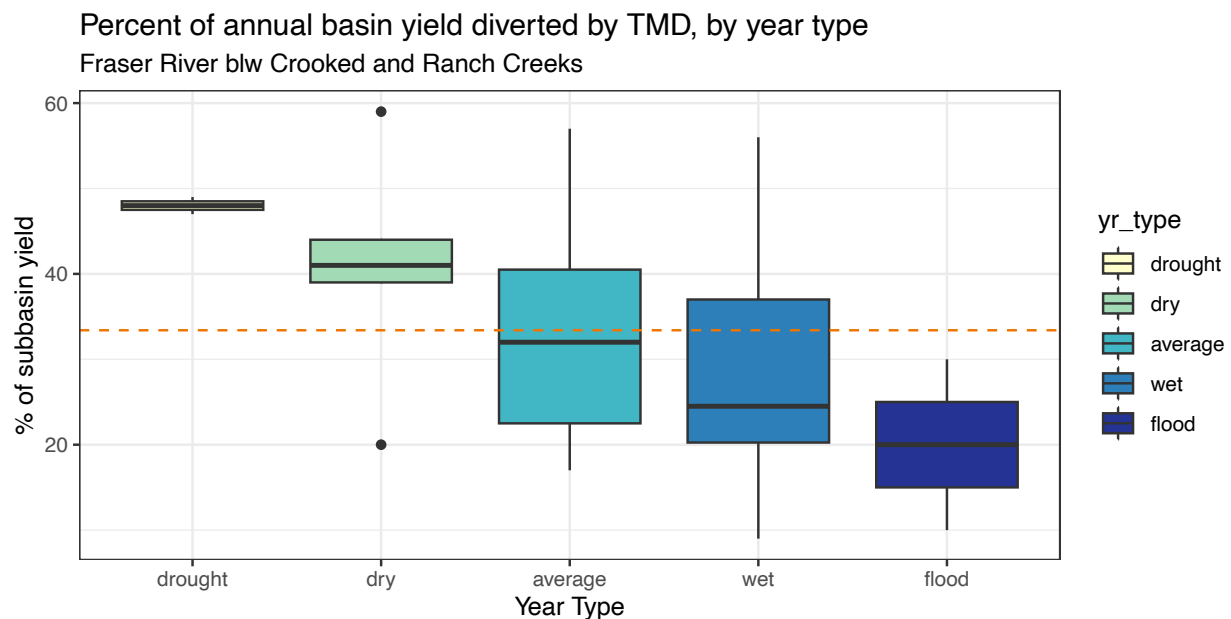
Fraser River blw Crooked and Ranch Creeks



Orange dashed line is mean yield for 30-yr POR.



Orange dashed line is mean percent for 30-yr POR.



Dashed orange line represents average yield to TMD across all years

Colorado River blw Windy Gap

Similar to Fraser basin calculations, the Williams Fork import flows are backed out of the Moffat Tunnel yield prior to calculating relative yield proportions.

Flow record locations include:

09034250 - Colorado River blw Windy Gap

ADATUNCO - Adams Tunnel

MOFTUNCO - Moffat Tunnel

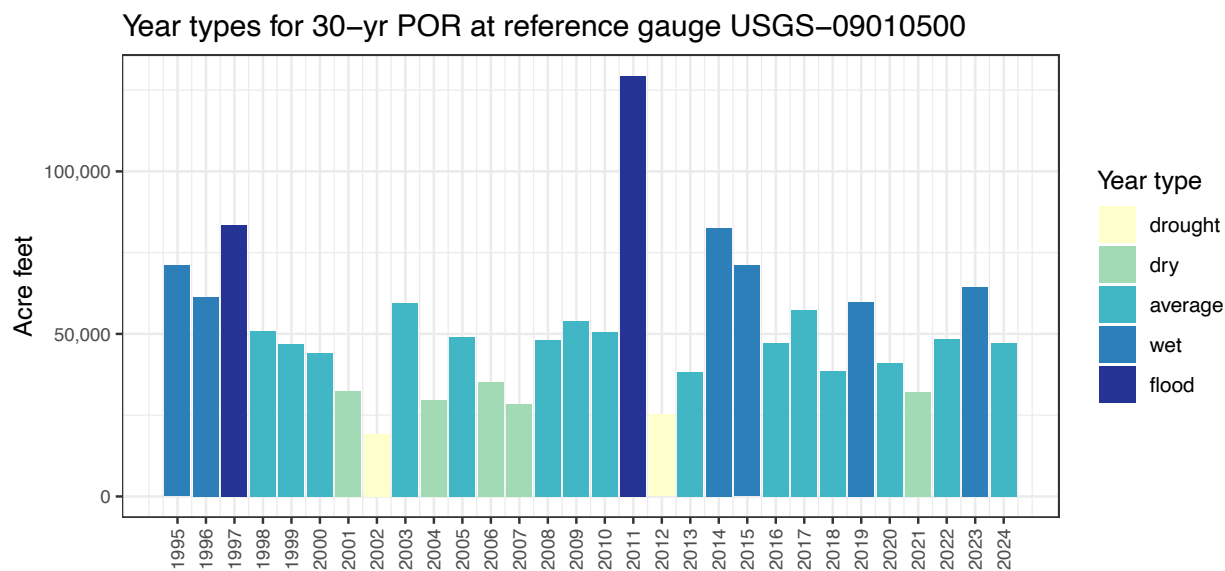
GRNDRDCO - Grand River Ditch
5104603 - Williams Fork Tunnel

Flow balance relies on:

$(\text{GRNDRDCO} + \text{ADATUNCO} + \text{MOFTUNCO} - 5104603) / (09034250 + \text{GRNDRDCO} + \text{ADATUNCO} + \text{MOFTUNCO} - 5104603)$

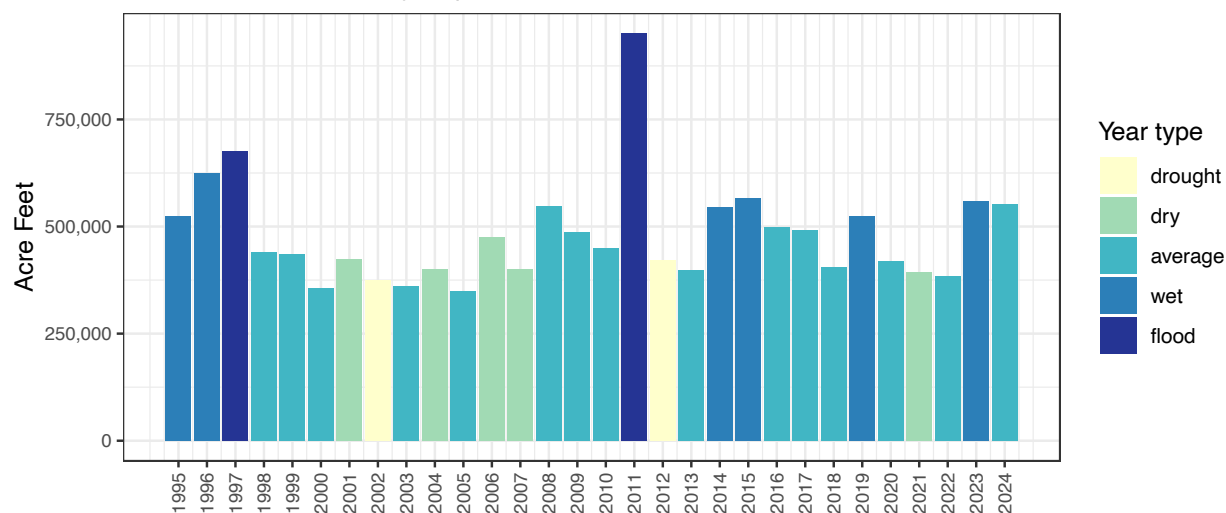
yr_type	mean_yr_type	basin
drought	80.5	Colorado River blw Windy Gap
dry	77	Colorado River blw Windy Gap
average	62	Colorado River blw Windy Gap
wet	47.8	Colorado River blw Windy Gap
flood	38.5	Colorado River blw Windy Gap
all years	61.3	Colorado River blw Windy Gap

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Upper Colorado	Colorado River blw Windy Gap	drought	85	83	81	76	81	80	75	84	84	80	72	70
Upper Colorado	Colorado River blw Windy Gap	dry	88	87	81	63	74	73	68	76	81	65	51	84
Upper Colorado	Colorado River blw Windy Gap	average	78	78	75	49	49	44	63	64	68	58	44	78
Upper Colorado	Colorado River blw Windy Gap	wet	84	82	71	39	37	21	40	66	71	53	39	74
Upper Colorado	Colorado River blw Windy Gap	flood	82	84	64	46	30	18	38	31	62	43	75	74



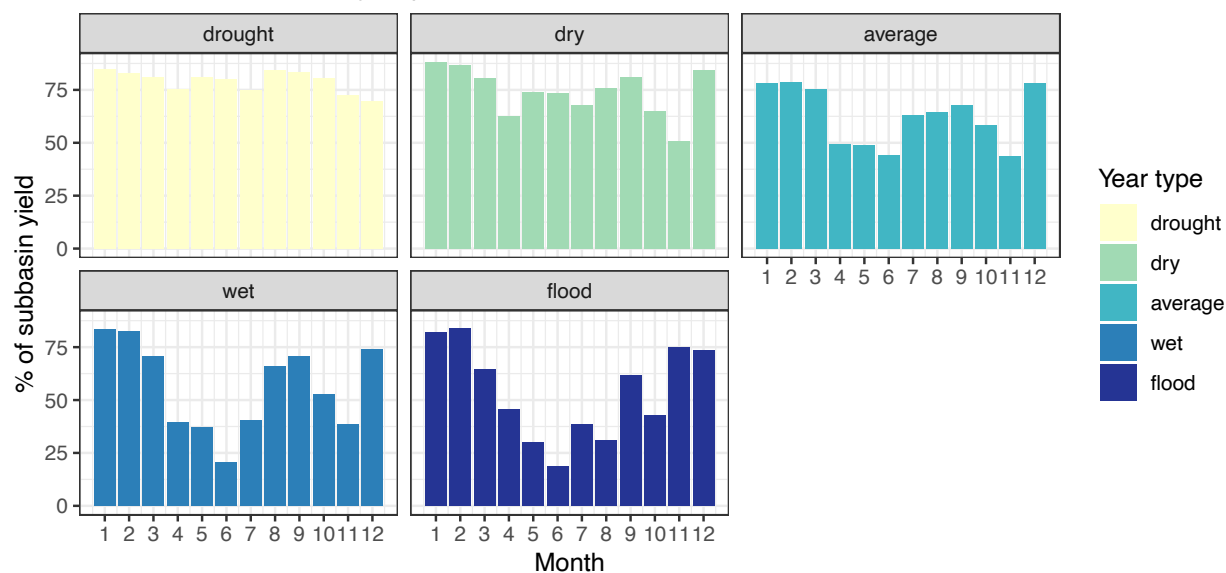
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Colorado River blw Windy Gap



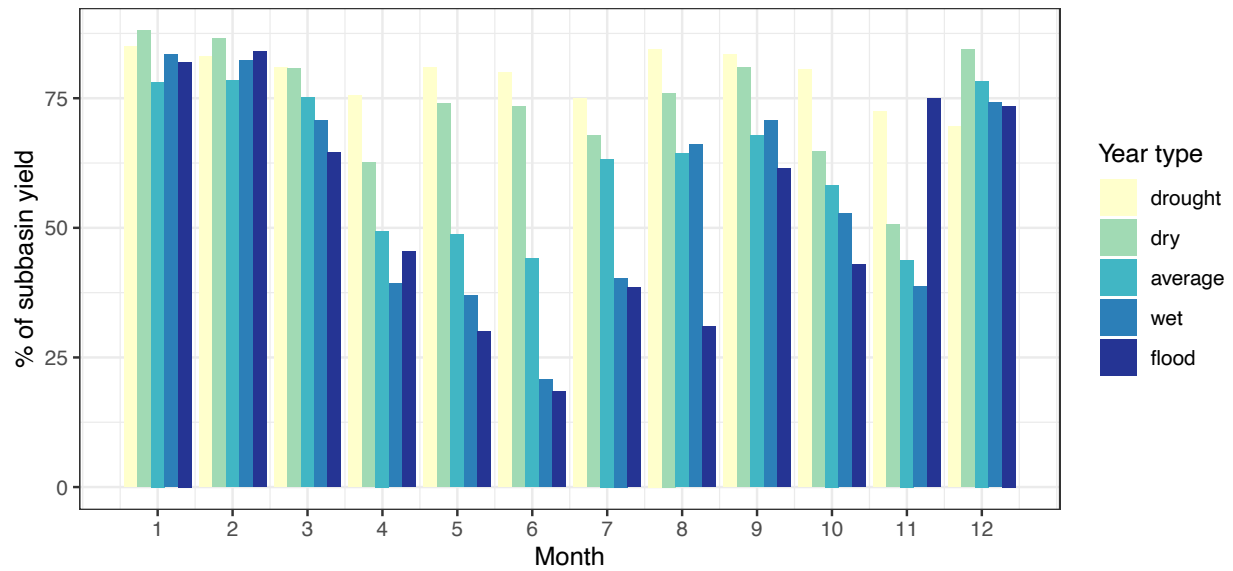
Year types based on annual yield at basin reference gauge USGS-09010500

Percent of watershed yield diverted via TMD by month
Colorado River blw Windy Gap



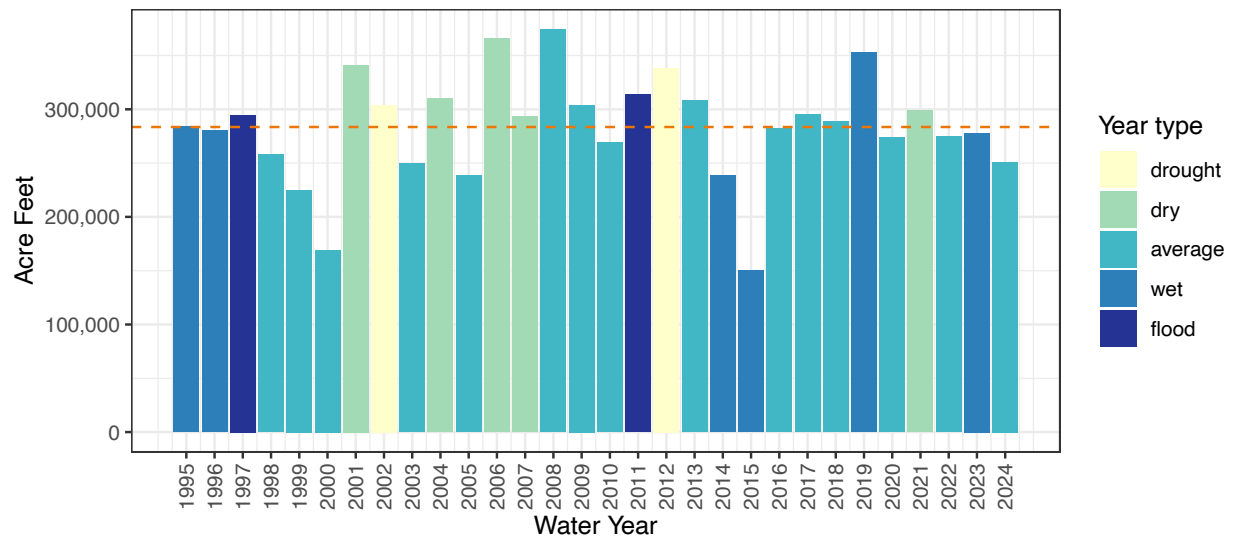
Percent of watershed yield diverted via TMD

Colorado River blw Windy Gap

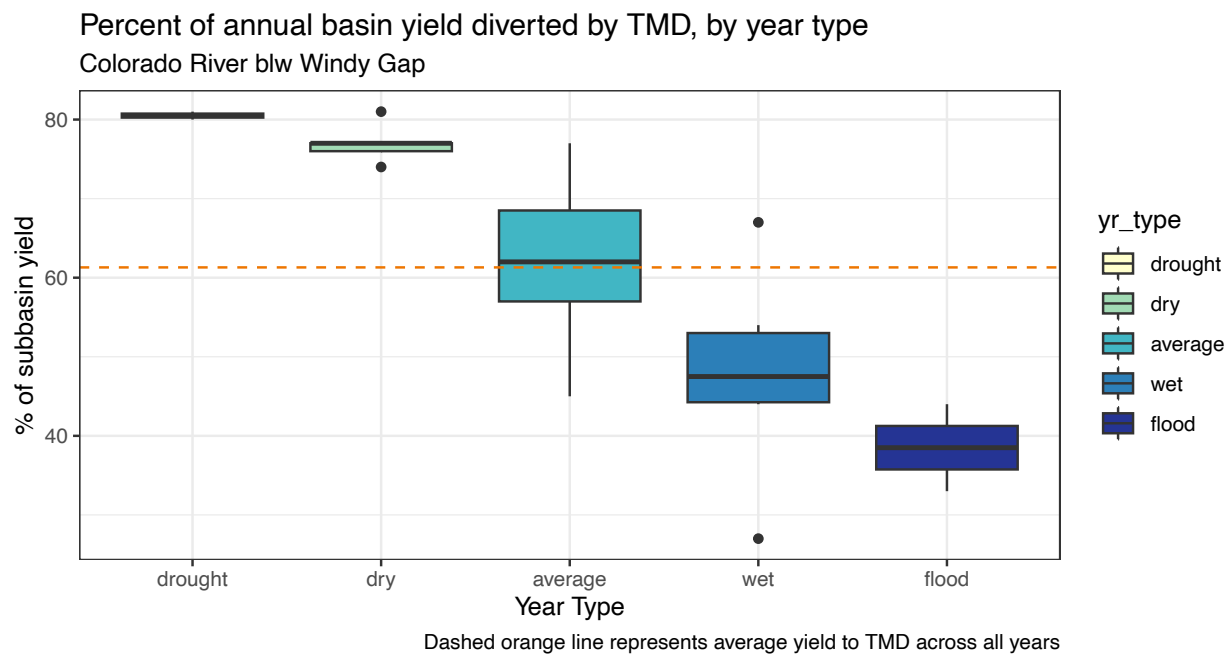
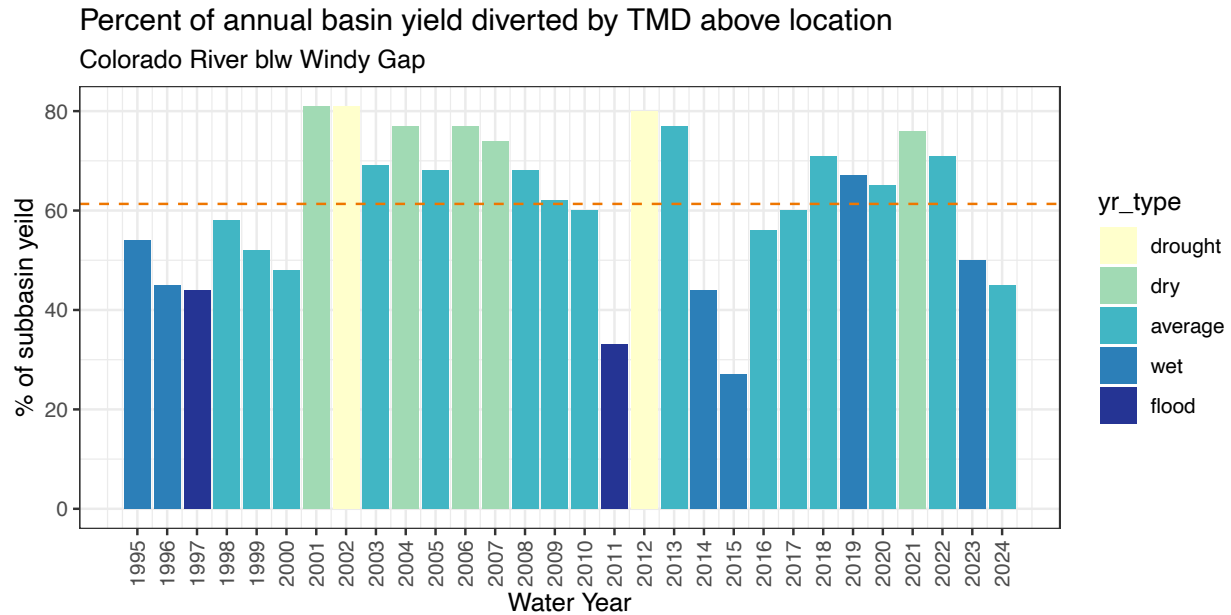


Annual TMD Yield, UPPER COLORADO basin

Colorado River blw Windy Gap



Orange dashed line is mean yield for 30-yr POR.



Williams Fork subbasin

Flow record locations include:

09036000 - USGS Williams Fork near Leal CO

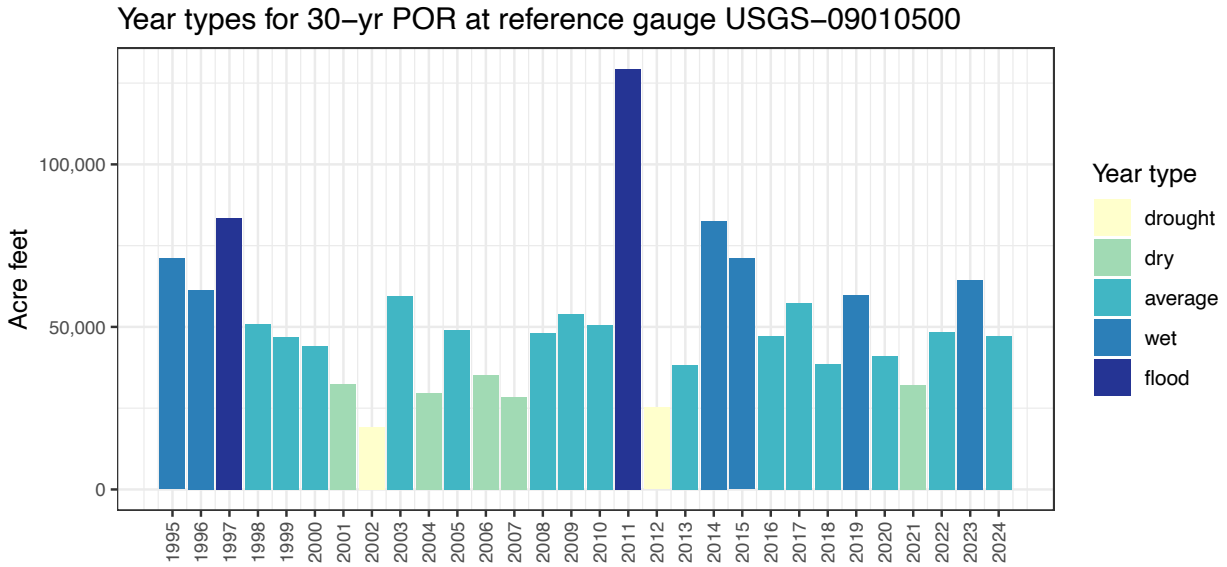
5104603 - Williams Fork Tunnel

Flow balance relies on:

$$(5104603) / (5104603 + 09036000)$$

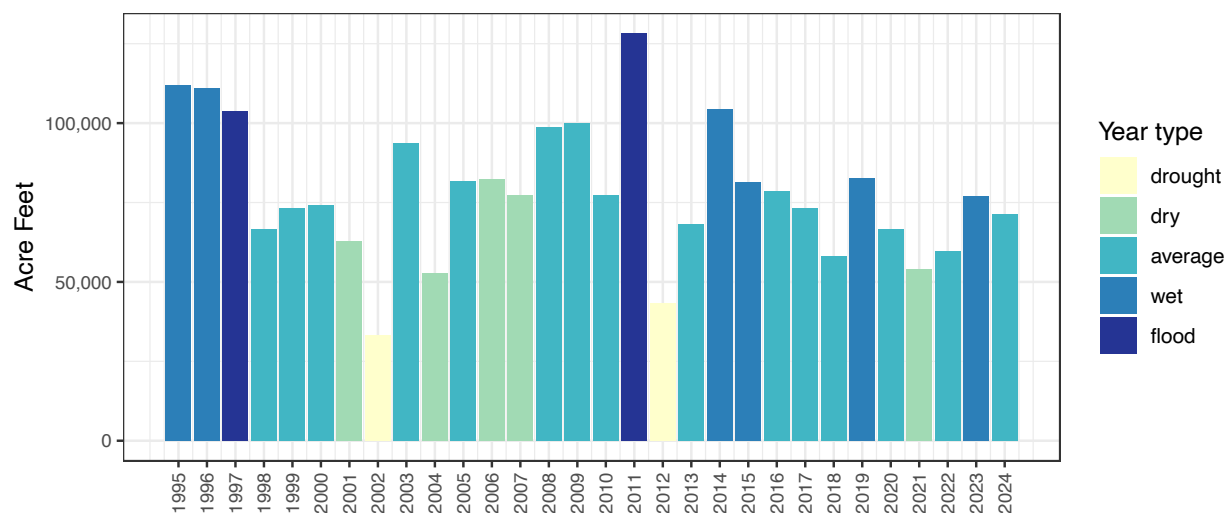
yr_type	mean_yr_type	basin
drought	21.5	Williams Fork near Leal
dry	11.4	Williams Fork near Leal
average	5.5	Williams Fork near Leal
wet	3.2	Williams Fork near Leal
flood	2.5	Williams Fork near Leal
all years	6.9	Williams Fork near Leal

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Upper Colorado	Williams Fork near Leal	drought	4	10	10	14	26	29	26	25	22	18	6	11
Upper Colorado	Williams Fork near Leal	dry	12	11	9	7	13	8	13	21	17	10	12	13
Upper Colorado	Williams Fork near Leal	average	6	5	4	4	6	2	10	12	10	9	8	7
Upper Colorado	Williams Fork near Leal	wet	6	5	5	4	2	1	4	8	8	5	7	6
Upper Colorado	Williams Fork near Leal	flood	6	4	4	2	4	0	5	4	8	6	6	4



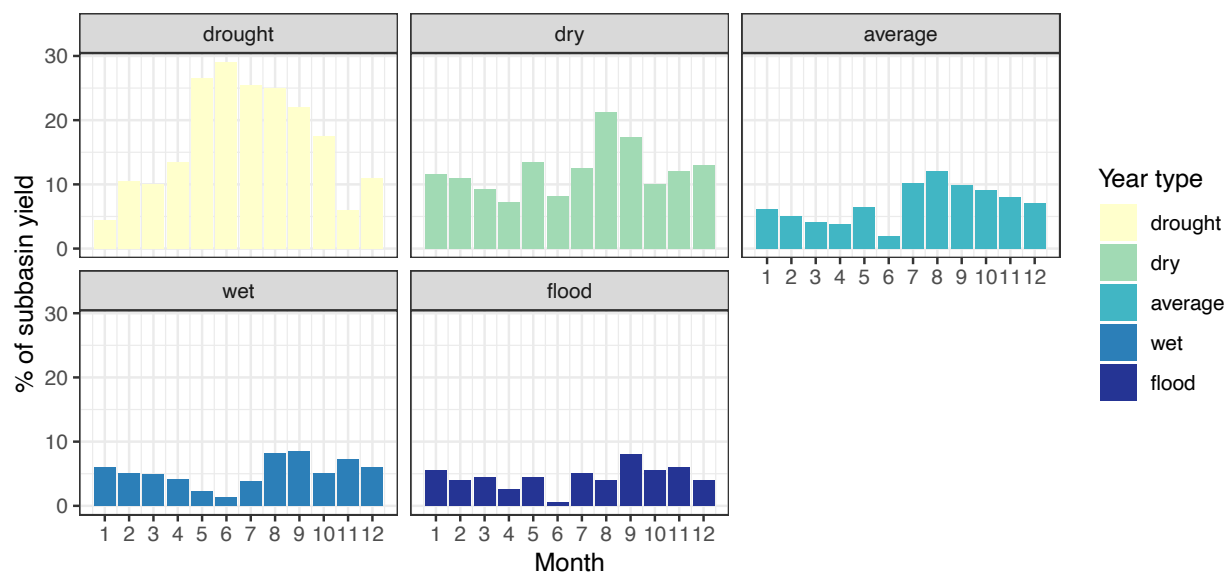
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Williams Fork near Leal



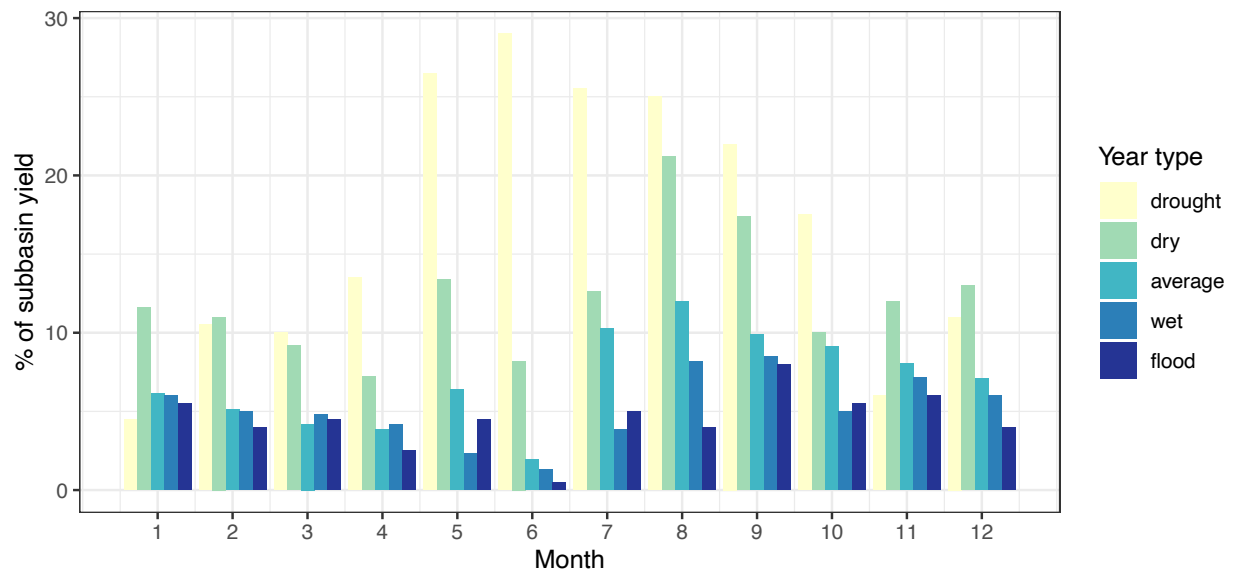
Year types based on annual yield at basin reference gauge USGS-09010500

Percent of watershed yield diverted via TMD by month
Williams Fork near Leal



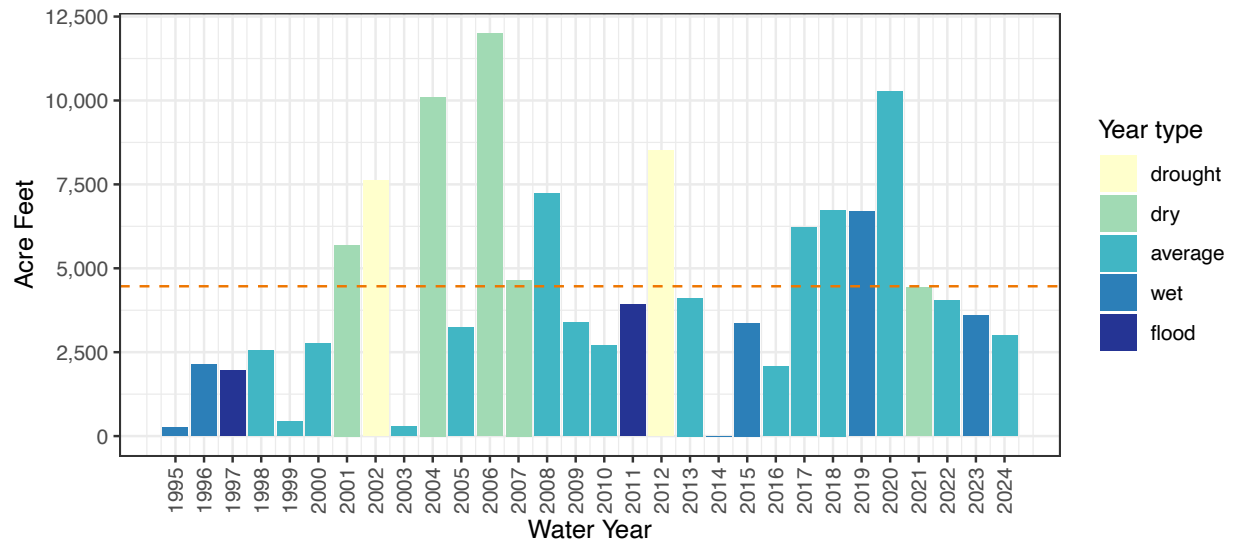
Percent of watershed yield diverted via TMD

Williams Fork near Leal



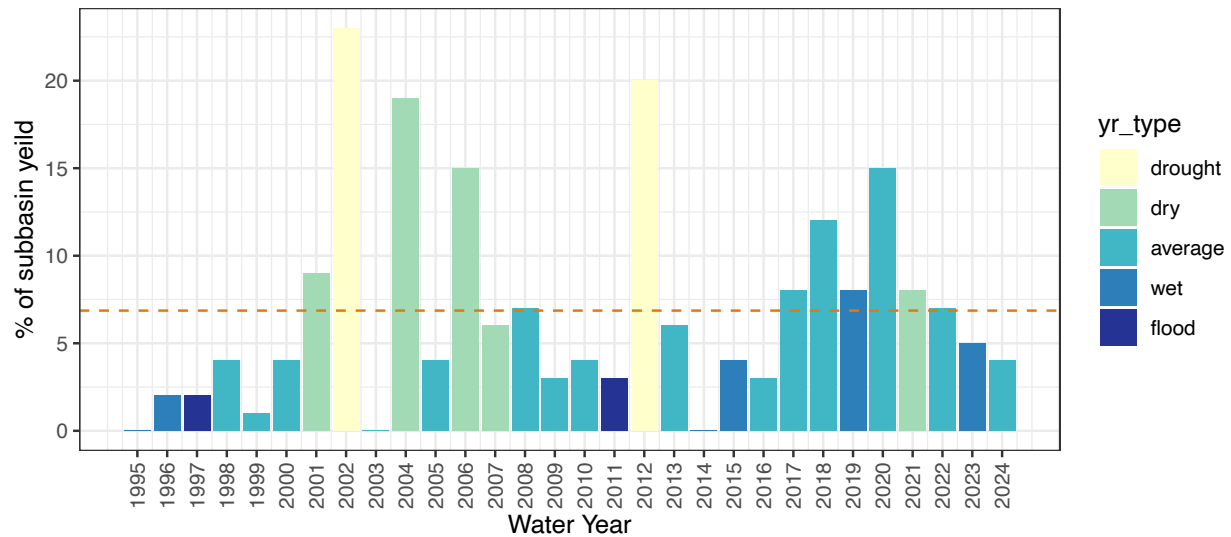
Annual TMD Yield, UPPER COLORADO basin

Williams Fork near Leal



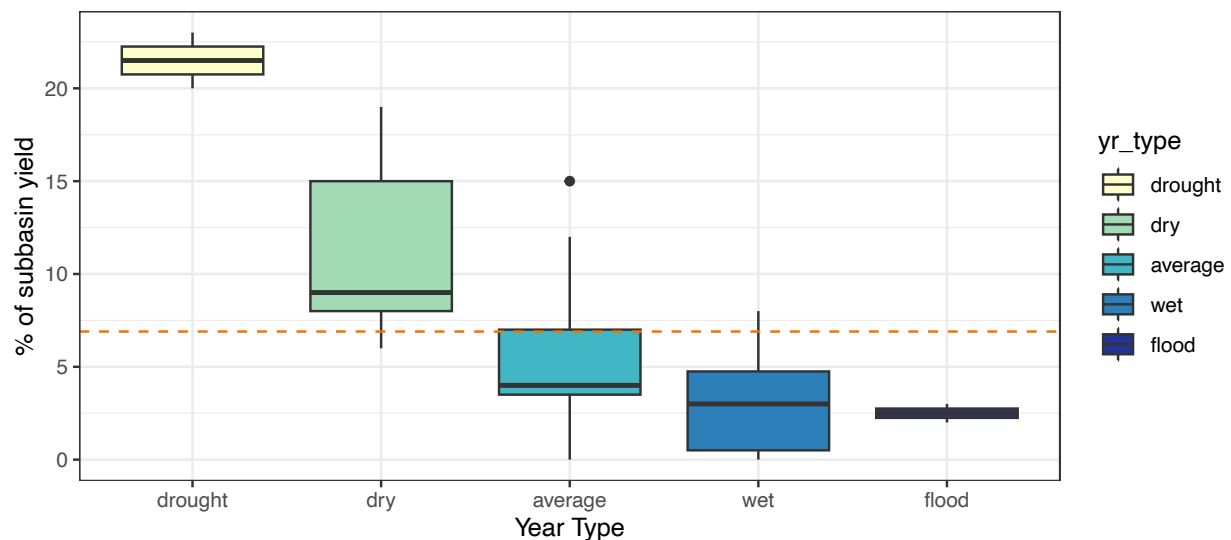
Orange dashed line is mean yield for 30-yr POR.

Percent of annual basin yield diverted by TMD above location
Williams Fork near Leal



Orange dashed line is mean percent for 30-yr POR.

Percent of annual basin yield diverted by TMD, by year type
Williams Fork near Leal



Dashed orange line represents average yield to TMD across all years

Gunnison River

Two locations are available in the Gunnison to capture TMD yields from the Tomichic Creek tributary drainage, however the lower gauge near the Town of Gunnison (which captures the diversions from Cochetopa Creek as well) is believed to be significantly impacted by local consumptive use from the extensive hay cultivation along Tomichi Creek. Therefore, a balance here is likely to overestimate the percent of subbasin yield captured by TMDs. Only the gauge at Sargents is presented:

Tomichi Creek at Sargents

Flow record locations include:

09115500 - USGS Tomichi Creek near Sargent CO

LARDITCO - Larkspur Ditch

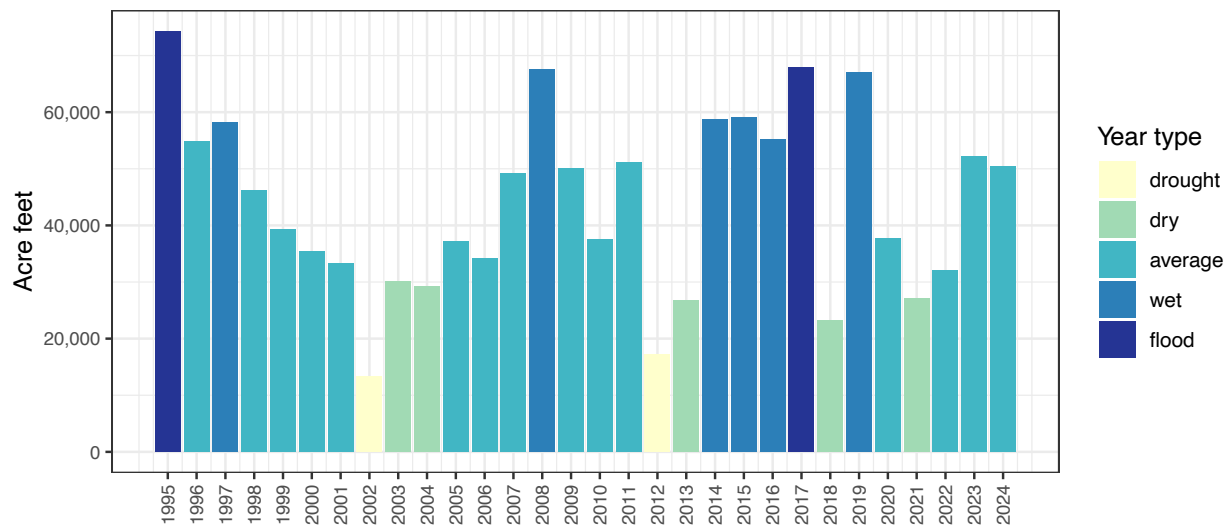
Flow balance relies on:

(LARDITCO) / (09115500 + LARDITCO)

yr_type	mean_yr_type	basin
drought	0	Tomichi Creek at Sargents
dry	0.2	Tomichi Creek at Sargents
average	0.9	Tomichi Creek at Sargents
wet	0.8	Tomichi Creek at Sargents
flood	0.5	Tomichi Creek at Sargents
all years	0.7	Tomichi Creek at Sargents

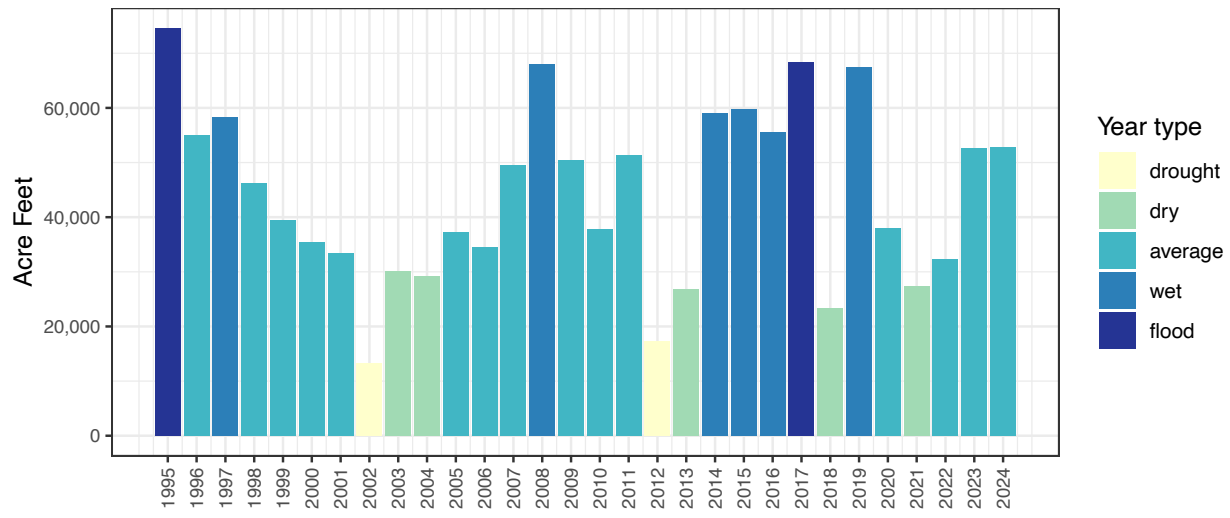
Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Gunnison	Tomichi Creek at Sargents	drought	0	0	0	0	0	0	0	0	0	0	0	0
Gunnison	Tomichi Creek at Sargents	dry	0	0	0	0	0	0	0	0	1	1	0	0
Gunnison	Tomichi Creek at Sargents	average	3	2	0	0	0	1	1	1	1	1	0	1
Gunnison	Tomichi Creek at Sargents	wet	0	0	0	0	0	1	1	2	2	1	0	0
Gunnison	Tomichi Creek at Sargents	flood	0	0	0	0	0	0	2	2	2	1	0	0

Year types for 30-yr POR at reference gauge USGS-09115500



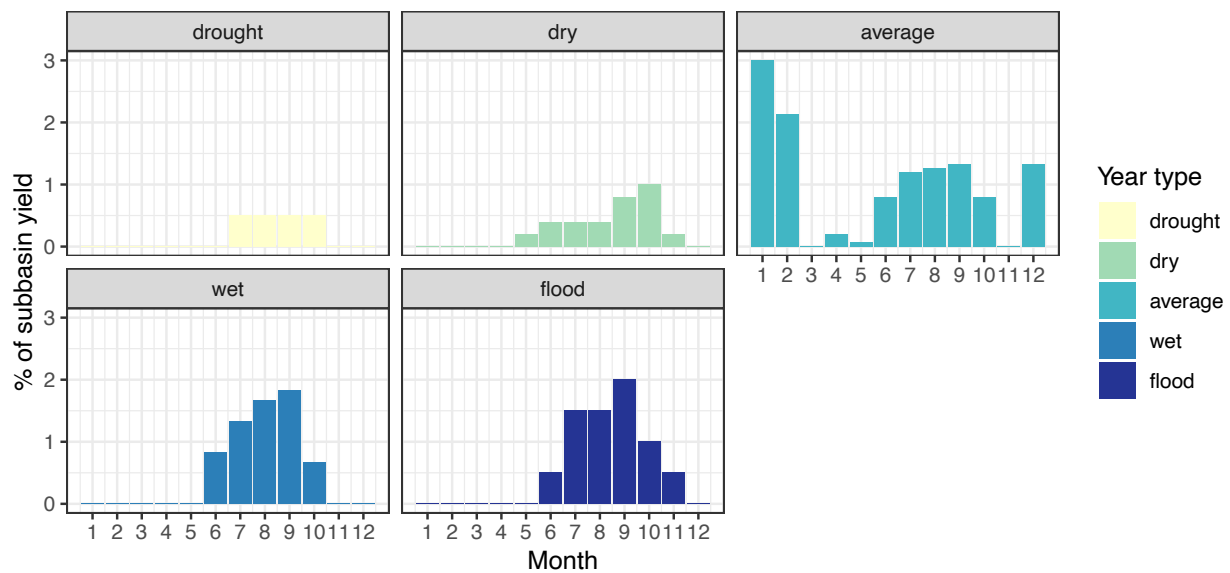
(Year types are defined using the 5th, 25th, 75th, 95th, and 100th percentile breaks for annual yields at the reference gauge.)

Combined yield for TMD gauge(s) and In-basin gauge site(s)
Tomichi Creek at Sargents



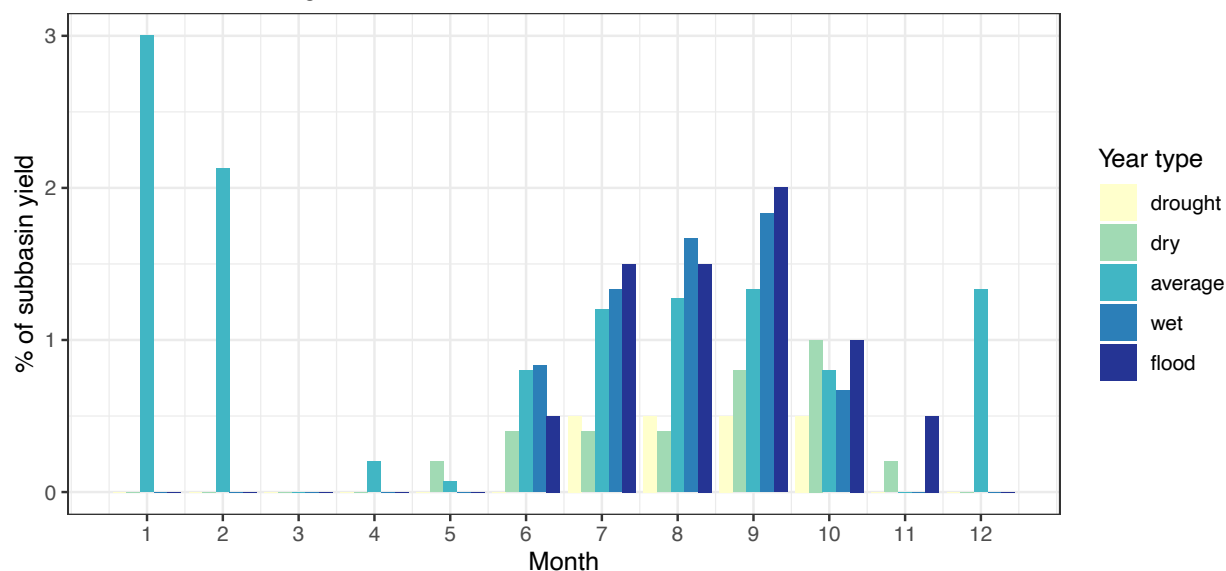
Year types based on annual yield at basin reference gauge USGS-09115500

Percent of watershed yield diverted via TMD by month
Tomichi Creek at Sargents



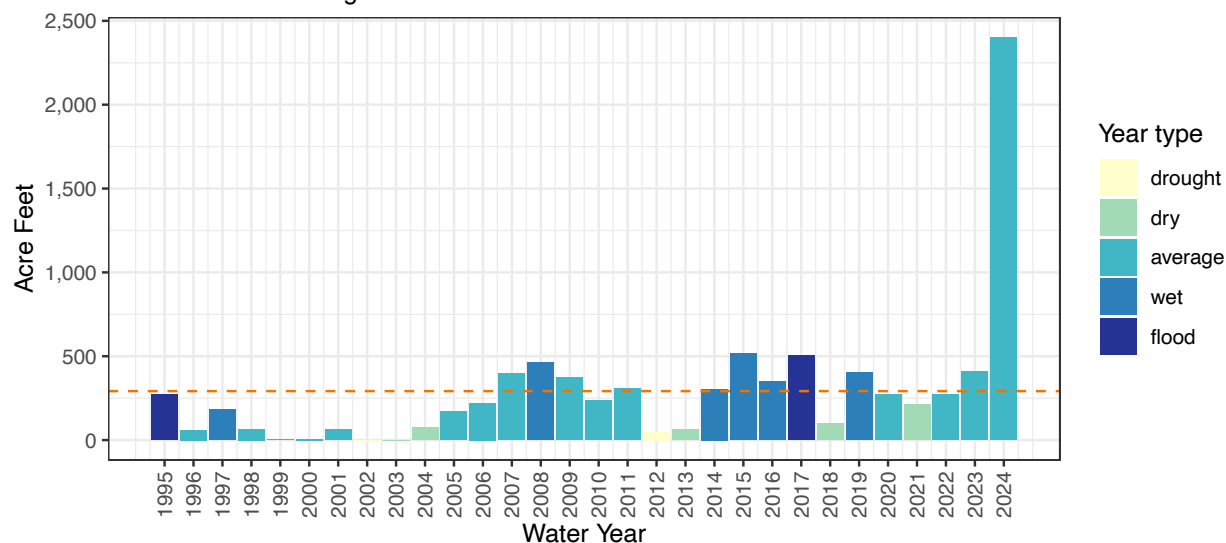
Percent of watershed yield diverted via TMD

Tomichi Creek at Sargents



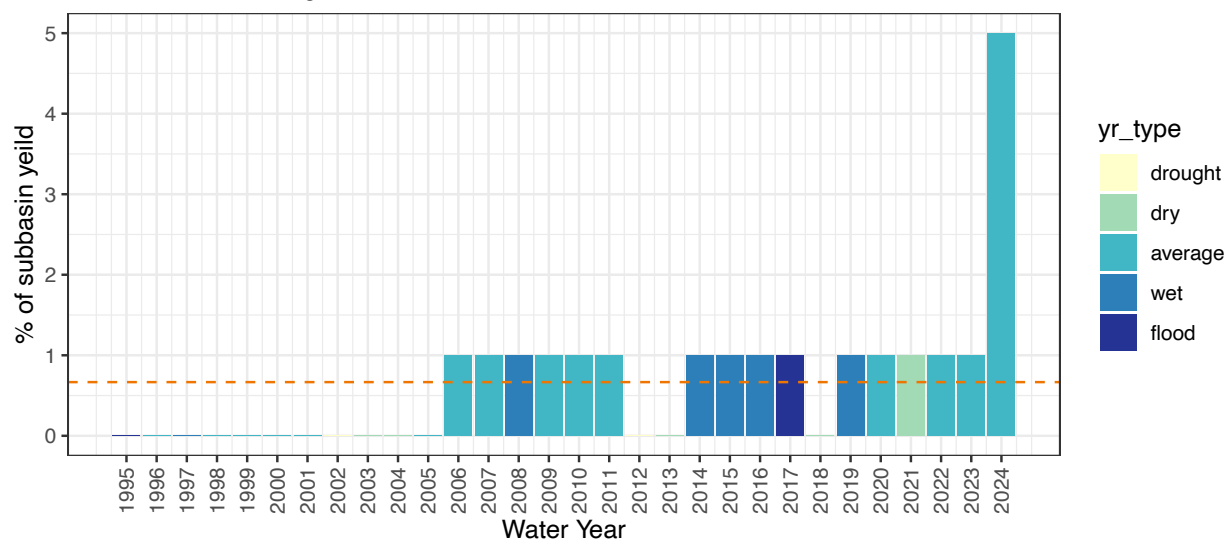
Annual TMD Yield, GUNNISON basin

Tomichi Creek at Sargents



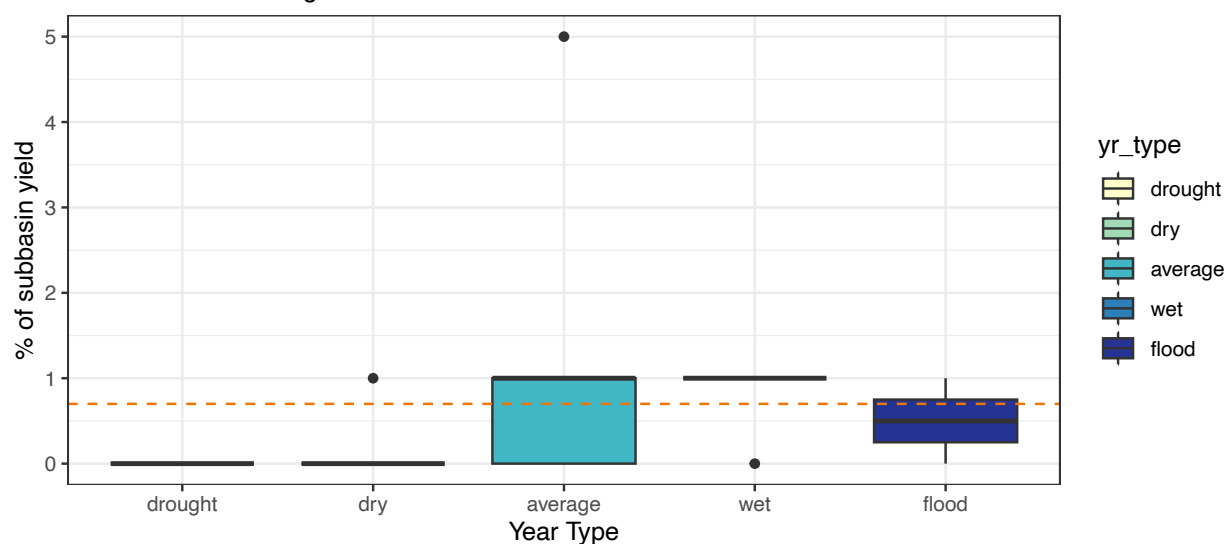
Orange dashed line is mean yield for 30-yr POR.

Percent of annual basin yield diverted by TMD above location
Tomichi Creek at Sargents



Orange dashed line is mean percent for 30-yr POR.

Percent of annual basin yield diverted by TMD, by year type
Tomichi Creek at Sargents



Dashed orange line represents average yield to TMD across all years

Yampa River and North Platte

Basin balances for Yampa and North Platte are not computed due to the relatively small annual yield of most projects and the lack of well-placed gauges downstream of the subwatershed diversion systems. Total basin yields from TMD structures are included in the basin yield tables elsewhere.

Basin Water Balance Location Summaries

Some summary tables outputs are included in the sections below for use in reporting materials.

Table 23: Basin Diversion Percentages by Year Type

Basin	Drought	Dry	Average	Wet	Flood	All Years
Blue River at Blue River	36	38	31	20	8	29
Blue River at Dillon Dam (all major reservoir tribs.)	55	42	30	14	18	30
Colorado River blw Windy Gap	80	77	62	48	38	61
Eagle River near Minturn	44	30	24	18	20	25
Fraser River blw Crooked and Ranch Creeks	48	41	33	29	20	33
Fryingpan River at Meredith (abv Ruedi Res.)	22	33	37	35	37	35
Homestake Creek at Gold Park	70	64	53	46	48	54
Roaring Fork abv Difficult Creek nr Aspen	55	60	54	47	26	52
Straight Creek nr Dillon (Laskey Gulch)	6	3	2	2	2	3
Tomichi Creek at Sargents	0	0	1	1	0	1
Williams Fork near Leal	22	11	6	3	2	7

Table 24: Basin Diversion Percentages by Month and Year Type

Basin	Location	yr_type	1	2	3	4	5	6	7	8	9	10	11	12
Blue	Straight Creek nr Dillon (Laskey Gulch)	Drought	8	8	8	5	3	4	7	6	6	4	5	7
Blue	Straight Creek nr Dillon (Laskey Gulch)	Dry	4	4	4	3	2	3	4	4	4	3	3	4
Blue	Straight Creek nr Dillon (Laskey Gulch)	Average	5	5	5	3	1	2	4	4	4	4	4	4
Blue	Straight Creek nr Dillon (Laskey Gulch)	Wet	4	5	5	3	2	2	3	3	4	3	3	4
Blue	Straight Creek nr Dillon (Laskey Gulch)	Flood	4	2	4	4	2	0	2	4	5	4	3	4
Blue	Blue River at Blue River	Drought	0	0	0	14	54	70	20	2	2	52	7	0
Blue	Blue River at Blue River	Dry	0	0	0	12	40	55	38	13	15	49	25	0
Blue	Blue River at Blue River	Average	0	0	0	11	31	38	35	27	22	34	14	0
Blue	Blue River at Blue River	Wet	0	0	0	9	23	20	18	24	22	32	7	0
Blue	Blue River at Blue River	Flood	0	0	0	0	8	10	1	5	6	52	26	0
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	Drought	55	66	68	60	40	49	56	58	53	69	54	53
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	Dry	24	25	40	27	18	30	53	60	59	48	45	25
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	Average	35	35	34	24	13	17	34	45	46	42	39	36
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	Wet	23	30	19	20	3	4	17	14	37	32	25	19
Blue	Blue River at Dillon Dam (all major reservoir tribs.)	Flood	34	32	36	63	29	6	2	21	32	44	46	44
Eagle	Eagle River near Minturn	Drought	46	43	40	37	13	10	2	31	30	20	52	45
Eagle	Eagle River near Minturn	Dry	0	18	38	36	14	17	10	2	8	24	0	0
Eagle	Eagle River near Minturn	Average	0	8	61	41	15	16	11	11	4	1	0	0
Eagle	Eagle River near Minturn	Wet	0	14	56	43	8	14	17	12	4	2	5	0
Eagle	Eagle River near Minturn	Flood	0	26	50	72	0	6	14	26	0	42	0	0
Eagle	Homestake Creek at Gold Park	Drought	50	49	48	56	10	9	0	40	42	38	82	49
Eagle	Homestake Creek at Gold Park	Dry	0	20	49	53	23	22	9	0	12	36	2	0
Eagle	Homestake Creek at Gold Park	Average	0	11	75	66	32	23	12	18	7	2	0	0
Eagle	Homestake Creek at Gold Park	Wet	0	16	73	66	21	31	29	19	8	3	10	0
Eagle	Homestake Creek at Gold Park	Flood	0	42	72	95	0	0	24	48	0	48	0	0
Gunnison	Tomichi Creek at Sargents	Drought	0	0	0	0	0	0	0	0	0	0	0	0
Gunnison	Tomichi Creek at Sargents	Dry	0	0	0	0	0	0	0	0	1	1	0	0
Gunnison	Tomichi Creek at Sargents	Average	3	2	0	0	0	1	1	1	1	1	0	1
Gunnison	Tomichi Creek at Sargents	Wet	0	0	0	0	0	1	1	2	2	1	0	0
Gunnison	Tomichi Creek at Sargents	Flood	0	0	0	0	0	0	2	2	2	1	0	0
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	Drought	7	8	6	12	45	25	6	9	6	5	4	5
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	Dry	5	6	5	6	53	52	16	6	5	4	5	5
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	Average	7	8	6	5	40	57	36	10	5	5	5	6
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	Wet	6	6	7	6	28	51	50	21	5	5	4	5
Roaring Fork	Fryingpan River at Meredith (abv Ruedi Res.)	Flood	7	7	5	2	18	48	46	37	12	4	6	6
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	Drought	22	24	24	46	73	73	32	2	8	33	39	34
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	Dry	33	30	30	28	69	74	44	18	16	23	40	34
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	Average	29	26	23	26	61	59	57	44	28	39	43	35
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	Wet	38	34	32	26	54	51	47	24	18	44	47	42
Roaring Fork	Roaring Fork abv Difficult Creek nr Aspen	Flood	2	2	2	4	42	30	20	36	39	12	12	7
Upper Colorado	Williams Fork near Leal	Drought	4	10	10	14	26	29	26	25	22	18	6	11
Upper Colorado	Williams Fork near Leal	Dry	12	11	9	7	13	8	13	21	17	10	12	13
Upper Colorado	Williams Fork near Leal	Average	6	5	4	4	6	2	10	12	10	9	8	7

Upper Colorado	Williams Fork near Leal	Wet	6	5	5	4	2	1	4	8	8	5	7	6
Upper Colorado	Williams Fork near Leal	Flood	6	4	4	2	4	0	5	4	8	6	6	4
Upper Colorado	Colorado River blw Windy Gap	Drought	85	83	81	76	81	80	75	84	84	80	72	70
Upper Colorado	Colorado River blw Windy Gap	Dry	88	87	81	63	74	73	68	76	81	65	51	84
Upper Colorado	Colorado River blw Windy Gap	Average	78	78	75	49	49	44	63	64	68	58	44	78
Upper Colorado	Colorado River blw Windy Gap	Wet	84	82	71	39	37	21	40	66	71	53	39	74
Upper Colorado	Colorado River blw Windy Gap	Flood	82	84	64	46	30	18	38	31	62	43	75	74
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	Drought	22	15	14	32	64	74	50	48	62	45	33	24
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	Dry	18	16	13	18	47	42	59	55	46	37	26	20
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	Average	22	18	16	15	33	28	47	47	46	52	36	27
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	Wet	20	17	12	11	35	31	34	40	45	30	28	22
Upper Colorado	Fraser River blw Crooked and Ranch Creeks	Flood	18	14	10	8	32	12	30	32	36	46	42	26